PRASC

Project for the Regional Advancement of Statistics in the Caribbean

Projet régional pour l'avancement de la statistique dans les Caraïbes

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Time Series Modelling: Back-casting, Forecasting and Nowcasting explained

Project for the Regional Advancement of Statistics in the Caribbean (PRASC)

Steve Matthews
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Delivering insight through data for a better Canada

Back-casting, Forecasting, Now-casting

Techniques to extend a time series using statistical models

- Time series models can take advantage of the following predictable features:
  - long-term trends
  - cyclical patterns
  - seasonal patterns
  - relationships with other available data

Some series are by nature unpredictable and forecasts will not be accurate

- Volatile concepts (e.g. oil prices)
- Measurement errors (e.g. sample surveys at very detailed levels)

Back-casting

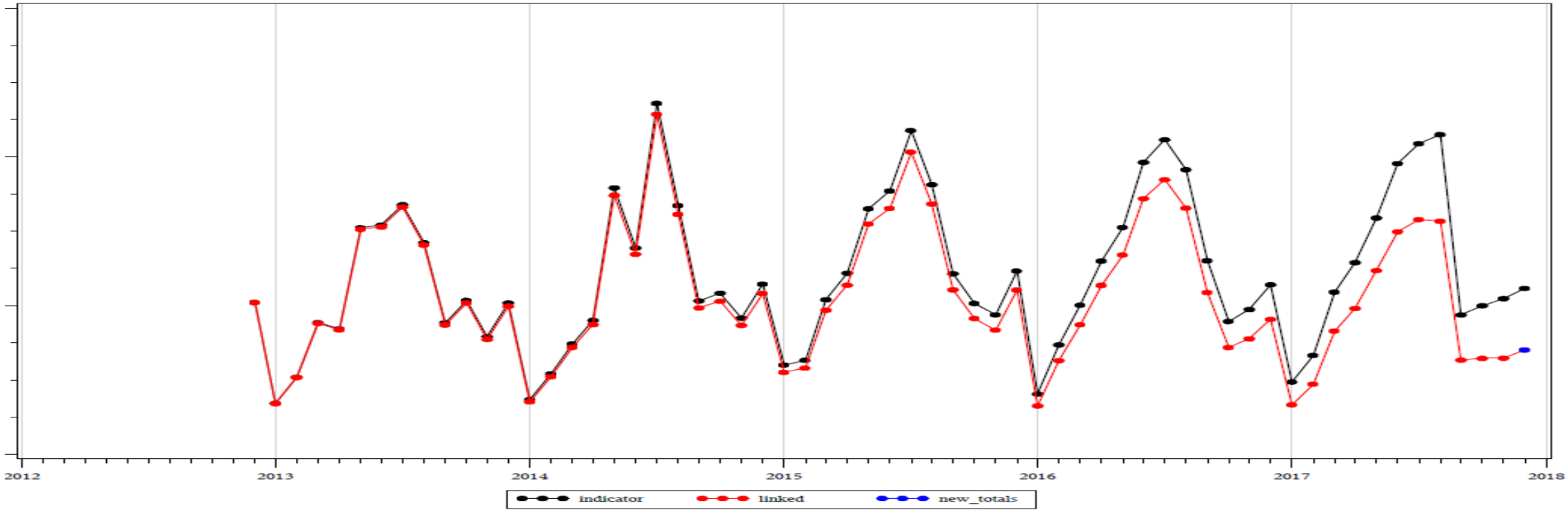
- Using time-series models to extend a series of observations back in time

- Quality depends on strength of model
  - accuracy, availability of reliable indicator series, validity of assumptions, etc.

- Used in several contexts at Statistics Canada
  - to extend a series back in time from where it was first measured
    - **strong** assumptions are needed
  - to adjust historical estimates to restore time series continuity
    - change in methodology causing discontinuity, back-casting to smooth breaks and fill gaps
    - different measures of a concept for stretches of time, back-casting to create one continuous series

Back-casting

- Restratification of Monthly Survey of Manufacturing (December 2017)
  - Leads to artificial change in level - November 2017 to December 2017
    - Future periods will be measured based on new sample
    - Adjust historical estimates to be comparable with future
    - Gradually adjust level to match new sample December 2017



Forecasting

- Using time-series models to extend a time series into the future

- Forecasts are currently produced at Statistics Canada in several contexts
  - intermediate processes (e.g. seasonal adjustment)
  - external projections – usually from micro-simulations with explicit assumptions

Forecasting

- Statistics Canada doesn't *generally* publish forecasts
  - forecasting models are based on strong assumptions (sometimes subjective in nature) and no unexpected shocks
  - "Policy on Estimates with Future Reference Dates"

Policy

The production and publication of estimates with future reference dates (frequently referred to as projections or forecasts) is a legitimate part of Statistics Canada's mandate, provided that such estimates possess the following properties:

(i) They are generated using mathematical models whose specifications are explicitly articulated and available and open for public scrutiny (e.g. on our web site).

(ii) The assumptions used in the model are clearly defined and either presented in company with the estimates or as a readily available technical annex that is referenced in the estimates.

(iii) The estimates are exactly reproducible, that is, anyone using the same model, the same assumptions, and the same input data, will always obtain the same projected estimates.

Only future reference date estimates with these properties are consistent with the Agency's goal of objectivity and professionalism.

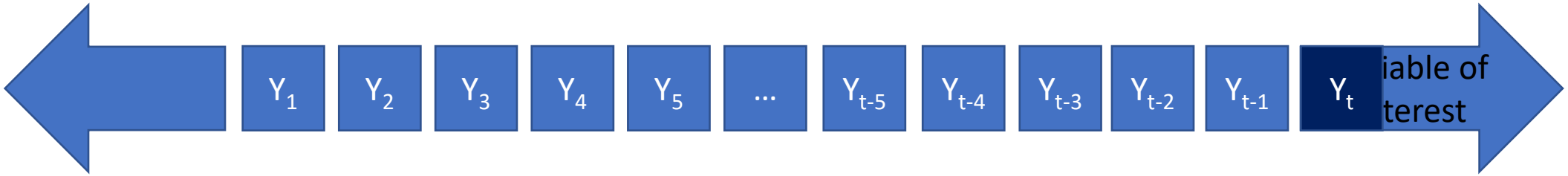
Nowcasting

- Using time-series models to extend a time series forward but not beyond the current time

A very early estimate produced for an economic variable of interest over the most recent reference period calculated on the basis of incomplete data using a statistical or econometric model different from the one used for regular estimates. (Eurostat, 2018)

- released as soon as feasible after the end of the reference period
- more information will be received and information will be used differently in regular estimate

Nowcasting for “Real-time estimation”

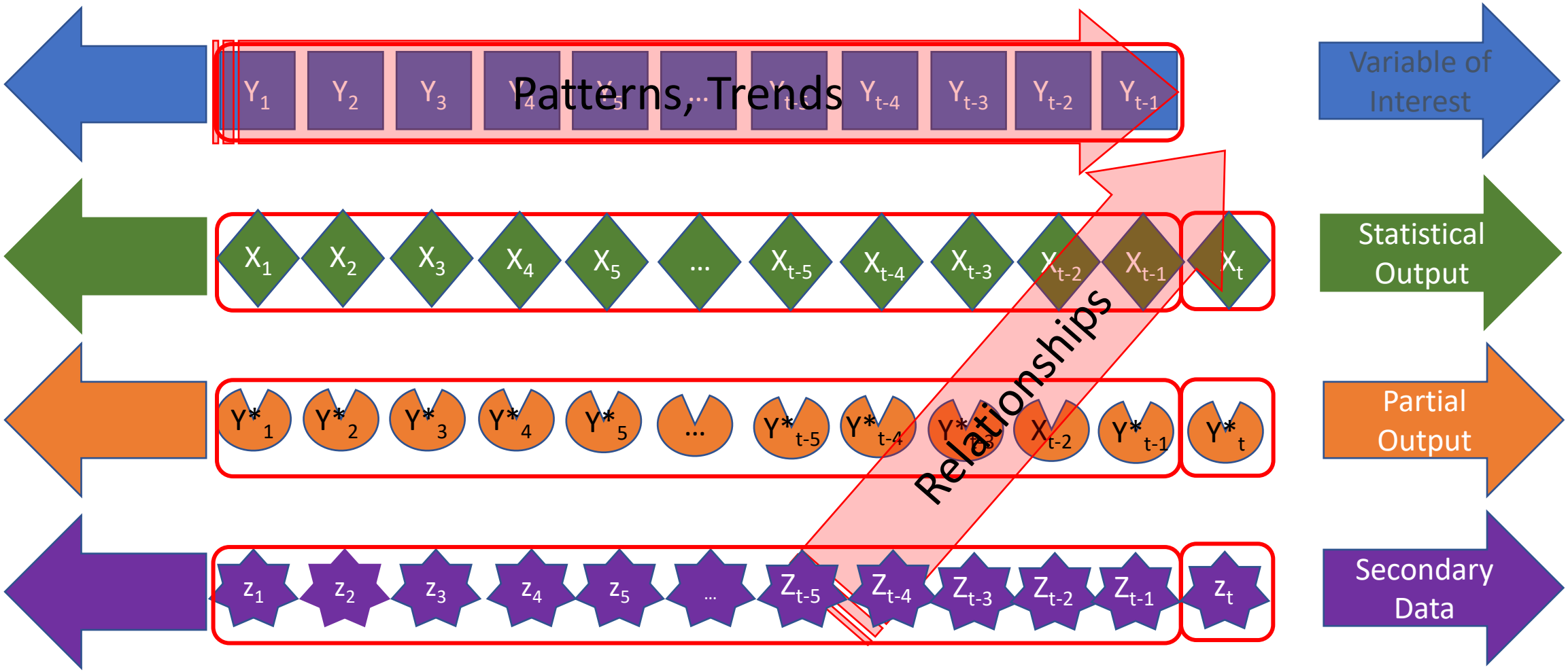


Based on “Major Economic Releases”

Frequency	Average Lag for “Preliminary” release
Annual	195 days
Quarterly	62 days
Monthly	39 days

Proof of concept exercises, evaluation studies underway to assess need for users, resource requirements, anticipated quality.

Nowcasting for “Real-time estimation”



Nowcasting for “Real-time estimation”

Case Study: International Trade

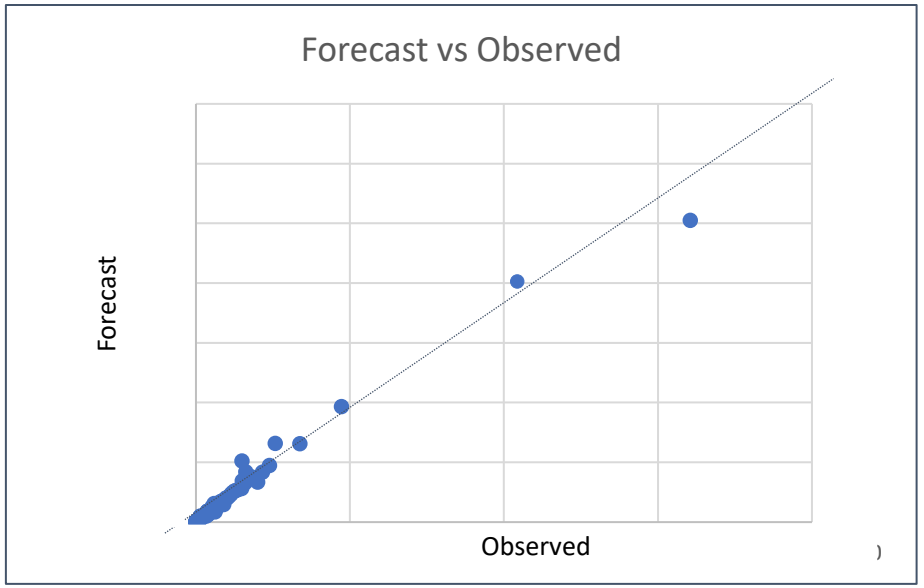
- Monthly estimates of imports and exports by commodity and trading partner
- Exports data obtained from United States Census Bureau on a monthly basis
- December 2018: US Government Shutdown meant data was not received

A time series model including the following features was used to “nowcast” the exports to the United States for each commodity

- seasonal component
- slowly evolving trend-cycle
- moving holiday effects
- Trading day effects

Nowcasting for “Real-time estimation”

Case Study: International Trade (cont’d)



Forecasts produced for internal use

- Including prediction interval
- Data was eventually received and published

Evaluation:

- Aggregate Exports to US: within 1.5%
- Commodity level: 1/2 with error > 7.5%

1/10 with error > 30%

Lessons Learned:

- Confirmed that precision is best at aggregate levels
- Prediction intervals are an important quality indicator
- Need for auxiliary data to improve model precision

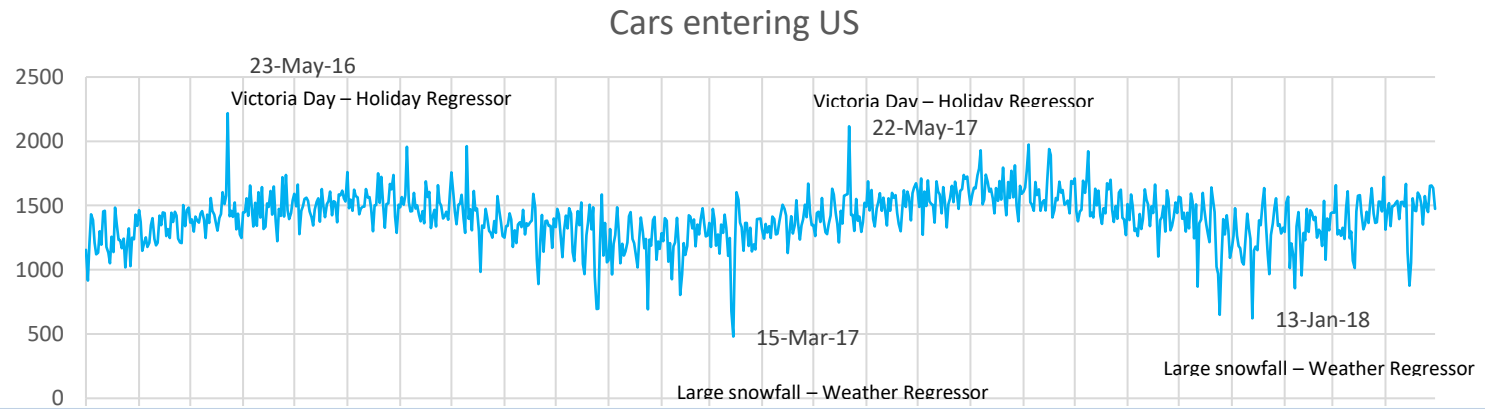
Nowcasting for “Real-time estimation”

Case Study: Monthly Frontier Counts

- Monthly estimates of cars crossing border at land ports
- Data obtained from United States Customs and Border Protection
- New data source: daily passenger counts at land ports (electronically)

A time series model including the following features was used to “nowcast” daily counts:

- seasonal component
- day-of-week component
- slowly evolving trend-cycle
- estimated holiday effects
- estimated weather effects



Nowcasting for “Real-time estimation”

Case Study: Monthly Frontier Counts

Nowcasts of unobserved daily counts are combined with observed daily counts to estimate total monthly counts.

1W Horizon	2W Horizon	3W Horizon
3.25	4.26	5.20

Lessons learned

- More observed counts lead to a better accuracy (timeliness vs. precision)
- Use of weather data, holiday effects improved model
- Could add more variables to further refine (events taking place in Buffalo, etc.)

Nowcasting for “Real-time estimation”

Upcoming Case Studies:

- Working closely with subject matter experts for input on:
  - Potential data that is available for use in models
  - Level of accuracy needed to be useful

- Working on recently identified case studies
  - Retail trade (based on alternate data sources)
  - Energy exports (based on domestic production)
  - Annual estimates (based on monthly counterparts)
  - Price indexes (based on alternate data sources)
  - And others…

Key Take-aways

General Time Series Models

- Build in long-term trend, seasonal patterns, and other effects
- Can extend series back in time (back-casting), or into the future (forecasting)
- Quality depends on stability and/or available information

Distinction between Nowcasting and Forecasting

- Some Forecasting for internal use
- Planning to develop “Nowcasting” at Statistics Canada
  - Able to use many predictor variables
  - To improve timeliness or supplement traditional estimates
  - Appreciated by users during pandemic

You can contact the PRASC team at:

statcan.prasc-prasc.statcan@canada.ca