TRIPLE A
RISK FINANCE

Non-Life Insurance in R

A Non-Life Stochastic Prognosis Model

Warsaw, 26 November 2015

- Introduction
- Model Outline
- Case Study
- Conclusions

Introduction

Introduction

- At a policy level
- Models: burning cost, frequency/severity, GLMs

Introduction

- At a policy level
- Models: burning cost, frequency/severity, GLMs

- At an aggregate level
- Models: Chain-Ladder, Bornhuetter-Ferguson, Cape Cod, stochastic and many more

Introduction

- At a policy level
- Models: burning cost, frequency/severity, GLMs

- At an aggregate level
- Models: Chain-Ladder, Bornhuetter-Ferguson, Cape Cod, stochastic and many more

- At a product, portfolio, entity etc. level
- Models: ERM

Introduction

- At a policy level
- Models: burning cost, frequency/severity, GLMs

- At an aggregate level
- Models: Chain-Ladder, Bornhuetter-Ferguson, Cape Cod, stochastic and many more

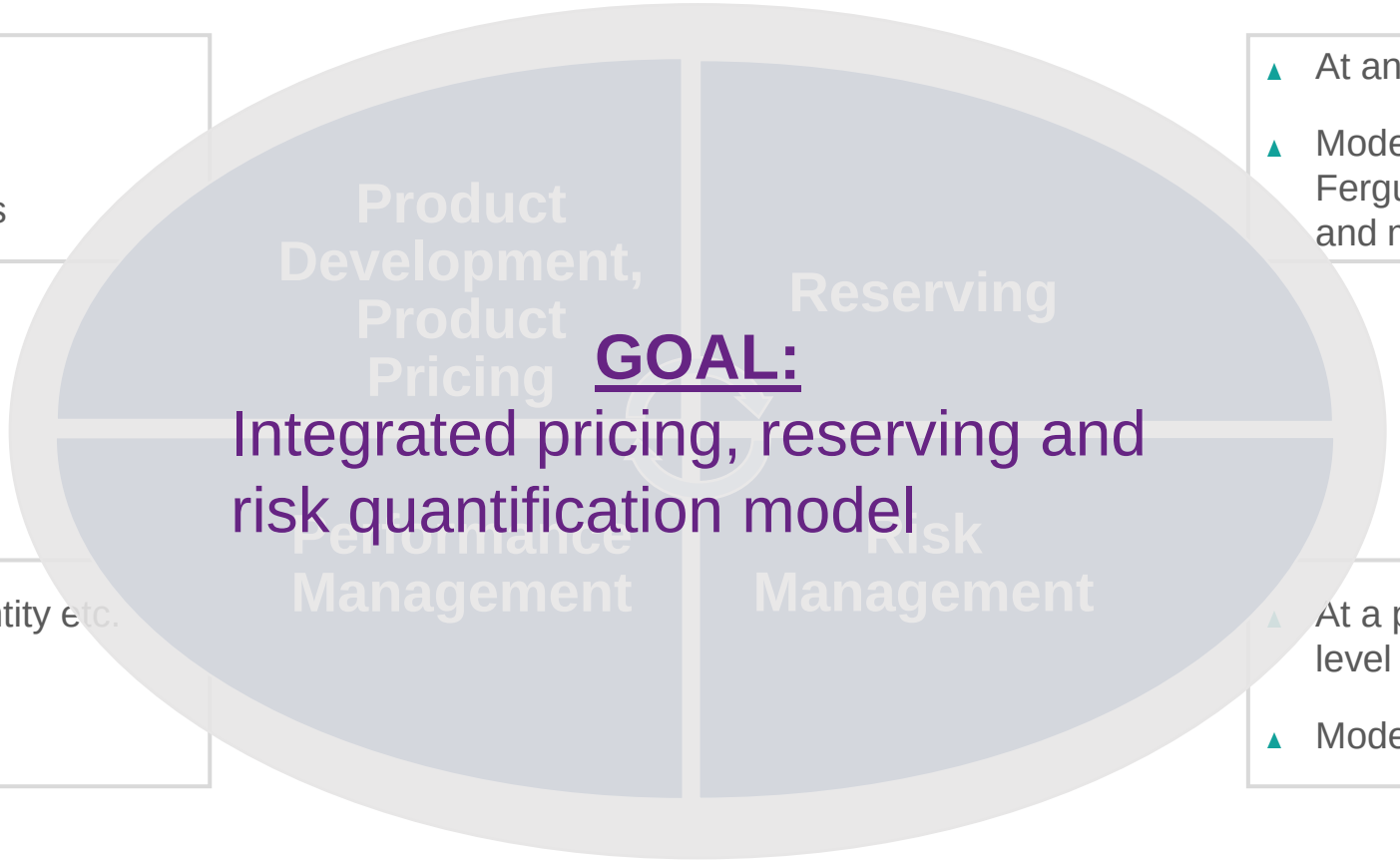
- At a product, portfolio, entity etc. level
- Models: DFM

- At a product, portfolio, entity etc. level
- Models: ERM

Introduction

- At a policy level
- Models: burning cost, frequency/severity, GLMs

- At an aggregate level
- Models: Chain-Ladder, Bornhuetter-Ferguson, Cape Cod, stochastic and many more



GOAL:

Integrated pricing, reserving and risk quantification model

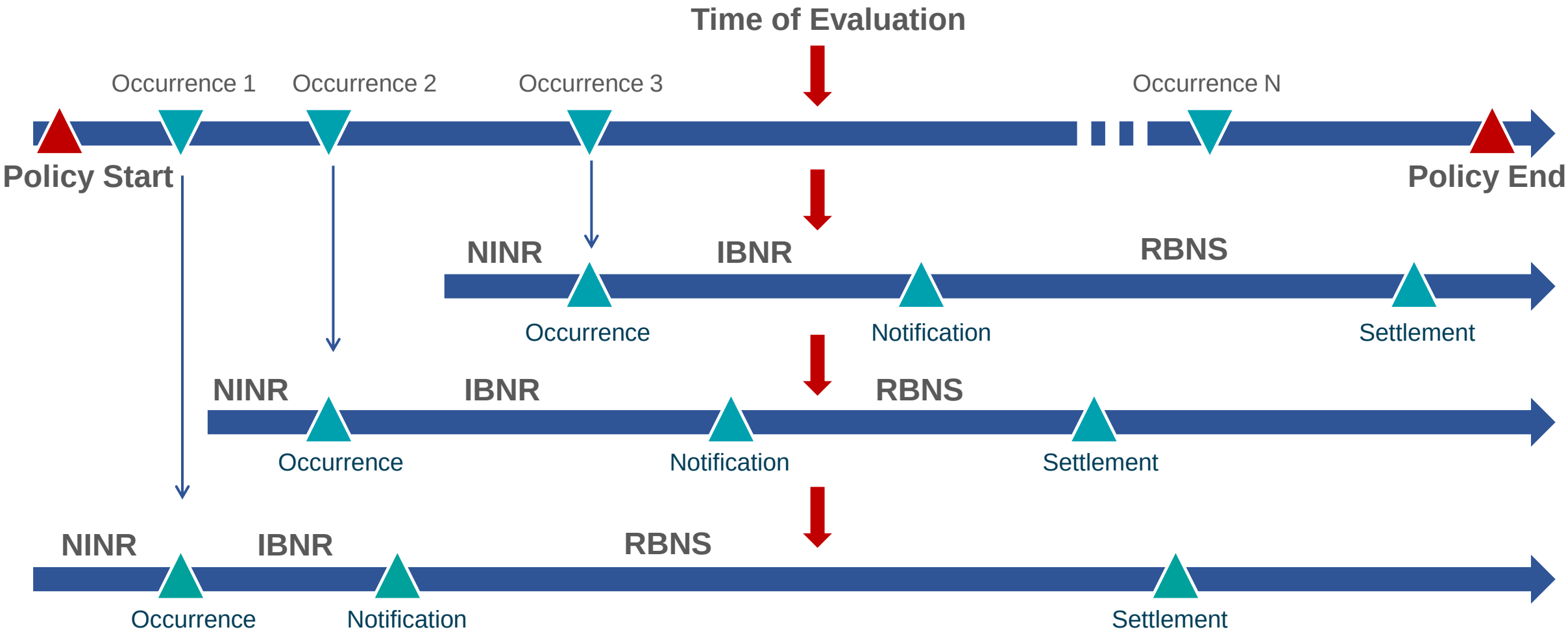
- At a product, portfolio, entity etc. level
- Models: DFM

- At a product, portfolio, entity etc. level
- Models: ERM

Model Outline

- **NINR**: Not Incurred and hence Not Reported
- **IBNR**: Incurred but Not Reported
- **RBNS**: Reported but Not Settled

Model Outline

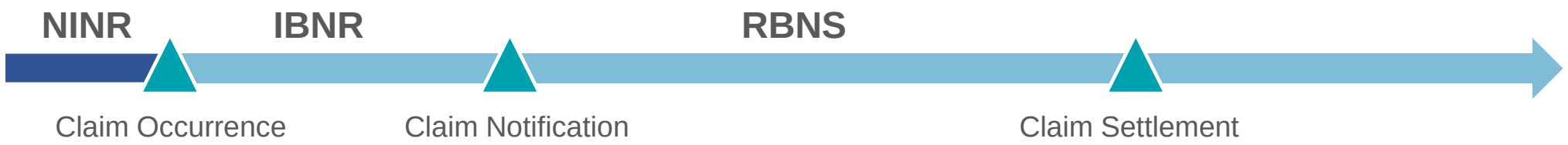


Model Outline

Observations

- For an individual policy, at any point in time, any claim is either NINR, IBNR or RBNS
- We would like to model the value of claims for each of the above categories over time...
- ... therefore we require at least the following elements:
    - A distribution for the number of NINR claims
    - A model for the number of IBNR claims
    - A model for the claim size

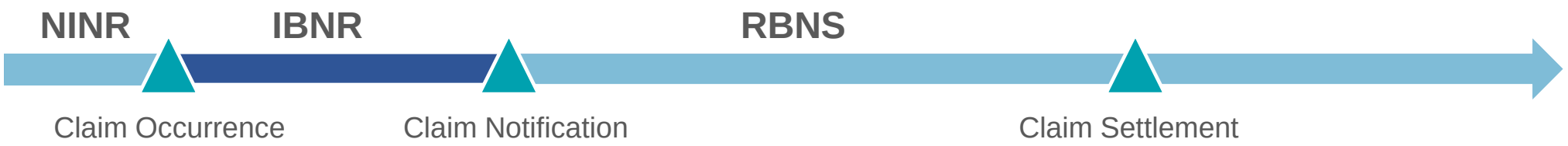
Model Outline



Model Assumptions

- Number of NINR claims in a certain time period follows a Poisson distribution
- Seasonality exists and is captured by the model

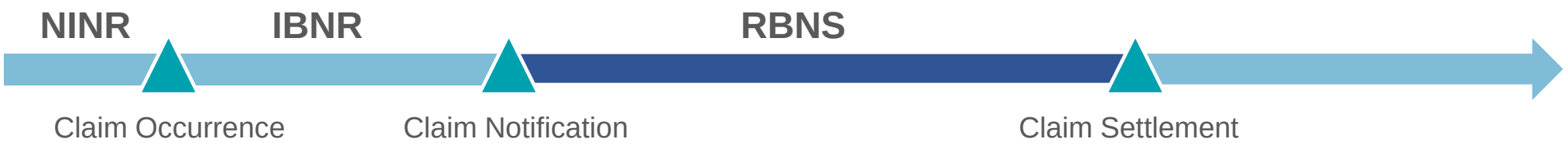
Model Outline



Model Assumptions

- IBNR claim defined as a difference between the number of claims that have occurred and the number of claims that have been reported
- If a policyholder reports a claim there are no claims other than the one reported…
- … hence when a claim has been reported the expected number of IBNR claims is set to zero

Model Outline



Model Assumptions

- Since RBNS clams have already been reported, we only need to estimate their value
- All claims are settled in one payment
- As we are aiming to fit a claim size distribution for individual policies in a way which is coherent with pricing models, a natural choice for a claim size model is GLM

Model Outline

Model Assumptions

- Number of claims can change over time, but is independent from the past
- Number of claims is independent of the claim size and conditional on policyholder behaviour
- Policyholders behave independently from each other

Case Study

Portfolio

- Small motor insurance portfolio (comprehensive cover)
- Six years of data (January 2008 – June 2013)
- Number of policyholders started at zero and increased up to 44k policyholders after six years

Case Study

Policy Data

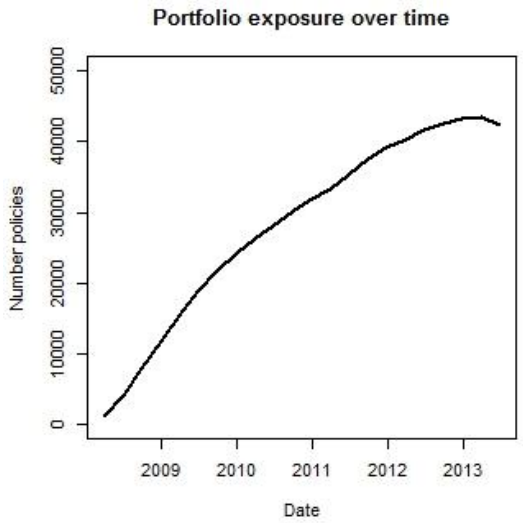
- Make, model
- Weight
- Mileage
- Value
- Fuel type
- Building year of vehicle
- Usage
- Region

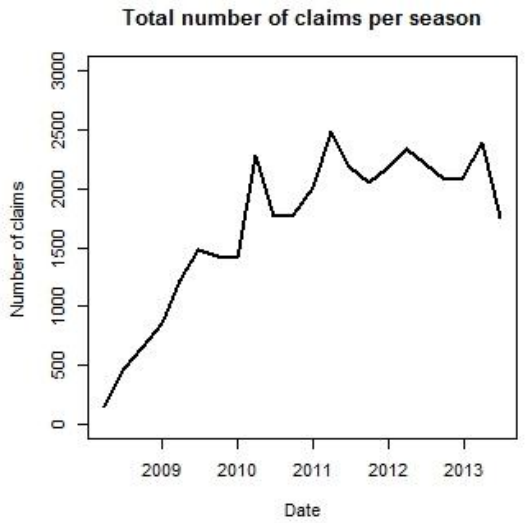
- Age
- Driving experience
- Number of claim-free years
- Deductible
- Net premium

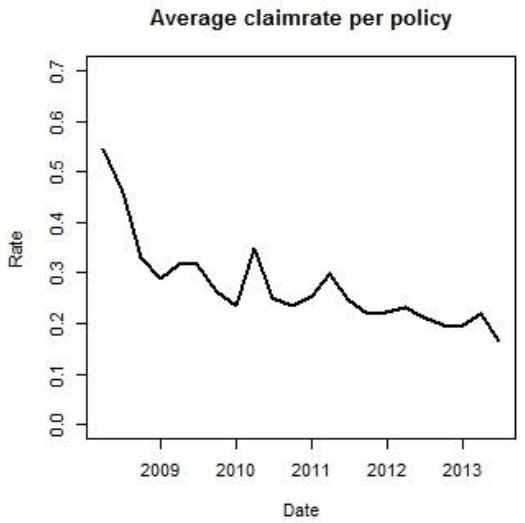
Claims Data

- Type of accident
- Occurrence time
- Reporting delay
- Size of payments
- Time of payments
- Time of settlement
- Case reserve
- Injury

Case Study



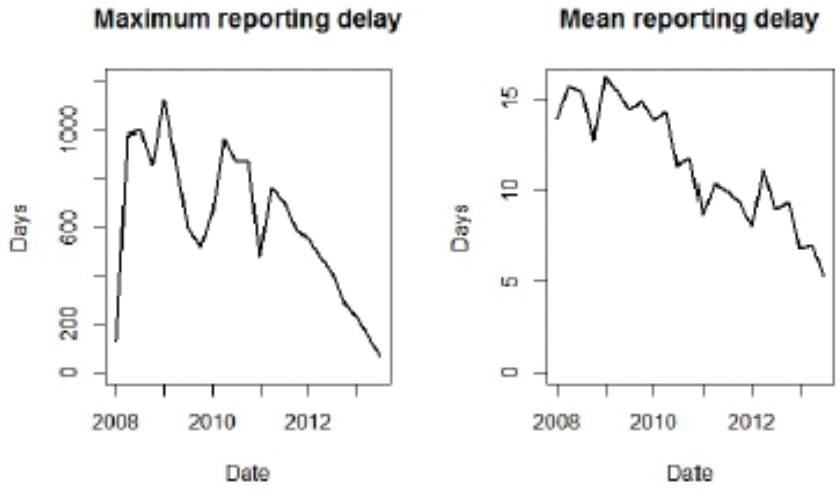




Claim Rate

- Values aggregated to a season level
- Slight downward trend in average claim rate visible

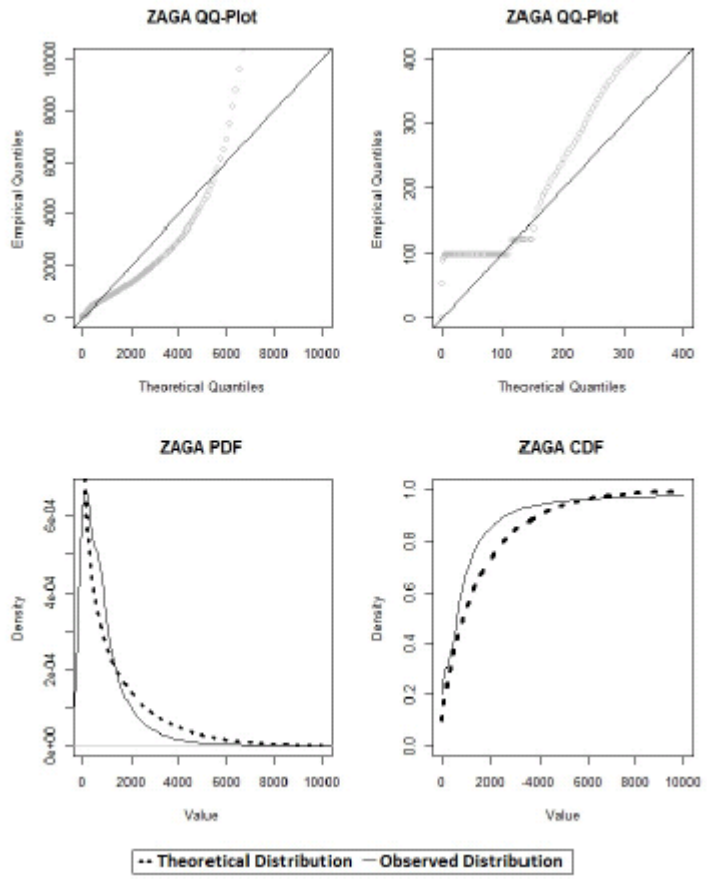
Case Study



Reporting Delay

- Estimate of reporting delay based on claims which occurred before January 2011
- Assume that the distribution does not change over time

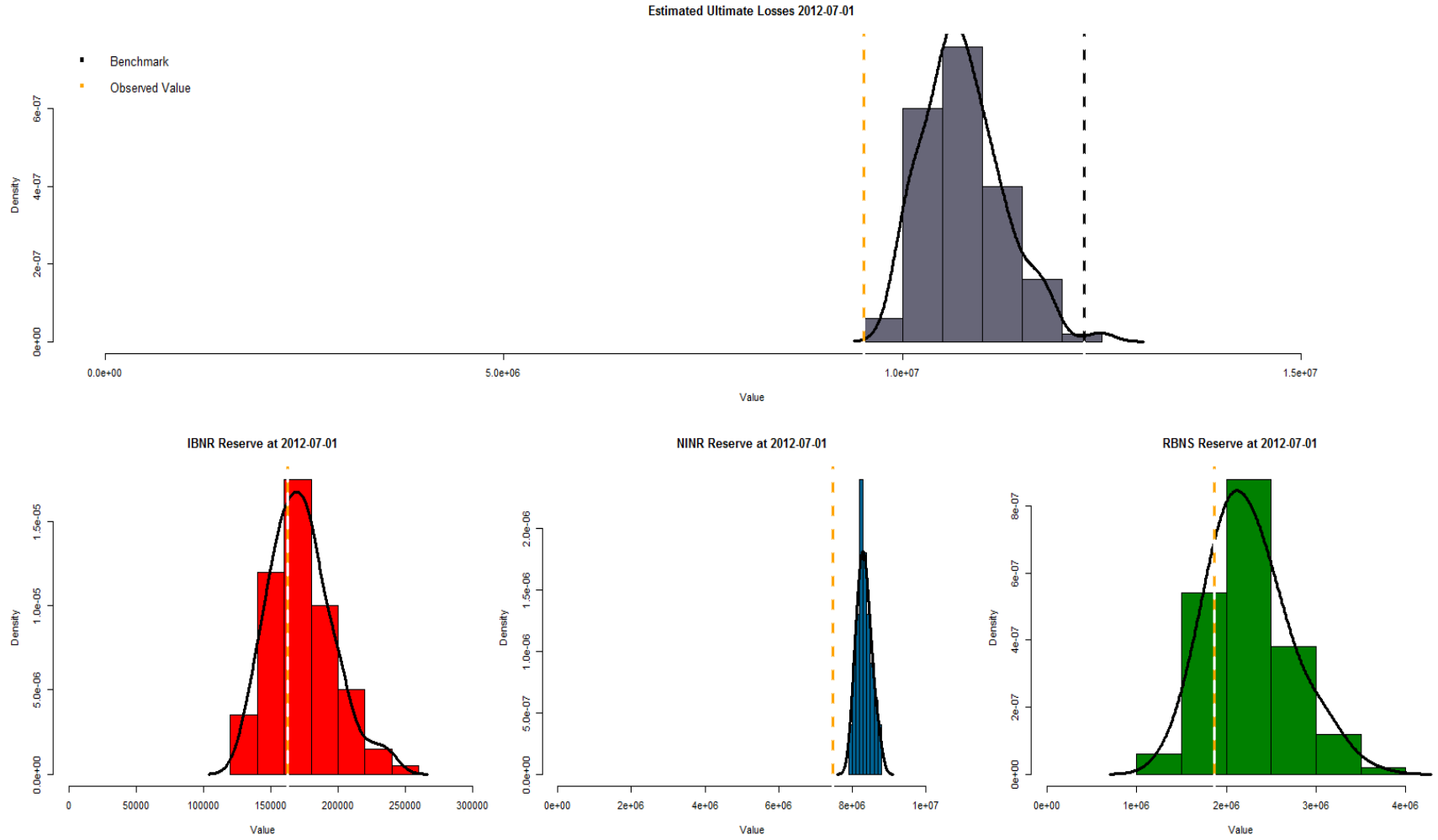
Case Study



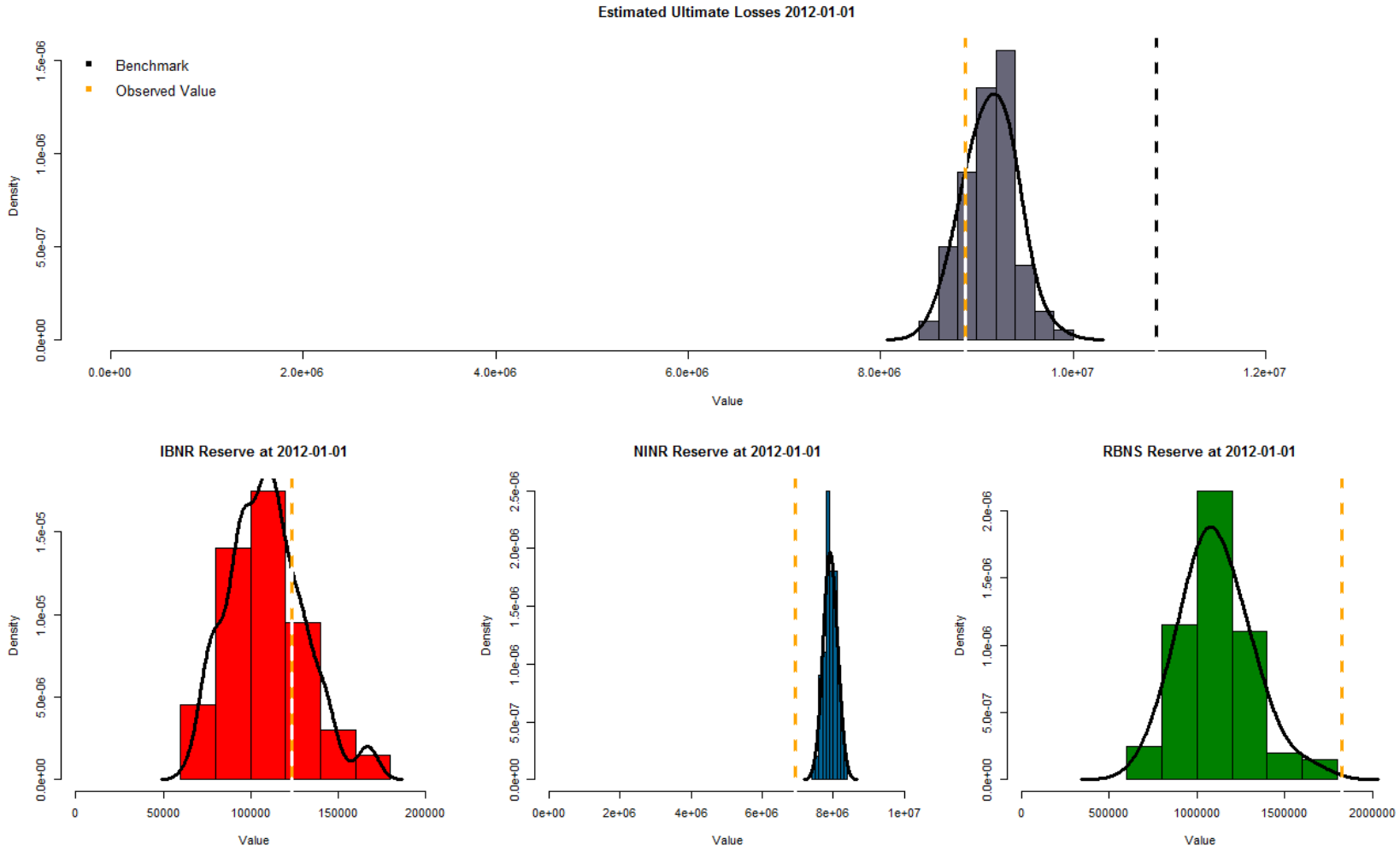
Claim Size

- Large number of cases with no payments hence...
- ... used Zero Adjusted Gamma Distribution (ZAGA) which used an extra parameter to allow probability mass at zero
- Two GLM models used, one for NINR and IBNR claims and one for RBNS claims

Case Study


Estimated Ultimate Losses 2012-07-01
Benchmark
Observed Value
Density
0e+00
2e-07
4e-07
6e-07
0.0e+00
5.0e+06
1.0e+07
1.5e+07
Value
IBNR Reserve at 2012-07-01
Density
0.0e+00
5.0e-06
1.0e-05
1.5e-05
0
50000
100000
150000
200000
250000
300000
Value
NINR Reserve at 2012-07-01
Density
0.0e+00
5.0e-07
1.0e-06
1.5e-06
2.0e-06
0e+00
2e+06
4e+06
6e+06
8e+06
1e+07
Value
RBNS Reserve at 2012-07-01
Density
0e+00
2e-07
4e-07
6e-07
8e-07
0e+00
1e+06
2e+06
3e+06
4e+06
Value

Case Study


Estimated Ultimate Losses 2012-01-01
Benchmark
Observed Value
Density
Value
IBNR Reserve at 2012-01-01
NINR Reserve at 2012-01-01
RBNS Reserve at 2012-01-01

Conclusions

Model Applications

- Reserving for inhomogeneous lines of business
- Valuable when the insurance portfolio or behaviour changes over time
- Profitability analyses on a detailed level, consistent with pricing and reserving
- Modelling capital requirements under Solvency II, ORSA input

Conclusions

Further Model Developments

- Multiple payments
- Separate models for property and bodily injury claims
- One-year horizon for Solvency II purposes
- Incorporation of lapses and catastrophe events

Conclusions

Pros

- Flexibility
- Does not require long observation history
- Does not required homogenous portfolio
- Allows joint calculation of net premium, reserves and risk measures
- Can be updated in a real time, no need to extrapolate as claims are modelled in continous time

Cons

- Complexity
- High amount of data required
- Long computation time
- Might be hard to parameterise
- Possible high parameter error
- Expert judgment involved

TRIPLE A
RISK FINANCE

Questions?

TRIPLE A
RISK FINANCE

Thank you

Emilia Kalarus FIA
emilia.kalarus@aaa-riskfinance.pl
+48 505 849 998

Plac Trzech Krzyży 3
00-535 Warszawa