

Math 115

Calculus, Part II with probability and matrices. (4h. 1 c.u.)

Functions of several variables, partial derivatives, multiple integrals; introduction to linear algebra and matrices with applications to linear programming and Markov processes. Elements of probability and statistics. Applications to the social and biological sciences.

Use of symbolic manipulation and graphics software in Calculus. Note: some sections of this course may use Maple®.

Texts:

[C] Stewart, James, *Calculus*, 6th Ed.

[P] Schaum's Outline Series: *Probability*, 2nd edition, by Seymour Lipschutz, pub. McGraw Hill, ISBN 0-07-135203-1

[H] *Linear Algebra* by Jim Hefferon, St. Michael's College; Text can be downloaded (for free) at: <http://joshua.smcvt.edu/linearalgebra/>.

[M] Maple/Calculus Lab Manual for Math 104/114/115

Syllabus:

<u>Chapter</u>	<u>Section & Topic</u>	<u>Core Problems</u>
<i>Calculus of Several Variables</i>		
15 [C] Partial Derivatives		
	15.1 Functions of Several Variables	1, 2, 6, 11, 30, 32
	15.3 Partial Derivatives	1, 4, 5, 16, 21, 51, 66, 83
	15.4 Tangent Planes and Linear Approximations	2, 12, 20, 24, 31
	15.5 The Chain Rule	4, 8, 16, 36
	15.7 Maximum and Minimum Values	1, 3, 5, 11, 23, 37
	15.8 Lagrange Multipliers	3, 4, 7, 14
16 [C] Multiple Integrals		
	16.1 Double Integrals over Rectangles	1, 6, 8, 12, 17
	16.2 Iterated Integrals	4, 5, 14
	16.3 Double Integrals over General Regions	3, 10, 24, 39, 43

Probability and Markov Processes

1 [P] Set Theory

- 1 Introduction.
- 2 Sets and Elements, Subsets. 1.48, 1.49
- 4 Set Operations. 1.50, 1.53
- 5 Finite and Countable Sets. 1.60, 1.61, 1.62, 1.63
- 6 Counting Elements in Finite Sets, Inclusion-Exclusion Principle.

2 [P] Techniques of Counting

- 1 Introduction.
- 2 Basic Counting Principles. 2.45-2.49
- 3 Factorial Notation. 2.39, 2.40
- 4 Binomial Coefficients. 2.41, 2.43
- 5 Permutations. 2.51, 2.52, 2.54, 2.57
- 6 Combinations. 2.59-2.61, 2.64-2.67
- 7 Tree Diagrams. 2.75, 2.76

3 [P] Introduction to Probability

- 1. Introduction.
- 2 Sample Space and Events. 3.41, 3.42, 3.44-3.48
- 4 Finite Probability Spaces. 3.50-3.52, 3.54
- 5 Infinite Sample Spaces. 3.59, 3.60

4 [P] Conditional Probability and Independence

- 1 Introduction.
- 2 Conditional Probability. 4.41-4.48, 4.53-4.55
- 3 Finite, Stochastic and Tree Diagrams. 4.56-4.60
- 4 Partitions, Total Probability, and Bayes' Formula. 4.63-4.66
- 5 Independent Events. ' 4.69, 4.70, 4.72, 4.74, 4.75
- 6 Independent Repeated Trials. 4.81, 4.84

5 [P] Random Variables

- 1. Introduction.
- 2 Random Variables. 5.54-5.57, 5.59, 5.60
- 5 Variance and Standard Deviation. 5.69, 5.73

6 [P] Binomial and Normal Distributions

- 1 Introduction.
- 2 Bernouli Trials, Binomial Distribution. 6.52, 6.56, 6.57
- 3 Normal Distribution. 6.62, 6.63, 6.84, 6.89

7 [P] Markov Processes

1. Introduction
2. Vectors and Matrices 7.23, 7.24, 7.26
3. Probability Vectors and Stochastic Matrices 7.27, 7.28, 7.29
4. Transition Matrix of a Markov Process 7.30, 7.32, 7.35
5. State Distributions 7.36, 7.38
6. Regular Markov Processes and Stationary State Distributions 7.39

Linear Algebra-

1 [H]: Linear Systems

I Solving Linear Systems

1. Gauss' Method 1.16, 1.17 a-d, 1.18, 1.19, 1.21a, 1.24
2. Describing the Solution Set 2.15, 2.17, 2.18a-d, 2.19b, 2.20, 2.25
3. General = Particular + Homogeneous 3.15a-c, 3.17, 3.21

III. [H] Reduced Echelon Form

1. Gauss Jordan Reduction 1.7a-c, 1.8a-b, 1.9b-c
2. Row Equivalence 2.11a-c, 2.24, Input-Output Analysis (pg. 64)

SAMPLE EXAM QUESTIONS (available from the Math Dept's Math 115 Web Page: <http://www.math.upenn.edu/ugrad/calc/m115/>) also form a part of the core.

The core problems indicate the kind of basic problems you will need to be able to solve by hand. They also provide a guide to the basic level of difficulty to be expected on the final exam.

Note: All sections of Math 115 have a COMMON FINAL EXAM
