

Course Description

Ve401 Probabilistic Methods in Engineering

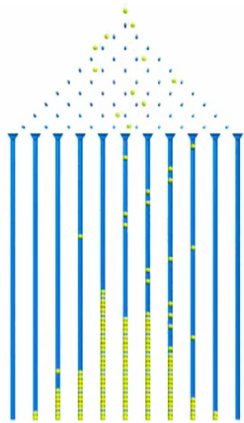


JOINT INSTITUTE
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Prerequisites: Vv256 or Vv286 and the preceding calculus courses.



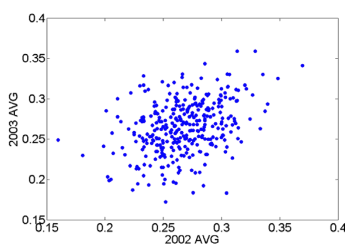
Gambling and Risk



Random Influences on Measurements



Statistics in the Middle Ages



Luck vs. Skill in Baseball

Intended Audience: ME and ECE undergraduate and graduate students.

Description: The first part of the course introduces some basic elements of probability theory and combinatorics, with proofs of theorems demonstrated as far as practical within the time constraints of the course. Students are expected to have a good knowledge of the standard calculus material of the first three terms, including, but not limited to, polar coordinates in higher dimensions, integration of single- and multiple-variable functions, the theory of convergence of series and sequences of functions, the theory of matrices and linear maps as well as systems of ordinary differential equations.

The second part of the course discusses some basic statistical methods for testing statistical hypotheses and analyzing means, variances and proportions. The results of the first part are applied to practical problems. Students are required to comprehend and interpret formulations of real-life situations, use their judgement and apply the correct procedure to find a suitable solution to a given problem. In this respect, the required skill sets are closer to a physics or engineering course than a mathematics course.

The third part of the course touches upon categorical data analysis, simple and multiple linear regression and analysis of variance (ANOVA). For regression problems in particular, familiarity with matrix calculus is required.

The course makes use of the Mathematica software, for which all JI students have a free license. The commands necessary for implementing statistical methods are given in the lecture at regular intervals.

A term project will be completed by groups of 4-5 students. The project includes analyses of quality control in China, the rate of homicides in London between 2004 and 2010 as well as performance data for sports teams.

Keywords: Basic concepts in probability, discrete and continuous probability distributions, joint distributions, descriptive statistics, estimation, hypothesis testing, non-parametric methods, analysis of categorical data, simple and multiple regression analysis, model selection, introduction to analysis of variance and experimental design.

Literature:

[MA] Milton and Arnold, *Introduction to Probability and Statistics*, 4th Edition, McGraw Hill, International Edition 2004.

[HMGB] Hines, Montgomery, Goldsman and Borror, *Probability and Statistics in Engineering*, 4th Edition, 2003, J. Wiley & Sons.

Syllabus:

Lecture	Lecture Subject	Textbook Sections
1	Introduction to Probability and Counting	[MA] 1
2	Some Probability Laws	[MA] 2
3	Discrete Random Variables	[MA] 3
4	Discrete Random Variables	[MA] 3
5	Continuous Random Variables	[MA] 4
6	The Normal Distribution	[MA] 4
7	Reliability	[MA] 4
8	Bivariate Random Variables	[MA] 5
9	First Midterm Exam	[MA] 1-5
10	Descriptive Statistics	[MA] 6
11	Point Estimation and Estimators	[MA] 7
12	The Chi-Squared Distribution	[MA] 7
13	Independence of Sample Mean and Sample Variance	—
14	Interval Estimation of Mean and Variance	[MA] 7
15	Hypothesis Testing	[MA] 8
16	OC Curves and Acceptance Sampling	[HMGB] 11-1, 11-2; [MA] 16.5
17	Significance Testing	[MA] 8
18	Comparison of Two Proportions	[MA] 9
19	Comparison of Two Variances	[MA] 10
20	Comparison of Two Means	[MA] 10
21	Second Midterm Exam	[MA] 6-10
22	Categorical Data	[MA] 15
23	Simple Linear Regression	[MA] 11
24	Simple Linear Regression	[MA] 11
25	Multiple Linear Regression	[MA] 12
26	Multiple Linear Regression	[MA] 12
27	Analysis of Variance	[MA] 13
28	Analysis of Variance	[MA] 13
29	Pitfalls and Controversies in Statistics	—
30	Final Exam	[MA] 11-13, 15

Course Grade Components:

- First midterm exam: 25%
- Second midterm exam: 25%
- Final exam: 25%
- Course work: 15%
- Term Project: 10%

Honor Code Policy:

The rules for observing the Honor Code in this course are quite simple: you must never show any other student your written work. You are not allowed to write down formulas for another student, or to let them see your homework, or to demonstrate something to them on a blackboard or use any other type of written communication.

You are allowed to talk about the course work (the weekly assignments), but may not communicate in writing. For example, it is OK to tell another student “I solved this differential equation by substituting as for a homogeneous equation.” It is not OK to actually show another student the written calculations of how you did this.

Of course, during exams, no communication of any kind (verbal or written) is allowed!