Scribed Notes Jaan Bains

Monte Carlo Risk/Return

1) Compare risk/return properties
2) Compute VaR (Value @Risk) of portfolio
3) Incorporating future sources of uncertainty into regression-based models

Key Idea in Monte Carlo Simulation

- Suppose you have random variables; x1,x2,x3,…xd representing returns on various assets
- You rarely have classes of assets that are totally uncorrelated
- Stocks and Bonds have negative correlation with risky assets
- With joint dist: p(x1,x2….xd)
- Of interest let f(x1…xd) example utility
- We want E(f(x1…xd) under the joint dist p (x1,….xd)

Strategy

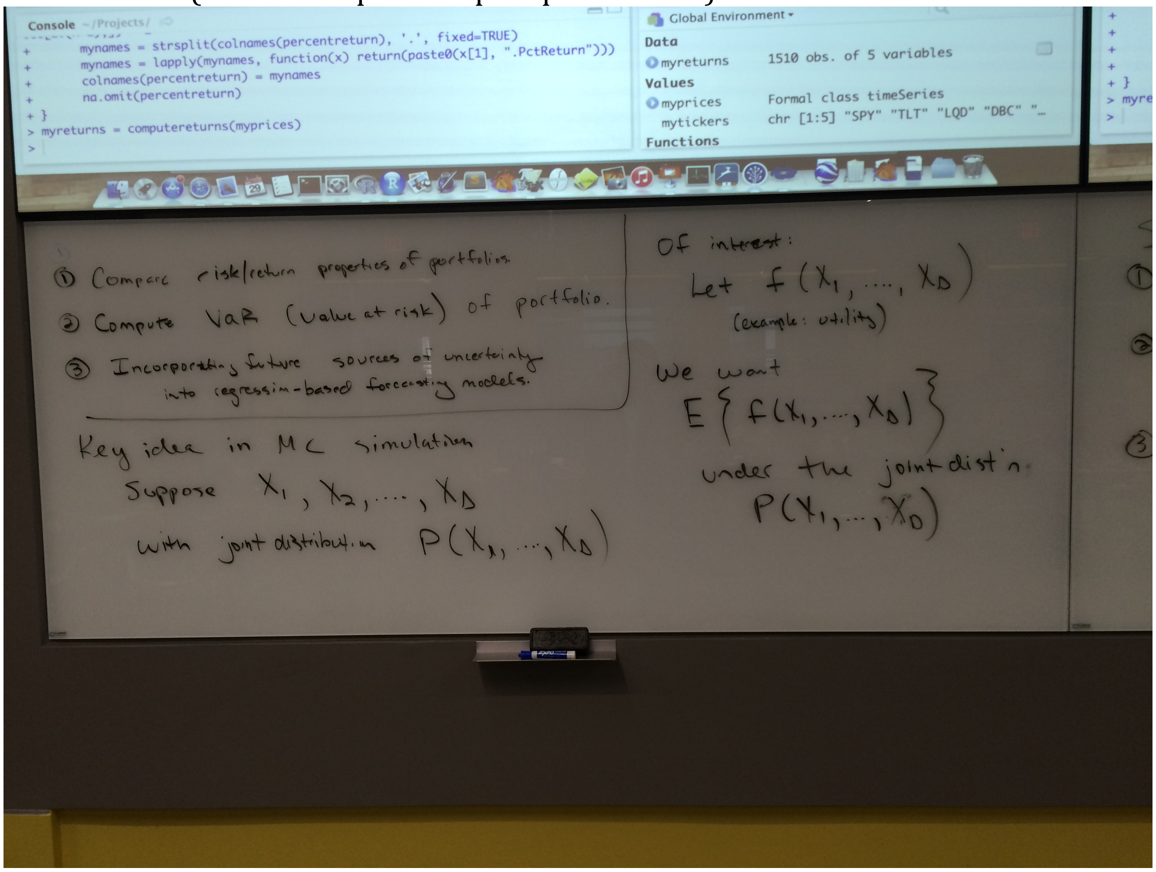
1) Repeatedly sample vector xi = (x1,x2….xd) n times when n is large
2) For each sample, evaluate the function
    a. F(x(i))= f(x1(i), x2(i)….xd(i))
3) Average the function evaluations
    a. E(f(x1….xd)) = 1/n Summation f(x1(i),x2(i)….xd(i))
    b. Says that pop. Mean is pretty close to the sample mean
    c. So what's the hard part?
        i. Taking repeated samples
        ii. We cant take 10,000 real days, so we settle for an approximation by using the past and bootstrapping it
        iii. All of the past data is a draw from the joint dist., so we say this is a sample of the pop., and then sample from it

Value at risk (VaR)

The VaR of some portfolio at level alpha (b/t 0+1) for time horizon T is defined as follows:

Let Xo is the known value of portfolio at beginning of horizon
Let X is (unknown/random) value of portfolio @ end of horizon

Let Y = x – xo (The VaR of part is alpha quantile of Y)



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eturns = computereturns(myprices)
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Values

myprices Formal class timeSeries

mytickers chr [1:5] "SPY" "TLT" "LQD" "DBC" "…

Functions

Strategy

① Repeatedly sample $\vec{X}^{(i)} = \left(X_1^{(i)}, X_2^{(i)}, \dots, X_D^{(i)} \right)$, N times where N is large.

② For each sample, evaluate the function:

$$f\left(\vec{X}^{(i)}\right) = f\left(X_1^{(i)}, X_2^{(i)}, \dots, X_D^{(i)} \right)$$

③ Average the function evaluations

$$E\left\{ f(X_1, \dots, X_D) \right\} \approx \frac{1}{N} \sum_{i=1}^{N} f\left(X_1^{(i)}, X_2^{(i)}, \dots, X_D^{(i)} \right)$$