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

Text: pp. 7 – 13
Problems: # 1 - 6

June 23  Vectors; the inner product; matrix multiplication

Text: pp. 13 – 23
Problems: # 7 - 12

June 24  Theorems concerning the basic matrix operations; the transpose

Text: pp. 23 – 27
Problems: # 13 - 20

June 25  Inverse of a matrix; the covariance matrix

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

June 28  Elementary row operations; Gaussian elimination; properties of the inverse

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

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

June 30  Trace of a matrix; linear dependence and independence of vectors

Text: pp. 49 – 53
Problems: # 37 – 40

July 1  The normal equations; the determinant of a matrix

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

July 2  Eigenvalues and eigenvectors; principal components

Text: pp. 79 – 94
Problems: # 48 – 50

Additional References

J. Gill. Essential Mathematics for Political and Social Research, Cambridge University Press, 2006


B. Calculus (nine lectures)

July 6     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 7     Limits; instantaneous rate of change of a function; the derivative; tangent line

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

July 8     Differentiation theorems; intervals of increase and decrease of a function

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

July 9     Concavity; inflection points

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

July 12    Maxima and minima of functions; exponents and logarithms

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

July 13    Differentiation of exponential and logarithmic functions

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

July 14    Partial Derivatives

Text: Appendix B3
Problems: # 19 – 21

July 15    Antidifferentiation; indefinite integrals

Text: F 300 – 301, F 303 - 306
Problems: P # 22
July 16  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


