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

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


**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.

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<th>Topic</th>
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<td>Nonlinear functions; slope; average rate of change of a function</td>
<td>F 1 – 39, F 116 - 129</td>
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<td>Limits; instantaneous rate of change of a function; the derivative; tangent line</td>
<td>F 99 – 104, F 130 – 159, F 170 – 179</td>
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<td>Differentiation theorems; intervals of increase and decrease of a function</td>
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<td>Antidifferentiation; indefinite integrals</td>
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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


