Reference Week Adjustment for Employment Insurance Statistics

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Delivering insight through data for a better Canada

Agenda

- Overview of Employment Statistics Program
- Reference Week
- Issues Encountered During Seasonal Adjustment (SA)
- Solution 1: Modelling
- Solution 2: Alternative Data Source

Overview of EI Statistics Program

- EI Statistics Program:
  - Monthly estimates
  - Statistics on number of EI beneficiaries, number of claims, type of benefits, number of disqualifications and disentitlements.
  - Uses administrative data: administered by Service Canada on behalf of Employment and Social Development Canada
  - Data seasonally adjusted (X-12-ARIMA)

Reference Week

- Reference Week (RW): The week containing the 15th day of the month
- Number of beneficiaries obtained by counting number of people who qualified for EI benefits during the reference week (whether or not they have received benefits for other weeks)
- Reference week introduces a calendar effect due to location of the 15th day.
- Impacts month-to-month change in the EI statistical estimates.

MONTH						
SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Issues Encountered During Seasonal Adjustment

- Prior to 2017: beneficiaries wait 2 weeks before receiving EI benefits.
- Adjustment is made relative to where the 15th falls compared to Wednesday; done via a linear regARIMA model:

$$y_t = \sum_i \beta_i x_{it} + z_t, \qquad z_t \sim \text{ARIMA}$$

- where:
  - y_t is the dependent time series
  - x_{it} are the regression variables depending on time t
  - β_i are the regression parameters
  - z_t are the regression residuals

Issues Encountered During Seasonal Adjustment

Positive adjustment

MONTH						
SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

$x_{it} = +2$

Negative adjustment

MONTH						
SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

$x_{it} = -3$

$$x_{it} = \delta_{it} - 15$$

where δ_{it} is Wednesday's date during RW

Issues Encountered During Seasonal Adjustment

- As of 2017: new legislation changed the waiting period to one week.

Before 2017:
2 week waiting period

As of 2017:
1 week waiting period

- This introduced a problem for the reference week adjustment we were using.

- Most beneficiaries would request EI benefits at end of month:
  - Before 2017: Waiting period often intersects reference week
  - After 2017: Waiting period rarely intersects reference week (big impact on Health and Education sectors)

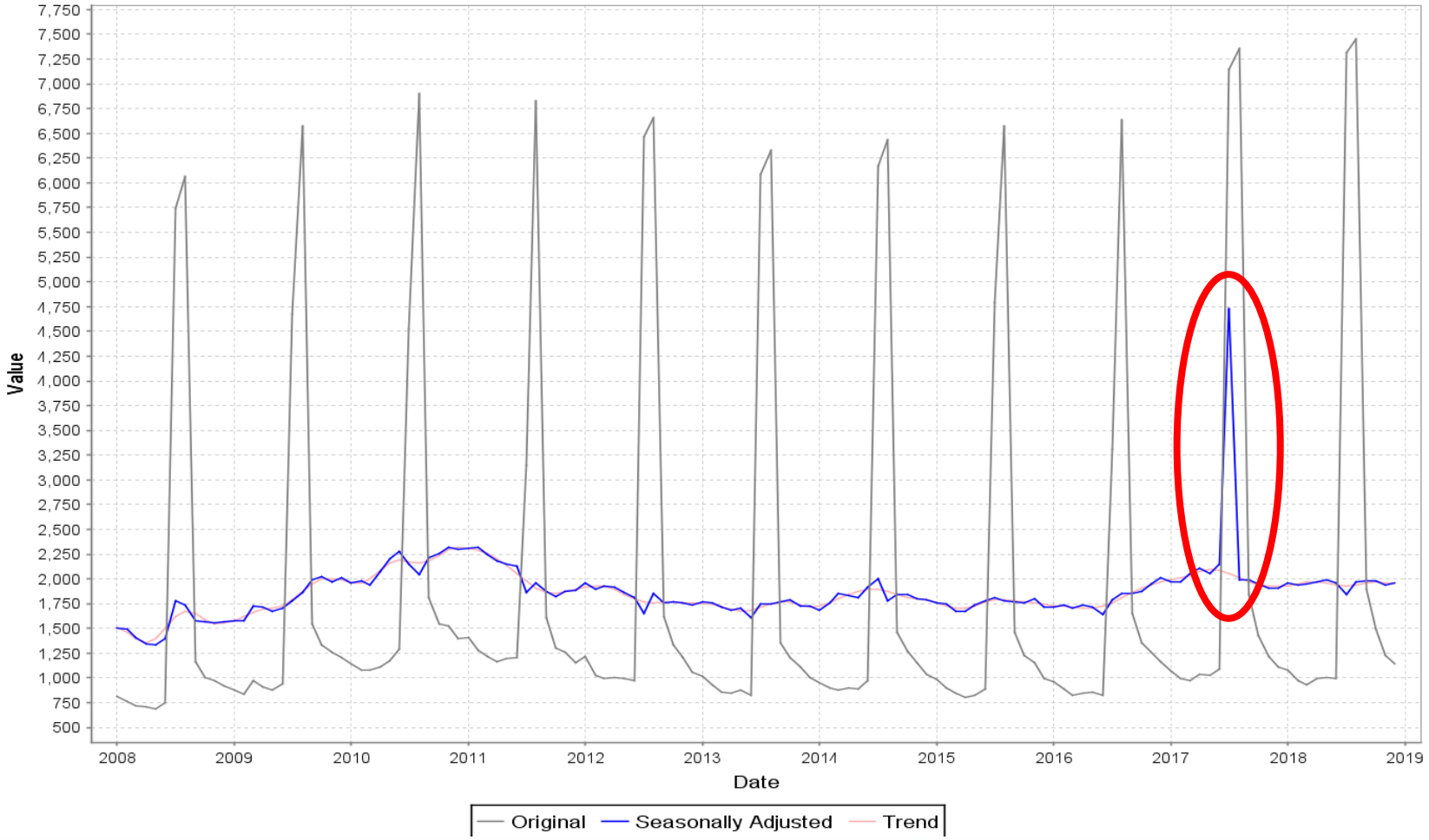
Issues Encountered During Seasonal Adjustment

- As of 2017, reference week adjustment did not seem necessary
- Keeping the linear reference week adjustment: spikes in the data would be introduced post-2017.
- Removing the reference week adjustment: spikes introduced in pre-2017 data.
- Obviously, the linear regressor was not working as we wanted.

- Had to think of a new solution to take care of this problem.

Issues Encountered During Seasonal Adjustment

Beneficiaries, Manitoba, Education (with linear regressor)



Solution 1: Use Various Non-Linear Models

- Here, we tried various non-linear models and compared to linear model:
  - $f(x_{it}) = \sqrt[3]{x_{it}}$
  - $f(x_{it}) = \exp(x_{it})$
  - $f(x_{it}) = {x_{it}}^2$
  - $f(x_{it}) = {x_{it}}^2 + x_{it}$
  - $f(x_{it}) = \text{expit}(x_{it})$

$$\text{expit}(x_{it}) = \text{logit}^{-1}(x_{it}) = \log^{-1}\left(\frac{x_{it}}{1 - x_{it}}\right) = \frac{\exp(x_{it})}{\exp(x_{it}) + 1}$$

- 1341 series: 6 models, 12 months → 96,552 results

Solution 1: Use Various Non-Linear Models

- Looking at the best model fit for each month based on R^2_{adj}, AIC, BIC (16,092 models)

R^2_{adj}

Model	% Frequency
Linear	5.56
Cube root	21.11
Exponential	11.38
Quadratic	37.61
Quadratic with linear term	17.83
Expit	6.50

AIC

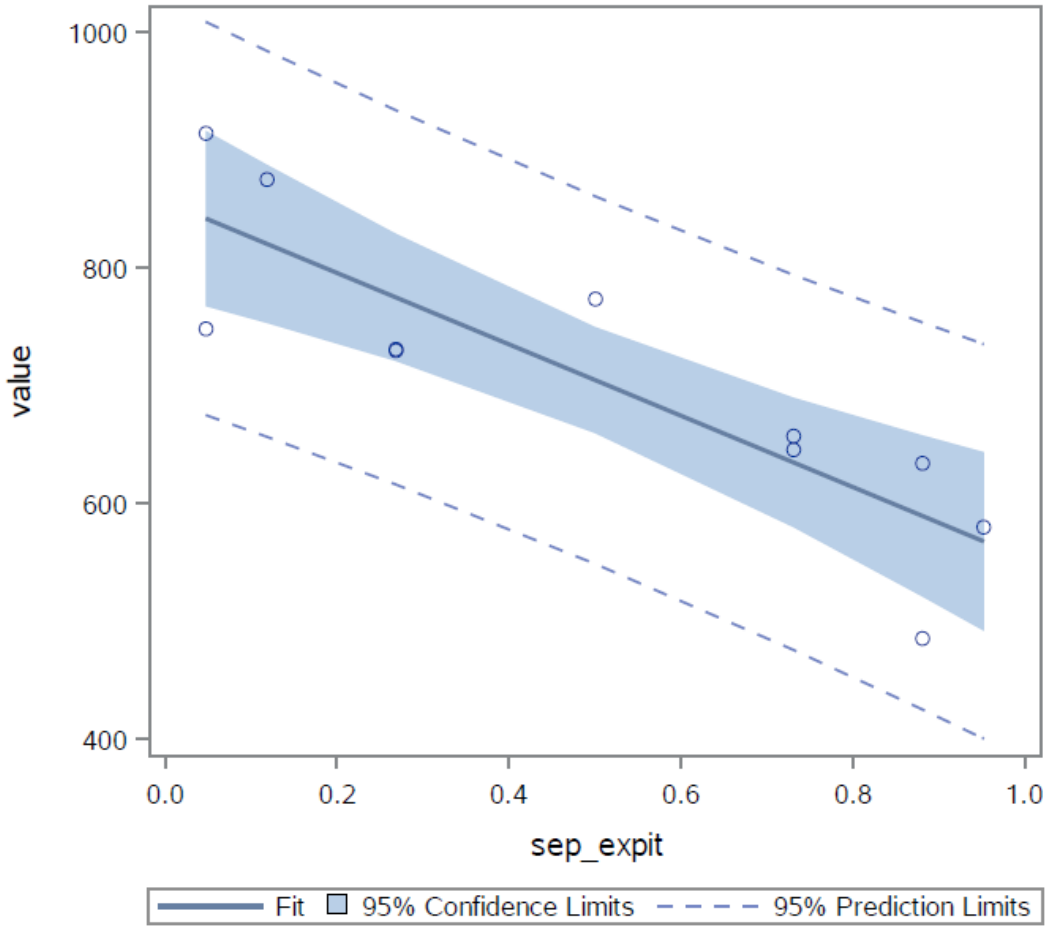
Model	% Frequency
Linear	6.05
Cube root	22.20
Exponential	12.93
Quadratic	42.09
Quadratic with linear term	9.57
Expit	7.16

BIC

Model	% Frequency
Linear	6.33
Cube root	23.01
Exponential	13.97
Quadratic	44.44
Quadratic with linear term	4.72
Expit	7.53

Solution 1: Use Various Non-Linear Models

Beneficiaries, Manitoba, Education: Expit model for September



Solution 2: Use Detailed Data

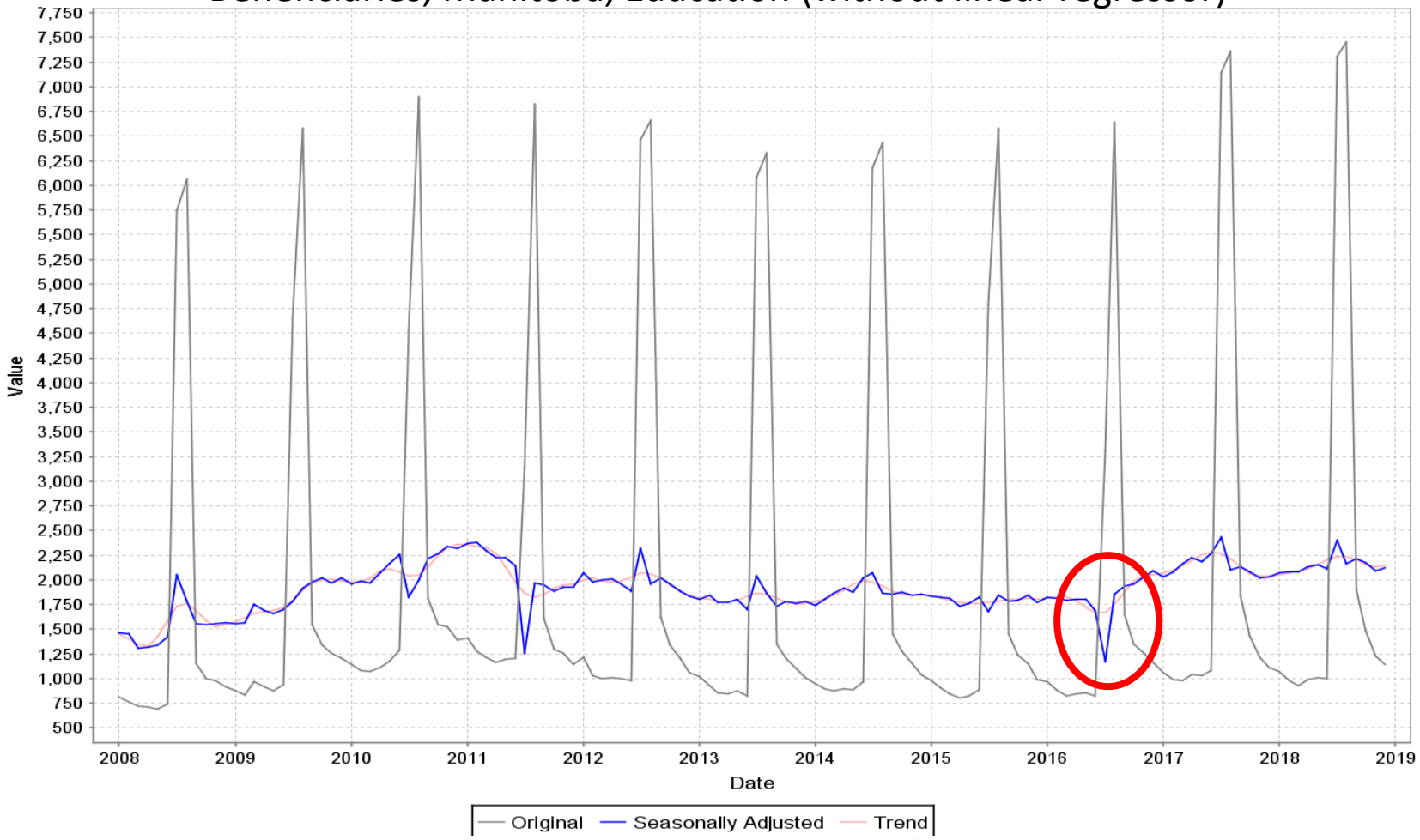
- Pretend beneficiaires prior to 2017 had one-week waiting period (we know the date when people applied for EI)

- Since reference week adjustment works well for up to end of 2016, we would do seasonal adjustment in 2 parts:
  - Prior to 2017: use the linear regARIMA model
  - Use the information from the detailed data where we pretend we have a 1-week period up to end of 2016, and use the actual data in 2017 onward.

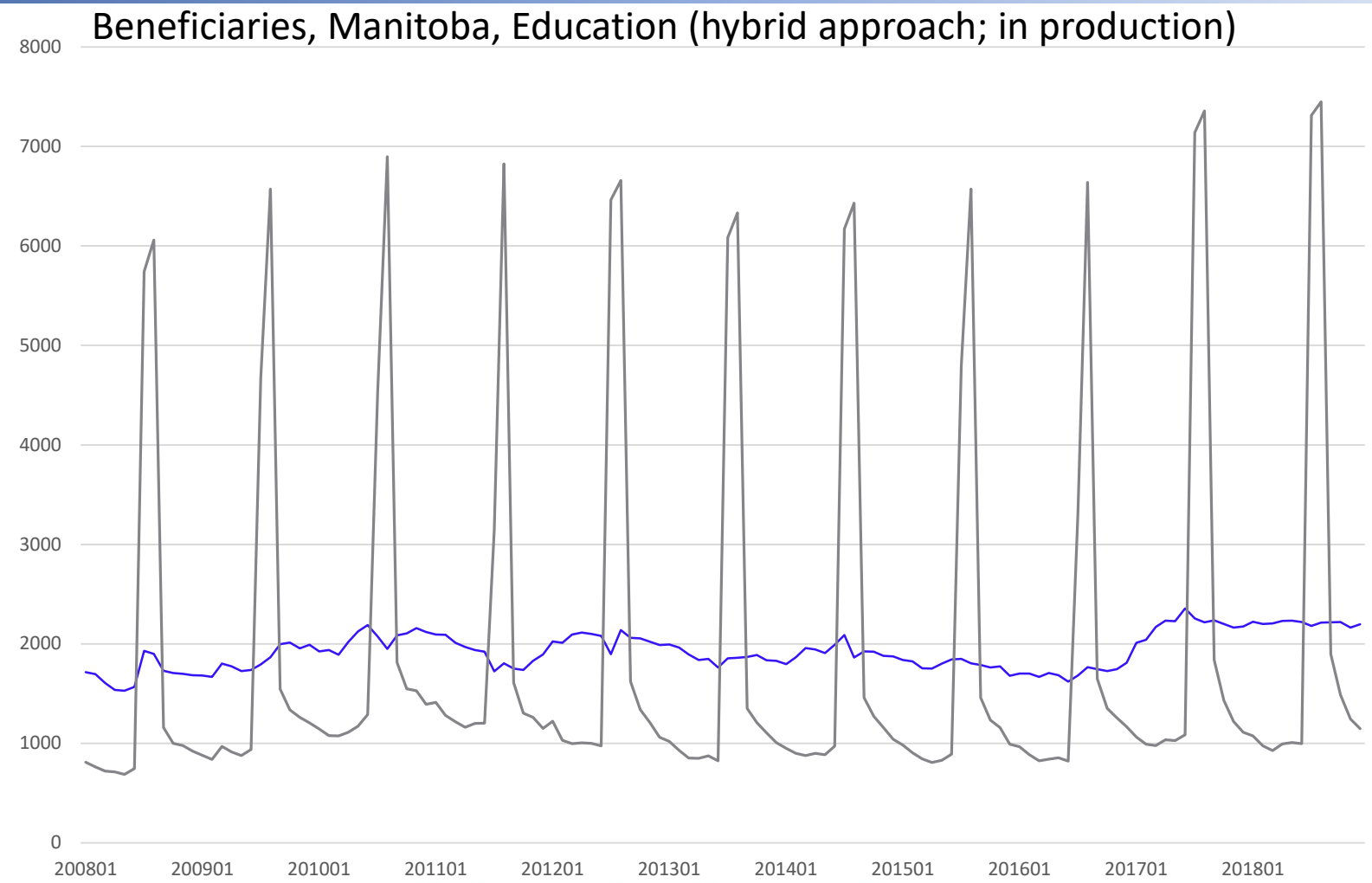
  - Results are better and results in smoother graphs with no spikes.

Solution 2: Use Detailed Data

Beneficiaries, Manitoba, Education (without linear regressor)



Solution 2: Use Detailed Data



Conclusion

- Discontinuity and spike in our data gave us issues in seasonal adjustment.
- 2 solutions considered: modelling and alternative data source.
  - The hybrid model we chose in the end removed spikes and worked well.
- Maintain the linear models for now
  - There may be potential for considering the other models (perhaps quadratic) and may leave the door open to other models when we get more data.

Thank You!

Questions?

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