

QFI IRM Model Solutions

Spring 2017

1. Learning Objectives:

3. Understand and be able to apply different approaches to risk measurement.

Learning Outcomes:

- (3a) Evaluate a company's or a portfolio's exposures to various risks.
- (3d) Analyze and evaluate risk aggregation techniques, including the use and misuse of correlation, integrated risk distributions and copulas.

Sources:

"The devil is in the tails: actuarial mathematics and the subprime mortgage crisis"
Embrechts, Donnelly

2-"Developments in Modelling Risk Aggregation", Basel Committee on Banking Supervision

Commentary on Question:

This question tested the candidate's understanding of Gaussian and Gumbel copulas, especially their advantages and disadvantages.

Solution:

- (a) Explain why the senior tranche can achieve a higher rating than the underlying pool of assets.

Commentary on Question:

Candidates performed brilliantly on this section. Most candidates were able to explain the order of losses if they occurred. Candidates who received less than full credit did not provide any additional reasoning.

The senior tranche will have the lowest risk and highest credit quality, giving it the highest rating.

The other two tranches will absorb any losses before the senior tranche does.

- (b) List three advantages and three disadvantages of using Gaussian copulas in modeling credit risk.

1. Continued

Commentary on Question:

Candidates performed above average for this section. While most candidates were able to cite the advantages of Gaussian copulas, they tended to lose credit by not citing a sufficient number of disadvantages.

Advantages	Disadvantages
-Simple -Enables fast computations -Easy to calibrate	-Insufficient model of default clustering/tail dependency -Tranche correlations not the same for one factor Gaussian -Stress testing weaker due to lack of modeling of economic factors

- (c) Explain whether Gumbel copulas can address the disadvantages of Gaussian copulas.

Commentary on Question:

Candidates performed below average for this section. Most candidates understood that Gumbel copulas can address the tail dependency limitation of Gaussian copulas. However, candidates often lost credit in incorrectly stating whether the Gumbel copulas could address the disadvantages of Gaussian copulas.

-Insufficient model of default clustering/tail dependency

YES - Gumbel addresses tail dependence while Gaussian does not.

-Tranche correlations not the same

YES - Common problem when using 1-factor Gaussian copula model

-Stress testing weaker due to lack of modeling of economic factors

YES - Especially when marginal loss info is available

- (d) Recommend whether Gaussian copula applying conservatism in its parameters vs. a Gumbel copula should be used for this task.

Commentary on Question:

Candidates performed as expected for this section. Many candidates formed a recommendation which was then supported. Candidates who did not earn full credit failed to clarify what their recommendation was, or failed to provide support for their recommendation.

1. Continued

This question can be answered two ways:

Gumbel:

- can address the tail risk, which is an issue for this block. A Gaussian copula will be inappropriate in this case.
- All come from manufacturing so there is catastrophe risk, and Gumbel addresses that better than Gaussian.
- Volatility will be high since the block is international, so distribution will not be straightforward, and Gumbel is a better choice for that.

OR

Gaussian:

- This portfolio should provide a sufficient return in normal market scenarios, and Gaussian handles that well.
- There is a high diversification factor with having companies be international.
- Since timing is a factor, the quicker calculations of Gaussian over Gumbel is an advantage.

2. Learning Objectives:

2. The candidate will understand and be able to apply the components of an effective risk management system.

Learning Outcomes:

- (2b) Identify and describe the various kinds of risks, including market, credit, operational, etc.
- (2c) Identify and describe various approaches for managing risks including risk budgeting, position limits, etc.

Sources:

QFII-113-17 “Revisiting the Role of Insurance Company ALM Within a Risk Management Framework”, Goldman Sachs Asset Management

QFII-114-17 Chapter 10 of “Modern Investment Management: An Equilibrium Approach”, Bob Litterman and The Quantitative Resources Group

Commentary on Question:

This question tested the candidates’ understanding of asset allocation in the context of pension plan liabilities. Candidates were also required to assess surplus risk in an integrated scenario characterized by regulatory uncertainty and rising interest rates.

Solution:

- (a) Calculate the Sharpe ratio for portfolios C and D

Commentary on Question:

Candidates performed very well on this section. They were able to solve for the risk-free rate using the given Sharpe ratio for portfolio A (or B), and plug it in the formula appropriately.

Sharpe Ratio = (Expected Annual Return – Risk Free Rate)/(Annual Variance)^{0.5}

From A calculate the risk free rate to be 1%

C = 0.4545

D = 0.4667

- (b) Recommend a portfolio based on your answer to part (a) that achieves the risk and return objectives of the plan

Commentary on Question:

This section was also done very well. A small number of candidates did not take into consideration the 5.5% annual return objective of the plan, and mistakenly recommended Portfolio B.

2. Continued

Portfolio D is recommended since it has the highest Sharpe ratio (meets risk objective) while meeting the return objective.

- (c)
- (i) Identify two shortcomings to using Sharpe ratio in performing the strategic asset allocation analysis for the pension plan
 - (ii) Recommend improvements to the Sharpe ratio approach

Commentary on Question:

Performance was fair on this section. Full credit was awarded in part ii) to those candidates who were able to clearly demonstrate how the Sharpe ratio could be extended to the RACS in the presence of liabilities. Partial credit was awarded to responses mentioning dynamic analysis.

- (i) Limitations of using the Sharpe ratio:
 - The Sharpe ratio only considers the risk and return of assets and ignores the presence of any liability stream
 - The Sharpe ratio is well-founded concept in one-period model, but pension plans have intermediate payments to make over long period
 - (ii) The Sharpe ratio can be generalized to a risk-adjusted change in surplus (RACS)
 - The numerator can be changed to expected value of Surplus where $S = A - L$ less risk free rate
 - The denominator can be changed from volatility of asset only returns to volatility of surplus
 - $$\frac{E_t[A_t(1+r_{A,t+1}) - L_t(1+r_{L,t+1}) - (A_t - L_t)(1+r_f)]}{\sigma_t[A_t(1+r_{A,t+1}) - L_t(1+r_{L,t+1})]}$$
- (d) Evaluate each investment strategy and recommend which one(s) should be implemented

Commentary on Question:

Performance was fair on this section. Candidates who scored well recognized that although the plan is overfunded, domestic bond allocation is only sufficient to cover the liabilities.

- (i) Increase equity allocation and decrease bond allocation

The plan is overfunded and the bond allocation is just sufficient to cover the liabilities. Increasing equity allocation increases the probability of losing surplus since the equities are less correlated with the liabilities. This strategy is not recommended.

2. Continued

(ii) Within the equity allocation, increase the allocation to global equity and decrease the allocation to domestic equity

Since we are leaving the bond allocation unchanged, the plan's liabilities are basically eliminated for the asset allocation problem. Given that the plan is overfunded, it would be advisable to increase allocation to global equity. Global equity could diversify the portfolio and increase the Sharpe ratio of the fund. As a result, this strategy is recommended.

(iii) Replace a portion of the domestic bonds with global bonds.

This strategy is not recommended regardless of the funding status of the plan. The increase in volatility from increasing global fixed income allocation is offset by lower correlation of liabilities with global fixed income assets. There will be a greater risk of a funding shortfall.

(e) Assess the appropriateness of these changes for improving the plan's funding ratio

Commentary on Question:

Candidates performed poorly on this section. To receive credit, candidates needed to provide an assessment in the context of the rising interest rate and uncertain regulatory environment postulated in the question.

(i) Relaxing the duration constraints

It is appropriate to relax duration constraints in an upward sloping yield curve environment in an effort to improve the funding ratio. Given that we expect interest rates to increase (and liabilities are now also more uncertain), it might be acceptable to shorten duration (to be less than the liabilities) to take advantage of reinvesting at higher rates in the future. The funding ratio/surplus could therefore increase over time if we allow ourselves to relax the duration constraints.

(ii) Increasing allocations to equity

The more underfunded a plan is, and the more uncertain future liabilities are, the more attractive equities appear relative to fixed income. However, it is important to note that there is greater tail risk inherent in this approach i.e. the plan could be even more greatly underfunded.

2. Continued

(iii) Offering lump sum payments as a benefit option under the plan

This is not appropriate for improving the funding ratio. This change would shorten the duration of the liabilities, which will be worse if the expectation is that interest rates will rise. In addition, the acceleration of benefits to be paid reduces the ability of the plan to reduce its funding ratio deficit.

(f) Calculate the annual required return on assets in excess of the return on liabilities that achieves Becky's objective

Commentary on Question:

Performance was mixed on this section. Approximately half the candidates skipped this question. However, those that attempted this part scored well.

R_A =return on assets, R_L =return on liabilities, F_0 =starting funding ratio, F_1 =ending funding ratio

P =proportion of liabilities paid out

$F_1 = F_0 * ((1 + R_A) / ((1 + R_L) * (1 - p))) - p / (1 - p)$, so $F_1 = F_0$ implies:

$(1 + R_A) / (1 + R_L) = (1 - p) + p / F_0$

Return on assets in excess of the return on liabilities = $(1 + R_A) / (1 + R_L) - 1 = p / F_0 - p$

Substituting given values, this equals $.065 / .8 - .065 = 1.625\%$

3. Learning Objectives:

1. The candidate will understand the needs and methods of governing investments.
2. The candidate will understand and be able to apply the components of an effective risk management system.

Learning Outcomes:

- (1a) Compare the interest of key stakeholders.
- (1b) Explain principal versus agent conflict.
- (1c) Identify sources of unethical conduct and explain the role of a fiduciary.
- (1d) Describe governance mechanisms that attempt to address these conflicts.
- (1f) Explain how governance may be structured to gain competitive advantages and efficiencies.
- (2e) Evaluate a company's risk management process.

Sources:

Risk Management: Foundations for a Changing World, Haslett, 2010, Ch 45: The Ten Commandments of Operational Due Diligence

QFII-101-14: Chapter 11 of Strategic Management: An Integrated Approach, Hill & Jones

Commentary on Question:

The first part of this question tested a candidate's understanding of stakeholder interests. The next few parts tested the candidate's understanding of the role of an operational due diligence unit. The next two parts offered the candidate an opportunity to apply their knowledge of corporate governance. The final two parts tested the candidate's ability to apply their knowledge of the balanced scorecard model to a real-world situation.

Candidates performed very well in the early parts of this question, received around half credit on the middle parts, and their performance varied widely on the last two parts.

Solution:

- (a)
 - (i) Identify three internal and three external stakeholders.
 - (ii) Describe their interests in XYZ.

3. Continued

Commentary on Question:

Candidates did very well on this part. The most common mistake was identifying creditors as an internal stakeholder.

Internal

- Stockholders: provide risk capital and expect management to maximize their return on investment
- Employees: provide labor and skills and expect commensurate income, job satisfaction, job security, and good working conditions at XYZ
- Board: provide oversight of management on behalf of stockholders in exchange for compensation

External

- Creditors: provide capital in the form of debt and expect to be paid on time, with interest
- Suppliers: provide inputs for making widgets in exchange for revenue and XYZ being a dependable buyer
- Customers: provide revenue in exchange for high-quality, reliable widgets that represent value for money

- (b) List five of the ten steps for implementing an operational due diligence program

Commentary on Question:

Candidates did very well on this part. Many candidates were able to provide more than five items, though that was not necessary to receive full credit.

- Define the role
- Segregate the function
- Document and communicate
- Work efficiently with investment research
- Note the tone at the top

- (c) Evaluate XYZ's operational due diligence unit.

Commentary on Question:

Candidates' responses were generally poorly structured. Candidates earned around half of the available credit on average. Most candidates were able to identify the infrequency of meetings with senior management and the failure to communicate to the whole company the new unit's creation as negatives.

Important deficiencies that many candidates missed were the lack of independent review by the due diligence unit and the lack of review of financial statements. Many candidates did not point out positives.

3. Continued

Positive

- senior management defined the goal of the unit properly (i.e. protecting shareholder value)
- thorough documentation of reviews

Negative

- The CFO's comments do not seem to indicate a "tone at the top" that is interested in an ongoing relationship with the unit. The CFO suggested meeting again in a year, which is far too long to be effective.
- The creation of the unit was not announced to the whole company. Only the BD team was informed.
- The unit relies solely on the review performed by the BD team as opposed to independently performing a review.
- No review is done of the fundamentals (financial statements).

- (d) Recommend four improvements.

Commentary on Question:

Candidates' responses were generally poorly structured. Candidates earned around half of the available credit on average. Recommendations for bullets 1 and 2 were done well by most candidates, but those for bullet 3 and 4 were often missed.

Bullet 1

- more frequent meetings with senior management

Bullet 2

- educate all personnel in the company about the operational due diligence unit's role and responsibility

Bullet 3

- operational due diligence unit should conduct an independent review of potential investments

Bullet 4

- review the fundamentals: adequate and timely financial reporting, verification, and support

- (e) Assess XYZ's governance framework.

Commentary on Question:

Candidates' responses were generally poorly structured. Candidates earned around half of the available credit on average. Many candidates were able to identify that the current method of determining business unit managers' compensation was not ideal, and many were able to explain why. Few candidates pointed out the lack of a target to compare the earnings against. Many candidates did not point out positives.

3. Continued

Positives

- senior management (at least the CFO) are compensated in part with stock
- senior management is thinking about how to align interests of business unit managers with those of senior management in order to reduce principal-agent conflict

Negatives

- linking compensation of business unit managers to the earnings that they report, which are not audited, is bad practice
 - linking compensation to earnings might make managers emphasize current profits over long-term profitability
 - will likely lead to unethical practices like information manipulation by the business unit managers
- earnings are not compared against a target

- (f) Recommend improvements for two of the deficiencies identified in (e).

Commentary on Question:

Candidates' responses were generally poorly structured. Candidates earned around half of the available credit on average. Many candidates identified the need for reviewing performance on a regular basis, judging performance on a risk-adjusted basis, and having an external audit. Few candidates identified the need for a target to compare earnings against.

Bullet 1

- create systems for measuring and monitoring performance on a regular basis
- require CEO and CFO to endorse the financial statements for XYZ in order to comply with SOX

Bullet 2

- judge performance on risk-adjusted basis
- establish standards and targets against which performance can be measured

Bullet 3

- hire an independent, accredited accounting firm to review the financial statements in order to comply with SOX

Bullet 4

- link business unit managers' compensation to stock performance with stock grants or stock options

3. Continued

- (g) Efficiency and quality are two building blocks of competitive advantage used in a balanced scorecard model.
- (i) List the other two building blocks.
 - (ii) Identify a metric and define a formula (based on the data above) for each of the four building blocks.

Commentary on Question:

Many candidates skipped this part. Of those who attempted it, many candidates did very well while others received around half of the available credit, usually because they did not know the other two building blocks. Innovation was the least well-done of the 4 building blocks. A fair number of candidates used the number of widgets produced in the formulas for customer responsiveness and quality, but minimal credit was lost for this.

- (i) Innovation and customer responsiveness
 - (ii)
 - Efficiency:
labor productivity =
 $\text{Widgets produced} / \text{Employee hours spent making widgets}$
 - Quality:
defective rate = $\text{Widgets returned as defective} / \text{Widgets sold}$
 - Innovation:
% of revenue from new products =
 $(\text{Total revenue} - \text{Revenue from widgets}) / \text{Total revenue}$
 - Customer Responsiveness:
on-time delivery % = $\text{Widgets delivered on time} / \text{Widgets sold}$
- (h)
- (i) Evaluate XYZ in terms of efficiency and quality over years 1 to 3.
 - (ii) Evaluate XYZ in terms of efficiency and quality as compared to the industry. Assume that the industry average for each metric is half of XYZ's metric.

Commentary on Question:

Many candidates skipped this part. Of those who attempted it, most candidates received about half of the available credit. These candidates were able to identify the trends in efficiency and quality, but very few went beyond simply stating the direction of the trend. Some explanation of the consequences or meaning of the trend was needed in order to receive full credit. The same was true for the relationship of XYZ's efficiency and quality to those of the industry.

3. Continued

(i)

	Yr1	Yr2	Yr3
labor productivity (widgets per hour)	100.0	94.7	84.2
defective rate (%)	2.6%	3.8%	5.3%

XYZ has been experiencing deteriorating efficiency over the past 3 years. The company should review their production process and talk with employees in order to determine the cause. This means future profitability will be impaired by excessive labor costs for a given production target

XYZ has been experiencing deteriorating quality over the past 3 years. Customers might stop purchasing widgets from XYZ and purchase them from a competitor if the quality is diminishing, which will hurt future profitability as XYZ loses market share.

(ii) Compared to its competitors, XYZ has a huge competitive advantage in labor productivity, but that is slowly eroding.

Its defective rate being higher than competitors' can cause problems for XYZ's reputation for quality among consumers if they do not rectify the situation.

4. Learning Objectives:

2. The candidate will understand and be able to apply the components of an effective risk management system.

Learning Outcomes:

- (2b) Identify and describe the various kinds of risks, including market, credit, operational, etc.
- (2c) Identify and describe various approaches for managing risks including risk budgeting, position limits, etc.
- (2d) Explain the features of a best practices enterprise risk management system.
- (2e) Evaluate a company's risk management process.

Sources:

“Financial Enterprise Risk Management” by Sweeting, Ch 1 “An Introduction to ERM”

“Financial Enterprise Risk Management” by Sweeting, Ch 8 “Risk Identification”

“Managing Investment Portfolios” by Maginn & Tuttle, Ch 9 “Risk Management”, sections 1–4 and 6

“The Top Ten Operational Risks: A Survival Guide for Investment Management Firms and Hedge Funds” by Miller and Lawton, 2010

Commentary on Question:

This question covered various components of a risk management system. It progressed from describing a general ERM program and identifying risks within the example provided to evaluating methods to mitigate the identified risks.

Solution:

- (a) Describe four of eight steps for implementing an ERM program.

Commentary on Question:

Candidates performed well on this section. In order to receive full credit, candidates needed to describe each step. Many candidates only listed steps for implementing an ERM program. Answers that listed steps but did not describe received half credit.

Assess the context in which the organization is operating. The internal and external environment of the organization should be considered. The internal environment includes the interests of employees and stockholders of the firm while the external environment may include regulators and external stakeholders.

4. Continued

Develop an organization-wide risk taxonomy so that all risk-related discussions are carried out consistently throughout the organization.

Calculate risk exposures and compare to the defined risk tolerance. This step involves quantifying the firm's exposure to previously identified risks and evaluating them in the context of the risk tolerance for each risk.

Continue to monitor and review the process. Revise the process to reflect new policies, preferences, and information when necessary.

- (b) Identify four key risks implied by the excerpt and explain how Niche Life is exposed to these risks.

Commentary on Question:

Candidates performed well on this section. Most candidates successfully identified three of four risks and many gave an explanation for each. Some candidates struggled to identify a fourth risk. Answers that listed risks but did not explain by referencing the excerpt did not receive full credit.

1. Interest rate risk: 90% of assets are bonds and there is aduration mismatch between asset and liability durations. As a result, interest rate fluctuations can adversely affect the company's surplus.

2. Credit risk: 45% of assets are high yield bonds which have higher default rate than investment-grade bonds.

3. Liquidity risk: 45% of assets are private placement bonds, which are not publicly traded. If there is an immediate liquidity need, a haircut would apply to these bonds upon being sold.

4. Policyholder behavior risk: Fixed deferred annuities make up the majority of the sales. Policyholders of these annuities have the right to lapse at their disretion. An increase in lapses relative to expectation could reduce the company's surplus.

4. Continued

- (c) Propose actions to mitigate each risk identified in Part (b).

Commentary on Question:

Candidates performed as expected on this question. To receive full credit, multiple actions needed to be proposed. Many candidates only proposed one action per risk and were awarded some credit. Actions for risks incorrectly identified in part b did not receive credit.

1. Interest rate risk mitigation :

- Adjust the asset portfolio to close the duration gap between asset and liability.
- On asset side, the company could sell long-term bonds or buy more short-term or floating rate bonds.

2. Credit risk mitigation :

- Limit the amount of exposure to certain levels of credit quality, using standard measures from rating agencies such as Moody's or Standard & Poor's.
- Transfer risk with credit derivatives such as credit default swaps and credit spread options

3. Liquidity risk mitigation :

- Reduce the exposure to private bonds and increase more liquid assets such as public bonds.
- Evaluate trusted borrowing facilities to secure funding options

4. Policyholder behavior mitigation :

- Update existing product design to discourage early lapses. For example, adding surrender charges or a market value adjustment.
- Diversify product mix. For example, offer another product with less policyholder behavior risk such as an income annuity

- (d) Critique each method and recommend the most effective method for the task.

Commentary on Question:

Candidates performed as expected on this question. To receive full credit, candidates needed to describe multiple critiques of each method for the task and recommend independent group analysis as the most effective method. No points were awarded for answers that explained what each method was but offered no critique of using the method in this situation.

4. Continued

Independent group analysis gathers ideas from all participants without collaboration. This method helps avoid convergent thinking and allows diversified perspectives be heard. As long as the group is comprised of participants with different areas of expertise, this is an effective method to uncover unidentified or emerging risks.

Interviews have a flexible structure allow immediate follow-up on responses. Framing interview questions, however, can affect the responses of the interviewees. Interviews can also be very time-consuming.

Working groups are made up of a small number of people who are familiar with the issues at hand. It is not optimal to identify risks using working groups since the participants have a very narrow focus and also could be subject to convergent thinking.

For reasons described above, independent group analysis is most effective method for this task.

- (e) Evaluate each operational change on the basis of potential operational risks.

Commentary on Question:

Candidates performed as expected on this question. Most candidates completing this section were able to correctly evaluate each change and its impact on Big Life's operational risk. Full credit was awarded for answers that correctly identified the impact as favorable or unfavorable and described reasons to support the answer. Some candidates incorrectly identified the vacation policy as an unfavorable change in regards to operational risk.

Terminating Niche Life's staff in two months introduces significant operational risk. Two months may not be enough time to ensure a complete transition of Niche Life's current valuation and financial reporting operations. There also seems to be inadequate time to review workflow documentation. This creates another layer of risk, as the documentation will be a valuable resource after the termination.

Consolidating three roles into one will also introduce significant operational risks. If highly productive manager is terminated, key person risk is introduced. The remaining manager will be assuming a large workload and could be over-extended or even burned out. The workload could make it very hard to track all employees and eventually lead to unhappy employees.

4. Continued

A two week mandatory vacation policy is a good idea for testing exposure to certain operational risks and should be implemented. This policy will show how effective cross-training efforts have been and whether or not the company can function if certain personnel are absent.

5. Learning Objectives:

3. Understand and be able to apply different approaches to risk measurement.

Learning Outcomes:

- (3a) Evaluate a company's or a portfolio's exposures to various risks.

Sources:

Liquidity Measurement and Management: A Practitioner's Guide to Global Best Practices

Commentary on Question:

This question tested candidates' ability to calculate cash flow cushion under various scenarios and create mitigation strategies for the level of liquidity risk within each scenario.

Candidates performed below average on this question. Many candidates did not correctly calculate cash inflow and did not receive full credit. Some candidates described one action to address the issues in scenarios 2 and 3, but many did not describe multiple actions as was required to receive full credit.

Solution:

- (a) Calculate the cash flow cushion factor under all three scenarios.

Scenario 1:

$$\text{Cash Inflow} = ((0.65\text{B} \times .95) + (2.00\text{B} \times .9) + (1.75 \times .9) + 0.5 + 1) = 5.49\text{B}$$

$$\text{Cash Outflow} = (1) = 1\text{B}$$

$$\text{Cash Flow Cushion} = 5.49\text{B} / 1\text{B} = 549\%$$

Scenario 2:

$$\text{Cash Inflow} = ((0.55 \times .95) + (1.66 \times .9) + (1.5 \times .9) + 0.5 + 1) = 4.87\text{B}$$

$$\text{Cash Outflow} = (1 + 2) = 3\text{B}$$

$$\text{Cash Flow Cushion} = 162\%$$

Scenario 3:

$$\text{Cash Inflow} = ((0.55 \times .95) + (1.66 \times .9) + (1.5 \times .9) + 0.5 + 0.1) = 3.97\text{B}$$

$$\text{Cash Outflow} = (1 + 2 + 1.5) = 4.5\text{B}$$

$$\text{Cash Flow Cushion} = 3.97\text{B} / 4.5\text{B} = 88\%$$

- (b) Recommend actions to address the implication of Scenario 2 .

The cash flow cushion has dropped significantly but is still above 100%. With a cushion above 100%, the main priority should be to develop a liquidity contingency policy and seek board approval so that the plan may be put into action as soon as it is needed.

5. Continued

The plan may include buying more liquid assets and selling illiquid assets or borrowing secured funding from back-tested sources.

A market value adjustment can be added to future issues of SPDAs. The market value adjustment will reduce the value of liabilities as interest rates rise.

An IT system should be developed to monitor daily exposures. The system will store the market values of assets, the values of liabilities and overall liquidity position.

- (c) Recommend additional actions to address the implication of Scenario3 relative to part (b).

After the credit downgrade, the cash flow cushion is below 100% and the company needs funds immediately for the forecasted cash outflows. Liquidity risk exposure must be reduced quickly. The company needs to increase its allocation to liquid assets, such as cash and treasuries, and sell assets a haircut if needed.

Explore capital markets for outside funding. Trusted sources should be used first, but other sources may be needed based on the severity of the situation.

A plan to address rating agency concerns needs to be developed. The company should have an on-going conversation with the rating agency to understand the agency's concerns and update the agency as the liquidity situation is improved

The company should purchase interest rate derivatives such as a cap to protect against a further increase in interest rates.