UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Statistical Methods for Business - 1

2526-2-E1802M119-T1

Learning objectives

Making decisions in business is often made difficult due to the uncertainty connected with a vague and not-systematic knowledge of the context. This course explains the statistical techniques which make use of data to reduce that uncertainty.
Specific goals of the course are as follows:

- *knowledge and understanding:* students should know how to measure uncertainty by probability; students should know the statistical techniques which combine uncertainty and data processing; students should know the statistical techniques which aim at measuring and at improving quality in business.
- *applied knowledge and understanding:* students should be able to translate decision problems into a statistical language; students should be able to locate the right statistical technique to support specific decisions; students should know how to assess the expected risk from wrong decisions; students should be able to implement statistical monitoring of quality in business; students should be able to process business data either by manual computations either by means of a specialized software
- *making judgements:* students should be able to assess the reliability of some results of data processing, with specific attention to the fulfilment of the underlying assumptions; students should be able to manage the subjectivity in the interpretation of some results of data processing; students should develop a critical thinking in the use of data processed by third parties
- *communication skills*: student should be able to explain the uncertainty connected with some results of data processing; students should be able to choose suitable ways to present some results of data processing; students should be able to customize some supporting statistical tools to the skills of decision makers
- *learning skills:* students should be able to understand other statistical technique (not covered in this course), suitable for other business problems faced for study or work

Contents

First, the course aims at providing suitable knowledge of probability and of statistical techniques for sampling data,

especially those concerning economic phenomena and business. Moreover, statistical techniques to monitor and to improve the quality of production processes will be studied.

Detailed program

Events and probability. Random experiments, basic combinatorial calculus, assignment of probabilities. Basic rules of probability. Probability of the complement of an event, union of events, intersection of events. Conditional probability. Product rule. Independent events. Bayes theorem. Discrete random variables. Probability functions. Expectation. Variance. Discrete uniform distribution. Binomial distribution. Poisson distribution. Hypergeometric distribution. Continuous random variables. Continuous uniform distribution. Normal distribution. Normal approximation to the binomial distribution.

Sampling and sampling distributions. Finite and infinite populations. Parameters and statistics. Simple random sampling and other schemes of sampling. Point estimation. Estimators and their properties. Estimators and sampling distributions. Sample mean. Sample proportion. Interval estimation. Confidence intervals, margin of error, confidence level. Confidence intervals for the population mean: known and unknown variance. Determination of the sample size. Confidence intervals for a proportion. Hypothesis testing. Null and alternative hypothesis. Type I and type II errors. Significance level of a test. Critical-value approach and p-value approach. One-sided and two-sided tests. Relationship between two-sided tests and confidence intervals. Tests on the population mean: known and unknown variance. Tests on a proportion. Tests and confidence intervals for the difference of two means: paired and independent samples. Tests and confidence intervals for the difference of two proportions. Chi-squared test: goodness-of-fit test and test of independence. Linear regression model. Assumptions of the model. Least squares method. Goodness-of-fit. Standard error of the estimate. Confidence intervals and tests for the parameters of the model. Forecasting. Graphical analysis of residuals.

Control charts. Choice of the control limits. Choice of the sample size and of the sample frequency. ARL, average run length and ATS, average time to signal. Interpreting a control chart. Control charts for the mean (x-bar charts) and for the range (R charts). Charts for the proportion and for the number of non-conforming items (p charts and np charts). Choice of the sample size in p charts. Charts for the number of non-conformities and for the mean number of non-conformities (c charts and u charts). Process capability. Process capability ratio. Capability indices for not centered processes.

Prerequisites

Basic statistics. Descriptive statistics. Basic mathematics.

Teaching methods

21 2-hour lessons (theory and examples) held in direct-teaching mode and carried out in presence.
12 integrative tutoring hours regarding the use of R for inferential statistical analyses and statistical quality control (activity subject to the avaliability of lab rooms or equipped rooms; activity partially carried out remotely)

Assessment methods

The assessment methods consist of a final written test. The possibility to ask for a supplementary oral test is guaranteed, at the discretion of both students and the teacher. In any case, the discretionary oral test can be only taken if the written test is graded 18/30 at least.
The written test contains exercises and open questions about the subjects dealt during lessons. The written test is organized into single questions, each graded from 2 to 4 points., with a total score of 31. The written test lasts 120 minutes. Examples of written tests, with solutions, can be found on the e-learning. Exam-papers showing is provided, so that students can ask for details about corrections and criteria used to grade.
The written test can be substituted by two partial tests. Each of them can be taken just in a single session, approximately at the half and at the end of the course. The assessment methods of the partial tests are the same as for the final written test; however, each partial test lasts 60 minutes and it deals mainly with the subjects explained in the lessons of the corresponding half of the course.

Textbooks and Reading Materials

D. Anderson, D. Sweeney, T. Williams “Statistica per le analisi economico-aziendali”, 2010, Apogeo Education – Maggioli Editore.

D. C. Montgomery “Controllo Statistico della Qualità (seconda edizione)”, 2006, McGraw-Hill

Reference to the textbooks is crucial to attend lessons and practical sessions. Additional materials are provided by the e-learning website.

Semester

Second semester.

Teaching language

Italian.

Sustainable Development Goals