RISK CONTROL

Fall 2002

Current risk management practices:

(1). VAR

(2). Stress testing

(3). Scenario testing

Value at Risk

Value at risk is a statement of possible loss.

Example of statement:

5% chance of losing at least $10 million in a week.

Example of calculation. Recall normal distribution:

Calculation

If we knew $\overline{R}$ and σ for weekly returns and assumed normal distribution.

$$\overline{R} - 1.65\sigma = \text{beginning of } 5\% \text{ return area}$$

Low return times amount is value at risk.

Using specific numbers:

(1). Assume have $100 million.

(2). $\overline{R}$ **per week is .3%.**

(3). σ **per week is 2%.**

.3 - 1.65 x 2 = -3%

-3 x 100 million is 3,000,000. This is value at risk.

Note that 5% of the time we expect this amount <u>or more</u> to be lost.

Issue is how to estimate $\overline{R}$ and σ.

<u>Three Standard Techniques</u>:

(1) Procedures we have learned plus assume normal distribution.

(2) Straight historical.

(3) Monte Carlo simulation.

Solution 1:

- **Use techniques we have learned.**

- **Assume normal distribution.**

How Expressions Change With Time.

Basic principle is central limit theorem: sum of independent normals is normal.

(1). Mean is sum of means.

(2). Variance is sum of variances.

Therefore distribution in a week is:

(1). $$\overline{R}_P = 5\overline{R}_{daily}$$

(2). $$\sigma_P^2 = 5\sigma 2_{daily}$$

(3). $$\sigma_P = \sqrt{5}\sigma_{daily}$$

Advantages:

(1). Powerful framework

(2). Accuracy

Disadvantage:

(1). Normal

Solution 2:

Straight Historical:

(1). Example use last 250 days returns.

(2). Assume history repeats.

(3). Calculate 5 percent point.
e.g. if var over week the 3 largest weekly losses (e.g., 50 weeks times .5 = 2.5 and round up)

If one does not assume normal one, usually uses Monte Carlo simulator.

Solution 3:

Monte Carlo Simulation

(1). Straight historical

Historical Return Series

Jan 80…….Jan 99

Stocks

Gov Bonds

Corp Bonds

Simulate returns by drawing from above series with independence.

(2). Structured historical

Assume multi-index distribution of $I's$ **and** e_{it}

$$R_{it} = \alpha_i + \beta_{i1} I_1 + \beta_{i2} I_2 + e_{it}$$

Simulate by drawing I's and assuming this structure.

Advantages:

(1). Allows non-normal return structure.

(2). With structure takes advantage of what we know.

Stress testing.

Assume extreme and see performance.

Scenario testing.

Assume some specific scenarios and check performance.