# Professional Master's Degree

## Statistical Techniques

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# Professional Master's Degree
## Statistical Techniques

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/ingenieria/professional-master-degree/master-statistical-techniques**

# Index

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# Introduction

Statistical studies allow professionals in this field to establish predictions with a very high percentage of accuracy. Thanks to the development of increasingly innovative and precise techniques, it is now possible to analyze yottabytes of information in a few seconds and obtain concrete results on a given trend. In order for those interested in this field to have access to education that allows them to learn the most innovative statistical methods of linear and multivariate prediction in detail, TECH has developed this program. It is a 100% online academic experience where students will thoroughly master the main estimation, design and data management techniques over the course of a 12-month program.

*If you need a program that guarantees you a very high degree of specialization in the field of Applied Statistics and its techniques, look no further: this program is perfect for you"*

If there is one thing that Statistics has shown, it is the flexibility and possibilities of applying its techniques and strategies to all fields and areas. Medicine, architecture, biology, politics, economics, marketing, etc. Any field makes use of the processes of probability and estimation to determine future trends and patterns of action, which increases the chances of achieving the expected results based on previous analysis of the behaviors displayed by agents or entities involved in a particular issue, such as customers, pathogens, resistance of materials, inclination of the vote, etc.

Thanks to the progress made in the field of Mathematics and Computer Science, it is now possible to use countless strategies that facilitate the automatic collection and massive management of data, optimizing processes and guaranteeing a series of more concrete and reliable results. For professionals in this field to know these intricacies in detail, TECH has developed the Professional Master's Degree in Statistical Techniques. This is a multidisciplinary and intensive program where students will be able to to immerse themselves in state-of-the-art features of chance and probability, data exploration and estimation. They will also comprehensively work on the main advanced linear and multivariate prediction methods to formulate problems with a high rate of computational success.

Therefore, the student will benefit from 1,500 hours of material distributed in different formats: mainly the syllabus, designed by experts in Statistics and Computer Science, use cases based on real situations and additional material such as detailed videos, research articles, complementary readings, dynamic summaries and much more. Everything will be available on the Virtual Campus, which can be accessed without schedules or limits from any device with an Internet connection. In this way, students will undertake training adapted to their needs that will undoubtedly increase their knowledge and statistical talent to the highest professional level.

This **Professional Master's Degree in Statistical Techniques** contains the most complete and up-to-date program on the market. The most important features include:

- The development of case studies presented by experts in Applied Statistics
- The graphic, schematic and practical contents of the book provide technical and practical information on those disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

*A 100% online program where you will be able to work on the most innovative concepts related to chance and probability applied to statistical calculation"*

*You will have a specific module specialized in databases, so you can implement the main strategies of design and management of information in your professional practice"*

*You will have access to the Virtual Campus 24 hours a day, 7 days a week, without limits or schedules, and all you need is a device with an Internet connection.*

*You will work on the central position characteristics of one-dimensional descriptive statistics, focusing on optimized and accurate data exploration.*

The program's teaching staff includes professionals from sector who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise during the academic year This will be done with the help of an innovative system of interactive videos made by renowned experts.

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# Objectives

The syllabus for this Professional Master's Degree has been designed so graduates are guaranteed to specialize in the field of Statistics, specifically to master the main estimation and regression techniques. In order to do so, they will have all the best material, as well as the most avant-garde and innovative academic technology in the current academic world. Therefore, students will work to achieve their most ambitious professional goals through a training program that will provide them with everything they need to achieve them in only 12 months' time.

*Whatever your goals are, TECH will provide you with everything you need to not only achieve them, but surpass them in less than 12 months”*

## General Objectives

- Understand computer algorithms used to manage databases and SQL language
- Critically evaluate the work performed using quality criteria
- Perform basic operations related to information debugging
- Use the appropriate sources of information for each type of applied study
- Handle the statistical software required to solve statistical inference problems

*An academic experience that will provide you with the keys to master the procedures to build estimators based on the most innovative statistical techniques"*

## Specific Objectives

### Module 1. Chance and Probability

- Apply the techniques of probability calculation
- Become familiar with the usual random variables
- Build elementary models
- Know how to use limit theorems (laws of large numbers and central limit theorem)

### Module 2. Data Description and Exploration

- Know the descriptive and exploratory techniques to summarize information contained in experimental data sets
- Represent univariate and bivariate data sets graphically and numerically
- Interpret results and graphs in the context of the data
- Use statistical software to manipulate data, perform descriptive analysis and graphs

### Module 3. Databases: Design and Management

- Manage a database
- Correctly identify types of data and measures
- Identify the advantages and disadvantages of the Internet as an important source of statistical information

### Module 4. Estimations I

- Become familiar with the methods of statistical inference: estimations
- Apply "statistical thinking" and deal with the different stages of a statistical study (from the problem statement to presenting results)

### Module 5. Estimations II

- Become familiar with the methods of statistical inference: hypothesis contrasting
- Choose and use the most appropriate estimation method in an investigation according to its objectives

### Module 6. Mathematics with Computers

- Know different programs to analyze statistics
- Develop statistical studies and reports using different programs
- Know the different types of functions used in different programs
- Use and choose the best program for each statistical study to help reflect on and reach a conclusion of statistical data

### Module 7. Linear Prediction Methods

- Introduce linear models
- Study, understand and apply simple linear regression models
- Study, understand and apply multiple linear regression models

### Module 8. Multivariate Statistical Techniques I

- Study and determine the true dimension of multivariate information
- Relate qualitative variables
- Classify individuals into previously established groups based on multivariate information
- Form groups of individuals with similar features

### Module 9. Multivariate Statistical Techniques II

- Acquire the conceptual and practical fundamentals to conduct multivariate qualitative data analysis
- Apply specific software to solve each of these problems

### Module 10. Advanced Prediction Techniques

- Study, understand and apply specific prediction methods for one or more variables in situations where traditional methods present problems of a theoretical nature, or when the solution provided is not sufficiently satisfactory

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# Skills

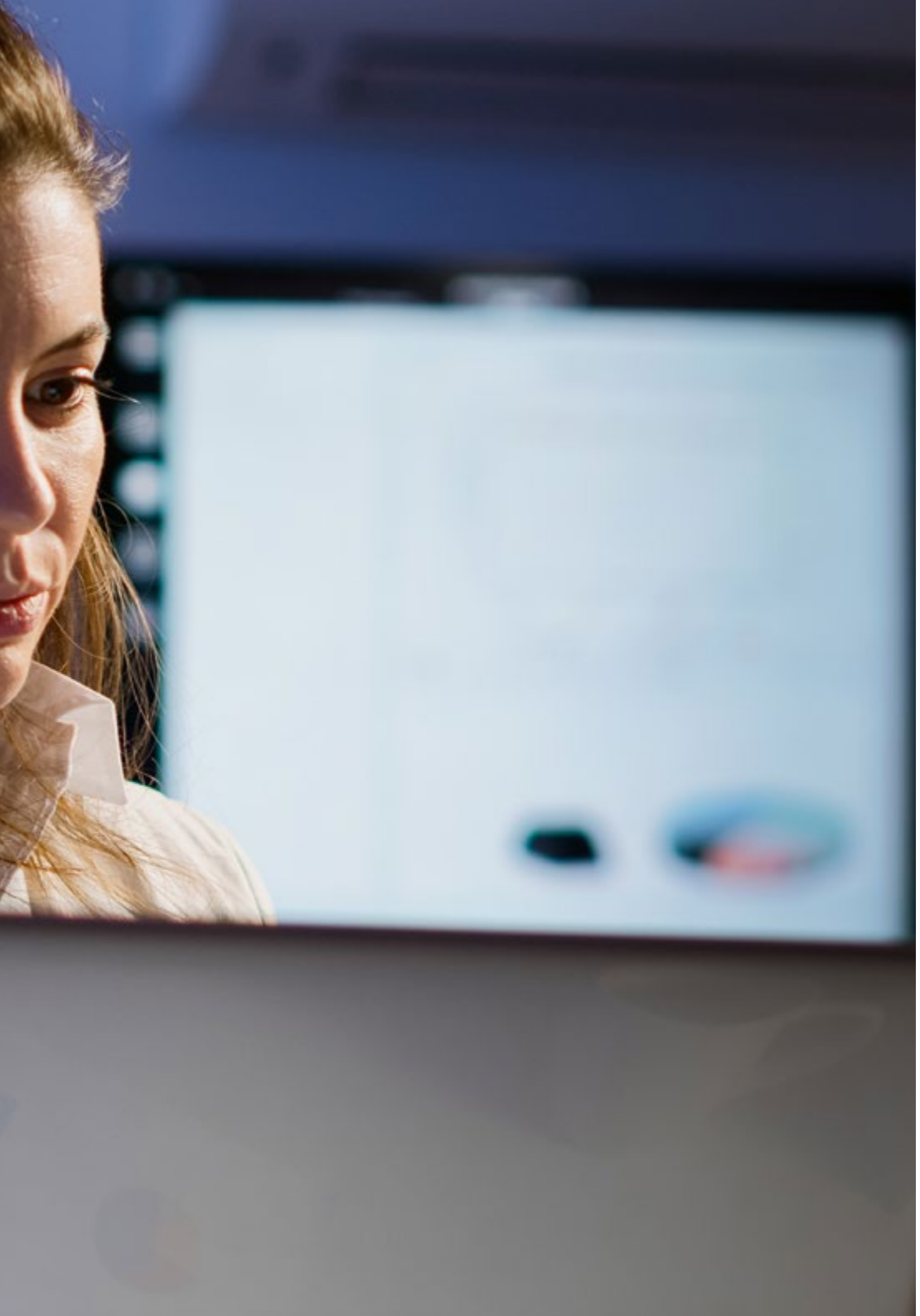
Thanks to the inclusion of use cases in the content of this Professional Master's Degree, graduates will actively work on perfecting their professional skills, adapting their profile to the current requirements in the statistical industry. This way, they will be able to apply the techniques and strategies included in the syllabus, by solving situations extracted from the work context. It is, therefore, a unique academic opportunity to access a educational program that will not only provide students with the most specialized knowledge in the field, but will also give them the keys to master it through high-level practice.

*Through hypothesis contrasting, you will perfect your skills in handling the main methods used in statistical inference"*

## General Skills

- Acquire a broad and specialized body of knowledge of current statistical techniques and their use in modern engineering
- Develop the necessary skills to master the main tools used to design statistical algorithms applicable to the computing environment
- Become deeply familiar with the most used software in current digital statistics and master their use based on market trends
- Master estimation techniques and statistical data exploration

*Would you like to include among your skills notions of HTML and CSS to structure and design web pages? This Professional Master's Degree allows you to do so thanks to the specific section devoted to it"*



## Specific Skills

- Become deeply familiar with current probabilistic models and their use in engineering, their main characteristics and their advantages and disadvantages
- Gain specialized knowledge of one-dimensional and two-dimensional descriptive statistics
- Perfectly command the main economic and statistical databases, as well as the most widely used information systems in the field
- Acquire a broad and exhaustive body of knowledge of estimator distribution and properties
- Manage different types of hypotheses contrasting and their relationship with confidence intervals
- Expand computer mathematical skills through an introduction to Matlab, LaTex, R, Sage and SAS
- Implement the main features of linear prediction methods into professional practice
- Know the latest advances related to multivariate statistical techniques in detail
- Master the use of stratified analysis in 2x2 tables, as well as the formulation of problems in log-linear models
- Thoroughly hone the main regression techniques based on the latest advances made in the field of Computer Engineering

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# Structure and Content

The Professional Master's Degree in Statistical Techniques is composed of 1,500 hours of the best theoretical, practical and additional content, the latter presented in different formats: use cases, complementary readings, self-knowledge exercises, research articles, news, dynamic summaries and videos detailing each unit. Everything will be available on the Virtual Campus from the very beginning and can be downloaded to any device with an Internet connection. In this way, graduates will be able to access the material at their own convenience, even after the 12 months of education are over.

*The content on the program has been developed using the Relearning methodology, which will allow you to save hours of study without renouncing to high-level, extensive training"*

## **Module 1.** Chance and Probability

1.1. Probabilistic Models
- 1.1.1. Introduction
- 1.1.2. Random Phenomena
- 1.1.3. Probability Spaces
- 1.1.4. Properties of Probability
- 1.1.5. Combinatorial

1.2. Conditional Probability
- 1.2.1. Definition of Conditional Probability
- 1.2.2. Event Independence
- 1.2.3. Properties of Event Independence
- 1.2.4. The Total Probability Formula
- 1.2.5. Bayes' Formula

1.3. One-Dimensional Random Variables
- 1.3.1. Concept of One-Dimensional Random Variables
- 1.3.2. Operations with Random Variables
- 1.3.3. Distribution Function of a One-Dimensional Random Variable. Properties
- 1.3.4. Discrete, Continuous and Mixed Random Variables
- 1.3.5. Random Variables Transformation

1.4. Characteristics of One-Dimensional Random Variables
- 1.4.1. Mathematical Expectation. Properties of Expectation Operators
- 1.4.2. Moments with Respect to the Origin. Moments with Respect to the Mean
- 1.4.3. Relations between Moments
- 1.4.4. Measures of Position, Dispersion and Shape
- 1.4.5. Chebyshev's Theorem

1.5. Discrete Distributions
- 1.5.1. Degenerate Distribution
- 1.5.2. Uniform Distribution on n Points
- 1.5.3. Bernoulli's Distribution
- 1.5.4. Binomial Distribution
- 1.5.5. Poisson distribution
- 1.5.6. Negative Binomial Distribution
- 1.5.7. Geometric Distribution
- 1.5.8. Hypergeometric Distribution

1.6. Normal Distribution
- 1.6.1. Introduction
- 1.6.2. Characteristics of Normal Distribution
- 1.6.3. Representation of Normal Distribution
- 1.6.4. Approximation of a Binomial by Normal Distribution

1.7. Other Continuous Distributions
- 1.7.1. Uniform Distribution
- 1.7.2. Gamma Distribution
- 1.7.3. Exponential Distributions
- 1.7.4. Beta Distribution

1.8. Two-Dimensional Random Variables
- 1.8.1. Introduction
- 1.8.2. Two-Dimensional Random Variables
- 1.8.3. Discrete Two-Dimensional Random Variables. Mass Function
- 1.8.4. Continuous Two-Dimensional Random Variables. Density Function

1.9. Two-Dimensional Random Variables Distributionsz
- 1.9.1. Joint Distribution Function. Properties
- 1.9.2. Marginal Distributions
- 1.9.3. Conditional Distributions
- 1.9.4. Independent Random Variables



1.10. Laws of Large Numbers and Central Limit Theorem
- 1.10.1. Sequence of Random Variable
- 1.10.2. Convergence of Sequences of Random Variables. Relations between the Different Types of Convergence
  - 1.10.2.1. Pointwise Convergence
  - 1.10.2.2. Almost Certain Convergence
  - 1.10.2.3. Convergence in Probability
  - 1.10.2.4. Convergence in Law or Distribution
- 1.10.3. Large Number Laws
- 1.10.4. Central Classical Limit Problem

## **Module 2.** Data Description and Exploration

2.1. Introduction to Statistics
- 2.1.1. Basic Concepts of Statistics
- 2.1.2. The Purpose of Exploratory Data Analysis or Descriptive Statistics
- 2.1.3. Types of Variables and Measurement Scales
- 2.1.4. Rounding and Scientific Notation

2.2. Summary of Statistical Data
- 2.2.1. Frequency Distributions: Tables
- 2.2.2. Grouping in Intervals
- 2.2.3. Graphical Representations
- 2.2.4. Differential Diagram
- 2.2.5. Integral Diagram

2.3. One-Dimensional Descriptive Statistics
- 2.3.1. Central Position Characteristics: Mean, Median, Mode
- 2.3.2. Other Position Characteristics: Quartiles, Deciles and Percentiles
- 2.3.3. Dispersion Characteristics: Variance and Standard Deviation (Sample and Population), Range, Inter-Quartile Range
- 2.3.4. Relative Dispersion Characteristics
- 2.3.5. Typical Scores
- 2.3.6. Shape Characteristics: Symmetry and Kurtosis

2.4. Complements in the Study of a Variable
- 2.4.1. Exploratory Analysis: Box Plots and Other Graphs
- 2.4.2. Transforming Variables
- 2.4.3. Other Averages: Geometric, Harmonic, Quadratic
- 2.4.4. Chebyshev's Inequality

2.5. Two-Dimensional Descriptive Statistics
- 2.5.1. Two-Dimensional Frequency Distributions
- 2.5.2. Double-Entry Statistical Tables. Marginal and Conditional Distributions
- 2.5.3. Concepts of Independence and Functional Dependence
- 2.5.4. Graphical Representations

2.6. Complements in the Study of Two Variables
- 2.6.1. Numerical Characteristics of a Two-Dimensional Distribution
- 2.6.2. Joint, Marginal and Conditional Moments
- 2.6.3. Relationship between Marginal and Conditional Measures

2.7. Regression
- 2.7.1. General Regression Line
- 2.7.2. Regression Curves
- 2.7.3. Linear Adjustment
- 2.7.4. Prediction and Error

2.8. Correlation
- 2.8.1. Concept of Correlation
- 2.8.2. Correlation Ratios
- 2.8.3. Pearson's Correlation Coefficient
- 2.8.4. Correlation Analysis

2.9. Correlation between Attributes
- 2.9.1. Spearman's Coefficient
- 2.9.2. Kendall Coefficient
- 2.9.3. Chi-Squared Coefficient

2.10. Introduction to Time Series
- 2.10.1. Time Series
- 2.10.2. Stochastic Processes
  - 2.10.2.1. Stationary Processes
  - 2.10.2.2. Non-Stationary Processes
- 2.10.3. Models
- 2.10.4. Applications

## **Module 3.** Databases: Design and Management

3.1. Introduction to Databases
- 3.1.1. What is a Database?
- 3.1.2. History of Database Systems

3.2. Information Systems and Databases
- 3.2.1. Concepts
- 3.2.2. Features
- 3.2.3. Evolution of Databases

3.3. Definition and Characteristics of a Database Management System
- 3.3.1. Definition
- 3.3.2. Features

3.4. Architecture of Database Management Systems
- 3.4.1. Centralized and Client-Server Architectures
- 3.4.2. Server Systems Architectures
- 3.4.3. Parallel Systems
- 3.4.4. Distributed Systems
- 3.4.5. Types of Networks

3.5. Main Database Management Systems
- 3.5.1. Types of DBMS

3.6. Development of Database Applications
- 3.6.1. Web Interfaces for Databases
- 3.6.2. Performance Tuning
- 3.6.3. Performance Testing
- 3.6.4. Standardization
- 3.6.5. E-Commerce
- 3.6.6. Inherited Systems

3.7. Database Design Stages
- 3.7.1. Conceptual Design
- 3.7.2. Logical Design
- 3.7.3. Application Design

3.8. Database Implementation
- 3.8.1. Structured Query Language (SQL)
- 3.8.2. Data Processing
- 3.8.3. Data Query
- 3.8.4. SQL Database Management
- 3.8.5. Working with SQLite Databases

3.9. Notions of HTML and Regular Expressions
- 3.9.1. Structure and Code of a Web Page
- 3.9.2. HTML and CSS Tags and Attributes
- 3.9.3. Text Searching with Regular Expressions
- 3.9.4. Special Characters, Sets, Groups and Repetitions

3.10. Collecting and Storing Data from Web Pages
- 3.10.1. Introduction to Web Scraping Tools
- 3.10.2. Programming Web Scraping Tools in Python
- 3.10.3. Searching and Obtaining Information with Regular Expressions
- 3.10.4. Searching and Obtaining Information with Beautiful Soup
- 3.10.5. Storing in Databases
- 3.10.6. Exporting Results in Comma-Separated Value Files

## **Module 4.** Estimations I

4.1. Introduction to Inference Statistics
- 4.1.1. What Is Inference Statistics?
- 4.1.2. Examples

4.2. General concepts
- 4.2.1. City
- 4.2.2. Sample
- 4.2.3. Sampling
- 4.2.4. Parameter

4.3. Statistical Inference Classification
- 4.3.1. Parametric
- 4.3.2. Non-Parametric
- 4.3.3. Classical Approach
- 4.3.4. Bayesian Approach

4.4. Statistical Inference Objective
- 4.4.1. What Objectives?
- 4.4.2. Statistical Inference Applications

4.5. Distributions Associated with Normal Distribution
- 4.5.1. Chi-Squared
- 4.5.2. *T-Student*
- 4.5.3. *F- Snedecor*

4.6. Introduction to Point Estimation
- 4.6.1. Definition of Simple Random Sample
- 4.6.2. Sample Space
- 4.6.3. Statistics and Estimators
- 4.6.4. Examples

4.7. Properties of Estimators
- 4.7.1. Sufficiency and Completeness
- 4.7.2. Factorization Theorem
- 4.7.3. Unbiased and Asymptotically Unbiased Estimators
- 4.7.4. Mean Square Error
- 4.7.5. Efficiency
- 4.7.6. Consistent Estimators
- 4.7.7. Estimating Mean, Variance, and Proportion of a Population

4.8. Procedures to Build estimators
- 4.8.1. Method of Moments
- 4.8.2. Maximum Likelihood Method
- 4.8.3. Properties of Maximum Likelihood Estimators

4.9. Introduction to Interval Estimation
- 4.9.1. Introduction to the Definition of Confidence Interval
- 4.9.2. Pivotal Quantity Method

4.10. Types of Confidence Intervals and their Properties
- 4.10.1. Confidence Intervals for the Mean of a Population
- 4.10.2. Confidence Interval for the Variance of a Population
- 4.10.3. Confidence Intervals for Proportions
- 4.10.4. Confidence Intervals for the Difference of Population Means. Independent Normal Populations. Paired Samples
- 4.10.5. Confidence Interval for the Variance Ratio of Two Independent Normal Populations
- 4.10.6. Confidence Interval for the Difference of Proportions of Two Independent Populations
- 4.10.7. Confidence Interval for a Parameter based on its Maximum Likelihood Estimator
- 4.10.8. Use of a Confidence Interval to Reject Hypotheses or Not

## **Module 5.** Estimations II

5.1. Introduction to Hypothesis Contrasting
- 5.1.1. Problem Statement
- 5.1.2. Null and Alternative Hypothesis
- 5.1.3. Contrast Statistics
- 5.1.4. Types of Error
- 5.1.5. Level of Significance
- 5.1.6. Critical Region. p-value
- 5.1.7. Power

5.2. Types of Hypothesis Contrasting
- 5.2.1. Likelihood Ratio Test
- 5.2.2. Contrasts on Means and Variances in Normal Populations
- 5.2.3. Contrasts on Proportions
- 5.2.4. Relationship between Confidence Intervals and Hypothesis Contrasting

5.3. Introduction to Bayesian Inference
- 5.3.1. A Priori Distributions
- 5.3.2. Conjugate Distributions
- 5.3.3. Reference Distributions

5.4. Bayesian Estimation
- 5.4.1. Point Estimation
- 5.4.2. Estimation of an Proportion
- 5.4.3. Mean Estimate in Normal Populations
- 5.4.4. Comparison to Classical Methods

5.5. Introduction to Non-Parametric Inference Statistics
- 5.5.1. Non-Parametric Statistical Methods: Concepts
- 5.5.2. Use of Non-Parametric Statistics

5.6. Non-Parametric Inference Compared to Parametric Inference
- 5.6.1. Differences between Inferences

5.7. Goodness-of-Fit Test
- 5.7.1. Introduction
- 5.7.2. Graphic Methods
- 5.7.3. Contrast of the Goodness-of-Fit Equation
- 5.7.4. Kolmogorov-Smirnov Test
- 5.7.5. Normality Contrasts

5.8. Independence Contrasts
- 5.8.1. Introduction
- 5.8.2. Randomness Contrasts. Contrast of Spurts
- 5.8.3. Independence Contrasts in Paired Samples
  - 5.8.3.1. Kendall's Contrast
  - 5.8.3.2. Spearman's Ranks Contrast
  - 5.8.3.3. Independence Chi-Square Test
  - 5.8.3.4. Generalization of the Chi-Square Contrast
- 5.8.4. Independence Contrasts in K Related Samples
  - 5.8.4.1. Generalization of the Chi-Square Contrast
  - 5.8.4.2. Kendall's Coefficient of Concordance

5.9. Position Contrast
- 5.9.1. Introduction
- 5.9.2. Position Contrasts for a Single Sample and Paired Samples
  - 5.9.2.1. Sign Test for a Single Sample. Median Test
  - 5.9.2.2. Sign Test for Paired Samples
  - 5.9.2.3. Wilcoxon Signed-Rank Test for a Single Sample
  - 5.9.2.4. Wilcoxon Signed-Rank Test for Paired Samples
- 5.9.3. Non-Parametric Contrasts for Two Independent Samples
  - 5.9.3.1. Wilcoxon-Mann-Whitney's Test
  - 5.9.3.2. Median Test
  - 5.9.3.3. Chi-Square Contrast
- 5.9.4. Position Contrasts for K Independent Samples
  - 5.9.4.1. Kruskal-Wallis Test
- 5.9.5. Independence Contrasts in K Related Samples
  - 5.9.5.1. Friedman's Test
  - 5.9.5.2. Cochran Q Test
  - 5.9.5.3. Kendall W Test

5.10. Homogeneity Contrast
- 5.10.1. Homogeneity Contrasts for Two Independent Samples
  - 5.10.1.1. Wald-Wolfowitz Contrast
  - 5.10.1.2. Kolmogorov-Smirnov Test
  - 5.10.1.3. Chi-Square Contrast

## **Module 6.** Mathematics with Computers

6.1. Introduction to MATLAB
- 6.1.1. What Is MATLAB?
- 6.1.2. Main Functions and Commands in MATLAB
- 6.1.3. Statistical Applications in MATLAB

6.2. Linear Algebra in MATLAB
- 6.2.1. Concepts of Linear Algebra
- 6.2.2. Main Functions and Commands
- 6.2.3. Examples

6.3. Examples
- 6.3.1. Concepts of Numerical and Functional Series
- 6.3.2. Main Functions and Commands
- 6.3.3. Examples

6.4. Functions of One and Several Variables in MATLAB
- 6.4.1. Concepts of Functions of One and Several Variables
- 6.4.2. Main Functions and Commands
- 6.4.3. Examples

6.5. Introduction to LaTex
- 6.5.1. What Is LaTex?
- 6.5.2. Main Functions and Commands in LaTex
- 6.5.3. Statistical Applications in LaTex

6.6. Introduction to R
- 6.6.1. What is R?
- 6.6.2. Main Functions and Commands in R
- 6.6.3. Statistical Applications in R

6.7. Introduction to Sage
- 6.7.1. What Is Sage?
- 6.7.2. Main Functions and Commands in Sage
- 6.7.3. Statistical Applications in Sage

6.8. Introduction to the Bash Operating System
- 6.8.1. What Is Bash?
- 6.8.2. Main Functions and Commands in Bash
- 6.8.3. Statistical Applications in Bash

6.9. Introduction to Python
- 6.9.1. What Is Python?
- 6.9.2. Main Functions and Commands in Python
- 6.9.3. Statistical Applications in Python

6.10. Introduction to SAS
- 6.10.1. What is SAS?
- 6.10.2. Main Functions and Commands in SAS
- 6.10.3. Statistical Applications in SAS

## **Module 7.** Linear Prediction Methods

7.1. Simple Linear Regression Models
- 7.1.1. Introduction to Regression Models and Preliminary Steps in Simple Regression: Data Exploration
- 7.1.2. Models
- 7.1.3. Hypotheses
- 7.1.4. Parameters

7.2. Simple Linear Regression Estimation and Contrasts
- 7.2.1. Point Estimation of Model Parameters
  - 7.2.1.1. Least Squares Method
  - 7.2.1.2. Maximum Likelihood Estimators
- 7.2.2. Inference on Model Parameters under the Gauss-Markov Hypothesis
  - 7.2.2.1. Intervals
  - 7.2.2.2. Test
- 7.2.3. Confidence Interval for the Mean Response and Prediction Interval for New Observations
- 7.2.4. Simultaneous Inferences in Simple Regression
- 7.2.5. Confidence and Prediction Bands

7.3. Simple Linear Regression Models Diagnosis and Validation
- 7.3.1. Analysis of Variance (ANOVA) of Simple Regression Models
- 7.3.2. Model Diagnostics
  - 7.3.2.1. Graphical Assessment of Linearity and Verification of the Hypotheses by Residuals Analysis
  - 7.3.2.2. Linear Lack-of-Fit Test

7.4. Multiple Linear Regression Models
- 7.4.1. Data Exploration with Multidimensional Visualization Tools
- 7.4.2. Matrix Expression of Models and Coefficient Estimators
- 7.4.3. Interpreting Coefficients of Multiple Models

7.5. Multiple Linear Regression Estimation and Contrasts
- 7.5.1. Laws of Estimation for Coefficients, Predictions, and Residuals
- 7.5.2. Applying Properties of Idempotent Matrices
- 7.5.3. Inference in Multiple Linear Models
- 7.5.4. Anova Models

7.6. Multiple Linear Regression Models Diagnosis and Validation
- 7.6.1. "Ligatures" Test to Solve Linear Constraints on Coefficients
  - 7.6.1.1. The Principle of Incremental Variability
- 7.6.2. Waste Analysis
- 7.6.3. Box-Cox Transformation

7.7. The Problem of Multicollinearity
- 7.7.1. Detection
- 7.7.2. Solutions

7.8. Polynomial Regression
- 7.8.1. Definition and Example
- 7.8.2. Matrix Form and Calculating Estimates
- 7.8.3. Interpretation
- 7.8.4. Alternative Approaches

7.9. Regression with Qualitative Variables
- 7.9.1. Dummy Variables in Regression
- 7.9.2. Interpreting Coefficients
- 7.9.3. Applications

7.10. Criteria for Models Selection
- 7.10.1. Mallows Cp Statistics
- 7.10.2. Model Cross Validation
- 7.10.3. Automatic Stepwise Selection

## **Module 8.** Multivariate Statistical Techniques I

8.1. Factor Analysis
- 8.1.1. Introduction
- 8.1.2. Fundamentals of Factor Analysis
- 8.1.3. Factor Analysis
- 8.1.4. Factor Rotation Methods and Factor Analysis Interpretation

8.2. Factor Analysis Modeling
- 8.2.1. Examples
- 8.2.2. Statistical Software Modeling

8.3. Main Component Analysis
- 8.3.1. Introduction
- 8.3.2. Main Component Analysis
- 8.3.3. Systematic Principal Component Analysis

8.4. Principal Component Analysis Modeling
- 8.4.1. Examples
- 8.4.2. Statistical Software Modeling

8.5. Correspondence Analysis
- 8.5.1. Introduction
- 8.5.2. Independence Test
- 8.5.3. Row and Column Profiles
- 8.5.4. Inertia Analysis of a Point Cloud
- 8.5.5. Multiple Correspondence Analysis

8.6. Correspondence Analysis Modeling
- 8.6.1. Examples
- 8.6.2. Statistical Software Modeling

8.7. Discriminant Analysis
- 8.7.1. Introduction
- 8.7.2. Decision Rules for Two Groups
- 8.7.3. Classification over Several Populations
- 8.7.4. Fisher's Canonical Discriminant Analysis
- 8.7.5. Selecting Variables: Forward and Backward Procedure
- 8.7.6. Systematic Discriminant Analysis

8.8. Discriminant Analysis Modeling
- 8.8.1. Examples
- 8.8.2. Statistical Software Modeling

8.9. Cluster Analysis
- 8.9.1. Introduction
- 8.9.2. Distance and Similarity Measures
- 8.9.3. Hierarchical Classification Algorithms
- 8.9.4. Non-Hierarchical Classification Algorithms
- 8.9.5. Procedures to Determine the Appropriate Number of Clusters
- 8.9.6. Characterization of Clusters
- 8.9.7. Systematic Cluster Analysis

8.10. Cluster Analysis Modeling
- 8.10.1. Examples
- 8.10.2. Statistical Software Modeling

## **Module 9.** Multivariate Statistical Techniques II

9.1. Introduction
9.2. Nominal Scale
  9.2.1. Measures of Association for 2x2 Tables
    9.2.1.1. Phi Coefficient
    9.2.1.2. Relative Risk
    9.2.1.3. Cross-Product Ratio (Odds Ratio)
  9.2.2. Measures of Association for IxJ Tables
    9.2.2.1. Contingency Ratio
    9.2.2.2. Cramer's V
    9.2.2.3. Lambdas
    9.2.2.4. Tau of Goodman and Kruskal
    9.2.2.5. Uncertainty Coefficient
  9.2.3. Kappa Coefficient
9.3. Ordinal Scale
  9.3.1. Gamma Coefficients
  9.3.2. Kendall's Tau-B and Tau-C
  9.3.3. Sommers' D
9.4. Interval or Ratio Scale
  9.4.1. Eta Coefficient
  9.4.2. Pearson's and Spearman's Correlation Coefficients
9.5. Stratified Analysis in 2x2 Tables
  9.5.1. Stratified Analysis
  9.5.2. Stratified Analysis in 2x2 Tables
9.6. Problem Formulation in Log-linear Models
  9.6.1. The Saturated Model for Two Variables
  9.6.2. The General Saturated Model
  9.6.3. Other Types of Models

9.7. The Saturated Model
- 9.7.1. Calculation of Effects
- 9.7.2. Goodness of Fit
- 9.7.3. Test of K effects
- 9.7.4. Partial Association Test

9.8. The Hierarchical Model
- 9.8.1. Backward Methods

9.9. Probit Response Models
- 9.9.1. Problem Formulation
- 9.9.2. Parameter Estimation
- 9.9.3. Chi-Square Goodness-of-Fit Test
- 9.9.4. Parallelism Test for Groups
- 9.9.5. Estimation of the Dose Required to Obtain a Given Response Ratio

9.10. Binary Logistic Regression
- 9.10.1. Problem Formulation
- 9.10.2. Qualitative Variables in Logistic Regression
- 9.10.3. Selection of Variables
- 9.10.4. Parameter Estimation
- 9.10.5. Goodness of Fit
- 9.10.6. Classification of Individuals
- 9.10.7. Prediction

## **Module 10.** Advanced Prediction Techniques

10.1. General Linear Regression Model
- 10.1.1. Definition
- 10.1.2. Properties
- 10.1.3. Examples

10.2. Partial Least Squares Regression
- 10.2.1. Definition
- 10.2.2. Properties
- 10.2.3. Examples

10.3. Principal Component Regression
- 10.3.1. Definition
- 10.3.2. Properties
- 10.3.3. Examples

10.4. RRR Regression
- 10.4.1. Definition
- 10.4.2. Properties
- 10.4.3. Examples

10.5. Ridge Regression
- 10.5.1. Definition
- 10.5.2. Properties
- 10.5.3. Examples

10.6. Lasso Regression
- 10.6.1. Definition
- 10.6.2. Properties
- 10.6.3. Examples

10.7. Elasticnet Regression
- 10.7.1. Definition
- 10.7.2. Properties
- 10.7.3. Examples

10.8. Non-Linear Prediction Models
- 10.8.1. Non-Linear Regression Models
- 10.8.2. Non-Linear Least Squares
- 10.8.3. Conversion to a Linear Model

10.9. Parameter Estimation in a Non-Linear System
- 10.9.1. Linearization
- 10.9.2. Other Parameter Estimation Methods
- 10.9.3. Initial Values
- 10.9.4. Computer Programs

10.10. Statistical Inference in Non-Linear Regression
- 10.10.1. Statistical Inference in Non-Linear La Regression
- 10.10.2. Approximate Inference Validation
- 10.10.3. Examples

05

# Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: ***Relearning.***

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the ***New England Journal of Medicine*** have considered it to be one of the most effective.

*Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"*

## Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

*At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"*


*You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.*

*The student will learn to solve complex situations in real business environments through collaborative activities and real cases.*

## A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

## Relearning Methodology

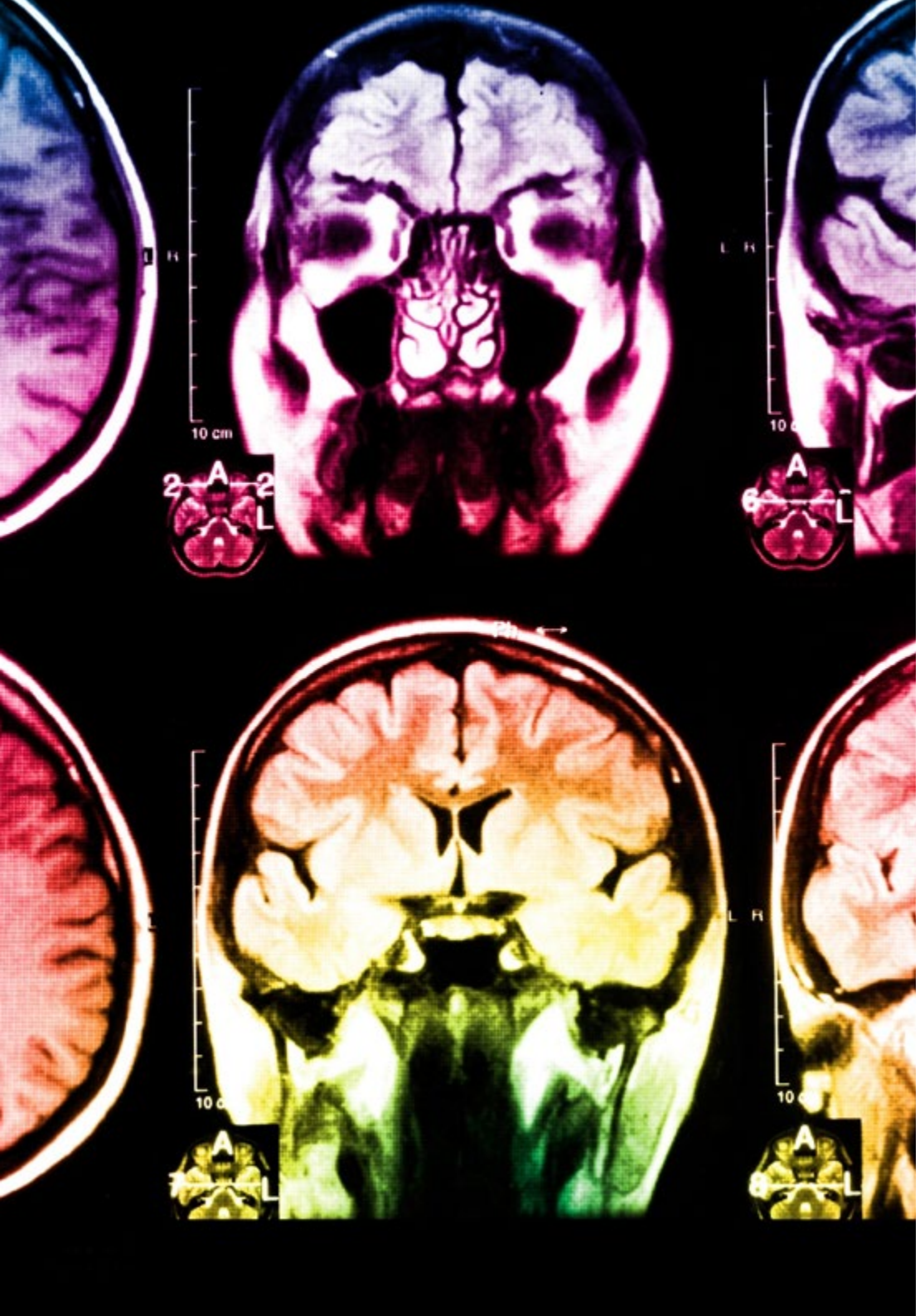
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

*In 2019, we obtained the best learning results of all online universities in the world.*

At TECH, you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

*Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.*

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.

**This program offers the best educational material, prepared with professionals in mind:**

### Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

### Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

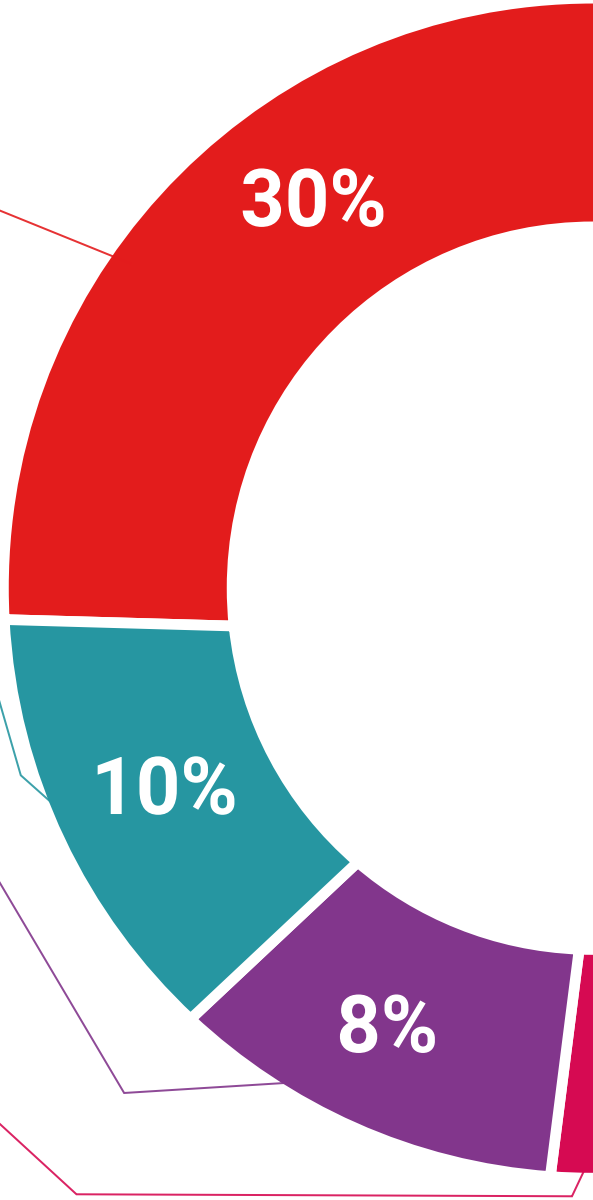
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

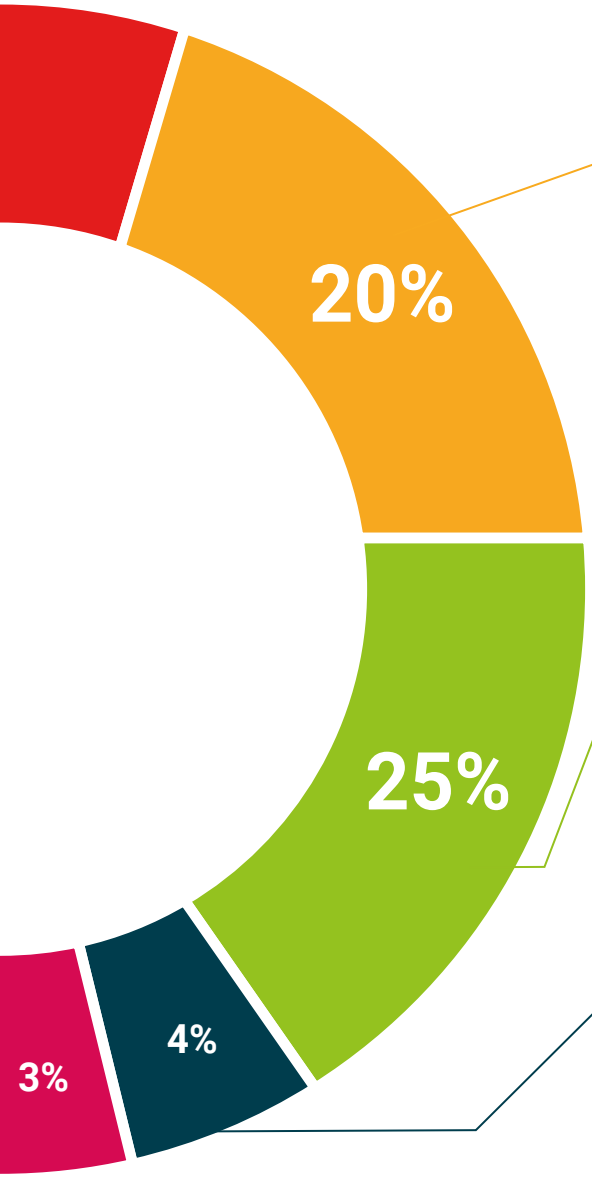
### Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

### Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.






### Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

### Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

### Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

06

# Certificate

The Professional Master's Degree in Statistical Techniques guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree diploma issued by TECH Global University.

*Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork"*

This program will allow you to obtain your **Professional Master's Degree diploma in Statistical Techniques** endorsed by **TECH Global University**, the world's largest online university.

**TECH Global University** is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Professional Master's Degree in Statistical Techniques**

Modality: **online**

Duration: **12 months**

Accreditation: **60 ECTS**

tech global university

Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

**Professional Master's Degree in Statistical Techniques**

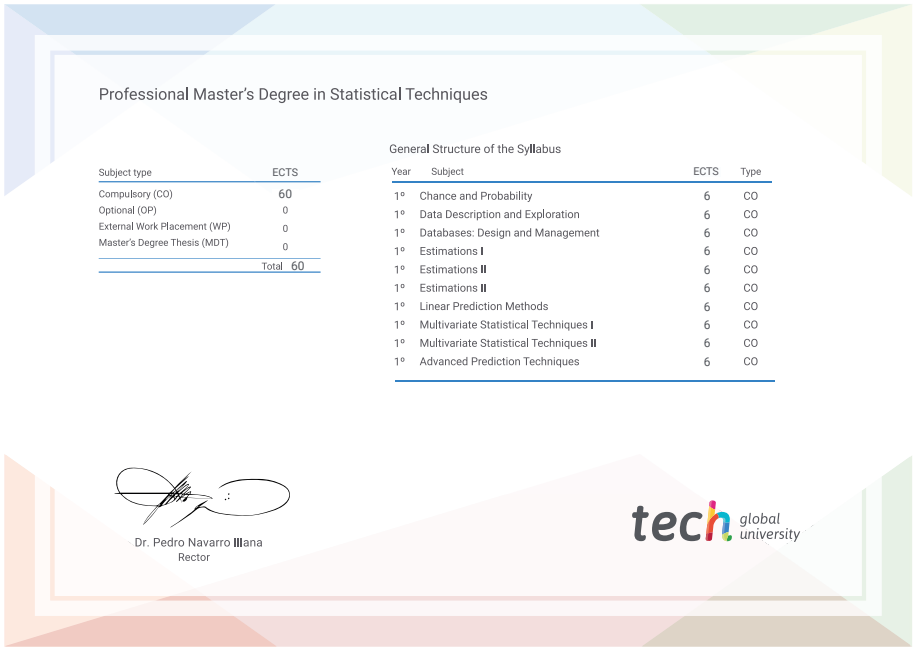
This is a program of 1,500 hours of duration equivalent to 60 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates



Professional Master's Degree in Statistical Techniques

| Subject type | ECTS |
|---|---|
| Compulsory (CO) | 60 |
| Optional (OP) | 0 |
| External Work Placement (WP) | 0 |
| Master's Degree Thesis (MDT) | 0 |
| Total | 60 |

General Structure of the Syllabus

| Year | Subject | ECTS | Type |
|---|---|---|---|
| 1º | Chance and Probability | 6 | CO |
| 1º | Data Description and Exploration | 6 | CO |
| 1º | Databases: Design and Management | 6 | CO |
| 1º | Estimations I | 6 | CO |
| 1º | Estimations II | 6 | CO |
| 1º | Estimations II | 6 | CO |
| 1º | Linear Prediction Methods | 6 | CO |
| 1º | Multivariate Statistical Techniques I | 6 | CO |
| 1º | Multivariate Statistical Techniques II | 6 | CO |
| 1º | Advanced Prediction Techniques | 6 | CO |

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Rector

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*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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# Professional Master's Degree

## Statistical Techniques

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

# Professional Master's Degree
## Statistical Techniques

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