UNIVERSITY OF BIRMINGHAM

Visualisation

Week 3

Time Series

-

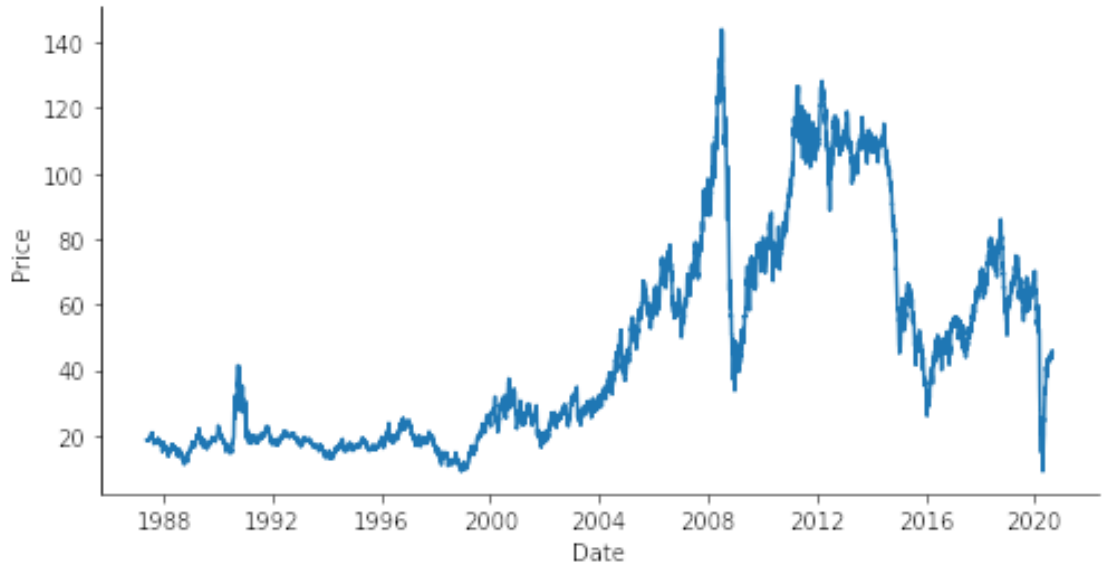
Introduction

What are Time Series?

What is a Time Series?

Date	Price		
1987-05-20	18.63	x_1	$f(1)$
1987-05-21	18.45	x_2	$f(2)$
1987-05-22	18.55		
1987-05-25	18.60	⋮	⋮
1987-05-26	18.63		
...	...		
2020-08-24	44.43	x_t	$f(t)$
2020-08-25	46.01		
2020-08-26	45.79	⋮	⋮
2020-08-27	44.84		
2020-08-28	45.22	x_n	$f(n)$

Vector $\boldsymbol{x}$ Function $f(t)$

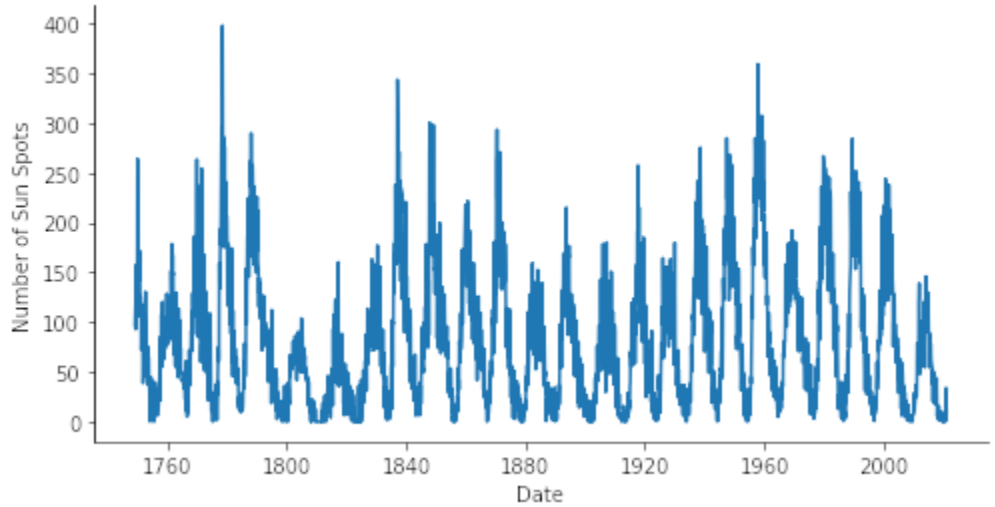


- A series of observations at discrete points in time.

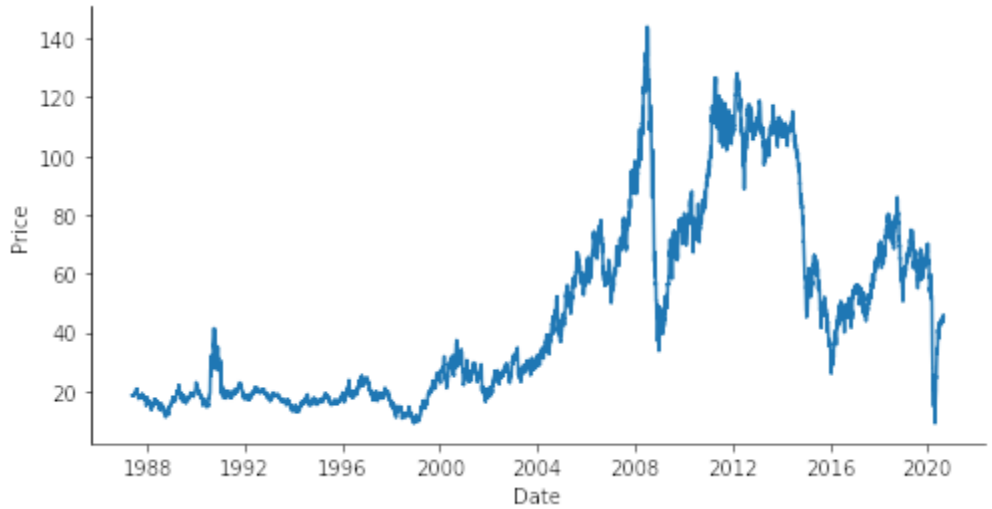
We will assume:

- Time is equally spaced.
- Only one Variable.

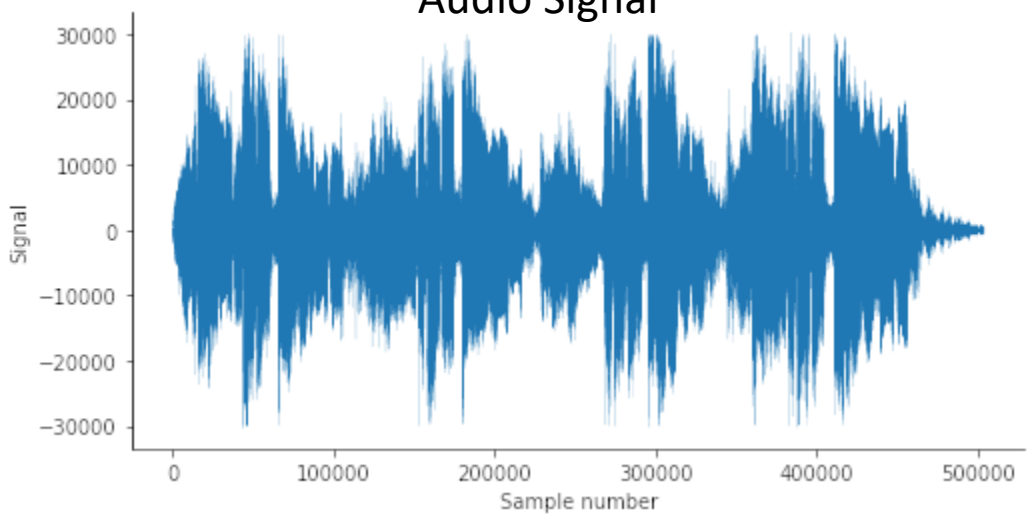
Number of Sunspots



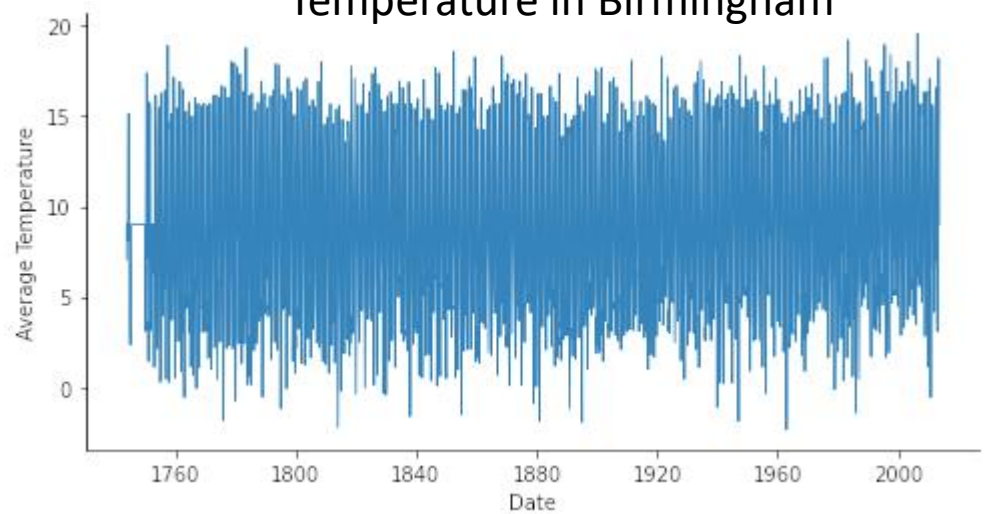
Oil Price (Brent)



Audio Signal



Temperature in Birmingham

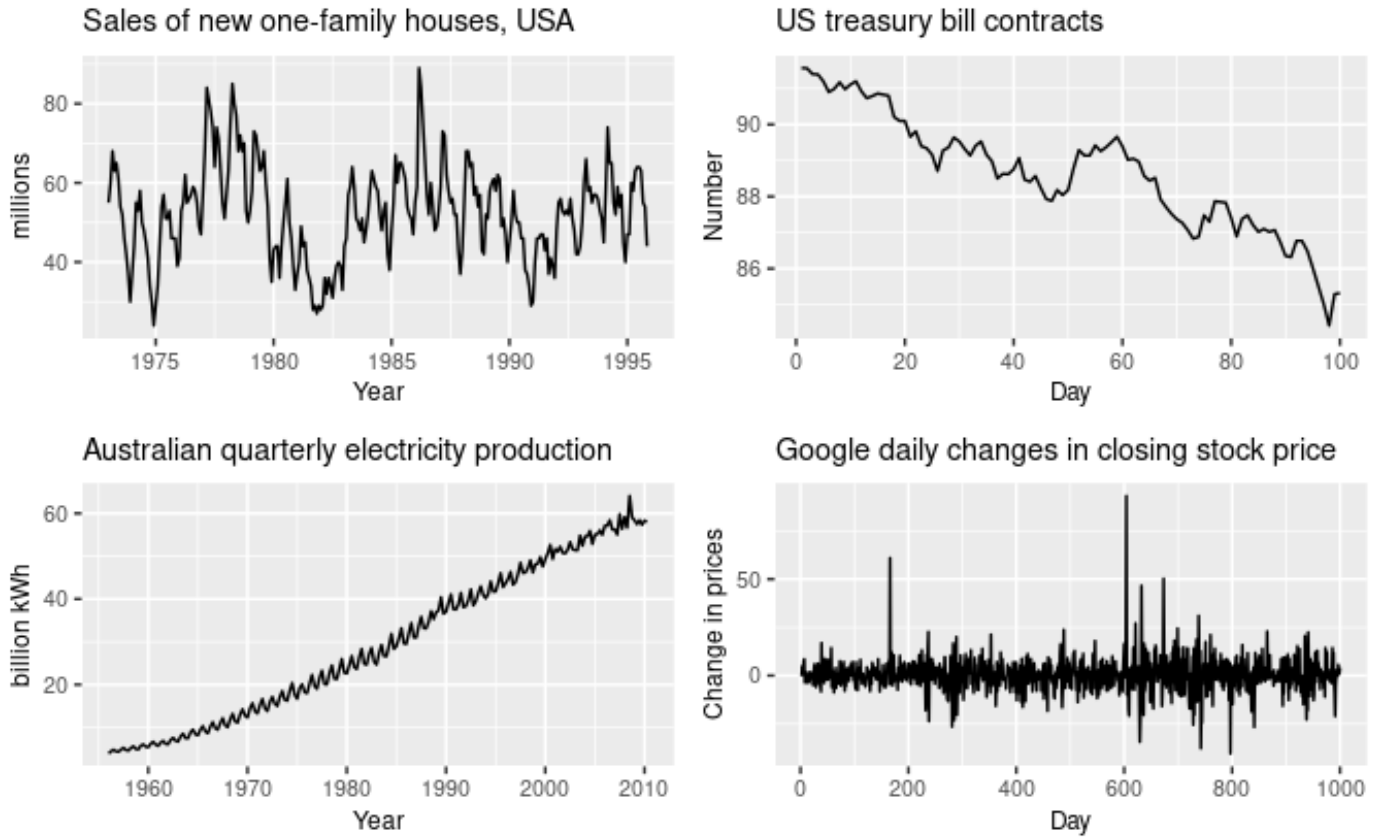


Some Types of Patterns

Trend:
- Long term increase/decrease
- Not necessarily linear

Seasonality:
- Fluctuations of a fixed/known frequency
- E.g., days of the week, seasons of the year

Cycle:
- Fluctuations of changing frequency/duration



We will look at…

- Smoothing
  - Rolling averages
  - Weighted averages
  - Convolutions
  - Exponential smoothing and Forecasting
- The Fourier Transform
  - Visualising the frequency domain
  - Smoothing and filtering in the frequency domain
- Autocorrelation
- Decomposition
  - Separating trend, seasonality, remainder