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Some discussions on calendar effects in X12-ARIMA

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Telling Canada's story in numbers

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Canada

Introduction

- We have had some success recently in Statistics Canada in studying weather effects on seasonally adjusted monthly data (Matthews & Patak, JSM 2017).
- In the same vein, this presentation explores the use of other regressors that could potentially improve seasonal adjustment, namely month-specific effects.
- This research is motivated by questions from our subject matter analysts that relate to the trading day component because of fixed holiday calendar patterns.

Outline

- Ways to test for the presence of month-specific effects
- Month-specific effects in the Canadian Monthly Retail Trade Survey (MRTS)
- Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)
- Conclusion

Ways to test for the presence of month-specific effects

Example: For the International Merchandise Trade car export series, in July 2016 we expected the values to be lower than the average July value because Canada Day (July 1st) fell on a Friday and Independence Day (July 4th) fell on a Monday.

1. Roughly, not a test per se: Verify if the same outcome was observed for the same month of previous years that had the same calendar. In the example, it was thus verified if what was observed for the July 2016 reference month was also observed for July 2011 and July 2005.

2. By adding a regressor which is equal to 1 for months with the pattern of interest and 0 for all other months.

Ways to test for the presence of month-specific effects

3. By adding a Trading Day (TD) effect specific to the month of interest, either TD or TDstock.
   a) Assuming that a TD regressor is incorporated in the model, in the original X12-ARIMA specs, output this regressor by adding “save=rmx” in the regression spec
   b) In this output, replace all values of the regressor that do not correspond to the month of interest with zeros
   c) Add the regressor to the specs as a user regressor

Ways to test for the presence of month-specific effects

Doing this can be viewed as having a distinct TD effect for the month of interest. For that reason, it makes sense to define the user regressor as a TD user regressor in the specs.

This will create six new regressors, which combined can only take 7 values corresponding to the 7 possible calendars for that month (e.g. Canada Day on a Monday, Tuesday, …, or Sunday).

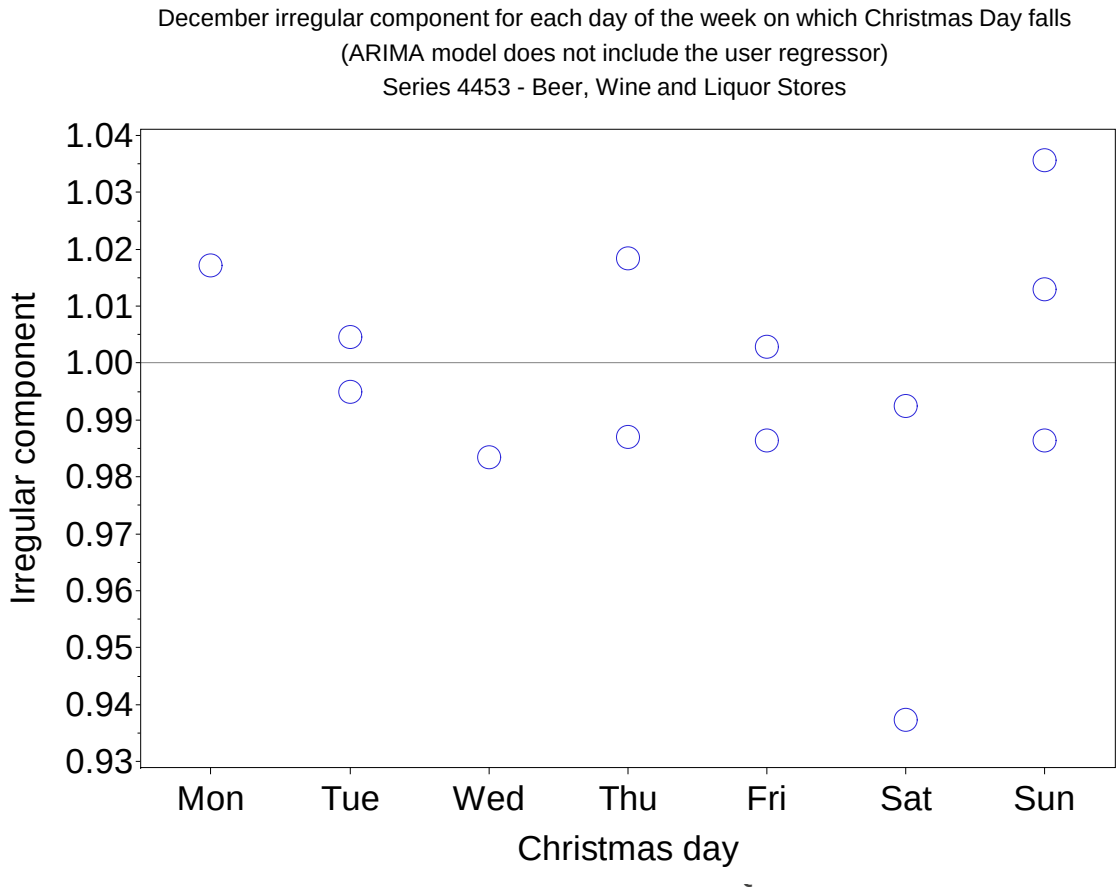
With monthly data, it is not possible to distinguish the two effects (i.e. month-specific TD effect vs. holiday calendar pattern effect).

Month-specific effects in the Canadian Monthly Retail Trade Survey (MRTS)

- MRTS:
  - Data starting in 200401 in current time series application
  - 37 sales series:
    - 21 NAICS
    - 10 provinces, 3 territories, 3 largest Census Metropolitan areas (Montreal, Toronto and Vancouver)
    - National series is derived from the sum of NAICS series

- Question: Does the day on which fall Christmas and the following New Year's Day have an impact on sales series NAICS 4453 – Beer, wine and liquor stores for December?

Month-specific effects in the Canadian Monthly Retail Trade Survey (MRTS)



Month-specific effects in the Canadian Monthly Retail Trade Survey (MRTS)

- The *F* test statistic is 3.08 with 6 and 140 degrees of freedom, leading to a *p*-value of 0.01.

- The December trading day factors (A6) with and without the December-specific user regressor are :

	Christmas Day falls on a:						
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Without	103.4	99.1	95.2	96.2	98.5	102.6	105.3
With	108.0	99.9	92.7	96.3	96.2	101.7	106.2

Month-specific effects in the Canadian Monthly Retail Trade Survey (MRTS)

- Summary of results for all 37 series:

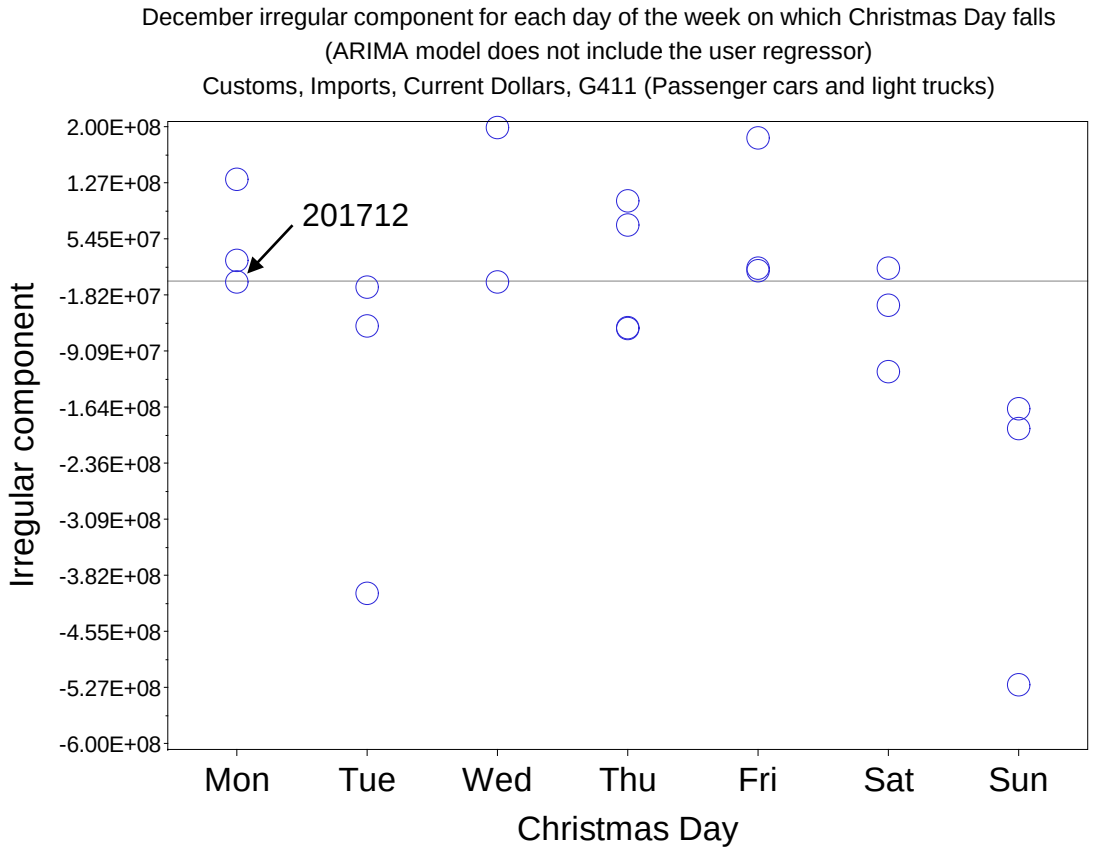
***p*-value<1%**	***1%≤p*-value<5%**	***5%≤p*-value<10%**
New Brunswick	Prince Edward Island	Newfoundland and Labrador
Montreal CMA	Nova Scotia	British Columbia
Quebec	**Beer, Wine and Liquor Stores 4453**	Yukon
Manitoba	Other General Merchandise Stores 4529	Northwest Territories
Vancouver CMA		Other Motor Vehicle Dealers 4412
Specialty Food Stores 4452		Jewellery, Luggage and Leather Good Stores 4483
Health and Personal Care Stores 446		
Miscellaneous Store Retailers 453		

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

- IMT:
  - 119 customs exports and 119 customs imports series:
    - 89 product categories
    - 30 countries/groups of countries
  - Export series start in 200201 in current time series application and import series start in 199701

- Question 1: Should the trading day factors be this low in December 2017 for importation of cars?

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)



Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

- The *F* test statistic is 3.16 with 6 and 226 degrees of freedom, leading to a *p*-value of 0.01.

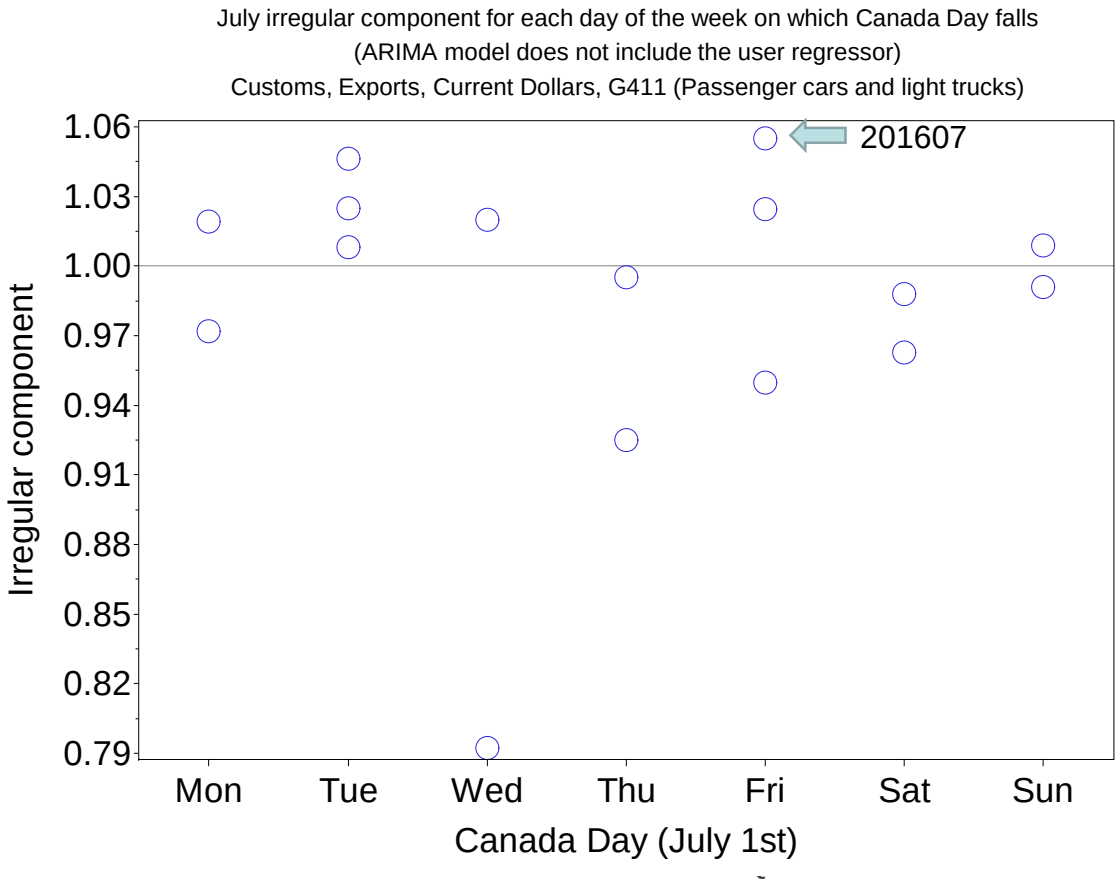
- The December trading day factors (A6) with and without the December-specific user regressor are :

	Christmas Day falls on a:						
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Without	-6.7E7	1.0E7	2.0E7	-1.6E7	2.7E7	0.8E7	1.9E7
With	9.0E7	-11.5E7	20.3E7	1.1E7	9.8E7	-3.7E7	-25.0E7

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

- Question 2: Canada Day (July 1st) 2016 was on a Friday and Independence Day (July 4th) 2016 was on a Monday, is it reasonable to expect a relatively low observed value in exportation of cars?

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)



Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

- The *F* test statistic is 1.31 with 6 and 166 degrees of freedom, leading to a *p*-value of 0.25.

- The July trading day factors (A6) with and without the July-specific user regressor are :

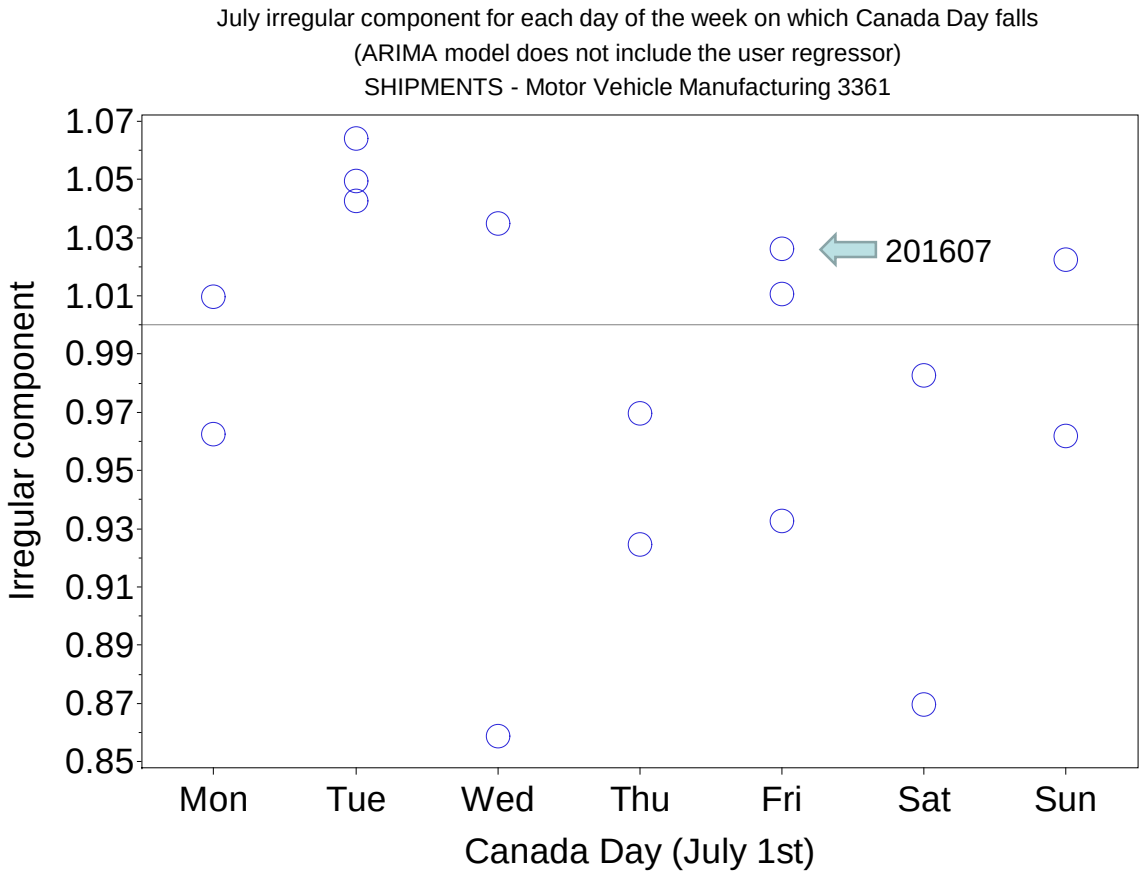
	Canada Day (July 1st) falls on a:						
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Without	101.0	101.2	101.7	101.0	98.9	97.5	98.7
With	99.0	107.1	110.1	95.0	99.6	92.4	98.1

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

- Question 2 prime: Canada Day (July 1st) 2016 was on a Friday and Independence Day (July 4th) 2016 was on a Monday, is it reasonable to expect a relatively low observed value in manufacturing of cars?

- MSM:
  - Data starting in 200201 in current time series application (same as IMT exports)
  - 27 NAICS
  - Sales, finished products, goods in process, raw materials, unfilled orders
  - Geography: National, 10 provinces, all 3 territories combined

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)



Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

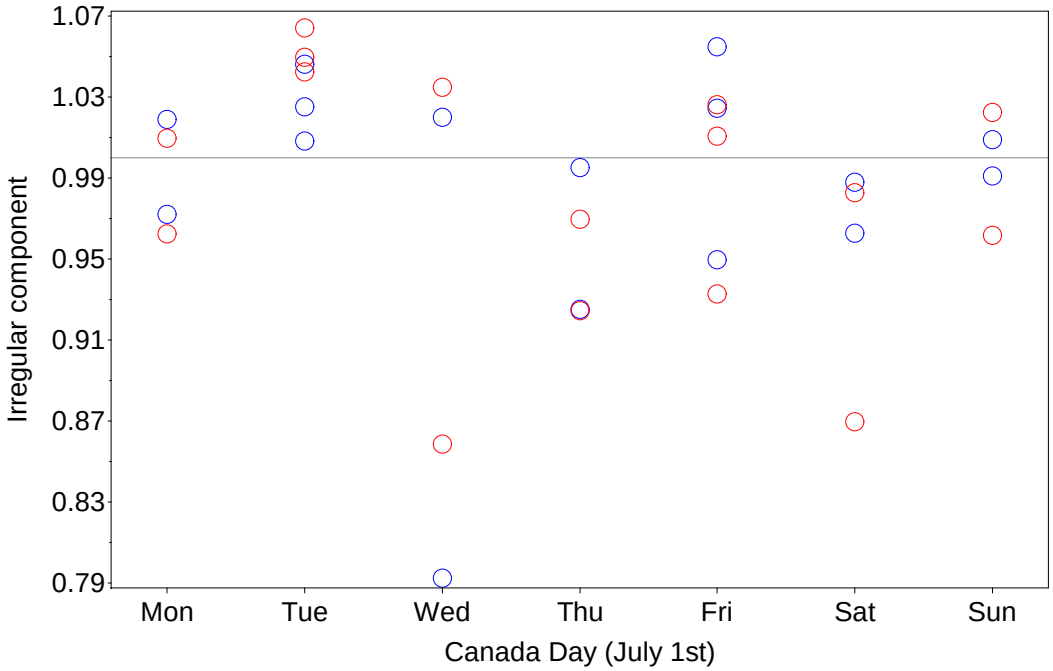
- The *F* test statistic is 6.93 with 6 and 163 degrees of freedom, leading to a *p*-value of 0.00.

- The July trading day factors (A6) with and without the July-specific user regressor are :

	Canada Day (July 1st) falls on a:						
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Without	104.1	103.8	103.6	99.9	94.5	96.8	97.8
With	100.7	113.2	118.8	91.4	92.4	90.0	97.2

Month-specific effects in the Canadian International Merchandise Trade (IMT) program and in the Canadian Monthly Survey of Manufacturing (MSM)

July irregular component for each day of the week on which Canada Day falls
(ARIMA model does not include the user regressor)
Blue: Customs, Exports, Current Dollars, G411 (Passenger cars and light trucks)
Red: SHIPMENTS - Motor Vehicle Manufacturing 3361



Conclusion

- Our study indicates that a month-specific trading day effect may sometimes be present.
- However, the study of month-specific effects in monthly data has its limits. The number of observed years might be small, which means some care must be taken when doing inferences. If many years of data are available, one must assume that the effect of the different patterns are stable on the long term to profit from it.
- The tests and trading factor estimates are pretty sensitive to changes in the data as seen in the IMT car export and MSM comparison. Furthermore, we have observed in the MRTS study (not presented) that the *F* test for the presence of an effect is sensitive to the addition of a data point. The study presented did not include December 2017. When this data point is added, the *p*-value goes from 0.01 to 0.18 and all trading day factors are a lot less affected by the inclusion of the December-specific user regressor.

Conclusion

- The kind of studies presented here might not always provide clear answers to questions from our analyst clients, but it provides a clearer picture of the situation and some relevant information.

- The study of daily data might provide more direct evidence of the presence or absence of a suspected effect. It would be less affected by a small number of years observed and could provide more timely results. These could in turn be used to help determine what are the most useful and appropriate month-specific regressors for seasonal adjustment of monthly data.

Thank you!

- For more information, please contact:
- Pour plus d'information, veuillez contacter :

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