Statistics for Engineers

Course Area: Managerial Engineering, Information Engineering, Industrial Engineering, Civil and Environmental Engineering

Instructors: Prof. Luigi Salmaso, University of Padova (coordinator), Prof. Rosa Arboretti, University of Padova, Prof. Marta Disegna, University of Padova.

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Program:

The course is an introduction to statistical methods most frequently used for experimentation in Engineering. Lectures are planned both in the classroom and in computer lab also for an introduction to the use of the following statistical software:

- R and Rstudio, both open-source software.
- MINITAB, licensed to University of Padova.

Topics:

1. Elements of univariate statistical methods:
    a. Elements of descriptive statistics: frequency, indices of synthesis (position, variability and shape) and graphical representations (histogram, boxplot, scatterplot).
    b. Elements of probability theory: discrete and continuous probability distributions.
    c. Elements of statistical inference: sampling distributions, point and interval estimation, hypothesis testing, One-way ANOVA.
2. Linear and non-linear regression models:
    a. Simple and multiple linear regression model
    b. Logit model
3. Multivariate data analysis:
    a. Cluster Analysis: idea and steps
    b. Multidimensional data, matrix representation and data preparation.
    c. Distance and dissimilarity matrices.
    d. Hard clustering algorithms: hierarchical clustering algorithms, non-hierarchical clustering algorithms and Bagged clustering algorithm.

e. Fuzzy clustering algorithms: fuzzy C-means and fuzzy C-medoids.
f. Validity indices and optimal number of clusters.
g. Labelling and profiling the clusters: an application of suitable tests and regression models.

4. DOE: Introduction to Factorial Designs, Two level and general factorial designs. Tutorials in MINITAB.

References:

- Slides and material available from instructors.
- Montgomery D.C., Design and analysis of experiments, Wiley.

Examination and grading: Attendance is required for at least 2/3 of the lecture hours. Final evaluation will be based on the discussion of a case study within the individual PhD project.

Course details:

The course is structured into 2 on-campus lectures and a Summer School of 4 days. A total of 40 hours in-person course will be delivered.

The on-campus lectures will take place on Wednesday the 2nd February 2022 and Wednesday the 9th February 2022. Classes will take place in the morning, 9am to 1pm, and in the afternoon, 2pm to 4pm for a total of 6 hours per day.

The Summer School will take place in Villa San Giuseppe, Monguelfo, Bolzano province (https://www.villasangiuseppemonguelfo.com) from Tuesday the 28th June 2022 to Friday the 1st July 2022 for a total of 28 hours. The Summer school will start at 2pm on Tuesday and will finish at 4pm on Friday.

Villa San Giuseppe offer a full board accommodation and rooms are of different size. The cost of the Summer School is €150 (for the full board accommodation to be paid on site) for the entire period.