Distribution Theory & Inference

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(course coordinator)

6 ECTS
DBAI - 2025-2026

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1. Course description / Introduction to the course

"Data beats emotions." — Sean Rad, Co-founder of Tinder

Statistics plays a critical role in modern business decision-making. In an environment where uncertainty is the norm and data is abundant, making informed decisions requires more than intuition—it requires the ability to analyze, interpret, and model data effectively.

This course, Inferential Statistics and Data Analysis, builds on students' prior knowledge of descriptive statistics and probability. It focuses on inferential statistics—methods that allow us to make predictions, estimate unknown parameters, and test hypotheses in situations where direct conclusions from data are not possible. These skills form the backbone of effective decision-making in uncertain, real-world contexts.

Throughout the course, students will explore both the theoretical foundations and practical applications of statistical inference. In addition to classical inferential and bivariate techniques, the course introduces key multivariate methods, such as multiple regression, factor analysis, and clustering, which are essential for analyzing complex data and solving applied problems in areas like Marketing, Human Resources, and Business Analytics.

This course is a vital part of the DBAI curriculum, helping students to:
- Develop data literacy and critical thinking in uncertain and data-rich environments,
- Build a solid foundation for advanced coursework in business analytics, research methods, and strategic decision-making, and
- Gain practical, transferable skills for data-informed roles in diverse business sectors.

2. Learning objectives and competencies

This course is designed to develop both the technical skills and the analytical mindset needed to apply statistics in real business environments. By the end of the course, DBAI students will be able to:

1. Apply statistical reasoning to real-world business problems and data-based decision-making.

2. Make informed decisions in uncertain and variable environments using appropriate inferential tools.

3. Draw logical connections between this course and other areas of the DBAI program (e.g., Marketing, HR, Strategy) and understand the relevance of statistical analysis in professional practice.

4. Make inferences about unknown population parameters using estimation and confidence intervals.

5. Select and apply the appropriate statistical techniques for tasks such as estimation, prediction, segmentation, and clustering.

6. Formulate and test hypotheses about population parameters or distributions using suitable inferential procedures.

7. Recognize the assumptions and limitations of each statistical method and apply them critically in context.

8. Use statistical software tools (e.g., IBM SPSS or Jamovi) to conduct analyses and support data-informed decisions.

By the end of the course, students are expected to have built a solid foundation in inferential statistics and gained hands-on experience in applying these tools to analyze business data, test hypotheses, and extract actionable insights. They will be equipped to transform raw data into knowledge that informs sound, ethical, and effective decision-making in diverse business contexts.

3. General academic guidelines

Discipline
This course follows strictly ESADE's Honor Code and thus, all students are expected to behave according to the principle of academic honesty. Conducting any irregularity or violation of the ESADE's Honor Code will imply the application of the penalties detailed in the DBAI Internal Rules and Regulations.

To ensure a respectful and productive learning environment, students are expected to behave professionally and responsibly during class sessions.
Failure to follow the guidelines below may result in immediate removal from the classroom and a grade of 0 in any continuous assessment activities related to the content of the Unit being covered (e.g., in-class exercises, quizzes, group work, or assignments), even if the graded activity takes place on a different day. Repeated violations may negatively impact the final course grade.

  - Eating or drinking during lectures.
  - Using laptops, tablets, or any electronic device for non-academic purposes.
  - Leaving the classroom without prior permission – please wait for the scheduled breaks.
  - Leaving the class without permission; please wait for the breaks.
  - Engaging in any behavior that disrupts the class or distracts others.

Respect for the learning environment, your classmates, and the teaching staff is essential. If you are unsure whether a behavior is appropriate, please consult with the instructor in advance.

Attendance
According to the DBAI Program Regulations (Section 2.2 from DBAI Rules & Regulations, please check it for additional information):

"*Attending class is mandatory. Student evaluation will only be possible if the minimum attendance requirement is met. This minimum attendance must be 80% for the first call and 50% for the second call. If this percentage is not exceeded, the student will receive the grade of "Not Presented". The Program Management will consider justified absences. If the attendance percentage is below 50%, regardless of whether the*

absences are justified, the student may be marked as Not Presented (NP) in both the ordinary and extraordinary calls of the current academic year."

Attendance will be taken in all sessions, and if you are not present when attendance is being checked, it will be counted as an absence. It is your responsibility to ensure that you are on the attendance list and communicate it to the professor as soon as possible, ideally in the same session.

You are not required to justify absences if they do not exceed the 20% limit. However, if your absences exceed this threshold, Program Management will contact you at the end of the term to request the necessary official justifications.

Punctuality
According to the DBAI Program Regulations:
"To ensure classes run smoothly and students take full advantage of them, Esade demands utmost punctuality by both faculty and students."

The door(s) will be locked at the beginning of each session and will be reopened 10 minutes after the start of the session. After this time, the door will remain locked, and you will not be able to enter. Please refrain from knocking or attempting to access the room. Kindly wait until the next scheduled break or session to enter.

Plagiarism
The following are considered to be infractions related to plagiarism in the academic context as detailed by the DBAI Program Regulations:

Very severe Infraction: "*Plagiarism, understood as presenting in one's name work or assignments for assessment when its full content is prepared by others.* "

Penalization: *"If the severe infraction occurs while completing the mid-term exam or any other activity subject to evaluation, excepting the final exam, said activity or assignment will receive a mark of 0 and, in addition, at the coordinator faculty member's sole discretion, the students in question may also receive a 0 in all or part of their ongoing assessment marks unless the decision is to impose the penalization indicated in sub-section a) and b) above"* (which refers to temporary and definite expulsion).

Severe infraction: "*Plagiarizing any academic activity or assignment, understood as using different sources without properly recognizing the authorship. Turning in work which students have previously presented at other institutions or in past subjects is also considered plagiarism, as this work is considered authentic but not original (self-plagiarism).*"

Penalization: "*If the severe infraction occurs while completing the mid-term exam or any other activity subject to evaluation, excepting the final exam, said activity or assignment will receive a mark of 0 and, in addition, at the coordinator faculty member's sole discretion, the students in question may also receive a 0 in all or part of their ongoing assessment marks unless the decision is to impose the penalization indicated in sub-section a) above*" (which refers to temporary expulsion).

Previous preparation for the sessions is expected and required from your side. Active participation in the sessions is encouraged. Sharing your contributions with the class will enrich all the participants and make the sessions more dynamic.

4. Course format and methodological approach

The course combines lectures, readings, and hands-on data exercises to help you develop both conceptual understanding and practical analytical skills.

- The first three units are conceptual in nature and will be introduced through lectures and assigned readings (from the textbook or class notes). Reading before class is essential—it allows us to move faster and go deeper during sessions. Lectures do not replace readings, and vice versa.

- The rest of the course is practice-oriented, focusing on case studies based on real data. The case method will challenge you to apply statistical tools to decision-making problems in a low-risk, high-learning classroom environment.

What We Expect from You

- Prepare in advance: Complete assigned readings and tasks so you can engage meaningfully with both individual and group work.

- Practice actively: The more you apply statistical concepts, the faster you'll master them. To support this, you'll receive microlearning content (Snackson app) on your smartphone or tablet throughout the course.

- Engage with others: A good way to test your understanding is to explain concepts to classmates. Use the Q&A forum on Moodle to discuss questions and help each other—faculty will guide and moderate.

- Seek support: Faculty are available for individual or group tutorials. Just email us to arrange a meeting.

All course materials (instructions, slides, updates, readings, etc.) will be available on Moodle. Please check the platform at least twice a week. Session slides will be posted in advance of each class.

5. Course Contents

Part 1: INFERENCE

1. SAMPLE DISTRIBUTIONS

1.1 Introduction to sample distributions
1.2 Distribution of sample mean
1.3 Distribution of sample proportion
1.4 Distribution of sample variance

2. ESTIMATION

2.1 Introduction
2.2 Point estimation
2.3 Interval estimation

3. HYPOTHESIS TESTING BASICS

3.1 Hypothesis testing concepts: P-value and the statistical power of tests
3.2 Test for means, variance and proportions (one sample)
3.3 Test for means, variance and proportions (two samples)
3.4 ANOVA test

4. NON-PARAMETRIC TESTS

4.1 Goodness-of-fit test
4.2 Pearson's chi-square test for independence and homogeneity

Part 2: MULTIVARIATE

5. DEPENDENCY

5.1 Introduction
5.2 Simple regression analysis
5.3 Multiple regression analysis

6. INTERDEPENDENCY

6.1 Introduction
6.2 Principal component analysis
6.3 Cluster analyses

6. Assessment

This course is made of two parts that will be independently assessed. Thus, there will be a mid-term exam covering the first four units *(exam 1)*, and a final exam covering the last two units *(exam 2)*.

The *final grade of the course* will be calculated as:

First Part: Inference	Second Part: Multivariate
Exam 1: 40%	**Exam 2**: 40%
Content integration multiple-choice test: 10% • Sample Distribution & Estimation • Hypothesis Testing	**Content integration multiple-choice test**: 10% • Regression Analysis • Principal Component Analysis

Not attending any of the abovementioned evaluations will be assessed with 0 points.
If the final grade is 5 or higher out of 10, students can boost their score by participating in Snackson micro-courses, earning an additional 0.50.

6.1. Final Grade Calculation for the Ordinary Evaluation

The final course grade will be determined based on a weighted average of the various assessment components, distributed as follows:
- 80% derived from the average of Exam 1 and Exam 2.
- 20% based on the average score of the content integration quizzes (continuous assessment).

Minimum requirements for applying the weighted average (final grade):

To be eligible for the calculation of the final grade using the weighted average, the student must obtain a minimum score of 3.5 out of 10 in both Exam 1 and Exam 2.

Consequences of Failing to Meet the Minimum Conditions:
- If a student scores below 3.5 in either Exam 1 or Exam 2, the weighted average will not be applied, and the student will be considered to have failed the course.
- In such cases, the lowest score between Exam 1 and Exam 2 will be recorded as the final grade in the academic transcript, regardless of the continuous assessment results.
- Furthermore, if the student scores at least 3.5 in both exams, but the final weighted average (including continuous assessment) is below 5.0, the student will also fail the course.

6.2. Extraordinary Examination (Resit)

Students whose final grade in the ordinary evaluation is below 5.0 must take the extraordinary (resit) examination.

Resit conditions:
- If the student has an average score of 5.0 or higher in the continuous assessments **and** scored 5.0 or higher in either Exam 1 or Exam 2 during the ordinary call, they will retake only the failed exam.
- In all other cases, students will be required to retake both parts of the course.

Final grade calculation in the extraordinary call:
- 80% from the resit exam average (or the result of the part retaken, if only one was required).
- 20% from the average score of the content integration quizzes completed during the course.

6.3. Students Enrolled under Exam-Only Evaluation

Students enrolled under the exam-only assessment modality will be evaluated in December through a comprehensive final examination, consisting of two parts:
– One part on Inferential Statistics
– One part on Multivariate Statistics

Passing criteria for this modality:
– A minimum score of 3.5 must be achieved in each part of the examination.
– In addition, the overall average must be 5.0 or higher.

If either part is scored below 3.5:
– Even if the overall average exceeds 5.0, the student will not pass the course.
– In such cases, the lowest score of the two parts will be recorded as the final course grade on the academic transcript.
– For the extraordinary exam, the student will retake only the failed part if they scored 5.0 or higher in the other part during the ordinary call; if not, they will need to retake both parts of the course.

7. Materials

To support your learning throughout the course, the following materials will be used:

A. Recommended Textbooks

These books are available through the Esade Library (there is no need to purchase them):

– Newbold, P., Carlson, W.L., & Thorne, B. (2012). Statistics for Business and Economics. Pearson – Prentice Hall. (eBook also available on Moodle)
– Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). Multivariate Data Analysis. Pearson – Prentice Hall.

B. Snackson App
Interactive mobile learning through short, focused content to reinforce key statistical concepts.

C. Class Materials

– Instructor-prepared notes and extended PowerPoint slides
– Solved exercises and past exam questions for practice and review

D. Additional Readings
Supplementary literature (academic articles, case studies, or book chapters) may be recommended throughout the course to deepen understanding of specific topics. Feel free to ask for further resources if you're interested in exploring a topic in more depth.

8. Faculty leading the course

Dr. Miguel Saiz ✉ *miguel.saiz@esade.edu*
Office: Room 309-E, Campus Sant Cugat
Office Hours: By appointment (please email to schedule)

Dr. Miguel Saiz holds a degree in Industrial Engineering from the University of Navarra (Tecnun), a PhD in Network and Information Technologies from Universitat Oberta de Catalunya and an MBA from Esade. He is a certified Project Management Professional (PMP®) by the Project Management Institute (PMI®, USA). Since 2001, he has worked in the automotive industry with companies such as Grupo Antolín, Bosch, Doga, and Lear Corporation, where he led product development projects for global brands including Ford, Chrysler, Honda, GM, Audi, VW, and SEAT.

In parallel with his industry work, Prof. Saiz is the founder of weOptimize, a Microsoft Partner focused on digital transformation. He also collaborates with the Intelligent Computing Systems Optimization (ICSO Meta) Research Group. Academically, he teaches in multiple institutions including Esade Business School, Tecnocampus, and EAE Business School, and has served as Director of several Esade Certificates related with Operations and Technology.

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Dr. Vicenta Sierra is a Full Professor at Esade Business School. She holds a PhD in Psychology from the University of Barcelona (UB), a bachelor's degree in Statistics from the Polytechnic University of Catalonia (UPC), and a University Degree in Psychology from UB.

Her areas of expertise include research methods, advanced statistics, and psychometrics. Dr. Sierra is an active researcher with a strong publication record in leading academic journals such as the Journal of Business Ethics, Journal of Public Administration Research and Theory, Public Administration, Public Policy & Management, Journal of Cleaner Production, and Supply Chain Management: An International Journal, among others.