Estimating Outstanding Claims in General Insurance

Exercise 1

You have received a dataset showing claims from two portfolios: Accident and Liability. Both are taken from real life. The data represents the least that you should ask from an insurance company that requires you to estimate its outstanding claims.

Please note that the claim dataset contains not just one snapshot of claims, but

- 11 snapshots of the Accident portfolio's claims (Valuation date =31.12.96-31.12.06).
- 8 snapshots of the Liability portfolio's claims (Valuation date =31.12.01-31.12.08).

Your first task is to prepare the data for analysis.

1. For each claim record, calculate the information marked yellow, i.e. Reported claim cost, Number of claims, Valuation year, Accident year, Reported year, Settlement year, Accident to reporting delay, Reporting to valuation delay, Accident to valuation delay, Reporting to settlement delay, and whether the claim is Settled.

2. Reproduce the triangles from pp. 42-43 in the lecture slides for the Accident portfolio.

3. Make similar triangles for the Liability portfolio.

4. Comment on the fact that the "triangles" for the Liability portfolio are not triangular. What does it mean?

Exercise 2 – Accident, Number of claims

For the Accident portfolio:

a) Estimate the number of claims IBNR using Bornhuetter-Ferguson's method.
b) Estimate the number of claims IBNR using the Chain ladder method.

You may assume that there will be no further claims reported after the latest observed delay.

Compare and discuss your results.

Exercise 3 – Liability, Number of claims

Same as Exercise 2, for the Liability portfolio. Discuss whether it makes sense to use the chain ladder method for this portfolio.

Exercise 4 – Accident, Claim payments

For the Accident portfolio:

a) Estimate the outstanding claim payments using Bornhuetter-Ferguson's method.
b) Estimate the outstanding claim payments using the Chain ladder method.

You may assume that there will be no further claim payments after the latest observed delay.

Exercise 5 – Liability, Claim payments

Same as Exercise 4, for the Liability portfolio. Discuss whether it makes sense to use the chain ladder method in this case.

Proposed solutions for exercises 2-5 are attached as pdf files, to show you how you can organise the calculations and to allow you to check your answers. But don't automatically assume that all my answers are correct.

Exercise 6 – Exam preparation

Please turn off your PC and do the following by hand calculator.
You must be able to do these calculations in your sleep.
The solutions are shown to help you.

You are the actuary of a general insurance company and have received the following data showing the number of reported claims on 31.12.2005.

	Reporting delay				
Accident year	0	1	2	3	4
2001	126	69	7	4	1
2002	87	58	8	3	
2003	77	45	8		
2004	79	41			
2005	84				

The exposure is shown in the next table.

Accident year	Exposure
2001	5 630
2002	5 124
2003	4 719
2004	3 898
2005	3 575

You may assume that no claims will reported with a delay of more than four years.

1. Bornhuetter-Ferguson method
   a. Estimate the delay-specific claim frequencies.
   b. Estimate the overall claim frequency per accident year.
   c. Estimate the reporting pattern.
   d. Estimate the outstanding number of claims for each accident year.
   e. Fill the missing cells in the run-off triangle with predictions.

2. Chain ladder method
   a. Estimate the development factors.
   b. Estimate the reporting pattern.
   c. Estimate the overall claim frequency per accident year.
   d. Estimate the outstanding number of claims for each accident year.
   e. Fill the missing cells in the run-off triangle with predictions.

Solutions to Exercise 6

Part 1 (Bornhuetter-Ferguson)

$$\theta_0^* = \frac{126+87+77+79+84}{5630+5124+4719+3898+3575} = 1.97\%$$

$$\theta_1^* = \frac{69+58+45+41}{5630+5124+4719+3898} = 1.10\%$$

a. $$\theta_2^* = \frac{7+8+8}{5630+5124+4719} = 0.15\%$$

$$\theta_3^* = \frac{4+3}{5630+5124} = 0.07\%$$

$$\theta_4^* = \frac{1}{5630} = 0.02\%$$

b. $$\theta^* = 1.97\% + 1.10\% + 0.15\% + 0.07\% + 0.02\% = 3.31\%$$

$$\pi_0^* = 1.97\% / 3.31\% = 59.73\%$$

$$\pi_1^* = 1.10\% / 3.31\% = 33.27\%$$

c. $$\pi_2^* = 0.15\% / 3.31\% = 4.50\%$$

$$\pi_3^* = 0.07\% / 3.31\% = 1.97\%$$

$$\pi_4^* = 0.02\% / 3.31\% = 0.54\%$$

d.

Accident year	Exposure	Developed to	pi(cum.)	Theta_star	Outstanding
2001	5630	4	100 %	3,31E-02	0,0
2002	5124	3	99 %	3,31E-02	0,9
2003	4719	2	97 %	3,31E-02	3,9
2004	3898	1	93 %	3,31E-02	9,0
2005	3575	0	60 %	3,31E-02	47,6
Total	22946				61,4

e.

Accident year	0,00	1,00	2,00	3,00	4,00
2001,00	126,00	69,00	7,00	4,00	1,00
2002,00	87,00	58,00	8,00	3,00	0,91
2003,00	77,00	45,00	8,00	3,07	0,84
2004,00	79,00	41,00	5,79	2,54	0,69
2005,00	84,00	39,31	5,31	2,33	0,63

Part 2 (Chain ladder)

Cumulative claims reported

Accident year	0	1	2	3	4
2001	126	195	202	206	207
2002	87	145	153	156	
2003	77	122	130		
2004	79	120			
2005	84				

a.

$$\delta_1^* = \frac{195+145+122+120}{126+87+77+79} = 157{,}72\%$$

$$\delta_2^* = \frac{202+153+130}{195+145+122+120} = 104.98\%$$

$$\delta_3^* = \frac{206+156}{202+153} = 101.97\%$$

$$\delta_4^* = \frac{207}{206} = 100.49\%$$

b.

	0	1	2	3	4
delta (incr.)		1,5772	1,0498	1,0197	1,0049
delta (cum.)	100 %	158 %	166 %	169 %	170 %
pi (cum.)	58,94 %	92,96 %	97,59 %	99,52 %	100,00 %
pi (incr.)	58,94 %	34,02 %	4,63 %	1,92 %	0,48 %

c.

Accident year	Exposure	Developed to	Observed	pi(cum.)	Theta_star(j)
2001	5630	4	207	100 %	3,68E-02
2002	5124	3	156	100 %	3,06E-02
2003	4719	2	130	98 %	2,82E-02
2004	3898	1	120	93 %	3,31E-02
2005	3575	0	84	59 %	3,99E-02
Total	22946		697		3,31E-02

d.

Accident year	Exposure	Developed to	Observed	pi(cum.)	Theta_star(j)	Outstanding
2001	5630	4	207	100 %	3,68E-02	0,0
2002	5124	3	156	100 %	3,06E-02	0,8
2003	4719	2	130	98 %	2,82E-02	3,2
2004	3898	1	120	93 %	3,31E-02	9,1
2005	3575	0	84	59 %	3,99E-02	58,5
Total	22946		697		3,31E-02	71,6

e.

Accident year	0	1	2	3	4
2001	126,00	69,00	7,00	4,00	1,00
2002	87,00	58,00	8,00	3,00	0,76
2003	77,00	45,00	8,00	2,56	0,64
2004	79,00	41,00	5,97	2,48	0,62
2005	84,00	48,49	6,60	2,74	0,69

Part 3 (Benktander)

With claim frequency and reporting pattern from question 1, apply Benktander's method to estimate the outstanding number of claims for each accident year.

Accident year	Exposure	Developed to	Observed	pi(cum.)	Theta_BF	Theta_CL	Credibility z	Theta_bar	Outstanding
2001	5630	4	207	100 %	3,31E-02	3,68E-02	100 %	3,68E-02	0,0
2002	5124	3	156	99 %	3,31E-02	3,06E-02	99 %	3,06E-02	0,8
2003	4719	2	130	97 %	3,31E-02	2,83E-02	97 %	2,84E-02	3,4
2004	3898	1	120	93 %	3,31E-02	3,31E-02	93 %	3,31E-02	9,0
2005	3575	0	84	60 %	3,31E-02	3,93E-02	60 %	3,68E-02	53,0
Total	22946		697						66,2