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200131 - TP - Probability Theory

Coordinating unit: 200 - FME - School of Mathematics and Statistics

Teaching unit: 749 - MAT - Department of Mathematics
715 - EIO - Department of Statistics and Operations Research

Academic year: 2018

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 7,5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: JUAN JOSÉ RUE PERNA

Others: Primer quadrimestre:
ANNA DE MIER VINUÉ - B
SONIA PEREZ MANSILLA - A
JUAN JOSÉ RUE PERNA - A, B

Degree competences to which the subject contributes

Specific:

1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

Generical:

5. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
6. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
7. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
8. CG-1. Show knowledge and proficiency in the use of mathematical language.
9. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
10. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
11. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:

4. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

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Learning objectives of the subject

There are two main objectives: (1) to present Probability Theory as a rich, attractive and useful tool in modeling random phenomena and (2) to provide the necessary background in probability for other subjects in the Debree of Mathematics.

The particular goals of the subject are the achievement by the students of the following aspects:

* To know the notion of probability and its main properties.
* To know the basic discrete and continuous probability models .
* To use the concept of random variable in formalizing and solving problems in probability.
* To know the concept of moments of a random variable and the main results associated to this notion.
* To know the notion of convergence of random variables, particularly the Central Limit Theorem and the Laws of Large Numbers.

Study load

Total learning time: 187h 30m	Hours large group:	45h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	16.00%
	Guided activities:	0h	0.00%
	Self study:	112h 30m	60.00%

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Content

Probability Spaces and Random Variables

Learning time: 23h 30m

Theory classes: 6h
Practical classes: 2h
Self study : 15h 30m

Description:
- Random experiments, outcomes and events.
- Probability.
- Conditional Probability.
- Independence.
- Product Spaces.
- Random Variables and probability distribution functions.
- Random Vectors. Independence of random variables.

Random Variables (I): discrete variables

Learning time: 36h

Theory classes: 7h 30m
Practical classes: 6h
Self study : 22h 30m

Description:
- Probability function.
- Independence.
- Expectation and Moments of a Random Variable.
- Models of Discrete Random Variables.
- Joint distribution. Covariance and Correlation. Independence.
- Conditional distributions. Conditional Expectation.
- Sums of Random Variables.

Random variables (II): continous variables

Learning time: 48h

Theory classes: 12h
Practical classes: 8h
Self study : 28h

Description:
- Density Probability Function.
- Expectation and Moments of a Random Variable.
- Models of Continuum Random Variables.
- Joint distributions. Independence. Conditional distributions.
- Functions of Random Variables
- Multivariate Normal distribution and related distributions.

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Generating Functions	Learning time: 36h Theory classes: 7h 30m Practical classes: 6h Self study : 22h 30m

Description:
- Probability Generating Function
- Moment Generating Function and Characteristic Function.
- Theorems of Inversion and Continuity.

Convergence of Random Variables	Learning time: 36h Theory classes: 7h 30m Practical classes: 6h Self study : 22h 30m

Description:
-Sequences of Random Variables
- Convergence in distribution. The Central Limit Theorem.
- Modes of convergence
- Laws of large numbers

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Bibliography

Basic:

Grimmett, G.R.; Stirzaker, D.R. Probability and random processes. 3a ed. Oxford [etc.]: Oxford University Press, 2001. ISBN 9780198572220.

Sanz, Marta. Probabilitats. Barcelona: Edicions de la Universitat de Barcelona, 1999. ISBN 8483380919.

Pitman, Jim. Probability. New York [etc.]: Springer, cop, 1993. ISBN 0387979743.

Gut, Allan. An Intermediate course in probability. 2nd ed. Springer, ISBN 978-1-4419-0162-0.

Complementary:

Julià de Ferran, Olga ... [et al.]. Probabilitats: problemes i més problemes. Barcelona: Universitat de Barcelona, 2005. ISBN 8447529061.

Feller, W. An introduction to probability theory and its applications (Vol. 1,2). 3rd ed. New York: John Wiley & Sons, 1968. ISBN 0471257117.

Grinstead, Charles M.; Snell, L.J. Introduction to probability. American Mathematical Society, 2006.

Chung, Kai Lai. A course in probability theory. New York: Academic Press, 1974. ISBN 012174650X.

Cuadras, C. M. (Carlos María). Problemas de probabilidades y estadística. Vol 1: Probabilidad. Barcelona: EUB, 2000. ISBN 8483120313.

Tabak, J. Probability and statistics: the science of uncertainty. New York: Facts On File, 2004. ISBN 0816049564.

Others resources:

Hyperlink

Grinstead, Charles M.; Snell,Laurie J. Introduction to Probability

http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/book.html

The Probability Web (Teaching resources)

http://www.mathcs.carleton.edu/probweb/probweb.html

Chance

http://www.dartmouth.edu/~chance/

The R Project for Statistical Computing
R is a free software environment for statistical computing and graphics.

http://www.r-project.org/

Mat2: Materials Matemàtics

http://www.mat.uab.es/matmat/Cast/index.html
Revista electrònica de divulgació matemàtica editada pel Departament de Matemàtiques de la Universitat Autònoma de Barcelona. Inclou articles molt interessants
sobre temes de probabilitat.