Thriving on Change

16th General Insurance Seminar

Institute of Actuaries of Australia

9-12th Nov 2008

Hyatt Regency Coolum

Modelling Claim Development Processes

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Outline

- Open Claims vs. Closed Claims
- Claims Development
- Models
- Results on CTP Industry Data
- Discussions
- Questions

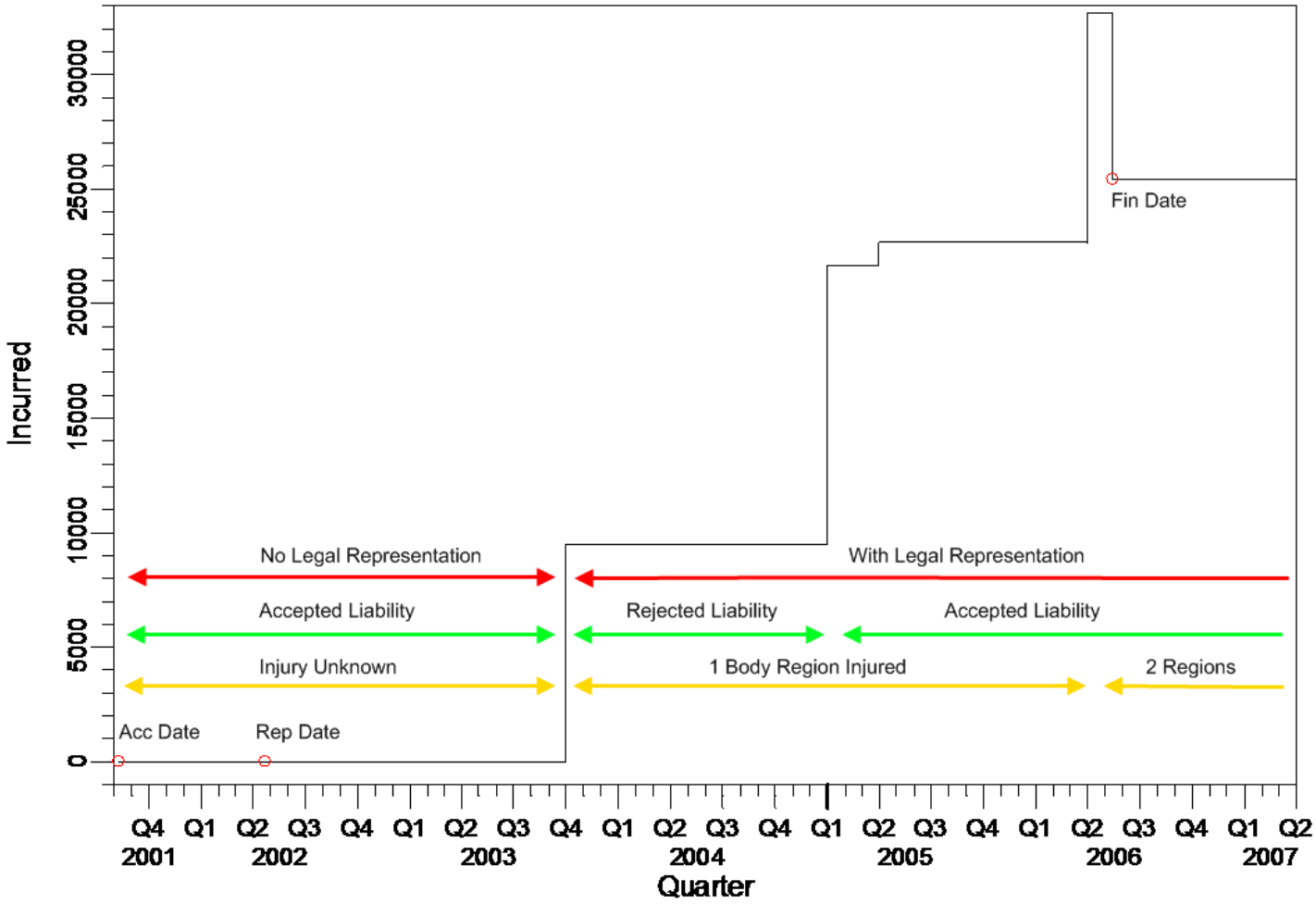
Open Claims

- Pricing
  - Open claims provide an incomplete view, estimates may not be central
  - Long tail products especially affected
- Solutions
  - Discard claims?
  - Discard accident periods?
  - Use Valuation – aggregated ultimate-to-case ratios

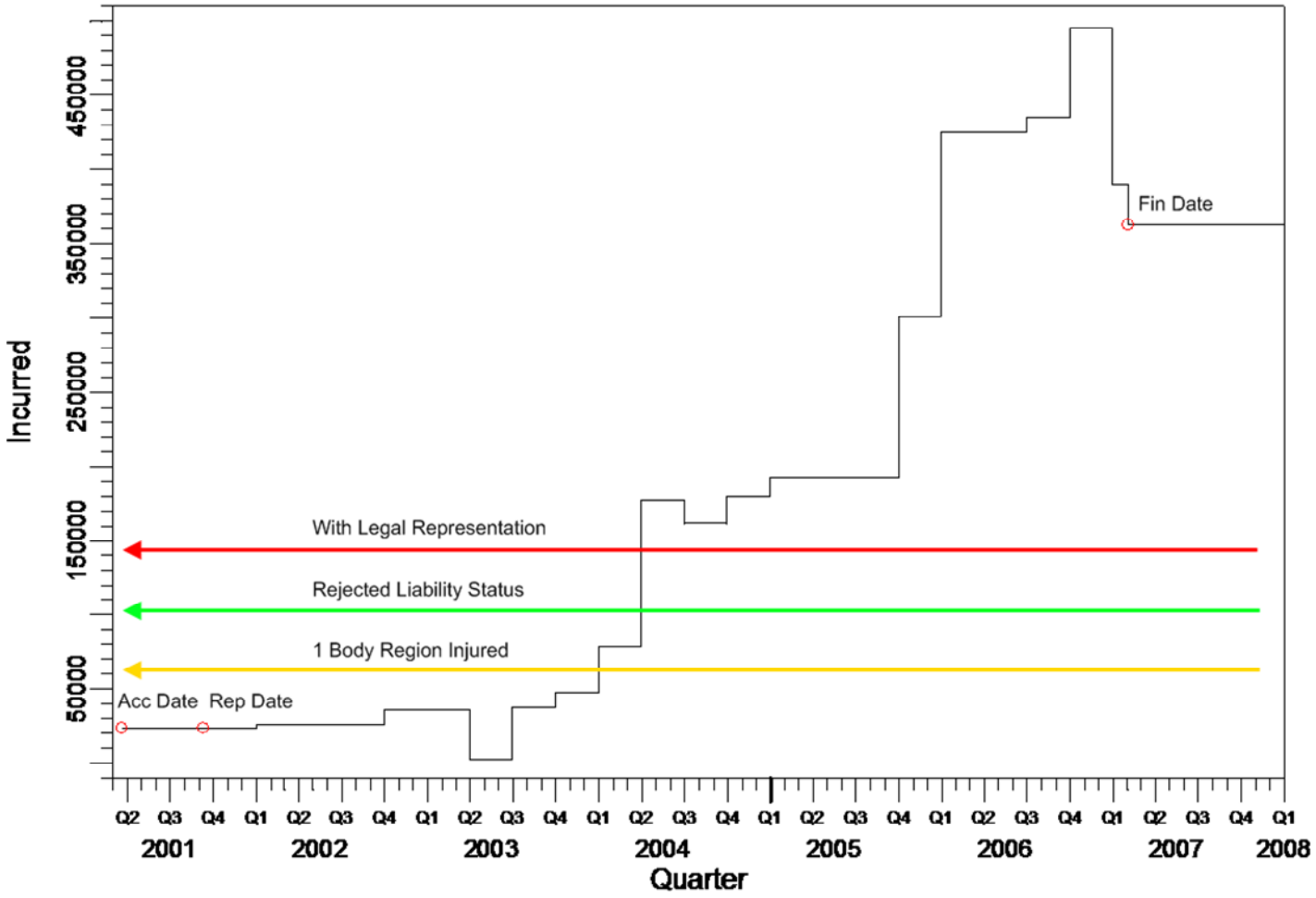
Claims Development

- Causes of change
  - New information about the claim
  - New claims environment
- From the new set of information
  - Revised view of claims cost
  - New case estimate
- Number of changes vs. Real time?

Sample Path 1



Sample Path 2



Component Processes

- The complete claims development process broken up
- Individual revisions
  - Delay since last revision
  - Claim settled or not
  - Direction of movement
  - Size of movement

Time Measurement

- Use number of changes
  - Can account for changes in finalisation
  - PPCF in operational time
  - Changes in claim profile?
- Modelling perspective: using number of changes guarantees a change

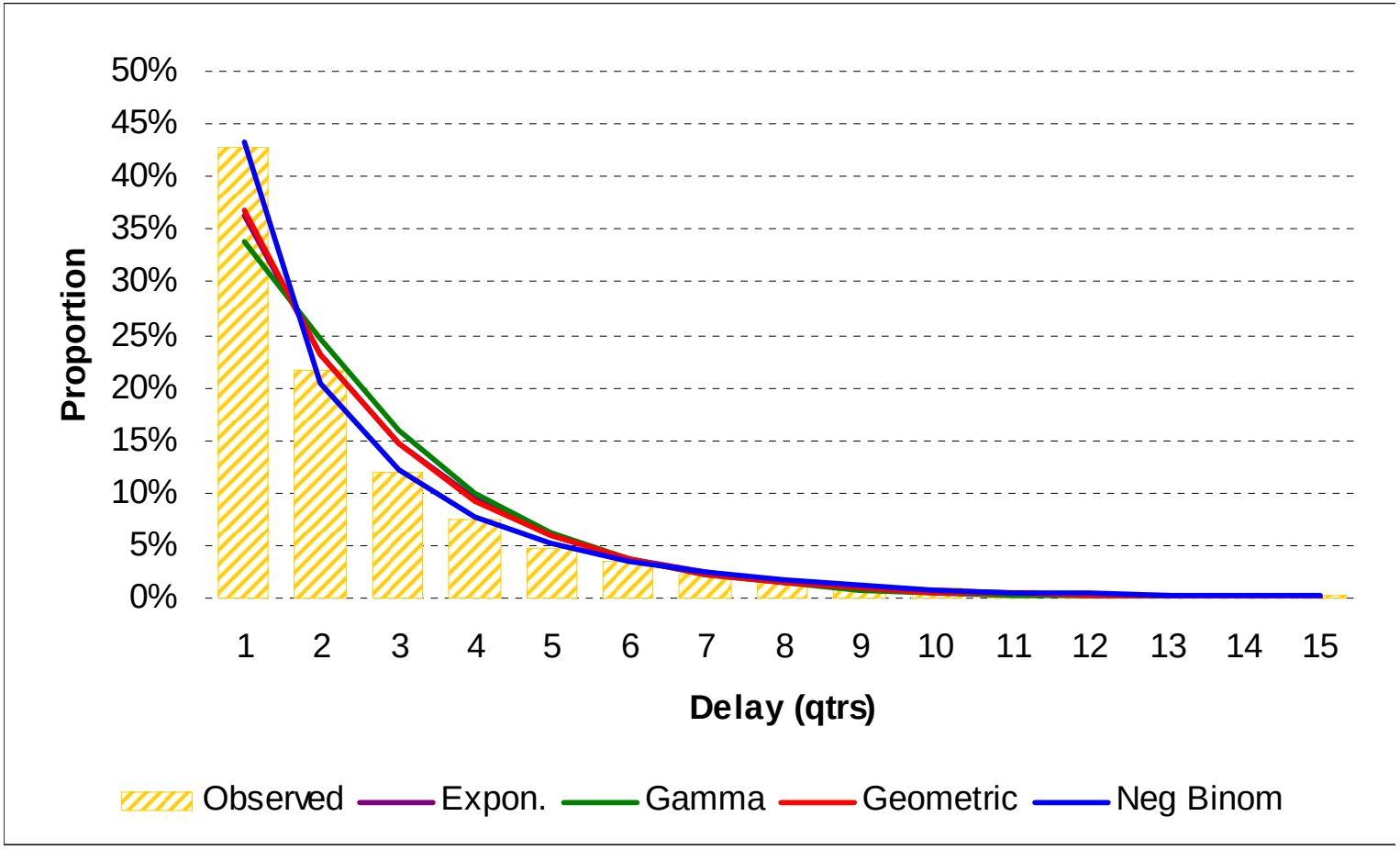
DATA

- NSW CTP Industry data
  - 7.5 years of data since accident year 2000
  - MACA
  - 70,000 claims, 60,000 finalised
  - 200,000 changes

Delay Process

- Time measured from last revision
- Choice of continuous or discrete distributions
- Provide information on other processes
- CTP Data – Negative Binomial fits well

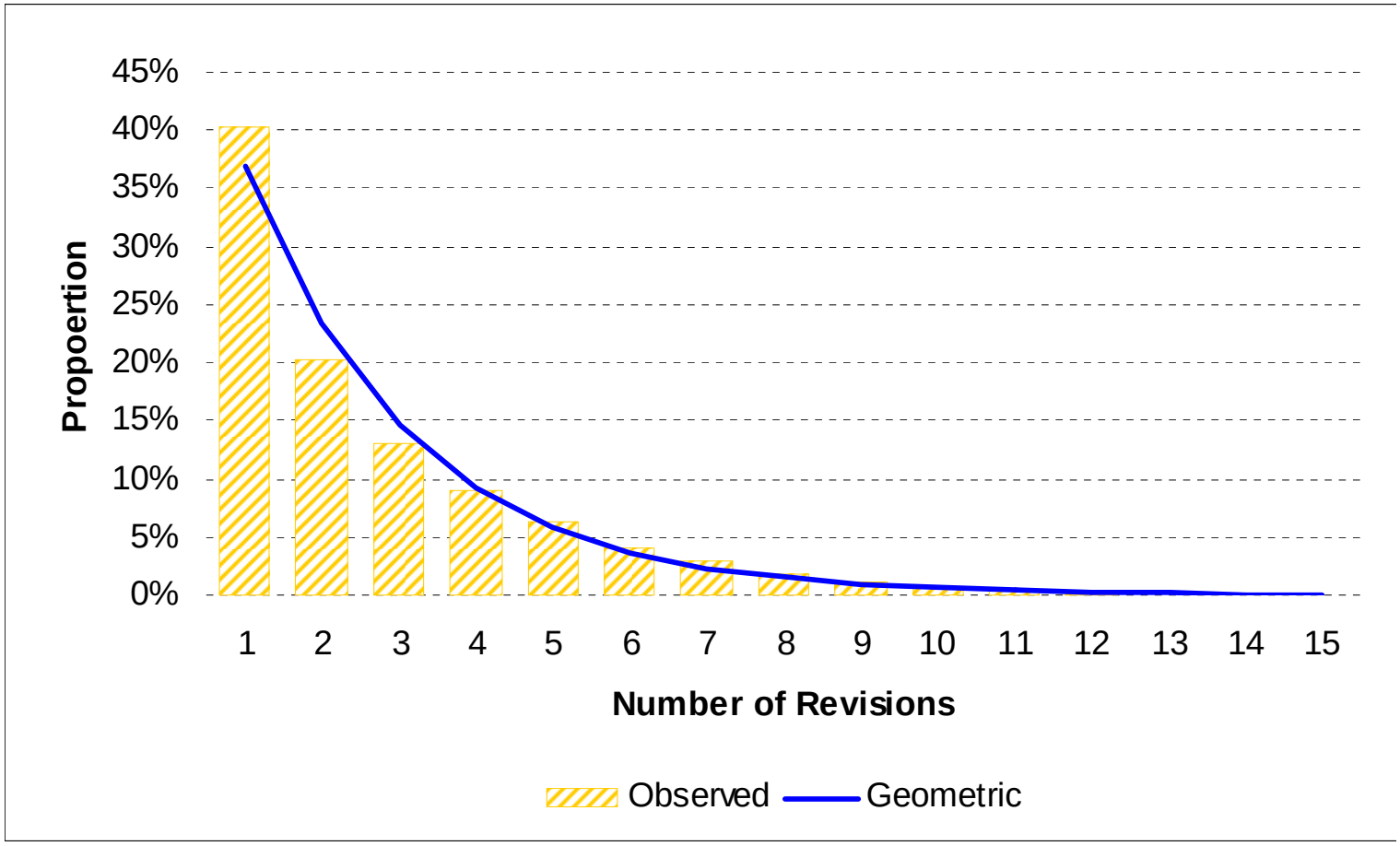
Delay Process, CTP Data



Claim Status

- Model number of revisions?
  - Cannot account for changing characteristics
- Binary variable to flag status of claim
  - Probability of finalisation is modelled
- If probability is constant, then the number of changes follows a Geometric distribution

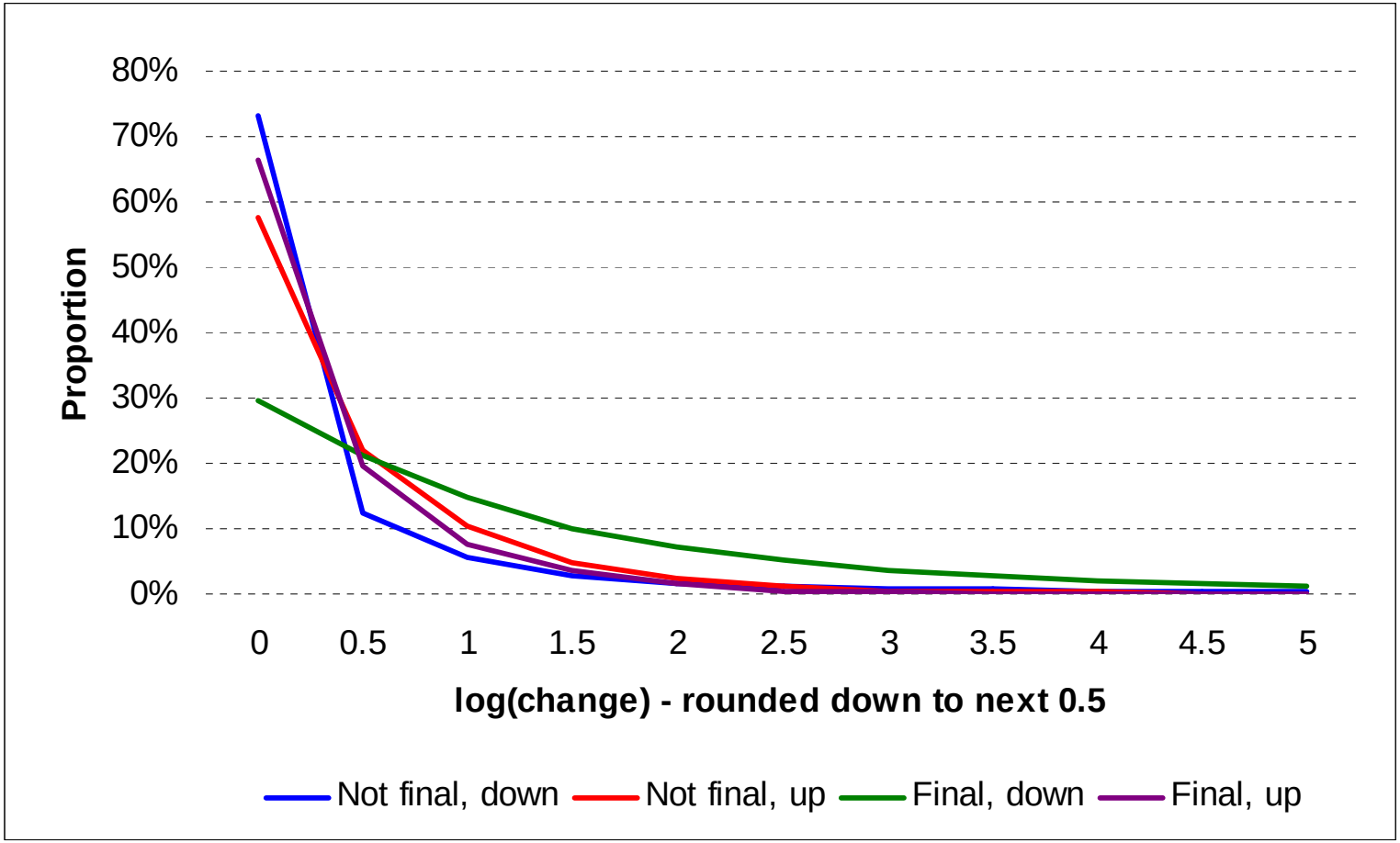
Number of Revisions, CTP Data



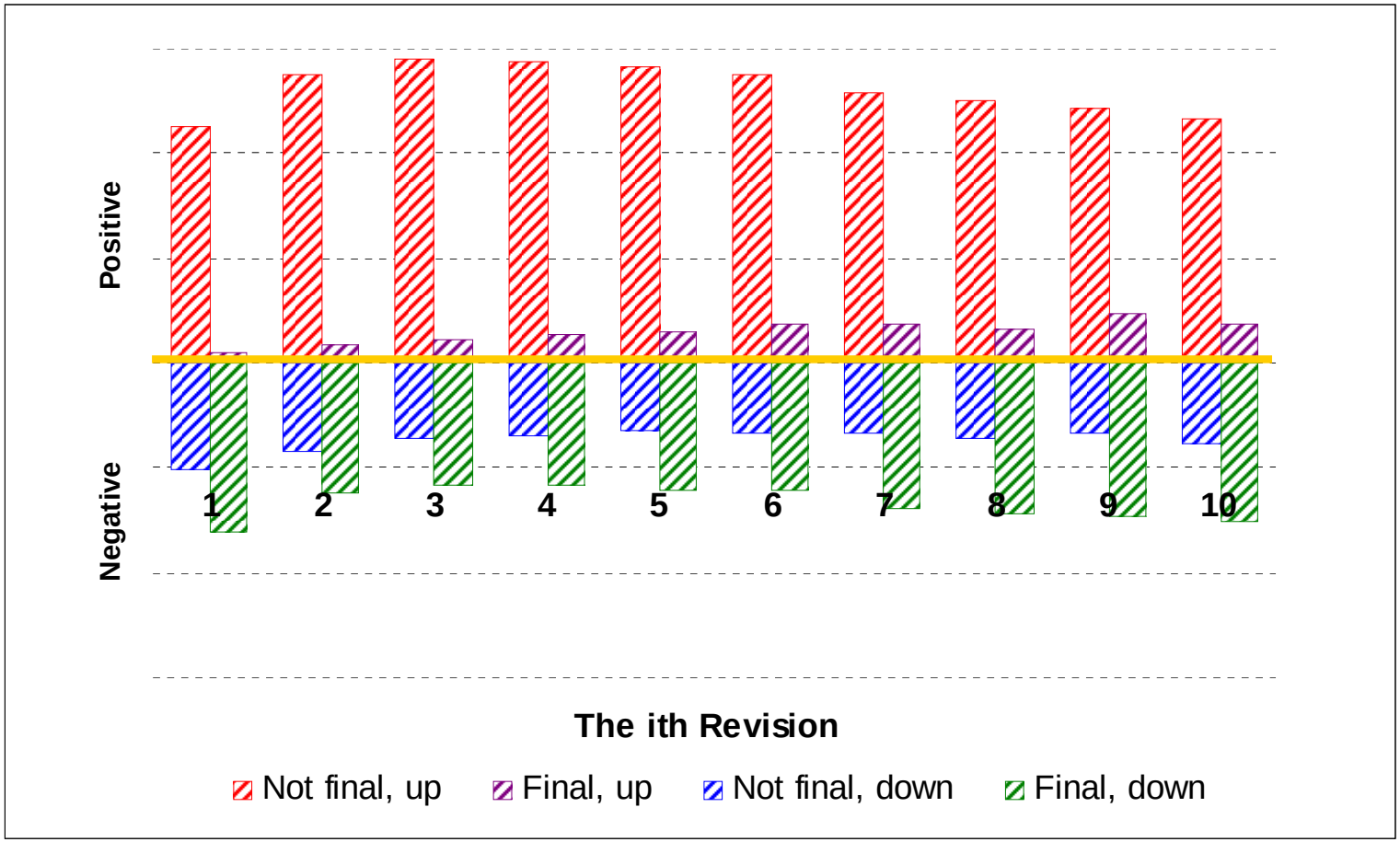
Direction of Change

- Modelling Direction and Size separately
  - Up and down movements behave differently
- Direction is modelled as a binary variable
  - Probability of an upward movement is modelled

Size of Change, by Direction and Status



Direction of Change

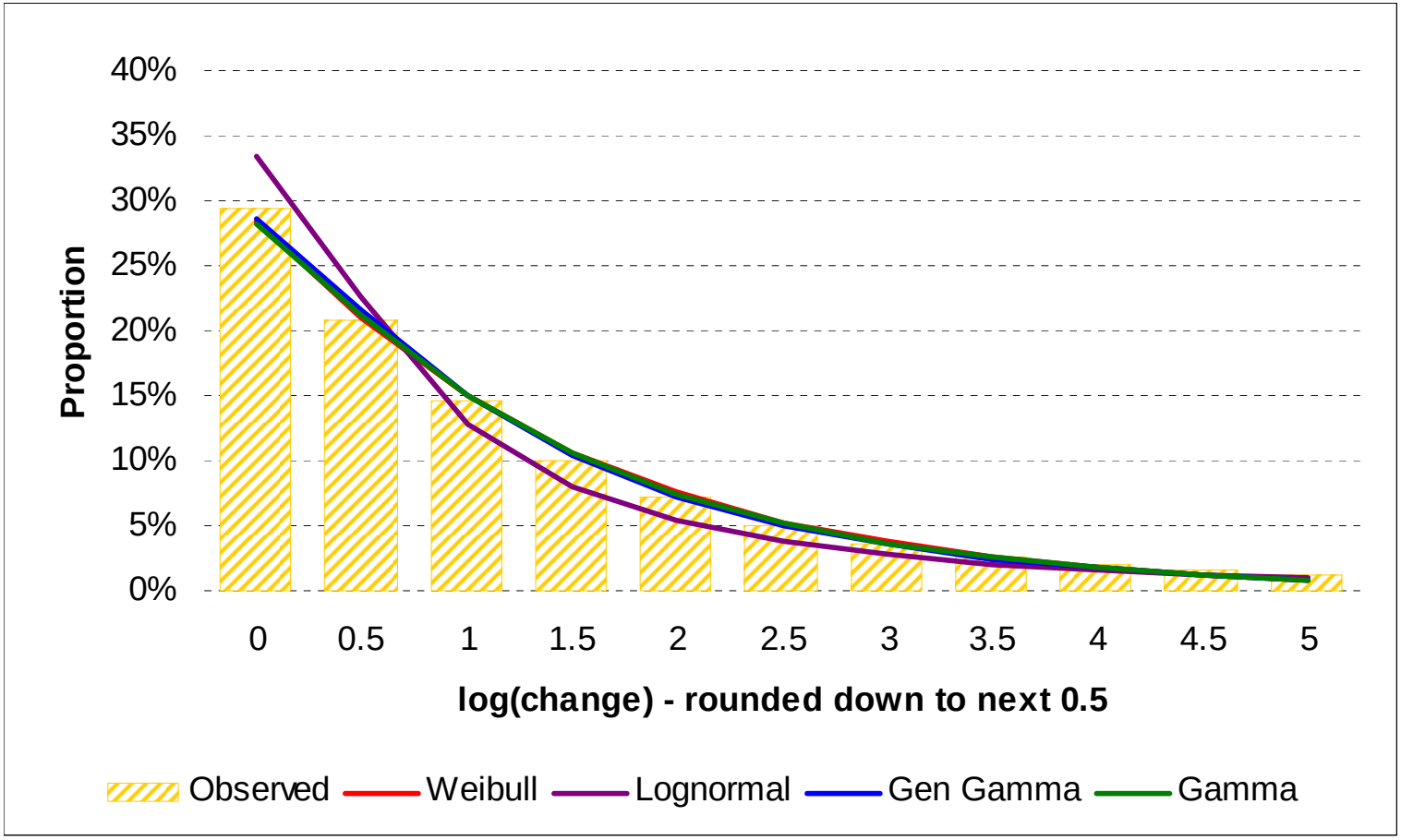


Size of Change

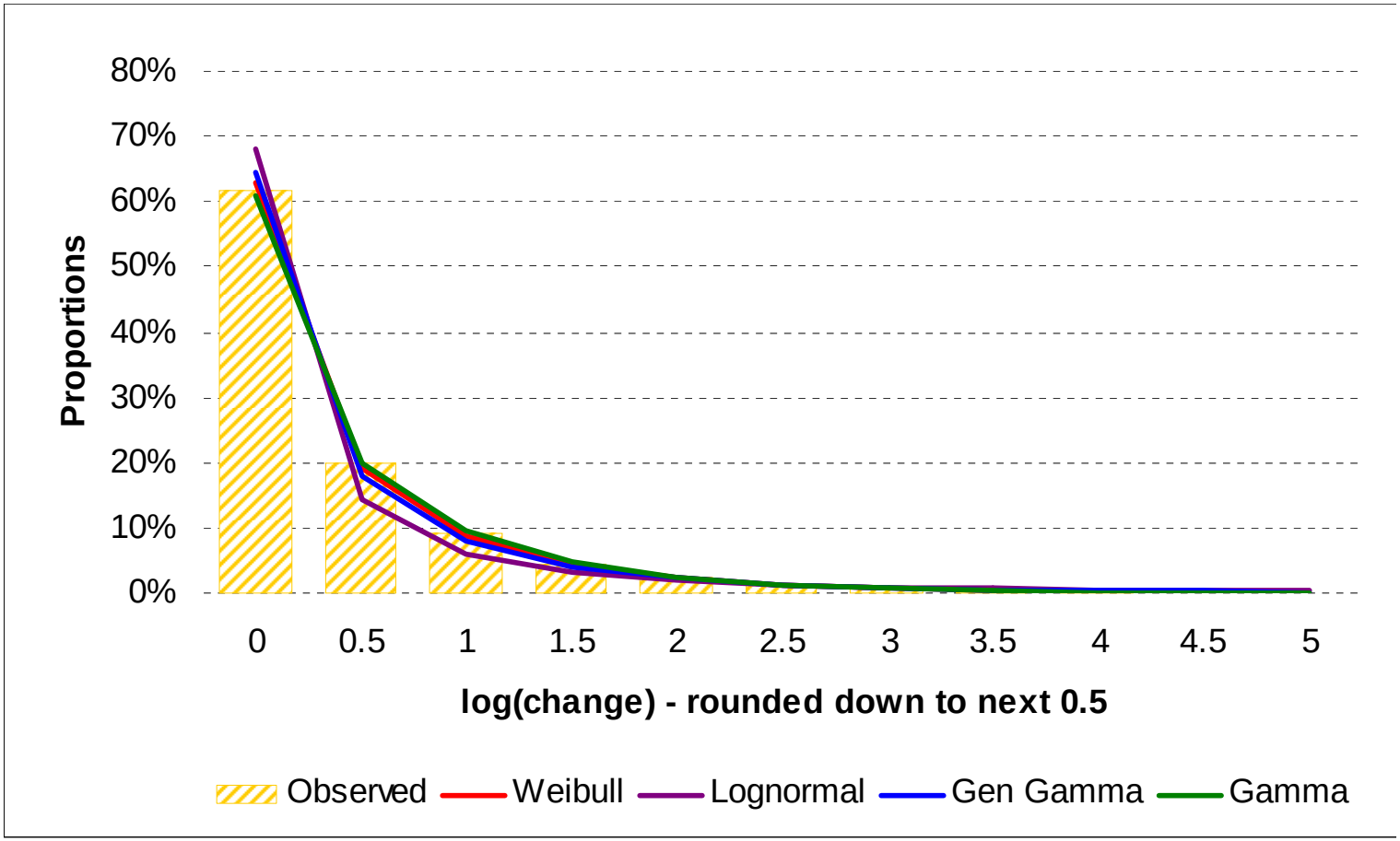
- abs(log(New Claims Cost/Old Claims Cost))

- Many distributions to chose from
  - Lognormal
  - Gamma
  - Generalised Gamma

Size of Change, Savings on Finalisation



Size of Change, Other Changes



Modelling

- Modelling Hierarchy
  1. Delay (only using information from last revision)
  2. Claim Status
  3. Direction of change
  4. Size of change
- GLM framework
  - Familiar grounds
  - Log links used, coefficients are easy to interpret

Variables

- Process Variables
  - Delay
  - Size of claim
  - Previous Change
- Static Variables
  - Age at Accident
  - Gender
  - Location (vehicle)
- Dynamic Variables

Dynamic Variables

- Variables that change value over the lifetime of the claim
  - Liability status
  - Legal representation/Litigation status
  - Injury severity
- More interesting
  - Current level, or
  - Changes in value

Dynamic Variables

- Easy to Model
  - Use as covariates in the GLM process
- Difficult to use to Predict
  - Predictive Model need to predict future values of dynamic variable
  - Ignore?
  - Condense many in one variable?
  - Survival Analyses?
  - Take a snapshot?

Software

- Specifying likelihood and maximising it is preferred
  - S-PLUS cannot handle dataset size
  - SAS 9.1 cannot handle programming
- SAS GLM used
  - Approximate for Delay process
- SAS 9.2 to contain programming functionality

Results

- Industry wide results
  - Do not apply to particular insurer
- Main effects only

The ith Revision

Type	Parameter	Level1	t_ij	S_ij	D_ij	Y_ij D_ij = 0	Y_ij D_ij = 1
D	Ith Revision	1	0.50	0.25 - 1.26		0.32 -	0.55
D	Ith Revision	2	-	-	-	-	-
D	Ith Revision	3	- 0.11	0.01	0.25 -	0.10	0.00
D	Ith Revision	4	- 0.17	0.08	0.36 -	0.16 -	0.00
D	Ith Revision	5	- 0.23	0.17	0.44 -	0.23	0.01
D	Ith Revision	6	- 0.25	0.21	0.49 -	0.23 -	0.04
D	Ith Revision	7	- 0.28	0.36	0.45 -	0.27 -	0.07
D	Ith Revision	8	- 0.29	0.33	0.34 -	0.23 -	0.09
D	Ith Revision	9	- 0.26	0.41	0.51 -	0.21 -	0.14
D	Ith Revision	10	- 0.29	0.41	0.30 -	0.32 -	0.16
D	Ith Revision	11 or more	- 0.28	0.43	0.73 -	0.35 -	0.22

Injury

Type	Parameter	Level1	t_ij	S_ij	D_ij	Y_ij D_ij = 0	Y_ij D_ij = 1
D	ISS	unknown/admin	.	-	-	-	.
D	ISS	1	.	0.30	- 0.40	.	.
D	ISS	2	.	0.21	- 0.34	.	.
D	ISS	3 - 5	.	0.09	- 0.19	.	.
D	ISS	6 - 10	.	- 0.03	- 0.04	.	.
D	ISS	11 - 30	.	- 0.05	0.01	.	.
D	ISS	31 - 75	.	0.42	0.12	.	.
D	ISS increase	1	.	0.38	.	.	.
D	ISS increase	0	.	-	.	.	.
D	Number of Regions	0	.	-	-	-	
D	Number of Regions	1	.	0.12	- 0.05	0.10	
D	Number of Regions	2	.	0.18	- 0.12	0.13	
D	Number of Regions	3	.	0.25	- 0.10	0.14	
D	Number of Regions	4	.	0.44	- 0.18	0.18	
D	Number of Regions	5	.	0.60	- 0.18	0.23	
D	Num Reg increase	1	.	0.48	- 0.18	0.10	
D	Num Reg increase	0	.	-	-	-	

Delay between Revisions

Type	Parameter	Level1	t_ij	S_ij	D_ij	Y_ij D_ij = 0	Y_ij D_ij = 1
P	t_0	1	.	-	-	-	-
P	t_0	2	.	- 0.18	0.11	0.20	- 0.04
P	t_0	3	.	- 0.06	0.17	0.35	0.04
P	t_0	4	.	- 0.06	0.25	0.42	0.09
P	t_0	5	.	- 0.03	0.25	0.48	0.13
P	t_0	6	.	0.05	0.35	0.51	0.17
P	t_0	7	.	- 0.01	0.38	0.53	0.19
P	t_0	8	.	0.09	0.35	0.56	0.17
P	t_0	9	.	0.04	0.49	0.52	0.22
P	t_0	10	.	0.12	0.47	0.56	0.21
P	t_0	11 - 15	.	0.11	0.60	0.54	0.23
P	t_0	16 or more	.	- 0.01	0.74	0.49	0.29
P	t_1	1	-	-	-	-	-
P	t_1	2	0.07	0.10	- 0.01	0.10	0.07
P	t_1	3	0.11	0.27	0.00	0.14	0.11
P	t_1	4	0.13	0.30	0.04	0.15	0.15
P	t_1	5	0.14	0.31	0.17	0.10	0.19
P	t_1	6	0.11	0.38	0.14	0.12	0.23
P	t_1	7	0.10	0.39	0.21	0.10	0.24
P	t_1	8	0.06	0.45	0.32	0.17	0.25
P	t_1	9	0.02	0.45	0.30	0.09	0.30
P	t_1	10	- 0.01	0.52	0.22	0.02	0.29
P	t_1	11 - 15	0.01	0.64	0.27	0.06	0.27
P	t_1	16 or more	0.06	0.46	0.25	- 0.00	0.14

Year Effects

Type	Parameter	Level1	t_ij	S_ij	D_ij	Y_ij D_ij = 0	Y_ij D_ij = 1
S	Year of Accident	2000	0.27	1.72	- 0.16	.	.
S	Year of Accident	2001	0.26	1.44	- 0.22	.	.
S	Year of Accident	2002	0.27	1.26	- 0.24	.	.
S	Year of Accident	2003	0.27	1.10	- 0.19	.	.
S	Year of Accident	2004	0.29	0.85	- 0.09	.	.
S	Year of Accident	2005	0.27	0.54	- 0.00	.	.
S	Year of Accident	2006	0.19	0.29	- 0.03	.	.
S	Year of Accident	2007	-	-	-	.	.
D	Year of Revision	2000	0.59	- 2.40	.	.	- 0.09
D	Year of Revision	2001	0.48	- 2.14	.	.	- 0.18
D	Year of Revision	2002	0.44	- 1.53	.	.	- 0.18
D	Year of Revision	2003	0.48	- 1.26	.	.	- 0.04
D	Year of Revision	2004	0.42	- 1.14	.	.	- 0.03
D	Year of Revision	2005	0.32	- 0.81	.	.	0.02
D	Year of Revision	2006	0.24	- 0.41	.	.	0.03
D	Year of Revision	2007	-	-	.	.	-

Industry Data

- Quarterly summarised
- Individual insurers' claims management practices all mingled
- Lack of insurer's active claim management information

What's Next?

- Pricing
  - Project to ultimate
  - Or, get hands dirty and work with likelihoods
- Reserving
  - Project to ultimate
  - Similar issues to SCE
  - Need Payment Pattern
  - Need IBNR Model
  - Risk Margins

Questions