

MATH-449

**Biostatistics**

Stensrud Mats Julius

| Cursus                            | Sem.     | Type |
|-----------------------------------|----------|------|
| Civil & Environmental Engineering |          | Opt. |
| Computational biology minor       | E        | Opt. |
| Ing.-math                         | MA2, MA4 | Opt. |
| Life Sciences Engineering         | MA2, MA4 | Opt. |
| Mathématicien                     | MA2      | Opt. |
| Statistics                        | MA2, MA4 | Opt. |

|                            |                 |
|----------------------------|-----------------|
| Language of teaching       | English         |
| Credits                    | 5               |
| Session                    | Summer          |
| Semester                   | Spring          |
| 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**

This course covers statistical methods that are widely used in medicine and biology. A key topic is the analysis of longitudinal data: that is, methods to evaluate exposures, effects and outcomes that are functions of time. While motivated by real-life problems, some of the material will be abstract

**Content**

- Analysis of time-to-events (survival analysis / failure time analysis)
  - Censoring
  - Likelihood functions for censored data
  - Martingales
  - Identification of parameters with a clear interpretation
  - Non-parametric and semi-parametric estimators
  - Discrete vs continuous time
- Longitudinal data analysis
  - Parametric regression models
  - Semi-parametric models
- Interpretation and evaluation of statistical parameters
  - Description, Prediction and Causal inference
  - Biases
  - Sensitivity analyses
- Precision medicine
  - Identification and estimation of optimal regimes
  - Optimal time-varying treatment regimes

**Keywords**

Biostatistics; statistical inference; survival analysis; longitudinal data; research synthesis

## Learning Prerequisites

### Required courses

The students are expected to have taken introductory courses in statistical theory, probability theory and regression modeling.

### Recommended courses

Undergraduate courses in statistics.

### Important concepts to start the course

Likelihood theory, statistical testing. Experience with R is an advantage, but is not required.

## Learning Outcomes

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

- Identify statistical methods that are suitable for answering a given scientific problem.
- Justify why a statistical method is applied to given problem.
- Apply methods that have been taught in the course.
- Critique evaluate published studies and methodologies.

## Transversal skills

- Communicate effectively with professionals from other disciplines.
- Access and evaluate appropriate sources of information.
- Demonstrate the capacity for critical thinking

## Teaching methods

Classroom lectures, where I will use Beamer slides and the blackboard. Exercises and take-home projects that will require programing in R.

## Assessment methods

Final written exam and continuous assessment.

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

### Teaching resources

- Aalen, O., Borgan, O. and Gjessing, H., 2008. Survival and event history analysis: a process point of

view. Springer

- Andersen, P.K., Borgan, O., Gill, R.D. and Keiding, N., 2012. Statistical models based on counting processes. Springer

### **Ressources en bibliothèque**

- [Andersen Statistical models](#)
- [Aalen survival and event history](#)

### **Moodle Link**

- <https://go.epfl.ch/MATH-449>