Summer Research Projects

Corina Constantinescu
Institute for Financial and Actuarial Mathematics
Department of Mathematical Sciences
University of Liverpool

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University of Liverpool

XJTLU - source of large number of students

- 400 UG students Mathematics with Finance and Actuarial Mathematics
- 25 MSc students Financial Mathematics

High demand for "internships."

2 models

- 2013: MSc students - cooperation with industry projects
- 2014: UG, MSc and PhD students - summer research internships

Summer of 2013

- 8 MSc students
- Calibrate some theoretical collective risk models to real insurance data, in an attempt to better model the risk-return dynamics of different lines of the insurance business.
- Joint work with **Joseph Lo**, Aspen UK
- **IFAM** academics involved: Olivier Menoukeu-Pamen, Apostolos Papaioannou, David Siska

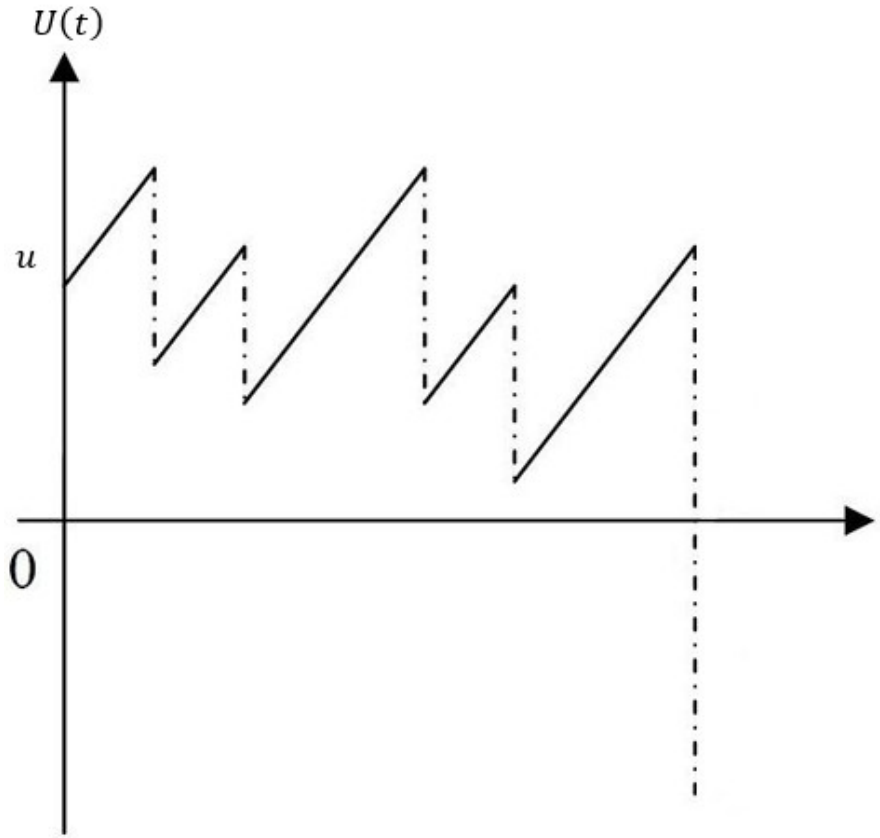
First meeting in London...

$$U(t) = u + ct - \sum_{k=1}^{N(t)} X_k$$

Task

Given real data from a few lines of business, calculate the probability of ruin (using Excel) in an attempt to answer pertinent risk management questions.

Ruin probability

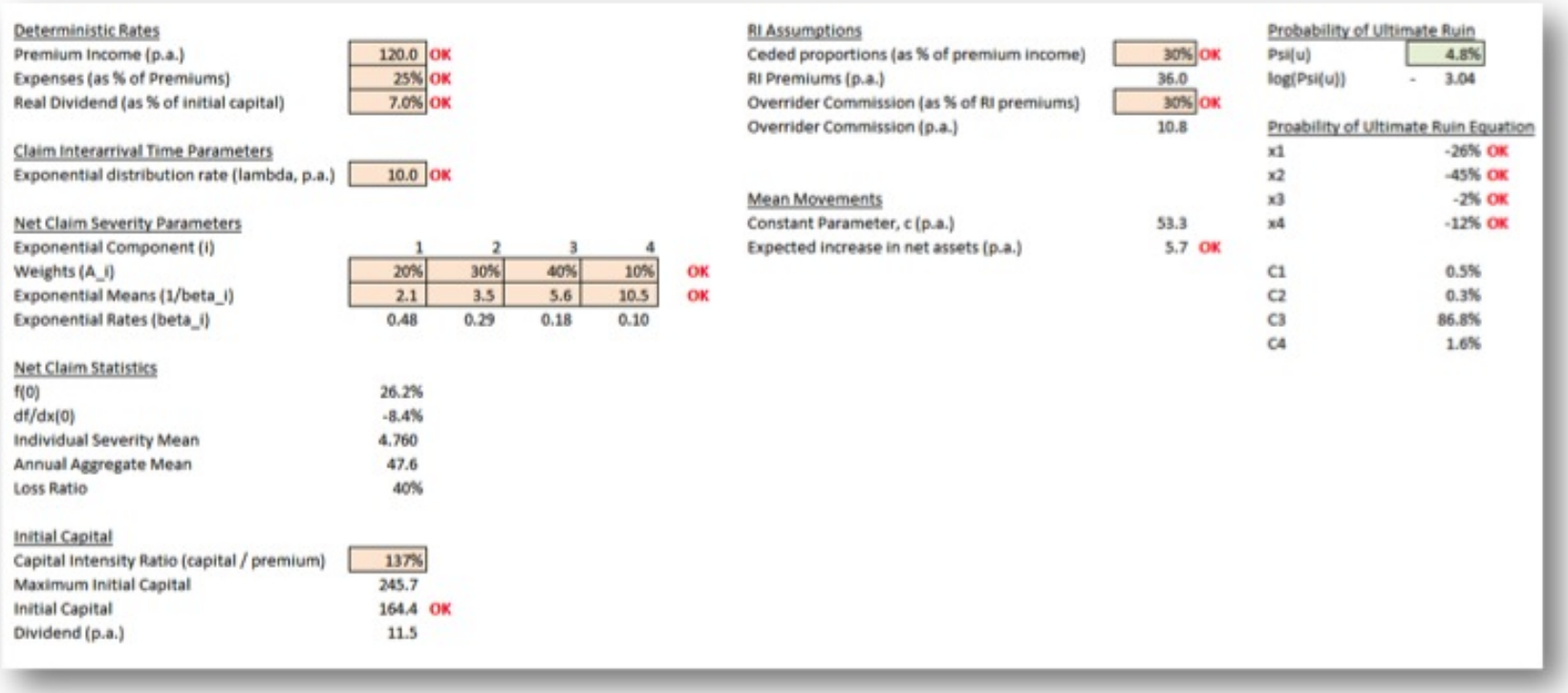


Time of ruin:

- $T_u = \inf_{t \leq 0}\{t : U(t) < 0 \mid U(0) = u\}$
- $P(T_u = \infty)$ means that ruin never happens

The probability of ruin with infinite horizon: $\Psi(u) = P(T_u < \infty)$.

Outcome - Excel spreadsheet



Deterministic Rates

Premium Income (p.a.)	120.0	OK
Expenses (as % of Premiums)	25%	OK
Real Dividend (as % of initial capital)	7.0%	OK

Claim Interarrival Time Parameters

Exponential distribution rate (lambda, p.a.)	10.0	OK

Net Claim Severity Parameters

Exponential Component (i)	1	2	3	4	
Weights (A_i)	20%	30%	40%	10%	OK
Exponential Means (1/beta_i)	2.1	3.5	5.6	10.5	OK
Exponential Rates (beta_i)	0.48	0.29	0.18	0.10	

Net Claim Statistics

f(0)	26.2%
df/dx(0)	-8.4%
Individual Severity Mean	4.760
Annual Aggregate Mean	47.6
Loss Ratio	40%

Initial Capital

Capital Intensity Ratio (capital / premium)	137%	
Maximum Initial Capital	245.7	
Initial Capital	164.4	OK
Dividend (p.a.)	11.5	

RI Assumptions

Ceded proportions (as % of premium income)	30%	OK
RI Premiums (p.a.)	36.0	
Overrider Commission (as % of RI premiums)	30%	OK
Overrider Commission (p.a.)	10.8	

Mean Movements

Constant Parameter, c (p.a.)	53.3	
Expected increase in net assets (p.a.)	5.7	OK

Probability of Ultimate Ruin

Psi(u)	4.8%	
log(Psi(u))	- 3.04	

Proability of Ultimate Ruin Equation

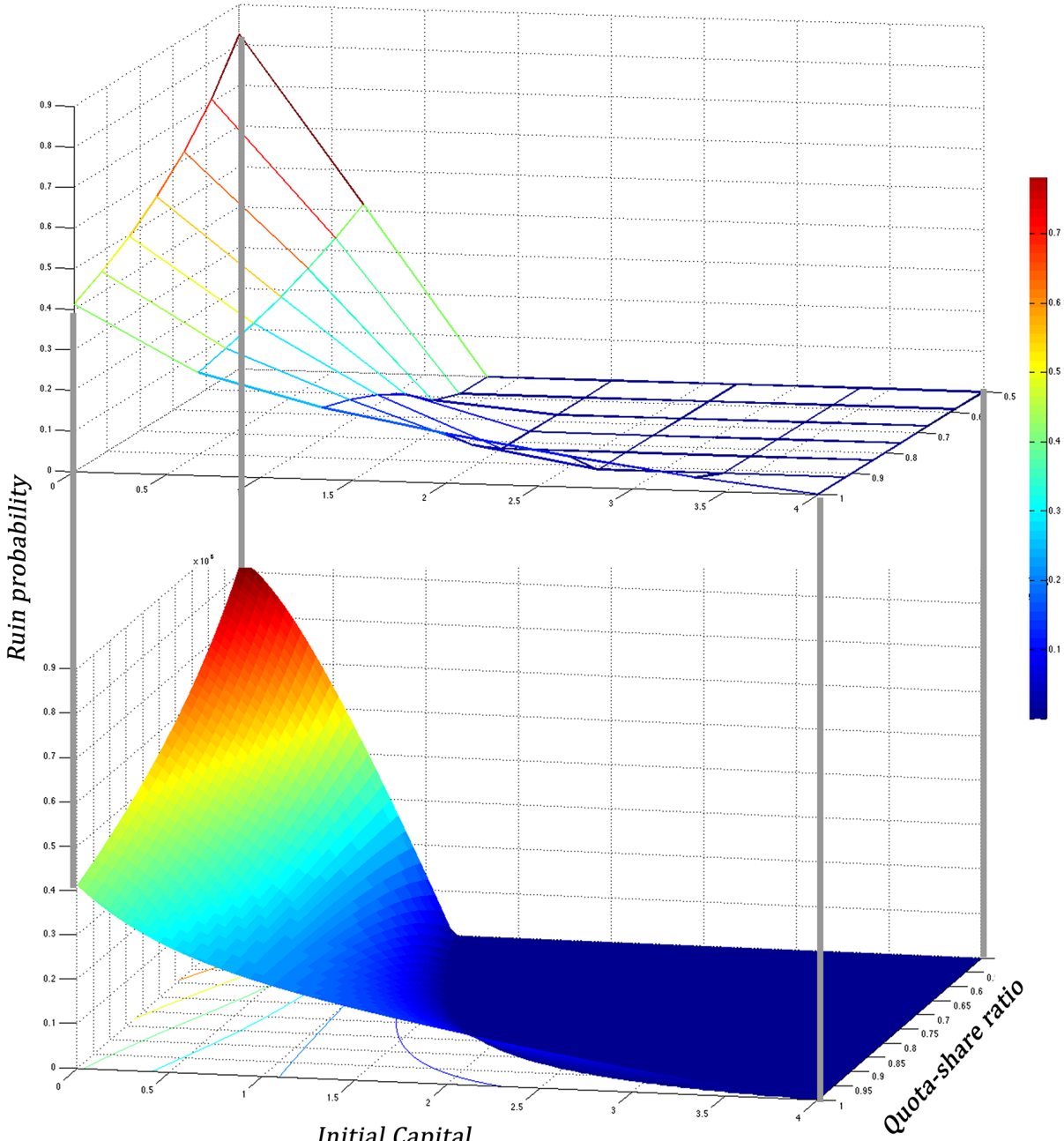
x1	-26%	OK
x2	-45%	OK
x3	-2%	OK
x4	-12%	OK
C1	0.5%	
C2	0.3%	
C3	86.8%	
C4	1.6%	

Lines of business...

Real data has been scaled and skewed for confidentiality purposes!

- Marine Insurance (1'800)
- Casualty Insurance (15'000)
- Casualty Reinsurance (347)
- Property Insurance (3'700)

Should we raise capital or buy reinsurance?



Summer of 2014

- in-house research internships
- huge number of applications
- 2 groups of mixed students (years, majors)

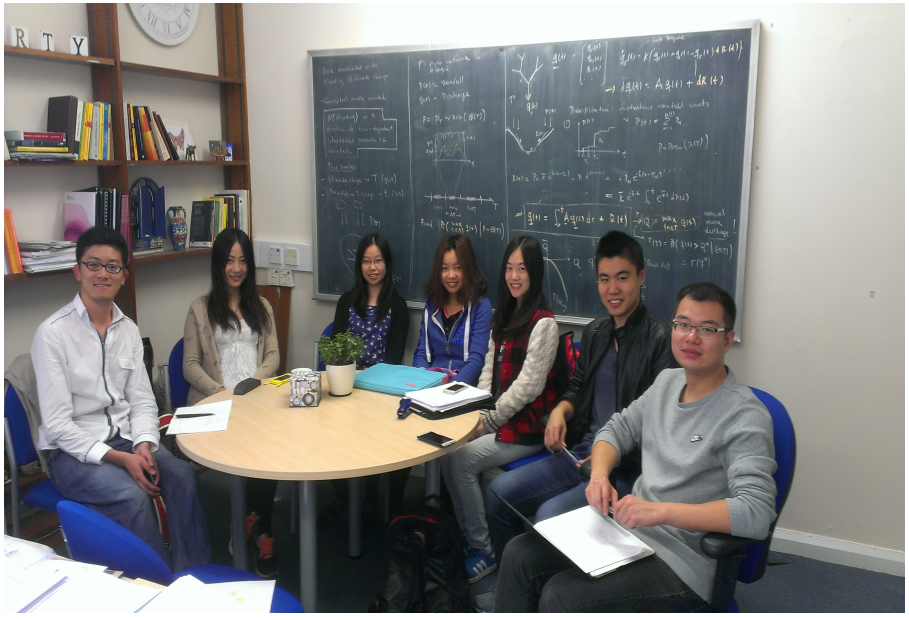
Recipe

- Questions from practitioners (with academics)
- Split in small projects for students, by academics (with practitioners)
- UG students supervised daily by graduate students

Group 1

- Improved the EM algorithm for fitting data
- Looked for ways to algorithmically determine the threshold

Group 2



- Implemented in Matlab two different ways to calculate the finite time ruin probability (numerically)
- Compared the results from the different methods and also with the exact solution in the classical case

The Results

Search Menu

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December 8th Workshop: Summer Research Internships

On December 8th, 2014, from 13:00 to 16:00 on VGM, Leggate Theater will take place a small workshop regarding Summer Research Internships in the Math Department at University of Liverpool. Details will follow. Students, academics and insurance practitioners are welcome.

Group 1

Group 2

Presented at a workshop in Liverpool, on December 8th, 2014, from 1-4pm. **Everyone is invited!**

Differences

- Practitioners involved via Skype, or in Liverpool visit, no visits to London offices
- PhD students supplemented the academics (no final project involved has been marked)
- 6 weeks sessions (3 weeks+ 1 week break+ 3weeks)
- Mixed of different levels made it challenging for students, but also enjoyable

Funding

University internal Knowledge Exchange funds.

Why

- UG Students: the exposure to "real world" problems; the opportunity to do research; the opportunity to work as part of a team; the possibility to have a long-term interview with a company involved
- Grad students: the possibility to supervise; exposure to concrete problems and deadlines; to explain
- Academics: new problems; challenge of transforming a real problem into small projects
- Practitioners: some answers; possibility to interact with students

IFoA

GIRO 2013, started a Working Party "Practising Ruin"

- practitioners: Kapil Radia, Andres Melo, Yuriy Krvavych
- academics: Ronnie Loeffen

GIRO 2014, presentation on "Optimal holding capital level"

The future

Toy model in Liverpool can be expanded:

- Possibility of involving PhD students from other institutions (RARE partners, funding)
- Industry partners - strengthen relationships
- New topics (RARE)
- All small projects might converge to a PhD proposal

THANK YOU FOR YOUR ATTENTION!

https://www.liv.ac.uk/institute-for-financial-and-actuarial-mathematics/research-internships/