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# FSAN/ELEG815

## Analytics I: Statistical Learning

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Fall 2018  
Tuesdays and Thursdays 2:00-3:15pm

GOR308

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### Course Description

Introduction to the mathematics of data science. Theory that establishes the conceptual framework for learning is included, and so are heuristics that influence the performance of real learning systems. Maximum Likelihood, Bayes estimation, linear regression and classification methods. The Singular Value Decomposition and the Principal Component Analysis. Statistical models for inference and prediction in finance, marketing, and engineering applications. Overfitting, regularization methods and principles of sparsity priors are applied.

### Topics

1. Review of Probability
2. Stationary processes
3. Eigen Analysis, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA)
4. The Learning Problem
5. Training vs Testing
6. The Wiener Filter
7. Adaptive Optimization: Steepest descent and the LMS algorithm
8. Least Squares (LS) Algorithm
9. Overfitting
10. Regularization: Ridge and Lasso regression models.
11. Neural Networks
12. Matrix Completion

### Requirements

Prerequisites: First course in linear algebra. First course in probability and statistics (ELEG310 or equivalent). Basic programming skills

### Suggested Textbooks and Reading Material

1. Textbook 1: Adaptive Filter Theory, S. Haykin, 4<sup>th</sup> Edition, Pearson 2013.
2. Textbook 2: Learning from Data, Yaser S. Abu-Mostafa, Malik Magdon-Ismael and Hsuan-Tien Lin, AMLbook 2012.

### Lecture slides available in

<https://www.eecis.udel.edu/~arce/courses/statisticallearning/>

### Evaluation

Homework and computer assignments (15%)

Midterm 1 (25%)

Midterm 2 (25%)

Final Exam (35%)