

Welcome to GEO4300

Geophysical Data Science

Purpose of GE04300

Data → Useful insights

⋮

Questions

answered through significance analysis,
hypothesis testing, regression,
modelling, classification

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- (Geophysical) Data Science = Statistics boosted with computational tools

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Tools

Purpose of GE04300

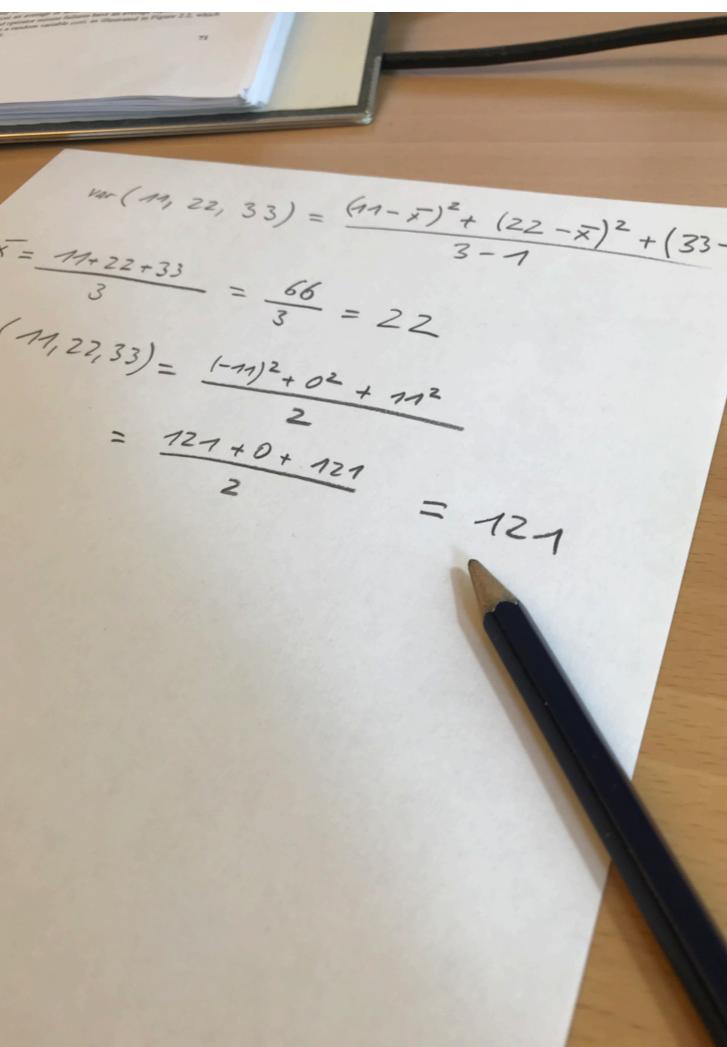
- To review basic **statistical concepts** and introduce you to **analytical tools** and their applications in the geosciences
- You will gain an understanding of how to **apply** your knowledge of statistics, when to use and when not to use various tools available
- The course covers a **broad range of topics** — each of which could potentially be a course on its own

Purpose of GE04300

Theoretical
understanding

$$V(x) = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}$$

$$\Rightarrow V(cx) = c^2 V(x)$$



Calculation “by hand”
and interpretation

Data handling in python

```
[>>> import numpy
[>>> numpy.array([11, 22, 33.]).var(ddof=1)
121.0
[>>>
[>>> numpy.array([11, 22, 33., numpy.nan]).var(ddof=1)
nan
>>> ]
```

Learning outcome

- Have competence to manage, conduct quality control of, and classify geophysical data
- Be able to statistically **characterise and model** geophysical data
- Conduct analysis of **extreme events** in the time and frequency domain
- Conduct multiple linear regression, hypothesis testing, and goodness-of-fit testing
- Evaluate and model **spatial variability**
- Conduct basic **time series analysis**
- Develop stochastic models and evaluate residuals from geophysical data
- *Gain skills to manage large and complex data from earth system models, reanalysis datasets, satellite products, and heterogeneous observations*

Teachers

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Canvas

- Important announcements
- Posting and hand-in of exercises
- Reading material, slides, notebooks, links, etc.
- Discussions, polls and chat

Reading material

- Compendium based on:
Haan, C.T., 2002, Statistics Methods in Hydrology, Iowa State Univ Press, Ames, Iowa
- Jupyter notebooks uploaded after each lecture
- Relevant material provided on Canvas

- Statistical Analysis in Climate Research, Von Stoch & Zwiers, ISBN:0-521-01230-9
- Statistical Methods in the Atmospheric Sciences, Volume 100, Third Edition (International Geophysics) 3rd, Wilks, ISBN-13: 978-0123850225

Lectures

Date	Time	Place	Planned topic	Chapter/ Module
Tu. 18. Aug	10:15–12:00	GE Mellrommet 102	Welcome. Intro. Basic concepts. Python/Jupyter	1
Tu. 25. Aug	10:15–12:00	GE Mellrommet 102	Properties of random variables	2
Tu. 1. Sep	10:15–12:00	GE Mellrommet 102	Discrete distributions +Normal and other continuous distributions	3/4
Tu. 8. Sep	10:15–12:00	GE Mellrommet 102	Frequency analysis	5
Tu. 15. Sep	10:15–12:00	GE Mellrommet 102	Confidence interval and hypothesis testing	6
Tu. 22. Sep	10:15–12:00	GE Mellrommet 102	Testing goodness-of-fit	7
Tu. 29. Sep	10:15–12:00	GE Mellrommet 102	Correlation and simple regression	8
Tu. 6. Oct	10:15–12:00	GE Mellrommet 102	Multiple regression	8/9
Tu. 13. Oct	10:15–12:00	GE Mellrommet 102	Multiple regression analysis and PCA	9
Tu. 20. Oct	10:15–12:00	GE Mellrommet 102	Parameter estimation theory and methods	10
Tu. 27. Oct	10:15–12:00	GE Mellrommet 102	Examples of machine learning and geostatistics	11
Tu. 3. Nov	10:15–12:00	GE Mellrommet 102	Time series analysis	12
Tu. 10. Nov	10:15–12:00	GE Mellrommet 102	Time series analysis in the frequency domain	12
Tu. 17. Nov	10:15–12:00	GE Mellrommet 102	Stochastic models and exam preparation	13

Computer labs

Date	Time	Place	Topic	Due hand-in	Returned hand-in
Th. 20. Aug	10:15–12:00	GE IT-Lab 209			
Th. 27. Aug	10:15–12:00	GE IT-Lab 209	Intro Python. Intro group projects		
Th. 3. Sep	10:15–12:00	GE IT-Lab 209	Probability distributions		
Th. 10. Sep	10:15–12:00	GE IT-Lab 209	Frequency analysis	Probability distributions	
Th. 17. Sep	10:15–12:00	GE IT-Lab 209	Confidence intervals	Frequency analysis	Probability distributions
Th. 24. Sep	10:15–12:00	GE IT-Lab 209	Hypothesis testing	Confidence intervals	Frequency analysis
Th. 1. Oct	10:15–12:00	GE IT-Lab 209	Regression analysis	Hypothesis testing	Confidence intervals
Th. 8. Oct	10:15–12:00	GE IT-Lab 209	Help for group projects	Regression analysis	Hypothesis testing
Th. 15. Oct	10:15–12:00	GE IT-Lab 209	Introduction to machine learning		Regression analysis
Th. 22. Oct	10:15–12:00	GE IT-Lab 209	Spatial data		
Th. 29. Oct	10:15–12:00	GE IT-Lab 209	Time series analysis	Spatial data	
Th. 5. Nov	10:15–12:00	GE IT-Lab 209	Help for group projects	Time series analysis	Spatial data
Th. 12. Nov	10:15–12:00	GE IT-Lab 209	Exam examples and Q/A	Group project	Time series analysis
Th. 19. Nov	10:15–12:00	VB IT-auditorium 3	To be announced		Group project

- 7 hand-ins in total (own hand-ins), +group project report (1 hand-in per group)
- Collaboration encouraged

Grading

- Hand-in exercises: 50%
 - 5 points / hand-in
 - 15 points for group project (2-3 people/group)
 - 50 points in total. Need at least 20 points for admission to written exam
- Final written exam: 50%
 - Home examination
 - Disclosure of exam assignment: November 23 at 9:00 AM
 - Submission deadline: November 23 at 12:00 PM
 - Examination system: Inspera
- 10 credit points, one grade A-E

Get in touch for help

- Ask class mates, Canvas discussion and chat
- Sigrid and Norbert. Normally 9-16 o'clock, but email appointment a good idea
- Vanja and Karl Johan
- SIO student counsellor