MTH 9845 Risk Management

Lecture 1

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Prefer to reach by work email

HW Form: HW<<space>><<assignment name>>

1. Ken can review Resume and Cover letter
2. Don't send zip or rar file
3. Email HW question to his gmail AND work addresses (include the questions)
4. Label your axes
5. Read WSJ and Bloomberg
6. Interview Background reading (Job interview); Reference(recommendation); Cover letter review
7. Take accounting course (Know the bank business, not just quant world)
8. Net worth(NW) = equity=capital; A=asset = NW+morgage

NW /A = leverage A/NW= leverage ratio

Firm	EQ	Asset	Leverage Ratio
Leman08	22	641	318
	0.0318		
GS08	42	1120	26
	0.837		

GS15

87

861

10

0.10

9. Dodd Frank

10.Basel

11. Risk management is not risk avoidance

12. EITF 0203

13. Firm risk: Operation risk, credit risk, market risk, model validation, COO(chief operation office), model development

SR 11-7 very important for model validation

14. read financial paper (14 pages)

Lecture 2

Exploratory Data Analysis (EDA)

1. For HW code: not use hard-code

2. Always check your data before proceeding (plot, plot 2D figure)

3. PCA is important for interview: estimate PNL, hedge

4. Autocorrelation: 1 to (n-1) compare with 2 to n

5. Plot: Not too much lines in one figure

6. Dual axis plot: select 2nd data set in the figure and chose 'secondary axis'

7. index function is very useful for creating hundreds similar graphs

8. Skewness: symmetry; Kurtosis: fat tail

9. ALT+R(?): insert row

10. SHIFT+SPACE: select whole row

ASSIGNMENT: read the 3 chapters posted on the forum

11. use linear interpolation for missing data (1day): decreasing the volatility

Use the previous day's data: increase the volatility

If big data: Brownian bridge

If lots correlated data: run regression based fill

If not correlated data: MC simulation fill

Last method: Brownian bridge

HW: Linear regression in Excel and another one for two weeks

Lecture 3

Introduction to Bonds (fixed income securities)

1. treasury.gov
2. DV01= PVBP=PV01
3. data table : what-if analysis in excel
4. frequency() in excel count the frequency of an array in the given bin array

VaR methodology

1. Small() function in excel: Returns the k-th smallest value in a data set. Use this function to return values with a particular relative standing in a data set.
2. The normal distribution always under estimate the actual likelihood loss, market data has fat tails (curved)
3. price-based instruments:
4. yield-based instruments: Z99(2.33)*std*closing-yield(0.0432 not 4.32%)*100-> get the change of bsp then time PV01 to calculate val

- Position details:
  - Size: USD 100
  - Maturity: 10 Years
  - Vol: 0.01312
  - DV01: -.07923 (***per 100***)
  - 12/27/06 Close = 4.644%
- VaR = -.07923*0.04644*.01312*2.33*100
  = 1.12479

5. required reading: Garbade papers, First 3 chapters of the MS Fixed Income Book
6. portfolio variance = X^T(covariance matrix)X X: unit vector (position vector)

7. Surface plot: make sure the left corner is empty!!!

Lecture 4 - VaR

1. Univariate

99% CI: 2.33*sigma

2. Since the fat tail of real data (empirical), the loss of empirical is larger than the 2.33*stdev simulation

3. Gaussian copular: General more multivariate random numbers to match historical features (correlation)

4. Always graph your data to check whether there are extreme outlier (poor data) before any analysis

Cholesky: **required spd**;

Eigenvalue-Eigenvector decomposition: spsd $: \Sigma = E\Lambda E'$

Square root matrix: EA^1/2

Check you work: e.g., EE-decomposition

5. If some data missing (data points of all stocks should be equal, or will get negative covariance) EEdecomposition must have same equal number data points to get covariance

F9 in excel: calculate

6. Independent test:

1) get the correlation matrix: indirect function
2) compute the standard error of correlation (sqrt((1-rho^2)/(n-2))) and compute 2.33* standard error
3) plot heat map: conditional formatting: color scales, all correlation should be less than 2.33* standard error

7. T-test of simulated correlation to the original correlation

sqrt((1-corr^2)/(n-2)) close to the original correlation

where s_r represents the standard error the correlation coefficient:

$$s_r = \sqrt{\frac{1-r^2}{n-2}}$$

8. Rates tend to be lognormal

9. Bond price VS yield: short-period: tend to be linear line

10. Get several points from the grid and then use interpolation instead of all data points to avoid the time consuming of simulation and re-pricing P231 in ppt

11. MC simulation: flexible, much more flexibility

Lecture 5

Historical simulation

1. Simulated VaR vs Empirical VaR

cross point: around 90% percentile 90% VaR

2. Choice of time period

3. Back filling data: regression

4. Exponential Weighting:

reference: riskmetrics exponential smoother http://www.investopedia.com/articles/07/ewma.asp

Exponential Weighting

- weights more recent observations more heavily, declines exponentially
- need to estimate ω (weighting factor)
- equation for covariance usually of form:

$$\sum_{i=1}^{n} \frac{\omega^i (x_i - \bar{x})(y_i - \bar{y})}{\sum \omega^i}$$

VaR Backtesting

yesterday VaR vs today profit

VaR required stationary (assumed)

Mid-term (1.5h)

1. data problem

skew, kurtosis, strength/weakness of different methods of VAR

backtesting

correlation/covariance

PV01

fixed income question

impact of call option on a bond

hedging: long-term bond, short-term bond

interpret different type of risk

EDA, VaR methodologies, missing data, bond algebra