ACADEMIC PROGRAM

PROBABILITY AND STATISTICS

B.F.A. IN COMPUTER SCIENCE

MODALITY: ON CAMPUS

ACADEMIC YEAR: 2022-2023

Name of the course:	Probability and Statistics
Degree :	Computer Science
Location:	Centro Universitario de Tecnología y Arte Digital
Area:	Science Fundamentals
Year:	2º
Teaching period:	1
Type:	B
ECTS credits:	6
Teaching modality:	On campus
Language:	English
Lecturer / Email	-
Web page:	http://www.u-tad.com/

SUBJECT DESCRIPTION

Area description

This subject is an integral part of the area of scientific fundamentals. This material provides the student with the mathematical base that enables them to acquire the degree of abstraction necessary to solve problems that arise in the world of software engineering.

Subject description

In this subject, the essential elements of Statistics and Probability are studied, a discipline that provides the mathematical rigor necessary to analyze random phenomena. This subject provides the knowledge that allows building statistical-mathematical models to solve problems that can be later modeled with computer tools.

COMPETENCIES AND LEARNING OUTCOMES

Competencies

BASIC AND GENERAL SKILLSs

CB1: Students demonstrate possession and understanding of knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge arising from the forefront of their field of study.

CB2: Students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are typically demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

CB3: Students have the ability to gather and interpret relevant data (normally within their area of study) in order to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature.

CB4: Students can transmit information, ideas, problems and solutions to both a specialized and non-specialized audience.

CB5: Students will have developed those learning skills necessary to undertake further studies with a high degree of autonomy

CG3 - Knowledge of the scientific foundations applicable to the resolution of problems in the area of computer science

CG11 – The ability to search for, analyze and manage information in order to extract knowledge from it

SPECIFIC SKILLS

CE24 – The Ability to solve mathematical problems that arise in computer engineering based on the knowledge acquired in linear algebra, differential and integral calculus and statistics

CE28 - Knowledge of the basic concepts of discrete mathematics, logic, algorithms and computational complexity and its application in solving problems in computer engineering

TRASVERSAL SKILLS

CT4 – The ability to update the knowledge acquired in the management of digital tools and technologies according to the current state of the sector and the technologies used

Learning outcomes

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- To understand and apply common demonstration strategies in mathematics (reductio ab absurdum, induction¿)

- To know and apply common numbering sets habituales (N, Z, Q, R y C).

- To know the basics of set theory.

- Basics of combinatorics in enumeration problems.

- To solve linear equation systems.

- To handle vectors, points, matrices, coordinates, distances, angles, conics, quadrics, movements, transformations, straight lines and planes in space

- To handle vector spaces and vector subspaces and linear applications.

- To apply the relation of linear applications and matrices to know the properties of a linear application according to its matrix representation.

- To apply real numbers, polynomials and expressions of inequality, absolute values, etc.

- To handle sequences and series of real number and to study their convergence.

- To understand and work intuitively and geometrically with the ideas of limits, derivative and integral.

- To know and handle common single variable functions and to find their properties (growth, maxima, minima, inflection points, concavity, convexity) and plot them.

- To be able to use elementary integration techniques of single variable functions and compute lengths, areas and volumes applying integral calculus.

- To be able to use software for symbolic computation and plotting

- To describe analytically and geometrically datasets

- To compute probabilities

- To solve elementary problems of regression, estimation and hypothesis testing

- To be able to use statistical software

CONTENTS

Descriptive Statistics

Probability

Stochastic Processes

Introduction to inference

Introduction to multiple regression

Data Visualization

SUBJECT SYLLABUS

Topic 1.-General concepts

1.1. Fundamentals of Statistics.

1.2. Population and sample.

1.3. Descriptive Statistics and Inferential Statistics

1.4. The statistical method

Topic 2.-Descriptive statistics I. One-dimensional distributions

2.1. Type of data. Classification of statistical variables

2.2. Data organization. Statistical tables

23. Data visualization. Statistical graphs

2.4. One-dimensional frequency distributions. Data analysis

2.4.1. Trend and position measures

2.4.2. Variability measures

2.4.3. Symmetry Measurements

2.4.4. Shape measurements

Topic 3.-Descriptive statistics II. Two-dimensional distributions

3.1. Two-dimensional and frequency distributions.

3.2. Data organization. Crosstabs

3.3. Data visualization. Two-dimensional data graphs

3.4. Marginal and conditional distributions

3.5. Functional and statistical dependence. Covariance. Linear correlation

3.6. The simple linear regression model. Least squares adjustment

3.7. Other regression models3.8. Multiple regression

Topic 4.-Calculation of Probabilities

4.1. Random events. Sample Space

4.2. Definitions of probability. Properties

4.3. Conditional probability. Independence of events

4.4. Total Probabilities Theorem

4.5. Bayes theorem

Topic 5.- Discrete probabilistic models

5.1. Random variable.

5.2. Discrete random variables. Quantity function and distribution function

5.3. Discrete one-dimensional models

5.3.1. Binomial Distribution

5.3.2. Poisson distribution

5.3.3. Geometric Distribution

5.3.4. Negative Binomial Distribution

Topic 6.- Continuous probabilistic models

6.1. Continuous random variables. Density function and distribution function

6.2. The Normal Distribution

6.3. Other continuous one-dimensional models - Exponential

Topic 7.- Fundamental sampling distributions

7.1. Two-dimensional models. Joint distribution

7.2.Multivariate Normal Distribution.

7.3. Random sampling.

7.4. The Central Limit Theorem

7.5.Distributions associated with normal populations

7.5.1.Pearson X2 Distribution

7.5.2. Student's t distribution

7.5.3. Snedecor5 F Distribution

7.6. Distributions of statistics in sampling

7.6.1. Sampling distribution of means

7.6.2. Sampling distribution of variances

7.6.3. Sampling distribution of proportions

Topic 8.- Introduction to Inference. Estimate

8.1. Statistical inference. Inference techniques

8.2. Point estimation and interval estimation

8.3. Maximum estimation error. Determination of sample size

8.4. Estimation of the mean of a normal population

8.5. Estimation of the variance of a normal population

8.6. Estimation of a population proportion

8.7. Estimation of the difference between two means

8.8. Estimation of the quotient between two variances (optional)

8.9. Estimation of the difference between two proportions

Topic 9.- Hypothesis testing

9.1. Hypothesis testing: general concepts.

9.2. The p-value. Application in decision making

9.3. Type I and II errors in a hypothesis test. Test power

9.4. Hypothesis testing about a population mean

9.5. Hypothesis testing about a population variance

9.6. Testing a hypothesis about a population proportion

9.7. Testing a hypothesis about a difference between two means

9.8. Hypothesis test on the quotient between two variances

9.9. Hypothesis test for the difference between two proportions

TRAINING ACTIVITIES AND TEACHING METHODOLOGIES

TRAINING ACTIVITIES

LEARNING ACTIVITIES	Total hours	Hours of presence
Theoretical / Expository classes	30,00	30,00
Practical classes	24,00	24,00
Tutorials	4,00	2,00
Independent study and autonomous work of the student	57,50	0,00
Elaboration of work (group or individual)	28,50	0,00
Evaluation Activities	6,00	6,00
TOTAL	150	62

Teaching methodologies

Expository method or master lesson

Case learning

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

Expository method or master lesson

Case method

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

TEMPORAL DEVELOPMENT

DIDACTIC UNITS / TOPICS TIME PERIOD

Topic 1. General concepts Week 1

Topic 2. Descriptive Statistics I.Distrib. One-dimensional frequenciesWeeks 2 and 3

Topic 3. Descriptive Statistics II.Distrib. Two-dimensional frequencies. Linear regressionWeeks 4 and 5

Topic 4. Calculation of Probabilities Week 6

Topic 5. Discrete probabilistic modelsWeeks 7 and 8

Topic 6. Continuous probabilistic modelsWeeks 9 and 10

Topic 7. Fundamental demonstration distributionsWeek 11

Topic 8. Introduction to Inference. EstimationWeeks 12 and 13

Topic 9. Hypothesis testing Weeks 14 and 15

EVALUATION SYSTEM

ASSESSMENT SYSTEM	MINIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%)	MAXIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%)
Assessment of participation in class, exercises or projects of the course	0	30
Assessment of assignments, projects, reports, memos	30	60
Objective test	30	60

GRADING CRITERIA

ASSESSMENT SYSTEM	ORDINARY EVALUATION	EXTRAORDINARY EVALUATION
Assessment of participation in class, exercises or projects of the course	10	10
Assessment of assignments, projects, reports, memos	30	30
Objective test	60	60

General comments on the evaluations/assessments

The evaluation of participation in class, in practices or in projects of the subject will be carried out based on attendance and active participation in class and in the rest of the activities carried out during the course, both mandatory and optional. This aspect will represent 10% of the final grade for the subject in the ordinary and extraordinary call.

- Throughout the course, activities, exercises and problems will be proposed that must be delivered through the Blackboard virtual platform (material sent by email will not be evaluated) before the established deadline, or exercises to be done in person at the class schedule. Tests delivered after the deadline with a maximum delay of one week will have a

30% penalty in the grade. Tests delivered more than seven days late will have a grade of zero.

- The grade in this section will be made by eliminating from the calculation the lowest score among all the activities, exercises and problems carried out during the course.

- This section of continuous evaluation will represent 30% of the final grade of the subject in the ordinary call, and in the extraordinary call the works that will be computed will be the same as those presented during the course, and therefore the grades obtained in ordinary.

- For the grading of continuous assessment tests carried out outside the classroom, the teacher may require the student to explain and reason issues related to the work performed; These explanations or knowledge will be taken into account in the grading of said tests.

- In no case will the continuous evaluation tests be repeated. Those students who have not taken a test will have a grade of zero. In the event that a student has not taken an in-person test and the absence is justified by the Teaching Secretary, said test will be eliminated from the calculation and the percentage corresponding to it will increase in the grade of the "exam" section.

- In the middle of the semester, a partial exam will be taken, which will be liberatory if the student so wishes, with the condition of obtaining at least a grade of 4.0 in said exam. Those students who do not pass this grade or who decide to voluntarily discard it must take separate exams corresponding to the two partial exams on the date assigned for the ordinary January session. The two partial exams will represent 60% of the final grade in the ordinary session (30% each).

- To pass the subject in the ordinary call, it is essential that the final grade (including the partial exams, the problems and activities to be delivered and the participation) is at least 5.0 (out of 10). In addition to this requirement, it is necessary that the average of the partial exams be at least 5.0 (out of 10), allowing the individual grade of one of the two partial exams to be greater than or equal to 4.0 (out of 10). If any of these requirements are not met, the subject will be automatically considered failed regardless of the rest of the grades.

-In the particular case that the student has not obtained an average grade of at least 5.0 in the exams, his/her final grade will be precisely that average grade, without considering the rest of the evaluable elements. If the student had obtained an average grade higher than 5.0 in the exams but one of them had a grade lower than 4.0, the final grade will be that of the exam with a grade lower than 4.0, without considering the rest of the evaluable elements.

- If the student does not pass the ordinary session in January, he or she may take the extraordinary session in July. In the extraordinary call, the subject required of the student for the exam will be all the content of the subject seen in class (including the activities delivered through the virtual classroom).

-Any student who does not take the ordinary exam will receive the grade of "Not Presented", regardless of his or her grades in the rest of the sections. The same criteria will be applied in the extraordinary call.

- In the exams, only scientific calculators and those forms that are permitted will be used, for which the student must refer to the teacher's specific instructions on this topic.

- No grades of any kind will be kept between different academic years, nor between different calls.

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- No grades of any kind will be kept between different academic years, nor between different calls.

LIST OF REFERENCES (BOOKS, PUBLICATIONS, WEBSITES):

Basic Bibliography:

- Basic Statistics with R. Alfonso García Pérez. Oct. 2011. Uned Ed.

- Probability and Statistics for Computer Scientists. Second edition. Baron, M (2013) CRC Press, 2013

Recommended Bibliography:

- R in a Nutshell. Joseph Adler. O'Reilly. 2nd Edition. Oct. 2012.

- Statistics in a Nutshell. Sara Boslaugh. O'Reilly. 2nd Edition. Nov 2012.

- Introduction to Economic and Business Statistics: Theory and Practice (3rd Edition). Paraninfo Editions. Martín-Pliego López, J. (2004)

- Statistics for Administration and Economics. Pearson. Newbold, P. (2013)

- Fundamentals of Statistics. Editorial Alliance. Peña, D. (2008)

- Fundamentals of Statistical Inference (3rd Edition). Ruíz-Maya Pérez, L. and Martín-Pliego López, J. (2005).

REQUIRED MATERIALS, SOFTWARE AND TOOLS

Type of classroom
Theory classroom

Board and projection system

Materials:
Personal computer.

Notebook or tablet for taking notes

Software:
Microsoft Office, R, RStudio