

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2019

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.

Mike Hammer
Chair of the Board of Examiners
December 2019

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 student 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 *student performance in this diet of the examination*.

Many candidates did not perform well in this diet. The paper included many questions that required candidates to apply knowledge to the circumstances described. 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 failed to acknowledge key features noted in the circumstances given. Additionally, some straight forward knowledge questions were not well answered.

C. Pass Mark

The Pass Mark for this exam was 63

Solutions for Subject SP9 – September 2019

1(i)

- Bond issuance size / outstanding amount [½]
- (Expected) liquidity of the bond [½]
- Robustness of the SPV setup in dealing with counterparty default risk [½]
- Underlying risk/peril [½]
- Preferred mix of perils / view on different types of catastrophe risk [1]
- Level of underwriting sophistication of underlying insurer(s) [1]
- Track record of underlying insurer(s) [½]
- Effectiveness of risk governance of underlying insurer(s) [½]
- Regulatory influences on the underlying insurer(s) [½]
- Threshold for pay-out from SPV to insurer [½]
- Probability of threshold being met [1]
- Coupon rate (new issuance) [½]
- Gross redemption yield (secondary market bonds) [½]
- Potential loss at various confidence intervals [½]
- Alignment of interest between bond investors and sponsoring insurer(s) [1]
- Modelability of the underlying catastrophe risk [½]
- Legal risk of dealing with the SPV [½]
- Operational risk within the SPV [½]
- Premium / discount of the cat bond, relative to corporate bonds of comparable risk profile [½]
- Credit rating (if any) [½]
- Currency of existing portfolio [½]
- Remaining term on secondary market bonds [½]

Other points accepted for ½ mark if they are applicable to the scenario [13, Max 9]

(ii)

- Managing risk concentration (i.e. need to diversify among many bond holdings) VS investing in most attractive bonds/obtaining the best investment return, which necessitates more concentrated bond holdings [1]
- Liquidity of the portfolio / level of diversification (more diversified holdings in smaller chunks may improve the overall liquidity of the portfolio and help reduce volatility) VS ability to perform deep research into specific bonds and ongoing monitoring (too many bonds to research into leads to additional effort in research and monitoring) [1]
- Running a lean operation / keep bonds comparable VS geographic / peril diversification, in other words, this is a trade-off between investing in fairly homogeneous bonds from the same niche area in the market (i.e. hurricanes in Country A), and investing across different domiciles and perils [1]

The trade off is a risk/cost vs return; marks for other relevant examples if both the risk/cost and the return are specified [½ mark for one factor, Max 3]

(iii)

- Caveats to the equivalent credit ratings [1]
- Unique characteristics that could cause non-payment such as specific T&Cs [1]
- Main metrics to use, probability of default vs loss rate vs combination [1]
- How frequently to update this [1]
- Allowance for potential correlation / contagion [1]
- Forward looking purely VS allowing for sponsoring insurers' track record [1]
- Past experience is not necessarily relevant due to future trends e.g. climate change [1]
- Allowance for stress / scenario testing results [1]
- Perhaps it's more sensible to compare a portfolio of cat bonds to a portfolio of corporate bonds, rather than on an individual basis [1]

[½ mark for other relevant examples, Max 6]

(iv)

Pros

- Flexible in calculation approach... [½]
- ... can be calculated using empirical, parametric or stochastic approaches [½]
- parametric calculation of the expected shortfall can be expressed in terms of the VaR and tail VaR [½]
- ... allows for both probability of loss and severity of loss beyond a certain point [½]
- It is a coherent risk measure [½]
- ... in particular, it is subadditive so can be aggregated [½]

Cons

- Has little intuitive meaning, i.e. difficult to relate to the current value of a portfolio [½]
- Low probability of loss may hide the severity of loss so it is useful to look this alongside TVaR [1]

[Max 3]

(v)

- Linear correlation or Pearson's Rho is unlikely to be an appropriate model for risk aggregation in this case. [1]
- Pearson's Rho is a valid approach if the marginal distributions are jointly elliptical... [1]
- ... meaning that the distributions are related to the multivariate normal distribution [½]
- If the marginal distributions are not jointly elliptical, then a Pearson's rho of zero does not necessarily imply that two variables are independent. [½]
- Pearson's Rho also might give the association between one variable and another, when it is not necessarily the case that there is any dependence [1]
- Catastrophe risk is unlikely to follow normal distribution [½]
- ... it is likely more likely to be fat tailed and/or skewed [½]
- ... which could lead to miscellaneous results for example where the variance is large [½]
- Different bonds may have exposure to the same event... [1]
- ... causing some bonds to be highly correlated in their performance [½]
- Other methods can potentially be explored which may work better [½]

[7½, Max 5]

(vi)

- Diversification, i.e. working with multiple insurers [½]
- Limit exposure to a single insurer [½]
- Purchase CDS on counterparty insurer [½]
- Purchase credit or surety insurance [½]
- Make the arrangement subject to collateralisation [1]
- Perform on-going monitoring [½]
- Limit any legal risk through good contracting practices [½]
- Vet insurers and only deal with ones with good solvency position etc [½]
- Agree to deduct premia from reinsurance payout [1]

[5½, Max 4]

(vii)

- Potentially cheaper so may increase reinsurance programme or tweak reinsurance counterparty line-up [1]
- Need to assess and manage counterparty risk [½]
- Also assess liquidity management of the firm [½]
- Additional counterparty which potentially helps with managing counterparty default risk [½]
- Need to consider regulatory treatment of such an arrangement and capital implications [1]
- Additional reinsurance capacity may help insurer grow business [½]
- Reinsurance capability is untested/unformed i.e. potentially unsophisticated provider [1]
- ...though can be gleaned potentially from track record on cat bond investing [½]
- Need to compare other terms and operational issues, [½]
- Alongside pricing terms... [½]
- e.g. paying out within 45 days may be particularly attractive [½]
- Consider if FAM has the capacity to accept the reinsurance [½]
- Consider FAM's ability as a new entrant to create a bespoke policy for the insurer [½]

[8, Max 6]

(viii)

Developing and applying a model could involve the following steps:

- Specify the purpose of the investigation. [½]
- Specify relevant output/metrics from the model [½]
- Collect data, i.e. statistics on catastrophe / perils [½]
- ... and historical statistics on performance of cat bonds [½]
- ... group or modify the data if necessary. [½]
- Choose the form of the model [½]
- ... identifying its parameters and variables [½]
- ... may need separate models for different perils [½]
- Model should allow for the setup inside the SPV [½]
- Alternatively, may decide to ignore the SPV aspect due to immateriality, to keep it simple [½]
- Estimate the required parameters. [½]
- Estimate any correlations between them. [½]
- Check that the goodness of fit is acceptable [½]
- ... try to improve the fit, and attempt to fit a different model if not. [½]

- Ensure that the model is able to project all required cashflows and other outputs, including interactions between them. [1]
- Run the model using the selected estimated variables [½]
- ...for stochastic models, this would require a large number of simulations using a random sample from the density function(s) chosen for the stochastic parameters [½]
- Output the results in an appropriate format (e.g. summarised for stochastic models). [½]
- Assess the sensitivity of results to certain previous catastrophic events, or scenarios of interest. [½]
- Ensure the model is well documented [½]
- And compliant with any regulations/industry standards [½]

[11, Max 8]

(ix)

Useful to conduct independent assessment [½]

- ... which demonstrates / can be used to demonstrate good understanding of the risks [1]
- ... acts as a check on the investment manager's modelling [½]
- ... forms own expectations of risk and investment return [½]
- ... can be integrated into ERM system [½]
- ... useful for capital calculations and stress and scenario testing [1]
- ... independent assessment may be a regulatory requirement [½]

May lack the expertise to do this [½]

- ... choose inappropriate model to model the underlying risks [½]
- ... fail to use sensible assumptions [½]
- ... fail to parameterise the models correctly [½]
- ... not familiar with SPV structure [½]
- ... not able to capture sufficient granularity in the modelling [½]
- ... end up having materially different assessment to the investment manager [½]
- ... data may not be available / adequate [½]

May incur significant additional costs / need to draw resource from elsewhere in the business [½]

[9, Max 7]

[Total 51]

1. *Many candidates failed to acknowledge the bonds were catastrophe bonds so didn't identify the points associated with the underlying perils. Similarly many candidates missed the SPV and associated points.*
2. *This question was generally well answered.*
3. *Many candidates focused on the process of deriving a credit rating and so missed some of the key decisions to be taken i.e. the factors to consider.*
4. *A straight forward question for well prepared candidates. This question was generally well answered.*
5. *This question was generally well answered.*
6. *Most candidates were able to score some marks. Well prepared candidate were able to generate more valid points.*
7. *Most candidates were able to score some marks. Well prepared candidate were*

- able to generate more valid points.*
8. *Well prepared candidates were able to recall the key stages in model development and apply them to the scenario. Most candidates were able to score some marks.*
9. *Most candidates were able to score some marks. Well prepared candidate were able to generate more valid points.*

2(i)

- Improve operational effectiveness as the team coordinates and manages all risks [½]
- Risk taxonomy avoids misunderstandings by ensuring consistent definitions [½]
- Help evaluate risks consistently across PP and RR [½]
- Embed consistent risk culture given it's a newly formed Group [1]
- Create standardised risk reporting across the group [½]
- Potentially have a positive impact on the Group's credit rating [½]
- Potentially reduce the risk of regulatory interference [½]
- May lead to a better trade-off between risk and return [½]
- Help recognise concentrations and diversifications [½]
- Helps identify upside risks/opportunities across the group [½]
- Can help Group react more quickly to emerging risks from both PP and RR [1]
- All of which help reduce the volatility in the Group's financial performance [1]
- ... which may help increase the value of the Group [½]
- Ensure overall risk level being consistent with an organisation's risk appetite [½]
- Optimise risk taking across the new group [½]

[9, Max 6]

(ii)

- Leads risk management across the company [½]
- Responsible for risk taxonomy to ensure consistency in identification and communication [½]
- Advise the board on risk [½]
- Ensuring that decisions of the board in relation to risk management are implemented [½]
- Develop and produce suitable management information [½]
- Assess the risks across PP and RR in aggregate [½]
- Review legacy policies and risk management practices and overtime enforce consistency [1]
- Educating managers and employees on the identification, quantification and management of risk [½]
- Determining the risk management policy and setting the standards to which all employees must adhere [1]
- Ongoing development of existing approaches in response to the changes in risk profile [½]
- Monitoring adherence (i.e. policing) and overseeing the implementation of risk management policies [1]
- Provide training in risk management techniques [½]
- Allocate economic capital around the Group [½]
- Liaising with external parties e.g. regulators, credit agencies... [½]

[8½, Max 6]

(iii)

- VaR gives only the point at which loss is expected to occur with a predetermined probability [½]
- ... and gives no indication of how much is likely to be lost if a loss is incurred [1]
- Parametric VaR is also potentially misleading if the assumed distribution does not reflect the risks being borne [½]
- VaR does not constitute a coherent risk measure as it is not sub-additive [½]
- ... meaning that the combined VaR for a number of portfolios is not necessarily less than or equal to the sum of the VaRs of the individual portfolios [1]
- VaR can potentially be gamed by executing certain hedging activities [½]
- Applying VaR to PP business may lead to difficulties regarding managing the business with historical consistency [½]
- It can be difficult to compare VaR across companies if different confidence levels or time horizons are used [½]

[5, Max 4]

(iv)

- Firstly need to agree the purpose of the economic capital model [½]
- ... and which risks to be modelled [½]
- ... allowing for key stakeholders' views [½]
- ... and materiality within the Group [½]
- For the in-scope risks, use a combination of factor tables, deterministic approaches and stochastic approaches [1]
- The factor table approach requires a certain amount of economic capital to be held in respect of each unit of a particular type of activity [½]
- The deterministic approach calculates the amount that a firm would lose under different scenarios, with the amount of economic capital required being related to the losses under the various scenarios [1]
- The stochastic approach involves the use of a model [½]
- ... the approach could be genuinely stochastic, parametric or empirical [½]
- The choice of approach depends on the cost of the approach and complexity of the institution involved [½]
- Once the risks are modelled at entity (PP, RR) level, decide how the results can be aggregated at entity and group levels [1]
- ... allowing for diversification across the firm [½]
- ... correlation between variables [½]
- ... management actions [½]
- ... it could be univariate model or fully integrated one risk factor at a time [½]
- Perform model validation [½]
- Generate the legacy metrics for comparison [½]
- ... as well as relevant metrics to aid decision making [½]
- Ongoing maintenance of economic capital model [½]

[11, Max 7]

(v)

Allocation using a risk measure:

- For example an Euler allocation [1/2]
- Can allocate in proportion to the risk measure applied to each line in isolation [1/2]
- or a more complicated numerical implementation requiring complex modelling [1/2]
- e.g. using co-measures or the consideration of capital as a shared asset [1/2]

Allocation by marginal capital costs:

- Allocate capital to lines of business in accordance with the marginal additional capital required for writing that business [1/2]
- ... given that the other lines of business are already in place. [1/2]

Allocation using game theory:

- For example, the Shapley method allocates capital with reference to an average of the marginal capital requirements [1/2]
- ... assuming that the segment under consideration is added to the overall portfolio first, second, third and so on. [1/2]

[4, Max 2]

(vi)

- May need to get buy-in from senior management of PP and RR [1/2]
- It may not be possible to move the capital e.g. due to regulation [1/2]

Allocation using a risk measure:

- Time and effort required for the calculation and the allocation itself [1/2]
- Accuracy/level of confidence of the modelling results [1/2]
- Results obtained from different approaches can be very different, even for the same risk measure [1/2]
- Difficult to explain and/or justify the method chosen [1/2]

Allocation by marginal capital costs:

- This approach corresponds to the financial principle of marginal pricing [1/2]
- But may depend on the order of consideration and generate inconsistent results [1/2]

Allocation using game theory:

- For example, the Shapley method allocates capital with reference to an average of the marginal capital requirements, assuming that the segment under consideration is added to the overall portfolio first, second, third and so on. [1/2]
- This approach ensures that equality between business units is achieved regardless of the order in which they are added. [1/2]
- But it is computationally intensive [1/2]

[5½, Max 2]

(vii)

- Capabilities to consistently identify and measure risk (i.e. risk modelling capabilities) [1/2]
- Capabilities to manage risk exposures and losses [1/2]
- ... within the company's predetermined tolerance guidelines [1/2]
- ... and to what extent these cover all significant risks [1/2]
- Frequency / severity of unexpected losses which are outside of tolerance level [1/2]
- The Group's expertise in optimising risk-adjusted returns [1/2]
- Role of risk and risk management in the insurer's corporate decision making [1/2]
- Robustness of the new ERM function [1/2]
- ... and to what extent this has been embedded in business activities and tested under stress [1/2]

- Record keeping and ability to learn from best ERM practices from legacy operations and from external organisations [½]
 - Ability to identify, monitor and manage any emerging risk [½]
- [5½, Max 5]
- (viii)
- Reduce the amount of equity holding [1]
 - Sell equity futures of the appropriate amount [½]
 - Purchase equity put options of the appropriate amount [½]
 - Implement appropriate option strategies, e.g. put spread, collar [1]
 - Set up total return swaps in the OTC market [1]
 - Exit from more risky/volatile equity investments and increase the allocation to more defensive stocks [½]
 - Invest in a better diversified portfolio (e.g. across geographies, industries etc) [½]
- [5, Max 3]
- (ix)
- Capital position strengthened/capital requirement reduced [½]
 - ... provided that the approach taken is admissible for capital calculation purposes [1]
 - Diversification may reduce the impact at the Group level [½]
 - Derivatives may introduce counterparts default risk, which reduces benefits [½]
 - Other actions may also introduce operational risks [½]
- [3, Max 2]
- (x)
- Hold more cash [1]
 - Better understanding of liquidity needs, i.e. better projection of liability cashflows and improved liability modelling [1]
 - Use stress and scenario testing to check where the weak points are [½]
 - A wide range of scenarios are useful for this, covering both economic shocks and events directly related to business operations (e.g. large claims from related events) [1]
 - Better matching of asset and liability cashflows [½]
 - Useful to have contingency plans for certain scenarios [½]
 - Improve the liquidity profile of asset holdings, e.g. exiting illiquid investment where appropriate [½]
 - ... also where appropriate, exit assets that are subject to large drawdowns in stressed market conditions (e.g. equities) [½]
 - Assess how best to manage liquidity at the Group level, allowing for how quickly liquidity can move between the two entities [1]
 - Important to allow for interactions between liquidity and other risks, in particular market and interest rate risks in the scenario specifications [½]
 - Assess emergency liquidity facilities, and the reliability of these under extreme circumstances [½]
 - Improve the liquidity profile of the liabilities e.g. changes to notice period on savings accounts to reduce the risk of unexpected calls [½]
 - Some derivative strategies e.g. zero coupon cashflow swap [½]
- [8½, Max 5]

(xi)

- Reputational risk of mismanaging such a large migration can damage company brand and employee morale [1]
- Project risk – delay in getting everything implemented with agreed timeframe [½]
- ... or materially overspending [½]
- ... or not being able to deliver full benefits due to design issues [½]
- ... or not being able to replicate/enhance capabilities of legacy systems [½]
- ... which would have financial consequences (e.g. mispricing) [½]
- Heavier reliance on internet access as everything is cloud-based [½]
- ... which may increase business disruption risk [½]
- Heavy exposure to the risk control and business continuity of the IT service provider [½]
- Unified system means that any technology failure will cause more damage than before [½]
- New coding may mean undiscovered errors which will take time to root out and may cause losses to the company [½]
- Counterparty risk that the external provider is unable to support the platform [½]
- Potentially increases cyber risk, e.g. stealing customer data [½]
- ... or pricing systems being hacked so business operation disrupted [½]
- Such large changes in systems may create opportunities for internal/external fraud to happen [1]
- During and after development, this potentially introduces greater “key individual” risk, with great reliance on the expertise of the group of people developing and coding the new system. [½]

[9, Max 7]

[Total 49]

[Paper Total 100]

1. *Most candidates failed to acknowledge the Group was newly formed from the merger of two separate companies so didn't identify the benefits specific to this scenario. Most candidates were able to score some marks.*
2. *A straight forward question for a well prepared candidate. This question was generally well answered.*
3. *A straight forward question for well prepared candidates. This question was generally well answered.*
4. *Most candidates failed to focus on the economic capital element and the scenario described (i.e. two separate companies with different economic capital metrics that have merged) and instead described the generic process for developing a model.*
5. *A straight forward question for well prepared candidates. However, this question was generally not well answered by candidates who did not know capital allocation methods.*
6. *Candidates that struggled with part v) also struggled here.*
7. *This question was generally well answered.*
8. *This question was generally well answered.*
9. *A straight forward question for well prepared candidates. However, this question was generally not well answered by candidates who did not consider admissibility*

or diversification.

10. *This question was generally well answered.*

11. *This question was generally well answered.*

END OF EXAMINERS' REPORT