

# MTH5126 - Statistics for Insurance

Academic Year: 2022-23

Semester: B

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## Worksheet 10

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You are recommended to use Excel spreadsheet to perform your calculations for run-off triangles.

### Q1. Ruin theory (Excel-based)

Individual claim amounts are exponentially distributed with mean 1 and the premium loading factor is  $\theta$ . The formula for the probability of ultimate ruin,  $\Psi(U)$  is:

$$\Psi(U) = \frac{1}{1 + \theta} \exp \left\{ - \frac{\theta U}{1 + \theta} \right\}$$

- i) Plot a chart showing how the probability of ruin varies for values of  $\theta$  ranging from 0 to 1, when  $U = 0.5$ .
- ii) Comment on what can be concluded from your chart in part (i).

[See solutions in Excel spreadsheet on QMplus.](#)

### Q2. Run-off triangles

- (i) Explain why insurance companies make use of run-off triangles.
- (ii) The run-off triangle below shows incremental claims incurred on a portfolio of general insurance policies.

<i>Policy Year</i>	<i>Development Year</i>			
	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>
2011	4,657	3,440	931	572
2012	6,089	5,275	1,381	
2013	5,623	4,799		
2014	7,224			

Calculate the outstanding claims reserve for this portfolio using the basic chain ladder method.

**Solution:**

(i) There is normally a delay between accidents/claim events/incidents leading to claim and the insurance pay out.

Insurance companies need to estimate future claims for reserving purposes.

It makes sense to use historical data to infer future patterns of claims.

(ii)

Cumulate claims:

		Development year			
Policy year		0	1	2	3
	2011	4,657	8,097	9,028	9,600
	2012	6,089	11,364	12,745	
	2013	5,623	10,422		
	2014	7,224			

Development factors:

$$DF_{2,3} = 9600 / 9028 = 1.063358$$

$$DF_{1,2} = (9028 + 12745) / (8097 + 11364) = 1.118802$$

$$DF_{0,1} = (8097 + 11364 + 10422) / (4657 + 6089 + 5623) = 1.825585$$

Project claims:

		Development year			
Policy year		0	1	2	3
	2011	4,657	8,097	9,028	9,600
	2012	6,089	11,364	12,745	<b>12745 * 1.063358 = 13,552.50</b>
	2013	5,623	10,422		<b>10422 * 1.118802 * 1.063358 = 12,398.92</b>
	2014	7,224			<b>7224 * 1.825585 * 1.118802 * 1.063358 = 15,689.62</b>

Assuming that claims incurred are equal to claims paid:

Outstanding claims reserve

$$= (13,552.50 - 12,745) + (12,398.92 - 10,422) + (15,689.62 - 7,224)$$

$$= 807.50 + 1,976.92 + 8,465.62$$

$$= 11,250$$

**Further practice:**

**As usual, after each lecture and tutorial, check that you can now do the lecture examples/questions and tutorial questions without looking at the answers.**