

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

April 2021

Subject SP9 – Enterprise Risk Management Specialist Principles

Introduction

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

Paul Nicholas
Chair of the Board of Examiners
July 2021

A. General comments on the aims of this subject and how it is marked

1. The aim of the Enterprise Risk Management (ERM) subject is to instil in successful candidates the key principles underlying the implementation and application of ERM within an organisation, including governance and process as well as quantitative methods of risk measurement and modelling. The candidate should gain the ability to apply the knowledge and understanding of ERM practices to any type of organisation.
2. The SP9 exam generally requires bullet point form or short form essay style answers that apply general principles to directly address specific circumstances. The answers given below are just one possible set of acceptable answers.
3. Candidates are awarded marks for all reasonable answers including different but still reasonable numerical solutions. Marks are awarded for working in the case of numerical answers.
4. Candidates' answers are made up of a series of points. For example, a point can be stating a valid type of risk, describing the type of risk or (part of) a calculation.
5. Candidates who give well-reasoned points, not in the marking schedule, are awarded marks for doing so.

B. Comments on candidate performance in this diet of the examination.

1. Many candidates did not perform well in this diet.
2. The paper included many questions that required candidates to apply knowledge to circumstances described including data provided. These questions gave candidates the opportunity to score well as a range of solutions were awarded marks. Some of these questions were very well answered with better prepared candidates able to generate a volume of valid points. However, some of these questions were not well answered, particularly where candidates did not use the information given in the question to tailor their response.

C. Pass Mark

The pass mark for this exam was 61.

273 candidates presented themselves and 67 passed.

Solutions for Subject SP9 – April 2021

Q1

(i)

RBC has a fixed price structure	[½]
so it is subject to the risk that costs are higher than expected (project risk)	[1]
Metal M is a key component of RBC's project costs	[½]
Futures can be used to fix or lock in the cost of the underlying asset	[1]
which could help reduce earnings volatility	[½]

RBC may use futures for speculation [½]
[Marks available 4, maximum 3]

(ii)

Futures eliminate the upside and downside risk of market movements [1]

so RBC will miss out on potential profits from falls in the price of metal [½]

but will be protected from Metal M price rises [½]

RBC will need to accurately estimate the amount of Metal M [½]

needed in each period accurately otherwise the hedge will be ineffective [½]

too much and RBC will have incurred additional costs – an excess of Metal M [½]

too early and RBC will have additional roll forward costs or an excess of Metal M
– additional storage costs [½]

too little and RBC will be exposed to the market price movements to cover the excess amount [½]

too late and RBC will have a shortage and be exposed to market price movements or project delays leading to additional costs [½]

Expertise is required to trade in derivatives which RBC may not have in house (operational risk) [½]

There is some counterparty risk with the clearing house, mitigated in part by margin calls [½]

Margin calls may exacerbate liquidity risk [1]

Along with other costs like transaction fees, create an expense risk if greater than expected [½]

Futures are standardised so the Metal M available may not be the right quality, or the right type (any example of basis risk) [1]

Futures may be closed out by cash settlement or delivery so a candidate who answered from either perspective gained marks

[Marks available 8½, maximum 4]

(iii)

They are establishing an interim RMF so the benefits can be realised more quickly [½]

Particularly in light of the upcoming stock market listing [½]

Quarterly assessments can be used to evidence the robustness of the RMF to stakeholders e.g. regulator, analysts, investors, etc [1]

The new CRO and team can build on this more easily than working from scratch [½]

The RMF is external so not biased by company history or culture [½]

The RMF has access to market and operational risk expertise [½]

However, they may not have experience in infrastructure projects [½]

Expertise is limited to market and operational risk [½]

No expertise noted in other risks e.g. liquidity risk, climate risk, etc [½]

which may be particularly relevant for RBC in infrastructure [½]

Could also be a lack of focus on the interdependencies between the other risks and/or the other risks with market and operational risk [½]

LMN may fail to deliver – counterparty risk [½]

Quarterly assessments may not be frequent enough to spot control failures [½]

Lack of transparency as findings are reported to one person, the CEO [½]

Assessments may foster a policing culture	[½]
which may dissuade employees from raising new risks/reporting risk breaches	[½]
The company may view risk management as separate from their day-to-day work rather than an integrated part of their role	[1]
No statements/policies on corporate governance	[½]

Future improvements

Make use of expertise and experience within the company to set the taxonomy and risk policies	[1]
this will also contribute to a more open risk management culture	[½]
and allow RBC to develop expertise internally	[½]
Board should set the risk appetite	[½]
and approve the risk policies	[½]
Develop a process for identifying and managing emerging risks	[½]
Include corporate governance	[½]
such as establishing a risk committee	[½]
More frequent reporting e.g. monthly	[½]
to the whole board not just the CEO	[½]
Expand the reports to cover more than just the effectiveness of the controls	[½]
key risks, new risks, KRIs such as changes in exposures, losses, incidents (any reasonable example)	[½]

Markers may cross mark this question with part viii if candidates have included points here relevant to part viii (but be careful not to double mark).

[Marks available 16½, maximum 6]

(iv)

The summary of the interim RMF will give the stakeholder an indication of the effectiveness of the interim RMF so could be used when deciding whether to do business with/invest in/assess RBC	[1]
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All stakeholders

will look for evidence of effective identification of emerging risks and effective management of existing risks to reduce chance risk of company failure	[½]
Risk management policies demonstrate management of existing risks	[½]
Unclear how emerging risks are being identified and managed under the interim RMF	[½]

Customer

RBC’s main customer is likely to be the local authority	[½]
Main concern is that payment is made but the project is not completed or not completed well	[½]
Unclear how project risks are being identified and managed under the interim RMF	[½]

Suppliers and subcontractors

RBC’s main supplier is likely to be the provider of the key material – miners of metal M	[½]
Main concern is loss of business or default (an order is mined or delivered but not paid for)	[½]

Analysts/potential investors

We don't yet know if RBC has any other investors as it is a family owned business [1/2]

Analysts/potential investors include an assessment of the RMF in their assessment of the ability of RBC to earn a return in the future [1]

Likely to have good understanding of financial statements/KPIs/KRIs so understand details [1/2]

They will input the data into their model to assess the future profitability of the business [1/2]

However the limitations noted in the previous question part will also be assessed [1/2]

Credit rating agencies

Credit rating agencies may have access to more detailed information than the summary [1/2]

Credit rating agencies include risk management in their assessment of the ability of RBC to repay loans in the future [1]

Likely to have good understanding of financial statements/KPIs/KRIs so understand details [1/2]

They will input the data into their own models to assess the credit rating [1/2]

However the limitations noted in the previous question part will also be assessed [1/2]

Employees

Main concern is the ongoing stability of RBC as if the company fails/makes losses this may result in redundancies [1/2]

Some employees may not understand detailed financial statements/KPIs/KRIs [1/2]

Regulator and auditor

Main concern is the ongoing stability of RBC i.e. whether it is a going concern [1/2]

The interim RMF shows the company is beginning to improve its risk management which should reduce risk of company failure [1/2]

Other concerns may include crime prevention such as fraud, money laundering, tax evasion [1/2]

These stakeholders would have access to the detailed information not just the summary [1/2]

And the expertise to use the information in their own models [1/2]

and compare to other firms [1/2]

[Marks available 15, maximum 6]

(v)

Regulator is responsible for the financial stability of the whole market not just individual companies [1]

so will want to prevent a systemic collapse and maintain confidence in the market [1/2]

It has seen the impact that contagion has had on the neighbouring country and wishes to avoid this in country A [1/2]

Individual companies can do little to minimise systemic risk as it cannot be diversified [1]

so regulator has responsibility to monitor it [1/2]

[Marks available 3½, maximum 2]

(vi)

Most sources of systematic risk cannot be avoided or diversified away	[½]
RBC's assets are listed on Country A's stock exchange	[½]
This is a counterparty RBC has in common with other organisations that cannot be avoided	[½]
It is likely that RBC's only client is Country A's government (and their subsidiaries)	[½]
The counterparty risk with the government cannot be avoided	[½]
All of RBC's transactions take place using the banking system (including the stock exchange)	[½]
All organisations and individuals in country A use country A's financial infrastructure so this cannot be avoided/diversified	[½]
Many organisations have liquidity requirements so invest in assets similar to RBC	[½]
A common market position is a source of systematic risk	[½]
[Marks available 4½, maximum 3]	

(vii)

RBC is large company with ties to many others so its failure cause losses in other organisations. This is an example of contagion.

Employees

RBC has a significant number of employees and these will be unemployed	[½]
their loss of income could lead to lower spending across country A	[½]
and larger dependency on state benefits (if these exist)	[½]
in the extreme this could lead to a recession	[½]
Directors/senior managers may face criminal charges if they are responsible for the collapse	[½]

Auditors

Auditors aim to provide assurance that the financial statements give a true picture of the financial strength of the company	[½]
so stakeholders will question whether they failed in this task	[½]
The loss of confidence could results in a severe loss of business for LMN which may result in LMN failure	[½]

Credit rating agencies

Aim to assess the risk of corporate default	[½]
So stakeholders will question whether rating agencies correctly and contemporaneously assessed the risk of company default	[½]
And downgrade their rating	[½]
The loss of confidence in these stakeholders will impact all companies in Country A	[½]

Owners/investors

Have lost their investment	[½]
and any potential future profits	[½]

Local authority (main customer)

If there was a project in progress, the local authority may lose their payment/be left with an unfinished project	[½]
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An alternative company will need to be found which may be more expensive/produce substandard result [1/2]

Metal M miners (main supplier)

If a transaction was in progress they may have lost payment [1/2]

In the long term they have a lost a main customer so will suffer a loss of future revenue [1/2]

Metal M has other uses so this may not lead to total failure but could result in job losses [1/2]

There are many other valid stakeholders – e.g. governments, competitors

[Max 3 stakeholders, Maximum [1] per stakeholder]

[Marks available 9½, maximum 3]

(viii)

LMN has been auditing RBC for the last 7 years [1/2]

however under SOx the external auditor partner must be rotated every 5 years [1/2]

LMN is a consultancy and has started to give advice on the stock exchange listing [1/2]

as well as providing the interim RMF for RBC [1/2]

however under Sox audit and non-audit services may not be provided by the same firm [1/2]

The CEO and the audit partner have a good relationship so the CEO is more likely to report any issues to the audit partner [1/2]

under SOx the CEO (and CFO) are legally responsible for setting up, maintaining and evaluating internal controls, and reporting any issues to the external auditors [1/2]

Conversely the good relationship may mean the CEO is inclined to interfere in the audit process [1/2]

under Sox, directors are prohibited from interfering in the audit process [1/2]

The good relationship between the CEO and audit partner may mean the audit partner feels pressured to overlook issues [1/2]

Under SOx, the auditor must be independent i.e. able to exercise objective and impartial judgement [1/2]

[Marks available 5½, maximum 3]

(ix)

An extreme event has serious consequences (high severity) [1/2]

but rarely occurs (low frequency) [1/2]

For RBC examples could include significant political/environmental protest preventing work/mining of Metal M, torrential rain or any extreme weather preventing construction, cyber-attack that disrupts the financial system in country A, a pandemic that prevents mining (*any reasonable example*) [1]

(x)

GEV/Block maxima

Separate the data into even sized blocks [1/2]

Select the highest observation in each block [1/2]

Fit a generalised extreme value distribution to the data [1/2]

using maximum likelihood estimation [1/2]

GPD/peak over threshold

Determine a threshold such that all observations above the threshold are deemed extreme

[½]

One method may be a plot of the empirical mean excess $e(u)$, against the threshold u , looking for linearity

[½]

Or such that the threshold corresponds to the largest, say 5% of losses

[½]

For observations greater than the threshold fit a generalised Pareto distribution to the observations less the threshold

[½]

using maximum likelihood estimation

[½]

Candidates may describe the return level or return period approaches under the GEV/Block approach

[Max 2 per approach]

[Marks available 5, maximum 4]

(xi)

The GEV approach can potentially ignore useful information (data points)

[½]

As only one observation per block is included in the distribution fitting

[½]

In the data set given there are clusters of extreme values (32-35 and 48-50) but only one value from each cluster would be used in the fitting

[1]

The GPD approach would capture all the extreme values

[½]

if an appropriate threshold is selected

[½]

As the loss to the firm occurs if the costs exceed 8,000, 8,000 could be chosen as a threshold

[½]

Alternatively any value above the expected cost including overhead and/or profit margin (and below 8,000) could be chosen

[½]

Both methods assume the underlying data is independent identically distributed

[½]

This is unlikely to be the case with project costs over time

[½]

Block sizes between 5 and 10 are acceptable with justification

Thresholds between 5,700 and 8,000 are acceptable with justification

[Marks available 5, maximum 3]

[Total 39]

This question was generally well answered by candidates.

Well prepared candidates were able to generate a range of points for parts i to iv.

However, parts v and vi on contagion were not well answered with many candidates listing generic risk categories. Parts vii and viii were generally well answered, with candidates generating many valid points. Well prepared candidates scored well on parts ix and x. Most candidates were able to generate some points on part x with better candidates able to apply the theory to the data provided to make a recommendation.

Q2

(i)

A risk taxonomy ensures all users define and categorise risks the same way

[½]

Using different taxonomies means the same risk may be categorised differently for

different branches [1]

For example one branch may categorise the underwriting risk as part of its catastrophe risk, a sub category of insurance risk, but another branch as an external event risk, part of its operational risk (*or any other example from the 3 risks given*) [1]

If head office compared the risk profile of the two different branches they may appear very different even if they are very similar and vice versa [1/2]

This inconsistency is damaging when aggregating risks [1/2]

as risks may be double counted or omitted [1/2]

Particularly when considering correlations between risks as these may not be applied appropriately if the definitions are different [1]

Inconsistencies are damaging as they may lead to inappropriate decision making [1/2]

such as mispricing, incorrect reinsurance level/terms, inappropriate acceptance of risk (*any reasonable example*) [1/2]

However the existing taxonomy may be tailored to the specific branch [1/2]

and well understood within the specific branch [1/2]

There may be communication problems between branches [1/2]

and with external stakeholders e.g. regulators [1/2]

[Marks available 8, maximum 3]

(ii)

Different natural catastrophes impact different risks [1/2]

e.g. an earthquake may damage a property but a drought may not [1/2]

Difficulty in collecting a sufficient number of data points [1/2]

that are relevant to the risks of interest [1/2]

given these are tail events [1]

Choice of tail may result in unstable parameterisation in the model [1/2]

and very different results [1/2]

Pearson’s rho is only a valid measure of correlation if the marginal distributions are jointly elliptical [1/2]

For heavy-tailed loss distributions (with large variances) such as those for catastrophes, Pearson’s rho may give a value close to 0, which is misleading since correlation may be present [1/2]

Rank correlation coefficients, like Spearman’s rho and Kendall’s tau, do not depend on the underlying shape of data series, only the relative position of observations [1]

[Marks available 6, maximum 3]

(iii)

Avoid underwriting certain risk exposures by cover exclusion [1]

or tightening policy wording [1/2]

and / or set low cover amount [1/2]

Write less property insurance business to reduce exposure [1/2]

Diversify business written geographically, i.e. away from the west coast [1/2]

Diversify lines of business written to lines less affected by catastrophe risk [1/2]

Regular monitoring of claims experience so that adverse experience is spotted early and adjustments can be made to the underwriting process / pricing [1/2]

Relocate certain branches [1/2]

or relocate some of the staff / roles to other regions with lower chance of catastrophes	[½]
or enhance building infrastructure	[½]
and invest in business continuity	[½]
Diversify the investment strategy e.g. to overseas assets (less affected by domestic catastrophe)	[½]
Sell bonds issued by firms with high exposure to natural catastrophes	[1]
or purchase credit insurance / CDS for these	[½]
or investigate how these firms deal with their exposure (e.g. insurance protection put in place by these firms)	[1]
Investigate how previous natural catastrophes have impacted bond prices of the relevant firms	[½]
and the impact on the credit prospect, including any impact on the credit rating	[½]
Investigate how previous catastrophes have impacted share prices of the relevant firms	[½]
Investigate any impact on government bond prices and term deposits from previous catastrophes	[½]
Purchase reinsurance cover for insurance risk exposure	[½]
with appropriate terms and excess	[1]
at the appropriate price	[½]
Arrange appropriate insurance cover for local branches with a commercial insurer	[½]
or through self-insure / captive insurer	[½]
Underwrite risks with low correlation with natural catastrophes, including at the tail	[1]
Invest in bonds/equities issued by firms which are not / positively impacted by natural catastrophes	[½]
Hold additional capital against catastrophe risk	[½]
Cat-e-puts to give the insurer the option to raise capital should a catastrophe occur	[½]
[Marks available 16½, maximum 10]	

(iv)

Pros:

A range of natural catastrophes can be tested, whether or not they have occurred in the past	[½]
Results will serve as the “base line”, which could be used to again to check if any risk mitigation actions against extreme events have the desired impact	[1]
The process of specifying the appropriate natural catastrophe scenarios is a good way to engage with experts	[½]
which may lead to additional ideas in dealing with natural catastrophes	[½]
or a better understanding of the insurer’s exposure to such events	[½]
Useful when resources and/or data are limited as fewer runs are required	[½]

Cons:

The scenarios will always be limited by what is thought to be plausible by the person defining them	[1]
and may be subject to biased e.g. dislike of negative events	[½]
It may be difficult to set consistent assumptions for events if they occur rarely or have never happened	[½]

The exercise gives no indication of how likely an event / a combination of events is to occur [1/2]

which may lead to high severity natural catastrophes being discounted easily given “unrealistic” impact [1/2]

[Marks available 6½, maximum 4]

(v)

First step is to gain an understanding of liabilities [1/2]

in particular their term and potential variation in this term [1/2]

and in this case the specifics about policies involving natural catastrophes [1/2]

and also the implications of natural catastrophes on the insurer’s own cash needs [1/2]

Understand the assets, including the timing [1/2]

and certainty of payment streams [1/2]

the potential ability to sell assets within particular time frames, [1/2]

and the price at which such assets might be realised [1/2]

Put the asset and liabilities considerations together, allowing for the different scenarios of natural catastrophes [1/2]

should also allow for market-wide stresses (e.g. lots of insurers selling similar assets at the same time) [1]

A cashflow model may be used to project the income and outgo at specified time intervals to determine the liquidity position [1/2]

Where reinsurance payments are relied upon, should allow for the timeliness of these under stressed scenarios [1/2]

Where management actions/other mitigations are relied upon, should allow for the timeliness/cost of these under stressed conditions e.g. selling assets may occur at a loss under stressed scenarios (*any reasonable examples*) [1/2]

Choose a suitable metric to output, measured over a relevant timeframe [1/2]

number of instances when liability calls exceeds liquid assets or number of instances when ratio of liquid assets/liquid liabilities <1 for example (*accept any reasonable metric*) [1/2]

It may be possible to benchmark against other similar companies/competitors [1/2]

[Marks available 8½, maximum 5]

(vi)

The insurer is invested in term deposits, government bonds, corporate bonds and equities.

Interest rate risk refers to risks arising from changes in interest rates [1/2]

Interest rates could be more volatile during a catastrophe [1/2]

impacts the government bonds and corporate bonds [1/2]

as well as the equities [1/2]

Economic risk refers to risks arising from the impact of macroeconomic factors [1/2]

including inflation and changes in demand [1/2]

A catastrophe such as a drought/fire/earthquake could lead to shortages and increases in demand for food, fuel etc impacting inflation [1/2]

which could erode the real return on all the asset classes held [1/2]

Equity risk refers to the losses from changes in equity prices [1/2]

Credit risk refers to the losses from credit defaults [1/2]

and/or mark-to-market losses from credit spread widening [1/2]

The reduced economic growth from catastrophes puts financial strain on companies (e.g. bankruptcies) which increases the credit risks [½]
 primarily impacts corporate bonds [½]
 Counterparty default risk arises if the entity the insurer deposits with fails to return the deposits, or fails to pay the agreed interest [½]
 Feedback risk / pro-cyclicality arises when a change in price will result in further changes in the same direction [½]
 impacts primarily corporate bonds and equities [½]
 Currency / Foreign Exchange risk losses arise from movements in exchange rates [½]
 where investments are denominated in foreign currencies [½]
 Contagion risk refers to the risk that failure in one firm, sector or market will result in further failures [½]
 impacts all the asset classes to varying extent [½]

[Marks available 10, maximum 5]

(vii)

Both

Both measures are retrospective [½]
 Can be compared year-on-year [½]
 Neither looks at the expected position in the next period [½]
 or any potential future scenarios [½]
 such as a natural catastrophe [½]
 All components are reported in the financial statements so unless the metric is required at interim periods there are no additional data or reporting requirements [1]
 Easy to explain [½]
 Neither metric highlights specific liquidity incidents e.g. when contingency funds were utilised or assets were sold at a loss [½]

KR1

The metric allows for liquid assets and total assets are considered however there is no allowance for liabilities which are a source of liquidity risk [1]
 Definition of 'liquid assets' must be agreed e.g. whether cash reserves, contingent funds are included [½]

KR2

Claims may not yet be reported (IBNR) [½]
 and the total claim amount may not be known at the reporting date [½]
 The metric allows for claims but no other cash requirements e.g. expenses, which can cause liquidity issues [1]
 Premiums are not the only liquid asset the company holds [½]
 Changes in new business volumes, for example seasonality will skew the metric [½]
 Definition of 'claims' must be agreed e.g. whether net/gross reinsurance, incurred/reported [½]
 Definition of 'premiums' must be agreed e.g. whether gross/net reinsurance [½]

[Marks available 10, maximum 5]

(viii)

Insurance risk policy

Protocol to access contingent funds to cover claims [1/2]

Protocol to report/escalate claims clusters [1/2]

Market/credit risk policy

Liquidity risk tolerance such as minimum amounts of liquid assets to be held [1/2]

Minimum number of counterparties/maximum with any single counterparty for investments including deposit accounts [1/2]

Terms for contingent funds [1/2]

Periodic testing of contingent funds or other emergency cash sources [1/2]

Escalation of liquidity issues [1/2]

Identify who is accountable for liquidity risks and reporting lines [1/2]

How liquidity risk is assessed and modelled [1/2]

KRIs i.e. how liquidity risk is monitored and reported [1/2]

Credit was given if items are listed under different risk policies e.g. operational risk policy

[Marks available 5, maximum 3]

(ix)

Conduct more detailed planning to ensure that travelling to the backup site is still possible after an extreme event, allowing for potential traffic disruptions and road congestions [1/2]

May need to move location if the backup site is likely to be affected also [1/2]

Check that the IT and other infrastructure is fit-for-purpose (may require upgrading from the “basic” facilities currently) [1/2]

Potentially more frequent drills or drills carried out by the wider team [1/2]

Get some team members to regularly work at the backup site (as oppose to conduct drills) to thoroughly test the facilities and IT systems there [1]

The junior member may not understand all the requirements of the system so more team members/more senior team members should be involved in the testing [1/2]

Test non-IT requirements e.g. availability of accommodations if they are unable to travel 150 miles each day [1/2]

Test whether traders could alternatively operate from home [1/2]

Carry out due diligence on the third-party maintaining the site, e.g. previous experience, financial stability [1/2]

Monitor the third party to ensure that they are maintaining the site [1/2]

Investigate whether access to the backup site is exclusive or whether it is shared with other firms [1/2]

If shared, there is a risk that other firms will want to use it following a catastrophe. Testing should take place to see whether the backup site can cater for multiple users all at the same time [1/2]

To ensure good communication, document the contact details and high-level business continuity arrangements of both external parties (e.g. brokers, trading system providers etc) [1/2]

and internal stakeholders (e.g. the CEO) which may also be affected [1/2]

Have clear and detailed documentation of the procedure and update it regularly [1/2]

and ensure that team members and key contacts have it for reference when necessary [½]
 [Marks available 8½, maximum 4]
[Total Marks 42]

Candidate scores varied on this question as some candidates struggled with the liquidity risk question parts.
Well prepared candidates were able to generate a range of points of parts (i), (iii), (iv) and (vi). Most candidates were able to score some points on part (ii).
Some candidates did not score well on part (v) as they described steps for setting up a model but did not tailor this to the liquidity risk circumstances in the question. Many candidates were able score some points on part vii but did not score well on part (viii). Most candidates generated a range of points of part (ix).

Q3

(i)

The insurer is likely to hold corporate bonds to maturity in order to match its annuity liabilities therefore default risk is likely to be a key risk [1]
 Defaults occur in the tail of the distribution of credit risk losses and a model will help assess the health of the portfolio at the tail [½]
 The model can be used to investigate different investment strategies – sectors, ratings [½]
 which may lead to changes to the investment allocation [½]
 A standardised model may not be cost effective [½]
 Whilst the insurer may want to match most of the assets to liabilities, it may be seeking higher returns on any excess assets [½]
 Default risk is specific to the issuing company so a standardised model may not fully capture the specific risks [½]
 Standardised models may not be appropriate if the insurer wants to or already invests in non-standard bonds [½]
 The model can also be used help the insurer to optimise risk taking, i.e. the optimal investment mix [½]
 The model can be used to run scenarios specific to insurer – default events, longevity stresses [½]
 or can be used to provide information on the insurer’s financial state to a regulator [½]
 Can also be used to help measure performance [½]
 including the risk adjusted return on capital, or cost of capital adjusted investment return [½]
 Can help determine risk limits [½]
 and monitor against the limits over time [½]
 Facilitate the comparison with other key risk-taking areas [½]

[Marks available 8½, maximum 5]

(ii)

$$F(t) = 1 - e^{-ht}$$

May be typed as

$$F(t) = 1 - \exp(-ht)$$

or

$$F(t) = 1 - e^{-\int_0^t h(s)ds}$$

May be typed as

$$F(t) = 1 - \exp\{-\text{INT}(0,t):h(s)ds\}$$

or

$$F(t) = 1 - \exp\{-\text{integral over } 0 \text{ to } t \ h(s)\}$$

with h or h(s) being the hazard rate

[1]

Note: Probability of survival = $\exp(-ht)$ but question asks for probability of default

(iii)

$$h = -\ln(1-a)/t \quad [1]$$

$$\text{so } h = -\ln(1-0.12)/20 \quad [1/2]$$

$$= 0.6392\% \quad [1/2]$$

If no working is shown here and ii is correct, then give full marks as ii could be classed as the working in this case

(iv)

The data range dictates that Method 1 has much lower default probabilities than Method 2

[1]

The higher number for Method 2 also reflects higher correlation at the tail

[1/2]

Method 1 is more relevant to normal market conditions

[1/2]

whereas Method 2 is probably more relevant to the tail situation / purpose of the economic capital model

[1]

Method 1 (normal copula) which is parametrised by a single variable – the linear correlation coefficient

[1/2]

Method 2 (t copula) is also parameterised by the degrees of freedom

[1/2]

Lower degrees of freedom for t-copula leads to greater level of association in the tails relative to that in the centre of the joint distribution

[1/2]

which is a desirable feature for the modelling here, as credit defaults tend to cluster

[1]

Dial up the degrees of freedom to infinity for t-copula, and it tends to the form of the Normal copula

[1/2]

Method 2 is sensitive to parametrisation given the smaller number of data points available to it

[1]

To make the results relevant to future economic conditions, certain adjustments may need to be applied to both methods

[1/2]

[Marks available 7½, maximum 5]

(v)

TRORS cover both pricing/market and default risk, whereas CDS covers mainly the default risk

[1]

there is some hedging effect with CDS on the pricing side, though this is not explicit

[1/2]

TRORS may provide certainty to the financial outcome

[1/2]

while CDS provides credit protection and retains the upside from pricing moves

[1/2]

Both TRORS and CDS introduce counterparty risk with the other parties to the swaps

[1/2]

Proposal 1 probably introduces more of it, as it is concentrated with a single bank

[1/2]

CDS is more liquid to trade than the TRORS or even the underlying bonds	[½]
TRORS, as is structured at the portfolio level, is not liquid and could be expensive to restructure	[1]
thus limiting the flexibility of changing the underlying investments	[½]
Both should be fairly straightforward to take credit for in capital calculations however there may be difference in treatment	[½]
though CDS may not be available for some of the bonds in the portfolio	[½]
Trading CDS is more flexible and one can take market opportunities as they arise	[½]
CDSs can be settled physically as an alternative to cash settlement	[½]
There may be tax differences in the way the instruments are treated e.g. income vs capital gains	[½]

This question asks for a comparison of the two proposals given the scenario, not a regurgitation of how a CDS works and another regurgitation of how a TRORS works.

[Marks available 8, maximum 6]

[Total Marks 19]

Candidate scores varied on this question.

Some candidates produced a generic list of the advantages to building an economic capital model without linking them to the circumstances in the question and so did not score well on part (i).

On parts (ii) and (iii) some candidates confused the probability of survival with the probability of default.

Most candidates were able to score some points on part (iv). Candidates that scored well noted the differences in the underlying data sets and the purpose of the model as well as the differences in the copulas.

For part (v), some candidates reproduced a description of a CDS and another on TRORS without comparing the two, so did not score well.

[Paper Total 100]

END OF EXAMINERS’ REPORT