Univariate time series
Introduction

V. Lefieux

Table of contents

The universe of time series

Examples

Course aims

Table of contents

The universe of time series

Examples

Course aims

The object of study

A **time series** is set of observations recorded in time order.

Many fields

- history (e.g. industrial revolution),
- geography (e.g. migratory flows),
- demography (e.g. growth of a population),
- economics (e.g. rate of inflation),
- finance (e.g. stock price),
- meteorology (e.g. temperatures),
- medicine (e.g. electrocardiogram),
- epidemiology (e.g. spread of a disease),
- geophysics (e.g. earthquakes),
- communication (e.g. digital television),
- energy (e.g. load curve, wind and solar generation),
- . . .

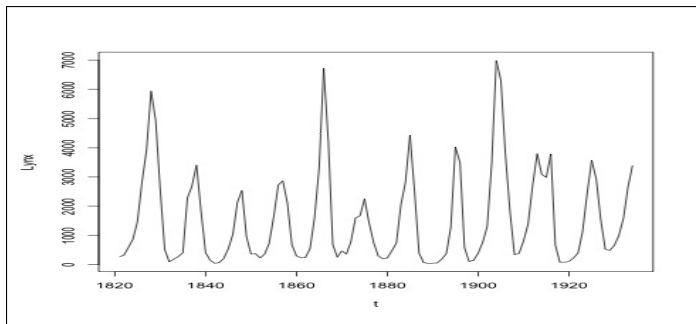# Some general questions

- Forecast and/or explain ?

Figure: Numbers of annual lynx trappings in Canada from
1821 to 1934

- Forecast interval.
- Cost of the forecasting error.
- Agreggate experts ?
- Univariate or multivariate time series ?

History of times series analysis

1. Graphics period
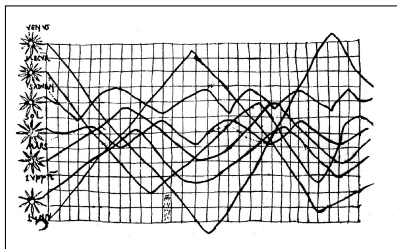   From 10th century (earlier ?), with astronomy:

   Figure: A.T. Macrobius, 10th century [4]

2. Deterministic period
   From 18th century, with frequency analysis (Fourier, Stokes, Schuster) and trend-seasonality decomposition (Pearson).

3. Probabilistic period
   From 20th century (Yule, Cramer, Wold, Kolmogorov).

Table of contents

The universe of time series

Examples

Course aims

Music score

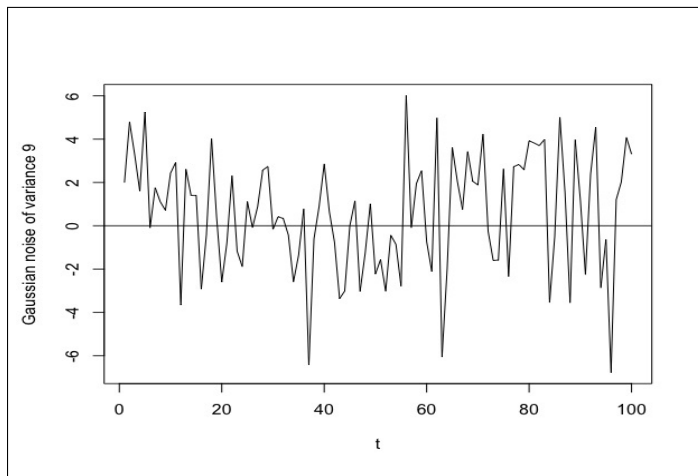Figure: French song 18th century (Archives départementales du
Pas-de-Calais)

Gaussian white noise with variance 9 ($n = 100$)

10-years USA population from 1790 to 1990 (in millions) from 1790 to 1990
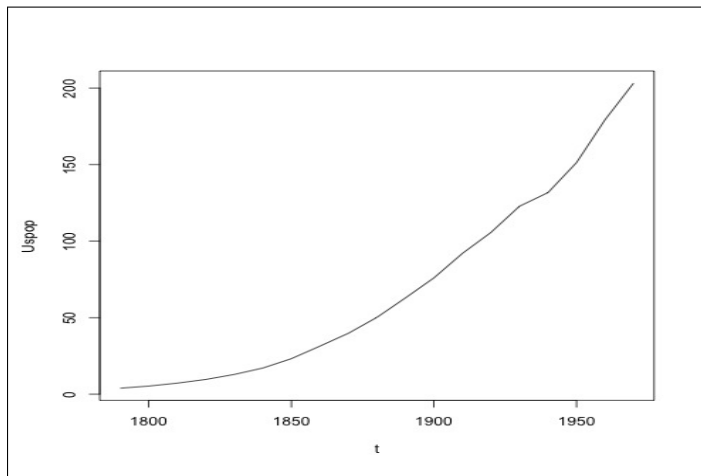
Monthly number international airline passengers (in millions) from January 1949 to December 1960
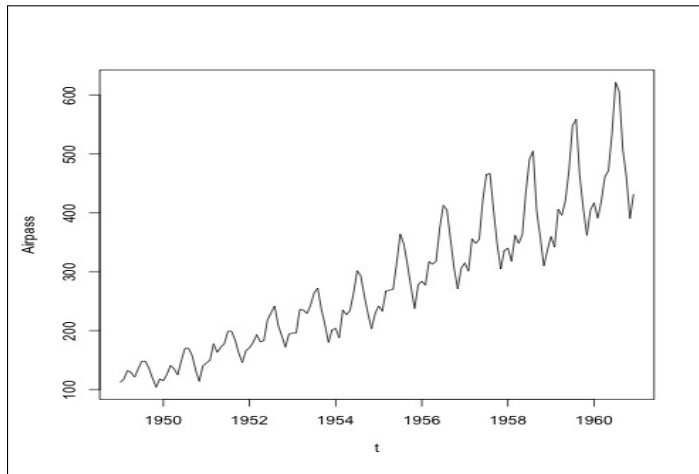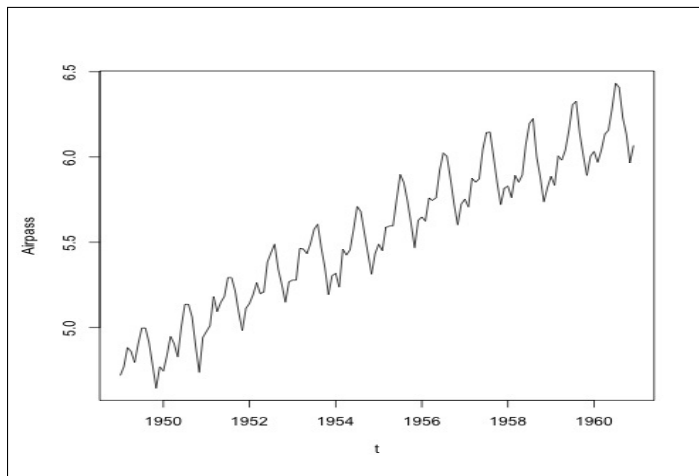
Logarithm of *airpass*

Monthly Australian beer production (in megaliters) from January 1956 to February 1991
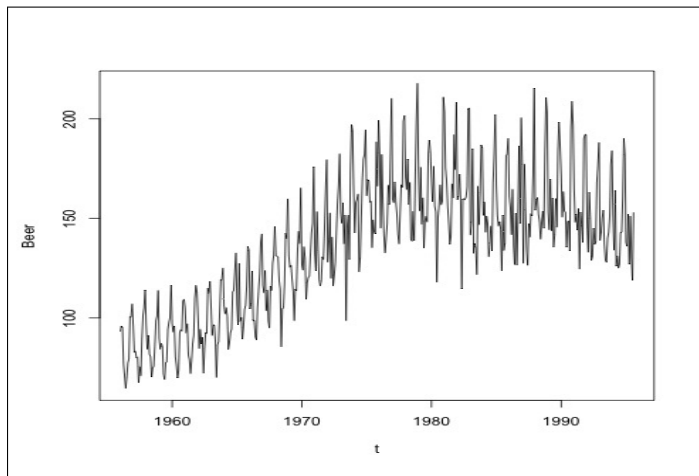
Yearly number of sunspots from 1790 to 1970
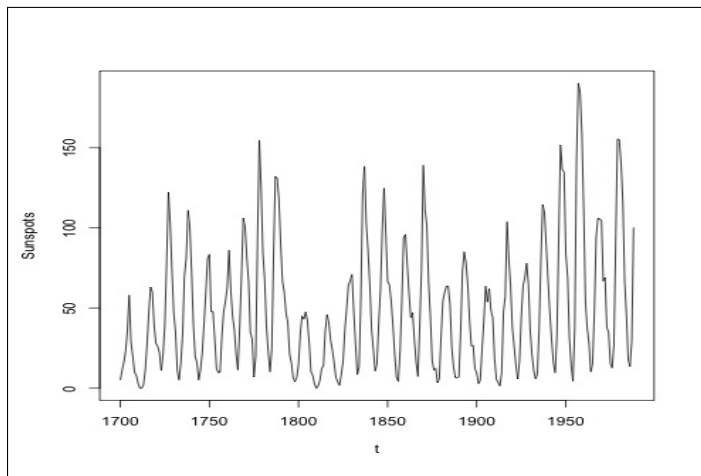
Table of contents

The universe of time series

Examples

Course aims

Course aims

- ▶ understand the problematic of time dependent data (stationarity),
- ▶ use simple signal processing tools (periodogram),
- ▶ be able to use a linear modeling on time series,
- ▶ and forecast.

References

.

[1] Gwilym M. Box, George E. P.and Jenkins and Gregory C.
Reinsel. *Time series. Theory and methods*. Wiley, 4
edition, 2008.

[2] Peter J. Brockwell and Richard A. Davis. *Introduction to
time series and forecasting*. Springer, 2 edition, 2002.

[3] Peter J. Brockwell and Richard A. Davis. *Time series:
Theory and methods*. Springer, 2 edition, 2009.

[4] Michael Friendly. A brief history of data visualization. In
Chun-houh Chen, Wolfgang Härdle, and Antony Unwin,
editors, *Handbook of data visualization*, chapter II.1,
pages 15–56. Springer, 2008.

[5] Alan Pankratz. *Forecasting with dynamic regression
models*. Wiley, 1991.

[6] Robert H. Shumway and David S. Stoffer. *Time series
analysis and its applications. With R examples*. Springer
Texts in Statistics. Springer, 3 edition, 2011.