SOCIETY OF ACTUARIES
Foundations of CFE Exam

Exam CFEFD

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 5 questions numbered 9 through 13 for a total of 40 points. The points for each question are indicated at the beginning of the question. No questions pertain to the Case Study.

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.

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 CFEFD.

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.

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Exam CFEFD-Front Cover

****BEGINNING OF EXAMINATION****
Afternoon Session
Beginning with Question 9

9. (*9 points*) Azure Care ("Azure") is a large assisted care provider and is considering an acquisition of a small long term care insurance company, Teal Insurance ("Teal"). The table below contains the current financial information of Azure and projections for Teal.

	Equity Cost of Capital	Debt Cost of Capital	Corporate Tax Rate	Target Debt-to-Value Ratio
Azure	12%	6%	35%	40%
Teal	10%	5.5%	35%	30%

Azure is expecting a perpetual free cash flow from the acquisition, starting at $15 million at the end of the first year and growing at 2% annually. The initial investment is $80 million. Assume that Azure maintains its target debt-to-value ratio continuously, even after the acquisition.

(a) (*2 points*)

(i) Calculate the Net Present Value (NPV) of the acquisition, using the Weighted Average Cost of Capital (WACC) method.

(ii) Recommend whether Azure should pursue the acquisition based on the NPV calculated.

In reality, Azure only adjusts its debt level annually to maintain its target debt-to-value ratio. Also, Azure revised the unleveraged cost of capital to 10% for the acquisition. Azure is currently at its target debt-to-value ratio and has $30 million of debt outstanding.

(b) (*3 points*)

(i) Calculate the NPV of the acquisition based on the new information.

(ii) Recommend whether Azure should pursue the acquisition based on the new information.

(c) (*1 point*) Describe how scenario analysis can help Azure further analyze the risks of this investment.

9. Continued

Azure decides to perform scenario analysis on the risk of acquiring Teal. Azure's CEO states, "We've never owned an insurance company before. I've heard they are very sensitive to the cost of holding risk. I would like to understand why and how can we capture that in the scenario analysis."

(d) (*3 points*)

(i) Describe features of insurance companies and market imperfections that combine to cause increased sensitivity to the cost of holding risk.

(ii) Design a scenario for each of the features of insurance companies from part (i) to capture specific risks of acquiring an insurer.

10. (*7 points*) You work for a small U.S. life insurance company, Sepia Life. The following information applies to Sepia:

- Cost of Equity = 10%
- Cost of Debt = 12%
- Discount Rate = 10%
- Tax rate = 30%

Sepia's projection of profit and capital (millions):

Year	1	2	3
NOPAT (Net Operating Profit After-Tax)	10	10	10
Average Debt	60	60	60
Average Equity	40	40	40

Your manager says: "ROE is the only measure I look at because it focuses on return to shareholders, which ties to our goal of maximizing shareholder value."

(a) (*1 point*) Critique your manager's comment.

(b) (*2 points*) Calculate Market Value Added ("MVA") of your company using three years of data.

Sepia is considering opening a new sales office. You are asked to prepare a revised financial projection for Sepia, assuming the new office is opened. You have projected the following NOPAT (in millions):

Year	1	2	3
NOPAT	6	10	18

You estimate that 10 million of additional capital needs to be raised for the new office. New capital can be either debt or equity without further impacting NOPAT.

(c) *(3 points*)

(i) Recommend the optimal funding source for the new office. Support your recommendation.

(ii) Recommend whether Sepia should invest in the new office, based on MVA using three years of data. Show your work.

10. Continued

Your manager has expressed concern regarding your projection results: "Sepia's return on capital is much lower than when the market was less competitive 10 years ago. But compared to the low yield on our excess cash, opening the new sales office is the right thing to do."

(d) (*1 point*) Critique your manager's comments using two lessons learned during the 2008 financial crisis.

11. (*9 points*) You work for Tiny Insurance Company which uses the percentile approach to calculate market value margins (MVMs). Tiny, a small insurance company, is interested in learning more about using the Market Cost of Capital (MCoC) approach to calculate MVMs.

(a) (*2 points*) Compare the percentile and MCoC approaches to calculate MVMs specifically for Tiny.

(b) (*1 point*) Describe the "Down But Not Out" approach to calculating a fair value risk margin.

You are given the following information regarding Tiny's 5-year term life product for the mortality risk margin:

Year	**Base**	**Shocked**	**Values per survivor**			**Margin**	**Capital**
t	q_{x+t}	$\hat{q}_{x+t}$	${}_tV_0$	${}_tV$	${}_t\hat{V}$	${}_tV - {}_tV_0$	${}_t\hat{V} - {}_tV$
0			50.336	51.836	56.965	1.500	5.129
1	0.00100	0.00110	42.896	43.959	48.353	1.063	4.394
2	0.00108	0.00119	34.278	34.955	(iii)	0.677	(ii)
3	0.00117	(i)	24.320	24.679	27.184	0.359	2.505
4	0.00126	0.00139	12.952	13.079	14.413	0.127	1.333
5	0.00136	0.00150					

- The same mortality shock multiple is used for every projection year with $\alpha = 1$
- Face value is 10,000
- Interest rate is 5%
- Ignore the impact of premiums and expenses

(c) (*2 points*) Calculate the Return on Capital used in the above table for Tiny's 5-year term life insurance business.

(d) (*2 points*) Calculate the values for (i), (ii), and (iii) in the table above.

11. Continued

Assume Tiny adopts the MCoC approach. One year later, a flu pandemic results in a 1-in-100-year mortality event. Tiny's CFO addresses the pandemic's impact at the annual shareholder meeting:

> "Most of our mortality risk capital is gone because of the flu pandemic, which obviously means our five-year term product had negative returns. However, because we have sufficient loadings in future mortality rates we can expect a reasonable return on investment if we replace the lost capital now. If this capital is replaced we can be sure that this will not happen again for at least another 100 years. You can also gain comfort knowing that our approach includes margin for parameter risk in case our mortality assumption is incorrect."

(e) (*2 points*) Critique the CFO's statement.

12. (*8 points*) You manage the interest rate hedging program for Plum Life Insurance Company. Plum currently uses the Black-Scholes formula to determine the market implied volatility of options.

(a) (*1 point*) State two benefits of calculating the market implied volatility.

(b) (*1 point*)

(i) Define delta of a European put option.

(ii) State the formula for delta of a European put option using Black-Scholes.

(c) (*1 point*) Determine how an increase in the following variables would affect the delta of a long European Black-Scholes put option:

(i) Risk-free rate

(ii) Strike price

(iii) Market implied volatility

Your boss asks you to develop a risk measure to be used in analyzing the effectiveness of Plum's hedging program.

(d) (*3 points*)

(i) Identify two examples for each of ex-post and ex-ante portfolio risk measures.

(ii) Recommend a specific risk measure to analyze the effectiveness of an interest rate hedge. Justify your recommendation.

(iii) Design a stress test using the risk measure in (ii) to determine the effectiveness of an interest rate hedge. Support your answer.

You decide to introduce stochastic simulation to Plum's hedging program.

(e) (*1 point*) List four quality criteria for a random number generator.

(f) (*1 point*) Explain how to use entropy to improve the stochastic simulation.

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13. (*7 points*) Cornflower Corporation is considering selling alcohol in its restaurants. The company has assembled the following market research:

- 80% of alcohol sales ventures that were profitable had successful test markets.
- 25% of alcohol sales ventures that were unprofitable had successful test markets.
- 40% of alcohol sales ventures are unprofitable.

(a) (*1 point*) Calculate the probability that alcohol will be profitable for Cornflower given that it was successful in the test market. Show your work.

(b) (*1 point*)

(i) Define heterogeneous benchmark.

(ii) Explain how it could apply to Cornflower.

After its competition introduced alcohol in their restaurants, Cornflower has decided to do so also. Below is the incremental projection for Cornflower alcohol sales:

Income Statement Items (millions)	Year 1	2	3
Revenues	50	125	175
Cost of Goods Sold	30	75	105
Depreciation	2	2	2
Other Expenses	6	6	6

Balance Sheet Items (millions)	Year 1	2	3
Additional Cash Held	0	0	0
Inventory	6	15	16
Accounts Payable	1	2	2.5
Accounts Receivable	0	0	0

13. Continued

Cornflower included the following information with the projection:

- The initial start-up cost to sell alcohol in its restaurants is 50 million.
- Cornflower's WACC is 12%.
- Cornflower's tax rate is 35%.
- Assume no interest expense.

(c) (*3 points*) Calculate the NPV of selling alcohol in Cornflower's restaurants. Show your work.

The agency responsible for issuing alcohol permits to Cornflower is considering increasing the cost of the permits, which would increase the initial start-up cost by 15 million.

There is a 60% chance the cost of the permits will increase if Able Baker is appointed to head the alcohol permit agency. There is a 40% chance the cost of the permits will increase if Charlie Delta is appointed to head the alcohol permit agency. There is a 55% chance of Able Baker being appointed.

The NPV of lost restaurant sales if Cornflower does not start selling alcohol is estimated to be 5 million.

Cornflower must decide whether to begin selling alcohol before the new agency head is appointed.

(d) (*2 points*) Assess whether Cornflower should begin selling alcohol in its restaurants. Support your assessment.

****END OF EXAMINATION****
Afternoon Session

USE THIS PAGE FOR YOUR SCRATCH WORK