Time Series Analysis

Fall 2019

Andreas Jakobsson

Administration

- Course program
- Course webpage
  http://www.maths.lu.se/kurshemsida/fmsn45masm17/
- Registration
  Sign up, check, add social security number.
- Book
  3rd Edition (2019). Available from studiecentrum.

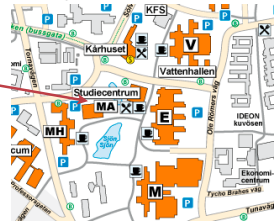
Course material

General material:

- Course program
- All the below slides, as well as the pdf and matlab files, etc, can be downloaded here.
- An errata for the textbook is available here.
- Scalable learning videos. Course code: BVYKW-50374.

Lecture notes and schedule:

- Week 1:
  - L1: Introduction and overview. Multivariate random variables. [slides 1, 2]
  - L2: Multivariate random variables. Stochastic processes. [slides 3, 4, 5]
  - Reading instructions: Ch. 1, 2, 3.1-3.3
  - Textbook problems: 2.1-2.3, 3.1-3.4
  - Mini project: [pdf, data]
- Week 2
  - L3: Stochastic processes. [slides 1, 2, 3]
  - L4: Stochastic processes. Identification. [slides 4, 5]
  - Reading instructions: Ch. 3, 4.1-4.2



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Teaching staff

Prof. Andreas Jakobsson, MH:217, aj@maths.lth.se
Office hours: Wedn 10-12 (until 11/12).
Additional office hours: 12/12 at 9-12.
Note: I will be unavailable 13-19/12. Please plan accordingly.

Filip Elvander, MH:138
*Office hours: Tue 9-12 (**until 4/12**)*

Per Niklas Waaler, MH:223
Office hours: 10-11 on the 5/12 and 10/12, and 10-12 on the 16/12.

Per Niklas Waaler, Amanda Nilsson, Erik Wik, Wilhelm Ålander

Tutorial exercises

The tutorials will be held on Thursdays and Fridays; see schedule. No tutorials this week.

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Regular problems

Regular textbook problems from the course book.

Mini projects

There are three mini-projects to prepare you for the computer exercises. These are *voluntary*.

Computer exercises

The course examination consist of 3 **mandatory** computer exercises. They take a **long** time; come **well** prepared. Sign up on the webpage. If you are not done, try to get graded at a later exercise.

Computer exercise 0 is *voluntary* and review stochastic processes.

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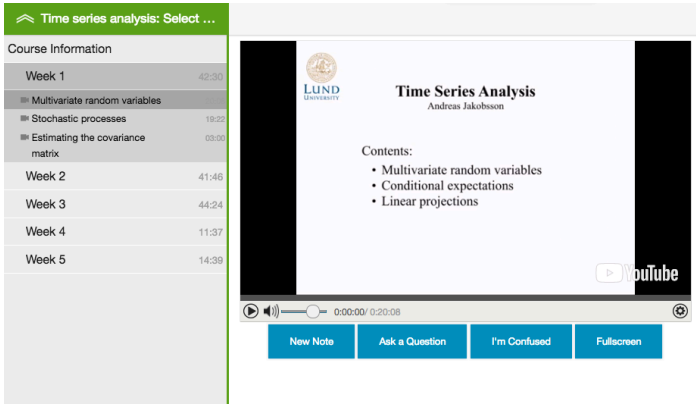

https://www.scalable-learning.com

course code: BVYKW-50374

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Examination

The examination consist of the **computer exercises**, a **take-home exam** and a **project**.

Project examination will take place on **21/12 (13-16)** or on **18/1 (13-16)**.

A detailed **project report** and **presentation material** should be handed in *no later* than at the start of the presentation.

The take-home is available at 12.00 on 14/1, and is due **21/1, at 13.15**.

	Max	Pass
Computer exercises	P/F	P
Take-home exam	30	P
Project presentation	P/F	P
Project report	60	30

LTH		NF	
3	45	G	45
4	60	VG	70
5	75		

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CEQ

After the course, you will be asked to provide an evaluation of the course (via email). *Please do this!!!*

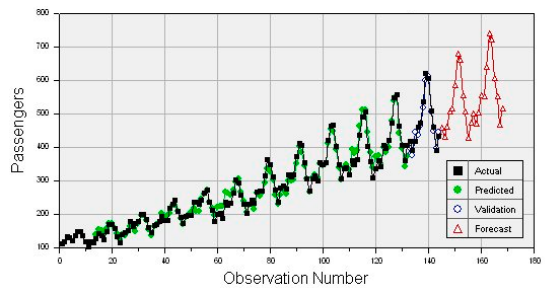
Some remarks from earlier evaluations:

- The course is rewarding, fun, and relevant.
- ”One of the most time demanding courses I have taken”
- Read the theory / listen to the videos **before** the lectures.
- The labs are very helpful for the project, but they take a lot of time. Come well prepared. Make sure you read the theory before the lab!
- Try to get ahead.
- The project is challenging and takes **a lot** of time. Start early.
- Remember to **create naive solutions** to compare to.
- The take-home exam should only be required for the higher grades.

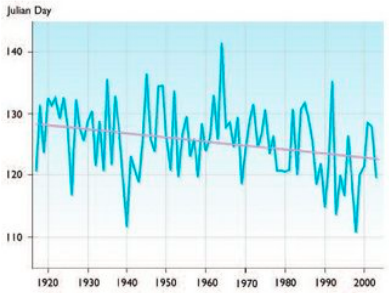
Course representative?

Note on Ladok:

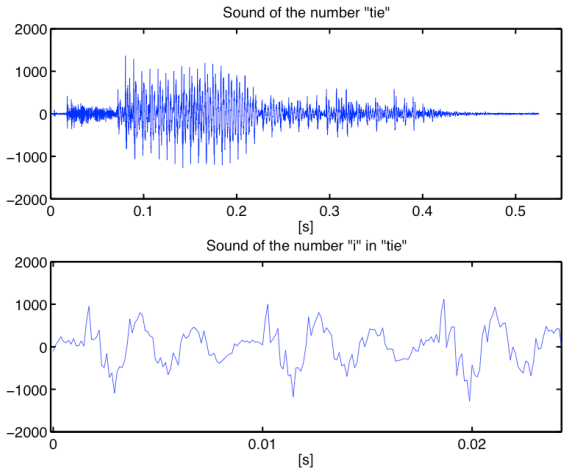
You’ll get an entry for ”lab 1” and ”lab 2” - the latter is for lab 2 **and** 3.

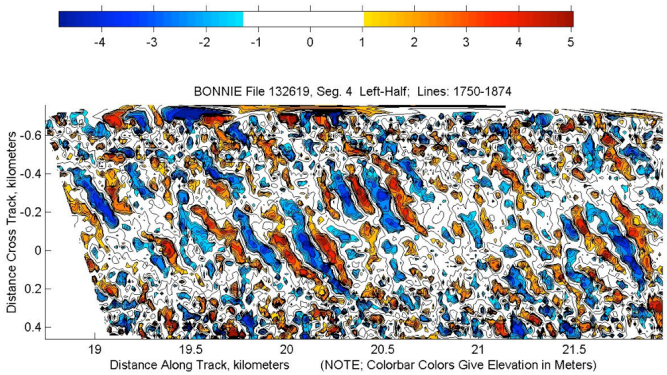


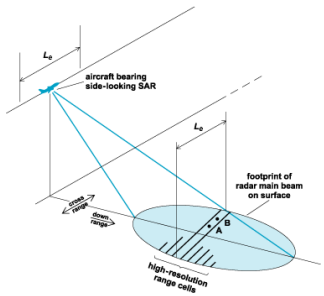
Number of airline passengers

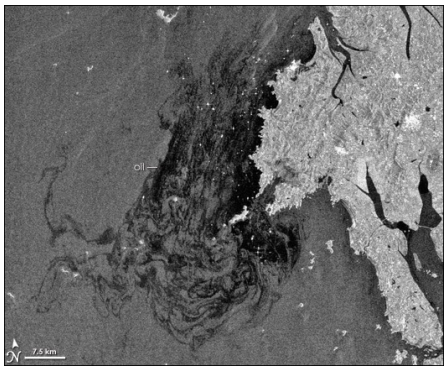


Average ice breakup date of the Tanara River

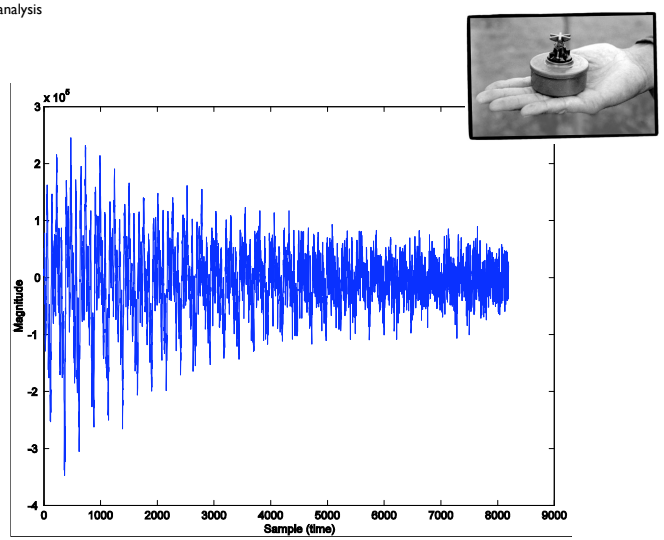




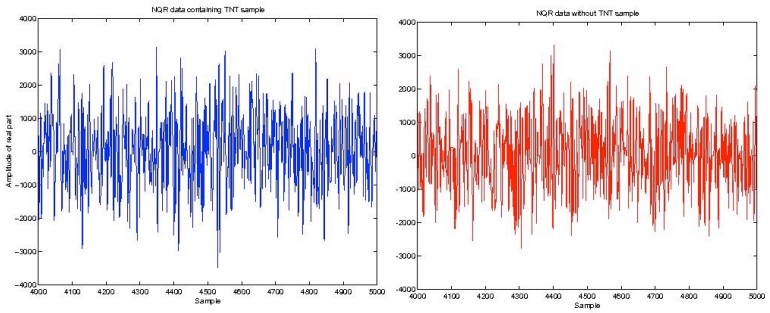




SAR image of oil spill covering the costal waters of the Yellow Sea, South Korea, Dec. 11, 2007



NQR signal from 180 g TNT (2000 measurements ≈ 8.5 h).



NQR signal from 180 g TNT (4 measurements).

Course content

This course treats:

- Modelling of linear stochastic systems
- Pre-treatment of measurements
- Prediction, filtering and reconstruction
- Parameter estimation
- Model selection and validation
- Recursive techniques
- Spectral estimation

What to do next:

- Stationary and non-stationary spectral estimation (VT1, 2020).
- Non-linear time series analysis (HT1+2).
- Financial statistics (HT2).
- Valuation of derivative assets (HT1).
- **Loads of cool thesis projects!!**

Thesis proposals

Some current thesis proposals:

- Future spaceborne synthetic aperture radar systems (with German Aerospace Center, Oberpfaffenhofen, Germany).
- Three projects on radar signal processing (with Axis).
- Evaluation of energy prognosis (with EnergyOpticon).
- Unsupervised learning of sepsis data.
- Modelling of gait patterns for Parkinson patients.
- Detection and modelling of voice changes.

This week

We will cover

- Multivariate random variables. Stochastic processes.
- Reading instructions: Ch. 1, 2, 3.1-3.3
- Problems: 2.1-2.3, 3.1-3.4
- Three video lectures!