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[www.statcan.gc.ca](http://www.statcan.gc.ca)

# Quality Assurance of Seasonal Adjustment Process

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**Statistics Canada**

**1st Seasonal Adjustment Practitioners Workshop**  
**Washington, December 4<sup>th</sup> 2016**

# Overview

- Seasonal adjustment at Statistics Canada
- Quality assurance approach
  - Seasonal adjustment context
- Quality assurance tools
  - Preliminary [Seasonal Adjustment Dashboard](#)
  - [Protocol](#) for analysis and intervention in the SA process
- Summary

# Seasonal Adjustment at Statistics Canada:

## Time Series Research and Analysis Centre (TSRAC)

- Focal point / specialized services in time series analysis and methods
  - Consultation, Training, R&D
  - G-Series Software ( benchmarking and balancing time series in SAS)
  - Support on time series methods (with emphasis on SA)
  - Available to all StatCan programs/employees and external clients
- 10-12 employees (mostly mathematical statisticians) within the Methodology Branch
- TSRAC chief : [Steve.Matthews@canada.ca](mailto:Steve.Matthews@canada.ca)
- *TSRAC also provide full methodological support (frame, sample, post-collection, analysis...) to Price Index programs (including CPI) (+ 6-8 employees).*

# Seasonal Adjustment at Statistics Canada:

## Project Roles and Responsibilities for Seasonal Adjustment

### Development and Maintenance (Time Series Research and Analysis Centre)

- Analysis to initialize system
  - Determine options and parameters for seasonal adjustment and reconciliation
- Periodic review of seasonal adjustment options
- Support for analysis, verification and explanation of results
  
- Support and development of the *Time Series Processing System (TSPS)*
  - Seasonal adjustment is done using X-12-ARIMA and X-13-ARIMA-SEATS (for analysis and development or production) or SAS Proc X12 (for production).
  - “Wrapper” around SAS Proc X12 and G-series

# Seasonal Adjustment at Statistics Canada:

## Project Roles and Responsibilities for Seasonal Adjustment

### Ongoing Production (Subject Matter Analysts)

- Manage survey process to produce unadjusted estimates
- Run survey-specific seasonal adjustment system
- Data validation
  - *Directive for the Validation of Statistical Outputs*
  - *Guidelines for the Validation of Statistical Outputs*
    - Includes verification of SA estimates
- Analysis of seasonally adjusted (and unadjusted) estimates



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# **QUALITY ASSURANCE**

# Quality Assurance Framework at StatCan

- Some of the guiding principles:
  - Quality is relative, not absolute
  - Quality is **multidimensional**
  - Users must be informed of data quality so that they can judge whether the statistical information is appropriate for their particular use
- Some of the mechanisms
  - Quality review
  - Quality guidelines

# Quality Assurance Framework at StatCan

Interpretability

Coherence

Relevance

Accessibility

Timeliness

Accuracy

## Statistics Canada's Quality Guidelines (5<sup>th</sup> edition)

- 6 dimensions of quality of statistical information
- Comprehensive list of principles, guidelines and quality indicators for individual survey steps

*“Quality must be at the forefront of all activities”*

- Survey Step: Seasonal Adjustment and Trend-Cycle Estimation

# Quality of Seasonally Adjusted Data

## i) User-friendly explanation of concepts

### Interpretability

Coherence

Relevance

Accessibility

Timeliness

Accuracy

### FAQ

- **Seasonally adjusted data – Frequently asked questions**

<http://www.statcan.gc.ca/eng/dai/btd/sad-faq>

- **Trend-cycle estimates: Frequently asked questions**

<http://www.statcan.gc.ca/eng/dai/btd/tce-faq>

### Various outreach activities

- Internal and external users
- Business economists associations
- Animated video coming soon

# Quality of Seasonally Adjusted Data

## ii) Consistent Underlying Methodology

Interpretability

**Coherence**

Relevance

Accessibility

Timeliness

Accuracy

### Methodology:

- Use X12ARIMA methodology
- Use concurrent estimation

### Parameters & Options

- Include span of 10-15 years
- Assess identifiable seasonality
- Review options periodically, minimize revisions (frequency and size)
- Evaluate direct or indirect adjustments and **reconciliation** methods

# Quality of Seasonally Adjusted Data

## iii) Availability of Data and Relevant Information

- Raw, SA, Trend-cycle are publicly available
- Implemented SA options are available to users on request

### Transparency of Revisions

- Revisions are stored and publicly available
- Update SA options according to pre-determined schedule
- Unplanned updates governed by [internal protocol document](#)
  - criteria to implement unplanned changes
  - linked to diagnostics
  - reporting to senior management

Interpretability

Coherence

**Relevance**

**Accessibility**

Timeliness

Accuracy

# Quality of Seasonally Adjusted Data

## iv) Analytical and Statistical Properties

Interpretability

Coherence

Relevance

Accessibility

**Timeliness**

**Accuracy**

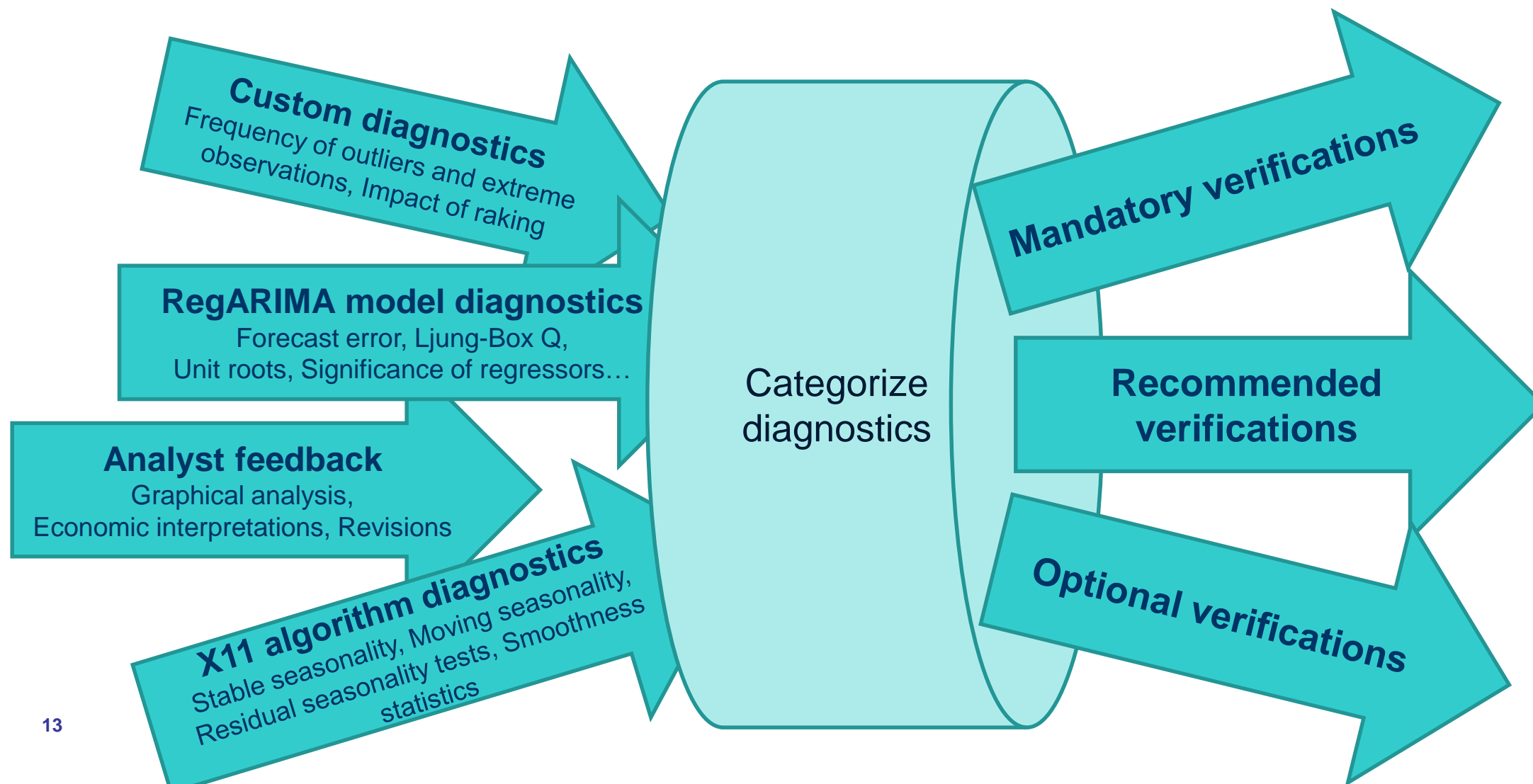
Highlights importance of identifying and removing seasonality

- Refers to diagnostics and tests from textbooks
  - Determining seasonality
  - Identifying residual seasonality
  - Assessing quality of RegARIMA model
  - Producing summary statistics on historical revisions

Many diagnostics on seasonal adjustment process

- Some felt to be more critical than others

# Quality of Seasonally Adjusted Data (X12ARIMA)



# Quality Assurance - General Approach

Objective: Monitor, maintain and report on quality of seasonal adjustment on an on-going basis

## Scheduled Periodic Reviews (majority of updates)

- Review by time series specialist to update options in production system
- Conducted on a predetermined schedule, usually along with historical (annual) revisions
- High volume of series for many projects, limited time for review, overlapping schedules
- Regular level of reporting and approval required

## Ad hoc Reviews (updates made on an exceptional basis)

- In response to analyst concerns in monthly processing
- Updates to options lead to revisions (impact on quality)
- Increased level of reporting and approval required

# Quality Assurance - General Approach

## General Monitoring Schedule

- Can be modified based on quality requirements and operational factors

Review type (frequency)	Mandatory Verifications	Recommended Verifications	Optional Verifications	Reporting on updates
Comprehensive (Annual)	YES	YES	Time Permitting	Subject Matter Analysts
Interim (*) (Quarterly)	YES	Time Permitting		Senior Management
Ad hoc (On request)	YES	YES	Time Permitting	Senior Management



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# SEASONAL ADJUSTMENT DASHBOARD

# Seasonal Adjustment Dashboard

## Preliminary version

- Provides a snapshot of an individual series at a point in time
- Intended for analysts, managers, specialists to understand process
- Isolate individual components and their effects
- Include sections for different aspects
  - Recent history
  - Verification of diagnostics and
  - Relevant patterns for individual components
  - Explanation of most recent month-to-month movement



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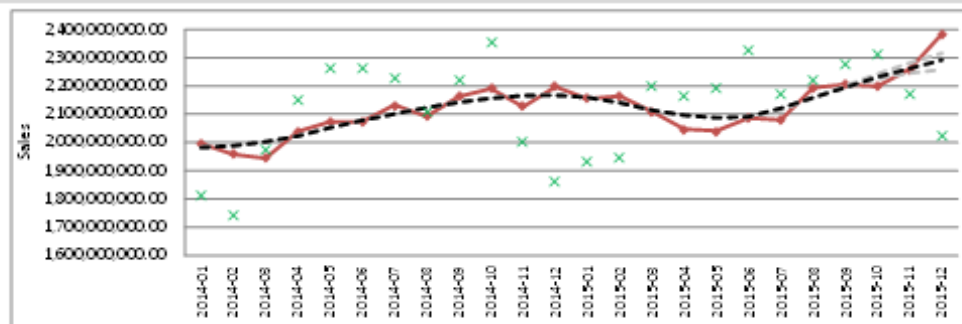
## Seasonal Adjustment Dashboard

Survey: Example

Series: Example

Reference Month: 2015-12

### Recent History of Series

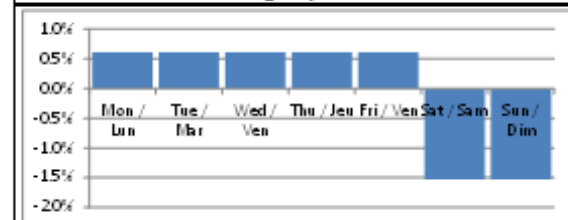


### Summary of Key Diagnostics

	Statistic	Value	Indicator
Adjustability:	M7	0.17	✓
Residual Seasonality:	RSE3	0.29	✓
Smoothness:	E6E5_Std	0.39	✓
Recent Outliers:	Month (m)	Regular	✓
	Month (m-1)	Regular	✓
Recurring Outliers:	Max	0.20	✓
Moving Seasonality:	Fm	0.95	✓
ARIMA model:	FE	0.06	✓
Autocorrelation:	LBO-24	0.10	✓

### Estimated Patterns and Anticipated Movements

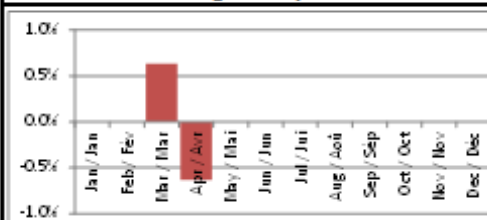
#### Trading Day Pattern



Trading Day Effects: ↗ expected

Previous Month:	-1%	Extra Sun, Mon
Current Month:	2%	Extra Tue, Wed, Thu

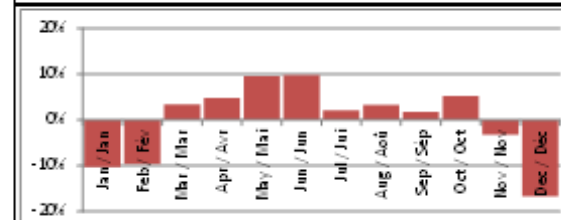
#### Moving Holiday Pattern



Moving Holiday Effects: ↗ expected

Previous Month:	0%	Easter: March 27
Current Month:	0%	

#### Seasonal Pattern

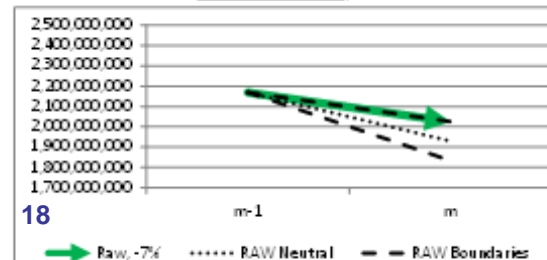


Seasonal Effects: ↘ expected

Previous Month:	-3%	(weaker than average)
Current Month:	-17%	(weaker than average)

### Net Effect of Seasonal Adjustment

#### Unadjusted (RAW)



18

Observed 6.7% raw decrease from last month

Neutral result requires 11.5% raw decrease from last month

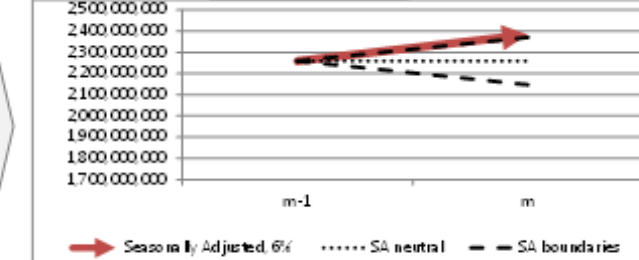
Trading day effects represent 2.4% raw increase

No moving holiday effect

Seasonal effects represent 13.9% raw decrease

SA movement of 5.5% from last month

#### Seasonally Adjusted (SA)



# Seasonal Adjustment Dashboard

## Recent History of Series

- Intended to identify trend direction, overall volatility and obvious outliers

## Summary of Key Diagnostics

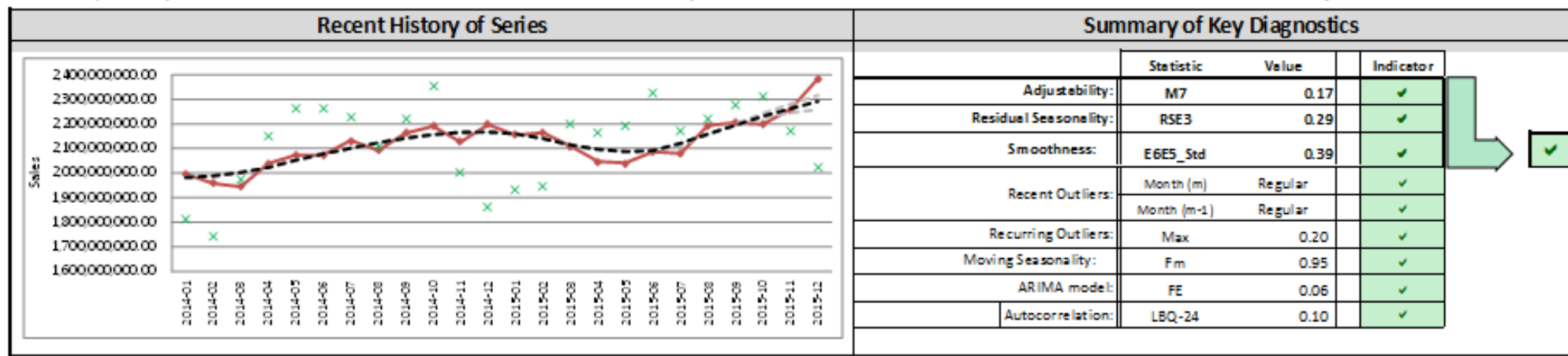
- Mandatory Verifications: Adjustability, Residual Seasonality and Smoothness
- Recommended Verifications: Recent and Recurring Outliers, Moving Seasonality, ARIMA Model error and error autocorrelation

Seasonal Adjustment Dashboard

Survey: Example

Series: Example

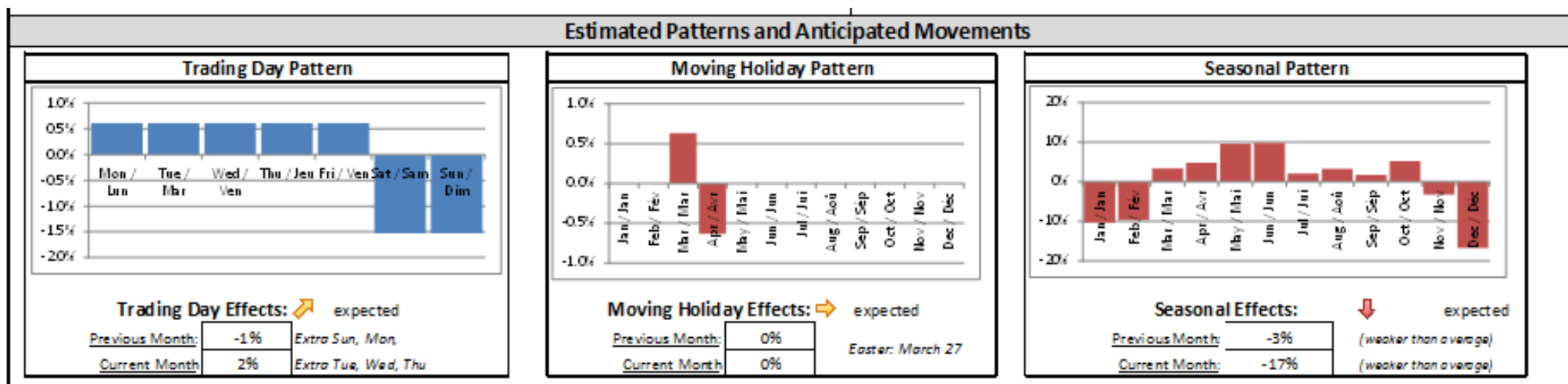
Reference Month: 2015-12



# Seasonal Adjustment Dashboard

## Estimated Patterns and Anticipated Movements

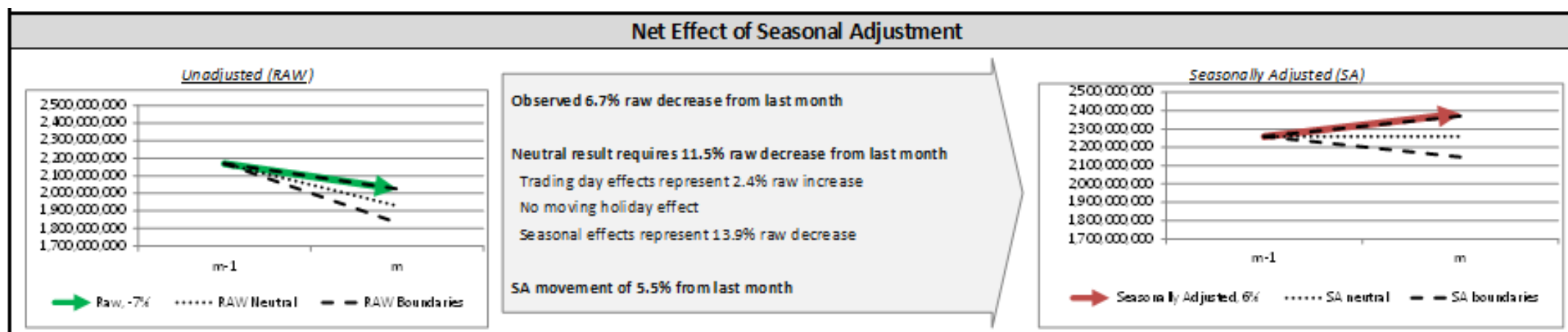
- Summarizes estimated trading day, moving holiday and seasonal pattern
- Presents expected movement in unadjusted based on each (current month, previous month and combined)



# Seasonal Adjustment Dashboard

## Net Effect of Seasonal Adjustment

- Movement in Raw, compared to typical ranges centered around “neutral” value
- Movement in Seasonally Adjusted, compared to typical ranges
- Emphasize link between observed and “neutral” movement in raw and SA





# **PROTOCOL FOR INTERVENTION IN THE SEASONAL ADJUSTMENT PROCESS**

## Protocol for the SA process

- Requested after 2 programs had a seemingly similar situation (“weird” SA results) and different outcomes (one let the data be; the other “intervened”).
- To present some principles and guidelines behind the monthly analysis of the seasonal adjustment process and results.
- Part of a wider strategy for [data quality evaluation](#) which includes amongst other things the validation of the unadjusted data (i.e. data prior to seasonal adjustment).

## What is an “intervention” ?

- An intervention in the SA process is when we **modify** the data produced (macro adjustment) or the options used in the process.
  - Done outside of regular schedule
- Situations where we strongly consider an intervention are also included.
  - Interventions are reported to high management as they occur and on an annual basis.
  - We want to report on “almost” interventions as well.

## Guiding principles

- When seasonal adjustment is applied properly, (i.e. as per [Statistics Canada Quality Guidelines](#)), the need for explicit interventions will be **rare**.
- Situations where interventions are not warranted:
  - To address issues or problems in the raw data
  - To lessen the degree of month-to-month “volatility”
    - (which can be addressed via trend-cycle estimation )

## Recommended interventions (1)

(Mandatory intervention) SA data not produced

- When : **System issues** / critical error.
- How : Modify SA options/models (by Time Series analysts)
- Detection : Identified automatically with the [system diagnostics](#).
- Example : Raw data not provided; unexpected negative raw data.

## Recommended interventions (2)

Clear evidence that the SA process is no longer applicable or appropriate.

- When : Statistical presence of **residual seasonality**.
- How : Modify SA options/models (by Time Series analysts).
- Detection : through **seasonal adjustment diagnostics** produced by the Time Series Processing System.

## Recommended interventions (3)

Abrupt structural break in pattern

- When : historical data no longer representative of expected pattern.
- How : Modify SA options/models or macro adjustment
- Detection : compelling external information. Change or break is permanent.
- Example : inclusion of a new statutory holiday; bylaw change for opening hours; changes to operational processes related to the calendar; very abrupt economical turning points.

## Acceptable interventions (4)

Economically highly questionable results or excessive revisions to the previous months.

- When : More than one set of SA options are “acceptable” and one yields more plausible results.
- How : Modify SA options/models (by Time Series analysts).
- Detection : Subject Matter expertise; based on reliable economical intelligence and not simply *perceived* anomalies.

## Other diagnostics

### Outlying data detected by the SA process

- When : SA process detected unusual raw data *and* processing issues confirmed.
  - SA outliers are not expected to represent erroneous data and *should not* be systematically modified.
- How : adjustment to raw data
- Detection : **SA analytical diagnostics** and further investigation in raw data.



## **CONCLUSIONS / FUTURE WORK**

## Conclusions and future work

- Summary
  - QA approach, QA tools, Communications
- Lessons learned from QA tools
  - Protocol & dashboard
- Continued improvements
  - Feedback from stakeholders
  - Continuous review of tools and *statistical* methods for monitoring quality

## Thank you!

- For more information,  
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