Food and Agriculture Organization
of the United Nations

Nowcasting and Forecasting at FAO

Marcello D'Orazio (*marcello.dorazio@fao.org*)
Office of the Chief Statistician (OCS)
Food and Agriculture Organization (FAO) of the UN
Rome, Italy

CCS-UN Technical Workshop on Nowcasting in International Organizations

3-4 February 2020, Geneva, Switzerland

Statistics at FAO

Statistics is at the core of FAO's work and represent a highly visible area of the Organization's work (Art. 1 FAO Constitution)

- Agriculture
- Forestry
- Fisheries
- Land use and Water resources use
- Climate and Environment
- Food security
- …

http://www.fao.org/statistics/en/

FAO is the custodian UN agency for **21 SDG indicators** (and is a contributing agency for a further 5)

http://www.fao.org/sustainable-development-goals/indicators/en/

FAO statistics

Typically, FAO collects **secondary data** from countries or other international organizations (but not only, e.g. geospatial data, etc.)

↳ **Timeliness** of FAO statistics is strongly dependent on timeliness of country estimates

Two examples of nowcasting/forecasting at FAO:

- Crops' production statistics forecasting
- Food Security statistics nowcasting

FAO Nowcasting/Forecasting of Crops

Data collected from countries (http://www.fao.org/faostat/en/#data/QC):

- **Area harvested**, **production quantity** and **yield** for **173** products
- All primary crops for all countries and regions in the World, from 1961 up to 2017 (last update December 19, 2019)

Short-term Forecasts for basic food commodities (cereals, meat, etc.) at country and regional/global level part of statistical outputs in the FAO **Global Information and Early Warning System** (GIEWS) http://www.fao.org/giews/en/

Forecasts based on the exploitation of all the available information:

- Earth observation data
- Ground based information
- Rainfalls data

Medium-term forecasts (10 years) in the **OECD-FAO Agricultural Outlook** (http://www.agri-outlook.org/)

- rely on input from country and commodity experts and from the OECD-FAO Aglink-Cosimo model of global agricultural markets

FAO Nowcasting of PoU

Prevalence of Undernourishment (**PoU**; SDG indicator 2.1.1):

Proportion of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life

http://www.fao.org/sustainable-development-goals/indicators/211/en/

Model-based estimates: country distribution of the habitual dietary energy intake is estimated using a number of different data sources.

- PoU estimates at country level (3-years moving average) available from 2000 to 2017
- PoU annual regional and global level estimates go from 2000 to 2018

- **Nowcasts** for 2018: based on (independent) nowcasts of the parameters of the model using basic time series models or models exploiting updated (or forecasted) auxiliary information
  - Nowcasts allow calculation of 2017 country estimates (2016-2018 moving average) and annual regional/global estimates for 2018 (http://www.fao.org/publications/sofi/en/)
- **Forecasts** up to 2030 (*in future*); different options: time-series methods; forecast of the parameters of the model

FAO nowcasting/forecasting SDGs (1/3)

a) As for the PoU, nowcasting would be useful for other SDGs indicators under FAO custodianship (at both country and regional/global levels)

b) to judge whether targets set in Agenda for SD can be achieved in 2030 there is the NO need of explicit forecasts for the SDG indicators

Typical problems with SDGs indicators at FAO:

- Too short time series (e.g. only 4 data points, excluding PoU and 14.4.1)
- Data gaps: missing values and missing countries
- Types of data: often proportions or ratios

- **Nowcasting** (a) would require fitting models that exploit existing (when available) reliable auxiliary information (EO data, etc.)

- Objective (b) currently based on simple time-series models (**random walk with drift**, to data or to *log*-transf. data), as done also in other Agencies

FAO nowcasting/forecasting SDGs (2/3)

Assessing progress toward the SDG targets currently based on simple time-series models (**Random Walk with Drift**, to data or to *log*-transf. data)

Linear growth (*RW with drift*)	$x_{t_0+k} = x_{t_0} + k \times g$	SDSN (2019)
Geometric growth (*RW with drift on log-transf.*)	$x_{t_0+k} = x_{t_0} \times (1+\gamma)^k$	Eurostat (2019) WHO-UNICEF (2017) UN ESCAP (2017)

- Estimation of the growth:
  - Only two data points: last available vs. baseline (x_{t_0})
  - Fitting linear regression with the time series starting from t_0 (when enough)
  - Weighted regression, higher weights to more recent growth rates (UN ESCAP)
  - Nonparametric approach (e.g. Sen's slope)

For PoU FAO is also testing the Holt's "double exponential smoothing" (with and without damped trend) (with an adequate length of the time series, depending also on variability)

FAO nowcasting/forecasting SDGs (3/3)

- Assessment of indicator's trend:
  - Comparison current growth vs. required growth to reach the target (Eurostat, SDSN, WHO-UNICEF)
  - Comparison 2030 forecast vs. target value (UN ESCAP)
  - presence of a significant monotonic trend vs. desired direction of the trend (OECD, 2019)

OECD and Eurostat approaches do NOT require having an explicit target!

Some conclusions

FAO experience application of “pure” time-series based models in nowcasting/forecasting is quite limited

More complex models exploiting available updated auxiliary information seem preferred

Nonetheless, “pure” time-series based models can be used (with a reasonable length of time series, depending also on variability):

- ✓ In absence of any reliable auxiliary information
- ✓ As a **benchmark** for more complex methods. Popular benchmarks are (Hyndman, 2018, https://robjhyndman.com/hyndsight/benchmark-combination/):
  - Random-walk model (with/without drift)
  - Simple Exponential Smoothing with drift (“theta” method)
  - Automatically selected ETS model (state space model for exponential smoothing)
  - Automatically selected ARIMA model
  - Ensemble forecasts, average of the forecasts (all or a subset) of the previous methods

In addition, they permit to assess “easily” the uncertainty associated to forecasts

Thank You
for your attention