# INSTITUTE AND FACULTY OF ACTUARIES

# EXAMINERS' REPORT

April 2011 examinations

## Subject ST8 — General Insurance: Pricing Specialist Technical

**1** Credit insurance covers a creditor against the risk that debtors will not pay their obligations.
e.g. trade credit, mortgage indemnity guarantee.

Creditor insurance provides cover to individuals who are subject to obligations to repay credit advances or debt.
e.g. to cover personal loans, mortgage loans or credit card debts.

Creditor cover is usually against disability or unemployment as these perils may prevent the insured from receiving an income …
… while credit insurance covers non-payment for any reason.

Creditor cover will pay the regular loan payments until the borrower is recovered / working / loan is paid off or a policy limit is reached…
… whereas credit insurance is likely to pay a one-off lump sum for the amount owed upon default of the debtor.

*A common error in this part was interchanging the definitions of the two types of insurance.*

**2** We would usually use the past history of claims from an insured or a group of insureds (e.g. a firm of solicitors) in order to estimate the future costs of providing insurance.

But many events are random so we do not know what the true cost of claims will be in the future.

The claims from the last few years may not always be a good estimate of the future, especially if there haven't been many claims, or their final amounts are uncertain.

So we might get a better estimate by combining this past data with some other information about professional indemnity risks.

This other information is often obtained from a larger pool of claims.

The more data we have on the individual risk, and the more stable the experience, the more credible it is.

For example, suppose that recent experience indicates that an individual solicitor should be charged a rate of £180 for £100,000 of professional indemnity insurance cover but the normal rate for other risks is £165 (this is the "other information"). The new rate could be £180 or £165 or something in between, and credibility theory helps us to decide.

There are different mathematical models that can be used to come up with the weightings to use. (*NB – it is not appropriate to go into these in this answer*)

The other elements of premium (expenses, profit etc) need to be added on to the cost of claims to determine the final premium.

*Most candidates started their answers well and explained the basic points, but many went on to include detailed theory and formulae, for which no credit was available. Looking at the marks available for the question should have indicated that a great level of detail was not required. Very few candidates gave a good example or mentioned other elements of premium besides claims cost.*

## 3

- Event module

  A database of stochastic events (the event set) with each event defined by its physical parameters, location and annual probability/frequency of occurrence.

- Hazard module

  This module determines the hazard of each event at each location. The hazard is the consequence of the event that causes damage.

  For example in the case of a hurricane wind speed is the primary cause, for an earthquake it is ground shaking (or other suitable example).

- Inventory (or exposure) module

  A detailed exposure database of the insured systems and structures.

  This will include details such as location, age, occupancy or construction.

- Vulnerability module

  Vulnerability can be defined as the degree of loss to a particular system or structure resulting from exposure to a given hazard.

- Financial Analysis module

  Uses a database of policy conditions to translate the total ground-up loss into an insured loss.

The inventory and financial analysis modules rely primarily on input data that is specific to the user of the models *(must say both modules to score fully)*

The other three modules are based on scientific assessment (seismology, meteorology and engineering). *(must say "others" or name modules to score fully)*

*Common errors in this bookwork question were:*

- *putting limits, deductibles etc. in the vulnerability module, rather than the financial analysis module*
- *stating the wrong name for the "Financial Analysis" module*
- *failing to pick up the final two points*

**4** The following regulatory restrictions on the actions of a general insurer may be encountered in one or more countries of the world:

- Restrictions on the territory or type of business a general insurer can write or the classes for which the insurer is authorised.
- Limits or controls (including requirement to file rates) on the premium rates that can be charged.
- Restrictions on the information that may be used in underwriting and premium rating.
- A requirement to deposit assets to back claims reserves.
- A requirement that the general insurer maintains a minimum level of solvency.
- Restrictions on the types of assets or the amount of a particular asset that a general insurer can take into account for the purposes of demonstrating solvency.
- A requirement to use prescribed bases for calculating and/or liabilities (including technical reserves) when demonstrating solvency.
- A requirement to take account of uncertainties and risks in the business when calculating the solvency requirement.
- Restrictions on individuals holding key roles in companies.
- Licensing of agents to sell insurance and requirements on the methods of sale and disclosure of commission / broking terms.
- A requirement to pay levies to consumer protection bodies.
- Legislation to protect policyholders if a general insurer fails.
- Limitation of ownership e.g. only own 49% of Indian company.
- Monopoly and merger restrictions.
- Requirement to have an office in a location if underwriting there.
- Restrictions as to whether claims equalisation reserves are needed.
- Compulsory covers e.g. requirement to offer terrorism cover in some countries or to offer flood (or other) cover to high-risk policyholders.
- Prescribed policy conditions or minimum level of cover allowed on specific classes.
- Requirement to produce financial reports or accounts.
- Requirements on level, type or quality of reinsurance protection.
- Requirement to uphold customer treatment standards.

*Most candidates scored well on this bookwork question, although few gained full marks. Many ignored the "state" command word and gave unnecessarily long descriptions.*

**5** (i) Adjustments are:

- A loading for reinsurance.
- Loadings for internal expenses (claims handling/admin/overheads).
- Acquisition expenses, such as commissions and aggregator fees.
- A capital charge to reflect cost/availability of capital.
- Allowance for profit.
- Contingency loading.
- Investment income.

- Explicit discounts, such as NCD or cashback.
- Tax…
- …e.g., premium or purchase tax; tax on profits (or other valid example).
- Levies…
- …e.g., policyholder protection; fire brigade (or other valid example).
- Adjustments or cross-subsidies to allow for competition and market forces.
- Adjustments or cross-subsidies to allow for expected policy lifetime (new/renewal).
- Adjustment to reflect strategy or relationships (eg market share, broker relationships).
- Practical constraints of the rating structure or computer system.
- Regulatory constraint (e.g., maximum or minimum rates).

*Most candidates scored close to full marks on this part.*

(ii)

Commissions paid to insurer from reinsurer are greater than those paid out by the insurer to brokers…
…as a result of:

- Overriders/commissions to cover insurer's expenses.
- Profit commissions.
- …especially as the account seems to be quite profitable.

*Some candidates appeared to forget that this is a quota share contract. Many failed to demonstrate understanding of how overriders and profit commissions operate.*

(iii) Points:

- If commissions remain the same:
  - We can expect to recover more on large claim events.
  - Lowering the net loss ratios.

- In reality the commissions will change to reflect this i.e. reinsurance commission will decrease.

- A higher event limit decreases our losses from large events i.e. lowers the volatility of losses we expect.
- Lower volatility lowers the capital charge on the account.
- Hence decreases the office premium.
- Hence can be written at a higher loss ratio.

- Assuming the reinsurance commission change doesn't swamp it.
- Expected recoveries from a particular reinsurer are greater.
- Credit (reinsurer default) risk may increase.
- This is especially relevant as credit ratings may decrease after a large event.

- Hence we will increase the office premium, lowering the expected net loss ratio.

*This part was generally not answered well. Frequent errors were:*

- *stating that the reinsurance premium would go up, even though this is a quota share contract*
- *mistaking the limit for an excess, even though its operation was described in the question*
- *omitting credit risk and claims volatility*

(iv) Points For and Against and Neutral

**For**

- The market for household might be more competitive than for product liability.
- Pricing product liability business is more uncertain than household.
- and will hence need a higher capital charge…
- …because of:
  - Long tail – difficult to accurately reserve old claims.
  - Inflation more uncertain.
  - Latent claims.
  - Less data.
  - Other suggestions.

**Against**

- Property may be susceptible to natural catastrophes.
- This will require high capital charges.
- Investment returns should be better on product liability business.

**Neutral**

- Must also consider:
  - Reinsurance charges on different business.
  - Different regulatory capital requirements.
  - Different economic capital requirements due to mix of business in the company.
  - Expectations of shareholders, impacting required return on investment.
  - Position in insurance cycle could be different.
  - Expenses/commission.
  - The insurer's strategy for the two classes.

*Answers to this part were very mixed. The stronger candidates broke down their answers into sections, as above. Some candidates mistook target loss ratios for premium levels.*

**6** (i) OEP – the probability that the largest individual event loss in a year exceeds a particular threshold.

AEP – the probability that the aggregate losses from all loss events in a year exceeds a particular threshold.

*Precise definitions were required to get full marks. Many candidates wrote "a single" instead of "the largest" for the definition of OEP.*

(ii)

| | | |
|---|---|---|
| Loss (1 in 10) | 3,630,884 | From AEP table |
| Expense adjustment | 0.9 | 1–10% |
| Brokerage adjustment | 0.85 | 1–15% |
| GP | 4,746,254 | Loss / (0.85 × 0.9) |

*The most common mistakes here were using figures from the OEP table instead of AEP, or multiplying by 1.15 instead of dividing by 0.85. Some candidates, who were in doubt about whether to use the OEP or AEP table, gave two different answers. In this situation, even when one answer was correct, marks could not be awarded for it.*

(iii)

| | | |
|---|---|---|
| Expected Loss | 1,090,000 | |
| GP | 2,180,000 | loss/.5 |
| NP | 1,853,000 | GP × (1 – 15%) |
| Expenses | 185,300 | NP × 10% |
| NP – Expenses | 1,667,700 | |
| Required loss | 1,667,700 | |

Interpolated

| *x_i* | *f*(*x_i*) | *wt_i* |
|---|---|---|
| 1,852,218 | 0.2 | 89% |
| 237,743 | 0.5 | 11% |

| | |
|---|---|
| *X* | 1,667,700 |
| *f*(*x*) | **0.23** |

*In general, candidates who answered part (ii) correctly went on to make a good attempt at part (iii).*

(iv) The ceding reinsurer in a retrocession contract is called the **retrocedant**. The assuming reinsurer is called the **retrocessionnaire**

*Bookwork and answered very well by almost all candidates.*

(v)

| | | | |
|---|---|---|---|
| Probability | 0.0067 | | |
| Interpolated | *x_I* | *f*(*x_i*) | *wt_i* |
| | 0.0050 | 6,822,562 | 67% |
| | 0.0100 | 6,137,908 | 33% |
| | *X* | 0.0067 | |
| | *f*(*x*) | **6,594,344** | |

*The most common mistake in this part was to use figures from the AEP table instead of OEP. Again, where two different answers were given, neither could be credited.*

**7** (i) $E(X) = (250 * 0.8) + (750 * 0.19) + (5{,}000 * 0.01) = 392.5$

$E(X^2) = (250^2 * 0.8) + (750^2 * 0.19) + (5{,}000^2 * 0.01) = 406{,}875$

$E(X^3) = (250^3 * 0.8) + (750^3 * 0.19) + (5{,}000^3 * 0.01) = 1{,}342{,}656{,}250$

*This part was generally well-answered.*

(ii) $E(S) = \lambda E(X) = 0.05 * 392.5 = 19.625$

$\text{Var}(S) = \lambda E(X^2) = 0.05 * 406{,}875 = 20{,}343.75$

$\text{Skew}(S) = \lambda E(X^3) = 0.05 * 1{,}342{,}656{,}250 = 67{,}132{,}812.5$

$$\text{Coeff(S)} = \frac{\text{Skew}(S)}{\text{Var}(S)^{1.5}} = \frac{67{,}132{,}812.5}{(20{,}343.75)^{1.5}} = \frac{67{,}132{,}812.5}{2{,}901{,}660} = 23.136$$

*Many candidates did not calculate the coefficient of skewness in this part.*

(iii) Let $Y + k$ be a gamma random variable with the same moments as $S$.

Equating parameters:

$E(S) = (\alpha / \delta) + k = 19.625$

$\text{Var}(S) = \alpha / \delta^2 = 20{,}343.75$

$\text{Coeff}(S) = 2 / \sqrt{\alpha} = 23.136$

OR:

$\text{Skew}(S) = 2\alpha / \delta^3 = 67{,}132{,}812.5$

Solve simultaneous equations to give:

Sensible workings shown

$\alpha = 0.00747$
$\delta = 0.00061$
$k = 7.29517$

*Answers could be very sensitive to rounding precision. Full credit was given if correct to 5dp for alpha and delta and 2dp for k. This should allow for using 7dp in underlying calculations.*

*Candidates normally used their answers from part (ii) correctly, but some failed to provide sufficient workings that would have generated partial credit even where final answers were wrong.*

(iv) For 1,000 policies, $E(S) = 1{,}000 * 19.625 = 19{,}625$
And Var $(S) = 1{,}000 * 20{,}343.75 = 20{,}343{,}750$
(because $\text{Var}(S) = E(N)\text{Var}(X) + \text{Var}(N)[E(X)]^2$ and
$E(N) = \text{Var}(N) = 1{,}000 * 0.05$ so $\text{Var}(S) = 50 * E(X^2) = 20{,}343{,}750$)

$$\Pr(S > 30{,}000) = \Pr\left[ N(0,1) > \frac{30{,}000 - 19{,}625}{\sqrt{20{,}343{,}750}} \right]$$
$$= 1 - \Phi(2.3)$$
$$= 1 - 0.98928$$
$$= 0.01072$$

*A common mistake was to use a factor of $1000^2$ instead of 1000 when calculating Var(S).*

(v) It can require a significant amount of computer time to calculate values for $G(x)$

The recursion formula cannot be used unless the distributions of both $N$ and $X_i$ are known (or can be estimated fairly precisely).

*Most candidates wrote the first point but very few went on to get the second.*

# 8

*A general problem with this question was inability to interpolate correctly.*

(i)

Give credit for any reasonable estimate with adequate explanation
e.g. Growth in the last 2 years is 5m => select 85m.

Going forward we use E85m

*Most candidates gave a sensible estimate with reasoning.*

(ii)

Two methods are shown, each using a different order of trending and interpolating

**Method 1 – Trend then interpolate**

| *Fiscal Year* | *Payroll (Em)* |
|---|---|
| 2007 | 55.0 |
| 2008 | 70.0 |
| 2009 | 71.0 |
| 2010 | 75.0 |
| 2011 | 80.0 |
| 2012 (proj) | 85.0 |

| | *Mid point* | | |
|---|---|---|---|
| *Fiscal Year* | *Policy Year* | *Years Trend* | *Trend Factor* |
| 01/11/2007 | 01/01/2012 | 4.17 | 1.23 |
| 01/11/2008 | 01/01/2012 | 3.17 | 1.17 |
| 01/09/2009 | 01/01/2012 | 2.33 | 1.12 |
| 01/07/2010 | 01/01/2012 | 1.50 | 1.08 |
| 01/07/2011 | 01/01/2012 | 0.50 | 1.02 |
| 01/07/2012 | 01/01/2012 | (0.50) | 0.98 |

| *Fiscal Year* | *Trended Payroll* | |
|---|---|---|
| 2007 | 67.4 | 55 × 1.226 |
| 2008 | 81.7 | 70 × 1.167 |
| 2009 | 79.6 | 71 × 1.121 |
| 2010 | 80.7 | 75 × 1.076 |
| 2011 | 82.0 | 80 × 1.025 |
| 2012 | 83.0 | 85 × 0.976 |

| *Policy Year* | *Mid Point* | *Tr Payroll* | |
|---|---|---|---|
| 2007 | 01/01/2008 | 69.79 | =(2*81.7+10*67.4)/12 |
| 2008 | 01/01/2009 | 81.27 | =(2*79.6+8*81.7)/10 |
| 2009 | 01/01/2010 | 80.02 | =(4*80.7+6*79.6)/10 |
| 2010 | 01/01/2011 | 81.35 | =(6*82.0+6*80.7)/12 |
| 2011 | 01/01/2012 | 82.47 | =(6*83.0+6*82.0)/12 |

**Method 2 – Interpolate then trend**

| *Fiscal Year* | *Payroll (Em)* |
|---|---|
| 2007 | 55.0 |
| 2008 | 70.0 |
| 2009 | 71.0 |
| 2010 | 75.0 |
| 2011 | 80.0 |
| 2012 | 85.0 |

Linearly interpolate onto historical policy years. Always 1 July

| *Policy Year* | *Mid Point* | *Tr Payroll* | |
|---|---|---|---|
| 2007 | 01/01/2008 | 57.50 | =(2*70+10*55)/12 |
| 2008 | 01/01/2009 | 70.20 | =(2*71+8*70)/10 |
| 2009 | 01/01/2010 | 72.60 | =(4*75+6*71)/10 |
| 2010 | 01/01/2011 | 77.50 | =(6*80+6*75)/12 |
| 2011 | 01/01/2012 | 82.50 | =(6*85+6*80)/12 |

| *Policy Year* | *Payroll (Em)* | *Years Trend* | *Trend Factor* | *Trended Payroll (Em)* | |
|---|---|---|---|---|---|
| 2007 | 57.5 | 4 | 1.22 | 69.9 | 57.5×1.216 |
| 2008 | 70.2 | 3 | 1.16 | 81.3 | 70.2×1.518 |
| 2009 | 72.6 | 2 | 1.10 | 80.0 | 72.6×1.103 |
| 2010 | 77.5 | 1 | 1.05 | 81.4 | 77.5×1.05 |
| 2011 | 82.5 | 0 | 1.00 | 82.5 | 82.5×1 |

Assumptions:

- Linear interpolation is appropriate when converting fiscal year exposure to policy year exposure *(accept "payroll is uniform within each fiscal year").*
- The mid-point of the policy year is suitable for approximating the earnings growth.
- The same weight is given to shorter fiscal periods as longer ones in the calculation.

Going forward we use the results from M1.

*Most candidates chose to interpolate then trend, but many struggled with policy years 2007 and 2008. Credit was given for alternative assumptions where these were consistent with the calculation method. However, no credit was given for "uniform incidence of risk" or "policies written evenly over the year" (since there is only one policy).*

(iii)

| *Policy Year* | *Claims /Exp (m)* | *Economic Load* | *Economic Adjustment* | *Adjusted Claims/Exp (m)* |
|---|---|---|---|---|
| 2007 | 32,956 | | 1.00 | 32,956 |
| 2008 | 46,142 | 30% | 0.77 | 35,494 |
| 2009 | 44,362 | 30% | 0.77 | 34,125 |
| 2010 | 34,419 | | 1.00 | 34,419 |
| 2011 | | | | |

Estimate 2011 claims/exp figure (eg average 07-09 = 34,191)
Use exposure and claims (eg 82.47 * 34,191 = 2,819,732)

Assumptions in selection and calculation:

- Economic climate only affects claims per unit exposure, not exposure itself
- All years are representative and can be used
- Assume no change to Ts&Cs
- Assume payroll is adequate risk measure

*Very few candidates followed the exact approach suggested above, but equivalent valid approaches were given full credit. The usual approach was to adjust the trended ultimate claims from part (ii) for 2008-9, divide each by the appropriate payroll, take an average and multiply by the 2011 payroll.*

(iv) Discussion of which years to select:

- Older years are less relevant as they come from a differing claims environment
- e.g. propensity to claims or exposure less predictive or different working practices
- Some of the policy years may be less relevant because of changes in cover
- Older years are more sensitive to errors in the trend rate for claims or exposure
- Newer years are less developed and hence more uncertain
- This is especially true in liability business
- However this may not be the case here due to the fixed awards
- Using more years reduces the effect of random fluctuations in any one year (gives more stability)
- 2008-9 may be less reliable because they have been adjusted

*Most candidates made some valid points, but few scored full marks. Some students did not attempt this part of the question, whilst others misread it and discussed the issues of using policy year as opposed to fiscal year.*

(v) Possibilities are:

- Average age of crew
- Experience of crew
- Size of crew
- Wages of crew
- Days spent at sea
- Type of vessel

- Condition/age of vessel
- Type of fishing
- Location
- Safety precautions on board
- Safety training of staff
- Overall fleet size (may affect risk management capabilities)
- Claims experience
- Additional coverages e.g. GL
- Tools handled
- Size of vessel
- Type of propulsion/fuel
- Period of cover

*Some candidates forgot that this question related only to employers' liability and listed factors that would be used for property damage classes.*

**9** (i)

- Fire
- Explosion
- Hail / tornado
- Windstorm / hurricane
- Flood
- Extremes of temperature
- Subsidence/heave
- Lightning
- Breakdown/failure of machinery
- Liability for damage to property of a third party eg damage to a road or the power grid
- Liability for death or bodily injury sustained by a third party
- Employers' liability for people employed at the site
- Earthquake
- Volcano
- Nuclear, chemical, biological
- Theft (eg copper wiring)
- Malicious damage / vandalism
- Impact
- Wave/tsunami damage
- Accidental damage
- Damage to parts in transit
- Loss of profits/consequential loss
- Terrorism/war
- Power surge from grid
- Environmental damage/pollution
- Exploration and construction risks

*Most candidates generated a variety of perils.*

(ii)

- Reinsurer or broker data
- Competitor rates for similar power plants
- Aggregate market statistics (if these exist)
- Industry/scientific studies e.g. by environmental groups, meterology
- Academia, e.g. engineering studies
- Publicly available data curves
- Catastrophe model vendors

*Most candidates identified a good range of data sources.*

(iii) External data may be:

- sparse,
- not developed, as the cover is new and fast-evolving
- out of date
- of poor quality
- not detailed enough (especially for pricing)
- not representative of the type of business you want to sell or of the insureds you intend to sell to
- expensive

There will be heterogeneity
…due to:

- data coming from wind turbines in different countries, each with different exposure to storms, earthquakes etc.
- differing levels of cover
  e.g. loss of profits included/excluded (or similar example)
  or different limits, deductibles, excesses
- the nature of the data stored by different insurers being different e.g. claims information may be paid or paid + outstanding
- inconsistent coding of data
- if claim figures include outstanding amounts, different insurers are likely to have different reserving philosophies
- different insurers having different procedures e.g. claims handling and settlement, underwriting, making it difficult to compare claims amounts
- different loadings for expenses and profit in different insurer's premiums

*This part was generally well-answered, with most candidates making a variety of points.*

(iv) Cover details:

- term required e.g. 1 year, 5 years
- deductible or excess required
- limits of cover required
- types of cover
- exclusions

Rating factors:

- territory in which the wind turbines are located
  - as this affects the exposure to weather-related perils like storm or lightning and to earthquakes
  - also affects legal environment for liability claims …
  - … and exchange rates and local inflation rates will affect the cost of repair
  - may affect possible compensation claims eg proximity to a highly populated area
- whether located on land or in the sea
  - this affects theft or wave damage (or other suitable example)
- size of plant/number of turbines covered
- plans for upgrading turbines or increasing the numbers in the future
- value of plant (sum insured/ EML)
- power/size of the turbines
  - more power may mean more potential issues
- ease of access for repairs
  - e.g. is it necessary to build a road big enough to take a crane before repairs can be carried out
- manufacturer of the turbines
  - may affect quality, may have guarantees that kick in before the insurance
- model of turbine
- age of the turbines
  - this will also reflect the level of technology (which is changing fast)
- safety features/procedures within the turbines
  - e.g. lightning conductors, circuit breakers
- quality of management of turbine operator
  - levels of monitoring, frequency and quality of maintenance and servicing procedures, staff training
- security of the site
  - affects theft & vandalism & liability
- Turnover/profit
  - for business interruption cover
- Size of workforce/payroll
  - relevant to employers' liability
- Last year's premium

History of losses:

- numbers of losses (whether claimed for or not)
  - may give an idea of the likelihood of future losses, together with any actions taken to prevent similar claim events happening in the future
- cause/peril/type of losses for each one
- exposure details to match claims history
- rating factor details to match past claims
  - since turbines may have been upgraded, meaning that past risks are no longer likely

- dates
- claim status
- amounts & estimates
- currency

*Most candidates made a variety of valid points, but often tended to generalise by stating "rating factors" or "claims data" without enough specific details. Very few mentioned that historical exposure and claims data should match (ie correspond).*

## END OF EXAMINERS' REPORT