ADVANTAGES OF A MATLAB ENGINE IN THE REINSURANCE MARKET

Dr. Paul Bassan Ph.D.
Powering insurance companies of the future

paul@cytora.com
www.cytora.com
Cytora enables commercial insurers to improve **risk selection, pricing and premium growth** via **automated underwriting** of entire markets.

With Cytora, commercial insurers can improve loss ratios by up to 18p.p., reduce expenses by as much as 10p.p., and provide frictionless buying experiences to their customers.
What is reinsurance?
Difficulty of pricing contracts
Problems with Excel
How Aspen Re built a Enterprise standard calculation engine using MATLAB
Founded in 2002
NYSE:AHL
$13bn of assets at the end of 2017
Offices in 9 countries
Specialise in complex risks and reinsurance
$3.1 bn gross written premium
WHAT IS REINSURANCE?

- Insurance companies buy reinsurance for risk management and prevention of financial ruin.
- Insurers might want to be involved in insuring large risks e.g. cargo ships, oil rigs, aircraft etc.
- Risk management in case of catastrophes
  - Natural: Hurricanes, earthquakes etc.
  - Non-natural: Financial crisis
- Contracts can be very large, sometimes greater than $100m
REINSURANCE PRICING AIMS

- Profitability of contract & economic values
- VaR calculations
- Volatility
- Capital requirements for the contract
REINSURANCE PRICING AIMS

Client Data
- Claims
- Business mix
- Product

Pricing process
- Process data
- Choose assumptions
  - Inflation
  - Interest rates etc.
- Assess risk

Output
- Price in $
- Economic value
- Return on capital
Consider an insurance company who specialises in medical malpractice

- Income is $20m per year
- Covers physicians for malpractice claims up to a limit of $10m
- Wants to protect itself from claims from larger than $1m and is willing to absorb the first $1m of loss from any claim
- Chooses to purchase a $10m excess of $1m reinsurance treaty
A EXAMPLE CONTRACT

- Chooses to purchase a $10m limit in excess of $1m per individual claim reinsurance treaty

- Example scenarios:

  A claim of $500k
  - Insurer pays $500k
  - Reinsurer pays $0

  A claim of $5m
  - Insurer pays $1m + $4m
  - Reinsurer pays $10m

  A claim of $15m
  - Insurer pays $1m + $4m
  - Reinsurer pays $10m

  One claim of $15m and one claim of $20m
  - Insurer pays $15
  - Reinsurer pays $20m

Dr. Paul Bassan Ph.D. | Matlab Computational Finance Conference | 24th May 2018
Resulting Distributions

- Evaluation has to be done using simulation methods / stochastic models
- Resulting distributions are complex
- Analytical evaluation not possible
Annual limits for the contract e.g. $50m in our previous example

- Protects the reinsurer from scenarios where there are many claims
  - There could be 50 claims of $2m or 5 claims of $11m which would both result in a loss of $50m for the year

Results in equations with many mins and max points
There are commission structures that depend on the loss ratio (i.e.)
the performance of the insurance company buying the reinsurance
program.

<table>
<thead>
<tr>
<th>Loss Ratio</th>
<th>Commission (reinsurer outgo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% to 40%</td>
<td>10%</td>
</tr>
<tr>
<td>40% to 50%</td>
<td>9%</td>
</tr>
<tr>
<td>50% to 60%</td>
<td>7%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Imagine a large insurance company with many products
- Medical malpractice
- Employer’s liability
- Commercial Property
- Public Liability
- Product Liability
More simulations results in greater accuracy

For rare events, a large number of simulations is required such that a sufficient number of events occurring in the calculation

For this application we simulate 500,000 years of the contract where each year will contain a number of individual claims

Millions of claims are often simulated for a single contract
EXCEL AND VBA BASED MODELS

- Helpful for initial prototypes
- Slow for simulation based calculations
- 100,000 years of simulation took minutes to complete and some calculations had to be turned off altogether
- Difficult to distribute and control version across the company
MATLAB PRODUCTION SERVER

- Huge toolkit of standard functions which are well optimized
- Unit-testing framework included
- Handling of queues of jobs
- Enterprise grade
- Calculation time now around 5 to 15 seconds for typical cases with more calculations than the VBA version
MATLAB PRODUCTION SERVER

Excel Spreadsheet
- User puts parameters into spreadsheet interface
- Excel calls the MATLAB Production Server sending parameters through http (or https) requests
- Calculation outputs received and presented to user
- Distributed globally using Citrix

MATLAB Production Server
- 24 workers ready
- Full disaster recovery on second site
- Available to all global offices as a service
MATLAB PRODUCTION SERVER

Dr. Paul Bassan Ph.D. | Matlab Computational Finance Conference | 24th May 2018
DEVELOPMENT & DEPLOYMENT (I)

- Develop the code using standard MATLAB desktop environment
- Can debug efficiently
- Understand and verify calculations using plots etc. that would not be used in production
- Testing scripts
  - Automatically run 10s of thousands of real deals through the engine
DEVELOPMENT & DEPLOYMENT (2)

- Compile code using MATLAB compiler
- Publish to UAT environment for users to test
- Publish to MATLAB Production Server
- Can keep previous archives of code on server
ADDITIONAL IN MARKET

- Able to price complex deals which are not analytical evaluable
- Quickly prototype and deploy new features
- Instead of inaccurate estimations due to lack of computational power, we can simulate and get a good estimate of the profitability
CONCLUSION

- Fast and scalable
- One version of the calculations under actuarial control
- Development and automated testing easier than VBA based method
- Reusable service for applications - prevents reinventing the wheel
- Libraries available for artificial intelligence & machine learning
THANK YOU FOR LISTENING!

Contacts:

Paul Bassan – Senior Pricing Actuary at Cytora
- paul@cytora.com

Joseph Lo – Head of R&D at Aspen Reinsurance
- Jo.Lo@aspen.co

Chris Spratt – Head of Reinsurance Pricing at Aspen Reinsurance
- Christopher.Spratt@aspen.co