INSTITUTE AND FACULTY OF ACTUARIES

Curriculum 2019

SPECIMEN SOLUTIONS

Subject SP2 – Life Insurance
Specialist Principles

General comments on Subject SP2

The Examiners' solutions covers more points than would be expected to get full marks. This is so that alternative approaches to questions by different candidates can be accommodated within the marking scheme. Candidates are expected to show knowledge of the relevant content of the Core Reading, but those who tailor their answer to the specifics mentioned in the question will score more highly than those who answer in a more generic way.

Comments on the SP2 Specimen 2019 paper

This exam is largely based on the September 2014 ST2 exam. The exception is Q1 which is based on the Q1 from the ST2 April 2016 paper.

Q1

½   The terms after alteration should be supportable by the earned asset share at the date of alteration so as to avoid the company making a loss.

½   Ideally the profit expected from the contract after alteration should be the same as that before.

½   Or alternatively the profit expected should be the same as the expected amount had the policy been written originally on its altered terms.

½   The alteration should be consistent with boundary conditions.

½   For example, as the outstanding term tends to zero, the premiums charged should look consistent with the difference between the surrender value and the maturity value.

½   Or the premium after alteration should approach zero as the sum assured approaches the paid-up sum assured.

½   If the benefits are to be increased, this should be on terms consistent with the additional premium which would be charged for a new policy with a sum assured equal to the proposed increase.

½   If the policy term is to be extended, the terms should reflect the current premium basis so far as the period of extension is concerned.

½   Any methods adopted should be stable in that small changes in benefits should result in small changes in premium (if expenses of alteration are ignored).

½   Alternatively, an alteration method should ideally reproduce the existing terms if a policy is altered to itself (ignoring the impact of the cost of the alteration).

½   The terms offered after alteration should avoid the option of lapse and re-entry.

½   Any increase in benefit may be subject to additional evidence of health, depending in part on the scale of the alteration and when it occurs in the policy's lifetime.

½   The costs associated with carrying out an alteration should be recovered.

½   The alteration should be easy to calculate, document and explain.

[Max 7]

2   (i)

½   The company would need to decide whether there would be a charge for the guarantee. If an additional charge is not imposed, profit per policy will fall.

½   The terms after alteration should be supportable by the earned asset share at the date of alteration so as to avoid the company making a loss.

½   The addition of this benefit would, in itself, make the contract more attractive to customers. This could lead to a significant increase in sales, which could lead to higher overall profits.

½   The company would need to consider the products offered by competitors.

½   If the competitors offer such a guarantee, then it may be necessary to do this in order to maintain/grow market share.

½   If they do not, then the increase in sales could be significant though the competition may follow suit.

½   However, the marketability of the new product would also depend on the level of additional charges imposed, if any.

½   One practical detail would need to be addressed: whether the guarantee also extends to the maturity benefit.

½   If not, this would lead to significant surrenders late in the contract, if the guarantee was biting.

½   Depending on the extent to which charges are introduced, the surrender value guarantee is likely to increase the non-unit reserves that have to be held and could significantly increase the capital requirements of the contract.

½   The company may not have the capital to support this new business.

½   There may be increased persistency risk. There is an increased risk from early surrender and not having recouped initial expenses, having removed the surrender penalty.

½   Withdrawal rates may be materially higher than under the previous version of the product, when the guarantee "bites" and even potentially when it does not "bite", due to the removal of the explicit surrender penalties.

½   The company does not have experience of withdrawals under the new design so may have to increase pricing (and reserving) margins.

½   If the company was charging for the guarantee, it would have to monitor its experience and re-price.

½   The proposal also significantly increases the market / investment risk to the insurance company. Policyholders may tend to "select against" the company by withdrawing when market values are depressed.

½   The introduction of the guaranteed surrender value benefit could also lead to significant lapse and re-entry risk. Particularly from those policyholders who have recently purchased a policy and who may feel they would have preferred the new version. This could result in reputational risk.

½   To prevent this, it may be decided to add the guarantee to existing customers' policies. This would be easier if there were no charge, but would add materially to the risk on those policies where the fund value was lower than the guaranteed amount.

½   If no charge is made, then the cost of the guarantee would vary significantly from policy to policy and hence there would be significant cross-subsidies.

½   The company would need to decide whether any charge levied would vary by fund.

½   The cost would be higher for those in higher risk (i.e. most volatile) unit funds. This may provide the policyholder the opportunity to select against the company by choosing high risk funds.

½   This would be exacerbated by the likely higher annual management charge on these funds.

½   The cost would also be higher for those that had selected the additional death benefit, as the mortality deductions would depress the unit value relative to the guaranteed benefit.

½   These cross-subsidies would increase new business mix risk.

½   There are also practical implications; for example, administration systems would need to be changed, as would policy literature.

½   The company needs to consider the overall development costs required and whether it expects to sell sufficient additional volumes to recoup this.

½   There would be increased operational risk due to the increased complexity, for example, in the valuation.

½   There is a risk from higher than expected new business volumes leading to admin and capital strains.

½   The proposal increases the benefits to the policyholders, so is unlikely to breach any regulatory requirements.

½   If the additional life cover element of the product is reinsured, then the proposal would need to be discussed with the reinsurer.
½   For example, because the level of selective withdrawals might change, so impacting expected mortality.

[Max 13]

(ii)

1   In theory, a charge could be derived by the use of option market prices. The guarantee can be taken at any time so may need to use an American option or could approximate as a series of put options.

½   If market prices are not available for appropriate options, could consider using a closed form Black-Scholes approach.

½   But the charge is more likely to be determined using a stochastic model.

½   The stochastic model would simulate future investment returns.

½   These simulations would differ for each of the unit funds, e.g. different volatilities. A large number of simulations would be required.

½   Suitable model points would be chosen.

½   The model would project forward the unit fund and premiums and allow for future mortality.

1   The simulated cost of the guarantee at time t is the excess of the guaranteed surrender value (i.e. sum of premiums paid up to time t) over the projected unit value at time t, if this is greater than zero, multiplied by the assumed surrender rate at time t.

½   The surrender rates would need to alter dynamically with the simulations.

½   This is because the likelihood of surrender will increase in simulations where unit values fall below the guaranteed amount.

½   The charge will have to be modelled within the stochastic model as the charge in itself will increase the cost of the guarantee.

½   The charge would most likely be an additional annual management charge.

½   Sensitivity testing of the deterministic assumptions e.g. mortality, would be performed.

½   The values would be discounted back to time zero.

1   The charge can then be determined so that the present value of the modelled charge equates to the present value of the guarantee averaged across all of the simulations plus a risk loading and possibly also a profit margin.

½   The company would want to compare the final charges against those being charged by its competitors.

[Max 9]
[Total 22]

3 (i) (a)

1 The cedant company reinsures a percentage of the sum assured or of the sum at risk i.e. the excess of the benefit over reserves on the reinsurer's own risk premium rates….

½ ….which can be annually renewable or guaranteed.

1 The part to be reinsured can be on an individual surplus (i.e. the reinsured amount is the excess of the original benefit over the cedant's retention limit on any individual life)

1 or a quota share basis (i.e. a specified percentage of each policy is reinsured).

1 The reinsurance company determines its risk premium rates by assessing the likely experience of the business it is to reinsure and then adding expense and profit margins.

(b)

½ Also known as co-insurance.

½ All aspects of the contract are shared (including profits and losses).

½ The cedant provides its premium rates to the reinsurer, these premium rates are known as "retail rates".

½ The cedant receives commission from the reinsurer.

1 An alternative approach is where the reinsurer supplies the cedant with a set of premium rates upon which the cedant can load its costs and profit test to get the intended retail rates.

1 This approach has become more common due to the fact that the level of competition in retail markets in recent times requires frequent changes to rates.

½ Original terms can be written on an individual surplus basis or on a quota share basis.

[Max 9]

(ii)

½ Reinsurance helps to reduce new business strain
½ e.g. through provision of financing commission to enable the company to grow faster and reach critical mass by writing more new business
½ or by writing larger policies and to use the limited available capital to best effect.

½   It can provide the cedant with access to the technical expertise of the reinsurer which will be useful for the company as it will be new to the market and will have no previous experience.

½   The company could use the risk premium rates to price its own mortality charges.

½   Risk premium reinsurance helps the company to build up retained premium income as quickly as possible.

½   Reinsurance helps to reduce any mortality fluctuation risk whilst the portfolio is small.

½   In particular, it helps protect the company against mortality risk arising from a guaranteed minimum death benefit particularly for early duration policies (due to lower unit fund, if regular premium).

½   Original terms reinsurance can be hard to purchase for unit-linked liabilities, so risk premium may therefore be more appropriate this is because under original terms the reinsurer would need to match the unit liability, which can be difficult.

[Max 4]

(iii)

1   The net liabilities will reduce by $300k (= 25% of the before reinsurance reserves) after reinsurance.

1   Risk premium paid to reinsurer will be $2m × 0.25 × $0.65 = $325k, and hence assets will reduce by this amount.

1   Overall impact on the balance sheet before tax will therefore be a reduction in surplus assets of $25k.

½   There may also be a reduction in capital requirements which would offset this fall in surplus assets to some extent.

[Max 3]

(iv)

1   The mathematical reserves after reinsurance will be $600k, i.e. a reduction in liabilities of $600k (=50% of the before reinsurance reserves).

1   Premium income and thus assets will reduce by $550k (= 50% of the total reinsured premium x 1.1 to allow for the reinsurer's margin).

1   Overall impact on the balance sheet before tax will therefore be an increase in surplus assets of $50k.

½   This may be further increased through any reduction in capital requirements.

[Max 3]
[Total 19]

4   (i)

1   The average sum assured at YE 2012 = 9,986 and at YE 2013 = 10,888.

1   The average premium at YE 2012 = 999 and at YE 2013 = 1,222.

1   As at YE 2012 the premium to sum assured ratio is 0.1 and as at YE 2013 this ratio is 0.11.

½   All of the above look to be material increases and warrant further investigation.

Alternatively candidates may have approached the answer in the following way.

½ Increase in the number of policies is 12%.
½ Increase in total premiums is 38%.
½ Increase in total sum assured is 23%.

1½   The increase in the premiums is materially higher than the increase in the number of policies and sum assured. This warrants further investigation.

[Max 3]

(ii)

1   A data reconciliation should be performed to assess whether the data at previous investigation + new data − exits = data at current investigation.

½   We cannot perform this data check precisely as there has been no withdrawal investigation. However we can ascertain the following about the implied policies going off:

1   Numbers off = 10,014 + 2000 − 11,255 = 759.

1   Sum assured off = 100,000,129 + 30,100,000 −122,550,011 = 7,550,118.

1   Premiums off = 10,000,121 + 4,500,000 − 13,755,005 = 745,116.

1   The average sum assured going off is 9,947, which is consistent with the YE 2012 in force and suggests accuracy of data.

1   The average premium going off is 982, which is consistent with the YE 2012 in force and suggests accuracy of data.

1   The average premium to sum assured ratio of the implied offs is 0.1, which again is consistent with YE 2012 and supports accuracy of data.

1   The implied withdrawal rate is 759/10,014 = 7.6%, which is higher than in previous years even allowing for the inherent inclusion of deaths.

Alternatively candidates may have approached the answer above in the following way:

Based on the expected withdrawal experience of around 4%, we would expect the following:

Expected numbers at the end = 10,014 × .96 + 2,000 = 11,613

Expected sum assured at end = 100,000,129 × .96 + 30,100,000 = 126,100,124

Expected premium at end = 10,000,121× .96 + 4,500,000 = 14,100,116

All the above estimates are higher than the actuals, which could mean that actual off rates are higher than historic rates even allowing for the inherent inclusion of deaths.

½   The above analysis may mean that the data is inaccurate or it could mean that there has been some lapse and re-entry with policyholders moving to the new product for the better benefits. This might also be part of the reason behind the high sales.

½   The average sum assured, average premium and premium to sum assured ratio for new business have all increased. This is consistent with the information provided in relation to the higher benefits sold and the higher cost.

½   Looking at the new business in isolation gives:

½   New business average sum assured is £15,050.
½   New business average premium is £2,250.
½   New business average premium to sum assured ratio is 0.15 or alternatively sum assured to premium ratio is 6.69.

½   These figures are higher than those in part (i) and so reasonable given the re-pricing information.

[Max 9]

(iii)

½   Checks should be made for any unusual values, for example:

½   very large benefit values
½   zero or very small benefit values
½   impossible dates of birth
½   impossible start dates

½   As well as looking at individual values, it may also be possible to group items and look at how well distributed they are.
½   For example, an unusually high clustering of birth month may represent a data input error worthy of further investigation.

½   The information required for the above would be the full policy data with the benefit and date of entry/birth fields populated.
½   It is good practice to compare an extract of the computer held data with the information in the paper administration files.
½   This can be done on a spot check basis by randomly selecting a number of policies.

½   The paper administration files would be required for this check.

½   A major discrepancy or large unexplained in the analysis of surplus compared to previous analyses may indicate a problem with the data.

½   The information required for this is an analysis of surplus, which would mean using both revenue data and experience analyses.
½   Given the time constraints mentioned, such an analysis of surplus may not have been performed.

½   Reconciliations could be performed against other sources e.g. accounting information.

½ In particular, it might be possible to obtain other information (e.g. from claims servicing areas) to determine the actual number of withdrawals in the year.

½ This would therefore allow the reconciliations described in part (ii) to be performed more accurately.

½ Additional data on the death exits may be required.

[Max 8]
[Total 20]

5 (i)

½ The main risk to the insurer for term assurance products is mortality risk.

½ In particular, the risk of a higher number of deaths than expected.

½ This could be due to aggregation or concentration of risks and a related catastrophe event e.g. a pandemic.

½ Aggregation and catastrophe risk are increased for group business.

½ Anti-selection risk is an issue for the individual version of the contract, but this is much reduced for the group version.

½ The level of anti-selection risk is linked to the level of underwriting employed by the company.

½ There will also be a mortality risk from selective withdrawals.

½ In particular, the risk that those who withdraw from (or do not renew) the contract are those with lighter overall mortality experience and so the average mortality experience of those remaining increases.

½ There is a financial risk from higher than expected withdrawals at times when the asset share is negative or if lapses occur before the initial expenses are recouped.

½ Especially in the case of decreasing term assurances, if the cost of benefit exceeds the premium being charged early in the term.

½ At later times, if lapses are expected to lead to profits to the insurer (since no payment is made) there is a risk of fewer than expected such lapses.

½ There is an expense risk i.e. that the actual costs of administering the contract are greater than the amounts loaded into the premium.

½ This may also be due to higher than expected inflation.

½ The basic reserves for term assurance contracts are relatively small and fixed interest assets are likely to be held to back them, so investment risk is not likely to be significant.

½   However, there is still a risk that investment returns are lower than expected.

½   There would also be a risk of counterparty default if corporate bonds are held.

½   There is a risk of having inadequate data on which to price the business, particularly mortality data which needs to be relevant to the target market.

½   There is a risk of selling an adverse mix of new business if cross-subsidies exist in the pricing

½   e.g. selling smaller sum assured business than expected.

½   There is a risk of selling a higher volume of new business than expected, which can cause unexpected capital strain.

½   This is because initial capital strain can arise for regular premium policies due to high initial expenses and solvency capital requirements.

½   Higher than expected new business can also result in administration strain.

½   There is also a risk of selling lower new business volumes than expected, resulting in overheads and fixed expenses not being recovered.

½   New business volume risks are closely linked to risks relating to the actions of competitors

½   e.g. a new entrant taking away market share or an existing company materially reducing its term assurance prices.

½   If options are offered (e.g. convertible term assurances), there is a risk of mis-estimating the take-up rates if the option is costly to the insurer.

½   And similarly of mis-estimating the level of mortality, allowing for anti-selection, amongst those who convert.

½   There is a risk that the board makes decisions which are not in the long-term interests of the insurer

½   e.g. cutting term assurance premium rates to an unprofitable level.

½   There may be a risk that the distributors mis-sell the business, which could impact the reputation of the insurer.

½   There may be other reputational risks such as the company not paying out on a claim.

½   There may be a risk that policyholders are encouraged by distributors to lapse and re-enter.

½   There may be a risk of non-recovery of outstanding premium balances held by distributors.

½   There is a risk of failure of the underlying systems, e.g. the claims payment process.

½ There is a risk of default of a reinsurer, if reinsurance is used.

½ There is a risk of adverse regulatory changes in relation to term assurances, e.g. introduction of maximum premium rates.

½ There is a risk of adverse taxation changes,
½ e.g. inheritance tax changes can reduce the attractiveness of some term assurance products.

½ There may be a risk of fraudulent activity,
½ e.g. false death claims.
½ There may be operational risks relating to poor pricing models.

½ Poor documentation or badly worded terms and conditions may result in the company having to pay out on more claims than anticipated.

½ There may be liquidity risk
½ e.g. when unexpectedly having to pay out on a large claim.
<div align="right">[Max 17]</div>

(ii)

There are three uses the company could have for term assurance:

1 To provide protection against the financial loss that might arise on the death of a key person within the organisation.

1 A group equivalent of the term assurance contract can be used to provide a benefit to dependants on the death of an employee whilst in employment.

1 A group version can also be used by this company, to provide a benefit on the death of a customer equal to the balance outstanding on a credit card.
½ This would be needed if no other payment protection was in place and no estate available to pay the debt.
<div align="right">[Max 3]</div>

(iii)

½ The specified benefit amount is paid out on the death of the specified individual(s) within the specified term of the contract.

½ For key person cover the sum assured will be based on the expected financial loss to the company if that person were to die. This may vary depending on the position and experience of the key person. It may include expected recruitment costs for a replacement.

½ For group term assurance the sum assured will vary by each individual employee and it is usually based on a multiple of the employee's salary.

½   For the credit card protection the sum assured will be based on the potential outstanding balance for each customer. This may be the maximum credit limit on each card or some proportion based on previous experience. There also may be some allowance for whether debt is likely to be paid by either another protection policy or the estate.

½   There may need to be options for all these products to review the sum assured regularly e.g. due to salary rises for group term assurance or increased credit limits for credit card protection.

½   The term will vary by life insured. For the key person the terms are likely to be based on the time to retirement date. For the employee group benefits the policy is likely to be set up on a one year renewable basis. For the credit card protection the term is likely to be substantially shorter possibly with extension options.

½   It is likely that a conventional without profits basis would be used for all purposes here though an index-linked version would potentially reduce the need to review sum assureds.

½   There is no benefit paid on lapse.

½   Underwriting is performed on key person insurance but little underwriting performed on the others.

½   The product may be compulsory for group death in service benefit.

½   The products are usually regular premium, though as the employee group benefits are likely to be on a one year renewable basis this is effectively a recurrent single premium.   [Max 8]

(iv)

½   The main risk to the credit card company is that the amount of benefit provided turns out to be insufficient. This is more relevant for the key person and credit card protection products, as the end beneficiary of the group term assurance is the employee's family.

½   Given the potential long-term nature of the contracts, this risk is exacerbated by the effects of inflation over time. If an index-linked version is used, the risk is that the index does not replicate the rate that the benefit needed to increase by.

½   A further risk is that if there is not the ability to review sum assureds regularly then a gap between the amount insured and amount required will grow over time.
½   A subsidiary risk is that the insurer becomes insolvent and unable to meet the guaranteed benefits in full.

½   The credit card company is exposed to the risk of being unable to maintain premiums due to lack of cashflow or due to reviewable premiums increasing materially.

½   The credit card company could also be exposed to the risk of mis-estimating the proportion of deaths where the credit card debt would be paid off using other means, if this has been allowed for in the arrangement.

½   In addition there is a mis-selling risk, i.e. the risk that the credit card company does not fully understand when each of the policies would pay out and so would not be covering the risks it intended to cover.

½   There is a risk of over-insurance on the credit card cover.

[Max 4]
[Total 32]

END