60848 - Statistical Models in Engineering

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	532 - Master's in Industrial Engineering
ECTS	6.0
Course	2
Period	First semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

5.1.General methodological presentation

The proposed methodology encourages students for continuous work. All sessions are held in the computer lab to enable students to use statistical software. The theoretical foundations supporting the statistical techniques are introduced in the form of lectures in large-group sessions. The theory is illustrated with industrial applications by means of case examples based on real data. Practical hands-on sessions are developed in small groups for student training with specific statistical software. Each student has to complete an individual task concerning the use of statistical procedures in industrial data. A written report is mandatory.

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5.2.Learning activities

Classroom activities:

Lectures: Introduction to the theory of statistics as well as the statistical techniques which are illustrated with case studies at computer lab sessions.

Computer lab work: Students will analyze data collections from the industrial field by using statistical software.

Individual work: Each student will develop several tasks concerning the application of statistical techniques in actual problems drawn from the industrial context.

Tutorials: Personal assistance provided by the instructor to review and discuss with students about both, the topics presented in class and the assigned tasks.

Formative assessment. Each student should deliver an oral presentation focusing on one of the works previously developed.

5.3.Program

BLOCK 1: REGRESSION MODELS

1. Descriptive analysis of association between variables. Scatterplot. Smoothing

2. Correlation. Simple linear regression model. Model checking

3. Multiple linear regression. Covariates and factors. Model construction: step-wise regression

4. Logistic regression.

BLOCK 2: STATISTICAL QUALITY CONTROL.

1. Acceptance sampling. Acceptance sampling for attributes: Definition of a Single-Sampling Plan. Rectifying Inspection. ANSI/ASQC Z1.4, ISO 2859. Acceptance sampling by variables: ANSI/ASQC Z1.9-1993.

2. Review of Statistical Process Control (SPC): Control charts for variables. Control charts for a attributes. Seven tools for control and process improvement. Acceptance sampling vs Control Chart.

3. Capability Analysis: Histograms and probability plots. Non-normal data. Specification Limits vs Natural Tolerance Limits.

4. Advanced Methods for SPC: tests for randomness. Modified Control Charts. CUSUM Chart. Temporal dependence analysis.

5. Multivariate SPC: T 2 chart. Control Chart for weighted means. Multivariate capability analysis.

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BLOCK 3: DESIGN AND ANALYSIS OF EXPERIMENTS

1. Introduction to design and analysis of experiments: Basic principles of the design of experiments. Comparison of two populations. One factor experiments: Analysis of Variance.

2. Classical models of experimental analysis: fixed effect models with randomized complete block designs. Latin square design. Full factorial experiments.

3. 2 k and 3 k factorial designs: the structure of factorial experiments. Blocking of full factorial designs. Fractional factorial designs.

4. Exploration of response surfaces: Second orden designs. Canonical representation.

BLOCK 4: RELIABILITY ANALYSIS

1. Failure models: Time to failure, reliability function, failure rate, mean residual life and parametric models: exponential, weibull, normal, lognormal, etc.

2. System reliability analysis structure function, system examples: series, parallel, k-out-of n, etc., coherent systems, reliability of systems with independent components and redundancy.

3. Statistical life data analysis: censored data sets, parametric analysis: exponential and Weibull and nonparametric analysis: de Kaplan-Meier estimator of reliability function.

4. Accelerated life testing.

5. Regression models in reliability.

5.4.Planning and scheduling

The course is structured in 4 hours/week along the semester. A review of previous knowledge on data analysis is performed during the first week.

The remaining weeks are developed as follows: the statistical technique to be used will be presented in the first one hour and a half. The students will practice with data bases specifically designed for this purpose during the following 2 hours and 30 minutes.

Both, personal study and assigned tasks require about 88 working hours for each student.

Oral presentations will take 30 minutes.

5.5.Bibliography and recomended resources