

CHAPTER 6

1. a) $\frac{1}{52}$ b) $\frac{1}{4}$ c) $\frac{16}{52}$ d) $\frac{2}{52}$ e) $\frac{103}{2704}$
2. a) $\frac{1}{6}$ b) $\frac{4}{6}$ c) $\frac{5}{36}$ d) $\frac{1}{9}$ e) 0
3. a) $\frac{1}{4}$ b) $\frac{1}{8}$ c) $\frac{3}{8}$ d) $\frac{1}{2}$
4. $\frac{13}{20}$
5. 1; $\frac{5}{2}$
6. $\frac{20}{26}$
7. $\frac{21}{37}$
8. 43.75
9. 11
10. .221
11. 6141.30
12. 2192.98; .1696
13. .0574
14. .6875
15. 10,258.31
16. 108,888,888.89
17. 2749.31
18. 2343.75
19. 116.18
20. .1987
21. .012
22. a) 858.02 b) 1120.88 c) .08237 per half year

CHAPTER 7

1.	Age	l_x	d_x	q_x
	0	1000	700	.7
	1	300	90	.3
	2	210	84	.4
	3	126	126	1

2. a) $\frac{l_{45}}{l_{20}}$ b) $\frac{l_{25}}{l_{20}}$ c) $\frac{l_{25} - l_{26}}{l_{20}}$ d) $\frac{l_{60}}{l_{20}}$ e) $1 - \left(\frac{l_{60}}{l_{20}}\right)^2$

3. .13043

4. a) $4\left(\frac{l_{60}}{l_{30}}\right)^3 \left(\frac{l_{50} - l_{55}}{l_{30}}\right)$ b) $1 - \left(\frac{l_{60}}{l_{30}}\right)^4 - 4\left(\frac{l_{60}}{l_{30}}\right)^3 \left(\frac{l_{30} - l_{60}}{l_{30}}\right)$

6.	x	l_x	d_x	p_x	q_x
	0	1000	100	.90	.10
	1	900	150	.83	.16
	2	750	150	.80	.20
	3	600	300	.50	.50
	4	300	180	.40	.60
	5	120	120	.00	1.00
	6	0			

7. a) .95 b) .0975 c) .01073 d) .0486

8. $\frac{\frac{1}{2}d_{35}}{l_{30}}$

11. .16

12. .32

13. a) 1000 b) 0 c) 8 d) .77 e) .3 f) .05263 g) .07465

14. $p_x = \frac{119-x}{120-x}$; $q_x = \frac{1}{120-x}$; $\mu_x = \frac{1}{120-x}$

16. $\mu_x = -\ln s - 2x \ln w - c^x (\ln c)(\ln g)$

21. a) 90 b) 90 c) .2857 d) .1385

22. a) .5 b) $\frac{1}{30}$ c) 80

23. a) .99830 b) .99154 c) .00170 d) .00846

e) .00169 f) .00505

25. .12857

28. a) $\frac{1000\ell_{35}}{T_{35} - .4T_{50} - .6T_{65}}$ b) $\frac{400\ell_{50}}{T_{35} - .4T_{50} - .6T_{65}}$

c) $\frac{1000(\ell_{35} - .4\ell_{50} - .6\ell_{65})}{T_{35} - .4T_{50} - .6T_{65}}$

29. .0194

32. 540,000

33. $e_{90} = 4.5$; ${}^{\circ}e_{90} = 5$ (both exactly and approximately)

35. 63.63

36. a) 70 b) 80 c) 54.375 d) 42.2

37. a) 60 b) 20

38. a) 80 b) 10

39. $40 + \frac{T_{40} - T_{50} + T_{75} - 10\ell_{50} + 35\ell_{75}}{\ell_{40} - \ell_{50} + \ell_{75}}$

40. a) $\frac{100(T_{20} - T_{65})}{T_{65}}$ b) 45

41. i) $({}_{7}p_{40}^{(\tau)})q_{47}^{(b)}$

ii) $({}_{4}p_{40}^{(\tau)})(q_{44}^{(b)} + q_{44}^{(c)}) + ({}_{5}p_{40}^{(\tau)})(q_{45}^{(b)} + q_{45}^{(c)})$
 $+ ({}_{6}p_{40}^{(\tau)})(q_{46}^{(b)} + q_{46}^{(c)}) + ({}_{7}p_{40}^{(\tau)})(q_{47}^{(b)} + q_{47}^{(c)})$

iii) $q_{30}^{(a)} = \frac{d_{30}^{(a)}}{\ell_{30}^{(\tau)}}; \quad m_{30}^{(a)} = \frac{d_{30}^{(a)}}{\ell_{30}^{(\tau)} - \frac{1}{2}d_{30}^{(\tau)}}$

iv) decrement (c) only acts on ages $x < 50$

43. $\frac{1 - \frac{1}{2}(a + b)}{1 + \frac{1}{2}(a + b)}$

44. 103

45. a) .737 b) .194 c) .0163

CHAPTER 8

1. a) 618.16 b) 267.01 c) 225.53 d) 520.54 e) 628.04
2. 287,223.64
3. 1110.50
4. a) 36,923.08 b) 34,528.49
5. a) 11,773.36 b) 10,138.45
6. a) 36,693.42 b) 34,404.64
7. $500 \sum_{t=1}^{\infty} (1.13)^{-2t} {}_2tP_{45}$
8. 1296.93
9. 1567.84
10. 4099.37
13. 1356.61
14. 2441.99
15. a) 1799.00 b) 13,256.14
16. a) 55,647.06 b) 53,882.35 c) 57,647.06 d) .06
17. a) $\frac{20,000N_{48}}{D_{38}}$ b) $\frac{20,000(N_{48} - N_{62} + N_{72})}{D_{38}}$
c) $\frac{20,000(D_{38} \cdot v^{10} \ddot{a}_{\overline{5}|} + N_{53})}{D_{38}}$
19. .112
20. (a), (b), (d) are equal to each other, but (c) is different
21. 5027.59
22. 2.8167
23. a) .3863 b) .568
24. a) 81,400 b) 81,000 c) 81,800 d) No
28. $\frac{N_x - N_{x+n} - (\frac{m-1}{2m})(D_x - D_{x+n})}{D_x}$ or $\frac{N_x^{(m)} - N_{x+n}^{(m)}}{D_x}$
29. 270.02
30. 267.10

31. 263,780.49
 32. 279,822.15
 33. 78,214.11
 34. 82,970.66
 35. 65,699.85; 69,695.35
 36. 461.82
 38. $\bar{a}_{x:\overline{n}|} = \frac{N_x - \frac{1}{2}D_x - (N_{x+n} - \frac{1}{2}D_{x+n})}{D_x}$; ${}_n|\bar{a}_x = \frac{N_{x+n} - \frac{1}{2}D_{x+n}}{D_x}$
 39. a) 10,000.00 b) 9502.13 c) 9295.00
 40. 18,804.27
 41. 105,600
 42. 27,466.67
 43. 62,933.33
 44. 3733.33
 46. $\frac{10N_x + S_{x+1} - 2S_{x+6} + S_{x+21}}{D_x}$
 47. ${}_n|(I\ddot{a})_x = \frac{S_{x+n}}{D_x}$; $(D\ddot{a})_{x:\overline{n}|} = \frac{(n+1)N_x - S_x + S_{x+n+1}}{D_x}$
 52. 2165.03
 53. 197.46
 54. 216.84
 55. 334.86
 56. 1.4286

CHAPTER 9

1. a) 30,769.23 b) 10,255.34
 2. a) 25,527.41 b) 7912.74
 3. a) 30,087.74 b) 9994.20
 4. a) 32,302.58 b) 11,528.11
 5. a) 31,842.58 b) 11,146.28

6. a) 23,977.21 b) 10,511.82
9. 77,482.30
10. 84,582.90
11. 87,343.87
15. $(1 - {}_{10}p_x)v^{10} + ({}_{10}p_x)v^{10}A_{x+10}$
17. 7466.67
18. a) 48,076.92 b) 40,828.40
19. 41,346.15
20. $\frac{50,000(M_{30} - M_{80} + D_{80} + M_{50} - M_{70})}{D_{30}}$
22. a) .0476 b) 19,800.00
23. 6148.89
24. 22,461.17
25. 79,348.05
26. a) 17,164.35 b) 15,965.94 c) 19,456.91
27. a) 44,444.44 b) 41,457.53 c) 48,178.08
28. a) 27,708.65 b) 22,196.28 c) 34,946.58
29. 9648.56
30. 33,778.45
31. 118,181.82
32. 55,554.16
33. a) Decrease b) Increase
36. $\frac{\ln(2\mu + \delta) - \ln\mu}{\mu + \delta}$
37. 40,726.69
38. a) 28,571.43 b) 57,243.34
40. 29,600.00
41. 11,800.00
42. 26,200.00
43. 31,920.00

45. $\frac{10}{v}$
46. 65
47. 92
49. a)
50. a)
52. 13
53. 19
54. 20
55. 23
56. 1
57. 1
58. 2
59. 3
60. $\frac{1}{a}$
61. $\frac{1}{v}$
62. a
63. a
- b
- c
- d
66. a
67. a
68. .
69. .
72. a
73. a

45. $\frac{1000(R_0 - R_{10}) + 40,000M_{51}}{D_0}$
46. 651.36
47. 9270.83
49. a) 681.82 b) 824.18 c) 59.55
50. a) 74.07 b) 61.39
52. 1318.18
53. 1966.67
54. 206.55
55. 215.84
56. 1179.25
57. 1182.76
58. 20,176.47
59. 3431.88
60. $\frac{11,000 A_{50}}{\ddot{a}_{50:\overline{30}|} + 1.1(DA)_{50:\overline{29}|}^1}$
61. $\frac{(1+r)M_x + kD_x + h(N_x - N_{x+n})}{(1 - \frac{i}{100})(N_x - N_{x+n})}$
62. a) 1118.64 b) 9274.78 c) 15,040.63 d) .63586
63. a) $\frac{5000R_{20}}{N_{20} + 2N_{30}}$
- b) $\frac{5000R_{20}}{N_{20} + 2N_{30}}$
- c) $\frac{25,000M_{25} + 5000R_{25} - \left(\frac{5000R_{20}}{N_{20} + 2N_{30}}\right)(N_{25} + 2N_{30})}{D_{25}}$
- d) $\frac{150,000M_{50} + 5000R_{50} - 3\left(\frac{5000R_{20}}{N_{20} + 2N_{30}}\right)N_{50}}{D_{50}}$
66. a) 285.32 b) 1995.23 c) 2103.56 d) 0
67. a) 437.22 b) 3057.45 c) 3223.45 d) 0
68. .64
69. .143865
72. a) .03788 b) .03784 c) .04 d) .01692
73. a) .1739 b) .1875