

ACSC/STAT 3720, Life Contingencies I

Winter 2015

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Homework Sheet 8

Due: Friday 7th April: 12:30 PM

Basic Questions

1. A woman aged 32, for whom the ultimate part of the lifetable in Table 1 is appropriate, buys a 20-year term insurance policy with a death benefit of \$800,000. (The policy uses a net annual premium.) Five years later, she wants to surrender the policy. The interest rate is $i = 0.04$. This gives $A_{32} = 0.106825$, $A_{37} = 0.128530$ and $A_{52} = 0.220514$. If the insurance company pays a cash surrender value of 80% of the net policy value, how much does she receive?
2. An insurance company sells a 15-year term insurance policy to a life aged 29 to whom the ultimate part of the lifetable in Table 1 applies. The death benefit is \$180,000 in the first two years, \$160,000 in the third to fifth year and \$140,000 for the remaining 10 years. The premiums are \$96.85 for the first three years, and \$26.64 for the remaining twelve years. The interest rate is $i = 0.05$ for the first 4 years, and $i = 0.07$ for the remaining 11 years. Calculate the retrospective policy value after 1 year.
3. A man aged 47, who is a select life on Table 1 buys a whole life insurance with a benefit of \$500,000. The interest rate is $i = 0.05$, which gives $A_{[47]} = 0.1283161$, $A_{[47]+2} = 0.1403596$, $A_{52} = 0.159677$ and $A_{54} = 0.173724$. Using a Full preliminary term of 2 years, calculate the policy value after 5 years.

Standard Questions

4. A man aged 38, who is a select life on Table 1 buys a 10-year annual endowment insurance policy with a benefit of \$400,000. The interest rate is $i = 0.06$, so $A_{[38]:\overline{10}|} = 0.5591854$ and $A_{[43]:\overline{5}|} = 0.7475003$. The insurance company pays a cash surrender value of 85% of the policy value. If he is still a select life at age 43, would he save money by surrendering his current policy and buying a new 5-year policy for the same coverage?
5. A man bought a whole life insurance policy 6 years ago. At the time, his age was 42, and his mortality followed the ultimate part of the lifetable in Table 1. The interest rate is $i = 0.06$. He now wants to convert the policy to a paid-up term policy with the same death benefit. The insurance company offers a cash surrender value of 80% of the policy value. What is the term of the new insurance contract? You are given the following values of A_x :

| x | A_x | x | A_x | x | A_x |
|-----|-----------|-----|----------|-----|----------|
| 42 | 0.0714153 | 55 | 0.136941 | 63 | 0.199371 |
| 48 | 0.0969315 | 56 | 0.143702 | 64 | 0.208588 |
| 49 | 0.101917 | 57 | 0.150748 | 65 | 0.218135 |
| 50 | 0.107134 | 58 | 0.158086 | 66 | 0.228016 |
| 51 | 0.112588 | 59 | 0.165721 | 67 | 0.238233 |
| 52 | 0.118287 | 60 | 0.173662 | 68 | 0.248787 |
| 53 | 0.124241 | 61 | 0.181913 | 69 | 0.259679 |
| 54 | 0.130456 | 62 | 0.190481 | 70 | 0.27091 |

Table 1: Select lifetable to be used for questions on this assignment

| x | $l_{[x]}$ | $l_{[x]+1}$ | $l_{[x]+2}$ | $l_{[x]+3}$ | x | $l_{[x]}$ | $l_{[x]+1}$ | $l_{[x]+2}$ | $l_{[x]+3}$ |
|-----|-----------|-------------|-------------|-------------|-----|-----------|-------------|-------------|-------------|
| 25 | 9998.75 | 9997.65 | 9996.30 | 9994.66 | 74 | 8987.73 | 8932.10 | 8862.49 | 8775.52 |
| 26 | 9997.00 | 9995.83 | 9994.40 | 9992.66 | 75 | 8897.04 | 8836.71 | 8761.27 | 8667.10 |
| 27 | 9995.14 | 9993.90 | 9992.38 | 9990.52 | 76 | 8798.69 | 8733.34 | 8651.66 | 8549.78 |
| 28 | 9993.16 | 9991.84 | 9990.22 | 9988.24 | 77 | 8692.13 | 8621.41 | 8533.09 | 8423.00 |
| 29 | 9991.05 | 9989.65 | 9987.92 | 9985.80 | 78 | 8576.81 | 8500.36 | 8404.95 | 8286.16 |
| 30 | 9988.81 | 9987.30 | 9985.46 | 9983.18 | 79 | 8452.13 | 8369.60 | 8266.68 | 8138.66 |
| 31 | 9986.40 | 9984.80 | 9982.82 | 9980.38 | 80 | 8317.52 | 8228.53 | 8117.67 | 7979.93 |
| 32 | 9983.83 | 9982.11 | 9979.99 | 9977.37 | 81 | 8172.36 | 8076.57 | 7957.35 | 7809.41 |
| 33 | 9981.07 | 9979.23 | 9976.95 | 9974.13 | 82 | 8016.08 | 7913.13 | 7785.15 | 7626.56 |
| 34 | 9978.11 | 9976.13 | 9973.68 | 9970.64 | 83 | 7848.11 | 7737.67 | 7600.54 | 7430.89 |
| 35 | 9974.93 | 9972.79 | 9970.16 | 9966.88 | 84 | 7667.89 | 7549.66 | 7403.05 | 7221.99 |
| 36 | 9971.50 | 9969.20 | 9966.36 | 9962.82 | 85 | 7474.92 | 7348.64 | 7192.27 | 6999.51 |
| 37 | 9967.80 | 9965.33 | 9962.25 | 9958.44 | 86 | 7268.77 | 7134.21 | 6967.86 | 6763.22 |
| 38 | 9963.81 | 9961.14 | 9957.82 | 9953.69 | 87 | 7049.07 | 6906.07 | 6729.62 | 6513.04 |
| 39 | 9959.50 | 9956.61 | 9953.02 | 9948.55 | 88 | 6815.55 | 6664.05 | 6477.46 | 6249.02 |
| 40 | 9954.84 | 9951.71 | 9947.82 | 9942.98 | 89 | 6568.09 | 6408.10 | 6211.48 | 5971.42 |
| 41 | 9949.79 | 9946.41 | 9942.19 | 9936.94 | 90 | 6306.70 | 6138.35 | 5931.96 | 5680.73 |
| 42 | 9944.32 | 9940.66 | 9936.08 | 9930.38 | 91 | 6031.59 | 5855.15 | 5639.41 | 5377.67 |
| 43 | 9938.39 | 9934.41 | 9929.45 | 9923.26 | 92 | 5743.19 | 5559.08 | 5334.61 | 5063.27 |
| 44 | 9931.96 | 9927.64 | 9922.25 | 9915.52 | 93 | 5442.15 | 5250.97 | 5018.61 | 4738.86 |
| 45 | 9924.97 | 9920.28 | 9914.42 | 9907.10 | 94 | 5129.44 | 4931.97 | 4692.79 | 4406.12 |
| 46 | 9917.37 | 9912.28 | 9905.91 | 9897.94 | 95 | 4806.33 | 4603.54 | 4358.89 | 4067.08 |
| 47 | 9909.11 | 9903.58 | 9896.65 | 9887.98 | 96 | 4474.39 | 4267.51 | 4018.96 | 3724.10 |
| 48 | 9900.13 | 9894.11 | 9886.57 | 9877.13 | 97 | 4135.60 | 3926.04 | 3675.44 | 3379.91 |
| 49 | 9890.36 | 9883.80 | 9875.59 | 9865.30 | 98 | 3792.25 | 3581.66 | 3331.11 | 3037.57 |
| 50 | 9879.71 | 9872.57 | 9863.63 | 9852.42 | 99 | 3447.02 | 3237.23 | 2989.05 | 2700.39 |
| 51 | 9868.12 | 9860.34 | 9850.59 | 9838.38 | 100 | 3102.90 | 2895.94 | 2652.63 | 2371.88 |
| 52 | 9855.48 | 9847.01 | 9836.39 | 9823.08 | 101 | 2763.19 | 2561.21 | 2325.37 | 2055.64 |
| 53 | 9841.72 | 9832.48 | 9820.90 | 9806.39 | 102 | 2431.39 | 2236.61 | 2010.90 | 1755.27 |
| 54 | 9826.71 | 9816.64 | 9804.02 | 9788.18 | 103 | 2111.15 | 1925.80 | 1712.81 | 1474.18 |
| 55 | 9810.34 | 9799.37 | 9785.60 | 9768.33 | 104 | 1806.12 | 1632.34 | 1434.48 | 1215.44 |
| 56 | 9792.49 | 9780.52 | 9765.51 | 9746.67 | 105 | 1519.82 | 1359.55 | 1178.94 | 981.65 |
| 57 | 9773.03 | 9759.97 | 9743.60 | 9723.05 | 106 | 1255.46 | 1110.36 | 948.70 | 774.71 |
| 58 | 9751.79 | 9737.56 | 9719.69 | 9697.28 | 107 | 1015.81 | 887.14 | 745.58 | 595.71 |
| 59 | 9728.63 | 9713.10 | 9693.62 | 9669.17 | 108 | 802.96 | 691.49 | 570.56 | 444.87 |
| 60 | 9703.36 | 9686.43 | 9665.17 | 9638.51 | 109 | 618.23 | 524.17 | 423.71 | 321.41 |
| 61 | 9675.80 | 9657.33 | 9634.15 | 9605.07 | 110 | 462.04 | 385.00 | 304.13 | 223.65 |
| 62 | 9645.73 | 9625.59 | 9600.31 | 9568.61 | 111 | 333.80 | 272.80 | 210.00 | 149.10 |
| 63 | 9612.94 | 9590.98 | 9563.42 | 9528.85 | 112 | 231.99 | 185.53 | 138.71 | 94.62 |
| 64 | 9577.18 | 9553.24 | 9523.19 | 9485.52 | 113 | 154.19 | 120.34 | 87.07 | 56.74 |
| 65 | 9538.19 | 9512.09 | 9479.35 | 9438.30 | 114 | 97.30 | 73.90 | 51.50 | 31.84 |
| 66 | 9495.69 | 9467.25 | 9431.58 | 9386.86 | 115 | 57.78 | 42.55 | 28.41 | 16.52 |
| 67 | 9449.37 | 9418.39 | 9379.54 | 9330.85 | 116 | 31.92 | 22.69 | 14.43 | 7.81 |
| 68 | 9398.90 | 9365.17 | 9322.87 | 9269.88 | 117 | 16.15 | 11.04 | 6.63 | 3.30 |
| 69 | 9343.95 | 9307.23 | 9261.20 | 9203.55 | 118 | 7.34 | 4.79 | 2.69 | 1.21 |
| 70 | 9284.12 | 9244.18 | 9194.11 | 9131.43 | 119 | 2.90 | 1.79 | 0.93 | 0.37 |
| 71 | 9219.03 | 9175.59 | 9121.17 | 9053.07 | 120 | 0.95 | 0.55 | 0.26 | 0.09 |
| 72 | 9148.24 | 9101.03 | 9041.91 | 8967.97 | 121 | 0.23 | 0.13 | 0.05 | 0.01 |
| 73 | 9071.30 | 9020.03 | 8955.85 | 8875.63 | 122 | 0.03 | 0.02 | 0.01 | 0.00 |