

Asset-Liability Management 2018

Project v2

Introduction

In this project you will design a DFA model.

Your report should not be longer than 15 pages. A neat presentation counts in your favour. Please place all important tables and graphs into your report.

You may write your report in English or Portuguese.

You are free to work in groups of not more than three persons.

You may contact me with questions at the address walther.neuhaus@zabler-neuhaus.no.

The deadline for delivery is Wednesday, 6th February 2019.

Good work!

Introduction

You are the actuary of an insurance company in Portugal. You have been asked to produce a small Dynamic Financial Analysis to analyse the insurance company's exposure to insurance risk and currency risk.

You have received a dataset of historical claim severities of approximately 2500 claims (EUR).

Assume that the insurance company wants to insure the same type of risk in Portugal (PT), Great Britain (GB) and in Switzerland (CH). You may assume that the claim severity distribution in each country will be similar to the one you already have, but of course it must be expressed in each country's own currency. The current exchange rates are shown below.

CHF pr. EUR	GBP pr. EUR
1.1292	0.8976

1. Simulation of gross insurance claims

For each of the three countries, produce 1000 simulations of gross insurance claims under the following assumptions:

- The number of policies is $p=1500$ in PT, $p=750$ in GB and $p=500$ in CH;
- the claim frequency in one simulation is a random variable Θ , one for each country; it follows an independent gamma distribution with $E(\Theta) = 0.12$ and $SD(\Theta) = 0.02$.
- given the claim frequency Θ , the actual number of claims in one simulation is a $Poisson(p\Theta)$ random variable;
- the claim severities replicate the empirical severity distribution of the historical claims.

2. Preliminary gross premium calculation

For each country, calculate the average aggregate claim cost from the 1000 simulations.

Calculate the premium that is needed to achieve an expected loss ratio of 70%.

You may assume that administration expenses are 20% of average aggregate claim cost.

The simulation must be in local currency (EUR, GBP and CHF).

3. Reinsurance modelling

Assume that reinsurance program has the same structure in each country, with parameters adjusted to local currencies where necessary.

First there is a quota share reinsurance contract. Necessary input parameters are the percentage reinsured, the commission rate, and the lower and upper limit of the loss corridor. You can assume 50% reinsured, 20% commission, loss corridor in the interval 110%-180% ¹.

To protect the company's retention after the quota share contract, it has an Excess of Loss contract. Necessary input parameters are the XL priority, the XL limit and the profit loading. Assume that the XL contract for PT is for EUR400,000 xs EUR100,000 and that the profit loading is 30%. The XL premium you calculate by adding the profit loading to the average cost of the XL reinsurer.

For each of the 1000 gross simulations, calculate:

- Gross premium
- Admin expenses
- Quota premium
- XL premium
- Reinsurance premium
- Reinsurance commission
- Gross claims
- Quota recoveries
- XL recoveries
- Reinsurance recoveries
- Loss Corridor liability
- Net result

Similar calculation for the other countries. The simulation must be in local currency.

4. Estimating currency volatility

You have received a dataset showing monthly average exchange rates for GBP and CHF since January 2009 (120 months). Use the data to estimate the one-year volatility of GPB and CHF against EUR.

5. Simulating currency fluctuations

Make 1000 simulations of the currency exchange rates in one year's time, using a bivariate normal distribution for the exchange rate of GPB and CHF (make sure to avoid negative values and zeroes).

¹ Typical loss corridor clause: "In the case that the combined ratio (the reinsurer's combined ratio is the sum of commission and reinsured losses, divided by the reinsurance premium), is 110% or more, the reinsured shall be liable for all further losses falling under this treaty (losses falling under this treaty means losses that the reinsurer otherwise would pay) until a combined ratio of 180% is reached."

For the exchange rates in one year's time, you should assume that the expected value of the currency exchange rate is the same as today and use the yearly covariance matrix that you estimated in step 4.

6. Overall results converted to EUR

For each of the 1000 simulations, calculate overall net results of the company converted back to EUR, using the simulated exchange rates of GBP and CHF. That is, there will be randomness in claims as well as randomness in exchange rates.

For each of the 1000 gross simulations, calculate in EUR the overall of:

- Gross premium
- Admin expenses
- Quota premium
- XL premium
- Reinsurance premium
- Reinsurance commission
- Gross claims
- Quota recoveries
- XL recoveries
- Reinsurance recoveries
- Loss Corridor liability
- Net result

Define a loss as the negative net result and calculate the VaR and TailVaR at 95% confidence level.

Make a percentile graph to illustrate the volatility of the net result to your mathematically illiterate boss.

7. The fun has only started

A DFA is never meant to provide just one answer.

Make sure your program is structured in such a way that you can easily answer questions “what if”, concerning all the parameters that are under the control of the company (they are set in **red** above).

Demonstrate this by showing the percentile graph from question 6, using a small handful of alternative assumptions.