general insurance seminar

Tides of Change

12-13 November 2012

Sofitel Sydney Wentworth

Actuaries Institute

Seeing the Bigger Picture in Claims Reserving

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Motivation 1

- **Pictures for decisions:**
  - How many periods
  - Odd values
  - Seasonality
  - Tail ratios
  - Superimposed inflation

Calendar year	(Actual - Fitted) /Fitted
1980	51%
1981	56%
1982	9%
1983	29%
1984	12%
1985	3%
1986	-9%
1987	-16%
1988	-30%
1989	-24%
1990	-2%
1991	-2%
1992	-12%
1993	3%
1994	18%
1995	23%

?

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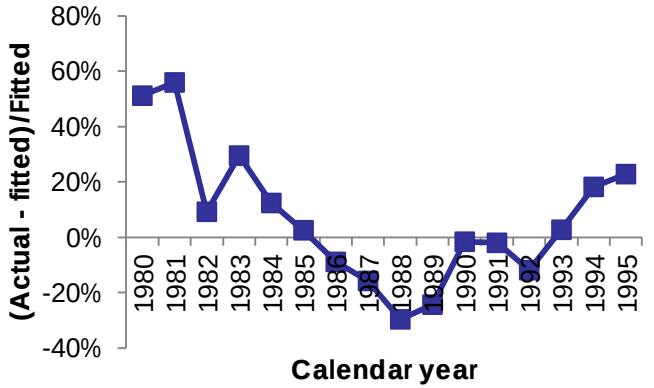
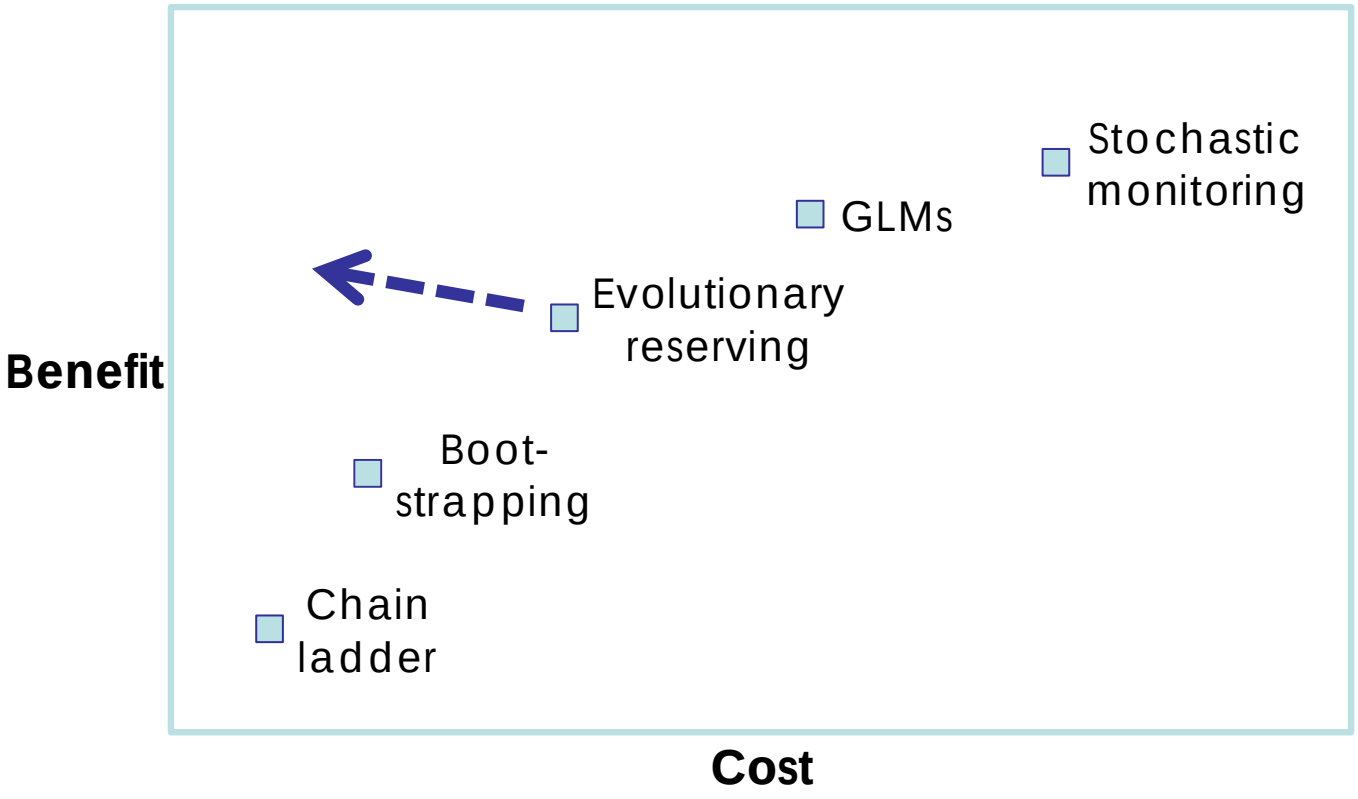


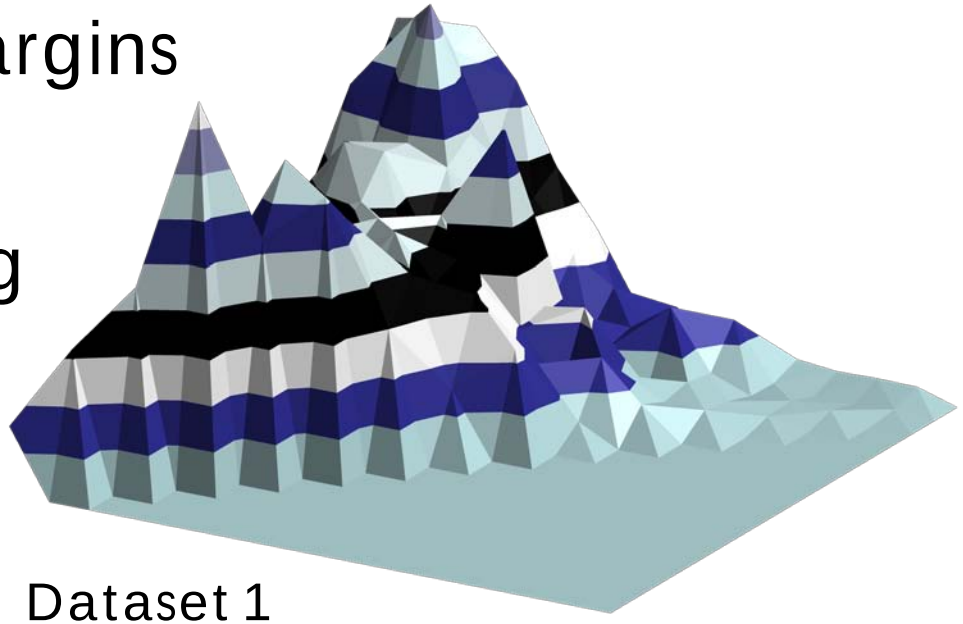
Motivation 2

- Lower cost/more benefit



Outline: Pictures and Their Stories

- Simple models – what can they tell us?
- Model error in risk margins
- Automating reserving



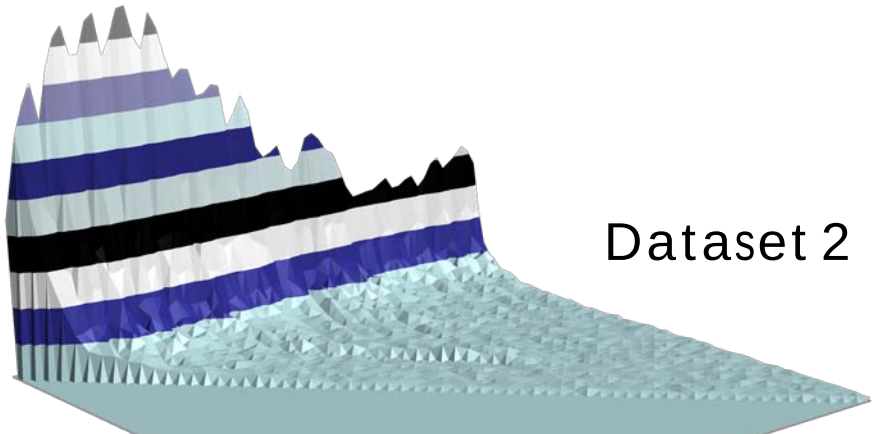
Dataset 1

Simple Models

- No model
- Chain ladder
- Simplified development pattern and grouped accident periods
- Smoothed accident periods

Increasing effort

- but not too much



Dataset 2

No Model

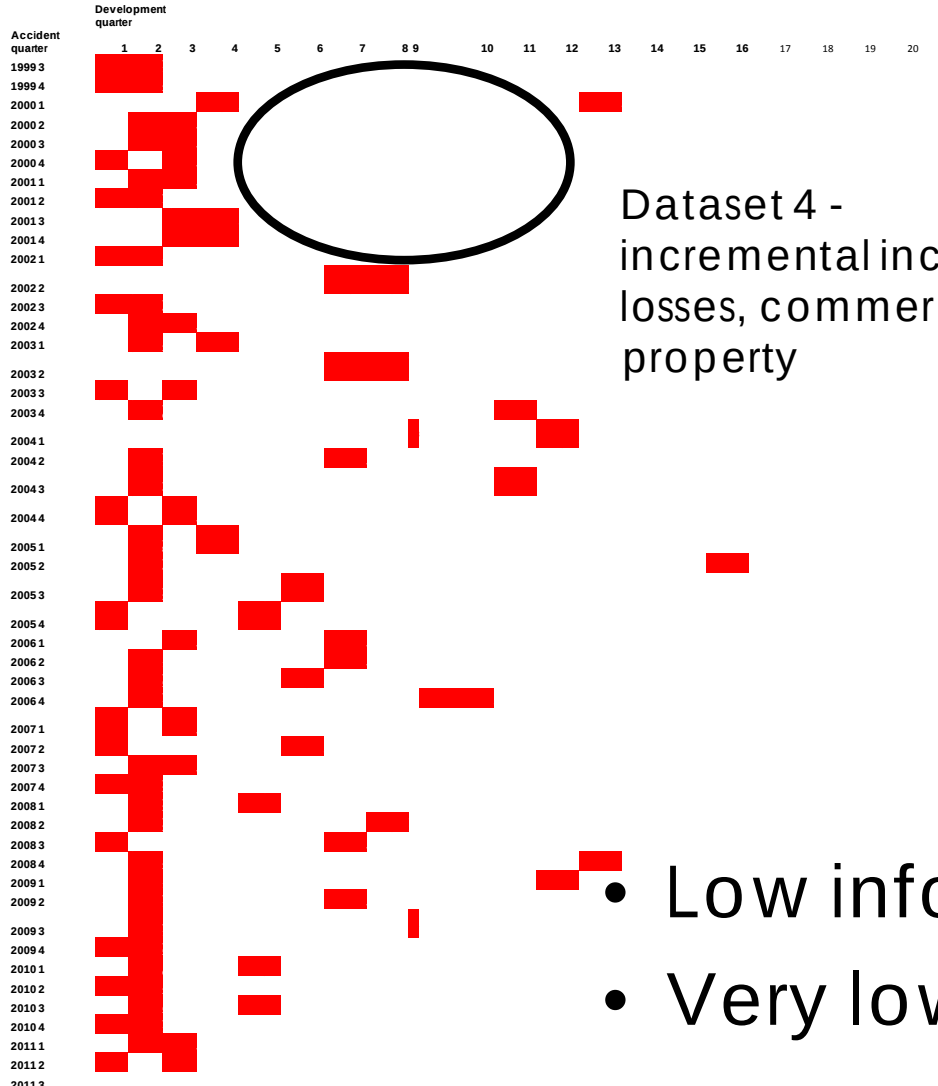
- Look for the peak shifting as you go down the triangle

Dataset 1 - Inflated Payment per Claim Incurred for Motor Bodily Injury

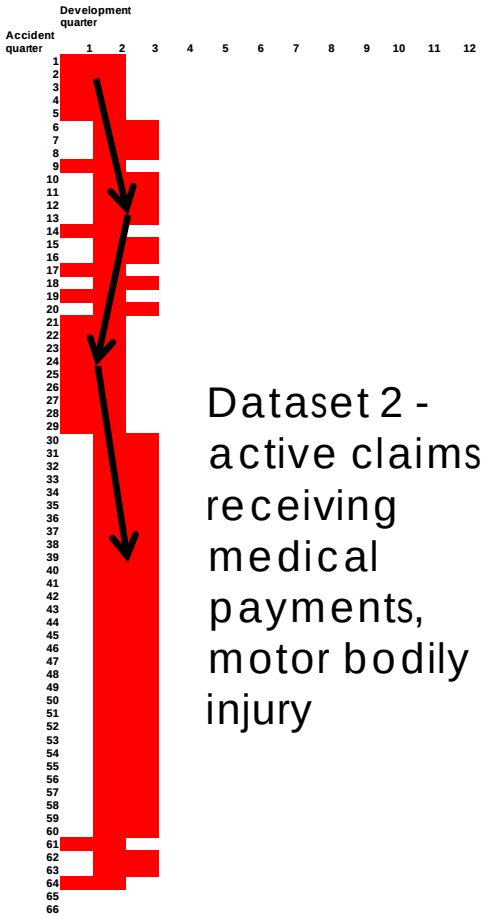
Accident year	Development year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1980	6,004	12,823	11,228	13,129	11,004	7,428	4,949	1,856	2,069	803	1,504	757	562	607	573	0
1981	5,686	8,698	13,805	12,720	8,344	6,648	4,428	3,243	1,908	1,919	2,844	286	41	48	171	
1982	3,271	11,039	11,457	15,446	9,826	6,050	2,712	1,786	2,403	3,687	1,026	331	478	401		
1983	3,735	7,794	8,555	9,675	8,904	4,404	4,249	3,336	2,089	614	1,233	717	381			
1984	3,708	7,530	10,018	9,912	6,494	4,973	12,138	4,265	4,574	1,792	961	938				
1985	2,625	5,366	7,442	8,233	7,145	8,352	5,948	3,861	1,386	3,271	1,461					
1986	2,369	6,227	6,452	7,368	8,466	6,624	7,291	4,594	3,246	944						
1987	2,349	4,328	6,196	8,053	7,598	8,831	6,848	6,726	4,528							
1988	2,128	6,043	4,177	8,614	5,900	6,598	7,851	2,944								
1989	2,670	4,028	6,082	6,948	11,626	10,613	6,027									
1990	2,836	5,498	5,040	8,578	13,680	12,325										
1991	2,996	4,543	9,458	9,086	10,698											
1992	2,883	6,004	7,309	17,273												
1993	3,561	5,615	8,985													
1994	2,961	6,430														
1995	3,131															

- Peak moves from 3-4 to 5-6
- Use no more than about 10 periods in standard model

No Model



Dataset 4 - incremental incurred losses, commercial property

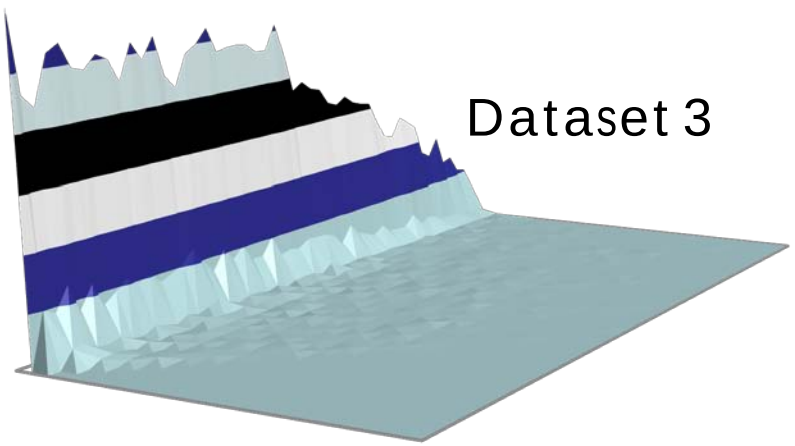


Dataset 2 - active claims receiving medical payments, motor bodily injury

- Low information
- Very low cost

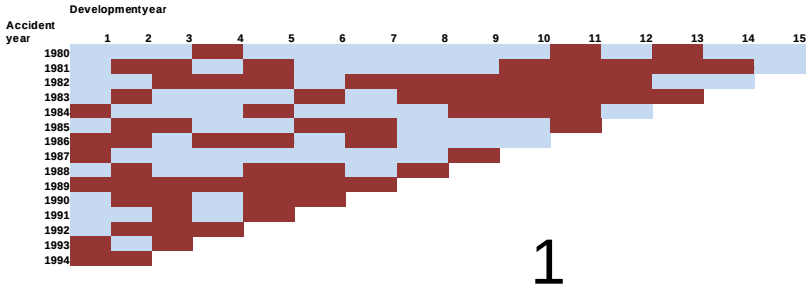
Chain Ladder Model Deviations

- Calculate ratios for usual "all" chain ladder
- Set up Fitted triangle
- Set up (Actual – Fitted) or (Actual – Fitted)/Fitted triangles
- Run macro
- Look for patterns

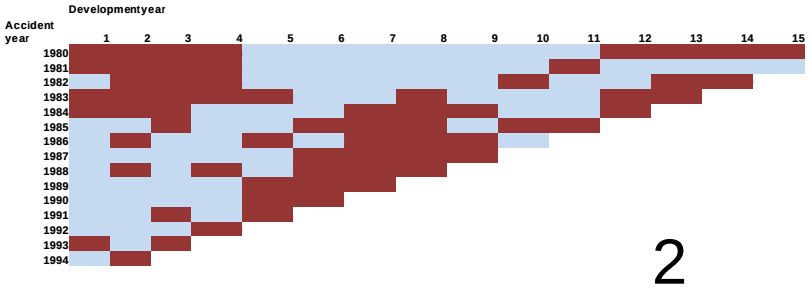


Chain Ladder Model Deviations

- Pick the real data from the random data



1



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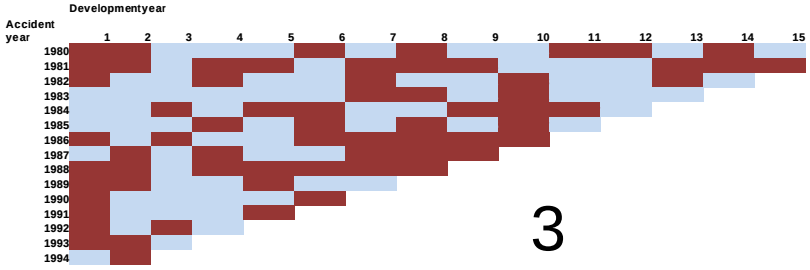

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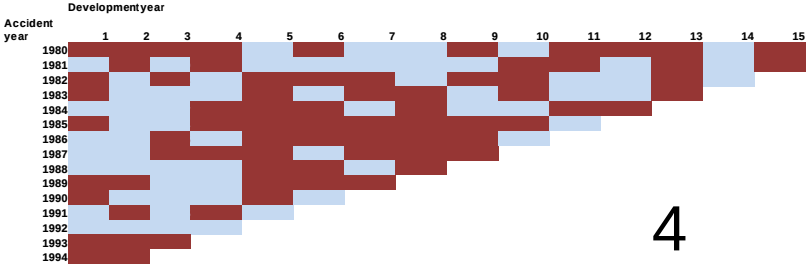
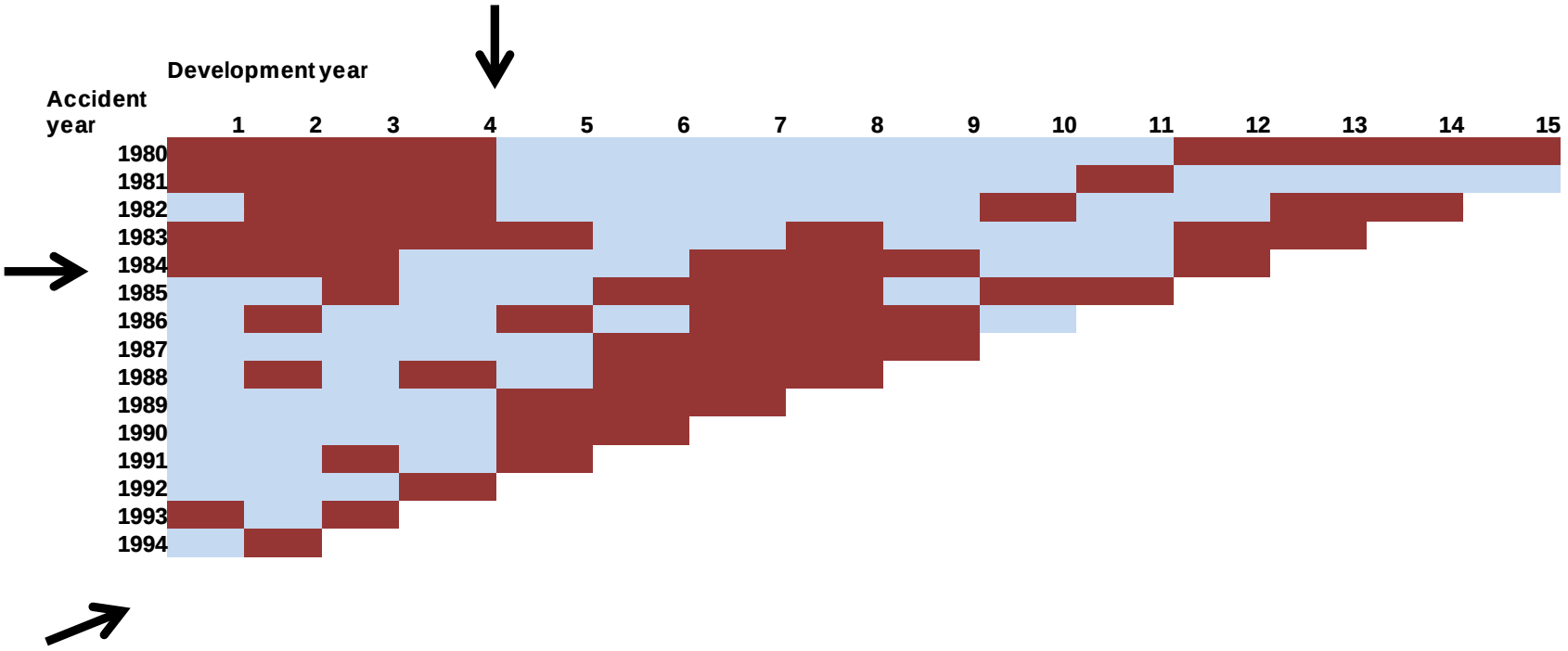


4

Chain Ladder Model Deviations

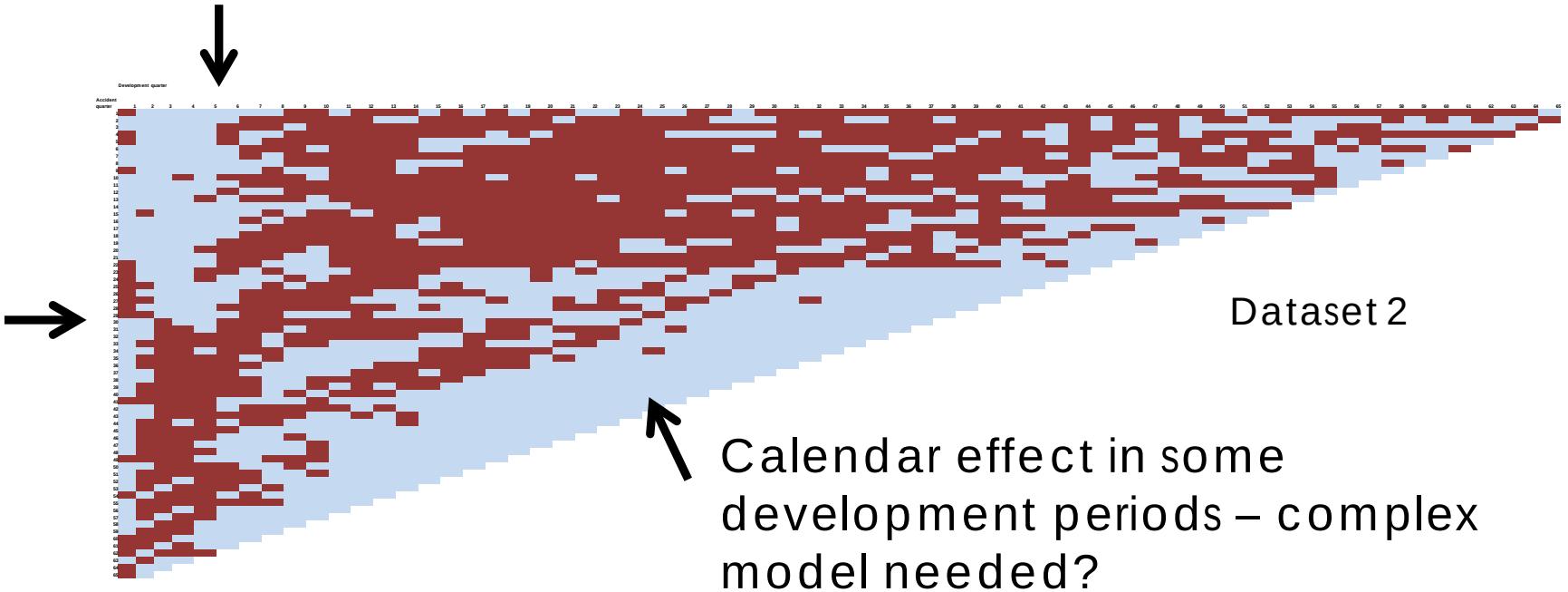
- Two colours are good for seeing changes in patterns



- Shift in development pattern after 1984
- Possible superimposed inflation recently

Chain Ladder Model Deviations

Change in development pattern



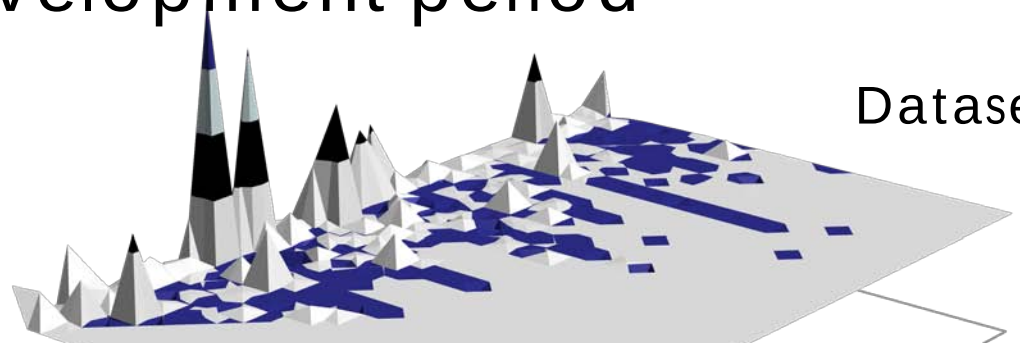
Dataset 2

Calendar effect in some development periods – complex model needed?

- Moderate information
- Low cost

Grouping Accident Periods

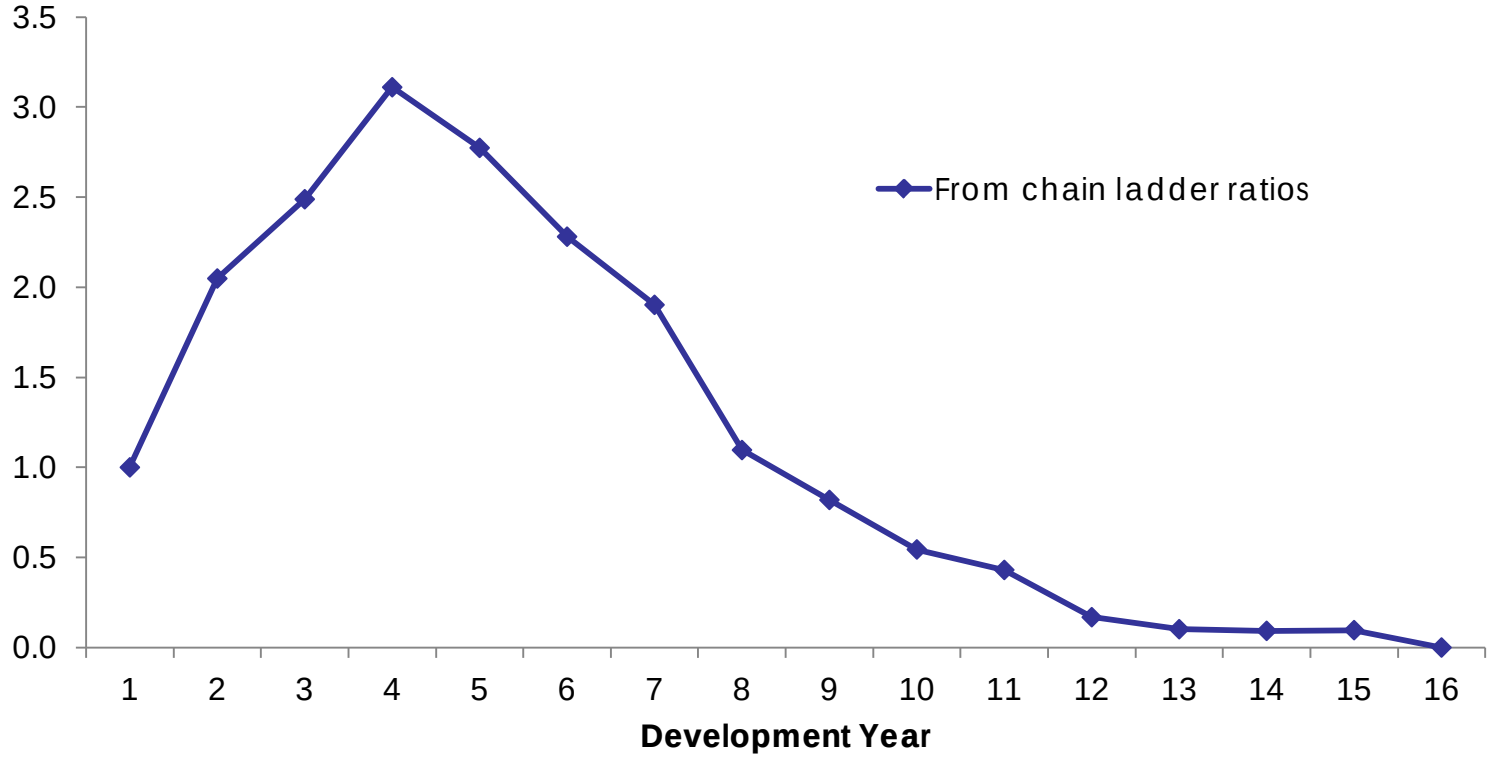
- Choose an economical description of the development pattern and accident groups
- Set up Fitted triangle
- Set up (Actual – Fitted) triangle
- Run Solver macro
- Plot parameters by accident period, fitted values by development period



Dataset 4

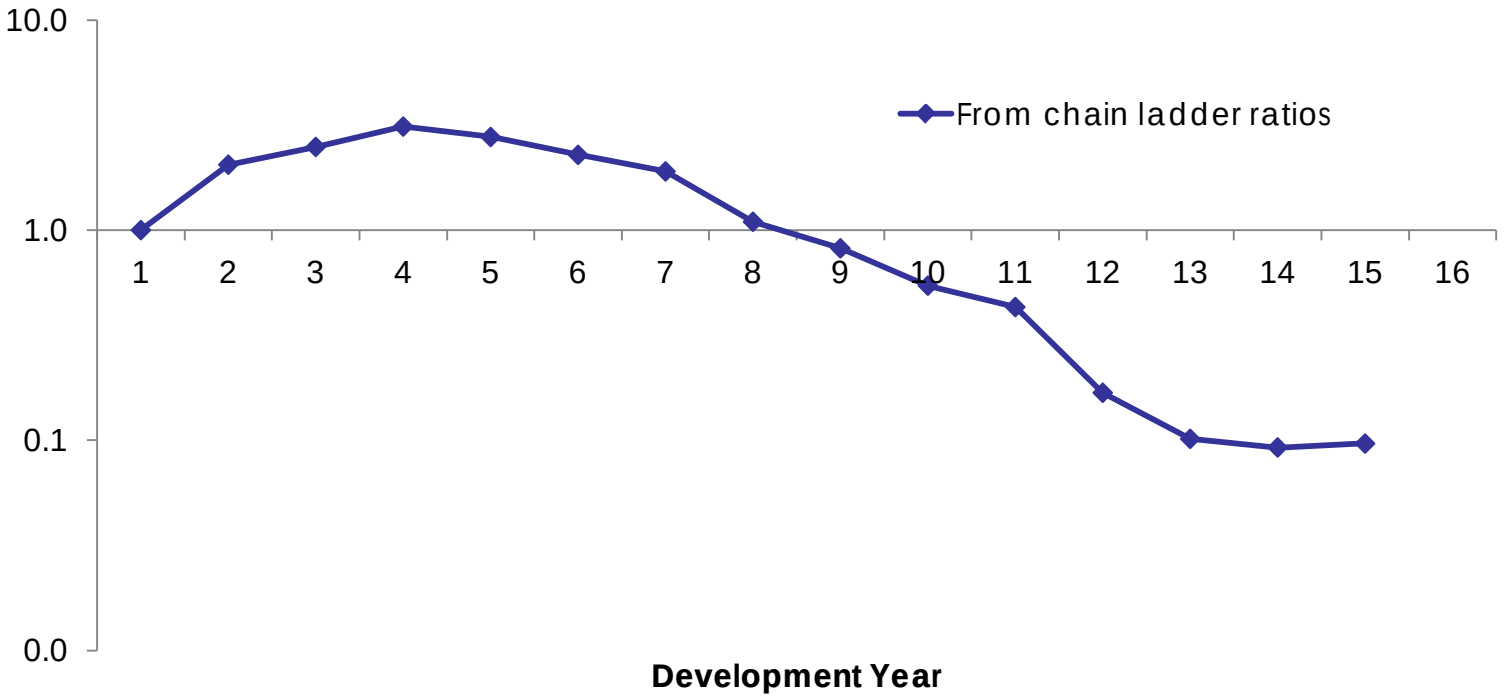
Grouping Accident Periods

- Calculate the development pattern from the chain ladder ratios for all periods



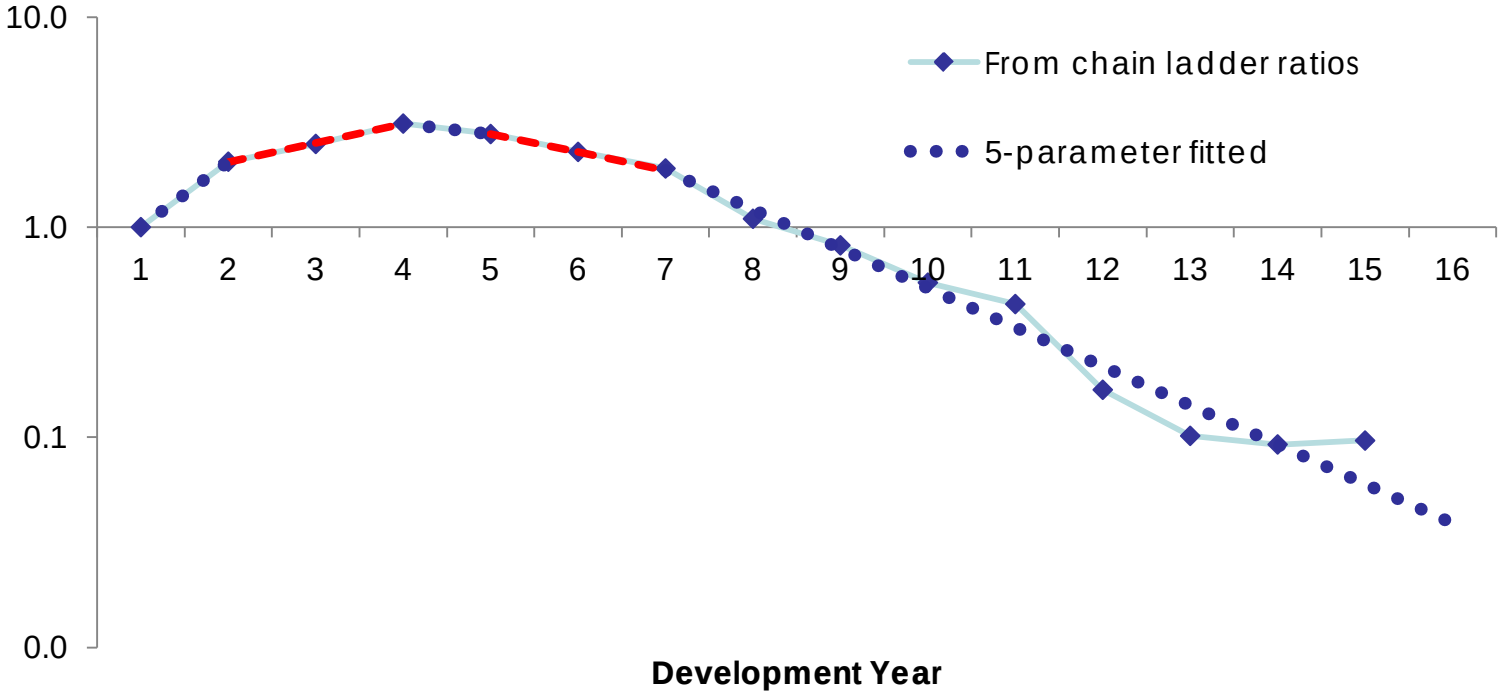
Grouping Accident Periods

- Switch to log scale



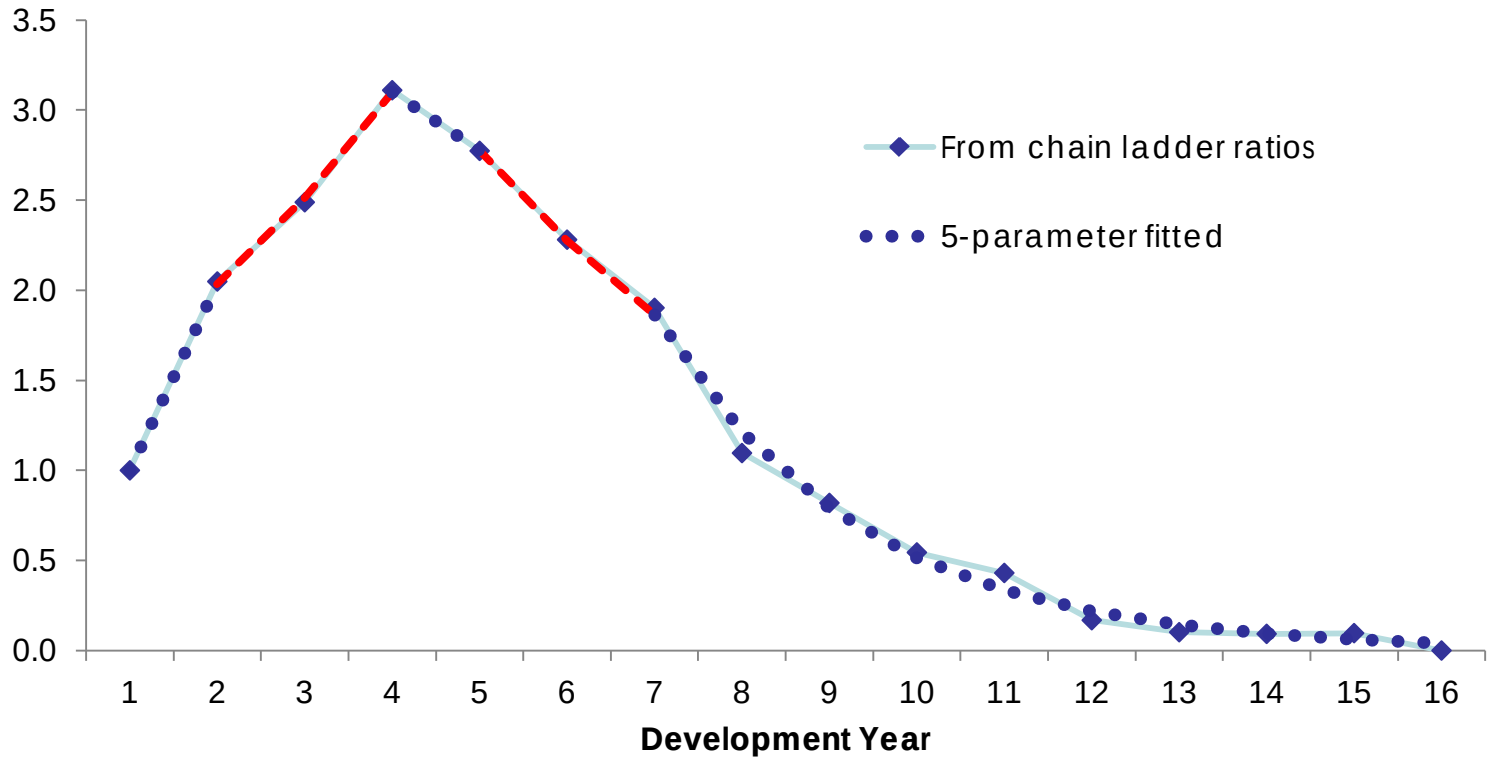
Grouping Accident Periods

- Choose linear segments – with enough joints to "flex"



Grouping Accident Periods

- Switch back to linear scale



Grouping Accident Periods

- Add an intercept and set up a table

	Parameters					
From	1	2	3	5	6	8
To	1	2	4	5	7	16
Accident year						
1980	**6,004**	**2.00**	**1.00**	**0.80**	**0.60**	**0.60**
1981	6,004	2.00	1.00	0.80	0.60	0.60
1982	6,004	2.00	1.00	0.80	0.60	0.60
1983	6,004	2.00	1.00	0.80	0.60	0.60
1984	6,004	2.00	1.00	0.80	0.60	0.60
1985	6,004	2.00	1.00	0.80	0.60	0.60
1986	6,004	2.00	1.00	0.80	0.60	0.60
1987	6,004	2.00	1.00	0.80	0.60	0.60
1988	6,004	2.00	1.00	0.80	0.60	0.60
1989	6,004	2.00	1.00	0.80	0.60	0.60
1990	6,004	2.00	1.00	0.80	0.60	0.60
1991	6,004	2.00	1.00	0.80	0.60	0.60
1992	6,004	2.00	1.00	0.80	0.60	0.60
1993	6,004	2.00	1.00	0.80	0.60	0.60
1994	6,004	2.00	1.00	0.80	0.60	0.60
1995	6,004	2.00	1.00	0.80	0.60	0.60

Grouping Accident Periods

- Calculate fitted values

Parameters						
From	1	2	3	5	6	8
To	1	2	4	5	7	16
Accident year						
1980	**6,004**	**2.00**	**1.00**	**0.80**	**0.60**	**0.60**
1981	6,004	2.00	1.00	0.80	0.60	0.60
1982	6,004	2.00	1.00	0.80	0.60	0.60
1983	6,004	2.00	1.00	0.80	0.60	0.60
1984	6,004	2.00	1.00	0.80	0.60	0.60
1985	6,004	2.00	1.00	0.80	0.60	0.60
1986	6,004	2.00	1.00	0.80	0.60	0.60
1987	6,004	2.00	1.00	0.80	0.60	0.60
1988	6,004	2.00	1.00	0.80	0.60	0.60
1989	6,004	2.00	1.00	0.80	0.60	0.60
1990	6,004	2.00	1.00	0.80	0.60	0.60
1991	6,004	2.00	1.00	0.80	0.60	0.60
1992	6,004	2.00	1.00	0.80	0.60	0.60
1993	6,004	2.00	1.00	0.80	0.60	0.60
1994	6,004	2.00	1.00	0.80	0.60	0.60
1995	6,004	2.00	1.00	0.80	0.60	0.60

Fitted incremental values

	Development year															
Accident year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1980	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1981	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1982	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1983	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1984	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1985	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1986	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1987	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1988	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1989	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1990	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1991	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1992	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1993	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1994	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35
1995	6,004	12,008	12,008	12,008	9,606	5,764	3,458	2,075	1,245	747	448	269	161	97	58	35

Grouping Accident Periods

- Calculate (Actual – Fitted) values
- Run Solver macro – minimises the error in each accident period (or groups)

Actual - expected

Accident year	Development year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Error	Result
1980	0	815	-780	1121	1398	1664	1491	-219	824	56	1056	488	401	510	515	-35		875
1981	-318	-3310	1797	712	-1262	884	970	1168	663	1172	2396	17	-120	-49	113			1343
1982	-2733	-969	-551	3438	220	286	-746	-289	1158	2940	578	62	317	304				1508
1983	-2269	-4214	-3453	-2333	-702	-1360	791	1261	844	-133	785	448	220					1890
1984	-2296	-4478	-1990	-2096	-3112	-791	8680	2190	3329	1045	513	669						3379
1985	-3379	-6642	-4566	-3775	-2461	2588	2490	1786	141	2524	1013							3306
1986	-3635	-5781	-5556	-4640	-1140	860	3833	2519	2001	197								3552
1987	-3655	-7680	-5812	-3955	-2008	3067	3390	4651	3283									4461
1988	-3876	-5965	-7831	-3394	-3706	834	4393	869										4443
1989	-3334	-7980	-5926	-5060	2020	4849	2569											4924
1990	-3168	-6510	-6968	-3430	4074	6561												5360
1991	-3008	-7465	-2550	-2922	1092													4025
1992	-3121	-6004	-4699	5265														4888
1993	-2443	-6393	-3023															4320
1994	-3043	-5578																4493
1995	-2873																	2873
																Total		3290

Grouping Accident Periods

- Check the Solver results

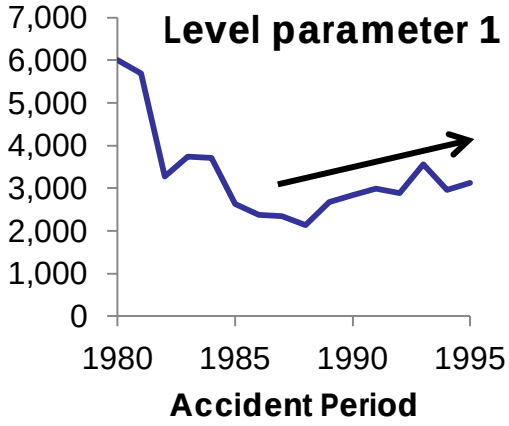
Parameters						
From	1	2	3	5	6	8
To	1	2	4	5	7	16
Accident year						
1980	6,004	2.04	1.01	0.88	0.64	0.65
1981	5,686	1.75	1.17	0.62	0.74	0.72
1982	3,271	3.18	1.20	0.66	0.56	0.81
1983	3,735	2.07	1.12	0.88	0.66	0.72
1984	3,708	2.17	1.13	0.46	1.51	0.54
1985	2,625	2.16	1.22	0.92	0.90	0.66
1986	2,369	2.58	1.09	1.11	0.93	0.62
1987	2,349	1.90	1.35	0.99	0.97	0.80
1988	2,128	2.25	1.28	0.74	1.16	0.38
1989	2,670	1.63	1.28	1.70	0.76	0.38
1990	2,836	1.67	1.31	1.68	0.90	0.38
1991	2,996	1.93	1.30	1.09	0.90	0.38
1992	2,883	1.59	1.92	1.09	0.90	0.38
1993	3,561	1.58	1.60	1.09	0.90	0.38
1994	2,961	2.17	1.60	1.09	0.90	0.38
1995	3,131	2.17	1.60	1.09	0.90	0.38

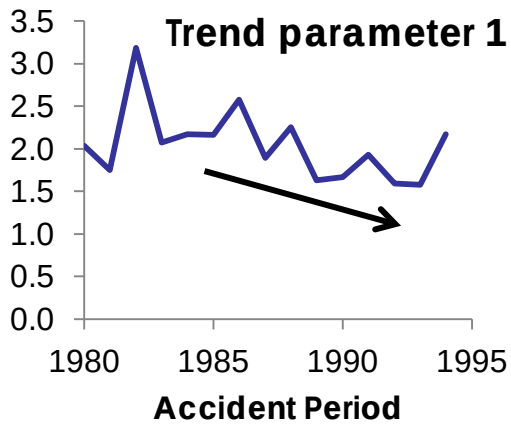
Actual - expected

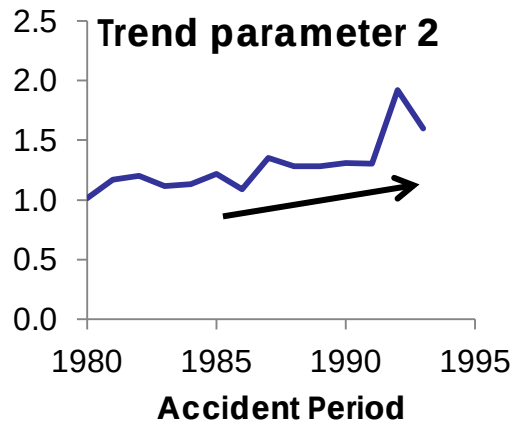
Accident year \ Development year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Error	Result	
1980	0	590	-1165	575	-92	287	353	-1112	152	-435	705	241	229	392	434	-90		539	0
1981	0	-1259	2151	-919	-138	374	-213	-83	-475	211	1620	-591	-588	-402	-152			858	1
1982	0	627	-1045	435	-122	432	-460	-775	335	2017	-322	-757	-401	-309				747	1
1983	0	47	-85	38	395	-1200	558	683	182	-757	247	8	-128					486	1
1984	0	-515	909	-402	1701	-2256	1236	-1672	1341	31	2	416						1138	1
1985	0	-315	516	-212	-608	1347	-381	-330	-1389	1434	244							792	1
1986	0	116	-213	98	409	-878	307	233	523	-757								447	1
1987	0	-124	183	-68	-481	992	-758	615	-382									513	1
1988	0	1252	-1956	764	79	-137	59	0										866	1
1989	0	-324	506	-197	-534	1413	-934											712	1
1990	0	764	-1165	445	0	0												597	1
1991	0	-1248	1916	-736	0													1074	1
1992	0	1425	-1484	386														1047	1
1993	0	0	0															0	1
1994	0	0																0	1
1995	0																	0	0
																Total		746	

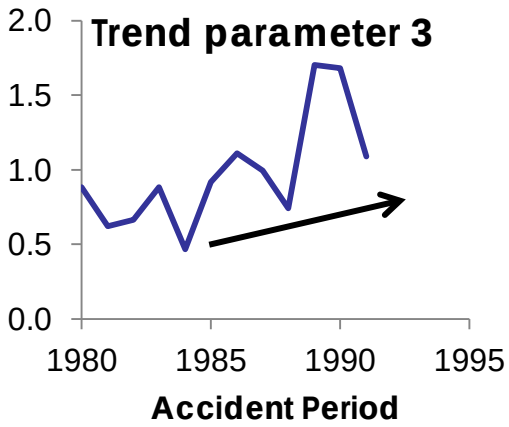
Grouping Accident Periods

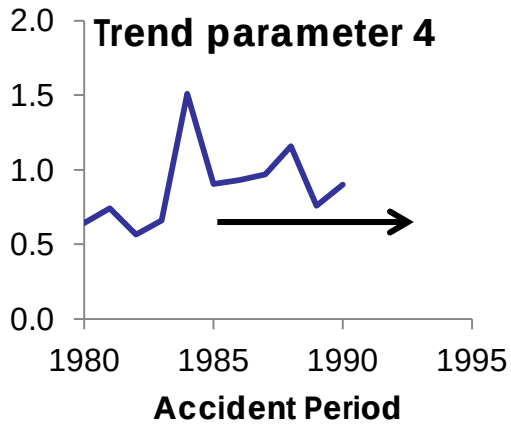
- How do the parameters change?

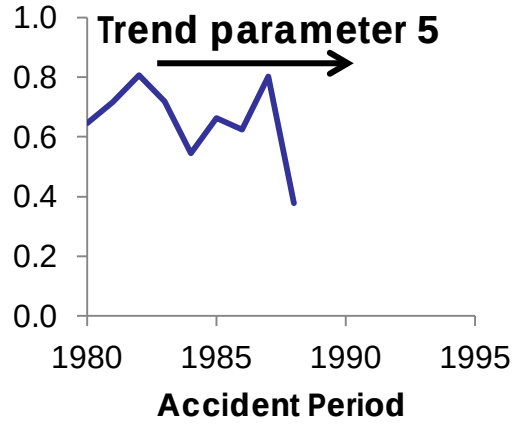






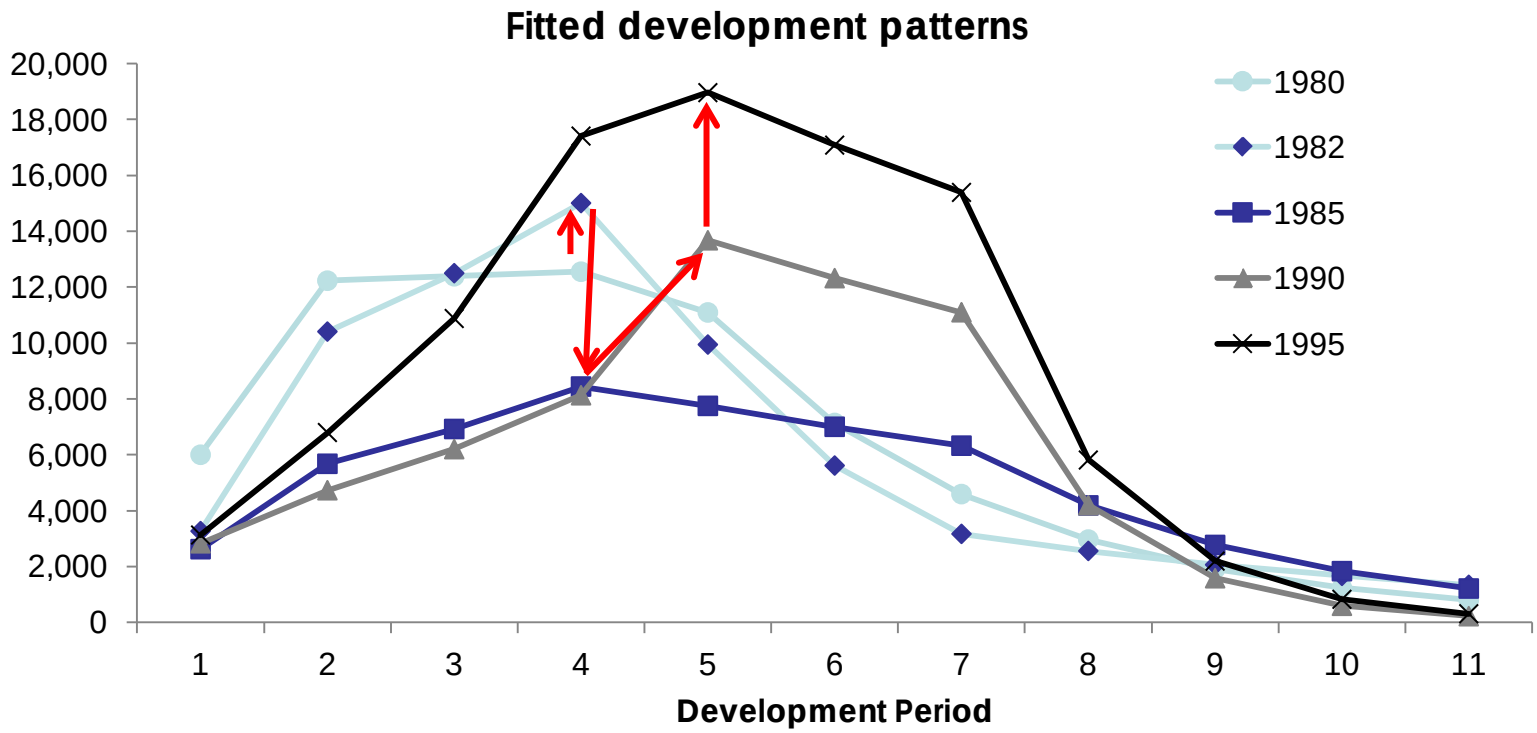






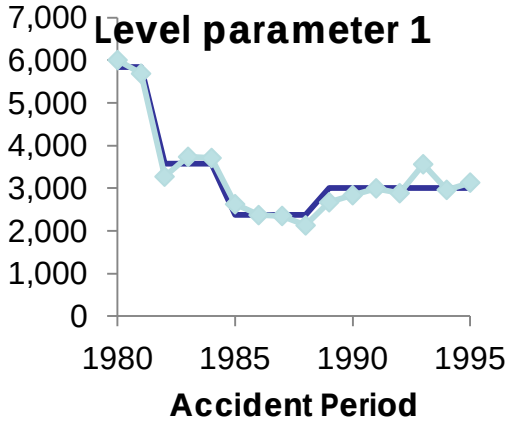
Grouping Accident Periods

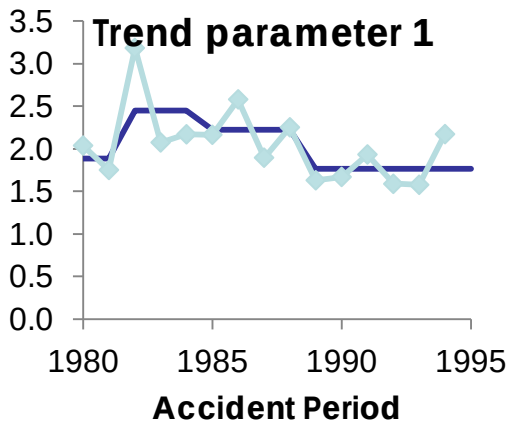
- For 16 "groups":

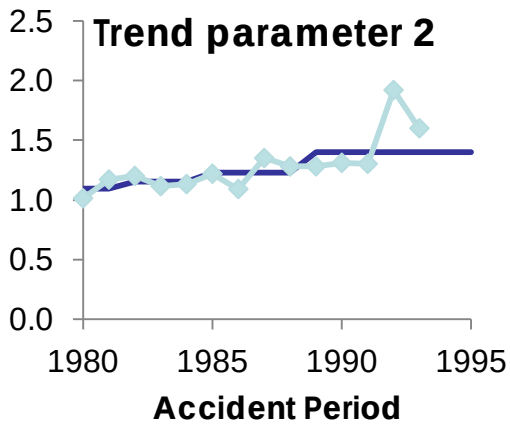


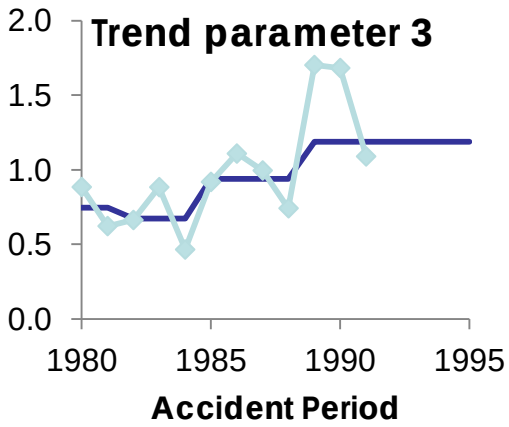
Grouping Accident Periods

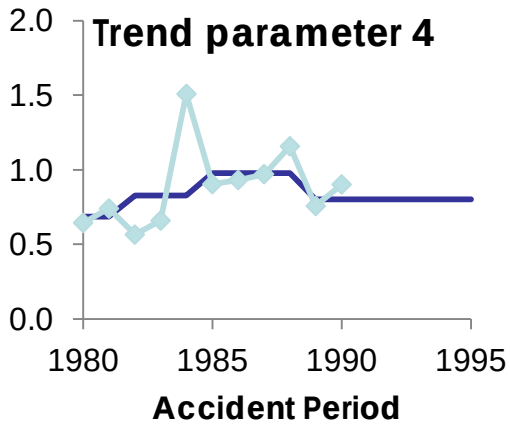
- Four groups

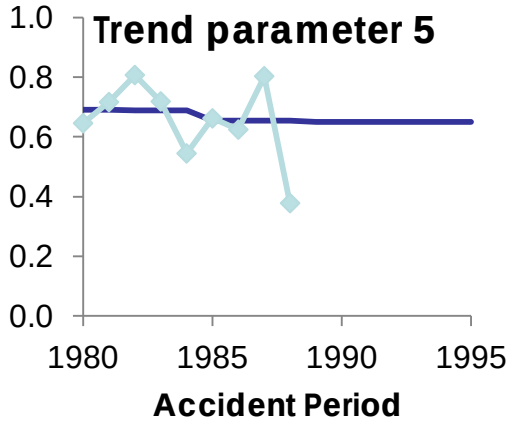






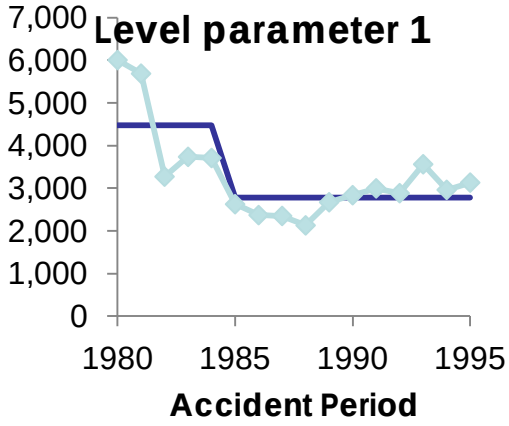


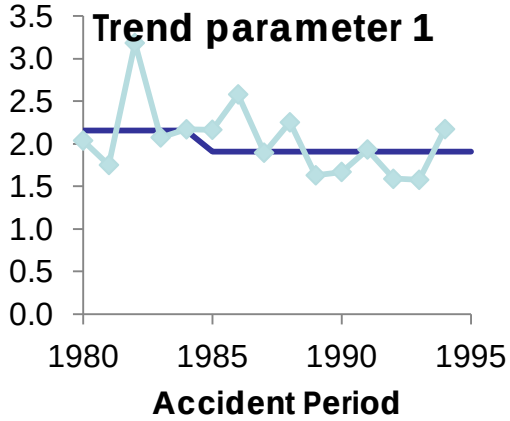


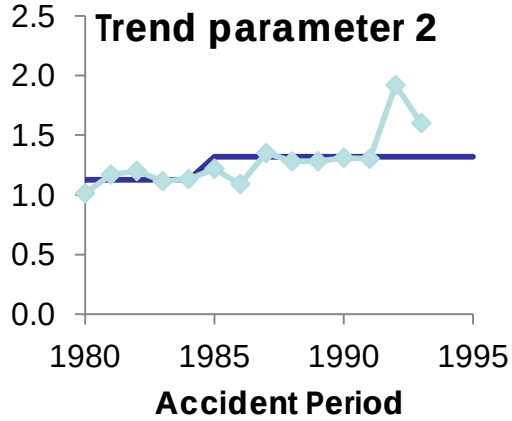


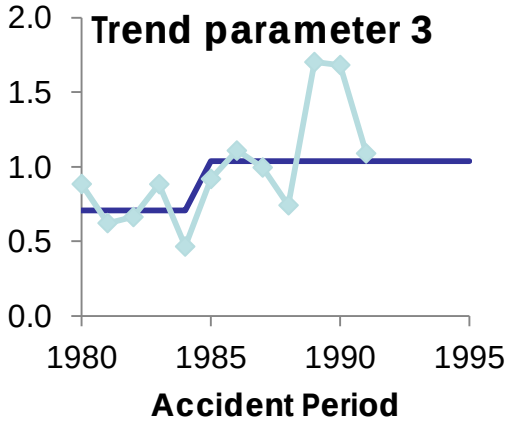
Grouping Accident Periods

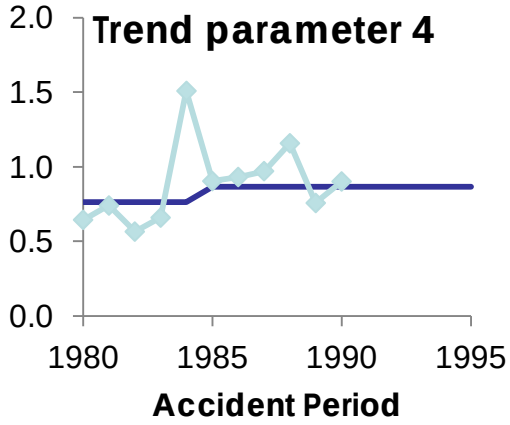
- Two groups

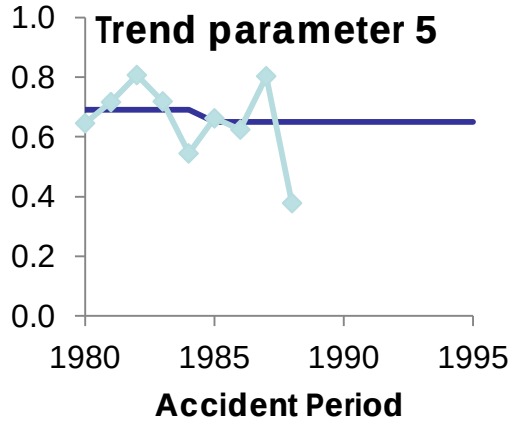












Grouping Accident Periods

- Two group model probably not a good fit
- Four group looks OK
- 7 year average OK in a standard model?
- Sensitivity to high values in 1984 and 1992

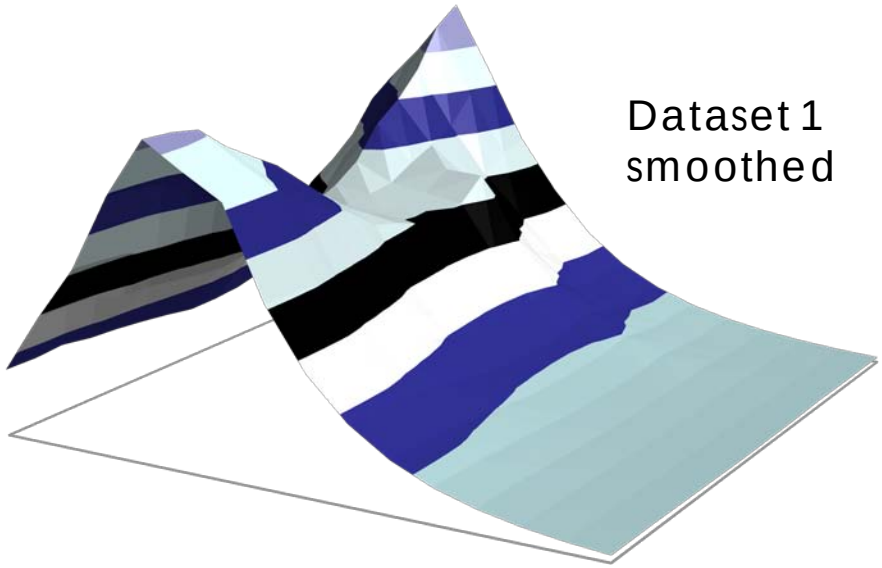
Accident year	Development year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1980	159	1801	-809	-15	1213	733	371	-1308	-118	-708	459	35	63	262	335	-165
1981	-159	-2324	1768	-424	-1447	-47	-150	79	-279	408	1799	-436	-458	-297	-67	
1982	-300	2297	1368	3803	1982	-453	-2679	-1924	-150	1930	-183	-501	-95	7		
1983	164	-948	-1534	-1968	1060	-2099	-1142	-374	-464	-1143	24	-115	-192			
1984	137	-1212	-71	-1731	-1350	-1530	6747	555	2021	35	-248	106				
1985	257	109	993	322	-295	1084	-1153	-791	-1661	1275	153					
1986	1	970	3	-543	1026	-644	190	-58	199	-1052						
1987	-19	-929	-253	142	158	1563	-253	2074	1481							
1988	-240	786	-2272	703	-1540	-670	750	-1708								
1989	-335	-1283	-1364	-3491	-785	681	-1921									
1990	-169	187	-2406	-1861	1269	2393										
1991	-9	-768	2012	-1353	-1713											
1992	-122	693	-137	6834												
1993	556	304	1539													
1994	-44	1119														
1995	126															

4 group deviations

- High information
- Moderate cost

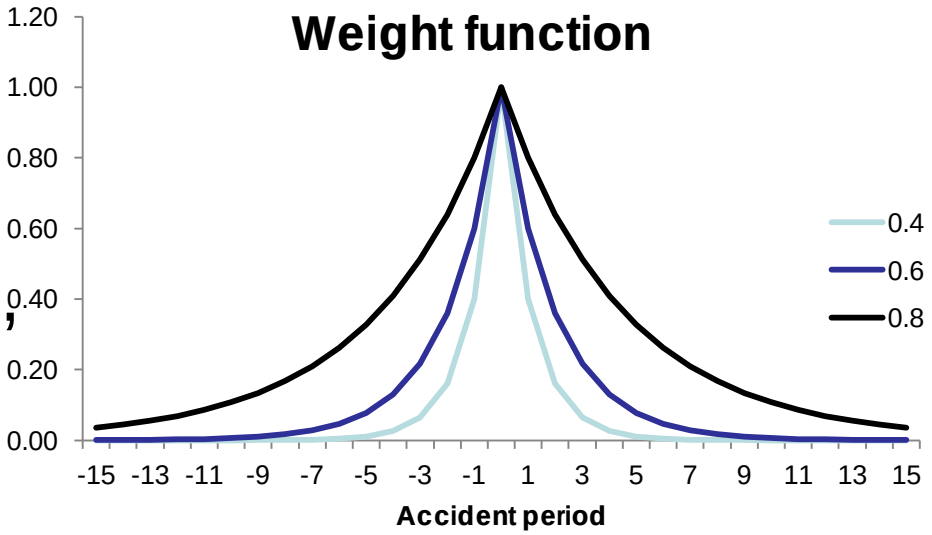
Smoothing Accident Periods

- Time-consuming to select "optimal" number of groups
- Smoothing has potential to be low intervention or even automated
- Three methods in paper – only the second discussed here



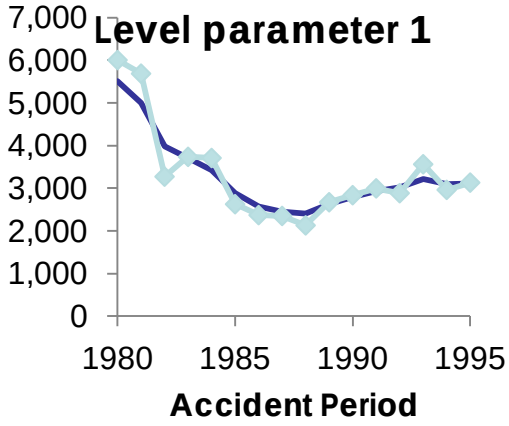
Smoothing Accident Periods

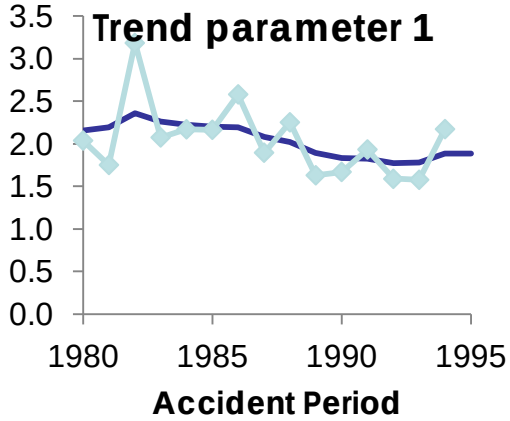
- Based on the individual accident period fits
- Parameters are smoothed independently
- Smoothing criterion – 1-step forecast or by eye
- Further research in progress on cross-validation, AIC, BIC, but "by eye" works well

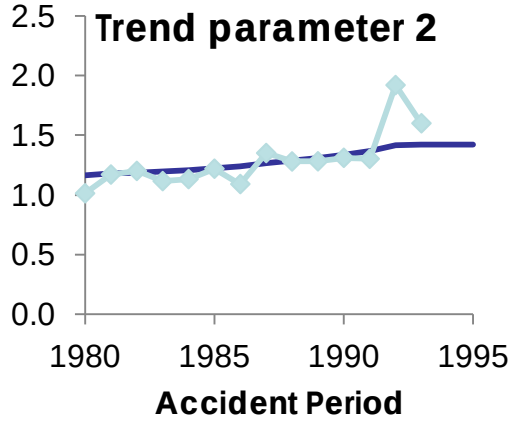


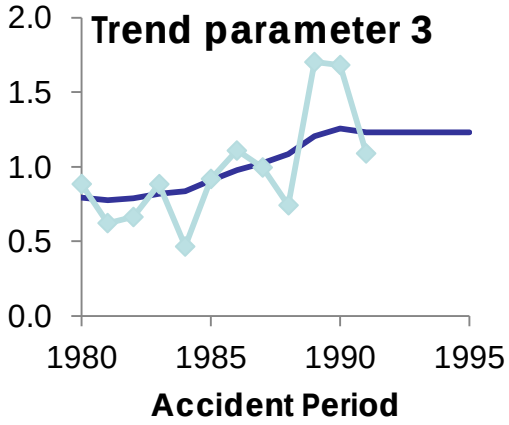
Smoothing Accident Periods

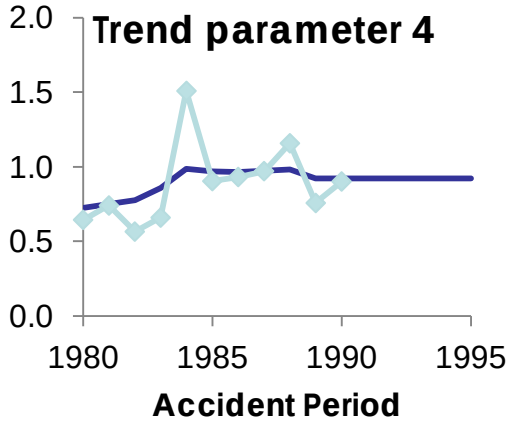
- Smoothed by eye:

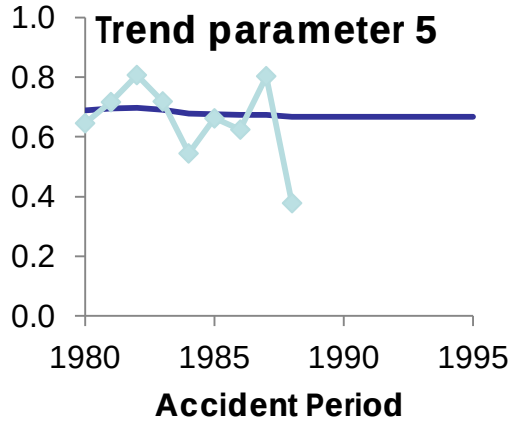






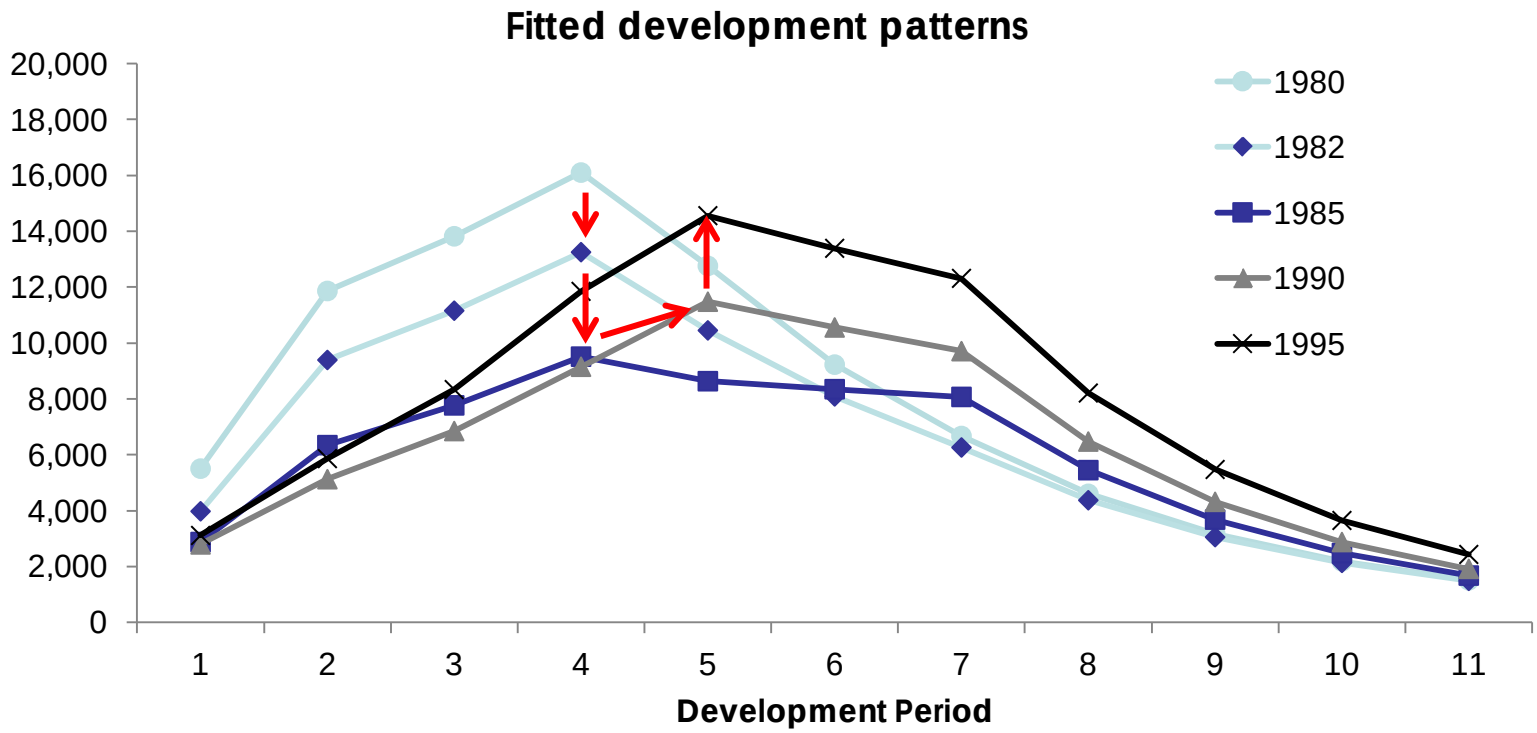






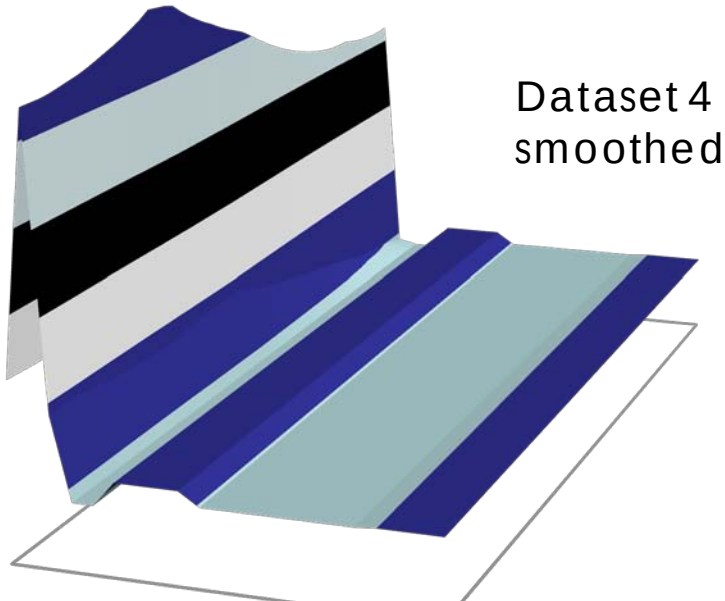
Smoothing Accident Periods

- Smoothed by eye:



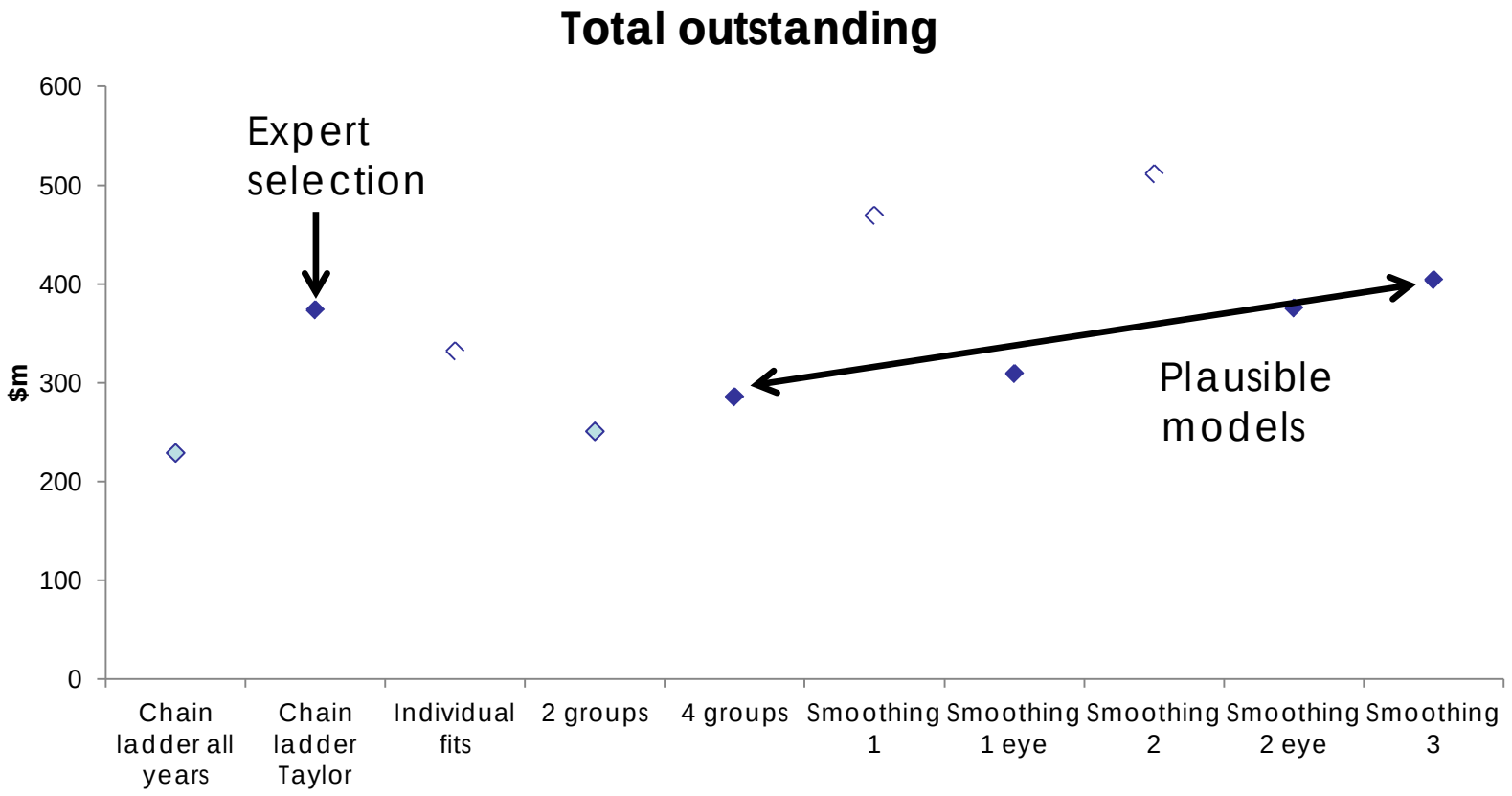
Smoothing Accident Periods

- Can be used as a model or to select assumptions in a standard model
- May need manual adjustment to smoothing
- High information
- Moderate cost



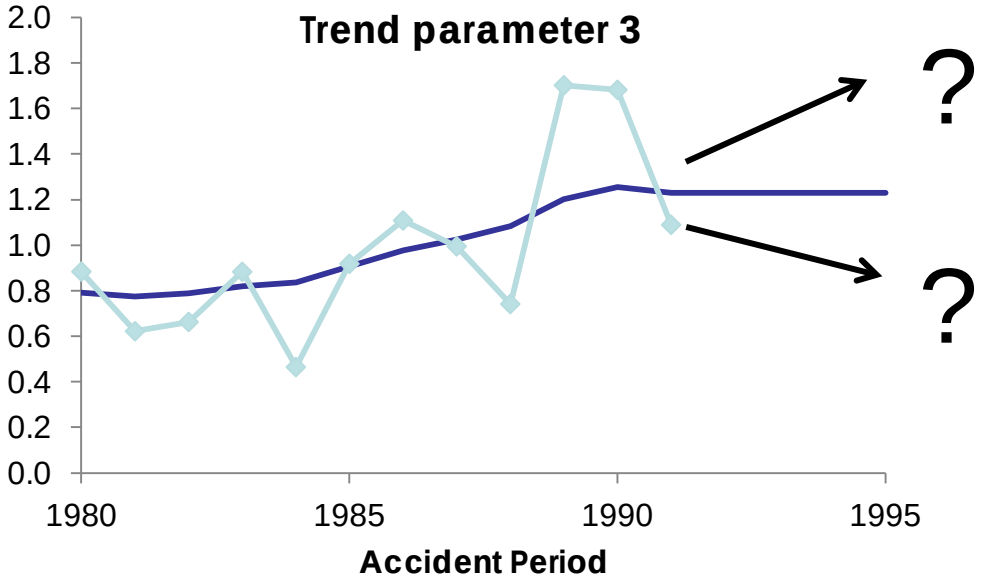
Model Error in Risk Margins

- Estimates with plausible levels of smoothing should be sufficiently likely in risk margin distribution



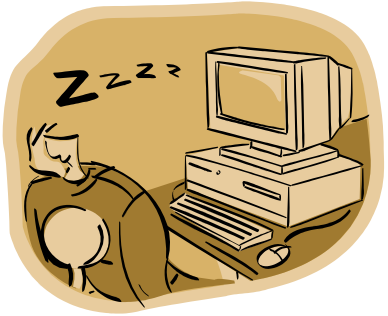
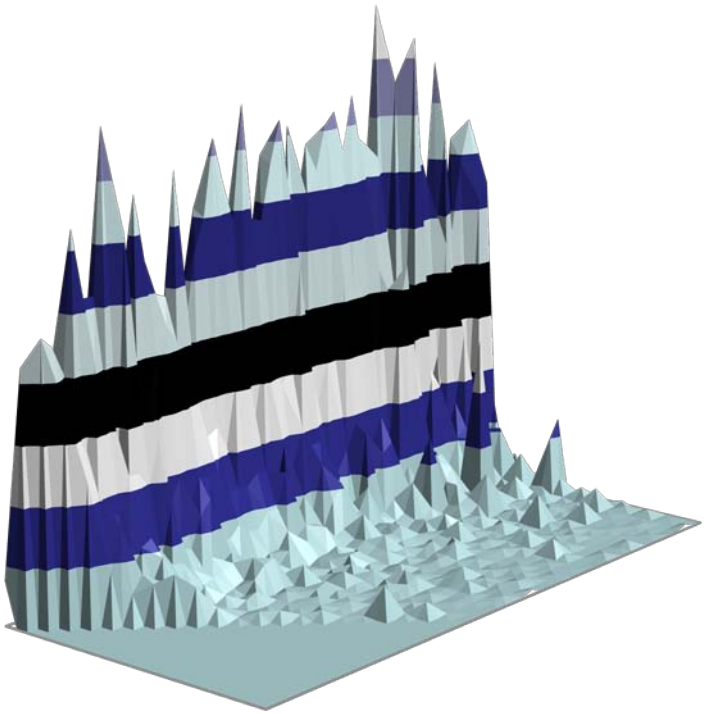
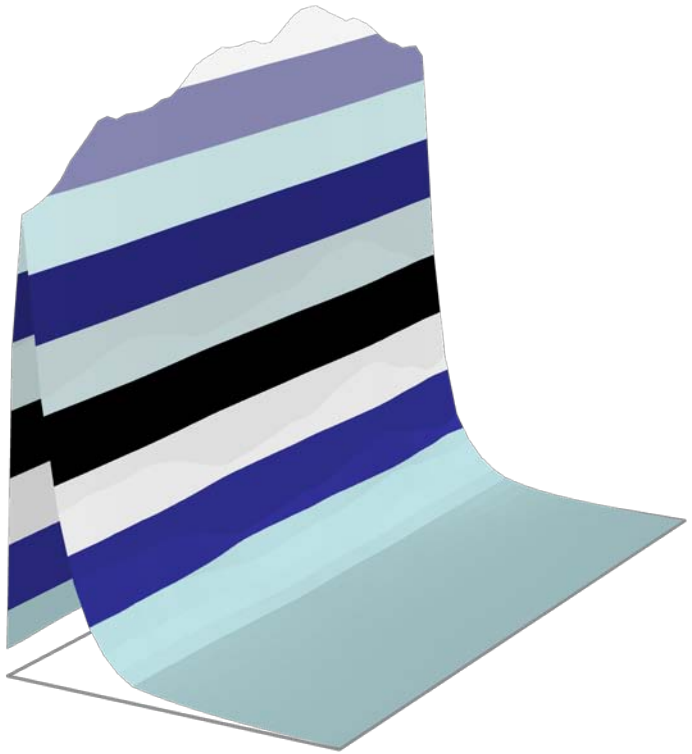
Model Error in Risk Margins

- Large or frequent changes in the past suggest potential for similar changes in the future



Automating Reserving

- Central estimates for simple or stochastic smoothing models can be found in Excel using the Solver
- Smoothing done by judgement – research needed for automatic selection
- Diagnostics needed to alert the 'expert'
- Try it!



Questions?