

## MULTIVARIATE STATISTICS

<b>Course code</b>	GRAV007
<b>Course title</b>	<i>Multivariate Statistics</i>
<b>Type of course</b>	<i>Compulsory</i>
<b>Level of course</b>	<i>Graduate</i>
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester</b>	1 <sup>st</sup>
<b>Number of credits</b>	6 ECTS; 36 hours of class work, 124 hours of self-study, 2 hours of consultations (distant or direct)
<b>Lecturer</b>	Lect. Marius Kušlys, PhD Candidate, <a href="mailto:markus@ism.lt">markus@ism.lt</a>
<b>Course prerequisites</b>	<i>Statistical Data Analysis</i>
<b>Form of studies</b>	<i>Consecutive (evening)</i>
<b>Teaching language</b>	<i>English</i>

### Objective of the course

Multivariate statistics encompass fundamentals behind quantitative data analysis, which is widely applied in data-driven decision making, marketing research and consumer behaviour studies. It is virtually impossible to succeed in the business world in the age of big data without a working knowledge of basic data analysis approaches and statistical software. The aim of the course is to introduce a variety of standard statistical methods used to analyse multivariate data, emphasizing the implementation and interpretations of these methods. The course covers the design of a research project, the choice of suitable multivariate methods, the testing of the fundamental assumptions underlying various methods, the application and evaluation of multivariate methods and interpretation of the results. Practical examples, having a real-world relevance, will be provided and participants involved with hands-on experience of data analysis using SPSS and R/radiant as the main tools. Students will be advised to study relevant chapters from textbook and read articles in academic journals.

### Learning outcomes

At the end of the course the students will be able to:

Course learning outcomes (CLO)	Study methods	Assessment methods
CLO1. Demonstrate knowledge and understanding of the different multivariate data analysis methods most commonly used in business and marketing.	Lectures, practical assignments	Individual project, practical assignments, exam
CLO2. Apply multivariate statistical techniques to conduct marketing research.	Lectures, practical assignments	Individual project, practical assignments
CLO3. Determine correct statistical methods for decision-making.	Lectures, practical assignments	Individual project, practical assignments, exam
CLO4. Interpret the results of statistical analysis and present them in a rigorous, understandable, clear and concise manner.	Lectures, practical assignments	Individual project, practical assignments
CLO5. Argue the choice of statistical methods when analysing business or marketing case.	Lectures, practical assignments	Individual project

### Learning methods

The course is taught entirely in English and is designed to achieve its aims through a combination of lectures and practical exercises, as well as assignments and individual project. Exercises and lectures are designed to encourage active participation, co-operative and creative work, interactive communication, as well as critical and statistical thinking.

### Quality issues

The lecturer assures a variety of teaching and learning methods, interim knowledge assessment, and supply of learning material to students, as well as discussions of practical and individual work in class during the course.

### Cheating issues

Individual testing, supervised practical assignments and individual project ensure studying quality and are forms to prevent cheating. The ISM regulations on academic ethics, including cheating (see, *ISM University regulations*) are fully applied in the course.

### Course content

No.	Topic	Readings	In-class hours
1	Introduction to multivariate analysis. Distributions, descriptive statistics, hypothesis testing (p-value, statistical significance), (in-)dependent samples, t-test, (non-)parametric tests.	[1] 1; [2] 1-3; [3] 1-3; [4] 2-3, 10; [5] 3-5; [6] 3, 5-6	4
2	Correlation (Pearson, Spearman), Chi-squared, ANOVA, ANCOVA, MANOVA, MANCOVA.	[1] 8; [2] 5; [3] 4-6, 7; [4] 4, 12-13; [6] 4	4
3	Regression analysis: introduction, mediation and moderation, regression diagnostics.	[1] 4, 8; [3] 4, 6; [4] 4, 13-14; [6] 7	4
4	Supervised learning techniques: discriminant analysis, (multinomial) logit, decision tree.	[1] 7; [3] 8; [5] 6; [6] 9, 13	4
5	Unsupervised learning techniques: clustering (k-means), dimensionality reduction (PCA).	[1] 3, 9-10; [5] 11; [6] 8, 11	4
6	Choice modeling: conjoint analysis, part-worths, relative importance of attributes.	[1] 6	4
7	Analysis of survey data: scale reliability by Cronbach $\alpha$ , imputation of missing data.	[1] 3, 4	4
8	Market basket analysis: support, confidence, lift, rule redundancy removal, visualization.	[5] 9; [6] 12	4
9	Canonical correlation analysis. Overview of the course.	[1] 5	4
	FINAL EXAM	<b>Total:</b>	36

#### Literature (course materials and readings)

1. J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson (2010). Multivariate data analysis (7<sup>th</sup> edition). Pearson.
2. J.R. Estep (2013). Statistics, not sadistics: a practical guide to statistics for non-statisticians. Online resource.
3. A.C. Elliot, W.A. Woodward (2007). Statistical analysis quick reference guidebook: with SPSS examples. Sage.
4. N.A. Weiss (2008). Elementary statistics (8<sup>th</sup> edition). Boston, Pearson Education.
5. M.J.A. Berry, G.S. Linoff (2004). Data mining techniques: for marketing, sales, and CRM (2<sup>nd</sup> edition). Wiley.
6. C. Chapman, E. MD. Feit (2015). R for marketing research and analytics. Springer.

#### Course tasks and assessment of achievements

Method	Percentage of the final grade	Total hours
Practical assignments (4 exercises with SPSS and/or R)	40	54
Individual project	20	27
Final exam	40	55
<b>Total:</b>	<b>100</b>	<b>124</b>

The course final grade and overall assessment involves 3 tasks, which are described below:

1. Practical **assignments** will count for the **40%** of the final mark. There will be 4 assignments, each worth 10%. Students will be assigned to a group and they are expected to attend exercises in the computer classroom.
2. Individual **project** will count for the **20%** of the final mark. Students will have to upload a finished project report for evaluation before a specified deadline.
3. A two-hour final **exam** in a written form, which will include open questions on the topics discussed during the lectures of the course. Final exam will be held in the end of the course and will count for the **40%** of the final mark.

Students must score for all tasks of the course at the specified time. Some postponing (for example, lag of 1 week) is possible only for practical assignments, but not for other tasks. Precision of composite evaluations is left intact (up to 2 decimal places) until the end of semester and only the final evaluation will be subject to rounding. In case of failing final evaluation, student has a possibility to retake the final exam (**40%** of the final grade).