Forecasting methods and steps

EC 361–001

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Spring 2024

Materials

Required readings:

- `Hyndman & Athanasopoulos, ch. 1`
  - Sections 1.4—1.6.

Forecasting methods

Forecasting methods

A proper forecasting exercise is heavily dependent on **good-quality data**.

- The *more* data, the *better.*

We will mostly focus on the so-called **quantitative prediction** methods, where:

1. *Numerical/quantitative* information on the variable(s) of interest is available;
2. We can assume that *past* observations/patterns of such data will continue in the future.

For these two reasons, *quantitative forecasting* is mostly applicable to **time-series** data (i.e., data collected at *regular intervals* over time).

- *Yearly, hourly, quarterly, weekly...*

Forecasting methods

In addition to quantitative methods, **qualitative** forecasting may be applied if

1. There are *no* data available;
2. The available data are *not important* to the forecast process.

Such procedures fall into the realm of **judgmental forecasts**, which we will cover if time allows.

Quantitative forecasting

Quantitative forecasting

Focusing on **quantitative** forecasting practices, our course will only pay attention to **regular time-series data**.

- This means that we will work *only* with data that are observed **sequentially** over time **at regular intervals**.

`US Unemployment rate`

`US Real Gross Domestic Product`

`US Federal Funds rate`

Quantitative forecasting

When forecasting time series data, the aim is to estimate *how the sequence of observations will continue into the future*.

This **simplest** way to go about this estimation is to use **only** information on the variable to be forecast, and make no attempt to discover the **factors** that affect its behavior.

In this case, **trend** and **seasonal** patterns are crucial for good forecasts.

Therefore, using so-called **decomposition** methods will be our starting point for forecasting.

- Exponential smoothing;
- ARIMA models.

Quantitative forecasting

However, factors **external** to the variable we wish to forecast may also influence its future observations.

Thus, forecasting exercises may also benefit from using **predictor** variables.

As an example, suppose we wish to forecast **aggregate consumption**, and we know that it may be a **function** of other factors, such as

- Disposable Income;
- Interest rates.

$$\text{Consumption} = f(\text{Disposable Income}, \text{Interest rates})$$

Quantitative forecasting

One **issue** is that such relationships are not **exact**.

Some changes in aggregate consumption may **not** be due to changes in the itself and the two other variables we listed.

Therefore, any additional **random variation** in the behavior of a time series that the model does not capture is left to an element we label as **error term**.

$$\text{Consumption}_{t+1} = f(\text{Consumption}_t, \text{Consumption}_{t-1}, \text{Disposable Income}_{t-1}, \text{Interest rates}_t, \text{error})$$

Such **mixed models** will be studied in the form of *dynamic regression models* later on.

The necessary steps

The necessary steps

Now that we know some different categories of forecasting methods, we move on to the necessary **steps** for a successful forecasting exercise.

They are the following:

1. Problem *definition*;
2. *Collecting* information;
3. *Exploratory* analysis;
4. *Choosing* and *fitting* models;
5. *Applying* and *evaluating* forecasting models.

The necessary steps

(1) Problem definition:

The **most difficult** part!

What?

Who?

Why?

The necessary steps

(2) Collecting information:

Relies on the existence of

- *Statistical* data;
- *Expertise* in data collection and forecasting.

The necessary steps

(3) Exploratory analysis:

Graphing the data is **crucial**, as it allows us to observe:

- Consistent *patterns*;
- *Trends*;
- Do the data change in a *seasonal* way?
- Are there *business cycles*?
- *Outliers*?
- Are *relationships* useful and existing?

The necessary steps

(4) Choosing and fitting models:

It is common to **compare** different potential models to be used.

Each model is itself an **artificial construct** that is based on a set of *assumptions* (explicit and implicit) and usually involves one or more parameters which must be estimated using the known historical data.

The necessary steps

(5) Applying and evaluating models:

After a model is selected and estimated, its performance can **only** be properly evaluated after the data for the forecast period have become available.

However, several **techniques** have been developed to help in assessing the **accuracy** of forecasts.

The necessary steps

For our course purposes, we will assume that steps **(1)** and **(2)** have been taken care of.

Thus, we will start next week by doing **exploratory analysis**, then moving on to steps **(4)** and **(5)**.

Next time: Time series graphics