Subject F203 — *General Insurance*
Specialist Applications
20 October 2014
MEMORANDUM

QUESTION 1

(i) *Examiners' notes: Candidates explained the product features without focusing on the role of agricultural insurance in South Africa. Price volatility (and that this can be addressed by using derivatives) were hardly mentioned.*

- Two major areas of risk and uncertainty in agricultural crop production relates to:
  - volatility in the levels of production, driven by all forces that impact the production process
  - price volatility in the market, driven by market forces
- These risks are expected to increase in the future due to expected changes / liberation in:
  - trade (price risk)
  - climate change (production risk)
- Agricultural investments are generally risky and therefore justify a role for insurance
- Traditional agricultural crop insurance will offer protection to production
- Price volatility is more likely to be addressed using derivatives and other instruments in `` the securities markets.
- Policies offer protection against natural and man-made catastrophes
- and usually takes the form of a multi-peril policy uniquely designed according to the policyholder's needs
- Policyholders are liable to be affected by same catastrophic events which inter alia will mean much reliance on the strength of insurance and reinsurance companies. (Gives access to reinsurance to alleviate the risk of large catastrophes)
- Agricultural insurance therefore assists to:
  - protect financial stability of farmers
  - and all other role-players in the agricultural produce value-chain
  - serve as security for banks as a source of upfront capital
  - support the South African Government, both financially and technically, in its efforts to provide protection to farmers
  - ensure long term production capacity in the agricultural sector by sharing the insured's financial losses during catastrophes or other losses
  - gives farmers the ability to focus on what they're good at – farming
- Overall this means more stability in the South African agricultural sector as a whole and the important role it plays in the South African economy (approx. 3% of South African GDP).

[Max 8]

(ii)

In addition to hail, perils covered by a South African crop insurance product:

- drought
- fire

- pests / disease / plague
- storms/flood
- deterioration of or damage to produce
- theft

[Max 3]

(iii)

Data preparation:

- Frequency and severity needs to be modelled separately
- Need to understand whether data provided are from the ground up losses
- Split between attritional and large losses
- Claims data and exposure data over the period would be required
- Granular for both data sets so effects at different times of the year can be evaluated
- Claim amounts need to be adjusted for inflation
- Data must be standardised for the following :
    - Cresta Zone, province, or some geographical grouping
    - Crop type
    - Price volatility
    - Season
- Adjustments for changes in technology or farming practices needs to be allowed for (Check if all historical data is still relevant – some could be removed if not relevant anymore e.g. due to climate change)
- Need to consider IBNR/IBNER for most recent claim years. Some manual or statistical adjustment might be necessary
- Model-input needs to allow for expected future exposure by each rating category

Frequency/Incidence

- The most practical way to model frequency would be to model the incidence of hail storms and not hail claims in particular
- However, the incidence of hail claims could be modelled if a reliable estimate of hail cover exposure is available, which is unlikely and difficult to determine
- Whichever method is chosen, the model should output the number of hail events over a time period t for exposure u of crop type v
- A simple probability could be selected, perhaps split by Cresta Zone, province or defined area group
- Otherwise, a standard Poisson distribution could be fitted
- If the variance > mean, could use a negative binomial distribution
- At least, the model should differentiate between attritional claims and large claims, ie based on claim size
  Parameterisation
    - Can fit using method of moments (MOM)
    - or by using maximum likelihood estimates (MLE), which is the same in the case of the Poisson distribution – the Poisson parameter is the mean frequency per unit of exposure

Severity/Cost

Below threshold

- Claims below the catastrophe threshold will be modelled using an appropriate statistical distribution
- eg, Gamma, Weibull or any type of positively skewed distribution
- Parameterisation ideally by means of MLE
- Statistical goodness of fit tests include, Chi-Square, AIC/BIC
- Visual goodness of fit tests include a QQ plot
- The distribution will be truncated at the chosen threshold level

Choice of threshold

- When fitting a GPD, the selection of threshold u above which one approximates the claims distribution to the GPD is a trade-off between the quality of the approximation and the level of bias in the fit we achieve
- For high u we have high accuracy, but high bias. For low u we have less accuracy, but less bias
- The most useful graphical tool for the determining the threshold is the mean excess function.

- If Y is a random variable with right endpoint yF then the mean excess function is defined as:

$$e(u) = E(Y - u \mid Y > u), 0 \leq u < yF$$

- For claim amounts Y the mean excess over a chosen threshold u is plotted against increasing values of u
- For the GDP we would choose a threshold u above which the mean excess of claim amounts over u is linear

- Another graphical diagnostic tool is the Hill plot, that plots the Hill Estimator against a parameter k in order to find the optimal threshold

Above threshold – Fit GDP distribution

- Parameterisation can be done as follows:
  - Maximum-Likelihood Estimation
    - Either on total claim amounts or on excess of claim amounts above threshold (Pickands and Balkema-De Haan)
    - Preferred and most commonly used method to parameterise a GDP
  - Method of Moments
    - Not reliable for small datasets
    - Use Hoskins and Wallis probability-weighted moments to parameterise the GDP
  - The Hill-estimator
    - Also an MLE for the GDP

Frequency and claim cost models are combined to model gross of reinsurance risk cost

[Max 16]

(iv)

- When using an internal model under SAM, capital needs to be held at the 99.5th percentile of the claims amount distribution.
- A rough approximation would be the severity of a 1 out of 200 year catastrophe as in the event loss table below.
- Above such level the capital required will be equal to the amount at the 99.5th as no more capital is required
- Below such level, required capital is reduced by approved reinsurance and equal to the deductible

Deductible	Capital Required (iv) (b)
240,000,000	200,000,000
200,000,000	200,000,000
160,000,000	160,000,000
120,000,000	120,000,000
80,000,000	80,000,000
40,000,000	40,000,000

Assumptions

- Acknowledging that capital needs to be held at the 99.5th percentile or equal to the severity of a 1 out of 200 year event
- Assuming reinsurance needs to be "approved" to hold less capital for lower deductibles

Calculations

- Marks for calculating the capital required column correctly

[Max 4]

(v)

- Marginal Cost of Capital = R40,000,000 x Cost of Capital %
- Layer Frequency = 1 / Return Period
- Layer Severity is given
- Layer Total Expected Loss Cost = Layer Frequency x Layer Severity
- Marginal Cost of Retention = Marginal Cost of Capital + Layer Total Expected Loss Cost
- Marginal Reinsurance Cost = Layer Reinsurance Premium = ROL x R40,000,000

Layer	Cost of Capital (Given)	Marginal Cost of Capital	Layer Frequency	Layer Severity (R'000) (Given)	Layer Marginal Expected Risk Cost	Marginal Cost of Retention
R40 million XS R240 million	3.8%	-	0.0025	39,500	98,750	98,750
R40 million XS R200 million	3.1%	1,240,000	0.0050	35,000	175,000	1,415,000
R40 million XS R160 million	2.4%	960,000	0.0080	34,500	276,000	1,236,000
R40 million XS R120 million	2.0%	800,000	0.0125	33,500	418,750	**1,218,750**
R40 million XS R80 million	1.4%	560,000	0.0250	31,250	781,250	1,341,250
R40 million XS R40 million	1.0%	400,000	0.0400	30,000	1,200,000	1,600,000

Layer	Reinsurance ROL	Marginal Reinsurance Cost
R40 million XS R240 million	1.6%	640,000
R40 million XS R200 million	2.1%	840,000
R40 million XS R160 million	2.6%	1,040,000
R40 million XS R120 million	3.0%	**1,200,000**
R40 million XS R80 million	4.2%	1,680,000
R40 million XS R40 million	5.5%	2,200,000

Assumptions and Approach:

- Company has unlimited access to capital
- EML not necessarily maximum claim, breach of EML possible

Calculations – award marks for

- Calculate layer frequency correctly
- Calculate marginal risk cost correctly
- Calculate marginal cost of capital correctly
- Calculate marginal total cost of retention correctly
- Calculate marginal reinsurance costs correctly

Conclusions

It will be optimal for the company to move from a R40 million deductible to a R120 million deductible
(Marks were also awarded if the deductible is wrong but concept regarding deductible calculation is correct e.g. cost of retention = cost of capital + risk cost vs. reinsurance cost)

Reason

- Below a R120 million deductible the company can retain the risk at a lower cost (risk and cost of capital) than reinsuring it. Above R120 million the cost of reinsurance becomes lower than the cost of risk retention
- OR, the optimal level of reinsurance will be where the marginal cost of reinsurance on a layer equals the marginal total cost of absorbing the risk internally
- OR the optimal level will be where the total cost of retention plus reinsurance is a minimum

[Max 11]

(vi) Government-supported agricultural insurance fund

- Government may collect and channel funds towards the fund in various ways
- Specifically, the Government may allocate part of the disaster recovery budget towards the fund
- Corporate sponsors with vested interest in the agricultural sector may support the fund
- Fees could be collected from farmers / premium collected via tax
- In return farmers could spend a lot less on agricultural insurance cover, because
- risk could be managed, priced and transferred better as the fund will pool a much larger and diversified set of risks together
- and more effective distribution of overhead expenses will be achieved
- possibly access to better and/or cheaper reinsurance
- reducing credit risk of non-recovery of reinsurance claims
- reduced anti-selection if participation is obligatory
- may operate at a much lower profit/ROE requirements than insurance products
- as the investors may subsidise required capital and view rewards as;
- better stability in the agricultural sector output / increased confidence in industry / creating jobs
- willingness to participate in agriculture/more farmers being insured
- more awareness around the importance of risk management in agriculture
- fund would probably pay benefits only during extreme events
- administration of fund could be similar to other government funds e.g. RAF, SASRIA
- fund contributions are likely to attract tax benefits / subsidies
- may offer cover to previously uninsurable events / guaranteed cover / additional benefits nut currently provided for (or expensive) in current insurance market
- Fund may have a mutual nature / if surplus in a year, either distribute or keep to reduce future premiums
- May have longer settlement delays

[Max 8]

[Total 50]

QUESTION 2

(i) *Examiners' notes: Many candidates did not interpret "basis" correctly and gave details on how the different reserves (IBNR, OCR etc.) are calculated under the two bases.*

- **Current statutory basis**
  - Generally speaking the current reserving basis can be considered prudent basis
  - Current statutory requirements prescribe the calculation of the IBNR and UPP on a deterministic basis / formula approach
  - Margins within the current calculation are not calculated or reported separately
  - For example, profit margins that exist within the UPP are released evenly over the term of the policy

- **SAM basis**
  - Generally speaking the SAM reserving basis can be considered a market valuation of the insurer's liabilities since the provisions should be the amount paid between a willing buyer and willing seller to transfer liabilities between insurers
  - This consists of calculating an explicit best estimate and explicit risk margin
  - Best estimate makes explicit allowance for all future cash flows, so implicit margins are not allowed
  - Any margin within current provisions are immediately released to own funds, for example:
    - Inherent profit margins within the UPP
    - Inherent case margins within the OCR
    - Inherent prudent margins within the assumptions selected for the IBNR
  - Discounting is introduced releasing the future investment return on provisions immediately / Profit allowed to be earned on day one
  - The risk margin calculation methodology is specified with no room for overlaying judgement in determining the explicit risk margin
  - Simplifications are allowed
  - Risk margin calculated using a cost of capital approach
  - Explicit ULAE is required
  - No IBNR, OCR and UPP but instead split between premium and claims reserves
  - Adjustment for binary events

[Max 5]

(ii) *Examiners' notes: It seems that many candidates interpreted this question under the Board Notice 169 regime instead of SAM. Surprisingly many candidates did not know that SAM's technical provisions are calculated using a discounted cash flow approach. General statements, not focusing on the question did not get marks – for example "make adjustments for changes in exposure" or "adjust for trends". Bonus marks were given for stating the appropriate SAM formulae, it was not essential to provide the formulae.*

1. **Domestic contents only**
    a. **Premium provisions – best estimate**
        - Contract boundary is likely to be 1 month – no UPP
        - For the few annual premium policies make use of simplification formulae
        - Calculate best estimate as unearned proportion of premium with allowance for discounting
        - No claims bonus: discounted cash flow model where future benefit is discounted and partially accrued on a time basis

        Best estimate Premium provision =
        [Pro-rata of unearned premium over the life of the premium + Adjustment for any expected insufficiency of the premium in respect future claims and expenses] / (1 + rf_rate_1y / 3)
        where:
        rf_rate_1y is the risk-free interest rate 1-year term

        Max (2)

    b. **Claims provisions – best estimate (includes both OCR and IBNR)**
        - OCR needs to be at a best estimate
        - Should have sufficient detailed information to derive claims reporting pattern and claims payment pattern of business using conventional run-off triangle techniques.
        - Could create a discounted cash flow model, but settlement would be a matter of months
        - Instead revert to use of simplifications for outstanding reported claim as number of claims times average cost of claims less incurred to date
        - Estimate IBNR as number of IBNR claims times average cost of IBNR claims
        - The size of claims incurred in a year should have small variance (contents only insurance) and should have sufficient number of claims to allow average cost to be representative
        - Include allowance for future inflation and discounting
        - [Also gave marks for discounted cash flow approach.]

        Formula for outstanding reported claim

$$\sum_{i}^{n}\left((N_i \times A_i) - P_i\right)$$

where:

Ni = number of claims reported, incurred in year i

Ai = average cost of claims closed in year i

Pi = payments for claims incurred in year i

Formula for IBNR

IBNR reserve year t = $C_t \times N_t$
where:
C t = average cost of IBNR claims
Nt = number of IBNR claims expected based on historic reporting patterns

Max (3)

2. All risk corporate insurance

Best estimate premiums and claims provision

- All risk generally considered to provide wide form of cover spanning property type claims (fire claims) and liability type claims (3rd party property damage / bodily injury claims)
- Despite being a large insurer with plenty of data, claims data expected to show erratic patterns from large losses
- Implement a discounted cash flow model that considers:
    - Future premiums
    - Receivables for salvages and recoveries
    - Contingent commission provisions (Reinsurance profit sharing)
    - Claim payments
    - Administrative expenses
    - Investment management expenses
    - Claims handling expenses
- Up to the contract boundary
- Include allowance for taxation
- Derive claims reporting pattern and claims payment pattern of business using conventional run-off triangle techniques while smoothing out effect of large losses
- Discount to present value to allow for time value of money
- Model must be able to separately report premium provisions from claims provisions

Max (5)

3. Risk margin (for both products)

- Determine the SCR for Innovation at the valuation date
- Then project the SCR forward
- Run the SCR down based on cash flow run-off profile (recalculating SCR every year in future could be future refinement)
- Multiply with cost of capital rate -> 6% per annum is being tested in QIS 3
- Discount to a present value to allow for time value of money

Max (2)

4. Unallocated loss adjustment expenses (for both products)
    - Need to establish the indirect cost of administering the business
    - Could be derived making use of any activity based costing analysis done previously by Innovation
    - Project future indirect cost at a slower rate than the cash flow run-off (reverse of economies of scale)
    - Need to allow for indirect cost inflation outstripping general inflation as staff salaries are likely to be a significant proportion of cost base
    - Discount to a present value the future indirect costs

Max (3)

[Max 15]

(iii)

1. What is meant by conducting an ORSA?

- ORSA itself is a **process** followed within an insurer and not just a reporting requirement
- With the documented outcome of the ORSA process often referred to as an ORSA report
- Depending on size of insurer -> principle of proportionality, possible for insurer to have an ORSA policy and have a ORSA process document
- Within the ORSA process the capital requirements both now and in future are formally assessed
- Projection is considered within the context of the risk management and capital management framework within the insurer i.e. those structures that manage the risk and provide sources of funding (Solvency position)
- To determine if the insurer has sufficient own funds now and going forward under business as usual (Economic capital and regulatory capital)
- Part of ORSA process should consider the insurer's ability to remain financially sound in stress and / scenario testing
- With neither the number nor details of stresses and / scenarios not being prescribed but designed by insurer to suit the underlying business
- Consideration of exposure to risk thus not only limited to underwriting but extends further to include all other risks, governance issues and internal controls both quantitatively (eg, using Pillar 1 metrics) and qualitatively
- Usual for the ORSA to be conducted regularly, often at least annually or if the business should change notably, for example in take-over situation
- For the Board to be informed of the ORSA process and outcome and for the ORSA report to be submitted to the regulator
- Being implemented locally as emerging SAM thinking under Pillar II / part of future legislation
- Being implemented internationally as a regulatory requirement as part of the parallel run process leading up to Solvency II implementation
- Most benefits to be gained from approaching it as a good business practice and see what business benefits can be obtained rather than approaching only as regulatory requirement

Max (7)

2. Generic outline of ORSA report
    - Purpose and scope
    - Executive summary of ORSA
    - Overview of ORSA process
    - Business plan summary
    - Review of risk management framework / risk management statement
    - Review of capital management framework
    - Risk profile / analysis of capital requirements at evaluation date
    - Analysis of own funds / capital resources at evaluation date
    - Projected business plan capital requirements
    - Projected capital requirements under stress and scenario testing
    - section on assets and/or ALM
    - Cover other risks e.g. liquidity, credit, market risk, operational risk
    - Technical provisions
    - Description of control functions

Max (3)

[Max 10]

(iv) *Examiners' notes: Many candidates covered recommendations (asked for in part (v)) in this section as well. Many candidates' answer for part (iv) was approximately the same length as for (v) – the mark allocation needs to be taken into account in deciding how much to write in each section. Candidates need to read through the whole question before starting the answer.*

Although most candidates had the main concepts correct (investments suitable for domestic contents but not for the other products) not enough detail was given to support the reasoning behind whether the investment portfolio is suitable or not. Very little detail was given on the asset cash flow profile (most focused on the liability profile) and "other liabilities" was hardly considered.

General statements that weren't relating to the specifics of the scenario given did not get any marks. (For example "Assets should match the liabilities' nature, term and currency.")

Asset cash flow profile

- Existing strategy ensure high level of liquid assets readily available -> money market assets. This allows payment of claims as these are incurred.
- Little volatility in investment returns from money market
- Existing strategy is targeting capital preservation (investment returns practically never reaching negative levels) with high liquidity
- Returns generated from asset portfolio close to observed CPI inflation but unlikely to provide real returns in the long term
- Term of cash flow profile is short < 90 days
- No mention of currency -> possible all ZAR currency
- Need to check assets against admissibility rules of regulator
- Free assets are poorly matched / restrictive mandate is giving a limiting return
- Consider the investment income assumptions used in pricing

Max (3)

Liability cash flow profile

1. **Domestic contents only**
   - Quick reporting pattern with generally quick payment pattern
   - Large insurer -> large portfolio predictable cash flow requirements to meet claim payments
   - Main perils of theft followed by storm and consequential loss show minor seasonality effects
   - Although replacement value is known, partial losses are common. Some claims will be total losses for full replacement value with additional claims related costs like clean-up costs and assessor fees. / Claims inflation will be similar to CPI inflation.
   - A fair proportion of content items may be imported and exposed to changes in exchange rate when insuring on a replacement basis.
   - Underinsurance may allow the application of the average principle to reduce claims cost
   - Current asset selection will produce cash flows that match the cash flow requirements for this product
   - Claims may be correlated with the economy (more claims in times of economic downturn)

Max (4)

2. **Commercial and corporate all risks**
   - Generally longer reporting pattern and settlement pattern - Term of cash flows on product probably a matter of years / need to understand how the wind turbine liability will develop over time
   - Nature would vary between perils covered. Property claims more predictable than say liability covers.
   - Large unexpected claims could put strain on cash resources, especially if not reinsured
   - Range of inflation pressures on various components:
     - Claims assessors and investigators – salary inflation
     - Property damage claims – influenced by salary and price inflation
   - Liability claims (like business interruption cover) subject to price and salary inflation
   - Wind turbine cover has longest term (25 years)
   - Need to understand how the wind turbine liability profile will develop over time
   - Specific inflation pressure for wind turbine cover with imported parts subject to currency exchange fluctuations and additional inflation pressures on cost of repair (specialist skill that is scarce)
   - Liability exposure unknown, for example future environmental damage claims.
   - Cash flow requirements for this product over longer durations are poorly matched by current asset selection
   - Serious risk of real assets in future being far less than value of real liabilities on this product, especially for the wind turbine product
   - Serious risk of insolvency if long term risk free interest rates drop (liability PV increases drastically with asset valuation not responding)

- Short-term bonds is an attempt to seeking assets of longer term (for matched position), but proportion is simply not enough (90% of liabilities are accounted for by this product) and term of bonds not long enough.
- Forms the bulk of the portfolio, therefore should drive the investment strategy

Max (6)

3. **Other liabilities**
   - Range of creditors and other current accounts - Requirement for liquid cash assets
   - Current asset selection will produce cash flows that match the cash flow requirements for other liabilities

Max (1)

4. **General**
   - Free assets are poorly invested / restricted mandate is giving a limited return
   - Consider investment income assumptions made in pricing to determine whether investment portfolio is suitable or not
   - Investment portfolio needs to comply with regulatory requirements

[Max 14]

(v)

Assuming Innovation Ltd follows a principle of matching:

- **Household contents**
  - Current asset selection could be left unchanged for household contents cover
  - It provides liquidity in appropriate currency that is not exposed to undue inflation differential in liabilities and assets

- **Commercial and corporate product**
  - Must adjust the asset selection for the liabilities on corporate and commercial all risk product to have closer matching by selecting a greater proportion of assets that provide inflation protection and provide some currency hedging (for wind turbine product)
  - Assets that outperform inflation include equity, property, corporate bonds, inflation linked government bonds although the market cap is small.
  - Each of these have return characteristics and implications for liquidity {*Propose a percentage allocation (with justification) alongside asset classes*}

- **Considerations for change on commercial and corporate product**
  - Higher yielding assets associated with greater volatility in asset values – this will flow through into balance sheet
  - Introducing new asset classes will change investment administration cost and potentially are subject to other types of tax
  - Assets providing currency hedge could imply exchange control regulation
  - Need to consider skills of existing asset managers to manage any new assets

- **Own funds**
  - Shareholders' required return on capital likely to be much higher than inflation
  - Can improve the profits after tax by seeking higher return assets for own fun
  - Still require sufficient liquidity in a portion of own funds to meet unexpected outflow

- **General Considerations for changes**
  - Does the current portfolio match the insurer's risk appetite?
  - Capital requirements will change as asset portfolio is changed. Generally speaking, higher yielding assets with higher volatility in value and return are associated with higher capital requirements.
  - Tiering of assets allocated to own funds for Solvency Capital Requirements
  - Administration impact - feeding asset values onto accounting platform
  - Potential investment policy changes needed to allow investing in certain asset classes
  - Consider the current level of investment markets. For example if equity market is viewed to be over-valued one may need to phase-in an asset allocation change
  - Consider the admissibility of assets (regulatory requirements)
  - Concentration of assets – need to make sure assets are suitably diversified

[Max 6]

[Total 50]