

Using GOAL to Study for Exam CM1!

QUESTION 6 OF 11 Question # Goal

Written Answer

This problem features a written answer component. Please write out your solution using your preferred method. When you are ready to review your work and score yourself, click the following button.

Reveal / Review Written Answer Scoring

Written answers must be graded if you wish to include them in your GOAL Score during Practice sessions.

Information

For a 10-year deferred 10-year term insurance issued to a life aged x , you are given:

- During the deferred period:
 - The net annual premium is P payable at the beginning of each year as long as the policyholder is healthy at that time.
- After the deferred period:
 - The death benefit is 1000 payable at the end of the year of death.
 - The sick benefit is 100 payable at the end of each year as long as the policyholder is sick at that time.

The insurer uses a multiple state model to price the policy:

- State H: Healthy
- State S: Sick
- State D: Dead

Assume that transitions occur at the end of each year. The probabilities ${}_k p_x^{HH}$ and ${}_k p_x^{HS}$ are given in the "Base" sheet.

In addition, the annual effective interest rate is 6%.

Please download this 'Workbook'

- Quickly access the Hub for additional learning.
- Flag problems for review, record notes, and email a professor for help.
- Reveal answers and review to score yourself.
- Background information to get you started.
- Excel Workbook for questions.

Excel Workbook Base

k	$k p_x^{HH}$	$k p_x^{HS}$	Terminology
0	1.00000	0.00000	DB
1	0.93143	0.04877	SB
2	0.92701	0.05121	P
3	0.92227	0.05377	L
4	0.91719	0.05646	CF
5	0.91173	0.05928	NPV
6	0.90586	0.06224	
7	0.89956	0.06536	
8	0.89279	0.06863	
9	0.88550	0.07206	
10	0.87765	0.07566	
11	0.86920	0.07944	
12	0.86009	0.08341	
13	0.85027	0.08758	
14	0.83968	0.09196	
15	0.82824	0.09656	
16	0.81589	0.10139	
17	0.80255	0.10646	
18	0.78813	0.11178	
19	0.77253	0.11737	
20	0.75566	0.12324	

- View difficulty level.
- Exam style questions with points system for easy scoring.

Question - Part A Difficulty: Advanced

[2 points]

i. Draw a transition diagram for the multiple state model.

Note: Draw a transition diagram.

Question - Part B Difficulty: Advanced

[2 points]

ii. Calculate ${}_k p_x^{HD}$ and $\Pr(\text{Death in year } k \text{ given that the policyholder is healthy at age } x)$.

Note: You should edit the yellow cells and comment in the yellow box only.

k	$k p_x^{HH}$	$k p_x^{HS}$	$k p_x^{HD}$	$\Pr(\text{Death in year } k)$
0	1.00000	0.00000		
1	0.93143	0.04877		
2	0.92701	0.05121		
3	0.92227	0.05377		
4	0.91719	0.05646		
5	0.91173	0.05928		
6	0.90586	0.06224		
7	0.89956	0.06536		
8	0.89279	0.06863		
9	0.88550	0.07206		
10	0.87765	0.07566		
11	0.86920	0.07944		
12	0.86009	0.08341		
13	0.85027	0.08758		
14	0.83968	0.09196		
15	0.82824	0.09656		
16	0.81589	0.10139		
17	0.80255	0.10646		
18	0.78813	0.11178		
19	0.77253	0.11737		
20	0.75566	0.12324		

- View difficulty level.
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Question - Part C Difficulty: Advanced

[2 points]

iii. Review the data and identify any questionable data values.

Note: Identify any questionable data values.

k	$k p_x^{HH}$	$k p_x^{HS}$	$k p_x^{HD}$	$\Pr(\text{Death in year } k)$
0	1.00000	0.00000	0.00000	0.00000
1	0.93143	0.04877	0.00000	0.00000
2	0.92701	0.05121	0.00000	0.00000
3	0.92227	0.05377	0.00000	0.00000
4	0.91719	0.05646	0.00000	0.00000
5	0.91173	0.05928	0.00000	0.00000
6	0.90586	0.06224	0.00000	0.00000
7	0.89956	0.06536	0.00000	0.00000
8	0.89279	0.06863	0.00000	0.00000
9	0.88550	0.07206	0.00000	0.00000
10	0.87765	0.07566	0.00000	0.00000
11	0.86920	0.07944	0.00000	0.00000
12	0.86009	0.08341	0.00000	0.00000
13	0.85027	0.08758	0.00000	0.00000
14	0.83968	0.09196	0.00000	0.00000
15	0.82824	0.09656	0.00000	0.00000
16	0.81589	0.10139	0.00000	0.00000
17	0.80255	0.10646	0.00000	0.00000
18	0.78813	0.11178	0.00000	0.00000
19	0.77253	0.11737	0.00000	0.00000
20	0.75566	0.12324	0.00000	0.00000

- View difficulty level.
- Exam style questions with points system for easy scoring.

Question - Part D Difficulty: Advanced

[12 points]

iv. Calculate the net annual premium P .

Note: You should edit the yellow cells only.

k	$k p_x^{HH}$	$k p_x^{HS}$	$k p_x^{HD}$	$\Pr(\text{Death in year } k)$	v^k	DB	SB	P	$\Pr(\text{Death in year } k) \cdot v^k \cdot DB$	$\Pr(\text{Death in year } k) \cdot v^k \cdot SB$	$\Pr(\text{Death in year } k) \cdot v^k \cdot P$	Expected Loss at Issue =
0	1.00000	0.00000	0.00000	0.00000	1.00000	0.00	0.00	0.00000	0.00	0.00	0.00	
1	0.93143	0.04877	0.00000	0.00000	0.94259	0.00	0.00	0.00000	0.00	0.00	0.00	
2	0.92701	0.05121	0.00000	0.00000	0.89693	0.00	0.00	0.00000	0.00	0.00	0.00	
3	0.92227	0.05377	0.00000	0.00000	0.85364	0.00	0.00	0.00000	0.00	0.00	0.00	
4	0.91719	0.05646	0.00000	0.00000	0.81240	0.00	0.00	0.00000	0.00	0.00	0.00	
5	0.91173	0.05928	0.00000	0.00000	0.77301	0.00	0.00	0.00000	0.00	0.00	0.00	
6	0.90586	0.06224	0.00000	0.00000	0.73528	0.00	0.00	0.00000	0.00	0.00	0.00	
7	0.89956	0.06536	0.00000	0.00000	0.70000	0.00	0.00	0.00000	0.00	0.00	0.00	
8	0.89279	0.06863	0.00000	0.00000	0.66700	0.00	0.00	0.00000	0.00	0.00	0.00	
9	0.88550	0.07206	0.00000	0.00000	0.63693	0.00	0.00	0.00000	0.00	0.00	0.00	
10	0.87765	0.07566	0.00000	0.00000	0.60928	0.00	0.00	0.00000	0.00	0.00	0.00	
11	0.86920	0.07944	0.00000	0.00000	0.58384	0.00	0.00	0.00000	0.00	0.00	0.00	
12	0.86009	0.08341	0.00000	0.00000	0.56031	0.00	0.00	0.00000	0.00	0.00	0.00	
13	0.85027	0.08758	0.00000	0.00000	0.53850	0.00	0.00	0.00000	0.00	0.00	0.00	
14	0.83968	0.09196	0.00000	0.00000	0.51824	0.00	0.00	0.00000	0.00	0.00	0.00	
15	0.82824	0.09656	0.00000	0.00000	0.50000	0.00	0.00	0.00000	0.00	0.00	0.00	
16	0.81589	0.10139	0.00000	0.00000	0.48354	0.00	0.00	0.00000	0.00	0.00	0.00	
17	0.80255	0.10646	0.00000	0.00000	0.46875	0.00	0.00	0.00000	0.00	0.00	0.00	
18	0.78813	0.11178	0.00000	0.00000	0.45544	0.00	0.00	0.00000	0.00	0.00	0.00	
19	0.77253	0.11737	0.00000	0.00000	0.44344	0.00	0.00	0.00000	0.00	0.00	0.00	
20	0.75566	0.12324	0.00000	0.00000	0.43259	0.00	0.00	0.00000	0.00	0.00	0.00	

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Question - Part E Difficulty: Advanced

[4 points]

v. Calculate the loss at issue for the above scenario.

Note: You should edit the yellow cells only.

k	$k p_x^{HH}$	$k p_x^{HS}$	$k p_x^{HD}$	$\Pr(\text{Death in year } k)$	k	v^k	CF	$CF \cdot v^k$
0	1.00000	0.00000	0.00000	0.00000	0	1.00000	0.00	0.00
1	0.93143	0.04877	0.00000	0.00000	1	0.94259	0.00	0.00
2	0.92701	0.05121	0.00000	0.00000	2	0.89693	0.00	0.00
3	0.92227	0.05377	0.00000	0.00000	3	0.85364	0.00	0.00
4	0.91719	0.05646	0.00000	0.00000	4	0.81240	0.00	0.00
5	0.91173	0.05928	0.00000	0.00000	5	0.77301	0.00	0.00
6	0.90586	0.06224	0.00000	0.00000	6	0.73528	0.00	0.00
7	0.89956	0.06536	0.00000	0.00000	7	0.70000	0.00	0.00
8	0.89279	0.06863	0.00000	0.00000	8	0.66700	0.00	0.00
9	0.88550	0.07206	0.00000	0.00000	9	0.63693	0.00	0.00
10	0.87765	0.07566	0.00000	0.00000	10	0.60928	0.00	0.00
11	0.86920	0.07944	0.00000	0.00000	11	0.58384	0.00	0.00
12	0.86009	0.08341	0.00000	0.00000	12	0.56031	0.00	0.00
13	0.85027	0.08758	0.00000	0.00000	13	0.53850	0.00	0.00
14	0.83968	0.09196	0.00000	0.00000	14	0.51824	0.00	0.00
15	0.82824	0.09656	0.00000	0.00000	15	0.50000	0.00	0.00
16	0.81589	0.10139	0.00000	0.00000	16	0.48354	0.00	0.00
17	0.80255	0.10646	0.00000	0.00000	17	0.46875	0.00	0.00
18	0.78813	0.11178	0.00000	0.00000	18	0.45544	0.00	0.00
19	0.77253	0.11737	0.00000	0.00000	19	0.44344	0.00	0.00
20	0.75566	0.12324	0.00000	0.00000	20	0.43259	0.00	0.00

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See the solution below!

QUESTION 9 OF 11 Question # Goal

Written Answer

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- State D: Dead

Assume that transitions occur at the end of each year. The probabilities ${}_k p_x^{HH}$ and ${}_k p_x^{HS}$ are given in the "Base" sheet.

In addition, the annual effective interest rate is 6%.

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Question - Part A Difficulty: Advanced

[2 points]

i. Draw a transition diagram for the multiple state model.

Note: Draw a transition diagram.

Question - Part B Difficulty: Advanced

[2 points]

ii. Calculate ${}_k p_x^{HD}$ and $\Pr(\text{Death in year } k \text{ given that the policyholder is healthy at age } x)$.

Note: You should edit the yellow cells and comment in the yellow box only.

k	$k p_x^{HH}$	$k p_x^{HS}$	$k p_x^{HD}$	$\Pr(\text{Death in year } k)$	k	v^k	CF	$CF \cdot v^k$
0	1.00000	0.00000	0.00000	0.00000	0	1.00000	0.00	0.00
1	0.93143	0.04877	0.00000	0.00000	1	0.94259	0.62	0.62
2	0.92701	0.05121	0.00180	0.01980	2	0.89693	0.62	0.56
3	0.92227	0.05377	0.02396	0.02180	3	0.85364	0.62	0.53
4	0.91719	0.05646	0.02636	0.02240	4	0.81240	0.62	0.51
5	0.91173	0.05928	0.02899	0.02264	5	0.77301	0.62	0.49
6	0.90586	0.06224	0.03189	0.02290	6	0.73528	0.62	0.47
7	0.89956	0.06536	0.03508	0.02351	7	0.70000	0.62	0.45
8	0.89279	0.06863	0.03850	0.02419	8	0.66700	0.62	0.43
9	0.88550	0.07206	0.04245	0.02486	9	0.63693	0.62	0.41
10	0.87765	0.07566	0.04669	0.02544	10	0.60928	0.62	0.39
11	0.86920	0.07944	0.05136	0.02607	11	0.58384	0.62	0.37
12	0.86009	0.08341	0.05650	0.02674	12	0.56031	0.62	0.35
13								