1. Consider the daily electricity demand in a metropolitan area. Identify deterministic and stochastic components that could influence the data generation process. Explain how each component impacts the electricity demand.

   Solution:

   Deterministic Components:

   a. **Trend:** As the population of the metropolitan area grows, there will be an increase in the electricity demand, representing a long-term upward trend in the data.

   b. **Seasonal:** Electricity usage patterns will vary predictably throughout the week, typically lowering during weekends when many businesses are closed. Demand will peak during summer and winter due to heating and cooling needs, showing predictable seasonal highs and lows.

   Stochastic Components:

   a. **Measurement errors:** Inaccuracies in meter readings or data collection can introduce noise into the time series, leading to random fluctuations in the observed data.

   b. **Irregular Events:** Sudden, unpredictable events like industrial strikes or power plant failures can cause substantial changes in electricity usage, distinct from normal patterns.

2. For each case, list the possible predictor variables that might be useful, assuming that the relevant data are available. Provide at least four predictor variables for each case.

   Source: Section 1.8 Exercise 1 from *Forecasting: Principles and Practice* (3rd ed).

   (a) A large car fleet company asked us to help them forecast vehicle resale values. They purchase new vehicles, lease them out for three years, and then sell them. Better forecasts of vehicle sales values would mean better control of profits; understanding what affects resale values may allow leasing and sales policies to be developed in order to maximize profits.
   At the time, the resale values were being forecast by a group of specialists. Unfortunately, they saw any statistical model as a threat to their jobs, and were uncooperative in providing information. Nevertheless, the company provided a large amount of data on previous vehicles and their eventual resale values.

   Solution: Consider the following predictor variables:

   - Model and make of the vehicle
   - Odometer reading
   - Conditions of the vehicle
   - Company the vehicle was leased to
   - Color of the vehicle
   - Date of sale

(b) In this project, we needed to develop a model for forecasting weekly air passenger traffic on major domestic routes for one of Australia's leading airlines. The company required forecasts of passenger numbers for each major domestic route and for each class of passenger (economy class, business class and first class). The company provided weekly traffic data from the previous six years.

Air passenger numbers are affected by school holidays, major sporting events, advertising campaigns, competition behaviour, etc. School holidays often do not coincide in different Australian cities, and sporting events sometimes move from one city to another. During the period of the historical data, there was a major pilots' strike during which there was no traffic for several months. A new cut-price airline also launched and folded. Towards the end of the historical data, the airline had trialled a redistribution of some economy class seats to business class, and some business class seats to first class. After several months, however, the seat classifications reverted to the original distribution.

Solution: Consider the following predictor variables:

- Day of the week
- Day of the year
- Is the day before long weekend
- Is the day in the end of long weekend
- Is the day before or in the beginning of school holidays (one variable per every state)
- Is the day in the end of school holidays (one variable per every state)
- Is the day before or in the beginning of a major sport event
- Is the day after of a major sport event
- Competitors' prices (relative to the price of the airline in question)
- Is there a pilot strike at some of the competitors' airlines
- Is there a pilot strike at the airline in question

3. Analyze the patterns shown in the series of plots provided below and describe any notable features or trends observed in each case.

Source: Section 2.10 Exercise 1 from *Forecasting: Principles and Practice* (3rd ed).

(a) Clay bricks production: Figure 1.

Solution: An upward trend is apparent until 1980, after which the number of clay bricks being produced starts to decline. A seasonal pattern is evident in this data. Some sharp drops in some quarters can also be seen.

(b) Canadian lynx trapping: Figure 2.

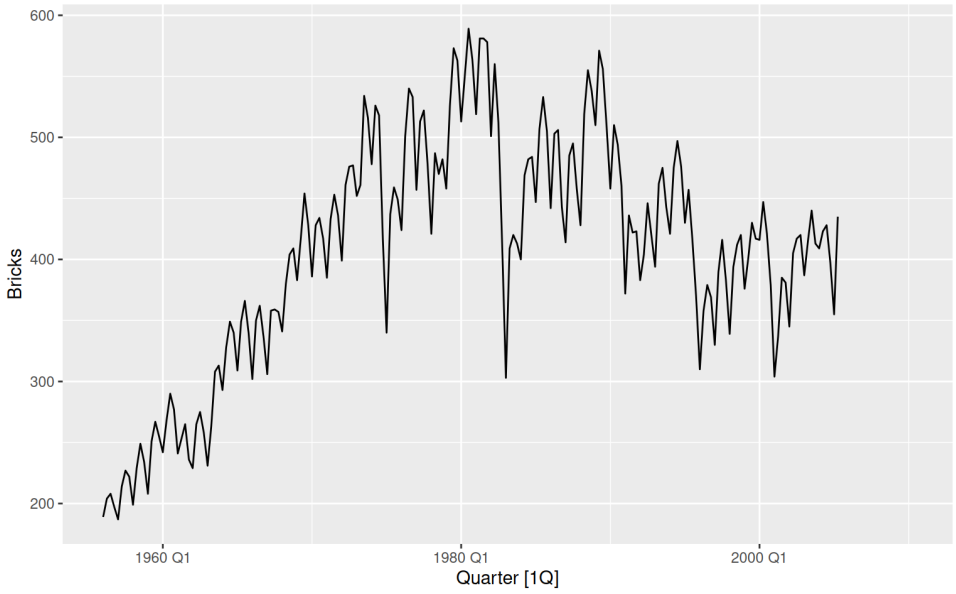

Figure 1: Clay bricks production

Solution: Canadian lynx trappings are cyclic, as the extent of peak trappings is unpredictable, and the spacing between the peaks is irregular but approximately 10 years.

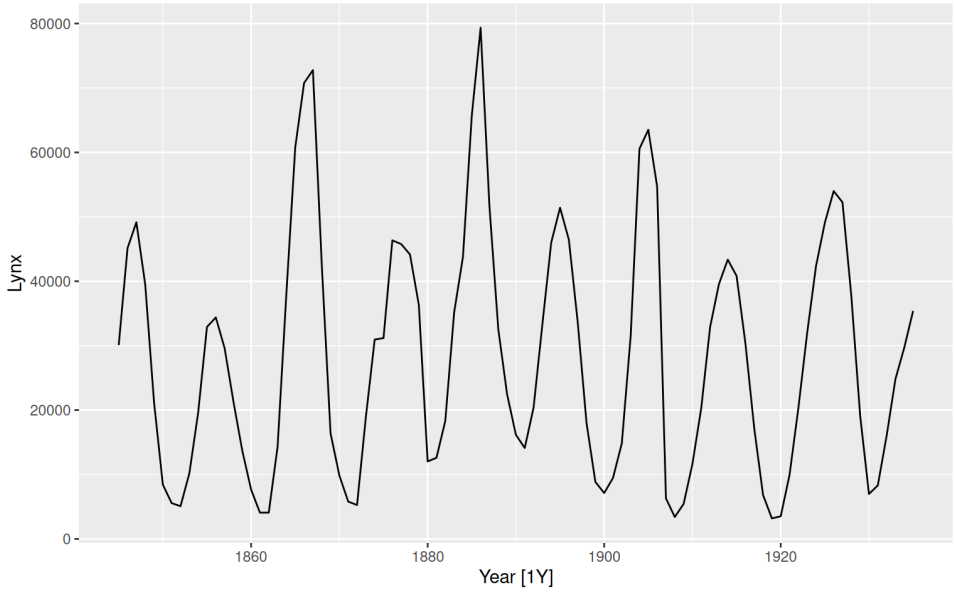

Figure 2: Canadian lynx trapping