Casualty Loss Reserve Seminar
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Fairmont
Austin, Texas

Robert Wolf, FCAS, MAAA, CERA
Vice President , Chief Actuary
Stonetrust Commercial Insurance Company

Stochastic Loss Reserving with Bayesian MCMC – A Case Study

Description

Bayesian MCMC model enable a wide variety of models to be applied to a loss triangle. The output from those models enable one to calculate ranges of actuarial estimates or even a cost of capital risk margin. A problem with this ability to fit a wide variety of models is that one has to choose which one to use.

This session takes two loss triangles, based on paid and incurred data from a real company, with the following characteristics: (1) rapid premium growth; (2) changing claim settlement rates; and (3) changing loss reserving practices. It illustrates goodness of fit and graphic diagnostics that identify these problems. It then proposes a Bayesian MCMC model to use to obtain the best estimate of the loss liability and its range of possible estimates under these conditions.

……..Let's set up the Case Study

Let's start by talking About this Exhibit

XYZ COMMERCIAL INSURANCE COMPANY
Total Net Results - All States
Excludes Assigned Pools and Adjujsting and Other Expenses
Exhibit A

AS OF December 31, 2017
($s are in 000s)

Accident Year	Per Occur Retention	Net Earned Premium ($)	Net Paid Loss &DCC ($)	Net Case Loss & DCC Reserves ($)	Net Case Incurred Loss & DCC ($)	Reported Net LR	IBNR ($)	Indicated Estimated Ultimate	Indicated Ult LR	Prior Carried Ultimate	Prior Ult LR	Change
2002	750	13,750	7,036	-	7,036	51.2%	-	7,036	51.2%	7,036	51.2%	-
2003	750	28,052	11,117	-	11,117	39.6%	50	11,167	39.8%	11,182	39.9%	(15)
2004	750	44,853	27,859	-	27,859	62.1%	-	27,859	62.1%	27,859	62.1%	-
2005	750	70,507	41,875	-	41,875	59.4%	-	41,875	59.4%	41,900	59.4%	(25)
2006	750	80,285	45,199	-	45,199	56.3%	-	45,199	56.3%	45,199	56.3%	-
2007	750	96,286	57,378	-	57,378	59.6%	-	57,378	59.6%	57,378	59.6%	-
2008	750	130,481	65,943	191	66,134	50.7%	-	66,134	50.7%	66,134	50.7%	(0)
2009	750	142,059	48,346	809	49,155	34.6%	941	50,096	35.3%	49,254	34.7%	843
2010	750	131,024	70,789	2,418	73,207	55.9%	367	73,573	56.2%	71,817	54.8%	1,756
2011	750	131,870	87,468	3,151	90,618	68.7%	906	91,525	69.4%	91,000	69.0%	525
2012	750	122,125	80,433	3,686	84,119	68.9%	2,116	86,235	70.6%	83,750	68.6%	2,485
2013	750	125,456	81,000	6,226	87,226	69.5%	3,129	90,355	72.0%	87,500	69.7%	2,855
2014	750	201,129	91,884	13,884	105,768	52.6%	6,690	112,458	55.9%	105,000	52.2%	7,458
2015	750	271,351	109,789	24,939	134,729	49.7%	15,685	150,413	55.4%	144,750	53.3%	5,663
2016	750	297,237	96,858	43,599	140,457	47.3%	35,952	176,409	59.3%	171,500	57.7%	4,909
2017	750	292,035	36,954	59,274	96,228	33.0%	76,073	172,301	59.0%			
				158,178			141,909					26,453

Counts and Averages

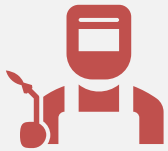
XYZ COMMERCIAL INSURANCE COMPANY
Total Net Results - All States
Excludes Assigned Pools and Adjujsting and Other Expenses

Exhibit A

AS OF December 31, 2017
($s are in 000s)

Accident Year	# Closed Claims	#Open Claims	#Reported Claims	#IBNR Claims	#Ultimate Claims	Frequency Per $100,000 Earned Premium	Average Closed Claim	Average Open Claim	Average Reported Claim	Average Unpaid Claim	Average Ultimate Claim
2002	625	-	625	-	625	4.5	11.3	-	11.3	-	11.3
2003	1,395	5	1,400	-	1,400	5.0	8.0	-	7.9	10.0	8.0
2004	2,345	-	2,345	-	2,345	5.2	11.9	-	11.9	-	11.9
2005	3,160	-	3,160	-	3,160	4.5	13.3	-	13.3	-	13.3
2006	3,365	-	3,365	-	3,365	4.2	13.4	-	13.4	-	13.4
2007	3,710	-	3,710	-	3,710	3.9	15.5	-	15.5	-	15.5
2008	4,195	5	4,200	-	4,200	3.2	15.7	38.2	15.7	38.2	15.7
2009	4,010	15	4,025	-	4,025	2.8	12.1	53.9	12.2	116.6	12.4
2010	4,945	20	4,965	-	4,965	3.8	14.3	120.9	14.7	139.2	14.8
2011	5,805	30	5,835	-	5,835	4.4	15.1	105.0	15.5	135.2	15.7
2012	4,865	50	4,915	-	4,915	4.0	16.5	73.7	17.1	116.0	17.5
2013	4,485	50	4,535	-	4,535	3.6	18.1	124.5	19.2	187.1	19.9
2014	6,310	140	6,450	-	6,450	3.2	14.6	99.2	16.4	147.0	17.4
2015	7,110	325	7,435	-	7,435	2.7	15.4	76.7	18.1	125.0	20.2
2016	6,995	680	7,675	23	7,698	2.6	13.8	64.1	18.3	113.2	22.9
2017	4,445	1,595	6,040	386	6,426	2.2	8.3	37.2	15.9	68.3	26.8
	67,765	2,915	70,680	409	71,089		-	-			

Adding some commentary



Workers Compensation

Growth

Claims Philosophy Changes

Significant Reserve Development

XYZ COMMERCIAL INSURANCE COMPANY

Run-off of Net Carried Loss and DCC (aka ALAE Reserves) ($000s)
Adequacy of Net reserves in Hindight at Prior-Year Ends
Source- Derivations from using December 31, 2017 Schedule P Data

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2014	$ 145,170	$ 158,865 9.4%	$ 166,370 14.6%	$ 182,100 25.4%
		$ -	$ -	$ -
Annual Change		$ 13,695	$ 7,505	$ 15,730
Cumulative Change		$ 13,695	$ 21,200	$ 36,930

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2015	$ 207,945	$ 208,500 0.3%	$ 229,905 10.6%	
		$ -	$ -	
Annual Change		$ 555	$ 21,405	
Cumulative Change		$ 555	$ 21,960	

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2016	$ 244,470	$ 272,095 11.3%		
		$ -		
Annual Change		$ 27,625		
Cumulative Change		$ 27,625		

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2017	$ 306,365			
Annual Change				
Cumulative Change				

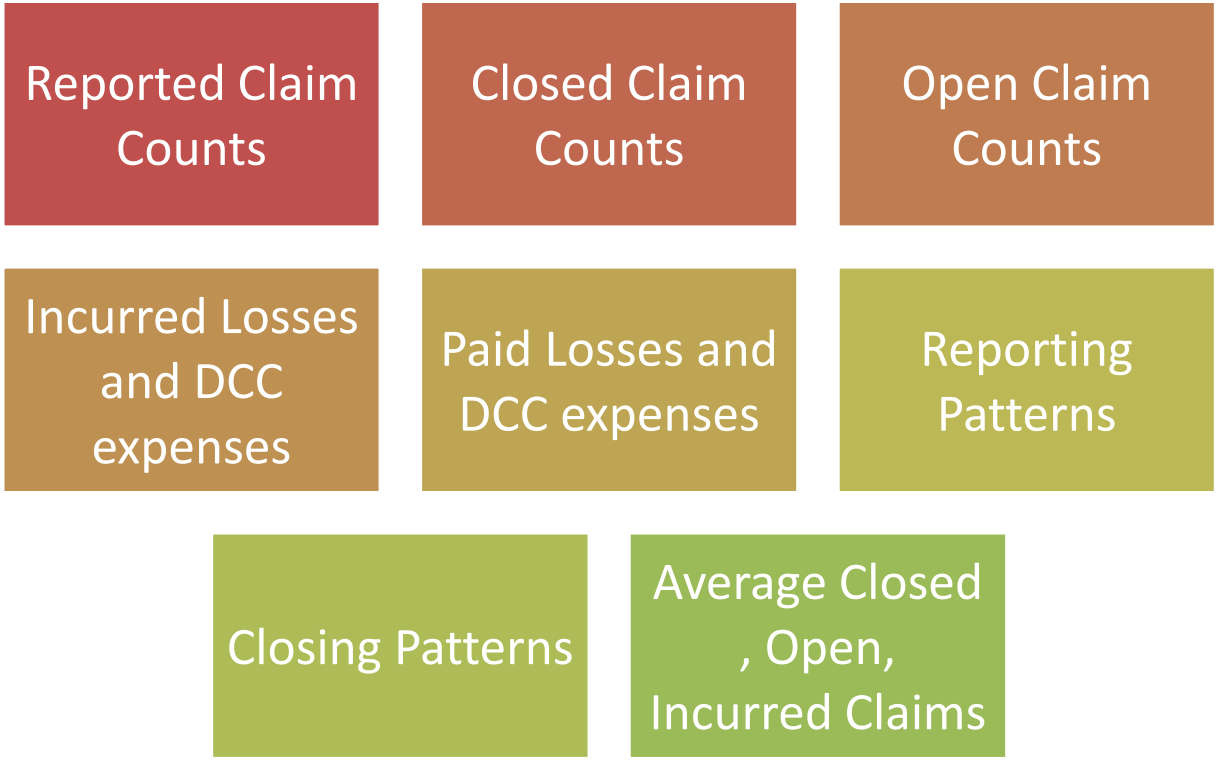
Actuarial Opinion- History

MMMMmmmmmm…… ??????

Statement of Actuarial Opinions

	Appointed Actuary	Carried Reserves	Appointed Actuary Central Estimate	Actuarial Opinion Summary Range	RMAD
12/31/2014	A	145,170	145,170	141,396 to 174,494	
		Reasonable	0.0%	-2.6% 20.2%	NO
12/31/2015	A	207,945	207,945	188,190 to 245,583	
		Reasonable	0.0%	-9.5% 18.1%	NO
12/31/2016	A	244,470	253,675	229,504 to 299,465	
		Reasonable	3.8%	-6.1% 22.5%	NO
12/31/2017	B	306,365	306,365	290,434 to 321,377	
		Reasonable	0.0%	-5.2% 4.9%	YES

Diagnostic Triangles



Nothing Unusual in Reported Claim Development

XYZ Commercial Insurance Company
Net of Reinsurance and Excldluing Assigned Risk Plans
Reported/Ultimate Claim Counts

Accident	Net	Months of Development																
Year	EP	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204
2002	13,750	0.984	0.992	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-
2003	28,052	0.832	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	
2004	44,853	0.898	0.989	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	
2005	70,507	0.900	0.995	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-	
2006	80,285	0.944	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-	-	
2007	96,286	0.918	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-	-	-	
2008	130,481	0.930	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-	-	-	-	
2009	142,059	0.945	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-	-	-	-	-	
2010	131,024	0.946	0.994	1.000	1.000	1.000	1.002	1.000	1.000	-	-	-	-	-	-	-	-	
2011	131,870	0.959	0.997	1.002	1.003	1.002	1.000	1.000	-	-	-	-	-	-	-	-	-	
2012	122,125	0.932	0.999	1.002	1.000	1.000	1.000	-	-	-	-	-	-	-	-	-	-	
2013	125,456	0.918	0.993	1.001	1.000	1.000	-	-	-	-	-	-	-	-	-	-	-	
2014	201,129	0.922	0.998	1.000	1.000	-	-	-	-	-	-	-	-	-	-	-	-	
2015	271,351	0.934	0.996	0.999	-	-	-	-	-	-	-	-	-	-	-	-	-	
2016	297,237	0.944	0.994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2017	292,035	0.941	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Notwithstanding the Growth in 2014- 2016, Settlement Patters appear relatively consistent within the last three diagonals

XYZ Commercial Insurance Company
Net of Reinsurance and Excldluing Assigned Risk Plans
Closed/Ultimate Claim Counts

Accident	Net	Months of Development															
Year	EP	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
2002	13,750	0.744	0.912	0.976	0.984	0.992	0.992	0.984	0.984	0.984	0.992	1.000	1.000	1.000	1.000	1.000	1.000
2003	28,052	0.557	0.911	0.964	0.979	0.986	0.989	0.993	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	-
2004	44,853	0.712	0.906	0.964	0.979	0.985	0.991	0.994	0.996	1.000	1.000	1.000	1.000	1.000	1.000	-	-
2005	70,507	0.557	0.884	0.948	0.978	0.992	0.994	0.995	0.998	0.998	0.998	1.000	1.000	1.000	-	-	-
2006	80,285	0.606	0.906	0.957	0.975	0.987	0.990	0.997	0.997	1.000	1.000	1.000	1.000	-	-	-	-
2007	96,286	0.643	0.914	0.946	0.972	0.980	0.995	0.999	1.000	1.000	1.000	1.000	-	-	-	-	-
2008	130,481	0.602	0.898	0.945	0.973	0.989	0.998	0.998	0.999	0.999	0.999	-	-	-	-	-	-
2009	142,059	0.646	0.883	0.959	0.989	0.994	0.994	0.995	0.996	0.996	-	-	-	-	-	-	-
2010	131,024	0.635	0.896	0.963	0.981	0.987	0.993	0.995	0.996	-	-	-	-	-	-	-	-
2011	131,870	0.626	0.925	0.967	0.985	0.991	0.991	0.995	-	-	-	-	-	-	-	-	-
2012	122,125	0.733	0.906	0.952	0.976	0.989	0.990	-	-	-	-	-	-	-	-	-	-
2013	125,456	0.684	0.899	0.949	0.983	0.989	-	-	-	-	-	-	-	-	-	-	-
2014	201,129	0.672	0.922	0.962	0.978	-	-	-	-	-	-	-	-	-	-	-	-
2015	271,351	0.662	0.915	0.956	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	297,237	0.692	0.909	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	292,035	0.692	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Implied Case Incurred to Ultimate Ratios May Make me appear optimistic. Do we need to increase my projections

XYZ Commercial Insurance Company
Net of Reinsurance and Excldluing Assigned Risk Plans
Incurred/Ultimate

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
2002	13,750	0.974	0.990	1.026	1.033	0.991	0.959	0.997	1.027	1.027	1.047	1.000	1.000	1.000	1.000	1.000	1.000
2003	28,052	0.699	1.235	1.008	1.004	0.987	0.995	1.003	0.997	0.997	0.994	0.995	0.994	0.994	0.995	0.996	-
2004	44,853	0.515	0.766	0.810	0.906	0.967	0.966	0.981	1.015	1.000	1.000	1.000	1.000	1.000	1.000	-	-
2005	70,507	0.567	0.938	0.968	0.971	0.974	0.982	1.008	1.005	0.999	0.998	0.999	1.000	1.000	-	-	-
2006	80,285	0.601	0.858	0.951	0.957	0.976	0.994	0.991	0.994	1.000	1.000	1.000	1.000	-	-	-	-
2007	96,286	0.519	0.785	0.949	0.980	1.036	0.995	1.000	1.000	1.000	1.000	1.000	-	-	-	-	-
2008	130,481	0.448	0.815	0.907	0.963	0.962	0.975	0.986	1.000	1.000	1.000	-	-	-	-	-	-
2009	142,059	0.648	1.015	1.013	0.974	0.980	0.980	0.983	0.981	0.981	-	-	-	-	-	-	-
2010	131,024	0.523	0.863	0.908	0.887	0.900	0.932	0.968	0.995	-	-	-	-	-	-	-	-
2011	131,870	0.579	0.833	0.893	0.921	0.949	0.982	0.990	-	-	-	-	-	-	-	-	-
2012	122,125	0.619	0.740	0.802	0.888	0.951	0.975	-	-	-	-	-	-	-	-	-	-
2013	125,456	0.559	0.719	0.892	0.921	0.965	-	-	-	-	-	-	-	-	-	-	-
2014	201,129	0.443	0.694	0.829	0.941	-	-	-	-	-	-	-	-	-	-	-	-
2015	271,351	0.567	0.781	0.896	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	297,237	0.605	0.796	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	292,035	0.558	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Really do not have a very Long Tail

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Open Claim Counts
Exhibit 9

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120	132	144
2002	13,750	150	50	15	10	5	5	10	10	10	5	-	-
2003	28,052	385	120	50	30	20	15	10	5	5	5		
2004	44,853	435	195	75	50	35	20	15	10	-	-	-	-
2005	70,507	1,085	350	160	70	25	20	15	5	5	5	-	-
2006	80,285	1,135	300	145	85	45	35	10	10	-	-	-	-
2007	96,286	1,020	300	200	105	75	20	5	-	-	-	-	-
2008	130,481	1,375	425	225	115	45	10	10	5	5	5	-	-
2009	142,059	1,205	460	165	45	25	25	20	15	15	-	-	-
2010	131,024	1,540	485	185	95	65	45	25	20	-	-	-	-
2011	131,870	1,940	425	205	105	65	55	30	-	-	-	-	-
2012	122,125	975	455	245	120	55	50	-	-	-	-	-	-
2013	125,456	1,065	430	235	75	50	-	-	-	-	-	-	-
2014	201,129	1,610	490	245	140	-	-	-	-	-	-	-	-
2015	271,351	2,025	610	325	-	-	-	-	-	-	-	-	-
2016	297,237	1,965	680	-	-	-	-	-	-	-	-	-	-
2017	292,035	1,595	-	-	-	-	-	-	-	-	-	-	-

Implied Incurred/Current Ultimate

XYZ Commercial Insurance Company
Net of Reinsurance and Excldluing Assigned Risk Plans
Incurred/Ultimate

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	0.974	0.990	1.026	1.033	0.991	0.959	0.997	1.027	1.027	1.047
2003	28,052	0.699	1.235	1.008	1.004	0.987	0.995	1.003	0.997	0.997	0.994
2004	44,853	0.515	0.766	0.810	0.906	0.967	0.966	0.981	1.015	1.000	1.000
2005	70,507	0.567	0.938	0.968	0.971	0.974	0.982	1.008	1.005	0.999	0.998
2006	80,285	0.601	0.858	0.951	0.957	0.976	0.994	0.991	0.994	1.000	1.000
2007	96,286	0.519	0.785	0.949	0.980	1.036	0.995	1.000	1.000	1.000	1.000
2008	130,481	0.448	0.815	0.907	0.963	0.962	0.975	0.986	1.000	1.000	1.000
2009	142,059	0.648	1.015	1.013	0.974	0.980	0.980	0.983	0.981	0.981	-
2010	131,024	0.523	0.863	0.908	0.887	0.900	0.932	0.968	0.995	-	-
2011	131,870	0.579	0.833	0.893	0.921	0.949	0.982	0.990	-	-	-
2012	122,125	0.619	0.740	0.802	0.888	0.951	0.975	-	-	-	-
2013	125,456	0.559	0.719	0.892	0.921	0.965	-	-	-	-	-
2014	201,129	0.443	0.694	0.829	0.941	-	-	-	-	-	-
2015	271,351	0.567	0.781	0.896	-	-	-	-	-	-	-
2016	297,237	0.605	0.796	-	-	-	-	-	-	-	-
2017	292,035	0.558	-	-	-	-	-	-	-	-	-

Need to note--

Implied Paid/Current Ultimate Appear Relatively Reasonable Though

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Paid/Ultimate

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	0.559	0.772	0.938	0.979	0.967	0.943	0.953	0.957	0.959	0.992
2003	28,052	0.378	0.942	0.905	0.967	0.985	0.989	0.998	0.996	0.993	0.994
2004	44,853	0.255	0.536	0.698	0.782	0.857	0.946	0.957	0.965	1.000	1.000
2005	70,507	0.258	0.635	0.807	0.899	0.959	0.970	0.989	1.005	0.998	0.998
2006	80,285	0.314	0.660	0.807	0.894	0.926	0.946	0.975	0.982	1.000	1.000
2007	96,286	0.316	0.642	0.784	0.874	0.958	0.979	0.997	1.000	1.000	1.000
2008	130,481	0.245	0.576	0.740	0.857	0.908	0.965	0.975	0.989	0.991	1.000
2009	142,059	0.346	0.736	0.869	0.915	0.938	0.947	0.957	0.962	0.965	-
2010	131,024	0.255	0.561	0.729	0.818	0.863	0.879	0.924	0.946	-	-
2011	131,870	0.258	0.585	0.767	0.852	0.887	0.908	0.947	-	-	-
2012	122,125	0.238	0.542	0.727	0.831	0.892	0.933	-	-	-	-
2013	125,456	0.218	0.572	0.756	0.846	0.901	-	-	-	-	-
2014	201,129	0.190	0.528	0.713	0.817	-	-	-	-	-	-
2015	271,351	0.233	0.580	0.730	-	-	-	-	-	-	-
2016	297,237	0.251	0.549	-	-	-	-	-	-	-	-
2017	292,035	0.217	-	-	-	-	-	-	-	-	-

Vertical Trends – 4.5% is reasonable

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Average Closed
Exhibit 6

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	8.5	9.5	10.8	11.2	11.0	10.7	10.9	11.0	11.0	11.3
2003	28,052	5.4	8.3	7.5	7.9	8.0	8.0	8.0	8.0	8.0	8.0
2004	44,853	4.2	7.0	8.6	9.5	10.3	11.3	11.4	11.5	11.9	11.9
2005	70,507	6.1	9.5	11.3	12.2	12.8	12.9	13.2	13.3	13.3	13.3
2006	80,285	7.0	9.8	11.3	12.3	12.6	12.8	13.1	13.2	13.4	13.4
2007	96,286	7.6	10.9	12.8	13.9	15.1	15.2	15.4	15.5	15.5	15.5
2008	130,481	6.4	10.1	12.3	13.8	14.4	15.2	15.3	15.6	15.6	15.7
2009	142,059	6.7	10.4	11.3	11.5	11.8	11.9	12.0	12.0	12.1	-
2010	131,024	6.0	9.4	11.4	12.6	13.2	13.3	14.0	14.3	-	-
2011	131,870	6.5	10.0	12.5	13.7	14.2	14.5	15.1	-	-	-
2012	122,125	5.7	10.5	13.4	14.9	15.8	16.5	-	-	-	-
2013	125,456	6.3	12.6	15.8	17.0	18.1	-	-	-	-	-
2014	201,129	4.9	10.0	12.9	14.6	-	-	-	-	-	-
2015	271,351	7.1	12.8	15.4	-	-	-	-	-	-	-
2016	297,237	8.3	13.8	-	-	-	-	-	-	-	-
2017	292,035	8.3	-	-	-	-	-	-	-	-	-

Average Case Reserves Look Out of Whack @ December 31, 2014

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Average Open
Exhibit 7

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	19.5	30.6	41.1	38.3	33.5	21.6	30.6	48.9	47.9	76.9
2003	28,052	9.3	27.2	23.0	13.7	1.3	4.4	5.4	3.3	8.3	-
2004	44,853	16.7	32.9	41.4	69.1	87.5	28.9	45.8	139.7	-	-
2005	70,507	11.9	36.2	42.0	42.9	25.1	23.7	52.4	5.9	5.7	0.6
2006	80,285	11.4	29.9	44.9	33.7	50.8	62.8	67.8	55.8	-	-
2007	96,286	11.4	27.3	47.4	58.2	59.8	46.0	43.8	-	-	-
2008	130,481	9.8	37.3	49.6	62.0	83.0	79.8	92.6	179.8	153.1	38.2
2009	142,059	12.5	30.4	43.9	65.7	83.9	67.0	65.7	63.1	53.9	-
2010	131,024	12.6	44.3	66.0	42.4	25.2	62.3	83.2	120.9	-	-
2011	131,870	15.0	52.2	53.2	54.0	75.7	111.4	105.0	-	-	-
2012	122,125	33.7	37.5	26.2	41.6	92.3	73.7	-	-	-	-
2013	125,456	29.0	31.6	53.9	96.1	124.5	-	-	-	-	-
2014	201,129	17.6	38.2	53.4	99.2	-	-	-	-	-	-
2015	271,351	24.7	49.6	76.7	-	-	-	-	-	-	-
2016	297,237	31.8	64.1	-	-	-	-	-	-	-	-
2017	292,035	37.2	-	-	-	-	-	-	-	-	-

Implied Average Unpaid (Reflecting My Current IBNR) Seems Reasonable. I like my Central Estimate

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Average Unpaid
Exhibit 6

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	19.4	29.2	28.9	14.8	46.4	80.0	32.8	29.9	28.9	10.7
2003	28,052	11.2	5.1	21.3	12.2	8.6	8.1	2.3	9.7	14.5	14.1
2004	44,853	30.8	58.8	98.9	121.7	113.4	75.6	80.6	96.7	-	-
2005	70,507	22.2	41.9	49.0	60.2	68.9	61.8	30.8	(38.1)	13.8	13.2
2006	80,285	23.4	48.8	60.3	56.4	74.7	69.9	110.8	82.9	-	-
2007	96,286	29.6	64.1	61.9	68.9	32.5	59.4	38.3	-	-	-
2008	130,481	29.8	65.0	74.6	81.9	135.3	229.1	166.0	143.4	116.3	1.4
2009	142,059	23.0	28.2	39.8	94.4	123.8	106.7	107.3	125.8	116.6	
2010	131,024	30.8	63.8	109.4	143.4	158.1	258.6	226.3	201.7		
2011	131,870	31.4	87.1	110.4	152.2	189.3	154.9	161.6			
2012	122,125	50.1	85.9	100.0	121.7	168.9	116.0				
2013	125,456	49.0	83.6	95.4	184.2	177.1					
2014	201,129	43.1	105.2	131.8	147.0						
2015	271,351	45.8	98.8	121.3							
2016	297,237	55.2	109.8								
2017	292,035	67.4									

My Client is asking me why all of this reserve development in the last three years?

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2014	$ 145,170	$ 158,865 9.4%	$ 166,370 14.6%	$ 182,100 25.4%
		$ -	$ -	$ -
Annual Change		$ 13,695	$ 7,505	$ 15,730
Cumulative Change		$ 13,695	$ 21,200	$ 36,930

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2015	$ 207,945	$ 208,500 0.3%	$ 229,905 10.6%	
		$ -	$ -	
Annual Change		$ 555	$ 21,405	
Cumulative Change		$ 555	$ 21,960	

		1 Year Later	2 years later	3 years later
		(Paid + Remaining Reserves)		
Carried Reserves as of December 31, 2016	$ 244,470	$ 272,095 11.3%		
		$ -		
Annual Change		$ 27,625		
Cumulative Change		$ 27,625		

After all, the previous Actuary Stated the reserves to be reasonable and no risk of material adverse deviation and I am saying its reasonable @12/31/17 with a risk of material adverse deviation

Statement of Actuarial Opinions

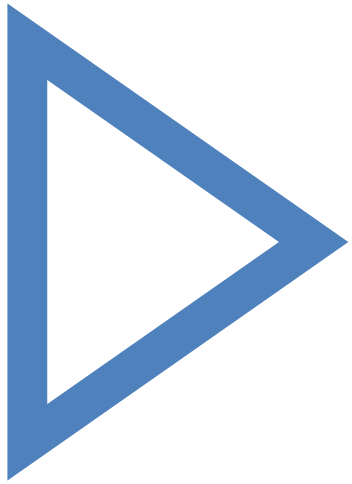
	Appointed Actuary	Carried Reserves	Appointed Actuary Central Estimate	Actuarial Opinion Summary Range	RMAD
12/31/2014	A	145,170	145,170	141,396 to 174,494	
		Reasonable	0.0%	-2.6% 20.2%	NO
12/31/2015	A	207,945	207,945	188,190 to 245,583	
		Reasonable	0.0%	-9.5% 18.1%	NO
12/31/2016	A	244,470	253,675	229,504 to 299,465	
		Reasonable	3.8%	-6.1% 22.5%	NO
12/31/2017	B	306,365	306,365	290,434 to 321,377	
		Reasonable	0.0%	-5.2% 4.9%	YES

Discussion

WHAT HAPPENED?

SHOULD THIS HAPPEN?

ASOPS? WHAT WAS VIOLATED? IF ANY?



MY TAKE

Let’s go Back Three Years, Realizing Hindsight is 20/20

Actuary A applied traditional unadjusted Chain-ladder methods

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Age to Age Factors
Exhibit 6

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
		24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
2002	13,750	1.016	1.037	1.007	0.959	0.967	1.040	1.030	1.000	1.020	0.955	1.000	1.000			
2003	28,052	1.767	0.816	0.996	0.983	1.008	1.008	0.994	1.000	0.996	1.001	0.999				
2004	44,853	1.487	1.056	1.119	1.068	0.999	1.015	1.035	0.985	1.000	1.000					
2005	70,507	1.653	1.032	1.004	1.003	1.008	1.026	0.998	0.994	0.999						
2006	80,285	1.427	1.108	1.007	1.020	1.019	0.996	1.004	1.006							
2007	96,286	1.513	1.209	1.033	1.056	0.961	1.005	1.000								
2008	130,481	1.818	1.113	1.062	0.999	1.014	1.012									
2009	142,059	1.567	0.999	0.961	1.006	1.000										
2010	131,024	1.649	1.052	0.977	1.015											
2011	131,870	1.439	1.072	1.032												
2012	122,125	1.194	1.084													
2013	125,456	1.287														
2014	201,129															

Considerations

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Average Closed
Exhibit 6

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	8.5	9.5	10.8	11.2	11.0	10.7	10.9	11.0	11.0	11.3
2003	28,052	5.4	8.3	7.5	7.9	8.0	8.0	8.0	8.0	8.0	8.0
2004	44,853	4.2	7.0	8.6	9.5	10.3	11.3	11.4	11.5	11.9	11.9
2005	70,507	6.1	9.5	11.3	12.2	12.8	12.9	13.2	13.3	13.3	13.3
2006	80,285	7.0	9.8	11.3	12.3	12.6	12.8	13.1	13.2	13.4	
2007	96,286	7.6	10.9	12.8	13.9	15.1	15.2	15.4	15.5		
2008	130,481	6.4	10.1	12.3	13.8	14.4	15.2	15.3			
2009	142,059	6.7	10.4	11.3	11.5	11.8	11.9				
2010	131,024	6.0	9.4	11.4	12.6	13.2					
2011	131,870	6.5	10.0	12.5	13.7						
2012	122,125	5.7	10.5	13.4							
2013	125,456	6.3	12.6								
2014	201,129	4.9									
2015	-										
2016	-										
2017	-										

Actuary A should have had to pay attention to this. Significant Drop in Average Case Reserves

XYZ Commercial Insurance Company
Net of Reinsurance and Exclduing Assigned Risk Plans
Average Open
Exhibit 7

Accident Year	Net EP	Months of Development 12	24	36	48	60	72	84	96	108	120
2002	13,750	19.5	30.6	41.1	38.3	33.5	21.6	30.6	48.9	47.9	76.9
2003	28,052	9.3	27.2	23.0	13.7	1.3	4.4	5.4	3.3	8.3	-
2004	44,853	16.7	32.9	41.4	69.1	87.5	28.9	45.8	139.7	-	-
2005	70,507	11.9	36.2	42.0	42.9	25.1	23.7	52.4	5.9	5.7	0.6
2006	80,285	11.4	29.9	44.9	33.7	50.8	62.8	67.8	55.8	-	
2007	96,286	11.4	27.3	47.4	58.2	59.8	46.0	43.8	-	-	
2008	130,481	9.8	37.3	49.6	62.0	83.0	79.8	92.6			
2009	142,059	12.5	30.4	43.9	65.7	83.9	67.0			-	
2010	131,024	12.6	44.3	66.0	42.4	25.2				-	
2011	131,870	15.0	52.2	53.2	54.0					-	
2012	122,125	33.7	37.5	26.2						-	
2013	125,456	29.0	31.6							-	
2014	201,129	17.6								-	
2015										-	
2016										-	
2017										-	

Should Have Anticipated Significant Pattern Shift at 12/31/14 as I have seen in my review @12/31/17 ???. I know hindsight is 20/20

XYZ Commercial Insurance Company
Net of Reinsurance and Excldluing Assigned Risk Plans
Age to Age Factors

Exhibit 6		Months of Development														
Accident Year	Net EP	12 24	24 36	36 48	48 60	60 72	72 84	84 96	96 108	108 120	120 132	132 144	144 156	156 168	168 180	180 192
2002	13,750	1.016	1.037	1.007	0.959	0.967	1.040	1.030	1.000	1.020	0.955	1.000	1.000	1.000	1.000	1.000
2003	28,052	1.767	0.816	0.996	0.983	1.008	1.008	0.994	1.000	0.996	1.001	0.999	1.000	1.001	1.000	
2004	44,853	1.487	1.056	1.119	1.068	0.999	1.015	1.035	0.985	1.000	1.000	1.000	1.000	1.000		
2005	70,507	1.653	1.032	1.004	1.003	1.008	1.026	0.998	0.994	0.999	1.000	1.001	1.000			
2006	80,285	1.427	1.108	1.007	1.020	1.019	0.996	1.004	1.006	1.000	1.000	1.000				
2007	96,286	1.513	1.209	1.033	1.056	0.961	1.005	1.000	1.000	1.000	1.000					
2008	130,481	1.818	1.113	1.062	0.999	1.014	1.012	1.014	1.000	1.000						
2009	142,059	1.567	0.999	0.961	1.006	1.000	1.003	0.998	1.000							
2010	131,024	1.649	1.052	0.977	1.015	1.036	1.039	1.028								
2011	131,870	1.439	1.072	1.032	1.030	1.036	1.008									
2012	122,125	1.194	1.084	1.108	1.071	1.026										
2013	125,456	1.287	1.240	1.033	1.048											
2014	201,129	1.567	1.194	1.134												
2015	271,351	1.378	1.148													
2016	297,237	1.315	-													
2017	292,035	-														

Discussion

I used Berquist Sherman Considerations

I used Ruth Salzman's Postulates considering "Stage of Development" over "Age of Development" and arrived at close to the needed reserves that should have been indicated as of December 31, 2014.

Confusion on Ranges, RMADs

What is a reserve range?

Types of ranges

Two types of ranges are commonly discussed:

Range of possible outcomes: includes the full range of potential results of the claim process

Range of reasonable estimates: expresses the degree of uncertainty in an estimate

Sometimes, both are referred to as "ranges," but they have very different meanings

A range of possible outcomes is not the same as a range of reasonable estimates!

The type of range will vary depending on its intended purpose or use

Examples of uses of ranges

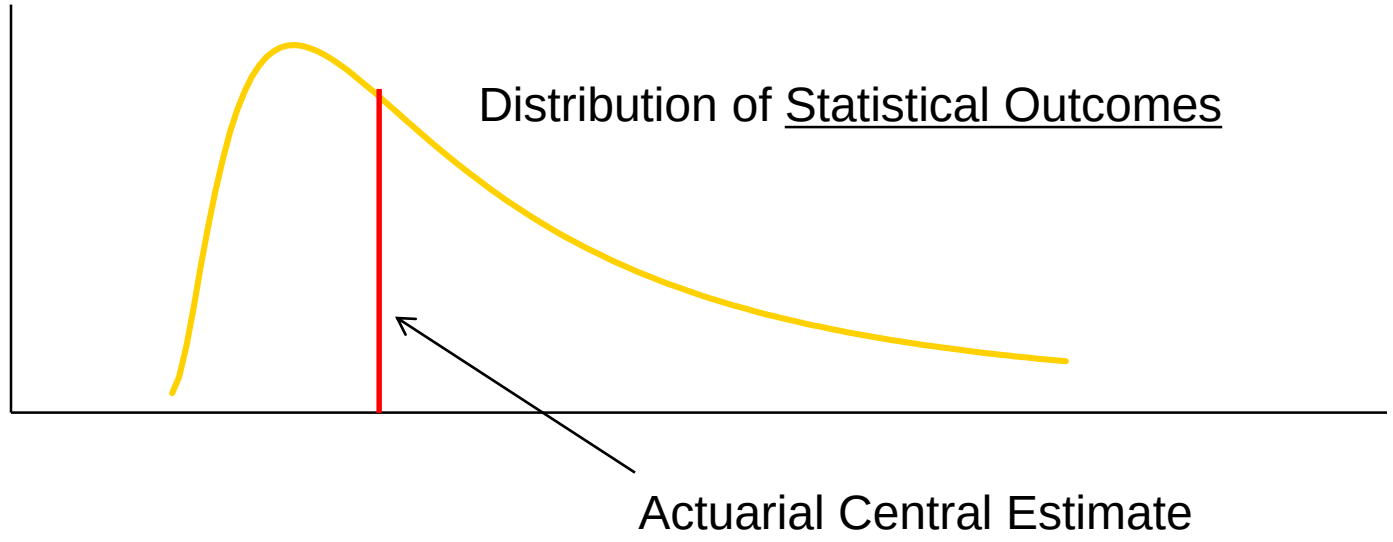
Range of Reasonable Estimates	Range of Possible Outcomes
Reports supporting the SAO: opinion on carried loss and LAE reserves	Capital modeling: full probability distribution for aggregate reserves
Internal communications: Aid in setting management's best estimate	Risk management: scenario testing
Audits and statutory exams: testing management's best estimate	Planning: subset of the full distribution provides an outcome confidence interval
SEC filings: comments on reliability of current earnings could relate to uncertainty in the range of estimates or variability around the estimates	
M&A: profitability, ranges of future outcomes could relate to the uncertainty in the range of estimates or variability around the estimates	

My Take

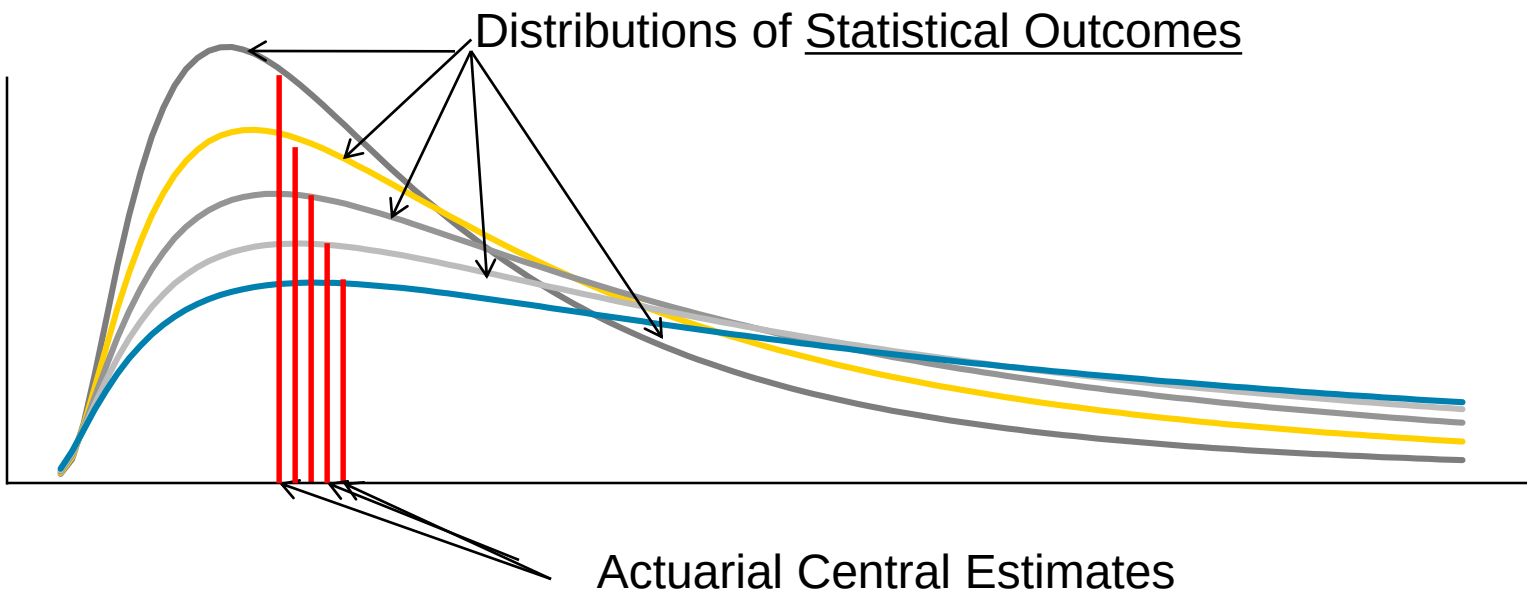
*A range of reasonable actuarial central estimates considers primarily **parameter** and **model** risk, not **process** risk*

- **Process Risk: the randomness of future outcomes** *given a known distribution of possible outcomes*
- **Parameter Risk: the potential error in the estimated parameters** used to describe the distribution of possible outcomes, *assuming the process generating the outcomes is known*
- **Model Risk: the chance that the model ("process") used** to estimate the distribution of possible outcomes is incorrect or incomplete

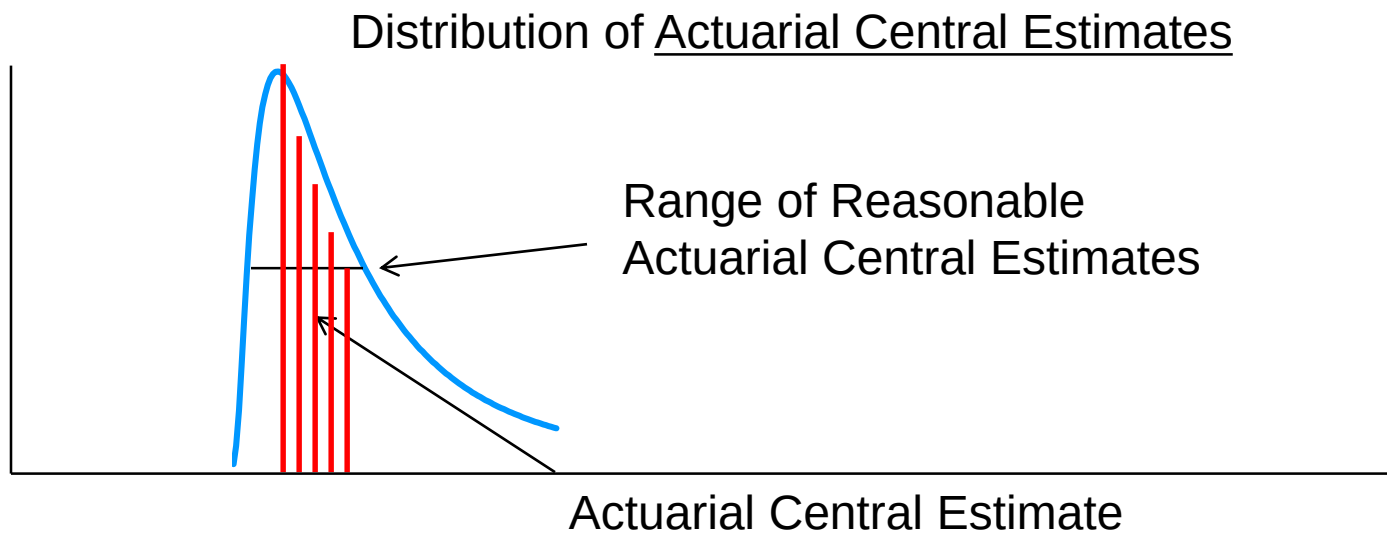
What is a range of reasonable actuarial central estimates?



What is a range of reasonable actuarial central estimates?



What is a range of reasonable actuarial central estimates?



Discussion

Do you think ASOPS were violated by Actuary A?

Is there a better another way ? Glenn?

Appendix

Sources of guidance and information

Guidance:

ASOP Nos. 36 and 43

Statements of Statutory Accounting Principles

NAIC Annual Statement Instructions

Actuarial Literature

Mack; England/Verrall—each describe advanced techniques on reserve variability—both include process risk

Walker/Littman (2013)—attempt to establish a potential connection between a range of reasonable estimates and a range of possible outcomes

ASOP No. 36: SAOs Regarding P/C Loss and Loss Adjustment Expense Reserves

3.7 Reserve Evaluation (emphasis added)—The actuary **should consider a reserve to be reasonable if it is within a range of estimates that *could be* produced by an unpaid claim estimate analysis** that is, in the actuary's professional judgment, consistent with both ASOP No. 43, *Property/Casualty Unpaid Claim Estimates,* and the identified stated basis of reserve presentation.

3.7.1 Evaluation Based on Actuary's Unpaid Claim Estimates (emphasis added)—When developing unpaid claim estimates to evaluate the reasonableness of a reserve, the actuary may develop **a point estimate, a range of estimates, or both**. The actuary should be **guided by ASOP No. 43** for the development of these unpaid claim estimates.

SSAP 55, Paragraphs 11-12

"…[M]MANAGEMENT SHALL RECORD ITS BEST ESTIMATE" … **BY LINE AND IN THE AGGREGATE**

(THIS IS TOUGHER THAN CONSTRAINT PUT ON ACTUARY.)

"[MANAGEMENT'S ANALYSIS] … SHALL INCLUDE AN ANALYSIS OF THE AMOUNT OF VARIABILITY IN THE ESTIMATE"

MANAGEMENT MAY CONSIDER A RANGE OF "… RESERVE ESTIMATES BOUNDED BY A HIGH AND A LOW ESTIMATE …" AND RECORD WITHIN THAT RANGE

"MANAGEMENT'S RANGE SHALL BE REALISTIC AND, THEREFORE, SHALL NOT INCLUDE THE SET OF ALL POSSIBLE OUTCOMES BUT ONLY THOSE OUTCOMES THAT ARE CONSIDERED REASONABLE"