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Seasonal Adjustment Diagnostics

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Census Bureau Guideline

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Census Bureau Guideline: Seasonal Adjustment Diagnostics

Introduction

The Census Bureau Principle: Production of Estimates and Projections states,

> "The Census Bureau performs seasonal adjustment of a time series of estimates only given clear evidence of seasonal behavior and only when the adjustment passes a suitable set of diagnostic tests. Diagnostics will be reviewed on a regular basis.
>
> "Program areas will be responsible for . . . specifying seasonal adjustment program options and evaluation of the resulting adjustments, including determining whether or not a series should be seasonally adjusted."

The purpose of these guidelines is to help staff use the Census Bureau's set of diagnostics to ensure the above principle is met.

Scope

These guidelines apply to any time series published by the U.S. Census Bureau that is seasonally adjusted or is part of a seasonally adjusted composite series. A *seasonal adjustment* of a time series removes seasonality and/or other calendar effects, such as trading day and moving holiday effects. *Trading day effects* are recurring effects associated with the weekday composition of the month. *Moving holidays* are holidays that are not always on the same date, such as Easter. A *composite* series is a series that is a combination, usually a sum, of other time series.

These guidelines recommend methods for using the diagnostics produced by X-12-ARIMA, the Census Bureau's seasonal adjustment program. All seasonal adjustments published by the Census Bureau should be produced by X-12-ARIMA because the Census Bureau supports the program, and most of these diagnostics are available only in X-12-ARIMA. Reviewers should ensure that their adjustments are calculated using the current released version of X-12-ARIMA.

Census Bureau seasonal-adjustment reviewers analyze diagnostics periodically, usually once per year and usually in conjunction with benchmarking operations if the series are benchmarked. In this Guideline, the normal periodic review will be called the *annual review*. These guidelines are designed to help prevent seasonal adjustment problems and to detect and solve problems that may arise. They apply, not only during the annual review, but also during the production of published seasonally-adjusted estimates and any other time that problems may occur.

Guidelines for Seasonal Adjustment Diagnostics

1. To implement the Census Bureau Principle shown in the introduction, reviewers should seasonally adjust a series only if it meets the following criteria.
   a. The series shows clear evidence of seasonal behavior. For series that are long enough (five years for monthly series or 15 years for quarterly series), reviewers should assess the spectral diagnostics for evidence of seasonal behavior. For shorter series, reviewers should check that the series passes the X-12-ARIMA diagnostics that measure seasonality. The F-test for seasonality assuming stability should be greater than 7.0, and the M7 diagnostic should be less than 1.0.
   b. The series has acceptable seasonal adjustment stability diagnostic values. For series that are long enough (more than ten years for most series), reviewers should assess the stability using the sliding spans diagnostics and the revisions history diagnostics. For shorter series, reviewers should consult with the Time Series Methods Staff of the Office of Statistical Methods and Research for Economic Programs (OSMREP) or the Time Series Research Staff of the Statistical Research Division (SRD) at the Census Bureau before publishing the seasonally adjusted series.

2. Seasonally adjusted series should not have residual seasonality or calendar effects. This guideline applies to both the individual seasonally adjusted series and to the seasonally adjusted composite series. Residual effects should be assessed by the spectral diagnostics if the series is long enough. For shorter series, F-tests for residual seasonal effects should be nonsignificant after the series is seasonally adjusted.

3. For every seasonally adjusted time series, reviewers should prefer greater stability. Less stable adjustments may lead to large revisions of the seasonally adjusted series when additional data are available. Data users may think that large revisions indicate problems with the adjustments, and large revisions may damage the Census Bureau's credibility for producing high quality data products. To improve stability, series should be adjusted concurrently with forecast extension using regARIMA (regression and ARIMA) time series models with acceptable diagnostics.

4. Reviewers should prefer parsimonious (simpler) regARIMA models.
   a. Reviewers should avoid high-order or mixed ARIMA models. In this context, a mixed ARIMA model is one with autoregressive (AR) and moving average (MA) parameters in the same component of the model. For example, (1 1 1)(0 1 1) and (0 1 1)(1 0 1) are mixed models; (1 0 0)(0 1 1) is not a mixed model.
   b. Reviewers should consider the model diagnostics and the length of the series to avoid overspecifying the regression model. (Greatly overspecified models can cause estimation problems.) Reviewers should exercise great care when specifying outlier regressors in the range of data that might be revised before the next annual review. They should try to determine the cause of the outlier(s) and may need to discuss the outlier(s) with subject-matter analysts. If possible, reviewers should monitor the revisions to make sure that any specified outliers are still significant as measured by the regression t-statistics. If the revised values are

no longer significant as outliers, the outlier regressor should no longer be specified in the model. Reviewers should be extremely cautious about changing the model at any time other than at annual review and should avoid situations that may be more likely to require changes.

See the Supporting Document for a Seasonal Adjustment Diagnostics Checklist.

Documentation of Current Practices

To obtain background information for these guidelines, the guidelines team surveyed the programs that use seasonal adjustment. Reviewers for the programs generally review and set seasonal adjustment options once per year and use these options when making concurrent adjustments for each production publication period (monthly or quarterly), when new data become available.

Responsibilities

Reviewers for the program areas will:

- Review the diagnostics in detail periodically, usually once per year (annual review).
- Change the seasonal adjustment input specifications after annual review, if appropriate.
- Communicate decisions for changes to subject-matter analysts involved with publishing the series.
- Evaluate the adjustments briefly every time the time series is published (monthly or quarterly) or support the subject-matter analysts who will evaluate the adjustments.
- Consult with the Time Series Methods Staff in the Office of Statistical Methods and Research for Economic Programs (OSMREP) and with the Time Series Research Staff in the Statistical Research Division (SRD) before changing seasonal adjustment input specifications at any time other than after annual review. The Census Bureau historically has maintained consistent input specification between annual reviews, which is a testament to the integrity of the seasonal adjustment procedure. Changing specifications at other times may cause suspicions or accusations of deceptive or politicized behavior.

The Methodology and Standards Council will:

- Initiate periodic evaluations, reviews, and updates to the guidelines, as necessary.
- Guide program areas in implementing the guidelines.

Inquiries

Inquiries relating to the interpretation of this guideline should be addressed to the Census Bureau Methodology and Standards Council.

Supporting Document:

A. Seasonal Adjustment Diagnostics Checklists

References

Findley, D. F., B. C. Monsell, W. R. Bell, M. C. Otto, and B. C. Chen (1998), "New Capabilities of the X-12-ARIMA Seasonal Adjustment Program" (With Discussion), *Journal of Business and Economic Statistics* 16, 127–77, www.census.gov/ts/papers/jbes98.pdf.

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