Applied Economic Forecasting

Basics of Time Series & Forecasting

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Section 1

Introduction to Economic Forecasting

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Outline

1. What is Economic Forecasting?
2. Explaining Time Series
3. Forecasting Methods and Steps
4. Types of Forecasts
5. Data Sources
6. Forecasting Software

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What is Economic Forecasting?

- Predicting future values based on
  - qualitative and/or qualitative judgement.

The appropriate forecasting methods depend largely on what data are available.

1. If there are no data available, or if the data available are not relevant to the forecasts, then **qualitative** forecasting methods must be used.

- require the use of well-developed judgemental forecast methods.

2. **Quantitative** forecasting can be applied when two conditions are satisfied:

i. numerical information about the past is available;
ii. it is reasonable to assume that some aspects of the past patterns will continue into the future.

What is Economic Forecasting?

Quantitative forecasts

Most quantitative prediction problems use either time series data or cross-sectional data (collected at a single point in time).

In this course, we are concerned with forecasting future data, and we will concentrate on the time series domain.

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What is Economic Forecasting?

> *Often in forecasting, a key step is knowing when something can be forecast accurately, and when forecasts will be no better than tossing a coin. Good forecasts capture the genuine patterns and relationships which exist in the historical data, but do not replicate past events that will not occur again.*
>
> *~Rob Hyndman*

A time series is a sequence of measurements over time, usually obtained at regular, equally spaced intervals

- Every minute
- Hourly
- Daily
- Weekly
- Monthly
- Quarterly
- Yearly

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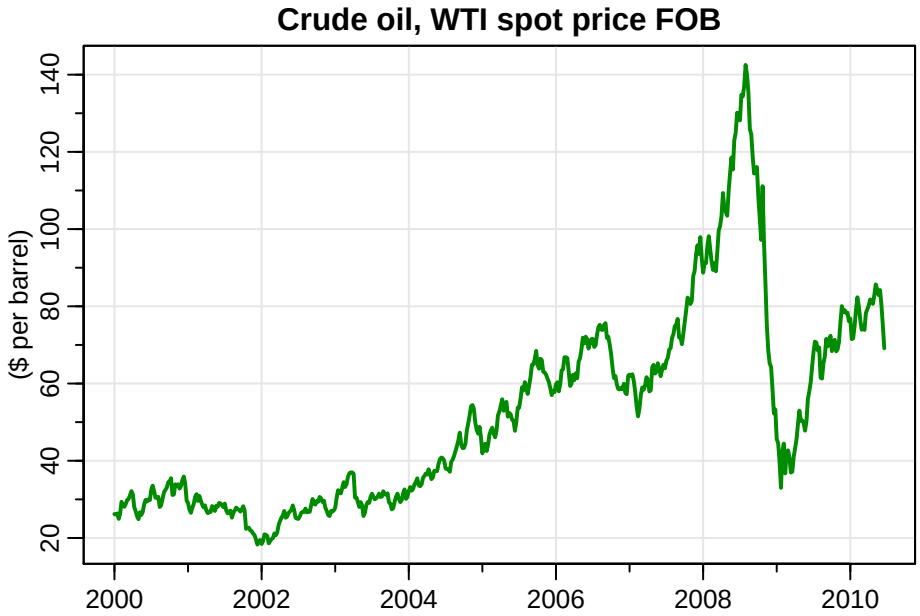
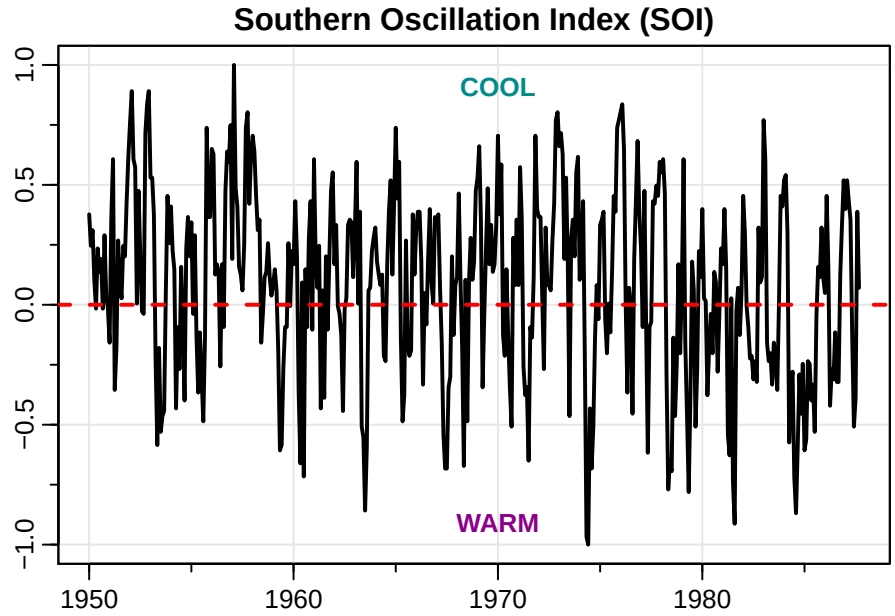
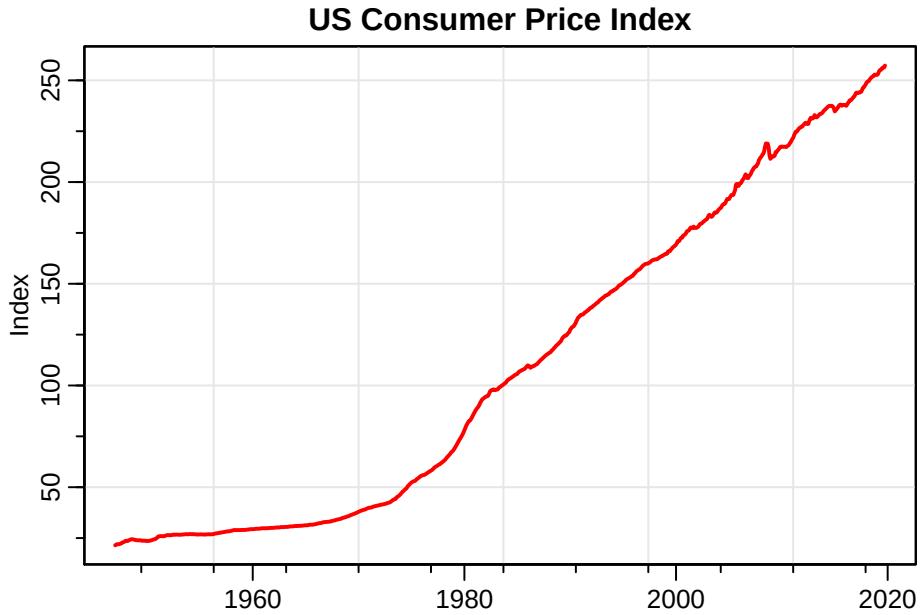
Examples of Time Series Models







Components of a Time Series

- **Trends** (exists when there is a longrun increase or decrease in the data.)
  - Linear
  - Nonlinear
- **Seasonality** (occurs when a time series is affected by seasonal factors such as the time of the year or the day of the week.)
  - Seasonality is **always of a fixed and known frequency**.
    - These patterns repeat themselves within a year.
    - These fluctuations are usually due to economic conditions, and are often related to the "business cycle".
    - The duration of these fluctuations is usually at least 2 years.
- **Cycles**
  - Rises and falls that are not of a fixed frequency

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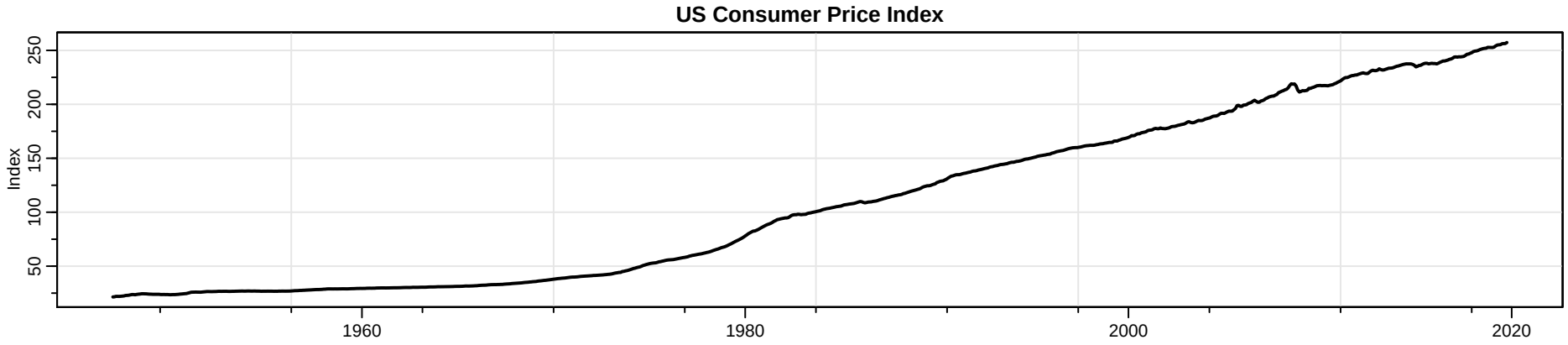
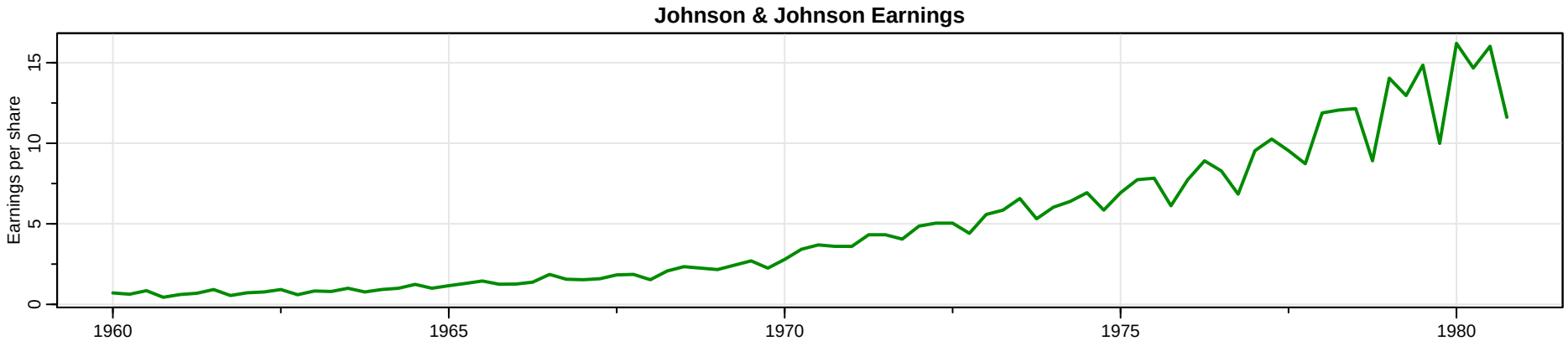
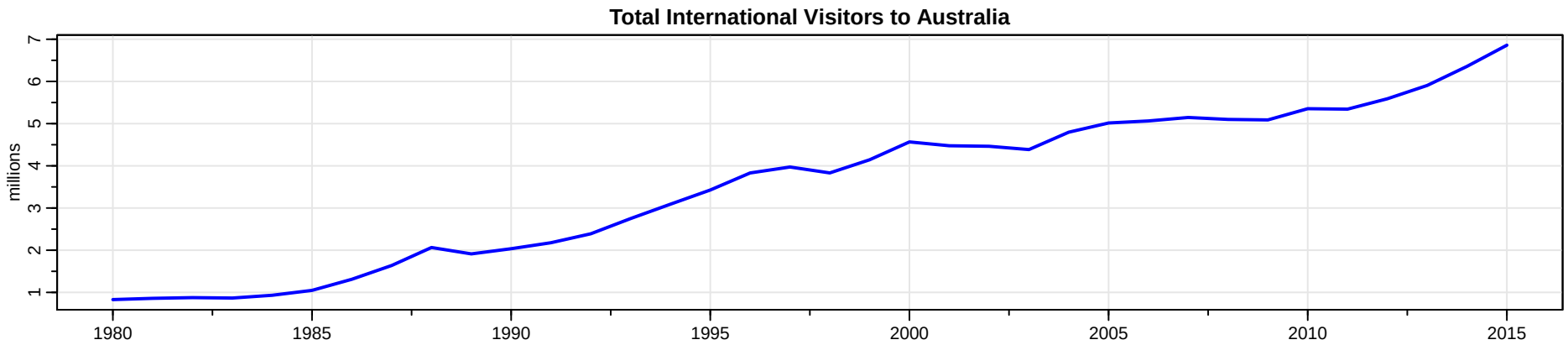
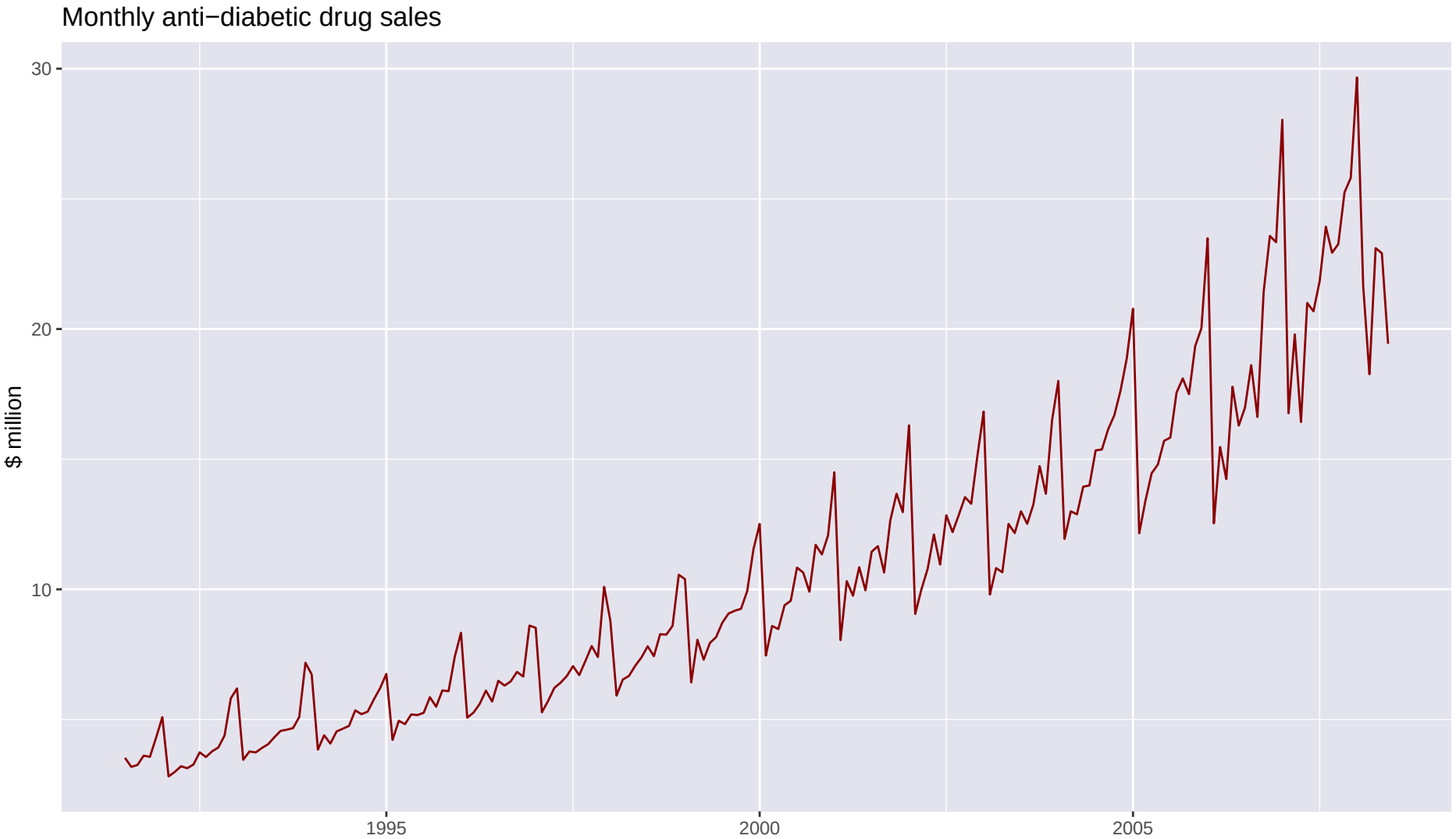
(Linear) trend models







Models with Trends and Seasonality



Forecasts of this series would need to capture the seasonal pattern and a slowly changing trend.

Forecasting Methods & Steps

1. Problem formulation
2. Data collection
3. Data manipulation and cleaning
4. Model building
5. Model evaluation
6. Model implementation (the actual forecast)
7. Forecast evaluation

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Forecasting Methods & Steps

1. **Problem formulation**

- Why is a forecast needed?
- Who will use the forecast?
- What are specific requirements on forecasting?
- What level of detail or aggregation is required?
- What is the proper time horizon?
- What forecasting methods should be chosen?

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2. **Data collection**

- Where to obtain data required by the forecasting problem?
- What are data frequencies, sample periods, sources?
- How much does data collection cost?
- What level of data is required?
- What is the data quality?

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3. **Data manipulation and cleaning**

- Missing values
- Outliers
- Different data sources
- Different units
- ...

Forecasting Methods & Steps

4. **Model building**

- This will depend on the characteristic of the data and the purpose for the forecast.
- See How to choose the right forecasting Technique

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5. **Model evaluation**

- Is the chosen model best suited for data?
- Are the underlying assumptions of the model satisfied?
  - For example, assumptions for ordinary least square (OLS) regression:
    - A.1: zero error term mean
    - A.2: error terms are homoscedasticity
    - A.3: error terms have no autocorrelation
    - A.4: no multicollinearity
    - A.5: explanatory variables and error terms are uncorrelated.
    - ...

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Forecasting Methods & Steps

6. **Model implementation for forecasting**

- rolling window forecast
- recursive/expanding window forecast
- estimation period and forecasting period
- parameter updating frequencies
- ...

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7 Forecast Evaluation

- Choice of loss functions:
  - Mean Absolute Deviations (MAD)

$$MAD = \frac{1}{T}\sum_{t=1}^{T}\left|Y_t - \widehat{Y}_t\right|$$

  - Mean Squared Error (MSE)

$$MSE = \frac{1}{T}\sum_{t=1}^{T}\left(Y_t - \widehat{Y}_t\right)^2$$

  - Root Mean Squared Error (RMSE)

$$RMSE = \sqrt{MSE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(Y_t - \widehat{Y}_t\right)^2}$$

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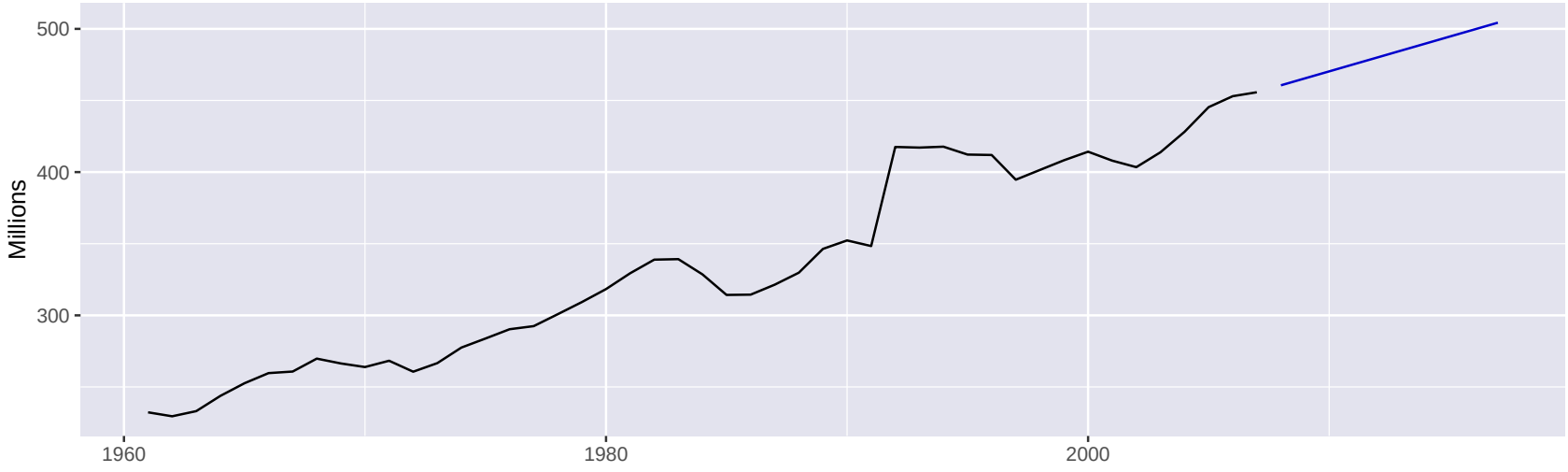
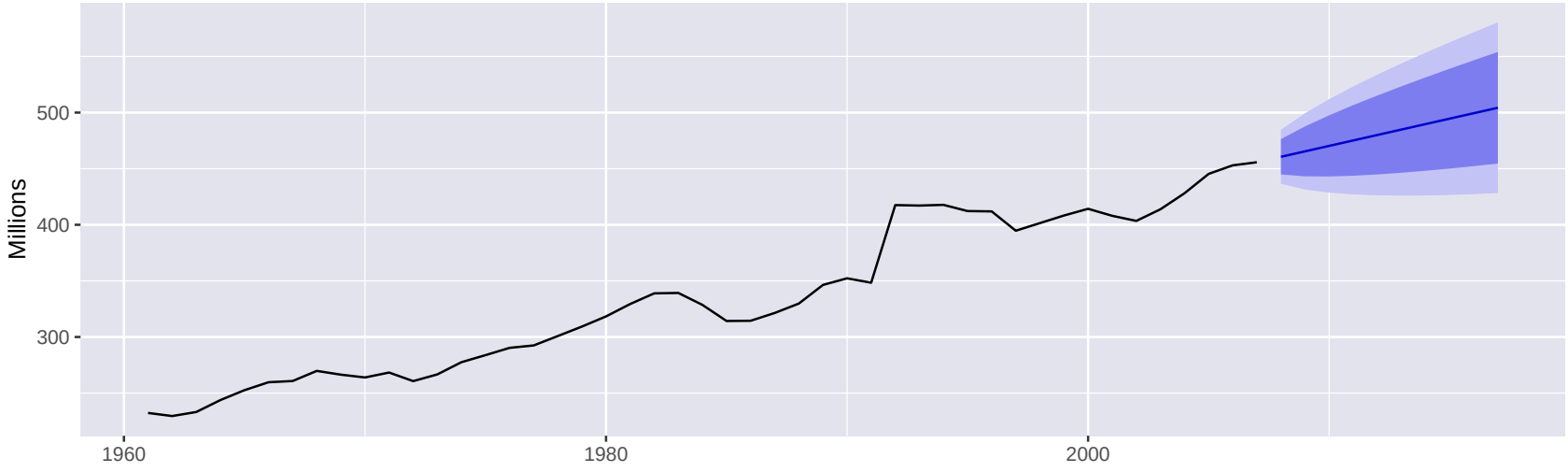
❽ Types and Objectives of Forecasting

Point Forecasts of Sheep livestock in Asia



Forecasts of Sheep livestock in Asia with Prediction intervals



Data Sources

- Federal Reserve Economic Data (https://fred.stlouisfed.org/)
- The World Bank (http://data.worldbank.org/)
- EuroStat (http://ec.europa.eu/Eurostat)
- U.S. Bureau of Economic Analysis (www.bea.gov)
- U.S. Bureau of Labor Statistics (www.bls.gov)
- U.S. Census Bureau (www.census.gov)
- OECD iLibrary (http://www.oecd-ilibrary.org/statistics)
- IMF Data (https://www.imf.org/en/Data)
- Financial Time Series (http://www.finance.yahoo.com)
- ...

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Forecasting Software

- General statistical packages
  - Minitab
  - Excel
  - SPSS
  - EVIEWS
- General statistical programming software:
  - **R**
  - Matlab
  - Mathematica
  - SAS
  - Stata
  - C
  - Fortran
  - Python

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