**Active Portfolio Management**

**Instructors:** Prof. Jerome Benveniste (PhD, Mathematics, Chicago)
 Prof. Gordon Ritter (PhD, Physics, Harvard)

**Course Description:** The course will develop a general quantitative approach to modern portfolio theory, optimization, trading, and the use of machine learning in making predictions as relevant to the above topics. We begin by discussing utility functions, and the theory of rational decision making under uncertainty. Expected utility maximization is shown to give rise to mean-variance optimization under certain assumptions. We then discuss multi-period optimization in the presence of trading costs, and market impact models. We then devote several lectures to prediction of the major terms in the utility function: return, risk, and trading costs. In the process, we will develop a rigorous approach to prediction problems in general and explore the deep connection between prediction and machine learning. All of the above topics will eventually be understood in the unifying framework of Markov decision processes and multi-period stochastic control problems. In each case, the focus will be on using statistical learning to achieve a deeper understanding of the model and the data. Where appropriate, we will apply the relevant statistical models to real financial data.

**Main Text:** The instructor’s notes, distributed in class and online, will be the main reference material for the course. Certain parts of the course may follow particular sections from the recommended texts below, and this will be indicated where appropriate.

**Recommended Texts:**

1. Grinold, Richard, and Ronald N. Kahn. Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Selecting Superior Money Managers. Irwin/McGraw-Hill, 1999.
2. Gregory Connor, Lisa R. Goldberg, and Robert A. Korajczyk. Portfolio Risk Analysis. Princeton University Press, 2010.
3. Stephen Boyd and Lieven Vandenberghe. Convex Optimization. Cambridge University Press (available online)
4. Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. *The elements of statistical learning*. Vol. 1. New York: Springer series in statistics, 2001.

**Homework:** All homework assignments are due in two weeks unless otherwise announced. All homework will be collected and graded via the NYU Classes website. The homework will typically be a mix of theory and application, with some coding required in either R or Java.

**Final grade:** Homework assignments, 50%; Midterm Exam, 15% (in class); Final Exam, 35%.

**Prerequisites:** Linear algebra and multivariable calculus. Statistics at the level of a standard undergraduate sequence including multivariate statistics. Familiarity with financial markets and trading. Some basic coding experience in either Python, R, Java, or C++.