2014

FRM Examination Practice Exam

PART I and PART II

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INTRODUCTION

The FRM Exam is a practice-oriented examination. Its questions are derived from a combination of theory, as set forth in the core readings, and "real-world" work experience. Candidates are expected to understand risk management concepts and approaches and how they would apply to a risk manager's day-to-day activities.

The FRM Exam is also a comprehensive examination, testing a risk professional on a number of risk management concepts and approaches. It is very rare that a risk manager will be faced with an issue that can immediately be slotted into one category. In the real world, a risk manager must be able to identify any number of risk-related issues and be able to deal with them effectively.

The 2014 FRM Practice Exams I and II have been developed to aid candidates in their preparation for the FRM Exam in May and November 2014. These Practice Exams are based on a sample of questions from the 2010 through 2013 FRM Exams and are suggestive of the questions that will be in the 2014 FRM Examination.

The 2014 FRM Practice Exam for Part I contains 25 multiple-choice questions and the 2014 FRM Practice Exam for Part II contains 20 multiple-choice questions. Note that the 2014 FRM Exam Part I will contain 100 multiple-choice questions and the 2014 FRM Exam Part II will contain 80 multiple-choice questions. The Practice Exams were designed to be shorter to allow candidates to calibrate their preparedness without being overwhelming.

The 2014 FRM Practice Exams do not necessarily cover all topics to be tested in the 2014 FRM Exam as the material covered in the 2014 Study Guide may be different from that that covered by the 2010 through 2012 Study Guides. The questions selected for inclusion in the Practice Exams were chosen to be broadly reflective of the material assigned for 2014 as well as to represent the style of question that the FRM Committee considers appropriate based on assigned material.

For a complete list of current topics, core readings, and key learning objectives candidates should refer to the 2014 FRM Exam Study Guide and AIM Statements.

Core readings were selected by the FRM Committee to assist candidates in their review of the subjects covered by the Exam. Questions for the FRM Exam are derived from the "core" readings. It is strongly suggested that candidates review these readings in depth prior to sitting for the Exam.

Suggested Use of Practice Exams

To maximize the effectiveness of the Practice Exams, candidates are encouraged to follow these recommendations:

1. **Plan a date and time to take each Practice Exam.**
   Set dates appropriately to give sufficient study/ review time for the Practice Exam prior to the actual Exam.

2. **Simulate the test environment as closely as possible.**
   - Take each Practice Exam in a quiet place.
   - Have only the practice exam, candidate answer sheet, calculator, and writing instruments (pencils, erasers) available.
   - Minimize possible distractions from other people, cell phones and study material.
   - Allocate 60 minutes for the Practice Exam and set an alarm to alert you when 60 minutes have passed. Complete the exam but note the questions answered after the 60 minute mark.
   - Follow the FRM calculator policy. You may only use a Texas Instruments BA II Plus (including the BA II Plus Professional), Hewlett Packard 12C (including the HP 12C Platinum and the Anniversary Edition), Hewlett Packard 10B II, Hewlett Packard 10B II+ or Hewlett Packard 20B calculator.

3. **After completing the Practice Exam,**
   - Calculate your score by comparing your answer sheet with the Practice Exam answer key. Only include questions completed in the first 60 minutes.
   - Use the Practice Exam Answers and Explanations to better understand correct and incorrect answers and to identify topics that require additional review. Consult referenced core readings to prepare for Exam.

Reference Table: Let Z be a standard normal random variable.

z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)
-3	0.0013	-2.50	0.0062	-2.00	0.0228	-1.50	0.0668	-1.00	0.1587	-0.50	0.3085
-2.99	0.0014	-2.49	0.0064	-1.99	0.0233	-1.49	0.0681	-0.99	0.1611	-0.49	0.3121
-2.98	0.0014	-2.48	0.0066	-1.98	0.0239	-1.48	0.0694	-0.98	0.1635	-0.48	0.3156
-2.97	0.0015	-2.47	0.0068	-1.97	0.0244	-1.47	0.0708	-0.97	0.1660	-0.47	0.3192
-2.96	0.0015	-2.46	0.0069	-1.96	0.0250	-1.46	0.0721	-0.96	0.1685	-0.46	0.3228
-2.95	0.0016	-2.45	0.0071	-1.95	0.0256	-1.45	0.0735	-0.95	0.1711	-0.45	0.3264
-2.94	0.0016	-2.44	0.0073	-1.94	0.0262	-1.44	0.0749	-0.94	0.1736	-0.44	0.3300
-2.93	0.0017	-2.43	0.0075	-1.93	0.0268	-1.43	0.0764	-0.93	0.1762	-0.43	0.3336
-2.92	0.0018	-2.42	0.0078	-1.92	0.0274	-1.42	0.0778	-0.92	0.1788	-0.42	0.3372
-2.91	0.0018	-2.41	0.0080	-1.91	0.0281	-1.41	0.0793	-0.91	0.1814	-0.41	0.3409
-2.9	0.0019	-2.40	0.0082	-1.90	0.0287	-1.40	0.0808	-0.90	0.1841	-0.40	0.3446
-2.89	0.0019	-2.39	0.0084	-1.89	0.0294	-1.39	0.0823	-0.89	0.1867	-0.39	0.3483
-2.88	0.0020	-2.38	0.0087	-1.88	0.0301	-1.38	0.0838	-0.88	0.1894	-0.38	0.3520
-2.87	0.0021	-2.37	0.0089	-1.87	0.0307	-1.37	0.0853	-0.87	0.1922	-0.37	0.3557
-2.86	0.0021	-2.36	0.0091	-1.86	0.0314	-1.36	0.0869	-0.86	0.1949	-0.36	0.3594
-2.85	0.0022	-2.35	0.0094	-1.85	0.0322	-1.35	0.0885	-0.85	0.1977	-0.35	0.3632
-2.84	0.0023	-2.34	0.0096	-1.84	0.0329	-1.34	0.0901	-0.84	0.2005	-0.34	0.3669
-2.83	0.0023	-2.33	0.0099	-1.83	0.0336	-1.33	0.0918	-0.83	0.2033	-0.33	0.3707
-2.82	0.0024	-2.32	0.0102	-1.82	0.0344	-1.32	0.0934	-0.82	0.2061	-0.32	0.3745
-2.81	0.0025	-2.31	0.0104	-1.81	0.0351	-1.31	0.0951	-0.81	0.2090	-0.31	0.3783
-2.8	0.0026	-2.30	0.0107	-1.80	0.0359	-1.30	0.0968	-0.80	0.2119	-0.30	0.3821
-2.79	0.0026	-2.29	0.0110	-1.79	0.0367	-1.29	0.0985	-0.79	0.2148	-0.29	0.3859
-2.78	0.0027	-2.28	0.0113	-1.78	0.0375	-1.28	0.1003	-0.78	0.2177	-0.28	0.3897
-2.77	0.0028	-2.27	0.0116	-1.77	0.0384	-1.27	0.1020	-0.77	0.2206	-0.27	0.3936
-2.76	0.0029	-2.26	0.0119	-1.76	0.0392	-1.26	0.1038	-0.76	0.2236	-0.26	0.3974
-2.75	0.0030	-2.25	0.0122	-1.75	0.0401	-1.25	0.1056	-0.75	0.2266	-0.25	0.4013
-2.74	0.0031	-2.24	0.0125	-1.74	0.0409	-1.24	0.1075	-0.74	0.2296	-0.24	0.4052
-2.73	0.0032	-2.23	0.0129	-1.73	0.0418	-1.23	0.1093	-0.73	0.2327	-0.23	0.4090
-2.72	0.0033	-2.22	0.0132	-1.72	0.0427	-1.22	0.1112	-0.72	0.2358	-0.22	0.4129
-2.71	0.0034	-2.21	0.0136	-1.71	0.0436	-1.21	0.1131	-0.71	0.2389	-0.21	0.4168
-2.7	0.0035	-2.20	0.0139	-1.70	0.0446	-1.20	0.1151	-0.70	0.2420	-0.20	0.4207
-2.69	0.0036	-2.19	0.0143	-1.69	0.0455	-1.19	0.1170	-0.69	0.2451	-0.19	0.4247
-2.68	0.0037	-2.18	0.0146	-1.68	0.0465	-1.18	0.1190	-0.68	0.2483	-0.18	0.4286
-2.67	0.0038	-2.17	0.0150	-1.67	0.0475	-1.17	0.1210	-0.67	0.2514	-0.17	0.4325
-2.66	0.0039	-2.16	0.0154	-1.66	0.0485	-1.16	0.1230	-0.66	0.2546	-0.16	0.4364
-2.65	0.0040	-2.15	0.0158	-1.65	0.0495	-1.15	0.1251	-0.65	0.2578	-0.15	0.4404
-2.64	0.0041	-2.14	0.0162	-1.64	0.0505	-1.14	0.1271	-0.64	0.2611	-0.14	0.4443
-2.63	0.0043	-2.13	0.0166	-1.63	0.0516	-1.13	0.1292	-0.63	0.2643	-0.13	0.4483
-2.62	0.0044	-2.12	0.0170	-1.62	0.0526	-1.12	0.1314	-0.62	0.2676	-0.12	0.4522
-2.61	0.0045	-2.11	0.0174	-1.61	0.0537	-1.11	0.1335	-0.61	0.2709	-0.11	0.4562
-2.6	0.0047	-2.10	0.0179	-1.60	0.0548	-1.10	0.1357	-0.60	0.2743	-0.10	0.4602
-2.59	0.0048	-2.09	0.0183	-1.59	0.0559	-1.09	0.1379	-0.59	0.2776	-0.09	0.4641
-2.58	0.0049	-2.08	0.0188	-1.58	0.0571	-1.08	0.1401	-0.58	0.2810	-0.08	0.4681
-2.57	0.0051	-2.07	0.0192	-1.57	0.0582	-1.07	0.1423	-0.57	0.2843	-0.07	0.4721
-2.56	0.0052	-2.06	0.0197	-1.56	0.0594	-1.06	0.1446	-0.56	0.2877	-0.06	0.4761
-2.55	0.0054	-2.05	0.0202	-1.55	0.0606	-1.05	0.1469	-0.55	0.2912	-0.05	0.4801
-2.54	0.0055	-2.04	0.0207	-1.54	0.0618	-1.04	0.1492	-0.54	0.2946	-0.04	0.4840
-2.53	0.0057	-2.03	0.0212	-1.53	0.0630	-1.03	0.1515	-0.53	0.2981	-0.03	0.4880
-2.52	0.0059	-2.02	0.0217	-1.52	0.0643	-1.02	0.1539	-0.52	0.3015	-0.02	0.4920
-2.51	0.0060	-2.01	0.0222	-1.51	0.0655	-1.01	0.1562	-0.51	0.3050	-0.01	0.4960

Special Instructions and Definitions

1. Unless otherwise indicated, interest rates are assumed to be continuously compounded.

2. Unless otherwise indicated, option contracts are assumed to be on one unit of the underlying asset.

3. VaR = value-at-risk

4. ES = expected shortfall

5. GARCH = generalized auto-regressive conditional heteroskedasticity

6. CAPM = capital asset pricing model

7. LIBOR = London interbank offer rate

8. The following acronyms are used for selected currencies:

Acronym	Currency
ARS	Argentine peso
AUD	Australian dollar
BRL	Brazilian real
CAD	Canadian dollar
CHF	Swiss franc
EUR	euro
GBP	British pound sterling
HKD	Hong Kong dollar
INR	Indian rupee
JPY	Japanese yen
MXN	Mexican peso
SGD	Singapore dollar
USD	US dollar

Financial Risk Manager (FRM®) Examination

2014 Practice Exam

PART I

Answer Sheet

	a.	b.	c.	d.		a.	b.	c.	d.
1.	○	○	○	○	16.	○	○	○	○
2.	○	○	○	○	17.	○	○	○	○
3.	○	○	○	○	18.	○	○	○	○
4.	○	○	○	○	19.	○	○	○	○
5.	○	○	○	○	20.	○	○	○	○
6.	○	○	○	○	21.	○	○	○	○
7.	○	○	○	○	22.	○	○	○	○
8.	○	○	○	○	23.	○	○	○	○
9.	○	○	○	○	24.	○	○	○	○
10.	○	○	○	○	25.	○	○	○	○
11.	○	○	○	○					
12.	○	○	○	○					
13.	○	○	○	○					
14.	○	○	○	○					
15.	○	○	○	○					

Correct way to complete

1. ● ● ● ●

Wrong way to complete

1. ⊘ ⊖ ☑ ⊗

Financial Risk Manager (FRM®) Examination

2014 Practice Exam

PART I

Questions

1. An analyst is preparing a valuation report on Wacha Corporation, a conglomerate which consists of three separate business units. The analyst has already estimated the unlevered beta of each of the firm's business units based on data from the unit's closest competitors, but would like to construct a beta metric that reflects the composite risk profile of the firm, taking into consideration its financing. According to its most recent financial statements, the firm has a debt to equity ratio of 1.1 and an effective corporate tax rate of 32.0%. Additional information about the firm's three business units is as follows:

Business Unit	Percentage of Revenues	Unlevered Beta
Telecom	35%	0.49
Internet Services	40%	1.73
Software	25%	1.47

Based on this information, what is the levered beta of the firm?

    a. 1.75
    b. 1.92
    c. 2.15
    d. 2.33

2. The board of directors plays a key role in the process of creating a strong culture of risk management at an organization. As part of this role, one function that should be fulfilled by the board of directors is to:

    a. Monitor the effectiveness of the company's governance practices and make changes, if necessary, to ensure proper compliance.
    b. Ensure that the interests of the company's stakeholders are prioritized above its executives' interests in order to maximize the potential return on investment.
    c. Address issues that could potentially represent a conflict of interest by assigning committees composed exclusively of executive board members.
    d. Establish a policy to address individual risk factors by either reducing, hedging, or avoiding exposure to each risk.

3. A bank's risk manager is considering different viewpoints for reporting data quality metrics within a data quality scorecard: a data quality issues viewpoint, a business process viewpoint, and a business impact viewpoint. For which of the following purposes would a business process viewpoint be most effective?

    a. Aggregating the business impacts of poor quality data across different business processes.
    b. Creating a high-level overview of risks associated with data issues on the trading desk.
    c. Isolating the point at which data issues begin to arise in a foreign exchange hedging procedure.
    d. Identifying organizational processes that require enhanced monitoring and control.

4. Suppose the S&P 500 has an expected annual return of 7.6% and volatility of 10.8%. Suppose the Atlantis Fund has an expected annual return of 8.3% and volatility of 8.8% and is benchmarked against the S&P 500. If the risk-free rate is 2.0% per year, what is the beta of the Atlantis Fund according to the Capital Asset Pricing Model?

   a. 0.81
   b. 0.89
   c. 1.13
   d. 1.23

5. In October 1994, General Electric sold Kidder Peabody to Paine Webber, which eventually dismantled the firm. Which of the following led up to the sale?

   a. Kidder Peabody had its primary dealer status revoked by the Federal Reserve after it was found to have submitted fraudulent bids at US Treasury auctions.
   b. Kidder Peabody reported a large quarterly loss from highly leveraged positions, which left the company insolvent and on the verge of bankruptcy.
   c. Kidder Peabody suffered a large loss when counterparties to its CDS portfolio could not honor their contracts, which left the company with little equity.
   d. Kidder Peabody reported a sudden large accounting loss to correct an error in the firm's accounting system, which called into question the management team's competence.

6. You are evaluating the performance of a portfolio of Mexican equities that is benchmarked to the IPC index. You collect the information about the portfolio and the benchmark index shown in the table below:

Expected return on the portfolio	6.6%
Volatility of returns on the portfolio	13.1%
Expected return on the IPC Index	4.0%
Volatility of returns on the IPC Index	8.7%
Risk-free rate of return	1.5%
Beta of portfolio relative to IPC Index	1.4

What is the Sharpe ratio for this portfolio?

   a. 0.036
   b. 0.047
   c. 0.389
   d. 0.504

7. You have estimated a regression of your firm's monthly portfolio returns against the returns of three U.S. domestic equity indexes: the Russell 1000 Index, the Russell 2000 index, and the Russell 3000 index. The results are shown below.

Regression Statistics

Multiple R	0.951
R Square	0.905
Adjusted R Square	0.903
Standard Error	0.009
Observations	192

Regression Output	Coefficients	Standard Error	t Stat	P-value
Intercept	0.0023	0.0006	3.5305	0.0005
Russell 1000	0.1093	1.5895	0.0688	0.9452
Russell 2000	0.1055	0.1384	0.7621	0.4470
Russell 3000	0.3533	1.7274	0.2045	0.8382

Correlation Matrix	Portfolio Returns	Russell 1000	Russell 2000	Russell 3000
Portfolio Returns	1.000			
Russell 1000	0.937	1.000		
Russell 2000	0.856	0.813	1.000	
Russell 3000	0.945	0.998	0.845	1.000

Based on the regression results, which statement is correct?

a. The estimated coefficient of 0.3533 indicates that the returns of the Russell 3000 index are more statistically significant in determining the portfolio returns than the other two indexes.

b. The high adjusted R^2 indicates that the estimated coefficients on the Russell 1000, Russell 2000, and Russell 3000 indexes are statistically significant.

c. The high p-value of 0.9452 indicates that the regression coefficient of the returns of Russell 1000 is more statistically significant than the other two indexes.

d. The high correlations between each pair of index returns indicate that multicollinearity exists between the variables in this regression.

8. You are examining a portfolio that consists of 600 subprime mortgages and 400 prime mortgages. Of the subprime mortgages, 120 are late on their payments. Of the prime mortgages, 40 are late on their payments. If you randomly select a mortgage from the portfolio and it is currently late on its payments, what is the probability that it is a subprime mortgage?

    a. 60%
    b. 67%
    c. 75%
    d. 80%

9. Emanuel Lee is analyzing his new credit portfolio, which consists of a large number of companies. He assumes that the time, measured in years, between successive defaults follows an exponential distribution. If N denotes the number of defaults over the next year, what is the appropriate probability distribution of N?

    a. Poisson
    b. Generalized Pareto
    c. Weibull
    d. Gamma

10. Sarah Wong is testing her hypothesis that the beta, β, of stock CDM is 1. She runs an ordinary least squares regression of the monthly returns of CDM, R_{CDM}, on the monthly returns of the S&P 500 index, R_m, and obtains the following relation:

    $$R_{CDM} = 0.86\ R_m - 0.32$$

    Sarah also observes that the standard error of the coefficient of R_m is 0.80. In order to test the hypothesis $H_0: \beta = 1$ against $H_1: \beta \neq 1$, what is the correct statistic to calculate?

    a. t-statistic
    b. Chi-square test statistic
    c. Jarque-Bera test statistic
    d. Sum of squared residuals

11. Which of the following statements about the exponentially weighted moving average (EWMA) model and the generalized autoregressive conditional heteroscedasticity (GARCH(1,1)) model 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 estimate from the EWMA model is always between the prior day's estimated variance and the prior day's squared return.

    c. The GARCH(1,1) model always assigns less weight to the prior day's estimated variance than the EWMA model.

    d. A variance estimate from the GARCH(1,1) model is always between the prior day's estimated variance and the prior day's squared return.

12. A risk manager is examining a Hong Kong trader's profit and loss record for the last week, as shown in the table below:

Trading Day	Profit/Loss (HKD million)
Monday	10
Tuesday	80
Wednesday	90
Thursday	-60
Friday	30

The profits and losses are normally distributed with a mean of 4.5 million HKD and assume that transaction costs can be ignored. Part of the t-table is provided below:

Percentage Point of the t Distribution
$P(T>t) = \alpha$

Degrees of Freedom	α		
	0.3	0.2	0.15
4	0.569	0.941	1.19
5	0.559	0.92	1.156

According to the information provided above, what is the probability that this trader will record a profit of at least HKD 30 million on the first trading day of next week?

    a. About 15%

    b. About 20%

    c. About 80%

    d. About 85%

13. An experienced commodities risk manager is examining corn futures quotes from the CME Group. Which of the following observations would the risk manager most likely view as a potential problem with the quotation data?

    a. The volume in a specific contract is greater than the open interest.
    b. The prices indicate a mixture of normal and inverted markets.
    c. The settlement price for a specific contract is above the high price.
    d. There is no contract with maturity in a particular month.

14. A portfolio manager controls USD 88 million par value of zero-coupon bonds maturing in 5 years and yielding 4%. The portfolio manager expects that interest rates will increase. To hedge the exposure, the portfolio manager wants to sell part of the 5-year bond position and use the proceeds from the sale to purchase zero-coupon bonds maturing in 1.5 years and yielding 3%. What is the market value of the 1.5-year bonds that the portfolio manager should purchase to reduce the duration on the combined position to 3 years?

    a. USD 41.17 million
    b. USD 43.06 million
    c. USD 43.28 million
    d. USD 50.28 million

15. A 15-month futures contract on an equity Index is currently trading at USD 3,767.52. The underlying Index is currently valued at USD 3,625 and has a continuously-compounded dividend yield of 2% per year. The continuously compounded risk-free rate is 5% per year. Assuming no transactions costs, what is the potential arbitrage profit per contract and the appropriate strategy?

    a. USD 189, buy the futures contract and sell the underlying.
    b. USD 4, buy the futures contract and sell the underlying.
    c. USD 189, sell the futures contract and buy the underlying.
    d. USD 4, sell the futures contract and buy the underlying.

16. Savers Bancorp entered into a swap agreement over a 2-year period on August 9, 2008, with which it received a 4.00% fixed rate and paid LIBOR plus 1.20% on a notional amount of USD 6.5 million. Payments were to be made every 6 months. The table below displays the actual annual 6-month LIBOR rates over the 2-year period.

Date	6-month LIBOR
Aug 9, 2008	3.11%
Feb 9, 2009	1.76%
Aug 9, 2009	0.84%
Feb 9, 2010	0.39%
Aug 9, 2010	0.58%

Assuming no default, how much did Savers Bancorp receive on August 9, 2010?

a. USD 72,150
b. USD 78,325
c. USD 117,325
d. USD 156,650

17. The six-month forward price of commodity X is USD 1,000. Six-month, risk-free, zero-coupon bonds with face value USD 1,000 trade in the fixed income market. When taken in the correct amounts, which of the following strategies creates a synthetic long position in commodity X for a period of 6 months?

a. Short the forward contract and short the zero-coupon bond.
b. Short the forward contract and buy the zero-coupon bond.
c. Buy the forward contract and short the zero-coupon bond.
d. Buy the forward contract and buy the zero-coupon bond.

18. A call provision embedded in a corporate bond can be viewed as an option held by the _____, and therefore, the price of a callable bond will be _____ than the price of a similar noncallable bond.

a. issuer, greater
b. issuer, lower
c. investor, greater
d. investor, lower

19. 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.

20. Portfolio A has a 1-day 95% VaR, denoted by VaR(A), and Portfolio B has a 1-day 95% VaR, denoted by VaR(B). If Portfolio A and Portfolio B are combined into a new Portfolio C with a 1-day 95% VaR denoted by VaR(C), which of the following statements will always be correct?

- **a.** VaR(C) ≤ VaR(A) + VaR(B)
- **b.** VaR(C) = VaR(A) + VaR(B)
- **c.** VaR(C) ≥ VaR(A) + VaR(B)
- **d.** None of the above.

21. In evaluating the dynamic delta hedging of a portfolio of short option positions, which of the following is correct?

- **a.** The interest cost of carrying the delta hedge will be highest when the options are deep out-of-the-money.
- **b.** The interest cost of carrying the delta hedge will be highest when the options are deep in-the-money.
- **c.** The interest cost of carrying the delta hedge will be lowest when the options are at-the-money.
- **d.** The interest cost of carrying the delta hedge will be highest when the options are at-the-money.

QUESTIONS 22 AND 23 REFER TO THE FOLLOWING INFORMATION

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	2.08719
5.00%	101.61158	2.05010
5.02%	100.92189	2.01319

22. The DV01 of a comparable bond with no embedded options having the same maturity and coupon rate is closest to:

   a. 0.0185
   b. 0.2706
   c. 0.2891
   d. 0.3077

SEE INFORMATION PRECEDING QUESTION 23

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	2.08719
5.00%	101.61158	2.05010
5.02%	100.92189	2.01319

23. The convexity of the callable bond can be estimated as:

   a. -55,698
   b. -54,814
   c. -5.5698
   d. -5.4814

24. A portfolio contains a long position in an option contract on a US Treasury bond. The option exhibits positive convexity across the entire range of potential returns for the underlying bond. This positive convexity:

   a. Implies that the option's value increases at a decreasing rate as the option goes further into the money.
   b. Makes a long option position a superior investment compared to a long bond position of equivalent duration.
   c. Can be effectively hedged by the sale of a negatively convex financial instrument.
   d. Implies that the option increases in value as market volatility increases.

25. An implementation principle recommended by the Basel Committee to banks for the governance of sound stress testing practices is that stress testing reports should:

   a. Not be passed up to senior management without first being approved by middle management.
   b. Have limited input from their respective business areas to prevent biasing of the results.
   c. Challenge prior assumptions to help foster debate among decision makers.
   d. Be separated by business lines to help identify risk concentrations.

Financial Risk Manager (FRM®) Examination

2014 Practice Exam

PART I

Answers

	a.	b.	c.	d.		a.	b.	c.	d.
1.	○	○	●	○	16.	○	●	○	○
2.	●	○	○	○	17.	○	○	○	●
3.	○	○	●	○	18.	○	●	○	○
4.	○	○	●	○	19.	●	○	○	○
5.	○	○	○	●	20.	○	○	○	●
6.	○	○	●	○	21.	○	●	○	○
7.	○	○	○	●	22.	○	○	○	●
8.	○	○	●	○	23.	○	●	○	○
9.	●	○	○	○	24.	○	○	○	●
10.	●	○	○	○	25.	○	○	●	○
11.	○	●	○	○					
12.	○	●	○	○					
13.	○	○	●	○					
14.	●	○	○	○					
15.	○	○	○	●					

Correct way to complete

1. ● ● ● ●

Wrong way to complete

1. ⊘ ⊖ ☑ ⊗

Financial Risk Manager (FRM®) Examination

2014 Practice Exam

PART I

Explanations

1. An analyst is preparing a valuation report on Wacha Corporation, a conglomerate which consists of three sep-
    arate business units. The analyst has already estimated the unlevered beta of each of the firm's business units
    based on data from the unit's closest competitors, but would like to construct a beta metric that reflects the
    composite risk profile of the firm, taking into consideration its financing. According to its most recent financial
    statements, the firm has a debt to equity ratio of 1.1 and an effective corporate tax rate of 32.0%. Additional
    information about the firm's three business units is as follows:

Business Unit	Percentage of Revenues	Unlevered Beta
Telecom	35%	0.49
Internet Services	40%	1.73
Software	25%	1.47

    Based on this information, what is the levered beta of the firm?

    a. 1.75
    b. 1.92
    c. 2.15
    d. 2.33

Correct answer: c

Explanation: A levered equity beta can be calculated using the following formula:

Levered Beta = Unlevered Beta * (1 + (1-tax rate) (Debt/Equity))

First, we should calculate the unlevered beta, which is the weighted average of the unlevered segment betas
(weighted by proportion of revenues): (0.35 * 0.49) + (0.40 * 1.73) + (0.25 * 1.47) = 1.231.

Inputting this factor along with the given tax rate and debt/equity ratio into the equation provides the levered beta:

Levered beta = 1.231 * (1 + (1-.320) * 1.1) = 2.15

Section: Foundations of Risk Management
Reference: Oliviero Roggi, Maxine Garvey, Aswath Damodaran (2012), *Risk Taking: A Corporate Governance Perspective*
(International Finance Corporation: World Bank Group), pp. 20-21.
AIMS: Describe the impact of leverage and taxes in the calculation of an equity beta for a firm.

2. The board of directors plays a key role in the process of creating a strong culture of risk management at an organization. As part of this role, one function that should be fulfilled by the board of directors is to:

   a. Monitor the effectiveness of the company's governance practices and make changes, if necessary, to ensure proper compliance.
   b. Ensure that the interests of the company's stakeholders are prioritized above its executives' interests in order to maximize the potential return on investment.
   c. Address issues that could potentially represent a conflict of interest by assigning committees composed exclusively of executive board members.
   d. Establish a policy to address individual risk factors by either reducing, hedging, or avoiding exposure to each risk.

Correct answer: a

Explanation: One of the key responsibilities of a board of directors should be to monitor the effectiveness of the firm's governance practices and ensure proper compliance with these practices. Boards should ensure that the interest of management and stakeholders are aligned with neither group being prioritized, and should ideally address potential conflicts of interest by including a significant proportion of independent (non-executive) board members. A firm should not necessarily mitigate or avoid each risk factor it faces, as it can also add value in some situations by retaining specific risk factors in order to exploit those risks.

Section: Foundations of Risk Management
Reference: Oliviero Roggi, Maxine Garvey, Aswath Damodaran (2012), *Risk Taking: A Corporate Governance Perspective,* International Finance Corporation: World Bank Group.
AIMS: Describe a risk profile and describe the role of risk governance in an organization.

3. A bank's risk manager is considering different viewpoints for reporting data quality metrics within a data quality scorecard: a data quality issues viewpoint, a business process viewpoint, and a business impact viewpoint. For which of the following purposes would a business process viewpoint be most effective?

    a. Aggregating the business impacts of poor quality data across different business processes.
    b. Creating a high-level overview of risks associated with data issues on the trading desk.
    c. Isolating the point at which data issues begin to arise in a foreign exchange hedging procedure.
    d. Identifying organizational processes that require enhanced monitoring and control.

Correct answer: c

Explanation: A business process view would be the best choice when the firm is looking to isolate the specific point within a business process where data quality issues are introduced, as in this example.

Section: Foundations of Risk Management

Reference: Anthony Tarantino and Deborah Cernauskas (2009), Chapter 3: *Information Risk and Data Quality Management, Risk Management in Finance: Six Sigma and other Next Generation Techniques*, Hoboken, NJ, John Wiley & Sons.

AIMS: Describe the process of creating a data quality scorecard and compare three different viewpoints for reporting data via a data quality scorecard.

4. Suppose the S&P 500 has an expected annual return of 7.6% and volatility of 10.8%. Suppose the Atlantis Fund has an expected annual return of 8.3% and volatility of 8.8% and is benchmarked against the S&P 500. If the risk-free rate is 2.0% per year, what is the beta of the Atlantis Fund according to the Capital Asset Pricing Model?

    a. 0.81
    b. 0.89
    c. 1.13
    d. 1.23

Correct answer: c

Explanation: Since the correlation or covariance between the Atlantis Fund and the S&P 500 is not known, CAPM must be used to back out the beta: $\bar{R}_i = R_F + \beta_i \cdot (\bar{R}_M - R_F)$.

Therefore:

$$8.3\% = 2.0\% + \beta_i \cdot (7.6\% - 2.0\%); \text{ hence } \beta_i = \frac{(8.3\% - 2.0\%)}{(7.6\% - 2.0\%)} \text{ or } 1.13.$$

Section: Foundations of Risk Management

Reference: Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann, *Modern Portfolio Theory and Investment Analysis, 7th Edition* — Chapter 13.

AIMS: Use the CAPM to calculate the expected return on an asset.
Define beta and calculate the beta of a single asset or portfolio.

5. In October 1994, General Electric sold Kidder Peabody to Paine Webber, which eventually dismantled the firm. Which of the following led up to the sale?

    a. Kidder Peabody had its primary dealer status revoked by the Federal Reserve after it was found to have submitted fraudulent bids at US Treasury auctions.
    b. Kidder Peabody reported a large quarterly loss from highly leveraged positions, which left the company insolvent and on the verge of bankruptcy.
    c. Kidder Peabody suffered a large loss when counterparties to its CDS portfolio could not honor their contracts, which left the company with little equity.
    d. Kidder Peabody reported a sudden large accounting loss to correct an error in the firm's accounting system, which called into question the management team's competence.

Correct answer: d

Explanation: Kidder Peabody's accounting system failed to account for the present value of forward trades, which allowed trader Joseph Jett to book an instant, but fraudulent, accounting profit by purchasing cash bonds to be delivered at a later date. These profits would dissipate as the bonds approached their delivery date, but Jett covered this up by rolling the positions forward with increasingly greater positions and longer lengths to delivery, which created a higher stream of hypothetical profits due to the accounting flaw. Finally this stream of large profits was investigated and Kidder Peabody was forced to take a USD 350 million accounting loss to reverse the reported gains, which resulted in a loss of confidence in the firm and General Electric's subsequent sale.

Section: Foundations of Risk Management

Reference: Steve Allen, *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk* (New York: John Wiley & Sons, 2012), Chapter 4: Financial Disasters.

AIMS: Describe the key factors that led to and the lessons learned from the following risk management case studies: Kidder Peabody.

6. You are evaluating the performance of a portfolio of Mexican equities that is benchmarked to the IPC Index. You collect the information about the portfolio and the benchmark index shown in the table below:

Expected return on the portfolio	6.6%
Volatility of returns on the portfolio	13.1%
Expected return on the IPC Index	4.0%
Volatility of returns on the IPC Index	8.7%
Risk-free rate of return	1.5%
Beta of portfolio relative to IPC Index	1.4

What is the Sharpe ratio for this portfolio?

    a. 0.036
    b. 0.047
    c. 0.389
    d. 0.504

Correct answer: c

Explanation: The Sharpe ratio for the portfolio is $\frac{Expected\ Return\ on\ Portfolio - Risk\ Free\ Rate}{Volatility\ of\ Returns\ of\ Portfolio} = \frac{6.6\% - 1.5\%}{13.1\%} = 0.389$.

Section: Foundations of Risk Management
Reference: Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, England: Wiley, 2003), Chapter 4, Section 4.2 — Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators.
AIMS: Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.

7. You have estimated a regression of your firm's monthly portfolio returns against the returns of three U.S. domestic equity Indexes: the Russell 1000 Index, the Russell 2000 Index, and the Russell 3000 Index. The results are shown below.

Regression Statistics

Multiple R	0.951
R Square	0.905
Adjusted R Square	0.903
Standard Error	0.009
Observations	192

Regression Output	Coefficients	Standard Error	t Stat	P-value
Intercept	0.0023	0.0006	3.5305	0.0005
Russell 1000	0.1093	1.5895	0.0688	0.9452
Russell 2000	0.1055	0.1384	0.7621	0.4470
Russell 3000	0.3533	1.7274	0.2045	0.8382

Correlation Matrix	Portfolio Returns	Russell 1000	Russell 2000	Russell 3000
Portfolio Returns	1.000			
Russell 1000	0.937	1.000		
Russell 2000	0.856	0.813	1.000	
Russell 3000	0.945	0.998	0.845	1.000

Based on the regression results, which statement is correct?

a. The estimated coefficient of 0.3533 indicates that the returns of the Russell 3000 Index are more statistically significant in determining the portfolio returns than the other two indexes.

b. The high adjusted R2 indicates that the estimated coefficients on the Russell 1000, Russell 2000, and Russell 3000 Indexes are statistically significant.

c. The high p-value of 0.9452 indicates that the regression coefficient of the returns of Russell 1000 is more statistically significant than the other two indexes.

d. The high correlations between each pair of index returns indicate that multicollinearity exists between the variables in this regression.

Correct answer: d

Explanation: This is an example of multicollinearity, which arises when one of the regressors is very highly correlated with the other regressors. In this case, all three regressors are highly correlated with each other, so multicollinearity exists between all three. Since the variables are not perfectly correlated with each other this is a case of imperfect, rather than perfect, multicollinearity.

Section: Quantitative Analysis

Reference: Stock and Watson, *Introduction to Econometrics, Brief Edition* (Boston: Pearson Education, 2008).

• Chapter 6, Linear Regression with Multiple Regressors
• Chapter 7, Hypothesis Tests and Confidence Intervals in Multiple Regression

AIMS: Define and interpret the slope coefficient in a multiple regression.
Interpret the R2 and adjusted-R2 in a multiple regression.
Explain the concepts of imperfect and perfect multicollinearity and their implications.

8. You are examining a portfolio that consists of 600 subprime mortgages and 400 prime mortgages. Of the subprime mortgages, 120 are late on their payments. Of the prime mortgages, 40 are late on their payments. If you randomly select a mortgage from the portfolio and it is currently late on its payments, what is the probability that it is a subprime mortgage?

a. 60%
b. 67%
c. 75%
d. 80%

Correct answer: c

Explanation: In order to solve this conditional probability question, first calculate the probability that any one mortgage in the portfolio is late. This is: P(Mortgage is late) = (120 + 40)/1000 = 16%.

Next use the conditional probability relationship as follows:

P (Mortgage subprime | Mortgage is late) = P(Mortgage subprime and late) / P(Mortgage is late)

Since P(Mortgage subprime and late) = (120/1000) = 12%;
therefore P(Mortgage subprime | Mortgage is late) = 12% / 16% = 0.75 = 75%.

Hence the probability that a random late mortgage selected from this portfolio turns out to be subprime is 75%.

Section: Quantitative Analysis

Reference: James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston, Pearson Education, 2008), Chapter 2.

AIMS: Describe joint, marginal, and conditional probability functions.

9.   Emanuel Lee is analyzing his new credit portfolio, which consists of a large number of companies. He assumes that the time, measured in years, between successive defaults follows an exponential distribution. If N denotes the number of defaults over the next year, what is the appropriate probability distribution of N?

     a. Poisson
     b. Generalized Pareto
     c. Weibull
     d. Gamma

Correct answer: a

Explanation: The number of defaults in a given time period t with exponentially distributed default arrival times with density $f(x) = \frac{1}{\beta} e^{-x/\beta}$ are Poisson distributed with density $P(x = k) = \frac{\lambda^k}{k!} e^{-\lambda}$ where $\lambda = t/\beta$.

Section: Quantitative Analysis
Reference: Michael Miller, *Mathematics and Statistics for Financial Risk Management, 1st Edition* (Wiley, 2012) Chapter 4: Distributions.
AIMS: Describe the key properties of the following distributions: uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution, normal distribution, lognormal distribution, Chi-squared distribution, Student's t, and F-distributions, and identify common occurrences of each distribution.

10. Sarah Wong is testing her hypothesis that the beta, β, of stock CDM is 1. She runs an ordinary least squares regression of the monthly returns of CDM, R_{CDM}, on the monthly returns of the S&P 500 index, R_m, and obtains the following relation:

$$R_{CDM} = 0.86\ R_m - 0.32$$

Sarah also observes that the standard error of the coefficient of R_m is 0.80. In order to test the hypothesis $H_0: \beta = 1$ against $H_1: \beta \neq 1$, what is the correct statistic to calculate?

a. t-statistic
b. Chi-square test statistic
c. Jarque-Bera test statistic
d. Sum of squared residuals

Correct answer: a

Explanation: The correct test is the t test. The t statistic is defined by:

$$t = \frac{\beta\ estimated - \beta}{SE\ (estimated\ \beta)} = \frac{0.86 - 1}{0.8}$$

In this case t = -0.175. Since |t| < 1.96 we cannot reject the null hypothesis.

Section: Quantitative Analysis
Reference: Stock and Watson, *Introduction to Econometrics*, Chapter 5.
AIMS: Define and interpret hypothesis tests about regression coefficients.

11. Which of the following statements about the exponentially weighted moving average (EWMA) model and the generalized autoregressive conditional heteroscedasticity (GARCH(1,1)) model 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 estimate from the EWMA model is always between the prior day's estimated variance and the prior day's squared return.
    c. The GARCH(1,1) model always assigns less weight to the prior day's estimated variance than the EWMA model.
    d. A variance estimate from the GARCH(1,1) model is always between the prior day's estimated variance and the prior day's squared return.

Correct answer: b

Explanation: The EWMA estimate of variance is a weighted average of the prior day's variance and prior day squared return.

Section: Quantitative Analysis
Reference: John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 22: Estimating Volatilities and Correlations.
AIMS: Describe the exponentially weighted moving average (EWMA) model for estimating volatility and its properties, and estimate volatility using the EWMA model.
Describe the generalized autoregressive conditional heteroskedasticity (GARCH(p,q)) model for estimating volatility and its properties.

12. A risk manager is examining a Hong Kong trader's profit and loss record for the last week, as shown in the table below:

Trading Day	Profit/Loss (HKD million)
Monday	10
Tuesday	80
Wednesday	90
Thursday	-60
Friday	30

The profits and losses are normally distributed with a mean of 4.5 million HKD and assume that transaction costs can be ignored. Part of the t-table is provided below:

Percentage Point of the t Distribution
$P(T>t) = \alpha$

Degrees of Freedom	α		
	0.3	0.2	0.15
4	0.569	0.941	1.19
5	0.559	0.92	1.156

According to the information provided above, what is the probability that this trader will record a profit of at least HKD 30 million on the first trading day of next week?

a. About 15%
b. About 20%
c. About 80%
d. About 85%

Correct answer: b

Explanation: When the population mean and population variance are not known, the t-statistic can be used to analyze the distribution of the sample mean.

Sample mean = (10 + 80 + 90-60 + 30)/5 = 30
Unbiased sample variance = (1/4)[(-20)^2 + 50^2 + 60^2 + (-90)^2 + 0^2] = 14600/4 = 3650
Unbiased sample standard deviation = 60.4152
Sample standard error = (sample standard deviation)/√5 = 27.0185
Population mean of return distribution = 4.5 (million HKD)
Therefore the t-statistic = (Sample mean – population mean)/Sample standard error = (30-4.5)/27.02 = 0.9438. Because we are using the sample mean in the analysis, we must remove 1 degree of freedom before consulting the t-table; therefore 4 degrees of freedom are used. According to the table, the closest possibility is 0.2 = 20%.

Section: Quantitative Analysis
References: Michael Miller, *Mathematics and Statistics for Financial Risk Management, 1st Edition* (Wiley, 2012) Chapter 4: Distributions.
Stock and Watson, Introduction to Econometrics, Brief Edition, Chapter 5: Regression with a Single Regressor
AIMS: Define, describe, apply, and interpret the t-statistic when the sample size is small.

13. An experienced commodities risk manager is examining corn futures quotes from the CME Group. Which of the following observations would the risk manager most likely view as a potential problem with the quotation data?

   a. The volume in a specific contract is greater than the open interest.
   b. The prices indicate a mixture of normal and inverted markets.
   c. The settlement price for a specific contract is above the high price.
   d. There is no contract with maturity in a particular month.

Correct answer: c

Explanation: The reported high price of a futures contract should reflect all prices for the day, so the settlement price should never be greater than the high price.

Section: Financial Markets and Products
Reference: John Hull, *Options, Futures and Other Derivatives* (New York, Pearson, 2012), Chapter 2: Mechanics of Futures Markets.
AIMS: Define and describe the key features of a futures contract.

14. A portfolio manager controls USD 88 million par value of zero-coupon bonds maturing in 5 years and yielding 4%. The portfolio manager expects that interest rates will increase. To hedge the exposure, the portfolio manager wants to sell part of the 5-year bond position and use the proceeds from the sale to purchase zero-coupon bonds maturing in 1.5 years and yielding 3%. What is the market value of the 1.5-year bonds that the portfolio manager should purchase to reduce the duration on the combined position to 3 years?

   a. USD 41.17 million
   b. USD 43.06 million
   c. USD 43.28 million
   d. USD 50.28 million

Correct answer: a

Explanation: In order to find the proper amount, we first need to calculate the current market value of the portfolio (P), which is:

$$P = 88 * \exp(-0.04 * 5) = 72.05 \text{ million.}$$

The desired portfolio duration (after the sale of the 5-year bond and purchase of the 1.5 year bond) can be expressed as:

$$[5 * (P-X) + 1.5 * X]/P = 3 \text{ where X represents the market value of the zero-coupon bond with a maturity of 1.5 years.}$$

This equation holds true when $X = (4/7) * P$, or 41.17 million.

Section: Financial Markets and Products
Reference: Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 4: Interest Rates.
AIMS: Calculate the change in a bond's price given its duration, its convexity, and a change in interest rates.

15. A 15-month futures contract on an equity index is currently trading at USD 3,767.52. The underlying index is currently valued at USD 3,625 and has a continuously-compounded dividend yield of 2% per year. The continuously compounded risk-free rate is 5% per year. Assuming no transactions costs, what is the potential arbitrage profit per contract and the appropriate strategy?

a. USD 189, buy the futures contract and sell the underlying.
b. USD 4, buy the futures contract and sell the underlying.
c. USD 189, sell the futures contract and buy the underlying.
d. USD 4, sell the futures contract and buy the underlying.

Correct answer: d

Explanation: This is an example of index arbitrage. The no-arbitrage value of the futures contract can be calculated as the future value of the spot price: $S_0 \cdot e^{(\text{risk-free} - \text{dividend yield}) \times t}$, where S_0 equals the current spot price and t equals the time in years.

Future value of the spot price = $S_0 \cdot \exp[(\text{risk free rate} - \text{dividend yield}) \cdot 1.25] = 3763.5$

Since this value is different from the current futures contract price, a potential arbitrage situation exists. Since the futures price is higher than the future value of the spot price in this case, one can short sell the higher priced futures contract, and buy the underlying stocks in the index at the current price. The arbitrage profit would equal 3,767.52 - 3,763.52 = USD 4.

Section: Financial Markets and Products
Reference: John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 5.
AIMS: Calculate the forward price given the underlying asset's spot price, and describe an arbitrage argument between spot and forward prices.

16. Savers Bancorp entered into a swap agreement over a 2-year period on August 9, 2008, with which it received a 4.00% fixed rate and paid LIBOR plus 1.20% on a notional amount of USD 6.5 million. Payments were to be made every 6 months. The table below displays the actual annual 6-month LIBOR rates over the 2-year period.

Date	6-month LIBOR
Aug 9, 2008	3.11%
Feb 9, 2009	1.76%
Aug 9, 2009	0.84%
Feb 9, 2010	0.39%
Aug 9, 2010	0.58%

Assuming no default, how much did Savers Bancorp receive on August 9, 2010?

a. USD 72,150
b. USD 78,325
c. USD 117,325
d. USD 156,650

Correct answer: b

Explanation: The proper interest rate to use is the 6-month LIBOR rate at February 9, 2010, since it is the 6-month LIBOR that will yield the payoff on August 9, 2010. Therefore the net settlement amount on August 9th, 2010 is as follows:
Savers receives: 6,500,000 * 4.00% * 0.5 years, or USD 130,000
Savers pays 6,500,000 * (0.39% + 1.20%) * 0.5 , or USD 51,675.
Therefore Savers would receive the difference, or 78,325.

Section: Financial Markets and Products
Reference: John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson 2012), Chapter 7.
AIMS: Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows.

17. The six-month forward price of commodity X is USD 1,000. Six-month, risk-free, zero-coupon bonds with face value USD 1,000 trade in the fixed income market. When taken in the correct amounts, which of the following strategies creates a synthetic long position in commodity X for a period of 6 months?

    a. Short the forward contract and short the zero-coupon bond.
    b. Short the forward contract and buy the zero-coupon bond.
    c. Buy the forward contract and short the zero-coupon bond.
    d. Buy the forward contract and buy the zero-coupon bond.

Correct answer: d

Explanation: A synthetic commodity position for a period of T years can be constructed by entering into a long forward contract with T years to expiration and buying a zero-coupon bond expiring in T years with a face value of the forward price. The payoff function is as follows:

Payoff from long forward position = $S_T - F_{0,T}$, where S_T is the spot price of the commodity at time T and $F_{0,T}$ is the current forward price.
Payoff from zero coupon bond: $F_{0,T}$ at time T.
Hence, the total payoff function equals $(S_T - F_{0,T}) + F_{0,T}$ or S_T. This creates a synthetic commodity position.

Section: Financial Markets and Products
Reference: Robert McDonald, *Derivatives Markets* (Boston: Addison-Wesley, 2013). Chapter 6.
AIMS: Explain how to create a synthetic commodity position, and use it to explain the relationship between the forward price and the expected future spot price.

18. A call provision embedded in a corporate bond can be viewed as an option held by the _____, and therefore, the price of a callable bond will be _____ than the price of a similar noncallable bond.

    a. issuer, greater
    b. issuer, lower
    c. investor, greater
    d. investor, lower

Correct answer: b

Explanation: Many corporate bonds contain an embedded option that gives the issuer the right to buy the bonds back at a fixed price either in whole or in part prior to maturity. The feature is known as a call provision. The ability to retire debt before its scheduled maturity date is a valuable option for the issuer for which bondholders will demand compensation. All else being equal, this compensation will come in the form of bondholders paying a lower price for a callable bond than an otherwise identical option-free (i.e., straight) bond. The difference between the price of an option-free bond and the callable bond is the value of the embedded call option.

Section: Financial Markets and Products
Reference: Frank Fabozzi, *The Handbook of Fixed Income Securities, 8th Edition* (New York: McGraw Hill, 2012), Chapter 12.
AIMS: Describe the mechanisms by which corporate bonds can be retired before maturity.

19. 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.

Correct answer: a

Explanation: The option's return function is convex with respect to the value of the underlying; therefore the linear approximation method will always underestimate the true value of the option for any potential change in price. Therefore the VaR will always be higher under the linear approximation method than a full revaluation conducted by Monte Carlo simulation analysis. The difference is the bias resulting from the linear approximation, and this bias increases in size with the change in the option price and with the holding period.

Section: Valuation and Risk Models

Reference: Linda Allen, Jacob Boudoukh and Anthony Saunders, *Understanding Market, Credit and Operational Risk: The Value at Risk Approach* (Oxford: Blackwell Publishing, 2004), Chapter 3.

AIMS: Compare delta-normal and full revaluation approaches for computing VaR.

20. Portfolio A has a 1-day 95% VaR, denoted by VaR(A), and Portfolio B has a 1-day 95% VaR, denoted by VaR(B). If Portfolio A and Portfolio B are combined into a new Portfolio C with a 1-day 95% VaR denoted by VaR(C), which of the following statements will always be correct?

a. VaR(C) ≤ VaR(A) + VaR(B)

b. VaR(C) = VaR(A) + VaR(B)

c. VaR(C) ≥ VaR(A) + VaR(B)

d. None of the above.

Correct answer: d

Explanation: This question tests the concept of subadditivity. With a subadditive risk measure, at any given confidence level, $\rho(A + B) \leq \rho(A) + \rho(B)$, where ρ reflects the portfolio risk.

However, VaR is not a subadditive measure, which can be proved as follows: Assume that portfolio A and portfolio B each represent a USD 100 position in a single bond with a 1-year default probability of 4% and a recovery rate of zero, with the default probabilities of A and B independent of each other. Therefore, the individual 95% VaR of each portfolio is zero. However, when analyzing the combined portfolio, the probability of no loss is (1-0.04)², or 0.9216, so the probability of one or more defaults is 1-0.9216, or 7.84%. Since the probability of a loss is greater than than 5%, the 95% VaR of the combined portfolio is greater than zero.

Therefore, none of the relationships given in choices a, b, and c are correct.

Section: Valuation and Risk Models

Reference: Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).

Chapter 2 — Measures of Financial Risk.

AIMS: Explain why VaR is not a coherent risk measure.

21. In evaluating the dynamic delta hedging of a portfolio of short option positions, which of the following is correct?

a. The interest cost of carrying the delta hedge will be highest when the options are deep out-of-the-money.

b. The interest cost of carrying the delta hedge will be highest when the options are deep in-the-money.

c. The interest cost of carrying the delta hedge will be lowest when the options are at-the-money.

d. The interest cost of carrying the delta hedge will be highest when the options are at-the-money.

Correct answer: b

Explanation: The deeper into-the-money the options are, the larger their deltas and therefore the more expensive to delta hedge.

Section: Valuation and Risk Models

Reference: John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson Prentice Hall, 2012), Chapter 18.

AIMS: Describe the dynamic aspects of delta hedging.

QUESTIONS 22 AND 23 REFER TO THE FOLLOWING INFORMATION

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	2.08719
5.00%	101.61158	2.05010
5.02%	100.92189	2.01319

22. The DV01 of a comparable bond with no embedded options having the same maturity and coupon rate is closest to:

 a. 0.0185
 b. 0.2706
 c. 0.2891
 d. 0.3077

Correct answer: d

Explanation: The call option reduces the bond price, therefore the bond with no embedded options will be the sum of the callable bond price and the call option price.
Therefore the price of the bond with no embedded options at a rate of 4.98% would be 104.1657 and the price at a rate of 5.02% would be 102.9351.

DV01 is a measure of price sensitivity of a bond. To calculate the DV01, the following equation is used:

$$DV01 = -\frac{\Delta P}{10,000 * \Delta y}$$

Where ΔP is the change in price and Δy is the change in yield. Therefore

$$DV01 = -\frac{102.9351 - 104.1657}{10000 * (5.02\% - 4.98\%)} = 0.3077.$$

Section: Valuation and Risk Models
Reference: Bruce Tuckman, *Fixed Income Securities, 3rd Edition* (Hoboken: John Wiley and Sons, 2011), Chapter 4.
AIMS: Define and compute the DV01 of a fixed income security given a change in yield and the resulting change in price.

SEE INFORMATION PRECEDING QUESTION 23

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	2.08719
5.00%	101.61158	2.05010
5.02%	100.92189	2.01319

23. The convexity of the callable bond can be estimated as:

    a. -55,698
    b. -54,814
    c. -5.5698
    d. -5.4814

Correct answer: b

Explanation: 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:

$$C = \frac{1}{P_0} \frac{\frac{P_1 - P_0}{\Delta r} - \frac{P_0 - P_{-1}}{\Delta r}}{\Delta r} = \frac{1}{P_0} * \frac{P_1 - 2P_0 + P_{-1}}{\Delta r^2},$$

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

Therefore, the best estimate of convexity is:

$$C = \frac{1}{101.61158} * \frac{100.92189 - (2 * 1 \, 01.61158) + 102.07848}{(0.02\%)^2} = -54,814.$$

Section: Valuation and Risk Models
Reference: Bruce Tuckman, *Fixed Income Securities, 3rd Edition* (Hoboken: John Wiley and Sons, 2011), Chapter 4.
AIMS: Define, compute, and interpret the convexity of a fixed income security given a change in yield and the resulting change in price.

24. A portfolio contains a long position in an option contract on a US Treasury bond. The option exhibits positive convexity across the entire range of potential returns for the underlying bond. This positive convexity:

a. Implies that the option's value increases at a decreasing rate as the option goes further into the money.

b. Makes a long option position a superior investment compared to a long bond position of equivalent duration.

c. Can be effectively hedged by the sale of a negatively convex financial instrument.

d. Implies that the option increases in value as market volatility increases.

Correct answer: d

Explanation: The relationship between convexity and volatility for a security can be seen most clearly through the second-order Taylor approximation of the change in price given a small change in yield. The resulting change in price can be estimated as:

$$\frac{\Delta P}{P} \approx -D\Delta y + \frac{1}{2} C \Delta y^2$$

where d is equal to the duration, c is the convexity and y is the change in the interest rate. Since Δy^2 is always positive, positive convexity will lead to an increase in return as long as interest rates move, with larger interest moves in either direction leading to a greater return benefit from the positive convexity. Therefore, a position in a security with positive convexity can be considered a long position in volatility.

This relationship can also be explained graphically. The price curve of a security with positive convexity will lie above and tangentially to the price curve of the underlying. If volatility of the underlying increases, then so will the volatility of either a long call or a long put, but the deviation from the price of the underlying will be positive when there is positive convexity, and negative with negative convexity. Therefore, the expected terminal value over the in-the-money region will increase while the expected terminal value over the out-of-the-money region will remain zero, an aggregate effect of increasing the total expected value of the option.

Section: Valuation and Risk Models

Reference: Bruce Tuckman, *Fixed Income Securities, 3rd Edition* (Hoboken: John Wiley and Sons, 2011), Chapter 4.

AIMS: Define, compute, and interpret the convexity of a fixed income security given a change in yield and the resulting change in price.

25. An implementation principle recommended by the Basel Committee to banks for the governance of sound stress testing practices is that stress testing reports should:

    a. Not be passed up to senior management without first being approved by middle management.
    b. Have limited input from their respective business areas to prevent biasing of the results.
    c. Challenge prior assumptions to help foster debate among decision makers.
    d. Be separated by business lines to help identify risk concentrations.

Correct answer: c

Explanation: The Basel Committee states "At banks that were highly exposed to the financial crisis and fared comparatively well, senior management as a whole took an active interest in the development and operation of stress testing... stress testing at most banks, however, did not foster internal debate nor challenge prior assumptions..." Therefore, the Basel Committee recommends that prior assumptions used in stress testing be challenged to ensure that the stress test best captures the potential for extreme scenarios given current market conditions.

Section: Valuation and Risk Models
Reference: Basel Committee on Banking Supervision Publication (2009), *Principles for Sound Stress Testing Practices and Supervision.*
AIMS: Describe weaknesses identified and recommendations for improvement in: The use of stress testing and integration in risk governance.

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Answer Sheet

	a.	b.	c.	d.		a.	b.	c.	d.
1.	○	○	○	○	14.	○	○	○	○
2.	○	○	○	○	15.	○	○	○	○
3.	○	○	○	○	16.	○	○	○	○
4.	○	○	○	○	17.	○	○	○	○
5.	○	○	○	○	18.	○	○	○	○
6.	○	○	○	○	19.	○	○	○	○
7.	○	○	○	○	20.	○	○	○	○
8.	○	○	○	○					
9.	○	○	○	○					
10.	○	○	○	○					
11.	○	○	○	○					
12.	○	○	○	○					
13.	○	○	○	○					

Correct way to complete

1.	●	●	●	●

Wrong way to complete

1.	Ø	⊖	☑	⊗

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Questions

1. A fund holds a portfolio of principal-only strips of mortgage-backed securities. All other things being equal, which of the following will most likely reduce the weighted average maturity of the portfolio?

    a. An increase in interest rates.
    b. An increase in prepayment speed.
    c. A small decrease in the value of the homes backing the mortgage pool.
    d. A small decrease in the real incomes of the underlying mortgage holders.

2. Which of the following statements concerning Asian options is correct?

    a. Asian options are not suitable for hedging positions on underlying assets that trade very frequently.
    b. Asian options tend to be more expensive than otherwise comparable vanilla options.
    c. Asian options are not suitable for hedging exposures that involve regular cashflows.
    d. Asian options tend to have payoffs that are less volatile than those of comparable European options.

3. A consultant has recommended using copulas to better account for dependencies in a portfolio. Which of the following statements about copula approaches is correct?

    a. Copulas can be used to join marginal distributions to construct a multivariate distribution.
    b. Copulas can only be used with mixtures of normal distributions.
    c. Copulas require the estimation of only one parameter.
    d. Copulas necessarily provide better estimates of tail dependence than correlation estimates for multivariate

4. A risk manager is analyzing a 1-day 98% VaR model. Assuming 252 days in a year, what is the maximum number of daily losses exceeding the 1-day 98% VaR that is acceptable to conclude, at a 95% confidence level, that the model is calibrated correctly?

    a. 5
    b. 9
    c. 10
    d. 12

5. Which of the following is not a VaR mapping method for fixed-income portfolios?

    a. Principal mapping.
    b. Duration mapping.
    c. Convexity mapping.
    d. Cash mapping.

6. A risk manager is constructing a term structure model and intends to use the Cox-Ingersoll-Ross Model. Which of the following describes this model?

   a. The model presumes that the volatility of the short rate will increase at a predetermined rate.
   b. The model presumes that the volatility of the short rate will decline exponentially to a constant level.
   c. The model presumes that the basis-point volatility of the short rate will be proportional to the rate.
   d. The model presumes that the basis-point volatility of the short rate will be proportional to the square root of the rate.

7. A firm has entered into a USD 20 million total return swap on the NASDAQ 100 Index as the index payer with ABC Corporation, which will pay 1-year LIBOR + 2.5%. The contract will last 1 year, and cash flows will be exchanged annually. Suppose the NASDAQ 100 Index is currently at 2,900 and LIBOR is 1.25%. The firm conducts a stress test on this total return swap using the following scenario:

   NASDAQ 100 in 1 year: 3,625
   LIBOR in 1 year: 0.50%

   For this scenario, what is the firm's net cash flow in year 1?

   a. A net cash outflow of USD 4.40 million.
   b. A net cash outflow of USD 4.25 million.
   c. A new cash inflow of USD 4.25 million.
   d. A new cash inflow of USD 4.40 million.

8. An analyst is reviewing a bond for investment purposes. The bond is expected to have a default probability of 2%, with an expected loss of 80 bps in the event of default. If the current risk-free rate is 4%, what is the minimum coupon spread needed on the bond for its expected return to match the risk-free rate?

   a. 90 bps
   b. 120 bps
   c. 200 bps
   d. 280 bps

9. You are the credit risk manager for a bank and are looking to mitigate counterparty credit risk exposure to ABCO, an A-rated firm. Currently your bank has the following derivatives contracts with ABCO:

Contract	Contract Value (HKD)
A	20,000,000
B	30,000,000
C	14,000,000
D	1,000,000

With the information provided, what is the most appropriate credit risk mitigation technique in this case?

a. Implement a netting scheme.
b. Use credit triggers.
c. Sell credit default swaps on ABCO.
d. Increase collateral.

10. The exhibit below presents a summary of bilateral mark-to-market (MtM) trades for three counterparties. If netting agreements exist between all pairs of counterparties shown, what is the correct order of net exposure per counterparty, from highest to lowest?

MtM Trades for Four Counterparties (USD Million)

	Opposing Counterparty		
Counterparty A		B	C
	Trades with positive MtM	10	10
	Trades with negative MtM	-10	0
Counterparty B		A	C
	Trades with positive MtM	10	0
	Trades with negative MtM	-10	-5
Counterparty C		A	B
	Trades with positive MtM	0	5
	Trades with negative MtM	-10	0

a. A-B-C
b. A-C-B
c. C-A-B
d. C-B-A

11. An underlying exposure with an effective annual price volatility of 6% is collateralized by a 10-year U.S. Treasury note with an effective price volatility of 8%. The correlation between the exposure and the U.S. Treasury note is zero. Changes in the value of the overall position (exposure plus collateral) are calculated for a 10-day horizon at a 95% confidence interval (assume a year of 250 days). Which of the following would one expect to observe from this analysis?

   a. The presence of collateral increases the current exposure and increases the volatility of the exposure between remargining periods.
   b. The presence of collateral increases the current exposure, but decreases the volatility of the exposure between remargining periods.
   c. The presence of collateral decreases the current exposure, but increases the volatility of the exposure between remargining periods.
   d. The presence of collateral decreases the current exposure and decreases the volatility of the exposure between remargining periods.

12. A trader observes a quote for Stock ZZZ, and the midpoint of its current best bid and best ask prices is CAD 35. ZZZ has an estimated daily return volatility of 0.25% and average bid-ask spread of CAD 0.1. Assuming the returns of ZZZ are normally distributed, what is closest to the estimated liquidity-adjusted, 1-day 95% VaR, using the constant spread approach on a 10,000 share position?

   a. CAD 1,000
   b. CAD 2,000
   c. CAD 3,000
   d. CAD 4,000

13. The risk management department at Southern Essex Bank is trying to assess the impact of the capital conservation and countercyclical buffers defined in the Basel III framework. They consider a scenario in which the bank's capital and risk-weighted assets are as shown in the table below (all values are in EUR millions):

Risk-weighted assets	3,110
Common equity Tier 1 (CET1) capital	230
Additional Tier 1 capital	34
Total Tier 1 capital	264
Tier 2 capital	81
Tier 3 capital	-
Total capital	345

Assuming that all Basel III phase-ins have occurred and that the bank's required countercyclical buffer is 0.75%, which of the capital ratios does the bank satisfy?

   a. The CET1 capital ratio only.
   b. The CET1 capital ratio plus the capital conservation buffer only.
   c. The CET1 capital ratio plus the capital conservation buffer and the countercyclical buffer.
   d. None of the above.

14. An operational risk manager is trying to compute the aggregate loss distribution for a firm's investment banking division. When using Monte Carlo simulation, which of the following loss frequency and loss severity distribution pairs is the most appropriate to use?

    a. Poisson, normal
    b. Poisson, lognormal
    c. Binomial, lognormal
    d. Binomial, normal

15. Under the proposals for Basel III, which of the following instruments would meet the criteria to be eligible to be considered as Tier II capital?

    a. A senior unsecured bond with a step-up coupon and six years left until maturity.
    b. A senior unsecured bond with 10 years left until maturity.
    c. A subordinated bond with original maturity of seven years and a call option exercisable after five years.
    d. A subordinated bond with nine years left until maturity that is guaranteed by a subsidiary of the issuing entity.

16. Even though risk managers cannot eliminate model risk, there are many ways managers can protect themselves against model risk. Which of the following statements about managing model risk is correct?

    a. Models should be tested against known problems.
    b. It is not advisable to estimate model risk using simulations.
    c. Complex models are generally preferable to simple models.
    d. Small discrepancies in model outputs are always acceptable.

17. When marking-to-market an illiquid position for Basel III compliance, the least desirable source of price information would be:

    a. An interpolation from trade prices on liquid securities similar to the one being valued.
    b. An average of price quotes given over the phone from three reputable independent brokers.
    c. A price from a broker screen.
    d. A price from an active exchange.

18. A risk analyst is evaluating the risks of a portfolio of stocks. Currently, the portfolio is valued at EUR 110 million and contains EUR 10 million in stock A. The standard deviation of returns of stock A is 12% annually and that of the overall portfolio is 19% annually. The correlation of returns between stock A and the portfolio is 0.5. Assuming the risk analyst uses a 1-year 99% VaR and that returns are normally distributed, how much is the component VaR of stock A7

a. EUR 0.254 million

b. EUR 0.986 million

c. EUR 1,396 million

d. EUR 3,499 million

19. Which of the following statements about risk management in the pension fund industry is correct?

a. A pension plan's total VaR is equal to the sum of its policy-mix VaR and active-management VaR.

b. Pension fund risk analysis does not consider performance relative to a benchmark.

c. In most defined-benefit pension plans, if liabilities exceed assets, the shortfall does not create a risk for the plan sponsor.

d. From the plan sponsor's perspective, nominal pension obligations are similar to a short position in a long term bond.

20. A risk manager is evaluating a pairs trading strategy recently initiated by one of the firm's traders. The strategy involves establishing a long position in Stock A and a short position in Stock B. The following information is also provided:

- 1-day 99% VaR of Stock A is USD 100 million
- 1-day 99% VaR of Stock B is USD 125 million
- The estimated correlation between long positions in Stock A and Stock B is 0.8

Assuming that the returns of Stock A and Stock B are jointly normally distributed, the 1-day 99% VaR of the combined positions is closest to?

a. USD 0 million

b. USD 75 million

c. USD 160 million

d. USD 225 million

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Answers

	a.	b.	c.	d.			a.	b.	c.	d.
1.	○	●	○	○		14.	○	●	○	○
2.	○	○	○	●		15.	○	○	●	○
3.	●	○	○	○		16.	●	○	○	○
4.	○	●	○	○		17.	●	○	○	○
5.	○	○	●	○		18.	○	○	●	○
6.	○	○	○	●		19.	○	○	○	●
7.	○	●	○	○		20.	○	●	○	○
8.	●	○	○	○						
9.	○	○	○	●						
10.	○	●	○	○						
11.	○	○	●	○						
12.	○	●	○	○						
13.	○	●	○	○						

Correct way to complete

| 1. | ● | ● | ● | ● |

Wrong way to complete

| 1. | ⊘ | ⊖ | ☑ | ⊗ |

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Explanations

1. A fund holds a portfolio of principal-only strips of mortgage-backed securities. All other things being equal, which of the following will most likely reduce the weighted average maturity of the portfolio?

    a. An increase in interest rates.
    b. An increase in prepayment speed.
    c. A small decrease in the value of the homes backing the mortgage pool.
    d. A small decrease in the real incomes of the underlying mortgage holders.

Correct answer: b

Explanation: An increase in prepayment speed will reduce the weighted average maturity of the portfolio, however, the rest of the choices will not have this effect.

Section: Market Risk Measurement and Management
Reference: Frank Fabozzi, Anand Bhattacharya, William Berliner, *Mortgage Backed Securities: Products, Structuring and Analytical Techniques, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011). Chapter 2: Overview of the Mortgage-Backed Securities Market.
AIMS: Explain the creation of agency (fixed rate and adjustable rate) and private-label MBS pools, pass-throughs, CMOs, and mortgage strips.

2. Which of the following statements concerning Asian options is correct?

    a. Asian options are not suitable for hedging positions on underlying assets that trade very frequently.
    b. Asian options tend to be more expensive than otherwise comparable vanilla options.
    c. Asian options are not suitable for hedging exposures that involve regular cashflows.
    d. Asian options tend to have payoffs that are less volatile than those of comparable European options.

Correct answer: d

Explanation: While a European option payoff is a function of the difference between the strike and the underlying asset's terminal price, an Asian option payoff is a function of the difference between the strike and the underlying asset's average price over the life of the option. The average price is less volatile than the terminal price, so Asian options have lower expected payoff (and lower premium) than European options. Hedging the average price rather than the terminal price may be more appropriate for underlying assets which are either paying/receiving regular cash flows or trade frequently.

Section: Market Risk Measurement and Management
Reference: John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson Prentice Hall, 2012). Chapter 25: Exotic Options.
AIMS: Define and contrast exotic derivatives and plain vanilla derivatives.
Identify and describe the characteristics and pay-off structure of the following exotic options: forward start, compound, chooser, barrier, binary, lookback, shout, Asian, exchange, rainbow, and basket options.

3. A consultant has recommended using copulas to better account for dependencies in a portfolio. Which of the following statements about copula approaches is correct?

a. Copulas can be used to join marginal distributions to construct a multivariate distribution.
b. Copulas can only be used with mixtures of normal distributions.
c. Copulas require the estimation of only one parameter.
d. Copulas necessarily provide better estimates of tail dependence than correlation estimates for multivariate distributions.

Correct answer: a

Explanation: Copulas can be used to join marginal distributions to construct a multivariate distribution.

Section: Market Risk Measurement and Management
Reference: Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).
Chapter 5: Appendix — Modeling Dependence: Correlations and Copulas.
AIMS: Explain the drawbacks of using correlation to measure dependence. Describe how copulas provide an alternative measure of dependence. Explain how tail dependence can be investigated using copulas.

4. A risk manager is analyzing a 1-day 98% VaR model. Assuming 252 days in a year, what is the maximum number of daily losses exceeding the 1-day 98% VaR that is acceptable in a 1-year backtest to conclude, at a 95% confidence level, that the model is calibrated correctly?

a. 5
b. 9
c. 10
d. 12

Correct answer: b

Explanation: The risk manager will reject the hypothesis that the model is correctly calibrated if the number x of losses exceeding the VaR is such that:

$$(x-pT)/\text{sqrt}(p(1-p)T) > 1.96$$

where p represents the failure rate and is equal to 1-98%, or 2%; and T is the number of observations, 252.

Then 1.96 = two-tail confidence level quantile --> x > 1.96 * sqrt(2% * 98% * 252) + p * T = 9.40.

So the maximum number of exceedances would be 9 to conclude that the model is calibrated correctly.

Section: Market Risk Measurement and Management
Reference: Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition.* (New York: McGraw-Hill, 2007), Chapter 6: Backtesting VaR.
AIMS: Explain the framework of backtesting models with the use of exceptions or failure rates.

5. Which of the following is not a VaR mapping method for fixed-income portfolios?

    a. Principal mapping.
    b. Duration mapping.
    c. Convexity mapping.
    d. Cash mapping.

Correct answer: c

Explanation: Principal mapping, duration mapping and cash flow mapping are methods of VaR mapping for fixed income portfolios. Convexity mapping is not a method of VaR mapping for fixed income portfolios.

Section: Market Risk Measurement and Management
Reference: Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition*. (New York: McGraw-Hill, 2007). Chapter 11: VaR Mapping.
AIMS: List and describe the three methods of mapping portfolios of fixed income securities.

6. A risk manager is constructing a term structure model and intends to use the Cox-Ingersoll-Ross Model. Which of the following describes this model?

    a. The model presumes that the volatility of the short rate will increase at a predetermined rate.
    b. The model presumes that the volatility of the short rate will decline exponentially to a constant level.
    c. The model presumes that the basis-point volatility of the short rate will be proportional to the rate.
    d. The model presumes that the basis-point volatility of the short rate will be proportional to the square root of the rate.

Correct answer: d

Explanation: In the CIR model, the basis-point volatility of the short rate is not independent of the short rate as other simpler models assume. The annualized basis-point volatility equals $\sigma\sqrt{r}$ and therefore increases as a function of the square root of the rate.

Section: Market Risk Measurement and Management
Reference: Tuckman, *Fixed Income Securities, 3rd Edition*. Chapter 10: The Art of Term Structure Models: Volatility and Distribution.
AIMS: Describe the short-term rate process under the Cox-Ingersoll-Ross (CIR) and lognormal models.

7. A firm has entered into a USD 20 million total return swap on the NASDAQ 100 Index as the index payer with ABC
    Corporation, which will pay 1-year LIBOR + 2.5%. The contract will last 1 year, and cash flows will be exchanged
    annually. Suppose the NASDAQ 100 Index is currently at 2,900 and LIBOR is 1.25%. The firm conducts a stress test
    on this total return swap using the following scenario:

    NASDAQ 100 in 1 year: 3,625
    LIBOR in 1 year: 0.50%

    For this scenario, what is the firm's net cash flow in year 1?

    a. A net cash outflow of USD 4.40 million.
    b. A net cash outflow of USD 4.25 million.
    c. A new cash inflow of USD 4.25 million.
    d. A new cash inflow of USD 4.40 million.

    Correct answer: b

    Explanation: The NASDAQ will increase 25%, or (3625/2900)-1, over the next year, so the index payer will pay
    USD 5 million (0.25 * 20 million) to ABC Corp. Since ABC Corp's payments depend on today's LIBOR, it will pay
    3.75% (1.25% + 2.5%) or USD 0.75 million (0.0375 * 20 million), So the firm's net cash flow would be 0.75 million –
    5 million = -USD 4.25 million.

    Section: Credit Risk Measurement and Management
    Reference: Christopher Culp, *Structured Finance and Insurance: The Art of Managing Capital and Risk* (Hoboken, NJ:
    John Wiley & Sons, 2006). Chapter 12: Credit Derivatives and Credit-Linked Notes.
    AIMS: Explain the mechanics of asset default swaps, equity default swaps, total return swaps and credit linked notes.

8. An analyst is reviewing a bond for investment purposes. The bond is expected to have a default probability of 2%, with an expected loss of 80 bps in the event of default. If the current risk-free rate is 4%, what is the minimum coupon spread needed on the bond for its expected return to match the risk-free rate?

    a. 90 bps
    b. 120 bps
    c. 200 bps
    d. 280 bps

Correct answer: a

Explanation: The credit risky bond is preferable when

$$(1\text{-PD}) * (1 + r + z) + \text{PD} * \text{RR} > 1 + r$$

where PD is the probability of default, RR is the recovery rate, r is the coupon paid by a risk-free bond, and z is the coupon spread for a risky bond that compensates for the default risk.

Since expected loss (EL) = PD * the loss given default (LGD), LGD = (EL/PD). Also the recovery rate RR = 1-LGD.

Therefore RR = 1-EL/PD = 0.6, and using the relationship above: (1-2%) * (1 + 4% + z) + 2% * 60% > 1 + 4%.

Making the calculations simplifies the equation as follows: $0.98 * (1.04 + z) + 0.012 > 1.04$;

hence $z > \frac{(1.04 - 0.012)}{0.98} - 1.04$ so $z > 0.00897$ or 90 bps.

Section: Credit Risk Measurement and Management
Reference: Allan Malz, *Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011), Chapter 6: Credit and Counterparty Risk.
AIMS: Calculate expected loss from recovery rates, the loss given default, and the probability of default.

9. You are the credit risk manager for a bank and are looking to mitigate counterparty credit risk exposure to ABCO, an A-rated firm. Currently your bank has the following derivatives contracts with ABCO:

Contract	Contract Value (HKD)
A	20,000,000
B	30,000,000
C	14,000,000
D	1,000,000

With the information provided, what is the most appropriate credit risk mitigation technique in this case?

a. Implement a netting scheme.
b. Use credit triggers.
c. Sell credit default swaps on ABCO.
d. Increase collateral.

Correct answer: d

Explanation: Increasing collateral would effectively reduce current credit exposure depending on the contract parameters, mainly minimum transfer amount and threshold.

Section: Credit Risk Measurement and Management
Reference: Jon Gregory, *Counterparty Credit Risk and Credit Value Adjustment: A Continuing Challenge for Global Financial Markets* (West Sussex, UK: John Wiley & Sons, 2012), Chapter 3: Defining Counterparty Credit Risk.
AIMS: Identify and describe the different ways institutions can manage and mitigate counterparty risk.

10. The exhibit below presents a summary of bilateral mark-to-market (MtM) trades for three counterparties. If netting agreements exist between all pairs of counterparties shown, what is the correct order of net exposure per counterparty, from highest to lowest?

MtM Trades for Four Counterparties (USD Million)

	Opposing Counterparty	
Counterparty A	B	C
Trades with positive MtM	10	10
Trades with negative MtM	-10	0
Counterparty B	A	C
Trades with positive MtM	10	0
Trades with negative MtM	-10	-5
Counterparty C	A	B
Trades with positive MtM	0	5
Trades with negative MtM	-10	0

a. A-B-C
b. A-C-B
c. C-A-B
d. C-B-A

Correct answer: b

Explanation: One must properly net the positive and negative trades per counterparty for all three counterparties shown. The properly netted amounts are:

For counterparty A: exposure to B = USD 0, exposure to C = USD 10 for a sum of USD 10;
For counterparty B: exposure to A = USD 0, exposure to C = USD 0 for a sum of USD 0;
For counterparty C: exposure to A = USD 0, exposure to B = USD 5 for a sum of USD5.

Therefore, the correct sequence is as shown above.

Section: Credit Risk Measurement and Management
Reference: Jon Gregory (2010), Counterparty Credit Risk: The New Challenge for Global Financial Markets, West Sussex, UK, John Wiley & Sons.
AIMS: Describe the different ways institutions can manage counterparty risk.

11. An underlying exposure with an effective annual price volatility of 6% is collateralized by a 10-year U.S. Treasury note with an effective price volatility of 8%. The correlation between the exposure and the U.S. Treasury note is zero. Changes in the value of the overall position (exposure plus collateral) are calculated for a 10-day horizon at a 95% confidence interval (assume a year of 250 days). Which of the following would one expect to observe from this analysis?

   a. The presence of collateral increases the current exposure and increases the volatility of the exposure between remargining periods.
   b. The presence of collateral increases the current exposure, but decreases the volatility of the exposure between remargining periods.
   c. The presence of collateral decreases the current exposure, but increases the volatility of the exposure between remargining periods.
   d. The presence of collateral decreases the current exposure and decreases the volatility of the exposure between remargining periods.

Correct answer: c

Explanation: Worse case change for the value of the collateral is: -1.96 * (10/250)^0.5 * 8% = -3.136%
The overall volatility of the position: (.06^2 + .08^2)^0.5 = 10%
Thus the worst case change in the value of this position (exposure + collateral) is:
-1.96 * 10% * (10/250)^0.5 = -3.92%
Thus, the collateral mitigates the exposure today while increasing the volatility of the position in the future.

Section: Credit Risk Measurement and Management
Reference: Jon Gregory, Counterparty Credit Risk and Credit Value Adjustment: A Continuing Challenge for Global Financial Markets (West Sussex, UK: John Wiley & Sons, 2012), Chapter 8: Credit Exposure.
AIMS: Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.

12. A trader observes a quote for Stock ZZZ, and the midpoint of its current best bid and best ask prices is CAD 35. ZZZ has an estimated daily return volatility of 0.25% and average bid-ask spread of CAD 0.1. Assuming the returns of ZZZ are normally distributed, what is closest to the estimated liquidity-adjusted, 1-day 95% VaR, using the constant spread approach on a 10,000 share position?

    a. CAD 1,000
    b. CAD 2,000
    c. CAD 3,000
    d. CAD 4,000

Correct answer: b

Explanation: The daily 95% VaR = 35 *10,000 * (1.645 * 0.0025) = CAD 1,440

The constant spread approach adds half of the bid-ask spread (as a percent) to the VaR calculation, using the following formula:

Liquidity Cost (LC) = ½ (*Spread* * P), where *Spread* is equal to the actual spread divided by the midpoint and P is the value of the position.

Therefore the liquidity cost (LC) = 350,000 * (0.5 * 0.1/35) = CAD 500

Liquidity-adjusted VaR (LVaR) = VaR + LC = CAD 1,940.

Section: Operational and Integrated Risk Management
Reference: Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005). Chapter 14: Estimating Liquidity Risks.
AIMS: Describe and calculate LVaR using the constant spread approach and the exogenous spread approach.

13. The risk management department at Southern Essex Bank is trying to assess the impact of the capital conser-
vation and countercyclical buffers defined in the Basel III framework. They consider a scenario in which the
bank's capital and risk-weighted assets are as shown in the table below (all values are in EUR millions):

Risk-weighted assets	3,110
Common equity Tier 1 (CET1) capital	230
Additional Tier 1 capital	34
Total Tier 1 capital	264
Tier 2 capital	81
Tier 3 capital	–
Total capital	345

Assuming that all Basel III phase-ins have occurred and that the bank's required countercyclical buffer is 0.75%,
which of the capital ratios does the bank satisfy?

a. The CET1 capital ratio only.
b. The CET1 capital ratio plus the capital conservation buffer only.
c. The CET1 capital ratio plus the capital conservation buffer and the countercyclical buffer.
d. None of the above.

Correct answer: b

Explanation: The bank has CET1 capital ratio of (230/3110) or 7.4%. This ratio meets the 4.5% minimum and the
additional 2.5% capital conservation buffer but not the additional countercyclical buffer of 0.75% (4.5% + 2.5% +
0.75 = 7.75%).

Section: Operational and Integrated Risk Management

Reference: "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised
Version," (Basel Committee on Banking Supervision Publication, June 2011).

AIMS: Describe changes to the regulatory capital framework, including changes to: the measurement, treatment,
and calculation of Tier 1, Tier 2, and Tier 3 capital.

14. An operational risk manager is trying to compute the aggregate loss distribution for a firm's investment banking division. When using Monte Carlo simulation, which of the following loss frequency and loss severity distribution pairs is the most appropriate to use?

a. Poisson, normal
b. Poisson, lognormal
c. Binomial, lognormal
d. Binomial, normal

Correct answer: b

Explanation: Pareto and lognormal distributions (fat-tailed) are generally used for loss severity. Poisson and Negative Binomial distributions are appropriate for loss frequency.

Section: Operational and Integrated Risk Management
Reference: Eric Cope, Giulio Mignola, Gianluca Antonini and Roberto Ugoccioni, "Challenges and Pitfalls in Measuring Operational Risk from Loss Data," *The Journal of Operational Risk*, Volume 4/Number 4, Winter 2009/10: pp. 3-27.
AIMS: Explain the loss distribution approach to modeling operational risk losses.

15. Under the proposals for Basel III, which of the following instruments would meet the criteria to be eligible to be considered as Tier II capital?

a. A senior unsecured bond with a step-up coupon and six years left until maturity.
b. A senior unsecured bond with 10 years left until maturity.
c. A subordinated bond with original maturity of seven years and a call option exercisable after five years.
d. A subordinated bond with nine years left until maturity that is guaranteed by a subsidiary of the issuing entity.

Correct answer: c

Explanation: Choice c meets all of the Basel Committee's proposed criteria for inclusion in Tier II capital while the others do not. In this case, the bond is subordinated, has a minimum original maturity of at least five years and it is callable at the initiative of the issuer only after a minimum of five years.

Section: Operational and Integrated Risk Management
Reference: "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised Version," (Basel) Committee on Banking Supervision Publication, June 2011).
AIMS: Describe changes to the regulatory capital framework, including changes to the measurement, treatment, and calculation of Tier 1, Tier 2, and Tier 3 capital.

16. Even though risk managers cannot eliminate model risk, there are many ways managers can protect them-selves against model risk. Which of the following statements about managing model risk is correct?

   a. Models should be tested against known problems.
   b. It is not advisable to estimate model risk using simulations.
   c. Complex models are generally preferable to simple models.
   d. Small discrepancies in model outputs are always acceptable.

Correct answer: a

Explanation: One way to protect against model risk is to test a model against known problems. It is always a good idea to check a model against simple problems to which one already knows the answer, and many problems can be distilled to simple special cases that have known answers. If the model fails to give the correct answer to a problem whose solution is already known, then this indicates that there is something wrong with it.

Section: Operational and Integrated Risk Management
Reference: Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).
Chapter 16: Model Risk.
AIMS: Identify ways risk managers can protect against model risk.

17. When marking-to-market an illiquid position for Basel II compliance, the least desirable source of price information would be:

   a. An interpolation from trade prices on liquid securities similar to the one being valued.
   b. An average of price quotes given over the phone from three reputable independent brokers.
   c. A price from a broker screen.
   d. A price from an active exchange.

Correct answer: a

Explanation: Marking-to-market is the process of valuing positions, at least daily, using readily available close out prices in orderly transactions that are sourced independently. Examples of readily available close out prices include exchange prices, screen prices, or quotes from several independent reputable brokers. Only where marking-to-mar-ket is not possible, should banks mark-to-model. Marking-to-model is defined as any valuation which has to be benchmarked, extrapolated or otherwise calculated from a market input.

Section: Operational and Integrated Risk Management
Reference: "Revisions to the Basel II Market Risk Framework—Updated as of 31 December 2010," (Basel Committee on Banking Supervision Publication, February 2011).
AIMS: Describe the regulatory guidance on prudent valuation of illiquid positions.

18. A risk analyst is evaluating the risks of a portfolio of stocks. Currently, the portfolio is valued at EUR 110 million and contains EUR 10 million in stock A. The standard deviation of returns of stock A is 12% annually and that of the overall portfolio is 19% annually. The correlation of returns between stock A and the portfolio is 0.5. Assuming the risk analyst uses a 1-year 99% VaR and that returns are normally distributed, how much is the component VaR of stock A?

    a. EUR 0.254 million
    b. EUR 0.986 million
    c. EUR 1.396 million
    d. EUR 3.499 million

Correct answer: c

Explanation: Let α(99%) represent the 99% confidence factor for the VaR estimate, which is 2.326.
$VaR_A = w_A * \sigma_A * \alpha(99\%)$ = EUR 10 million x 0.12 x 2.326 = EUR 2.792 million
Component $VaR_A = \rho * VaR_A$ = 0.5 x 2.792 = EUR 1.396 million

Section: Risk Management and Investment Management
Reference: Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition*. (New York: McGraw-Hill, 2007). Chapter 7: Portfolio Risk: Analytical Methods.
AIMS: Define, compute, and explain the uses of marginal VaR, incremental VaR and component VaR.

19. Which of the following statements about risk management in the pension fund industry is correct?

    a. A pension plan's total VaR is equal to the sum of its policy-mix VaR and active-management VaR.
    b. Pension fund risk analysis does not consider performance relative to a benchmark.
    c. In most defined-benefit pension plans, if liabilities exceed assets, the shortfall does not create a risk for the plan sponsor.
    d. From the plan sponsor's perspective, nominal pension obligations are similar to a short position in a long term bond.

Correct answer: d

Explanation: Nominal pension obligations are similar to a short position in a bond.

Section: Risk Management and Investment Management
Reference: Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition*. (New York: McGraw-Hill, 2007). Chapter 17: VaR and Risk Budgeting in Investment Management.
AIMS: Define and describe the following types of risk: absolute risk, relative risk, policy-mix risk, active management risk, funding risk and sponsor risk.

20. A risk manager is evaluating a pairs trading strategy recently initiated by one of the firm's traders. The strategy involves establishing a long position in Stock A and a short position in Stock B. The following information is also provided:

- 1-day 99% VaR of Stock A is USD 100 million
- 1-day 99% VaR of Stock B is USD 125 million
- The estimated correlation between long positions in Stock A and Stock B is 0.8

Assuming that the returns of Stock A and Stock B are jointly normally distributed, the 1-day 99% VaR of the combined positions is closest to?

   a. USD 0 million
   b. USD 75 million
   c. USD 160 million
   d. USD 225 million

Correct answer: b

Explanation: $\sqrt{(VaR_A^2 + VaR_B^2 + 2*\rho*VaR_A*VaR_B)}$ = $\sqrt{(100^2 + 125^2 + 2 - 0.8*100*125)}$ = USD 75 million

Since this is a pairs trading strategy with a long and a short position, the proper correlation to use is -0.8.

Section: Risk Management and Investment Management

Reference: Philippe Jorion, Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition, (New York McGraw-Hill, 2007), Chapter 7: Portfolio Risk: Analytical Methods.

AIMS: Define, calculate, and distinguish between the following portfolio VaR measures: Individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR.

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