

## Quantitative Courses of Interest to Psychologists

This document lists quantitative courses that are taught in the UW Psychology Department, and quantitative courses on special topics that are often of interest to psychologists whether or not they are in the Psychology Department. These topics include:

- Cognitive and Neuroscience Modeling
- Computational Software
- Linear Algebra
- Linear Systems Theory
- Miscellaneous Statistical Topics
- Multivariate Statistics
- Multilevel Modeling (MLM) and Hierarchical Linear Modeling (HLM)
- Psychometrics and Test Theory
- Stochastic Models
- Structural Equation Modeling (SEM)
- Survey Research

Courses that are very advanced mathematically have been omitted even if they are relevant in content. If you have revisions or additions to suggest for this document (including the creation of new topics), please send these suggestions to John Miyamoto ([jmiyamot@u.washington.edu](mailto:jmiyamot@u.washington.edu)).

<b>Abbreviation</b>	<b>Department</b>
AMATH	Applied Mathematics
BIOST	Biostatistics
CSE	Computer Science
CS&SS	Center for Statistics & Social Science
EdPsy	Educational Psychology (College of Education)
Math	Mathematics
MEBI	Medical Education and Biomedical Informatics
NEUBEH	Neurobiology & Behavior (Interdisciplinary Graduate Programs )
PBio	Physiology & Biophysics (School of Medicine)
Psych	Psychology
QMeth	Quantitative Methods (School of Business Administration)
QSci	Quantitative Science (Fisheries and Forest Resources). To access from the UW website, go to <a href="http://www.washington.edu/students/crscat/">http://www.washington.edu/students/crscat/</a> and then search for "Q Sci".
STAT	Statistics

### 1. Graduate Level Quantitative Courses in the UW Psychology Department<sup>1</sup>

- PSYCH 526. Multivariate Statistics<sup>2</sup>
- PSYCH 527. Mathematical Modeling for Psychology and the Neurosciences<sup>2</sup>

<sup>1</sup> This list does not include the required introductory graduate statistics courses, Psychology 522, 523, 524, and 525.

<sup>2</sup> This course is currently mothballed for lack of an instructor.

## Continuation of 1. Graduate Level Quantitative Courses in the UW Psychology Department<sup>1</sup>

- Psych 528. Practical Methods for Behavioral Research. Methodological, practical, and communication problems in behavioral research: Selecting research problems, use of theory, types of validity, common sense about statistics, when to replicate, dealing with unpredicted results, strategies for presentation and publication.
- Psych 529. Advanced Research Methods. Surveys topics relevant to clinical research, including structural equation modeling, hierarchical linear modeling, growth curve modeling, and taxometric analyses.
- Psych 530. Introduction to Latent Variables. Discussion of measurement error, confirmatory structural equation models, and causation and association.
- Psych 531. Research Methods in Clinical and Community Psychology.
- Psych 532. Single Subject Design and Research. Design and implementation of research in clinical and community psychology. Topics include validity; reliability; experimental, quasi-, and non-experimental designs; causal inference; interpretation of data; and research ethics.
- Psych 548. Advances in Quantitative Psychology. Psychology faculty uses this number to teach quantitative courses that do not yet have a separate number. Listed below are courses that have been taught under this number in recent years. Check with the instructor whether and when they plan to teach the topic again.
  - \* Flaherty: Confirmatory factor analysis and SEM
  - \* Miyamoto: Intro to linear mixed effects models

## 2. Cognitive and Neuroscience Modeling (see also linear systems theory).

- Psych 527 Mathematical Modeling for Psychology and the Neurosciences<sup>2</sup>
- PBio 545. Quantitative methods in neuroscience (Rieke, Fairhall, Shadlen)
- CSE 415, 473, 573, 574, 592. Artificial intelligence.
- CSE 455. Computer vision.
- CSE 472. Introduction to computational linguistics.
- CSE 500. Computers and society.
- NEUBEH 528/CSE 528. Computational neuroscience (Rao, Fairhall).

## 3. Computational Software

- Matlab for the Behavioral Sciences: How to program your own experiment. This course is taught by Ione Fine and Geoffrey Boynton under the Psych 448 number which is a generic number used by multiple instructors for different topics.
- Psych 522/523. Emphasis on SPSS in psychological research.
- AMATH 301. Emphasis is on MatLab modeling.
- CS&SS 508. Introduction to R for Social Scientists.
- BIOST 534/535 (STAT 534/535). Statistical computing with C<sup>++</sup>.

## 4. Linear Algebra

- Math 308 (Matrix Algebra with Applications) or Math 318 (Linear Algebra). As one might surmise from the course catalog, Math 308 emphasizes concrete manipulation of matrices whereas Math 318 is more of an abstract algebraic introduction to linear algebra. Deciding which course is better for a particular student depends on the background and mentality of the individual student.
- CS&SS 505 (Review of Mathematics for Social Scientists). Includes a review of linear algebra. This course would be especially appropriate for clinical or social/personality students who do not expect to need a thorough background in linear algebra.
- AMATH 352 (Applied Linear Algebra and Numerical Analysis). This course emphasizes algorithms for linear algebraic computations with MatLab.

## 5. Linear Systems Theory

- PBio 545 (Quantitative Methods in Neuroscience). Discusses quantitative methods applicable to the study of the nervous system. May include linear systems theory, Fourier analysis, ordinary differential equations, stochastic processes, signal detection and information theory.
- QSci 392/393 (Techniques of Applied Mathematics in Biology I & II). Emphasizes applications of linear and nonlinear differential equations to biological processes.
- Math 309 (Linear Analysis). Introduction to linear differential equations, Fourier series and partial differential equations, the phase plane and/or Laplace transforms.
- Math 435, 436. Introduction to dynamical systems.
- AMATH 351. Introduction to differential equations .
- AMATH 353. Fourier analysis and partial differential equations.
- AMATH 383 (Introduction to Continuous Mathematical Modeling). Emphasis on modeling of physical and biological problems in terms of differential equations.

## 6. Miscellaneous Topics in Statistics and Computation

- Bayesian Statistics: CS&SS 564 (Bayesian Statistics for the Social Sciences)
- Bootstrapping: STAT 403 (Introduction to resampling inference)
- Categorical Data Analysis: CS&SS 536 (Log-Linear Modeling and Logistic Regression for the Social Sciences) (also listed as Stat 536); STAT 427 (Introduction to analysis of categorical data)
- Clinical Trials: BIOST 524 (Design of medical studies)
- Meta-Analysis: MEBI 541 (Introduction to Systematic Reviews and Meta-analysis of Evidence)
- Nonparametric stats: STAT 425 (Introduction to nonparametric statistics)
- Practical Methods for Behavioral Research: Psych 528 (described in Topic 1)
- Social Networks: CS&SS 567 (Social Networks)
- Survival Analysis: BIOST 513 (Medical biometry) and BIOST 537 (Survival data analysis in epidemiology).

## 7. Multilevel Modeling and Hierarchical Linear Modeling (MLM and HLM)

- EDPSY 576. Hierarchical Linear Models (Abbott)
- CS&SS 560. Hierarchical Modeling for the Social Sciences
- John Miyamoto has taught a MLM course under the Psych 548 number.

## 8. Multivariate Statistics<sup>3</sup>

- Psych 526 Multivariate statistics<sup>2</sup>
- Psych 529 Advanced Research Methods
- Psych 530 Introduction to latent variables.
- Ed Psych 594. Advanced correlational techniques.
- CS&SS 589. Multivariate Data Analysis for the Social Sciences. Topics include principal components, cluster, factor, latent class analysis.
- CS&SS 594. Maximum Likelihood Methods for the Social Sciences.
- Biostat 574. Multivariate stats.

## 9. Psychometrics and Test Theory

- EdPsy 495. Introduction to educational measurement
- EdPsy 513. Instrument development

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<sup>3</sup> The linear algebra courses (Topic 4) are useful as background to multivariate statistics. The courses in linear systems theory (Topic 5) are useful in a similar way, although not quite so directly relevant.

- EdPsy 595. Item response theory and psychological tests.
- EdPsy 597. Technical requirements of large scale tests

#### 10. **Stochastic Models**

- AMATH 423. Introduction to the basics of stochastic models.
- Math 394, 395, 396. Probability theory. (Also listed as Stat 394/395/396).
- Math 491, 492. Introduction to stochastic processes.
- QMeth 592. Focuses on development and application of queuing theory and discrete event simulation.

#### 11. **Structural Equation Modeling (SEM)**

- CS&SS 526. Introduction to SEM
- CS&SS 566. Introduction to causal modeling.
- EdPsy 575. Introduction to SEM

#### 12. **Survey Research**

- CS&SS 529. Sample survey techniques (presumably with emphasis on social science studies of human populations).
- EdPsy 588. Survey research methodology and theory.
- BioStats (BIOST 529). Sample survey techniques (presumably with emphasis on biomedical applications).
- Business Administration (Q METH 528). Introduction to design and implementation of sample surveys with emphasis on business applications.