



NATIONAL UNIVERSITY OF ENGINEERING COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - STATISTICS AND PROBABILITIES

I. GENERAL INFORMATION

CODE	: MA611
SEMESTER	: 3
CREDITS	: 3
HOURS PER WEEK	: 5 (Theory – Practice)
PREREQUISITES	: MA123 Mathematics II
CONDITION	: Compulsory
DEPARTMENT	: Basic Sciences
INSTRUCTOR	: Carlos Bravo, Gonzalo Panizo, Flor Quinonez
INSTRUCTOR E-MAIL	: cbravov@gmail.com

II. COURSE DESCRIPTION

This course trains students in the application of concepts, methods and techniques of the differential and descriptive statistics to describe and analyze data and variable sets. Concepts of probability and random variables are introduced and applied to predict expected future values. Regression techniques are applied to build models relating a data and variable set. Problems of engineering application are solved and specialized software is used too.

III. COURSE OUTCOMES

1. Organize data for their adequate analysis and interpretation and calculate and interpret their fundamental statistical properties (Average value y variance).
2. Explain and determine the random probability of events and variables, as well as their probability density function.
3. Understand and apply random vectors and determine their function of joint probability density.
4. Interpret the concept of sampling distribution and apply it to calculate the probability of an event or variable.
5. Build models of linear regression to represent the relationship between the representative parameters of a data set.
6. Apply chi-square tests to check the probability density function of a data set, as well as the dependence or independence of two variables.

IV. LEARNING UNITS

1. DATA ORGANIZATION AND MAIN STATISTICAL PARAMETERS / 8 HOURS

Statistics / Population, sample and variable / Classification of variables / Methods for organizing and presenting data / Qualitative data / Frequency distribution table / Graphic representations / Measures of central tendency: mean, median, weighted mean / Dispersion methods: variance, standard deviation, coefficient of variation / Measures of quartile, decile and percentile positions / Box plots.

2. PROBABILITY / 8 HOURS

Count methods / Addition and multiplication rules / Permutations and combinations / Probability / Random experiments, sampling space and events / Operations with events / Conditional probability / Total probability / Bayes' theorem / Tree chart / Independent events.

3. RANDOM VARIABLES AND PROBABILITY DISTRIBUTION / 12 HOURS

Random variable: Types, expected value and standard deviation / Distribution of probability of a discrete variable: binomial, Poisson and hyper-geometric / Distribution of probability of a continuous variable: uniform, normal, gamma and exponential.

4. RANDOM VECTORS / 4 HOURS

Joint probability density function / Marginal distribution / Expected vector, variance and covariance / Expected value of two random functions / Covariance of two random variables.

5. SAMPLING DISTRIBUTION / 4 HOURS

Sampling / Sampling techniques / Probability sampling / Sampling distribution of average value, the variance / Central limit theorem.

6. ESTIMATION AND HYPOTHESIS TESTING / 12 HOURS

Punctual estimation of a random sampling / Punctual estimators: mean, mean proportional, difference of means, variance / Hypothesis testing / Interval estimation. Confidence intervals: mean, mean proportional and variance / Hypothesis testing / Types of error / Correlation coefficient / Prediction intervals / Hypothesis testing on regression coefficients.

7. REGRESSION AND CORRELATION ANALYSIS / 8 HOURS

Simple regression / Scatter plot / Parameter estimation / Total variance decomposition / Determination coefficient / Estimation errors / Correlation coefficient / prediction intervals / Hypothesis testing on regression coefficients.

8. CHI-SQUARE TESTS / 8 HOURS

Setting tests for uniform, binomial and Poisson's distributions / Contingency tables / Independence tests,

V. LABORATORIES AND PRACTICAL EXPERIENCES

Lab 1: Generation of random sequences (normal and uniform).

Lab 2: Determination and graphs of the probability density function.

Lab 3: Linear and quadratic regression.

VI. METHODOLOGY

This course is carried out in theory, practical and lab sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practical sessions, several problems are solved and their solution is analyzed. In lab sessions, application software is used to solve problems and analyze their solutions. In all sessions, students' active participation is encouraged.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = 0.30 EP + 0.30 EF + 0.20 PP + 0.20 LB$$

EP: Mid-Term Exam

EF: Final Exam

PP: Average of quizzes

LB: Average of laboratory reports

VIII. BIBLIOGRAPHY

1. **MENDENHALL, WILLIAM**
Statistics and probability for engineering (Spanish)
Prentice Hall Editorial
2. **ALVAREZ, JOSÉ AND TORRES LUIS**
Probability and Statistics (Spanish)
Alfa Omega Editorial

IX. COURSE CONTRIBUTIONS TO STUDENT OUTCOMES ATTAINMENT

Course contributions to Student Outcomes are shown in the following table:

K = Key **R** = Related **Empty box** = Does not apply

	Outcome	Contribution
Engineering Design	Design civil works satisfying requirements and needs as well as given constraints and limitations.	
Problem solving	Identify, formulate and solve engineering problems properly using the methods, techniques and tools of civil engineering.	K
Sciences Application	Apply the knowledge and skills of mathematics, sciences and engineering to solve civil engineering problems.	K
Experimentation	Conceive and conduct experiments, analyze data and interpret results	
Modern Engineering	Use and apply techniques, methods and tools of modern engineering necessary for the practice of civil engineering.	K
Engineering Impact	Understand the impact of engineering solutions on people and society in local and global contexts.	R
Project Management	Plan and manage civil engineering projects taking into account efficiency and productivity criteria.	
Environmental Appraisal	Takes into account the importance of preserving and improving the environment in the development of their personal and professional activities.	
Lifelong Learning	Recognize the need to keep their knowledge and skills up to date according to advances of civil engineering and engage in lifelong learning.	R
Contemporary Issues	Know and analyze relevant contemporary issues in local, national and global contexts.	R
Ethics and Professional Responsibility	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.	
Communication	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.	
Teamworking	Appraise the importance of teamworking and participate actively and effectively in multidisciplinary teams.	

