Risk Modeling: Lecture outline and projects

(updated Mar5-2012)
Lecture 1 outline

● Intro to risk measures economic and regulatory capital
● what risk measurement is done and how is it used
● concept and role of economic capital
● applications for decision making and capital allocation
● overview of regulatory framework for trading assets & contrast with a unified model
● theoretical and computational challenges
Lecture 2 outline

- Value at Risk models
- standard approaches
  - historical simulation
  - parametrized distributions and simulation
  - GARCH effects
- Stressed VaR
- theoretical and computational challenges, validation
Lecture 3 outline

- Portfolio credit risk models
- Loan portfolios
- Traditional view of counterparty exposure
- Default and repricing models
  - IRC
  - CRM
- Theoretical and computational challenges, validation
Lecture 4/5 outline

- Counterparty exposure measurement and pricing
- Simulating counterparty risk
  - netting sets
  - collateral treatment
  - relatedness (wrongway)
  - conditional vs explicit treatment of default
- Counterparty exposure within the Basel II framework
- CVA calculation
- CVA business model
- DVA, conceptual basis, bilateral CVA
- Basel III and CVA
Project 1: credit market risk

- Measure Value at Risk for a portfolio including bonds and credit default swaps
- Collect data (Bloomberg) on ~100 traded credits with both bond and CDS prices
- Develop an empirical volatility model and correlation model based on data
- Compare historical simulation and parameterized simulation approaches to VAR
- Compare different approaches to treating the basis risk between bonds and CDS
- Compare Expected Tail Loss vs quantile estimators for 95% and 99% 1-day VAR
- Backtest model with a fixed portfolio
Project 2: approaches to VaR

- Compare approaches to computing Value at Risk for a portfolio consisting of equities: single name stock plus call options.
- Collect data from Bloomberg on 50-100 equities
- Construct portfolio consisting of stock options + equity delta hedge
- Develop historical simulation and parameterized monte carlo simulation VAR calculations
- Consider issues of 1-day vs 10-day VAR measurement
  - autocorrelation of returns
  - Choice of drift
  - full revaluation vs delta-approximation for options
Project 3: Stressed VAR

- Consider VAR for major market indices and issues of regime shift
- Select 10 major market indices with long (>5yr) liquid time series. Should cover equities, credit, fixed income and commodities
- Develop historical simulation and a garch model of your choice
- Compare VAR results and backtest your model through the two year period from Jan 2008 - Dec 2009.
  - Compare different decay and garch parameters
- Develop approach to "Stressed VAR" consistent with the regulatory guidelines
- Compare Stressed VAR predictive performance and level/stability through the crisis period
Project 4: IRC/CRM

- Compute long-term risk measures for portfolios consisting of credit assets
- Select a portfolio consisting of bonds and CDS and more ambitiously Credit tranches.
- Develop a simulation model with a 6-month risk horizon able to compute the loss-distribution including effects of spread movement and default/recovery
- Compare the results obtained using historical vs market implied default frequencies
- Include the impact of an index delta hedge (rebalanced periodically if using a multiperiod simulation)
- Explore the sensitivity to intra-portfolio default correlation and spread correlation
- Examine the effect of decorrelation between the drivers of credit spread and default
Project 5: Counterparty risk

- Compute counterparty exposure for a small portfolio consisting of 10-20 derivative trades sensitive to 5-10 underlying assets
- Construct portfolio of derivatives with associated pricing models: can include simple options, swaps, forwards, and/or more complicated (e.g., path dependent or basket) options
- Develop simulation approach for underlying assets with weekly timesteps out to maturity of portfolio.
- Calibrate simulation to historical and implied data
- Compute exposure profile measures: expected and peak (95% quantile)
- Examine impact of netting inside the portfolio
- Examine impact of collateral agreements
- Compute CVA from exposure profiles and compute its sensitivity to counterparty credit spreads as well as the current levels of the relevant market factors.