This series of lectures will present some of the ideas that form the foundation of quantitative work in the social sciences. In particular, topics from matrix theory and from calculus will be discussed with emphasis on the understanding of concepts and the development of intuition. The lectures assume some familiarity with the topics in the ICPSR course “Mathematics for Social Scientists I.” Both matrix theory and calculus problems, as well as their solutions, are provided in the coursepack found at http://homepages.umflint.edu/~hmthomps/ICPSR/. These problems enable the participant to evaluate his or her understanding of the material. The lectures may be supplemented by reading the following texts.


**A. Matrix Theory** (nine lectures)

**Day 1**

Introduction; matrices; matrix addition and subtraction; basic properties; scalar multiplication

Text: pp. 7 – 13
Problems: # 1 - 6

**Day 2**

Vectors; the inner product; matrix multiplication

Text: pp. 13 – 23
Problems: # 7 - 12

**Day 3**

Theorems concerning the basic matrix operations; the transpose

Text: pp. 23 – 27
Problems: # 13 - 20

**Day 4**

Inverse of a matrix; the covariance matrix

Text: pp. 33 – 35
Problems: # 21, 22, 23a, 24

**Day 5**

Elementary row operations; Gaussian elimination; properties of the inverse

Text: p. 29, pp. 35 – 41
Problems: # 23bcd, 25 – 29
Day 6  Rank of a matrix; systems of linear equations

Text: pp. 53 – 64, pp. 70 – 74
Problems: # 30 – 36

Day 7  Trace of a matrix; linear dependence and independence of vectors

Text: pp. 49 – 53
Problems: # 37 – 40

Day 8  The normal equations; the determinant of a matrix

Text: pp. 41 – 46, pp. 74 – 78
Problems: # 41 – 47

Day 9  Eigenvalues and eigenvectors; principal components

Text: pp. 79 – 94
Problems: # 48 – 50

Additional References


B. Calculus (nine lectures)

“F” stands for frame. Kleppner & Ramsey is divided into frames. “P” stands for problem. The problems are in the coursepack. “R” stands for review. The review exercises and answers to them are in Kleppner & Ramsey.

Day 1    Nonlinear functions; slope; average rate of change of a function

Text: F 1 – 39, F 116 - 129
Problems: P # 1 – 4, R # 1 – 3, 29, 32

Day 2    Limits; instantaneous rate of change of a function; the derivative; tangent line

Problems: P # 5, 6, 7, R # 21, 33

Day 3    Differentiation theorems; intervals of increase and decrease of a function

Text: F 180 – 208, F 160 – 169
Problems: P # 8 – 10

Day 4    Concavity; inflection points

Text: F 242 – 245
Problems: P # 11, R # 34 - 37

Day 5    Maxima and minima of functions; exponents and logarithms

Text: F 250 – 259, F 75 - 95
Problems: P # 12 – 15

Day 6    Differentiation of exponential and logarithmic functions

Text: F 222 – 240
Problems: P # 16 – 18, R # 16 – 20, 51, 64, 67

Day 7    Partial Derivatives

Text: Appendix B3
Problems: # 19 – 21

Day 8    Antidifferentiation; indefinite integrals

Text: F 300 – 301, F 303 - 306
Problems: P # 22
Day 9
Definite integrals; Fundamental Theorem of Calculus, the Gini Index

Problems: P # 23 – 26, R # 79, 86

Optional
Limited time does not permit a discussion of the trigonometric functions. However, during the last week we will have some “lunch meetings” for those interested in this topic.

Text: F 40 – 74, F 209 – 221, F 302, F 346 – 348
Problems: R # 8, 10, 40, 41, 45, 54, 66, 74, 83

Additional References


