Probability Theory — LMAC/MMA, 1^{st} Sem. 2021/22

General info

- **Faculty**

  Manuel Cabral Morais

- **Contacts**

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  Floor 5 – Room 5.49 – Mathematics Building

- **General objectives**

  To introduce students to probability theory at an intermediate-level, covering: probability spaces, random variables and distributions, transforms of random variables and vectors; independence; integration and expectation; convergence of sequences of random variables and classical limit theorems; conditional expectation and martingales.

- **Website**

- **Faculty website**

Detailed program

1. Probability spaces
   - 1.1 Random experiments
   - 1.2 Events and classes of sets
   - 1.3 Probabilities and probability functions
   - 1.4 Distribution functions; discrete, absolutely continuous and mixed probabilities
   - 1.5 Conditional probability

2. Random variables
   - 2.1 Fundamentals
   - 2.2 Combining random variables
   - 2.3 Distributions and distribution functions
   - 2.4 Key r.v. and random vectors and distributions
     - 2.4.1 Discrete continuous r.v. and random vectors
     - 2.4.2 Absolutely continuous r.v. and random vectors
   - 2.5 Transformation theory
     - 2.5.1 Transformations of r.v., general case
     - 2.5.2 Transformations of discrete r.v.
     - 2.5.3 Transformations of absolutely continuous r.v.
     - 2.5.4 Transformations of random vectors, general case
     - 2.5.5 Transformations of discrete random vectors
     - 2.5.6 Transformations of absolutely continuous random vectors
     - 2.5.7 Random variables with prescribed distributions

3. Independence
   - 3.1 Fundamentals
   - 3.2 Independent r.v.
   - 3.3 Functions of independent r.v.

Bibliography

- **Recommended**

Karr, A.F. (1993). *Probability.* Springer-Verlag.

This book *is not encyclopaedic* and *quite deliberately incomplete, globally and locally* (Karr, 1993, p. v). The author also recommends that *students should be made aware of the role of probability within the broader context of measure theory* and also adds that *to dismiss probability as the special case of a 'space with total measure one' is neither honest nor helpful.*

- **Optional**

Resnick, S.I. (1999). *A Probability Path.* Birkhäuser. (QA273.4-.67.RES.49925)

Rohatgi,V.K. (1976). *An Introduction to Probability Theory and Mathematical Statistics.* John Wiley & Sons.

Teaching material

- **Lectures notes** (sent by e-mail, chapter by chapter)
- **Tables**
- **Detailed solutions** of the tests and exams from *2009/10*, *2010/11*, *2013/14*, *2014/15*.

Classes and schedule

- **Classes**

  In English, in case there are any students who do not speak Portuguese, and with the following structure: motivation, result, example, exercise. The exercises are chosen and assigned to students in advance, and are solved by the students on the blackboard for *Mathematics is better learned actively than passively* (Karr, 1993, p. ix).

- **Schedule (classrooms)**

  Mon., 13:30–15:30 (V1.11, Civil Engineering Building)

  Tue., 9:00–11:00 (V1.27, Civil Engineering Building)

  Tue., 19:00–20:00 (P8, Mathematics Building)

- **Office hours**

  Proposed: Mon., 11:00–13:30, *zoom (https://videoconf-colibri.zoom.us/j/86203397812)*

  The professor will eventually leave the zoom room if the students are more than 30 minutes late.

- **Extra office hours**

  By appointment preferably by sms (927941249), tel. (218417047 or Ext. 1047) or e-mail (maj@math.ist.utl.pt), at least 24 hours in advance.

  The professor will eventually leave the *zoom* room if the students are more than 30 minutes late.

Assessment method

- The assessment method comprises two compulsory components:
  - a 2 hour exam (50%);
  - at most five 30 minute tests, one per chapter (50%).
- The exam will cover all chapters/sections taught. The date of Exam 1 (resp. Exam 2) is February 7 (resp. February 18), 2022.
- To pass the course:
  - the mark of the exam has to be exceed 7.4 (out of 20) points;
  - and the average of the mark of the exam and of the mean of the scores of the 30 minute tests has to exceed 9.4 points (out of 20) points.

  Whenever a student takes Exam 2, the mark obtained in it is considered for the final mark if and only if it is higher than that obtained in Exam 1.

- Permitted material

  The only material allowed during the 2 hour exams and the 30 minute tests is:
  - test/exam sheet and scrap paper (WITHOUT any written COMMENTS or ADDITIONS);
  - calculator (GRAPHING calculators are NOT ALLOWED);
  - tables and formulae available.

  The use of any other material is punishable and can lead to the annulment of the exam.

  The use of mobile phones is also forbidden during the 2 hour exams and the 30 minute tests.

- Personal identification

  The student (or identity card) should be taken to the exam and the 30 minute tests.