Time Series Analysis

Spring-Summer-Semester 2023

University of Mannheim
Department of Economics
Chair of Statistics
Dr. Toni Stocker

Times Series Analysis (TSA) - Content

Introduction to TSA

General Course Information

Prerequisites

- Students in Economics from Mannheim: no problem
- All other students: should have solid understanding of Basic Statistics and Basic Econometrics (a one-semester-all-in-one-course is not appropriate!)
- *Basic Econometrics* should have included (at least): OLS, Linear Multiple Regression (LMR), F-test for testing joint hypotheses, R^2 and "adjusted R^2" (on this level or more but not less)
- The statistical software *R* will intensively be used throughout this course. Students who are not yet familiar with R must work through chapters 1-5 of the *R introduction* (see course folder) on their own by February 22 at the latest.
- Though R is easy to learn, you need to invest some time at the beginning. But you may benefit from it for a long time.

General Course Information

Times and Locations

Format	Day	Time	Method
Lecture	Friday	12:00-13:30	L7, 3-5, 001
Group Exercise Session 1	Thursday	17:15-18:45	L9, 1-2, 002
Group Exercise Session 2	Friday	10:15-11:45	L9, 1-2, 003
Homework-Tut (optional)	Wednesday	15:00-16:30	in presence / via Zoom

Choose one of the two compulsory GE-Sessions! The Homework-Tutorial is not compulsory in terms of grading. It starts in the 2nd week.

Contact

Office Hour: Wednesday, 3:00-4:30 p.m. in presence or via Zoom

Office: L7, 3-5, 1st floor, 143

Phone: 0621-181-3963

Email: stocker@uni-mannheim.de

General Course Information

Course Material

Slides (Lecture), **Assignments**, **'Introduction to R'** (see p. 2)

References

Stock and Watson (2020):
Introduction to Econometrics; Pearson 4th ed.

Marno Verbeek (2008):
A Guide to Modern Econometrics; Wiley 3rd ed.

Brockwell and Davis (2002):
Introduction to Time Series and Forecasting; Springer

Brockwell and Davis (1991):
Time Series: Theory and Methods; Springer

Helmut Lütkepohl (2005):
New Introduction to Multiple Time Series Analysis; Springer

Schlittgen and Streitberg (2001):
Zeitreihenanalyse; Oldenbourg (in German)

Examination

Exam + Assignments:
80% written exam (120 minutes) + 20% Exercises (individual and collaborative part) in terms of points to earn in total.

Example:

	Points
Written Exam:	60 (from 80)
Exercises:	18 (from 20):
Total:	78 (from 100)

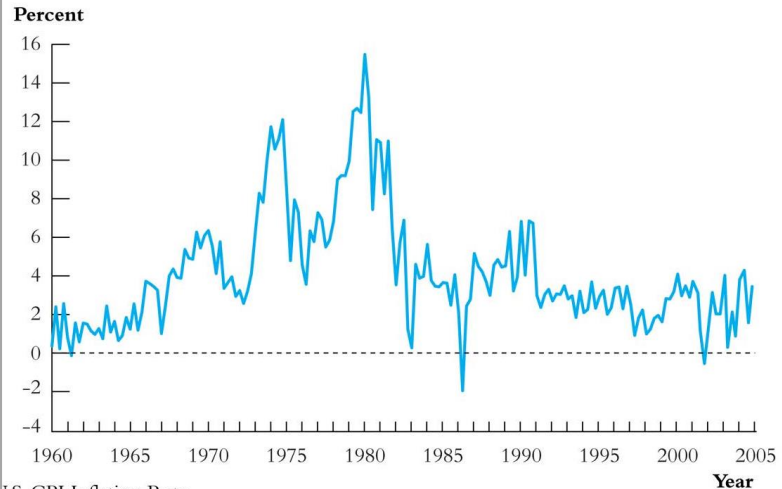
=> Grading will be based on 78 points (from 100)

Minimum for passing: ≤ 40

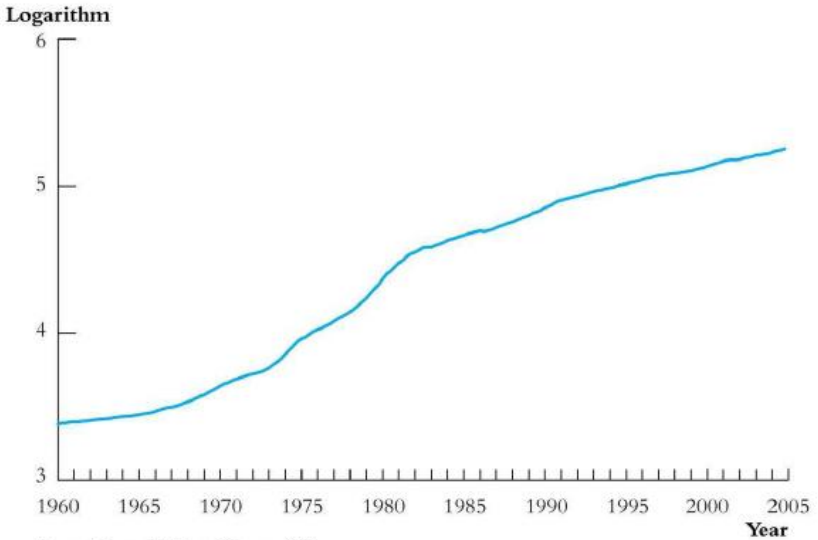
Assignments:
Need to submit homework and attend tutorial. To get full points (20) you need to work at least on 10 assignments (out of 13) in a meaningful way. (See *Course Guidelines*)

What is it about?

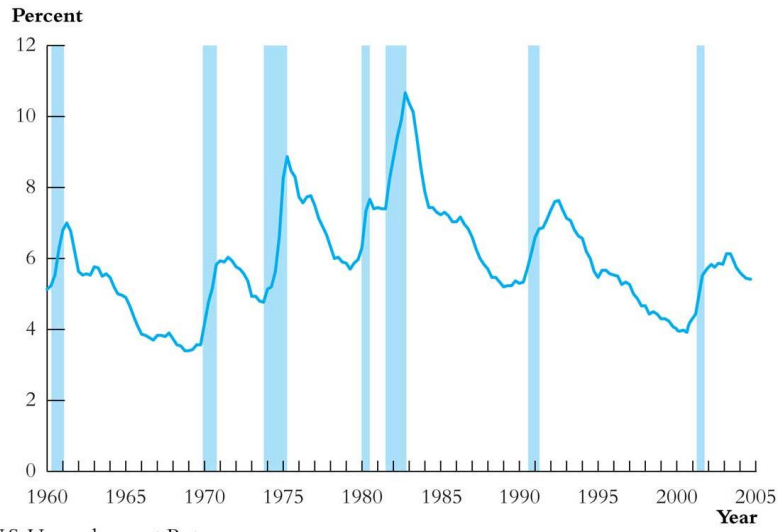
Examples (taken from S&W)



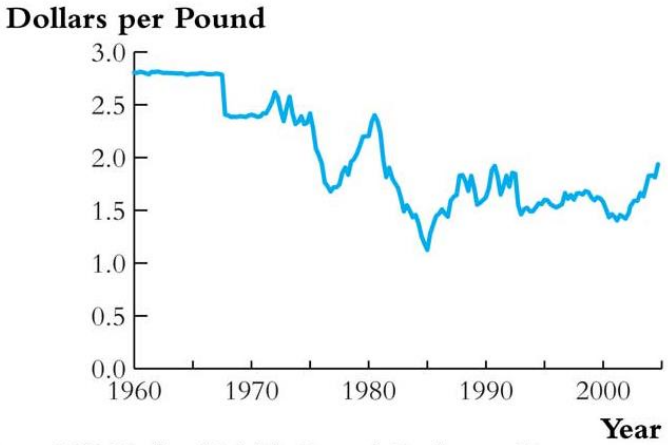
U.S. CPI Inflation Rate



Logarithm of United States CPI

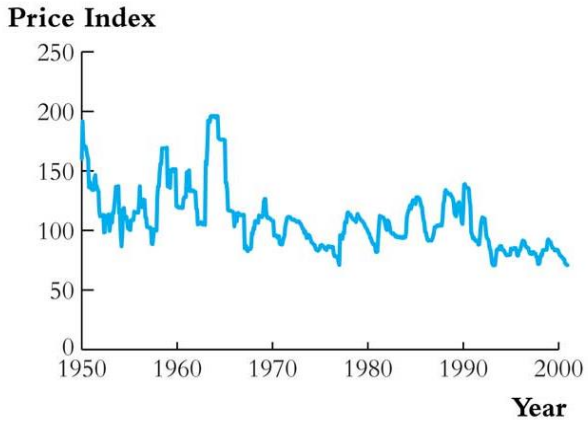


U.S. Unemployment Rate

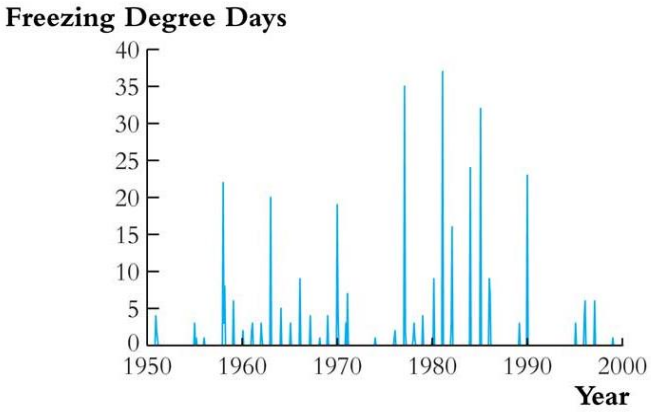


U.S. Dollar/British Pound Exchange Rate

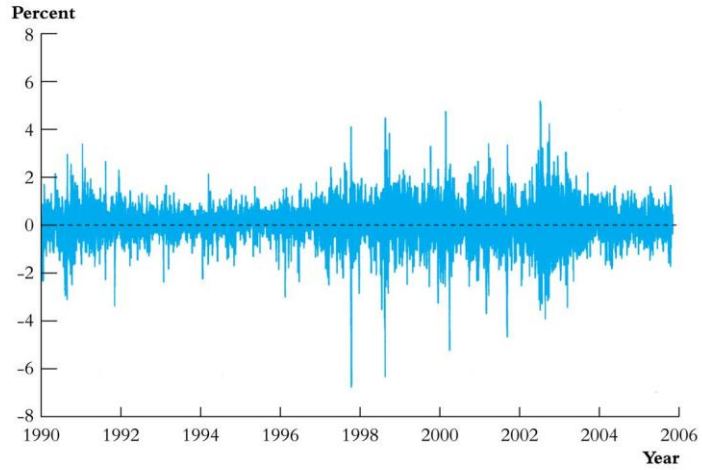
What is it about?



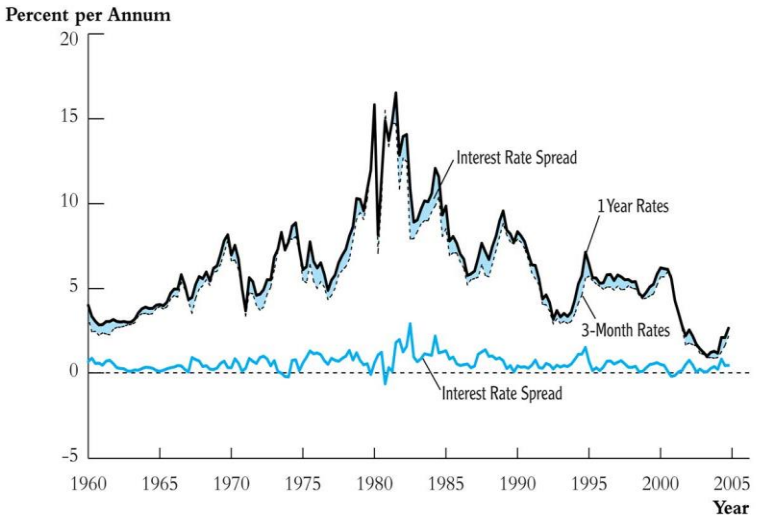
(a) Price Index for Frozen Concentrated Orange Juice



(c) Monthly Freezing Degree Days in Orlando, Florida



Daily NYSE percentage price changes exhibit volatility clustering, in which there are some periods of high volatility, such as in the late 1990s, and other periods of relative tranquility, such as in the mid-1990s.



One-year and three-month interest rates share a common stochastic trend. The spread, or the difference, between the two rates does not exhibit a trend. These two interest rates appear to be cointegrated.

What is it about?

Issues of Time Series Analysis (TSA)

Times Series data are data collected on the same observational unit at multiple time periods

Further Examples:

- Aggregate consumption and GDP for a country
  (e.g., 20 years of quarterly observations = 80 obs.)
- Yen/$, Pound/$ and Euro/$ exchange rates
  (e.g. daily data for 1 year = 365 obs.)
- Cigarette consumption per capita in a state, by year

What is it about?

New technical issues of TSA

- Time lags
- Correlation over time (***serial correlation*** or ***autocorrelation***)
- New types of regression models (using time lagged values)
  - ***autoregressive models*** (AR models)
  - ***autoregressive distributed lag models*** (ADL models)
- Other types of model assumptions (e.g. ***stationarity***) needed (Why?)
- Other types of LLN's and CLT's needed
- New estimation techniques needed

This is an applied course. We will not deal with asymptotic theory in detail.

What is it about?

Course outline

- Lecture 0: Introduction to TSA
- Lecture 1: Review of Basic Essentials (part 1) **Assignment 1**
- Lecture 2: Review of Basic Essentials (part 2) **Assignment 2**
- Lecture 3: Basic Elements of TSA **Assignment 3**
- Lecture 4: Basic Properties of Time Series **etc.**
- Lecture 5: Forecasting Theory
- Lecture 6: AR(I)MA Processes (part 1)
- Lecture 7: AR(I)MA Processes (part 2)
- Lecture 8: ADL-Models
- Lecture 9: VAR-Models
- Lecture 10: Nonstationarity: Trend
- Lecture 11: Nonstationarity: Breaks
- Lecture 12: Estimation of Dynamic Causal Effects
- Lecture 13: Short Intro: Cointegration, ARCH and GARCH Models

Note: This is just a plan!
Topics may be skipped;
Order may be changed;
lecture topics may overlap

What is it about?

Main Objectives

... at the end of the semester you

- know and (hopefully) understand most common TSA methods and their theoretical background
- know how to construct forecasting models, how to conduct model based forecasts and how to check model performance
- can proficiently use R for all important parts of TSA: constructing graphics, estimating and testing, forecasting, model diagnosis and assessment
- have experienced the possibilities and limitations of time series methods on the basis of real data examples

Generally: This is an introductory and applied course.
We will not deal with all aspects and techniques of TSA.
Some important topics will not be covered .