

# Fall 2003 Course 5 Written-Answer Solutions

## Question #1 Solution

(a)

- Older workers are treated fairly – allows unproductive workers (due to age) to be able to retire.
- Wages deferred – cost of retirement shifted to working years
- Need for retirement income – companies want to provide for retirement of employees
- Shift investment risk to or from employee – DC plan allows employee to participate in risk. DB plan places risk with employer
- Competition – Need good benefits to attract good employees
- Unions may demand a plan – may adopt to keep worker from unionizing
- Tax treatment is favorable for qualified pensions – company can deduct contributions. Plan assets are not taxed on buildup. Benefits only taxed when received

(b) Consider Internal and external factors

- Why is company considering plan
- Who should benefit the most – young or old employees?
- Financial position of company – how much can it afford?
- Employees understand DC plans more, older employees appreciate DB plans
- DB or DC?
- Who should pay – employer or employee?
- Economic conditions

Market research – what plans does the competition sponsor, what do employees want

Preliminary plan design

- Come to consensus on main plan features
  - DC or DB
  - Ancilliary benefits such as death, disability
  - Risk classes offered
  - Employee contributory or employer paid
- Determine feasibility
  - Regulatory barriers – filing of plan, is it discriminatory
  - Implementation barriers – registering employees
- Preliminary Pricing
  - Estimate expected participation
  - Need to determine assumptions
  - Expected profit margin for insurance company if insured
- Cost benefit analysis – decide whether to proceed

## Question #1 Solution Continued

### Final plan design

- Review initial pricing for errors and inconsistencies
- Agree on final plan design
- Finalize assumptions
- Price key cells using final assumption
- Include more cells for pricing
- Sensitivity Test assumptions

### Implementation – starts early and finishes late

- May need new software – buy or develop
- Administration procedures developed
- Enroll employees
- Calculate normal costs / supplemental costs
- Choose a funding method
- File plan

### Product Management

- Track experience
- File reports with ERISA/IRS
- Funding
- Pay benefits

### Funding Method differences to consider

- Normal costs allocated by benefit or cost
- If cost, level dollar or level percent
- Is a supplemental liability created?
- Entry age or attained age
- Spread loss or immediate recognition and amortization
- Aggregate or individual
- Open or closed groups

## Question #2 Solution

a.i)

- Flat Amount  
Small maybe 10,000 or 25,000
- Salary Bracket Plan  
Example such as Salary up to \$20K = \$20K, Salary \$20 - \$40K = 40K
- Position Plan  
Example such as: Hourly Employees = \$25K, Non-Officer managers = \$50K,
  - Officers - \$100K
- Multiple of Earnings  
Benefit is typically 1x, 2x, 3x earnings
- May reduce amount according to age  
Subject to Age discrimination laws

a.ii)

- Only Full time Employees  
Usually defined as 20 hours per week or more
- Actively at work as of the effective date  
Defined as performing all usual duties at normal place of employment
- Non-Contributory Plans is Employer pays 100% and 100% of eligible insureds participate
- Contributory Plans require Minimum participation rate (such as 75%).
- Medical evidence of insurability (underwriting)
- Specify plan maximum to avoid large amounts on single life

a.iii)

- Conversion Provision  
Can convert to Individual policy at termination of employment  
Premiums based on attained age at time of conversion
- Waiver of Premium Disability Provisions  
Group term coverage continues without further premium payments
- Total and Permanent Disability  
Pays out Monthly Installment Benefit while disabled but alive  
At death, benefit is Original Benefit less Disability Installments already paid
- Extended Death Benefit

b.i)

- Flat Dollar Plans
- Multiple of Earnings
- More Limited Disability Provisions Typically only Waiver of Premium Option
- Employee Pay-All Premiums

## Question #2 Solution continued

bii)

- More Liberal Participation Rates  
Typically 25 – 75%
- Evidence of Insurability (underwriting)
- Suicide exclusion

biii)

- Portability Option  
allow participants who terminate employment to continue group coverage  
pay premium directly to insurer

### Question #3 Solution

- (a)
- 1) stay below retention limit = the most \$ of risk willing to retain on one individual
  - 2) smooth earnings and reduce risk - reinsurer can reduce mortality, lapse, expense, and other risk and also remove fluctuations in earnings caused by these risks
  - 3) Use facultative reinsurance to take on a risk not comfortable with the underwriting – facultative = on a policy by policy basis
  - 4) Write business that agents want, but company not comfortable with the risk – can keep agents happy and avoid risk involved
  - 5) Use excess capital of reinsurer to grow and expand more quickly – especially useful for smaller companies
  - 6) Leverage business retained if reinsurer has lower cost of capital than insurance company
  - 7) Reinsurance rates may be lower than seeding company can price for – so cheaper to reinsure than to retain
  - 8) Manage taxes
  - 9) Use reinsurer to help, partner with them, to develop and / or price new product – can use their expertise also when entering a new line of business.

(b) Policy 1:

first dollar	= (x)(NAR)
quota share	= 0.4(NAR) = 0.4(750,000) = \$300,000 = S
Amount retained	= min (500,000, NAR – first dollar)
	= min ((500,000, 750,000 – 300,000)
	= \$450,000 = R
Excess Basis	= max (0, NAR – S – R)
	= max (0, 750,000 – 300,000 – 450,000)
	= 0 = T

Policy 2: Excess = NAR – Y – Z = 100,000  
 since there is excess reinsurance (100,000 > 0) then the company hit the retention limit  $\Rightarrow Y = 500,000$  amount reins (1<sup>st</sup> \$) = 0.4 (NAR)  
 $0.4 (x) = Z$

$$100,000 = x - 500,000 - 0.4 (x)$$

$$\Rightarrow 0.6x = 600,000$$

$$\Rightarrow x = 1,000,000 = \text{NAR}$$

$$Z = 0.4(1,000,000) = 400,000 = \text{amount reinsured on 1}^{\text{st}} \text{ \$ basis}$$

	<u>Policy 1</u>	<u>Policy 2</u>
<b>NAR</b>	750,000	1,000,000
<b>Retained</b>	450,000	500,000
<b>1<sup>st</sup> \$</b>	300,000	400,000
<b>excess</b>	0	100,000

## Question #4 Solution

### A. Regulation of Market conduct:

1. Regulation of Policy form content and filing: almost all states need approval before a product can be sold.
2. Regulation of Rates: concerned about excessive, inadequate or unfairly discriminatory rates.
3. Regulation of Policy owner dividends: Management has discretion in determining policyowner dividends but must balance
  - a. keeping surplus for financial soundness
  - b. adequate return for investors
  - c. Distributing to policyowner
  - d. financing company growth
4. For corporation of agents, brokers, analysts – need to be state certified.

### B. Regulation of Market conduct:

1. Unfair Trade Practices: are those that flagrantly
  - a. disregard the law
  - b. committed frequently.
2. Disclosure: NAIC regulation requires disclosure of pricing information to potential policyholder including cost and surrender index.

The aim of the disclosure is to

- a. help policyholders understand the basic features of the policy.
- b. know what policy is best for their needs
- c. help compare cost and prices for the same type of policies.

Potential policyholders must also get a free buying guide, policy summary and “10 day” free look provision

3. Advertising rules: NAIC regulates
  - a. form and content of advertisement
  - b. establishing minimum disclosure requirements
  - c. establish enforcement procedures

Advertising can be neither misleading nor deceptive.

4. Policy Illustrations: Illustration of future benefits based on assumption, these are neither prediction nor a guarantee.

#### Question #4 Solution continued

5. Replacement: sometimes policyholders switch insurers or change policies between insurers because their agents, who receive high commissions, recommended these changes. These changes could be in the
  - a. best interest of policyholder or
  - b. personal gain.

NAIC regulation requires policyholders understand their policies best so that it can control the amount of misrepresentation by agents.

6. Unfair claim practices: Insured and beneficiary must receive fair payments promptly.

## Question #5 Solution

(a) Non-participating whole life joint last-to-die paid-up at first death

- cash values
- no dividends
- joint last-to-die means that death benefit paid on the second death only
- paid-up at first death means that no more premiums need to be paid after the first death
- can use death benefit to pay estate taxes after the second death

5 year term rider life insurance convertible and renewable

- premiums increase every 5 years at each renewal
- can be converted to a whole life policy before age 65
- save policy fee when issued as a rider instead of a separate policy

Critical illness rider

- provides a lump sum benefit if insured contracts a covered critical illness
- typically covers heart attack, cancer and stroke

Disability income rider

- provides a fixed monthly benefit once the insured qualifies as disabled
- definition of disability: inability to perform usual occupation (own occ)

(b) Non-par Policy

- buy a participating policy instead of a non-par (less expensive over long term when combine premiums and dividends)
- purchase without paid-up on first death feature (i.e. continue to pay premiums after first death)

Term Rider

- buy a longer term rider (like term to 65) instead of the Term 5 (higher premium initially but cost is fixed)
- purchase without the convertible feature
- buy a joint term first-to-die product instead of 2 separate term riders

Critical Illness

- cover less illnesses (maybe only the major ones rather than 50 illnesses)
- buy an integrated CI rider (reduce death benefit if CI benefit paid) instead of an independent CI rider

Disability Income

- reduce the benefit period to age 65 (say) instead of lifetime
- increase the waiting period



## Question #6 Solution

(a) Under PUC:  $AL^{PUC} = B_x V^{r-n} {}_{r-n}P_x \ddot{a}_r^{(12)}$

EE A:  $n = 40, r = 65. \quad Svc = 10$

$$B_{40} = \underbrace{0.015}_{1.5\%} \times \underbrace{30,000 \times (1.04)^{24}}_{\text{expected final salary}} \times \underbrace{10}_{\text{Svc to age } n} = 11,534.8687 \text{ p.a.}$$

$$\begin{aligned} AL_A^{PUC} &= 11,534.87 (1.06)^{-25} {}_{25}P_{40} \ddot{a}_{65}^{(12)} \\ &= 11,534.87 (1.06)^{-25} (1)(12) \\ &\quad \text{no pre retirement decrement} \\ &= 32,251.30 \end{aligned}$$

EE B:  $n = 60 \quad r = 65 \quad Svc = 30$

$$B_{60} = 50,000 (1.04)^4 [0.015 \times 10 + 0.02 \times 20] = 32,171.1104$$

$$\begin{aligned} AL_B^{PUC} &= 32,171.1104 (1.06)^{-5} {}_5P_{60} \ddot{a}_{65}^{(12)} \\ &= 32,171.11 (1.06)^{-5} (1)(12) \\ &= 288,481.50 \end{aligned}$$

$$\text{Total } AL^{PUC} = 288,481.50 + 32,251.30 = 320,732.80$$

$$UAL = AL - F = 320,732.80 - 300,000 = 20,732.80$$

unfunded Actuarial liability at 1/1/03

(b) let  $1/1/03 = \text{time } 0$   
 $1/1/04 = \text{time } 1$

$${}^{EXP}UAL_1 = (UAL_0 + NC_0)(1+i) - {}^iC$$

Need to calculate  $NC_0$

$$NC^{PUC} = b_x V^{r-n} {}_{r-n}P_x \ddot{a}_r^{(12)}$$

where  $b_x = \text{benefit accrued at age } x \text{ } 10x \text{ } 1$

$$EE A: b_x = 0.02 \times 30,000 \times (1.04)^{24} = 1537.9825$$

### Question #6 Solution continued

$$NC_A^{PUC} = 1537.98(1.06)^{-25} (1)(12) = 4,300.17$$

$$EEB : b_x = 0.02 \times 50,000(1.04)^4 = 1,169.8586$$

$$\begin{aligned} NC_B^{PUC} &= 1,169.86(1.06)^{-5} {}_5P_{60} \ddot{a}_{65}^{(12)} \\ &= 1,169.86(1.06)^{-5} (1)(12) \\ &= 10,490.24 \end{aligned}$$

$$\begin{aligned} \text{Total } NC_0 &= 10,490.24 + 4300.17 \\ &= 14,790.41 \end{aligned}$$

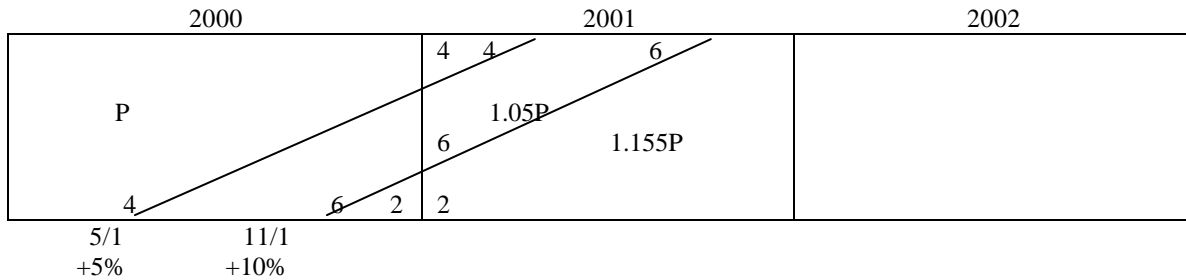
$$\begin{aligned} {}^{EXP}UAL_1 &= (20,732.80 + 14,790.41)(1.06) - 5000 \\ &= 32,654.60 \end{aligned}$$

$${}^{ACT}UAL_1 = AL_1 - F_1 = 350,000 - 320,000 = 30,000$$

$$\begin{aligned} \Rightarrow \text{gain} &= {}^{EXP}UAL_1 - {}^{ACT}UAL_1 \\ &= 2,654.60 \end{aligned}$$

## Question #7 Solution

Parallelogram method



$$1.05 * 1.10 = 1.155$$

Average rate in 2000

$$\text{Area for } 1.155P: \frac{1}{2} \times \left( \frac{2}{12} \times \frac{2}{12} \right) = 0.0139$$

$$\text{Area for } 1.05P: \frac{1}{2} \times \left( \frac{8}{12} * \frac{8}{12} \right) - 0.0139 = 0.2083$$

$$\text{Area for } P: 1 - 0.0139 = 0.7778$$

$$2000EP = 0.7778 * P + 0.2083 * (1.05P) + 0.0139 * (1.155P) = 1.012569P$$

Average rate in 2001

$$\text{Area for } P: \frac{1}{2} \times \left( \frac{4}{12} \times \frac{4}{12} \right) = 0.0556$$

$$\text{Area for } 1.05P: \frac{1}{2} \times \left( \frac{10}{12} \times \frac{10}{12} \right) - 0.0556 = 0.2916$$

$$\text{Area for } 1.155P: 1 - 0.0556 - 0.2916 = 0.6528$$

$$2001EP = 0.6258 * 1.155P + 0.2916 * 1.05P + 0.0556 * P = 1.115764P$$

Average rate in 2002

$$2002EP = 1.155P$$

2000 Earned Premium at Current Rates

$$\frac{1.155}{1.012569} * 120000$$

$$= 136879.5$$

2001 Earned Premium at Current Rates

$$\frac{1.155}{1.115764} * 130000$$

$$= 134571.5$$

### Question #7 Solution continued

2002 Earned Premium at Current Rates

= 140000

Total earned Premium at current rates

= 136,879.5 + 134,571.5 + 140,000 = 411,451

loss ratio =  $(100,000 + 110,000 + 120,000) / 411,451$

= 0.802

Permissible Loss Ratio =  $1 - \text{Expense Ratio} = 1 - 0.3 = 0.7$

Expected Rate increase =  $\frac{0.802}{0.7} - 1 = 14.577\%$

New rate =  $1.14577 \times 45 = 51.56$

## Question #8 Solution

(a) Vision and Hearing Benefits

- Some benefits are included with traditional medical programs

Benefit Design

- Usually pay for one annual examination
- Often a prescribed dollar maximum or specified list of providers
- Covers treatment for detected problems
- Vision plans cover one set of lenses every year or two
- Hearing plans will pay for new devices about every five years
- Affinity vision programs just provide discounts for exams and lenses

Selection and pricing issues

- Demographic
- Risk Selection
- Individual selection (bigger problem with small groups)
- Higher cost if new benefit

Trends

- Will become more popular as workforce ages, but also more expensive
- Fits well with flexible spending accounts

(b) Group Legal

- Started with bar-sponsored and from collective bargaining
- Not a common benefit

Benefit Design

- Could be limited benefit (just a few hours of phone consultation) or more comprehensive (e.g. wills, leases, etc.)
- Fees negotiated with attorneys in the network

Selection and pricing issues

- Usually all paid by the employer. So no individual selection risk

## Question #9 Solution

### Cost of living assumption

- affects post-retirement benefit increases to keep pace with inflation
- used in indexing maximum compensation and maximum benefit limits
- used in Social Security benefits – important if plan is integrated with social security

### Interest Rate

- should reflect expected long-term rate of return on plan assets
- important assumption since many payments are projected many years into the future
- should include an inflationary component, a basic return component and a risk premium component, usually 1-3% for pension plans

### Salary Progression

- important if benefits are salary based
- can vary increase by age and years of service though many times assume constant increase for all ages and years of service
- composed of:
  - cost of living component - keep pace with inflation
  - increase beyond COLA – usually for productivity increases or additional years of service
  - merit increase – becoming more skilled

### Decrement assumptions

- Termination – most important decrement
  - like to use companies own experience, but not suited for small plans or new plans
  - should consider amount of liabilities terminating, not number of participants terminating – old worker with many years of service more important than young worker
  - rates vary by age, sex, industry, hourly versus salaried
- Death
  - usually use published tables – but can change to reflect company experience
  - could use company experience but would need to smooth transitions and add margins
  - females have lower mortality, so may have gender specific assumptions (separate tables or setback)
  - actives may have better mortality
  - some tables: 1951 GAM, 1971 GAM, 1983 GAM, UP84, GAR94, UP94
- Disability
  - typically use tables from OASDI or Railroad disability
  - rates vary by definition of disability, waiting period, interpretation of definition economic conditions, amount of benefit

## Question #9 Solution continued

### Retirement

- can usually retire at various ages, but with different benefits
- rates vary by age; typically spike occurs at
  - earliest retirement age
  - age 62
  - age 65

### Population Increment Assumptions (for closed valuations)

- change in size of population
- distribution of new entrants by age, sex and salary (usually younger workers with low salary)

## Question #10 Solution

(a) Components of Interest Rate Risk are:

(i) Disintermediation Risk

- Risk that if interest rate increases, the individual could withdraw funds and park them with another company, or directly invest them himself.
- Can be reduced by having surrender charges, as that creates impediments to withdrawals and surrenders
- Can be handled by having MVA clause. If interest rates rise, MVA of investor fund could fall, making investor reluctant to withdraw funds.

(ii) Liquidity Risk:

- This relates to when the customer wants to surrender the policy. In order to give him CSV, investments have to be liquidated.
- In case general investors, or few very large ones do it at same time, lot of assets would have to be liquidated
- In case the assets where the company has invested are not liquid, sudden sales would drive down price, forcing company to sell at a great loss.
- Can be handled by
  - (a) No CSV's
  - (b) Surrender Charges.
  - (c) MVAs

(iii) Interest Spread Risk:

- Risk that the interest spread required by the company to cover expenses, insurance charges (COI), profits, etc. may not be available
- Reasons for not getting interest spreads are:
  - (a) Not enough investment opportunities
  - (b) Poor communications between investment people and product people
  - (c) Promising too high a guaranteed rate in order to get sales
  - (d) Unexpected increases in expenses, etc. reducing net effective spreads

(iv) Interest Guarantee Risk:

- Risk that company may not be able to fulfill minimum interest rate guarantees
- Could take place because too high and unrealistic interest rate guarantees given to facilitate sales.
- Sudden drop in interest rates in the economy



## Question #10 Solution continued

### (b) Treatment of Interest Risk

#### (i) U.S. – (Risk-Based Capital)

- Interest rate risk is denoted by C3.
- Factors are applied to reserves net of policy loans.
- Policy loans are netted off, as they are directly to policy holder
- Factors depend on
  - Type of product. Term has lower factors
  - In case of CSV and no surrender charge, factors are higher
  - Factors depend on guaranteed minimum promised.
- Please note the co-variance factor with Asset Default Risk (C1) i.e.

$$RBC = \sqrt{(C_1 + C_3)^2 + C_2^2} + C_4$$

#### (ii) Canada (Minimum continuing capital and surplus requirement)

##### (A) Interest Risk.

- Interest risk depends on policy liabilities
- Factors depend on type of product
- If product has CSV and no surrender charge, factors are higher.
- Factors depend on guaranteed minimum
- If MVA clause, factors are lower

##### (B) Interest Spread Risk: (Canada)

- depends on net liabilities.

## Question #11 Solution

- (a) Type of claim reserved liability:
- due and unpaid (reported and known in amount)
  - in case of settlement (reported but unknown in amount, may still under investigation)
  - incurred and reported (combine first 2 above)
  - incurred and unreported (happened but unknown to insurance)
  - unaccrued (service after valuation – liability)
  - deferred maternity and other extended benefit (benefits are deferred)
  - others (i.e. waiver premium) For LTC & LTD, there are open claim (claim that benefit are paying currently ? largest component), pending claim (reporting, but may still under investigation), IBNR (unknown to insurance)
- (b)
1. differences in incurred dates
  2. discount expected payment
  3. control and reconciliation
  4. level of conservatism (statutory is more conservative)
  5. internal company practices
  6. external influences
  7. policy provision
  8. insurance characteristics
  9. reserve cell
  10. managed care
  11. trend
  12. seasonality
  13. economic conditions
  14. claim administrative expenses

For long-term reserve, we also need to consider:

1. Morbidity
2. Interest
3. Expense
4. Policy provision: COLA
  - Partial & residual benefit
  - Benefit limitations
  - Benefit integration
  - Non-level daily benefit
  - Waiver prem
5. Diagnosis – based tabular reserve
6. LTC case reserve
7. data integrity

### Question #11 Solution continued

- (c) I would recommend to use lag / development method. Since this is a large block of group major medical business, it means it has a lot of data to develop the table.

data needed: claim payment by paid period and incurral period exposure live or premium for the same incurral period

Steps:           develop the table of claim paid by incurred period  
                  develop lag/runoff chart

Estimate Claim = Claim paid-to-date / completion factor

Estimate Reserve = estimate Claim – Claim paid-to-date

## Question #12 Solution

### 1. Definition of disability

1. start with cannot perform tasks of “own occupation” for a time period (~2 years), then switch to “any occ” definition.
2. reduced income by at least 20% due to the accident or illness
3. “own occ” are common for professionals:
  - Activities of daily living
    - newer definition
    - tougher to satisfy
    - less costly

### 2. Elimination Period

- must be disabled for a specified period to qualify for benefit payments
- duration ranges from 1 month – 2 years but usually 3-6 month when coordinating with Short Term Disability benefit
- need elimination period to
  1. prevent antiselection
  2. lower administration cost
  3. lower premiums must be charged, more affordable to general public.
- sometimes partial disability may qualify toward the required time
- allows ees try to return to work for a few days or weeks without have to qualify for another elimination period, this is to prevent penalizing effort to return to work.

### 3. Benefit Amount

- usually a % of pre-disability income
- higher % result in more claims, higher costs
- should coordinate total disability income, so not exceed income earned before disabled

### 4. Benefit Period

- payment duration varies
- could be a specified duration period, or to a certain age ~65.
- to age 65 to coordinate with Social Security

## Question #12 Solution continued

### Benefit Offset

- coordinate disability income with other source of benefits / income to ensure that total disability income is less than income earned before disabled
- other sources of income: Social Security benefit, part-time employment income
- ways to integrate with Social Security benefits
  1. deduct primary insurance benefit only
  2. deduct family insurance benefit
  3. deduct family insurance benefit only if the total income exceeds a specified % of pre-disability income
  4. encourages ees to apply for Social Security benefits
- ways to integrate with ee income
  1. reduce disability benefit by 50% ee income
  2. % of income lost due to disability multiplied by the benefit payable to calculate the benefit to be paid
  3. Not to reduce benefit in the first 12 months (unless exceeds pre-disability income), then apply either (1) or (2) above.

### 5. Exclusions and Limitations

- Exclude war, self-inflicted injury, or disability caused while committing crime
- Limits on mental health and drug addicts (to avoid antiselection), usually to 2 years
- some regulators questioning the lawfulness on these limitations.

### 6. Other features / options available

- cost of living adjustment – benefit increased with inflation
- initial additional cost helping with the transition
- expense reimbursement (i.e. day care)
- pension contribution while disabled
- survivor benefit (lump sum paid to survivor if employee dies)
- spousal benefit
- total permanent disability

## Question #13 Solution

(a) Solvency Reserves:

- The purpose of solvency reserves is to make sure the insurance company can meet its liability obligations as and when they fall due.
- The regulation governing the calculation of solvency reserves tends toward conservatism. This means assets are usually understated and liabilities are usually overstated. This helps ensure the solvency of the company.
- Acquisition costs usually have to be met in the first policy year.
- Often the net cash flow in the first policy year is lower than the reserve needed at the end of the first policy year, this is referred to as new business strain. Large successful companies that write a lot of new business will have large new business strain and this will reduce profits
- Assumptions are usually conservative or include provisions for adverse deviations.
- In most countries, solvency reserves are based on the simplified net premium method.
- In Canada and Australia, solvency reserves are based on the gross premium method with prescribed PADs.
- Solvency reserves are used to determine distributable earnings.

Earnings Reserves:

- Used to illustrate the earnings of the company to stockholders and other interested parties.
- Based on a fair and consistent basis so comparisons of companies is simplified.
- More realistic assumptions than solvency reserves.
- Acquisition costs are spread out over a number of policy years. This reduces or eliminates new business strain which can lead to profits in the first policy year.
- Used to calculate stockholder earnings.
- Realistic net premium reserve method is often used for earnings reserves. If actual experience matches the assumptions used, then earnings will emerge as a level percentage of premiums.
- US GAAP used for earnings reserves in US.

Tax Reserves:

- Used to calculate the taxable earnings of the company
- Usually based on solvency reserves. The reasons for this are:
  1. Only tax those earnings in excess of what is needed for solvency purposes.
  2. Eliminates having to do another reserve calculation
  3. Produces less tax payable.
- Sometimes taxable reserves are less than solvency reserves in order to increase taxable earnings. This means more tax revenue for the government.

### Question #13 Solution continued

- (b) The differences between taxable earnings and pre-tax solvency earnings are due to timing differences and permanent differences.

Timing differences reverse themselves over time. They result from the difference between solvency and tax standards with respect to the current value of assets and liabilities. Sources of timing differences include:

- Treatment of unrealized and realized capital gains and losses.
- Carrying value for bonds, mortgages, real estate, and other assets.
- Treatment of uncollected amounts
- Amortization schedule for goodwill, DAC, and other assets
- Reserve calculations with respect to interest rate, mortality rates, and the reserve method
- Claim liability calculations with respect to interest, expenses, IBNR, and contested claims.
- Timing for incurring policy dividend liabilities.
- Liabilities not recognized for tax purposes (reserve to stabilize investment returns, reserve to offset future capital losses, other contingency reserve, required capital)
  
- Insurance regulators tend toward conservatism, so overstating liabilities and understating assets.
- Tax authorities are more interested in tax revenue, so they tend to overstate assets and understate liabilities

Permanent differences do not reverse themselves over time. Examples of this include:

- investment income on certain assets is non-taxable or taxed at a lower rate.
- tax credits for certain expenditures (eg. research and development)
- non-deductible expenses (eg. business entertainment expenses)

## Question #14 Solution

(a) ROI

- Set  $\sum pv$  profit equal to zero
- Use distributable earnings or after Tax Solvency earnings.
- No solution if all year profits are positive or too less profit in the 1<sup>st</sup> year
- More than one solution if profit emerging pattern fluctuation (change sign). Then none of solution is correct.
- Only work if profit starts out negative and stays positive there after

ROE

- $$\frac{\text{After Tax Stockholder earnings } (t)}{\text{Equity Base } (t)}$$
- Equity base  $(t) = \text{Stock Equity } (t-1) \text{ or } \frac{\text{Stock Equity } (t-1) + \text{Stock Equity } (t)}{2}$
- Stock Equity = Stock Asset – Stock Liability
- Stock asset = solvency reserve + required capital + DAC
- Stock Liability = Benefit Reserve + Deferred TAX Liability

(b) Average equity base (1)

$$= \frac{1}{2}(0 + 6.1) = 3.05$$

$$\text{stock asset } (1) = 1 + 0.4 + 10 = 11.4$$

$$\text{stock liability } (1) = 5.3$$

$$\text{stock equity } (1) = 11.4 - 5.3 = 6.1$$

$$\text{ROE } (1) = \frac{0.1}{3.05} = 3.28\%$$

(c) weighted average ROE = 
$$\frac{\text{PV After Tax Stockholder Earnings}}{\text{PV Equity base}}$$

$$\text{PV after TAX Stockholder earnings} = \frac{0.1}{1.095} + \frac{0.3}{1.095^2} + \frac{0.45}{1.095^3} = 0.6843$$

<u>t</u>	<u>Stock Asset</u>	<u>Stock Liability</u>	<u>Stock Equity</u>	<u>Equity Base</u>
1	11.4	5.3	6.1	3.05
2	8.7	3.8	4.9	5.5
3	0	0	0	2.45



**Question #14 Solution continued**

$$\begin{aligned} \text{PV Equity base} &= \frac{3.05}{1.095} + \frac{5.5}{1.095^2} + \frac{2.45}{1.095^3} \\ &= 9.2385 \end{aligned}$$

$$\text{Weighted AVG ROE} = \frac{0.6843}{9.2385} = 7.41\%$$

## Question #15 Solution

1. Disability Factors – must consider the affect of disability options of the rates.
  - Usually waiver of premium is used.
  - Once an insured is put on disability claim, a disability reserve is put against the plan's experience
  - If the insured dies then, the reserve is released to pay for the death claim
  - If the insured recovers then the reserve is credited back to the plan's experience
  - SOA studies have shown that extended death benefit has better experience than waiver of premium
2. Effective date adjustment – the insured age is the insured birth year subtracted from the current year. This assumes that the insured's birth date is July 1.
  - If the plan effective date is July 1, no adjustment has to be made.
  - Other dates, adjustments need to be made like .97 for January 1 and 1.03 for December 1
3. Industry Factors – Factors based on industry may be set by the SIC (Standard Industry Codes). This is needed since some industries are more hazardous than others. For example, bank and insurance industry may set a discount while mining industries may be loaded.
4. Regional Factors – not used much, usually considered to be taken care of implicitly with the Industry Factors.
5. Schedule Factors – studies have shown that experience based on amount of insurance instead of lives is better. Some give discount for multiples of earnings
6. Contribution Schedule – Non-contribution plans have the best experience
  - Contribution plans with a fixed contribution for all ages have worse experience
  - Contribution plans with contribution based on age have experience closer to non-contribution
  - So discounts may be given based on the contribution schedule
7. Lifestyle Factors – some adjust for nonsmoker and smoker status,
  - Can only do if able to collect the information. Example may discount nonsmoker 5% and load a smoker 30%
8. Marketing Considerations - experience varies by the way the policy was sold
  - Sold through captive agents have the best experience
  - Welfare and Union groups have the worst experience
  - Adjustments may be made based on the way the product was sold
9. Plan Options – the varying of options available and how often they can be selected.
  - The more options available, the worse the experience
  - The experience is also worse if the option can be selected at anytime instead of at certain enrollment times.

**Course 5**  
**Fall 2003**

**Multiple-Choice Answer Key**

Question #	Answer
1.	B
2.	B
3.	E
4.	C
5.	C
6.	B
7.	D
8.	C
9.	D
10.	C
11.	D
12.	D
13.	D
14.	E
15.	D
16.	A
17.	D
18.	E

Question #	Answer
19.	D
20.	B
21.	C
22.	B
23.	C
24.	E
25.	B
26.	C
27.	B
28.	A
29.	B
30.	D
31.	C
32.	E
33.	A
34.	A
35.	D
36.	A