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 $\bar{R}$ and $\sigma$ for weekly returns and assumed normal distribution.

\[
\bar{R} - 1.65\sigma = \text{beginning of 5\% return area}
\]

Low return times amount is value at risk.
Using specific numbers:

(1). Assume have $100 million.

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

(3). $\sigma$ per week is 2%.

\[ .3 - 1.65 \times 2 = -3\% \]

-3 \times 100 \text{ million} is 3,000,000. This is value at risk.

Note that 5% of the time we expect this amount or more to be lost.
Issue is how to estimate $\overline{R}$ and $\sigma$.

Three Standard Techniques:

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). \[ \bar{R}_{P} = 5\bar{R}_{\text{daily}} \]

(2). \[ \sigma^2_{P} = 5\sigma^2_{\text{daily}} \]

(3). \[ \sigma_{P} = \sqrt{5}\sigma_{\text{daily}} \]
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

\[ R_{it} = \alpha_i + \beta_{il} I_{il} + \beta_{i2} I_{i2} + e_{it} \]

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.