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Dharini Shah
SRM Assignment 1

Q1)

AY	0	1	2	3
2001	1245	999	610	356
2002	1455	1088	723	
2003	1567	1079		
2004	1491			

Year	Inflation adjustment	
2001	(1.021) (1.072) (0.992)	= 1.02498
2002	(1.072) (0.992)	= 1.003904
2003	0.992	= 0.992
2004	1	= 1

Incremental mid 2004 priced adjustment.

	0	1	2	3
2001	1276.11	1002.9	605.11	356
2002	1460.68	1079.3	723	
2003	1554.46	1079		
2004	1491			

Cumulative claims

	0	1	2	3
2001	1276.11	2279.07	2884.13	3240.13
2002	1460.68	2539.98	3262.98	
2003	1554.46	2633.46		
2004	1491			
df	1.7366	1.2756	1.1234	

Developed

	0	1	2	3
2001	1276.11	2279.01	2884.13	3240.13
2002	1460.68	2539.98	3262.98	3665.74
2003	1554.46	2633.46	3319.245	377 ~~3.89~~
2004	1491	2589.36	3302.99	3710.69

Incremental prices

	0	1	2	3
~~2004~~	~~1098.36~~	~~712.64~~		
2004		1098.36	712.64	407.7
Inflation index		1.025	1.050625	1.076891
Adjustment		1125.819	748.72	439.05

Total : 2313.5875 × 1000 = 2313587.5

(ii) Ultimate amount for 2004 policies = 5250000 × 0.73
Bornheutter ferguson method, = 3937500

	0	1	2	3
cdfs	-	2.48891	1.43304	1.82343
Reverse	1	1.2343	1.43304	2.48071
1/f	1	0.81017	0.6978	0.4018
1-1/f	0	0.18983	0.3022	0.5982

DY	EL
1	3937.5 (1/1.43304 - 1/2.4887) = 1165.57
2	3937.5 (1/1.2343 - 1/1.433) = 757.24
3	3937.5 (1 - 1/1.2343) = 432.61

Adjusting for inflation:

B

1 $1165.51 \times 1.025 = 1194.68$

2 $757.24 \times 1.0506 = 795.59$

3 $432.61 \times 1.076391 = 465.87$

Total emerging liability : $1194.68 + 795.59 + 465.87$

: 2456.09×1000

$= 2456090$.

Q3) doubt as years are not same

Q2]

Incurred

U/W	1	2	3
	Development year		
2005	3512	7210	9563
2006	2889	6723	
2007	3876		

Loss Ratio = 87%

Total claims paid = 20103000

Premium Income

2005	11041
2006	11314
2007	12549

Ans)

	1	2	3	Ultimate
2005	3512	7210	9563	9563
2006	2889	6723		
2007	3876			

r	2.1767	1.3264	1
f	2.8872	1.3264	1
(1 - 1/f)	0.6536	0.24608	0

AY	2007	2006	2005
EP	12549	11314	11041
IUL	10917.63	9843.18	9605.67
EL	7135.76	2422.21	0
RL	3876	6723	9563
UL	11005.76	9145.21	9563

Total UL : 29713.97 ×1000 (as it is in 1000s)

∴ Reserves = ~~29713.97 - 20103000~~

= 29713970 - 20103000

= 9610970

Q4) ACPC cumulative

	DY		
	0	1	2
2005	530.63	720.75	830.532
2006	491.32	716.092	
2007	753.84		

Grossing up factors.

	0	1	2	Ultimate
2005	63.891%	86.78%	100%	830.532
2006	59.5420%	86.28%		825.1714
2007	61.716%			1221.4591

No. of claims.

	DY		
	0	1	2
2005	88	121	156
2006	128	163	
2007	98		

Grossing up factors

	0	1	2	Ultimate
2005	52.56%	77.56%	100%	156
2006	60.96%	77.58%		210.149
2007	56.738%			172.73

Projected ultimate loss.

Acc year

2006 825.1714 × 210.149 = 173408.9445

2007 1221.4591 × 172.723 = 210975.0042

$\boxed{2005}$ + 129562.99

513946.9407

Outstanding claims = 513946.9407 − (73876 + 116723 + 129563)

$\boxed{O/S = 193784.9384}$

Q5) $X \sim Exp(\lambda) \rightarrow 2006$

$Y \rightarrow 2007$

(i) $\cancel{Pf}$: $Y = kX$

$\therefore P(Y < y) = P(kX < y)$

$= P(X < y/k)$

$$= \int_0^{y/k} \lambda e^{-\lambda z}\, dz$$

where $kz = \cancel{k}$

$$= \int_0^{y} \lambda e^{\frac{\lambda}{k} x} \frac{dx}{k}$$

$$= \int_0^{y} \frac{\lambda}{k} e^{\frac{\lambda}{k} x}\, dx$$

$\rightarrow$ pdf of exponential distribution.

$Y \sim Exp\left(\frac{\lambda}{k}\right)$

(ii) $P(X > M) = e^{-\lambda M}$

$P(Y > M) = e^{-\lambda M/k}$

$$L = C \times e^{-4\lambda M} \times \prod (\lambda e^{-\lambda x_i}) \times e^{-6\lambda M/k} \times \prod \left(\frac{\lambda}{k} e^{-\lambda y_i/k}\right)$$

$$\log L = C' - 4\lambda M + 10\log\lambda - \lambda \Sigma x_i - \frac{6\lambda M}{k} + 12\log\lambda - \frac{\lambda}{k}\Sigma y_i$$

$$= C - 4\lambda M + 22\log\lambda - 13500\lambda - 6\lambda M/k - 17000\lambda/k$$

$$\frac{d\log L}{d\cancel{\lambda}} = -4M + \frac{22}{\lambda} - 13500 - \frac{6M}{k} - \frac{17000}{k}$$

$$-\frac{4M+22}{\lambda} - 13500 - \frac{6M}{K} - \frac{17000}{K} = 0$$

$$\hat{\lambda} = \frac{22}{13500 + \frac{17000}{K} + 4M + \frac{6M}{K}}$$

(iii) a) $$\lambda = \frac{22}{13500 + \frac{17000}{1.1} + 4 \times 1600 + \frac{6 \times 1600}{1.1}}$$

$$= 0.000499$$

b) Expected payment

$$\int_0^M x\lambda e^{-\lambda x}\,dx + M\int_M^\infty \lambda e^{-\lambda x}\,dx = \left[-xe^{-\lambda x}\right]_0^M + \int_0^M e^{-\lambda x}\,dx$$

$$+ M\left[-e^{-\lambda x}\right]_M^\infty$$

$$= -Me^{-\lambda M} + \left[-\frac{1}{\lambda}e^{-\lambda x}\right]_0^M + Me^{-\lambda M}$$

$$= \frac{1}{\lambda}\left(1 - e^{-\lambda M}\right)$$

$$= \frac{1}{0.00049}\left(1 - e^{-0.00049 \times 1600}\right)$$

$$= 1102.107$$

$\mu = \frac{\lambda}{1.05 \times 1.1}$; need Retention R so

$$1102.107 = \int_0^R x\mu e^{-\mu x}\,dx + R\int_R^\infty \mu e^{-\mu x}\,dx$$

$$= \frac{1}{\mu}\left(1 - e^{-\mu R}\right) = \frac{1.05 \times 1.1}{0.0004999}\left(1 - e^{-\frac{0.000499R}{1.05 \times 1.1}}\right)$$

$$0.47615 = 1 - e^{-0.000432}$$

$$R = 1496.52$$

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Q6) 1. i) Heterogenous group as parameters vary by patient.

2. ii) a) $E(\cancel{X_1}) = 0.5 \times 0.1 + \frac{1}{3} \times 0.3 + \frac{1}{6} \times 0.9$

$= 0.3$

$E(X_1^2) = 0.5 \times 0.1^2 + \frac{1}{3} \times 0.3^2 + \frac{1}{6} \times 0.9^2$

$= 0.17$

$V(X_1) = 0.17 - 0.3^2 = 0.08$

b) $E(S/\lambda) = (\lambda m) \; Var(S_i/\lambda_i)$

$= \cancel{\lambda} \; \lambda_i m_2$

$E(S_i) = E[E(S_i/\lambda_i)) = E(\lambda_i m_1)$

$= 0.3 m_1$

$= 0.3 \times 250$

$= 75$

3. (iii) $Var(\lambda_i) = 0.5(0.2^2 + 0.4^2) - 0.3^2 = 0.01$

$E[\Sigma S_i) = n E(S_i) = 0.3 \times 100 \times 250 = 7500$

$V(\Sigma S_i) = 0.3 \times 100 \times 200 + 0.01 \times 100^2 \times 250^2$

$= 6256000$

IV) double

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Q7) Claim ~ Poi (50)

Amount ~ 100X

$f(x) = \frac{3}{32} (6x - x^2 - 5)$ when $1 < x < 5$

$= 0$ otherwise

(i) E(100X)

$= 100 \times \frac{3}{32} \int_1^5 x(6x - x^2 - 5)\, dx$

$= 100 \times \frac{3}{32} \times \int_1^5 6x^2 - x^3 - 5x \, dx$

$= 100 \times \frac{3}{32} \left[\frac{6 \times x^3}{3} - \frac{x^4}{4} - \frac{5x^2}{2} \right]_1^5$

$= \frac{300}{32} [31.25 + 0.75] = 300$

$Var(100X) = E(100X)^2 - [E(100X)]^2$

$E(100X)^2 = 100^2 \; E(X^2)$

$= 100^2 \times \frac{3}{32} \int_1^5 x^2 (6x^2 - x^3 - 5x)\, dx$

$= \frac{30000}{32} \left[\frac{6x^4}{4} - \frac{x^5}{5} - \frac{5x^3}{3} \right]_1^5$

$= 98000$

$Var(100X) = 8000$

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$E(Y) = 0.3 \times 200$
$= 60$

$V(Y) = 0.3 \times 200^2 - (60)^2$
$= 8400$

$Z = X + Y$
$E(Z) = E(X) + E(Y)$ as X & Y are independent
$= 360$

$V(Z) = Var(X+Y)$
$= Var(X) + Var(Y)$ as X & Y are independent
$= 16400$

$E(S) = E(N)\,E(Z)$
$= 50 \times 360$
$= 18000$

$V(S) = E(N)\,Var(Z) + Var(N)\,E(Z)^2$
$= 50 \times 16400 + 50 \times 300^2$
$= 7300000$