



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Piani Sperimentali per il Marketing

2425-2-F7702M035-F7702M106M

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#### Learning objectives

The course focuses on experimental designs, with particular emphasis on practical application through case studies related to the business context. The aim is to illustrate the use of specific models to analyze how a quantitative variable depends on one or more qualitative variables. Part of the course will focus on estimating model parameters and their interpretation. The goal is for students to develop skills in applying statistical models and interpreting results to be then used in operational contexts.

#### Contents

Experimental designs with one or more factors, linear models.

#### Detailed program

Review of basic statistic: Statistical indicators, random variables, expected value, variance, and their properties. Random variables: normal, Student's t, Chi-square, Fisher's F. Point estimates of the mean and variance. Hypothesis testing for the mean in the case of sampling from a normal distribution. Introduction to R software for solve statistical problems.

Completely randomized single-factor experimental designs: Description of the experimental design and objectives. Specification of the model interpreting the quantitative dependent variable, interpretation of parameters, and assumptions. Hypothesis testing to be performed on model parameters. Estimation and hypothesis testing with known and unknown parameters. Decomposition of total sample deviance into within-group deviance and between-group deviance. Variance estimator based on within-group deviation and variance estimator based on between-group deviation: definitions, expected value, probability distribution. Construction of the test statistic. Balanced and

unbalanced design. ANOVA table. p-value. Statistical indicators. Applications.

Completely randomized two-factor experimental designs: Description of the experimental design and objectives. The model interpreting the dependent quantitative variable, interpretation of parameters, assumed hypotheses, and useful graphs for main effects and interaction parameters. Descriptions of hypotheses to be tested. Decomposition of total sample variance: variance due to the first factor, variance due to the second factor, variance due to interaction between the two factors, variance due to error. Construction of the test statistic. ANOVA table. Applications.

Linear model with qualitative variables: Review of the linear model, assumptions underlying it, and parameter estimation. Specification of the model with one quantitative covariate and one qualitative covariate with two levels. Specification of the model with one quantitative covariate and one qualitative covariate with multiple levels. Linear model with interactions between variables and multiple qualitative covariates. Interpretation of the model, hypothesis testing on parameters, and implementation. Applications.

Extension of linear model concepts to generalized linear models: Specification of the model with one quantitative covariate and one qualitative covariate with two levels. Interpretation of the model, and applications.

The applications will be partly carried out with the support of the statistical software R.

## **Prerequisites**

Knowledge of basic statistics and inference.

## **Teaching methods**

Frontal lectures with presentation of practical examples.

## **Assessment methods**

The exam is in written form. The written exam includes exercises designed to assess the student's ability to apply the concepts studied to solve practical problems and interpret the results obtained to provide practical guidance to operators in the context under consideration.

## **Textbooks and Reading Materials**

Piccolo, D. *Statistica per le decisioni*. Il mulino, terza edizione, 2020.

Optional: Dean, A., Voss, D., Dragulji?, D. *Design and Analysis of Experiments* (Springer Texts in Statistics) 2nd ed. 2017.

Optional: Montgomery, D. C., *Progettazione e analisi degli esperimenti*, 2005.

## **Semester**

Second semester

## **Teaching language**

Italian

## **Sustainable Development Goals**

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