WINTER SEMESTER

1. Statistical Quality Control (Reading Course)
   St. Psarakis
   7 ECTS credits

   Communication with Lecturer
   e-mail: spsa@aueb.gr

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

   Course contents

   Recommended or required reading

2. Computational Statistics (master course)
   D. Karlis
   7,5 ECTS credits

   Communication with Lecturer
   e-mail: karlis@aueb.gr

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

   Course contents
R programming, simulation techniques, Monte Carlo methods, numerical methods for stats, smoothing, numerical optimisation, bootstrap, MCMC.

**Recommended or required reading**

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### 3. Actuarial Science II (Reading course)

A. Zimbidis  
7 ECTS credits

**Communication with Lecturer**

e-mail: aaz@aueb.gr

**Prerequisites**

Basic knowledge of Mathematics, Probability and Statistics.

**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»
  Kluwer Academic Print

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### 4. Data Analysis (master course)

I. Ntzoufras  
7.5 ECTS credits

**Communication with Lecturer**

e-mail: ntzoufra@aueb.gr

**Prerequisites**

Statistical Inference, Regression Analysis, Basic knowledge of R.
**Course contents**
Primary aim of this course is the understanding and the application of statistical method in real life problems of various scientific fields such as Management, Marketing, Psychology, Medicine, Sports and Social Sciences. Focus is given on the review of parametric and non-parametric hypothesis tests for one and two samples (t-tests και Wilcoxon tests), analysis of variance and regression models. Emphasis is given in the implementation of all methods using R and in problem solving. Interesting real life datasets and problems are analyzed during this course with aim to provoke their attention and motivate them.

The course is taught in 12 four-hour sessions (9 lectures and 3 labs) which will cover the following topics: Introduction to data analysis and analytics - motivation; Descriptive analysis and Data visualization; Basic principles of Statistical Inference (Estimators, point estimation, interval estimation, hypothesis tests, p-values, data analysis with R (t-tests, χ², ANOVA, normality tests, tests for equality of variances); Correlation and Simple linear regression, Regression diagnostics; Outliers and influential points; Multiple regression; Collinearity; AIC and BIC; Stepwise variable selection; Ridge regression; Lasso Regression.

**Examination**
One assignment (50%) and one written examination (50%) with the requirement the grade in the written examination to be higher than 5 (out of 10).

**Recommended or required reading**

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**5. Applied Linear Models** *(Reading Course)*

V. Vasdekis
8 ECTS credits

**Communication with Lecturer**
e-mail: vasdeki@aueb.gr

**Prerequisites**
Linear Algebra, Linear Models

**Course contents**
Recommended or required reading

6. Probability and Statistical Inference (master course)
A.Giannacopoulos – N.Demiris
7.5 ECTS credits

Communication with Lecturer
e-mail: ayannaco@aueb.gr & nikos@aueb.gr

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.
7. **Econometrics** (Course or Reading course, depending on the number of students)

A. Livada, I. Vrontos

8 ECTS credits

**Communication with Lecturer**
e-mail: livada@aueb.gr, vrontos@aueb.gr

**Prerequisites**
Linear Algebra, Regression Analysis

**Course Content**
Introduction to Hypotheses and properties for the classical model LS method, Indirect LS ML method 2sls, 3sls, FIML, Instrumental Variables Violations Autocorrelation Heteroscedasticity Multicollinearity Multipliers Identification problem Dummy variables.
1. **Multivariate Statistical Analysis** ADVANCED LEVEL (Reading Course)

D. Karlis

8 ECTS credits

**Communication with Lecturer**
e-mail: karlis@aueb.gr

**Prerequisites**
Knowledge of
- Statistical Inference
- Linear Algebra
- Basic knowledge of R

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

During the course there are 3-4 projects. The projects need computing in R.

2. **Statistical Learning** (*master course*)

I. Papageorgiou

3,5 ECTS credits

**Communication with Lecturer**
e-mail: ioulia@aueb.gr

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

**Course contents**
Unsupervised learning: association rules, clustering, self organizing maps
Supervised Learning: LDA, QDA, k-nn, penalized LDA
Kernel methods and regularization methods (Ridge, Lasso, Elastic Net)
Model Assessment and Selection.
Big data problems

**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
3. Introduction to Probability and Statistics using R (Reading Course) ADVANCED LEVEL

D. Karlis, X.X. Penteli
7.5 ECTS credits

Communication with Lecturer
e-mail: karlis@aeub.gr, xpedeli@aeub.gr

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

Course Content
Emphasis is given on R programming using ideas from probability and Statistics. So, the course is mainly an R programming course. The course 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.

4. Actuarial Science I (Reading course)

A. Zimbidis
7 ECTS credits

Communication with Lecturer
e-mail: aaz@aeub.gr

Prerequisites
Basic knowledge of Mathematics, Probability and Statistics.

Course contents

Recommended or required reading
- “Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance”, Actex Publications,
5. Financial Econometrics (master course)

P.Dellaportas

4 ECTS credits

Communication with Lecturer
e-mail: petros@aueb.gr

Prerequisites
Statistical Inference, Regression Analysis, Basic knowledge of Matlab.

Course contents
Introduction to Course: Outline of Topics, Basic Econometric Models, Mean-Variance Portfolio Theory (Return and risk, Portfolio diversification, Construction of optimal portfolios, Basic empirical application), Performance Evaluation of Financial Assets (Capital asset pricing model, Treynor measure, Sharpe measure, Jensen’s alpha, Multifactor models, Alternative measures, Empirical application), Characteristics of Financial Data (Fat tails, Volatility clustering phenomenon, Leverage effect), Heteroskedasticity Models (ARCH, GARCH and EGARCH models, Properties of time-varying models, Estimation of heteroskedastic models, Empirical application), Multivariate Factor models (Single index models, General multivariate multifactor model), Multivariate Heteroskedasticity Models (Multivariate ARCH/GARCH models, Constant conditional correlation model, Empirical application)

Recommended or required reading

6. Biostatistics (master course)

X.X. Penteli

4 ECTS credits

Communication with Lecturer
xpedeli@aueb.gr

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)
Rates of disease: Rates, Rate ratio, Test of null hypothesis, Exposures with more than two levels, Stratified analysis of rates – Controlling for confounders
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
Clinical trials: Definition/Phases of CTs, Ethics, Standard CTs designs (parallel group, cross-over, control arms, single arms, active control, placebo), Hypotheses/Aims (superiority, non-inferiority, equivalence, primary secondary), Endpoints/Measurements, Treatments/Interventions, Randomization, Stratification, Blinding, Sample Size, Interim Analyses, Sequential Monitoring

Recommended or required reading

7. Probability Theory (master course)
Ch. Pavlopoulos
4 ECTS credits

Communication with Lecturer
e-mail: hgp@aueb.gr

Course contents
Probability Theory
Expected value. Almost sure convergence and the dominated convergence theorem.

Recommended or required reading
8. Advanced Stochastic Processes (master course)

M.Zazanis
4 ECTS credits

Communication with Lecturer
e-mail: zazanis@aueb.gr

Course contents

Recommended or required reading

9. Official Statistics (Course or Reading Course, depending on the number of students)

A. Livada
7 ECTS credits

Communication with Lecturer
e-mail: livada@aueb.gr

Course Content
Definitions.
Simple and Composite Indices.
Choice of goods and services.
Weights.
Arithmetic, Geometric, Harmonic Mean Indices.
Laspeyres’ Index, Paasche’s Index, Marshall-Edgeworth Index, Fisher Index. Criteria of choice.
Applications (Consumer Price Index etc)