November 2000
Society of Actuaries

COURSE 5
MORNING SESSION

APPLICATION OF BASIC ACTUARIAL PRINCIPLES

SECTION A—WRITTEN ANSWER
1. (5 points)
   (a) With respect to Group Accidental Death and Dismemberment insurance, describe the different types of coverage and outline typical plan provisions.

   (b) With respect to Group Long Term Disability insurance, outline the definitions of disability and describe typical limitations and exclusions.

2. (9 points) ABC.Life.com will market individual life insurance exclusively through the internet. The company will offer two products:
   (i) 10-year level term life insurance; and
   (ii) flexible premium universal life insurance.

   (a) Describe pricing strategies which could be used by ABC.Life.com.

   (b) Explain the sensitivity and scenario testing that should be performed before launching these products.

   (c) Outline pricing pitfalls commonly encountered when pricing insurance products.
3. (5 points) You are given the following:

Normal retirement benefit: 1% final one-year salary for each year of service

Actuarial assumptions:
- Interest rate: 6% per year
- Salary increase: 3% (for Projected Unit Credit Cost Method only)
- Preretirement deaths and terminations: None
- Retirement age: 65
- Annuity factor ($a_{65}$): 10

Data for sole participant as of January 1, 2001:
- Age at hire: 30
- Age at January 1, 2001: 45
- Year 2001 annual salary: 50,000
- Year 2002 annual salary: 52,500

(a) Under each of the Traditional Unit Credit Cost Method and the Projected Unit Credit Cost Method, calculate the following:

(i) the actual liability as of January 1, 2001;
(ii) the expected liability as of January 1, 2002;
(iii) the actual liability as of January 1, 2002; and
(iv) the liability gain or loss at January 1, 2002.

(b) Compare and explain the difference between the liability gain or loss under the Traditional Unit Credit Cost Method and the Projected Unit Credit Cost Method.

Show all work.
4. (4 points)

(a) Explain the reasons for using deductibles and the problems associated with them.

(b) Describe different types of deductibles commonly used today.

(c) Explain the reasons for placing a limit on policy coverage.

5. (5 points) Describe the characteristics of the life insurance industry and its products that make the application of taxation a very difficult task.
6. (6 points) You are a consulting actuary for ABC, a multi-line P&C insurance company. You are given the following information regarding the current ratemaking practices in the organization.

- Due to current market conditions, rates are being held below expected claims on auto liability policies so that sales projections can be met. This shortfall will be covered by increasing homeowner property insurance rates where there is less competition.

- ABC used to give premium discounts to owners of the auto collision policies that were accident free for three years in a row but have recently stopped this practice as it was felt to be too expensive.

- A major earthquake in the previous year required ABC to pay out substantial claims. Management would like to increase rates on property insurance by 50% this year to recover those losses. Rates would be returned to their expected levels afterwards.

- Data is collected and analyzed on a policy year basis.

- The following credibility formula is used for all lines of business:
  \[ Z = \sqrt{\frac{n}{10000}} \quad 0 \leq Z \leq 1 \]
  Where n is the number of claims.

Analyze ABC’s current ratemaking practices and recommend changes where appropriate.
7. *(8 points)* Describe the following distribution channels used for individual life and health insurance:

   (i) career agents;

   (ii) worksite marketing;

   (iii) direct marketing; and

   (iv) banks.
COURSE 5
MORNING SESSION

APPLICATION OF BASIC ACTUARIAL PRINCIPLES

SECTION B—SHORT WRITTEN ANSWER*

*These questions are worth 1 point each.
8. (1 point) Given the following:

- Mr. Fixit owns a cottage valued at $125,000.
- The cottage is insured for $75,000.
- The insurance company requires 75% of full coverage for full reimbursement of the insured amount. When coverage is less than 75%, reimbursement is on a pro-rata basis of what would have been paid if the 75% requirement had been met.
- The deductible is $1,000.
- Lightning causes $12,000 worth of damage.

Calculate the benefit Mr. Fixit will receive from his policy. Show all work.
SHORT WRITTEN-ANSWER QUESTIONS

9. (1 point) List the cost control strategies that are commonly used for group dental insurance plans.

10. (1 point) Briefly describe the motivations for a life insurance company to switch from a heaped commission structure to a level commission structure.

11. (1 point) Briefly describe the impact of paying “Yearly Renewable Term” reinsurance premiums annually versus quarterly.
1-15. Each of questions 1 through 15 consists of an assertion in the left-hand column and a reason in the right-hand column. Code your answer to each question by blackening space:

(A) If both the assertion and the reason are true statements, and the reason is a correct explanation of the assertion.

(B) If both the assertion and the reason are true statements, but the reason is NOT a correct explanation of the assertion.

(C) If the assertion is a true statement, but the reason is a false statement.

(D) If the assertion is a false statement, but the reason is a true statement.

(E) If both the assertion and the reason are false statements.

<table>
<thead>
<tr>
<th>ASSERTION</th>
<th>REASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Income tax rates for large corporations are generally progressive.</td>
<td>BECAUSE The ability to pay income taxes usually increases with the size of the company.</td>
</tr>
<tr>
<td>2. A trust can exhibit substantial asset growth without incurring a current income tax.</td>
<td>BECAUSE A trust is allowed an income tax deduction for amounts distributed to beneficiaries.</td>
</tr>
</tbody>
</table>
3. **ASSERTION**: The inside build-up of cash surrender value of life insurance products has historically received favorable income tax treatment. **REASON**: Income tax is collected from the cash value portion of life insurance benefits at the time of death.

4. **ASSERTION**: In a defined benefit pension plan, there is no opportunity for post-retirement benefit increases. **REASON**: Automatic increases to pension benefits paid to retired participants tend to be expensive.

5. **ASSERTION**: In Canada and the U.S., partnerships are tax-reporting entities. **REASON**: In Canada and the U.S., partnerships are tax-paying entities.
1-15. Each of questions 1 through 15 consists of an assertion in the left-hand column and a reason in the right-hand column. Code your answer to each question by blackening space:

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(E) If both the assertion and the reason are false statements.

**ASSERTION**

**REASON**

6. Most flexible benefit plans in Canada use a modular approach rather than a pure cafeteria approach.  
   BECAUSE Employers feel they should provide a minimum safety net to their employees in most types of benefits.

7. Most companies have removed normal pregnancy as an exclusion from their long term disability contracts.  
   BECAUSE There is little additional expected cost to a long term disability contract by inclusion of disability arising from normal pregnancy.
<table>
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<th>REASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Self-insured medical plans are popular with smaller employers.</td>
<td>BECAUSE Administrative Services Only plan services and consulting services may be purchased independently.</td>
</tr>
<tr>
<td>9. Poor investment returns do not reduce benefits under a defined contribution plan.</td>
<td>BECAUSE The Pension Benefit Guarantee Corporation guarantees a minimum level of benefits under a defined contribution plan.</td>
</tr>
<tr>
<td>10. The primary insolvency risk for a life insurance company centers on amounts and types of its liabilities.</td>
<td>BECAUSE A life insurance company’s liabilities tend to be unpredictable.</td>
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(E) If both the assertion and the reason are false statements.

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**11.**

**ASSERTION**  
A risk-averse individual will not pay a gross premium for an insurance contract which exceeds the expected value of the loss.

**REASON**  
For a risk-averse individual, as extra units of wealth are added, the utility derived from such units decreases.

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**12.**

**ASSERTION**  
In a pension plan, decrements include death and retirement.

**REASON**  
The probability of death is independent of the probability of retirement.
13. **ASSERTION**
The benefit cost method is typically used by indemnity type plans to estimate medical claim costs.

**REASON**
*BECAUSE*
The benefit cost method is most useful to estimate medical claim costs where there are co-pays and limits that apply to specific services.

14. **ASSERTION**
A gross premium valuation of life insurance policy liabilities does not use provisions for adverse deviations.

**REASON**
*BECAUSE*
With respect to life insurance policy liabilities, provisions for adverse deviations cause most earnings to be recognized at issue.

15. **ASSERTION**
The traditional accrued benefit cost method is generally used for the funding requirements for final average pay plans.

**REASON**
*BECAUSE*
Under the traditional accrued benefit cost method for final average pay plans, the normal cost increases as a percentage of salary as age increases.
16-22. Each of questions 16 through 22 consists of two lists. In the list at the left are two items, lettered X and Y. In the list at the right are three items, numbered I, II, and III. ONE of the lettered items is related in some way to EXACTLY TWO of the numbered items. Indicate the related items using the following answer code:

<table>
<thead>
<tr>
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<tr>
<td>(A) X</td>
<td>I and II only</td>
</tr>
<tr>
<td>(B) X</td>
<td>II and III only</td>
</tr>
<tr>
<td>(C) Y</td>
<td>I and II only</td>
</tr>
<tr>
<td>(D) Y</td>
<td>I and III only</td>
</tr>
<tr>
<td>(E)</td>
<td>The correct answer is not given by (A), (B), (C) or (D).</td>
</tr>
</tbody>
</table>

16. X. Managed Care
    Y. Self Insurance
    I. Reduced benefit costs
    II. Increased claims administrative expense
    III. Exempt from state mandated benefits

17. X. HMO
    Y. PPO
    I. Does not take insurance risk
    II. Can provide care through its own hospitals
    III. Often offers two levels of benefits
18. X. Automatic Reinsurance Treaty  
I. First in, best offer  
Y. Facultative Reinsurance Treaty  
II. First dollar quota share  
III. Excess of retention  

19. X. Creditor under a Group Credit Life Insurance Policy  
I. Beneficiary of policy  
Y. Debtor under a Group Credit Life Insurance Policy  
II. Generally pays premium  
III. Receives dividends  

20. X. With-profits products in the U.K.  
I. Backed primarily by bonds and mortgages  
Y. Participating products in the U.S.  
II. Lower cash value guarantees  
III. Generally higher premiums
16-22. Each of questions 16 through 22 consists of two lists. In the list at the left are two items, lettered X and Y. In the list at the right are three items, numbered I, II, and III. ONE of the lettered items is related in some way to EXACTLY TWO of the numbered items. Indicate the related items using the following answer code:

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</tr>
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</tr>
<tr>
<td>(E)</td>
<td>The correct answer is not given by (A), (B), (C) or (D).</td>
</tr>
</tbody>
</table>

21. X. Group Long Term Disability  I. Higher percentage of self insurance  
     Y. Group Short Term Disability  II. High claim frequency  
                                           III. High amount of claim  

22. X. Defined contribution plan  I. Implicitly emphasizes termination benefits over retirement benefits  
     Y. Defined benefit plan  II. Plan sponsor’s contribution reflects actual experience  
                                           III. One type is a profit-sharing plan
23. This question consists of two lists. In the list at the left are two items, lettered X and Y. In the list at the right are four items, numbered I, II, III and IV. EACH of the lettered items is related in some way to EXACTLY TWO of the numbered items. Match the lettered items (X and Y) with the numbered items (I, II, III, and IV) shown below.

Indicate the related items using the following answer code:

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) I and II</td>
<td>III and IV</td>
</tr>
<tr>
<td>(B) I and III</td>
<td>II and IV</td>
</tr>
<tr>
<td>(C) I and IV</td>
<td>II and III</td>
</tr>
<tr>
<td>(D) II and III</td>
<td>I and IV</td>
</tr>
<tr>
<td>(E) II and IV</td>
<td>I and III</td>
</tr>
</tbody>
</table>

23. X. “Spread Gain” pension funding cost methods

Y. “Immediate Gain” pension funding cost methods

I. Entry Age Normal

II. Frozen Initial Liability

III. Individual Aggregate

IV. Unit Credit
24. Rank in increasing order of restrictiveness (least restrictive to most restrictive) the following definitions of disability:

I. Activities of daily living
II. Own occupation
III. Any occupation

(A) I < II < III
(B) I < III < II
(C) II < III < I
(D) III < I < II
(E) III < II < I
The following questions relate to asset defaults.

25. Investment yield assumptions are normally net of expected asset defaults.
   (A) True
   (B) False

26. There is no asset default risk associated with policy loans.
   (A) True
   (B) False

27. There is no asset default risk associated with required capital.
   (A) True
   (B) False
The following questions relate to utilization management for managed care.

28. Utilization management can take place after care is delivered.
   (A) True
   (B) False

29. The cost savings associated with utilization management programs are well documented.
   (A) True
   (B) False
The following questions relate to methods used to estimate medical plan claim costs.

30. Community rating is a process where a group’s utilization and cost experience are used to establish estimated claim costs.

   (A) True
   (B) False

31. The budgetary method is not an appropriate method for estimating claim costs.

   (A) True
   (B) False

32. In developing the cost per service, an actuary must reflect provider arrangements under the aggregate method.

   (A) True
   (B) False

** END OF EXAMINATION 5 **
MORNING SESSION
12. (5 points)

(a) Describe the reasons for extensive regulation of life and health insurance.

(b) Outline the arguments for centralized regulation of life and health insurance.

(c) Outline the arguments for decentralized regulation of life and health insurance.

13. (7 points) Describe the major underwriting considerations for the small group life and health insurance market.
14. (4 points) Describe the compensation arrangements typically used by managed care organizations with hospitals and physicians.

15. (4 points) Describe the factors involved in developing the expense component of the gross premiums for group insurance products.
16. (5 points) For a 10-year level premium life insurance policy, you are given the following:

Death benefit per unit = $1,000 in all years

Annual gross premium per unit = $6.50

Reserve interest rate = 5.0% in all years

\( q_x^d (1) = 0.0045 \) (mortality is the only decrement considered)

<table>
<thead>
<tr>
<th>Year</th>
<th>Present Value of Future Premiums</th>
<th>Present Value of Future Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47.47</td>
<td>46.80</td>
</tr>
<tr>
<td>2</td>
<td>43.23</td>
<td>44.43</td>
</tr>
</tbody>
</table>

(a) Using the full preliminary term method, calculate:

(i) the initial expense; and,

(ii) the reserve per unit in-force at the end of the second policy year.

(b) Compare solvency reserves to earnings reserves and tax reserves.

Show all work.
17. (7 points)

(a) Describe the following considerations and how they are used when developing profit goals:

(i) risk;
(ii) rate of return; and
(iii) accounting basis.

(b) Explain and differentiate each of the following profit measures:

(i) embedded value;
(ii) return on investment; and
(iii) weighted average return on equity.
18. (8 points) For a newly established plan, you are given the following data:

- Normal retirement benefit: $10 per month per year of service
- Normal retirement age: 65
- Interest rate: 6%
- Pre-retirement terminations other than by death: None
- Pre-retirement death benefit: None
- Selected annuity values: \( \ddot{a}_{65}^{(12)} = 10 \)
- Amortization of frozen initial liability: Level dollar amount over 20 years
- Plan effective date: January 1, 2001
- Plan assets as of January 1, 2001: 0

Selected commutation factors:

<table>
<thead>
<tr>
<th>Age</th>
<th>( D_x )</th>
<th>( N_x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>1,468</td>
<td>23,018</td>
</tr>
<tr>
<td>33</td>
<td>1,382</td>
<td>21,550</td>
</tr>
<tr>
<td>62</td>
<td>215</td>
<td>2,287</td>
</tr>
<tr>
<td>65</td>
<td>171</td>
<td>1,689</td>
</tr>
</tbody>
</table>

Data for sole participant:

<table>
<thead>
<tr>
<th>Name</th>
<th>Date of Hire</th>
<th>Date of Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones</td>
<td>1/1/1970</td>
<td>1/1/1938</td>
</tr>
</tbody>
</table>

For Jones, calculate the normal cost under the following methods as of January 1, 2001:

(i) Frozen Initial Liability (Attained Age Normal);
(ii) Frozen Initial Liability (Entry Age Normal); and
(iii) Aggregate.

Show all work.

** END OF EXAMINATION **
SOCIETY OF ACTUARIES

NOVEMBER 2000

COURSE 5 EXAMINATION

SOLUTIONS

MORNING SESSION

APPLICATION OF BASIC ACTUARIAL PRINCIPLES

SECTION A—WRITTEN ANSWER
Answer to 1

a. Usually offered as companion coverage.
   Optional amounts may be offered on an employee paid basis
   Coverage may be non-occupational or 24 hour
   Group AD&D coverage is typically a lump sum benefit, and a member who is eligible for
   Basic Group Term Life Insurance is eligible for AD&D also. Generally, no conversion is
   available at termination. Exclusions could be war, self-inflicted, illness or disease,
   infection (other than pyogenic at the time of injury), or during air travel as a pilot, student
   pilot, or air crew member. No income is imputed under Section 79 for this benefit (unlike
   basic group term life) as taxable income.

   The benefit amount is typically equal to the Basic Group Term Life Insurance amount in
   the case of accidental death. Dismemberment benefit is typically 50% of the death benefit
   for loss of a single limb, and 100% of the death benefit of loss of multiple limbs.

   Other benefit enhancements: seat belt use, child education.
   Named beneficiary gets death benefit
   The employee gets the dismemberment benefit
   The loss must be within a specified period after the accident
   Exclusion for suicide

b. Group Long Term Disability is typically triggered by the “own occ” definition – the
   member must be unable to perform the material & substantial duties of his own
   occupation. Typically, after 2 years the “any occ” definition must be met for continued
   payments, requiring the member to be unable to perform the material & substantial duties
   of any occupation for which they are suited by education or ability. Insured must suffer a
   20% reduction in income. “Any occ” encourage disabled people to return to employment.
   A recent development is a definition of disability requiring that the member be unable to
   perform certain activities of daily living. This broader definition allows coverage of some
   risks that were previously ineligible (as a point of contrast, Social Security disability
   income benefits are subject to a requirement that the individual can’t perform substantial
   gainful activity - $500 a month in a recent year). Typical exclusions are for war-related
   disability, self-inflicted disability, disability occurring in commission of a felony, a pre-
   existing condition excludes disability.

   A waiting period, of typically either 3 months or 6 months, is applied before long-term
   disability benefits are payable. The waiting period equals the benefit period for short-
   term disability. Many insurers offer partial or residual benefits. May require total
   disability for awhile to qualify for partial/residual. Common to limit benefit for mental
   conditions to two years. The legality of this limit has been challenged.
Answer to 2

a. Buyer oriented strategies
   penetration pricing
   set prices low enough to generate much higher level of sales
   profit margin may be reduced, but overall profit may increase
   can build economies of scale
   best with commodity type products like term
   commissions can be used as part of this strategy
   neutral pricing
   price at level most buyers would consider reasonable
   price/commission not far from industry coverage
   very common in life insurance
   segmented pricing
   different price for different buyers with different behaviors
   examples: vary insurance price by age, gender, risk class, amount of
   insurance, market
   skim pricing
   set price high to maximize profit margin
   use where high demand and low supply
   rare in life insurance

Competitor oriented strategies
   independent pricing
   common where company has no real competitors
   price set independent of prices of others
   common in specialized niche markets, rare in large markets
   cooperative pricing
   common where a few companies dominate market
   pattern of stable prices, commissions, profits
   most likely when high or costly barrier to entry
   if profit margins too high, competitors may be attracted

   adaptive pricing
   most common form of pricing behavior
   review prices of others, then set own price
   tendency to set price just higher than price leaders then try to compete on
   image, quality, service
   often only strategy for companies that aren’t strong competitors

   opportunistic pricing
   use price as a competitive weapon
   used by most efficient companies
   drive prices down to level where only highly efficient can survive to force
   out others
   used by large term writers
   more companies using – rapidly changing prices and thinner margins
predatory pricing
   charging price below cost
   drive competitors out even at a loss
   raise prices when competition gone
   regulation generally prevents such pricing
   once raise prices, few barriers to competitors returning

b.
(i) 10-year level term
    lapse rates
       important to sensitivity test lapse rate at end of level period (11th year)
    premium rates
       in general, to test profit sensitivity to change in premium
       in year 11, to determine profitability once select lives leave
    mortality rates
       mortality deterioration highly likely at end of level premium period as
       healthy lives get re-underwritten for new insurance
    mix of business
       average size mix
       risk class mix
       age mix
    level of sales

(ii) universal life
    lapse rates
       test various lapse levels once surrender charges expire
       ultra low lapses during surrender charge to test lapse support
    premium payment
       test effect of higher premium termination rates
       test effect of higher/lower premiums versus target premium
    interest rates
       perform scenario testing to explore way changing interest rates affect lapse
       rates, mortality, profits
    mortality
       sensitivity of profits to different mortality levels
    non-guaranteed policy charges
       test sensitivity of profits at different levels on on-guaranteed charges (e.g.
       current charges versus guaranteed maximum charges)
    mix of business
       average size mix
       risk class mix
       age mix
    level of sales
    expenses – since UL may have much higher implementation costs than term,
    sensitivity test
b. inappropriate pricing assumptions
   using educated guesses for key assumptions
   not accounting for effect of new market, new distribution system or changes in economy
   not accounting for rational buyer and seller behavior
   offering product with commission and cash value greater than premium in first year
   offering product where profits depend on policyowners lapsing
   pricing a product where most cells subsidize a few high profile cells
   not clearly understanding cost of options granted to policyowner
   not understanding your environment
   not accurately reflecting accounting, reserves, capital required, taxation
   pricing using terminal reserves and ignoring mean reserve conservatism
   not accurately reflecting timing of cashflows (e.g. taxes paid mid year not end of year)
   assuming tax advantages to policyowner never taken away (lapsation)
   counting investment income on prior year profits in current year profits (should be excluded)
   discounting using an inappropriate rate
   discounting future losses with a high discount rate
Answer to 3

(a) TUC

\[ B_x = 0.01 \left( S_{65} \right) (x-e) \]

(i) actual liability as of 1/1/2001 = \[ B_{45}^{20} v^{20} p_{45}^{12} a_{65} \]

\[ = \frac{0.01(50,000)(15)}{1.06^{20}} \] (1) (10)

\[ = 23,385.35 \]

(ii) expected liability as of 1/1/2002 = \[ B_{46}^{19} v^{19} p_{45}^{12} a_{65} \]

\[ = \frac{0.01(50,000)(16)}{1.06^{19}} \] (1)(10)

\[ = 26,441.04 \]

(iii) actual liability as of 1/1/2002

\[ = B_{46}^{19} v^{19} p_{45}^{12} a_{65} \]

\[ = \frac{0.01(52,500)(16)}{1.06^{19}} \] (1)(10)

\[ = 27,763.09 \]

(iv) liability loss as of 1/1/2001 = actual liability @ 1/1/2002 – expected liability @ 1/1/2002

\[ = 27,763.09 - 26,441.04 = 1322.05 \]

(a) PUC

(i) actual liability @ 1/1/2001 = \[ B_{45}^{20} v^{20} p_{45}^{12} a_{65} \]
\[ \frac{0.01(50,000)(1.03^{20})(15)}{1.06^{20}} (1)(10) \]

= 41,006.36

(ii) expected liability @ 1/1/2002 = \( B_{46}^{\text{expected}} v_{19}^{19} p_{46}^{12} \).

\[ \frac{0.01(50,000)(1.03^{20})(16)}{1.06^{19}} (1)(10) \]

= 46,364.53

(iii) actual liability @ 1/1/2002 = \( B_{46}^{\text{actual}} v_{19}^{19} p_{46}^{12} \).

\[ \frac{0.01(52,500)(1.03)^{19}(16)}{1.06^{19}} (1)(10) \]

= 47,264.81

(iv) liability loss at 1/1/2002 = actual liability @ 1/1/2002 – expected liability @ 1/1/2002

= 47,264.81 - 46,364.53 = 900.28

(b) Both methods produce a liability loss but the loss under PUC is smaller than TUC. This is because:

- TUC does not project for any salary increases at all. Therefore when actual salary at age 46 ($52,500) turns out to be higher than what is expected at $50,000, this produces a loss (since benefit is a function of salary).
- PUC loss is smaller because a salary projection has already been included (3%). However, this 3% increase turns out to be smaller than actual salary ($50,000 \times 1.03 = 51,500$ versus $52,500$ (actual))
∴ A loss arises because of the insufficiency of salary increase originally assumed. If the salary increase had been at least \( 5\% \times \frac{52,500}{50,000} - 1 \), PUC method will not produce a loss.
Answer to 4

(a) Reasons for deductibles include the following:
- small losses do not create a claim, thus saving the associated expenses
- for larger losses, the average claim payment is reduced by the amount of the deductible which results in premium savings
- the policyholder is at risk, which provides an economic incentive for him to prevent a claim
- the policyholder can optimize the use of limited premium dollars by using the deductible to save money where the value of the coverage is not as great

Problems associated with deductibles include the following:
- the insured may be disappointed that losses are not paid in full
- deductibles can lead to misunderstandings and bad public relations
- deductibles may make the marketing of coverage more difficult
- the insured may inflate the claim to recover the deductible
- may delay treatment, leading to higher claim cost

(b) Describe different types of deductibles commonly used today:
- fixed dollar deductibles – apply to each claim
- fixed percentage deductibles – percentage of either the loss or policy limit
- disappearing deductible – insurer pays nothing is less than $A; if loss exceeds $B, insurer pays full loss; if loss is between $A and $B, then linear proration occurs
- franchise deductible – is loss is less than $N, insurer pays nothing; if loss is equal to or exceeds $N, insurer pays full loss
- fixed dollar deductible per calendar year – used by health insurance or medical insurance policies; could vary between single and family coverage
- disability income and sickness insurance benefits often have elimination period, which is the period from the time of the disablement to the date that disability benefits begin

(c) Explain the reasons for placing a limit on policy coverage:
- it clarifies the insurer’s obligation
- it provides an upper bound to the loss distribution for the insurer and lessens the risk assumed by the insurer
- it decreases the probability of insurer insolvency
- it decreases the premium that must be charged for the basic coverage
- it enforces the principle of indemnity, i.e. the insured should not profit from a loss
- it allows the policyholder to choose appropriate coverage at an appropriate price
Answer to 5

the participating policyholders are both the customers and owners of a life insurance company

the purchase of permanent life insurance is both a personal expenditure and a source of investment income. There is no completely satisfactory method to separate the taxable investment income and non-deductible expenditure in a manner that is simple, fair and understandable to policyholder and reasonable relative to other forms of investment

the long duration of permanent life insurance makes it difficult to determine annual income

permanent life insurance and annuity have been favorable treated by tax laws, and often to the detriment of the term and non-life forms of investment

the life insurance industry has not followed the general rules of income tax law and it always argues for exceptional treatment and has been successful

the statutory accounting is too conservative to use for income determination

political pressure has prevented taxing annually the investment income of permanent life insurance and the investment gains at death

government has made changes to the tax law to meet their revenue needs and not based on principles

stock life companies have argued and with considerable success, that the non-participating policyholders receive excess interest credits, experience refund, are significantly different from the participating policyholders receiving dividend, even though from economic and practical viewpoint, they are the same

millions depend on solvency life insurance companies

it maintains a balance between mutual and stock life insurance companies

beneficiaries of the advantages will not willingly part with those advantages in return for a more principled taxation of the result is higher taxes
Answer to 6

1. Rates should cover expected losses and expenses
2. Rates should make adequate provisions for contingencies
3. Rates should encourage loss control
4. Rates should satisfy regulators
5. Rates should be relatively stable

ABC’s practice of setting low auto rates and high homeowner’s rates violates Objective #1. The auto rates should be set independently and should cover expected losses and expenses associated with this line of business. There should be no subsidies between lines of business. If management decides to sell products below cost, they can, but the loss should come from the owner’s equity or surplus, not another line of business.

ABC’s former policy of lowering rates for good drivers was consistent with Objective #3 as it promoted loss control. This policy should be continued, if it is too expensive, maybe increase the number of years before the discount applies or reduce amount of discount.

Raising rates on property insurance by 50% violates Objective #2. Rates should have been set taking into account contingencies. An increase of 50% may not be acceptable to the regulators and will not be understood by the general public. Also, raising rates may cause a lot of policyholders to lapse. May want to consider reinsurance to stabilize rates. Unexpected event pricing should be included into the insurer’s ratemaking practice each year.

Collecting data on a policy year basis means that any claim rising from a policy that was effective in calendar year Z will be accounted for as policy year Z. The exposure period is 24 months. The disadvantage of collecting data on a policy year basis is that it is not possible to obtain complete policy year information until after December 31, Z+1.

I recommend switching to accident year data as the data is quickly available and it is also a more common method.

The credibility formula is valid – it meets all requirements:

\[ 0 \leq Z \leq 1 \]
\[ \frac{dZ}{dE} > 0 \]
\[ \frac{d}{dE} \left[ \frac{dZ}{dE} \right] < 0 \]

However, using one formula for all lines of business is inappropriate.

The choice of the formula will depend on the nature of the claims and severities, should look at each line of business severity and frequency of claims to determine appropriate formula. If severity has a small range then less claims are needed for full credibility.
Answer to 7

(i) Career Agents
- These are agents who sell for only one company
- One of the oldest forms of distribution
- May be trained by a general agent
- A general agent is given an allowance or reimbursement to set up an office and they receive an override commission on all sales
- A personal producing agent is a general agent on his own and therefore receives a larger commission
- Agents also work through branches
- Branch manager is an employee of the company
- This type tends to be on the decline

(ii) Worksite Marketing
- The sponsor is the employer
- May be payroll deduction
- Must be actively at work
- Employer considers benefit to employee
- Employer endorses company

(iii) Direct Marketing
- No agent
- Low response rate
- Example: direct mail, internet, telemarketing, direct response (to an ad or commercial)
- Usually little underwriting
- Simpler products
- No commissions, but extra costs in advertising and marketing

(iv) Banks
- In some countries banks cannot sell life insurance
- In others, banks can market life insurance, but not sell it
- In others, banks can own life insurance companies and vice versa
- Banks already have a distribution system and lots of customers, so it is very convenient
- Usually sell term insurance to cover loans and mortgages or investment-type products
- Usually simple products issues quickly with little or no underwriting
APPLICATION OF BASIC ACTUARIAL PRINCIPLES

SECTION B—SHORT WRITTEN ANSWER*

*These questions are worth 1 point each.
Answer to 8

\[
\text{coins } \% = \frac{\text{insured value}}{.75(\text{full value})} = \frac{75,000}{.75(125,000)} = .80
\]

\[
\text{benefit} = \text{damage} \times \text{coins } \% - \text{deductible}
\]

\[
= 12,000 (.80) - 1000
\]

\[
= $8,600
\]
SHORT WRITTEN-ANSWER QUESTIONS

Answer to 9

1. Missing tooth exclusion
2. Exclusion of cosmetic treatment
3. Time limit on major restoration like crown, bridges, dentures
4. Pre-authorization requirement if expected treatment more than certain amount
5. Limit TMJ payment
6. Alternative treatment clause
7. Pay/reimbursement based on usual and customary charges/schedule fees
8. Computer adjudication
9. Scheduled plans
Answer to 10

- encourage new agents to service orphaned business
- discourage agents from replacing existing products because they can earn big $1^{st}$ year commissions on new sales under heaped
- improve service on existing products since agents are paid more to service them; this increases product persistency
Answer to 11
- Annual payments will be easier and less expensive from an administrative standpoint (calculating the net amount at risk for each policy, etc.)
- The annual reinsurance payments will create a larger asset than the quarterly payments. The annual payment is made, but the reinsurer hasn’t completely earned those premiums until the end of the year. Therefore, the annual payment will result in a larger reserve credit initially than the quarterly payments
- Cash flow advantage to paying premiums quarterly rather than annually
- The overall net amount at risk for each policy does not change substantially from one quarter to the next and calculating these amounts annually should be sufficient
- Less investment income for annual premium since premium paid up front
- Annual does not match dynamic products like UL or VUL as well as quarterly since NARs continually change
MORNING SESSION

APPLICATION OF BASIC ACTUARIAL PRINCIPLES

SECTION C—MULTIPLE CHOICE

Course 5
November 2000
Answer Key

1. E    16. A
2. B    17. D
3. C    18. B
5. C    20. B
6. A    21. C
7. A    22. E
8. D    23. D
10. E   25. A
11. D   26. A
12. C   27. B
13. D   28. A
15. D   30. B
31. A
32. B
This afternoon session consists of 7 questions numbered 12 through 18 for a total of 40 points. The points for each question are indicated at the beginning of the question.

Answer to 12

a. Insurance is affected by the public interest. Public can be injured if companies do not adhere to standards. Policies are long-term and the public must be able to trust the company to honor obligations. Policies are complicated and technical, not understood by consumers, who are at a disadvantage. Product and sales process are regulated to protect consumer rights and ensure companies are fair.

b. Uniformity – Replace 50 state system with one federal agency. This appeals to companies operating nationally. Effective – Adequate federal budget and very qualified regulators. It is hard for small states with small budgets to be effective.

c. Flexible – state governments are more aware of local needs and can adapt better than a central bureaucracy. Current U.S. system works, ongoing system has been doing the job. NAIC brings uniformity. Decentralized system appeals to smaller companies.
Answer to 13

Must consider certain characteristic of the group as a whole (small group u/w)
1. Financial viability – how strong is the company
   - will they be able to make payments
   - will they be laying off people in the near future
2. Group size – as group size gets bigger, costs go down. Laws limit the amount of rating for group size.
3. Industry – affect the lifestyle of the workers
   - job stress, hazardous conditions affect claim levels
4. Workers’ Compensation – often exclude claims covered by workers’ compensation
   - require worker’s comp before covering
5. Participation rate – require certain percent participation to reduce antiselection (some states require 75%)
6. Level of contributions – require employers to contribute certain amount in order to increase employee participation
7. Previous experience – why are they getting insurance now if it is their first time?
   - what is their past experience?
8. Eligibility rules/classes –
   - hourly vs. salary
   - part-time vs. full-time
   - who will be covered?
   - how is eligibility to be determined?

Must consider certain characteristics of each individual (U/W at the individual level)
1. Enforcement of eligibility – when there is a claim, make sure the person is eligible to receive benefits.
2. Pre-existing conditions – Protects insurer from anti-selection but HIPAA says can’t put limits for people who have had coverage for the prior 12 months
3. Treatment of new and late entrants
   • distinguish since extra anti-selection from new/late
   • limits on pre-existing conditions
   • how many months before makes it pre-existing (12-18 months)
4. Past issue underwriting
   • make sure there is no fraud misstatement of age
   • if this is sound, return premiums and cancel coverage for that individual
5. Underwriting options
   • usually just make options available at issue
   • may require full participation in order to reduce anti-selection
6. Individual medical assessment
   • could be done for each individual to get rate for entire group, but can’t reject individuals based on health status (HIPAA requires guaranteed issue)
   • can use short or long questionnaire with medical record or APS
Answer to 14

Hospitals
Discount off billed charges – pay percentage of billed charges (ex. 70% of billed charges)

Per diem – pay flat amount per day (i.e. 700 per day while in hospital). May differ from type of service (i.e. medical, surgical)

Case rate – flat fee for service (i.e. $5000 per hospital admit). Same amount no matter how long person in hospital. May pay case rate by DRG (different rate depending on DRG)

DRG – Medicare uses this system. Pay flat fee per Diagnosis Related Group (DRG). Subject to miscoding.

ASG – Hospital Outpatient Reimbursement System similar to DRG system. Outpatient procedure assigned Ambulatory Surgical code and get flat case rate for outpatient procedure

Global Capitation – fixed fee per member per month for hospital and physician services. Not very common. May age/sex rate the global capitation.

Capitation – set fee per member per month (ex. $30 per month for each enrollee). May age/sex rate the capitation

Percentage of premium capitation – pay a percentage of the gross premium to the hospital. Not very common.

Withhold arrangement – only pay certain amount of reimbursement to hospital and give them the rest as bonus if they meet certain utilization targets. Ethical issues with this form of reimbursement.

Physicians
Set fee schedule – negotiate a set fee schedule for physicians’ services

Discount off billed charges – pay percentage of billed charges (ex. 70% of billed charges). Doesn’t control utilization of services

Capitation – pay a set fee per member per month (ex. $20 per member per month). May age/sex rate the capitation based on age/sex factor

Global capitation – pay fixed fee per member per month for hospital & physician services

Withhold arrangement – only pay a certain amount of the reimbursement to the physicians and give them the rest as a bonus if they meet certain utilization targets. Ethical issues with this form of reimbursement.

Salary in staff model HMO’s
Answer to 15

Expenses must cover the costs of:
- Product Development
- Distribution
- Underwriting
- Administration

Need to consider:
- Company Structure – organization of functions
- Expense policy – how is overhead allocated?
- Product related – what services are required for this product?
- Competition – what does the competition include in expenses?

Data can come from Internal Studies where expenses are recorded by function or from External sources such as LIMRA

Expenses can be allocated two different ways:
- Activity Based – expenses allocated by estimation of use
- Functional Expense – distribute by activity categories by line of business

Expenses can be expressed as a percent of premium, percent of claims or per policy
Answer to 16

a. Full Preliminary Term as reserve = 0, at the end of year 1, V1 = 0
V1 = PVFB1 – Net Premium Ratio x PVFP1 = 0
New Premium Ratio = PVFB1/PVFP1 = 46.80/47.77 = .9858
Initial Expense = NP Ratio x GP/unit – DB/unit x q1 / (1 + i) = .9858 x 6.50 – 1000 x .0045 / 1.05 = 2.0749

V2 = PVFB2 – Net Premium Ration x PVFP2 = 44.43 - .9858 x 43.23 = 1.810

b. Solvency Reserves
1. Ensure that insurance company meets its obligations to policyholders
2. Uses conservative assumptions
3. Ensures soundness of insurance company
4. Standards prescribed by regulators
5. Change in reserves is used in the calculation of distributed earnings
6. It impacts amount invested in the business
7. It impacts when return on capital realized
8. Limited ability to defer acquisition cost or acquisition costs expensed immediately
9. Results in new business strain

Earnings Reserve:
1. Purpose: to calculate earnings on a fair and consistent basis over time. Calculate earnings on a going concern or ongoing basis
2. Assumptions are less conservative than for solvency reserves or more realistic basis
3. Change in reserves used in calculation earnings reported to stockholders
4. Important for subsidiaries and local branches of foreign insurers
5. Defer most acquisition costs or amortize costs
6. Reduce or eliminate new business strain

Tax Reserves:
1. To calculate earnings used in tax calculations
2. Usually, Tax Reserves = Solvency Reserves
3. Advantages of Tax = Solvency
   - simple and easy to administer
   - promotes solvency
   - allows largest possible tax deduction
4. Some countries, Tax reserves < Solvency reserves, increases tax income
Answer to 17

a. Reflecting risk in profit goals
   (i) there are many ways to reflect risk in pricing, but a realistic approach is recommended using best estimate assumptions with profit goals related to the degree of risk
   (ii) using conservative or padded assumptions produces results that are too difficult to interpret
   (iii) could reflect a degree of risk by developing a formula that determines the profit margin as a function of the degree of risk
   (iv) could set profit margin to reflect the estimated degree of risk – requires judgement
   (v) examining product design and origin of assumptions could identify risks that require special treatment
   (vi) might be able to adjust product design to reduce risk
   (vii) might have to give consideration to unexpected occurrences – either through an explicit assumption or scenario testing

b. Discount rates and rates of return
   (i) when pricing a product, need to determine what rate to discount income streams and to determine profit
   (ii) value for discount values affected by several factors
   (iii) company’s cost of capital – weighted average and marginal
   (iv) company would not want to accept a rate of return less than the cost of capital
   (v) what range of returns can be expected for alternate investments in other, similarly risky ventures (opportunity cost)
   (vi) company would not want to accept a rate of return less than what other ventures can provide unless good reason (strategically important or other ventures don’t use all the funds)
   (vii) the company’s current capital position and expected over next few years
   (viii) if lots o capital, might want to invest in short-term opportunities instead of leaving funds idle
   (ix) how will discounting be used?
   (x) if discounting used to determine whether a product produces an acceptable rate of return, the discount rate should be based on the cost of capital or the opportunity cost
   (xi) discounting using after-tax interest rates uses the returns available on very safe investments (wouldn’t be used as targeted rates of return – only for comparison to different stream amounts)
   (xii) discounting using before-tax interest rates has no theoretical basis
   (xiii) basing the discount rate on the cost of capital or opportunity cost has greatest appeal but may be hard for mutual company to determine
(iii) Accounting basis
- many companies report one set of earnings to regulators based on solvency reserves and another set to stockholders based on earnings reserves
- when two sets are done, most favor using solvency reserves in pricing because they drive shareholders’ investments in and returns from the business
- if heavy emphasis is placed on stockholders earnings, would probably price with them – would then use earnings reserves, solvency reserve and required capital
- some reject stockholder earnings as a basis because of added difficulty since almost every change requires a recalculation of earnings reserves

b.
(i) Embedded value
- equals present value of profits over n policy years, discounted at hurdle rate
- profits are after-tax solvency earnings or distributable earnings
- one of the simplest profit measures
- needs to define hurdle rate
- hurdle rate should be consistent with the return available on investments of comparable risks
- for a stock company, hurdle rate should be in line with the company’s weighted average cost of capital
- can analyze embedded value generated by each product line
- negative embedded value happens when the rate of return of a product is less than the hurdle rate

(ii) Return on investment
- solve for discount rate that causes the present value of profits to equal zero
- profits are after-tax solvency earnings or distributable earnings
- calculations can blow up if all years are profitable or if the first year loss is small compared to the renewal years’ profits
- can overcome this problem by calculating ROI in aggregate
- simpler ROI versus generalized ROI

(iii) Weighted average return on equity
- equals the present value of after-tax stockholder earnings divided by the present value of the equity base, over a period of n years
- equity base is beginning of year or average stockholder equity
- stockholder equity equals solvency reserves plus required capital plus DAC less GAAP reserves and deferred tax liability
- can weight policy year results by growth rates, ROI goals or hurdle rates
Answer to 18

(i) \[ NC = \frac{PVB - Assets - UAL}{\tilde{a}_{63.2\rceil}} \]
\[ PVB = \text{present value of benefits} \]
\[ UAL = \text{unfunded accrued liability (based initially on unit credit cost numbers)} \]
\[ \tilde{a}_{63.2\rceil} = \text{average future service} \]

Projected benefit at retirement
\[ = (12) (10) (33 \text{ yrs}) = 3960 \]
Accrued benefit at 1/1/01 = 3960 \times \frac{31}{33} = 3720

Unit credit: \[ AL = (3720)(10)\left(\frac{D_{65}}{D_{63}}\right) = (3720)(10)\left(\frac{171}{215}\right) = 29,587 \]

* I’m assuming they meant to give us \( D_{63} \) instead of \( D_{62} \)
If DOB = 1/1/38 he is 63 at 1/1/01. So I’m using \( D_{63} = 215 \) since initial assets are 0, UAL = 29,587 under traditional unit credit

\[ PV_{P} = (3960)(10)\left(\frac{D_{65}}{D_{63}}\right) = 3960(10)\left(\frac{171}{215}\right) = 31,496 \]
again I’m assuming \( N_{63} = N_{62} \)

\[ NC = \frac{31,496 - 0 - 29,587}{\left(N_{63} - N_{65}\right)/D_{63}} = \frac{1909}{2287 - 1689} \times 215 = 686 \]
the UAL is amortized separately so the normal cost is 686 under this method

(ii) Frozen initial liability (entry age normal)
Need UAL based on EAN cost numbers
\[ PV_{P,EA} = \frac{4613}{\tilde{a}_{32.37\rceil}} = \frac{N_{32} - N_{65}}{D_{32}} = \frac{23,018 - 1689}{1468} = 317.50 \]

Present value benefits at entry age
\[ = (10)(12)(33)(10)\left(\frac{D_{65}}{D_{32}}\right) \]
\[ = (3960)(10)\left(\frac{171}{1468}\right) = 4613 \]
\[ PVFNC = 317.50 \left( \frac{N_{63} - N_{65}}{P_{63}} \right) = 317.50 \left( \frac{2287 - 1689}{215} \right) = 883.0 \]

\[ PVB_{AA} = 31,496 \text{ (from last section)} \]
\[ AL = 31,496 - 883 = 30,163 \]
\[ or \quad 317.50 \left( \frac{N_{32} - N_{63}}{P_{63}} \right) = 30,614 \]

UAL using EAN = 30,613

FIL – EAN

\[ NC = \frac{31,496 - 0 - 30,613}{N_{63} - N_{65}} = \frac{883}{2287 - 1689} \]

NC = 317

(iii) Aggregate

\[ NC = \frac{PVB_{AA} - \text{Assets}}{N_{63} - N_{65}} = \frac{31,496 - 0}{2287 - 1689} \]

= 11,324

(aggregate NC is so high because it doesn’t set up a supplemental cost – you have to pay for this guy’s benefit over the next 2 years)

* Throughout this problem N_{62} and D_{62} for D_{63} and N_{63} was used

** END OF EXAMINATION **