# Syllabus

## *Course Description*

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| **Course Title** | Statistics |
| **Course Code** | 27010 |
| **Course Title Additional** | |
| **Scientific-Disciplinary Sector** | STAT-01/A |
| **Language** | Italian |
| **Degree Course** | Bachelor in Economics and Management |
| **Other Degree Courses (Loaned)** | |
| **Lecturers** | Prof. Davide Ferrari,<br>Davide.Ferrari2@unibz.it<br>https://www.unibz.it/en/faculties/economics-management/academic-staff/person/39001<br>dr. Giulia Bertagnolli,<br>Giulia.Bertagnolli@unibz.it<br>https://www.unibz.it/en/faculties/economics-management/academic-staff/person/49312 |
| **Teaching Assistant** | Dr. Sara Casagrande |
| **Semester** | First semester |
| **Course Year/s** | 2 |
| **CP** | 6 |
| **Teaching Hours** | 36 |
| **Lab Hours** | 18 |
| **Individual Study Hours** | - |
| **Planned Office Hours** | 18 |
| **Contents Summary** | The course introduces the fundamental concepts of descriptive statistics, probability and statistical inference. Students learn how to classify data, construct graphical and numerical summaries and analyse relationships through correlation and regression.<br><br>The section on probability covers random variables, discrete and continuous distributions, conditional probability and the Central |

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| | Limit Theorem. The section on inference develops the logic of estimation and hypothesis testing for means, variances and proportions. Emphasis is placed on understanding statistical reasoning and applying the methods to socio-economic data using R. |
| **Course Topics** | 1) Probability: Sample spaces, events and axioms of probability. Conditional probability and independence. Total probability theorem and Bayes' theorem.<br>2) Discrete Distributions: Random variables and probability mass functions. Expected value and variance. Main families: Bernoulli, Binomial, Geometric, Poisson.<br>3) Continuous Distributions: Density functions and distribution functions. Expected value and variance. Main families: Uniform, Normal, Exponential, Chi-square, Student's t.<br>4) Distributions of Random Variable Functions: Linear combinations of random variables. Sample distributions of mean, variance and proportion. Central Limit Theorem.<br>5) Point Estimation: Statistics and Estimators. Properties of estimators: correctness, consistency, efficiency. Estimation methods: method of moments, maximum likelihood.<br>6) Estimation by Intervals: Confidence intervals for mean, variance and proportion. Choice of sample size.<br>7) Testing Statistical Hypotheses: Concepts of hypothesis testing: test statistics, type I and type II errors, p-value. Tests for mean and proportion (one-sample and two-sample). Chi-square tests: variance, fit, independence.<br>8) Applications in R: Descriptive analysis and graphical representations. Probability models and simulations. Estimation, confidence intervals and hypothesis tests. Applications to socio-economic data. |
| **Keywords** | Probability, Distributions, Estimation, Inference |
| **Recommended Prerequisites** | |
| **Propaedeutic Courses** | |
| **Teaching Format** | The course combines lectures with problem-solving sessions and guided exercises. Lectures introduce the theoretical concepts of probability, distributions, estimation and inference, while exercises focus on applied problem-solving and statistical reasoning practice. Selected topics are implemented using the statistical software R, with demonstrations and practical examples to consolidate both |

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| | the theoretical and applied aspects of the course. |
| **Mandatory Attendance** | Attendance not compulsory, but recommended |
| **Specific Educational Objectives and Learning Outcomes** | ILO (Intended Learning Outcomes)<br><br>ILO 1 Knowledge and understanding<br>ILO1.1 knowledge of tools for static, dynamic, and comparative analysis of data on individuals, firms and economies<br>ILO 1.2 knowledge and understanding of descriptive statistics, the fundamentals of probability theory and sample methods, standard distributions and their application to economic analysis as well as linear and non-linear regression<br>ILO 1.3 understanding of parametric estimation and hypothesis testing<br><br>ILO 2 Ability to apply knowledge and understanding<br>ILO2.1 be able to analyse economic data using descriptive statics, parametric and non-parametric methods as well as linear and non-linear regression and interpret the results<br>ILO2.2 know how to work with basic and intermediate level mathematical and basic level statistical tools to study the behaviour of economic subjects, from a theoretical and empirical point of view<br><br>ILO 3 Making judgements<br>ILO 3.1 choose the most appropriate quantitative and qualitative methods of analysis<br>ILO 3.2 finding the necessary information in databases, legal sources and scientific literature<br>ILO 3.3 using logical reasoning to combine information and analytical methods, also using modern software packages, to arrive at a solution<br><br>ILO 4 Learning skills<br>ILO 4.1 retrieve information from databases, scientific literature, laws and regulations as required in professional life<br>ILO 4.2 to analyse, critically process and integrate data, information and future experience, also using advanced software |
| **Specific Educational Objectives and Learning** | INTENDED LEARNING OUTCOMES (ILO) |

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| Outcomes (additional info.) | ILO 1 – Knowledge and understanding<br>Upon successful completion of the course, students will demonstrate:<br>ILO 1.1<br>Knowledge and understanding of the foundations of probability theory, including sample spaces, events, axioms of probability, conditional probability, independence, the law of total probability, and Bayes' theorem.<br>ILO 1.2<br>Knowledge and understanding of discrete and continuous random variables, probability mass and density functions, distribution functions, expected value and variance, and the main discrete and continuous distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Normal, Exponential, Chi-square, Student's t).<br>ILO 1.3<br>Understanding of the distribution of functions of random variables, including linear combinations, sampling distributions of the mean, variance and proportion, and the Central Limit Theorem.<br>ILO 1.4<br>Understanding of the principles of parametric statistical inference, including point estimation, properties of estimators (unbiasedness, consistency, efficiency), confidence intervals, and statistical hypothesis testing.<br><br>ILO 2 – Ability to apply knowledge and understanding<br>Students will be able to:<br>ILO 2.1<br>Apply probability models and statistical distributions to describe and analyse random phenomena relevant to socio-economic data.<br>ILO 2.2<br>Construct and interpret point estimates and confidence intervals for means, variances and proportions, and determine appropriate sample sizes.<br>ILO 2.3<br>Formulate and conduct statistical hypothesis tests for means, proportions and variances (one-sample and two-sample), including chi-square tests for goodness of fit and independence, and correctly interpret test results.<br>ILO 2.4 |

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| | Use the R software environment to perform descriptive analysis, simulations, estimation, confidence interval construction and hypothesis testing on real socio-economic datasets.<br><br>ILO 3 – Making judgements<br>Students will be able to:<br>ILO 3.1<br>Select the most appropriate probabilistic and statistical methods for a given empirical problem, based on data characteristics and modelling assumptions.<br>ILO 3.2<br>Critically evaluate the results of statistical analyses, including uncertainty, assumptions and limitations of the applied methods.<br>ILO 3.3<br>Use logical and quantitative reasoning, supported by statistical software, to combine data, models and evidence in order to draw sound conclusions.<br><br>ILO 4 – Learning skills<br>Students will be able to:<br>ILO 4.1<br>Retrieve and use data and documentation from databases, scientific literature and official sources relevant to statistical and socio-economic analysis.<br>ILO 4.2<br>Independently analyse, critically process and integrate data and new methodological knowledge, using R and other statistical tools, to support lifelong learning and professional development. |
| **Assessment** | The assessment consists of three parts:<br>1) Four homework assignments during the semester worth 20% of the final grade (ILOs 1,2, 3, 4).<br>2) One midterm written examination worth 30% of the final grade (ILOs 1,2, 3, 4).<br>3) A final written examination worth 50% of the final grade (ILOs 1,2, 3, 4).<br><br>The intermediate and final examinations are based on a series of problems designed to assess knowledge and understanding of statistical instruments and their correct use. The final examination |

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| | is worth 100% of the final grade for students who choose not to take point 1) or 2). |
| **Evaluation Criteria** | Assessment will be based on the student's ability to demonstrate both theoretical understanding and practical application of statistical methods. In written examinations, emphasis will be placed on clarity and correctness of reasoning, appropriate use of formulae and statistical terminology, and accurate interpretation of results. Homework will be graded on completeness, correctness and clarity of exposition, with the aim of fostering continuous learning throughout the semester. To pass the course, students will need to achieve a positive overall grade, demonstrating competence in descriptive analysis, probability, estimation and hypothesis testing, as well as the correct use of R software for data analysis. |
| **Required Readings** | Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2020).<br>Probability and Statistical Inference (10th ed.). Pearson.<br>ISBN: 9780135189399. |
| **Supplementary Readings** | Newbold, P., Carlson, W. L., & Thorne, B. M. (2022).<br>Statistics for Business and Economics (10th ed., Global<br>Edition). Pearson Education. ISBN 978-1292436845<br>Italian Translation: Newbold, P., Carlson, W. L., &<br>Thorne, B. M. (2021). Statistica. Ediz. MyLab (9ª ed.).<br>Pearson. ISBN 978-8891910653 |
| **Further Information** | |
| **Sustainable Development Goals (SDGs)** | No poverty, Partnerships fot the goals, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, Zero hunger |