

## Risk and Portfolio Management 2013

### Final Assignment

1. Why are Gaussian distributions inappropriate for modeling financial data? What is the meaning of the phrase "Stock returns have fat-tailed distributions"? Can you quantify this statement and give examples?
2. Define the notion of persistence in the context of time-series. Describe a financial time-series which exhibits persistence.
3. What is the Marchenko-Pastur distribution in Random Matrix Theory? Describe how certain features of the MP distribution can be used to analyze the cross-sectional correlations of returns?
4. How many risk-factors are needed to model the deformations of the US Treasury yield curve?
5. Give an approximate range for the number of eigenportfolios (mathematical risk factors) which are needed to describe the joint distribution of the components of the S&P 500 Index. Is there a connection between the number of significant factors and the volatility levels in the stock market? (As described by VIX, for example).
6. Describe the eigenportfolio corresponding to the largest eigenvalue of the correlation matrix (principal eigenportfolio). Is there any relation between this first eigenportfolio and a capitalization-weighted index?
7. How many significant factors (from a PCA perspective) are needed to model the Brazilian stock market? Interpret this result in view of the main industry sectors of companies listed in the Bovespa.
8. Define liquidity of a financial asset.
9. What is the Almgren-Chriss liquidation model (for equity portfolios)?
10. Describe how, according to the Almgren-Chriss model, one could use S&P futures to improve the execution of a large portfolio transaction (block trade) involving the components of the S&P 500. (Hint: use the AC model with two "stocks": one very liquid (futures) and less liquid (the portfolio, and with appropriate initial conditions).
11. What is "statistical arbitrage"? Describe the strategy in the context of a large universe of securities. Can you give an idea of the returns of stat arb from a historical perspective? (Hint: see Khandani and Lo (2007), Avellaneda-Lee (2008)).