Universitat Autònoma de Barcelona

2020/2021

Multidimensional Distributions

Code: 104857
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

Prerequisites

Elementary probability. Real random variables. Differential and integral calculation. Elemental algebra: vector spaces and determinants.

Objectives and Contextualisation

The probability distribution of a random vector (discrete or continuous) is the main objective of this course.

We analyze the principal characteristics of the joint distribution: the vector of means, the variance-covariance matrix, the

marginal and conditional distributions, etc.

As a principal example we study the multidimensional normal distribution. It is an important continuous distribution, with applications in linear

model theory, multivariate analysis and statistical decision theory.

Theory and calculations related to continuous multidimensional distributions, strongly depends on integral and differential calculus

with functions of several variables. Having this in mind, we review the principal technics focusing on multivariate probability

applications.

Competences

- Correctly use a wide range of statistical software and programming languages, choosing the best one for each analysis, and adapting it to new necessities.
- Make efficient use of the literature and digital resources to obtain information.
- Select statistical models or techniques for application in studies and real-world problems, and know the tools for validating them.

- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

Learning Outcomes

1. Make effective use of references and electronic resources to obtain information.
2. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
3. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
4. Use software to visualise data with multi-dimensional distributions.
5. Use statistical software to obtain summary indices of the variables in the study.
6. Use the properties of the functions of distribution and density.

Content

1. Random vectors.

k-dimensional random vectors. The component variables of a random vector. Definition of the joint law of a random vector:

the discrete case and the absolutely continuous case. The joint probability distribution function. Bivariate discrete finite

distributions: marginal and conditional distributions.

2. Discrete distributions.

General bivariate discrete distributions. Marginal distributions. Multivariate discrete distributions. Marginal distributions.

The multinomial distribution. Functions of a discrete random vector.

3. Continuous distributions.

General bivariate continuous distributions. Marginal distributions. Multivariate continuous distributions. Marginal

distributions. Functions of a continuous random vector.

4. Independence and conditional distributions.

Statistically independent random variables and joint distributions. Conditional distributions: discrete and continuous case.

5. Mathematical expectation and other numerical characteristics.

Expectation of a function of a random vector. The moment generation function. Covariance and correlation coefficient.

The variance-covariance matrix. Conditional expectation. Conditional variance. The double expectation theorem.

6. The multidimensional normal distribution.

The bidimensional normal distribution. The multidimensional normal distribution. Distributions related to the normal distribution: chi-square distributions, Student t distributions and Fisher-Snedecor F distributions. Student theorem.

Cochran theorem.

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

Teaching methodology is based on the following activities and material:

- Theory lessons.
- Practical lessons about problems and exercises.
- Computer laboratory practical sessions (with Maxima and R).
- Personal work dossier (DTP).
- Theory and problem textbooks.
- Study and personal work weekly guides (GETPS).
- Course workspace on the UAB Virtual Campus Moodle.

The proposed teaching methodology may experience some modifications depending

on the restrictions to face-to-face activities enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory lessons	28	1.12	3, 2, 1, 6, 5, 4
Type: Supervised			
Computer laboratory practical sessions (with Maxima and R)	14	0.56	3, 2, 1, 6, 5, 4
Practical lessons about problems and exercises	14	0.56	3, 2, 1, 6, 5, 4
Type: Autonomous			
Personal work dossier (exercices and theory)	22	0.88	3, 2, 1, 6, 5, 4

Assessment

Students can obtain up to 40% of the total score with personal work, done along the course:

personal work dossier (DTP), computer lab work (PRC) and classroom problems (EA), if delivered within the term.

The remaining score is covered by two (independent and equal weight) partial examinations, EP1 and EP2, both with a

second-chance examination, EF1 and EF2.

To pass the course, is required to obtain a minimum of 30% in each of both partial examinations, as well as a minimum of 50%

of the total score.

Denote DTP, EA, PRC, EP1, EP2, EF1 and EF2 the points (over 10) obtained on each of these evaluation items. Then the final

global punctuation QF (over 10) is calculated by means of the next formula:

QF = TC + 0.05 (10-TC-TC1) [max(EP1 , EF1) + max(EP2 , EF2)]

where TC = 0.2 DTP+0.1 EA+0.1 PRC and TC1 = max(0 , 1-0.2 DTP)+(1-0.1 EA) .

The minimum condition on partial examinations is: min{max(EP1 , EF1) , max(EP2 , EF2)} >=3

If this condition is not satisfied then the final global punctuation is min(QF , 4.5).

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Classroom problems (EA)	10%	14	0.56	3, 2, 1, 6, 5, 4
Computer lab work (with Maxima and R)	0% to 10%	14	0.56	3, 2, 1, 6, 5, 4
Final examinations (EF1, EF2)	0% to 50%	0	0	3, 2, 1, 6, 5, 4
Partial examinations (EP1, EP2)	20% to 40% (each one)	0	0	3, 2, 1, 6, 5, 4
Personal work dossier of exercices and theory (DTP)	10% to 20%	44	1.76	3, 2, 1, 6, 5, 4

Bibliography

J.E. Marsden & J. Tromba: Calculo Vectorial (Addison-Wesley).

M. de Groot: Probabilidad y Estadística (Addison-Wesley).

D. Peña: Fundamentos de Estadística ()Alianza Editorial).

D. Peña: Análisis de datos multivarianters (McGraw-Hill).

J.G. Kalbfleisch: Probabilidad e Inferencia Estadística (Vol. 1) (AC).

V. Zaiats; M.L. Calle; R. Presas: Probabilitat i Estadística. Exercicis I. U.A.B. (Materials, 107).