X11ARIMA version 2000

an update of the

X11ARIMA/88
SEASONAL ADJUSTMENT METHOD

developed by
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FOUNDATIONS AND USER'S MANUAL

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PREFACE TO X11ARIMA VERSION 2000

The X-11-Variant of the Census Method II Seasonal Adjustment software, which forms the core of the X11ARIMA/88 program, was developed in the sixties when the year 2000 seemed in the distant future. Consequently, a two-digit year identifier was deemed adequate at the time. Similarly, the built-in calendar used in some of the estimation extended only to the year 1999. The purpose of producing X11ARIMA version 2000 was to remedy these problems in order to make the program Y2K compliant. The modifications should be transparent to the user, i.e., the new program will still operate using the last two digits of the year as year identifier. We have introduced, however, two new formats to accommodate a four-digit year identifier.

The release of this new version provided a perfect opportunity to incorporate several other modifications to the program, partly to correct small errors that have been discovered since the last release and partly to enhance the flexibility of the software. A list of these changes is shown at the beginning of Chapter I.

Producing X11ARIMA version 2000 was very much of a team effort by the staff of the Time Series Research and Analysis Centre. Special thanks are due, nevertheless, to Paul Wong for his dedicated programming work and France Guindon for her conscientious preparation of the revised manual. Dominique Ladiray, a visiting researcher from L'INSEE, France, merits special mention for pointing out and helping to resolve some inconsistencies between the computer coding and the X11ARIMA specifications as they appeared in Chapter IV.

Time Series Research and Analysis Centre
Business Survey Methods Division
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PREFACE TO X11ARIMA/88

The X11ARIMA/88 is the result of several years of research done by the staff members of the Time Series Research and Analysis Division and myself. The research was addressed to problems that affected most time series during this decade because of major institutional, technological, economical and behavioural changes.

X11ARIMA/88 is an enriched version of X11ARIMA/80 that includes all the options available in the latter. Among the various features, X11ARIMA/88 offers two other ARIMA models for the automatic extrapolation routine, estimation of Easter effects, automatic variable selection of the seasonal moving averages, permanent a-priori modifications, automatic removal of trading-day variations and/or Easter effects before ARIMA modelling, charts and user-specified printouts.

I would like to thank very specially the following collaborators: Kim Chiu for writing the microcomputer version and introducing the changes in the main frame version; Mike Cheng for writing the keyword based preprocessor of both versions; Guy Huot for planning and coordinating the implementation of both the features and the User's Manual and Marietta Morry for planning and coordinating the testing. I am also thankful to John Higginson, Pierre Cholette, Helen Fung, Paul Wong, Sean House, Nhan Luong, Maria Andrassy-Bitto and France Guindon for their valuable assistance in various stages of this project.

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PART A

YEAR 2000 VERSION
IMPROVEMENTS

X11ARIMA/88
FEATURES, FOUNDATIONS
AND SPECIFICATIONS

CHAPTER I

YEAR 2000 VERSION IMPROVEMENTS

1. The existing X11ARIMA built-in data formats containing the 2-digit year identifier will still be acceptable. The 2-digit year identifier will be checked by the program and transformed to a 4-digit identifier, according to the following algorithm:
   - If the 2-digit year is less than or equal to 25 (this also includes 00), the first two digits of the 4-digit year are set to 20.
   - If the 2-digit year is greater than 25, the first two digits of the 4-digit identifier are set to 19.

2. A new CANSIM format has been introduced to conform to the new CANSIM format containing the 4-digit year identifier; the input option keyword is "CANSIM2" (A8,I4,I2,2X,I4,I2,2X,12E16.10,1X,I1,12X) and the corresponding output format is "7" (ie. PUNCH 7 (tab1, id1, dec1, tab2, id2, dec2, ...)).

3. Two new built-in formats have been introduced;
   - The first one is "format 8": (A8,I4,6F11.0,2X/12X,6F11.0,2X) for monthly, and (A8,I4,4F11.0,24X) for quarterly data, both for input and output; it has a 4-digit year identifier and a 8-character series identifier (left justified).
   - The second one is "format 6" to output tables in columns, up to a maximum of 9 tables. The format is (9F12.0).

4. There are now three TOTAL options for adjusting the annual total of the seasonally adjusted series to agree with the annual total of the raw or modified raw series: TOTAL 0, TOTAL 1 and TOTAL 2. TOTAL 0 is the default, and doesn't change the annual totals of the seasonally adjusted at all. If there are no permanent priors applied, TOTAL 1 and TOTAL 2 options have the same effect, i. e. the seasonally adjusted annual totals will equal the annual totals of table A1 (the original series). If there are permanent priors applied, the TOTAL 1 option will make the seasonally adjusted annual totals equal to the annual totals of table A3 (i. e. the series adjusted by the permanent priors), and TOTAL 2 option will make these annual totals equal to the annual totals of table A1 (i.e. the original series). When a set of series is processed in a compositing mode, the TOTAL option of the first series in the set will be automatically applied to all the following series in the set.

5. A new statistics file (STAT) has been produced; it contains the statistics on the components of each series.

Customers who purchased the X11ARIMA/88 program prior to 1990 should note that we introduced a gradual impact Easter model to remove Easter variation from series where the impact on the activity starts several days before the date of Easter.

Customers should also note that we have also corrected an error in the extreme identification and replacement subroutine, therefore the new software will produce slightly different estimates for some series.

To help users identify the version 2000 improvements in this manual we highlighted them in grey.

X11ARIMA/88 FEATURES, FOUNDATIONS AND SPECIFICATIONS

SECTION 1. Introduction

In the decade of the eighties, several economic and institutional events have affected the pattern of the time series components, consequently, new problems on the accuracy and usefulness of the seasonally adjusted data emerged. Among these events, notable ones are the deep recession of 1981-1982; the introduction of new government regulations that enable business stores to be open longer hours and/or Sunday, and the early arrival of Easter (1980, 1983, 1985, 1986 and 1988). To cope with these problems, a significant amount of research was carried out at the Time Series Research and Analysis Division, that led to new developments and their implementation in X11ARIMA/88.

The X11ARIMA/88, as the X11ARIMA developed by Dagum (1980, here described in Chapters II and III), performs three basic functions: (1) Forecasting; (2) Seasonal adjustment; and (3) Composition of original and seasonally adjusted data. The new developments concern the first two key functions.

The features of X11ARIMA for its forecasting function are: 1) Built-in ARIMA models; 2) Variable forecast horizons; 3) Back casts are provided only for series shorter than 7 years; 4) Levels of acceptance for the fitting and extrapolation criteria; 5) Printing the Autocorrelation of the residuals from the built-in ARIMA models; 6) Iterations can be omitted for the parameter estimation of user-supplied models; and 7) Automatic removal of trading-day variations and Easter effect (if present) before ARIMA modelling.

The seasonal adjustment function of X11ARIMA offers: (1) Estimation of Easter effects; (2) Increased accuracy of the asymmetric Henderson trend-cycle filters; (3) Selection of the seasonal filters by the default option based on a global seasonal irregular I/S ratio; (4) Rescaling of the original series; (5) Temporary and permanent a-priori adjustment of original values; (6) Graphs of the trading-day and irregulars by type of month; and (7) User-specified printouts.

As in X11ARIMA/80, the 1988 version can be applied in two different modes, namely, (1) with ARIMA extrapolations (which is now the default option) and (2) without ARIMA extrapolations. In the latter case, the estimates of the various time series components are close but not necessarily equal to those obtained with the Method II X-11-Variant (Siskin, Young and Musgrave, 1967). The discrepancies are due mainly to differences in the identification and replacement of extreme values and in the increased accuracy in the seasonal and trend-cycle asymmetric filters.

SECTION 2. Features in the Forecasting Function

2.1 Built-in ARIMA Models

The major social and economic events of the early 80's made it necessary to assess the adequacy of the built-in models in X11ARIMA/80. A study by Chiu, Higginson and Huot (1985) was conducted on a sample of 190 seasonal series ending in 1983 and representing eleven sectors of the Canadian economy.

These authors evaluated the performance of a set of seven ARIMA models (including the three available in X11ARIMA/80) according to the following eight criteria: mean absolute percentage error of the forecasts for the last three years, the chi-square statistic for the randomness of the residuals, underdifferencing, overdifferencing, stability, invertibility, correlation between parameters and the presence of small parameter values. Although dependent, these criteria were useful to evaluate the goodness of fit and the forecasting performance for each model.

The study ranked the four first models as follows:

(1) - $(0,1,1)\ (0,1,1)_s$
(2) - $(0,1,2)\ (0,1,1)_s$
(3) - $(2,1,0)\ (0,1,1)_s$
(4) - $(0,2,2)\ (0,1,1)_s$

These models are here expressed in the classical Box and Jenkins (1970) symbolic notation $(p,d,q)(P,D,Q)$, where p and P denote the number of the ordinary and seasonal autoregressive parameters; q and Q denote the number of the ordinary and seasonal moving average; d and D denote the degree of the ordinary and seasonal differences.

The combined rate of success for the first three models varied from 97% for labour series to 21% for external trade series. The rate was considered good, given the fact that during two of the three years tested, Canada suffered a severe recession. Furthermore, it was evident that the rate of success of model (1) was much smaller than the rate obtained by Lothian and Morry (1978) with series ending in 1977. The fourth model (0,2,2) (0,1,1) was found to fit well an important class of series (series with a steep change in trend) that all the other models fit poorly (similar conclusions were reached by Lothian and Morry, 1978).

The new experiment detected two other models, the (0,1,2) $(0,1,1)_s$ and the (2,1,0) $(0,1,1)_s$ as being good for extrapolation and fitting of a large class of series. It was then decided to keep the currently available three ARIMA models (i.e.: (0,1,1) (0,1,1), (0,2,2) (0,1,1) and (2,1,2) (0,1,1)) and add the two new models. The reason for keeping the (2,1,2) $(0,1,1)_s$ model was its excellent performance for forecasting the data.

The availability of five models instead of three does not increase the cost of running X11ARIMA/88 because these models are tested sequentially in the order shown above, (2,1,2) (0,1,1) being the last. In other words, if model (1) passes, then the program does not try the others; and if model (1) fails, it tries model (2) and so on.

For the micro-computer version of X11ARIMA/88 the (2,1,2) (0,1,1) model is not automatically tested because it takes too much time. It can always be requested with the user-supplied model option if desired.

2.2 Variable Forecasting Horizon

This subroutine enables the user to select the length of the forecast horizon up to three years (36 months or 12 quarters), the default option being one year. The length of the forecast horizon is strongly tied to the problem of minimization of revisions due to filter changes which has been extensively discussed by Dagum (1982.a, 1982.b) and Dagum and Laniel (1987).

A study by Dagum (1982.c) addressed the problem of revisions of the concurrent and other non-symmetric filters when one, two, and three years of data are extrapolated from the three built-in ARIMA models in X11ARIMA/80, with several combinations of parameter values. She showed that the largest gain was obtained with one year of extrapolated values, there was a small incremental gain if two years were used, and finally there was no gain going from two to three years. This study was extended for the concurrent filter by Huot et al (1986) using four models, namely, (0,1,1) $(0,1,1)_{12}$, (2,1,0) $(0,1,1)_{12}$, (0,1,2) $(0,1,1)_{12}$ and (0,2,2) $(0,1,1)_{12}$. These authors investigated the effect of various forecast horizons on the total revisions for selected parameter values. Their results showed that the optimal forecast horizon that minimizes filter revisions changes with the parameter values of the model. Thus for the (0,1,1) $(0,1,1)_{12}$ where $\theta=0.50$ and $\Theta=0.90$, the filter revisions are minimized for a forecast horizon of 24 months. On the other hand, for small values of Θ (say $\Theta=0.40$) the forecast horizon should be shorter than a year. These results are in agreement with the fact that the larger the value of Θ, the more stable the seasonal pattern is assumed to be and, consequently, a longer forecast horizon is feasible.

2.3 Backcasting

Another modification introduced into the automatic ARIMA extrapolation option concerns backcasting. The X11ARIMA/80 enabled the user to backcast one year of data for all series shorter than 15 years. Backcasting improves the seasonal adjustment, in general, but introduces permanent revisions of the estimated components at the beginning year of the series. Backcasting also introduces revisions of current seasonally adjusted values for series of 8, 9 and 10 years. This is due to the fact that the backcast values will change whenever the parameter values of the ARIMA models change. An optimal trade-off in the sense that the advantages of backcasting dominate the disadvantages was found for series shorter than 7 years where the use of backcasting enables the application of symmetric filters to observations in the middle.

2.4 Levels of Acceptance for the Criteria of Fitting and Forecasting

The criteria of fitting and extrapolation for the built-in ARIMA models introduced by Dagum (1981) have been relaxed. The mean absolute percentage forecast error (M.A.P.E) has been raised to 15% from 12% and the level of significance of the chi-squared distribution of the Ljung and Box (1978) test for the randomness of the residuals is 5% instead of 10%. These changes in the level of the acceptance criteria do not affect the advantages of using the ARIMA extrapolations and enable a more frequent application of the automatic ARIMA options.

2.5 Autocorrelation Values of the Residuals

The autocorrelation values of the residuals from the ARIMA models of the automatic option are printed up to a lag of two years.

This information is critical for the user who wishes to modify the ARIMA models that failed because of a very low χ^2 probability value or the presence of overdifferencing.

2.6 Zero Iteration for the Parameter Estimations of User-supplied Models

This option enables users to maintain the initial parameter values.

2.7 Automatic Removal of Trading-Day and Easter Effects Before the ARIMA Modelling

The estimation of trading-day variations by the X11ARIMA/88 program as described in Chapter 4 is based on a regression model developed by Young (1965) and is the same as that used by X11ARIMA/80 and by Method II X-11-variant. Trading-day variations cannot be picked up by the usual ARIMA models. Similarly, the estimation of Easter effects assumes a deterministic behaviour that cannot be modelled by the ARIMA models. Consequently, these two sources of variation (when present) are automatically removed from the original series before the ARIMA modelling.

SECTION 3. Features in the Seasonal Adjustment Functions

3.1 Estimation of Easter Effects

X11ARIMA/80 does not provide an estimation of the effect of Easter on series affected by this type of variation. Easter is a moving holiday that can cause serious distortions in month-to-month (also quarter-to-quarter) changes when it occurs in March or at the very beginning of April. During this decade, Easter fell in March or during the first week of April in 1980, 1983, 1985, 1986 and 1988. The very early arrival of Easter in March 1986, seriously affected international trade series, particularly imports where a large drop in March was followed by an increase in April. This was caused by the fact that customs forms at the end of March were processed in April because of the Easter closing of customs offices. The impact of Easter in this case is <u>immediate</u> in the sense that only the holiday period displays a change of activity. To take into account this type of effect the following model has been introduced in X11ARIMA/88.

$$E_i = 1/2\ f(Z_i)\left[\frac{\sum_{i \in M}(I_{i,j+1} - I_{i,j})}{n_M} - \frac{\sum_{i \in A}(I_{i,j+1} - I_{i,j})}{n_A}\right] \qquad (3.1)$$

where Z_i = number of days between Easter Sunday in year i and March 22 (the earliest possible Easter date)

$f(Z_i)$ = 1 if $Z_i \leq$ 9 (Easter falls in March)

$f(Z_i)$ = 0 if $Z_i \geq$ 9 (Easter falls in April)

I_{ij} = residuals estimated in first iteration of X11ARIMA and assumed to be affected by Easter effect (E_i); i denotes year and j month of March (consequently j+1 denotes April)

n_M = number of years when Easter fell in March

n_A = number of years when Easter fell in April.

There is another type of Easter effect which affects not only the holiday period but days (sometimes weeks) before it. This type of <u>gradual</u> impact can occur in retail trade series such as chocolates, flowers, and, women's clothing. A model has been developed for this kind of Easter effect (see Dagum, Huot and Morry, 1988).

In this model it is assumed that the effect increases (or decreases) linearly during the 'k' days before Easter i.e.:

$f(Z_i) = 1 \quad$ if $Z_i \leq 9$ (Easter falls in March)

$f(Z_i) = \dfrac{k + 9 - Z_i}{k} \quad$ if $9 < Z_i < k + 9$ (Easter falls in April before the k-th of April)

$f(Z_i) = 0 \quad$ if $Z_i \geq 9 + k$ (Easter falls on or after the k-th of April)

where Z_i is the number of days between Easter Sunday and March 22 (the earliest possible Easter date) in year i.

The estimated Easter effect $\hat{E}_i$ is as follows:

$$\hat{E}_i = 1/2 \; f(Z_i) \left\{ \frac{\sum_{i \in M} (I_{i,j+1} - I_{i,j})}{n_M} - \frac{\sum_{i \in LA} (I_{i,j+1} - I_{i,j})}{n_{LA}} \right\}$$

where $I_{i,j}$ residuals estimated in first iteration of X11ARIMA and assumed to be affected by Easter effect $\hat{E}_i$;

- i denotes the year
- j denotes March
- $j+1$ denotes April
- n_M number of years when Easter fell in March
- n_{LA} number of years when Easter fell in late April (on or after the k-th of April)
- M subset of years when Easter fell in March
- LA subset of years when Easter fell in late April.

The build-up, period 'k' can be supplied by the user (possible values are 1 to 9 days) or can be estimated by the program (i.e. the program selects that value of 'k' which minimizes the error sum of squares between the observed and the fitted values). The actual factors for adjusting for Easter variation are the following:

March factor$_i$ $= 1 - \hat{E}_i$ multiplicative
$= -\hat{E}_i$ additive

April factor$_i$ $= 1 + \hat{E}_i$ multiplicative
$= \hat{E}_i$ additive

In order to test if there is significant Easter variation present in a series, one can make use of an F-test.

Let

$$Diff_i = (I_{i,j+1} - I_{i,j})$$

$$\overline{Diff}_M = \frac{1}{n_M} \sum_{i \in M} (I_{i,j+1} - I_{i,j})$$

$$\overline{Diff}_{LA} = \frac{1}{n_{LA}} \sum_{i \in LA} (I_{i,j+1} - I_{i,j})$$

$$\overline{Diff} = \frac{1}{n_M + n_{LA}} \sum_{i \in M \text{ or } i \in LA} Diff_i$$

then the F-value for the presence of Easter effect is calculated using:

$$F_{1,\, n_M+n_{LA}-2} = \frac{1}{n_M+n_{LA}-2}\left(\frac{n_M(\overline{Diff}_M-\overline{Diff})^2+n_{LA}(\overline{Diff}_{LA}-\overline{Diff})^2}{\sum_{i\in M \text{ or } i\in LA}(Diff_i-\overline{Diff})^2-[n_M(\overline{Diff}_M-\overline{Diff})^2+n_{LA}(\overline{Diff}_{LA}-\overline{Diff})^2]}\right)$$

There is an additional option available to users, associated with this Easter Model. The user can instruct the program to exclude the extremes of the model (residuals of the model that lie beyond the 2σ limit) from the estimation of the Easter effect, the significance test and (where applicable) the determination of the optimal build-up period. Under this option only the extremes in late April Easter years are removed (usually there are too few March Easter years for successfully identifying the extremes).

This extreme identification procedure can be applied to the immediate impact model as well by fitting the gradual impact model with a build-up period of '1'.

3.1.1 Easter Extreme Identification Procedure

Calculate the standard deviation of the March to April movement in late April Easter years:

$$\sigma_{LA} = \sqrt{\frac{\sum_{i\in LA}(I_{i,j+1}-I_{i,j})^2 - \frac{1}{n_{LA}}\left(\sum_{i\in LA}(I_{i,j+1}-I_{i,j})\right)^2}{n_{LA}-1}}$$

where $I_{i,j}$ is the irregular component estimated in a first iteration of X11ARIMA.

When calculating the Easter effect exclude those years from the calculation for which

3.2 Increased Accuracy of the Asymmetric Henderson Filters

The weights of all asymmetric trend-cycle filters in X11ARIMA/80 are those of the Method II X-11-Variant. These weights are given with three digits only and, thus, the degree of accuracy of the estimates is limited. The reason for not using higher precision was the lack of documentation on how these weights were derived by Shiskin, Young and Musgrave (1967).

A study by Laniel (1985) gives a formula that enables us to reproduce exactly the end-weights of the 13-term Henderson filter as in the X-11-Variant and consequently, they can now be calculated to any degree of precision. The formula used to obtain these weights is based on the minimization of the mean squared revision (MSR) between the final estimate (obtained by the application of a symmetric filter) and the preliminary estimate (obtained by the application of an asymmetric filter) subject to the constraint that the sum of the weights is equal to one. The assumption made is that at the end of the series the seasonally adjusted values are equal to a linear trend-cycle plus a purely random irregular $NID.(0,\sigma_a^2)$. The equation used by Laniel (1985) is,

$$E\,[r_t^{(i,m)}]^2 = C_1^2\left(t - \sum_{j=-i}^{m} h_{ij}(t-j)^2 + \sigma_a^2 \sum_{j=-m}^{m}(h_{mj}-h_{ij})^2\right) \qquad (3.2.1)$$

where h_{mj} and h_{ij} are the weights of the symmetric (central) filter and the asymmetric filters, respectively; $h_{ij}=0$ for j=-m,...,-i-1, C_1 is the slope of the line and σ_a^2 denotes the noise variance.

There is a relation between C_1 and σ_a^2 such that,

$$I/C = (4\sigma_a^2/\pi)^{\frac{1}{2}} \; / \; *C_1* \tag{3.2.2}$$

The I/C noise to signal ratio in the Census X-11-Variant and X11ARIMA as well, determines the length of the Henderson trend-cycle filter to be applied. Thus, setting $t=0$ and $m=6$ for the end-weights of the 13-term Henderson, we have,

$$\frac{E\ r_0^{(i,6)}}{\sigma_a^2} = \frac{4}{\pi(I/C)^2}\left(\sum_{j=-i}^{6} h_{ij}\right)^2 + \sum_{j=-6}^{6} (h_{6j}-h_{ij})^2 \tag{3.2.3}$$

Making I/C=3.5 (the most noisy situation where the 13-term Henderson is applied), Laniel (1985) obtained the same set of end-weights as those of Census X-11-Variant. These end-weights have been calculated for the remaining Henderson filters using, for quarterly series I/C=3.5 for the 5-term filter and I/C=7 for the 7-term filter; for monthly series I/C=.99 for the 9-term filter and I/C=7 for the 23-term filter. These weights are now incorporated in the X11ARIMA/88 program.

3.3 Automatic Selection of the Default Seasonal Filters Based on the Global I/S Ratio

The X11ARIMA/80 computer program automatically selects a 5-term and a 7-term weighted moving average (3 x 3 m.a. and 3 x 5 m.a., respectively) as seasonal filters whenever the default option is applied. However, Lothian (1984) has shown that depending on the moving seasonality ratio (MSR) given by the global irregular-seasonal ratio value (I/S) printed in Table F2, other seasonal moving averages may be more appropriate for a given series. Lothian (1984) gives the following ranges:

Average	Range of the MSR(I/S) for series shorter than 15 yrs.	Range of the MSR(I/S) for series longer than 15 yrs.
3-term	0.0 - 2.3	0.0 - 2.1
3 x 3	2.3 - 4.1	2.1 - 3.8
3 x 5	4.1 - 5.2	3.8 - 5.0
3 x 9	5.2 - 6.5	5.0 - 6.9
Simple N-Term	6.5 - 7.1	6.9 - 7.1

The problem of incorporating the above ranges in an automatic option is that of getting unnecessary extra revisions for values near the boundaries. It suffices to have a few extreme values not well identified and/or replaced to obtain I/S values that change significantly in very short periods of time. In order to avoid this, the automatic selection of the seasonal moving average is done as follows:

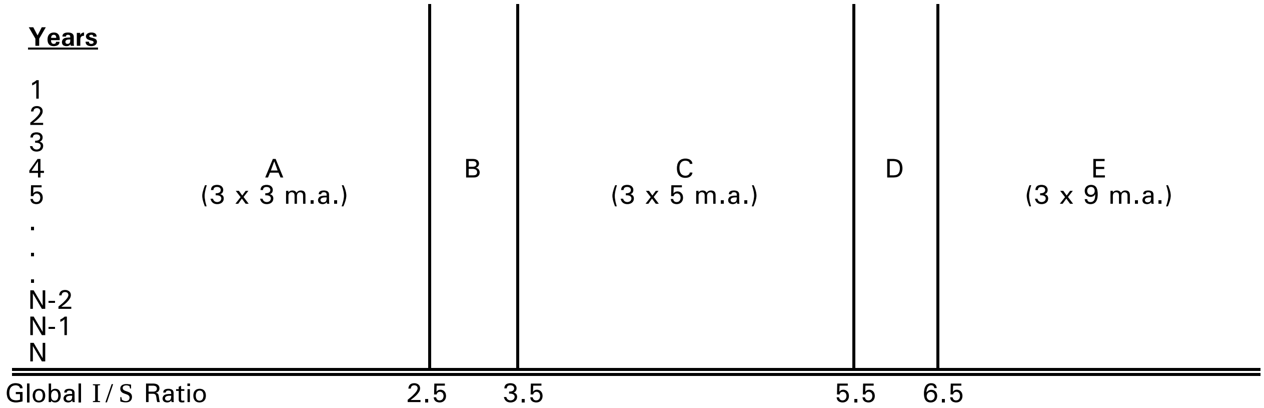
(1) The global I/S ratio is calculated using data that ends in the last full calendar year available. This implies that the I/S ratio will not be changed when new observations are added until a full year of data is completed.

(2) Bandwidths are used instead of the cut-off points given by Lothian (1984). Looking at Figure 1 below the selection process is done as follows:

  (a) If the global I/S ratio for the entire series up to and including the last whole year N, falls in set A ($I/S \leq 2.5$) then a 3 x 3 m.a. is applied; if in set C ($3.5 \leq I/S \leq 5.5$) then a 3 x 5 m.a. is applied and if in set E ($I/S \geq 6.5$) then a 3 x 9 m.a. is used.

  (b) If the global I/S ratio for the entire series up to and including the last whole year falls either in set B or D the last year of data is dropped and the I/S ratio is calculated again to see whether it now falls in A, C or E. If the I/S ratio still falls in the sets B or D, another year of data is dropped and I/S ratio is recalculated. This process is done for the last five years and if the I/S ratio does not fall in A, C or E then the 3 x 5 m.a. is used.

Figure 1 - Criteria for the selection of the seasonal moving average by the default option



Similarly to the variable trend-cycle subroutine the automatic selection of the seasonal filters of the default option operates only in Part D of the program. For Part B and C the same steps as in X11ARIMA/80 are followed. Furthermore, this option does not apply for series shorter than five full years.

3.4 Re-scale of the Original Series

This option enables one to re-scale the values of the original series if they are too big or too small.

3.5 Temporary and Permanent a-priori Adjustments of Original Values

The X11ARIMA/80 permitted only temporary a-priori adjustment of original values in the sense that these adjustments were reintroduced in the final seasonally adjusted data. The major purpose for having temporary a-priori replacement of original values is to provide a smoother input for the estimation of the components.

There are cases, however, where it is convenient to have permanent a-priori adjustments of the original values; for such cases, the permanent adjustments are not reintroduced in the final output. This option enables one to keep a record of the permanent adjustments done to the original series. It is very useful for series affected by Easter and other moving holidays, the effects of which one does not want to appear in the final adjusted series.

The X11ARIMA permits the use of both kind of a-priori modification.

3.6 Graphs of Trading-day and Irregular Variations by Type of Months

Optional graphs (G8) that plot the trading-day and irregulars for the 22 types of months are incorporated in X11ARIMA/88. These graphs permit one to evaluate the adequacy of the daily weights estimated by the program to produce reasonable trading-day variations for each month. They also facilitate the detection of breaks in the pattern of the trading-day variations.

This option is not available in the microcomputer version of X11ARIMA/88.

3.7 User-Specified Printouts

This option in X11ARIMA/88 enables the user to select the tables he/she wants to have printed out up to a maximum of twenty tables.

3.8 Statistics File

X11ARIMA version 2000 produces an additional output file. This file contains selected statistics and diagnostics tests on the ARIMA models and on the components of the time series from the X11ARIMA printout. This file should help the user document the type of options applied and provide a quick overview of the quality of the adjustment.

3.9 Prior Daily Weight File

This file, available in X11ARIMA version 2000, is useful when processing a set of series affected by trading-day variation. It lists the seven prior daily weights estimated for each series by the trading-day regression routine.

CHAPTER II*

FOUNDATIONS OF THE X11ARIMA SEASONAL ADJUSTMENT METHOD

SECTION 1. Introduction

The majority of the seasonal adjustment methods so far developed are based on univariate time series models. They are selected mainly for their simplicity and can be applied without specialized knowledge in a subject matter field.

A few attempts have been made to estimate seasonals based on causal explanations but none of them reached further than the experimental stage. Mendershausen (1939), for instance, tried to regress the seasonal for each month on a set of exogenous variables (meteorological and social variates) in order to build an explanatory model for seasonality but his empirical results were inconclusive.

Univariate time series methods of seasonal adjustment try to estimate the generating mechanism of the observations under the simple assumption that the series is composed of a systematic part which is a well determined function of time, and a random part which obeys a probability law (Anderson, 1971; Dagum, 1974). The random element is assumed to be identically distributed with constant mean, constant variance and zero autocorrelation. The feasibility of this decomposition was proven in a famous theorem by Herman Wold in 1938.

The methods of estimation of the components of a time series can be grouped into two broad categories (Dagum, 1978.b and 1979.b):

- regression methods; and

- moving average techniques, also called linear smoothing procedures.

The regression methods assume that the seasonals and the other systematic components, trend and cycle, are deterministic functions over the entire span of the series.

The methods based on moving averages or linear smoothing filters assume that, although the time series components are smooth functions of time, they cannot be closely approximated by simple functions over the entire range of time under consideration. The assumptions implicit in the moving average procedures are that the trend, cycle and seasonals are stochastic and not deterministic.

The majority of the seasonal adjustment methods officially adopted by statistical agencies belong to the category of moving average techniques. They include among them, the U.S. Bureau of the Census Method II X-11-Variant; the BLS seasonal factor method; the Burman Method of the Bank of England; the Berlin Method, ASA II; the method of the Statistical Office of the European Economic Communities of Brussels; and the method of the Dutch Central Planning Bureau. These methods have often been criticized because they lack an explicit model concerning the decomposition of the original series and because their estimates for the observations of the most recent years do not have the same degree of reliability as compared to those of central observations (Kuiper, 1976; and Dagum, 1976.b).

The lack of an explicit model applies to the whole range of the series. Moving average procedures do make assumptions concerning the time series components, but the assumptions are valid only within the span of the set of weights of the moving average.

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* This chapter is reproduced from the X11ARIMA Seasonal Adjustment Method by Dagum (1980).

The second limitation is inherent in all linear smoothing procedures since the first and last observations cannot be smoothed with the same set of symmetric weights applied to central observations. Because of this, the estimates for current observations must be revised as more data is added to the original series. Frequent revisions, however, confuse the users of seasonally adjusted data, particularly if the revisions are relatively large or if they introduce changes in the direction of the general movement of the adjusted series. In fact, faced with the problem of controlling the level of the economic activity, policy makers will hardly base their decisions on seasonally adjusted data that are subject to significant revisions whenever new information is available.

The Statistics Canada **X11ARIMA**, as developed by Dagum (1975, and 1978.c) does not share the two common constraints of moving average procedures. It offers an **ARIMA** model for the series and minimizes the revision of the seasonals in mean square error.

The **X11ARIMA** basically consists of:

1. Modelling the original series by integrated autoregressive moving average processes (**ARIMA** models) of the Box and Jenkins (1970) types.

2. Extrapolating one year of unadjusted data at each end of the series from **ARIMA** models that fit and project the original series well. This operation, called "forecasting" and "backcasting" is designed to extend the observed series at both ends.

3. Seasonally adjusting the extended (original) series with various moving averages of Method II X-11-variant as developed by Shiskin, Young and Musgrave (1967). In addition, the user now has the option of applying a centred 24-term filter to replace the centred 12-term moving average for the preliminary estimation of the trend-cycle. This new filter gives better results for series strongly affected by short cycles (less than three years) or sudden changes in trend.

The **ARIMA** part incorporated into the X-11 program plays a very important role in the estimation of seasonal factor forecasts and current seasonal factors when seasonality is moving rapidly in a stochastic manner, a phenomenon often found in key economic indicators (Dagum, 1978.a). Since the series are extended with extra data, the filters applied by the X-11 to seasonally adjust current observations and to generate the seasonal forecasts are closer to the filters used for central observations. Consequently, the degree of reliability of the extended series for current estimates is greater than that of the unextended, and the magnitude of the revisions is significantly reduced. Similar conclusions were obtained from comparisons made with other seasonal adjustment methods based on moving averages (Kuiper, 1976).

Generally, a reduction of about 30% in the bias and of 20% in the absolute values of the total error in the seasonal factor forecasts for the 12 months (4 quarters) has been found for Canadian and American series (Kuiper, 1976; Farley and Zeller, 1976; and Dagum, 1978.b). The percentage reduction for those months (quarters) corresponding to peaks and troughs is larger than the average for the whole year.

Pierce (1978) shows that **ARIMA** extrapolation makes the **X11ARIMA** a minimum mean square error seasonal adjustment method and that, in fact, this type of extrapolation would minimize the revisions of any moving average seasonal adjustment procedure in the mean square error sense. Similar conclusions are obtained by Geweke (1978) who extrapolates the future values of the series using the spectrum and one **ARIMA** model.

For series with rather stable seasonality, a significant improvement can be obtained when the trend-cycle is growing fast or the last year of data is one with a turning point. The final weights of **X11ARIMA** to estimate the trend-cycle are a combination of the symmetric Henderson weights and the asymmetric weights of the **ARIMA** model used for the extrapolated data. Since these final weights change with the **ARIMA** model fitted to the series, they reflect the most recent movement of the series and, as a result, seldom miss a turning point. Better estimates of the seasonal-irregular ratios (or differences) are obtained which then are averaged to produce stable seasonals.

From the viewpoint of seasonal adjustment, another important advantage of **X11ARIMA** is that it offers a statistical model for the whole range of the series. The existence of a model that fits the data well, fulfils the basic underlying principle of seasonal adjustment, namely that the series is decomposable. If a series does not lend itself to the identification of an **ARIMA** model (here including all **AR, MA** and **ARMA** as subclasses) which simply describes the general structure of the series as a function of past values and lagged random disturbances, any further decomposition into trend, cycle, and seasonals becomes dubious. In fact, the lack of fit by an **ARIMA** model indicates that the series is either deterministic or is practically a purely random process, or that it is so much contaminated by the irregulars that its systematic movement is unidentifiable.

The **X11ARIMA** generates extrapolated values of the original data such that the one-lead projected value has a minimum mean-square-error and thus can be used as a reference for preliminary figures. This is particularly useful to producers of original data obtained from incomplete returns, as is often the case with series that are flows.

SECTION 2. ARIMA Models and Extrapolation

A fundamental step in the improvement of the seasonal adjustment by the X-11 program (equally applicable to any seasonal adjustment method based on moving averages) is to decide what kind of extrapolation method should be used to extend the original series. For the **X11ARIMA**, the selection was made according to the following requirements, (Dagum, 1978.b):

- The extrapolation method must belong to the "simplest" class in terms of its description of the real world. No explanatory variable must be involved; the series should be described simply by its past values and lagged random disturbances. This requirement is necessary to facilitate the incorporation of the extrapolation method into the X-11 program, since the procedure has to be automated.

- The identified models must be robust to the incorporation of one or two extra years of data, and the corresponding extrapolated values should not change significantly with small variations in parameter values. This condition is necessary to avoid frequent changes of models and significant revisions that confuse the users of seasonally adjusted data.

- The method must produce extrapolated values that follow the intra-year movement reasonably well although they could miss the level. This requirement reflects the fact that these projected values are not for policy or decision making but to improve current seasonal adjustment.

- It must generate optimum extrapolated values in the minimum mean square error sense. This condition allows the extrapolated values, at least the one lead extrapolation, to be used as benchmarks for preliminary data coming from incomplete returns.

- The method must be parsimonious in the number of parameters. The main characteristics of the series are thus summarized in a small number of parameters.

This set of conditions led to the selection of a univariate method of forecasting and, among the several well developed methods, the **ARIMA** models (autoregressive integrated moving averages) of the Box and Jenkins (1970) type were chosen. **ARIMA** models have been found to be powerful forecasting procedures for a large class of series (Newbold and Granger, 1974; Reid 1975).

ARIMA models bring together two basic concepts in extrapolating: autoregression and moving averages. **ARIMA** is an acronym with the first two letters, **AR**, standing for "Autoregressive"; the last two letters, **MA**, for "Moving Average" and the **I**, for "Integration", or summation. This part of **ARIMA** is indispensable since stationary models which are fitted to the differenced data have to be summed or "integrated" to provide models for the non-stationary data.

In the Box-and-Jenkins notation, the general multiplicative **ARIMA** model for a series with seasonality is expressed as $(p,d,q)\,(P,D,Q)_s$, where d is the order of the ordinary difference and D is the order of the seasonal differences applied to the original series to make it stationary. In other words, the statistical structure of the series must be independent of time; this implies model stability. To correct for a continuous change in level due to an upward or downward trend, a first difference ($d=1$) is applied to the original series Z_t; i.e., the new series is $W_t = Z_t - Z_{t-1}$. Symbolically, $W_t = (1-B)Z_t$, where B is the lag operator such that $B^n Z_t = Z_{t-n}$. For more complex cases of deterministic or stochastic instability, higher order differences are applied. To correct for a stable seasonality, the power of the seasonal difference, D, is made equal to one, and the transformed series is then $W_t = Z_t - Z_{t-s} = (1-B^s)Z_t$, where s is the seasonal periodicity, equal to 12 for monthly data and to 4 for quarterly data. Higher order seasonal differences remove other kinds of seasonal patterns.

P and p are the number of seasonal and ordinary autoregressive parameters, respectively. If $p=1$ and the parameter is of order one, the independent variable is lagged once, i.e. we work with Z_{t-1}; similarly, if $P=1$ and the parameter has order s, we work with Z_{t-s}. These lagged variables are affected by autoregressive parameters φ and Φ respectively, which measure the impact of the previous observed value (month, quarter) and the previous year observed value for the month or quarter, on the dependent variable Z_t.

Q and q are the numbers of seasonal and ordinary moving average parameters. If $q=1$ and the parameter has order one, then the residuals a_t are lagged once, i.e. we work with a_{t-1}; and if $Q=1$ and the seasonal parameter has order s, the residuals are also lagged once, i.e. we work with a_{t-s}. The lagged residuals are affected by the parameters θ and Θ respectively, which measure the impact of the residuals of the previous value (months, quarters) and of the previous year value for the month or quarter, on the dependent variable Z_t.

Thus for **ARIMA** models, the variable Z_t is a function of lagged dependent variables and of lagged innovations a_t. For example, the simple **ARIMA** model (0,1,1) $(0,1,1)_4$ of Z_t reduces to,

$$(1-B)(1-B^4)\ Z_t = (1-\theta B)(1-\Theta B^4)\ a_t \tag{1}$$

or

$$Z_t = Z_{t-1} + Z_{t-4} - Z_{t-5} + a_t - \theta a_{t-1} - \Theta a_{t-4} + \theta\Theta a_{t-5} \tag{2}$$

(2) says that Z_t is equal to the previous quarter value Z_{t-1} plus the difference between the values for the corresponding last year quarter and previous last year quarter, plus the present innovation and lagged residuals.

For a crude approximation, θ can be interpreted as the extent to which innovations incorporate themselves in the subsequent history of the trend-cycle and Θ as the extent to which the residuals incorporate themselves in the subsequent seasonal pattern.

θ and Θ take values between -1 and 1. When both are equal to plus or minus one, the innovations have their maximum impact on the subsequent evolution of the series making the process deterministic. When both are equal to zero, the innovations have a transitory or instantaneous impact only and the process is strongly stochastic.

The procedure followed by model (1) to obtain an estimate of Z_t is not new to practicing statisticians who often use a very similar approach to get a projected value to compare with a figure being checked.

The values of the autoregressive parameters φ and Φ, and of the moving average parameters θ and Θ, vary for each series and, therefore, the **ARIMA** models are very flexible and can follow well the systematic movement of a large class of series.

The **ARIMA** extrapolating function can be expressed in different forms but for computational purposes the difference equation form is the most useful. For a detailed discussion of the properties and basic assumptions of **ARIMA** models the reader is referred to Box and Jenkins (1970), and Granger and Newbold (1977).

SECTION 3. The Selection of ARIMA Models in the X11ARIMA/80 Computer Version

The ARIMA Automatic Option

The **ARIMA** models to be used in the context of the **X11ARIMA/80** method must fulfil the double condition of fitting the data well and of generating "reasonable" projections for the last three years of observed data. By "reasonable" projections is meant projections with a mean absolute error smaller than 5% for well-behaved series (e.g., Employment adult males) and smaller than 12% for highly irregular series (e.g., Unemployment teenage males).

These guidelines have been tested with more than 250 economic time series and are rather conservative. In fact, even with larger extrapolation errors, the **X11ARIMA/80** produces current and forecast seasonals more reliable than those from X-11.

If possible, the identification of the **ARIMA** models should be made using data previously treated for extreme values. This recommendation is even more relevant if the outliers fall in the most recent years, in order to avoid the rejection of good models simply because the outliers have inflated the absolute average extrapolation error above the acceptance level of the guidelines.

To determine whether or not a model fits the data well, the portmanteau test-of-fit developed by Box and Pierce (1970) with the variance correction for small samples introduced by Ljung and Box (1978) is used. The null hypothesis of randomness of the residuals is tested at a 10% level of significance and the estimated parameters are checked to avoid over-differencing.

Based on the above criteria for fitting and extrapolation, three **ARIMA** models were incorporated into the X-11 program in order to automate **X11ARIMA/80**. The user can either supply his own model or choose the automatic option. The latter can be used for series that are at least five years long and the program automatically checks whether one of the three models passes the required guidelines. For series longer than 15 years, only the last 15 years will be used in the **ARIMA** fit and extrapolation. In the affirmative case, the model chosen is the one that gives the smallest average extrapolation error. Then the program automatically extends the unadjusted series with one year of extrapolated data, and seasonally adjusts.

In the event that none of the three models is found acceptable, a message is given indicating that extrapolated values have not been incorporated into the unadjusted series. Particularly for flow series such as imports, retail trade and others, which can be strongly affected by strikes and trading-day variations, it is recommended that these sources of variation be removed from the series before using the automatic option or identifying the **ARIMA** model. The program offers an option where the extreme values of the series are replaced by the fitted values of the **ARIMA** model that passes the guidelines of acceptance, in a first run, and then the same model is re-submitted to the modified series to extrapolate. This option, however, does not modify extreme values that might be in the $2(p + Pxs + d + Dxs)$ observations at the beginning of the series. Thus for a $(0,1,1)\ (0,1,1)_{12}$ monthly model, this means that no replacement of extreme values is made in the first 26 observations.

When the three automatic models are rejected, the user should determine whether the rejection is due to an extremely large average extrapolated error for one particular year only. If such is the case, the models printed in the program can still be considered good if the year in question has been an unusual one, for example, of a strong recession. The best model should then be re-submitted using the option corresponding to user's **ARIMA** model identification.

The automated option for multiplicative and log-additive seasonal adjustments chooses from the following three **ARIMA** models: log $(0,1,1)\ (0,1,1)_s$, log $(0,2,2)\ (0,1,1)_s$ and log $(2,1,2)\ (0,1,1)_s$ and for the additive decomposition, from $(0,1,1)\ (0,1,1)_s$, $(0,2,2)\ (0,1,1)_s$ and $(2,1,2)\ (0,1,1)_s$.

The selection of the three first models was made from a set of 12 **ARIMA** models testing **out-of-sample** extrapolated values, for the four last years, on 174 economic time series of 15 years of length and of quarterly and monthly observations.

The 12 models tested were:

1. (1,1,1) $(1,1,1)_s$
2. (2,1,2) $(0,1,1)_s$
3. (2,0,1) $(0,1,2)_s$
4. (1,1,2) $(0,1,2)_s$
5. (2,0,0) $(0,1,1)_s$
6. (1,1,2) $(1,0,2)_s$
7. (2,1,1) $(0,1,2)_s$ log
8. (0,1,2) $(1,1,2)_s$ log
9. (0,1,1) $(0,1,1)_s$ log
10. (0,1,1) $(0,2,2)_s$ log
11. (0,2,2) $(0,1,1)_s$ log
12. (2,1,1) $(0,1,1)_s$ log

The 174 series were obtained from the following sectors: the System of National Accounts, Manufacturing, Prices, Labour, Construction, Domestic Trade, and Finance.

Originally, the models were ranked according to how well they fitted the series and met only two of the criteria of acceptance, the P^2 test of randomness at 1% and the absolute average forecasting error lower than 10% (Lothian and Morry, 1978.a). In further experimentations the P^2 probability level was raised to 10% and the absolute average forecasting error for the last three years to 12% (Dagum, 1979.a).

It was found that model 2 fitted and forecasted well 73% of the series. For the class of series not passed by model 2, model 11 provided acceptable results for 19% of those remaining (or 5% of the total). For the remaining series not passed by either model 2 or model 11, model 9 showed the best performance, passing an additional 2% of the total number of series. Thus models 2, 11, and 9 jointly passed 80% of the series. An additional 1% could have been fitted by the other 9 models, while none of the 12 models tested provided acceptable results for the remaining 19% of the series.

The objective of an automatic procedure is to find adequate models for a great variety of series at minimal cost, i.e., have a small set of models that cover a large class of economic series.

The average forecast errors for each of the 174 series were ranked. It was found that when models 9 and 11 passed the guidelines, one of the two models often placed first among the 12 models. Due to this result only models 9 and 11 are fitted initially; model 2 is fitted only if neither 9 nor 11 pass the guidelines.

For a larger sample of 305 series and testing **within sample** extrapolated values for the same 12 models, it was found that the best three models were (2,1,2) $(0,1,1)_s$, (2,0,1) $(0,1,2)_s$ and log(2,1,2) $(0,1,2)_s$ (Dagum, 1978.c). The average **out of the sample** extrapolation error for this set of three models when testing the sample of 174 series was close to the average obtained by the other three models chosen and both sets passed the guidelines of acceptance. However, models 2, 9 and 11 have been preferred because they are more parsimonious in the number of parameters. Furthermore, one of the **IMA** type models, the log(0,1,1) $(0,1,1)_s$ has a system of weights similar to those of the additive standard option of the X-11 program according to Cleveland and Tiao (1976). The need for the logarithmic transformation stems from the fact that the majority of the series tested followed a multiplicative relationship among the trend, cycle, seasonal and irregulars.

For those series seasonally adjusted additively, the automatic selection is made from the (0,1,1) $(0,1,1)_s$, (0,2,2) $(0,1,1)_s$ and (2,1,2) $(0,1,1)_s$ non-log models. Although the first two models did not enter in the set of models originally tested, further experimentation with series that followed an additive relation among the components showed that the logarithmic transformation adversely affected both the average forecasting error and the P^2 probability value. It is also apparent that when the additive option is used because of the presence of zeros or negative values in a series, the automatic option would test only the model (2,1,2) $(0,1,1)_s$ if these changes had not been made. For further details on the model selection, evidences of over-differencing, and new modifications from the first experiment, the reader is referred to Dagum (1979.a).

The extrapolation **ARIMA** option prints:

- The tested models expressed in the classical form (p,d,q) $(P,D,Q)_s$ as described in Section 2 above.
- The transformation performed on the data before testing the models.
- The absolute average percentage error of the extrapolated values for each of the last three years and the average for the three years. If the average forecasting error is greater than 12%, the **ARIMA** automatic option rejects the model.
- The P^2 probability for testing the null hypothesis of randomness of the residuals. If the P^2 probability is smaller than 10%, the **ARIMA** automatic option rejects the model.
- The coefficient of determination R^2.
- The values of the estimated parameters in the following order: First, the ordinary autoregressive parameters φ, the number of which is given by p; second, the seasonal autoregressive parameter Φ, the number of which is given by P; third, the ordinary moving average parameters θ, the number of which is given by q; and fourth, the seasonal moving average parameters Θ, the number of which is given by Q.
- Evidences of over-differencing are present if the sum of the ordinary moving average parameters, or of the seasonal moving average parameters, is greater than 0.90. In such cases, the model is rejected.

If any of the three models of the automatic option passes the guidelines of acceptance, the program uses the best one to backcast one year. The backcasts are tested in a similar manner except that the absolute average backcasting error must be greater than 18% to reject the model. This increase in the upper bound of acceptance is due to the fact that the extrapolation errors are all expressed in percentage of the level of the series, and for most series, their level has more than doubled during the last 10 years. Furthermore, for series of 11 years or more, the influence of the backcasts in the current seasonal factors is minor.

The program has also an option by which only forecasts are generated from the **ARIMA** model chosen.

The Identification of ARIMA Models by the User

The guidelines for the acceptance of an **ARIMA** model when using the automatic option are conservative. If the series fails these guidelines "marginally", the users may still apply the best of the three models if it is considered satisfactory for the series in question. By marginally is meant here a P^2 probability between 5% and 10%; and for highly irregular series, an average forecasting error between 12% and 15%. If none of the three selected models is marginally acceptable, the user should identify a new model. In many cases, the identification that leads to a good model requires minor changes to the automatic option's models. The following rules have been useful to improve the fitting and extrapolation for a large number of series.

- **Correcting for a low P^2 probability.** A low P^2 probability indicates that the residuals of the fitted model are autocorrelated. This frequently happens because the log transformation is not needed (if applied) or vice versa. Resubmitting the model with the transformation changed may correct the low P^2 value. In other cases, this low P^2 value is the result of over-differencing and once this is corrected, as described below, the model becomes adequate.

- **Correcting for evidence of overdifferencing.** Evidence of overdifferencing leads to cancellation of parameters suggesting a more parsimonious model. For example, if the estimated ordinary moving average parameters of the $(0,2,2)$ $(0,1,1)_4$ model are $\theta_1 = 1.3$ and $\theta_2 = 0.3$, because their sum is greater than 0.90, the program will reject the model on the basis of evidence of overdifferencing. In effect, the $(0,2,2)$ $(0,1,1)_4$ model can be written as:

$$(1-B)^2(1-B^4)\ Z_t = (1-1.3B+0.3B^2)(1-\Theta B^4)\ a_t, \tag{3}$$

where Θ is the seasonal moving average parameter and $s=4$ is the seasonal periodicity. The right hand member of (3) can be factored, as follows:

$$(1-1.3B+0.3B^2)(1-\Theta B^4) = (1-B)(1-0.3B)(1-\Theta B^4) \tag{4}$$

substituting (4) into (3) and simplifying, it becomes:

$$(1-B)(1-B^4)\ Z_t = (1-0.3B)(1-\Theta B^4)\ a_t. \qquad (5)$$

The (5) is a (0,1,1) $(0,1,1)_4$ model. Because the estimation of the parameters is not exact, the model suggested by the parameter cancellation is not always the correct one. Often some modifications must be made. In our example, if the (0,1,1) $(0,1,1)_4$ model is not adequate, by simply adding an ordinary moving average parameter to compensate for the complete elimination of the ordinary differences $(1-B)$, a good model can be obtained, e.g; (0,1,2) $(0,1,1)_4$. Another common case of overdifferencing occurs when the seasonal moving average parameter Θ is > 0.90. In such cases, model (5) reduces to:

$$(1-B)\ Z_t = (1-0.3B)\ a_t \qquad (6)$$

that is, a (0,1,1) model. The cancellation suggests that seasonality is not present; or seasonality, if present, is mostly of a **deterministic** character. In the first case, further evidence can be obtained by looking at the tests for presence of seasonality available in the **X11ARIMA/80** program. If these tests indicate that seasonality is present, the user can try a simpler model with only a seasonal moving average parameter, say (0,1,1) (0,0,1) to generate the extrapolated value. Whether the **ARIMA** option is applied or not, it is recommended that the seasonal adjustment be made using the moving averages for stable seasonality.

- **Correcting for high extrapolation errors.** Generally, having corrected for the low P^2 probability and/or evidence of overdifferencing, the extrapolation errors are reduced. However, if such is not the case, users should identify their own model using any computer program for **ARIMA** model identification and estimation.

SECTION 4. Basic Properties of the X11ARIMA Moving Averages.

Main Steps in Producing a Seasonally Adjusted Series

The main steps in producing seasonally adjusted series using the **X11ARIMA** method are equal to those of Method II X-11-variant (Shiskin, Young and Musgrave, 1967) as shown in Appendix A. The main differences are: (i) the extension of the unadjusted series with one year of extrapolated values from **ARIMA** models at one or both ends of the series whenever the **ARIMA** option is used; (ii) the option of applying a centred 24-term moving average for the preliminary estimation of the trend-cycle; (iii) short series of three and four years are seasonally adjusted with the stable seasonality option only.

The **X11ARIMA** assumes that the main components of a time series follow a multiplicative, an additive or a log additive model, that is:

1. Multiplicative: $O_t = C_t S_t I_t$ and $\sum_1^{12} \frac{S_t}{n} = 1$
2. Additive: $O_t = C_t + S_t + I_t$ and $\sum_1^{12} S_t = 0$
3. Log additive: $\log O_t = \log C_t + \log S_t + \log I_t$ and $\Pi_1^{12} S_t = 1$

where O_t stands for the unadjusted series, C_t the trend-cycle, S_t the seasonal and I_t the irregular.

The estimation is made with different kinds of moving averages that are applied sequentially in 13 steps, and repeated.

For the standard option of the computer program these 13 steps are:

1. Compute the ratios between the original series and a centred 12-term moving average (2 x 12 m.a., that is a 2-term average of a 12-term average) as a first estimate of the seasonal and irregular components (SI).

2. Apply a weighted 5-term moving average (3 x 3 m.a.) to the seasonal-irregular ratios (SI) of each month separately, to obtain a preliminary estimate of the seasonal factors.

3. Compute a centred 12-term moving average of the preliminary factors found in step 2 for the entire series. To obtain the six missing values at either end of this average, repeat the first (last) available moving average value six times. Adjust the factors to add to 12 (approximately) over any 12-month period by dividing the centred 12-term average into the factors.

4. Divide the seasonal factor estimates into the seasonal irregular (SI) ratios to obtain an estimate of the irregular component.

5. Compute a moving five-year standard deviation (σ) of the estimates of the irregular component and test the irregulars in the central year of the five-year period against 2.5σ. Remove values beyond 2.5σ as extreme and recompute the moving five-years. Assign a zero weight to irregulars beyond 2.5σ and a weight of 1 (full weight) to irregulars within 1.5σ. Assign a linearly graduated weight between 0 and 1 to irregulars between 2.5σ and 1.5σ.

6. For the first two years, the σ limits computed for the third year are used; and for the last two years, the σ limits computed for the third-from-last year are used. To replace an extreme ratio in either of the two beginning or ending years, the average of the ratio times its weight and the three nearest full-weight ratios for that month are taken.

7. Apply a weighted 5-term moving average to the SI ratios with extreme values replaced, for each month separately, to estimate preliminary seasonal factors.

8. Repeat step 3, applied to the factors found in step 7.

9. To obtain a preliminary seasonally adjusted series divide 8 into the original series.

10. Apply a 9-, 13-, or 23-term Henderson moving average to the seasonally adjusted series and divide the resulting trend-cycle into the original series to give a second estimate of the SI ratios. (In the first iteration, only the 13-term Henderson is applied.)

11. Apply a weighted 7-term moving average (3 x 5 m.a.) to each month's SI ratios separately, to obtain a second estimate of the seasonal component.

12. Repeat step 3.

13. Divide the result of operation 11 into the original series to obtain the seasonally adjusted series.

Allan Young (1968), using a linear approximation of the Census Method II, arrives at the conclusion that a 145-term moving average is needed to estimate one seasonal factor with central weights if the trend-cycle component is adjusted with a 13-term Henderson moving average. The first and last 72 seasonal factors (six years) are estimated using sets of asymmetrical end-weights. It is important to point out, however, that the weights given to the more distant observations are very small and, therefore, this moving average can be very well approximated by taking one half of the total number of terms plus one. So, if a 145-term moving average is used to estimate the seasonal factor of the central observation, a good approximation is obtained with only 73 terms, i.e., six years of observations. The properties of the filters used in the Method II X-11 program are extensively discussed in Dagum (1976.a and 1978.b) and the stochastic properties for data filtering of **X11ARIMA** are analyzed in Dagum (1979.c). A brief discussion is made here for monthly series and the conclusions are also valid for quarterly series.

Basic Properties of the Two-sided Linear Smoothing Filters (Central Weights) of the X11ARIMA

The linear smoothing filters applied by Method II X-11 and the **X11ARIMA** to produce seasonally adjusted data can be classified according to the distribution of their set of weights into symmetric (two-sided) and asymmetric (one-sided). The symmetric moving averages are used to estimate the component values that fall in the middle of the span of the average, say $2n+1$, and the asymmetric moving averages, to the first and last n observations. The sum of the weights of both kinds of filters is unity and thus the mean of the original series is unchanged in the filtering process[1].

It is very important in filter design that the filter not displace in time the components of the output relative to those of the input.; in other words, the filter must not introduce phase shifts[2]. Symmetric moving averages introduce no time displacement for some of the components of the original series and a displacement of ± 180E, for others. A phase shift of ± 180E is interpreted as a reverse in polarity, which means that maxima are turned into minima and vice versa. In other words, peaks (troughs) in the input are changed into troughs (peaks) in the output.

For practical purposes, however, symmetric moving averages act as though the time displacement is null. This is so because the sinusoids that will have a phase shift of ± 180E in the filtering process, are cycles of short periodicity (annual or less) and moving averages tend to suppress or significantly reduce their presence in the output.

The centred 12-term moving average. The centred 12-term moving average is used for a preliminary estimate of the trend-cycle (step 1). This filter reproduces exactly the central point of a linear trend and annihilates a stable seasonality over a 12-month period in an additive model. If the relationship among the components is multiplicative, then only a constant trend multiplied by a stable seasonality will be perfectly reproduced.

The main limitation of this filter is that it misses peaks and troughs of short cycles (three or two years) and unless the irregular variations are small, it will not smooth the data successfully. If the input to this filter is a curve of three-year periodicity and amplitude 100, the output is a curve of equal periodicity but with amplitude reduced to 82.50; the amplitude of waves of two-year periodicity is reduced to 75; and only waves whose period is five years or more are passed with very small reductions in their amplitudes. However because the trend-cycle variation of most economic time series is mainly due to long cyclical variations of 40 months or more (Davis, 1941), this filter is generally good for a preliminary estimation of the trend-cycle.

The centred 24-term moving average. For series mostly dominated by short cyclical fluctuations (three or two years) or affected by sudden changes in trend level, an optional centred 24-term filter is included in **X11ARIMA/88**. This filter is a modified version (Cholette, 1979) of the Leser filter (1963).

The amplitude of waves of three and two-year periods are reduced by only 5% and 18% respectively.

Furthermore, this filter reduces the irregular variation more than the centred 12-term filter does. Unfortunately, as we depart from the central observation, the estimation of the 12 points at each side deteriorates gradually. Because of this, in **X11ARIMA** the asymmetric weights that estimate only the six points at each side of the central observation are used. The first and last six observations are deleted as in the centred 12-term filter. These asymmetric weights applied to observation 7 to 12 and 14 to 19 share the same spectral properties of the centred 24-term filter except for small phase shifts.

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1 The sum of the weights of a filter determines the ratio of the mean of the smoothed series to the mean of the unadjusted series assuming that these means are computed over periods long enough to ensure stable results.

2 In spectral analysis, the phase is a dimensionless parameter that measures the displacement of the sinusoid relative to the time origin. Because of the periodic repetition of the sinusoid, the phase can be restricted to ± 180E. The phase is a function of the frequency of the sinusoid, the frequency being equal to the reciprocal of the period, or length of time required for one complete oscillation.

The 9-,13- and 23-term Henderson moving averages. The Henderson moving averages were developed by summation formulae mainly used by actuaries. The basic principle for the summation formulae is the combination of operations of differencing and summation in such a manner that when differencing above a certain order is ignored, they will reproduce the functions operated on. The merit of this procedure is that the smoothed values thus obtained are functions of a large number of observed values whose errors, to a considerable extent, cancel out. These filters have the properties that, when fitted to second or third degree parabolas, their output will fall exactly on those parabolas and, when fitted to stochastic data, they will give smoother results than can be obtained from the weights which give the middle point of a second degree parabola fitted by least squares. Recognition of the fact that the smoothness of the resulting filtering depends on the smoothness of the weight diagram led Robert Henderson (1916) to develop a formula which makes the sum of squares of the third differences of the smoothed series a minimum for any number of terms.

The Henderson moving averages are applied to obtain an improved estimate of the trend-cycle (step 10). They give the same results as would be obtained by smoothing the middle values of a third degree polynomial fitted by weighted least squares, where the weights given to the deviations are as smooth as possible.

The fact that the trend-cycle is assumed to follow a parabola over an interval of short duration (between one and two years approximately) makes these filters adequate for economic time series.

None of the Henderson filters used by the **X11ARIMA** method eliminates the seasonal component but since they are applied to data that are already seasonally adjusted, this limitation becomes irrelevant. On the other hand, they are extremely good for passing waves of any period longer than a year. Thus, the 13-month Henderson, which is the most frequently used, will not reduce the amplitude of waves of period 20 months or more, which stand for trend-cycle variations. Moreover, it eliminates almost all the irregular variations that can be represented by waves of very short periodicity, six months or less.

The weighted 5-term (3 x 3) and the weighted 7-term (3 x 5) moving averages. The weighted 5-term moving average is a 3-term moving average of a 3-term moving average (3 x 3 m.a.). Similarly, the weighted 7-term moving average is a 3-term moving average of a 5-term moving average (3 x 5 m.a.). These two filters are applied to the seasonal-irregular ratios (or differences) for each month, separately, over several years. Their weights are all positive and, consequently, they reproduce the middle value of a straight line within their spans. This property enables the **X11ARIMA** program to estimate a linearly moving seasonality within five and seven-year spans. Therefore, these filters can approximate quite well the gradual seasonal changes that follow non-linear patterns over the whole range of the series (more than seven years).

The weighted 5-term moving average (3 x 3 m.a.) is a very flexible filter that allows for fairly rapid changes in direction, but since the span of the filter is short, the irregulars must be small for the SI to be smoothed successfully.

The weighted 7-term moving average (3 x 5 m.a.) is less flexible and it is applied for the final estimate of the seasonal factors. For series whose irregular component is large, the program provides other optional sets of weights which are applied to longer spans and thus produce smoother seasonal factors.

Basic Properties of the one-sided Smoothing Filters (End-Weights) of the X11ARIMA Method.

It is inherent in any moving-average procedure that the first and last n points of an unadjusted series cannot be smoothed with the same set of symmetric weights applied to middle values. In the **X11ARIMA** the seasonal adjustment of current years and the seasonal factor forecasts are obtained from the combination of two filters: (i) the one-sided filters used for extrapolating the unadjusted data from the **ARIMA** models and (ii) the filters of the X-11 program used for seasonal adjustment. The extrapolation filters of the **ARIMA** models change with the series and are therefore very flexible. These filters reflect the most recent movements of the series, in particular, rapidly changing seasonality.

The X-11 filters applied to the **extended** unadjusted series for the trend-cycle estimation are two-sided. Therefore, they do not miss turning points and do not introduce phase shifts, which allows them to estimate the cyclical variations well.

The X-11 filters that estimate the seasonal factors are still one-sided but closer to the symmetric filters used for central observations. Thus, with one year of extrapolated data, the seasonal factor forecasts are obtained from the extrapolated data with the X-11 filters used for producing current seasonal adjustment.

It is the combination of the fixed filters from X-11 (the same for any series) with the flexible filters of the **ARIMA** models (changing with the series) that makes **X11ARIMA** a better method than X-11 for current adjustment.

SECTION 5. The Advantages of X11ARIMA/80 Computer Program Over Method II X-11-Variant

The main advantages of **X11ARIMA/80** over the X-11-variant are:

1. The availability of a statistical model that provides relevant information on the quality of the raw data. The existence of a model that fits the original series, even though it does not pass the guidelines for extrapolation, fulfils the fundamental principle of seasonal adjustment, that is, the series is decomposable. In other words, if a series does not lend itself to the identification of an **ARIMA** model (including any type **AR**, **MA**, **ARIMA**) which simply describes the series as a function of past values and lagged random disturbances, any decomposition into trend-cycle, seasonal and irregulars can be seriously criticized and of doubtful validity. In fact, the lack of fit by an **ARIMA** model can indicate deficiencies concerning the way in which the observations are made, e.g., improper sampling interval.

   If the series has an **ARIMA** model, the expected value and the variance of the original series can be calculated and thus, confidence intervals can be constructed for the observations. This permits the identification of extreme values, particularly at the end of the series.

2. The one-step extrapolation from **ARIMA** models is a minimum-mean-square-error extrapolation and can be used as a projected value or benchmark for preliminary figures.

3. If current seasonal factors are applied to obtain current seasonally adjusted data, there is no need to revise the series more than twice. For many series, one revision alone will give seasonal factors that are "final" in a statistical sense.

4. The total error in the seasonal factor forecasts and in the current seasonal factors is significantly reduced for all the months. Generally, a reduction of some 30% in the bias and of 20% in the absolute value of the total error has been found for Canadian and American series.

   There are several reasons for the significant reduction of the error in the seasonal factor forecasts and concurrent seasonal factors. The **X11ARIMA/80** produces seasonal factor forecasts from the combination of two filters: (i) the filters of the autoregressive integrated moving averages (**ARIMA**) models used to extrapolate the raw data; and (ii) the filters that Method II X-11-variant applies to obtain the first revised seasonal factors. In this manner, the seasonal factor forecasts are obtained from the extrapolated raw values with a set of moving averages whose weights, though still asymmetric, are closer to the weights applied to central observations as compared to the forecasting function of the X-11-variant.

5. Another advantage of **X11ARIMA/80** is that the trend-cycle estimate for the last observation is made with the symmetric weights of the Henderson moving averages (which can reproduce a cubic in their time span) combined with the weights of the **ARIMA** model used for the extrapolated data. Since these latter weights change with the **ARIMA** model fitted to the series, they reflect the most recent movements and a better trend-cycle estimation is obtained from the combined weights. This is

particularly true for years with turning points because the X-11 applies the asymmetric weights of the Henderson filters which can adequately estimate only a linear trend.

6. Finally, by adding one or two more years of extrapolated data (with no extremes, since they are mere projections) a better estimate of the variance of the irregulars is obtained. The latter allows a significant improvement in the identification and replacement of outliers which, as is well known, can severely distort the estimates obtained with linear smoothing filter. For current seasonal factors, the same observations are valid except that the seasonal filters are closer to the central filters than those corresponding to the seasonal factor forecasts. For this reason, the number of revisions in the seasonal factor estimates is also significantly reduced. It was found that one year of forecast and backcast is the best compromise for the majority of the series when using the automated option.

SECTION 6. Other Main Improvements Incorporated into the Automated Version of the X11ARIMA/80

A set of new statistical tests, tables and graphs have been incorporated into the present automated version of the **X11ARIMA/80** besides the automatic selection of the **ARIMA** models, as discussed earlier in Section 3 of this chapter. These tests are used to assess the quality of the original series and the reliability of the seasonal adjustment. A brief description of these improvements follows:

- **An F-Test for the Presence of Seasonality in Table B1.**

  This test is based on a one-way analysis of the variance on the SI ratios (differences) similar to the one already available in Method II X-11-variant for the presence of stable seasonality in Table D8. It differs only in that the estimate of the trend-cycle is made directly from the original series by a centred 12-term moving average. The estimate of the trend-cycle is removed from the original series by division into (subtraction from) the raw data for a multiplicative (additive) model.

  The value of the F ratio is printed in Table B1. The F is a quotient of two variances: (i) the "between months or quarters" variance which is mainly due to the seasonals and (ii) the "residual" variance which is mainly due to the irregulars.

  Since several of the basic assumptions in the F-test are probably violated, the value of the F ratio to be used for rejecting the null hypothesis, i.e., no significant seasonality present is tested at the one per thousand probability level.

- **A Test for the Presence of Moving Seasonality in Table D8**

  The moving seasonality test is based on a two-way analysis of variance performed on the SI ratios (differences) from Table D8 (Higginson, 1975). It tests for the presence of moving seasonality characterized by gradual changes in the seasonal amplitude but not in the phase.

  The total variance of the SI ratios (differences) is considered as the sum of the:

  1 σ_m^2, the "between months or quarters" variance which primarily measures the magnitude of the seasonality. It is equal to the sum of squares of the difference between the average for each month of the SI and the total average, corrected by the corresponding degrees of freedom.

  2 σ_y^2 , the "between years" variance which primarily measures the year-to-year movement of seasonality. It is equal to the sum of squares of the differences between the annual average of the SI for each year and the total average of the SI for the whole table corrected by the corresponding degrees of freedom.

  3. σ_r^2, the "residual" variance which is equal to the total variance minus the "between months or quarters" variance and the "between years" variance.

The F ratio for the presence of moving seasonality is the quotient between the "between years" variance and the "residual" variance.

To calculate the variance in an additive model the absolute values of S+I are used, otherwise the annual average is always equal to zero. For a multiplicative model, the SI ratios are replaced by absolute deviations from 100, i.e., by |SI-100|. Contrary to the previous test, for which a high value of F is a good indication of the presence of measurable seasonality, a high value of F corresponding to moving seasonality reduces the probability of a reliable estimate of the seasonal factors. The F-test is printed in Table D8 indicating whether moving seasonality is present or not.

- **A Combined Test for the Presence of Identifiable seasonality in Table D8**

This test combines the previous test for the presence of moving seasonality with the F-test for the presence of stable seasonality and the Kruskal-Wallis Chi-squared test (a non-parametric test for the presence of stable seasonality).

The main purpose of this test is to determine whether the seasonality of the series is "identifiable" or not. For example, if there is little stable seasonality and most of the process is dominated by rapidly moving seasonals, chances are that the seasonals will not be accurately estimated for they will not be properly identified by the **X11ARIMA/80** method.

The test basically consists of combining the F values obtained from the three previously prescribed tests as follows:

1. If the F_S-test for the presence of stable seasonality at the 0.1% level of significance fails, the null hypothesis, i.e., seasonality is not identifiable, is accepted.

2. If (1) passes and the F_M test for the presence of moving seasonality at the 5% level of significance fails, then this F_M value is combined with the F_S value from (1) to give

$$T_1 = \frac{7}{F_M \,\&\, F_S} \qquad \text{and} \qquad T_2 = \frac{3F_M}{F_S}$$

   a simple average of the two T's is calculated. If this average is greater than or equal to one, the null hypothesis, i.e., identifiable seasonality not present, is accepted.

3. If (1) passes and the F_M-test passes and one of the two T's statistics fails, or the Kruskal-Wallis test fails at the 1% level, then the program prints "identifiable seasonality probably present".

4. If the F_S, F_M and the Kruskal-Wallis chi-squared values pass, then the null hypothesis (of identifiable seasonality not present) is rejected. The program prints "identifiable seasonality present".

The messages are printed at the end of Table D8.

For further details, the reader is referred to Lothian and Morry (1978 b.)

- **A Test for the Presence of Residual Seasonality in Table D11**

This is an F-test applied to the values of Table D11 and calculated for the whole length of the series as well as for the last three years. The effect of the trend is removed by a first-order difference of lag three for monthly series and lag one for quarterly series, that is $\hat{O}_t \,\&\, \hat{O}_{t\&s/4}$ where $\hat{O}_t$ are the values of Table D11. Two F ratios are printed at the end of the table as well as a message indicating the presence or absence of residual seasonality for the last three years and the whole length of the series (Higginson, 1976).

- **The Normalized Cumulative Periodogram Test for the Randomness of the Residuals**

The Method II X-11-variant uses the Average Duration of Run (ADR) statistic to test for autocorrelation in the final estimated residuals obtained from Table D13. This non-parametric test was developed by W.A. Wallis and G.H. Moore (1941), and is constructed on the basis of the number of turning points. It is efficient for testing the randomness of the residuals against the alternative hypothesis that the errors, I_t, follow a first-order autoregressive process of the form $I_t = \rho I_{t-1} + e_t$ where ρ is the autocorrelation coefficient and e_t is a purely random process.

If a process is purely random and we have an infinite series, the ADR statistic is equal to 1.50. For a series of 120 observations, the ADR will fall within the range 1.36 and 1.75 with a 95% confidence level. Values greater than 1.75 indicate positive autocorrelation and values smaller than 1.36 indicate negative autocorrelation.

This test, however, is not efficient for detecting the existence of periodic components in the residuals, which can happen when relatively long series are seasonally adjusted or when the relative variation of the seasonal component is small with respect to that of the irregular. To test independence of the residuals against the alternative hypothesis implying periodic processes, the normalized cumulative periodogram has been incorporated in the **X11ARIMA/80** program.

The normalized cumulative periodogram values are given in a table and also in a graph. By visual inspection it is possible to determine if components with certain periodicity are present or not in the irregulars.

If the residuals are the estimates of a sample realization of a purely random process, and if the size of the sample tends to infinity, then the normalized cumulative periodogram tends to coincide with the diagonal of the square in which it is drawn.

Deviations of the periodogram from the line expected if the residuals were purely random can be assessed by use of the Kolmogorov-Smirnov test. This test is useful to determine the nature of hidden periodicities left in the irregulars, whether of seasonal or cyclical character and complements the information provided by the test for the presence of residual seasonality. (A simple explanation of this test is given in Dagum, Lothian and Morry, 1975).

- **A Table D11A Where the Annual Totals of the Seasonally Adjusted Values are Equal to the Annual Totals of the Raw Data**

This new Table D11A produces a modified seasonally adjusted series where the annual totals of the seasonally adjusted values and the raw data are made equal.

The discrepancy between the annual totals is distributed over the seasonally adjusted values of Table D11 in a way that preserves the month-to-month or quarter-to-quarter movements of the seasonally adjusted series. The procedure is based on a quadratic minimization of the first differences of the annual discrepancies expressed as differences or ratios. For further details the reader is referred to Huot (1975) and Cholette (1978).

- **A Set of Quality Control Statistics**

The Statistics Canada X-11 version developed in 1975 had two statistics called Q_1 and Q_2 that provided an indication of the amount and nature of the irregulars and the seasonal components respectively. These statistics and their basic assumptions are discussed by Huot and De Fontenay (1973).

Considerable research has been carried out since the first set of guidelines was developed and they are now reduced to only one Q-statistic which results from the combination of several other measures (Lothian and Morry, 1978.c). Most of them are obtained from the summary measures of Table F2. Their values vary between 0 and 3, and only values less than one are considered acceptable. The statistics that are combined to produce the final Q-statistic follow:

1. The relative contribution of the irregulars over three-month spans as obtained from Table F2B denoted by M1.

2. The relative contribution of the irregular component to the stationary portion of the variance as obtained from Table F2F denoted by M2.

3. The value of the I/C ratio (the ratio of the average absolute month-to-month or quarter-to-quarter percent change in the irregular to that in the trend-cycle) for the selection of the Henderson moving averages in Table D7 printed in Table F2E denoted by M3.

4. The value of the average duration of run for the irregulars from Table F2D denoted by M4.

5. The MCD or QCD (the number of months or quarters it takes the average absolute change in the trend-cycle to dominate the average absolute change in the irregular) from Table F2E denoted by M5.

6. The total I/S moving seasonality ratio obtained as an average of the monthly moving seasonality ratios from Table D9 denoted by M6. (It is the ratio of the average absolute year-to-year percent change in the irregulars to that in the seasonals).

7. The amount of stable seasonality in relation to the amount of moving seasonality, from the tests of Table D8, printed in Table F2I denoted by M7.

8. A measure of the year-to-year variation of the seasonal component for the whole series from Table D10 denoted by M8.

9. The average linear movement of the seasonal component for the whole series from Table D10 denoted by M9.

10. Same as 8 but calculated for recent years only and denoted by M10.

11. Same as 9 but calculated for recent years only and denoted by M11.

Tables

Two tables, B20 and C20, produce the extreme values from the decomposition of the irregulars I' of Table B13 and Table C13 respectively. For additive models the extreme values are equal to $I(1-W)$ and for multiplicative models they are equal to $I/(1+W(I'-1))$.

Table D16 gives the total effect due to both the trading-day factors and the seasonal factors.

Charts

The following charts are available:

G1 chart plots the values of the original series as in A1, or in B1 if prior modifications are made, together with the backcasts and forecasts generated from the **ARIMA** option. It also plots the values of the original series as modified for extreme values from Table E1.

G6 graph corresponding to the Cumulative Periodogram test for the randomness of the residuals.

A Logarithmic Model

An option allows the user to decompose the original series in an additive relation using the logarithms of the components. It is the additive equivalent of the multiplicative model (Lothian, 1978).

Other Features of X11ARIMA/80

1. In Method II X-11-variant the end of the series is not treated in the same manner as the beginning, and seasonally adjusting the data in reverse time order does not give the same results as the original series. This is due to a non-homogenous effect in the identification of the extremes. This effect is not present in the **X11ARIMA/80** program.

2. A new F3 Table is introduced containing the new monitoring and quality control statistics.

3. Images of the main control and ARIMA cards are printed on the title page.

4. In the F2 Table, several summary measure statistics are introduced. For monthly series the first 14 autocorrelations of the final irregular are calculated (the first six for quarterly series). The approximate contribution of the components to the stationary portion of the variance is given (the series is made stationary by removing a linear trend for additive models and an exponential trend for multiplicative models). The results of all the analysis-of-variance tests in the program are printed with their associated probability values. The I/C ratio from Table D12 is printed.

5. The probability values for the normal, chi-squared, F, and t-values, are printed.

6. A variable trend-cycle routine that includes the 5 and 7-term Henderson filter and prior adjustment are available in the quarterly program.

7. If there is prior adjustment, except by trading-day factors, the D11 Table equals Table A1 divided by Table D10 for the multiplicative version and equals A1 minus D10 for the additive version.

8. If the MCD (or QCD) is an even number, the MCD moving average is centred by taking an average of two MCD moving averages.

9. Two printout options. These are a brief printout which prints only three to five tables and an analysis printout.

10. The quality control statistics for each series adjusted are collected and printed at the end of the printout.

This allows users to quickly judge the acceptability of all series adjusted.

11. New input and output data formats were added. New formats for the prior adjustment factors were added.

12. The number of decimals of the input data no longer controls the number of decimals on the printout. The decimals on the printout are controlled by a separate option.

13. If the data is read from tape (or disk), the user can select an option which allows the program to search the tape for the series with the required series identifier. Another option will rewind the tape and search.

14. All weights for the moving averages (except the end-weights for the Henderson) are calculated using their explicit formulae.

CHAPTER III*

THE SEASONAL ADJUSTMENT OF COMPOSITE SERIES

Composite series here refers to a series that results from the addition, subtraction, multiplication, and/or division of several components. These component series can enter into the composite with equal or different weights. The direct seasonal adjustment consists of making the composite of the unadjusted components, and then seasonally adjusting the composite series. The indirect seasonal adjustment consists of first seasonally adjusting the component series and then the seasonally adjusted composite series is obtained by implication. Because of non-linearities involved in the process of composing the series by multiplication and division and in their seasonal adjustment method, the direct and indirect seasonally adjusted composites are usually different. In order to decide whether the composite series should be seasonally adjusted using the direct or the indirect procedure the criterion of smoothness is often used. A classical measure of the degree of roughness or lack of smoothness in a seasonally adjusted composite series is the sum of squares of the first difference of the series. That is:

$$R_1 = \sum_t (\hat{X}_t - \hat{X}_{t-1})^2 \qquad (7)$$

where $\hat{X}_t$ is the series in question. The larger R_1 the rougher the series $\hat{X}_{t-1}$ or, equivalently the less smooth.

The rational of this measure is that the first difference filter removes most of the variations of long periodicities (trend and cycle). Lothian and Morry (1977) have found that the R_1 measure is related to the magnitude of the revisions in the seasonally adjusted series. The implicit definition of smoothness of R_1 however, excludes cycles of short periodicities, and to compensate for this a new measure of roughness R_2 based on the 13-term Henderson filter is given in Dagum (1979). The R_2 measure is:

$$R_2 = \sum_t (\hat{X}_t - H\hat{X}_t)^2 = \sum_t [(I-H)\hat{X}_t]^2 \qquad (8)$$

where $I-H$ is the complement of the Henderson filter.

These two measures, expressed as averages, and in percentages when the composition is multiplicative, have been incorporated in the X11ARIMA/80 program used for the direct and the indirect seasonal adjustment of composite series. Generally, both measures give consistent results in favouring one procedure over the other from the viewpoint of smoothness. However, this consistency is not present when the composite series are strongly affected by cyclical variations of short periodicity and, in such cases, R_2 should be preferred in deciding which of the two procedures gives the smoothest seasonally adjusted data.

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* This chapter is reproduced from the X11ARIMA Seasonal Adjustment Method by Dagum (1980).

CHAPTER IV

THE X11ARIMA SPECIFICATIONS

Symbolic Notation

Description	Multiplicative	Additive or log additive
Original series (O) composed of trend-cycle (C), seasonal (S), trading-day (D), and irregular (I''') variations.	$O=CSI'''D$;	$O=C+S+I'''+D$;
	$D=D_pD_r$;	$D=D_r$;
Irregular variations (I''') include holiday variation, major strikes, etc., which may be removed by prior adjustment factors permanently (P') and/or temporarily (P''), Easter Holiday effects (H), plus extremes (E) and residual or "true" irregular (I). Extremes are defined as irregular values falling outside 2.5 standard deviations (σ's). For the purpose of **ARIMA** extrapolation these extreme values can be replaced by the corresponding function values of a fitted ARIMA model chosen in a first iteration. For the purpose of fitting curves in Parts C and D, the unmodified irregular (I) values are assigned linearly graduated weights varying between 0.0 and 1.0 for values between 2.5σ and 1.5σ. Values within 1.5σ receive full weight.	D_p= Prior trading-day adjustment factors;	(D_p not available in additive model, i.e.: $D_p=0$)
	D_r= Any residual trading-day variation left after applying D_p (or all trading-day variation if no prior trading-day factors are used);	
The selection of 1.5 and 2.5 as σ limits is optional. For special purposes other limits may be more appropriate. (See User's Manual).	$I'''=P'P''EHI$;	$I'''=P'+P''+E+H+I$;
	$I''=P''EHI$;	$I''=P''+E+H+I$;
	During the first run of this program $I'=EHI$ if Easter Holiday effects (H) are present. In the second run, $I'=EI$.	During the first run of this program $I'=E+H+I$, if Easter Holiday effects (H) are present. In the second run, $I'=E+I$.
	where	where
	$E=\|I'-1.0\|>2.5\sigma_{I'}$;	$E=\|I'\|>2.5\sigma_{I'}$;
	$I^w=1.0+w(I'-1.0)$;	$I^w=I'w$
	where	where
	w =0.0 when $\|I'-1.0\|>2.5\sigma_{I'}$ =1.0 when $\|I'-1.0\|<1.5\sigma_{I'}$ $=2.5-\|I'-1.0\|/\sigma_{I'}$	w =0.0 when $\|I'\|>2.5\sigma_{I'}$ =1.0 when $\|I'\|<1.5\sigma_{I'}$ $=2.5-\|I'\|/\sigma_{I'}$
	when	when
	$1.5\sigma_{I'} \leq \|I'-1.0\| \leq 2.5\sigma_{I'}$.	$1.5\sigma_{I'} \leq \|I'\| \leq 2.5\sigma_{I'}$.
	In general, if U = upper σ limit and L = lower σ limit,	In general, if U = upper σ limit and L = lower σ limit,
	$w=\frac{1.0}{U-L}[U-\frac{\|I'-1.0\|}{\sigma_{I'}}]$	$w=\frac{1.0}{U-L}[U-\frac{\|I'\|}{\sigma_{I'}}]$
	when $L\sigma_{I'} \leq \|I'-1.0\| \leq U\sigma_{I'}$.	when $L\sigma_{I'} \leq \|I'\| \leq U\sigma_{I'}$.
	NOTE: The irregular (I) is presented here as having a mean of 1.000, although it is shown in the computer printout as a percentage with a mean of 100.0. Seasonal, trading-day, Easter effects and prior factors are also shown as percentages.	

SPECIFICATIONS - Monthly X-11-ARIMA/88

PART A. Prior Adjustments

This part describes the various prior adjustments that the user should make to the original unadjusted series, when applicable, to produce efficient estimates of the seasonal and trading-day factors and Easter effects. If no prior adjustments are needed, the computations start with those described in Part B.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
		NOTE: Additive or Log Additive descriptions are underlined.		
A1.	Original Series	Original monthly or quarterly series.	O=CSI'''D	O = C+S+I'''+D
A2.	Permanent prior monthly factors	To adjust permanently for certain holidays, change the level of the series, etc., the user may supply monthly adjustment factors. The new series is thus permanently modified and becomes the input on which all other transformations will be made.	P'	P'
A3.	Original series adjusted for prior permanent factors	Divide **(subtract)** (A2) into **(from)** the original data (A1).	O/P'=CSI''D	O-P'=C+S+I''+D
A4.	Temporary prior monthly factors	To adjust temporarily for certain holidays, change the level of the series, etc., the user may supply monthly adjustment factors. The new series is thus temporarily modified and becomes the input on which all other transformations will be made. These temporary modifications will be re-introduced in the final seasonally adjusted, trading-day adjusted and/or Easter adjusted data.	P''	P''
A5.	Original series adjusted for prior permanent (if any) and temporary monthly factors	Divide the (A4) factors **(subtract the (A4) factors from)** into the original data (A1) or (A3) (if permanent priors have been used).	O/P'P''=CSI'D	O-P'-P''=C+S+I'+D
A6.	User supplies prior daily weights and trading-day monthly factors	To adjust for Trading-Day Variations, the user may supply seven daily weights from which the program computes monthly factors that are divided into **(subtracted from)** (A1), (A3) or (A5). The program adjusts the seven daily weights to total 7.00 (0.00). For the multiplicative case, the monthly calendar factors are calculated by: $M_i ' \frac{X_{1i}(D_{p1})+...+X_{7i}(D_{p7})}{N_i}$ and for the log-additive case, $M_i=X_{1i}b_{p1}+...+X_{7i}b_{p7}$	D_p $CSI'D/D_p=CSI'D_r$	D_p not available for additive model Not Available

PART A. Prior Adjustments - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
A6.	User supplies prior daily weights and trading-day monthly factors (continued)	where M_i is the monthly factor for month i. X_{ji} is the number of times that day-of-week i occurs in month i; $D_{pj}=D_{pj}+1.0$ is the prior daily weight for day-of-the-week j, N_i is 31, 30 or 28.25 day months of February. If length of month variation is to be included in trading-day factors, N_i is 30.4375 for all months. Same as C15.		

PROGRAM ESTIMATED DAILY WEIGHTS AND FINAL TRADING-DAY MONTHLY FACTORS.

These daily weights and final trading-day monthly factors are obtained from a first run of the program that includes steps (A1) to (A6) and (B1) to (C20) described below.

A7.	Program estimated final daily weights	Same as C15. **NOTE:** To avoid unnecessary revisions due to changes in the regression parameters anytime a new observation is added, the daily weights to be applied during the current year t are calculated using data ending in December of year t-1. These daily weights are revised when a complete year of observations is added to the series. However, if the user requests removal of Easter effects, as well, the trading-day estimates are recalculated each time a new observation is added. If the user wishes to keep the daily weights fixed, he will have to use the PDW option in the manual instead of TDR. (Only for multiplicative or log-additive models.)	$[I'D_r]$ 6 D_r	$[I'+D_r]$ 6 D_r
A8.	Program estimated Final trading-day factors	Same as C16 when using regression daily weights only. Same as C18 when using combined prior and regression daily weights.	$[I'D_r]/D_r=I'$ $D=D_pD_r$ $[I'D]/D=I'$	$[I'+D_r]-D_r=I'$ $D=D_p+D_r$ (for log-additive model only) $[I'+D]-D=I'$
A9.	Final trading-day adjusted series	Divide **(subtract)** (A6) or (A8) into **(from)** (A1) or (A3) if permanent prior modifications are made.	$[CSI'''D]/D=CSI'''$	$[C+S+I'''+D]-D= C+S+I'''$

PROGRAM ESTIMATED EASTER HOLIDAY MONTHLY FACTORS.

Easter monthly adjustment factors are obtained from a first run of the program that includes steps (A1) to (A6) and (B1) to (D13) described below.

A10.	F-test for the presence of Easter holiday variations	An F-test for the presence of Easter variations is applied to the irregular of March and April from Table D13. A message is printed to indicate the presence (or not) of Easter effects at a 10% level of significance.		

PART A. Prior Adjustments - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
A11.	Final Easter Holiday monthly factors	The Easter Holiday Effect is calculated by using a gradual or immediate impact model according to section 3.1 specifications.	H	H
A12.	Final Easter holiday adjusted series	Divide <u>(subtract)</u> (A11) into <u>(from)</u> (A1) or (A3) if permanent prior modifications are made.	[CSDI'']/H=CSDI'P'' = CSDP''IE	[C + S + D + I''] - H = C + S + D + I' + P'' = C + S + D + P'' + I + E
A13.	Combined Trading-day and Easter Holiday monthly factors	Multiply <u>(add)</u> Trading-day factors from (A6) or (A8) by (to) Easter Holiday factors from (A11).	DH	D+H
A14.	Final combined Trading-day and Easter Holiday adjusted series	Divide <u>(subtract)</u> (A13) into <u>(from)</u> (A1) or (A3) if permanent prior modifications are made.	[CSDI'']/[DH]=CSI'P'' = CSP''IE	[C + S + D + I''] - [D + H] = C + S + I' + P'' = C + S + P'' + I + E
A15.	ARIMA extrapolation model (forecast)	To extend the series with variable time horizon forecasts (the default option is one year of forecasts), five ranked ARIMA models can be automatically fitted to the original series, or if applicable, to the original series adjusted by permanent priors (P'), temporary priors (P''), Trading-day factors (D) and Easter Holiday factors (H). For multiplicative decomposition the input series is log transformed except for the (2,1,2) (0,1,1) model. The model automatically selected for forecasting is the first one to pass all of the following criteria; (1) The mean absolute percentage errors (M.A.P.E) of the forecasts for the last three years is less then or equal to 15%. (2) The chi-squared probability value of the residuals is greater than 5%, and (3) There is no evidence of over-differencing. No automatic model is applied if any of the above criteria fails. These criteria apply only to the five program-supplied models and not to user-supplied models. The user can also request that extreme values be automatically replaced by the corresponding function values of the ARIMA model in a first iteration. Thus, a prior treatment of extreme values consists of testing the residuals from the fitted ARIMA model of the first iteration that fulfils the criteria for acceptance against ±2.5σ. The values that fall outside this interval are replaced by the corresponding function values. The same ARIMA model is then fitted to the modified data to produce the forecasts.	Ranked ARIMA models L(0,1,1) $(0,1,1)_s$ L(0,1,2) $(0,1,1)_s$ L(2,1,0) $(0,1,1)_s$ L(0,2,2) $(0,1,1)_s$ (2,1,2) $(0,1,1)_s$ where L = log transformation	 (0,1,1) $(0,1,1)_s$ (0,1,2) $(0,1,1)_s$ (2,1,0) $(0,1,1)_s$ (0,2,2) $(0,1,1)_s$ (2,1,2) $(0,1,1)_s$

PART A. Prior Adjustments - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
A15.	ARIMA extrapolation model (forecast) (Continued)	NOTE: Whenever the default option is used, to avoid revision due to at change in the model, the model selection is done using data up to the last complete year. Then the same model is used through out the current year for forecasting, but the parameter values are re-estimated using the full series.		
A16.	ARIMA extrapolation model (backcast)	The series can be extended with one year of backcasts with the user-supplied model option. NOTE: X11ARIMA produces backcasts for series of at least five years and less than six years.		

FIRST RUN OF THE PROGRAM IF THE USER REQUESTS:

(A) Program estimated trading-day factors;

and/or

(B) Program estimated Easter holiday factors.

PART B. Preliminary Estimation of Trading-day Variation

Preliminary trading-day adjustment factors and weights for reducing the effect of extreme or near-extreme irregular values are developed from the data. These estimates are refined in Part C, where final estimates are developed.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
			$M_i[Y]$ or $M_{nxm}[Y]$ represents a moving average computed from a series Y.	$M_i[Y]$ or $M_{nxm}[Y]$ represents a moving average computed from a series Y.
B1.	Prior adjusted original series or original series	Either the original series or original series adjusted by: (1) the prior factors shown in A2; and/or (2) the prior factors shown in A4; and/or (3) the prior trading-day factors shown in A6. An F-test for the presence of seasonality (see Chapter I) is applied to B3, but the message is printed after B1 to indicate right away whether or not seasonality is present at the 0.1% level.	$CSI'D_r$	$C+S+I'+D_r$
B2.	Preliminary trend-cycle	Compute a centred 12-term moving average (a 2-term average of a 12-term average) of (B1) as an estimate of the trend-cycle. In step B5 the 6 missing values at either end of the series will be imputed. The user has the option of computing a centred 24-term moving average (2-term average of a 24-term average) of B1 as a preliminary estimate of the trend-cycle (see Chapter II).	$M_{2x12}[CSI'D_r]=C_1$	$M_{2x12}[C+S+I'+D_r]=C_1$
B3.	Unmodified S-I ratios (differences)	Divide (B2) into (B1) (subtract (B2) from (B1)) to obtain seasonal-irregular (S-I) ratios (differences).	$(CSI'D_r)/C_1=SI'D_r$	$(C+S+I'+D_r)-C_1=S+I'+D_r$
B4.	Replacement values for extreme S-I ratios (differences)	To the B3 S-I ratios (differences), apply a weighted 5-term moving (3x3) average separately to each month to estimate preliminary seasonal factors. See Appendix B for the weights for the 5-term (3 x 3) average.	$M_{3x3}[SI'D_r]=S$	$M_{3x3}[S+I'+D_r]=S$
		Compute a centred 12-term moving average of the preliminary factors for the entire series. To obtain the six missing values at either end of this average, repeat the first (last) available moving average value six times. Adjust the factors to sum to 12.000 (0.000) (approximately) over any 12-month period by dividing (subtracting) the centred 12-term average into (from) the factors.	$S''=S'/M_{2x12}(S')$	$S''=S'-M_{2x12}(S')$
		Divide the seasonal factor estimate into the S-I ratios (subtract the seasonal factor estimates from the S-I differences) to obtain an estimate of the irregular component.		

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B4.	Replacement values for extreme S-I ratios (differences) (continued)	Compute a moving five-year standard deviation (σ) of the estimates of the irregular component and test the irregulars in the central year of the five-year period against 2.5σ. Remove values beyond 2.5σ as extreme and re-compute the moving five-years σ. Note that the limits of 1.5 and 2.5σ are used as default and they can be assigned a value between 0.1 and 9.9 by the user.	$(SI'D_r)/S''=I'D_r$	$(S+I'+D_r)-S''=I'+D_r$
		Assign a zero weight to irregulars beyond 2.5σ and a weight of 1.0 (full weight) to irregulars within 1.5σ. Assign a linearly graduated weight between 0.0 and 1.0 to irregular between 2.5σ and 1.5σ.		
		For values receiving less than full weight, the corresponding S-I ratios (differences) are replaced with an average of the ratio (difference) times its weight and the two nearest preceding and two nearest following full-weight ratios (differences) for that month. If four full-weight ratios (differences) are not available, then a simple average of all the ratios (differences) for the month is taken.	$I'=I^w$ for $\|I'-1.0\|>1.5\sigma_{I'}$	$I'=I^w$ for $\|I'\|>1.5\sigma_{I'}$
		For the first two years, the σ limits computed for the third year are used; and for the last two years, the σ limits computed for the third-from-end year are used. To replace an extreme ratio (difference) in either of the two beginning or ending years, the average of the ratio (difference) times its weight and the four nearest full-weight ratios (differences) for that month is taken.		
		The moving five-year σ's and the replacement values for the extreme S-I ratios (differences) are shown in Table B4.	SI^wD_r	SI^w+D_r
B5.	Seasonal factors	To the B3 S-I ratios (difference) with extreme values replaced by the corresponding B4 values apply a weighted 5-term average (3x3) to each month separately to estimate preliminary seasonal factors.	$M_{3x3}[SI^wD_r]=S'$	$M_{3x3}[S+I^w+D_r]=S'$
		Adjust the factors to sum to 12.000 using a centred 12-term moving average (see second paragraph in B4).	$S_1=S'/M_{2x12}(S')$	$S_1=S'-M_{2x12}(S')$
		To obtain factors for the six missing values at either end of the series due to the use of the centred 12-term trend-cycle moving average in step B2, repeat the nearest available factor for that particular month.		
B6.	Seasonally adjusted series	Divide (B5) into (B1) (subtract (B5) from (B1)) to obtain a preliminary seasonally adjusted series.	$(CSI'D_r)/S_1=CI'D_r$	$(C+S+I'+D_r)-S_1=C+I'+D_r$

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B7.	Trend-cycle	Apply the variable trend-cycle curve routine (modified so that the weighted 13-term Henderson average is selected for $\overline{I}/\overline{C} > 0.99$) to (B6). See note at the end of these specifications for details of the variable trend-cycle curve routine.	$M_H[CI'D_r]=C_2$	$M_H[C+I'+D_r]=C_2$
		Adjustment of Trend-Cycle for Strikes (optional). The effects of extreme values on the B7 trend-cycle component are reduced by the optional computations in the remainder of step B7, below. These computations can be of use when adjusting series affected by major prolonged strikes or similar irregular occurrences. See Chapter III for the selection of this option.		
		Divide (subtract) the trend-cycle estimates provided by the variable trend-cycle curve routine into (from) the seasonally adjusted series to obtain an estimate of the irregular.	$(CI'D_r)/C=I'D_r$	$(C+I'+D_r)-C=I'+D_r$
		Compute a moving five-year standard deviation (σ) of the monthly estimates of the irregular component and test the irregulars in the central year of the five-year period against 2.5σ limits. Remove values beyond 2.5σ and recompute σ.		
		Assign a zero weight to irregulars beyond 2.5σ and a weight of 1.0 (full weight) to irregulars within 1.5σ. Assign a linearly graduated weight between 0.0 and 1.0 to irregulars between 2.5σ and 1.5σ.		
		For values receiving less than full weight, the corresponding seasonally adjusted values are replaced with an average of the value times its weight and the two nearest full-weight preceding and two nearest full-weight following seasonally adjusted values.	$I'=I^w$ for $\|I'-1.0\|>1.5\sigma_{I'}$	$I'=I^W$ for $\|I'\|>1.5\sigma_{I'}$
		For the first two years, the σ limits computed for the third year are used; and for the last two years, the σ limits computed for the third-from-end year are used. To replace an extreme value in either of the two beginning or ending years, the average of the value times its weight and four nearest full-weight values is taken.	CI^wD_r	$C+I^w+D_r$
		To the seasonally adjusted values modified for extremes, apply the variable trend-cycle curve routine to estimate a preliminary trend-cycle which is shown in B7.	$M_H[CI^wD_R]=C_2$	$M_H[C+I^w+D_r]=C_2$
B8.	Unmodified S-I ratios (differences)	Same as B3 except that B7 trend-cycle values are used.	$(CSI'D_r)/C_2=SI'D_r$	$(C+S+I'+D_r)-C_2= S+I'+D_r$

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B9.	Replacement values for extreme S-I ratios (differences)	Same as B4 except that B8 S-I ratios (differences) are used and that a weighted 7-term average (3x5) is applied to estimate seasonal factors. See Appendix B for the weights for the 7-term (3 x 5) average.	$M_{3x5}[SI'D_r]=S'$ $S_1=S'/H_{2x12}(S')$ $(SI'D_r)/S_1=I'D_r$ $I'=I^w$ for $\vert I'-1.0\vert >1.5\sigma_r, SI^wD_r$	$M_{3x5}[S+I'+D_r]=S'$ $S_1=S'-H_{2x12}(S')$ $(S+I'+D_r)-S_1=I'+D_r$ $I'=I^w$ for $\vert I'\vert >1.5\sigma_r, S+I^w+D_r$
B10.	Seasonal Factors	To the B8 S-I ratios (differences) with extreme values replaced by the corresponding B9 values, apply the weighted 7-term average (3x5) to each month separately to estimate preliminary seasonal factors.	$M_{3x5}[SI^wD_r]=S'$	$M_{3x5}[S+I^w+D_r]=S'$
		Adjust the factors to sum to 12.000 using a centred 12-term moving average. (See second paragraph in B4).	$S_2=S'/M_{2x12}(S')$	$S_2=S'-M_{2x12}(S')$
B11.	Seasonally adjusted series	Same as B6 except that B10 seasonal factors are used.	$(CSI'D_r)/S_2=CI'D_r$	$(C+S+I'+D_r)-S_2= C+I'+D_r$
B12.	Not used			
B13.	Irregular Series	Divide (B7) into (subtract (B7) from) (B11) to obtain a preliminary irregular series.	$(CI'D_r)/C_2=I'D_r$	$(C+I'+D_r)-C_2=I'+D_r$
		Adjustment for Trading-Day Variation (optional). Steps B14 and B16 and B18 to B19 are included only when a trading-day adjustment based upon the information in the monthly series is desired. To adjust for trading days on the basis of external information. Table A4 is used. Various combinations of these options are described in Chapter IV.		
B14.	Extreme irregular values excluded from trading-day regression	Sort B13 irregulars for 31-day months into seven groups depending upon the day of the week the month begins. Likewise, sort 30-day months into seven groups. For February, separate leap years from non-leap years. There are 15 groups overall.		
		For 31 and 30-day months and non leap-year Februaries, compute the mean of each group and the squared deviations of the values from their respective means. From these, compute a "trading-day" variance (σ_t^2) over the entire series, which is used to identify extremes. Identify and remove values beyond $2.5\sigma_t$ limits. (The built-in σ limit is 2.5, but a different limit for identifying extremes may be specified in the option card.) See Chapter IV.		
		Re-compute the means and σ_t and re-identify and remove extremes beyond $2.5\sigma_t$. For leap year Februaries, throw out values that deviate from 1.0 (0.0) by more than $2.5\sigma_t$. Values removed as extremes are shown in Table B14. They are not included in the Trading-day regression in B15.	For $\vert I'-1.0\vert >2.5\sigma_t$ $[I'D_r]$ removed from regression	For $\vert I'\vert >2.5\sigma_t$ $[I'+D_r]$ removed from regression

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title	Multiplicative and Additive or Log Additive	Symbolic Notation	
		Multiplicative	Additive or Log Additive
B15. Preliminary trading-day regression	Estimate by least squares, seven daily weights from the B13 irregular (with extremes omitted) using the specification: Multiplicative: $(ID_r)_i\text{-}1.0=\frac{X_{1i}B_1\%X_{2i}B_2\%...\%X_{7i}B_7\%I_i}{N_i};$ where $(ID_r)_i$ is the irregular component for month i with residual trading-day variation; Additive: $(I+D_r)_i=X_{1i}B_1+X_{2i}B_2\%...\%X_{7i}B_7\%I_i;$ where, $[I+D_r]_i$ is the irregular component for month i with residual trading-day variation; X_{ji} is the number of times that day-of-the-week j occurs in month i; Monday = 1,....,Sunday = 7; B_j's are the seven "true" daily weights; where $\overset{7}{\underset{1}{'}}\ B_j=0;$ N_i is either 31, 30, or 28.25 if no prior adjustment was made, depending upon whether month i is a 31 - or 30-day month or February. N_i is equal to the sum of the prior daily weights (D_p) for all the days of the month if a prior adjustment was made; I_i is the "true" irregular from month i. Let b_j denote the least-squares estimate of B_j and σ_j the standard error of b_j. Multiplicative: If prior weights (D_{pj}) are used, combine with regression weights by the formula: $D_j\,'\,b_j\%D_{pj}$ where D_j are the combined weights. If no prior weights are available, use 1.0 for all D_p. Compute $t_j(p)\,'\,b_j/\hat{\sigma}_j \quad (j=1,...,7)$ which are the t-ratios for testing whether combined weight D_j is significantly different from prior weight D_{pj} and 1.0, respectively. $\hat{\sigma}$ is also the standard error for D_j.	$[I\ D_r]\ 6\ D_r$	$[I+D_r]\ 6\ D_r$

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B15.	Preliminary trading-day regression (continued)	Additive: $D_j = b_j$ and $t_j(0) = D_j / \hat{\sigma}_j \quad (j=1,\ldots,7)$, where $t_j(0)$ is the t-ratio for testing whether D_j is significantly different from 0.0. If the computed t-ratios are greater than the tabled 1% level (2.62), messages of significance are printed. Compute $F = \sigma_D^2 / \sigma_R^2$ where σ_D^2 and σ_R^2 are the variance explained by the regression and the residual variance, respectively. If the computed F-ratio is greater than the tabled 1% level (2.95), a message that significant trading-day variation is present is printed.		
B16.	Trading-day adjustment factors derived from regression coefficients	Construct monthly calendar adjustment factors by the formula: Multiplicative: $M_i = \frac{X_{1i}(b_1+1.0)+X_{2i}(b_2+1.0)+\ldots+X_{7i}(b_7+1.0)}{N_i}$; Additive: $M_i = X_{1i}b_1+X_{2i}b_2+\ldots+X_{7i}b_7$; where M_i is the monthly factor for month i; N_i is 31 or 30 where month i is a 31 or 30-day month. N_i is 28.25 for February if no prior adjustment was made. N_i is 29 or 28 for leap year and non-leap year February if a prior adjustment was made.		
		Print out monthly factors in Table B16. Divide these factors into (B13) (subtract these factors from (B13)) to obtain an irregular component without trading-day variation. This component is not printed out.	$[I'D_r]/D_r=I'$	$[I'+D_r]-D_r=I'$
B17.	Preliminary weights for irregular component	Compute a moving five-year σ of the irregular in B16 (or B13 if a trading-day adjustment is not made) and test the irregulars in the central year of the five-year period against 2.5σ. For the first two years, the σ limits computed for the third year are used; and for the last two years, the σ limits computed for the third-from-end year are used. Remove values beyond 2.5σ and recompute the moving five-year σ.		

PART B. Preliminary Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B17.	Preliminary weights for irregular component (continued)	Assign a zero weight to irregulars beyond 2.5σ and a weight of 1.0 (full weight) to irregulars within 1.5σ. Assign a linearly graduated weight between 0.0 and 1.0 to irregulars between 2.5σ and 1.5σ. Print out the moving five-year σ's and the weights for the irregular component in Table B17.	[I']=w	[I']=w
B18.	Trading-day factors derived from combined daily weights	Construct monthly trading-day factors from the combined prior and estimated trading-day factors developed in B15 using the same formula as shown in step B16 except that D_j is substituted for $(b_j+1.0)$.	$D=D_pD_r$	$D=D_p+D_r$ (log-additive) Not Available for Additive (B18=B15)
B19.	Original series adjusted for trading-day variation	Divide (B18) into (B1) or (A1) if prior adjustments are not made. In the additive case, B19=B1-B15.	[CSI'D]/D=CSI'	[C+S+I'+D]-D= C+S+I'
B20.	Extreme values	Estimate the extreme values from the irregulars of B13 or the irregular component without trading-day variation of B16 (not printed out) with the weights obtained from B17 as follows: Multiplicative: $I'/(1+w(I'-1))$ Additive or Log Additive: $I'(1-w)$		

FIRST RUN OF THE PROGRAM IF THE USER REQUESTS:

(A) Program estimated trading-day factors;
and/or
(B) Program estimated Easter holiday factors.

PART C. Final Estimation of Trading-day Variation

The original series adjusted for trading-day variation is modified for extreme and near extreme values with the B17 weights. These improved estimates are divided into (subtracted from) the original series, and final trading-day factors are estimated from the resulting irregular, refined in Part C, where final estimates are developed.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
C1.	Original series modified by preliminary weights and adjusted for trading-day and prior variation	Modify the original series adjusted for trading-day and prior variation (B19 or B1 if the trading-day option is not used) using B20.	$\{CSI'[1.0+w(I'-1.0)]\}/I' = CSI^w$	$[C+S+I']-I'(1.0-w) = C+S+I^w$
C2.	Preliminary trend-cycle	Same as (B2) except that (C1) is used.	$M_{2x12}[CSI^w]=C_3$	$M_{2x12}[C+S+I^w]=C_3$
C3.	Not used			
C4.	Modified S-I ratios (differences)	Divide (C2) into (C1) to obtain S-I ratios (subtract (C2) from (C1) to obtain S-I differences).	$[CSI^w]/C_3=SI^w$	$[C+S+I^w]-C_3=S+I^w$
C5.	Seasonal factors	Same as B5 except that C4 ratios (differences) are used.	$M_{3x3}[SI^w]=S_3$	$M_{3x3}[S+I^w]=S_3$
C6.	Seasonally adjusted series	Divide (C5) into C1) (subtract (C5) from (C1)) to obtain a preliminary seasonally adjusted series.	$[CSI^w]/S_3=CI^w$	$[C+S+I^w]-S_3=C+I^w$
C7.	Trend-cycle	Apply the variable trend-cycle curve routine to (C6) to estimate a preliminary trend-cycle.	$M_H[CI^w]=C_4$	$M_H[C+I^w]=C_4$
C8.	Not used			
C9.	Modified S-I ratios (differences)	Divide (C7) into (C1) to obtain S-I ratios (subtract (C7) from (C1) to obtain S-I differences).	$[CSI^w]/C_4=SI^w$	$[C+S+I^w]-C_4=S+I^w$
C10.	Seasonal factors	Same as B10 except that C9 S-I ratios (differences) are used.	$M_{3x5}[SI^w]=S_4$	$M_{3x5}[S+I^w]=S_4$
C11.	Seasonally adjusted series	Reintroduce trading-day variation and extreme and near-extreme values by dividing (B1) by (C10) (subtracting (C10) from (B1)).	$[CSI'D_r] / S_4=CI'D_r$	$[C+S+I'+D_r]-S_4=C+I'+D_r$
C12.	Not used			
C13.	Irregular series	Divide (C11) by (C7) (subtract (C7) from (C11)) to obtain an estimate of the irregular.	$[CI'D_r] / C_4=I'D_r$	$[C+I'+D_r]-C_4=I'+D_r$
		Adjustment of Trading-Day Variation (optional). When the trading-day routine is applied in B14 to B16 and B18 to B19, it is reapplied in C14 to C16 and C18 to C19 to obtain improved estimates.		

PART C. Final Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
C14.	Extreme irregular values excluded from trading-day regression	In reapplying the trading-day routine, the variance is computed using the 22 types of monthly trading-day factors shown in B16 instead of the means of the 31 and 30-day months and non-leap-year Februaries. This improves the treatment of extremes, particularly for leap-year Februaries. Extremes beyond 2.5σ_t are shown in C14. $\sigma_t^2 \text{'} \frac{1}{N}\ j\ (C13\text{-}B16)^2$	For $\|I'\text{-}1.0\|>2.5\sigma_t$ $I'D_r$ removed from regression	For $\|I'\|>2.5\sigma_t$ $I'\text{+}D_r$ removed from regression
C15.	Final trading-day regression	Same as B15 except that the computations are based on C13 (with extremes omitted). Using the standard errors of the seven daily weights, compute estimates of the standard errors of the monthly calendar adjustment factors M_i as follows: <u>Multiplicative</u>: 31-day months beginning on day-of-the-week j: $\hat{\sigma}_{M31}\ \text{'}\ \frac{1}{31}\ [\hat{\sigma}_j^2 \% \hat{\sigma}_{j\%1}^2 \% \hat{\sigma}_{i,j\%2}^2$ $\%2\ (\hat{\sigma}_{j,j\%1} \% \hat{\sigma}_{j,j\%2} \% \hat{\sigma}_{j\%1,j\%2}]^{1/2}$; 30-day months beginning on day-of-the-week j: $\hat{\sigma}_{M30}\ \text{'}\ \frac{1}{30}\ [\hat{\sigma}_j^2 \% \hat{\sigma}_{j\%1}^2 \% \hat{\sigma}_{j,j\%1}]^{1/2}$; Leap-year Februaries: $\hat{\sigma}_{M29}\ \text{'}\ \frac{1}{29}\ \hat{\sigma}_i$; Non-leap-year Februaries: $\hat{\sigma}_{M28}\ \text{'}\ 0$; where $\hat{\sigma}_{j\%7}\ \text{'}\ \hat{\sigma}_j$.	$[ID_r]$ 6 D_r	$[I\text{+}D_r]$ 6 D_r
		If a length-of-month adjustment is included in the trading-day factors, the denominator of all $\hat{\sigma}_M$'s is 30.4375. Since the $\hat{\sigma}_M$ for each length month, are almost equal in practice, only one estimate is shown for each of the seven $\hat{\sigma}_{M31}$'s, $\hat{\sigma}_{M30}$'s and $\hat{\sigma}_{M29}$'s. <u>Additive</u>: Same as multiplicative except that the denominator of $\hat{\sigma}_M$'s is 1.0 in all cases rather than 31, 30, 29 or 30.4375.	$[ID_r]$ 6 D_r	$[I\text{+}D_r]$ 6 D_r
C16.	Final trading-day adjustment factors derived from regression coefficients	Same as B16 except that the factors are divided into <u>(subtracted from)</u> (C13).	$[I'D_r]\ /D_r\text{=}I'$	$[I'\text{+}D_r]\text{-}D_r\text{=}I'$

Part C. Final Estimation of Trading-day Variation - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
C17.	Final weights for irregular component	Same as B17 except that C16 [or C13 if the trading-day option is not used] is used.	[I']=w	[I']=w
C18.	Final trading-day factors derived from combined daily weights	Same as B18 except that the final residual weights estimated in C15 are used. If length-of-month variation is included with the trading-day factors, N_i is 30.4375 for all months. This option is not available with an additive adjustment.	$D=D_pD_r$	$D=D_p+D_r$
C19.	Original series adjusted for trading-day variation	Divide (C18) into (B1) or (A1) if prior adjustments are not made (same as A9). In the additive case, C19=B1-C15.	[CSI'''D]/D=CSI'''	[C+S+I'''+D]-D=C+S+I'''
C20.	Extreme values	Same as B20 except that C13 and C17 are used.		

FIRST RUN OF THE PROGRAM IF THE USER REQUESTS:

(A) Program estimated Easter holiday factors

PART D. Estimation of Easter Holiday Factors

The original series adjusted for trading-day variation if applicable, is modified for extreme and near-extreme values by the C17 final weights and final estimates and Easter holiday factors are derived.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
D1.	Original series modified by final weights and adjusted for trading-day and prior variation (if any)	Modify the original series adjusted for trading-day and prior variation (C19 or B1 if the trading-day option is not used) using C20.	$\{CSI'[1.0+w(I'-1.0)]\}/I' = CSI^w$	$[C+S+I']-I'(1.0-w) = C+S+I^w$
D2.	Preliminary trend-cycle	Same as (B2) except that (D1) is used.	$M_{2x12}[CSI^w]=C_5$	$M_{2x12}[C+S+I^w]=C_5$
D3.	Not used			
D4.	Modified S-I ratios (differences)	Divide (D2) into (D1) to obtain S-I ratios (subtract (D2) from (D1) to obtain S-I differences).	$[CSI^w]/C_5=SI^w$	$[C+S+I^w]-C_5=S+I^w$
D5.	Seasonal factors	Same as B5 except that D4 ratios (differences) are used.	$M_{3x3}[SI^w]=S_5$	$M_{3x3}[S+I^w]=S_5$
D6.	Seasonally adjusted series	Divide (D5) into (D1) (subtract (D5) from (D1)) to obtain a preliminary seasonally adjusted series.	$[CSI^w]/S_5=CI^w$	$[C+S+I^w]-S_5=C+I^w$
D7.	Trend-cycle	Same as C7 except that D6 is used.	$M_H[CI^w]=C_6$	$M_H[C+I^w]=C_6$
D8.	Unmodified S-I ratio (differences)	Divide (D7) into (C19) (subtract (D7) from (C19)) or (B1) if the trading-day option is not used to obtain final unmodified S-I ratios (differences).	$[CSI']/C_6=SI'$	$[C+S+I']-C_6=S+I^w$
D9.	Replacement values for extreme S-I ratios (differences)	Divide (D7) into (D1) (subtract (D7) from (D1)) to obtain S-I ratios (differences) modified for extreme and near-extreme values. Print out values not identical to the corresponding entries in D8.	$[CSI^w]/C_6=SI^w$	$[C+S+I^w]-C_6=S+I^w$
D9A.		For each month, compute and print out the average year-to-year percent change (difference) in estimates of the irregular ($\bar{I}'$) and the seasonal ($\bar{S}'$) and their ratio ($\bar{I}'/\bar{S}'$ = MSR = moving seasonality ratio), where S is an un-weighted 7-term average of the D8 and D9 S-I ratios (differences) and I is obtained by dividing S into the ratios (subtracting S from the differences).	$[CSI^w]/C_6=SI^w$	$[C+S+I^w]-C_6=S+I^w$
D10.	Seasonal factors	A variable seasonal curve routing is applied to D8 with extreme SI ratios (differences) modified as shown in D9.	$M_S[SI^w]=S_6$	$M_S[S+I^w]=S_6$
D11.	Series adjusted for seasonality, trading-day variations and permanent priors	Divide (D10) into (C19) (subtract (D10) from (C19)) or (A1) to obtain the seasonally adjusted series or (A3) if permanent priors are used.	$[CSI']/S_6=CI'$	$[C+S+I']-S_6=C+I'$

PART D. Estimation of Easter Holiday Factors - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
D12.	Trend-cycle	Divide (D1) by (D10) (subtract (D10) from (D1)) to obtain a modified seasonally adjusted series. Apply the variable trend-cycle curve routine to the modified seasonally adjusted series to obtain the final trend-cycle.	$M_H[CI^w]=C_7$	$M_H[C+I^w]=C_7$
D13.	Irregular	Divide (D12) into (D11) (subtract (D12) from (D11)) to obtain the final irregular. Compute the standard deviation for each year, each month, and the entire series. The Easter Holiday Effect printed in A11 is calculated from D13.	$[CI']/C_7=I'$	$[C+I']-C_7=I'$

FINAL (second) RUN OF THE PROGRAM

PART B. Preliminary Estimation of Weights for Extreme Values

Preliminary estimation of weights for reducing the effect of extreme or near-extreme irregular values are developed from the data. These estimates are refined in Part C, where final estimates are developed.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B1.	Prior adjusted original series or original series	Either the original series or original series adjusted by: (1) the prior factors shown in A2; and/or (2) the prior factors shown in A4; and/or the trading-day factors as shown in A6 or A8; and/or (4) the Easter Holiday factors as shown in A11; and/or (5) the prior **ARIMA** modifications. The latter consists of extending the original series, at both ends, with one year of backcasts and forecasts or forecasts only, from the **ARIMA** model chosen in A15 and A16 and if applicable, replacement of extreme values by the corresponding function values of the **ARIMA** model chosen. An F-test for the presence of seasonality (see Chapter I) is applied to B1 and a message is printed to indicate whether or not seasonality is present at the 0.1% level.	CSI'=CSIE	C+S+I'=C+S+I+E
B2.	Preliminary trend-cycle	Same as B2 in the first run.	$M_{2x12}[CSI']=C_1$	$M_{2x12}[C+S+I']=C_1$
B3.	Unmodified S-I ratios (differences)	Same as B3 in the first run.	$(CSI')/C_1=SI'$	$(C+S+I')-C_1=S+I'$
B4.	Replacement values for extreme S-I ratios (differences)	Same as B4 in the first run.	$M_S[SI']=S$ $(SI')/S=I'$ $I'=I^w$ for $\lvert I'-1.0\rvert>1.5\sigma_{I'}$ SI^w	$M_S[S+I']=S$ $(S+I')-S=I'$ $I'=I^w$ for $\lvert I'\rvert>1.5\sigma_{I'}$ $S+I^w$
B5.	Seasonal factors	Same as B5 in the first run.	$M_S[SI^w]=S_1$	$M_S[S+I^w]=S_1$
B6.	Seasonally adjusted series	Same as B6 in the first run.	$(CSI')/S_1=CI'$	$(C+S+I')-S_1=C+I'$
B7.	Trend-cycle	Same as B7 in the first run.	$M_C[C\ I']=C_2$ $(CI')/C=I'$ $I'=I^w$ for $\lvert I'-1.0\rvert>1.5\sigma_{I'}$ CI^w $M_C[CI^w]=C_2$	$M_C[C+I']=C_2$ $(C+I')-C=I'$ $I'=I^w$ for $\lvert I'\rvert>1.5\sigma_{I'}$ $C+I^w$ $M_C[C+I^w]=C_2$
B8.	Unmodified S-I ratios (differences)	Same as B8 in the first run.	$(CSI')/C_2=SI'$	$(C+S+I')-C_2=S+I'$

PART B. Preliminary Estimation of Weights for Extreme Values

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
B9.	Replacement values for extreme S-I ratios (differences)	Same as B9 in the first run.	$M_S[SI']=S$ $(SI')/S=I'$ $I'=I^w$ for $\|I'-1.0\|>1.5\sigma_{I'}$ SI^w	$M_S[S+I']=S$ $(S+I')-S=I'$ $I'=I^w$ for $\|I'\|>1.5\sigma_{I'}$ $S+I^w$
B10.	Seasonal factors	Same as B10 in the first run.	$M_S[SI^w]=S_2$	$M_S[S+I^w]=S_2$
B11.	Seasonally adjusted series	Same as B11 in the first run.	$(CSI')/S_2=CI'$	$(C+S+I')-S_2=C+I'$
B12.	Not used			
B13.	Irregular series	Divide (B7) into (subtract (B7) from) (B11) to obtain a preliminary irregular series. Adjustment for Trading-Day Variation (optional). Steps B14 and B18 to B19 are included only when a trading-day adjustment based upon the information in the monthly series is desired. To adjust for trading-days on the basis of external information, Table A4 is used. Various combinations of these options are described in the User's Manual.	$(CI')/C_2=I'$	$(C+I')-C_2=I'$
B17.	Preliminary weights for irregular component	Same as B17 in the first run.	$[I']=w$	$[I']=w$
B20.	Extreme values	Same as B20 in the first run.		

FINAL (second) RUN OF THE PROGRAM

PART C. Final Estimation of the Weights for Extreme Values

The original series or prior adjusted series is modified for extreme and near-extreme values with the B17 weights and improved trend-cycle and seasonal estimates are obtained.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
C1.	Original series or prior adjusted series modified by preliminary weights	Modify the original series (A1) or the prior adjusted series (B1) for the extreme values by reducing the irregular variations where less than full weight was assigned to the irregular in B17.	$\{CSI'[1.0+w(I'-1.0)]\}/I' = CSI^w$	$[C+S+I']I'(1.0-W) = C+S+I^w$
C2.	Preliminary trend-cycle	Same as C2 in the first run.	$M_C[CSI^w]=C_3$	$M_C[C+S+I^w]=C_3$
C3.	Not used			
C4.	Modified S-I ratios (differences)	Same as C4 in the first run.	$[CSI^w]/C_3=SI^w$	$[C+S+I^w]-C_3=S+I^w$
C5.	Seasonal factors	Same as C5 in the first run.	$M_S[SI^w]=S_3$	$M_S[S+I^w]=S_3$
C6.	Seasonally adjusted series	Same as C6 in the first run.	$[CSI^w]/S_3=CI^w$	$[C+S+I^w]-S_3=C+I^w$
C7.	Trend-cycle	Same as C7 in the first run.	$M_C[CI^w]=C_4$	$M_C[C+I^w]=C_4$
C8.	Not used			
C9.	Modified S-I ratios (differences)	Same as C9 in the first run.	$[CSI^w]/C_4=SI^w$	$[C+S+I^w]-C_4=S+I^w$
C10.	Seasonal factors	Same as C10 in the first run.	$M_S[SI^w]=S_4$	$M_S[S+I^w]=S_4$
C11.	Seasonally adjusted series	Reintroduce extreme and near-extreme values by dividing (B1) by (C10) (subtracting (C10) from (B1)).	$[CSI']/S_4=CI'$	$[C+S+I']-S_4=C+I'$
C12.	Not used			
C13.	Irregular series	Divide (C11) by (C7) (subtract (C7) from (C11)) to obtain an estimate of the irregular.	$[CI']/C_4=I'$	$[C+I']-C_4=I'$
C17.	Final weights for irregular component	Same as B17 except that C13 is used.	$[I']=w$	$[I']=w$
C20.	Extreme values	Same as C20 in the first run.		

FINAL (second) RUN OF THE PROGRAM

PART D. Final Estimation of Seasonal Factors, Trend-cycle, Irregular and Series Adjusted for Seasonality, Trading-Day Variations, Easter Holiday Effects, and Permanent Priors

The original series adjusted for all the priors of Part A (except temporary priors) is modified for extreme and near-extreme values by the C17 final weights and final estimates of the seasonal trend-cycle and irregular are derived.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	**Additive or Log Additive**
D1.	Original series or prior adjusted series modified by final weights	Same as C1 except that C17 weights are used.	$\{CSI'[1.0+w(I'-1.0)]\}/I' =CSI^w$	$[C+S+I']-I'(1.0-w) =C+S+I^w$
D2.	Preliminary trend-cycle	Same as D2 in the first run.	$M_C[CSI^w]=C_5$	$M_C[C+S+I^w]=C_5$
D3.	Not used			
D4.	Modified S-I ratios <u>(differences)</u>	Same as D4 in the first run.	$[CSI^w]/C_5=SI^w$	$[C+S+I^w]-C_5=S+I^w$
D5.	Seasonal factors	Same as D5 in the first run.	$M_S[SI^w]=S_5$	$M_S[S+I^w]=S_5$
D6.	Seasonally adjusted series	Same as D6 in the first run.	$[CSI^w]/S_5=CI^w$	$[C+S+I^w]-S_5=C+I^w$
D7.	Trend-cycle	Same as D7 in the first run.	$M_C[CI^w]=C_6$	$M_C[C+I^w]=C_6$
D8.	Final unmodified S-I ratios <u>(differences)</u>	Divide (D7) into (A14) <u>(subtract (D7) from (A14))</u>, or use (A1) or (A3) if trading-day and Easter holiday adjustments are not applied. An F-test and a non-parametric test for the presence of stable seasonality are applied to the SI ratios and messages are printed to indicate whether seasonality is present at the 0.1% level and 1% level (see Chapter I). A combined test for identifiable seasonality is performed with the above tests and a message in printed to indicate whether identifiable seasonality is present (see Chapter I).	$[CSI']/C_6=SI'$	$[C+S+I']-C_6=S+I'$
D9.	Final replacement values for extreme S-I ratios <u>(differences)</u>	Same as D9 in the first run.	$[CSI^w]/C_6=SI^w$	$[C+S+I^w]-C_6=S+I^w$
D10.	Final seasonal factors	Same as D10 in the first run.	$M_S[SI^w]=S_6$	$M_S[S+I^w]=S_6$
D10A.	Seasonal factors, one year ahead	Seasonal factor forecasts for one year are obtained from: (1) the extrapolated **ARIMA** values; or (2) the extrapolated final seasonal factors of D10 by the formula $S_{n\%1} ' S_n\%1/2[S_n\&S_{n\&1}]$ if the **ARIMA** option is not applied (see Chapter I).		

PART D. Final Estimation of Seasonal Factors, Trend-cycle, Irregular and Series Adjusted for Seasonality, Trading-Day Variations, Easter Holiday Effects, and Permanent Priors - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
D11.	Final series adjusted for Seasonality, Trading-day Variations, Easter Holiday effects and Permanent priors	Divide (subtract) (D10) into (from): (1) (A1) or (A3) if permanent priors are used to obtain the seasonally adjusted series; (2) (A9) if combined seasonal and trading-day adjustments are requested, and; (3) (A14) if combined seasonal, trading-day and Easter holiday adjustments are requested. An F-test for the presence of residual seasonality is applied to the D11 values and a message is printed indicating whether there is residual seasonality: (1) for the whole series at the 1% level; and (2) for the last three years only, at the 1% and 5% levels (see Chapter I).	$[CSI']/S_6=CI'$	$[C+S+I']-S_6=C+I'$
D11A.	Final adjusted series with revised yearly totals	This is an optional table that produces a modified adjusted series where the annual totals of (D11) are equal to those of (A1) or (A3) if permanent prior adjustments are made.		
D12.	Final trend-cycle	Same as (D12) in the first run.	$M_C[CI^w]=C_7$	$M_C[C+I^w]=C_7$
D13.	Final irregular	Same as (D13) in the first run.	$[CI']/C_7=I'$	$[C+I']-C_7=I'$
D16.	Combined seasonal trading-day and Easter holiday factors	Divide (subtract) (D11) into (from) (A1) or (A3) if prior permanent modifications are made to obtain the combined seasonal, trading-day and Easter holiday factors.	$[CSI'D_r]$ / $[CI']$	$[C+S+I'+D_r]$ - $[C+I']$

PART E. Modified Original, Final Series Adjusted for Seasonality, and Trading-Day Variations, Easter Holiday Effects, and Permanent Priors

The original, final adjusted, and irregular series are modified for extremes (beyond 2.5σ). Tables E4, E5 and E6 provide aids to interpreting the quality of the adjustment.

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	**Additive or Log Additive**
E1.	Original series modified for extreme values with zero final weights	Replace those values in the original series (A1 or A3) where a zero weight was assigned in C17 (beyond 2.5σ) with the product (sum) of the trend-cycle, seasonal, trading-day, Easter and prior adjustment components shown in D12, D10, A6 or A8, A11, A4 to obtain an original series modified for extremes.	Where w=0.0, I' set equal to 1.0; i.e., CSI''D=CSPD	Where w=0.0, I' set equal to 0.0; i.e., C+S+I''+D=C+S+P+D
E2.	Modified final adjusted series	Replace those values in the final seasonally adjusted series (D11) where a zero weight was assigned in C17. Compute the standard deviation for each year, each month, and the entire series.	Where w=0.0, I' set equal to 1.0; i.e., CI'=C	Where w=0.0, I' set equal to 0.0; i.e., C+I'=C
E3.	Modified irregular series	Replace those values in the final irregular series (D13) with 1.0 (0.0) where a zero weight was assigned in C17. Compute the standard deviation for each year, each month, and the entire series.	Where w=0.0, I' set equal to 1.0	Where w=0.0, I' set equal to 0.0
E4.	Ratios (differences) of annual totals	Compute the ratios (differences) of the annual totals of (between) (a) the original (A1) to (and) the final adjusted (D11) series and (b) the modified original (E1) to (and) the modified adjusted (E2) series.		
E5.	Percent changes (differences) in original series	Compute and print out the individual month-to-month percent changes (differences) in A1.		
E6.	Percent changes (differences) in final adjusted series	Compute and print out the individual month-to-month percent changes (differences) in D11.		

PART F. MCD Moving Average and Summary Measures

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
F1.	MCD moving average	Compute simple moving average of the final adjusted series (D11) with number of terms equal to MCD (see F2E for computation of MCD). When an even number of terms is used (MCD = 2,4,6), the moving average value is centred by taking an average of the two MCD values.	$M_{MCD}[CI']=C_{MCD}$	$M_{MCD}[C+I']=C_{MCD}$
F2A.	Summary measures	Average Percent Changes (Differences) Without Regard to Sign Over Selected Spans. Compute the average without regard to sign of the percent changes (differences) for the following series over spans t = 1 to 12 months: Table / Symbol / Series A1 / $\bar{O}_t$ / Original series D11 / $\overline{CI}_t$ / Final adjusted series D13 / $\bar{I}_t$ / Final irregular series D12 / $\bar{C}_t$ / Final trend-cycle D10 / $\bar{S}_t$ / Final seasonal factors A2 / $\bar{P}_t$ / Prior monthly adjustment factors C18 / $\overline{TD}(()_t$ / Final trading-day adjustment factors F1 / $\overline{MCD}_t$ / Months (quarters) for cyclical dominance. E1 / $\bar{O}_t^M$ / Modified original series E2 / $\overline{CI}_t^M$ / Modified adjusted series E3 / $\bar{I}_t^M$ / Modified irregular series Where * denotes no allowance for length-of month variation and ** denotes allowance for length-of-month variation. For each of the above series, average the percent changes (differences) for each span t without regard to sign and print out the average with the table number of the series from which the percent changes (differences) were computed and the symbol assigned above.		

PART F. MCD Moving Average and Summary Measures - Continued

Table Number and Title	Multiplicative and Additive or Log Additive	Symbolic Notation	
		Multiplicative	Additive or Log Additive

F2B. Relative Contributions of Components to Percent Changes (Differences) in Original Series

Compute the relative contribution of each component to the percent changes (differences) in the original series over each span t using the relationship

$$\bar{O}_t^2 - \bar{I}_t^2 \% \bar{C}_t^2 \% \bar{S}_t^2 \% \bar{P}_t^2 \% \overline{TD}_t^2$$

Since the sum of squares of the percent changes (differences) does not equal $\bar{O}'^2_t$ exactly, substitute $\bar{O}'^2_t$ where

$$\bar{O}'^2_t - \bar{I}_t^2 \% \bar{C}_t^2 \% \bar{S}_t^2 \% \bar{P}_t^2 \% \overline{TD}_t^2 .$$

Then compute the ratios $\bar{I}_t^2 / \bar{O}'^2_t$,..., $\overline{TD}_t^2 / \bar{O}'^2_t$, which express the relative importance of the changes in each component. Also, compute the ratio $\bar{O}'^2_t / \bar{O}_t^2$ as an indicator of how well the approximation $\bar{O}'^2_t . \bar{O}_t^2$ holds.

F2C. Means and Standard Deviations of Percent Changes (differences)

Compute the mean and standard deviation of the percent changes (differences) for O, I, C, S, CI and MCD over each span t (t=1,...,12). Print out the means and standard deviations of the percent changes (differences) with the symbol and table number of the series from which the measures were computed.

F2D. Average Duration of Run

Compute average duration of run (the average number of consecutive monthly changes in the same direction; "no change" is counted as a change in the same direction as the preceding change) for the following series:

Table	Symbol	Series
D11	CI	Final adjusted series
D13	I	Final irregular series
D12	C	Final trend-cycle
F1	MCD	MCD moving average

PART F. MCD Moving Average and Summary Measures - Continued

Table Number and Title	Multiplicative and Additive or Log Additive	Symbolic Notation	
		Multiplicative	Additive or Log Additive
F2E.	Compute and print out $\bar{I}_t / \bar{C}_t$ for $t=1,\ldots,12.$ Designate as the MCD span the shortest span for which $\bar{I}_t / \bar{C}_t < 1.0.$		
F2F.	Relative Contribution of the Components to the Stationary Portion of the Variance of the Original Series The series is made stationary by removing a linear trend (from D12) for additive and log additive decompositions and an exponential trend for multiplicative decomposition. The relative contribution to the variance is calculated for I, C, S, P, TD and total.		
F2G.	The Autocorrelation of the Final Irregular for Spans 1 to 14		
F2H.	The Final I/C Ratio from Table D12 The Final I/S Ratio from Table D10		
F2I.	The Statistics Values and Their Corresponding Probability Levels: - F-test for stable seasonality from Table B1; - F-test for the trading-day regressions from Table C15; - F-test for stable seasonality from Table D8; - Kruskal-Wallis chi-square test for stable seasonality from Table D8; - F-test for moving seasonality from Table D8.		
F3. Monitoring and quality assessment statistics	All the measures below are in the range from 0 to 3 with an acceptance region from 0 to 1 (see Chapter I). 1. The relative contribution of the irregular over a one quarter span (from Table F2B), M1. 2. The relative contribution of the irregular component to the stationary portion of the variance (from Table F2F), M2. 3. The amount of month-to-month change in the irregular component as compared to the amount of month-to-month change in the trend-cycle (from Table F2H), M3. 4. The amount of autocorrelation in the irregular as described by the average duration of run (Table F2D), M4. 5. The number of months it takes the change in the trend-cycle to surpass the amount of change in the irregular (from Table F2E), M5.		

PART F. MCD Moving Average and Summary Measures - Continued

Table Number and Title		Multiplicative and Additive or Log Additive	Symbolic Notation	
			Multiplicative	Additive or Log Additive
F3.	Monitoring and quality assessment statistics (continued)	6. The amount of year-to-year change in the irregular as compared to the amount of year-to-year change in the seasonal (from Table F2H), M6. 7. The amount of stable seasonality present relative to the amount of moving seasonality (from Table F21), M7. 8. The size of the fluctuations in the seasonal component throughout the whole series, M8. 9. The average linear movement in the seasonal component throughout the whole series, M9. 10. Same as 8, calculated for recent years only, M10. 11. Same as 9, calculated for recent years only, M11. A message is printed indicating the level of acceptance for the combined statistics.		

PART G. Charts

Charts G1 and G2 are available as part of the standard printout. G3 and G4 are available optionally. The user may also specify that no charts are to be printed. See Chapter III for further details.

Table number and title	Multiplicative and additive or log additive
G1. Chart	Plot the original series if prior modifications are not made (A1) or the modified series with extrapolated value (B1) and modified series (E1).
G2. Chart	Plot the final adjusted series and final trend-cycle (D11 and D12 respectively).
G3. Chart	Plot the final S-I ratios (differences) with extremes, final S-I ratios (differences) without extremes, and final seasonal factors (D8, D9 and D10 respectively).
G4. Chart	Plot in calendar order the final S-I ratios (differences) with extremes, final S-I ratios (differences) without extremes, and final seasonal factors (D8, D9 and D10 respectively).
G5. Chart	Plot the final irregular and final modified irregular (D13 and E3 respectively).
G6. Chart	Plot the cumulative periodogram of the final irregulars from Table D13.
G7. Chart	Plot the cumulative periodogram from Table D8.
G8. Chart	Plot the trading-day and irregulars for the 22 types of months from Table C13 and C15 of the first run.
	Scales on Charts
	Multiplicative:
	The scales for Charts G1 and G2 are semi-log. The program selects one of the six following semi-log scales so as to maximize the space utilized by the charts:
	5-cycle - largest value is 100,000 times the smallest value on the scale;
	4-cycle - largest value is 10,000 times the smallest;
	2-cycle - largest value is 100 times the smallest;
	1-cycle - largest value is 10 times the smallest;
	"half-cycle" - largest value is twice the smallest;
	The scales for the charts in G3, G4, G5 and G6 are arithmetic. They are chosen so as to maximize the space utilized by the charts.
	Additive:
	The scales for all charts are arithmetic and are chosen so as to maximize the space utilized by the charts.

Specifications - Variable Trend-cycle Curve Routine

The steps in the variable trend-cycle curve routine are as follows:

1. As a preliminary estimate of C, compute a 13-term Henderson moving average of the seasonally adjusted series. Do not extend to ends of series.

2. As a preliminary estimate of I, divide (subtract) the 13-term moving average into (from) the adjusted series.

3. Compute the average month-to-month percent change (difference) without regard to sign in the preliminary estimates of the irregular (I) and the trend-cycle (C). Compute their ratio (I/C) to obtain an estimate of the importance of the irregular variations relative to the movements in the trend-cycle.

$\bar{I}/\bar{C}$	**Moving average**
0.00 to 0.99	9-term Henderson
1.00 to 3.49	13-term Henderson
3.50 and over	23-term Henderson

For the weight patterns for the Henderson moving averages and the weights used for extending the averages at the ends of the series, see Appendix B.

Specifications: Variable Seasonal Curve Routine

The steps in the variable seasonal curve routine are as follows:

1. It applies to D10.

2. The average I/S ratio is first calculated using complete years for the entire series, that is up to and including year N being $N > 5$. The selection of a seasonal moving average is based on the value of the average I/S_N ratio:

   a) If $I/S_N \leq 2.5$ then use a 3 x 3 m.a.
      If $3.5 \leq I/S_N < 5.5$ then use a 3 x 5 m.a.
      If $6.5 \leq I/S_N$ then use a 3 x 9 m.a.
   b) If $2.5 < I/S_N < 3.5$
      or $5.5 < I/S_N < 6.5$
      Redo a) using the I/S_{N-1} ratio.

   If none of the conditions in a) are satisfied when using I/S_{N-1}, redo a) using I/S_{N-2} and so on.

   If none of the I/S ratios satisfy the conditions in a) when using five (5) years of data (excluding backcasts), then use a 3 x 5 m.a.

   For the weight pattern for the seasonal moving averages, see text Table I and II of Chapter V.

Specifications - Quarterly Program (Multiplicative or Additive and Log Additive) X11ARIMA (Q)

The steps in the quarterly program are analogous to those in the monthly program with the following changes:

1. Table A4 is not applicable.

2. The tables dealing with trading-day variation (B14 to B16, B18, B19, C14 to C16, C18 and C19) are not applicable.

3. The available options are slightly different from the monthly options. See Chapter III for further details.

4. The estimates of the trend-cycle are derived by a centred 4-term moving average (Tables B2, C2, D2) or an optional centred 8-term moving average. The final estimate of this trend-cycle (Tables B7, C7, D7, D12) is derived by a 5-term or a 7-term Henderson moving average selected by the program.

5. The seasonal factor estimates are adjusted to sum to 4.000 using a centred 4-term moving average (Tables B4, B5, B9, B10, C5, C10, D5, D10).

6. In the strike option of step B7, replace an extreme value with the average of the value times its weight and the nearest full-weight value on either side. To replace a value in the first (last) quarter, replace the extreme value with an average of the value times its weight and the nearest full-weight value.

7. In Table F2, the P and TD summary measures are not applicable. Summary measures are shown over one to four-quarter spans. Table F1 uses the quarters for cyclical dominance (QCD) moving average.

CHAPTER V.

FIXED MOVING-AVERAGE WEIGHTS OF X11ARIMA

Seasonal-factor Curve Weights[3]

Text Tables I and II give the fixed weight patterns for the seasonal-factor curve moving averages available in X11ARIMA, the weights for extending the averages at the ends of the series, and the implicit weights for one year-ahead seasonal factors. The stable seasonal, uses an unweighed average of all available S-I ratios for all seasonal factors (including those at the ends) and the year-ahead factors. "N" is the last year for which an S-I ratios is available, and the weights for year "N+1" represent the implicit weights for the year-ahead seasonal factors. **When the ARIMA option is used only the symmetric weights are fixed; the end-weights and the implicit weights for the year-ahead seasonal factors change with the ARIMA model and parameter values.**

TEXT TABLE I. Seasonal-factor Curve Fixed Moving Average Weights

Factor for year	Weight given S-I ratios in year										
	3 x 1 moving average										
									N - 2	N - 1	N
N + 1									-.167	.419	.749
N									0	.390	.610
N - 1									.333	.333	.333
	3 x 3 moving average										
							N - 4	N - 3	N - 2	N - 1	N
N + 1							0	-.056	.148	.426	.481
N							0	0	.185	.407	.407
N - 1							0	.111	.259	.370	.259
N - 2							0.111	.222	.333	.222	.111
	3 x 5 moving average										
					N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1					0	0	-.034	.134	.300	.300	.300
N					0	0	0	.150	.283	.283	.283
N - 1					0	0	.067	.183	.250	.250	.250
N - 2					0	.067	.133	.217	.217	.217	.150
N - 3					0.067	.133	.200	.200	.200	.133	.067
	3 x 9 moving average										
	N - 10	N - 9	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	0	0	0	0	-.014	.031	.096	.180	.208	.236	.265
N	0	0	0	0	0	.051	.112	.173	.197	.221	.246
N - 1	0	0	0	0	.028	.092	.144	.160	.176	.192	.208
N - 2	0	0	0	.032	.079	.123	.133	.143	.154	.163	.173
N - 3	0	0	.034	.075	.113	.117	.123	.128	.132	.137	.141
N - 4	0	.034	.073	.111	.113	.114	.116	.117	.118	.120	.084
N - 5	0.037	.074	.111	.111	.111	.111	.111	.111	.111	.074	.037

3 Most weights used by the program are expressed as rational numbers and thus have eight digits.

TEXT TABLE II. Seasonal-factor Curve Fixed Moving Average Weights for Series with a Shorter Span than the Terms in the Average Applied[4]

Factor for year	Weight given S-I ratios in year				
	Five-year series - 3 x 5 moving average				
	N - 4	N - 3	N - 2	N - 1	N
N + 1	-.034	.134	.300	.300	.300
N	0	.150	.283	.283	.283
N - 1	.067	.183	.250	.250	.250
N - 2	.200	.200	.200	.200	.200

Factor for year	**Six-year series - 3 x 5 moving average**					
	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	0	-.034	.134	.300	.300	.300
N	0	0	.150	.283	.283	.283
N - 1	0	.067	.183	.250	.250	.250
N - 2	0.067	.133	.217	.217	.217	.150

Factor for year	**Five-year series - 3 x 9 moving average**				
	N - 4	N - 3	N - 2	N - 1	N
N + 1	.200	.200	.200	.200	.200
N	.200	.200	.200	.200	.200
N - 1	.200	.200	.200	.200	.200
N - 2	.200	.200	.200	.200	.200

Factor for year	**Six-year series - 3 x 9 moving average**					
	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	-.007	.085	.176	.212	.248	.286
N	.051	.112	.173	.197	.221	.246
N - 1	.167	.167	.167	.167	.167	.167
N - 2	.167	.167	.167	.167	.167	.167

Factor for year	**Seven-year series - 3 x 9 moving average**						
	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	-.014	.031	.096	.180	.203	.236	.265
N	0	.051	.112	.173	.197	.221	.246
N - 1	.028	.092	.144	.160	.176	.192	.208
N - 2	.143	.143	.143	.143	.143	.143	.143
N - 3	.143	.143	.143	.143	.143	.143	.143

Factor for year	**Eight-year series - 3 x 9 moving average**							
	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	0	-.014	.031	.096	.180	.208	.236	.265
N	0	0	.051	.112	.173	.197	.221	.246
N - 1	0	.028	.092	.144	.160	.176	.192	.208
N - 2	.032	.079	.123	.133	.143	.154	.163	.173
N - 3	.125	.125	.125	.125	.125	.125	.125	.125

Factor for year	**Nine-year series - 3 x 9 moving average**								
	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	0	0	-.014	.031	.096	.180	.208	.236	.265
N	0	0	0	.051	.112	.173	.197	.221	.246
N - 1	0	0	.028	.092	.144	.160	.176	.192	.208
N - 2	0	.132	.079	.123	.133	.143	.154	.163	.173
N - 3	.034	.075	.113	.117	.123	.128	.132	.137	.141
N - 4	.111	.111	.111	.111	.111	.111	.111	.111	.111

Factor for year	**Ten-year series - 3 x 9 moving average**									
	N - 9	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N + 1	0	0	0	-.014	.031	.096	.180	.208	.236	.265
N	0	0	0	0	.051	.112	.173	.197	.221	.246
N - 1	0	0	0	.028	.092	.144	.160	.176	.192	.208
N - 2	0	0	.132	.079	.123	.133	.143	.154	.163	.173
N - 3	0	.034	.075	.113	.117	.123	.128	.132	.137	.141
N - 4	0.034	.073	.111	.113	.114	.116	.117	.118	.120	.084

4 Series with less than five complete years of data are always seasonally adjusted with the stable seasonality option.

Trend-cycle Curve Weights[5]

Text Table III gives the fixed weight pattern for the trend-cycle average used: (1) in the variable routine, i.e., 5- and 7-term Henderson curve for quarterly series and 9-, 13-, and 23-term Henderson curve for monthly series and corresponding sets of end-weights; and (2) in the preliminary trend-cycle estimation, i.e., centred 8-term moving average for quarterly series and centred 24-term moving average for quarterly series and their corresponding end-weights. "N" is the last month for which a value in the seasonally adjusted series is available.

TEXT TABLE III. Trend-cycle Curve Moving Average Weights

C value for quarter: — **Weight given CI values in quarter**

5-term Henderson

C value for quarter	N - 4	N - 3	N - 2	N - 1	N
N	0	0	-.073	.403	.670
N - 1	0	-.073	.294	.522	.257
N - 2	-.073	.294	.558	.294	-.073

7-term Henderson

C value for quarter	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N	0	0	0	-.034	.116	.383	.534
N - 1	0	0	-.054	.061	.294	.410	.289
N - 2	0	-.053	.058	.287	.400	.275	.034
N - 3	-.059	.059	.294	.413	.294	.059	-.059

C value for month: — **Weight given CI values in month**

9-term Henderson

C value for month	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N	0	0	0	0	-.156	-.034	.185	.424	.581
N - 1	0	0	0	-.049	-.011	.126	.282	.354	.298
N - 2	0	0	-.022	0	.120	.259	.315	.242	.086
N - 3	0	-.031	-.004	.120	.263	.324	.255	.102	-.029
N - 4	-.041	-.010	.119	.267	.330	.267	.119	-.010	-.041

13-term Henderson

C value for month	N - 12	N - 11	N - 10	N - 9	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N	0	0	0	0	0	0	-.092	-.058	.012	.120	.244	.353	.421
N - 1	0	0	0	0	0	-.043	-.038	.002	.080	.174	.254	.292	.279
N - 2	0	0	0	0	-.016	-.025	.003	.068	.149	.216	.241	.216	.148
N - 3	0	0	0	-.009	-.022	.004	.066	.145	.208	.230	.201	.131	.046
N - 4	0	0	-.011	-.022	.003	.067	.145	.210	.235	.205	.136	.050	-.018
N - 5	0	-.017	-.025	.001	.066	.147	.213	.238	.212	.144	.061	-.006	-.034
N - 6	-.019	-.028	0	.066	.147	.214	.240	.214	.147	.066	0	-.028	-.019

23-term Henderson

C value for month	N - 22	N - 21	N - 20	N - 19	N - 18	N - 17	N - 16	N - 15	N - 14	N - 13	N - 12	N - 11
N	0	0	0	0	0	0	0	0	0	0	0	-.077
N - 1	0	0	0	0	0	0	0	0	0	0	-.046	-.041
N - 2	0	0	0	0	0	0	0	0	0	-.022	-.025	-.025
N - 3	0	0	0	0	0	0	0	0	-.008	-.014	-.018	-.015
N - 4	0	0	0	0	0	0	0	-.001	-.008	-.013	-.012	-.003
N - 5	0	0	0	0	0	0	.003	-.006	-.011	-.011	-.002	.015
N - 6	0	0	0	0	0	.002	-.006	-.012	-.011	-.003	.015	.039
N - 7	0	0	0	0	.001	-.007	-.013	-.001	-.0030	.015	.039	.068
N - 8	0	0	0	-.002	-.007	-.013	-.013	-.003	.014	.039	.068	.097
N - 9	0	0	-.003	.010	-.015	-.014	-.005	.014	.040	.069	.097	.122
N - 10	0	-.004	-.011	-.016	-.015	-.005	.013	.039	.068	.097	.122	.138
N - 11	-.004	-.011	.016	-.015	-.005	.013	.039	.068	.097	.122	.138	.148

5 The weights used by the program have eight digits.

TEXT TABLE III. Trend-cycle Curve Moving Average Weights - continued

C value for month:	Weight given CI values in month										
	23-term Henderson - concluded										
	N - 10	N - 9	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N	-.064	.049	.028	.002	.039	.084	.133	.182	.227	.263	.288
N - 1	-.035	-.024	-.004	.025	.061	.101	.141	.176	.203	.219	.224
N - 2	-.019	-.005	.018	.049	.082	.116	.146	.166	.177	.176	.166
N - 3	-.004	.015	.042	.073	.103	.129	.147	.154	.150	.134	.112
N - 4	.015	.040	.068	.098	.121	.137	.142	.136	.119	.095	.066
N - 5	.039	.067	.095	.119	.134	.139	.131	.114	.088	.059	.027
N - 6	.068	.096	.118	.134	.138	.132	.114	.089	.059	.027	.001
N - 7	.096	.120	.135	.140	.133	.116	.090	.060	.031	.005	-.015
N - 8	.120	.137	.140	.136	.118	.094	.064	.034	.008	-.010	-.021
N - 9	.138	.143	.137	.120	.095	.067	.037	.011	-.007-	-.017	-.019
N - 10	.144	.138	.122	.097	.068	.039	.013	-.005	.015	-.016	-.011
N - 11	.138	.122	.097	.068	.039	.013	-.005	-.015	-.016	-.011	-.004

C value for quarter[6]:	Weight given CI values in quarter								
	Centred 8-term moving average for preliminary trend-cycle estimation								
	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N
N - 2	0	-.004	-.058	.008	.179	.254	.308	.242	.071
N - 3	0	-.052	.001	.132	.293	.302	.249	.118	-.043
N - 4	-.026	-.021	.125	.271	.302	.271	.125	-.021	-.026

C value for month[7]:	Weight given CI values in month												
	Centred 24-term moving average for preliminary trend-cycle estimation												
	N - 24	N - 23	N - 22	N - 21	N - 20	N - 19	N - 18	N - 17	N - 16	N - 15	N - 14	N - 13	N - 12
N - 6	0	.019	.011	-.002	-.016	-.026	-.031	-.027	-.017	-.001	.019	.044	.070
N - 7	0	.018	.005	-.011	-.024	-.029	-.027	-.018	-.002	.017	.041	.065	.090
N - 8	0	.012	-.004	-.018	-.026	-.025	-.018	-.004	.014	.034	.057	.081	.106
N - 9	0	.002	-.012	-.021	-.023	-.016	-.004	.012	.030	.047	.069	.093	.115
N - 10	0	-.011	-.020	-.021	-.014	-.003	.012	.027	.043	.059	.081	.102	.118
N - 11	0	-.022	-.023	-.016	-.003	.012	.028	.041	0.56	.073	.091	.106	.115
N - 12	-.011	-.027	-.019	-.005	.011	.027	.042	.056	.072	.089	.103	.111	.106
	N - 11	N - 10	N - 9	N - 8	N - 7	N - 6	N - 5	N - 4	N - 3	N - 2	N - 1	N	
N - 6	.064	.072	.085	.100	.110	.114	.110	.100	.084	.064	.039	.014	
N - 7	.065	.079	.094	.107	.113	.111	.101	.085	.066	.042	.018	-.006	
N - 8	.071	.087	.101	.110	.109	.101	.087	.069	.049	.027	.003	-.022	
N - 9	.081	.096	.105	.106	.099	.087	.072	.054	.036	.014	-.010	-.032	
N - 10	.094	.103	.104	.098	.086	.071	.056	.040	.024	.002	-.019	-.034	
N - 11	.106	.107	.099	.086	.071	.055	.042	.027	.010	-.008	-.023	-.031	
N - 12	.111	.103	.089	.072	.056	.042	.027	.011	-.005	-.019	-.027	-.011	

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6 No estimates are computed for N and N-1.

7 No estimates are computed for N, N-1, ..., N-5.

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PART B

X11ARIMA version 2000

USER'S MANUAL

MICROCOMPUTER USERS

PLEASE NOTE

1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2) (0,1,1) MODEL. IT ONLY INCLUDES THE FIRST FOUR MODELS.

2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.

3. NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS (G.8) IS AVAILABLE.

4. ALL 9 TYPES OF SPECIAL OUTPUT FORMATS ARE NOW AVAILABLE ON THE PC AS WELL.

SECTION 1. Introduction

The X11ARIMA/88 user-interface differs greatly from the X11ARIMA (1980) version of this program. The column/card orientation has been replaced by a "user-friendly", free format, keyword-based system, with the option of running it in either batch or interactive mode. The X11ARIMA/88 program was designed to be used by both the new user and the experienced professional. The keywords will greatly decrease the learning curve for new users while experienced users will benefit from the self-documenting nature of the keywords.

The user's manual consists of several sections. It begins with the conventions of the user's manual, the methods of accessing X11ARIMA, and a summary of X11ARIMA command keywords. These command keywords have been grouped into 11 major functions; each function is comprised of related commands. These functions are: Input, Seasonal Adjustment and ARIMA, Prior Adjustment, Modification of Extreme Values, Trading Day Adjustment, Easter Adjustment, Adjustment of Yearly Totals, Moving Averages, Output, Composition, and finally Interactive Access commands.

SECTION 2. X11ARIMA Conventions

The X11ARIMA program is driven by the user issued free format commands. A command always begins with a command keyword and ends with a semi-colon (;). In general, the X11ARIMA control language has two basic types of keywords: COMMAND keywords and OPTION keywords.

1. COMMAND Keywords

   - Are indicated by L and displayed in **BOLD**face when first introduced.
   - End with a semi-colon {;}. The operand field is between the keyword and the semi-colon.

2. OPTION Keywords

   - Are used to change the default options of the COMMAND keywords SA and COMP_END.
   - Are indicated by ± and displayed in *ITALICIZED* print when first introduced.

3. Commands may have an abbreviated form, which is referred to as the ALIAS of the command.

4. When an example contains both user-inputted commands and the system's response, the text that the user types will be underlined.

5. In examples, the **BOLD**face text "**COMMAND:**" represents the prompt used in the interactive version of X11ARIMA.

6. Throughout the document the symbols "<" and ">" will be used to denote OPTIONAL parameters.

7. The notation "..." denotes that there are several parameters which may follow, and that these parameters will be of the same form as the preceding parameter.

In performing seasonal adjustment of a time series, there are numerous options possible. All options have default values. By specifying various option keywords and associated values in the seasonal adjustment commands, the users are able to alter those default options.

SECTION 3. Accessing X11ARIMA on the Mainframe

X11ARIMA currently runs, at Statistics Canada, on an IBM OS/390 Version 2 Release 6 under MVS/TSO, and supports a batch mode.

NOTE: *The following descriptions define the methods of accessing X11ARIMA at Statistics Canada; outside users should contact their system administrators for local modifications to the access methods*.

BATCH access

The user is expected to have a general familiarity with JCL (job control language); it is not within the scope of this manual to teach such things.

The X11ARIMA catalogued procedure has two steps. It will read **keywords** and execute X11ARIMA with the appropriate options. Users must provide at least 2 input files in step 1 and can control up to 6 output files in step 2. In the first step the X11ARIMA control cards are written to a temporary disk file. This file is then passed as input to the X11ARIMA program in step 2. The X11ARIMA program will be executed only when there are no errors detected and at least one seasonal adjustment command has been issued.

The user must specify the SYSIN file as it supplies the keywords and can specify their own input file. A user can specify their original data to be read into core from unit 10. The input files required are:

SYSIN	This file will hold all of the X11ARIMA keywords that will be executed.
FT10F001	This file will hold all original data to be seasonally adjusted.

The user can control the output produced by X11ARIMA. If a user wishes to specify the special print option with the PUNCH keyword, he/she should specify the appropriate JCL for unit 11. The user has control over the following units:

FT04F001	This file will contain the prior daily weights estimated through a trading-day regression
FT09F001	This file will contain the main printout of X11ARIMA
FT11F001	This file will contain the special table output from the PUNCH option.
FT15F001	This file will hold the summary quality control statistics.
FT16F001	This file will hold the F2 and F3 tables
FT18F001	This file will contain selected statistics from the main printout.

Output on units FT09F001, FT15F001 and FT16F001 may be suppressed or dummied, otherwise, the default is to print its contents. Unless a filename is specified for FT04F001, FT11F001 and FT18F001 these files are dummied out as default.

i.e. //S2.FTxxF001 DD DUMMY   Where xx is the file unit number.

To use X11ARIMA submit a job with the following JCL:

```
//   JOB card ....
//PROCLIB DD DSN=STC2.X11ARIMA.VER2000.PROC,DISP=SHR
//   EXEC X11ARIMA
//FT10F001 DD ...  specifies an input dataset for the original data, if needed
//SYSIN    DD *    specifies an input dataset for X11AR commands

          ( place X11ARIMA Commands here)

//S2.FT11F001 DD ...  specifies an output file for special output option
```

SECTION 4. **Index of X11ARIMA Commands**

8 Applies to Multiplicative or Logarithmic Seasonal Adjustment only.

SECTION 4. **Index of X11ARIMA Commands (cont'd)**

NOTE: Option keywords are specified in the commands named SA or COMP_END.

SECTION 5. INPUT Related Commands

The commands available for INPUT are the following:

1) To provide input data in free format:
   DATA

2) To describe the range of the input data:
   RANGE

3) To provide input data in fixed format stored previously on a file:
   X11ARDATA

1) Providing Data to X11ARIMA in Free Format

Data to be seasonally adjusted must be provided to X11ARIMA **prior** to issuing seasonal adjustment commands (see **SA** - command).

L **Command:** **DATA** (used to enter data in free format)

Syntax: DATA Id p y sp;

- Id specifies the name of the time series (id should not exceed 8 characters in length, and the first character must be alphabetic)
- p the periodicity of the time series (4 for quarterly, 12 for monthly)
- y beginning year (can be 2 digits or 4 digits)
- sp beginning month/quarter.

Data should follow immediately and be terminated by a semi-colon(;).

Example:
```
DATA  X1  12 81  1;
1.0  2.0  3.0  4.0  5.0  6.0 7.0  8.0  9.0  10.0  11.0  12.0  13.0  14.0 15.0  16.0  17.0
18.0  19.0  20.0  21.0 22.0 23.0  24.0  25.0  26.0;
```

2) Describing the Range of the Input Data

L **Command:** **RANGE** (used to:
a) specify the length of each read-in series when using the USER-SUPPLIED form of the **X11ARDATA** command;
b) define the data to be seasonally adjusted, if different from the read-in data. See the section SEASONAL ADJUSTMENT related commands for the uses of the RANGE command.)

NOTE: Once this command is issued, it remains effective throughout the session or until it is over-written by a subsequently issued **RANGE** command. It may be necessary to define RANGE for each series if they are of different length.

Syntax: **RANGE** p y1 p1 y2 p2;

- p periodicity (4 for quarterly and 12 for monthly series)
- y1 beginning year (in 2 or 4 digits)
- p1 beginning month or quarter
- y2 ending year (in 2 or 4 digits)
- p2 ending month or quarter

Example:	RANGE 12 85 01 98 12;	Specifies a monthly series beginning in January of 1985 and ending in December of 1998.
Example:	RANGE 4 1984 1 2004 4;	Specifies a quarterly series beginning in the first quarter 1984 and ending in the fourth quarter of 2004.

3) Providing Input Data Previously Stored on a File

L **Command:** **X11ARDATA** (used to read data already on file. It has three forms, BUILT-IN, USER-SUPPLIED, and CANSIM[9])

Alias: XRD

Syntax:	X11ARDATA	p t d;	BUILT-IN
Syntax:	X11ARDATA	CANSIM;	CANSIM
Syntax:	X11ARDATA	FORMAT (f) Id_1, Id_2, ...	USER-SUPPLIED

The BUILT-IN form consists of 7 selectable data formats; the CANSIM form consists of two. They are described below in FORTRAN notation. When using the CANSIM form of the **X11ARDATA** command, the series Id will have any internal blanks removed (ie "D   4596" would be referred to as "D4596", thus the Id will be five characters long instead of eight).

Unlike the BUILT-IN and CANSIM forms, the USER-SUPPLIED form will recognize data only (i.e. neither the series Id nor the month/quarter/year identifiers will be recognized). The time span and the periodicity of the series must then be defined by the **RANGE** command. The series Id must also be supplied as a parameter to the **X11ARDATA** command.

Once X11ARIMA has stored all of the input data in core, it is able to search for any specific time series. As a result of this, the **S**easonal **A**djustment command is not dependant on the order of the series. Data stored in core will be lost when the session is terminated. When reading a file X11ARIMA will read all of the data series in the file up to a maximum of 200 series for microcomputer and 3,000 for mainframe.

BUILT-IN

X11ARDATA p t d;

p indicates the periodicity of data, 4 for quarterly and 12 for monthly.

t indicates in what format the data exists, it should be one of the following:

```
t=0, format (12F6.0,I2,A6) for monthly data
            (4(12X,F6.0),I2,A6) for quarterly data
t=2, format (6F12.0,/,6F12.0,I2,A6) for monthly data
            (4F12.0,24X,I2,A6) for quarterly data
t=3, format (A6,I2,12F6.0) for monthly data
            (A6,I2,4(12X,F6.0)) for quarterly data
t=4, format (A8,I2,10X,12E16.10,18X) for both monthly and quarterly data.
t=5, format (A6,I2,6F12.0/8X,6F12.0) monthly data
            (A6,I2,4F12.0) for quarterly data
t=7, format (A8,I4,I2,2X,I4,I2,2X,12E16.10,1X,I1,12X) same as CANSIM2 format
t=8, format (A8,I4,6F11.0,2X/12X,6F11.0,2X) monthly data
            (A8,I4,4F11.0,2X) for quarterly data.
```

In these FORTRAN formats, A6 or A8 refers to the series identifier, I2 refers to the last two digits of the year (ie 80 for 1980), I4 refers to the four digits of the year (ie 1980), and the rest refer to the data found on the input file.

9 CANSIM stands for Canadian Socio-economic Information Management System; it is composed of Statistics Canada's computerized data bank and its supporting software.

Values of t = 1 and t = 6 are not available for this command; the sequence of the t-values has been chosen to agree with the corresponding formats in the PUNCH command.

The formats chosen may be modified further by the user-specified number of decimal digits.

d indicates number of decimal digits on the input data, $0 \leq d \leq 5$

Example: We wish to input quarterly data using format (A6,I2,4(12X,F6.2)) that was previously stored on a file.

X11ARDATA 4 3 2;

USER-SUPPLIED

X11ARDATA FORMAT (f) Id_1 Id_2 ...;

f is the user-supplied format to be used to read the data. It should be in the form of a FORTRAN input format statement.

Id_i the time series identifiers.

Example: We wish to input monthly data in user-supplied format (6F12.4). We also wish to associate the date range (1991 1) to (2002 10) with the data values, and read three series which we will name "Id1", "Id2" and "Id3".

RANGE 12 91 1 02 10;
X11ARDATA FORMAT(6F12.4) Id1 Id2 Id3;

NOTE: A RANGE command (see above) should be issued before this command.

CANSIM

X11ARDATA CANSIM;

Data is in CANSIM utility format (A8,I2,10X,12E16.10,18X). This is basically the same as option 4 of the built-in format except that here the program also checks for valid CANSIM database information in fields 11 to 20 and 213 to 230. This is the CANSIM format used prior to 1997.

X11ARDATA CANSIM2;

This new format (A8,I4,I2,2X,I4,I2,2X,12E16.10,1X,I1,12X) has been introduced to conform to the new CANSIM format introduced in 1997 containing the 4-digit year identifier.

Example: We wish to input data in CANSIM utility format.

X11ARDATA CANSIM;
X11ARDATA CANSIM2;

SECTION 6. SEASONAL ADJUSTMENT and ARIMA Related Commands and Options

In performing seasonal adjustment, the following information is required:

1) Data

2) Series title:
    TITLE

3) Seasonal Adjustment Commands:
    RANGE
    SA (Id,M,N) Id = Series Id
    M = Type of Adjustment
    N = ARIMA
    SA Id
    SUMMARY

4) User-supplied ARIMA model (if applicable):
    MODEL
    ORDER
    INITIAL

5) ARIMA model options (if applicable):
    HORIZON
    MIT
    CHISQ
    FCLIMIT

1) Data

See the section **INPUT Related Commands**.

2) Series Title

The series title is provided by the **TITLE** Command.

L **Command:** **TITLE** (Specifies title information for the printouts)

Alias: T

Syntax: $TITLE_1$ string;
.
.
.
$TITLE_n$ string; $(n \leq 9)$

The TITLE command is mandatory and should not occupy more than 1 line (although 9 title commands may be issued for each time series). Any text following the TITLE statement, and before the semicolon, will be used as-is (it is not examined and may be anything). Unlike the RANGE command, which stays effective until over-written, Title(s) information is used once only and is subsequently removed.

3) Seasonal Adjustment Commands

In addition to the previously mentioned TITLE command, Seasonal Adjustment requires the use of the following commands (and options if applicable).

L **Command:** **RANGE** (Establishes the global periodicity and range of data to undergo seasonal adjustment)

This command allows seasonal adjustment to be performed upon the entire series or any subset of the series. Once this command is issued, it remains effective throughout the session or until it is overwritten by a RANGE command.

Syntax: RANGE p y1 p1 y2 p2;

- p periodicity (either 4 for quarterly or 12 for monthly)
- y1 beginning year (in 2 or 4 digits)
- p1 beginning month or quarter
- y2 ending year (in 2 or 4 digits)
- p2 ending month or quarter

L **Command:** **SA** (initiates the **S**easonal **A**djustment process)

Before issuing this command, **TITLE** information and an active **RANGE** command should have been provided.

Syntax: SA (Id,m,n) options...;
Default: SA Id options...; (defaults to multiplicative adjustment and automatic ARIMA extrapolation)

Id the Id of the time series to undergo seasonal adjustment;

m type of adjustment ($0 \leq m \leq 2$);
m = 0 multiplicative adjustment(default);
m = 1 additive adjustment;
m = 2 logarithmic adjustment.

n ARIMA extrapolation option ($0 \leq n \leq 5$).

This option produces extrapolated values from ARIMA models to extend the original series at the beginning (backcasts) and at the end (forecasts). It can only be applied to series of AT LEAST FIVE COMPLETE YEARS. For series longer than 15 complete years, only the last 15 years will be used to fit the model. The ARIMA models are fitted to series already adjusted for trading-day variations, Easter effects, and prior factors if applicable.

When using the automatic ARIMA option (n=0), none of the five built-in models is chosen, and no extrapolation is made, if:

(1) the mean absolute percentage error for the last three years is greater than 15% for the forecasts or

(2) the P^2 probability is smaller than 5% or

(3) there is evidence of over-differencing.

(Command: SA - Continued)

If the above model failed the previous criteria, the user can still apply the same model by resubmitting the series with that model as a "user-supplied model" (see below). If no model passes, the program automatically estimates the various components without the extrapolated values (a message will be printed identifying this condition). Whenever the default option is applied, the model selection is based upon data taken up, and including, the last complete year. The selected model is then used during the current year for forecasting and only the parameter values are re-estimated using the full series. In this manner unnecessary revisions introduced by spurious model changes are avoided. Users can also select the length of the extrapolation, ranging between six months (two quarters) and thirty-six months (twelve quarters) using the HORIZON option keyword.

n = 0 the five built-in models are automatically fitted, one at a time, to the series. The first model that passes the selection criteria is used to forecast one year ahead (default);

n = 1 no ARIMA model is used;

n = 2 user-supplied model -- forecast and backcast even if the built-in acceptance criteria have failed.

n = 3 user-supplied model -- automatic replacement of extreme values by the corresponding estimates of the ARIMA model chosen, forecast and backcast;

n = 4 user-supplied model -- forecast only;

n = 5 user-supplied model -- automatic replacement of extreme values by the corresponding estimates of the ARIMA model chosen, forecast only.

N.B.: Backcasts are produced only for those series that are longer than 5 years and less than 6 years long.

± **Option keyword:** *SUMMARY* (Specifies 'Type of Adjustment')

Syntax: SUMMARY n ($0 \leq n \leq 1$)

n = 0 for seasonal adjustment (default);
n = 1 summary measures develops estimates of the trend-cycle, irregular, I/C, MCD, residual trading-day and seasonal variation but does not produce a seasonally adjusted series. The original series is used as the final seasonally adjusted series in Table D11 and D11A.

4) User-Supplied ARIMA MODELS

ARIMA models can be specified with the following Option keywords:

± **Option keyword:** *MODEL* (Specifies a user-supplied ARIMA model)

Syntax : MODEL < POWER pw > < ADD a1 > p d q P D Q < c_0 >
Syntax : MODEL < LOG > < ADD a1 > p d q P D Q < c_0 >

For a given model, either LOG or POWER transformation may be specified but not both.

LOG indicates a logarithmic transformation of the original data.

POWER indicates a transformation of the original data by a power of pw (where pw is a real number).

ADD adds a constant, a1, to the original data before the transformation. It is meaningful only when either LOG or POWER is specified. The constant a1 is a real number.

p	the number of regular autoregressive parameters	$(0 \leq p \leq 4)$
d	the number of regular differences	$(0 \leq d \leq 4)$
q	the number of regular moving average parameters	$(0 \leq q \leq 4)$
P	the number of seasonal autoregressive parameters	$(0 \leq P \leq 4)$
D	the number of seasonal differences	$(0 \leq D \leq 4)$
Q	the number of seasonal moving average parameters	$(0 \leq Q \leq 4)$

c_0 indicates the existence of a deterministic constant term:
- $c_0 = 0$ none (default)
- $c_0 = 1$ deterministic constant term (δ)

Constraints:
1: $0 \leq \{p, d, q, P, D, Q\} \leq 4$
2: $p + q + P + Q \leq 10$
3: $0 \leq c_0 \leq 1$
4: $-9999.99 \leq a1 \leq 99999.99$
5: $-0.99 \leq pw \leq 9.99$

Examples:
1 MODEL 0 1 3 0 1 1
2 MODEL LOG 0 1 3 0 0 1
3 MODEL POWER .5 1 0 1 1 0 0 1
4 MODEL LOG ADD 123.45 0 2 2 0 1 1 1

± **Option keyword:** *ORDER* (sets the orders of the parameters)

Syntax : ORDER n_1 n_2 n_3, ..., where n_i is an integer
Default:
1	for first regular autoregressive parameter and 2 for the second, etc
1	for first regular moving average parameter and 2 for the second, etc
4 or 12	for the first seasonal autoregressive parameter and 8 or 24 for the second, etc
4 or 12	for the first seasonal moving average parameter and 8 or 24 for the second, etc (12 for monthly series and 4 for quarterly series)
0	for δ (if applicable)

This optional keyword is recognized only when a "user-supplied" ARIMA model has been previously specified. If the order of any one of the parameters in the model is not the same as the default value, then the order of EACH of the parameters in the model must be specified using this option keyword.

The orders are supplied in the following sequence:

p	order of the regular autoregressive parameters
q	order of the regular moving average parameters
P	order of the seasonal autoregressive parameters
Q	order of the seasonal moving average parameters
c_0	order of the deterministic constant term (if any)

Example: MODEL 0 1 2 0 1 1 ORDER 1 3 12

± **Option keyword:** *INITIAL* (sets INITIAL values for all parameters)

Syntax: INITIAL c_1 c_2 ... $(-9.999 \leq \{c_1, c_2, ..., c_i\} \leq 99.999)$ $i \leq 8$
Default: INITIAL 0.1 0.1 0.1 .....

This option keyword is recognized only when a "user-supplied" ARIMA model has been previously specified. The number of initial values specified here must equal the total number of parameters in the model.

The initial values should be supplied in the following order:

p regular autoregressive parameters
q regular moving average parameters
P seasonal autoregressive parameters
Q seasonal moving average parameters
c_0 deterministic constant term (if present)

Example: MODEL LOG 0 1 2 0 1 1 INITIAL .123 .234 .753

5) <u>ARIMA Models Options</u>

The modelling process can be modified through the use of the following Option keywords:

± **Option keyword:** *HORIZON* (specifies the forecast HORIZON)

Syntax: HORIZON n 2 $\leq$ n $\leq$ 12 for quarterly series
6 $\leq$ n $\leq$ 36 for monthly series
Default: HORIZON 4 (for quarterly series)
HORIZON 12 (for monthly series)

± **Option keyword:** *MIT* (Maximum number of ITerations)

Syntax: MIT n (0 $\leq$ n $\leq$ 50)
Default: MIT 30

MIT 0 bypasses the non-linear estimation process and uses only the initial parameter values supplied by the user.

± **Option keyword:** *CHISQ* (tests the lack of fit of the ARIMA model)

Syntax: CHISQ n (0 $\leq$ n $\leq$ 99)
Default: CHISQ 5

The option is used to alter the chi-square acceptance limit (in %) for the ARIMA models in the automatic model selection option.

The default value is 5% (probability $\geq$ 0.05).

± **Option keyword:** *FCLIMIT* (tests the within-sample forecast error)

Syntax: FCLIMIT n (0 $\leq$ n $\leq$ 99)
Default: FCLIMIT 15

This option is used to alter both forecast and backcast (available through the automatic model selection option) acceptance limits (in %) for the ARIMA models.

The default for forecast is 15%.

SECTION 7. PRIOR ADJUSTMENT Related Options

> These are two types of adjustment which may be made to the data series prior to **S**easonal **A**djustment:
>
> 1) Re-scale the original series:
>   *DIVPOWER*
>
> 2) Permanent and Temporary prior adjustment of original values:
>   *PERM_PRIOR*
>   *TEMP_PRIOR*

1) Re-scale the Original Series

To re-scale the original series use the following option:

± **Option keyword:** *DIVPOWER* (DIVides the original series by 10 to the POWER of n)

Syntax: DIVPOWER n (-9 $\leq$ n $\leq$ 99)
Default: DIVPOWER 0

If the data in the original series are too big or too small in absolute value, this keyword may be used to scale them to the appropriate magnitude.

Example: DIVPOWER 6 divides by 10^6
DIVPOWER -2 divides by 10^{-2} (multiply by 10^2)

2) Permanent and Temporary Prior Adjustment of Original Values

Two commands have been provided for adjustment of original values. These options require that the adjustment factors have been read into core (in the same manner as any other series, see the section **INPUT Related Commands**). The two option keywords are:

± **Option keyword:** *PERM_PRIOR* (PERManent PRIOR adjustment of original values.)

Syntax: PERM_PRIOR Id (Id is the identifier of the series which contains the permanent prior adjustment factors. This series should have the same periodicity and range as the time series to be seasonally adjusted.)

The permanent prior factors are divided into the original data if the type of the adjustment requested is multiplicative or logarithmic, and subtracted from them if additive. The original values removed using the permanent prior adjustment factors are **not** reintroduced in the seasonally adjusted series or in any other tables of the program output.

± **Option keyword:** *TEMP_PRIOR* (TEMPorary PRIOR adjustment of original values)

Syntax: TEMP_PRIOR Id (Id is the identifier of the series which contains the temporary prior adjustment factors. This series should have the same periodicity and range as the time series to be seasonally adjusted.)

This series should have the same periodicity and range as the time series to be seasonally adjusted.

The temporary prior factors are divided into the original data if the type of the adjustment requested is multiplicative or logarithmic, and subtracted from them if additive. The original values removed using the temporary prior adjustment factors are reintroduced in the seasonally adjusted series and in some other tables of the program output.

SECTION 8. MODIFICATION OF EXTREME VALUES: Related Options

There are two option keywords that are related to the modification of extreme values:

1) Adjust the series for strikes:
ADJTC

2) Sigma limits for Seasonal and Trend-cycle components:
SLSTC

1) Adjust the Series for Strikes

± **Option keyword:** *ADJTC* (ADJustment of Trend-Cycle for strikes.)

Syntax : ADJTC n $(0 \leq n \leq 1)$
Default: ADJTC 0

Modifications of extreme values may be made before computing the trend-cycle estimate. The adjustment for extremes substantially reduces the effect of major prolonged strikes or similar irregular events. However care should be exercised in its use since for some series the estimates near sharp business peaks or troughs will be similarly affected.

n=0 no adjustment for strikes
n=1 adjustment for strikes

2) Sigma limits for Seasonal and Trend-cycle components

± **Option keyword:** *SLSTC* (Sigma Limit for graduating extreme values in estimating the Seasonal and Trend-Cycle components)

Syntax: SLSTC c1 c2 $(0.1 \leq \{c1\ \ c2\} \leq 9.9)$
Default: SLSTC 1.5 2.5

c1 is the lower sigma (σ) limit
c2 is the upper sigma (σ) limit

Example: SLSTC 1.0 3.0

SECTION 9. TRADING-DAY ADJUSTMENT: Related Options

These are four option keywords that are related to Trading-day Adjustment:

1) Assigns a prior daily weight to each day of the week:
   PDW

2) Adjust for Trading-day effect:
   TDR

3) Sigma limits for Trading-day component:
   SLTD

4) Adjust for variations resulting from the differing length of months:
   LMA

1) Assigns a prior daily weight to each day of the week

± **Option keyword:** *PDW* (Prior Daily Weights)

Syntax: PDW w1 w2 w3 w4 w5 w6 w7 (0.000 ≤ {w1 w2 w3 w4 w5 w6 w7} ≤ 9.999)
Default: PDW 1.00 1.00 1.00 1.00 1.00 1.00 1.00

This option is available only with multiplicative or logarithmic adjustment. It is used to specify seven prior daily weights which are combined to yield the prior trading-day adjustment factors. The first value entered is the prior weight for Monday. The second value entered is for Tuesday and so on. The program adjusts the weights to total 7.000. These weights may be modified by the trading-day regression routine.

Example: PDW 0.5 1.5 1.5 1.5 1.0 1.0 0.0

2) Adjust for Trading-day effect

± **Option keyword:** *TDR* (Trading-Day Regression)

Syntax: TDR a b c (0 ≤ a ≤ 3), (1926 ≤ {b c} ≤ 2025)
Default: TDR 0 0000 0000

Seven daily weights for the estimation of trading-day variations are calculated using data up to and including the last complete year. Trading-day variations are removed from the original series before ARIMA model fitting and the final decomposition of the series. Trading-day variations from the data may be computed and used, not used, or used only if they explain significant variations on the basis of an F-test. Prior daily weights if supplied, may be corrected by these estimates.

a Enables trading-day adjustment

- a = 0 excludes the computation of the trading-day regression (default).
- a = 1 computes the trading-day regression and print the results but do not adjust the series by the factors computed.
- a = 2 computes the trading-day regression, print the results and adjust the series by the regression estimates. If prior weights have been supplied, correct them on the basis of these estimates.
- a = 3 computes the trading-day regression and print the results. In iteration B of the program (see Appendix A), adjust the series by the regression estimates or prior weights corrected by the regression estimates to obtain preliminary weights for the irregular series. In iteration C (see appendix A), use the regression estimates only if they explain significant variation on the basis of the F-test.

b* Specifies the starting year for computing trading-day regression.

b = 0000 derive estimates of the trading-day weights using the entire series as input to the regression (default).
b = 1926 -2025 derive estimates of the trading-day weights using only the part of the series beginning with January of the year typed here as input to the regression.

c* Specifies the starting year for applying trading-day regression. The starting year determined by this option is independent of the year selected in b (it may be earlier, the same, or later).

c = 0000 applies the trading-day regression estimates or prior trading-day weights corrected by regression estimates to the entire series (default).
c = 1926 -2025 applies the trading-day regression estimates only to the part of the series beginning with the year punched here. If prior weights are supplied, adjust the part of the series preceding this date by the prior weights only, and adjust the part of the series from this date to the end by the prior weights corrected by the regression estimates.

The parameter values (a,b,c) do not have to be explicitly specified (i.e. they can be left blank) unless a non-default parameter value is selected. When this occurs, each parameter to the left of that parameter must be explicitly selected (i.e. TDR 2 blank blank is the same as TDR 2 0000 0000 but TDR 2 blank 2001 must be specified as TDR 2 0000 2001).

Examples: 1 We wish to adjust both the series and prior weights for trading-day regression, calculated on the whole series and applied for the whole series.

TDR 2 or TDR 2 0000 0000

2 We wish to calculate and not use the monthly weights for trading-day regression, calculated on the series beginning in 1980 and applied from 1990.

TDR 1 1980 1990

*** Please note that unlike in the previous versions where fields b and c were using 2-digit year identifiers, in X11ARIMA version 2000 4-digit year identifiers are needed.**

3) Sigma limits for Trading-day component:

± **Option keyword:** *SLTD* (Sigma Limits for graduating extreme values in estimating the Trading-Day component)

Syntax: SLTD c1 ($0.1 \leq c1 \leq 9.9$)
Default: SLTD 2.5

This option is meaningful only if the trading-day regression is computed. In estimating trading-day variation from the data, irregular values more than "c1" standard deviations (σ's) away from the mean are excluded as extreme from the trading-day regression.

c1 is the sigma (σ) limit

Example: SLTD 2.0

± **Option keyword:** *LMA* (Length-of-Month Allowance)

Syntax: LMA n ($0 \leq n \leq 1$)
Default: LMA 0

This option allows the inclusion of variations arising from the length of month in the seasonal factors or in the trading-day factors.

This option is meaningful only if a prior and/or trading-day regression is made, and is available only with the multiplicative adjustment.

n = 0 do not include an allowance for the length of month in the trading-day factors. Length-of-month variations are included with the seasonal factors (default). Divisors used in the construction of monthly weights are 31, 30, and 28.25 (February).

n = 1 include length-of-month variation in the trading-day factors rather than in the seasonal factors. The divisor for all months is 30.4375 (the average length of a month).

SECTION 10. EASTER ADJUSTMENT: Related Option

There are three option keywords related to Easter Adjustment:

1) Removal of the Easter effect:
EASTER

2) Specification the build-up period:
BUILDUP

3) Removal of the extremes of the Easter model:
EASTXM

1) Removal of the EASTER Effect

± **Option keyword:** *EASTER*

Syntax: EASTER n ($0 \leq n \leq 6$)
Default: EASTER 0

Easter factors for the months of March and April are calculated using data up to and including the last available complete year. Easter effects are removed from the original series prior to ARIMA model fitting and any decomposition of the series.

n = 0 exclude the computation of Easter weights (default).
n = 1 compute the Easter factors and print the results but do not adjust the series by the computed factors.
n = 2 compute the Easter factors and adjust the series by those estimates.
n = 3 compute the Easter factors and print the results. Adjust the series by these estimates only if they explain significant variation on the basis of the F-test.
n = 4 calculate the gradual impact Easter effect but do not apply it.
n = 5 calculate the gradual impact Easter effect and apply it.
n = 6 calculate the gradual impact Easter effect and apply it only if it is significant at the 10% level.

2) Specification of the Build-up Period

± **Option keyword:** *BUILDUP*

Syntax: BUILDUP k ($0 \leq k \leq 9$)
Default: BUILDUP 0

This option is meaningful only if Easter option is greater than 3.

k = 0 the program will estimate the optimal build-up period 'k' based on the data.
k=1-9 users specified build-up period of 1 to 9 days.

3) Removal of the Extremes of the Easter Model

± **Option keyword:** *EASTXM*

Syntax: EASTXM n ($0 \leq n \leq 1$)
Default: EASTXM 0

This option is meaningful only if Easter option is greater than 3. Under this option only the extremes in Late April Easter years are removed.

n = 0 do not remove the extremes of the model.
n = 1 remove the extremes of the model in Late April, (on or after the 'k'-th of April) Easter years.

SECTION 11. ADJUSTMENT OF YEARLY TOTALS

> There is only one option keyword related to the adjustment of yearly totals:
>
> *TOTAL*

± **Option keyword:** *TOTAL* (Adjustment of yearly TOTALs)

Syntax: TOTAL n $(0 \leq n \leq 2)$

This option is used to make the yearly totals of the seasonally adjusted series the same as those of the original series. X11ARIMA adjusts for partial years by applying the same adjustment factor to observations in the partial year as the one applied to the last observation of the previous year.

n = 0	no adjustment of yearly totals (default);
n = 1	IF there are permanent priors, this option will adjust the seasonally adjusted series to make it's yearly totals equal to the yearly totals of the original series adjusted for prior permanent factors. If there are no permanent priors, it will do the same as the TOTAL 2 option.
n = 2	adjust the seasonally adjusted series to make its yearly totals equal to the yearly totals of the original series even if there were permanent priors applied

SECTION 12. MOVING AVERAGES: Related Options

There are two groups of Moving Average option keywords: 1) Seasonal Moving Averages: *MAVS* *DMAS* 2) Trend-Cycle Moving Averages: *MAVTC* *TCMA*

1) Seasonal Moving Averages

± **Option keyword:** *MAVS* (Moving Average for Variable Seasonal factor curves)

Syntax: MAVS n $(0 \leq n \leq 7)$
Default: MAVS 0

n = 0	select a 3 x 3, and then a 3 x 5, moving average for the estimation of preliminary seasonal factors in the first two iterations (parts B and C, see Appendix A). For the estimation of the final seasonal factors (Table D10) the program automatically selects an appropriate moving average from the following three: 3 x 3 m.a., 3 x 5 m.a. and 3 x 9 m.a.;
n = 1	select a 3 x 3 moving average in all iterations;
n = 2	select a 3 x 5 moving average in all iterations;
n = 3	select a 3 x 9 moving average in all iterations;
n = 4	select a stable (average of all values for the month/quarter) in all iterations;
n = 5	select a different moving average for each month/quarter based on I/S ratio per month/quarter.
n = 6	select a 3 x 3 for the first estimate, and a 3 x 5 for the second estimate of the seasonals in each iteration and a 3 x 5 in the final estimate in each iteration;
n = 7	select a 3 x 1 moving average in all iterations;

For series shorter than 5 complete years, the program chooses only the stable seasonality option and the user has no control over it.

The default of automatic selection is based on an average of the twelve (four) I/S monthly (quarterly) ratios which have been calculated using data up to and including the last complete year (See Chapter 1 for more details).

For the user-selection of different moving averages for different months/quarters the user is referred to the option keyword DMAS.

± **Option keyword:** *DMAS* (Different Moving Average for Seasonal factor for different months/quarters)

Syntax : DMAS n_1 n_2 n_3 n_4 $(0 \leq n_i \leq 4)$
DMAS n_1 n_2 ... n_{12}
Default: DMAS 0 0 ... 0

This option is used to specify different seasonal moving average options for different months (or quarters). The first value entered is used to specify the moving average option for January or first quarter. The second value entered is for February or second quarter and so on.

$n_i = 0$ use the moving average specified by keyword MAVS.
$n_i = 1$ select a 3 x 3 moving average.
$n_i = 2$ select a 3 x 5 moving average.
$n_i = 3$ select a 3 x 9 moving average.
$n_i = 4$ select a stable moving average (average of all values for the month or quarter).

Example: DMAS 1 2 3 4 1 2 3 4 1 2 3 4, for monthly series
DMAS 2 2 3 3, for quarterly series.

2) Trend-Cycle Moving Averages

± **Option keyword:** *MAVTC* (Moving Average for Variable Trend-Cycle routine.)

Syntax : MAVTC n ($0 \le n \le 3$)
Default: MAVTC 0

n = 0 select an appropriate moving average from the three listed below (default)
n = 1 select a 9-term Henderson for monthly series, or a 5-term Henderson for quarterly series.
n = 2 select a 13-term Henderson for monthly series, or a 7-term Henderson for the quarterly series.
n = 3 select a 23-term Henderson for the monthly series. Not applicable for the quarterly series.

± **Option keyword:** *TCMA* (Trend Cycle Moving Average)

Syntax: TCMA n ($0 \le n \le 1$)
Default: TCMA 0

n = 0 for monthly series use 12-term centred moving average; for quarterly series use 4-term (default).
n = 1 for monthly series use 24-term centred moving average; for quarterly series use 8-term.

SECTION 13. OUTPUT: Related Options

The following option keywords define the OUTPUT of the X11ARIMA Program:

1) General output option keywords:
   CHART
   PRTDEC
   PUNCH

2) Selection of Standard Printouts:
   PRINT n

3) Selection of User-Specified Printouts:
   PRINT (table Id's)

1) General output option keywords

± **Option keyword:** *CHART* (specifies CHARTs option)

Syntax: CHART n ($0 \leq n \leq 3$)
Default: CHART 0

n = 0 standard charts: chart of the original series, the seasonally adjusted series, and the trend-cycle (default).
n = 1 no charts.
n = 2 same as chart 0 plus the 12 monthly seasonal charts.
n = 3 all charts: same as chart 2 plus charts of the final seasonal factors, irregulars, the Kolmogorov-Smirnov cumulative periodogram and 25 charts of the trading-days by type of month (for mainframe only).

± **Option keyword:** *PRTDEC* (the number of decimals for output values)

Syntax: PRTDEC n ($0 \leq n \leq 5$)
Default: PRTDEC 0

This option is used to specify the number of decimals on output tables. Most tables will be printed with the number of decimals entered here. In the multiplicative version trading-day adjustment factors on A6 and A8, seasonal factors on Table D10 and combined factors on Table D16 are shown with two decimals in the regular output only. Tables of ratios are shown with one decimal.

Example: PRTDEC 4

± **Option keyword:** *PUNCH* (special output)

Syntax: PUNCH n(tab1, Id1, dec1, tab2, Id2, dec2, ...) <(ufmt)>
Default: none

n the punch output format. The format options are identical to those described in X11ARDATA command.

- n = 0 format (12F6.0,I2,A6) for monthly data
  (4(12X,F6.0),I2,A6) for quarterly data
- n = 1 USER-SUPPLIED format
- n = 2 format (6F12.0,/,6F12.0,I2,A6) for monthly data
  (4F12.0,24X,I2,A6) for quarterly data
- n = 3 format (A6,I2,12F6.0) for monthly data
  (A6,I2,4(12X,F6.0)) for quarterly data
- n = 4 CANSIM format (A8,I2,10X,12E16.10,18X)
- n = 5 format (A6,I2,6F12.0,/,8X,6F12.0) for monthly data
  (A6,I2,4F12.0) for quarterly data
- n = 6 format (9F12.0) (outputs tables in columns to a maximum of 9 tables per series)
- n = 7 CANSIM2 format (A8,I4,8X,12E16.10,18X)
- n = 8 format (A8,I4,6F11.0,2X/12X,6F11.0,2X) for monthly data
  (A8,I4,4F11.0,2X) for quarterly data

tab1 first table number to be punched.
Id1 output series identification code for tab1.
dec1 number of decimals to be punched for tab1.
tab2 second table number to be punched, and so on.
Id2 series identification code for tab2 and so on.
dec2 number of decimals to be punched for tab2 and so on.
ufmt user-supplied format. It is needed only when n is 1 (which calls for a user-supplied format). This format should be specified using FORTRAN format notation. NOTE - No identifiers or years will be printed with the data.

Most tables in X11ARIMA can be outputted on disk (or tape). At most nine tables can be outputted by this option and only those requested by the PRINT option can be reproduced. The tables are produced without any headings or titles and in the same sequence as they appear in the printout. When using format 6, a blank line will separate the tables of different series.

NOTE: If n = 0, 2, 3, or 5 then the output series Id is limited to a length of 6 characters.

The dec1 and dec2 parameters have no effect on formats 1, 4 and 7.

Examples: PUNCH 1(D10,MSD10,0,D12,MSD12,0,D13,MSD13,0) (6F12.2)
PUNCH 5(D10,CPID10,2,D11,CPID11,2,D16,CPID16,2)

2) Selection of Standard Printouts

± **Option keyword:** *PRINT* (specifies type of PRINTout desired)

Syntax: PRINT n $(0 \leq n \leq 5)$
Default: PRINT 0

- n = 0 standard printout (19 to 31 tables are printed depending on the options selected) (default).
- n = 1 brief printout (3 to 8 tables (A1, A8, A10, A15, B1, D10, D11 and D16)).
- n = 2 analysis printout (7 to 13 tables (A1, D, E and F tables)).
- n = 3 short printout (7 to 13 tables (mainly D and F tables)).
- n = 4 long printout (28 to 42 tables).
- n = 5 full printout (82 to 99 tables).

3) <u>Selection of User-specified Printouts</u>

± **Option keyword:** *PRINT* (specifies tables to print)

Syntax: PRINT (tId_1 tId_2 tId_3 ... tId_{20})
Default: PRINT 0 (See above : Selection of Standard Printouts)

tId_i are table identifiers to be printed. Up to 20 tables may be specified in this way.

Example: PRINT (D10 D11 D16 D13)

SECTION 14. COMPOSITION Related Commands & Options

The following commands and option keywords allow Seasonal Adjustment of a composite series:

1) Initiates the Composition:
   COMP_BEGIN

2) Specifies the Direct Adjustment:
   COMP_END

3) Specifies if a component the series is entered by addition, by division etc. in the composite:
   COMP1

4) Specifies the weights assigned to a component series:
   COMP2

The X11ARIMA seasonal adjustment program allows the user to seasonally adjust directly and indirectly composite series that result from the addition, subtraction, multiplication or division of any number of components, with weights.

The optional keyword *COMP1* is used to specify how the series is composed (the default is additive composition). *COMP2* specifies the weights (the default is one).

The program automatically adjusts the series for seasonality directly and indirectly. In the case of direct seasonal adjustment, the component series are composed and then the total is seasonally adjusted. With indirect seasonal adjustment, the program first seasonally adjusts each of the component series and then performs the composition of the adjusted series.

Some series do not require seasonal adjustment. The indirect method of seasonal adjustment can still be applied to such series by requesting a *SUMMARY* measures run of the original series (instead of the seasonal adjustment run for series that do not require seasonal adjustment).

To operate the composite series adjustment program, the user has to provide:

a COMP_BEGIN command (to initiate the composition);

a RANGE command (all of the series must have the same span. That is, they must begin in the same month/quarter and year, and end in the same month/quarter and year);

a TITLE and a SA (Id,m,n) command for the indirect adjustment of each component series; and

a TITLE and a COMP_END (Id,m,n) command for the direct adjustment of the aggregate series.

Note: The two option keywords, COMP1 and COMP2, are specified in the SA command.

An example of the structure of the composition option follows:

```
COMP_BEGIN;
RANGE 12 1989 01 2001 07;
TITLE (For Indirect Adjustment of component series 1);
SA (Id,m,n) (options);
:
:
TITLE (For Indirect Adjustment of component series n);
SA (Id,m,n) SUMMARY1;
:
:
TITLE (For Direct Adjustment of aggregate);
COMP_END (Id,m,n) (options);
```

1) Initiates the Composition:

L **Command:** **COMP_BEGIN** (begin composition of the series)

Syntax: COMP_BEGIN;

All the components in the aggregate must be monthly or all must be quarterly. There are no restrictions on the other options, for instance, some of the series can be adjusted by an additive or a logarithmic decomposition model and the remainder by the multiplicative decomposition model.

2) Specifies the Direct Adjustment:

L **Command:** COMP_END (specifies the end of composition of the series)

Syntax: COMP_END (Id, m, n) options ...;
Syntax: COMP_END Id options ...;

This command will produce a direct and indirect seasonal adjustment of the composite series. The options for this command keyword are the same as those for the **SA** command keyword; refer to all sections following the INPUT section of this document.

- Id a name to be given to the composite series
- m decomposition model ($0 \leq m \leq 2$)
- n ARIMA extrapolation option ($0 \leq n \leq 5$)

3) Specifies if a component of the series is entered by addition, by division etc. in the composite

± **Option keyword:** *COMP1* (specifies how a series enters into a composition)

Syntax: COMP1 n ($0 \leq n \leq 3$)
Default: COMP1 0 (by being added)

This parameter is specified on the SA command and is only meaningful if a COMP_BEGIN command has been previously issued.

- n = 0 series enters into the composite by being added (default).
- n = 1 series enters into the composite by being subtracted.
- n = 2 series enters into the composite by being multiplied.
- n = 3 series enters into the composite by being divided.

4) Specifies the weights assigned to a component series

± **Option keyword:** *COMP2* (specifies the weight of a series in the composite)

Syntax: COMP2 c1 (0.001 ≤ c1 ≤ 99.999)

Default: COMP2 1.0 (if applicable)

This option is specified as a parameter to the SA command. The component series will be multiplied by the constant entered here before being entered into the composite.

Example of a Series Composition:

Command: COMP_BEGIN;

Command: RANGE 12 1991 1 2006 12;

Command: TITLE INDIRECT SEASONAL ADJUSTMENT, COMPONENT BC;

Command: SA (BC,0,0) COMP2 .9 TDR 1 LMA 1;

Command: TITLE INDIRECT SEASONAL ADJUSTMENT, COMPONENT ALTA;

Command: SA (ALTA,1,0) COMP2 1.0 TDR 2 LMA 1;

Command: TITLE INDIRECT SEASONAL ADJUSTMENT, COMPONENT SASK;

Command: SA (SASK,0,1) COMP2 1.1 TDR 3 LMA 1;

Command: TITLE FINAL COMPOSED SERIES;

Command: COMP_END (WEST,0,1) TDR 3 ;

SECTION 15. MISCELLANEOUS Commands

The following command signals the end of all keywords. **END**

L **Command:** **END** (used to terminate an X11ARIMA processing session)

Syntax: END;

After this command is issued, the program will terminate.

THE

X11ARIMA version 2000

SEASONAL ADJUSTMENT METHOD

- PRINTOUT EXAMPLES* -

* All these printouts were obtained using the microcomputer version of the program.

EXAMPLE 1

Sample SERIES 1 with identifier SERI1

This example demonstrates how a quarterly series with a 2-digit year identifier (format 3), whose time span ranges from 1998 1^{st} quarter to 2002 4^{th} quarter is processed through X11ARIMA version 2000 program.

Cards File (Seasonal adjustment commands and options read by X11ARIMA version 2000):	Data File (Raw data read by X11ARIMA version 2000):
X11ARDATA 4 3 0; RANGE 4 1998 1 2002 4 ; T SAMPLE SERIES 1 ; SA (SERI1,0,4) MODEL LOG 0 1 1 0 1 1 CHART 1 PUNCH 6(D11,D11,0,D12,D12,0) ; END ;	SERI1 98 611341 542816 591983 634623 SERI1 99 813599 801263 789745 698972 SERI1 00 824659 854467 831617 722230 SERI1 01 821594 855368 800186 694863 SERI1 02 821925 763765 712938 602628

```
                                                   STATISTICS CANADA

                           X11ARIMA VERSION 2000 QUARTERLY SEASONAL ADJUSTMENT METHOD
                                    TIME SERIES RESEARCH AND ANALYSIS CENTRE,
                                        BUSINESS SURVEY METHODS DIVISION

                            THIS VERSION MODIFIES X11ARIMA AND X11ARIMA/88 DEVELOPED
                            UNDER THE DIRECTION OF DR. ESTELA BEE DAGUM.

              MICROCOMPUTER USERS PLEASE NOTE:
              1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2)(0,1,1) MODEL.
                 IT ONLY INCLUDES THE FIRST FOUR MODELS.
              2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.
              3. THERE IS NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS(G.8).

    SERIES TITLE-  SAMPLE SERIES 1                                                                      SERIES NO. SERI1
 DATE :  7/ 8/1999
          -PERIOD COVERED-  1ST QUARTER,1998 TO  4TH QUARTER,2002
          -TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
          -STANDARD PRINTOUT.       NO CHARTS.
          -SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
          -SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.
          -TABLES REQUESTED FOR PUNCHING ARE : D11 ,D12 ,


A 1.  ORIGINAL SERIES

   YEAR         1ST QUAR                2ND QUAR                3RD QUAR                4TH QUAR                 TOTAL

   1998          611341.                 542816.                 591983.                 634623.              2380763.
   1999          813599.                 801263.                 789745.                 698972.              3103579.
   2000          824659.                 854467.                 831617.                 722230.              3232973.
   2001          821594.                 855368.                 800186.                 694863.              3172011.
   2002          821925.                 763765.                 712938.                 602628.              2901256.

   AVGE          778624.                 763536.                 745294.                 670663.

              TABLE TOTAL-   14790580.       MEAN-  739529.       STD. DEVIATION-   95723.

                              AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM


A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

                                THIS PROGRAM WAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN
                                   'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.
                                AVERAGE PERCENTAGE STANDARD
                                     ERROR IN FORECASTS
                                ----------------------------
    MODEL      TRAN.   ADDITIVE LAST 3  LAST  LAST-1 LAST-2 CHI-SQ. R-SQUARED              ESTIMATED PARAMETERS
                       CONSTANT  YEARS  YEAR   YEAR   YEAR   PROB.    VALUE
-----------------------------------------------------------------------------------------------------------------------------

(0,1,1)(0,1,1)  LOG    .000E+00   4.55   7.10   4.99   1.56  45.11%   .3736       -.295     -.189
-----------------------------------------------------------------------------------------------------------------------------

              THE MODEL CHOSEN IS (0,1,1)(0,1,1)0 WITH TRANSFORMATION -  LOG

              THE MAXIMUM NUMBER OF ITERATIONS IS     30

B 1.  ORIGINAL SERIES

   YEAR         1ST QUAR                2ND QUAR                3RD QUAR                4TH QUAR                 TOTAL

   1998          611341.                 542816.                 591983.                 634623.              2380763.
   1999          813599.                 801263.                 789745.                 698972.              3103579.
   2000          824659.                 854467.                 831617.                 722230.              3232973.
   2001          821594.                 855368.                 800186.                 694863.              3172011.
   2002          821925.                 763765.                 712938.                 602628.              2901256.

   AVGE          778624.                 763536.                 745294.                 670663.

              TABLE TOTAL-   14790580.       MEAN-  739529.       STD. DEVIATION-   95723.

B 1A. ORIGINAL SERIES EXTRAPOLATED  4 QUARTERS AHEAD

   YEAR         1ST QUAR                2ND QUAR                3RD QUAR                4TH QUAR                 TOTAL

   2003          710409.                 646165.                 603792.                 507842.              2468209.
```

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN QUARTERS	644.7897	3	214.92992	24.675**
RESIDUAL	104.5246	12	8.71038	
TOTAL	749.3144	15		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

C17. FINAL WEIGHTS FOR IRREGULAR COMPONENT
GRADUATION RANGE FROM 1.5 TO 2.5 SIGMA

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	S.D.
1998	.0	.0	100.0	100.0	1.4
1999	100.0	100.0	100.0	100.0	1.4
2000	100.0	100.0	100.0	100.0	1.4
2001	.0	.0	100.0	100.0	1.0
2002	100.0	100.0	100.0	100.0	1.0

D 8. FINAL UNMODIFIED SI RATIOS

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	AVGE
1998	113.5	99.2	97.8	90.8	100.3
1999	107.3	103.0	100.7	89.5	100.1
2000	104.9	105.1	100.7	88.8	99.9
2001	102.5	107.2	100.9	88.5	99.8
2002	107.1	103.4	100.8	88.3	99.9
AVGE	107.1	103.6	100.2	89.2	

TABLE TOTAL- 2000.1 MEAN- 100.0 STD. DEVIATION- 7.1

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN QUARTERS	895.6743	3	298.55810	42.232**
RESIDUAL	113.1106	16	7.06941	
TOTAL	1008.7849	19		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

NONPARAMETRIC TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

KRUSKAL-WALLIS STATISTIC	DEGREES OF FREEDOM	PROBABILITY LEVEL
15.1371	3	.170%

SEASONALITY PRESENT AT THE ONE PERCENT LEVEL

MOVING SEASONALITY TEST

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN YEARS	2.8194	4	.704846	.092
ERROR	92.3883	12	7.699022	

NO EVIDENCE OF MOVING SEASONALITY AT THE FIVE PER CENT LEVEL

COMBINED TEST FOR THE PRESENCE OF IDENTIFIABLE SEASONALITY

IDENTIFIABLE SEASONALITY PRESENT

D 9. FINAL REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR
1998	107.3	103.2	***************	***************
1999	***************	***************	***************	***************
2000	***************	***************	***************	***************
2001	106.1	104.1	***************	***************
2002	***************	***************	***************	***************

D 9A. YEAR TO YEAR CHANGE IN IRREGULAR AND SEASONAL COMPONENTS AND MOVING SEASONALITY RATIO

	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR
I	1.161	1.009	.873	.513
S	.145	.119	.336	.379
RATIO	8.00	8.49	2.60	1.35

D10. FINAL SEASONAL FACTORS
3X5 MOVING AVERAGE SELECTED AND I/S RATIO IS 3.63

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	AVGE
1998	106.51	103.87	99.99	89.61	100.00
1999	106.52	103.85	100.10	89.47	99.98
2000	106.57	103.78	100.43	89.11	99.97
2001	106.61	103.79	100.72	88.74	99.96
2002	106.73	103.75	100.99	88.41	99.97
AVGE	106.59	103.81	100.45	89.07	

TABLE TOTAL- 1999.55 MEAN- 99.98 STD. DEVIATION- 6.67

D10A. SEASONAL FACTORS, 4 QUARTERS AHEAD

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	AVGE
2003	106.83	103.77	101.02	88.31	99.98

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	TOTAL
1998	573983.	522583.	592031.	708191.	2396788.
1999	763786.	771558.	788993.	781228.	3105564.
2000	773847.	823366.	828058.	810458.	3235729.
2001	770639.	824168.	794442.	783057.	3172305.
2002	770087.	736183.	705946.	681597.	2893813.
AVGE	730468.	735572.	741894.	752906.	

TABLE TOTAL- 14804200. MEAN- 740210. STD. DEVIATION- 84423.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .05

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = 1.65

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

D12. FINAL TREND CYCLE - HENDERSON CURVE
5-TERM MOVING AVERAGE SELECTED. I/C RATIO IS .34

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	TOTAL
1998	539608.	545685.	603020.	697813.	2386125.
1999	760501.	778339.	784554.	778956.	3102350.
2000	785466.	814242.	827722.	811681.	3239111.
2001	800178.	798268.	794336.	784775.	3177558.
2002	766860.	737826.	705974.	684183.	2894843.
AVGE	730522.	734872.	743121.	751482.	

TABLE TOTAL- 14799990. MEAN- 739999. STD. DEVIATION- 84035.

D13. FINAL IRREGULAR SERIES

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	S.D.
1998	106.4	95.8	98.2	101.5	4.0
1999	100.4	99.1	100.6	100.3	.6
2000	98.5	101.1	100.0	99.8	.9
2001	96.3	103.2	100.0	99.8	2.5
2002	100.4	99.8	100.0	99.6	.3
S.D.	3.3	2.5	.8	.7	

TABLE TOTAL- 2000.9 MEAN- 100.0 STD. DEVIATION- 2.2

E 1. ORIGINAL SERIES MODIFIED FOR EXTREMES WITH ZERO FINAL WEIGHTS

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	TOTAL
1998	574729.	566812.	591983.	634623.	2368147.
1999	813599.	801263.	789745.	698972.	3103579.
2000	824659.	854467.	831617.	722230.	3232973.
2001	853087.	828488.	800186.	694863.	3176624.
2002	821925.	763765.	712938.	602628.	2901256.
AVGE	777600.	762959.	745294.	670663.	

TABLE TOTAL- 14782580. MEAN- 739129. STD. DEVIATION- 96377.

E 2. FINAL SEASONALLY ADJUSTED SERIES MODIFIED FOR EXTREMES WITH ZERO WEIGHTS

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	TOTAL
1998	539608.	545685.	592031.	708191.	2385515.
1999	763786.	771558.	788993.	781228.	3105564.
2000	773847.	823366.	828058.	810458.	3235729.
2001	800178.	798268.	794442.	783057.	3175945.
2002	770087.	736183.	705946.	681597.	2893813.
AVGE	729501.	735012.	741894.	752906.	

TABLE TOTAL- 14796570. MEAN- 739828. STD. DEVIATION- 85036.

E 3. MODIFIED IRREGULAR SERIES

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	S.D.
1998	100.0	100.0	98.2	101.5	1.2
1999	100.4	99.1	100.6	100.3	.6
2000	98.5	101.1	100.0	99.8	.9
2001	100.0	100.0	100.0	99.8	.1
2002	100.4	99.8	100.0	99.6	.3
S.D.	.7	.6	.8	.7	

TABLE TOTAL- 1999.2 MEAN- 100.0 STD. DEVIATION- .7

E 4. RATIOS OF ANNUAL TOTALS, ORIGINAL AND ADJUSTED SERIES

YEAR	UNMODIFIED	MODIFIED
1998	99.33	99.27
1999	99.94	99.94
2000	99.91	99.91
2001	99.99	100.02
2002	100.26	100.26

E 5. QUARTER-TO-QUARTER CHANGES IN THE ORIGINAL SERIES

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	AVGE
1998	***************	-11.2	9.1	7.2	1.7
1999	28.2	-1.5	-1.4	-11.5	3.4
2000	18.0	3.6	-2.7	-13.2	1.4
2001	13.8	4.1	-6.5	-13.2	-.4
2002	18.3	-7.1	-6.7	-15.5	-2.7
AVGE	19.6	-2.4	-1.6	-9.2	

TABLE TOTAL- 11.9 MEAN- .6 STD. DEVIATION- 12.1

E 6. QUARTER-TO-QUARTER CHANGES IN THE FINAL SEASONALLY ADJUSTED SERIES (D11.)

YEAR	1ST QUAR	2ND QUAR	3RD QUAR	4TH QUAR	AVGE
1998	***************	-9.0	13.3	19.6	8.0
1999	7.9	1.0	2.3	-1.0	2.5
2000	-.9	6.4	.6	-2.1	1.0
2001	-4.9	6.9	-3.6	-1.4	-.8
2002	-1.7	-4.4	-4.1	-3.4	-3.4
AVGE	.1	.2	1.7	2.3	

TABLE TOTAL- 21.4 MEAN- 1.1 STD. DEVIATION- 6.8

F 1. QCD MOVING AVERAGE
QCD IS 1

THE SAME AS TABLE D11.

F 2. SUMMARY MEASURES

F 2A: AVERAGE, PER CENT CHANGE WITHOUT REGARD TO SIGN OVER THE INDICATED SPAN

SPAN IN QUARTERS	B1 O	D11 CI	D13 I	D12 C	D10 S	A4 P	C18 TD	F 1 QCD	E 1 MOD.O	E 2 MOD.CI	E 3 MOD.I
1	10.13	4.98	2.19	3.43	8.62	.00	.00	4.98	9.38	3.60	.90
2	12.80	7.70	2.25	6.83	10.56	.00	.00	7.70	12.44	7.23	.91
3	14.16	10.27	1.76	9.89	9.27	.00	.00	10.27	13.82	10.20	.58
4	11.49	11.49	1.86	11.86	.17	.00	.00	11.49	12.05	12.05	.83

F 2B: RELATIVE CONTRIBUTIONS TO THE VARIANCE OF THE PER CENT CHANGE IN THE COMPONENTS OF THE ORIGINAL SERIES

SPAN IN QUARTERS	D13 I	D12 C	D10 S	A4 P	C18 TD	TOTAL	RATIO (X100)
1	5.27	12.93	81.79	.00	.00	100.00	88.44
2	3.11	28.55	68.34	.00	.00	100.00	99.64
3	1.66	52.35	45.99	.00	.00	100.00	93.16
4	2.41	97.57	.02	.00	.00	100.00	109.20

F 2C: AVERAGE, PER CENT CHANGE WITH REGARD TO SIGN AND STANDARD DEVIATION OVER INDICATED SPAN

SPAN IN QUARTERS	B1 O AVGE	S.D.	D13 I AVGE	S.D.	D12 C AVGE	S.D.	D10 S AVGE	S.D.	D11 CI AVGE	S.D.	F1 QCD AVGE	S.D.
1	.63	12.12	-.29	3.30	1.38	5.04	-.42	10.87	1.12	6.77	1.12	6.77
2	2.66	16.01	-.08	3.05	3.23	9.95	-.52	11.53	3.23	11.44	3.23	11.44
3	4.64	18.64	-.01	2.47	5.04	14.05	-.40	11.04	5.09	14.84	5.09	14.84
4	6.14	16.77	-.07	2.47	6.24	16.56	-.02	.22	6.15	16.75	6.15	16.75

F 2D: AVERAGE DURATION OF RUN,

CI	I	C	QCD
2.71	1.46	4.75	2.71

F 2E: I/C RATIO FOR ,QUARTERS SPAN

1	2	3	4
.64	.33	.18	.16

QUARTERS FOR CYCLICAL DOMINANCE: 1

F 2F: RELATIVE CONTRIBUTION OF THE COMPONENTS TO THE STATIONARY PORTION OF THE VARIANCE IN THE ORIGINAL SERIES

I	C	S	P	TD	TOTAL
2.77	71.07	28.52	.00	.00	102.36

F 2G: THE AUTOCORRELATION OF THE IRREGULARS FOR SPANS 1 TO 6

1	2	3	4	5	6
-.40	-.26	.13	.15	-.22	.07

F 2H: THE FINAL I/C RATIO FROM TABLE D12: .34
THE FINAL I/S RATIO FROM TABLE D10: 3.63

F 2I:,

		STATISTIC	PROBABILITY LEVEL
F-TEST FOR STABLE SEASONALITY FROM TABLE B 1.	:	24.675	.00%
F-TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	42.232	.00%
KRUSKAL-WALLIS CHI SQUARED TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	15.137	.17%
F-TEST FOR MOVING SEASONALITY FROM TABLE D 8.	:	.092	98.33%

```
                                    1         2         3         4         5         6         7         8
        COLUMN NUMBER            : 12345678901234567890123456789012345678901234567890123456789012345678901234567890
  IMAGE OF THE MAIN OPTION CARD:   Q1SERI1   01980402  1     1      4                                             0
 IMAGE OF THE ARIMA OPTION CARD:   L0110110                                                                       0
 IMAGE OF THE INPUT FORMAT CARD:   (4F18.6)                                                                       0
```

F 3. MONITORING AND QUALITY ASSESSMENT STATISTICS

ALL THE MEASURES BELOW ARE IN THE RANGE FROM 0 TO 3 WITH AN ACCEPTANCE REGION FROM 0 TO 1.

1. THE RELATIVE CONTRIBUTION OF THE IRREGULAR OVERONE QUARTER SPAN (FROM TABLE F 2.B). M1 = .527

2. THE RELATIVE CONTRIBUTION OF THE IRREGULAR COMPONENT TO THE STATIONARY PORTION OF THE VARIANCE (FROM TABLE F 2.F). M2 = .277

3. THE AMOUNT OF QUARTER TO QUARTER CHANGE IN THE IRREGULAR COMPONENT AS COMPARED TO THE AMOUNT OF QUARTER TO QUARTER CHANGE IN THE TREND-CYCLE (FROM TABLE F2.H). M3 = .006

4. THE AMOUNT OF AUTOCORRELATION IN THE IRREGULAR AS DESCRIBED BY THE AVERAGE DURATION OF RUN (TABLE F 2.D). M4 = .000

5. THE NUMBER OF QUARTERS IT TAKES THE CHANGE IN THE TREND-CYCLE TO SURPASS THE AMOUNT OF CHANGE IN THE IRREGULAR (FROM TABLE F 2.E). M5 = .200

6. THE AMOUNT OF YEAR TO YEAR CHANGE IN THE IRREGULAR AS COMPARED TO THE AMOUNT OF YEAR TO YEAR CHANGE IN THE SEASONAL (FROM TABLE F 2.H). M6 = .147

7. THE AMOUNT OF MOVING SEASONALITY PRESENT RELATIVE TO THE AMOUNT OF STABLE SEASONALITY (FROM TABLE F 2.I). M7 = .293

*** ACCEPTED *** AT THE LEVEL .26

END OF X-11 ARIMA

EXAMPLE 2

Sample SERIES 2A and 2B with identifier SERI2A and SERI2B

In this example we process two monthly series SERI2A and SERI2B and form their sum SERI2AB in a composite run. The time span is 1977 January to 2004 December.

Cards File (Seasonal adjustment commands and options read by X11ARIMA version 2000):

```
X11ARDATA 12 8 0;
RANGE 12 1997 1 2004 12 ;
COMP_BEGIN ;
T SAMPLE SERIES 2A ;
SA (SERI2A,0,0) CHART 1 PRINT 1 DIVPOWER 3 ;
T SAMPLE SERIES 2B ;
SA (SERI2B,0,0) CHART 1 PRINT 1 DIVPOWER 3 ;
T SAMPLE SERIES 2A + SAMPLE SERIES 2B ;
COMP_END (SERI2AB,0,0) CHART 1 PRINT 1 ;
END ;
```

Data File (Raw data read by X11ARIMA version 2000):

```
SERI2A  1997  1201882.  1188921.  1222089.  1216221.  1366545.  1447705.
              1568578.  1552303.  1276398.  1258552.  1228020.  1188367.
SERI2A  1998  1144043.  1134710.  1157179.  1164006.  1282867.  1368250.
              1467044.  1436515.  1190365.  1179175.  1129922.  1088952.
SERI2A  1999  1018562.  1003026.  1008617.  1026318.  1148506.  1229305.
              1345049.  1328792.  1096901.  1089869.  1053454.  1029506.
SERI2A  2000   974862.   958616.   975770.   981525.  1100830.  1186809.
              1277306.  1259673.  1042114.  1030715.   988100.   983390.
SERI2A  2001   928802.   940443.   961573.   963141.  1075589.  1167191.
              1262848.  1239567.  1030701.  1006385.   980436.   984585.
SERI2A  2002   923704.   935167.   957092.   958153.  1105104.  1190303.
              1303093.  1277468.  1065851.  1034781.  1032414.  1001091.
SERI2A  2003   969674.   970284.   984041.   975800.  1106199.  1199225.
              1272416.  1259093.  1018505.  1031597.   992537.   991555.
SERI2A  2004   938255.   958433.   964387.   984155.  1085079.  1169484.
              1268720.  1259802.  1026557.  1012534.   983918.   977461.
SERI2B  1997  5002998.  5030807.  5049481.  5085640.  5220638.  5307528.
              5309401.  5350170.  5342527.  5311362.  5234622.  5151092.
SERI2B  1998  5081093.  5096759.  5107401.  5174713.  5279000.  5354810.
              5380793.  5379539.  5362272.  5334200.  5218465.  5135221.
SERI2B  1999  5026413.  5014343.  5010101.  5082654.  5213327.  5285869.
              5304665.  5305859.  5314835.  5280126.  5180454.  5090114.
SERI2B  2000  4996584.  4991582.  5000908.  5024355.  5165886.  5267194.
              5287417.  5285970.  5303448.  5284092.  5227961.  5169185.
SERI2B  2001  5094683.  5121574.  5127539.  5172109.  5296828.  5405158.
              5406869.  5426549.  5419095.  5410152.  5357334.  5278387.
SERI2B  2002  5171480.  5214543.  5237502.  5274237.  5437448.  5505871.
              5554979.  5572497.  5563356.  5544029.  5511341.  5428146.
SERI2B  2003  5344207.  5337351.  5360550.  5411239.  5538958.  5625596.
              5644217.  5674445.  5706961.  5642554.  5596397.  5515014.
SERI2B  2004  5438758.  5430356.  5452731.  5508688.  5599775.  5661774.
              5709643.  5752544.  5733794.  5705827.  5647003.  5597287.
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STATISTICS CANADA

X11ARIMA VERSION 2000 MONTHLY SEASONAL ADJUSTMENT METHOD
TIME SERIES RESEARCH AND ANALYSIS CENTRE,
BUSINESS SURVEY METHODS DIVISION

THIS VERSION MODIFIES X11ARIMA AND X11ARIMA/88 DEVELOPED
UNDER THE DIRECTION OF DR. ESTELA BEE DAGUM.

MICROCOMPUTER USERS PLEASE NOTE:
1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2)(0,1,1) MODEL.
   IT ONLY INCLUDES THE FIRST FOUR MODELS.
2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.
3. THERE IS NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS(G.8).

SERIES TITLE- SAMPLE SERIES 2A — SERIES NO. SERI2A
DATE : 7/ 8/1999
-PERIOD COVERED- 1ST MONTH,1997 TO 12TH MONTH,2004
-TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
- BRIEF PRINTOUT. NO CHARTS.
-SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
-DIVIDING SERIES BY THE EXPONENT OF 10.
-SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.

A 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	1202.	1189.	1222.	1216.	1367.	1448.	1569.	1552.	1276.	1259.	1228.	1188.	15716.
1998	1144.	1135.	1157.	1164.	1283.	1368.	1467.	1437.	1190.	1179.	1130.	1089.	14743.
1999	1019.	1003.	1009.	1026.	1149.	1229.	1345.	1329.	1097.	1090.	1053.	1030.	13378.
2000	975.	959.	976.	982.	1101.	1187.	1277.	1260.	1042.	1031.	988.	983.	12760.
2001	929.	940.	962.	963.	1076.	1167.	1263.	1240.	1031.	1006.	980.	985.	12541.
2002	924.	935.	957.	958.	1105.	1190.	1303.	1277.	1066.	1035.	1032.	1001.	12784.
2003	970.	970.	984.	976.	1106.	1199.	1272.	1259.	1019.	1032.	993.	992.	12771.
2004	938.	958.	964.	984.	1085.	1169.	1269.	1260.	1027.	1013.	984.	977.	12629.
AVGE	1012.	1011.	1029.	1034.	1159.	1245.	1346.	1327.	1093.	1080.	1049.	1031.	

TABLE TOTAL- 107321. MEAN- 1118. STD. DEVIATION- 150.

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM

A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

THIS PROGRAM WAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN
'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.

MODEL	TRAN.	ADDITIVE CONSTANT	AVERAGE PERCENTAGE STANDARD ERROR IN FORECASTS: LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS		
(0,1,1)(0,1,1)	LOG	.000E+00	2.03	.78	1.19	4.12	2.04%	.9877	.266	.690	
(0,1,2)(0,1,1)	LOG	.000E+00	1.60	.61	1.02	3.17	18.78%	.9891	.277	-.334	.703

THE MODEL CHOSEN IS (0,1,2)(0,1,1)0 WITH TRANSFORMATION - LOG

HERE ARE THE AUTOCORRELATIONS OF THE MODEL(S)

MODEL 1	-.119	.368	-.098	.136	-.091	.214	-.165	.047	.063	-.070	.077	.023
	.025	.010	.086	-.230	.156	.007	.055	.075	.040	-.080	.090	-.093
MODEL 2	-.072	.059	-.171	.057	-.003	.207	-.188	.007	.080	-.070	.035	.029
	.022	.079	.028	-.276	.123	.069	.036	.068	-.003	-.078	.112	-.071

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	1202.	1189.	1222.	1216.	1367.	1448.	1569.	1552.	1276.	1259.	1228.	1188.	15716.
1998	1144.	1135.	1157.	1164.	1283.	1368.	1467.	1437.	1190.	1179.	1130.	1089.	14743.
1999	1019.	1003.	1009.	1026.	1149.	1229.	1345.	1329.	1097.	1090.	1053.	1030.	13378.
2000	975.	959.	976.	982.	1101.	1187.	1277.	1260.	1042.	1031.	988.	983.	12760.
2001	929.	940.	962.	963.	1076.	1167.	1263.	1240.	1031.	1006.	980.	985.	12541.
2002	924.	935.	957.	958.	1105.	1190.	1303.	1277.	1066.	1035.	1032.	1001.	12784.
2003	970.	970.	984.	976.	1106.	1199.	1272.	1259.	1019.	1032.	993.	992.	12771.
2004	938.	958.	964.	984.	1085.	1169.	1269.	1260.	1027.	1013.	984.	977.	12629.
AVGE	1012.	1011.	1029.	1034.	1159.	1245.	1346.	1327.	1093.	1080.	1049.	1031.	

TABLE TOTAL- 107321. MEAN- 1118. STD. DEVIATION- 150.

B 1A. ORIGINAL SERIES EXTRAPOLATED 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2005	926.	936.	950.	955.	1072.	1155.	1248.	1232.	1011.	1000.	973.	961.	12419.

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	9676.6153	11	879.69230	1001.303**
RESIDUAL	63.2554	72	.87855	
TOTAL	9739.8708	83		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

D10. FINAL SEASONAL FACTORS
3X5 MOVING AVERAGE SELECTED AND I/S RATIO IS 4.14

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1997	89.15	88.59	91.08	91.83	103.09	110.66	120.39	119.26	98.95	98.06	95.28	93.67	100.00
1998	89.11	88.63	91.07	91.80	103.05	110.77	120.45	119.25	98.96	97.99	95.17	93.74	100.00
1999	89.02	88.73	91.04	91.72	103.06	110.96	120.58	119.17	98.96	97.88	95.00	93.81	99.99
2000	88.92	88.90	91.06	91.58	103.13	111.15	120.72	119.10	98.88	97.72	94.79	93.88	99.99
2001	88.86	89.17	91.09	91.42	103.24	111.33	120.79	119.09	98.74	97.55	94.56	93.91	99.98
2002	88.84	89.49	91.20	91.35	103.30	111.41	120.78	119.14	98.56	97.35	94.41	93.90	99.98
2003	88.85	89.78	91.28	91.34	103.37	111.41	120.73	119.18	98.39	97.21	94.38	93.86	99.98
2004	88.90	89.97	91.35	91.38	103.40	111.37	120.65	119.24	98.26	97.18	94.39	93.80	99.99
AVGE	88.96	89.16	91.15	91.55	103.21	111.13	120.64	119.18	98.71	97.62	94.75	93.82	

TABLE TOTAL- 9598.90 MEAN- 99.99 STD. DEVIATION- 10.77

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
2005	88.96	90.05	91.36	91.40	103.42	111.35	120.57	119.30	98.18	97.22	94.38	93.76	100.00

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	1348.	1342.	1342.	1324.	1326.	1308.	1303.	1302.	1290.	1283.	1289.	1269.	15726.
1998	1284.	1280.	1271.	1268.	1245.	1235.	1218.	1205.	1203.	1203.	1187.	1162.	14761.
1999	1144.	1130.	1108.	1119.	1114.	1108.	1115.	1115.	1108.	1114.	1109.	1097.	13383.
2000	1096.	1078.	1072.	1072.	1067.	1068.	1058.	1058.	1054.	1055.	1042.	1047.	12767.
2001	1045.	1055.	1056.	1053.	1042.	1048.	1045.	1041.	1044.	1032.	1037.	1048.	12547.
2002	1040.	1045.	1049.	1049.	1070.	1068.	1079.	1072.	1081.	1063.	1094.	1066.	12776.
2003	1091.	1081.	1078.	1068.	1070.	1076.	1054.	1056.	1035.	1061.	1052.	1056.	12780.
2004	1055.	1065.	1056.	1077.	1049.	1050.	1052.	1057.	1045.	1042.	1042.	1042.	12632.
AVGE	1138.	1135.	1129.	1129.	1123.	1120.	1116.	1113.	1108.	1107.	1106.	1099.	

TABLE TOTAL- 107371. MEAN- 1118. STD. DEVIATION- 94.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .09

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = .25

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

STATISTICS CANADA

X11ARIMA VERSION 2000 MONTHLY SEASONAL ADJUSTMENT METHOD
TIME SERIES RESEARCH AND ANALYSIS CENTRE,
BUSINESS SURVEY METHODS DIVISION

THIS VERSION MODIFIES X11ARIMA AND X11ARIMA/88 DEVELOPED
UNDER THE DIRECTION OF DR. ESTELA BEE DAGUM.

MICROCOMPUTER USERS PLEASE NOTE:
1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2)(0,1,1) MODEL.
   IT ONLY INCLUDES THE FIRST FOUR MODELS.
2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.
3. THERE IS NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS(G.8).

SERIES TITLE- SAMPLE SERIES 2B SERIES NO. SERI2B
DATE : 7/ 8/1999
-PERIOD COVERED- 1ST MONTH,1997 TO 12TH MONTH,2004
-TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
- BRIEF PRINTOUT. NO CHARTS.
-SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
-DIVIDING SERIES BY THE EXPONENT OF 10.
-SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.

A 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	5003.	5031.	5049.	5086.	5221.	5308.	5309.	5350.	5343.	5311.	5235.	5151.	62396.
1998	5081.	5097.	5107.	5175.	5279.	5355.	5381.	5380.	5362.	5334.	5218.	5135.	62904.
1999	5026.	5014.	5010.	5083.	5213.	5286.	5305.	5306.	5315.	5280.	5180.	5090.	62109.
2000	4997.	4992.	5001.	5024.	5166.	5267.	5287.	5286.	5303.	5284.	5228.	5169.	62005.
2001	5095.	5122.	5128.	5172.	5297.	5405.	5407.	5427.	5419.	5410.	5357.	5278.	63516.
2002	5171.	5215.	5238.	5274.	5437.	5506.	5555.	5572.	5563.	5544.	5511.	5428.	65015.
2003	5344.	5337.	5361.	5411.	5539.	5626.	5644.	5674.	5707.	5643.	5596.	5515.	66397.
2004	5439.	5430.	5453.	5509.	5600.	5662.	5710.	5753.	5734.	5706.	5647.	5597.	67238.
AVGE	5145.	5155.	5168.	5217.	5344.	5427.	5450.	5468.	5468.	5439.	5372.	5296.	

TABLE TOTAL- 511581. MEAN- 5329. STD. DEVIATION- 201.

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM

A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

THIS PROGRAM WAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN
'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.

MODEL	TRAN.	ADDITIVE CONSTANT	AVERAGE PERCENTAGE STANDARD ERROR IN FORECASTS: LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS	
(0,1,1)(0,1,1)	LOG	.000E+00	.53	.54	.29	.76	49.31%	.9886	.093	.695

THE MODEL CHOSEN IS (0,1,1)(0,1,1)0 WITH TRANSFORMATION - LOG

HERE ARE THE AUTOCORRELATIONS OF THE MODEL(S)

MODEL 1	-.009	.018	.149	.132	.104	.034	-.113	.102	.058	-.111	.044	.133
	.155	.020	.042	.003	.140	-.035	-.091	.032	.035	-.171	-.016	-.122

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	5003.	5031.	5049.	5086.	5221.	5308.	5309.	5350.	5343.	5311.	5235.	5151.	62396.
1998	5081.	5097.	5107.	5175.	5279.	5355.	5381.	5380.	5362.	5334.	5218.	5135.	62904.
1999	5026.	5014.	5010.	5083.	5213.	5286.	5305.	5306.	5315.	5280.	5180.	5090.	62109.
2000	4997.	4992.	5001.	5024.	5166.	5267.	5287.	5286.	5303.	5284.	5228.	5169.	62005.
2001	5095.	5122.	5128.	5172.	5297.	5405.	5407.	5427.	5419.	5410.	5357.	5278.	63516.
2002	5171.	5215.	5238.	5274.	5437.	5506.	5555.	5572.	5563.	5544.	5511.	5428.	65015.
2003	5344.	5337.	5361.	5411.	5539.	5626.	5644.	5674.	5707.	5643.	5596.	5515.	66397.
2004	5439.	5430.	5453.	5509.	5600.	5662.	5710.	5753.	5734.	5706.	5647.	5597.	67238.
AVGE	5145.	5155.	5168.	5217.	5344.	5427.	5450.	5468.	5468.	5439.	5372.	5296.	

TABLE TOTAL- 511581. MEAN- 5329. STD. DEVIATION- 201.

B 1A. ORIGINAL SERIES EXTRAPOLATED 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2005	5506.	5513.	5532.	5582.	5711.	5794.	5825.	5853.	5852.	5819.	5759.	5684.	68429.

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	373.1044	11	33.91859	333.711**
RESIDUAL	7.3181	72	.10164	
TOTAL	380.4226	83		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

D10. FINAL SEASONAL FACTORS
3X3 MOVING AVERAGE SELECTED AND I/S RATIO IS 2.48

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1997	96.83	96.97	97.22	98.07	100.54	102.09	102.38	102.52	102.56	102.01	100.19	98.61	100.00
1998	96.86	96.98	97.22	98.08	100.53	102.08	102.40	102.47	102.53	101.98	100.20	98.65	100.00
1999	96.91	97.02	97.24	98.08	100.50	102.07	102.38	102.41	102.45	101.91	100.26	98.72	99.99
2000	96.99	97.10	97.28	98.05	100.46	102.04	102.36	102.36	102.31	101.79	100.36	98.81	99.99
2001	97.10	97.20	97.35	98.04	100.44	101.97	102.26	102.35	102.19	101.66	100.48	98.88	99.99
2002	97.22	97.24	97.43	98.04	100.42	101.86	102.17	102.39	102.12	101.55	100.52	98.97	99.99
2003	97.34	97.26	97.48	98.10	100.36	101.77	102.07	102.42	102.12	101.51	100.50	99.04	100.00
2004	97.41	97.26	97.52	98.14	100.31	101.71	102.01	102.44	102.15	101.50	100.43	99.10	100.00
AVGE	97.08	97.13	97.34	98.07	100.44	101.95	102.25	102.42	102.30	101.74	100.37	98.85	

TABLE TOTAL- 9599.60 MEAN- 100.00 STD. DEVIATION- 2.09

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
2005	97.44	97.27	97.53	98.17	100.27	101.69	101.98	102.45	102.17	101.51	100.40	99.12	100.00

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	5167.	5188.	5194.	5186.	5193.	5199.	5186.	5219.	5209.	5207.	5225.	5224.	62395.
1998	5246.	5256.	5253.	5276.	5251.	5246.	5255.	5250.	5230.	5231.	5208.	5205.	62906.
1999	5187.	5169.	5152.	5182.	5187.	5178.	5181.	5181.	5188.	5181.	5167.	5156.	62111.
2000	5151.	5141.	5141.	5124.	5142.	5162.	5166.	5164.	5184.	5191.	5209.	5231.	62006.
2001	5247.	5269.	5267.	5276.	5273.	5301.	5287.	5302.	5303.	5322.	5332.	5338.	63517.
2002	5319.	5362.	5376.	5380.	5415.	5405.	5437.	5443.	5448.	5459.	5483.	5484.	65011.
2003	5490.	5488.	5499.	5516.	5519.	5528.	5530.	5540.	5588.	5559.	5569.	5569.	66395.
2004	5583.	5583.	5591.	5613.	5583.	5566.	5597.	5615.	5613.	5621.	5623.	5648.	67239.
AVGE	5299.	5307.	5309.	5319.	5320.	5323.	5330.	5339.	5345.	5346.	5352.	5357.	

TABLE TOTAL- 511580. MEAN- 5329. STD. DEVIATION- 161.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .18

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = .75

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

STATISTICS CANADA

X11ARIMA VERSION 2000 MONTHLY SEASONAL ADJUSTMENT METHOD
TIME SERIES RESEARCH AND ANALYSIS CENTRE,
BUSINESS SURVEY METHODS DIVISION

THIS VERSION MODIFIES X11ARIMA AND X11ARIMA/88 DEVELOPED
UNDER THE DIRECTION OF DR. ESTELA BEE DAGUM.

MICROCOMPUTER USERS PLEASE NOTE:
1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2)(0,1,1) MODEL.
   IT ONLY INCLUDES THE FIRST FOUR MODELS.
2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.
3. THERE IS NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS(G.8).

SERIES TITLE- SAMPLE SERIES 2A + SAMPLE SERIES 2B   SERIES NO. SERI2AB
DATE : 7/ 8/1999
-PERIOD COVERED- 1ST MONTH,1997 TO 12TH MONTH,2004
-TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
- BRIEF PRINTOUT. NO CHARTS.
-SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
-SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.

A 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	6205.	6220.	6272.	6302.	6587.	6755.	6878.	6902.	6619.	6570.	6463.	6339.	78112.
1998	6225.	6231.	6265.	6339.	6562.	6723.	6848.	6816.	6553.	6513.	6348.	6224.	77647.
1999	6045.	6017.	6019.	6109.	6362.	6515.	6650.	6635.	6412.	6370.	6234.	6120.	75487.
2000	5971.	5950.	5977.	6006.	6267.	6454.	6565.	6546.	6346.	6315.	6216.	6153.	74764.
2001	6023.	6062.	6089.	6135.	6372.	6572.	6670.	6666.	6450.	6417.	6338.	6263.	76058.
2002	6095.	6150.	6195.	6232.	6543.	6696.	6858.	6850.	6629.	6579.	6544.	6429.	77800.
2003	6314.	6308.	6345.	6387.	6645.	6825.	6917.	6934.	6725.	6674.	6589.	6507.	79168.
2004	6377.	6389.	6417.	6493.	6685.	6831.	6978.	7012.	6760.	6718.	6631.	6575.	79867.
AVGE	6157.	6166.	6197.	6250.	6503.	6672.	6795.	6795.	6562.	6519.	6420.	6326.	

TABLE TOTAL- 618903. MEAN- 6447. STD. DEVIATION- 265.

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM

A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

THIS PROGRAM WAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN
'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.

MODEL	TRAN.	ADDITIVE CONSTANT	AVERAGE PERCENTAGE STANDARD ERROR IN FORECASTS LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS	
(0,1,1)(0,1,1)	LOG	.000E+00	.70	.55	.34	1.22	8.80%	.9868	.109	.603

THE MODEL CHOSEN IS (0,1,1)(0,1,1)0 WITH TRANSFORMATION - LOG

HERE ARE THE AUTOCORRELATIONS OF THE MODEL(S)

MODEL 1	-.022	.181	.180	.045	.041	.104	-.123	.061	.041	-.048	.070	.108
	.101	.063	.171	-.123	.194	-.065	-.054	-.015	.073	-.227	.061	-.150

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	6205.	6220.	6272.	6302.	6587.	6755.	6878.	6902.	6619.	6570.	6463.	6339.	78112.
1998	6225.	6231.	6265.	6339.	6562.	6723.	6848.	6816.	6553.	6513.	6348.	6224.	77647.
1999	6045.	6017.	6019.	6109.	6362.	6515.	6650.	6635.	6412.	6370.	6234.	6120.	75487.
2000	5971.	5950.	5977.	6006.	6267.	6454.	6565.	6546.	6346.	6315.	6216.	6153.	74764.
2001	6023.	6062.	6089.	6135.	6372.	6572.	6670.	6666.	6450.	6417.	6338.	6263.	76058.
2002	6095.	6150.	6195.	6232.	6543.	6696.	6858.	6850.	6629.	6579.	6544.	6429.	77800.
2003	6314.	6308.	6345.	6387.	6645.	6825.	6917.	6934.	6725.	6674.	6589.	6507.	79168.
2004	6377.	6389.	6417.	6493.	6685.	6831.	6978.	7012.	6760.	6718.	6631.	6575.	79867.
AVGE	6157.	6166.	6197.	6250.	6503.	6672.	6795.	6795.	6562.	6519.	6420.	6326.	

TABLE TOTAL- 618903. MEAN- 6447. STD. DEVIATION- 265.

B 1A. ORIGINAL SERIES EXTRAPOLATED 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2005	6433.	6446.	6480.	6538.	6783.	6951.	7083.	7098.	6860.	6815.	6729.	6649.	80865.

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	979.9766	11	89.08879	564.060**
RESIDUAL	11.3718	72	.15794	
TOTAL	991.3485	83		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

D10. FINAL SEASONAL FACTORS
3X3 MOVING AVERAGE SELECTED AND I/S RATIO IS 2.30

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1997	95.37	95.43	96.06	97.08	100.95	103.62	105.74	105.49	101.86	101.18	99.36	97.82	100.00
1998	95.42	95.44	96.07	97.05	100.95	103.63	105.71	105.44	101.84	101.19	99.35	97.83	100.00
1999	95.48	95.52	96.11	97.00	100.93	103.67	105.63	105.35	101.80	101.16	99.35	97.87	99.99
2000	95.57	95.66	96.19	96.94	100.91	103.70	105.54	105.24	101.73	101.06	99.35	97.95	99.99
2001	95.67	95.83	96.30	96.92	100.90	103.67	105.42	105.15	101.66	100.92	99.38	98.02	99.99
2002	95.81	95.97	96.40	96.93	100.89	103.57	105.30	105.11	101.60	100.79	99.39	98.09	99.99
2003	95.95	96.06	96.48	97.01	100.84	103.46	105.16	105.12	101.57	100.75	99.38	98.14	99.99
2004	96.04	96.10	96.52	97.09	100.79	103.37	105.06	105.16	101.54	100.74	99.37	98.19	100.00
AVGE	95.66	95.75	96.27	97.00	100.89	103.59	105.45	105.26	101.70	100.97	99.37	97.99	

TABLE TOTAL- 9599.21 MEAN- 99.99 STD. DEVIATION- 3.41

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
2005	96.07	96.13	96.53	97.14	100.74	103.33	105.01	105.19	101.53	100.75	99.37	98.22	100.00

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	6506.	6518.	6529.	6492.	6525.	6519.	6505.	6543.	6498.	6493.	6504.	6481.	78112.
1998	6524.	6529.	6521.	6531.	6500.	6488.	6478.	6464.	6434.	6437.	6390.	6362.	77657.
1999	6331.	6300.	6262.	6298.	6303.	6285.	6295.	6298.	6298.	6297.	6275.	6253.	75493.
2000	6248.	6220.	6213.	6195.	6210.	6224.	6220.	6220.	6238.	6249.	6257.	6282.	74775.
2001	6296.	6326.	6323.	6330.	6316.	6339.	6327.	6340.	6344.	6358.	6377.	6390.	76067.
2002	6362.	6408.	6426.	6430.	6485.	6466.	6513.	6517.	6525.	6527.	6584.	6555.	77796.
2003	6581.	6567.	6576.	6584.	6590.	6597.	6577.	6596.	6621.	6624.	6630.	6630.	79172.
2004	6640.	6648.	6649.	6688.	6633.	6609.	6642.	6668.	6658.	6669.	6673.	6696.	79871.
AVGE	6436.	6439.	6437.	6443.	6445.	6441.	6445.	6456.	6452.	6457.	6461.	6456.	

TABLE TOTAL- 618944. MEAN- 6447. STD. DEVIATION- 143.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .10

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = .37

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

X11ARIMA VERSION 2000

INDIRECT SEASONAL ADJUSTMENT OF COMPOSITE SERIES

STATISTICS CANADA

SERIES TITLE- SAMPLE SERIES 2A + SAMPLE SERIES 2B SERIES NO. SERI2AB

PERIOD COVERED- 1/1997 TO 12/2004.

THERE ARE 2 COMPONENTS IN THE COMPOSITE.

D10. FINAL SEASONAL FACTORS
3X3 MOVING AVERAGE SELECTED AND I/S RATIO IS 2.56

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1997	95.25	95.25	95.96	96.80	101.06	103.81	106.00	105.86	101.84	101.23	99.22	97.64	99.99
1998	95.34	95.34	96.02	96.86	101.01	103.73	105.80	105.60	101.86	101.24	99.26	97.76	99.99
1999	95.48	95.53	96.14	96.95	100.95	103.64	105.61	105.38	101.83	101.20	99.33	97.86	99.99
2000	95.58	95.68	96.21	96.93	100.92	103.60	105.48	105.20	101.73	101.10	99.43	97.99	99.99
2001	95.73	95.86	96.30	96.94	100.90	103.52	105.32	105.10	101.62	100.99	99.51	98.07	99.99
2002	95.85	95.98	96.41	96.95	100.89	103.44	105.25	105.15	101.53	100.87	99.50	98.15	100.00
2003	95.93	96.03	96.46	97.00	100.85	103.34	105.05	105.10	101.54	100.82	99.52	98.21	99.99
2004	96.06	96.09	96.54	97.05	100.80	103.25	104.96	105.10	101.54	100.82	99.49	98.27	100.00
AVGE	95.65	95.72	96.26	96.93	100.92	103.54	105.43	105.31	101.69	101.03	99.41	97.99	

TABLE TOTAL- 9599.14 MEAN- 99.99 STD. DEVIATION- 3.42

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
2005	96.12	96.13	96.58	97.07	100.77	103.20	104.91	105.10	101.53	100.83	99.47	98.30	100.00

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1997	6515.	6530.	6536.	6510.	6518.	6507.	6489.	6520.	6499.	6490.	6514.	6492.	78121.
1998	6530.	6536.	6524.	6544.	6496.	6481.	6473.	6454.	6433.	6434.	6395.	6367.	77667.
1999	6331.	6299.	6260.	6301.	6302.	6286.	6297.	6296.	6296.	6294.	6276.	6254.	75493.
2000	6248.	6219.	6212.	6196.	6209.	6229.	6224.	6222.	6238.	6246.	6252.	6279.	74773.
2001	6292.	6324.	6323.	6329.	6315.	6349.	6333.	6343.	6347.	6353.	6369.	6387.	76064.
2002	6359.	6407.	6425.	6428.	6485.	6474.	6516.	6515.	6529.	6522.	6576.	6550.	77788.
2003	6582.	6569.	6577.	6584.	6589.	6604.	6584.	6597.	6624.	6620.	6620.	6625.	79175.
2004	6639.	6649.	6647.	6690.	6632.	6616.	6649.	6672.	6658.	6663.	6665.	6690.	79871.
AVGE	6437.	6442.	6438.	6448.	6443.	6443.	6445.	6452.	6453.	6453.	6458.	6456.	

TABLE TOTAL- 618952. MEAN- 6447. STD. DEVIATION- 143.

MEASURES OF ROUGHNESS R1 AND R2 FOR SEASONALLY ADJUSTED SERIES

	DIRECT		INDIRECT		PERCENTAGE CHANGE	
	FULL SERIES	LAST THREE YEARS	FULL SERIES	LAST THREE YEARS	FULL SERIES	LAST THREE YEARS
R1-MEAN SQUARE ERROR	526.353	650.297	506.790	647.905	3.717%	.368%
R1-ROOT MEAN SQUARE ERROR	22.942	25.501	22.512	25.454	1.876%	.184%
R2-MEAN SQUARE ERROR	180.258	236.767	163.422	230.560	9.340%	2.621%
R2-ROOT MEAN SQUARE ERROR	13.426	15.387	12.784	15.184	4.784%	1.319%

POSITIVE PERCENTAGE CHANGES INDICATE THAT THE INDIRECT SEASONALLY ADJUSTED COMPOSITE IS SMOOTHER THAN THE DIRECT SEASONALLY ADJUSTED COMPOSITE.

END OF X-11 ARIMA

EXAMPLE 3

Sample SERIES 3 with identifier SERI3

This is a monthly flow series starting in 1987 January and ending in 1998 March. It is included to demonstrate how the 36 months ARIMA forecasts (HORIZON 36) that extend beyond the year 2000 appear in the X11ARIMA version 2000 program. It also demonstrates the use of Easter adjustment with user-supplied buildup period of 9 days and with removal of Easter extremes.

Data (Raw data) & Cards File (Seasonal adjustment commands and options) read by X11ARIMA version 2000:

```
DATA SERI3 12 87 01;
    3089498.    2729117.    2831914.    3071958.    3369493.    3207052.
    3380458.    3200054.    3089497.    3418411.    3038747.    3543179.
    3147440.    2911792.    3210622.    3261241.    3214930.    3371929.
    3509246.    3255723.    3392738.    3334886.    3214484.    3884129.
    3080177.    2990672.    3386801.    3272196.    3410603.    3635748.
    3487640.    3453842.    3552369.    3282863.    3395945.    3791843.
    3223905.    3137980.    3627565.    3338644.    3661286.    3747909.
    3534272.    3740217.    3586276.    3474794.    3620688.    3781055.
    3448458.    3180044.    3648628.    3420476.    3910309.    3764680.
    3646241.    3929750.    3469766.    3643338.    3700627.    3713268.
    3613632.    3461052.    3462189.    3707875.    3975956.    3764532.
    3952060.    3791679.    3711903.    4042092.    3577226.    4106255.
    3880830.    3453753.    3676397.    3907559.    4021575.    3947535.
    4297167.    3867957.    3955855.    4056945.    3778995.    4336895.
    3827927.    3577030.    4000097.    4071556.    4080166.    4198416.
    4362466.    4030410.    4111084.    3986577.    3909665.    4637513.
    3786811.    3667668.    4079626.    4057209.    4166111.    4338396.
    4257925.    4219578.    4250460.    3882003.    3959787.    4495960.
    3747851.    3753801.    4031158.    3848619.    4254267.    4107439.
    4165670.    4473567.    3885075.    4163630.    4198031.    4288324.
    4223530.    3797070.    4139426.    4059530.    4656550.    4230641.
    4513074.    4597175.    4223019.    4454486.    4216694.    4544188.
    4533382.    3892931.    4107558.
            ;
RANGE 12 87 1  98 03 ;
T SAMPLE SERIES 3 ;
SA (SERI3 ,0 ,4 ) MODEL LOG 0 1 1 0 1 1
   PUNCH 8(B01,010001,0,B01A,010001,2)
   TOTAL 1 PRINT 0 CHART 2 MAVS 0 TDR 2 EASTER 5 BUILDUP 9 EASTXM 1
   DIVPOWER 3 HORIZON 36
   ;
END;
```

STATISTICS CANADA

X11ARIMA VERSION 2000 MONTHLY SEASONAL ADJUSTMENT METHOD
TIME SERIES RESEARCH AND ANALYSIS CENTRE,
BUSINESS SURVEY METHODS DIVISION

THIS VERSION MODIFIES X11ARIMA AND X11ARIMA/88 DEVELOPED
UNDER THE DIRECTION OF DR. ESTELA BEE DAGUM.

MICROCOMPUTER USERS PLEASE NOTE:
1. THE AUTOMATIC ARIMA EXTRAPOLATION OPTION DOES NOT FIT THE (2,1,2)(0,1,1) MODEL.
   IT ONLY INCLUDES THE FIRST FOUR MODELS.
2. THE MAXIMUM LENGTHS OF THE MONTHLY INPUT SERIES IS 27 YEARS INCLUDING THE EXTRAPOLATIONS.
3. THERE IS NO PLOTTING OF THE TRADING-DAY, AND IRREGULARS CHARTS(G.8).

SERIES TITLE- SAMPLE SERIES 3   SERIES NO. SERI3
DATE : 7/ 8/1999
-PERIOD COVERED- 1ST   MONTH,1987 TO 3RD   MONTH,1998
-TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
-STANDARD PRINTOUT. EXPANDED CHARTS.
-SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
-DIVIDING SERIES BY THE EXPONENT OF 10.
-MODIFY THE D11 SERIES TO MAKE THE YEARLY TOTALS OF THE SEASONALLY ADJUSTED SERIES AGREE WITH THAT OF THE ORIGINAL SERIES (OR ORIGINAL ADJUSTED FOR PERMANENT PRIORS, IF PRESENT).
-SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.
-36 MONTHS   OF FORECASTS FROM AN ARIMA MODEL SELECTED BY THE USER.
-TRADING-DAY REGRESSION COMPUTED STARTING JANUARY   1987 EXCLUDING IRREGULAR VALUES OUTSIDE 2.5-SIGMA LIMITS.
-TRADING-DAY REGRESSION ESTIMATES APPLIED STARTING JANUARY   1987
-TRADING-DAY REGRESSION WEIGHTS USED AS PRIOR WEIGHTS.
-GRADUAL IMPACT EASTER ADJUSTMENT FACTORS APPLIED.
-USERS SPECIFIED BUILD-UP PERIOD OF 9 DAYS.
-REMOVE THE EXTREMES OF THE MODEL IN LATE APRIL.
-TABLES REQUESTED FOR PUNCHING ARE : B 1 ,B 1A,

A 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3089.	2729.	2832.	3072.	3369.	3207.	3380.	3200.	3089.	3418.	3039.	3543.	37969.
1988	3147.	2912.	3211.	3261.	3215.	3372.	3509.	3256.	3393.	3335.	3214.	3884.	39709.
1989	3080.	2991.	3387.	3272.	3411.	3636.	3488.	3454.	3552.	3283.	3396.	3792.	40741.
1990	3224.	3138.	3628.	3339.	3661.	3748.	3534.	3740.	3586.	3475.	3621.	3781.	42475.
1991	3448.	3180.	3649.	3420.	3910.	3765.	3646.	3930.	3470.	3643.	3701.	3713.	43476.
1992	3614.	3461.	3462.	3708.	3976.	3765.	3952.	3792.	3712.	4042.	3577.	4106.	45166.
1993	3881.	3454.	3676.	3908.	4022.	3948.	4297.	3868.	3956.	4057.	3779.	4337.	47181.
1994	3828.	3577.	4000.	4072.	4080.	4198.	4362.	4030.	4111.	3987.	3910.	4638.	48793.
1995	3787.	3668.	4080.	4057.	4166.	4338.	4258.	4220.	4250.	3882.	3960.	4496.	49162.
1996	3748.	3754.	4031.	3849.	4254.	4107.	4166.	4474.	3885.	4164.	4198.	4288.	48917.
1997	4224.	3797.	4139.	4060.	4657.	4231.	4513.	4597.	4223.	4454.	4217.	4544.	51655.
1998	4533.	3893.	4108.	********	********	********	********	********	********	********	********	********	12534.
AVGE	3634.	3379.	3683.	3638.	3884.	3847.	3919.	3869.	3748.	3795.	3692.	4102.	

TABLE TOTAL-   507778.   MEAN-   3761.   STD. DEVIATION-   422.

A 7. TRADING-DAY REGRESSION FROM FIRST PASS

	COMBINED WEIGHT	PRIOR WEIGHT	REGRESSION COEFF.	ST.ERROR (COMB.WT.)	T (1)	T (PRIOR WT.)
MONDAY	.442	1.000	-.558	.041	-13.588***	-13.588***
TUESDAY	.831	1.000	-.169	.041	-4.098***	-4.098***
WEDNESDAY	.733	1.000	-.267	.041	-6.442***	-6.442***
THURSDAY	1.398	1.000	.398	.041	9.676***	9.676***
FRIDAY	1.505	1.000	.505	.041	12.312***	12.312***
SATURDAY	1.714	1.000	.714	.040	17.685***	17.685***
SUNDAY	.376	1.000	-.624	.041	-15.195***	-15.195***

THE STARS INDICATE THE COMBINED WT. IS SIGNIFICANTLY DIFFERENT
FROM 1 OR THE PRIOR WT. THE SIGNIFICANCE LEVELS ARE
3 STARS (0.1 PERCENT), 2 STARS (1 PERCENT) 1 STAR (5 PERCENT),
AND NO STARS INDICATES NOT SIGNIFICANT AT THE 5 PERCENT LEVEL

SOURCE OF VARIANCE	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F
REGRESSION	92.701	6	15.450	564.648***
ERROR	3.256	119	.027	
TOTAL	95.957	125		

*** RESIDUAL TRADING DAY VARIATION PRESENT AT THE 1 PER CENT LEVEL

STANDARD ERRORS OF TRADING DAY ADJUSTMENT FACTORS DERIVED FROM REGRESSION COEFFICIENTS

31-DAY MONTHS-	.12
30-DAY MONTHS-	.13
29-DAY MONTHS-	.14
28-DAY MONTHS-	.00

A 8. REGRESSION TRADING DAY ADJUSTMENT

A 8A. FINAL DAILY WEIGHTS -

MON	TUE	WED	THU	FRI	SAT	SUN
.442	.831	.733	1.398	1.505	1.714	.376

A 8B. FINAL TRADING-DAY FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	105.22	99.12	95.64	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.01
1988	101.92	100.68	99.88	104.06	95.64	100.44	101.92	96.80	103.01	98.49	98.55	105.22	100.55
1989	95.64	99.12	102.05	100.30	96.80	103.01	98.49	99.88	104.06	95.64	100.44	101.92	99.78
1990	96.80	99.12	105.22	96.06	99.88	104.06	95.64	102.05	100.30	96.80	103.01	98.49	99.79
1991	99.88	99.12	101.92	97.58	102.05	100.30	96.80	105.22	96.06	99.88	104.06	95.64	99.88
1992	102.05	105.18	95.64	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.26
1993	101.92	99.12	96.80	103.01	98.49	98.55	105.22	95.64	100.44	101.92	97.58	102.05	100.06
1994	98.49	99.12	99.88	104.06	95.64	100.44	101.92	96.80	103.01	98.49	98.55	105.22	100.13
1995	95.64	99.12	102.05	100.30	96.80	103.01	98.49	99.88	104.06	95.64	100.44	101.92	99.78
1996	96.80	104.06	101.92	97.58	102.05	100.30	96.80	105.22	96.06	99.88	104.06	95.64	100.03
1997	102.05	99.12	98.49	98.55	105.22	96.06	99.88	101.92	97.58	102.05	100.30	96.80	99.83
1998	105.22	99.12	95.64	********	********	********	********	********	********	********	********	********	99.99
AVGE	100.14	100.16	99.60	100.22	99.67	100.12	99.93	100.03	100.15	99.93	99.92	100.24	

TABLE TOTAL- 13501.18 MEAN- 100.01 STD. DEVIATION- 2.90

A 8C. FINAL TRADING-DAY FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1998	**********	********	********	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.02
1999	101.92	99.12	96.80	********	********	********	********	********	********	********	********	********	99.28

A 9. FINAL TRADING-DAY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	2936.	2753.	2961.	3059.	3306.	3287.	3312.	3249.	3135.	3249.	3163.	3547.	37958.
1988	3088.	2892.	3214.	3134.	3361.	3357.	3443.	3364.	3294.	3386.	3262.	3692.	39487.
1989	3220.	3017.	3319.	3262.	3524.	3530.	3541.	3458.	3414.	3432.	3381.	3720.	40819.
1990	3331.	3166.	3448.	3476.	3666.	3602.	3695.	3665.	3576.	3590.	3515.	3839.	42567.
1991	3453.	3208.	3580.	3505.	3832.	3753.	3767.	3735.	3612.	3648.	3556.	3882.	43532.
1992	3541.	3291.	3620.	3692.	3901.	3858.	3873.	3850.	3767.	3842.	3724.	4111.	45068.
1993	3808.	3485.	3798.	3793.	4083.	4006.	4084.	4044.	3939.	3981.	3873.	4250.	47142.
1994	3887.	3609.	4005.	3913.	4266.	4180.	4280.	4164.	3991.	4048.	3967.	4408.	48717.
1995	3959.	3700.	3998.	4045.	4304.	4212.	4323.	4225.	4085.	4059.	3942.	4411.	49263.
1996	3872.	3607.	3955.	3944.	4169.	4095.	4304.	4252.	4044.	4169.	4034.	4484.	48928.
1997	4139.	3831.	4203.	4119.	4426.	4404.	4518.	4511.	4328.	4365.	4204.	4695.	51742.
1998	4309.	3928.	4295.	********	********	********	********	********	********	********	********	********	12531.
AVGE	3628.	3374.	3700.	3631.	3894.	3844.	3922.	3865.	3744.	3797.	3693.	4094.	

TABLE TOTAL- 507753. MEAN- 3761. STD. DEVIATION- 409.

A10. EASTER EFFECT FOR GRADUAL IMPACT MODEL.

WARNING: SOME OUTLIERS MIGHT BE REMOVED (BEYOND TWO SIGMA)

NO. OF POINT(S) REMOVED 0

THE BUILD-UP PERIOD PROVIDED BY THE USER 9

NO. OF YEARS OF DATA 11
NO. MARCH EASTERS 3
NO. EARLY APRIL EASTERS 3
NO. LATE APRIL EASTERS 5

MARCH EASTERS
EHAT = -.015745

EARLY APRIL EASTER
DATE IN APRIL = 3 EHAT = -.010497

EARLY APRIL EASTER
DATE IN APRIL = 3 EHAT = -.010497

EARLY APRIL EASTER
DATE IN APRIL = 7 EHAT = -.003499

MARCH AND EARLY APRIL EASTERS

MARCH FACTOR 1-EHAT
APRIL FACTOR 1+EHAT

SOURCE OF VARIANCE	SUM OF SQUARES	DEGRES OF FREEDOM	MEAN SQUARE
EASTER	.0019	1	.0019
RESIDUAL	.0010	6	.0002
TOTAL	.0029	10	

F STATISTIC 11.243570
SIGNIFICANCE LEVEL .985 SIGNIFICANT AT 1.5 % LEVEL

EASTER EFFECT SIGNIFICANT AT 5% LEVEL BUT NOT AT 1%

A11. EASTER FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1988	100.00	100.00	101.05	98.95	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1989	100.00	100.00	101.57	98.43	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1990	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1991	100.00	100.00	101.57	98.43	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1992	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1993	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1994	100.00	100.00	101.05	98.95	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1995	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1996	100.00	100.00	100.35	99.65	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1997	100.00	100.00	101.57	98.43	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1998	100.00	100.00	100.00	********	********	********	********	********	********	********	********	********	100.00
AVGE	100.00	100.00	100.60	99.35	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

TABLE TOTAL- 13500.00 MEAN- 100.00 STD. DEVIATION- .38

A11A. EASTER FACTORS ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1998	**********	********	********	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1999	100.00	100.00	100.00	********	********	********	********	********	********	********	********	********	100.00

A12. ORIGINAL SERIES ADJUSTED BY EASTER FACTOR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3089.	2729.	2832.	3072.	3369.	3207.	3380.	3200.	3089.	3418.	3039.	3543.	37969.
1988	3147.	2912.	3177.	3296.	3215.	3372.	3509.	3256.	3393.	3335.	3214.	3884.	39710.
1989	3080.	2991.	3334.	3325.	3411.	3636.	3488.	3454.	3552.	3283.	3396.	3792.	40741.
1990	3224.	3138.	3628.	3339.	3661.	3748.	3534.	3740.	3586.	3475.	3621.	3781.	42475.
1991	3448.	3180.	3592.	3475.	3910.	3765.	3646.	3930.	3470.	3643.	3701.	3713.	43474.
1992	3614.	3461.	3462.	3708.	3976.	3765.	3952.	3792.	3712.	4042.	3577.	4106.	45166.
1993	3881.	3454.	3676.	3908.	4022.	3948.	4297.	3868.	3956.	4057.	3779.	4337.	47181.
1994	3828.	3577.	3959.	4115.	4080.	4198.	4362.	4030.	4111.	3987.	3910.	4638.	48795.
1995	3787.	3668.	4080.	4057.	4166.	4338.	4258.	4220.	4250.	3882.	3960.	4496.	49162.
1996	3748.	3754.	4017.	3862.	4254.	4107.	4166.	4474.	3885.	4164.	4198.	4288.	48917.
1997	4224.	3797.	4075.	4124.	4657.	4231.	4513.	4597.	4223.	4454.	4217.	4544.	51656.
1998	4533.	3893.	4108.	********	********	********	********	********	********	********	********	********	12534.
AVGE	3634.	3379.	3662.	3662.	3884.	3847.	3919.	3869.	3748.	3795.	3692.	4102.	

TABLE TOTAL- 507780. MEAN- 3761. STD. DEVIATION- 422.

A13. COMBINATION OF FINAL TRADING DAY AND EASTER FACTOR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	105.22	99.12	95.64	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.01
1988	101.92	100.68	100.93	102.97	95.64	100.44	101.92	96.80	103.01	98.49	98.55	105.22	100.55
1989	95.64	99.12	103.66	98.72	96.80	103.01	98.49	99.88	104.06	95.64	100.44	101.92	99.78
1990	96.80	99.12	105.22	96.06	99.88	104.06	95.64	102.05	100.30	96.80	103.01	98.49	99.79
1991	99.88	99.12	103.52	96.04	102.05	100.30	96.80	105.22	96.06	99.88	104.06	95.64	99.88
1992	102.05	105.18	95.64	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.26
1993	101.92	99.12	96.80	103.01	98.49	98.55	105.22	95.64	100.44	101.92	97.58	102.05	100.06
1994	98.49	99.12	100.93	102.97	95.64	100.44	101.92	96.80	103.01	98.49	98.55	105.22	100.13
1995	95.64	99.12	102.05	100.30	96.80	103.01	98.49	99.88	104.06	95.64	100.44	101.92	99.78
1996	96.80	104.06	102.28	97.24	102.05	100.30	96.80	105.22	96.06	99.88	104.06	95.64	100.03
1997	102.05	99.12	100.04	97.00	105.22	96.06	99.88	101.92	97.58	102.05	100.30	96.80	99.83
1998	105.22	99.12	95.64	********	********	********	********	********	********	********	********	********	99.99
AVGE	100.14	100.16	100.20	99.56	99.67	100.12	99.93	100.03	100.15	99.93	99.92	100.24	

TABLE TOTAL- 13501.20 MEAN- 100.01 STD. DEVIATION- 2.93

A13A. COMBINED FACTORS ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1998	**********	********	********	100.44	101.92	97.58	102.05	98.49	98.55	105.22	96.06	99.88	100.02
1999	101.92	99.12	96.80	********	********	********	********	********	********	********	********	********	99.28

A14. ORIGINAL SERIES ADJUSTED BY COMBINED FINAL TRADING DAY AND EASTER FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	2936.	2753.	2961.	3059.	3306.	3287.	3312.	3249.	3135.	3249.	3163.	3547.	37958.
1988	3088.	2892.	3181.	3167.	3361.	3357.	3443.	3364.	3294.	3386.	3262.	3692.	39487.
1989	3220.	3017.	3267.	3315.	3524.	3530.	3541.	3458.	3414.	3432.	3381.	3720.	40819.
1990	3331.	3166.	3448.	3476.	3666.	3602.	3695.	3665.	3576.	3590.	3515.	3839.	42567.
1991	3453.	3208.	3524.	3561.	3832.	3753.	3767.	3735.	3612.	3648.	3556.	3882.	43532.
1992	3541.	3291.	3620.	3692.	3901.	3858.	3873.	3850.	3767.	3842.	3724.	4111.	45068.
1993	3808.	3485.	3798.	3793.	4083.	4006.	4084.	4044.	3939.	3981.	3873.	4250.	47142.
1994	3887.	3609.	3963.	3954.	4266.	4180.	4280.	4164.	3991.	4048.	3967.	4408.	48717.
1995	3959.	3700.	3998.	4045.	4304.	4212.	4323.	4225.	4085.	4059.	3942.	4411.	49263.
1996	3872.	3607.	3941.	3958.	4169.	4095.	4304.	4252.	4044.	4169.	4034.	4484.	48928.
1997	4139.	3831.	4138.	4185.	4426.	4404.	4518.	4511.	4328.	4365.	4204.	4695.	51743.
1998	4309.	3928.	4295.	********	********	********	********	********	********	********	********	********	12531.
AVGE	3628.	3374.	3678.	3655.	3894.	3844.	3922.	3865.	3744.	3797.	3693.	4094.	

TABLE TOTAL- 507755. MEAN- 3761. STD. DEVIATION- 409.

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM

A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

THIS PROGRAM WAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN
'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.

MODEL	TRAN.	ADDITIVE CONSTANT	AVERAGE PERCENTAGE STANDARD ERROR IN FORECASTS: LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS	
(0,1,1)(0,1,1)	LOG	.000E+00	1.82	.86	2.53	2.07	58.91%	.9849	.404	.495

THE MODEL CHOSEN IS (0,1,1)(0,1,1)0 WITH TRANSFORMATION - LOG

THE MAXIMUM NUMBER OF ITERATIONS IS 30

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	2936.	2753.	2961.	3059.	3306.	3287.	3312.	3249.	3135.	3249.	3163.	3547.	37958.
1988	3088.	2892.	3181.	3167.	3361.	3357.	3443.	3364.	3294.	3386.	3262.	3692.	39487.
1989	3220.	3017.	3267.	3315.	3524.	3530.	3541.	3458.	3414.	3432.	3381.	3720.	40819.
1990	3331.	3166.	3448.	3476.	3666.	3602.	3695.	3665.	3576.	3590.	3515.	3839.	42567.
1991	3453.	3208.	3524.	3561.	3832.	3753.	3767.	3735.	3612.	3648.	3556.	3882.	43532.
1992	3541.	3291.	3620.	3692.	3901.	3858.	3873.	3850.	3767.	3842.	3724.	4111.	45068.
1993	3808.	3485.	3798.	3793.	4083.	4006.	4084.	4044.	3939.	3981.	3873.	4250.	47142.
1994	3887.	3609.	3963.	3954.	4266.	4180.	4280.	4164.	3991.	4048.	3967.	4408.	48717.
1995	3959.	3700.	3998.	4045.	4304.	4212.	4323.	4225.	4085.	4059.	3942.	4411.	49263.
1996	3872.	3607.	3941.	3958.	4169.	4095.	4304.	4252.	4044.	4169.	4034.	4484.	48928.
1997	4139.	3831.	4138.	4185.	4426.	4404.	4518.	4511.	4328.	4365.	4204.	4695.	51743.
1998	4309.	3928.	4295.	********	********	********	********	********	********	********	********	********	12531.
AVGE	3628.	3374.	3678.	3655.	3894.	3844.	3922.	3865.	3744.	3797.	3693.	4094.	

TABLE TOTAL- 507755. MEAN- 3761. STD. DEVIATION- 409.

B 1A. ORIGINAL SERIES EXTRAPOLATED 36 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998	**********	********	********	4328.	4584.	4530.	4672.	4630.	4441.	4498.	4349.	4846.	40879.
1999	4423.	4068.	4431.	4467.	4732.	4676.	4823.	4780.	4584.	4643.	4490.	5002.	55120.
2000	4565.	4199.	4574.	4612.	4885.	4827.	4979.	4934.	4732.	4793.	4634.	5164.	56898.
2001	4713.	4335.	4722.	********	********	********	********	********	********	********	********	********	13769.

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	2452.6999	11	222.97272	269.891**
RESIDUAL	91.7035	111	.82616	
TOTAL	2544.4034	122		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

C17. FINAL WEIGHTS FOR IRREGULAR COMPONENT
GRADUATION RANGE FROM 1.5 TO 2.5 SIGMA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1987	100.0	100.0	.0	100.0	100.0	100.0	100.0	100.0	.0	100.0	100.0	.0	.5
1988	100.0	100.0	100.0	100.0	82.9	100.0	100.0	100.0	100.0	77.6	100.0	.0	.5
1989	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.5
1990	100.0	72.7	100.0	100.0	100.0	.0	100.0	100.0	100.0	100.0	100.0	100.0	.4
1991	100.0	100.0	100.0	100.0	.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.4
1992	100.0	100.0	100.0	.0	100.0	100.0	41.6	100.0	100.0	100.0	100.0	100.0	.4
1993	.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.4
1994	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.0	100.0	100.0	88.8	.5
1995	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.0	.5
1996	.0	100.0	100.0	100.0	100.0	1.4	90.8	100.0	.0	100.0	100.0	100.0	.5
1997	100.0	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.4
1998	36.2	100.0	100.0	********	********	********	********	********	********	********	********	********	.3

D 8. FINAL UNMODIFIED SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	95.6	89.1	95.1	97.5	104.7	103.5	103.9	101.6	97.9	101.2	98.3	110.0	99.9
1988	95.6	89.4	98.2	97.6	103.2	102.7	104.9	102.0	99.4	101.7	97.7	110.3	100.2
1989	96.0	89.8	96.9	98.1	104.0	104.0	104.1	101.5	99.9	100.1	98.1	107.2	100.0
1990	95.4	90.3	97.9	98.4	103.6	101.5	103.8	102.7	99.9	100.1	97.9	106.9	99.9
1991	96.1	89.2	97.7	98.5	105.7	103.4	103.6	102.7	99.3	100.3	97.6	106.3	100.0
1992	96.6	89.5	98.0	99.5	104.8	103.2	103.2	102.1	99.4	100.8	97.1	106.7	100.1
1993	98.5	90.0	97.9	97.6	104.9	102.5	104.1	102.6	99.5	100.2	97.2	106.3	100.1
1994	96.9	89.7	98.1	97.5	104.9	102.7	105.1	102.3	98.0	99.3	97.2	107.7	100.0
1995	96.6	90.0	97.1	98.2	104.4	102.2	105.1	102.9	99.8	99.5	97.0	108.9	100.1
1996	95.8	89.4	97.8	98.1	103.1	100.8	105.4	103.6	98.0	100.3	96.5	106.7	99.6
1997	97.9	90.2	97.1	97.8	103.1	102.3	104.6	104.0	99.6	100.2	96.3	107.4	100.0
1998	98.3	89.4	97.4	********	********	********	********	********	********	********	********	********	95.0
AVGE	96.6	89.7	97.4	98.1	104.2	102.6	104.3	102.5	99.1	100.3	97.4	107.7	

TABLE TOTAL- 13484.3 MEAN- 99.9 STD. DEVIATION- 4.6

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	2823.0694	11	256.64268	357.095**
RESIDUAL	88.3995	123	.71869	
TOTAL	2911.4689	134		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

NONPARAMETRIC TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

KRUSKAL-WALLIS STATISTIC	DEGREES OF FREEDOM	PROBABILITY LEVEL
125.8670	11	.000%

SEASONALITY PRESENT AT THE ONE PERCENT LEVEL

MOVING SEASONALITY TEST

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN YEARS	10.6931	10	1.069313	1.623
ERROR	72.4740	110	.658855	

NO EVIDENCE OF MOVING SEASONALITY AT THE FIVE PER CENT LEVEL

COMBINED TEST FOR THE PRESENCE OF IDENTIFIABLE SEASONALITY

IDENTIFIABLE SEASONALITY PRESENT

D 9. FINAL REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1987	**********	********	97.4	********	********	********	********	********	99.7	********	********	107.3
1988	**********	********	********	********	103.4	********	********	********	********	101.5	********	107.3
1989	**********	********	********	********	********	********	********	********	********	********	********	********
1990	**********	90.1	********	********	********	103.2	********	********	********	********	********	********
1991	**********	********	********	********	104.5	********	********	********	********	********	********	********
1992	**********	********	********	98.1	********	********	103.7	********	********	********	********	********
1993	96.7	********	********	********	********	********	********	********	********	********	********	********
1994	**********	********	********	********	********	********	********	********	99.3	********	********	107.7
1995	**********	********	********	********	********	********	********	********	********	********	********	107.1
1996	97.3	********	********	********	********	102.0	105.4	********	99.2	********	********	********
1997	**********	90.2	********	********	********	********	********	********	********	********	********	********
1998	97.9	********	********	********	********	********	********	********	********	********	********	********

D 9A. YEAR TO YEAR CHANGE IN IRREGULAR AND SEASONAL COMPONENTS AND MOVING SEASONALITY RATIO

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
I	.394	.572	.659	.318	.529	.436	.463	.457	.334	.586	.282	.443
S	.189	.051	.096	.056	.128	.123	.128	.166	.047	.113	.152	.086
RATIO	2.09	11.13	6.89	5.64	4.13	3.54	3.61	2.76	7.10	5.20	1.86	5.14

D10. FINAL SEASONAL FACTORS
3X5 MOVING AVERAGE SELECTED AND I/S RATIO IS 4.12

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	95.73	89.55	97.60	97.85	103.97	103.37	104.24	101.85	99.71	100.84	98.03	107.24	100.00
1988	95.73	89.54	97.61	97.91	103.98	103.36	104.18	101.95	99.68	100.75	97.98	107.15	99.99
1989	95.80	89.56	97.67	98.02	104.01	103.34	104.11	102.08	99.65	100.64	97.87	107.03	99.98
1990	95.96	89.58	97.68	98.09	104.15	103.31	104.01	102.21	99.61	100.49	97.73	106.87	99.97
1991	96.16	89.63	97.77	98.09	104.32	103.19	104.01	102.33	99.56	100.33	97.56	106.80	99.98
1992	96.37	89.65	97.77	98.04	104.53	103.03	104.11	102.44	99.52	100.15	97.41	106.79	99.98
1993	96.59	89.67	97.80	97.96	104.55	102.79	104.37	102.56	99.46	100.06	97.23	106.86	99.99
1994	96.84	89.74	97.69	97.89	104.39	102.56	104.62	102.76	99.46	99.99	97.04	106.95	99.99
1995	97.09	89.77	97.61	97.87	104.09	102.37	104.84	103.02	99.45	99.95	96.87	107.08	100.00
1996	97.30	89.79	97.47	97.90	103.78	102.21	104.93	103.32	99.44	99.97	96.74	107.16	100.00
1997	97.50	89.72	97.42	97.94	103.53	102.11	104.96	103.54	99.36	100.08	96.63	107.21	100.00
1998	97.65	89.71	97.37	********	********	********	********	********	********	********	********	********	94.91
AVGE	96.56	89.66	97.62	97.96	104.12	102.88	104.40	102.55	99.54	100.30	97.37	107.01	

TABLE TOTAL- 13483.39 MEAN- 99.88 STD. DEVIATION- 4.50

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1998	**********	********	********	97.94	103.38	102.05	104.90	103.70	99.32	100.17	96.56	107.25	101.70
1999	97.74	89.65	97.39	********	********	********	********	********	********	********	********	********	94.93

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3067.	3075.	3034.	3126.	3180.	3179.	3178.	3190.	3144.	3222.	3227.	3308.	37930.
1988	3226.	3230.	3259.	3235.	3233.	3248.	3305.	3299.	3304.	3361.	3329.	3445.	39473.
1989	3362.	3369.	3345.	3382.	3388.	3416.	3401.	3388.	3426.	3410.	3455.	3476.	40817.
1990	3471.	3534.	3529.	3543.	3520.	3486.	3553.	3586.	3590.	3572.	3597.	3592.	42573.
1991	3591.	3580.	3605.	3631.	3673.	3637.	3622.	3650.	3628.	3636.	3645.	3635.	43532.
1992	3674.	3670.	3702.	3766.	3732.	3745.	3720.	3758.	3785.	3836.	3823.	3850.	45060.
1993	3942.	3886.	3883.	3872.	3906.	3897.	3913.	3943.	3960.	3978.	3983.	3977.	47141.
1994	4013.	4022.	4057.	4039.	4086.	4076.	4091.	4052.	4013.	4048.	4088.	4121.	48707.
1995	4078.	4122.	4096.	4133.	4135.	4114.	4124.	4101.	4107.	4061.	4070.	4120.	49260.
1996	3979.	4017.	4044.	4043.	4017.	4006.	4101.	4115.	4067.	4170.	4170.	4184.	48914.
1997	4245.	4270.	4247.	4273.	4275.	4313.	4305.	4356.	4356.	4362.	4351.	4379.	51731.
1998	4412.	4378.	4411.	********	********	********	********	********	********	********	********	********	13201.
AVGE	3755.	3763.	3768.	3731.	3740.	3738.	3756.	3767.	3762.	3787.	3794.	3826.	

TABLE TOTAL- 508339. MEAN- 3765. STD. DEVIATION- 370.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .79

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = .26

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

D11A. FINAL SEASONALLY ADJUSTED SERIES WITH REVISED YEARLY TOTALS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3064.	3072.	3032.	3125.	3180.	3180.	3180.	3194.	3151.	3231.	3238.	3322.	37969.
1988	3243.	3250.	3281.	3257.	3256.	3271.	3328.	3321.	3324.	3378.	3344.	3456.	39709.
1989	3369.	3372.	3345.	3378.	3382.	3408.	3392.	3377.	3414.	3398.	3442.	3464.	40741.
1990	3461.	3525.	3520.	3534.	3511.	3478.	3545.	3578.	3582.	3565.	3589.	3585.	42475.
1991	3582.	3571.	3597.	3623.	3666.	3631.	3616.	3646.	3625.	3635.	3645.	3638.	43476.
1992	3679.	3676.	3710.	3774.	3742.	3755.	3730.	3769.	3795.	3846.	3832.	3858.	45166.
1993	3948.	3891.	3887.	3875.	3908.	3899.	3915.	3945.	3962.	3981.	3987.	3982.	47181.
1994	4021.	4030.	4066.	4049.	4096.	4085.	4100.	4060.	4019.	4053.	4091.	4122.	48793.
1995	4075.	4117.	4089.	4125.	4125.	4104.	4113.	4090.	4097.	4051.	4062.	4113.	49162.
1996	3975.	4015.	4043.	4043.	4018.	4008.	4103.	4117.	4069.	4171.	4171.	4184.	48917.
1997	4243.	4267.	4243.	4268.	4269.	4306.	4298.	4349.	4347.	4353.	4342.	4370.	51655.
1998	4403.	4369.	4402.	********	********	********	********	********	********	********	********	********	13174.
AVGE	3755.	3763.	3768.	3732.	3741.	3739.	3756.	3768.	3762.	3788.	3795.	3827.	

TABLE TOTAL- 508419. MEAN- 3766. STD. DEVIATION- 367.

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = .79

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = .28

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

D12. FINAL TREND CYCLE - HENDERSON CURVE
13-TERM MOVING AVERAGE SELECTED. I/C RATIO IS 1.55

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3071.	3089.	3110.	3133.	3154.	3172.	3187.	3198.	3206.	3214.	3222.	3228.	37984.
1988	3232.	3234.	3237.	3242.	3251.	3265.	3281.	3299.	3317.	3332.	3343.	3349.	39382.
1989	3355.	3362.	3370.	3379.	3387.	3394.	3401.	3407.	3416.	3428.	3447.	3469.	40814.
1990	3491.	3509.	3522.	3532.	3540.	3550.	3560.	3570.	3580.	3586.	3588.	3589.	42617.
1991	3592.	3598.	3608.	3618.	3627.	3633.	3635.	3635.	3635.	3637.	3642.	3650.	43510.
1992	3663.	3679.	3696.	3711.	3724.	3737.	3752.	3769.	3789.	3812.	3834.	3852.	45020.
1993	3866.	3875.	3882.	3888.	3895.	3907.	3921.	3938.	3954.	3969.	3982.	3995.	47072.
1994	4009.	4026.	4043.	4059.	4070.	4073.	4072.	4069.	4069.	4072.	4079.	4090.	48733.
1995	4100.	4110.	4117.	4122.	4124.	4123.	4117.	4106.	4093.	4077.	4063.	4050.	49203.
1996	4040.	4032.	4029.	4033.	4043.	4061.	4083.	4106.	4131.	4156.	4181.	4204.	49098.
1997	4227.	4246.	4261.	4274.	4289.	4304.	4321.	4337.	4350.	4360.	4367.	4374.	51710.
1998	4383.	4393.	4406.	********	********	********	********	********	********	********	********	********	13182.
AVGE	3752.	3763.	3773.	3726.	3737.	3747.	3757.	3767.	3776.	3786.	3795.	3805.	

TABLE TOTAL- 508325. MEAN- 3765. STD. DEVIATION- 370.

D13. FINAL IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1987	99.9	99.5	97.5	99.8	100.8	100.2	99.7	99.8	98.1	100.3	100.2	102.5	1.2
1988	99.8	99.9	100.7	99.8	99.4	99.5	100.7	100.0	99.6	100.9	99.6	102.9	.9
1989	100.2	100.2	99.3	100.1	100.0	100.6	100.0	99.4	100.3	99.5	100.2	100.2	.4
1990	99.4	100.7	100.2	100.3	99.4	98.2	99.8	100.4	100.3	99.6	100.2	100.1	.6
1991	100.0	99.5	99.9	100.4	101.3	100.1	99.6	100.4	99.8	100.0	100.1	99.6	.5
1992	100.3	99.8	100.2	101.5	100.2	100.2	99.1	99.7	99.9	100.6	99.7	99.9	.6
1993	102.0	100.3	100.0	99.6	100.3	99.8	99.8	100.1	100.1	100.2	100.0	99.5	.6
1994	100.1	99.9	100.3	99.5	100.4	100.1	100.5	99.6	98.6	99.4	100.2	100.8	.6
1995	99.5	100.3	99.5	100.3	100.3	99.8	100.2	99.9	100.3	99.6	100.2	101.7	.6
1996	98.5	99.6	100.4	100.3	99.3	98.7	100.5	100.2	98.5	100.3	99.7	99.5	.7
1997	100.4	100.6	99.7	100.0	99.7	100.2	99.6	100.4	100.1	100.0	99.6	100.1	.3
1998	100.7	99.7	100.1	********	********	********	********	********	********	********	********	********	.4
S.D.	.8	.4	.8	.5	.6	.7	.4	.3	.8	.5	.2	1.1	

TABLE TOTAL- 13500.4 MEAN- 100.0 STD. DEVIATION- .7

D16. COMBINED SEASONAL, TRADING DAY (IF PRESENT), AND EASTER (IF PRESENT) FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	100.73	88.76	93.34	98.28	105.97	100.87	106.38	100.32	98.26	106.10	94.16	107.11	100.02
1988	97.57	90.15	98.52	100.82	99.45	103.82	106.18	98.69	102.69	99.23	96.56	112.74	100.53
1989	91.63	88.76	101.24	96.76	100.67	106.45	102.54	101.96	103.69	96.26	98.29	109.08	99.78
1990	92.88	88.79	102.78	94.23	104.03	107.51	99.48	104.31	99.91	97.27	100.67	105.25	99.76
1991	96.04	88.83	101.22	94.21	106.46	103.50	100.68	107.67	95.64	100.21	101.53	102.14	99.84
1992	98.35	94.30	93.52	98.47	106.54	100.53	106.25	100.89	98.07	105.37	93.58	106.66	100.21
1993	98.45	88.87	94.67	100.91	102.97	101.29	109.81	98.09	99.90	101.98	94.87	109.06	100.07
1994	95.38	88.95	98.60	100.80	99.85	103.01	106.63	99.47	102.46	98.48	95.63	112.53	100.15
1995	92.86	88.98	99.61	98.17	100.75	105.45	103.26	102.89	103.49	95.60	97.30	109.13	99.79
1996	94.19	93.44	99.69	95.20	105.91	102.52	101.57	108.71	95.52	99.85	100.67	102.49	99.98
1997	99.51	88.93	97.46	95.00	108.93	98.09	104.83	105.52	96.96	102.13	96.92	103.78	99.84
1998	102.75	88.91	93.13	********	********	********	********	********	********	********	********	********	94.93
AVGE	96.69	89.81	97.81	97.53	103.77	103.00	104.33	102.59	99.69	100.23	97.29	107.27	

TABLE TOTAL- 13484.49 MEAN- 99.89 STD. DEVIATION- 5.37

D16A. COMBINED SEASONAL, TRADING DAY (IF PRESENT), AND EASTER (IF PRESENT) FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1998	**********	********	********	98.37	105.37	99.58	107.05	102.14	97.88	105.40	92.76	107.12	101.74
1999	99.61	88.85	94.27	********	********	********	********	********	********	********	********	********	94.25

E 1. ORIGINAL SERIES MODIFIED FOR EXTREMES WITH ZERO FINAL WEIGHTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3089.	2729.	2903.	3072.	3369.	3207.	3380.	3200.	3150.	3418.	3039.	3458.	38016.
1988	3147.	2912.	3211.	3261.	3215.	3372.	3509.	3256.	3393.	3335.	3214.	3776.	39601.
1989	3080.	2991.	3387.	3272.	3411.	3636.	3488.	3454.	3552.	3283.	3396.	3792.	40741.
1990	3224.	3138.	3628.	3339.	3661.	3816.	3534.	3740.	3586.	3475.	3621.	3781.	42543.
1991	3448.	3180.	3649.	3420.	3861.	3765.	3646.	3930.	3470.	3643.	3701.	3713.	43426.
1992	3614.	3461.	3462.	3654.	3976.	3765.	3952.	3792.	3712.	4042.	3577.	4106.	45113.
1993	3806.	3454.	3676.	3908.	4022.	3948.	4297.	3868.	3956.	4057.	3779.	4337.	47107.
1994	3828.	3577.	4000.	4072.	4080.	4198.	4362.	4030.	4169.	3987.	3910.	4638.	48851.
1995	3787.	3668.	4080.	4057.	4166.	4338.	4258.	4220.	4250.	3882.	3960.	4420.	49086.
1996	3805.	3754.	4031.	3849.	4254.	4107.	4166.	4474.	3946.	4164.	4198.	4288.	49035.
1997	4224.	3797.	4139.	4060.	4657.	4231.	4513.	4597.	4223.	4454.	4217.	4544.	51655.
1998	4533.	3893.	4108.	********	********	********	********	********	********	********	********	********	12534.
AVGE	3632.	3379.	3689.	3633.	3879.	3853.	3919.	3869.	3764.	3795.	3692.	4078.	

TABLE TOTAL- 507707. MEAN- 3761. STD. DEVIATION- 420.

E 2. FINAL SEASONALLY ADJUSTED SERIES MODIFIED FOR EXTREMES WITH ZERO WEIGHTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	3067.	3075.	3110.	3126.	3180.	3179.	3178.	3190.	3206.	3222.	3227.	3228.	37989.
1988	3226.	3230.	3259.	3235.	3233.	3248.	3305.	3299.	3304.	3361.	3329.	3349.	39377.
1989	3362.	3369.	3345.	3382.	3388.	3416.	3401.	3388.	3426.	3410.	3455.	3476.	40817.
1990	3471.	3534.	3529.	3543.	3520.	3550.	3553.	3586.	3590.	3572.	3597.	3592.	42636.
1991	3591.	3580.	3605.	3631.	3627.	3637.	3622.	3650.	3628.	3636.	3645.	3635.	43485.
1992	3674.	3670.	3702.	3711.	3732.	3745.	3720.	3758.	3785.	3836.	3823.	3850.	45005.
1993	3866.	3886.	3883.	3872.	3906.	3897.	3913.	3943.	3960.	3978.	3983.	3977.	47065.
1994	4013.	4022.	4057.	4039.	4086.	4076.	4091.	4052.	4069.	4048.	4088.	4121.	48763.
1995	4078.	4122.	4096.	4133.	4135.	4114.	4124.	4101.	4107.	4061.	4070.	4050.	49190.
1996	4040.	4017.	4044.	4043.	4017.	4006.	4101.	4115.	4131.	4170.	4170.	4184.	49038.
1997	4245.	4270.	4247.	4273.	4275.	4313.	4305.	4356.	4356.	4362.	4351.	4379.	51731.
1998	4412.	4378.	4411.	********	********	********	********	********	********	********	********	********	13201.
AVGE	3754.	3763.	3774.	3726.	3736.	3744.	3756.	3767.	3778.	3787.	3794.	3804.	

TABLE TOTAL- 508299. MEAN- 3765. STD. DEVIATION- 370.

E 3. MODIFIED IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1987	99.9	99.5	100.0	99.8	100.8	100.2	99.7	99.8	100.0	100.3	100.2	100.0	.3
1988	99.8	99.9	100.7	99.8	99.4	99.5	100.7	100.0	99.6	100.9	99.6	100.0	.5
1989	100.2	100.2	99.3	100.1	100.0	100.6	100.0	99.4	100.3	99.5	100.2	100.2	.4
1990	99.4	100.7	100.2	100.3	99.4	100.0	99.8	100.4	100.3	99.6	100.2	100.1	.4
1991	100.0	99.5	99.9	100.4	100.0	100.1	99.6	100.4	99.8	100.0	100.1	99.6	.3
1992	100.3	99.8	100.2	100.0	100.2	100.2	99.1	99.7	99.9	100.6	99.7	99.9	.4
1993	100.0	100.3	100.0	99.6	100.3	99.8	99.8	100.1	100.1	100.2	100.0	99.5	.2
1994	100.1	99.9	100.3	99.5	100.4	100.1	100.5	99.6	100.0	99.4	100.2	100.8	.4
1995	99.5	100.3	99.5	100.3	100.3	99.8	100.2	99.9	100.3	99.6	100.2	100.0	.3
1996	100.0	99.6	100.4	100.3	99.3	98.7	100.5	100.2	100.0	100.3	99.7	99.5	.5
1997	100.4	100.6	99.7	100.0	99.7	100.2	99.6	100.4	100.1	100.0	99.6	100.1	.3
1998	100.7	99.7	100.1	********	********	********	********	********	********	********	********	********	.4
S.D.	.3	.4	.4	.3	.4	.5	.4	.3	.2	.5	.2	.3	

TABLE TOTAL- 13499.3 MEAN- 100.0 STD. DEVIATION- .4

E 4. RATIOS OF ANNUAL TOTALS, ORIGINAL AND ADJUSTED SERIES

YEAR	UNMODIFIED	MODIFIED
1987	100.10	100.07
1988	100.60	100.57
1989	99.81	99.81
1990	99.77	99.78
1991	99.87	99.86
1992	100.24	100.24
1993	100.09	100.09
1994	100.18	100.18
1995	99.80	99.79
1996	100.01	99.99
1997	99.85	99.85

E 5. MONTH-TO- MONTH CHANGES IN THE ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	**********	-11.7	3.8	8.5	9.7	-4.8	5.4	-5.3	-3.5	10.6	-11.1	16.6	1.7
1988	-11.2	-7.5	10.3	1.6	-1.4	4.9	4.1	-7.2	4.2	-1.7	-3.6	20.8	1.1
1989	-20.7	-2.9	13.2	-3.4	4.2	6.6	-4.1	-1.0	2.9	-7.6	3.4	11.7	.2
1990	-15.0	-2.7	15.6	-8.0	9.7	2.4	-5.7	5.8	-4.1	-3.1	4.2	4.4	.3
1991	-8.8	-7.8	14.7	-6.3	14.3	-3.7	-3.1	7.8	-11.7	5.0	1.6	.3	.2
1992	-2.7	-4.2	.0	7.1	7.2	-5.3	5.0	-4.1	-2.1	8.9	-11.5	14.8	1.1
1993	-5.5	-11.0	6.4	6.3	2.9	-1.8	8.9	-10.0	2.3	2.6	-6.9	14.8	.7
1994	-11.7	-6.6	11.8	1.8	.2	2.9	3.9	-7.6	2.0	-3.0	-1.9	18.6	.9
1995	-18.3	-3.1	11.2	-.5	2.7	4.1	-1.9	-.9	.7	-8.7	2.0	13.5	.1
1996	-16.6	.2	7.4	-4.5	10.5	-3.5	1.4	7.4	-13.2	7.2	.8	2.2	-.1
1997	-1.5	-10.1	9.0	-1.9	14.7	-9.1	6.7	1.9	-8.1	5.5	-5.3	7.8	.8
1998	-.2	-14.1	5.5	********	********	********	********	********	********	********	********	********	-3.0
AVGE	-10.2	-6.8	9.1	.1	6.8	-.7	1.9	-1.2	-2.8	1.4	-2.6	11.4	

TABLE TOTAL- 72.8 MEAN- .5 STD. DEVIATION- 8.1

E 6. MONTH-TO- MONTH CHANGES IN THE FINAL SEASONALLY ADJUSTED SERIES (D11.)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	**********	.2	-1.3	3.0	1.7	.0	-.1	.4	-1.4	2.5	.2	2.5	.7
1988	-2.5	.1	.9	-.7	-.1	.5	1.8	-.2	.1	1.7	-.9	3.5	.3
1989	-2.4	.2	-.7	1.1	.2	.8	-.4	-.4	1.1	-.4	1.3	.6	.1
1990	-.2	1.8	-.1	.4	-.7	-.9	1.9	.9	.1	-.5	.7	-.1	.3
1991	.0	-.3	.7	.7	1.2	-1.0	-.4	.8	-.6	.2	.3	-.3	.1
1992	1.1	-.1	.9	1.7	-.9	.3	-.7	1.0	.7	1.4	-.3	.7	.5
1993	2.4	-1.4	-.1	-.3	.9	-.2	.4	.8	.4	.5	.1	-.2	.3
1994	.9	.2	.9	-.4	1.2	-.3	.4	-1.0	-1.0	.9	1.0	.8	.3
1995	-1.1	1.1	-.6	.9	.0	-.5	.2	-.6	.2	-1.1	.2	1.2	.0
1996	-3.4	1.0	.7	.0	-.6	-.3	2.4	.3	-1.2	2.5	.0	.3	.1
1997	1.4	.6	-.5	.6	.0	.9	-.2	1.2	.0	.1	-.3	.6	.4
1998	.8	-.8	.7	********	********	********	********	********	********	********	********	********	.2
AVGE	-.3	.2	.1	.6	.3	-.1	.5	.3	-.1	.7	.2	.9	

TABLE TOTAL- 37.1 MEAN- .3 STD. DEVIATION- 1.0

E 6A. MONTH-TO- MONTH CHANGES IN THE FINAL SEASONALLY ADJUSTED SERIES (D11A.)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1987	**********	.3	-1.3	3.1	1.8	.0	.0	.4	-1.4	2.5	.2	2.6	.7
1988	-2.4	.2	1.0	-.7	.0	.5	1.7	-.2	.1	1.6	-1.0	3.4	.3
1989	-2.5	.1	-.8	1.0	.1	.8	-.5	-.4	1.1	-.5	1.3	.6	.0
1990	-.1	1.8	-.1	.4	-.7	-.9	1.9	.9	.1	-.5	.7	-.1	.3
1991	-.1	-.3	.7	.7	1.2	-1.0	-.4	.8	-.6	.3	.3	-.2	.1
1992	1.1	-.1	.9	1.7	-.9	.4	-.7	1.0	.7	1.3	-.4	.7	.5
1993	2.3	-1.4	-.1	-.3	.8	-.2	.4	.8	.4	.5	.2	-.1	.3
1994	1.0	.2	.9	-.4	1.2	-.3	.4	-1.0	-1.0	.8	.9	.7	.3
1995	-1.1	1.0	-.7	.9	.0	-.5	.2	-.6	.2	-1.1	.3	1.3	.0
1996	-3.4	1.0	.7	.0	-.6	-.2	2.4	.3	-1.2	2.5	.0	.3	.2
1997	1.4	.6	-.6	.6	.0	.9	-.2	1.2	.0	.1	-.3	.6	.4
1998	.8	-.8	.7	********	********	********	********	********	********	********	********	********	.2
AVGE	-.3	.2	.1	.6	.3	-.1	.5	.3	-.1	.7	.2	.9	

TABLE TOTAL- 37.0 MEAN- .3 STD. DEVIATION- 1.0

F 1. MCD MOVING AVERAGE
MCD IS 3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1987	**********	3059.	3078.	3113.	3162.	3179.	3182.	3171.	3185.	3198.	3252.	3254.	34833.
1988	3255.	3238.	3241.	3242.	3238.	3262.	3284.	3303.	3321.	3331.	3378.	3379.	39472.
1989	3392.	3359.	3365.	3372.	3395.	3402.	3401.	3405.	3408.	3430.	3447.	3467.	40843.
1990	3494.	3512.	3536.	3531.	3516.	3519.	3542.	3576.	3583.	3586.	3587.	3593.	42574.
1991	3588.	3592.	3605.	3636.	3647.	3644.	3636.	3633.	3638.	3636.	3639.	3652.	43545.
1992	3660.	3682.	3713.	3733.	3747.	3732.	3741.	3754.	3793.	3815.	3836.	3872.	45078.
1993	3893.	3904.	3881.	3887.	3892.	3905.	3918.	3939.	3960.	3974.	3979.	3991.	47123.
1994	4004.	4031.	4039.	4061.	4067.	4084.	4073.	4052.	4038.	4050.	4086.	4096.	48680.
1995	4107.	4098.	4117.	4121.	4127.	4124.	4113.	4111.	4090.	4079.	4083.	4056.	49227.
1996	4039.	4013.	4035.	4034.	4022.	4042.	4074.	4095.	4117.	4136.	4175.	4200.	48981.
1997	4233.	4254.	4263.	4265.	4287.	4298.	4325.	4339.	4358.	4356.	4364.	4381.	51722.
1998	4390.	4400.	********	********	********	********	********	********	********	********	********	********	8790.
AVGE	3823.	3762.	3716.	3727.	3736.	3745.	3754.	3762.	3772.	3781.	3802.	3813.	

TABLE TOTAL- 500869. MEAN- 3766. STD. DEVIATION- 363.

F 2. SUMMARY MEASURES

F 2A: AVERAGE, PER CENT CHANGE WITHOUT REGARD TO SIGN OVER THE INDICATED SPAN

SPAN IN MONTHS	B1 O	D11 CI	D13 I	D12 C	D10 S	A4 P	C18 TD	F 1 MCD	E 1 MOD.O	E 2 MOD.CI	E 3 MOD.I
1	6.61	.79	.76	.31	4.49	.00	4.40	.41	6.48	.56	.49
2	6.61	.99	.76	.61	4.69	.00	3.88	.74	6.41	.74	.46
3	6.26	1.23	.70	.91	5.93	.00	2.21	1.03	6.09	1.01	.45
4	7.89	1.46	.68	1.20	6.20	.00	4.29	1.29	7.74	1.26	.41
5	6.49	1.68	.65	1.49	5.29	.00	3.35	1.56	6.44	1.54	.39
6	6.89	1.95	.71	1.78	6.08	.00	2.59	1.82	6.75	1.82	.45
7	7.46	2.16	.66	2.06	5.20	.00	4.38	2.09	7.33	2.10	.39
8	7.36	2.44	.71	2.34	6.23	.00	3.07	2.37	7.28	2.39	.46
9	7.18	2.73	.64	2.60	5.89	.00	2.15	2.64	6.97	2.65	.39
10	7.66	2.97	.68	2.87	4.94	.00	4.53	2.90	7.43	2.91	.43
11	6.26	3.22	.69	3.13	4.53	.00	2.98	3.15	6.10	3.16	.41
12	4.40	3.44	.69	3.38	.10	.00	2.91	3.41	4.30	3.41	.47

F 2B: RELATIVE CONTRIBUTIONS TO THE VARIANCE OF THE PER CENT CHANGE IN THE COMPONENTS OF THE ORIGINAL SERIES

SPAN IN MONTHS	D13 I	D12 C	D10 S	A4 P	C18 TD	TOTAL	RATIO (X100)
1	1.42	.23	50.21	.00	48.13	100.00	92.17
2	1.51	.98	57.79	.00	39.72	100.00	86.89
3	1.17	2.00	85.04	.00	11.78	100.00	105.58
4	.79	2.46	65.49	.00	31.27	100.00	94.53
5	1.00	5.32	66.87	.00	26.81	100.00	99.44
6	1.06	6.69	78.09	.00	14.16	100.00	99.51
7	.85	8.32	53.15	.00	37.68	100.00	91.63
8	.93	10.07	71.64	.00	17.36	100.00	100.03
9	.89	14.58	74.57	.00	9.95	100.00	90.06
10	.87	15.33	45.51	.00	38.30	100.00	91.50
11	1.20	24.62	51.83	.00	22.36	100.00	101.19
12	2.32	56.06	.05	.00	41.57	100.00	105.06

F 2C: AVERAGE, PER CENT CHANGE WITH REGARD TO SIGN AND STANDARD DEVIATION OVER INDICATED SPAN

SPAN IN	B1 O		D13 I		D12 C		D10 S		D11 CI		F1 MCD	
MONTHS	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.
1	.54	8.12	.01	.99	.27	.22	.18	5.73	.28	1.03	.28	.43
2	.83	8.23	.01	1.03	.54	.44	.23	6.43	.55	1.17	.55	.71
3	1.13	7.75	.03	1.02	.81	.64	.26	7.08	.84	1.30	.82	.95
4	1.57	9.26	.03	.96	1.07	.83	.34	7.26	1.11	1.39	1.08	1.09
5	1.65	8.12	.02	.93	1.33	1.00	.25	6.75	1.36	1.48	1.34	1.21
6	1.94	8.29	.02	.98	1.59	1.15	.27	7.28	1.62	1.61	1.61	1.33
7	2.17	8.72	.03	.92	1.86	1.29	.18	6.46	1.89	1.68	1.87	1.45
8	2.47	8.69	.03	.96	2.12	1.42	.24	7.22	2.15	1.80	2.14	1.58
9	2.74	8.04	.05	.97	2.38	1.54	.26	6.85	2.43	1.93	2.40	1.70
10	3.05	9.63	.05	.94	2.64	1.65	.27	7.14	2.69	2.01	2.65	1.79
11	3.27	7.56	.04	.98	2.90	1.75	.24	5.80	2.94	2.12	2.91	1.89
12	3.22	4.18	.02	.92	3.16	1.84	.00	.13	3.18	2.15	3.16	1.96

F 2D: AVERAGE DURATION OF RUN,

CI	I	C	MCD
1.58	1.49	19.14	3.77

F 2E: I/C RATIO FOR , MONTHS SPAN

1	2	3	4	5	6	7	8	9	10	11	12
2.47	1.24	.77	.57	.43	.40	.32	.30	.25	.24	.22	.20

MONTHS FOR CYCLICAL DOMINANCE: 3

F 2F: RELATIVE CONTRIBUTION OF THE COMPONENTS TO THE STATIONARY PORTION OF THE VARIANCE IN THE ORIGINAL SERIES

I	C	S	P	TD	TOTAL
1.37	7.02	61.33	.00	24.45	94.16

F 2G: THE AUTOCORRELATION OF THE IRREGULARS FOR SPANS 1 TO 14

1	2	3	4	5	6	7	8	9	10	11	12	13	14
-.03	-.11	-.14	-.01	.06	-.05	.09	.02	-.03	.04	-.05	.04	-.07	.13

F 2H: THE FINAL I/C RATIO FROM TABLE D12: 1.55
THE FINAL I/S RATIO FROM TABLE D10: 4.12

F 2I:,

		STATISTIC	PROBABILITY LEVEL
F-TEST FOR STABLE SEASONALITY FROM TABLE B 1.	:	269.891	.00%
F-TEST FOR THE TRADING DAY REGESSION IN TABLE C15.	:	564.648	.00%
F-TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	357.095	.00%
KRUSKAL-WALLIS CHI SQUARED TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	125.867	.00%
F-TEST FOR MOVING SEASONALITY FROM TABLE D 8.	:	1.623	10.92%
F-TEST FOR EASTER VARIATION FROM TABLE A10.	:	11.244	1.54%

```
                                          1         2         3         4         5         6         7         8
      COLUMN NUMBER            : 12345678901234567890123456789012345678901234567890123456789012345678901234567890
 IMAGE OF THE MAIN OPTION CARD:  M1SERI3   01870398  1  1 02    0 4                                       X2     0
IMAGE OF THE EXTRA OPTION CARD:  X                     3      365            91                                  0
IMAGE OF THE ARIMA OPTION CARD:  L0110110                                                                        0
IMAGE OF THE INPUT FORMAT CARD:  (4F18.6)                                                                        0
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F 3. MONITORING AND QUALITY ASSESSMENT STATISTICS

ALL THE MEASURES BELOW ARE IN THE RANGE FROM 0 TO 3 WITH AN ACCEPTANCE REGION FROM 0 TO 1.

1. THE RELATIVE CONTRIBUTION OF THE IRREGULAR OVERTHREE MONTHS SPAN (FROM TABLE F 2.B). M1 = .117

2. THE RELATIVE CONTRIBUTION OF THE IRREGULAR COMPONENT TO THE STATIONARY PORTION OF THE VARIANCE (FROM TABLE F 2.F). M2 = .137

3. THE AMOUNT OF MONTH TO MONTH CHANGE IN THE IRREGULAR COMPONENT AS COMPARED TO THE AMOUNT OF MONTH TO MONTH CHANGE IN THE TREND-CYCLE (FROM TABLE F2.H). M3 = .277

4. THE AMOUNT OF AUTOCORRELATION IN THE IRREGULAR AS DESCRIBED BY THE AVERAGE DURATION OF RUN (TABLE F 2.D). M4 = .027

5. THE NUMBER OF MONTHS IT TAKES THE CHANGE IN THE TREND-CYCLE TO SURPASS THE AMOUNT OF CHANGE IN THE IRREGULAR (FROM TABLE F 2.E). M5 = .402

6. THE AMOUNT OF YEAR TO YEAR CHANGE IN THE IRREGULAR AS COMPARED TO THE AMOUNT OF YEAR TO YEAR CHANGE IN THE SEASONAL (FROM TABLE F 2.H). M6 = .047

7. THE AMOUNT OF MOVING SEASONALITY PRESENT RELATIVE TO THE AMOUNT OF STABLE SEASONALITY (FROM TABLE F 2.I). M7 = .129

8. THE SIZE OF THE FLUCTUATIONS IN THE SEASONAL COMPONENT THROUGHOUT THE WHOLE SERIES. M8 = .230

9. THE AVERAGE LINEAR MOVEMENT IN THE SEASONAL COMPONENT THROUGHOUT THE WHOLE SERIES. M9 = .163

10. SAME AS 8, CALCULATED FOR RECENT YEARS ONLY. M10 = .301

11. SAME AS 9, CALCULATED FOR RECENT YEARS ONLY. M11 = .298

*** ACCEPTED *** AT THE LEVEL .20

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G 1. CHART
        (X) - B 1. ORIGINAL SERIES
        (O) - E 1. ORIGINAL SERIES MODIFIED FOR EXTREMES WITH ZERO FINAL WEIGHTS
        (*) - COINCIDENCE OF POINTS
        (E) - ARIMA EXTRAPOLATION
   SCALE-SEMI-LOG
     2729.1              3100.4              3522.1              4001.2              4545.4              5163.7
        .......................................................................................................
JAN1987 .                   *.                   .                   .                   .                    .
FEB1987 .*                   .                   .                   .                   .                    .
MAR1987 .      X   O         .                   .                   .                   .                    .
APR1987 .                   *.                   .                   .                   .                    .
MAY1987 .                    .            *      .                   .                   .                    .
JUN1987 .                    .    *              .                   .                   .                    .
JUL1987 .                    .             *     .                   .                   .                    .
AUG1987 .                    .    *              .                   .                   .                    .
SEP1987 .                   X.  O                .                   .                   .                    .
OCT1987 .                    .              *    .                   .                   .                    .
NOV1987 .                 *  .                   .                   .                   .                    .
DEC1987 .                    .                O  .X                  .                   .                    .
JAN1988 .                    . *                 .                   .                   .                    .
FEB1988 .          *         .                   .                   .                   .                    .
MAR1988 .                    .    *              .                   .                   .                    .
APR1988 .                    .       *           .                   .                   .                    .
MAY1988 .                    .     *             .                   .                   .                    .
JUN1988 .                    .            *      .                   .                   .                    .
JUL1988 .                    .                  *.                   .                   .                    .
AUG1988 .                    .       *           .                   .                   .                    .
SEP1988 .                    .             *     .                   .                   .                    .
OCT1988 .                    .          *        .                   .                   .                    .
NOV1988 .                    .     *             .                   .                   .                    .
DEC1988 .                    .                   .          O   X    .                   .                    .
JAN1989 .                   *.                   .                   .                   .                    .
FEB1989 .              *     .                   .                   .                   .                    .
MAR1989 .                    .             *     .                   .                   .                    .
APR1989 .                    .       *           .                   .                   .                    .
MAY1989 .                    .              *    .                   .                   .                    .
JUN1989 .                    .                   .    *              .                   .                    .
JUL1989 .                    .                 * .                   .                   .                    .
AUG1989 .                    .                *  .                   .                   .                    .
SEP1989 .                    .                   .*                  .                   .                    .
OCT1989 .                    .        *          .                   .                   .                    .
NOV1989 .                    .             *     .                   .                   .                    .
DEC1989 .                    .                   .           *       .                   .                    .
JAN1990 .                    .     *             .                   .                   .                    .
FEB1990 .                    . *                 .                   .                   .                    .
MAR1990 .                    .                   .    *              .                   .                    .
APR1990 .                    .           *       .                   .                   .                    .
MAY1990 .                    .                   .     *             .                   .                    .
JUN1990 .                    .                   .         X  O      .                   .                    .
JUL1990 .                    .                   .*                  .                   .                    .
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AUG1990 .                    .                   .        *          .                   .                    .
SEP1990 .                    .                   .  *                .                   .                    .
OCT1990 .                    .                 * .                   .                   .                    .
NOV1990 .                    .                   .   *               .                   .                    .
DEC1990 .                    .                   .          *        .                   .                    .
JAN1991 .                    .                *  .                   .                   .                    .
FEB1991 .                    .   *               .                   .                   .                    .
MAR1991 .                    .                   .     *             .                   .                    .
APR1991 .                    .              *    .                   .                   .                    .
MAY1991 .                    .                   .             O X   .                   .                    .
JUN1991 .                    .                   .         *         .                   .                    .
JUL1991 .                    .                   .    *              .                   .                    .
AUG1991 .                    .                   .                *  .                   .                    .
SEP1991 .                    .                 * .                   .                   .                    .
OCT1991 .                    .                   .    *              .                   .                    .
NOV1991 .                    .                   .       *           .                   .                    .
DEC1991 .                    .                   .       *           .                   .                    .
JAN1992 .                    .                   .   *               .                   .                    .
FEB1992 .                    .                *  .                   .                   .                    .
MAR1992 .                    .                *  .                   .                   .                    .
APR1992 .                    .                   .     O X           .                   .                    .
MAY1992 .                    .                   .                  *.                   .                    .
JUN1992 .                    .                   .         *         .                   .                    .
JUL1992 .                    .                   .                 * .                   .                    .
AUG1992 .                    .                   .           *       .                   .                    .
SEP1992 .                    .                   .       *           .                   .                    .
OCT1992 .                    .                   .                   . *                 .                    .
NOV1992 .                    .                   . *                 .                   .                    .
DEC1992 .                    .                   .                   .   *               .                    .
JAN1993 .                    .                   .           O  X    .                   .                    .
FEB1993 .                    .                *  .                   .                   .                    .
MAR1993 .                    .                   .      *            .                   .                    .
APR1993 .                    .                   .               *   .                   .                    .
MAY1993 .                    .                   .                   .*                  .                    .
JUN1993 .                    .                   .                 * .                   .                    .
JUL1993 .                    .                   .                   .          *        .                    .
AUG1993 .                    .                   .              *    .                   .                    .
SEP1993 .                    .                   .                 * .                   .                    .
OCT1993 .                    .                   .                   . *                 .                    .
NOV1993 .                    .                   .          *        .                   .                    .
DEC1993 .                    .                   .                   .            *      .                    .
JAN1994 .                    .                   .            *      .                   .                    .
FEB1994 .                    .                   . *                 .                   .                    .
MAR1994 .                    .                   .                   *                   .                    .
APR1994 .                    .                   .                   .  *                .                    .
MAY1994 .                    .                   .                   .  *                .                    .
JUN1994 .                    .                   .                   .       *           .                    .
JUL1994 .                    .                   .                   .             *     .                    .
AUG1994 .                    .                   .                   .*                  .                    .
SEP1994 .                    .                   .                   .   X O             .                    .
OCT1994 .                    .                   .                  *.                   .                    .
NOV1994 .                    .                   .               *   .                   .                    .
DEC1994 .                    .                   .                   .                   .  *                 .
JAN1995 .                    .                   .          *        .                   .                    .
FEB1995 .                    .                   .     *             .                   .                    .
MAR1995 .                    .                   .                   .  *                .                    .
APR1995 .                    .                   .                   . *                 .                    .
MAY1995 .                    .                   .                   .     *             .                    .
JUN1995 .                    .                   .                   .            *      .                    .
JUL1995 .                    .                   .                   .         *         .                    .
AUG1995 .                    .                   .                   .       *           .                    .
SEP1995 .                    .                   .                   .        *          .                    .
OCT1995 .                    .                   .              *    .                   .                    .
NOV1995 .                    .                   .                 * .                   .                    .
DEC1995 .                    .                   .                   .               O X .                    .
JAN1996 .                    .                   .         X O       .                   .                    .
FEB1996 .                    .                   .         *         .                   .                    .
MAR1996 .                    .                   .                   .*                  .                    .
APR1996 .                    .                   .             *     .                   .                    .
MAY1996 .                    .                   .                   .         *         .                    .
JUN1996 .                    .                   .                   .   *               .                    .
JUL1996 .                    .                   .                   .     *             .                    .
AUG1996 .                    .                   .                   .                 * .                    .
SEP1996 .                    .                   .              X  O .                   .                    .
OCT1996 .                    .                   .                   .     *             .                    .
NOV1996 .                    .                   .                   .       *           .                    .
DEC1996 .                    .                   .                   .          *        .                    .
JAN1997 .                    .                   .                   .       *           .                    .
FEB1997 .                    .                   .           *       .                   .                    .
MAR1997 .                    .                   .                   .    *              .                    .
APR1997 .                    .                   .                   . *                 .                    .
MAY1997 .                    .                   .                   .                   .   *                .
JUN1997 .                    .                   .                   .        *          .                    .
JUL1997 .                    .                   .                   .                  *.                    .
AUG1997 .                    .                   .                   .                   . *                  .
SEP1997 .                    .                   .                   .       *           .                    .
OCT1997 .                    .                   .                   .                *  .                    .
NOV1997 .                    .                   .                   .       *           .                    .
DEC1997 .                    .                   .                   .                   *                    .
JAN1998 .                    .                   .                   .                   *                    .
FEB1998 .                    .                   .               *   .                   .                    .
MAR1998 .                    .                   .                   .   *               .                    .
APR1998 .                    .                   .                   .           E       .                    .
MAY1998 .                    .                   .                   .                   .E                   .
JUN1998 .                    .                   .                   .                  E.                    .
JUL1998 .                    .                   .                   .                   .   E                .
```

```
AUG1998 .                    .                   .                   .                   .  E                 .
SEP1998 .                    .                   .                   .               E   .                    .
OCT1998 .                    .                   .                   .                 E .                    .
NOV1998 .                    .                   .                   .            E      .                    .
DEC1998 .                    .                   .                   .                   .         E          .
JAN1999 .                    .                   .                   .               E   .                    .
FEB1999 .                    .                   .                   .  E                .                    .
MAR1999 .                    .                   .                   .               E   .                    .
APR1999 .                    .                   .                   .                E  .                    .
MAY1999 .                    .                   .                   .                   .     E              .
JUN1999 .                    .                   .                   .                   .   E                .
JUL1999 .                    .                   .                   .                   .        E           .
AUG1999 .                    .                   .                   .                   .       E            .
SEP1999 .                    .                   .                   .                   .E                   .
OCT1999 .                    .                   .                   .                   .  E                 .
NOV1999 .                    .                   .                   .                 E .                    .
DEC1999 .                    .                   .                   .                   .              E     .
JAN2000 .                    .                   .                   .                   .E                   .
FEB2000 .                    .                   .                   .       E           .                    .
MAR2000 .                    .                   .                   .                   .E                   .
APR2000 .                    .                   .                   .                   . E                  .
MAY2000 .                    .                   .                   .                   .          E         .
JUN2000 .                    .                   .                   .                   .        E           .
JUL2000 .                    .                   .                   .                   .             E      .
AUG2000 .                    .                   .                   .                   .            E       .
SEP2000 .                    .                   .                   .                   .     E              .
OCT2000 .                    .                   .                   .                   .       E            .
NOV2000 .                    .                   .                   .                   .  E                 .
DEC2000 .                    .                   .                   .                   .                   E.
JAN2001 .                    .                   .                   .                   .     E              .
FEB2001 .                    .                   .                   .            E      .                    .
MAR2001 .                    .                   .                   .                   .     E              .
        .......................................................................................................
     2729.1              3100.4              3522.1              4001.2              4545.4              5163.7


G 2. CHART
        (X) - D11. FINAL SEASONALLY ADJUSTED SERIES
        (O) - D12. FINAL TREND CYCLE
        (*) - COINCIDENCE OF POINTS
   SCALE-SEMI-LOG
     3033.9              3269.8              3524.2              3798.3              4093.7              4412.1
        .......................................................................................................
JAN1987 .   *                .                   .                   .                   .                    .
FEB1987 .    XO              .                   .                   .                   .                    .
MAR1987 .X      O            .                   .                   .                   .                    .
APR1987 .        XO          .                   .                   .                   .                    .
MAY1987 .          O  X      .                   .                   .                   .                    .
JUN1987 .            OX      .                   .                   .                   .                    .
JUL1987 .            XO      .                   .                   .                   .                    .
AUG1987 .             XO     .                   .                   .                   .                    .
SEP1987 .          X    O    .                   .                   .                   .                    .
OCT1987 .               OX   .                   .                   .                   .                    .
NOV1987 .                *   .                   .                   .                   .                    .
DEC1987 .                 O  .  X                .                   .                   .                    .
JAN1988 .                XO  .                   .                   .                   .                    .
FEB1988 .                 *  .                   .                   .                   .                    .
MAR1988 .                 O X.                   .                   .                   .                    .
APR1988 .                 XO .                   .                   .                   .                    .
MAY1988 .                 XO .                   .                   .                   .                    .
JUN1988 .                  X O                   .                   .                   .                    .
JUL1988 .                    .O X                .                   .                   .                    .
AUG1988 .                    . *                 .                   .                   .                    .
SEP1988 .                    .  XO               .                   .                   .                    .
OCT1988 .                    .    O X            .                   .                   .                    .
NOV1988 .                    .    XO             .                   .                   .                    .
DEC1988 .                    .     O       X     .                   .                   .                    .
JAN1989 .                    .      *            .                   .                   .                    .
FEB1989 .                    .      OX           .                   .                   .                    .
MAR1989 .                    .     X O           .                   .                   .                    .
APR1989 .                    .        *          .                   .                   .                    .
MAY1989 .                    .        *          .                   .                   .                    .
JUN1989 .                    .         O X       .                   .                   .                    .
JUL1989 .                    .         OX        .                   .                   .                    .
AUG1989 .                    .        X O        .                   .                   .                    .
SEP1989 .                    .           *       .                   .                   .                    .
OCT1989 .                    .          X O      .                   .                   .                    .
NOV1989 .                    .             OX    .                   .                   .                    .
DEC1989 .                    .               *   .                   .                   .                    .
JAN1990 .                    .               XO  .                   .                   .                    .
FEB1990 .                    .                  O.X                  .                   .                    .
MAR1990 .                    .                   *                   .                   .                    .
APR1990 .                    .                   .*                  .                   .                    .
MAY1990 .                    .                   XO                  .                   .                    .
JUN1990 .                    .                X  . O                 .                   .                    .
JUL1990 .                    .                   . XO                .                   .                    .
AUG1990 .                    .                   .  O X              .                   .                    .
SEP1990 .                    .                   .   OX              .                   .                    .
OCT1990 .                    .                   .   XO              .                   .                    .
NOV1990 .                    .                   .    *              .                   .                    .
DEC1990 .                    .                   .    *              .                   .                    .
JAN1991 .                    .                   .    *              .                   .                    .
FEB1991 .                    .                   .   X O             .                   .                    .
MAR1991 .                    .                   .     *             .                   .                    .
APR1991 .                    .                   .      OX           .                   .                    .
MAY1991 .                    .                   .       O  X        .                   .                    .
```

```
JUN1991 .                    .                   .       *           .                   .                    .
JUL1991 .                    .                   .      XO           .                   .                    .
AUG1991 .                    .                   .       OX          .                   .                    .
SEP1991 .                    .                   .       *           .                   .                    .
OCT1991 .                    .                   .       *           .                   .                    .
NOV1991 .                    .                   .        *          .                   .                    .
DEC1991 .                    .                   .       XO          .                   .                    .
JAN1992 .                    .                   .         OX        .                   .                    .
FEB1992 .                    .                   .          *        .                   .                    .
MAR1992 .                    .                   .            *      .                   .                    .
APR1992 .                    .                   .             O   X .                   .                    .
MAY1992 .                    .                   .              *    .                   .                    .
JUN1992 .                    .                   .               *   .                   .                    .
JUL1992 .                    .                   .             X  O  .                   .                    .
AUG1992 .                    .                   .                XO .                   .                    .
SEP1992 .                    .                   .                  *.                   .                    .
OCT1992 .                    .                   .                   .O X                .                    .
NOV1992 .                    .                   .                   . *                 .                    .
DEC1992 .                    .                   .                   .   *               .                    .
JAN1993 .                    .                   .                   .    O    X         .                    .
FEB1993 .                    .                   .                   .    OX             .                    .
MAR1993 .                    .                   .                   .     *             .                    .
APR1993 .                    .                   .                   .    XO             .                    .
MAY1993 .                    .                   .                   .      *            .                    .
JUN1993 .                    .                   .                   .      XO           .                    .
JUL1993 .                    .                   .                   .       XO          .                    .
AUG1993 .                    .                   .                   .         *         .                    .
SEP1993 .                    .                   .                   .          *        .                    .
OCT1993 .                    .                   .                   .           *       .                    .
NOV1993 .                    .                   .                   .            *      .                    .
DEC1993 .                    .                   .                   .           X O     .                    .
JAN1994 .                    .                   .                   .             OX    .                    .
FEB1994 .                    .                   .                   .              XO   .                    .
MAR1994 .                    .                   .                   .                OX .                    .
APR1994 .                    .                   .                   .               X O .                    .
MAY1994 .                    .                   .                   .                 O X                    .
JUN1994 .                    .                   .                   .                  *.                    .
JUL1994 .                    .                   .                   .                  OX                    .
AUG1994 .                    .                   .                   .                XO .                    .
SEP1994 .                    .                   .                   .              X  O .                    .
OCT1994 .                    .                   .                   .                X O.                    .
NOV1994 .                    .                   .                   .                  OX                    .
DEC1994 .                    .                   .                   .                   O X                  .
JAN1995 .                    .                   .                   .                  XO                    .
FEB1995 .                    .                   .                   .                   .OX                  .
MAR1995 .                    .                   .                   .                   XO                   .
APR1995 .                    .                   .                   .                   . OX                 .
MAY1995 .                    .                   .                   .                   . OX                 .
JUN1995 .                    .                   .                   .                   .XO                  .
JUL1995 .                    .                   .                   .                   . *                  .
AUG1995 .                    .                   .                   .                   XO                   .
SEP1995 .                    .                   .                   .                   OX                   .
OCT1995 .                    .                   .                   .                 XO.                    .
NOV1995 .                    .                   .                   .                 * .                    .
DEC1995 .                    .                   .                   .                O  . X                  .
JAN1996 .                    .                   .                   .           X   O   .                    .
FEB1996 .                    .                   .                   .              XO   .                    .
MAR1996 .                    .                   .                   .               OX  .                    .
APR1996 .                    .                   .                   .               OX  .                    .
MAY1996 .                    .                   .                   .              X O  .                    .
JUN1996 .                    .                   .                   .             X   O .                    .
JUL1996 .                    .                   .                   .                  O.X                   .
AUG1996 .                    .                   .                   .                   .*                   .
SEP1996 .                    .                   .                   .                 X . O                  .
OCT1996 .                    .                   .                   .                   .   OX               .
NOV1996 .                    .                   .                   .                   .    XO              .
DEC1996 .                    .                   .                   .                   .     XO             .
JAN1997 .                    .                   .                   .                   .        OX          .
FEB1997 .                    .                   .                   .                   .         OX         .
MAR1997 .                    .                   .                   .                   .         XO         .
APR1997 .                    .                   .                   .                   .          XO        .
MAY1997 .                    .                   .                   .                   .           *        .
JUN1997 .                    .                   .                   .                   .            OX      .
JUL1997 .                    .                   .                   .                   .            XO      .
AUG1997 .                    .                   .                   .                   .              O X   .
SEP1997 .                    .                   .                   .                   .               OX   .
OCT1997 .                    .                   .                   .                   .                *   .
NOV1997 .                    .                   .                   .                   .               XO   .
DEC1997 .                    .                   .                   .                   .                 *  .
JAN1998 .                    .                   .                   .                   .                 O X.
FEB1998 .                    .                   .                   .                   .                 XO .
MAR1998 .                    .                   .                   .                   .                   *.
        .......................................................................................................
     3033.9              3269.8              3524.2              3798.3              4093.7              4412.1
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS     MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1               93.4                97.6              101.8               106.1               110.3
        .....................................................................................................
JANUARY
   1987 .                   .          *        .                   .                   .                   .
   1988 .                   .          *        .                   .                   .                   .
   1989 .                   .           X*      .                   .                   .                   .
   1990 .                   .         * X       .                   .                   .                   .
   1991 .                   .            *      .                   .                   .                   .
   1992 .                   .             X *   .                   .                   .                   .
   1993 .                   .              X+   .   O               .                   .                   .
   1994 .                   .               X*  .                   .                   .                   .
   1995 .                   .              *  X .                   .                   .                   .
   1996 .                   .           O     +X.                   .                   .                   .
   1997 .                   .                   X *                 .                   .                   .
   1998 .                   .                   X+ O                .                   .                   .
   1999 .                   .                   .E                  .                   .                   .
        .....................................................................................................
       89.1               93.4                97.6              101.8               106.1               110.3
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS     MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1               93.4                97.6              101.8               106.1               110.3
        .....................................................................................................
FEBRUARY
   1987 .* X                .                   .                   .                   .                   .
   1988 . *X                .                   .                   .                   .                   .
   1989 .  X*               .                   .                   .                   .                   .
   1990 .  X +O             .                   .                   .                   .                   .
   1991 .* X                .                   .                   .                   .                   .
   1992 .  *                .                   .                   .                   .                   .
   1993 .   X*              .                   .                   .                   .                   .
   1994 .   *               .                   .                   .                   .                   .
   1995 .   X*              .                   .                   .                   .                   .
   1996 . * X               .                   .                   .                   .                   .
   1997 .   X *             .                   .                   .                   .                   .
   1998 . * X               .                   .                   .                   .                   .
   1999 .  E                .                   .                   .                   .                   .
        .....................................................................................................
       89.1               93.4                97.6              101.8               106.1               110.3
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS     MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1               93.4                97.6              101.8               106.1               110.3
        .....................................................................................................
MARCH
   1987 .                   .       O          +X                   .                   .                   .
   1988 .                   .                   X  *                .                   .                   .
   1989 .                   .                *  X                   .                   .                   .
   1990 .                   .                   X *                 .                   .                   .
   1991 .                   .                   .*                  .                   .                   .
   1992 .                   .                   .X*                 .                   .                   .
   1993 .                   .                   .*                  .                   .                   .
   1994 .                   .                   X *                 .                   .                   .
   1995 .                   .                 * X                   .                   .                   .
   1996 .                   .                  X.*                  .                   .                   .
   1997 .                   .                * X.                   .                   .                   .
   1998 .                   .                  *.                   .                   .                   .
   1999 .                   .                  E.                   .                   .                   .
        .....................................................................................................
       89.1               93.4                97.6              101.8               106.1               110.3
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
APRIL
   1987 .                    .                   *X                  .                   .                    .
   1988 .                    .                   *X                  .                   .                    .
   1989 .                    .                   . *                 .                   .                    .
   1990 .                    .                   . X *               .                   .                    .
   1991 .                    .                   . X *               .                   .                    .
   1992 .                    .                   . *      O          .                   .                    .
   1993 .                    .                   * X                 .                   .                    .
   1994 .                    .                  *.X                  .                   .                    .
   1995 .                    .                   .X *                .                   .                    .
   1996 .                    .                   .X*                 .                   .                    .
   1997 .                    .                   .*X                 .                   .                    .
   1998 .                    .                   . E                 .                   .                    .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3


G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
MAY
   1987 .                    .                   .                   .         X  *      .                    .
   1988 .                    .                   .                   .      *  X         .                    .
   1989 .                    .                   .                   .         *         .                    .
   1990 .                    .                   .                   .       *  X        .                    .
   1991 .                    .                   .                   .           X+    O .                    .
   1992 .                    .                   .                   .            X*     .                    .
   1993 .                    .                   .                   .            X*     .                    .
   1994 .                    .                   .                   .           X *     .                    .
   1995 .                    .                   .                   .          X*       .                    .
   1996 .                    .                   .                   .     *  X          .                    .
   1997 .                    .                   .                   .     * X           .                    .
   1998 .                    .                   .                   .      E            .                    .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3


G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
JUNE
   1987 .                    .                   .                   .      X*           .                    .
   1988 .                    .                   .                   .   *  X            .                    .
   1989 .                    .                   .                   .      X  *         .                    .
   1990 .                    .                   .                 O .     +X            .                    .
   1991 .                    .                   .                   .     X*            .                    .
   1992 .                    .                   .                   .     X*            .                    .
   1993 .                    .                   .                   .  * X              .                    .
   1994 .                    .                   .                   .  X*               .                    .
   1995 .                    .                   .                   . *X                .                    .
   1996 .                    .                   .              O    .+X                 .                    .
   1997 .                    .                   .                   .X*                 .                    .
   1998 .                    .                   .                   .E                  .                    .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3
```

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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        ........................................................................................................
JULY
   1987 .                    .                    .                   .        *X         .                    .
   1988 .                    .                    .                   .          X  *     .                    .
   1989 .                    .                    .                   .          *        .                    .
   1990 .                    .                    .                   .        *X         .                    .
   1991 .                    .                    .                   .        *X         .                    .
   1992 .                    .                    .                   .     O  + X        .                    .
   1993 .                    .                    .                   .          *X       .                    .
   1994 .                    .                    .                   .            X  *   .                    .
   1995 .                    .                    .                   .             X*    .                    .
   1996 .                    .                    .                   .              X *  .                    .
   1997 .                    .                    .                   .            * X    .                    .
   1998 .                    .                    .                   .             E     .                    .
        ........................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3
```

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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        ........................................................................................................
AUGUST
   1987 .                    .                    .                  *X                   .                    .
   1988 .                    .                    .                   .*                  .                    .
   1989 .                    .                    .                 * .X                  .                    .
   1990 .                    .                    .                   . X *               .                    .
   1991 .                    .                    .                   . X *               .                    .
   1992 .                    .                    .                   .* X                .                    .
   1993 .                    .                    .                   .  X*               .                    .
   1994 .                    .                    .                   . * X               .                    .
   1995 .                    .                    .                   .    *X             .                    .
   1996 .                    .                    .                   .      X*           .                    .
   1997 .                    .                    .                   .       X *         .                    .
   1998 .                    .                    .                   .        E          .                    .
        ........................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        ........................................................................................................
SEPTEMBER
   1987 .                    .                    .O        *         .                   .                    .
   1988 .                    .                    .       * X         .                   .                    .
   1989 .                    .                    .         X*        .                   .                    .
   1990 .                    .                    .        X *        .                   .                    .
   1991 .                    .                    .      *X           .                   .                    .
   1992 .                    .                    .      *X           .                   .                    .
   1993 .                    .                    .        *          .                   .                    .
   1994 .                    .                    . O    +X           .                   .                    .
   1995 .                    .                    .        X*         .                   .                    .
   1996 .                    .                    . O    +X           .                   .                    .
   1997 .                    .                    .       X*          .                   .                    .
   1998 .                    .                    .       E           .                   .                    .
        ........................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
OCTOBER
   1987 .                    .                   .              X *  .                   .                    .
   1988 .                    .                   .              X   *.                   .                    .
   1989 .                    .                   .           * X     .                   .                    .
   1990 .                    .                   .           * X     .                   .                    .
   1991 .                    .                   .            *      .                   .                    .
   1992 .                    .                   .           X  *    .                   .                    .
   1993 .                    .                   .           *       .                   .                    .
   1994 .                    .                   .       *  X        .                   .                    .
   1995 .                    .                   .        * X        .                   .                    .
   1996 .                    .                   .          X *      .                   .                    .
   1997 .                    .                   .           *       .                   .                    .
   1998 .                    .                   .           E       .                   .                    .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3


G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
NOVEMBER
   1987 .                    .                   . X*                .                   .                    .
   1988 .                    .                   * X                 .                   .                    .
   1989 .                    .                   .X*                 .                   .                    .
   1990 .                    .                   .X*                 .                   .                    .
   1991 .                    .                   *                   .                   .                    .
   1992 .                    .                 *X.                   .                   .                    .
   1993 .                    .                 * .                   .                   .                    .
   1994 .                    .                X* .                   .                   .                    .
   1995 .                    .                *  .                   .                   .                    .
   1996 .                    .              *X   .                   .                   .                    .
   1997 .                    .             *X    .                   .                   .                    .
   1998 .                    .              E    .                   .                   .                    .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3


G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
       89.1                93.4                97.6               101.8               106.1               110.3
        .......................................................................................................
DECEMBER
   1987 .                    .                   .                   .                   .     *            O .
   1988 .                    .                   .                   .                   .    X+             O.
   1989 .                    .                   .                   .                   .    X*              .
   1990 .                    .                   .                   .                   .   *                .
   1991 .                    .                   .                   .                   .* X                 .
   1992 .                    .                   .                   .                   .  *                 .
   1993 .                    .                   .                   .                   .*  X                .
   1994 .                    .                   .                   .                   .   X  +O            .
   1995 .                    .                   .                   .                   .    *       O       .
   1996 .                    .                   .                   .                   .  * X               .
   1997 .                    .                   .                   .                   .    X*              .
   1998 .                    .                   .                   .                   .     E              .
        .......................................................................................................
       89.1                93.4                97.6               101.8               106.1               110.3

END OF X-11 ARIMA
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