

# Calculating VaR

Capital Market Risk Advisors



# How is VAR Calculated?

- ◆ **Sensitivity Estimate Models** - use sensitivity factors such as duration to estimate the change in value of the portfolio to changes in market rates and prices.
- ◆ **Full Revaluation Models** - use pricing algorithms such as bond formulae or option pricing models to estimate the change in value of the portfolio to changes in market rates and prices.

# VAR for One Asset Sensitivity Approach

Product	Position Size	Sensitivity	95% Daily Volatility	1 Day VAR
UST 10 Year Note 5.5%	\$10MM	\$7,600/bp	10 basis points	\$76,000

# VAR for One Asset Revaluation Approach

Product	Position Size	Current Price	New Price	1 Day VAR
UST 10 Year Note 5.5%	\$10MM	100 (YTM = 5.5%)	99.305 (YTM = 5.6%)	\$75,766



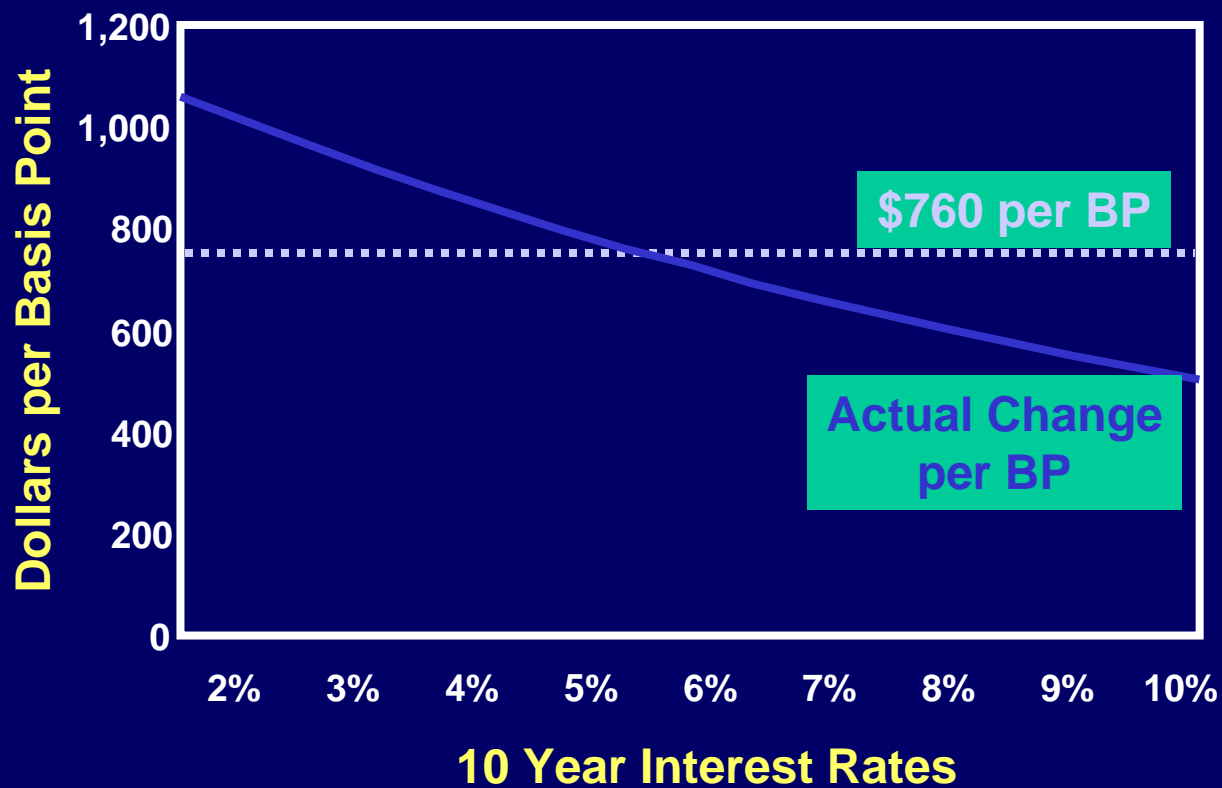
Requires Pricing  
Model

# Why is the VAR Different?

- ◆ The Sensitivity VAR assumed that the bond's value would change by \$7,000/basis point.
- ◆ But, as interest rates decrease, bond price become **more** sensitive to changes in interest rates.
- ◆ The change in sensitivity at different interest rate levels is commonly referred to as convexity.
- ◆ Virtually all fixed income securities and all options exhibit convexity.
- ◆ The full revaluation approach properly accounts for convexity because it actually reprices the security.

# Convexity

Change in Value of a 10 Year Bond  
for a 1 Basis Point Change in Rates

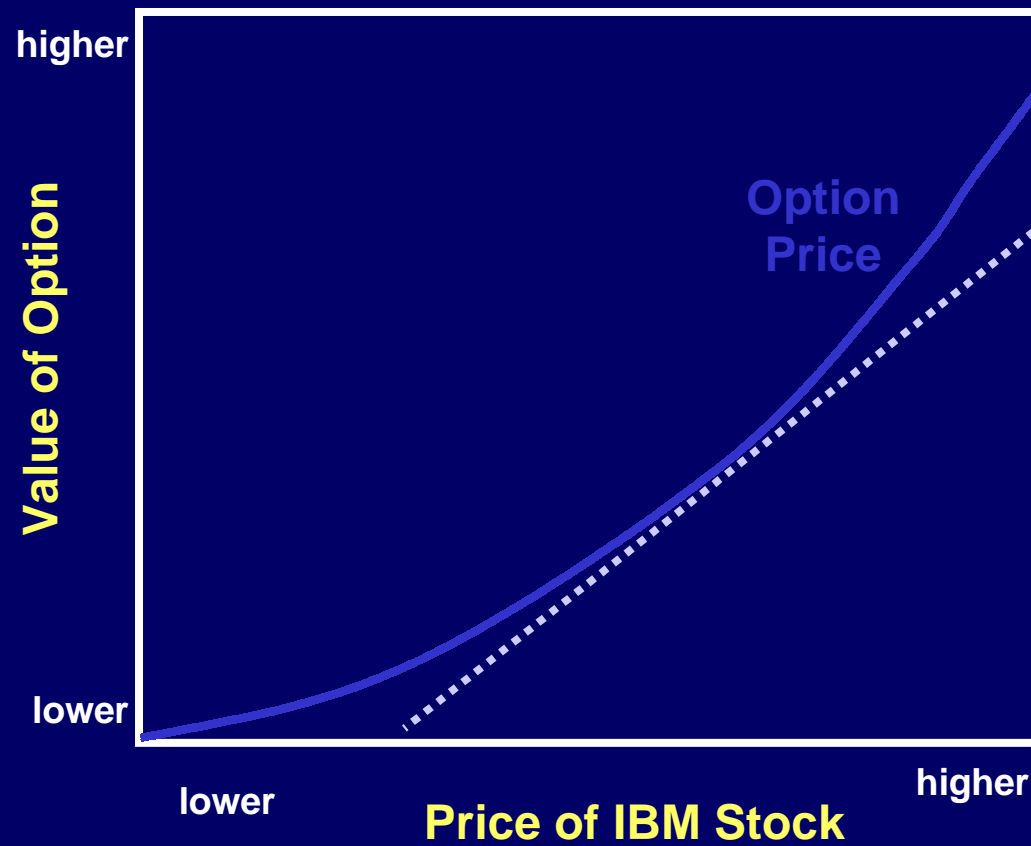


# Sensitivity vs. Revaluation

10 Year Rate	Sensitivity Estimated P&L	Revaluation (Actual) P&L	Difference	
8.0%	1,900,000	- \$1,698,493	\$201,507	12%
6.0%	380,500	- 371,864	8,636	2%
5.5%	0	0	na	na
5.0%	380,500	389,684	9,184	2%
3.0%	1,900,000	2,145,584	245,584	11%

# Gamma

Option Price for a Change in Underlying Stock Price



# VAR

## Sensitivity vs. Revaluation

### Sensitivity Models

- ◆ Fast
- ◆ Don't require model library
- ◆ Easy to understand
- ◆ Implement in less time
- ◆ Less maintenance (no models)
- ◆ Accept portfolio level data

### Revaluation Models

- ◆ Produce more accurate P&L results
- ◆ Are price-based
- ◆ Can handle complex products
- ◆ Do not rely on estimates
- ◆ Accept trade level data

# VAR Inputs

- ◆ Position Size - The size of the instruments contained in the portfolio.
- ◆ Price/Yield Volatility - The magnitude of the underlying prices and yields changes.
- ◆ Price/Yield Correlation - Degree to which price and yield changes move together.
- ◆ VAR Estimation Period - The time over which P/L is estimated.
- ◆ Confidence Level - The frequency which actual losses

# Volatility

- ◆ Volatility information is a measure of how much prices and interest rates can be expected to change over time.
- ◆ Standard Deviation ( $\sigma$ )
- ◆ Historic Time Series of Prices and Yields ( $P_t$ )

# Correlation

- ◆ Correlation is a measure of how much two assets price changes move together.
- ◆ Correlation of 1 --> asset prices change together perfectly
- ◆ Correlation of 0 --> asset price changes appear independent
- ◆ Correlation of -1 --> asset prices move in exact opposite direction

# VAR Estimation Period

- ◆ The VAR estimation period is the period of time over which changes in value are estimated.
- ◆ Daily
- ◆ Time between re-hedging or re-balancing of the portfolio
- ◆ Time necessary to unwind the portfolio
- ◆ Some longer period over which sufficient capital must be retained

# Confidence Interval

- ◆ The confidence interval indicates, on average, how often the actual P&L will be equal to or less than the VAR estimate.
- ◆ 99% suggests that one out of every 100 days, the actual P&L (loss only) will be greater than the VAR estimate

# VAR Parameters Technical Choices

- ◆ Calculations of Volatilities and Correlations
- ◆ Data filling
- ◆ Assumptions for scenario generator in Monte Carlo Simulation approach
- ◆ Alternative distributions
- ◆ Spline estimate for sensitivity based P&L
- ◆ Square root of t
- ◆ Consistency of valuation models between P&L and VAR models

# Common VAR Models

- ◆ **Variance Covariance** - Applies a single formula to estimates the change in value of a portfolio from the volatility and correlation inputs.
- ◆ **Historic Simulation** - Estimates the change in value of the portfolio for historic market price/rate changes.
- ◆ **Monte Carlo Simulation** - Generates market scenarios and estimates the change in value of the portfolio given each scenario.

# VAR Approaches

