7.1. For a special fully discrete whole life insurance on (40), you are given:

(i) The death benefit is 50,000 in the first 20 years and 100,000 thereafter.

(ii) Level net premiums of 875 are payable for 20 years.

(iii) Mortality follows the Standard Ultimate Life Table.

(iv) $i = 0.05$

Calculate $_{10}V$, the net premium reserve at the end of year 10 for this insurance.

(A) 11,090

(B) 11,120

(C) 11,150

(D) 11,180

(E) 11,210

[This is a modified version of Question 4 on the Fall 2012 Multiple Choice exam.]

7.11.   For a whole life insurance of 10,000 on (*x*), you are given:

(i)   Death benefits are payable at the end of the year of death.

(ii)   A premium of 30 is payable at the start of each month.

(iii)   Commissions are 5% of each premium.

(iv)   Expenses of 100 are payable at the start of each year.

(v) $i = 0.05$

(vi) $1000A_{x+10} = 400$

(vii) $_{10}V$ is the gross premium reserve at the end of year 10 for this insurance.

Calculate $_{10}V$ using the two-term Woolhouse formula for annuities.

(A)   950

(B)   980

(C)   1010

(D)   1110

(E)   1140

[This was Question 22 on the Spring 2013 Multiple Choice exam.]

6.37. For a fully discrete whole life insurance policy of 50,000 on (35), with premiums payable for a maximum of 10 years, you are given:

(i)   Expenses of 100 are payable at the end of each year including the year of death.

(ii)   Mortality follows the Standard Ultimate Life Table.

(iii) $i = 0.05$

Calculate the annual gross premium using the equivalence principle.

(A)   790

(B)   800

(C)   810

(D)   820

(E)   830

[This is a modified version of Question 9 on the Spring 2016 Multiple Choice exam.]

6.30. For a fully discrete whole life insurance of 100 on (x), you are given:

(i) The first year expense is 10% of the gross annual premium.

(ii) Expenses in subsequent years are 5% of the gross annual premium.

(iii) The gross premium calculated using the equivalence principle is 2.338.

(iv) $i = 0.04$

(v) $\ddot{a}_x = 16.50$

(vi) $^2A_x = 0.17$

Calculate the variance of the loss at issue random variable.

(A) 900

(B) 1200

(C) 1500

(D) 1800

(E) 2100

[This was Question 8 on the Fall 2015 Multiple Choice exam.]

8.1. A party of scientists arrives at a remote island. Unknown to them, a hungry tyrannosaur lives on the island. You model the future lifetimes of the scientists as a three-state model, where:

> State 0: no scientists have been eaten.

> State 1: exactly one scientist has been eaten.

> State 2: at least two scientists have been eaten.

You are given:

(i) Until a scientist is eaten, they suspect nothing, so
$$\mu_t^{01} = 0.01 + 0.02 \times 2^t, \quad t > 0$$

(ii) Until a scientist is eaten, they suspect nothing, so the tyrannosaur may come across two together and eat both, with
$$\mu_t^{02} = 0.5 \times \mu_t^{01}, \quad t > 0$$

(iii) After the first death, scientists become much more careful, so
$$\mu_t^{12} = 0.01, \quad t > 0$$

Calculate the probability that no scientists are eaten in the first year.

(A) 0.928

(B) 0.943

(C) 0.951

(D) 0.956

(E) 0.962

[This was Question 12 on the Fall 2012 Multiple Choice exam.]

8.27. P&C Insurance Company is pricing a special fully discrete 3-year term insurance policy on (70). The policy will pay a benefit if and only if the insured dies as a result of an automobile accident.

You are given:

(i)

x	$l_x^{(\tau)}$	$d_x^{(1)}$	$d_x^{(2)}$	$d_x^{(3)}$	Benefit
70	1000	80	10	40	5,000
71	870	94	15	60	7,500
72	701	108	18	82	10,000

where $d_x^{(1)}$ represents deaths from cancer, $d_x^{(2)}$ represents deaths from automobile accidents, and $d_x^{(3)}$ represents deaths from all other causes.

(ii) $i = 0.06$

(iii)   Level premiums are determined using the equivalence principle.

Calculate the annual premium.

(A)   122

(B)   133

(C)   144

(D)   155

(E)   166

[This was Question 2 on the Spring 2013 Multiple Choice exam.]

4.20. For a 25-year pure endowment of 1 on (x), you are given:

(i) Z is the present value random variable at issue of the benefit payment.

(ii) $Var(Z) = 0.10E[Z]$

(iii) $_{25}p_x = 0.57$

Calculate the annual effective interest rate.

(A) 5.8%

(B) 6.0%

(C) 6.2%

(D) 6.4%

(E) 6.6%

[This was Question 6 on the Fall 2017 Multiple Choice exam.]

6.46. For a special 10-year deferred whole life annuity-due of 300 per year issued to (55), you are given:

    (i)   Annual premiums are payable for 10 years.

    (ii)   If death occurs during the deferral period, all premiums paid are returned without interest at the end of the year of death.

    (iii) $\ddot{a}_{55} = 12.2758$

    (iv) $\ddot{a}_{55:\overline{10}|} = 7.4575$

    (v) $(IA)^1_{55:\overline{10}|} = 0.51213$

Calculate the level net premium.

(A)   195

(B)   198

(C)   201

(D)   204

(E)   208

[This was Question 7 on the Fall 2017 Multiple Choice exam.]

S1.1. Alice purchases a disability income insurance on January1, 2018, which pays a monthly benefit during eligible periods of sickness. The policy will expire on December31, 2025. The benefit payment term is 1 year. The waiting period is 2 months and the off period is 4 months.

Alice becomes sick on July 1, 2018. She recovers and returns to work on December 1, 2018. On March 1, 2019, she becomes sick again, until she returns to work on November 1, 2019. She remains in work until the end of 2019.

How many months of sickness benefit are paid under the policy in the period January 1, 2018 to December 31, 2019?

(A)   9

(B)   10

(C)   11

(D)   12

(E)   13

4.6. For a 3-year term insurance of 1000 on (70), you are given:

(i) q^{SULT}_{70+k} is the mortality rate from the Standard Ultimate Life Table, for $k = 0, 1, 2.$

(ii) q_{70+k} is the mortality rate used to price this insurance, for $k = 0, 1, 2.$

(iii) $q_{70+k} = (0.95)^k \, q^{SULT}_{70+k}, \quad \text{for } k = 0, 1, 2.$

(iv) $i = 0.05$

Calculate the single net premium.

(A) 29.05

(B) 29.85

(C) 30.65

(D) 31.45

(E) 32.25

[This is a modified version of Question 13 on the Fall 2013 Multiple Choice exam.]

10.11. Kevin is a participant in a defined benefit pension plan at DMN Pharmaceuticals. You are given:

(i) Kevin was born December 31, 1980.

(ii) Kevin was hired on January 1, 2011 with an annual salary of 35,000.

(iii) Kevin's salary has increased each year on January 1 by 3% in 2012 through 2015.

(iv) The annual accrued benefit as of any date under the pension plan is 2% of the average annual salary over the three years prior to that date multiplied by the number of years of service as of that date. The accrued benefit is payable annually on the first of the month following the participant's birthday, beginning on the first of the month following the 65th birthday.

A valuation is performed as of January 1, 2016 using the Traditional Unit Credit cost method and the following assumptions:

- Kevin's salary will increase by 3% on the valuation date and on each January 1 in the future as long as Kevin remains employed by DMN.
- The retirement assumption is a single decrement of 100% at age 65.
- All other decrements combined equal 5% at July 1 each year before age 65.
- There are no benefits except for retirement benefits.
- $i = 0.04$
- $\ddot{a}_{65} = 11.0$

Calculate the actuarial accrued liability for the retirement decrement under this valuation.

(A) 2770

(B) 2785

(C) 2810

(D) 2835

(E) 2850