CHAPTER TWENTY
Trading in Risk Dimensions

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Reading Questions

- Why do we have to consider probability distributions of data that are not simple Gaussian (bell-shaped) curves?
- Why do we use copulas when combining marginal distributions into a joint portfolio distribution?
- When would you use a global sampling algorithm like ASA for optimization, instead of using a simple Newton algorithm or exhaustive fit (calculating all possible values of parameters)?
- Why is it necessary to consider correlations among markets in a given portfolio?
- In a couple of sentences, describe Value at Risk (VaR). How useful is VaR in times of extreme stress like the deep recession at the end of the first decade in the 21st century?
- After sampling a portfolio's contract sizes for possible upcoming trades, why do we get many possibilities? (Hint: consider a portfolio of 10 stocks and each stock's price may go up, down or stay the same the next epoch – count all these possibilities.)
- What are some considerations when optimizing a portfolio to have post-processing of sets of contracts after sampling contract sizes?
- What are some advantages of using the "modified" Sharpe ratio (MSR) for defining a cost function with trading-rule parameters to be fit by optimization?
- Why is it sometimes important to define trading rules to be "adaptive," i.e., to be modified in real time?
- Explain the importance of separating data sets into in-sample and out-of-sample sub-sets, when training and testing trading rules.

Non-Gaussian Markets

- Most markets exhibit non-Gaussian distributions
- Correlations among markets in a portfolio must be estimated for risk-management

Tale of Tails

- Some times some markets have tails thinner than Gaussians
- Many times most markets have tails fatter than Gaussians
- Fat-tailed distributions imply higher risk is concentrated in the “outlier” tails

Copulas

- Estimate correlations among non-Gaussian markets
- Transform marginals to Gaussians
- Define portfolio distribution of all markets in their Gaussian-transformed spaces
- This induces the copula
- Correlations can be reasonably calculated in this copula space

Portfolio Distributions

- Details of trading often must be added to define a portfolio, e.g., dependent on trading rules being used
- Value at Risk (VaR) may not make sense for stressed “outlier” markets, although this is one variable that should be considered

Trading Systems

- Trading systems can be simple or complex
- Complex trading systems often include more market information than just price
- Complex trading systems may be adaptive in real time
- Training trading systems should include all features to be used in Testing as well as in actual real time trading

Distributions as Cost Functions

- Probability distributions make very good cost (or objective) functions to fit data
- Distributions may contain trading-rule and portfolio parameters to be fit to data
- Maximizing the distribution is equivalent to fitting most-likely paths of markets
- Most-likely paths may not be future paths

Portfolio Sampling

- Risk management of a portfolio often tests results of trading in a future epoch, by sampling a large number of possible random paths
- Such sampling takes place in a huge space of possible combinations of contracts
- Optimization finds the best sets of samples in this huge space

Beware Greeks Bearing Gifts

- Mathematical models are only as good – at best – as the data supporting them
- It may not make sense applying models based on historical data to current time
- It is important to stress-test models using random data generated in large windows around historical data