Understanding the past. Predicting the future.

Why you should take Descriptive and Predictive Analytics

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The desire to predict the future

From the first farmers watching the seasons change, to ancient civilisations studying the stars, humanity has always looked towards the future. Generations before us developed ways to anticipate what was coming, seeking patterns in the world around them. What began with observation, experience and intuition gradually evolved into something more systematic. The pursuit of understanding tomorrow is as old as civilisation itself.



1300–1046 BCE
Shang dynasty, China

Source: Henan Museum. Collection record

Oracle bone divination

In my hometown of Henan, Shang kings used heated animal bones and turtle shells to seek answers about rainfall, harvests and warfare. The resulting cracks were interpreted as messages from ancestors and deities.

Anticipating the Nile floods

The annual flooding of the Nile shaped Egyptian agriculture. Nilometers measured the river's water level, helping assess flood conditions and anticipate their implications for harvests and taxation.



c. 3rd century BCE
Elephantine Island, Egypt

Source: Library of Congress. Photograph of the Nilometer

Rather than interpreting cracks in bones or measuring the level of a river, we now collect data, identify patterns and use statistical models to make forecasts. The underlying question, however, remains the same: what might happen next?

Why forecasting matters today

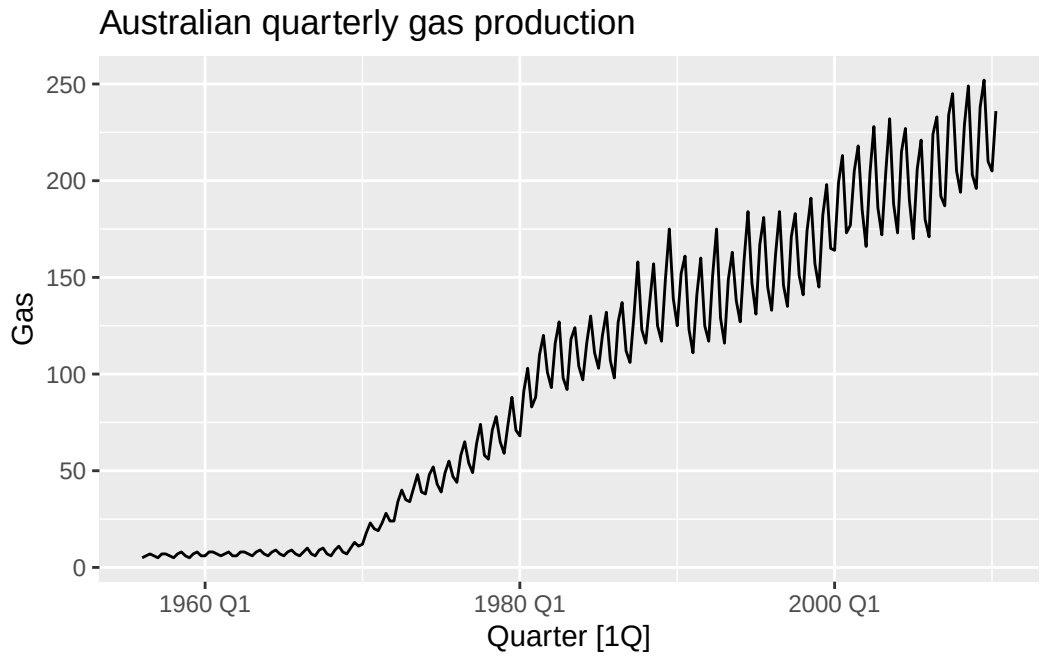
Forecasting is not just about predicting what comes next. It is about making better decisions today. Forecasts help organisations and individuals to:

- **Supply chain management:** Anticipate demand and coordinate production, transport and storage, reducing excess inventory, shortages and logistics costs.
- **Energy planning:** Estimate future gas and electricity supply to plan production, manage reserves and avoid costly supply disruptions.
- **Business and investment:** Forecast sales and revenue to plan budgets, allocate resources and assess investment opportunities.
- **Workforce planning:** Predict staffing needs to avoid overstaffing, understaffing and unnecessary labour costs.
- **Government and public policy:** Anticipate population growth, tax revenue and public service demand to plan infrastructure and allocate public funds.

A forecast does not need to be perfectly accurate to be useful. It needs to help us make better decisions under uncertainty.

What you will learn

Gas is an important part of Australia's energy production. The plot below shows quarterly gas production, measured in petajoules, over time. Take a look at the historical data. What do you think will happen to gas production in the future?



The course takes you from understanding historical data to making and evaluating forecasts.

- **Time series features and visualisation:** Learn how to explore and understand the past by identifying trends, seasonality and other patterns in data.
- **Forecasting methods and models:** Discover a range of statistical methods and models to predict what might happen in the future.
- **Forecast evaluation:** Learn how to assess forecast accuracy and compare methods to determine which forecasts are more reliable.

- **From theory to application:** Understand the mathematical foundations of forecasting methods and put them into practice using R programming, working with real-world data and developing practical analytical skills.

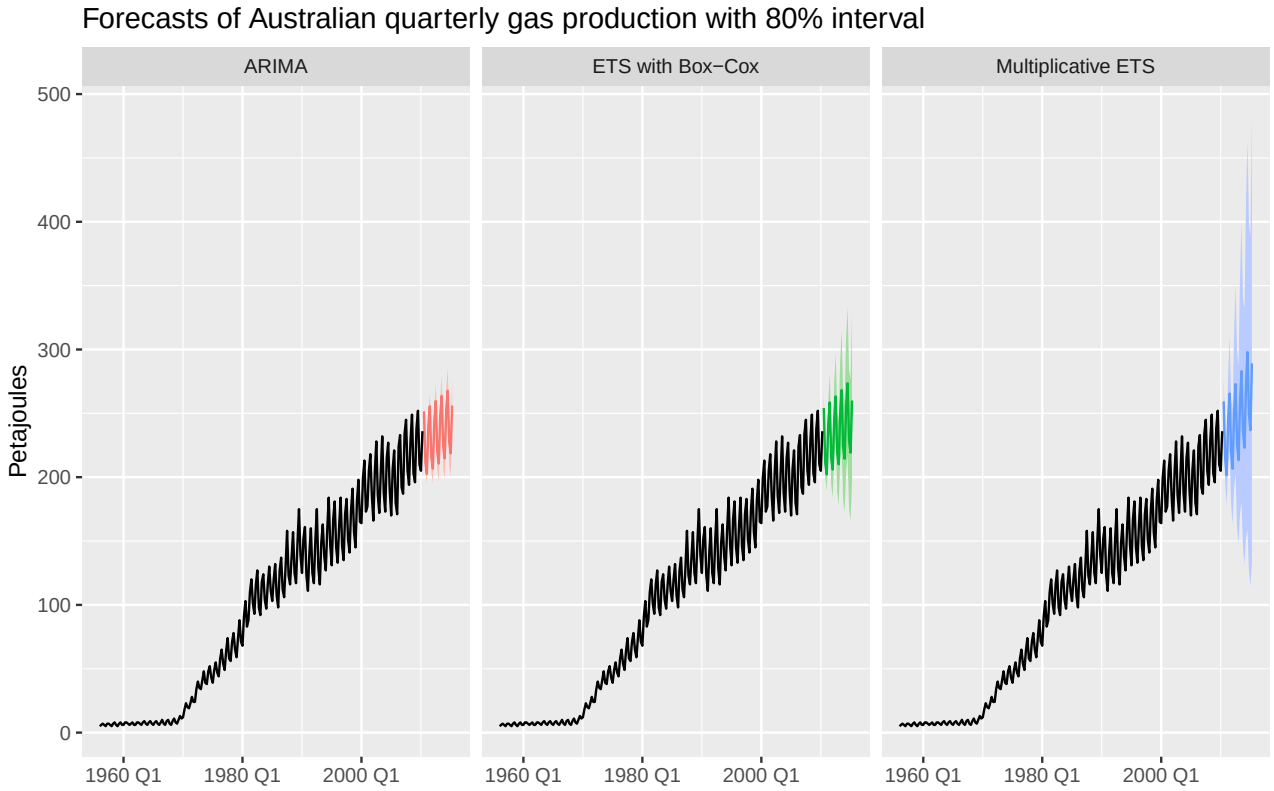
The course also includes a week on **discrete choice models and panel data models**. These methods allow you to analyse different types of outcomes and data structures, extending your statistical toolkit beyond time series forecasting.

The final assessment is a **forecasting project**. By the end of the course, you will be able to carry out a complete forecasting project, following the kind of workflow used in industry:

1. Understand and visualise the data.
2. Identify patterns and select appropriate forecasting methods.
3. Fit and compare forecasting models.
4. Evaluate forecast accuracy and assess the reliability of your results.

You will develop a systematic way of thinking about forecasting, as well as a solid foundation for exploring more advanced methods, tools and further study.

You will be able to produce forecasts like the examples below, and, just as importantly, know how to assess whether they are any good!



Compete for the International Institute of Forecasters Student Award

The top-performing student will receive the **International Institute of Forecasters (IIF) Student Award**. The IIF is a leading international organisation dedicated to advancing the theory and practice of forecasting through research, education and professional collaboration.

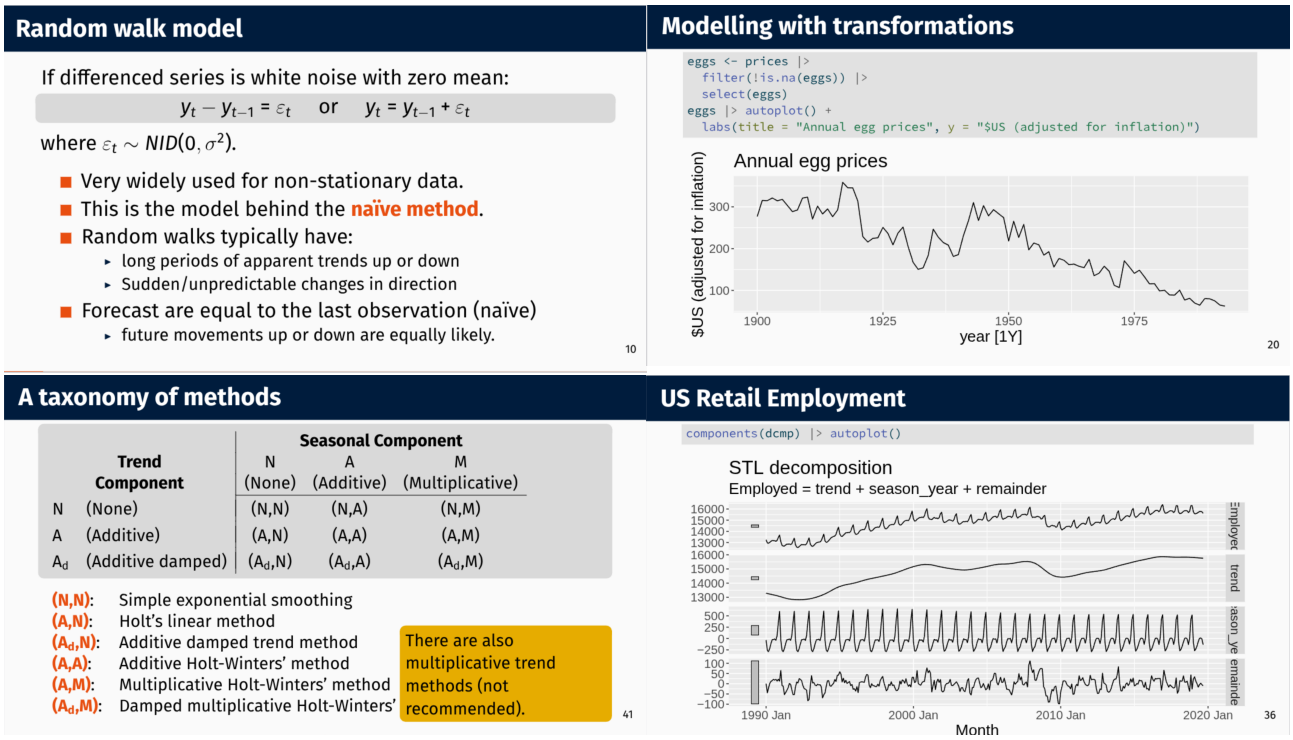
The award recipient will receive a **Certificate of Achievement** and a **complimentary one-year membership of the IIF**.

What the course looks like

The historical examples at the beginning are just an introduction. The course focuses on mathematical concepts, statistical models and hands-on programming in R.

Example lecture materials

Below are examples of the lecture slides, which introduce key concepts, explain the mathematical foundations and illustrate forecasting methods through real-world examples.



Example tutorial question

Work through mathematical exercises, interpret model outputs and apply forecasting methods to real data.

> The `us_gasoline` series consists of weekly data for supplies of US finished motor gasoline product, from 2 February 1991 to 20 January 2017. The units are in "thousand barrels per day". Consider only the data to the end of 2004. a. Fit a harmonic regression with trend to the data. Experiment with changing the number Fourier terms. Plot the observed gasoline and fitted values and comment on what you see.

```
gas <- us_gasoline |> filter(year(Week) <= 2004)
gas |> autoplot(Barrels)
```

