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. Examples will be chosen to illustrate the application of these concepts in the social sciences. The lectures assume some familiarity with the topics in the ICPSR course “Mathematics for Social Scientists I.” Problem sets will be made available and the problems will 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)

**June 23**

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

Text: pp. 7 – 13
Problems: # 1 - 6

**June 24**

Vectors; the inner product; matrix multiplication

Text: pp. 13 – 23
Problems: # 7 - 12

**June 25**

Theorems concerning the basic matrix operations; the transpose

Text: pp. 23 – 27
Problems: # 13 - 20

**June 26**

Inverse of a matrix; the covariance matrix

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

**June 29**

Elementary row operations; Gaussian elimination; properties of the inverse

Text: p. 29, pp. 35 – 41
Problems: # 23bcd, 25 – 29
June 30  Rank of a matrix; systems of linear equations

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

July 1  Trace of a matrix; linear dependence and independence of vectors

Text: pp. 49 – 53
Problems: # 37 – 40

July 2  The normal equations; the determinant of a matrix

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

July 6  Eigenvalues and eigenvectors; principal components

Text: pp. 79 – 94
Problems: # 48 – 50

Additional References


B. Calculus (nine lectures)

July 7  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

July 8  Limits; instantaneous rate of change of a function; the derivative; tangent line

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

July 9  Differentiation theorems; intervals of increase and decrease of a function

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

July 10  Concavity; inflection points

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

July 13  Maxima and minima of functions; exponents and logarithms

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

July 14  Differentiation of exponential and logarithmic functions

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

July 15  Partial Derivatives

Text: Appendix B3
Problems: # 19 – 21

July 16  Antidifferentiation; indefinite integrals

Text: F 300 – 301, F 303 - 306
Problems: P # 22
July 18

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


