COURSE DESCRIPTION
Statistical lab for industrial data analysis

SSD: STATISTICA PER LA RICERCA SPERIMENTALE E TECNOLOGICA (SECS-S/02)

DEGREE PROGRAMME: INGEGNERIA AEROSPAZIALE (M53)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
CHANNEL: FG A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 9

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

Statistical Lab for Industrial Data Analysis is a problem-based learning course whose aim is to train students on the application (illustrated through open-source statistical software environment R) of interpretable statistical techniques for decision-making, possibly scalable also up to big data frameworks. Every student must choose a data analysis project gathered along the course by experts in industrial engineering fields and develop it by working in a team. The industrial engineering experts may want to take part in initial, intermediate and final workshops, where student groups shall show their project work in progress. In this way, students will have the opportunity to improve their ability to recognize and implement the most suitable statistical techniques for the problem at hand as well as of communicating relevant results

and the impact of their analysis also to non- statisticians.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

Students should learn the basic statistical techniques for the data analysis in an industrial framework.

Applying knowledge and understanding

Students will be able to work in a team, to get the skills for the decision-making in a data analysis project.

COURSE CONTENT/SYLLABUS

[3CFU] Overview and course objectives. Description of multivariate data and inference about mean vectors. Elements of unsupervised learning: principal component analysis and clustering methods.
[3 CFU] Elements of supervised learning: problems in multivariate linear regression models; linear model selection and regularization (ridge regression, the lasso); reduction methods (principal components regression, partial least squares). Overview of classification methods.
[2 CFU] Statistical process monitoring and control: control charts for variables and attributes; the Hotelling control chart; regression adjustment; interpretation of out-of-control signals.
[1 CFU] Beyond multivariate data analysis: introduction to functional data analysis; statistical monitoring of functional data. Engineering examples through software environment.

READINGS/BIBLIOGRAPHY

Johnson, R.A., Wichern, D.W. (2007) Applied Multivariate Statistical Analysis (6th edition), Prentice Hall, Upper Saddle River.
Montgomery, D. C. (2014) Introduction to Statistical Quality Control. 7th edition. John Wiley &Sons.
James, G., Witten, D., Hastie, T., Tibshirani, R. (2013) An introduction to statistical learning. New York: Springer.
MOOC Industry 4.0 Big Data e Data Analytics III - a cura di B. Palumbo e M. L. Chiusano (2019) https://landing.federica.eu/industria40/

TEACHING METHODS OF THE COURSE (OR MODULE)

Problem-based learning. Flipped classroom. Lectures. Lab Sessions and Seminars. Peer-grading. Team work. Interactive and anonymous quiz games.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☑ Written

- [x] Oral
- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [x] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The final grade is formulated by the Examination Committee according to the scores achieved by the student in the peer-graded project discussion, the written exam and the successive discussion during the oral exam. The final evaluation is discussed and highlighted to each student.