

MATH-448

**Statistical analysis of network data**

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Cursus	Sem.	Type
Financial engineering	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Statistics	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

A first course in statistical network analysis and applications.

**Content****Keywords**

- Basic description of a network and its generalizations (e.g. hypergraphs).
- Network examples from a practical point of view.
- Simple network summaries such as the degree distribution.
- Sparse and dense networks. Edge versus node models.
- Statistical implications of probabilistic properties of large networks.
- Erdos Renyi networks, simple models (configuration and stochastic block models).
- Sampling properties of network summaries.
- Fitting simple network models.
- Multilayer networks and directed networks
- Hypergraphs
- Exchangeability and probabilistic symmetries.
- Other topics as time permits.

**Learning Prerequisites****Required courses**

probability and statistics

**Learning Outcomes**

By the end of the course, the student must be able to:

- Recognize when a network model is appropriate
- Compute simple network summaries
- Assess / Evaluate parameters of basic network models from data
- Assess / Evaluate a range of network models and understand their properties
- Assess / Evaluate the implications of model symmetries

## Teaching methods

Ex cathedra lectures and exercises

## Assessment methods

Final exam and assessed coursework that counts for 15%.

Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

## Supervision

Office hours	No
Assistants	Yes
Forum	No

## Resources

### Virtual desktop infrastructure (VDI)

No

## Bibliography

- R. Durrett: Random Graph Dynamics. Cambridge University Press 2007.
- E.D. Kolaczyk: Statistical Analysis of Network Data. Springer, 2009.
- Ibid Topics at the Frontier of Statistics and Network Analysis: (Re)Visiting The Foundations (SemStat Elements).
- R. van der Hofstad. Random Graphs and Complex Networks Volume One, 2016 .
  
- M. Newman: Networks: An Introduction, OUP 2010.
- Probabilistic Foundations of Statistical Network Analysis H Crane Chapman and Hall/CRC

## Ressources en bibliothèque

- [Statistical Analysis of Network Data / Kolaczyk](#)
- [Random Graph Dynamics / Durrett](#)
- [Topics at the Frontier of Statistics and Network Analysis / Kolaczyk](#)
- [Random Graphs and Complex Networks / van der Hofstad](#)
- [Networks / Newman](#)
- [Probabilistic Foundations of Statistical Network Analysis / Crane](#)

## Notes/Handbook

available on moodle

## Moodle Link

- <https://go.epfl.ch/MATH-448>

## Videos

- <https://tube.switch.ch/channels/fc8e052d?order=newest>