UCLouvain

lstat2460

*2023*

# Asymptotic Statistics

| 4.00 crédits | 15.0 h + 5.0 h | Q1 |
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| Enseignants | Segers Johan ; |
| Langue d'enseignement | Anglais |
| Lieu du cours | Louvain-la-Neuve |
| Préalables | Concepts et outils équivalents à ceux enseignés dans les UEs<br>LSTAT2190 — Concepts et traitement de vecteurs aléatoires<br>LSTAT2140 — Statistique nonparamétrique: méthodes de base<br>LSTAT2040 — Inférence statistique et vraisemblance<br>• Linear algebra: vectors and matrices<br>• Calculus, univariate and multivariate: limits, continuity, differentiability, Taylor's theorem, deterministic o and O calculus, norms, partial derivatives, Jacobian |
| Thèmes abordés | The course focuses on mathematical techniques to establish large-sample distributions of common estimators and test statistics arising in statistical methodology |
| Acquis d'apprentissage | **A la fin de cette unité d'enseignement, l'étudiant est capable de :**<br>To select and use the proper mathematical tools to establish the asymptotic distribution of a sequence of statistics (estimators, test statistics). With regard to the AA reference framework of the Master's programme in Statistics, general orientation, this activity contributes to the development and acquisition of the following AAs: 1.4, 4.1, 4.3. |
| Modes d'évaluation des acquis des étudiants | Each student will be given an assignment similar to those in the course. The examination is oral and is based on the submitted project. The assignments to be made during the year are worth bonus points. |
| Méthodes d'enseignement | In the lectures, the teacher will explain each technique in general and work out an example. The students will then be given an assignment to apply the technique in a similar situation and write out the mathematical developments in some detail in a text (format: LATEX or R Markdown) to be submitted for detailed feedback to both the other students and the teacher.<br>The practice sessions will focus on theoretical and numerical examples. |
| Contenu | • Basics: Convergence in distribution and in probability, continuous mapping theorem, Slutsky's lemma, stochastic op and Op calculus<br>• Univariate and multivariate central limit theorems (also Lindeberg–Feller)<br>  • Examples: sample variance, t-statistic (also multivariate, i.e., Hotelling?), Pearson chi-square tests, linear regression, . . .<br>• Delta-method (with proof)<br>  • Examples: sample skewness/curtosis, sample correlation, central order statistics (via quantile transform), variance-stabilizing transformations, . . .<br>• Sample moments and moment estimators<br>  • Example: parameter estimates in full-rank exponential families, . . .<br>• M- and Z-estimators, consistency and asymptotic normality under classical conditions<br>  • Examples: maximum likelihood estimators in smooth single-parameter models, robust estimators<br>• U-statistics via Hájek projection (conditional expectation as an L2-projection)<br>  • Examples: Wilcoxon's signed rank statistic, Kendall's tau<br>  • Optional: two-sample U-statistics, such as Mann–Whitney statistic and Mann– Kendall trend test<br>Attention will also be paid to verifying the accuracy of asymptotic approximations in finite samples via Monte Carlo simulation experiments in R.<br>*Note:* Given the modest prerequisites and the limited time available, the course will not venture into empirical process techniques (Glivenko–Cantelli and Donsker theorems). |
| Ressources en ligne | Course material (literature, explanations, exercises) available on Moodle. |

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| Bibliographie | Optional bibliography:<br>[1] Hunter, D. R. (2014). Notes for a graduate-level course in asymptotics for statisticians. Penn State University, http://personal.psu.edu/drh20/asymp/lectures/asymp.pdf.<br>[2] Lehmann, E. L. (1999). Elements of Large-Sample Theory. Springer Texts in Statistics. New York: Springer-Verlag. 2<br>[3] Polansky, A. M. (2011). Introduction to Statistical Limit Theory. Texts in Statistical Science Series. CRC Press, Boca Raton, FL.<br>[4] Segers, J. (2017). Théorie des probabilités. UCLouvain, syllabus LMAT1371.<br>[5] Serfling, R. J. (1980). Approximation Theorems of Mathematical Statistics. John Wiley & Sons, Inc., New York. Wiley Series in Probability and Mathematical Statistics.<br>[6] van der Vaart, A. W. (1998). Asymptotic Statistics. Cambridge: Cambridge University Press |
| Faculté ou entité en charge: | LSBA |

## Programmes / formations proposant cette unité d'enseignement (UE)

| Intitulé du programme | Sigle | Crédits | Prérequis | Acquis d'apprentissage |
|---|---|---|---|---|
| Master [120] en sciences mathématiques | MATH2M | 4 | | 🔍 |
| Master [120] en statistique, orientation générale | STAT2M | 4 | | 🔍 |
| Certificat d'université : Statistique et science des données (15/30 crédits) | STAT2FC | 4 | | 🔍 |