ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS
ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ & ΤΕΧΝΟΛΟΓΙΑΣ ΤΗΣ ΠΛΗΡΟΦΟΡΙΑΣ
SCHOOL OF INFORMATION SCIENCES & TECHNOLOGY
ΤΜΗΜΑ ΣΤΑΤΙΣΤΙΚΗΣ
DEPARTMENT OF STATISTICS

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ERASMUS COURSES
ACADEMIC YEAR 2021-2022

All students should come from Department of Statistics or Department of Mathematics

WINTER SEMESTER

Course Title: Statistics I: Probability and Estimation

Course Unit Code	6061
Level of course:	Undergraduate
Year of study:	1st year
Semester/trimester:	Winter (1st Semester)
Number of credits allocated:	6 ECTS credits

Name of lecturer:

Objectives of the course:

The students will be able to compute probabilities of events, expected values and variances of discrete and continuous random variables. They will also be able to apply the central limit theorem and find estimates of unknown parameters. Furthermore, they will have the necessary background for the construction of confidence intervals of the mean value and the variance of a normal population.

The students will be able to solve realistic problems that are related with random experiments.

- **Prerequisites and co-requisites**

Knowledge of Calculus

- **Recommended optional programme components**

None

- **Course contents**

Random Experiment. Sample Space. Axioms of Kolmogorov. Properties of Probabilities. Law of total probability. Bayes's Rule. Discrete and Continuous random variables. Expected value and variance of random variables. Binomial distribution. Geometrical Distribution. Poisson Distribution. Hypergeometrical Distribution. Uniform Distribution. Exponential Distribution. Normal Distribution. Central Limit Theorem. Law of Large Numbers. Estimator of unknown parameter. Unbiased Estimator. Consistent Estimator. Sufficient Estimator. Rao-Blackwell Estimator. Cramer-Rao lower bound. Method of maximum likelihood. Methods of moments.

Confidence Intervals for the Normal mean when (i) the population variance is known and (ii) when the population variance is unknown. Confidence Intervals for the difference of means of Normal populations. Confidence intervals for ratios. Confidence Intervals for the variance of a Normal distribution.

- **Recommended or required reading**
  - S. M. Ross, "A first course in Probability", 8th Edition, 2010, Prentice Hall.
  - S. M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, 2004, Elsevier.
  - G. G. Roussas, "A Course in Mathematical Statistics", 2nd Edition, 1997, Academic Press.

- **Planned learning activities and teaching methods**

Teaching in Class, distant learning (if necessary)

- **Assessment methods and criteria**

Written final exam, Assignments

Course Title: Computational Statistics (master course)

Course Unit Code	9007
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Winter (1st Semester)
Number of credits allocated:	7,5 ECTS credits
Name of lecturer:	D. Karlis, Professor

Objectives of the course:

The students learn the basic principles of simulations and its usage in modern statistical analyses. They also learn how to make statistical inference using the computer and how to apply numerical methods to solve statistical problems like, estimation, calculation of quantities that it is not possible otherwise etc.

- **Prerequisites and co-requisites**

Probability, Statistics, Estimation-Hypothesis testing, Linear Modelling, Analysis of Variance. The course is suitable for students from Statistics departments**.**

- **Recommended optional programme components**

None

- **Course contents**

R programming, simulation techniques, Monte Carlo methods, numerical methods for stats, smoothing, numerical optimization, bootstrap, MCMC.

- **Recommended or required reading**
  - Venables, W.N., Ripley, B.D. (2002). Modern Applied Statistics with S (4th edn). Springer Crawley, M.J. (2002). Statistical Computing: An introduction to data analysis using S-Plus. Wiley

- Robert, C.P. and Casella, G. (2010). Introducing Monte Carlo Methods with R, Springer.
- Efron, B. and Tibshirani, R.J. (1993). An Introduction to the Bootstrap, Chapman & Hall.

• Planned learning activities and teaching methods

Teaching face to face

1-2 extra lab sessions, the students need to bring their laptop

• Assessment methods and criteria

30% by two projects during the course

70% final exam

Course Title: Actuarial Science II (Reading course)

Course Unit Code	9001
Level of course:	Undergraduate
Year of study:	4th year
Semester/trimester:	Winter (7th Semester)
Number of credits allocated:	7 ECTS credits
Name of lecturer:	A. Zimbidis, Assistant Professor

Objectives of the course:

At the end of the course, students can deal with the main problems of pricing and reserving of life insurance policies.

• Prerequisites and co-requisites

Basic knowledge of Mathematics, Probability and Statistics.

• Recommended optional programme components

N/A

• Course contents

Survival function, Simple mortality table and related functions, force of mortality, laws Classics mortality, actuarial tables and commutation functions, Stochastic approach to Life Insurance. Life annuities with one or more payments annually, Relationship between annuities, life insurance of various kinds, Relationship annuities and insurance, interest rate movements and mortality. Net premiums and gross premiums, concept and process of calculating reserves, Relationship between successive stock price. Tables and Actuarial functions for two or more persons, Contingent actuarial functions..

• Recommended or required reading

- Zimbidis A.(2009), «Actuarial Mathematics of Life Insurance»
- Neil A. (1986), «Life Contingencies» Heinemann Professional Publishing
- Etienne De Vylder (1997), "Life insurance : Actuarial Perspectives"
- Kluwer Academic Print

• Planned learning activities and teaching methods

Teaching Method: Reading Course

• **Assessment methods and criteria**

Courseworks during the semester plus oral exam at the end of the semester.

Course Title: Probability and Statistical Inference (master course)

Course Unit Code	9075
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Winter (1st Semester)
Number of credits allocated:	7.5 ECTS credits
Names of lecturer:	A. Yannacopoulos, Professor, N.Demiris, Assistant Professor

Objectives of the course:

Upon successful completion of the course, students will be able to handle issues related to: probability and distribution theory, principles of sufficiency and likellihood, and statistical inference with emphasis on the presentation of analytical methods of finding and evaluating: point estimators, interval estimators and hypothesis tests (using the Frequentist and the Bayesian approachs).

• **Prerequisites and co-requisites**

Undergraduate probability and calculus of functions of multiple variables.

• **Recommended optional programme components**

None

• **Course contents**

The aim of the course is to present key topics of probability and distribution theory and to place particular emphasis on statistical inference. Initially, the axiomatic definition of probability is given by using measure theory and its interpretation in the classical/Bayes approach. Then the conditional probability is given, the concept of random variable, transformations, moments, moment generating function and characteristic functions. It follows the distribution theory, location/scale families, exponential family and goodness of fit measures. The topics defined in the one-dimensional case are presented for multivariate distributions and furthermore are defined the hierarchical models, the idea of independence, correlation and prediction, while some basic inequalities are given. Next, is the theory of order statistics, convergence (in probably, almost sure and by law), law of large numbers, central limit theorem and delta method. The principle of sufficiency and likelihood and completeness are also given. Finding point estimators (method of moments, maximum probability, Bayes rule) and their evaluation (mean square error, uniformly minimum variance unbiased estimator, Cramer-Rao, Rao-Blackwell, decision theory). Hypothesis testing (likelihood ratio test, Bayesian testing, union-intersection tests) and their evaluation (size and level, p-value, type I and II errors, even more powerful test, Neyman-Pearson lemma, monotone probability

ratio, Karlin-Rubin), hypothesis testing and large data, multiple comparisons and corrections. Finally, confidence interval material is covered by finding methods (inverting a test statistic, pivots and Bayes methods), their evaluation (coverage probability) and interpretation.

• **Recommended or required reading**

- R. Ash, Statistical Inference, Dover
- Jacod and Protter, Probability Essentials Springer.
- Berger and Casella, Statistical Inference

• **Planned learning activities and teaching methods**

In vivo and online teaching

• **Assessment methods and criteria**

Exercises during the semester, essays and written or oral exam.

SPRING SEMESTER

Course Title:	**Statistics II: Inference and Regression**
Course Unit Code	6132
Level of course:	Undergraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	6 ECTS credits

Name of lecturer:

Objectives of the course:

By completing the course the students will be able to:

Learn the fundamentals in statistical inference allowing them to understand which type of analysis is necessary and how it can be correctly implemented.

Learn about the theory and the accurate practice of regression analysis.

• **Prerequisites and co-requisites**

Knowledge of Probability and (point/interval) Estimation Theory.

• **Recommended optional programme components**

None

• **Course contents**

Έλεγχοι υποθέσεων, στατιστικές υποθέσεις, ελεγχοσυνάρτηση, έλεγχοι υποθέσεων για παραμέτρους πληθυσμών όπως μέσες τιμές, αναλογίες, διασπορές, σύγκριση παραμέτρων σε δύο πληθυσμούς, επίπεδο στατιστικής σημαντικότητας, παρατηρούμενο επίπεδο στατιστικής σημαντικότητας (p-τιμή), ισχύς ενός στατιστικού ελέγχου, καθορισμός μεγέθους δείγματος. Εισαγωγή στην παλινδρόμηση, απλό γραμμικό μοντέλο, στατιστικό γραμμικό μοντέλο, κανονικό γραμμικό μοντέλο, συμπερασματολογία στο κανονικό γραμμικό μοντέλο (διαστήματα εμπιστοσύνης/πρόβλεψης και έλεγχοι υποθέσεων), μετασχηματισμοί, κατάλοιπα και διαγνωστικά αποκλίσεων από τις υποθέσεις του γραμμικού μοντέλου. Πολλαπλό γραμμικό μοντέλο, επιλογή καλύτερου μοντέλου, μέθοδοι forward, backward,

stepwise, all possible regressions, επιλογή μοντέλου με κριτήρια πληροφορίας, AIC, BIC, Mallows Cp. Ανάλυση Διακύμανσης (ANOVA) για έναν παράγοντα. Εφαρμογές στην R.

- **Recommended or required reading**
  - "An Introduction to Probability and Statistical Inference", by G. Roussas, 2nd edition, 2014, Academic Press
  - "Statistical Inference" by G. Casella and R.L. Berger, 2nd edition, Duxbury Press, 2001
  - "Applied Linear Regression", by S. Weisberg, 3rd edition, Wiley 2005
  - "An R Companion to Applied Regression", by J. Fox and S. Weisberg, 2nd edition, SAGE Publications Inc, 2011.

- **Planned learning activities and teaching methods**

Teaching in Class, distant learning (if necessary)

- **Assessment methods and criteria**

Written final exam, Assignments

Course Title: Statistical Quality Control (Reading Course) (Μεταφορά από Χειμερινό ΓΣ 26/5/2021)

Course Unit Code	9057
Level of course:	Undergraduate
Year of study:	3rd year
Semester/trimester:	Spring (6th Semester)
Number of credits allocated:	7 ECTS credits
Name of lecturer:	St.Psarakis, Professor

Objectives of the course:

After the course the student will have the skills needed to deal with improving the quality of products or services using statistical methods.

- **Prerequisites and co-requisites**

Attendance and knowledge of topics related to Estimation-Hypothesis testing, are very useful.

- **Recommended optional programme components**

None

- **Course contents**

Basic concepts of quality control and statistical quality control. Cause and effect charts. Pareto charts. Control charts for variables (R,S). Attributes control charts (p,np,c,u). CUSUM and EWMA control charts. Capability indices. Introduction to multivariate control charts. The six sigma methodology. Acceptance sampling. Basic experimental design using principals of repetition and blocking.

- **Recommended or required reading**
  - Montgomery D (2012) Introduction to Statistical Quality Control, 7th Edition Wiley.
  - Ryan, T. (2000). Statistical methods for quality improvement. J. Wiley New York 2nd edition.

• **Planned learning activities and teaching methods**

Teaching in Class, distant learning (if necessary)

• **Assessment methods and criteria**

Written final exam, Assignments

Course Title: Multivariate Statistical Analysis ADVANCED LEVEL

Course Unit Code	9024
Level of course:	Undergraduate
Year of study:	3rd year
Semester/trimester:	Spring (6th Semester)
Number of credits allocated:	8 ECTS credits
Name of lecturer:	D. Karlis, Professor

Objectives of the course:

Upon completion of the course, the student will be able to: produce graphs and comprehend relations in his data, apply basic methods of multivariate data analysis, infer on multivariate data, use methods of dimension reduction.

• **Prerequisites and co-requisites**

Knowledge of

- Statistical Inference
- Linear Algebra
- Basic knowledge of R

• **Recommended optional programme components**

None

• **Course contents**

The course has the following parts

- Multivariate descriptive and graphs
- Multivariate normal and related distributions
- Hypotheses tests for multivariate data
- MANOVA
- Multivariate Linear model
- Principal Components Analysis
- Factor Analysis

• **Recommended or required reading**

- Everitt, Sidney B., Casella, Fienberg G., Olkin S., Ingram, An R and S-PLUS Companion to Multivariate Analysis, Springer-Verlag London Limited, 2005.
- Anderson, T. W. (1984). An Introduction to Multivariate Statistical Analysis, John Wiley & Sons, New York, 2nd edition.
- Bartholomew, D.J., Steele, F., Moustaki, I., Galbraith, J. (2011) Αναλυση πολυμεταβλητών τεχνικών στις κοινωνικές επιστήμες, Εκδόσεις ΚΛΕΙΔΑΡΙΘΜΟΣ
- Basilevski, A. (1994). Statistical Factor Analysis and Related Methods. Theory and Applications. John Wiley & Sons.

- Chatfield, C. and Collins, A.J. (1992). Introduction to Multivariate Analysis.
- Jackson, J. (1991). A User's Guide to Principal Components, John Wiley & Sons, Inc., New York, NY.
- Krzanowski, W. J. (1988). Principles of Multivariate Analysis. Oxford University Press.
- Mardia, K. V., Kent, J. T. & Bibby, J. M. (1979). Multivariate Analysis. London: Academic Press.

• Planned learning activities and teaching methods

Teaching Method: Face to Face.
Teaching includes: Class lectures. Tutorial. Research Assignment. Self Study.
During the course there are 3-4 projects. The projects need computing in R.

• Assessment methods and criteria

70% Written exam at the end of the semester

30% Projects

Course Title: Statistical Learning (master Course)

Course Unit Code	9044
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	4 ECTS credits
Name of lecturer:	~~I. Papageorgiou, Associate Professor~~

Objectives of the course:

Upon completion of the course, students will have the knowledge and the skills to implement statistical methods aiming to deal with the problem of non-linear modelling, data dimension reduction, classification and clustering. They will be able to interpret the results and assess the methodologies' performance.

• Prerequisites and co-requisites

Attendance only for students from Statistics departments with good knowledge of R, multivariate analysis, statistical inference, data analysis and Linear algebra.

• Recommended optional programme components

N/A

• Course contents

A range of statistical learning methods are covered. For supervised learning: k-nn regression, spline regression, smooth spline. LDA, QDA, k-nn, decision trees. For unsupervised learning: clustering (hierarchical, optimization clustering, model-based), data reduction methods. Model Assessment and Selection.

• Recommended or required reading

- Hastie, Tibshirani and Friedman (2009) Elements of Statistical Learning, 2nd edition Springer
- James, Witten, Hastie and Tibshirani (2011) Introduction to Statistical Learning with applications in R, Springer

- B. S. Everitt, S. Landau, M. Leese, and D. Stahl (2011) Cluster Analysis, Fifth Edition, Wiley

• Planned learning activities and teaching methods

Lectures in class. Lab for implementation of the techniques, projects for the students during the course.

• Assessment methods and criteria

Written exam and projects

Course Title: Introduction to Probability and Statistics using R

ADVANCED LEVEL

Course Unit Code	9046
Level of course:	Undergraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	7,5 ECTS credits
Names of lecturers:	D.Karlis, Professor, X.X.Penteli, Assistant Professor

Objectives of the course:

The student will be able to understand and make use of basic concepts about statistics and probability. They will be able to have sufficient knowledge of R program, as to be capable to implement basic programs in order to perform basic statistical methods, to create and understand basic descriptive visualization, to manage data of certain complexity and to extract them from large datasets. They will be also able to comprehend basic characteristics of real data and communicate them efficiently

• Prerequisites and co-requisites

Students should have taken introductory courses in Probability, Statistics and R programming. The course is suitable only for Statistics students

• Recommended optional programme components

None

• Course contents

Emphasis is given on R programming using ideas from probability and Statistics. So, the course is mainly an R programming course. The curse aims at introducing ideas from Probability and Statistics together with R programming. Such examples is using simulation to show and understand with the Central limit theorem, the law of large numbers, probability as frequency, descriptive statistics and their properties etc

• Recommended or required reading

- Verzani, J. (2018). Using R for introductory statistics. CRC press.
- Gelman, A. Nolan, D. (2002) Teaching Statistics: A bag of tricks. Oxford University Press
- Dalgaard, P. (2008) Introductory Statistics with R. Springer
- Kerns, J. (2011) Introduction to Probability and Statistics Using R. Available at

http://cran.r-project.org/web/packages/IPSUR/vignettes/IPSUR.pdf
- Horgan, J. (2008) Probability with R: An Introduction with Computer Science Applications. Wiley
- Crawley, M.J. (2014) Statistics: An Introduction Using R, 2nd Edition, Wiley

• Planned learning activities and teaching methods

Teaching Method: Face to Face.
Teaching includes: Class lectures. Bibliography studying and analyzing. Tutorial. Assignments. Self Study.

• Assessment methods and criteria

80% Written exam at the end of the semester
20% (Project)

Course Title: Actuarial Science I (Reading course)

Course Unit Code	9032
Level of course:	Undergraduate
Year of study:	2nd year
Semester/trimester:	Spring (4th Semester)
Number of credits allocated:	7 ECTS credits
Name of lecturer:	A. Zimbidis, Assistant Professor

Objectives of the course:

At the end of the lectures, the students are able to deal with the basic problems of pricing, reserving and reinsurance in a general insurance company.

• Prerequisites and co-requisites

Basic knowledge of Mathematics, Probability and Statistics.

• Recommended optional programme components

N/A

• Course contents

Uncertainty, Risk, Insurance, Insurance Companies, Actuaries, Insurance Concepts, Products, Actuarial base. Frequency, severity and pricing methodology premium adjustments, Projections and trends for the final payments by using linear and other models. Reserving methods, Analysis of Insurance Data, Triangular methods and olistic methods of reserving, Discounting reserves, and Confidence Intervals. Reinsurance schemes, «Bonus-Malus» and Markov Chains.

• Recommended or required reading

- Zimbidis A.(2008) “Actuarial Mathematics of Non-life Insurance”
- Brown R.L , Gottlieb L.R. (2005) -3rd edition
- “Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance”, Actex Publications,

- Mikosch T. (2006) “Non-Life Insurance Mathematics: An Introduction with Stochastic Processes”, Springer

• Planned learning activities and teaching methods

Teaching Method: Reading course.

• Assessment methods and criteria

Courseworks during the semester plus oral exam at the end of the semester.

Course Title: Financial Econometrics (master course)

Course Unit Code	9036
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	3,5 ECTS credits
Name of lecturer:	I.Vrontos, Associate Professor

Objectives of the course:

The aim of this module is to provide students with advanced statistical and econometric skills required to analyze empirical problems in finance. After successfully completing the course, students will be able to:

- interpret the concepts of return and risk in financial markets
- model the expected returns of financial assets
- model the variances and covariances/correlations of financial returns
- use advanced econometric tools to analyze models used in financial applications
- forecast financial returns
- assess the performance of portfolio managers
- understand modern portfolio theory
- solve mean-variance optimization problems
- estimate the risk of financial assets

• Prerequisites and co-requisites

Statistical Inference, Regression Analysis

• Recommended optional programme components

None

• Course contents

This course provides a broad introduction to the theory and empirical analysis of advanced econometric models in financial applications such as construction of optimal portfolios, evaluating managers' performance, and forecasting financial returns. Multi-factor models are introduced, which can be used to estimate the expected returns of financial assets, and univariate and multivariate heteroscedasticity models (ARCH/GARCH), which can be used to model the variations and covariances/correlations of financial returns. Indicative examples of the application of these advanced statistical and econometric models and techniques are (a)

the construction of optimal portfolios, (b) the evaluation of the performance of the various mutual fund or hedge fund investment managers, (c) forecasts of financial series, e.g. stock returns.

• Recommended or required reading

- Elton, E.J., Gruber, M.J., Brown, S.J., and Goetzmann W.N. (2014). Modern Portfolio Theory and Investment Analysis, 9th edition, Wiley.
- Sharpe, W.F., Alexander, G.J, and Bailey, J.V. (1999). Investments, 6th edition, Prentice-Hall.
- Tsay, Ruey S. (2010). Analysis of Financial Time Series, New York: Wiley.
- Selected papers.

• Planned learning activities and teaching methods

One three-hour lecture per week, study exercises, and programming exercises as homework (some to be submitted).

• Assessment methods and criteria

The final grade is the average of the final examination grade (weight 80%) and the grade of the study and programming exercises to be submitted (weight 20%), provided that the final examination grade is at least 5/10. Otherwise, the final grade equals the final examination grade.

Course Title: Biostatistics (master course)

Course Unit Code	9038
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	4 ECTS credits
Name of lecturer:	X.Pedeli, Assistant Professor

Objectives of the course:

After successfully completing the course, students will be able to:

- recognize the appropriate study design in a medical study, and
- use appropriate measures and statistical methods to help the health scientist in deriving sensible conclusions.

• Prerequisites and co-requisites

Students should have basic knowledge of probability theory and statistics. For the programming assignments of the course, programming experience in R is required.

• Recommended optional programme components

N/A

• Course contents

Introduction to epidemiology and epidemiological study designs. Measures of health and disease: Measures of disease frequency (prevalence, incidence), Risk measures (cumulative incidence or risk of disease, incidence rate of disease, odds of disease), Measures of exposure effect (risk ratio, rate ratio, odds ratio, risk difference, rate difference). Cohort studies: Rates, Rate ratio, Test of null hypothesis, Exposures with more than two levels, Stratified analysis of rates – Controlling for confounders. Survival analysis: Censored observations, The lifetable method, The Kaplan-Meier method, The log-rank and other tests for testing survival curves, The Nelson Aalen estimator, Survival regression (Cox's proportional hazard model, Aalen's additive model, Cox's time varying proportional hazard model). Case-control studies: Analysis of case-control studies (prospective/ retrospective approach), Analysis of unmatched case-control studies, Matched case-control studies, Choice of controls in case-control studies

• Recommended or required reading

- Armitage, P.; Berry, G.; Matthews, J.N.S. Statistical Methods in Medical Research; Wiley: Hoboken, NJ, USA, 2002.
- Clayton, D.; Hills, M. Statistical Models in Epidemiology; Oxford University Press: Oxford, UK, 2013.
- Pocock SJ. Clinical trials: a practical approach. Wiley, New York, 2013.
- David W. Hosmer, Jr., Stanley Lemeshow, Susanne May, 2008 Applied Survival Analysis: Regression Modeling of Time to Event Data, 2nd Edition. Wiley Series in Probability and Statistics
- Kenneth J. Rothman, Sander Greenland, Timothy L. Lash, 2012 Modern Epidemiology Third Edition, Lippincott Williams & Wilkins

• Planned learning activities and teaching methods

One three-hour lecture per week, assignment as homework (to be submitted).

• Assessment methods and criteria

The final grade is the weighted average of the final examination grade (80%) and the grade of the assignment to be submitted (20%).

Course Title: Advanced Stochastic Processes (master course)

Course Unit Code	9042
Level of course:	Postgraduate
Year of study:	1st year
Semester/trimester:	Spring (2nd Semester)
Number of credits allocated:	3,5 ECTS credits
Name of lecturer:	~~N.Fragos, Professor~~

Objectives of the course:

Upon successful completion of the course the students will have a working knowledge of the theory of stochastic processes (martingales and Brownian motion) as well as of Stochastic

Integration and Stochastic Differential Equations. They will also be able to use models based on these concepts in Statistics, Finance and Insurance Mathematics.

• Prerequisites and co-requisites

Probability Theory

• Recommended optional program components

N/A

• Course contents

Martingales in Discrete and Continuous Time. Brownian Motion: Characterization, Construction and Properties. Quadratic Variation. Ito integration. Properties of Ito integrals, the Ito formula. Stochastic Differential Equations. Existence and uniqueness of solutions. Examples and applications from Insurance, Finance, and Operations Research.

• Recommended or required reading

- Fima C. Klebaner (2005). *Introduction to Stochastic Calculus with Applications.* Imperial College Press.
- Bernt Oksendal (2003). *Stochastic Differential Equations, an Introduction with Applications.* Sixth Edition, Springer Verlag.
- J. Michael Steele (2000). *Stochastic Calculus and Financial Applications.* Springer Verlag.

• Planned learning activities and teaching methods

- Reading Course, weekly meetings

• Assessment methods and criteria

- Weekly homework