UCLouvain

# lstat2050

*2019*

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

| 5 credits | 30.0 h + 15.0 h | Q1 |
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| Teacher(s) | Pircalabelu Eugen ;von Sachs Rainer ; |
| Language : | French |
| Place of the course | Louvain-la-Neuve |
| Prerequisites | A basic course on methodological statistics, including an introductory course in probability and statistics, followed by the course LSTAT2040 "Analyse statistique - I".<br>*The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.* |
| Main themes | The course is a follow-up to the course LSTAT2040 "Analyse statistique - I". Concepts in statistical methodology will be treated in greater depth and will be complemented with more advanced ones. |
| Aims | 1 By the end of the course, the student will have become familiar with the necessary concepts in mathematical statistics in order to follow advanced courses of the finalité approfondie and to perform research in mathematical statistics on the PhD level. The student will be able to put the different themes in a general, abstract context, both regarding their application to problems in statistical analysis and regarding their interpretation. The student will master the technical tools to apply the concepts correctly and will be able to reproduce and to elaborate upon the mathematical arguments underlying the results.<br>- - - -<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.* |
| Evaluation methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>There will be an oral exam, preceded by a written preparation. |
| Teaching methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>The cours consists of both lectures and tutorials. |
| Content | **Part I - Theory of Optimality for Statistical Inference**<br>The concept of sufficiency, in particular when applied to the important and rich class of exponential families, delivers a non-asymptotic theory of optimality of statistical procedures. The applications are numerous: for risk-optimal point estimation one can define the concept of UMV(U) estimators, i.e. "uniformly minimal variance (unbiased)" estimators. For the theory of statistical hypothesis testing, to be more abstractly formalised following the Neyman principle, it is possible to characterise the optimality of existing tests via the concept of UMP(U) tests, i.e., "uniformly most powerful (unbiased)" tests. A particular challenge here is the treatment of multi parameter families. Finally, the results from test theory can be directly transferred to define optimality of confidence regions.<br>**Part II - Asymptotic Theory of Statistical Experiments**<br>A coherent framework to analyse the asymptotic performance of estimators is Lucien Le Cam's theory of statistical experiments. For regular parametric models, the associated experiments are locally asymptotically normal. This means that the limit experiment is equal to a Gaussian shift experiment, the problem being of estimating the mean of a Gaussian distribution with known covariance matrix. The proof of this result relies on the concept of contiguity of sequences of statistical experiments and in particular on Le Cam's lemmas. The Hajek--Le Cam convolution theorem theorem then stipulates a lower bound for the covariance matrix of regular estimators of the model parameters. This result provides a precise statement about the optimality of maximum likelihood estimators in smooth parametric models. |
| Inline resources | moodle |

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| Bibliography | A part du syllabus du cours, les ouvrages suivants sont à conseiller:<br>- Casella, G., Berger, R.L. (2001). Statistical Inference (2nd ed). Cengage Learning.<br>- Lehmann, E.L. (1999). Elements of Large-Sample Theory. Springer.<br>- Lehmann, E.L., Romano, J. (2005). Testing Statistical Hypotheses (3rd ed). Springer.<br>- Monfort, A. (1997). Cours de statistique mathématique (3rd ed). Economica.<br>- van der Vaart, A.W. (1998). Asymptotic Statistics. Cambridge University Press, Cambridge. Chapters 6-9. |
| Other infos | The course notes will be distributed during the lectures itself. |
| Faculty or entity in charge | LSBA |

## Programmes containing this learning unit (UE)

| Program title | Acronym | Credits | Prerequisite | Aims |
|---|---|---|---|---|
| Master [120] in Mathematics | MATH2M | 5 | | |
| Certificat d'université : Statistique et sciences des données (15/30 crédits) | STAT2FC | 5 | | |
| Master [120] in Statistic: General | STAT2M | 5 | LSTAT2040 | |