C.A.S. CARE SEMINAR
EXCESS LOSS DEVELOPMENT – PRACTICAL APPROACHES TO MAKING USE OF CLIENT DATA

May 21-22, 2014

Pete James, FCAS

Munich RE

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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- How pricing can vary from client to client.
- Traditional excess of loss experience rating
  - Observing patterns is sparse or volatile excess triangles.
  - Reflecting client patterns in excess of loss pricing.
- Individual claim development

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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Should pricing reflect individual client loss propensities?

Audience shout out your views and reasons.

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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What factors "drive" excess loss development?

Or

What factors distinguish a loss development pattern from account to account?

Audience shout out loss development drivers.

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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How do claims practices differ from insurer to insurer,

and how does this affect excess loss development patterns?

Audience shout out claim reserving philosophies

and

other claims practices that affect loss development patterns

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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An important take-away …

the excess development pattern of any given account is **strongly determined by**

the characteristics of that given book of business

and

the claims management practices of the particular insurer.

Excess Loss Development – Making use of client data
Why is it important to use client data, anyway?

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Traditional excess of loss experience rating pricing strategy:

Apply the concept of credibility

to excess loss development patterns

similarly to

expected loss selections.

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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Typical excess triangle -- age-to-age factors don't show a clear pattern.

Limit 250,000 Attachment 250,000

		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	250,000	778,680	1,364,436	1,667,536	2,710,718	3,032,786	4,016,614	4,017,746	3,998,925	4,032,537
01/01/2004	12/31/2004	28,802	1,321,346	1,561,183	2,171,059	2,981,371	3,507,946	3,986,755	3,997,329	4,728,352	
01/01/2005	12/31/2005		367,970	594,889	1,756,890	2,202,576	2,214,296	2,422,912	2,218,892		
01/01/2006	12/31/2006		285,662	546,402	1,330,983	1,377,890	1,693,174	2,067,368			
01/01/2007	12/31/2007		573,787	602,783	728,052	1,579,386	1,545,465				
01/01/2008	12/31/2008	74,260	1,067,229	1,898,606	2,316,388	2,965,412					
01/01/2009	12/31/2009	57,416	247,711	701,878	1,204,080						
01/01/2010	12/31/2010	268,657	1,617,288	2,402,939							
01/01/2011	12/31/2011	8,886	721,438								
01/01/2012	12/31/2012										

		12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003	12/31/2003	3.115	1.752	1.222	1.626	1.119	1.324	1.000	0.995	1.008	
01/01/2004	12/31/2004	45.877	1.182	1.391	1.373	1.177	1.136	1.003	1.183		
01/01/2005	12/31/2005		1.617	2.953	1.254	1.005	1.094	0.916			
01/01/2006	12/31/2006		1.913	2.436	1.035	1.229	1.221				
01/01/2007	12/31/2007		1.051	1.208	2.169	0.979					
01/01/2008	12/31/2008	14.372	1.779	1.220	1.280						
01/01/2009	12/31/2009	4.314	2.833	1.716							
01/01/2010	12/31/2010	6.020	1.486								
01/01/2011	12/31/2011			?			?		?		
All Year Volume Weighted		10.147	1.545	1.537	1.386	1.105	1.196	0.982	1.089	1.008	
	Cumulative	47.577	4.689	3.034	1.974	1.424	1.289	1.078	1.098	1.008	1.000
	Selected	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
	Cumulative	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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Select based on the cumulative development pattern

		Limit 250,000	Attachment 250,000								
		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	250,000	778,680	1,364,436	1,667,536	2,710,718	3,032,786	4,016,614	4,017,746	3,998,925	4,032,537
01/01/2004	12/31/2004	28,802	1,321,346	1,561,183	2,171,059	2,981,371	3,507,946	3,986,755	3,997,329	4,728,352	
01/01/2005	12/31/2005		367,970	594,889	1,756,890	2,202,576	2,214,296	2,422,912	2,218,892		
01/01/2006	12/31/2006		285,662	546,402	1,330,983	1,377,890	1,693,174	2,067,368			
01/01/2007	12/31/2007		573,787	602,783	728,052	1,579,386	1,545,465				
01/01/2008	12/31/2008	74,260	1,067,229	1,898,606	2,316,388	2,965,412					
01/01/2009	12/31/2009	57,416	247,711	701,878	1,204,080						
01/01/2010	12/31/2010	268,657	1,617,288	2,402,939							
01/01/2011	12/31/2011	8,886	721,438								
01/01/2012	12/31/2012										
		12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003	12/31/2003	3.115	1.752	1.222	1.626	1.119	1.324	1.000	0.995	1.008	
01/01/2004	12/31/2004	45.877	1.182	1.391	1.373	1.177	1.136	1.003	1.183		
01/01/2005	12/31/2005		1.617	2.953	1.254	1.005	1.094	0.916			
01/01/2006	12/31/2006		1.913	2.436	1.035	1.229	1.221				
01/01/2007	12/31/2007		1.051	1.208	2.169	0.979					
01/01/2008	12/31/2008	14.372	1.779	1.220	1.280						
01/01/2009	12/31/2009	4.314	2.833	1.716							
01/01/2010	12/31/2010	6.020	1.486								
01/01/2011	12/31/2011										
All Year Volume Weighted		10.147	1.545	1.537	1.386	1.105	1.196	0.982	1.089	1.008	
	Cumulative	47.577	4.689	3.034	1.974	1.424	1.289	1.078	1.098	1.008	1.000
	Selected	**10.000**	**1.700**	**1.450**	**1.300**	**1.200**	**1.120**	**1.060**	**1.030**	**1.008**	**1.000**
	Cumulative	47.398	4.740	2.788	1.923	1.479	1.233	1.101	1.038	1.008	1.000

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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These reported losses are jumping all around. Can I use this?

		Limit 500,000	Attachment 500,000								
		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004	12/31/2004		408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005	12/31/2005			500,000	1,645,993	2,510,613	1,877,724	1,877,244	1,877,244		
01/01/2006	12/31/2006		500,000	500,000	904,201	620,918	620,918	851,159			
01/01/2007	12/31/2007		828,478	1,000,000	660,555	684,801	835,910				
01/01/2008	12/31/2008		500,000	2,307,071	2,297,875	2,859,004					
01/01/2009	12/31/2009				500,000						
01/01/2010	12/31/2010	12,912	755,243	1,335,389							
01/01/2011	12/31/2011		137,662								
01/01/2012	12/31/2012										
		12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003	12/31/2003	1.381	1.023	1.029	1.702	1.704	1.429	0.991	0.990	1.000	
01/01/2004	12/31/2004		1.541	1.240	1.272	1.123	1.444	1.291	1.134		
01/01/2005	12/31/2005			3.292	1.525	0.748	1.000	1.000			
01/01/2006	12/31/2006		1.000	1.808	0.687	1.000	1.371				
01/01/2007	12/31/2007		1.207	0.661	1.037	1.221					
01/01/2008	12/31/2008		4.614	0.996	1.244						
01/01/2009	12/31/2009										
01/01/2010	12/31/2010	58.492	1.768								
01/01/2011	12/31/2011										
All Year Volume Weighted		7.448	1.895	1.332	1.269	1.085	1.285	1.068	1.049	1.000	
	Cumulative	37.271	5.004	2.641	1.983	1.562	1.440	1.121	1.049	1.000	1.000
	Selected	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Cumulative	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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Smoothing by 2-year age-to-age factors (1 of 2).

		Limit 500,000	Attachment 500,000								
		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004	12/31/2004		408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005	12/31/2005			500,000	1,645,993	2,510,613	1,877,724	1,877,244	1,877,244		
01/01/2006	12/31/2006		500,000	500,000	904,201	620,918	620,918	851,159			
01/01/2007	12/31/2007		828,478	1,000,000	660,555	684,801	835,910				
01/01/2008	12/31/2008		500,000	2,307,071	2,297,875	2,859,004					
01/01/2009	12/31/2009				500,000						
01/01/2010	12/31/2010	12,912	755,243	1,335,389							
01/01/2011	12/31/2011		137,662								
01/01/2012	12/31/2012										
		12 - 36	**24 - 48**	**36 - 60**	**48 - 72**	**60 - 84**	**72 - 96**	**84 - 108**	**96 - 120**	**108 -**	
01/01/2003	12/31/2003	1.413	1.053	1.752	2.901	2.435	1.416	0.982	0.990		
01/01/2004	12/31/2004		1.912	1.577	1.428	1.622	1.865	1.465			
01/01/2005	12/31/2005			5.021	1.141	0.748	1.000				
01/01/2006	12/31/2006		1.808	1.242	0.687	1.371					
01/01/2007	12/31/2007		0.797	0.685	1.265						
01/01/2008	12/31/2008		4.596	1.239							
01/01/2009	12/31/2009										
01/01/2010	12/31/2010	103.422									
01/01/2011	12/31/2011										
All Year Volume Weighted		13.605	2.568	1.578	1.390	1.371	1.361	1.150	0.990	1.000	
	Cumulative	162.894	11.973	4.663	2.954	2.125	1.550	1.139	0.990	1.000	1.000
	Selected	**13.605**	1.000	**1.578**	1.000	**1.371**	1.000	**1.150**	1.000	1.000	1.000
	Cumulative	33.856	2.488	2.488	1.577	1.577	1.150	1.150	1.000	1.000	1.000

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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Smoothing by 2-year age-to-age factors (2 of 2).

		Limit 500,000	Attachment 500,000								
		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004	12/31/2004		408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005	12/31/2005			500,000	1,645,993	2,510,613	1,877,724	1,877,244	1,877,244		
01/01/2006	12/31/2006		500,000	500,000	904,201	620,918	620,918	851,159			
01/01/2007	12/31/2007		828,478	1,000,000	660,555	684,801	835,910				
01/01/2008	12/31/2008		500,000	2,307,071	2,297,875	2,859,004					
01/01/2009	12/31/2009				500,000						
01/01/2010	12/31/2010	12,912	755,243	1,335,389							
01/01/2011	12/31/2011		137,662								
01/01/2012	12/31/2012										
		12 - 36	**24 - 48**	**36 - 60**	**48 - 72**	**60 - 84**	**72 - 96**	**84 - 108**	**96 - 120**	**108 -**	
01/01/2003	12/31/2003	1.413	1.053	1.752	2.901	2.435	1.416	0.982	0.990		
01/01/2004	12/31/2004		1.912	1.577	1.428	1.622	1.865	1.465			
01/01/2005	12/31/2005			5.021	1.141	0.748	1.000				
01/01/2006	12/31/2006		1.808	1.242	0.687	1.371					
01/01/2007	12/31/2007		0.797	0.685	1.265						
01/01/2008	12/31/2008		4.596	1.239							
01/01/2009	12/31/2009										
01/01/2010	12/31/2010	103.422									
01/01/2011	12/31/2011										
All Year Volume Weighted		13.605	2.568	1.578	1.390	1.371	1.361	1.150	0.990	1.000	
	Cumulative	162.894	11.973	4.663	2.954	2.125	1.550	1.139	0.990	1.000	1.000
	Selected	**7.500**	**2.568**	1.000	**1.390**	1.000	**1.361**	1.000	**0.990**	1.000	1.000
	Cumulative	36.086	4.811	1.874	1.874	1.348	1.348	0.990	0.990	1.000	1.000

Excess Loss Development – Making use of client data
Sparse triangle – can I use this client information?

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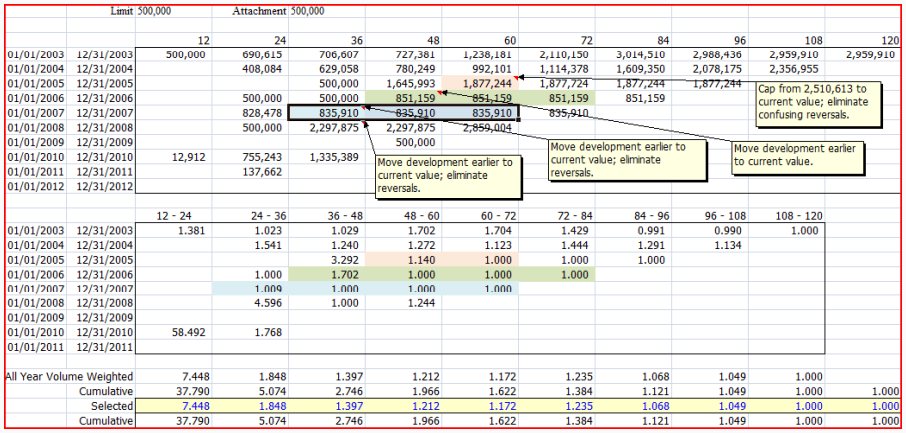
Capture the full development in making manual adjustments.



Limit 500,000 Attachment 500,000

		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004	12/31/2004		408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005	12/31/2005			500,000	1,645,993	1,877,244	1,877,724	1,877,244	1,877,244		
01/01/2006	12/31/2006		500,000	500,000	851,159	851,159	851,159	851,159			
01/01/2007	12/31/2007		828,478	835,910	835,910	835,910	835,910				
01/01/2008	12/31/2008		500,000	2,297,875	2,297,875	2,859,004					
01/01/2009	12/31/2009				500,000						
01/01/2010	12/31/2010	12,912	755,243	1,335,389							
01/01/2011	12/31/2011		137,662								
01/01/2012	12/31/2012										

Cap from 2,510,613 to current value; eliminate confusing reversals.

Move development earlier to current value; eliminate reversals.

Move development earlier to current value; eliminate reversals.

Move development earlier to current value.

		12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003	12/31/2003	1.381	1.023	1.029	1.702	1.704	1.429	0.991	0.990	1.000	
01/01/2004	12/31/2004		1.541	1.240	1.272	1.123	1.444	1.291	1.134		
01/01/2005	12/31/2005			3.292	1.140	1.000	1.000	1.000			
01/01/2006	12/31/2006		1.000	1.702	1.000	1.000	1.000				
01/01/2007	12/31/2007		1.009	1.000	1.000	1.000					
01/01/2008	12/31/2008		4.596	1.000	1.244						
01/01/2009	12/31/2009										
01/01/2010	12/31/2010	58.492	1.768								
01/01/2011	12/31/2011										
All Year Volume Weighted		7.448	1.848	1.397	1.212	1.172	1.235	1.068	1.049	1.000	
	Cumulative	37.790	5.074	2.746	1.966	1.622	1.384	1.121	1.049	1.000	1.000
	Selected	7.448	1.848	1.397	1.212	1.172	1.235	1.068	1.049	1.000	1.000
	Cumulative	37.790	5.074	2.746	1.966	1.622	1.384	1.121	1.049	1.000	1.000

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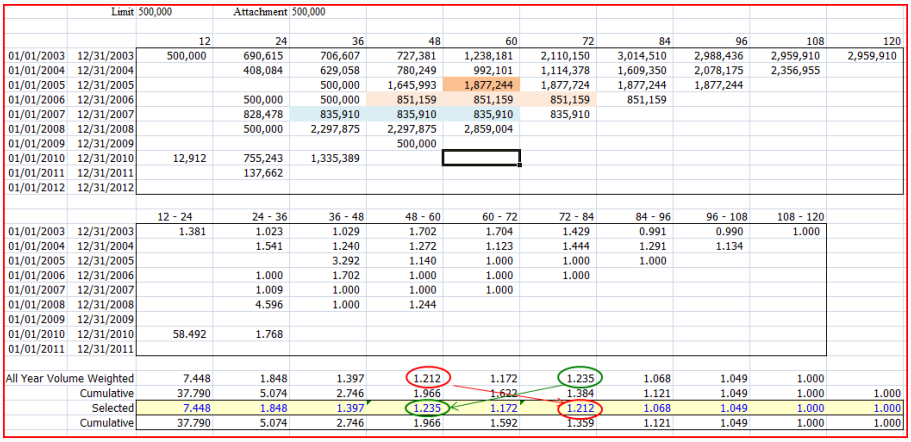
Finish it up by swapping link ratios, preserving the full development.



Limit 500,000 Attachment 500,000

		12	24	36	48	60	72	84	96	108	120
01/01/2003	12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004	12/31/2004		408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005	12/31/2005			500,000	1,645,993	1,877,244	1,877,724	1,877,244	1,877,244		
01/01/2006	12/31/2006		500,000	500,000	851,159	851,159	851,159	851,159			
01/01/2007	12/31/2007		828,478	835,910	835,910	835,910	835,910				
01/01/2008	12/31/2008		500,000	2,297,875	2,297,875	2,859,004					
01/01/2009	12/31/2009				500,000						
01/01/2010	12/31/2010	12,912	755,243	1,335,389							
01/01/2011	12/31/2011		137,662								
01/01/2012	12/31/2012										

		12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003	12/31/2003	1.381	1.023	1.029	1.702	1.704	1.429	0.991	0.990	1.000	
01/01/2004	12/31/2004		1.541	1.240	1.272	1.123	1.444	1.291	1.134		
01/01/2005	12/31/2005			3.292	1.140	1.000	1.000	1.000			
01/01/2006	12/31/2006		1.000	1.702	1.000	1.000	1.000				
01/01/2007	12/31/2007		1.009	1.000	1.000	1.000					
01/01/2008	12/31/2008		4.596	1.000	1.244						
01/01/2009	12/31/2009										
01/01/2010	12/31/2010	58.492	1.768								
01/01/2011	12/31/2011										
All Year Volume Weighted		7.448	1.848	1.397	1.212	1.172	1.235	1.068	1.049	1.000	
	Cumulative	37.790	5.074	2.746	1.966	1.622	1.384	1.121	1.049	1.000	1.000
	Selected	7.448	1.848	1.397	1.235	1.172	1.212	1.068	1.049	1.000	1.000
	Cumulative	37.790	5.074	2.746	1.966	1.592	1.359	1.121	1.049	1.000	1.000

Excess Loss Development – Making use of client data
Smoothing the losses to reveal a pattern

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Here is an algorithm that produces monotonically increasing values within a row.

Limit 500,000 Attachment 500,000

ORIGINAL TRIANGLE

	12	24	36	48	60	72	84	96	108	120
01/01/2003 12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	3,014,510	2,988,436	2,959,910	2,959,910
01/01/2004 12/31/2004	0	408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005 12/31/2005	0	0	500,000	1,645,993	2,510,613	1,877,724	1,877,244	1,877,244		
01/01/2006 12/31/2006	0	500,000	500,000	904,201	620,918	620,918	851,159			
01/01/2007 12/31/2007	0	828,478	1,000,000	660,555	684,801	835,910				
01/01/2008 12/31/2008	0	500,000	2,307,071	2,297,875	2,859,004					
01/01/2009 12/31/2009	0	0	0	500,000						
01/01/2010 12/31/2010	12,912	755,243	1,335,389							
01/01/2011 12/31/2011	0	137,662								
01/01/2012 12/31/2012	0									

formula:
=MAX(0,MIN(D15,AVERAGE(D15:E15),AVERAGE(D15:F15),AVERAGE(D15:G15),
AVERAGE(D15:H15),AVERAGE(D15:I15),AVERAGE(D15:J15),AVERAGE(D15:K15),
AVERAGE(D15:L15),AVERAGE(D15:M15)))

formula:MAX(D28,MIN(E15,AVERAGE(E15:F15),AVERAGE(E15:G15),AVERAGE(E15:H15),
AVERAGE(E15:I15),
AVERAGE(E15:J15),AVERAGE(E15:K15),AVERAGE(E15:L15),AVERAGE(E15:M15)))

formula:=MAX(L34,M15)

SMOOTHED TRIANGLE

	12	24	36	48	60	72	84	96	108	120
01/01/2003 12/31/2003	500,000	690,615	706,607	727,381	1,238,181	2,110,150	2,980,692	2,980,692	2,980,692	2,980,692
01/01/2004 12/31/2004	0	408,084	629,058	780,249	992,101	1,114,378	1,609,350	2,078,175	2,356,955	
01/01/2005 12/31/2005	0	0	500,000	1,645,993	2,035,706	2,035,706	2,035,706	2,035,706		
01/01/2006 12/31/2006	0	500,000	500,000	715,346	715,346	715,346	851,159			
01/01/2007 12/31/2007	0	793,459	793,459	793,459	793,459	835,910				
01/01/2008 12/31/2008	0	500,000	2,302,473	2,302,473	2,859,004					
01/01/2009 12/31/2009	0	0	0	500,000						
01/01/2010 12/31/2010	12,912	755,243	1,335,389							
01/01/2011 12/31/2011	0	137,662								
01/01/2012 12/31/2012	0									

Excess Loss Development – Making use of client data
Smoothing the losses to reveal a pattern

Munich RE

Here is an algorithm that produces monotonically increasing values within a row.

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	
01/01/2003 12/31/2003	1.381	1.023	1.029	1.702	1.704	1.413	1.000	1.000	1.000	
01/01/2004 12/31/2004		1.541	1.240	1.272	1.123	1.444	1.291	1.134		
01/01/2005 12/31/2005			3.292	1.237	1.000	1.000	1.000			
01/01/2006 12/31/2006		1.000	1.431	1.000	1.000	1.190				
01/01/2007 12/31/2007		1.000	1.000	1.000	1.054					
01/01/2008 12/31/2008		4.605	1.000	1.242						
01/01/2009 12/31/2009										
01/01/2010 12/31/2010	58.492	1.768								
Before Smoothing	7.448	1.895	1.332	1.269	1.085	1.285	1.068	1.049	1.000	
All Year Volume Weighted	7.380	1.855	1.374	1.240	1.180	1.251	1.071	1.055	1.000	
Cumulative	38.892	5.270	2.841	2.067	1.667	1.414	1.130	1.055	1.000	1.000
Selected	7.380	1.855	1.374	1.240	1.180	1.251	1.071	1.055	1.000	1.000
Cumulative	38.892	5.270	2.841	2.067	1.667	1.414	1.130	1.055	1.000	1.000

Excess Loss Development – Making use of client data
Why we did all this – credibility weighting client pattern

Munich RE

After making your judgments with client data, credibility weight with benchmark

Given this triangle with a development pattern that is less than obvious, what LDFs do we ultimately use?

Lead Umb/XS Limit 1,000,000 Attachment 1,000,000

	9	21	33	45	57	69	81	93	105	117	129
2003	1,241	7,358,565	10,337,779	14,019,938	16,913,638	27,261,099	27,496,412	29,770,049	29,788,258	30,922,494	31,192,023
2004	21	1,252,821	8,216,637	12,390,706	19,183,629	23,355,452	23,769,106	24,556,489	25,969,645	27,133,715	0
2005	33	3,868,685	14,071,488	19,923,505	24,616,292	32,289,578	31,370,009	34,540,166	34,182,097	0	0
2006	21	3,775,342	10,148,190	16,991,504	19,097,887	21,987,015	25,849,713	26,336,650	0	0	0
2007	17	3,362,917	11,822,105	17,111,702	21,105,253	29,331,660	28,699,005	0	0	0	0
2008	17	4,101,247	6,799,644	14,672,361	15,489,996	19,226,178	0	0	0	0	0
2009	9	91,584	3,204,707	8,812,051	13,573,703	0	0	0	0	0	0
2010	3,002	1,077,017	5,570,876	9,917,287	0	0	0	0	0	0	0
2011	5	1,030,037	3,371,421	0	0	0	0	0	0	0	0
2012	3,509	2,023,233	0	0	0	0	0	0	0	0	0
2013	10,011	0	0	0	0	0	0	0	0	0	0

	9-21	21-33	33-45	45-57	57-69	69-81	81-93	93-105	105-117	117-129
2003	~~5928.398~~	1.405	1.356	1.206	1.612	1.009	1.083	1.001	1.038	1.009
2004	~~59658.139~~	6.559	1.508	1.548	1.217	1.018	1.033	1.058	1.045	
2005	~~117232.877~~	3.637	1.416	1.236	1.312	0.972	1.101	0.990		
2006	~~179778.167~~	2.688	1.674	1.124	1.151	1.176	1.019			
2007	~~197818.639~~	3.515	1.447	1.233	1.390	0.978				
2008	~~241249.808~~	1.658	2.158	1.056	1.241					
2009	~~10176.000~~	34.992	2.750	1.540						
2010	~~358.767~~	5.173	1.780							
2011	~~206007.400~~	3.273								
2012	~~576.584~~									

Excess Loss Development – Making use of client data
Why we did all this – credibility weighting of client pattern

Munich RE

After making your judgments with client data, credibility weight them

	A	B	C	D	E	F	G	H	I	J	K	L
9	2006	21	3,775,342	10,148,190	16,991,504	19,097,887	21,987,015	25,849,713	26,336,650	0	0	0
10	2007	17	3,362,917	11,822,105	17,111,702	21,105,253	29,331,660	28,699,005	0	0	0	0
11	2008	17	4,101,247	6,799,644	14,672,361	15,489,996	19,226,178	0	0	0	0	0
12	2009	9	91,584	3,204,707	8,812,051	13,573,703	0	0	0	0	0	0
13	2010	3,002	1,077,017	5,570,876	9,917,287	0	0	0	0	0	0	0
14	2011	5	1,030,037	3,371,421	0	0	0	0	0	0	0	0
15	2012	3,509	2,023,233	0	0	0	0	0	0	0	0	0
16	2013	10,011	0	0	0	0	0	0	0	0	0	0
17												
18		9-21	21-33	33-45	45-57	57-69	69-81	81-93	93-105	105-117	117-129	
19	2003	~~5928.398~~	1.405	1.356	1.206	1.612	1.009	1.083	1.001	1.038	1.009	
20	2004	~~59658.139~~	6.559	1.508	1.548	1.217	1.018	1.033	1.058	1.045		
21	2005	~~117232.877~~	3.637	1.416	1.236	1.312	0.972	1.101	0.990			
22	2006	~~179778.167~~	2.688	1.674	1.124	1.151	1.176	1.019				
23	2007	~~197818.639~~	3.515	1.447	1.233	1.390	0.978					
24	2008	~~241249.808~~	1.658	2.158	1.056	1.241						
25	2009	~~10176.000~~	34.992	2.750	1.540							
26	2010	~~358.767~~	5.173	1.780								
27	2011	~~206007.400~~	3.273									
28	2012	~~576.584~~										
34												
35	Year Weighted Average	~~3548.01~~	2.84	1.62	1.25	1.32	1.02	1.06	1.01	1.04	1.01	
36	Benchmark Incremental	~~29.24~~	3.92	1.73	1.32	1.17	1.12	1.07	1.05	1.04	1.03	1.08
37	Client Credibility	~~1.00~~	0.90	0.85	0.00	0.10	0.50	0.35	0.15	0.05	0.00	
38	Selected Incremental	~~3548.01~~	2.95	1.64	1.32	1.19	1.07	1.07	1.04	1.04	1.03	1.08
39	Incremental Relativity	~~125.59~~	0.67	0.88	1.00	1.08	0.59	0.97	0.89	1.00	1.00	
40	Selected Cumulative	~~36929.28~~	10.41	3.53	2.16	1.64	1.38	1.29	1.21	1.16	1.12	1.08
41	Cumulative Benchmark	443.57	15.17	3.87	2.24	1.70	1.45	1.30	1.21	1.16	1.12	1.08
42	Calculated Relativity	1.73	0.86	0.93	0.95	0.93	0.87	0.97	0.98	1.00	1.00	

formula: =(ROUND(C37,3)-1)/(ROUND(C35,3)-1). Relativity references the unreported portion of the LDFs.

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Actuaries may find applications where it is useful to use individual claims that must be developed to ultimate …

- Average ultimate severity for frequency – severity method
- Trend factors analysis
- Size of loss distribution fitting
- Traditional excess of loss experience rating ???
- Reported Losses versus Open Claims ???

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Actuaries may find applications where it is useful to use individual claims that must be developed to ultimate …

Pitfall: An excess of loss layering method where individual large losses

1. are developed to ultimate using average age-to-ultimate loss development factors (e.g. one LDF for each Accident Year); and
2. are then layered and aggregated for calculating averages

has a systemic bias, understating expected losses in higher layers, while overstating losses below.

When developing individual claims, the variation of LDFs around the average must be taken into consideration in order to capture losses that will develop beyond a given layer attachment point.

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Solution: Use a stochastic methods to capture the excess layer expected loss

Possible Development Factors: $\beta_1, \beta_2, \beta_3, \cdots \beta_N$ for a given claim

Associated Probability weights: $w_1, w_2, w_3, \cdots w_N$ such that $1 = \sum_{i=1}^{N} w_i$

Average Development: $\bar{\beta} = \sum_{i=1}^{N} w_i \cdot \beta_i$

Expected Loss to Layer - Stochastic:

$$E(Layer) = \sum_{i=1}^{N} w_i \cdot MIN\{MAX(Loss \cdot \beta_i - AttPt, 0), Limit\}$$

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Step 1: Original database

Raw data.
Ground-up

Date of Loss	Item	AY	12	24	36	48	60	72	84
06/28/85	1	1985	24,840	39,532	368,718	377,118	377,118	436,925	502,585
07/09/85	2	1985	5,452	35,674	52,870	45,633	45,633	45,633	45,633
07/23/85	3	1985	22,316	57,376	58,573	58,573	69,548	61,221	61,179
08/06/85	4	1985	24,404	31,928	56,934	57,004	26,051	26,051	26,051
08/15/85	5	1985	511,694	515,245	515,621	518,843	520,907	510,588	410,681
09/16/85	6	1985	-	24,336	69,230	74,816	104,591	106,500	100,500
11/20/85	7	1985	17,760	46,728	46,728	73,118	73,163	44,822	44,822
11/20/85	8	1985	-	15,640	15,640	15,640	23,605	97,014	98,790
01/24/86	9	1986	33,060	55,031	114,751	151,010	151,803	173,303	173,471
02/25/86	10	1986	-	55,376	62,732	68,150	65,139	60,044	60,044
03/25/86	11	1986	34,698	46,068	72,310	71,946	33,866	33,712	71,946
04/02/86	12	1986	41,315	52,682	52,682	15,369	15,369	15,369	15,369
04/10/86	13	1986	19,449	24,115	59,364	59,364	59,364	56,498	56,498
05/06/86	14	1986	29,531	89,216	95,916	96,286	96,286	88,900	88,900
07/15/86	15	1986	10,096	31,647	52,587	46,897	46,897	46,897	46,897
08/11/86	16	1986	-	-	-	-	-	-	-
08/26/86	17	1986	-	29,300	29,300	29,357	51,988	47,713	47,763
11/11/86	18	1986	-	12,420	16,570	48,626	55,626	55,626	84,727

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Step 2: Create database of "large" losses representative of desired LDFs

Threshhold	Need high enough threshhold to measure large loss development characteristics.
50,000	Need low enough threshhold, as opp to half of retention, to minimize error from below

Date of Loss	Item	AY	12	24	36	48	60	72	84
06/28/85	1	1985	-	-	368,718	377,118	377,118	436,925	502,585
07/09/85	2	1985	-	-	52,870	-	-	-	-
07/23/85	3	1985	-	57,376	58,573	58,573	69,548	61,221	61,179
08/06/85	4	1985	-	-	56,934	57,004	-	-	-
08/15/85	5	1985	511,694	515,245	515,621	518,843	520,907	510,588	410,681
09/16/85	6	1985	-	-	69,230	74,816	104,591	106,500	100,500
11/20/85	7	1985	-	-	-	73,118	73,163	-	-
11/20/85	8	1985	-	-	-	-	-	97,014	98,790
01/24/86	9	1986	-	55,031	114,751	151,010	151,803	173,303	173,471
02/25/86	10	1986	-	55,376	62,732	68,150	65,139	60,044	60,044
03/25/86	11	1986	-	-	72,310	71,946	-	-	71,946
04/02/86	12	1986	-	52,682	52,682	-	-	-	-
04/10/86	13	1986	-	-	59,364	59,364	59,364	56,498	56,498
05/06/86	14	1986	-	89,216	95,916	96,286	96,286	88,900	88,900
07/15/86	15	1986	-	-	52,587	-	-	-	-
08/11/86	16	1986	-	-	-	-	-	-	-
08/26/86	17	1986	-	-	-	-	51,988	-	-
11/11/86	18	1986	-	-	-	-	55,626	55,626	84,727

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Step 3: Calc individual claim cumulative LDFs

Distribution of LDFs from Age to Ultimate

where "ultimate" is age 84 months.

		Age to ultimate LDF at age ...						
AY	Item	12	24	36	48	60	72	84
1985	1	z	z	1.363	1.333	1.333	1.150	1.000
1985	2	z	z	z	z	z	z	z
1985	3	z	1.066	1.044	1.044	0.880	0.999	1.000
1985	4	z	z	z	z	z	z	z
1985	5	0.803	0.797	0.796	0.792	0.788	0.804	1.000
1985	6	z	z	1.452	1.343	0.961	0.944	1.000
1985	7	z	z	z	z	z	z	z
1985	8	z	z	z	z	z	1.018	1.000
1986	9	z	3.152	1.512	1.149	1.143	1.001	1.000
1986	10	z	1.084	0.957	0.881	0.922	1.000	1.000
1986	11	z	z	z	z	z	z	z
1986	12	z	z	z	z	z	z	z
1986	13	z	z	0.952	0.952	0.952	1.000	1.000
1986	14	z	0.996	0.927	0.923	0.923	1.000	1.000
1986	15	z	z	z	z	z	z	z
1986	16	z	z	z	z	z	z	z
1986	17	z	z	z	z	z	z	z
1986	18	z	z	z	z	1.523	1.523	1.000

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Step 4: Analyze the LDF distribution

Distribution of LDFs from Age to Ultimate Claim threshhold = 50,000
where "ultimate" is age 84 months.

	Age =	12	24	36	48	60	72
	count =	129	214	226	209	193	184
	Average =	1.67	1.33	1.15	1.02	1.01	1.02
	Std Dev =	1.23	1.12	0.59	0.34	0.23	0.18
5	th pctl =	0.59	0.58	0.57	0.48	0.56	0.91
10	th pctl =	0.75	0.68	0.73	0.71	0.86	1.00
90	th pctl =	3.21	2.12	1.63	1.34	1.20	1.06
95	th pctl =	3.83	2.88	1.99	1.65	1.37	1.24

{=FREQUENCY('G State Age-84'!C8:C890,$B$35:$B$51)}

Frequency distribution of LDFs at age ...

		12	24	36	48	60	72	12	24	36	48	60	72	84
	0	0	0	1	1	1	0							
0	0.50	2	4	9	11	6	4	1.6%	1.9%	4.0%	5.3%	3.1%	2.2%	0.0%
0.50	0.75	12	29	16	13	8	0	9.3%	13.6%	7.1%	6.3%	4.2%	0.0%	0.0%
0.75	0.95	22	37	36	31	18	8	17.1%	17.4%	16.0%	14.9%	9.4%	4.3%	0.0%
0.95	1.05	17	49	83	105	123	153	13.2%	23.0%	36.9%	50.5%	64.1%	83.2%	100.0%
1.05	1.50	27	49	51	33	31	14	20.9%	23.0%	22.7%	15.9%	16.1%	7.6%	0.0%
1.50	2.00	19	23	18	13	5	3	14.7%	10.8%	8.0%	6.3%	2.6%	1.6%	0.0%
2.00	3.00	13	13	7	1	1	2	10.1%	6.1%	3.1%	0.5%	0.5%	1.1%	0.0%
3.00	5.00	15	6	5	1	0	0	11.6%	2.8%	2.2%	0.5%	0.0%	0.0%	0.0%
5.00	10.00	2	3	0	0	0	0	1.6%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
10.00	10.00	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	
		129	213	226	209	193	184	100%	100%	100%	100%	100%	100%	100%

Excess Loss Development – Making use of client data
Individual claim development – watch out!

Munich RE

Step 5: Simulation of potential ultimate losses (brute force)

Generate random lookup of LDFs for each claim.

	Layer:	250,000		XS	250,000									
					StochasticLDFs									
Item	AY	Age	Reported Layered Loss at Age	Reported Layered Loss at Age	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
883	2009	24	62,398	-	0.63	1.28	7.50	1.28	0.63	1.28	1.00	1.00	1.00	1.28
884	2010	12	103,780	-	4.00	2.50	1.75	2.50	1.75	1.28	1.75	7.50	4.00	1.00
885	2010	12	123,548	-	0.85	1.28	1.28	4.00	1.75	0.85	4.00	0.85	1.75	4.00
886	2010	12	129,060	-	1.28	1.75	1.75	7.50	0.85	1.28	4.00	1.75	1.28	1.75
887	2010	12	72,800	-	0.63	0.85	0.85	4.00	1.75	1.28	0.63	1.28	0.85	1.28
888	2010	12	215,666	-	1.75	4.00	0.85	1.00	1.28	0.85	4.00	1.75	1.28	1.75
889	2010	12	-	-	1.28	1.28	1.28	4.00	1.28	0.63	1.28	0.85	0.85	4.00
890	2010	12	750,000	250,000	0.85	0.85	7.50	0.85	1.75	1.75	0.85	1.28	1.28	1.28
891	2010	12	52,482	-	0.63	2.50	1.00	0.85	0.85	0.63	1.00	0.85	1.00	0.85
892	2010	12	53,798	-	1.28	1.00	2.50	1.28	1.00	1.75	1.75	1.28	1.00	1.28
893	2010	12	58,500	-	1.75	0.63	0.85	1.00	0.85	1.28	1.28	1.00	1.28	0.50
894	2010	12	65,008	-	1.28	1.28	1.28	1.00	1.28	0.85	0.85	1.00	0.85	1.00
895	2010	12	87,871	-	1.28	4.00	4.00	1.28	1.75	2.50	1.75	4.00	0.85	1.28
896	2010	12	50,242	-	0.85	1.00	1.75	4.00	2.50	0.85	1.00	1.28	4.00	0.63
897	2010	12	64,439	-	0.63	7.50	0.85	0.85	0.85	1.28	4.00	0.63	1.00	1.28
898	2010	12	106,081	-	1.00	1.75	1.28	0.63	1.28	2.50	4.00	1.28	1.75	0.63
899	2010	12	73,304	-	0.63	4.00	1.75	1.00	1.28	1.28	0.85	1.00	0.85	0.85
900	2010	12	82,500	-	0.63	4.00	1.75	0.63	2.50	4.00	1.75	2.50	4.00	1.28
901	2010	12	145,000	-	1.00	1.00	4.00	1.00	7.50	1.28	1.00	4.00	1.28	2.50
902	2010	12	50,748	-	0.63	0.63	1.75	0.85	0.85	0.63	1.28	7.50	1.28	1.00
903	2010	12	88,208	-	1.75	4.00	1.75	1.28	1.28	2.50	1.75	1.28	1.75	1.00

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Step 5: Simulation of potential ultimate losses (brute force)

Random ultimate losses, layered, with average for each claim.

	Layer:	250,000		XS	250,000										
						Stochastic Layered									
Item	AY	Age	Reported Ground-up Loss at Age	Reported Layered Loss at Age	Average Stochastic Layered Loss	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
883	2009	24	62,398	-	8,719	-	-	217,985	-	-	-	-	-	-	-
884	2010	12	103,780	-	45,670	165,120	9,450	-	9,450	-	-	-	250,000	165,120	-
885	2010	12	123,548	-	51,193	-	-	-	244,192	-	-	244,192	-	-	244,192
886	2010	12	129,060	-	45,812	-	-	-	250,000	-	-	250,000	-	-	-
887	2010	12	72,800	-	13,296	-	-	-	41,200	-	-	-	-	-	-
888	2010	12	215,666	-	71,542	127,416	250,000	-	-	26,052	-	250,000	127,416	26,052	127,416
889	2010	12	-	-	-	-	-	-	-	-	-	-	-	-	-
890	2010	12	750,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000
891	2010	12	52,482	-	-	-	-	-	-	-	-	-	-	-	-
892	2010	12	53,798	-	6,139	-	-	-	-	-	-	-	-	-	-
893	2010	12	58,500	-	7,550	-	-	-	-	-	-	-	-	-	-
894	2010	12	65,008	-	1,204	-	-	-	-	-	-	-	-	-	-
895	2010	12	87,871	-	28,416	-	101,484	101,484	-	-	-	-	101,484	-	-
896	2010	12	50,242	-	5,073	-	-	-	-	-	-	-	-	-	-
897	2010	12	64,439	-	10,573	-	233,293	-	-	-	-	7,756	-	-	-
898	2010	12	106,081	-	7,581	-	-	-	-	-	15,203	174,324	-	-	-
899	2010	12	73,304	-	3,457	-	43,216	-	-	-	-	-	-	-	-
900	2010	12	82,500	-	19,600	-	80,000	-	-	-	80,000	-	-	80,000	-
901	2010	12	145,000	-	63,650	-	-	250,000	-	250,000	-	-	250,000	-	112,500
902	2010	12	50,748	-	5,224	-	-	-	-	-	-	-	130,610	-	-
903	2010	12	88,208	-	4,113	-	102,832	-	-	-	-	-	-	-	-

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Step 5: Result of stochastic approach compared to deterministic

	Layer:	250,000	XS	250,000			
AY	Age	Reported Layered Loss	Deterministic LDF	Deterministic Ultimate Loss in Layer	Stochastic Ultimate Loss in Layer	Difference	Pct Difference
2001	120	265,593	1.000	265,593	265,593	-	0.0%
2002	108	1,045,998	1.000	1,045,998	1,045,998	-	0.0%
2003	96	799,466	1.000	799,466	799,466	-	0.0%
2004	84	1,238,514	1.000	1,238,514	1,238,514	-	0.0%
2005	72	2,419,166	1.023	2,473,626	2,466,129	(7,496)	-0.3%
2006	60	1,213,885	1.006	1,221,078	1,331,008	109,930	9.0%
2007	48	1,292,916	1.021	1,319,564	1,559,063	239,499	18.1%
2008	36	504,794	1.148	579,273	992,423	413,150	71.3%
2009	24	390,406	1.332	520,173	871,984	351,811	67.6%
2010	12	250,000	1.669	417,238	593,013	175,775	42.1%

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References:

The ideas discussed here are included under the description “dispersion” in Corro & Engl, and as the “big bang theory” in Philbrick & Holler.

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