金程教育®
GOLDEN FUTURE

2023 FRM Part I

百题巅峰班

估值与风险模型

2024 年 3 月

4. Valuation and Risk Models

4.1. Bond Replication

4.1.1. 重要知识点

4.1.1.1. Law of one price: absent confounding factors (e.g., liquidity, financing, taxes, credit risk), identical sets of cash flows should sell for the same price.

4.1.1.2. While the law of one price is intuitively reasonable, its justification rests on a stronger foundation. It turns out that a deviation from the law of one price implies the existence of an arbitrage opportunity, that is, a trade that generates profits without any chance of losing money.

4.1.2. 基础题

Q-1. You have been asked to check for arbitrage opportunities in the Treasury bond market by comparing the cash flows of selected bonds with the cash flows of combinations of other bonds. If a 1-year zero-coupon bond is priced at USD 96.12 and a 1-year bond paying a 10% coupon semi-annually is priced at USD 106.20, what should be the price of a 1-year Treasury bond that pays a coupon of 8% semiannually?

A. USD 98.10

B. USD 101.23

C. USD 103.35

D. USD 104.18

Q-2. The following table gives the prices of two out of three US Treasury notes for settlement on August 30, 2008. All three notes will mature exactly one year later on August 30, 2009. Assume semi-annual coupon payments and that all three bonds have the same coupon payment date.

Coupon	Price
2 7/8	94.40
4 1/2	?
6 1/4	101.30

Approximately what would be the price of the 4 1/2 US Treasury note?

A. 99.20

B. 99.40

C. 97.71

D. 100.20

Q-3. A bond fund manager has requested quotes from a bond dealer on two bonds, Bond X

and Bond Y, with the same maturity date and coupon rate. The dealer informs the manager that Bond X trades at a spread of 30 bps over the Treasury market, while Bond Y trades at a spread of 70 bps. Which of the following statements is a correct conclusion for the manager to make?

A. Bond X earns a lower return than that of the comparable Treasury bond, since its spread serves to increase the discount rate of its cash flows.

B. The price of Bond X is currently higher than the price of Bond Y.

C. To equate the present value of Bond Y's cash flows to its face value, 70 bps would need to be added to the yield to maturity of a Treasury bond with comparable maturity.

D. The spread differential indicates that there is a 0.4% difference in price between Bond X and Bond Y.

4.2. YTM

4.2.1. 重要知识点

4.2.1.1. Yield to Maturity

- The YTM of a bond is the single discount rate at which all cash flows of the bond are discounted and summed up to the market price

4.2.1.2. Coupon Effect

- Upward-sloping trend, the yield to maturity falls as the coupon rises.
- Downward-sloping trend, the yield to maturity rises as the coupon rises.

4.2.2. 基础题

Q-4. An eight (8)-year bond with a current price of $975.00 pays an annual coupon of 6.0%. What is the bond's yield-to-maturity (YTM)?

A. 5.88%

B. 6.41%

C. 6.89%

D. 7.14%

Q-5. Each of the following is necessarily TRUE about a bond's yield-to-maturity (YTM) EXCEPT:

A. A bond that sells at a premium to par has a yield (YTM) that is less than its coupon rate

B. A bond that sells at a discount to par has a yield (YTM) that is greater than its coupon rate

C. The yield (YTM) of a zero-coupon bond equals the spot (zero) rate of the bond's maturity

D. If the same term structure of spot rates applies to two bonds with identical maturities, the bond with the higher yield (YTM) is a superior investment

Q-6. A fixed-income analyst is decomposing the profit and loss (P&L) of a bond over the past 6 months. The bond has a 2% coupon rate, paid semi-annually, and had exactly 2 years remaining until maturity at the start of the 6-month period. Relevant information about the bond and market rates (semi-annually compounded) is shown below:

	Beginning	Ending
Bond price (SGD)	100.35	101.24
Bond spread (bps)	30	20

Forward rates (periods in years)	Beginning	Ending
0 – 0.5	0.8%	0.7%
0.5 – 1	1.4%	1.0%
1 – 1.5	1.8%	1.2%
1.5 – 2	2.1%	2.0%

The analyst has calculated the bond's carry roll-down, and under the forward rate assumption made for the purpose of that calculation, the ending value of the bond is SGD 100.55. Given this information, what is the component of the bond's P&L attributable to the change in rates over the 6-month period?

A. SGD 0.54

B. SGD 0.69

C. SGD 0.74

D. SGD 0.99

4.3. Duration and DV01

4.3.1. 重要知识点

4.3.1.1. Duration

- Macaulay Duration → Modified Duration

4.3.1.2. DV01 & DD

- DV01~1bps
- $\mathrm{DV01} = \mathrm{DD} \times 0.0001$

4.3.1.3. Portfolio Duration

- $\mathrm{D}_{\mathrm{portfolio}} = \sum_{i=1}^{k} w_j \times D_j$

4.3.2. 基础题

Q-7. A trading portfolio consists of two bonds, A and B. Both have modified duration of 3 years and face value of USD 1000, but A is a zero-coupon bond and its current price is USD 900, and bond B pays annual coupons and is priced at par. What do you expect will happen to the market prices of A and B if the risk-free yield curve moves up by 1 basis point?

A. Both bond prices will move up by roughly the same amount.

B. Both bond prices will move up, but bond B will gain more than bond A.

C. Both bond prices will move down by roughly equal amounts.

D. Both bond prices will move down, but bond B will lose more than bond A.

Q-8. Which of the following assumptions are made when using DV01 as a measure of interest rate risk?

I. Changes in the interest rates are small.

II. The yield curve is flat.

III. Changes to the yield curve are parallel.

IV. The yield curve is downward sloping.

A. I and III

B. I and II

C. I and IV

D. II and III

Q-9. Calculate the impact of a 10 basis point increase in yield on the following bond portfolio.

Bond	Value (USD)	Modified Duration
1	4,000,000	7.5
2	2,000,000	1.6
3	3,000,000	6.0
4	1,000,000	1.3

A. USD -41,000

B. USD -52,500

C. USD -410,000

D. USD -525,000

Q-10. A hedge fund manager who holds a portfolio of interest rate-sensitive positions has just received an economist's report forecasting a significant shift in interest rates. Accordingly, the manager wants to change the fund's interest rate exposure by investing in fixed-income securities with negative duration. Which of the following positions should the fund manager take?

A. A long position in a callable corporate bond

B. A long position in a putable corporate bond

C. An interest rate swap paying fixed and receiving LIBOR plus a spread

D. An interest rate swap paying LIBOR plus a spread and receiving fixed

Q-11. Consider a 5-year 8.5% coupon bond (assume annual coupons) priced to yield a 10% per annum, with a par value of $100 and a price of $94.3138. A risk analyst has computed the following information:

Macaulay Duration	4.2518
Modified Duration	3.8653
Convexity	24.0839
Modified Convexity	21.8945

Which pair of duration and convexity should the risk analyst use in computing the duration-convexity approximation for the capital loss if the yield were to change to 10.50% per annum? And what is the estimated dollar amount of the capital loss?

A. The risk analyst should use Macaulay duration and convexity, and the dollar amount of the capital loss is $1.9766.

B. The risk analyst should use modified duration and convexity, and the dollar amount of the capital loss is $1.7944.

C. The risk analyst should use modified duration and modified convexity, and the dollar amount of the capital loss is $1.7969.

D. The risk analyst should use Macaulay duration and modified convexity, and the dollar amount of the capital loss is $1.9792.

4.4. Price Approximation, Effect of Convexity

4.4.1. 重要知识点

4.4.1.1. The actual, exact price

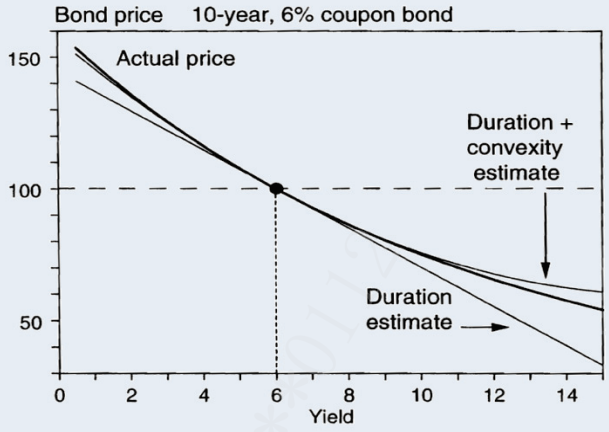
- $P = f(y_0 + \Delta y)$

4.4.1.2. The duration estimate:

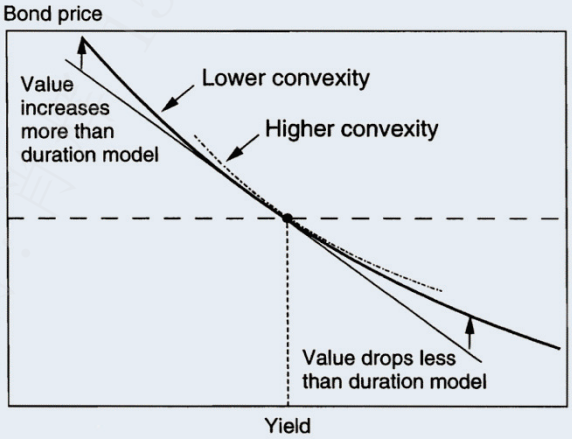
- $P = P_0 - DP_0\Delta y$

4.4.1.3. The duration and convexity estimate:

- $P = P_0 - DP_0\Delta y + \frac{1}{2}CP_0(\Delta y)^2$

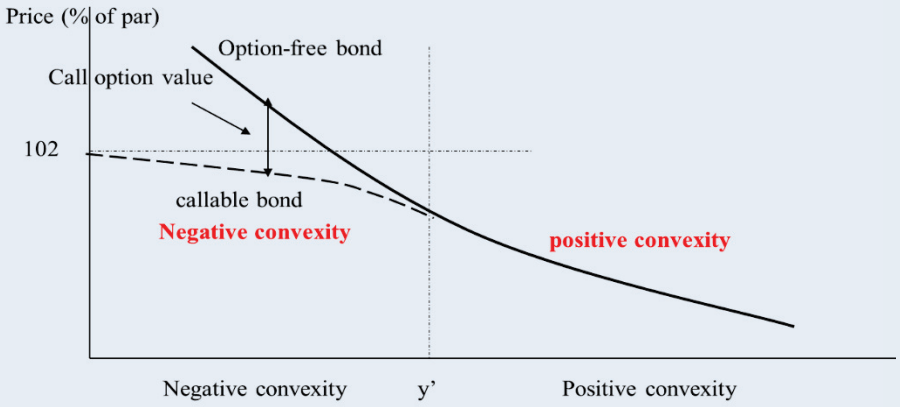


Price Approximation

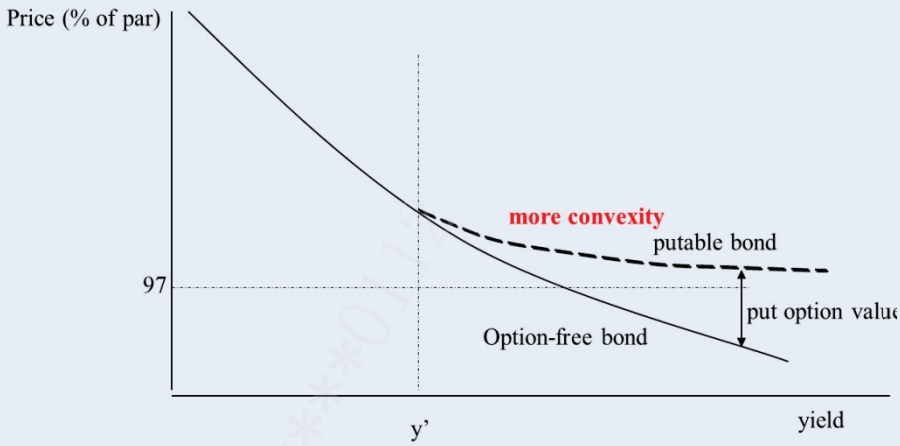


Effect of Convexity

4.4.1.4. Callable bond： Issuer has the right to buy back the bond in the future at a set price; as yields fall, bond is likely to be called; prices will rise at a decreasing rate-negative convexity.



4.4.1.5. Puttable bond: Bondholder has the right to sell bond back to the issuer at a set price.



4.4.2. 基础题

Q-12. For an option-free bond, which of the following are the effects of the convexity adjustment on the magnitude (absolute value) of the approximate bond price change in response to an increase in yield and in response to a decrease in yield, respectively?

	Decrease in Yield	Increase in Yield
A.	Increase in magnitude	Decrease in magnitude
B.	Increase in magnitude	Increase in magnitude
C.	Decrease in magnitude	Decrease in magnitude
D.	Decrease in magnitude	Increase in magnitude

Q-13. Which of the following is TRUE?

A. If a consol (perpetual) bond with a $100 face value pays a 3.0% coupon in perpetuity and the yield is 5.0%, the consol's price is $60 and its modified duration is 20 years.

B. Since a BARBELL bond portfolio has greater convexity than a BULLET, the barbell always

outperforms

C. Duration, convexity and DV01 are all (each) increasing with maturity

D. Portfolio duration is weighted average of individual (component) durations but portfolio convexity is not a weighted average of individual convexities

Q-14. Bonds issued by the XYZ Corp. are currently callable at par value and trade close to par. The bonds mature in 8 years and have a coupon of 8%. The yield on the XYZ bonds is 175 basis points over 8-year US Treasury securities, and the Treasury spot yield curve has a normal, rising shape. If the yield on bonds comparable to the XYZ bond decreases sharply, the XYZ bonds will most likely exhibit:

A. Negative convexity

B. Increasing modified duration

C. Increasing effective duration

D. Positive convexity

4.5. Effective Duration& Effective Convexity

4.5.1. 重要知识点

4.5.1.1. Effective Duration

- $\text{Effective Duration} = \frac{P_- - P_+}{2 \times P_0 \times \Delta y}$

4.5.1.2. Effective Convexity

- $\text{Effective Convexity} = \frac{P_- + P_+ - 2 \times P_0}{P_0 \times \Delta y^2}$

4.5.2. 基础题

Q-15. An 8-year 5% coupon bond with at par value of 100 is currently trading at a price of 94.65. The price of this bond rises to 96.35 when interest rates fall by 30 basis points and falls to 92.75 when interest rates rise by 30 basis points. The effective duration of this bond is closest to:

A. 5.99

B. 6.34

C. 6.69

D. 7.04

Q-16. A portfolio manager uses her valuation model to estimate the value of a bond portfolio at USD 125.482 million. The term structure is flat. Using the same model, she estimates

that the value of the portfolio would increase to USD 127.723 million if all interest rates fell by 30 basis points and would decrease to USD 122.164 million if all interest rates rose by 30 basis points. Using these estimates, the effective duration of the bond portfolio is closest to:

A. 7.38
B. 8.38
C. 14.77
D. 16.76

Q-17. A risk manager is evaluating the price sensitivity of an investment-grade callable bond using the firm's valuation system. The table below presents information on the bond as well as on the embedded option. The current interest rate environment is flat at 5%.

Value in USD per USD 100 face value		
Interest Rate Level	Callable Bond	Call Option
4.98%	102.07848	2.0871
5.00%	101.61158	2.0501
5.02%	100.92189	2.0131

The convexity of the callable bond can be estimated as:

A. -55,698
B. -54,814
C. -5.5698
D. -5.4814

4.6. Bullet versus Barbell Portfolio

4.6.1. 重要知识点

4.6.1.1. Barbell benefits more from interest rate volatility than does the bullet portfolio.

4.6.1.2. The barbell has greater convexity than the bullet because duration increases linearly with maturity while convexity increases with the square of maturity.

4.6.2. 基础题

Q-18. A fixed-income portfolio manager currently holds a bullet 7-year US Treasury position with USD 60 million face value. The manager would like to create a cost matching barbell portfolio by purchasing a combination of a 2-year Treasury and a 15-year Treasury that would have the same duration as the 7-year US Treasury position. The data for the three US Treasuries are listed below:

Maturity	Price	Duration
2 Years	100.972	1.938
7 Years	106.443	6.272
15 Years	122.175	11.687

Which of the following combinations correctly describes the weights of the two bonds that the manager will use to construct the barbell portfolio?

	Weight of 2-Year Treasury	Weight of 15-Year Treasury
A.	14.22%	85.78%
B.	44.46%	55.54%
C.	55.54%	44.46%
D.	85.78%	14.22%

Q-19. Assume two bond portfolios with identical yields of 5.0%. One is a bullet portfolio with duration equal to 9; the other is a barbell portfolio with duration also equal to 9. How do their convexities compare?

A. Barbell convexity is less than (<) bullet's convexity
B. Barbell convexity is greater than (>) bullet's convexity
C. Convexities are similar
D. Need more information

Q-20. If there is a LARGE parallel shift in the yield curve, how does their performance compare?

A. Barbell outperforms bullet
B. Bullet outperforms barbell
C. Same or similar
D. Need more information

4.7. Key Rate

4.7.1. 重要知识点

4.7.1.1. The key rate shift technique is an approach to nonparallel shifts in the yield curve, which is allows for changes in all rates to be determined by changes from selected key rates.

4.7.1.2. The rate of a given maturity is affected solely by its closest key-rate.

4.7.1.3. Shifts in the key-rates are decline linearly.

4.7.2. 基础题

Q-21. You are using key rate shifts to analyze the effect of spot rate changes on bond prices.

Suppose the 10-year spot rate has increased by 10 basis points and this shock decreases linearly to zero for the 20-year spot rate. What is the effect of this shock on the 14-year spot rate?

A. Increase of 0 basis points

B. Increase of 4 basis points

C. Increase of 6 basis points

D. Increase of 10 basis points

Q-22. Using key rates of 2-year, 5-year, 7-year, and 20-year exposures assumes all of the following except that the:

A. 2-year rate will affect the 5-year rate

B. 7-year rate will affect the 20-year rate

C. 5-year rate will affect the 7-year rate

D. 2-year rate will affect the 20-year rate

Use the following information to answer the following two questions:

The following table provides the initial price of a C-strip and its present value after application of a one basis shift in four key rates.

	Value
Initial value	25.11584
2-year shift	25.11681
5-year shift	25.11984
10-year shift	25.13984
30-year shift	25.01254

Q-23. What is the key rate '01 for a 30-year shift?

A. -0.058

B. 0.024

C. 0.103

D. 0.158

Q-24. What is the key-rate duration for a 30-year shift?

A. -4.57

B. 15.80

C. 38.60

D. 41.13

Q-25. Assume the three hedging securities: a 2-year, 5-year and 10-year bond. The maturities correspond to the three key rates at 2, 5 and 10 years. The key rate '01 (KR01) for the bonds are given in the table below, and they are reported per $100 face value. The KR01s of the underlying portfolio are given below (but they are reported for the face amount).

	Key Rate 01s (per $100 Face)		
Hedging Securities	2-year	5-year	10-year
2-year bond	0.010		
5-year bond	0.010	0.040	
10-year bond	0.010	0.050	0.100

	Key Rate 01s ($)		
	2-year	5-year	10-year
Underlying Portfolio	20.0	60.0	100.0

What is the face value of the two year (2-year) hedging bond that is required?

A. $25,000
B. $50,000
C. $75,000
D. $100,000

Q-26. An investment analyst is calculating the forward bucket 01 of a bond. The bond pays a 5% coupon annually, has a face value of CNY 100,000, and matures in 3 years. The analyst notes that the forward rate curve is flat at 3% (with all forward rates calculated for 1-year periods), and uses two forward buckets of 0-2 years and 2-3 years. What is the forward bucket 01 of the bond for the 2-3 year bucket, assuming an upward shift in interest rates?

A. CNY 9.33
B. CNY 19.11
C. CNY 20.04
D. CNY 27.98

4.8. Value Option Using a Binomial Tree

4.8.1. 重要知识点

4.8.1.1. $f = e^{-rt}[pf_u + (1-p)f_d]$

4.8.1.2. $p = \frac{e^{r\Delta t} - d}{u - d}$ $u = e^{\sigma\sqrt{\Delta t}}$ $d = \frac{1}{u}$

4.8.1.3. Stocks with dividends and stock indices: replace $e^{r\Delta t}$ with $e^{(r-q)\Delta t}$ where q is the dividend yield of a stock or stock index.

4.8.2. 基础题

Common text for following two questions:

A risk manager for Bank XYZ, Mark is considering writing a 6 month American put option on a non-dividend paying stock ABC. The current stock price is USD 50 and the strike price of the option is USD 52. In order to find the no-arbitrage price of the option. Mark uses a two-step binomial tree model. The stock price can go up or down by 20% each period. Mark's view is that the stock price has an 80% probability of going up each period and a 20% probability of going down. The annual risk-free rate is 12% with continuous compounding.

Q-27. What is the risk-neutral probability of the stock price going up in a single step?

A. 34.5%

B. 57.6%

C. 65.5%

D. 80.0%

Q-28. Martha used a three-step binomial model to value a (long-term) put option with three years to maturity; i.e., each time step is one year. While the risk-free rate is 4.0%, the underlying asset's volatility is 28.480%. Using these assumptions, she was pleasantly surprised to see that the risk-neutral probability of up movement in her model as 50.0%; i.e., p = d = 0.50. However, she forgot to include the assumption that the asset will pay a continuous dividend of 2.0% per annum. By how much will this assumption change her model's risk-neutral probability of a down (d) movement?

A. Decrease probability of down movement, (d), by about 10.79% percentage points

B. Decrease probability of down movement, (d), by about 3.57% percentage points

C. Increase probability of down movement, (d), by about 3.57% percentage points

D. Increase probability of down movement, (d), by about 10.79% percentage points

Q-29. The current price of a stock is $10, and it is known that at the end of three months the stock's price will be either $13 or $7. The risk-free rate is 4% per annum. What is the implied no arbitrage price of a three-month (T = 0.25) European call option on the stock with a strike price of $10? (Note: this does not include an assumption about the stock's volatility).

A. $0.97

B. $1.28

C. $1.53

D. $1.65

Q-30. A trader has an American put option with strike price of $50. The underlying asset is stock with a spot price of $40. Using an one-step binomial tree to evaluate the option. Suppose the stock price will go up or down by $8 in 6 month, the risk-free rate is 6.2%, what is the value of this American put?

A. USD 8.19

B. USD 8.45

C. USD 10.00

D. USD 10.32

Q-31. A stock with a current price of $32 and volatility of 15% pays a dividend of 2.0% per annum (with continuous compounding). The riskless rate is 2.0%. We use a twelve-step binomial model to price an American put option with one year to expiration; i.e., each step is one month. What is the risk-neutral probability of a down movement (1-p)?

A. 0.4646

B. 0.4962

C. 0.5108

D. 0.5375

Q-32. What is the risk-neutral probability of an up movement (p) in a two-step binomial model used to value an two-year American-style put option on a stock with a volatility of 38% when the risk-free rate is 4.0%; i.e., each step is one year?

A. 0.411

B. 0.459

C. 0.503

D. 0.548

Q-33. A stock with a (continuous) dividend yield of 1.0% has a current price of $30 and volatility of 22%. We use a two-step binomial model to value a two-year European style call option on the stock; i.e., each time step is one year. The risk-free rate is 3.0%. In the binomial tree, what is the stock price at the node with the lowest stock price?

A. $14.78

B. $19.32

C. $22.49

D. $25.25

Q-34. The current price of a non-dividend paying stock is $75. The annual volatility of the stock is 18.25%, and the current continuously compounded risk-free interest rate is 5%. A 3-year European call option exists that has a strike price of $90. Assuming that the price of the stock will rise or fall by a proportional amount each year, and the risk neutral probability that the stock will raise is approximately 60%, what is the value of the European call option?

A. $22.16

B. $12.91

C. $3.24

D. $7.36

Q-35. The NASDAQ-100 stock index is currently 7,300.0 and has a volatility of 40.0% and a dividend yield of 1.0%. The risk-free rate is 3.0%. If we employ a two-step binomial tree, which is nearest to the value of a European 6-month call option with a strike price of 7,500.0; i.e., the call is out-of-the-money by exactly 200?

A. $714.77

B. $734.20

C. $756.93

D. $777.51

Q-36. Brandon, FRM, is tuning the binomial tree option pricing model used for pricing a European call option. After changing the length of time step, Δt, from 1/2 to 1/12, what will be the impact on the model?

A. The option value as a model output will remain the same after reducing the length of time step.

B. The u used for constructing the binomial tree will increase after reducing the length of time step.

C. The d used for constructing the binomial tree will increase after reducing the length of time step.

D. The risk neutral probability of an upward movement is not affected by reducing the length of time step.

4.9. Black-Scholes-Merton Model

4.9.1. 重要知识点

4.9.1.1. Black-Scholes-Merton model on a non-dividend-paying stock

- $c = S_0N(d_1) - Ke^{-rT}N(d_2)$
- $p = Ke^{-rT}N(-d_2) - S_0N(-d_1)$
- $d_1 = \frac{\ln(S_0/K)+(r+\sigma^2/2)T}{\sigma\sqrt{T}}$
- $d_2 = d_1 - \sigma\sqrt{T}$

4.9.1.2. Black-Scholes-Merton model on a dividend-paying stock

- $c = S_0e^{-qT}N(d_1) - Ke^{-rT}N(d_2)$

4.9.1.3. Rules for Exercising American Option

- It is never optimal to exercise an American call on a non-dividend-paying stock before its expiration date.
- American puts can be optimally exercised early if they are sufficiently in-the-money.
- An American call on a dividend-paying stock may be exercised early if the dividend exceeds the amount of forgone interest.

4.9.2. 基础题

Q-37. Which of the following statements is correct about the early exercise of American options?

A. It is always optimal to exercise an American call option on a non-dividend-paying stock before the expiration date.

B. It can be optimal to exercise an American put option on a non-dividend-paying stock early.

C. It can be optimal to exercise an American call option on a non-dividend-paying stock early.

D. It is never optimal to exercise an American put option on a non-dividend-paying stock before the expiration date.

Q-38. Which of the following is not an assumption of the Black-Scholes options pricing model?

A. The price of the underlying moves in a continuous fashion.

B. The interest rate changes randomly over time.

C. The instantaneous variance of the return of the underlying is constant.

D. Markets are perfect, i.e. short sales are allowed, there are no transaction costs or taxes, and markets operate continuously.

Q-39. The current price of a stock is $25. A put option with a $20 strike price that expires in six

months is available. $N(d_1) = 0.9737$ and $N(d_2) = 0.9651$ .If the underlying stock exhibits an annual standard deviation of 25%, and the current continuously compounded risk-free rate is 4.25%, the Black-Scholes-Merton value of the put is closest to:

A. $0.01
B. $0.03
C. $0.33
D. $0.36

Q-40. A European call option has a time to maturity of six months on a stock with a 2% dividend yield. The current stock and strike prices are both $50. The volatility of the stock is 18% per annum. The risk free rate is 4%. What is the price of the call option?

A. $2.00
B. $2.75
C. $3.08
D. $3.16

Q-41. A one-year European call option on the Euro has an exercise price of $1.40 when the current exchange rate is EUR/USD $1.34. The risk-free rate in the United States is 4% and the Eurozone risk-free rate is 3%. The volatility of the spot exchange rate is 30% per annum. What is the price of the call option?

A. $0.136
B. $0.297
C. $0.355
D. $0.425

Q-42. What is the price of a three month European put option on a non-dividend-paying stock with a strike price of $50 when the current stock price is $50, the risk-free interest rate is 10% per annum, and the volatility is 30% per annum.

A. 2.37
B. 2.48
C. 2.25
D. 2.63

Q-43. Each of the following is an underlying assumption of the basic Black-Scholes option pricing model EXCEPT:

A. The stock price follows a geometric Brownian motion (GBM) which is a continuous

process without jumps

B. The continuously compounded rate of return on the stock is normally distributed, such that the distribution of the future stock price is lognormal

C. The expected rate of return on the stock (u) and volatility (sigma) are constant

D. The expected real-world (risky) rate of return on the stock is known and the value of the option is an increasing function of this rate of return

Q-44. The CFO at a non-dividend-paying firm asks a financial analyst to evaluate a plan by the firm to grant stock options to its employees. The firm has 60 million shares outstanding. Under the proposal, the firm would issue 3 million employee stock options, with each option giving the holder the right to buy one share of the firm's stock at a strike price of USD 70. The employee stock options would expire in 4 years. A four-year call option on the stock with the same strike price is currently valued at SGD 4.39 using the Black-Scholes-Merton model. Which of the following is the best estimate of the price of one employee stock option assuming that the call option is correctly priced?

A. SGD 3.97

B. SGD 4.18

C. SGD 4.39

D. SGD 4.45

Q-45. A risk manager at a hedge fund currently uses historical data to estimate the future volatility of a portfolio of US equities. To improve on the current methodology, the manager is considering adding the use of implied volatility of the equity assets, while also assessing the potential drawbacks of using this metric. Which of the following correctly describes a weakness of implied volatility as a predictor of future volatility?

A. Broad indexes of implied volatility do not exist, making forecasting the volatility of broad asset classes difficult.

B. Implied volatility is a backward-looking measure, which limits its usefulness in estimating future volatility.

C. Implied volatilities are not available for assets that do not have actively traded options.

D. In practice, implied volatilities differ for options with different maturities on the same underlying asset, even though theory suggests they should be the same.

Q-46. A derivative trading firm that previously used only the Black-Scholes-Merton (BSM) model to value options has recently decided to use the binomial tree option pricing model as well. An analyst at the firm is reviewing the different features of the two

models to compare and contrast their inputs and assumptions. In comparing the two models, which of the following statements is correct?

A. The BSM model uses an underlying asset's implied volatility as an input but the binomial tree approach uses its historical volatility.

B. The binomial tree approach, but not the BSM model, assumes that the expected return from the underlying asset is the risk-free rate of interest.

C. In the binomial tree approach, delta is equal at each node since the probabilities of the price moving up or down during a period are constant and equal for both the underlying asset and the option.

D. If the assumptions of the BSM model hold, the implied volatility of a longer-term option and the implied volatility of a shorter-term option on the same underlying asset will be the same.

Q-47. Jasmine Tang, FRM, is using a simple method called "successive bisection" to determine the implied volatility of a traded option. Jasmine starts with a volatility of zero (this gives a BSM price that is less than the option market price) and a volatility of 30% (this gives a BSM price that is higher than the option market price). She then takes the average of these two volatilities, i.e., 15%, as the new volatility and uses it to compute the option price using the BSM formula. The revised option price is now much closer to the market price but still a bit low. Which of the following statements correctly describes the next step that Jasmine should perform?

A. Replace 30% with 15%, recalculate the averaged volatility using 0% and 15%, use the new average to compute the option price using the BSM formula, and compare it with the market price.

B. Replace 0% with 15%, recalculate the averaged volatility using 30% and 15%, use the new average to compute the option price using the BSM formula, and compare it with the market price.

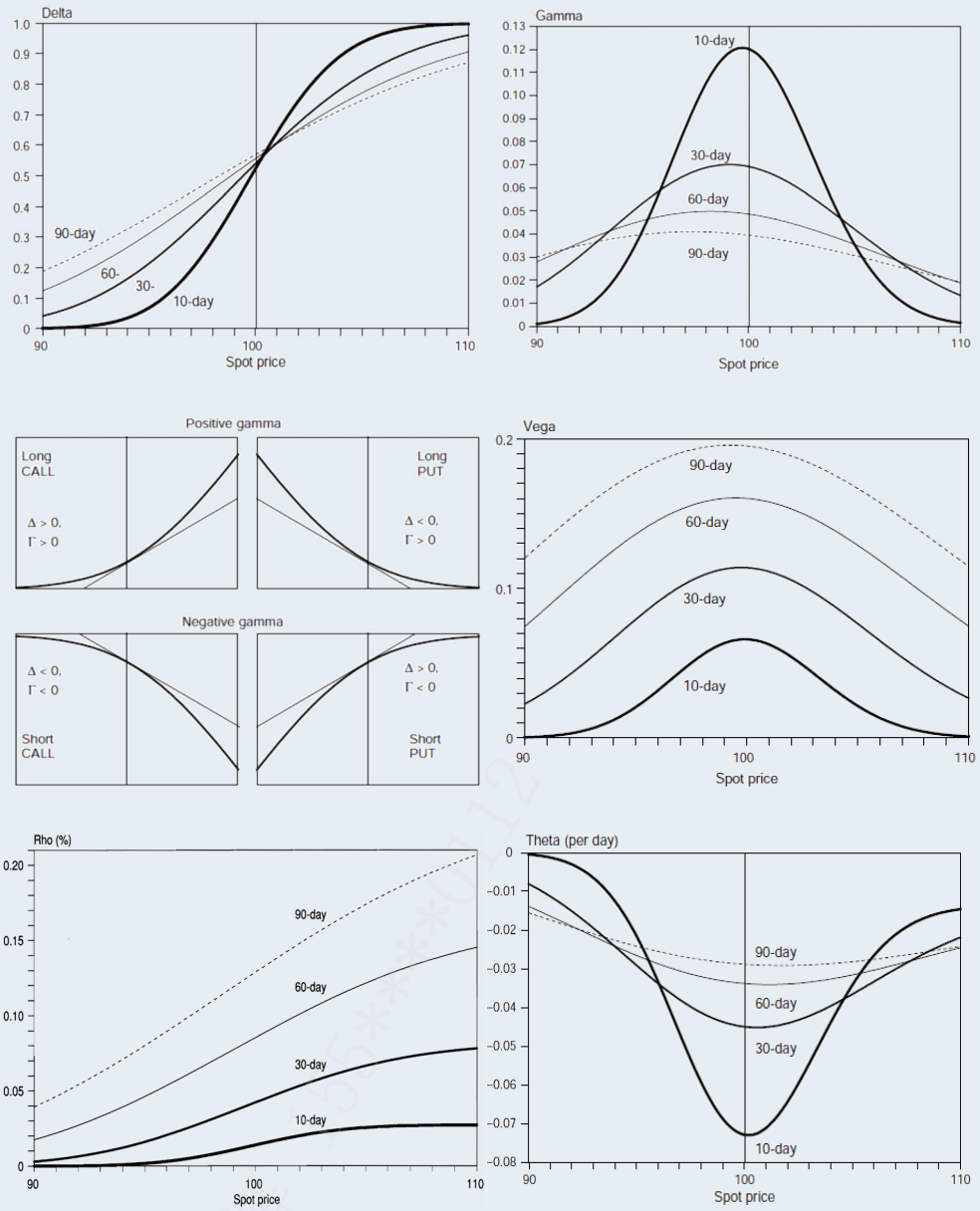
C. Treat 15% as a rough estimate of the implied volatility, because the revised option price is now much closer to the market price.

D. Shift to a procedure that are more numerically efficient, which involves solving a nonlinear equation.

4.10. Greek Letters

4.10.1. 重要知识点

4.10.1.1.



- Delta of an at-the-money call option is close to 0.5. Delta moves to 1as the call goes deep in the money. It moves to zero as the call goes deep out of the money.
- Gamma is highest for short-term at-the-money options.
- Vega is highest for long-term at-the-money options.
- Rho is similar to Delta.
- Theta is the variation in option value due to the passage of time. This is also the time decay. Unlike other factors, however, the movement in remaining maturity is perfectly predictable. Time is not a risk factor.

4.10.2. 基础题

Q-48. If risk is defined as a potential for unexpected loss, which factors contribute to the risk

of a short call option position?

A. Delta, Vega, Rho

B. Vega, Rho

C. Delta, Vega, Gamma, Rho

D. Delta, Vega, Gamma, Theta, Rho

Q-49. You are given the following information about a call option:

- Time to maturity = 2 years
- Continuous risk-free rate = 4%
- Continuous dividend yield = 1%
- $N(d_1) = 0.64$

Calculate the delta of this option.

A. -0.64

B. 0.36

C. 0.63

D. 0.64

Q-50. Mr. Black has been asked by a client to write a large put option on the S&P 500 index. The option has an exercise price and a maturity that is not available for options traded on exchanges. He, therefore, has to hedge the position dynamically. Which of the following statements about the risk of his position are not correct?

A. He can make his portfolio delta neutral by shorting index futures contracts.

B. There is a short position in an S&P 500 futures contract that will make his portfolio insensitive to both small and large moves in the S&P 500.

C. A long position in a traded option on the S&P 500 will help hedge the volatility risk of the option he has written.

D. To make his hedged portfolio gamma neutral, he needs to take positions in options as well as futures.

Q-51. Portfolio manager Sally has a position in 100 option contracts with the following position Greeks: theta = +25,000; vega = +330,000 and gamma = -200; ie., positive theta, positive vega and negative gamma. Which of the following additional trades, utilizing generally at-the-money (ATM) options, will neutralize (hedge) the portfolio with respect to theta, vega and gamma?

A. Sell short-term options + sell long-term options (all roughly at-the-money)

B. Sell short-term options + buy long-term options (~ ATM)

C. Buy short-term options + sell long-term options (~ ATM)

D. Buy short-term options + buy long-term options (~ ATM)

Q-52. Which of the following statements is correct?

I. The rho of a call option changes with the passage of time and tends to approach zero as expiration approaches, but this is not true for the rho of put options.

II. Theta is always negative for long calls and long puts and positive for short calls and short puts.

A. I only.

B. II only

C. I and II

D. Neither

Q-53. Which of the following statements is true regarding options Greeks?

A. Theta tends to be large and positive when buying at-the-money options.

B. Gamma is greatest for in-the-money options with long maturities.

C. Vega is greatest for at-the-money options with long maturities.

D. Delta of deep in-the-money put options tends toward +1.

Q-54. Which position is most risky?

A. Gamma-negative, delta-neutral

B. Gamma-positive, delta-positive

C. Gamma-negative, delta-positive

D. Gamma-positive, delta-neutral

Q-55. A portfolio of stock A and options on stock A is currently delta neutral, but has a positive gamma. Which of the following actions will make the portfolio both delta and gamma neutral?

A. Buy call options on stock A and sell stock A

B. Sell call options on stock A and sell stock A

C. Buy put options on stock A and buy stock A

D. Sell put options on stock A and sell stock A

Q-56. Which of the following choices will effectively hedge a short call option position that exhibits a delta of 0.5?

A. Sell two shares of the underlying for each option sold.

B. Buy two shares of the underlying for each option sold.

C. Sell the number of shares of the underlying equal to one-half the options sold.

D. Buy the number of shares of the underlying equal to one-half the options sold.

Q-57. The current stock price of a company is USD 80. A risk manager is monitoring call and put options on the stock with exercise prices of USD 50 and 5 days to maturity. Which of these scenarios is most likely to occur if the stock price falls by USD 1?

Scenario	Call Value	Put Value
A	Decrease by USD 0.94	Increase by USD 0.08
B	Decrease by USD 0.94	Increase by USD 0.89
C	Decrease by USD 0.07	Increase by USD 0.89
D	Decrease by USD 0.07	Increase by USD 0.08

A. Scenario A

B. Scenario B

C. Scenario C

D. Scenario D

Q-58. Wanda Zheng (FRM) is responsible for the options desk in a London bank. Zheng is concerned about the impact of dividends on the options held by the options desk. She asks you to assess which options are the most sensitive to dividend payments. What would be your answer if the value of the options is found by using the Black-Scholes model adjusted for dividends?

A. Everything else equal, out-of-the-money call options experience a larger decrease in value than in-the-money call options as expected dividends increase.

B. The increase in the value of in-the-money put options caused by an increase in expected dividends is always larger than the decrease in value of in-the-money call options.

C. Keeping the type of option constant, in-the-money options experience the greatest absolute change in value and out-of-the-money options the smallest absolute change in value as expected dividends increase.

D. Keeping the type of option constant, at-the-money options experience the largest absolute change in value and out of-the-money options the smallest absolute change in value as a result of dividend payment.

Q-59. An options trader wants to hedge the gamma and vega risks of a portfolio of several options on a single non-dividend paying stock. The portfolio currently has a positive gamma and a negative vega. There are two at-the-money call options available on this

stock, one with a 1-month expiration and the other with a 4-month expiration. Which combination of transactions in these two options would reduce the gamma and increase the vega of the current portfolio?

A. Buy both the 1-month and the 4-month options.
B. Buy the 1-month option and sell the 4-month option.
C. Sell the 1-month option and buy the 4-month option.
D. Sell both the 1-month and the 4-month options.

4.11. Delta Hedging

4.11.1. 重要知识点

4.11.1.1. A position with a delta of zero is called a delta neutral position.

4.11.1.2. A position is delta neutral only instantaneously (for a very short period of time). To maintain a delta neutral position, the trader must re-balance the portfolio.

4.11.2. 基础题

Q-60. A bank has sold USD 300,000 of call options on 100,000 equities. The equities trade at 50, the option strike price is 49, the maturity is in 3 months, volatility is 20%, and the interest rate is 5%. How does it the bank delta hedge? (round to the nearest thousand share)

A. Buy 65,000 shares
B. Buy 100,000 shares
C. Buy 21,000 shares
D. Sell 100,000 shares

Q-61. An option trader is currently holding short positions in 2,000 European call options that will all mature in one month. The current stock price is $19, while the strike price of those call options is $20. The trader is considering the delta hedging strategy based on a simple one-step binomial tree model. In the model setting, one month later, the stock price will be either $23.75 or $15.2. What should the trader do in order to make the position delta neutral?

A. Short about 877 shares.
B. Long about 877 shares.
C. Short about 1,111 shares.
D. Long about 1,111 shares.

Q-62. A company is holding a portfolio of 2,000 long call positions, each with a delta of 0.65.

The company decides to use the exchange-traded futures instead of the underlying itself to delta-hedge the option position. In order to make the option position delta-neutral, how many futures contracts should the company long or short? Suppose that the current risk-free rate is 3%, and both the options and futures are due in six months.

A. Long 1,281 futures.

B. Short 1,281 futures.

C. Long 1,300 futures.

D. Short 1,300 futures.

4.12. Gamma and Vega Hedging

4.12.1. 重要知识点

4.12.1.1. **Gamma** is used to correct the hedging error associated with delta-neutral positions by providing added protection against large movements in the underlying asset's price. If gamma is highly negative or highly positive, delta is very sensitive to price of the underlying asset.

4.12.1.2. **Gamma Neutral Positions:** hedge against larger changes in stock price

4.12.1.3. Vega is the rate of change of the value of the option with respect to the volatility of the underlying asset.

4.12.2. 基础题

Q-63. An option portfolio exhibits high unfavorable sensitivity to increases in implied volatility and while experiencing significant daily losses with the passage of time. Which strategy would the trader most likely employ to hedge his portfolio?

A. Sell short dated options and buy long dated options

B. Buy short dated options and sell long dated options

C. Sell short dated options and sell long dated options

D. Buy short dated options and buy long dated options

4.13. Market Risk

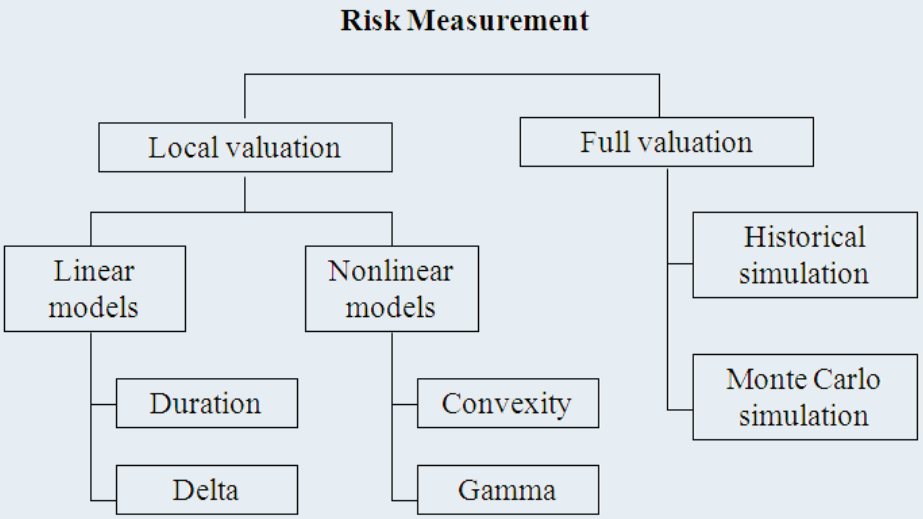
4.13.1. 重要知识点

4.13.1.1. **Value at Risk**

- **Calculating and Applying VaR**
  - $\mathrm{VaR} = Z_\alpha \times \sigma$
  - $\mathrm{VaR}_{T-\mathrm{days}} = \mathrm{VaR}_{1-\mathrm{days}} \times \sqrt{T}$
  - $\mathrm{VaR}_p^2 = \mathrm{VaR}_1^2 + \mathrm{VaR}_2^2 + 2\rho \times \mathrm{VaR}_1 \times \mathrm{VaR}_2$

- $\text{VaR}(dP) = |-D^*P| \times \text{VaR}(dy)$
- $\text{VaR}(df) = |\Delta| \times \text{VaR}(dS)$
- $\text{VaR}(dP) = |-D^*P| \times \text{VaR}(dy) - (1/2)(C \times P) \times \text{VaR}(dy)^2$
- $\text{VaR}(df) = |\Delta| \times \text{VaR}(dS) - (1/2)\Gamma \times \text{VaR}(dS)^2$

4.13.1.2. Risk Measurement



4.13.1.3. EWMA Model:

$$\sigma_n^2 = \lambda\sigma_{n-1}^2 + (1-\lambda)\mu_{n-1}^2$$

4.13.1.4. GARCH (1, 1) Model:

$$\sigma_n^2 = \omega + \alpha\mu_{n-1}^2 + \beta\sigma_{n-1}^2$$

4.13.1.5. Correlation Estimation:

$$\hat{\rho}_{xy} = \frac{cov_n}{\sigma_{x,n}\sigma_{y,n}}$$

$$cov_n = \lambda cov_{n-1} + (1-\lambda)x_{n-1}y_{n-1}$$

4.13.2. 基础题

Q-64. A risk manager states that the VaR of the portfolio at 95% confidence interval and 1-day holding period is $1 million. Which of the following statement is TRUE?

A. The daily loss on the portfolio will exceed $1 million 95% of time.

B. The daily loss on the portfolio will not exceed $1 million 95% of time.

C. The maximum loss that the portfolio can incur is $1 million at any point in time.

D. 95% of risk managers will agree that the maximum loss on the portfolio will be $1 million.

Q-65. Hugo Nelson is preparing a presentation on the attributes of value at risk. Which of Nelson's following statements is not correct?

A. VaR can account for the diversified holdings of a financial institution, reducing capital requirements.

B. VaR(10%) = $0 indicates a positive dollar return is likely to occur on 90 out of 100 days.

C. VaR(1%) can be interpreted as the number of days that a loss in portfolio value will exceed 1%.

D. VaR was developed in order to more closely represent the economic capital necessary to ensure commercial bank solvency.

Q-66. An analyst at Bergman International Bank has been asked to explain the calculation of VaR for linear derivatives to the newly hired junior analysts. Which of the following statements best describes the calculation of VaR for a linear derivative on the S&P 500 Index?

A. For a futures contract, multiply the VaR of the S&P 500 Index by a sensitivity factor reflecting the percent change in the value of the futures contract for a 1% change in the index value.

B. For an options contract, multiply the VaR of the S&P 500 Index by a sensitivity factor reflecting the percent change in the value of the futures contract for a 1% change in the index value.

C. For a futures contract, divide the VaR of the S&P 500 Index by a sensitivity factor reflecting the absolute change in the value of the futures contract per absolute change in the index value.

D. For an options contract, divide the VaR of the S&P 500 Index by a sensitivity factor reflecting the percent change in the value of the futures contract for a 1% change in the index value.

Q-67. The VaR on a portfolio using a 1-day horizon is USD 100 million. The VaR using a 10-day horizon is:

A. USD 316 million if returns are not independently and identically distributed.

B. USD 316 million if returns are independently and identically distributed.

C. USD 100 million since VaR does not depend on any day horizon.

D. USD 31.6 million irrespective of any other factors.

Q-68. In the presence of fat tails in the distribution of returns, VaR based on the delta-normal method would (for a linear portfolio):

A. Underestimate the true VaR.

B. Be the same as the true VaR.

C. Overestimate the true VaR.

D. Cannot be determined from the information provided.

Q-69. Consider the following single bond position of $10 million, a modified duration of 3.6 years, an annualized yield volatility of 2%. Using the duration method and assuming that the daily return on the bond position is independently identically normally distributed, calculate the 10-day holding period VaR of the position with a 99% confidence interval assuming there are 252 business days in a year.

A. $409,339
B. $396,742
C. $345,297
D. $334,186

Q-70. A commodity-trading firm has an options portfolio with a two-day Value-at-Risk (VaR) of 2.5 million. What would be an appropriate translation of this VaR to a ten-day horizon under normal conditions?

A. $3.713 million
B. $4.792 million
C. $5.590 million
D. Cannot be determined

Q-71. A risk manager would like to measure VaR for a bond. He notices that the bond has a puttable feature. What effect on the VaR will this puttable feature have?

A. The VaR will increase.
B. The VaR will decrease.
C. The VaR will remain the same.
D. The effect on the VaR will depend on the volatility of the bond.

Q-72. Mixed Fund has a portfolio worth USD 12,428,000 that consists of 42% of fixed income investments and 58% of equity investments. The 95% annual VaR for the entire portfolio is USD 1,367,000 and the 95% annual VaR for the equity portion of the portfolio is USD 1,153,000. Assume that there are 250 trading days in a year and that the correlation between stocks and bonds is zero. What is the 95% daily VaR for the fixed income portion of the portfolio?

A. USD 21,263
B. USD 46,445
C. USD 55,171
D. USD 72,635

Q-73. You have been asked to estimate the VaR of an investment in Big Pharma Inc. The company's stock is trading at USD 23 and the stock has a daily volatility of 1.5%. Using the delta-normal method, the VaR at the 95% confidence level of a long position in an at-the-money put on this stock with a delta of -0.5 over a 1-day holding period is closest to which of the following choices?

A. USD 0.28
B. USD 0.40
C. USD 0.57
D. USD 2.84

Q-74. Rational Investment Inc. is estimating a daily VaR for its fixed income portfolio currently valued at USD 800 million. Using returns for the last 400 days (ordered in decreasing order, from highest daily return to lowest daily return), the daily returns are the following: 1.99%, 1.89% 1.88% 1.87% ……, -1.76%, -1.82%, -1.84%, -1.87%, -1.91%

At the 99% confidence level, what is your estimate of the daily VaR using the historical simulation method?

A. USD 14.08 million
B. USD 14.56 million
C. USD 14.72 million
D. USD 15.04 million

Q-75. A market risk manager uses historical information on 1,000 days of profit/loss information to calculate a daily VaR at the 99th percentile, of USD 8 million. Loss observations beyond the 99th percentile are then used to estimate the conditional VaR. If the losses beyond the VaR level, in millions, are USD 9, USD 10, USD 11, USD 13, USD 15, USD 18, USD 21, USD24, and USD 32, then what is the conditional VaR?

A. USD 9 million
B. USD 32 million
C. USD 15 million
D. USD 17 million

Q-76. A trader has an option position in crude oil with a delta of 100000 barrels and gamma of -50000 barrels per dollar move in price. Using the delta-gamma methodology, compute the VaR on this position, assuming the extreme move on crude oil is $2.00 per barrel.

A. $100,000
B. $200,000

C. $300,000

D. $400,000

Q-77. An at-the-money European call option on the DJ EURO STOXX 50 index with a strike of 2200 and maturing in 1 year is trading at EUR 350, where contract value is determined by EUR 10 per index point. The risk-free rate is 3% per year, and the daily volatility of the index is 2.05%. If we assume that the expected return on the DJ EURO STOXX 50 is 0%, the 99% 1-day VaR of a short position on a single call option calculated using the delta-normal approach is closest to:

A. EUR 8

B. EUR 53

C. EUR 84

D. EUR 525

Q-78. Howard Freeman manages a portfolio of investment securities for a regional bank. The portfolio has a current market value equal to USD 6,247,000 with a daily variance of 0.0002. Assuming there are 250 trading days in a year and that the portfolio returns follow a normal distribution, the estimate of the annual VaR at the 95% confidence level is closest to which of the following?

A. USD 32,595

B. USD 145,770

C. USD 2, 297,854

D. USD 2,737,868

Q-79. Bank A and Bank B are two competing investment banks that are calculating the 1-day 99% VaR for an at-the-money call on a non-dividend-paying stock with the following information:

- Current stock price: USD 120
- Estimated annual stock return volatility: 18%
- Current Black-Scholes-Merton option value: USD 5.20
- Option delta: 0.6

To compute VaR, Bank A uses the linear approximation method, while Bank B uses a Monte Carlo simulation method for full revaluation. Which bank will estimate a higher value for the 1-day 99% VaR?

A. Bank A.

B. Bank B.

C. Both will have the same VaR estimate.

D. Insufficient information to determine.

Q-80. A junior market risk analyst is studying the mechanics of the EWMA approach for estimating volatility. The analyst observes that the approach applies various weights to a series of historical returns, and the return needed to update the EWMA calculation is the most recent day's squared return. Which of the following statements is correct?

A. Daily returns prior to the most recent day have no influence on the current variance rate estimate in the EWMA calculation.

B. Daily returns prior to the most recent day are reflected in the EWMA calculation by the smoothing parameter (λ).

C. Daily returns prior to the most recent day are reflected in the EWMA calculation by the most recent day's squared return.

D. Daily returns prior to the most recent day are reflected in the EWMA calculation by the previous variance rate estimate.

Q-81. A risk analyst at a hedge fund is conducting a historical simulation to estimate the ES of a portfolio. The value of the portfolio at market close of any given day depends on the price of a stock and the level of an interest rate at the close of that day. The analyst uses closing values of these variables on the most recent 501 trading days as the historical dataset for the simulation and collects the following data, with Day 0 representing the first data point and Day 500 representing the last data point of the historical period:

Day	Stock price (HKD)	Interest rate (%)
0	76.00	2.50%
1	72.00	2.60%
…	…	…
500	94.00	3.80%

What stock price and interest rate would be most appropriate for the analyst to use in the scenario of the historical simulation for Day 501?

A. The stock price would be HKD 89.05, and the interest rate would be 3.90%

B. The stock price would be HKD 89.05, and the interest rate would be 3.95%

C. The stock price would be HKD 92.00, and the interest rate would be 3.90%

D. The stock price would be HKD 92.00, and the interest rate would be 3.95%

Q-82. Assume that portfolio daily returns are independently and identically normally distributed. A new quantitative analyst has been asked by the portfolio manager to

calculate portfolio VaRs for 10-, 15-, 20-, and 25-day periods. The portfolio manager notices something amiss with the analyst's calculations displayed below. Which one of following VaRs on this portfolio is inconsistent with the others?

A. VaR(10-day) = USD 316M
B. VaR(15-day) = USD 465M
C. VaR(20-day) = USD 537M
D. VaR(25-day) = USD 600M

Q-83. Which of the following GARCH models will take the shortest time to revert to its mean?

A. $h_t = 0.05 + 0.03r_{t-1}^2 + 0.96h_{t-1}$
B. $h_t = 0.03 + 0.02r_{t-1}^2 + 0.95h_{t-1}$
C. $h_t = 0.02 + 0.01r_{t-1}^2 + 0.97h_{t-1}$
D. $h_t = 0.01 + 0.01r_{t-1}^2 + 0.98h_{t-1}$

Q-84. The current estimate of daily volatility is 1.5%. The closing price of an asset yesterday was $30.00. The closing price of the asset today is $30.50. Using the EWMA (Exponentially Weighted Moving Average) model (with λ = 0.94), the updated estimate of volatility is:

A. 1.5105%
B. 1.5085%
C. 1.5092%
D. 1.5083%

Q-85. We assume a lambda parameter of 0.850 under an exponential smoothing (i.e., EWMA) approach to the estimation of today's (t) daily volatility. Yesterday (t-1) is the most recent daily return in our series. What are the weights assigned, respectively, to yesterday's and the day before yesterday's returns; i.e., weight (t-1) and weight (t-2)?

A. 15.00% (t-1) and 2.25% (t-2)
B. 15.00% and 12.75%
C. 72.25% and 61.41%
D. 85.00% and 72.25%

Q-86. Given λ of 0.94, under an infinite series, what is the weight assigned to the seventh prior daily squared return?

A. 4.68%
B. 4.40%

C. 4.14%

D. 3.89%

Q-87. Which of the following four statements on models for estimating volatility is INCORRECT?

A. In the exponentially weighted moving average (EWMA) model, some positive weight is assigned to the long-run average variance.

B. In the EWMA model, the weights assigned to observations decrease exponentially as the observations become older.

C. In the GARCH (1,1) model, a positive weight is estimated for the long-run average variance.

D. In the GARCH (1,1) model, the weights estimated for observations decrease exponentially as the observations become older.

Q-88. A junior risk analyst is modeling the volatility of a certain market variable. The analyst considers using either the EWMA or the GARCH (1,1) model. Which of the following statements is correct?

A. The EWMA model is a special case of the GARCH (1,1) model with the additional assumption that the long-run volatility is zero.

B. A variance estimated from the GARCH (1,1) model is a weighted average of the prior day's estimated variance and the prior day's squared return.

C. The GARCH (1,1) model assigns a higher weight to the prior day's estimated variance than the EWMA model.

D. A variance estimated from the EWMA model is a weighted average of the prior day's estimated variance and the prior day's squared return.

Q-89. The CRO of a major bank is reviewing a new risk measure, W, with the risk team. The CRO runs a test on the new risk measure to determine if the measure is coherent and satisfies the property of translation invariance. Which of the following tests would correctly determine that the risk measure W exhibits translation invariance?

A. When cash is added to a portfolio, the value of W for that portfolio should decrease by the amount of cash that is added.

B. When W is used to measure the risk of two portfolios A and B, then W(A) + W(B) should be less than or equal to W(A+B).

C. When W is used to measure the risk of two portfolios A and B, and if portfolio A always produces a worse outcome than portfolio B, then W(A) should always be higher than W(B).

D. When W is used to measure the risk of portfolio A, and if all exposures in portfolio A are increased by a constant factor, then W(A) should increase proportionally by that factor.

Q-90. Expected shortfall (ES) is a risk measure that does take account of expected losses beyond the VaR level. It was first proposed by Artzner et al. (1999) as an example of the coherent risk measure. Formally, the ES is defined as the expected loss conditional on the fact that the loss is greater than the VaR level. Lauren Li, FRM, is currently examining the properties of the ES. Under which of the following conditions will the ES drop in magnitude?

A. The time horizon is reset to become longer.

B. The sample size is adjusted to become larger.

C. The confidence level is reset to become lower.

D. The ES is a constant measure of risk for a given portfolio.

Q-91. The exponentially weighted moving average (EWMA) and the generalized autoregressive conditional heteroscedasticity (GARCH) are two well-recognized volatility models. Suppose we have a EWMA and a GARCH (1, 1). Both have the same parameter attached on the σ_{n-1}^2, and $\sigma_{n-1}^2 = r_{n-1}^2$. Further assume that σ_{n-1}^2 is currently above the long-run variance, which model will forecast a lower day n volatility?

A. The EWMA model.

B. The GARCH (1, 1) model.

C. The forecast is the same for both models.

D. Further information is required in order to make the comparison.

Q-92. Kevin, FRM, is a risk manager in the local bank's derivatives trading desk. He is currently adopting a delta-normal approach to calculate the expected shortfall for various option positions. Specifically, the trading desk has positions in the call option on stock XYZ with strike prices $35, $40, $45, and $50. Given that the current spot price of stock XYZ is $40, which position's delta-normal ES will be the closest to the true ES?

A. The call option with a strike price of $35.

B. The call option with a strike price of $40.

C. The call option with a strike price of $45.

D. The call option with a strike price of $50.

4.14. Credit Ratings

4.14.1. 重要知识点

4.14.1.1.

Explanation	Standard & Poor's	Moody's Services
Investment grade:		
Highest grade	AAA	Aaa
High grade	AA	Aa
Upper medium grade	A	A
Medium grade	BBB	Baa
Speculative grade:		
Lower medium grade	BB	Ba
Speculative	B	B
Poor standing	CCC	Caa
Highly speculative	CC	Ca
Lowest quality, no interest	C	C
In default	D	
Modifiers: A+, A, A-, and A1, A2, A3		

4.14.2. 基础题

Q-93. You are considering an investment in one of three different bonds. Your investment guidelines require that any bond you invest in carry an investment grade rating from at least two recognized bond rating agencies. Which, if any, of the bonds listed below would meet your investment guidelines?

A. Bond A carries an S&P rating of BB and a Moody's rating of Baa.

B. Bond B carries an S&P rating of BBB and a Moody's rating of Ba.

C. Bond C carries an S&P rating of BBB and a Moody's rating of Baa.

D. None of the above.

Q-94. What is the lowest tier of an investment grade credit rating by Moody's?

A. Baa1

B. Ba1

C. Baa3

D. Ba3

Q-95. In regard to through-the-cycle (TTC) versus at-the-point (aka, point in time, PIT) approaches to credit ratings, each of the following statements is true EXCEPT which is

false?

A. Agency (i.e., external) credit ratings tend to be through-the-cycle (TTC).

B. Through-the-cycle (TTC) is conditional, while at-the-point (PIT) is unconditional.

C. Credit spreads are at-the-point (PIT) and PIT measures incorporate more information.

D. During crisis periods, PIT approaches imply higher expected and unexpected loss (EL & UL) such that PIT tends to be pro-cyclical.

Q-96. A newly hired risk analyst at a large commercial bank is studying the methodologies used by banks and external rating agencies to generate and communicate credit ratings of credit instruments, firms, and sovereign issuers. The analyst compares common approaches to producing internal and external ratings, and examines the differences between through-the-cycle and point-in-time ratings. Which of the following statements should the analyst find to be correct?

A. As the economy moves from a period of high growth to a period of low growth, a rating produced using a point-in-time approach is more likely to change than a rating produced using a through-the-cycle approach.

B. A bank's internal ratings are more likely to be produced using a through-the-cycle approach, while ratings from external agencies are more likely to be produced using a point-in-time approach.

C. External rating agencies use outlooks to indicate a near-term change in a rating, while using watchlists to indicate a medium-term change in a rating.

D. Banks typically produce internal ratings based solely on a set of financial ratios related to the borrower's leverage and earnings.

Q-97. A risk manager at a retail bank is conducting a training session for newly hired risk analysts about the concept of unexpected loss (UL). To illustrate the calculation of UL, the manager provides the following data on a hypothetical loan portfolio:

- Principal amount of loan portfolio: SGD 120 million
- Portfolio default rate: 2.5%
- Recovery rate: 30%
- year 99% VaR: SGD 9.6 million
- year 99% ES: SGD 14.8 million

What is the 1-year UL of the loan portfolio at the 99% confidence level?

A. SGD 7.5 million

B. SGD 11.7 million

C. SGD 12.7 million

D. SGD 16.9 million

Q-98. A senior trader on the fixed-income trading desk of an investment bank is presenting to a group of newly hired analysts on key drivers of credit risk. The trader illustrates the concept of recovery rates using a scenario of a bank buying a corporate bond. Which of the following would the trader be correct to identify as an example of a corporate bond that is held by the bank and has a recovery rate of 35%?

A. If the corporate issuer becomes insolvent, liquidation of the issuer's assets would result in the bank receiving 35% of the price it initially paid for the bond.

B. If the corporate issuer defaults on a collateralized bond, the bank would take possession of an amount of collateral valued at 65% of the bond's face value.

C. At the time the bank purchases the bond, there is a 65% unconditional probability that the corporate issuer will not make full and timely payments on the bond.

D. If the corporate issuer defaults on the bond, the value of the bond shortly after default is expected to equal 35% of the bond's par value.

Q-99. A junior analyst at a banking supervisory agency is taking an internal training class on the Vasicek model. The analyst reviews the following equations related to the model:

$$U_i = a_i F + \sqrt{1 - a_i^2} Z_i$$

$$\text{Default Rate as a function of } F = N\left(\frac{N^{-1}(PD) - aF}{\sqrt{1 - a^2}}\right)$$

Which of the following statements regarding the Vasicek model is correct?

A. The default probabilities of the individual loans in a portfolio are each mapped to the standard normal distribution Ui, of which values in the extreme right tail represent default.

B. A low value of the factor F indicates that the economy is strong, while a high value of F represents economic weakness.

C. For corporate borrowers, the value of the factor F is higher for loans to companies with more cyclical businesses.

D. The model coefficient a directly relates to the correlations between the default probability distributions Ui of the loans in the portfolio.

Q-100. A group of credit risk analysts at a large bank is discussing regulatory capital and economic capital in relation to different types of risk exposures. The analysts evaluate differences in the approach to calculating these measures and in their use. In comparing the two types of capital, which of the following statements would the analysts be correct

to make?

A. Firm-wide economic capital is typically equal to the sum of the separately calculated capital amounts for credit risk, market risk, and operational risk.

B. An increase in the probability of default of a loan portfolio increases economic capital, while leaving regulatory capital unchanged.

C. Economic capital is the amount of capital a bank needs to cover its expected losses, while regulatory capital is the amount of capital a bank needs to cover its unexpected losses.

D. Firm-wide economic capital typically considers correlations between credit risk, market risk, and operational risk.

Q-101. An operational risk analyst is attempting to estimate a bank's loss severity distribution. However, there is a limited amount of historical data on operational risk losses. Which of the following is the best way to address this issue?

A. Generate additional data using Monte Carlo simulation and merge it with the bank's internal historical data.

B. Estimate the parameters of a Poisson distribution to model the loss severity of operational losses.

C. Estimate relevant probabilities using loss information that is published by credit rating agencies.

D. Merge external data from other banks with the bank's internal data after making appropriate scale adjustments.

4.15. Transition Matrix

4.15.1. 重要知识点

4.15.1.1. Agencies publish cumulative default rates categorized by rating (i.e., the cumulative default rate per rating category) and transition matrices. Transition matrices plot the frequency of rating migrations over time

4.15.1.2. Lower rated obligors tend to default more frequently.

4.15.1.3. Better (worse) ratings are associated with lower (higher) default rates.

4.15.2. 基础题

Q-102. Which of the following statements is incorrect, given the following one-year rating transition matrix?

From/To (%)	AAA	AA	A	BBB	BB	B	CCC/C	D	Non Rated
AAA	87.44	7.37	0.46	0.09	0.06	0,00	0.00	0.00	4.59

AA	0.60	86.65	7.78	0.58	0.06	0.11	0.02	0.01	4.21
A	0.05	2.05	86.96	5.50	0.43	0.16	0.03	0.04	4.79
BBB	0.02	0.21	3.85	84.13	4.39	0.77	0.19	0.29	6.14
BB	0.04	0.08	0.33	5.27	75.73	7.36	0.94	1.20	9.06
B	0.00	0.07	0.20	0.28	5.21	72.95	4.23	5.71	11.36
CCC/C	0.08	0.00	0.31	0.39	1.31	9.74	46.83	28.83	12.52

A. BBB loans have a 4.08% chance of being upgraded in one year.

B. BB loans have a 75.73% chance of staying at BB for one year.

C. BBB loans have an 88.21% chance of being upgraded in one year.

D. BB loans have a 5.72% chance of being upgraded in one year.

Q-103. Given the following ratings transition matrix, calculate the two-period cumulative probability of default for a B credit.

Rating at beginning of period	Rating at End of period			
	A	B	C	D
A	0.95	0.05	0.00	0.00
B	0.03	0.90	0.05	0.02
C	0.01	0.10	0.75	0.14
Default	0.00	0.00	0.00	1.00

A. 2.0%

B. 2.5%

C. 4.0%

D. 4.5%

4.16. Expected Credit Loss and Unexpected Credit Loss

4.16.1. 重要知识点

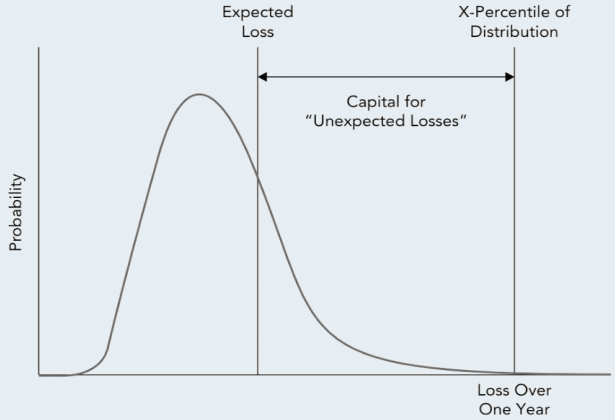
4.16.1.1. Expected Credit Loss

- The losses that banks take into account when setting lending rates.

$$EL = EAD \times PD \times LGD$$

4.16.1.2. Unexpected Credit Loss

- The actual loss in a given year above the expected loss



4.16.1.3. Mean and Standard Deviation of Credit Losses

$$\mu_i = p_i \times L_i(1-R_i) + (1-p_i) \times 0 = p_i L_i(1-R_i)$$

$$\sigma_i = \sqrt{p_i - p_i^2}(L_i(1-R_i))$$

$$\sigma_P^2 = n\sigma^2 + n(n-1)\rho\sigma^2$$

4.16.1.4. Gaussian Copula Model

- Used by regulators to determine capital for loan portfolios. It uses the Gaussian copula model to define the correlation between defaults.

4.1.1.1. One-Factor Correlation Model

$$U_i = a_i F + \sqrt{1-a_i^2} Z_i$$

- F is a factor common to all the U_i, Z_i is the component that is unrelated to the common factor F, a_i are parameters. The variables F and Z_i have standard normal distributions.

4.1.1.2. Vasicek Model

$$(\text{WCDR} - \text{PD}) \times \text{LGD} \times \text{EAD}$$

$$99.9 \text{ percentile for default rate} = N\left(\frac{N^{-1}(PD) - aN^{-1}(0.001)}{\sqrt{1-a^2}}\right)$$

4.16.2. 基础题

Q-104. An investor holds a portfolio of $100 million. This portfolio consists of A-rated bonds ($40 million) and BBB-rated bonds ($60 million). Assume that the one-year probabilities of default for A-rated and BBB-rated bonds are 3%and 5%, respectively, and that they are independent. If the recovery value for A-rated bonds in the event of default is 70% and the recovery value for BBB-rated bonds is 45%, what is the one-year expected credit loss from this portfolio?

A. $1672000

B. $1842000

C. $2010000

D. $2218000

Q-105. Consider the following four short-term loans held by a bank:

Loan	Remaining Term (in months)	Exposure at default (millions)	One-year Probability of Default (*)	Loss Given Default
a.	3	$100.00	4.00%	90.0%
b.	6	$120.00	3.00%	60.0%
c.	9	$150.00	2.00%	60.0%
d.	12	$200.00	1.00%	50.0%
(*)Hazard rate (aka, default intensity) which is by definition continuous, but it is okay to assume discrete as difference is not here material.				

Which loan has the highest expected loss in dollar terms?

A. Loan (a)

B. Loan (b)

C. Loan (c)

D. Loan (d)

Q-106. Bank regulators are examining the loan portfolio of a large, diversified lender. The regulators' main concern is that the bank remains solvent during turbulent economic times. Which of the following statements is most likely the area on which the regulators will want to focus?

A. Expected loss, since each asset can expect, on average, to decline in value from a positive probability of default.

B. Expected loss, given the decrease in underwriting standards of new loans.

C. Unexpected loss, since the bank will need to set aside additional capital for the unlikely event that recovery rates are smaller than expected.

D. Unexpected loss, since the bank will need to set aside additional capital for the unlikely event that loss rates are smaller than expected.

Q-107. Expected loss (EL) has three components: probability of default (PD), exposure amount (EA), and loss rate (LR). With respect to these components of EL, each of the following is true EXCEPT which is not accurate?

A. Exposure amount (EA) is the standard deviation of credit losses estimated at the end of the horizon excluding outstanding interest payments.

B. Probability of default (PD) is the probability that a borrower will default before the end

of a predetermined period of time (the estimation horizon typically chosen is one year).

C. Loss rate (LR) represents the ratio of actual losses incurred at the time of default (including all costs associated with the collection and sale of collateral) to the exposure amount.

D. Expected loss (EL) is equal to the product of: the probability of default up to time H (horizon); the exposure amount at time H; and the loss rate experienced at time H; i.e., $\mathrm{EL(H)} = \mathrm{PD(H)} \times \mathrm{EA(H)} \times \mathrm{LR(H)}$.

Common text for following two questions:

Q-108. Suppose that a bank has a portfolio with 50,000 loans, and each loan is USD 1 million with a 1.1% PD in a year. The recovery rate is 40% and the correlation between loans is 0.2. Assume that L=1. The standard deviation of the loss on a loan is closest to?

A. 0.01100.

B. 0.01088.

C. 0.04172.

D. 0.06258.

Q-109. The standard deviation of the loss from the loan portfolio as a percentage of its size is closest to?

A. 0.0152.

B. 0.0280.

C. 0.0416.

D. 0.0559.

Q-110. A risk manager at a bank is speaking to a group of analysts about estimating credit losses in loan portfolios. The manager presents a scenario with a portfolio consisting of two loans and provides information about the loans as given below:

	Loan 1	**Loan 2**
Amount borrowed	CNY 15 million	CNY 20 million
Probability of default	2%	2%
Recovery rate	40%	25%
Default correlation between Loan 1 and Loan 2	0.6	

Assuming portfolio losses are binomially distributed, what is the estimate of the standard deviation of losses on the portfolio?

A. CNY 1.38 million
B. CNY 1.59 million
C. CNY 3.03 million
D. CNY 3.36 million

Q-111. A risk analyst at a bank is estimating the distribution of credit losses for a portfolio of 30 identical loan exposures. The analyst assumes that the credit losses follow a binomial distribution. Each loan has the following characteristics:

- Amount: SGD 500,000
- Probability of default: 4%
- Recovery rate: 30%
- Average pairwise default correlation: 0.4

What is the standard deviation of losses on the loan portfolio expressed as a percentage of the size of the portfolio?

A. 3.8%
B. 5.8%
C. 7.8%
D. 8.9%

Q-112. A Swiss chemical company is considering issuing bonds to finance its planned expansion. A risk analyst involved in the capital raising program at the company is studying the external agency rating process to gain a better understanding of the implications of agency ratings for the firm's financing plans. Which of the following statements is correct?

A. Agency ratings tend to produce identical default rates for companies in the same industry but located in different countries.
B. Empirically, changes in bond and stock prices tend to be greater in cases of ratings downgrades than ratings upgrades.
C. Rating agencies produce point-in-time ratings, as these are designed to provide the best current estimate of future default probabilities.
D. Rating agencies provide outlooks to indicate the potential for a change in rating in the short-term, and use watchlists to indicate medium-term changes.

Q-113. A credit risk analyst at a bank is estimating the annual default probabilities of a 2-year loan that has just been extended. The analyst determines from rating agency data that the average hazard rate between today and end-of-year 2 is 2%, and uses this information to calculate the 1-year survival rate for the borrower. If the unconditional

default probability between end-of-year 1 and end-of-year 2 is 0.9656%, what is the survival rate of the borrower during the first year of the loan?

A. 0.9804.

B. 0.9704.

C. 0.9604.

D. 0.9504.

Q-114. A bank has a $100 million portfolio of loans with a PD of 0.75%. The correlation parameter is estimated to be 0.2, and the recovery rate in the event of a default is 30%. Suppose that the 99.9-percentile of the default rate given by the Vasicek model is 12.01%, what is the required regulatory capital?

A. $5.88 million.

B. $6.88 million.

C. $7.88 million.

D. $8.88 million.

4.17. Country Risk

4.17.1. 重要知识点

4.17.1.1. Sources of country risk

- Where the country is in the economy growth life cycle;
- Political risks;
- The legal systems of a country, including both the structure and the efficiency of legal system;
- The disproportionate reliance of a country on one commodity or service.

4.17.1.2. Factors influencing sovereign default risk

- A country's level of and stability of tax receipts;
- Political risks;
- A country's level of indebtedness;
- Obligations such as pension and social service commitments;
- Backing from other countries or entities.

4.17.2. 基础题

Q-115. One of the traders whose risk you monitor put on a carry trade where he borrows in yen and invests in some emerging market bonds whose performance is independent of yen. Which of the following risks should you not worry about?

A. Unexpected devaluation of the yen.

B. A currency crisis in one of the emerging markets the trader invests in.
C. Unexpected downgrading of the sovereign rating of a country in which the trader invests.
D. Possible contagion to emerging markets of a credit crisis in a major country.

Q-116. A fixed-income trader recently joined a large bank that acts as a dealer in the sovereign bonds of several countries. The trader researches the differences between a country's foreign currency sovereign bonds and its local currency sovereign bonds, including the differences in their default risk and investor demand. Which of the following would the trader find to be correct?

A. A country's foreign currency debt rating is typically higher than its local currency debt rating.
B. Investors in foreign currency sovereign bonds typically lose the entire value of their investment upon a country's default, whereas investors in local currency bonds do not.
C. Debt issued in foreign currency is usually sold to investors based in the issuing country.
D. Printing money to pay its local currency debt can be useful for a country in the short term, but can result in serious economic consequences in the long term.

Q-117. Bank QRS is considering extending loans to corporations based in a frontier market country. A credit risk analyst at the bank has conducted research on the country to determine factors that may affect its country risk and has compiled the following findings:

- Item 1: The country's economy is dominated by oil production, and it holdssignificant oil reserves.
- Item 2: The country has recently enacted laws making it easier for investorsto file lawsuits against firms and their management teams than before.
- Item 3: The country has recently reformed its legal system to make it more independent of other branches of government.
- Item 4: The country's sovereign credit spreads have declined over the pastyear.

Which of these items is most likely to have a negative impact on the country's riskscore?

A. Item 1
B. Item 2
C. Item 3
D. Item 4

Q-118. When a firm defaults, its creditors usually have the right to force it to liquidate so that the situation will be resolved. However, this is not the case when a country defaults. Which of the following statements is the most accurate regarding the modern

consequences of a default by a sovereign nation?

A. The domestic currency will depreciate, which will sharply enhance the export.

B. The equity market will boom in the short run.

C. Political stability, because it has been observed that people still feel confident on their leaders after a default by their country.

D. The banking systems of the defaulting country will become more vulnerable.

4.18. Operational Risk

4.18.1. 重要知识点

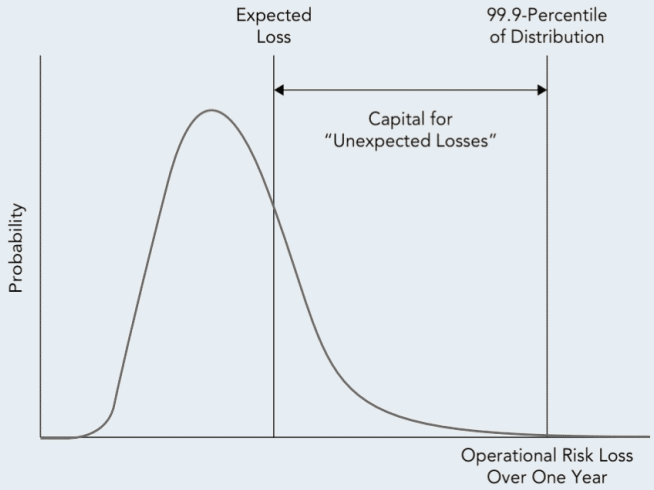
4.1.1.3. The definition of Operational Risk for Basel Committee: the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events, includes legal risk, but excludes strategic and reputational risk, which would be very difficult to measure.

4.1.1.4. Methods for capital requirements of Operational Risk

- Basic Indicator Approach: $\text{Capital}_{\text{BIA}} = \frac{\sum_{i=\text{last three years}} \text{GI}_i \times \alpha}{n}$
- Standardized Approach: $\text{Capital}_{\text{SA}} = \frac{\sum_{i=\text{last three years}} \max(\sum \text{GI}_{\text{line } 1-8} \times \beta_{\text{line } 1-8}, 0)}{3}$

Business Line	Beta Factor
Corporate finance	18%
Trading and sales	18%
Retail banking	12%
Commercial banking	15%
Payment, settlement	18%
Agency services	15%
Asset management	12%
Retail brokerage	12%

- Advanced Measurement Approach: $\text{Capital}_{\text{AMA}}$ = VaR(1-year, 99.9% confidence)



- Construction of the Loss Distribution: loss frequency (Possion distribution) and loss severity (lognormal distribution)

➢ Standardized Measurement

- The Basel committee provides a formula for calculating the required capital from the loss component and the BI component.

4.18.2. 基础题

Q-119. According to current Basel committee proposals, banks using the advanced measurement approach must calculate the operational risk capital charge at a:

A. 99 percentile confidence level and a 1-year time horizon.
B. 99 percentile confidence level and a 5-year time horizon.
C. 99.9 percentile confidence level and a 1-year time horizon.
D. 99.9 percentile confidence level and a 5-year time horizon.

Q-120. Which of the following statements concerning the measurement of operational risk is correct?

A. Economic capital should be sufficient to cover both expected and worst-case operational risk losses.
B. Loss severity and loss frequency tend to be modeled with lognormal distributions.
C. Operational loss data available from data vendors tend to be biased towards small losses.
D. The standardized approach used by banks in calculating operational risk capital allows for different beta factors to be assigned to different business lines.

Q-121. The standardized approach for calculating operational risk capital requirements uses beta factors for a given business line and annual gross income for business lines over a 3-year period. Which of the following business units has the highest beta factor?

A. Trading and sales.

B. Retail banking.

C. Agency and custody services.

D. Asset management.

Q-122. Your supervisor is an expert in market and credit risk. He recruits you to manage the operational risk department. He would like to use VaR to measure the firm's operational risk and proposes that you use the same VaR framework previously developed for market and credit risk. Which of the following arguments is a valid argument for why it is difficult to estimate an operational VaR using the same framework as market and credit VaR?

A. Market risk events are easier to map to risk factors than operational risk events.

B. Quantitative methods for estimating operational risk VaR do not exist.

C. Market and credit VaRs are estimated using only frequency distribution, but operational VaR is estimated using both a frequency distribution and a severity distribution.

D. Monte Carlo techniques cannot be used for an operational risk VaR because the underlying risk factors are not normally distributed.

Q-123. An operational risk manager is presenting to a group of risk analysts about different techniques to model operational risk. An analyst asks the manager about the appropriate use of the power law in estimating operational losses. Which of the following would be a correct statement for the manager to make about the use of the power law?

A. It implies that operational losses tend to follow a normal distribution.

B. It is more effective in modeling some types of operational risk, such as losses from fraud, than others, such as losses from natural disasters.

C. It is generally used to estimate routine operational losses which occur at a relatively high frequency.

D. It is suitable for modeling the tail of the operational loss distribution, but not for modeling the body of the distribution.

Q-124. An emerging market bank that has previously calculated operational risk capital using the basic indicator approach will begin using the Basel II standardized approach instead, having just met the necessary criteria for doing so. Which of the following correctly describes a way in which the bank's operational risk capital calculations will change?

A. The calculations will need to be broken down by the operational risk types defined by the Basel Committee.

B. The calculations will be based on a percentile of a loss distribution rather than a

percentage applied to gross income.

C. The calculations will need to be broken down by business line.

D. The calculations will now need to include a Business Indicator component.

4.19. Stress Testing

4.19.1. 重要知识点

4.1.1.5. Governance over Stress Testing

- Governance Structure
- Policies, Procedures and Documentation
- Internal Audit
- Validation and Independent Review

4.19.2. 基础题

Q-125. A manager at an asset management firm relies on a VaR-based risk measurement system that calculates VaR for each of the firm's portfolios as well as an aggregate firm-wide VaR. The CRO proposes implementation of a stress testing approach to supplement the VaR system. Which of the following statements best supports the CRO's proposal?

A. In practice, stress tests utilize a great number of scenarios while VaR measures rely on just a few scenarios to create their loss estimates.

B. Stress testing makes it possible to capture dependencies between asset classes in specific scenarios that cannot be captured well through a VaR-based system.

C. Stress testing is more accurate than a VaR-based system in predicting the probability of losses at a point in time.

D. While stress testing is similar to VaR, it is restricted to using only distributions of macroeconomic variables to generate its predictions.

Q-126. Which of the following statements about governance structure is/are not accurate?

I. Senior management has ultimate oversight responsibility and accountability for an entire institution.

II. Senior management should use scenario analysis, not stress testing, to evaluate an institutions risk decisions.

III. The board of directors has responsibility for implementing authorized stress testing activities.

IV. The board of directors can change an institution's capital levels and exposures following a review of stress test results.

A. II only.
B. I, II, III.
C. IV only.
D. All not.

Q-127. Which of the following statements best reflects the responsibilities of an internal audit?

I. An internal audit should assess the staff involved in stress testing activities.
II. An internal audit should review the manner in which stress testing efficiencies are identified and tracked.
III. The internal audit function needs to be impartial but does not need to be independent.

A. I and II only.
B. I, II and III.
C. II.
D. I only.

Q-128. A financial institution is planning to add stressed VaR to the measures it uses to assess market risk. In preparation for this development, a risk analyst at the institution researches the differences between stressed VaR and traditional VaR, including the appropriate data, time horizons, and distributions. Which of the following is a major characteristic of stressed VaR that distinguishes it from traditional VaR?

A. Stressed VaR is based on an unconditional loss distribution rather than a conditional loss distribution.
B. Stressed VaR typically uses much longer time horizons, often several months or years.
C. Stressed VaR uses a different assumed probability distribution as an input compared to traditional VaR.
D. Stressed VaR is not necessarily based on data from the immediately preceding period, unlike traditional VaR.

Q-129. The CRO of a multinational bank has assigned a team of risk analysts to design scenarios for an upcoming stress test. The analysts discuss the common approaches used by financial institutions to develop scenarios. Which of the following statements regarding stress testing scenarios is correct?

A. Scenarios that have not occurred in the past, but are created by assuming changes of a certain amount in key variables, are typically not used in stress testing.
B. Extremely adverse scenarios can be developed from moderately adverse periods in the

past by multiplying movements in all risk factors by a certain amount, although this approach may fail to account for changes in correlations between these factors.

C. Historical scenarios of one day or one week in length are not useful in stress testing because such periods are not considered long enough to pose a meaningful threat to a bank's financial stability.

D. Senior management should leave the development of scenarios to risk managers and analysts who have the deepest knowledge of the risk exposures of the various business lines.

Q-130. Which of the following reasons best explains why institutions use reverse stress tests?

I. To test events that threatens the viability of the institution.

II. To assess where multiple risks occur simultaneously.

A. I only.

B. II only.

C. Neither I nor II.

D. Both I and II.

Q-131. Which of the following statements regarding differences between stress tests and economic capital (EC) methods is (are) not correct?

I. Stress tests tend to analyze a shorter period of time compared to EC methods.

II. Stress tests tend to compute losses from the perspective of the market as opposed to EC methods that compute losses from an accounting perspective.

III. Stress tests tend to use ordinal rank arrangements, while EC methods use cardinal probabilities.

IV. Stress tests tend to focus on unconditional scenarios, which EC methods tend to focus on conditional scenarios.

A. I and II only.

B. I, II and III.

C. II only.

D. I ,II and IV.

Solutions

Valuation and Risk Models

Q-1. Solution: D

The solution is to replicate the 1 year 8% bond using the other two treasury bonds. In order to replicate the cash flows of the 8% bond, you could solve a system of equations to determine the weight factors, F_1 and F_2, which correspond to the proportion of the zero and the 10% bond to be held, respectively.

The two equations are as follows:

$(100 \times F_1) + (105 \times F_2) = 104$ (replicating the cash flow including principal and interest payments at the end of 1 year), and $(5 \times F_2) = 4$ (replicating the cash flow from the coupon payment in 6 months.)

Solving the two equations gives us $F_1 = 0.2$ and $F_2 = 0.8$. Thus the price of the 8% bond should be $0.2 \times 96.12 + 0.8 \times 106.2 = 104.18$.

Q-2. Solution: C

$$(2.875/2 + 100)X_1 + (6.25/2 + 100)(1 - X_1) = (4.5/2 + 100)$$
$$X_1 = 0.52$$
$$\text{Price} = 0.52 \times 94.40 + (1 - 0.52) \times 101.30 = 97.71$$

Q-3. Solution: B

B is correct. Spread is a measure of the excess return earned on a bond over the return provided by a reference security or securities (e.g. Treasury securities).

Because the cash flows offered by the reference security are discounted by the appropriate forward rates, adding a spread to these rates serves to decrease the corresponding discount factors. The larger the spread, the greater the decrease in the discount factors, therefore the lower the bond price. Thus, the price of Bond Y (with its 70 bps spread) is lower than the price of Bond X (with its 30 bps spread).

A is incorrect. As mentioned above, spreads can be interpreted as the excess return earned over the return provided by the comparable reference security. Bond X's positive spread indicates a higher return than the Treasury bond.

C is incorrect. Spreads are applied to the forward rate curve of the reference security, not its yield to maturity.

D is incorrect. This is not a valid application of spreads.

Q-4. Solution: B

N = 8, PV = -975, PMT = 60, FV = 1000, CPT I/Y = 6.40913%

Q-5. Solution: D

This ignores the coupon effect. Fairly prices bonds will have various yields.

In regard to (A), (B), and (C), each is TRUE.

Q-6. Solution: A

Explanation A is correct. Calculating the impact of the change in rates is the second step in decomposing the P&L of a bond, after calculating the carry roll-down. The impact of a rate change is calculated as the value of the bond at the end of the period using the ending forward rate curve (and the bond's beginning-of-period spread), minus the end-of-period value of the bond calculated using the forward rates assumed for the purpose of determining carry roll-down (which represent some sense of "no change" in the interest rate environment). The value of the bond under the ending forward rate curve is:

$$\frac{1}{1+\frac{0.007}{2}+\frac{0.003}{2}}+\frac{1}{\left(1+\frac{0.007}{2}+\frac{0.003}{2}\right)\times\left(1+\frac{0.01}{2}+\frac{0.003}{2}\right)}$$

$$+\frac{101}{\left(1+\frac{0.007}{2}+\frac{0.003}{2}\right)\times\left(1+\frac{0.01}{2}+\frac{0.003}{2}\right)\times\left(1+\frac{0.012}{2}+\frac{0.003}{2}\right)}$$

$$=101.09$$

Therefore, the impact of the rate change is:

SGD 101.09 - SGD 100.55 = SGD 0.54

B is incorrect. This uses the end-of-period spread of 20 bps in the above calculation rather than the beginning-of-period spread of 30 bps.

C is incorrect. This subtracts the bond's initial price, rather than the value from the carry roll-down calculation, from the value produced in the change in rates calculation: 101.09 – 100.35 = 0.74.

D is incorrect. This omits the spread from the above calculation of the impact of the change in rates.

Q-7. Solution: D

Assuming parallel movements to the yield curve, the expected price change is:

$\Delta P = -P \times \Delta y \times D$

P is the current price or net present value.

Δy is the yield change.

D is duration

All else equal, a negative impact of yield curve move is stronger in absolute terms at the bond which is currently priced higher. Upward parallel curve movements makes bonds cheaper.

Q-8. Solution: A

DV01 may not be a reliable measure when interest rates changes are not small. Also, when applying

DV01 we assume that the yield curve shifts are parallel.

Q-9. Solution: B

(A)	(B)	(C)	(D)	(E)
Bond	**Value (USD)**	**Modified Duration**	**(B × C)**	**(D/B)**
1	4,000,000	7.5	30,000,000	
2	2,000,000	1.6	3,200,000	
3	3,000,000	6	18,000,000	
4	1,000,000	1.3	1,300,000	
SUM	10,000,000		52,500,000	5.25

The portfolio modified duration is 5.25. This is obtained by multiplying the value of each bond by the modified duration(s), then taking the sum of these products, and dividing it by the value of the total bond portfolio.

The change in the value of the portfolio will be -10,000,000 × 5.25 × 0.1% = -52,500

Q-10. Solution: C

C is correct. In order to change the interest rate exposure by taking a position with negative duration, the manager will need to invest in securities that decrease in value as interest rates fall (and increase in value as interest rates rise). An interest rate swap paying fixed and receiving LIBOR plus a spread will increase in value as interest rates rise.

A is incorrect. Although the call feature of a callable bond decreases the bond's duration in comparison to an otherwise identical option-free bond, the overall duration of the bond remains positive.

B is incorrect. Similarly to a callable bond, the duration of a putable bond remains positive despite being lower than that of an otherwise identical option-free bond .

D is incorrect. An interest rate swap paying LIBOR plus a spread and receiving fixed will decrease in value as interest rates rise.

Q-11. Solution: C

C is correct. Under discrete compounding frequency (in this case, the compounding frequency is annual since we have assumed annual coupon payment), modified duration and modified convexity should be used to perform analysis. Based on the formula, we have:

$$\Delta P \approx -\text{Mod. D} \times P \times \Delta y + \frac{1}{2}\text{Mod. C} \times P \times (\Delta y)^2$$

$$= -3.8653 \times 94.3138 \times 0.005 + \frac{1}{2} \times 21.8945 \times 94.3138 \times 0.005^2$$

$$= -\$1.7969$$

Q-12. Solution: A

Option-free bonds have positive convexity and the effect of (positive) convexity is to increase the magnitude of the price increase when yield fall and to decrease the magnitude of the price decrease when yields rise.

Q-13. Solution: A

If a consol (perpetual) bond with a $100 face value pays a 3.0% coupon in perpetuity and the yield is 5.0%, the consol's price is $60 and its modified duration is 20 years. Each of the other three answers are FALSE (or not necessarily true):

In regard to (B), the barbell outperforms if rates move by a large amount, but the bullet outperforms if rates move by a small amount.

In regard to (C), duration and convexity are increasing with maturity, but DV01 is not necessarily increasing with maturity for (deeply) discounted bonds: DV01 = P*mod duration/10,000 such that with increasing maturity, mod duration in the numerator is increasing ("duration effect") but (think about "pull to par" in reverse), the (P) is decreasing with maturity (the "price effect").

In regard to (D), this is false as both portfolio duration and convexity are (simple) weighted averages.

Q-14. Solution: A

As yields in the market declines, the probability that the call option will get exercised increases. This causes the price to reduce relative to an otherwise comparable option free bond, which is also known as a negative convexity.

Q-15. Solution: B

$D = (P_- - P_+)/(2P_0\triangle Y) = (96.35 - 92.75)/ (2 \times 94.65 \times 0.003) = 6.34$

Q-16. Solution: A

$$D = \frac{V_- - V_+}{2 \times V_0 \times \Delta y} = \frac{127.723 - 122.164}{2 \times 125.482 \times 0.003} = 7.38$$

Q-17. Solution: B

Convexity is defined as the second derivative of the price-rate function divided by the price of the bond. To estimate convexity, one must first estimate the difference in bond price per difference in the rate for two separate rate environments, one a step higher than the current rate and one a step lower. One must then estimate the change across these two values per difference in rate. This

is given by the formula:

$$C = \frac{1}{P_0} \times \frac{\frac{P_+ - P_0}{\Delta r} - \frac{P_0 - P_-}{\Delta r}}{\Delta r} = \frac{1}{P_0} \times \frac{P_+ - 2P_0 + P_-}{(\Delta r)^2}$$

Where Δr is the change in the rate in one step; in this case, 0.02%.

Therefore, the best estimate of convexity is:

$$C = \frac{1}{101.61158} \times \frac{(100.92189 - 2 \times 101.61158 + 102.07848)}{(0.02\%)^2} = -54{,}814$$

Q-18. Solution: C

To construct a barbell portfolio with the same cost and same duration as the bullet:

Cost of bullet = (106.443/100) ×USD 60,000,000 = USD 63,865,800

If V_2 and V_{15} are values (costs) of the 2-Year and 15-Year Treasuries, respectively, then,

$V_2 + V_{15}$ = USD 63,865,800 (1)

Therefore, to match duration:

Duration of bullet = weighted-average duration of 2-year and 15-year Treasuries

6.272 = (V_2/63,865,800) ×1.938 + (V_{15}/63,865,800) ×11.687 (2)

From Equation (1), $V_2 = 63{,}865{,}800 - V_{15}$. Then, Equation (2) becomes:

6.272 = [(63,865,800 – V_{15})/63,865,800)] ×1.938 + (V_{15}/63,865,800) ×11.687

400,566,297.6 = 123,771,920.4 – $1.938V_{15}$ + $11.687V_{15}$

276,794,377.2 = $9.749V_{15}$

And so, V_{15} = USD 28,392,078.90

And so, V_2 = 63,865,800 – V_{15} = 63,865,800 – 28,392,078.90 = USD 35,473,721.10

Giving weight of 2-Year Treasury = 35,473,721.10/63,865,800 = 55.54%

And weight of 15-year Treasury = 28,392,078.90/63,865,800 = 44.46%

A is incorrect. It incorrectly calculates the weights based on duration as: weight of 2-Year T = 1.938/(1.938 + 11.687) = 14.22%; and weight of 15-year T = 1 – 0.1422 = 85.78%.

B is incorrect. It switches the weights derived in C above.

D is incorrect. It switches the weights explained in A above.

Q-19. Solution: B

As convexity scales with roughly the square of maturity, the long-duration bond in the barbell portfolio will disproportionately increase the convexity of the barbell.

Q-20. Solution: A

If large rate chance, barbell outperforms bullet.

Q-21. Solution: C

The 10 basis point shock to the 10-year spot rate is supposed to decline linearly to zero for the 20-year spot rate. Thus, the stock decrease by 1 basis point per year and will result in an increase of 6 basis points for the 14-year spot rate.

Q-22. Solution: D

Key rate exposures assume that key rates chosen adjacent to the rate of interest are affected, not across other key rates.

Q-23. Solution: C

Key rate'01 with respect to the 30-year shift is calculated as follows:

-1/10,000 (25.01254 − 25.11584) / (0.01%) = 0.103 or 25.01254-25.11584=0.103

This implies that the C-strip decreases in price by 0.103 per 100 face amount for a positive one basis point 30-year shift.

Q-24. Solution: D

Key rate duration for the 30-year shift is calculated as follows:

-1/25.11584 (25.01254 − 25.11584) / (0.01%) = 41.13

Q-25. Solution: C

We have three equations and three unknowns.

The 10-year face value required is simply =$100/$0.1*$100 = $100,000;

The five-year face value required is found by solving for F(5) in:

F(5)*0.04/100 + $100,000 * 0.05/100 = 60, such that F(5) = $25,000.

The two-year face value required is found by solving for F(2) in:

F(2)*0.01/100 + $25,000*0.01 / 100 + $100,000*0.01 /100 = 20, such that F(2) = $75,000.

Q-26. Solution: A

A is correct. The current value of the bond is:

$$\frac{5000}{1.03}+\frac{5000}{1.03^2}+\frac{150000}{1.03^3}=105657.22$$

When forward rates in the 2-3 year forward bucket are increased by 1 bp, the value of the bond becomes:

$$\frac{5000}{1.03}+\frac{5000}{1.03^2}+\frac{150000}{1.03^2*1.0301}=105647.89$$

The forward bucket 01 is the difference between these values: 105,657.22 – 105,647.89 = CNY 9.33

Q-27. Solution: B

Calculation follows:

$$P_{up} = \frac{e^{r\Delta t} - d}{u - d} = \frac{e^{0.12\times 3/12} - 0.8}{1.2 - 0.8} = 57.61\%$$

Q-28. Solution: C

Under the initial set of assumptions, $u = e^{\sigma\sqrt{\Delta t}} = e^{0.2840\sqrt{1}} = 1.32950$ and $d = 1/1.32950 = 0.75216$, such that $p = d = 0.50$.

If the dividend is included, then $p = \frac{e^{(r-q)\Delta t} - d}{u-d} = 0.46427$. Therefore, $d = 1 - 0.46427 = 0.53573$, and the increase is about 3.570%.

Q-29. Solution: C

Following Hull, a riskless portfolio consists of long delta (d) shares + short one option.

If the stock moves up, value of the riskless portfolio = $13×delta - $3 loss on the written call option; and

If the stock moves down, value of the riskless portfolio = $7×delta. Setting them equal (i.e., riskless payoff):

$\$13 \times d - \$3 = \$7 \times d, \text{and } 6d = 3, \text{so } d = 0.5.$

If delta (d) = 0.5, then value of portfolio today is:

$\$10 \times 0.5 - f = 5 - f = \$3.5 \times e^{-1\%}$, such that

$f = 5 - \$3.5 \times e^{-1\%} = \$1.53483$

Notationally,

- $u = \frac{13}{10} = 1.3;\ d = \frac{7}{10} = 0.7$
- $p = \frac{e^{r\times\Delta t} - d}{u-d} = 0.51675$
- $f = e^{-rT} \times (0.51675 \times \$3 + 0) = \$1.53483$

Q-30. Solution: C

$u = 48/40 = 1.2$

$d = 32/40 = 0.8$

$$P_{up} = \frac{e^{r\Delta t} - d}{u - d} = \frac{e^{6.2\%\times 0.5} - 0.8}{1.2 - 0.8} = 57.87\%$$

$f = [(50 - 48) \times 0.5787 + (50 - 32) \times (1 - 0.5787)] \times e^{-6.2\%\times 0.5} = 8.47$

Early Exercise, therefore, the value of this American put is 10.

Q-31. Solution: C

$a = e^{(r-q)\Delta t} = e^{(2\%-2\%)\times 1/12} = 1.0$

$u = e^{\sigma\sqrt{\Delta t}} = e^{15\%\sqrt{1/12}} = 1.044,\ d = 0.958$

$p = (a-d)/(u-d) = (1.0-0.958)/(1.044 - 0.958) = 0.4892;$

$1-p = 0.5108$

Q-32. Solution: B

$u = 1.462 \quad d = 0.684$

$p = \dfrac{e^{r\times\Delta t} - d}{u-d} = (1.040811 - 0.684)/(1.462 - 0.684) = 0.4586$

Q-33. Solution: B

A two-step binomial has six nodes; the lower price occurs at S(0)×d×d, in the lower right.

$d = e^{-\sigma\sqrt{\Delta t}} = e^{-22\%\sqrt{1}} = 0.8025;$

The lowest node = $\$30 \times d \times d = \$19.321.$

Q-34. Solution: D

$u = e^{\sigma\sqrt{\Delta t}} = e^{18.25\%\times\sqrt{1}} = 1.2 \quad d = e^{-\sigma\sqrt{\Delta t}} = 0.83$

Next, we project the various paths the stock's price can follow over the 3 year period. The stock has 4 potential ending values:

$S_{uuu} = \$75 \times 1.2 \times 1.2 \times 1.2 = \$129.60$

$S_{uud} = S_{duu} = S_{udu} = \$75 \times 1.2 \times 1.2 \times 0.83 = \$89.64$

$S_{udd} = S_{dud} = S_{ddu} = \$75 \times 1.2 \times 0.83 \times 0.83 = \$62.00$

$S_{ddd} = \$75 \times 0.83 \times 0.83 \times 0.83 = \$42.89$

The only point at which the option finishes in the money is after 3 upward moves, with a probability of $60\%^3 = 21.6\%$.

The value of the option today is therefore$(129.60 - 90) \times 21.6\% \times e^{-5\%\times 3} = 7.36.$

Q-35. Solution: A

u=1.221, d=0.819, p=0.4626.

0	0.25	0.5
		10,890.32 (3,390.32)
	8,916.24 (1,556.69)	
7,300.00 (714.77)		7,300.00 (0)

5,976.73 (0)	
	4,893.34 (0)

Q-36. Solution: C

C is correct. The formula of d is given by $e^{-\sigma\sqrt{\Delta t}}$. Clearly, if Δt drops, d will increase.

A is incorrect. Altering the length of time step will alter the u and d. Thus, the stock prices on the nodes will change, so as the future option values (which will be discounted back). Further, the risk-neutral probabilities and discounting procedure will be affected as well. As a result, the option value must also changes.

B is incorrect. The formula of u is given by $e^{\sigma\sqrt{\Delta t}}$. Clearly, if Δt drops, u will decrease, not increase.

D is incorrect. According to the formula, the risk-neutral probability of an upward movement is affected by Δt:

$$p^* = \frac{e^{r\Delta t} - d}{u - d} = \frac{e^{r\Delta t} - e^{-\sigma\sqrt{\Delta t}}}{e^{\sigma\sqrt{\Delta t}} - e^{-\sigma\sqrt{\Delta t}}}$$

Q-37. Solution: B

It is never optimal to exercise an American call option on a non-dividend-paying stock before the expiration date, but at any given time during its life, a put option should always be exercised early if it is sufficiently deep in the money. Thus, it can be optimal to exercise an American put option on a non-dividend-paying stock early.

Q-38. Solution: B

The BSM model assumes:

- The price of the underlying asset moves in a continuous fashion.
- Interest rates are known and constant.
- Variance of returns is constant.
- Perfect liquidity and transaction capabilities.

Q-39. Solution: B

$$\text{put} = \text{Ke}^{-\text{rT}}\text{N}(-\text{d}_2) - \text{SN}(-\text{d}_1) = 20 \times \text{e}^{-4.25\% \times 0.5} \times (1 - 0.9651) - 25 \times (1 - 0.9737)$$
$$= 0.03$$

Q-40. Solution: B

$$d_1 = \frac{\ln(S_0/K) + \left(r - q + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} = 0.1422;\ \ d_2 = 0.0149$$

$$N(d_1) = 0.5565 \text{ and } N(d_2) = 0.5060$$

$$c = S_0 e^{-qT} N(d_1) - K e^{-rT} N(d_2) = \$2.753$$

Q-41. Solution: A

$$d_1 = \frac{\ln(1.34/1.40) + \left(4\% - 3\% + \frac{30\%^2}{2}\right) \times 1}{30\%\sqrt{1}} = 0.0373$$

$$d_2 = d_1 - 30\%\sqrt{1} = -0.2627$$

$$N(d_1) = 0.5149 \text{ and } N(d_2) = 0.3964$$

The foreign riskfree rate replaces the dividend yield, such that:

$$c = 1.34e^{-3\%} N(d_1) - 1.40e^{-4\%} N(d_2) = \$0.1364$$

Q-42. Solution: A

In this case $S_0 = 50$, K = 50, r = 0.1, σ = 0.3, T = 0.25, and

$$d_1 = \frac{\ln(50/50) + (0.1 + 0.09/2)0.25}{0.3\sqrt{0.25}} = 0.2417$$

$$d_2 = d_1 - 0.3\sqrt{0.25} = 0.0917$$

The European put price is:

$$50N(-0.0917)e^{-0.1\times0.25} - 50N(-0.2417)$$

$$= 50 \times 0.4634e^{-0.1\times0.25} - 50 \times 0.4045 = 2.37$$

Q-43. Solution: D

While the drift rate (%) is assumed constant, per the risk-neutral valuation, we let drift rate equal the riskless rate. The real-world rate of return is not required, is not an input in the Black-Scholes, and as Hull explains, is not an increasing function of the option (as a higher implied discount rate offsets the higher expected growth rate).

In regard to (A), (B) and (C), EACH is TRUE as a key assumption underlying the Black-Scholes OPM.

Q-44. Solution: B

$$\frac{N}{N+M} \cdot c = \frac{60{,}000{,}000}{60{,}000{,}000 + 3{,}000{,}000} \times 4.39 = 4.1809$$

Q-45. Solution: C

C is correct. Options are not actively traded on all assets; in these instances, reliable implied volatilities are not available.

A is incorrect. Volatility indexes exist that track the implied volatility of several major asset class indexes, including the S&P 500 (i.e. the "VIX"), commodities, interest rates, currencies, and other stock indexes.

B is incorrect. Implied volatilities are forward looking, whereas the volatilities calculated from historical data are backward looking.

D is incorrect. Implied volatilities for options of different maturities on the same underlying do indeed differ. However, these implied volatilities for different maturities give an indication of average volatility expected over the respective time periods. Because volatility exhibits mean reversion, we do not expect implied volatilities to be the same for options of all maturities.

Q-46. Solution: B

D is correct. If all the BSM model assumptions hold, then all options on the same underlying asset will have the same implied volatility at all times.

A is incorrect. Both the BSM model and the binomial tree approach use asset volatility computed from historical prices.

B is incorrect. Both the BSM model and the binomial tree approach use the risk-neutral valuation, that is, assume that the expected return from the underlying asset is the risk-free rate of interest.

C is incorrect. In the binomial tree approach, delta does not remain constant at every node (through time) even though the approach takes the probability of the price moving up and the probability of the price moving down not to change during a given period.

Q-47. Solution: B

B is correct. One simple approach to determine implied volatility is called successive bisection. Note that the price of an option is a continuous increasing function of its volatility. This means that if we keep increasing volatility, we will find a volatility that is higher than the implied volatility (i.e., a volatility that gives a value for the option that is greater than the market price). We will refer to this as the "too high volatility". Similarly, a volatility of zero is lower than the implied volatility since it gives a price that is less than the market price. We will refer to this as the "too low volatility". In this question, the "too high volatility" is 30%, while the "too low volatility" is by definition 0%. The steps are as follows. We first try a volatility that is the average of the "too high volatility" and "too low volatility". In this question, it is 15%. If 15% gives a price that is too high, this volatility becomes the new "too high volatility". If it gives a price that is too low, it becomes the new "too low volatility". In this question, 15% is the new "too low volatility"

because it gives a price that is below the market price. The new "too high volatility" and "too low volatilities" are then averaged, and the procedure is repeated until the implied volatility is found.

Q-48. Solution: C

For a short call, Delta Vega, Gamma, and Rho contribute to the risk of the position. Theta is not a risk factor.

Q-49. Solution: C

The delta of a call option with a continuous dividend yield is given by the following formula:

$\text{Delta} = e^{-qT}N(d_1) = 0.64 \times e^{-1\%\times 2} = 0.63$

Q-50. Solution: B

The short index futures makes the portfolio delta neutral. It does not help with large moves.

Q-51. Solution: C

To buy short-term options + sell long-term options → negative position theta, negative position vega,and positive position gamma.

In regard to (A), sell short-term + sell long-term options → positive theta,negative vega; negative gamma.

In regard to (B), sell short-term + buy long-term options → positive theta,positive vega; and negative gamma.

In regard to (D), buy short-term + buy long-term → negative theta,positive vega; and positive gamma.

Q-52. Solution: D

Statement I is false – rho of a call and a put will change, with expiration of time and it tends to approach zero as expiration approaches.

Statement II is false-theta is positive for long ITM European put.

Q-53. Solution: C

Theta is negative for long positions in ATM options, so A is incorrect. Gamma is small for ITM options, so B is incorrect. Delta of ITM puts tens to -1, so D is incorrect.

Q-54. Solution: C

A riskier position is one that is expected to move around a lot in value. A delta neutral position should not change in value as the value of the underlying asset changes. This eliminates Choice A and Choice D Choice C is correct because a gamma-negative position means that delta and the change in the underlying asset move inversely with each other.

Q-55. Solution: D

To reduce positive gamma, one needs to sell options. When call options are sold, the delta becomes negative and one needs to buy stock to keep delta neutrality. When put options are sold, the delta becomes positive, and one needs to sell stock to keep delta neutrality.

Q-56. Solution: D

In order to hedge a short call option position, a manager would have to buy enough of the underlying to equal the delta times the number of options sold. In this case, delta = 0.5, so for every two options sold, the manager would have to buy a share of the underlying security. (Stop-loss strategies with call options are designed to limit the losses associated with short option positions. The strategy requires purchasing the underlying asset for a naked call position when the asset rises above the option's strike price.)

Q-57. Solution: A

The call option is deep in-the-money and must have a delta close to one. The put option is deep out-of-the-money and will have a delta close to zero. Therefore, the value of the in-the-money call will decrease by close to USD 1, and the value of the out-of-the-money put will increase by a much smaller amount close to 0. The choice that is closest to satisfying both conditions is A.

Q-58. Solution: C

In the Black-Scholes framework, an in-the-money option is expected to change its value the most and out-of-money the least as a result of dividend payments. For the purpose of illustration, the impact of dividend payment on the option is characterized by:

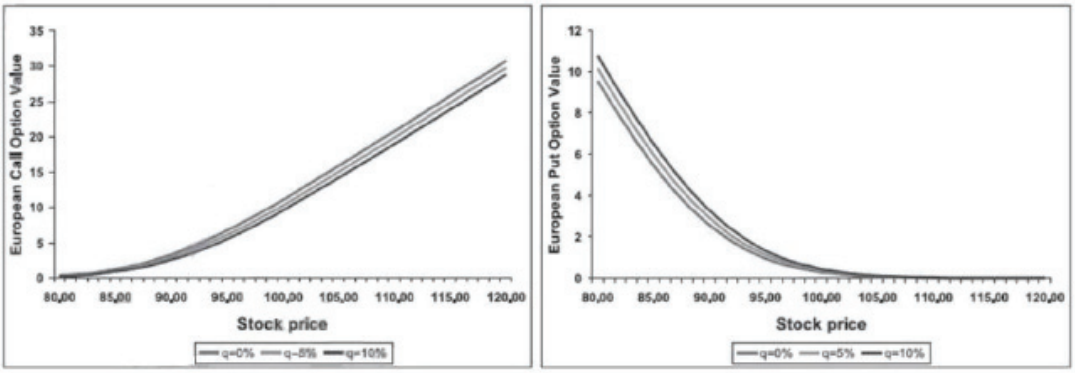
S = 93

K = 90

T = 60 days

r = 5%

sigma = 20%



Q-59. Solution: C

C is correct. Although gamma is similar to vega in that it is greatest for an option that is at-the-money and approaches zero as the option moves deep-in-the-money or deep-out-of-the-money, one important difference is that while vega increases as the time to maturity increases, gamma decreases. Since the 1-month option has a lower vega and a higher gamma than the 4-month option, a portfolio with a short position in the 1-month and a long position in the 4-month will have positive vega and negative gamma. Adding this to the original portfolio would reduce the gamma and increase the vega of the original portfolio.

A is incorrect. This would increase both gamma and vega.

B is incorrect. This would increase gamma and reduce vega.

D is incorrect. This would reduce both gamma and vega.

Q-60. Solution: A

Delta hedging the short call option position requires buying shares in an amount equal to the hedge ratio times the 100,000 shares underlying the call position. We can calculate the hedge ratio as $N(d_l)$ from the Black Scholes option pricing model. First we need to compute $N(d_l)$.

$$d_1 = \frac{\ln(50/49) + (0.05 + 0.20^2/2) \times 0.25}{0.20 \times \sqrt{0.25}} = 0.3770$$

We know that N(0.3770) has to be between 0.5 and 1.0, which means we need to buy somewhere between 50,000 and 100,000 shares. The only answer that fits is A, buy 65,000 shares. If you did have access to a probability table, you could determine that N(0.3770) = 0.6469, which means we need to buy exactly 64,690 shares to delta hedge the position.

Q-61. Solution: B

B is correct. In order to make the position delta neutral, we first need to compute the delta. Given the simple one-step binomial tree model, we can compute the delta for the long position on one call option:

$$\Delta = \frac{f_u - f_d}{S_0 u - S_0 d} = \frac{Max(23.75 - 20, 0) - Max(15.2 - 20, 0)}{23.75 - 15.2} = \frac{3.75}{8.55} = 0.4386$$

Because the trader holds short positions in 2,000 call options, the delta of his position is:

$$2{,}000 \times -0.4386 = -877.1930$$

Notice that the delta for a short position is the negative of that for a long position. Given the position delta, the trader should long about 877 shares (where each share has a delta of 1) to bring the delta to zero (i.e., delta neutral).

Q-62. Solution: B

B is correct. The company's current position has a delta of $2{,}000 \times 0.65 = 1{,}300$. Thus, we need a position with a delta of -1,300 to make achieve the delta neutrality. The delta of one futures contract (long position) is calculated as follows:

$$\Delta_{Futures} = e^{(r-q)T}$$

Because there is no information on dividend yield, we can assume that $q = 0$. Based on a risk-free rate of 3% and a six-month period, the futures delta is:

$$\Delta_{Futures} = e^{0.03 \times 0.5} = 1.0151$$

The amount of futures needed is therefore:

$$-\frac{1{,}300}{1.0151} = -1{,}280.6455$$

I.e., we short 1,281 futures to make the overall position delta neutral.

Q-63. Solution: A

Such a portfolio is short vega (volatility) and short theta (time). We need to implement a hedge that is delta-neutral and involves buying and selling options with different maturities. Long positions in short-dated options have high negative theta and low positive vega. Hedging can be achieved by selling short-term options and buying long-term options.

Q-64. Solution: B

This is standard definition of VaR, reworded slightly.

Q-65. Solution: C

VaR(X%) is defined as the dollar or percentage loss in portfolio value that will be exceeded only X% of the time. $\mathrm{VaR}(10\%) = \$0$ indicates that there is a 10% probability that on any given day the dollar loss will be greater than $0. Alternatively, we can say there is a 90% probability that on any given day the dollar gain will be greater than $0. VaR was developed by commercial banks to provide a more accurate measure of their economic capital requirements, taking into account the effects of diversification.

Q-66. Solution: A

The following formula is used to calculate the VaR for a linear derivative:

$VaRp = |\Delta| * VaR_f$

The delta in the formula is a sensitivity factor that reflects the change in value of the derivatives contract for a given change in the value of the underlying. The delta adjustment to the VaR of the underlying asset accounts for the fact that the relative changes in value between the underlying and the derivatives may not be one for one but nevertheless are linear in nature. Note that options are non-linear.

Q-67. Solution: B

If returns are independently and identically distributed, then

$\text{VaR}_{10-\text{day}} = \text{VaR}_{1-\text{day}} \times \sqrt{10} = 316{,}000{,}000$

Q-68. Solution: A

The VaR would be underestimated because of the greater frequency of losses in the tails of the distribution.

Q-69. Solution: D

$\text{VaR(dy)} = 2.33 \times 2\% \times \sqrt{10/252} = 0.0093$

$\text{VaR(dP)} = 3.6 \times 10{,}000{,}000 \times 0.0093 = 334{,}186$

Q-70. Solution: C

$\text{VAR}_{10-\text{day}} = \text{VAR}_{2-\text{day}} \times \frac{\sqrt{10}}{\sqrt{2}} = 5.59$

Q-71. Solution: B

With a puttable feature, the investor is long an option, because he or she can "put" back the bond to the issuer. This will create positive gamma, or lower VaR than otherwise.

Q-72. Solution: B

The computation follows: $\text{VaR}^2_{(\text{portfolio})} = \text{VaR}^2_{(\text{stocks})} + \text{VaR}^2_{(\text{fixed income})}$

Assuming the correlation is $1{,}367{,}000^2 = 1{,}153{,}000^2 + \text{VaR}^2_{(\text{fixed income})}$

$\text{VaR}_{(\text{fixed income})} = 734{,}357$

Next convert the annual VaR to daily VaR: $734{,}357/\sqrt{250} = 46{,}445$

Q-73. Solution: A

$\text{VaR} = |\Delta| \times 1.645 \times \sigma \times \text{S} = 0.5 \times 1.645 \times 0.015 \times \$23 = \$0.28$

The Δ of an at-the-money put is -0.5 and the absolute value of the Δ is 0.5.

Q-74. Solution: B

800*1.82%=14.56million

Q-75. Solution: D

A. is incorrect. This is the minimum.

B. is incorrect. This is the maximum.

C. is incorrect. This is the median.

D. is correct. Conditional VaR is the "mean" of the losses beyond the VaR level.

$$\text{Conditional VaR} = (\text{USD } 9 + \text{USD } 10 + \text{USD } 11 + \text{USD } 13 + \text{USD } 15 + \text{USD } 18 + \text{USD } 21 + \text{USD } 24 + \text{USD } 32)/9 = 17\text{million}$$

Q-76. Solution: C

$$\text{VaR} = |\Delta| \times \text{VAR(dS)} - \left(\frac{1}{2}\right)\Gamma \times \text{VAR(dS)}^2 = 100{,}000 \times 2 - \frac{1}{2} \times (-50{,}000) \times 2^2 = \$300{,}000$$

Q-77. Solution: D

If we just use a conversion factor of EUR 10 on the index, then we can use the standard delta, instead of the percent delta:

VaR(99% of Call) = D × index price × conversion × alpha (99%) × 1-day volatility = 0.5 × 2200 × 10 × 2.33 × 2.05% = EUR 525, with some slight difference in rounding.

Q-78. Solution: C

Annual VaR = 6,247,000 × (250^0.5) × (0.0002^0.5) × 1.645 = 2,297,854

Q-79. Solution: A

The VaR will always be higher under the linear approximation method than a full revaluation conducted by Monte Carlo simulation analysis.

Q-80. Solution: D

D is correct. The EWMA formula is:

$$\sigma_n^2 = (1-\lambda)r_{n-1}^2 + \lambda\sigma_{n-1}^2$$

Under the EWMA approach, when a new return is observed, the variance rate estimate is

updated using this return. When the next new return is observed, the previously observed return is not needed, as it is reflected in the previously calculated variance rate estimate. In this way, the term σ_{n-1}^2 in the formula contains information on all past returns.

Q-81. Solution: A

A is correct. In a historical simulation with a 500-day historical reference period, the 500 historical daily changes (from Day 0 through Day 500) are used to create 500 scenarios for what might happen between today and tomorrow (on Day 501).

In practice, the risk factors that may be used in a historical simulation are divided into two categories: those where the percentage change in the past is used to define a percentage change in the future, and those where the actual change in the past is used to define an actual change in the future. Stock prices are usually considered to be in the first category, while interest rates are usually considered to be in the second category.

The historical change in the stock price from Day 0 to Day 1 should therefore be measured as a 72 / 76 – 1 = -5.263% change, while the change in the interest rate should be measured as a 2.60% – 2.50% = 0.10% change. Applying these changes to the current stock price and interest rate of HKD 94 and 3.8%, respectively, produces a scenario for the historical simulation with a stock price of 94 * (1 – 0.05263) = HKD 89.05263, and an interest rate of 3.80% + 0.10% = 3.90%.

Q-82. Solution: A

The calculations follow. Calculate VaR(1-day) from each choice:

$\text{VaR}(10-\text{day}) = 316 \rightarrow \text{VaR}(1-\text{day}) = 316/\sqrt{10} = 100$

$\text{VaR}(15-\text{day}) = 465 \rightarrow \text{VaR}(1-\text{day}) = 465/\sqrt{15} = 120$

$\text{VaR}(20-\text{day}) = 537 \rightarrow \text{VaR}(1-\text{day}) = 537/\sqrt{20} = 120$

$\text{VaR}(25-\text{day}) = 600 \rightarrow \text{VaR}(1-\text{day}) = 600/\sqrt{25} = 120$

VaR(1-day) from A is different from those from other answers.

Q-83. Solution: B

The model that will take the shortest time to revert to its mean is the model with the lowest persistence defined by α＋β. So B is the right answer with α＋β = 0.97.

Q-84. Solution: A

$$\boldsymbol{\sigma_n^2 = \lambda\sigma_{n-1}^2 + (1-\lambda)\mu_{n-1}^2}$$

$$\sigma_t = \sqrt{(0.94)(0.015)^2 + (1-0.94)(\frac{30.5-30}{30})^2} = 0.01510519 = 1.5105\%$$

Q-85. Solution: B

The most recent weight is the highest at (1-lambda); in this case, 1 - 85% = 15%.

As successive weights have a constant proportion of lambda, the (t-2) weight = (1-lambda)*lambda; in this case, (1-85%)*85% = 12.75%

Q-86. Solution: C

$\text{Weight} = 0.94^6 \times (1 - 0.94) = 4.14\%$

Q-87. Solution: A

The EWMA model does not involve the long-run average variance in updating volatility, in other words, the weight assigned to the long-run average variance is zero. Only the current estimate of the variance is used. The other statements are all correct.

Q-88. Solution: D

D is correct. The EWMA estimate of variance is a weighted average of the variance rate estimated for the prior day and the prior day's observed squared return.

A is incorrect. EWMA is a particular case of GARCH (1,1) with the weight assigned to the long-run average variance rate as zero and the sum of the weights of the other two parameters equal to 1.

B is incorrect because there is also weight assigned to the long-run average variance rate.

C is incorrect because such a comparison can only be done under specific parameter configurations.

Q-89. Solution: A

A is correct. According to the property of translation invariance, adding an amount of cash, K, into a portfolio will decrease the risk measure by K. Therefore, choice A correctly describes translation invariance.

B is incorrect. This is a test for subadditivity. According to the property of subadditivity, given two portfolios A and B, the risk measure for the portfolio formed by merging A and B will be less than or equal to the sum of the risk measures for A and B.

C is incorrect. This is a test for monotonicity. According to the property of monotonicity, a portfolio that produces consistently worse results in comparison to another portfolio will have a higher risk measure.

D is incorrect. This is a test of homogeneity. According to the property of homogeneity, changing the size of a portfolio by multiplying the amount of all components by λ results in the risk measure being multiplied by λ.

Q-90. Solution: C

C is correct. The lower the confidence level, the lower the ES, holding all else constant; vice versa. This is because the ES can be treated as an average of tail VaRs, and a lower (higher) confidence level will lead to more mild (severe) loss quantiles being included in computing that average.

A is incorrect. A longer time horizon will lead to a higher ES since the magnitude of returns and losses are scaled with time.

B is incorrect. An increase in the sample size does not necessarily lead to an incline or decline in the magnitude of ES.

D is incorrect. The ES is certainly not a constant risk measure for a given portfolio.

Q-91. Solution: B

B is correct. Under the EWMA model:

$$\sigma_n^2 = (1-\lambda)r_{n-1}^2 + \lambda\sigma_{n-1}^2$$

We can see that the new estimate of the variance rate on day n is a weighted average of the estimate of the variance rate made for the previous day, $n-1$, and the most recent observation of the squared return (on day $n-1$). Because $\sigma_{n-1}^2 = r_{n-1}^2$, we can conclude that $\sigma_n^2 = \sigma_{n-1}^2 = r_{n-1}^2$. Under the GARCH (1, 1) model, however, we have:

$$\sigma_n^2 = \alpha r_{n-1}^2 + \beta\sigma_{n-1}^2 + \gamma V_L$$

Where V_L is the long-run variance rate, and $\alpha + \beta + \gamma = 1$. Thus, the new estimate of the variance rate on day n under the GARCH (1, 1) is a weighted average of the estimate of the variance rate made for the previous day, the most recent observation of the squared return, and the long-run variance rate. Because σ_{n-1}^2 (and also r_{n-1}^2) is currently above the long-run variance, the σ_n^2 under the GARCH model must be smaller than σ_{n-1}^2, r_{n-1}^2, and hence the EWMA forecast.

Q-92. Solution: D

D is correct. The smaller the gamma (i.e., the lower the sensitivity of delta to underlying's price), the closer the delta-normal risk measure to the true value (the risk measure here can be VaR or ES). Given that the gamma is largest when an option is ATM and approaches to zero when the option gets either deeper ITM or deeper OTM, the option with a strike price of $50 should have the lowest gamma among all the candidates. Thus, it will yield a delta-normal ES that is closest to the true ES.

Q-93. Solution: C

Q-94. Solution: C

Investment grade debt is debt rated BBB- rated or better by Standard's and Poor and Baa3 or better by Moody's.

Q-95. Solution: B

Through-the-cycle (TTC) is unconditional, while at-the point (PIT) is conditional.

In regard to (A), (C) and (D), each is TRUE.

- In regard to true (A), external agency credit ratings tend to be through-the-cycle (TTC).
- In regard to true (C), credit spreads are at-the-point (PIT) and PIT measures theoretically incorporate more information. Please note this point is debatable. Some people would argue that much of the information in some PIT approaches (e.g., structural) contain too much noise masquerading as information.
- In regard to true (D), during crisis periods, PIT approaches imply higher expected and unexpected loss (EL & UL) such that PIT tends to be pro-cyclical.

Q-96. Solution: A

A is correct. A through-the-cycle rating tries to capture the average creditworthiness of a firm over a period of several years (and across different phases of the economic cycle), and is therefore less likely to change in response to a cyclical decline in overall economic conditions. By contrast, a point-in-time rating is designed to provide the best current estimate of future default probabilities, and is more likely to change as the economic cycle evolves.

B is incorrect. Consistent with their desire to produce stable ratings, rating agencies produce through-the-cycle estimates. There is a tendency for internal ratings to be point-in-time.

C is incorrect. An outlook is a rating agency's indication of the most likely direction of a rating over the medium term, while placing a rating on a watchlist indicates a relatively short-term change is anticipated (usually within 3 months).

D is incorrect. Banks and other financial institutions typically base their internal ratings on several factors, such as financial ratios, cash flow projections, and an assessment of the firm's management.

Q-97. Solution: A

A is correct. Using the terminology of value-at-risk (VaR), the 1-year 99% unexpected loss of a portfolio is equal to its expected loss subtracted from its VaR with a 1-year time horizon and a 99% confidence level. The expected loss equals portfolio default rate * (1 – recovery rate) * exposure at default = 0.025 * (1 – 0.3) * 120 = SGD 2.1 million. Therefore, the UL of this loan portfolio is 9.6 – 2.1 = SGD 7.5 million.

Q-98. Solution: D

D is correct. The recovery rate for a bond is usually defined as the value of the bond shortly after

default and it is expressed as a percentage of its face (par) value. It can be thought of as the amount of the obligation the lender can expect to recover if the firm defaults.

A is incorrect. This would correspond to a 35% recovery rate if, in the event of bankruptcy, liquidation of the firm's assets would result in the bank receiving 35% of the face value of the bond.

B is incorrect. This would correspond to a 35% recovery rate if, given that a collateralized bond defaults, the bank would take possession of collateral valued at 35% of the bond's face value.

C is incorrect. Recovery rate is defined as described in the explanation for D above, and is a conditional probability (conditional on a default occurring).

Q-99. Solution: D

D is correct. The correlation between each pair of Ui distributions is equal to a^2.

A is incorrect. The default probabilities are each mapped to the standard normally distributed variable Ui, however, values in the extreme left tail represent default. As such, low values of F or Zi correspond with a higher likelihood of default.

B is incorrect. High values of F indicate a strong economy, and low values of F indicate a weak economy. As such, low values of F correspond with a higher likelihood of default.

C is incorrect. F is a common factor and is equal for all loans in the portfolio.

Q-100. Solution: D

D is correct. Economic capital is distinguished from regulatory capital in that it considers correlations between credit, market, and operational risks. Regulatory capital requirements only require that the separate risks be added to come up with total capital requirements.

A is incorrect. As noted in A above, regulatory capital adds the separate capital calculations for credit, market, and operational risk to find total capital requirements.

B is incorrect. Both economic and regulatory capital would go up in that case.

C is incorrect. Both economic capital and regulatory capital act as a cushion that covers unexpected losses. Economic capital is the bank's own estimate of the capital it should hold, while regulatory capital is the amount of capital regulators require it to hold.

Q-101. Solution: D

D is correct. Using external data obtained from other banks is one good way to increase the data set of historical operational losses. Data from other banks need to be adjusted for size, based on the relative size of the banks' revenues, before being merged with the'bank's internal data.

A is incorrect. Using distributions does not help resolve the issue of incomplete underlying data.

B is incorrect. Lognormal distributions, not Poisson distributions, are generally used for modeling loss severity. Also, using distributions does not help resolve the issue of incomplete underlying data.

C is incorrect. Credit losses are generally much better documented than operational losses inside the bank. External credit ratings publish probability of default and expected loss data that provides additional data. Operational loss is generally documented much less rigorously, and regulatory initiatives are now pushing banks to document operational loss data.

Q-102. Solution: C

A is incorrect. The chance of BBB loans being upgraded over 1 year is 4.08% (0.02 + 0.21 + 3.85).

B is incorrect. The chance of BB loans staying at the same rate over 1 year is 75.73%.

C is correct. 88.21% represents the chance of BBB loans staying at BBB or being upgraded over 1 year.

D is incorrect. The chance of BB loans being downgraded over 1 year is 5.72% (0.04 + 0.08 + 0.33 + 5.27).

Q-103. Solution: D

The first period probability of default for a B-rated bond is 2%. In second period the probability of default is the probability of surviving year 1 and defaulting in year 2. The year 2 probability of default = (0.03 × 0.00) + (0.90 × 0.02) + (0.05 × 0.14) = 2.5%. Therefore, the two-period cumulative probability of default = 2% + 2.5% = 4.5%.

Q-104. Solution: C

EL_P = 40 × 3% × (1 – 70%) + 60 × 5% × (1 – 45%) million = 2,010,000

Q-105. Solution: C

- Loan (c) has the highest dollar EL, which is

$$\$1.34 \text{ million} = \$150 \text{ mm} \times (1 - e^{-2\% \times 9/12}) \times 60.0\%.$$

- Loan (a) with default intensity of 4.0% and remaining term of three (3) months has

$$\text{PD} = 1 - e^{-4\% \times 3/12} = 1.00\%$$

- Loan (b) with default intensity of 3.0% and remaining term of six (6) months has

$$\text{PD} = 1 - e^{-3\% \times 6/12} = 1.49\%$$

- Loan (c) with default intensity of 2.0% and remaining term of nine (9) months has

$$\text{PD} = 1 - e^{-2\% \times 9/12} = 1.49\%$$

- Loan (d) with default intensity of 1.0% and remaining term of twelve (12) months has

$$\text{PD} = 1 - e^{-1\% \times 12/12} = 1.00\%$$

Q-106. Solution: C

As a precaution, the bank needs to set aside sufficient capital in the event that actual losses exceed

expected losses with a reasonable likelihood. For example, smaller recovery rates would be indicative of larger actual losses.

Q-107. Solution: A

Exposure amount (EA) is the expected amount of the bank's credit exposure to a customer or counterparty at the time of default.

Q-108. Solution: D

$$\sigma_i = \sqrt{p_i - p_i^2}\left(L_i(1 - R_i)\right) = 0.06258147$$

Q-109. Solution: B

$$\sigma_i = \sqrt{p_i - p_i^2}\left(L_i(1 - R_i)\right) = 0.06258147$$

$$\alpha = \frac{\sigma_P}{nL} = \frac{\sigma\sqrt{1 + (n - 1)\rho}}{L\sqrt{n}} = 0.02799848$$

Q-110. Solution: C

C is correct. The standard deviation of losses σ_i for each individual loan is:

$$\sigma_i = \sqrt{p_i - p_i^2[L_i(1 - R_i)]}$$

where, p_i represents probability of default (p1 = 2%, p2 = 2%), L_i represents exposure at default (amount borrowed) (L1 = CNY 15 million, L2 = CNY 20 million), and R_i represents recovery rate (R1 = 40%, R2 = 25%)).

Therefore, the standard deviations for loan 1 and loan 2 are:

$$\sigma_1 = \sqrt{0.02 - 0.02^2[15(1 - 0.4)]} = 1.26$$

$$\sigma_2 = \sqrt{0.02 - 0.02^2[20(1 - 0.25)]} = 2.1$$

The variance of losses on the portfolio can then be calculated as:

$$\sigma_p^2 = \sigma_1^2 + 2\rho\sigma_1\sigma_2 + \sigma_2^2 = 9.1728$$

$$\sigma_p = \sqrt{9.1728} = 3.0287$$

Q-111. Solution: D

D is correct. The standard deviation of losses for each individual loan is:

$$\sigma_i = \sqrt{p_i - p_i^2[L_i(1 - R_i)]} = \sqrt{0.04 - 0.04^2[500{,}000 * (1 - 0.3)]} = 68{,}585.71$$

where p represents probability of default, Li represents exposure at default (amount borrowed), and Ri represents recovery rate.

The standard deviation of losses on the portfolio of n loans as a percentage of its size is then calculated as:

$$\alpha = \frac{\sigma\sqrt{1+(n-1)\rho}}{L\sqrt{n}} = \frac{68{,}585.71\sqrt{1+(30-1)*0.4}}{500{,}000\sqrt{30}} = 8.9\%$$

Q-112. Solution: B

B is correct. Most researchers agree that stock and bond markets' reactions to ratings downgrades are significant, while the reaction to upgrades is less pronounced.

A is incorrect. While rating agencies strive for geographic consistency, historical data shows divergence in default rates between, U.S., European, and emerging market firms.

C is incorrect. Rating agencies produce through-the-cycle ratings, which reflect the long-term creditworthiness of firms, and are consistent with rating agencies' goal of ratings stability.

D is incorrect. Outlooks indicate the most likely direction of a rating over the medium term, while placing a rating on a watchlist indicates a relatively short-term change is anticipated (usually within three months).

Q-113. Solution: B

B is correct. The unconditional default probability between end-of-year 1 and end-of-year 2 is calculated as follows:

$$Uncon.PD_{1-2} = (1-e^{-2\%\times 2}) - \left(1-e^{-\lambda_1\times 1}\right) = e^{-\lambda_1\times 1} - e^{-2\%\times 2} = 0.9656\%$$

We can thus solve the survival rate of the borrower during the first year of the loan, which is $e^{-\lambda_1\times 1}$:

$$e^{-\lambda_1\times 1} = e^{-2\%\times 2} + 0.9656\% = 0.9704$$

Q-114. Solution: C

The regulatory capital can be computed by the following formula:

$$(WCDR - PD)\times EAD\times LGD = (12.01\% - 0.75\%)\times 100m\times(1-30\%) = \$7.88m$$

Q-115. Solution: A

Unexpected devaluation of the yen would result in a gain to the trader.

Q-116. Solution: D

D is correct. In the case of being in danger of a default on local currency bonds, printing money is likely to be attractive in the short term because a country's reputation and credit rating will not

immediately suffer. However, printing money debases the currency and leads to inflation in the longer term.

A is incorrect. The local currency rating of a country is typically one or two notches higher than the foreign currency rating.

B is incorrect. Most of the recent instances of foreign currency sovereign default involved the exchange of old bonds for new bonds with some net present value loss to lenders.

C is incorrect. Debt issued in a foreign currency is often purchased by global banks and other international lenders.

Q-117. Solution: A

A is correct. A higher dependence on a single commodity makes a country's overall economy more vulnerable to changes in demand or prices of that commodity.

B is incorrect. A legal system that provides for lawsuits against firms and their management allows investors recourse in the event of insider trading, fraud, or other actions that hurt investors, thereby lowering country risk.

C is incorrect. Because business activities inevitably generate disputes, firms do not want to invest in a country where the legal system is biased or subject to government interference.

D is incorrect. Declining credit spreads signal credit quality improvement.

Q-118. Solution: D

D is correct. The default by a sovereign nation has a negative impact on the GDP growth and the country's credit rating for many years. It can also hurt export and make the banking system of the defaulting country more vulnerable.

A is incorrect. The default by a sovereign nation will hurt, not enhance, the export.

B is incorrect. The overall economic will exhibit a downward trend if a sovereign nation defaults.

C is incorrect. The default by a sovereign nation will lead to political instability because people have lost confidence in their leaders.

Q-119. Solution: C

Q-120. Solution: D

In the standardized approach to calculating operational risk, a bank's activities are divided up into several different business lines, and a beta factor is calculated for each line of business. Economic capital covers the difference between the worst-case loss and the expected loss. Loss severity tends to be modeled with a lognormal distribution, but loss frequency is typically modeled using a Poisson distribution. Operational loss data available from data vendors tends to be biased towards

large losses.

Q-121. Solution: A

The beta factors used in the standardized approach for operational risk are as follows: trading and sales: 18%; retail banking : 12% ; agency and custody services: 15 % ; asset management: 12%.

Q-122. Solution: A

Operational losses are not easy to map to risk factors. Operational VaR can be calculated by both severity and frequency distribution. Monte Carlo techniques can be used for other distributions than the normal distribution.

Q-123. Solution: D

D is correct. If v is the value of a random variable and x is a high value of v, then the power law holds it is approximately true that:

$\Pr(v > x) \approx Kx^{-\alpha}$

where Pr denotes probability and K and α are parameters. The power law only describes the right tail of the distribution (not the whole distribution). That is why the equation above is approximately true only for high values of x.

A is incorrect. Operational losses do not follow a normal distribution, nor does the use of the power law in connection with a random variable suggest that the random variable is normally distributed.

B is incorrect. The power law has been shown to be applicable to a wide range of distributions, relating to events including natural disasters (i.e., the magnitude of earthquakes). The power law is no less appropriate for modeling operational losses from natural disasters than those from fraud or other sources.

C is incorrect. These losses occur in the body of the distribution so are unlikely to be modeled using the power law. These losses are not considered extreme events.

Q-124. Solution: C

C is correct. The basic indicator approach sets risk capital equal to 15% of the bank's 3-year average annual gross income. The standardized approach is similar, except that separate calculations are carried out by business line and the percentage applied to gross income varies across business lines.

A is incorrect. The advanced measurement approach, not the standardized approach, estimates the 99.9 percentile of the 1-year loss for every combination of business lines and the seven operational risk types identified by the Basel Committee.

B is incorrect. The advanced measurement approach, not the standardized approach, treats operational risk like credit risk and sets capital equal to the 99.9 percentile of the loss distribution

minus the expected operational loss.

D is incorrect. The Business Indicator is used in the standardized measurement approach developed under revisions to Basel III, not the standardized approach.

Q-125. Solution: B

The main purpose of value-at-risk (VaR) measures is to quantify potential losses under "normal" market conditions, where normal is defined by the confidence level, typically 99 percent. In principle, increasing the confidence level could uncover progressively larger but less likely losses. In practice, VaR measures based on recent historical data can fail to identify extreme unusual situations that could cause severe losses. This is why VaR methods should be supplemented by a regular program of stress testing. Stress testing is a non-statistical risk measure because it is not associated with a probability statement like VaR.

One other reason to stress test is that VaR measures typically use recent historical data. Stress testing, in contrast, considers situations that are absent from historical data or not well represented but nonetheless likely. Alternatively, stress tests are useful to identify states of the world where historical relationships break down, either temporarily or permanently.

A is incorrect. VaR utilizes a great number of scenarios while stress testing focuses on just a few. C is incorrect. This is a description of VaR. D is incorrect. Stress testing may employ scenarios that are not generated by distributions and probabilities in general do not play a prominent role.

Q-126. Solution: B

Stress testing can serve as an early warning sign of upcoming pressures and risks. The board of directors can take actions that include adjusting capital levels, increasing liquidity, adjusting risks, or engaging in or withdrawing from certain activities.

The board of directors has ultimate oversight responsibility and accountability for an entire institution. Senior management is responsible for implementing authorized stress testing activities. Senior management should use stress testing, complemented with scenario analysis, to evaluate an institutions risk decisions.

Q-127. Solution: A

An internal audit should review the manner in which stress testing efficiencies are identified, tracked, and remedied.

An internal audit should assess not only the stress testing activities, but also the staff involved in stress testing activities. The internal audit function needs to be independent and objective.

Q-128. Solution: D

D is correct. VaR is traditionally calculated using data from the period immediately preceding the analysis. In stressed VaR, however, this data is gathered from a particularly stressful period in the past, which would not necessarily include the immediately preceding period.

A is incorrect. Stressed VaR produces a conditional loss distribution and is a conditional risk measure.

B is incorrect. Typically, the time horizon for stressed VaR is a short period (i.e., one to ten days).

C is incorrect. Stressed VaR is calculated from historical data, rather than assuming a probability distribution of losses.

Q-129. Solution: B

B is correct. Sometimes, a moderately adverse scenario from the past is made more extreme by multiplying the movements in all risk factors by a certain amount. However, this approach assumes there is a simple linear relationship between the movements in risk factors. This is not necessarily the case, however, because correlations between risk factors tend to increase as economic conditions become more stressed.

A is incorrect. One approach to scenario building is to assume that a large change takes place in one or more key variables. In general, as tress tests are designed to be forward-looking, it is useful to consider scenarios that have not necessarily occurred in the past.

C is incorrect. Sometimes, historical scenarios are based on what happened to all market risk factors over one day or one week (e.g. October 19, 1987 or September 11, 2001). These short-horizon stress tests can be supplements to stressed VaR and stressed ES calculations.

D is incorrect. Senior management should challenge key assumptions in stress testing scenarios, or suggest new scenarios for consideration. Among other reasons, involving senior management in building scenarios makes it more likely that the stress testing will be taken seriously and used for decision-making.

Q-130. Solution: A

Institutions use reverse stress tests “break the bank” in order to assess the events that are outside of normal business expectations and could threaten the institutions viability.

Q-131. Solution: D

Stress tests tend to use ordinal rank arrangements, while EC methods use cardinal probabilities. Stress tests tend to focus on longer periods of time (e.g., several years) compared to EC methods (e.g., point in time). Stress tests tend to focus on conditional scenarios, while EC methods tend to focus on unconditional scenarios. Stress tests tend to compute losses from an accounting perspective which EC methods tend to compute them from a market perspective.