SOCIETY OF ACTUARIES
Quantitative Finance and Investment Core

Exam QFICORE

AFTERNOON SESSION

Date: Wednesday, May 4, 2016
Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 6 questions numbered 12 through 17 for a total of 40 points. The points for each question are indicated at the beginning of the question.

2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.

3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

4. When you are asked to calculate, show all your work including any applicable formulas. When you are asked to recommend, provide proper justification supporting your recommendation.

5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets because they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam QFICORE.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

12. (*4 points*) A bond fund manager is using enhanced indexing to closely match the returns of a Bond Index. The portfolio returns and the Bond Index returns have been the following over the last 4 years:

Year	Portfolio Return	Benchmark Return
Y-4	8.5%	8%
Y-3	5.00%	5.10%
Y-2	-4.00%	-3.80%
Y-1	3.50%	3.45%

(a)   (*1.5 points*) Calculate the tracking risk of this portfolio based on the past 4 years of returns.

Up to now, the manager has been using the variance to measure the risk of the bond portfolios she manages.

(b)   (*1 point*) Describe the limitations of using variance to measure the sensitivity of a portfolio with many bonds.

(c)   (*1.5 points*) Describe the following three measures that can be used in risk measurement and the limitations that each measure may have in risk quantification:

- Semi Variance
- Shortfall Risk
- Value at Risk (VaR)

13. (*9 points*) A portfolio manager at WY Investment Management manages the following fixed income portfolio:

Asset Class	Effective Duration	Face Amount (million)	Average Market Price per $100 Face Amount
U.S. Treasury	7	$20	$120
Investment grade non-callable bullet bond	5	$30	$110
Floating rate bond	x	$60	$100
Cash		$10	

The floating rate bond coupons are reset quarterly and the latest reset date was yesterday.

A Treasury futures has the following characteristics.

Delivery per contract	$100,000
Duration of CTD (Cheapest to Deliver)	8.5
Conversion factor	1.3

(a)   (*1 point*) Assess whether a non-callable bond will outperform or underperform a callable bond during the following rate environment.

- Rising interest rate environment
- Falling interest rate environment

(b)   (*1 point*) Explain the impact of each of the following provisions to the risk of a callable bond.

- Deferment period
- Nonrefundable
- Make-whole call provision

(c)   (*1 point*) Explain how the prices of floating rate bonds move over time before and at the reset dates.

(d)   (*1.5 points*) Calculate the effective duration of the portfolio described above.

13. Continued

Many economists have predicted a parallel increase in interest rates of 150 bps in the near future. The manager is worried about the impact of this increase in rates, and wants to limit the loss on the investment grade non-callable bullet bond to $2 million.

(e)　(*2.5 points*) Demonstrate how the manager can achieve this goal using Treasury futures. Show your calculations.

(f)　(*1 point*) Describe how the manager can also achieve this goal using swaps.

(g)　(*1 point*) Recommend two methods that the manager can use to hedge against interest rate increases while retaining upside potential.

14. (*5 points*) You are modeling monthly log returns of XYZ stock from January 1966 to December 2015 for six hundred observations. You have used AR(1)-GARCH(1,1) model so far.

(a)   (*1 point*) Describe the principal disadvantage of GARCH(1,1) model.

Consider an EGARCH(1,1) model in the following form:

$$\ln\left(\sigma_t^2\right) = \alpha_0 + \alpha_1 \frac{\left|\alpha_{t-1}\right| + \gamma_1 \alpha_{t-1}}{\sigma_{t-1}} + \beta_1 \ln\left(\sigma_{t-1}^2\right)$$

(b)   (*2 points*) Describe briefly how the EGARCH(1,1) model addresses the disadvantage identified in part (a).

You have estimated the parameters of the EGARCH(1,1) and the fitted model is

$$r_t = 0.011 + \alpha_t, \quad \alpha_t = \sigma_t \varepsilon_t$$

$$\ln\left(\sigma_t^2\right) = -0.55 + 0.22 \frac{\left|\alpha_{t-1}\right| - 0.264\alpha_{t-1}}{\sigma_{t-1}} + 0.29 \ln\left(\sigma_{t-1}^2\right)$$

(c)   (*2 points*) Compute the ratio of the conditional variance σ_t^2 given that $\varepsilon_{t-1} = -2$ to the conditional variance given that $\varepsilon_{t-1} = 2$

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15. (*10 points*) The chief actuary of BB Insurance Company has decided to add an equity component to a fund managed by her company because she believes that equities are a good inflation hedge.

    (a)   (*1 point*) Assess the chief actuary's belief regarding equities being a good inflation hedge.

The chief actuary asked a consultant to review active and passive management approaches as well as various weighting schemes used in constructing equity market indices.

    (b)   (*1.5 points*) Describe the biases of the following weighting schemes for stock indices.

        (i)   Price-weighted index

        (ii)   Market capitalization-weighted index

        (iii)   Equal-weighted index

The consultant has also received the following information from the chief actuary:

- BB Insurance Company has a tax rate of 30%.
- Chief actuary believes that capital markets are efficient.
- Chief actuary favors small cap stocks as compared to large cap stocks.
- Chief actuary prefers to have international exposure in the equity portfolio.

    (c)   (*1 point*) Evaluate whether active or passive management is more suitable for the equity portfolio, based on the above information.

15. Continued

BB Insurance Company would like to maximize active return for a given level of active risk determined by its level of aversion to active risk. Based on the consultant's assessment λ_A, the BB Insurance Company's trade-off between active risk and active return per unit of variance, is 3.

The consultant has identified two potential value-oriented equity portfolio managers with the following characteristics.

Manager	X	Y
Total return	10%	11%
Investor's Benchmark return	9%	9%
Manager's Normal Benchmark return	8%	8.5%
Total risk (standard deviation)	5%	9%
Total active risk (standard deviation)	4%	6%
True active risk (standard deviation)	3%	4%

(d)   (*1.5 points*)

   (i)   Recommend whether Manager X or Manager Y should be selected.

   (ii)   Describe how increasing λ_A would impact your recommendation in part (d)(i).

(e)   (*2 points*)

   (i)   Describe the sub-styles of value-oriented investing.

   (ii)   Explain concerns an investor should have regarding value-oriented managers.

The consultant has selected three equity portfolio managers who have expertise in the U.S. stock market. All three managers have excellent stock-picking skills. However, the consultant believes that the European economy will grow at a higher rate than the U.S. economy.

Question 15 continued on next page

15. Continued

    (f)   (*2 points*) Recommend and explain for each of the strategies below, how a portfolio can be constructed to capitalize on the higher growth rate in the broad European economy and the managers' stock-picking skills.

        (i)   Core-satellite approach

        (ii)   Alpha and beta separation approach

    (g)   (*1 point*) Outline the limitations of the alpha and beta separation approach.

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16. (*9 points*) As the Chief Investment Officer (CIO) of RMC Corporation, you are working on a strategic asset allocation recommendation for RMC.

You are using the sign-constrained Mean Varience Optimization (MVO) based on RMC's capital market expectations and the following asset classes:

A.   U.S. Equities

B.   International Equities

C.   U.S. Corporation short-term Bonds

D.   U.S. Corporation intermediate Bonds

E.   International Bonds

F.   Real Estate

Your analysis produces the following Corner Portfolios:

Corner Portfolio No.	Expected Annual Return	Standard Deviation	Sharpe Ratio	Asset Class (Portfolio Weight)					
				A	B	C	D	E	F
1	10.00%	18.00%	0.431	100%	0%	0%	0%	0%	0%
2	9.50%	17.00%	0.426	80%	20%	0%	0%	0%	0%
3	9.00%	15.50%	0.435	65%	10%	10%	10%	0%	5%
4	7.75%	11.75%	0.468	50%	20%	10%	10%	0%	10%
5	6.00%	10.50%	x	40%	20%	10%	10%	10%	10%
6	5.50%	9.00%	y	50%	40%	0%	0%	0%	10%

16. Continued

(a)   (*1.5 points*) Determine the tangency portfolio within portfolios 1-6.

The following information is extracted from the Investment Policy Statement (IPS) of RMC:

Return Objectives:

- RMC' assets shall be invested with the objective of earning at least 5.5% annually on average to cover corporate spending rate of 3%, an expected inflation rate of 2% and cost of earning investment return of 0.5%.

Risk Objectives:

- RMC's asset portfolio shall be constructed to minimize the probability of annual portfolio return falling below 3%.

And a very conservative RMC board member suggests changing the risk objective of IPS as follows:

- Minimizing the level of standard deviation subject to meeting RMC's return objective.
- Adding U.S. T-Bills (risk-free asset) to the permissible asset classes.

(b)   (*1.5 points*) Create the most appropriate asset allocation based on the above information and the result in part (a).

Another board member wants to know if there is an opportunity to add a portfolio of U.S. leveraged loans to RMC asset classes.

(c)   (*1.5 points*)

(i)   Describe key characteristics of leverage loans and their advantages from a borrower's perspective.

(ii)   Describe aspects that mitigate the risk of a leveraged loan for the investors.

Question 16 continued on next page.

16. Continued

RMC expects that a portfolio of leveraged loans will return 3% per annum with a standard deviation of 8%.

(d)   (*1.5 points*) Determine the condition needed for a leveraged loan portfolio to improve the efficiency of the portfolio in part (b) under the MVO framework.

The Chief Risk Officer (CRO) challenges the use of the traditional MVO approach.

(e)   (*1 point*) Describe the limitations of using the MVO approach in strategic asset allocation process.

In particular, the CRO believes that some of the asset classes are too highly correlated for the MVO tool to distinguish them. However, he is concerned that removing these asset classes is going to eliminate exposures to certain risks that offer diversification benefits. He suggests considering risk factor based portfolio optimization, which concentrates on the underlying risks instead of asset classes.

(f)   (*1 point*) Explain how risk factor based portfolio optimization may be able to address the CRO's concerns.

(g)   (*1 point*) Identify challenges in implementing risk factor based portfolio optimization result.

17. (*3 points*) You are interested in exploring alternatives to using size, value, and momentum as investment styles in equity portfolio management.

    (a)   (*0.5 points*) Describe how liquidity is proposed to be measured in Ibbotson's article, "Liquidity as an Investment Style."

    (b)   (*1.5 points*) Explain why liquidity meets the following criteria identified by William Sharpe to characterize an investment style.

        (i)   Not easily beaten

        (ii)   A viable alternative

    (c)   (*1 point*) Explain why liquidity is an economically significant indicator of long-run returns.

END OF EXAMINATION
Afternoon Session

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