

PENNSYLVANIA COMPENSATION RATING BUREAU

Measures of Goodness of Fit in Trend Calculations Using Severity Ratios

Estimates of trended severity ratios using from 4 to 10 data points for each loss development technique are shown in Exhibit 6.

The first page of the attachment shows  $R^2$  values for the regressions producing those trended severity ratios.

Pages 2 and 3 show indemnity fitted severity ratios for each loss development method using from 4 to 10 data points. Page 2 uses linear regression and page 3 uses exponential techniques. Pages 4 and 5 present analogous results for medical-linear and medical-exponential respectively.

Pages 6 through 9 show residuals resulting from the comparison of actual and fitted (actual minus fitted) values for the curves used in the trend projections. Page 6 shows indemnity results using linear regression, page 7 is for indemnity-exponential, page 8 for medical-linear and page 9 for medical-exponential.

INDEMNITY		Average	(Incur)	(Pd-27)
Freq Adj LR		(Pd & Inc)		
r <sup>2</sup>				
4 Point	Linear	0.914	0.719	0.968
5 Point	Linear	0.852	0.689	0.897
6 Point	Linear	0.645	0.325	0.758
7 Point	Linear	0.765	0.508	0.843
8 Point	Linear	0.811	0.644	0.876
9 Point	Linear	0.867	0.750	0.913
10 Point	Linear	0.894	0.799	0.930
4 Point	Expon'l	0.920	0.722	0.973
5 Point	Expon'l	0.859	0.693	0.904
6 Point	Expon'l	0.647	0.323	0.763
7 Point	Expon'l	0.770	0.511	0.849
8 Point	Expon'l	0.802	0.639	0.868
9 Point	Expon'l	0.860	0.745	0.907
10 Point	Expon'l	0.890	0.795	0.928

MEDICAL		Average	(Incur)	(Pd-27)
Freq Adj LR		(Pd & Inc)		
r <sup>2</sup>				
4 Point	Linear	0.936	0.896	0.945
5 Point	Linear	0.966	0.943	0.972
6 Point	Linear	0.969	0.958	0.969
7 Point	Linear	0.966	0.952	0.971
8 Point	Linear	0.971	0.963	0.973
9 Point	Linear	0.978	0.972	0.979
10 Point	Linear	0.972	0.968	0.974
4 Point	Expon'l	0.935	0.899	0.939
5 Point	Expon'l	0.963	0.940	0.969
6 Point	Expon'l	0.970	0.959	0.970
7 Point	Expon'l	0.971	0.956	0.975
8 Point	Expon'l	0.964	0.957	0.965
9 Point	Expon'l	0.974	0.969	0.975
10 Point	Expon'l	0.973	0.970	0.974

INDEMNITY Linear <b>FITTED</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.8244	0.7907	0.8579
	2011	0.8476	0.8040	0.8912
	2012	0.8709	0.8173	0.9245
	2013	0.8941	0.8305	0.9577
5 Point	2009	0.8174	0.7873	0.8474
	2010	0.8353	0.7973	0.8731
	2011	0.8531	0.8073	0.8988
	2012	0.8709	0.8173	0.9245
	2013	0.8887	0.8273	0.9501
6 Point	2008	0.8213	0.7948	0.8477
	2009	0.8332	0.8000	0.8663
	2010	0.8451	0.8052	0.8849
	2011	0.8570	0.8105	0.9035
	2012	0.8689	0.8157	0.9221
	2013	0.8808	0.8209	0.9407
7 Point	2007	0.8058	0.7855	0.8260
	2008	0.8185	0.7916	0.8453
	2009	0.8313	0.7978	0.8646
	2010	0.8440	0.8040	0.8839
	2011	0.8567	0.8101	0.9033
	2012	0.8695	0.8163	0.9226
	2013	0.8822	0.8225	0.9419
8 Point	2006	0.7731	0.7588	0.7874
	2007	0.7898	0.7691	0.8106
	2008	0.8066	0.7793	0.8338
	2009	0.8233	0.7896	0.8569
	2010	0.8400	0.7999	0.8801
	2011	0.8567	0.8101	0.9033
	2012	0.8734	0.8204	0.9264
	2013	0.8902	0.8307	0.9496
9 Point	2005	0.7474	0.7364	0.7585
	2006	0.7657	0.7488	0.7827
	2007	0.7840	0.7612	0.8068
	2008	0.8023	0.7736	0.8310
	2009	0.8206	0.7860	0.8552
	2010	0.8389	0.7984	0.8794
	2011	0.8573	0.8109	0.9036
	2012	0.8756	0.8233	0.9278
	2013	0.8939	0.8357	0.9520
10 Point	2004	0.7318	0.7253	0.7383
	2005	0.7496	0.7375	0.7618
	2006	0.7675	0.7497	0.7854
	2007	0.7854	0.7619	0.8090
	2008	0.8033	0.7741	0.8325
	2009	0.8212	0.7863	0.8561
	2010	0.8391	0.7985	0.8796
	2011	0.8570	0.8107	0.9032
	2012	0.8749	0.8229	0.9267
	2013	0.8927	0.8351	0.9503

INDEMNITY Expon'l <b>FITTED</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.8249	0.7910	0.8587
	2011	0.8474	0.8039	0.8906
	2012	0.8704	0.8170	0.9237
	2013	0.8941	0.8304	0.9581
5 Point	2009	0.8181	0.7875	0.8486
	2010	0.8352	0.7973	0.8729
	2011	0.8526	0.8071	0.8980
	2012	0.8704	0.8170	0.9237
	2013	0.8886	0.8271	0.9502
6 Point	2008	0.8219	0.7950	0.8489
	2009	0.8333	0.8000	0.8665
	2010	0.8448	0.8051	0.8844
	2011	0.8566	0.8103	0.9027
	2012	0.8684	0.8154	0.9213
	2013	0.8805	0.8206	0.9404
7 Point	2007	0.8064	0.7856	0.8274
	2008	0.8186	0.7916	0.8455
	2009	0.8310	0.7977	0.8640
	2010	0.8435	0.8038	0.8830
	2011	0.8562	0.8099	0.9023
	2012	0.8691	0.8161	0.9221
	2013	0.8823	0.8224	0.9423
8 Point	2006	0.7735	0.7586	0.7888
	2007	0.7894	0.7686	0.8103
	2008	0.8056	0.7787	0.8324
	2009	0.8221	0.7890	0.8551
	2010	0.8390	0.7994	0.8784
	2011	0.8562	0.8099	0.9023
	2012	0.8738	0.8206	0.9269
	2013	0.8917	0.8314	0.9522
9 Point	2005	0.7483	0.7363	0.7606
	2006	0.7654	0.7482	0.7827
	2007	0.7829	0.7603	0.8053
	2008	0.8007	0.7726	0.8287
	2009	0.8190	0.7851	0.8527
	2010	0.8377	0.7978	0.8774
	2011	0.8569	0.8107	0.9028
	2012	0.8764	0.8238	0.9290
	2013	0.8965	0.8372	0.9559
10 Point	2004	0.7334	0.7257	0.7415
	2005	0.7498	0.7373	0.7626
	2006	0.7667	0.7490	0.7843
	2007	0.7839	0.7609	0.8067
	2008	0.8015	0.7731	0.8296
	2009	0.8195	0.7854	0.8532
	2010	0.8378	0.7979	0.8775
	2011	0.8566	0.8106	0.9025
	2012	0.8759	0.8235	0.9282
	2013	0.8955	0.8366	0.9546

MEDICAL Linear <b>FITTED</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.9342	0.9061	0.9620
	2011	0.9729	0.9402	1.0055
	2012	1.0117	0.9743	1.0489
	2013	1.0504	1.0084	1.0923
5 Point	2009	0.8857	0.8572	0.9142
	2010	0.9277	0.8963	0.9591
	2011	0.9697	0.9353	1.0040
	2012	1.0117	0.9743	1.0489
	2013	1.0536	1.0133	1.0938
6 Point	2008	0.8552	0.8267	0.8836
	2009	0.8940	0.8634	0.9246
	2010	0.9329	0.9001	0.9656
	2011	0.9717	0.9368	1.0066
	2012	1.0106	0.9735	1.0476
	2013	1.0495	1.0102	1.0886
7 Point	2007	0.8292	0.8047	0.8538
	2008	0.8651	0.8380	0.8922
	2009	0.9010	0.8713	0.9306
	2010	0.9369	0.9046	0.9690
	2011	0.9727	0.9379	1.0074
	2012	1.0086	0.9712	1.0459
	2013	1.0445	1.0046	1.0843
8 Point	2006	0.7798	0.7590	0.8005
	2007	0.8184	0.7948	0.8419
	2008	0.8570	0.8306	0.8833
	2009	0.8956	0.8664	0.9247
	2010	0.9341	0.9022	0.9660
	2011	0.9727	0.9379	1.0074
	2012	1.0113	0.9737	1.0488
	2013	1.0499	1.0095	1.0902
9 Point	2005	0.7456	0.7274	0.7639
	2006	0.7834	0.7624	0.8045
	2007	0.8213	0.7975	0.8450
	2008	0.8591	0.8325	0.8856
	2009	0.8969	0.8676	0.9261
	2010	0.9347	0.9026	0.9666
	2011	0.9725	0.9377	1.0072
	2012	1.0103	0.9727	1.0477
	2013	1.0481	1.0078	1.0882
10 Point	2004	0.7214	0.7048	0.7381
	2005	0.7571	0.7379	0.7763
	2006	0.7927	0.7710	0.8145
	2007	0.8284	0.8041	0.8528
	2008	0.8641	0.8371	0.8910
	2009	0.8997	0.8702	0.9292
	2010	0.9354	0.9033	0.9674
	2011	0.9711	0.9364	1.0056
	2012	1.0067	0.9694	1.0438
	2013	1.0424	1.0025	1.0820

MEDICAL Expon'l <b>FITTED</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.9347	0.9068	0.9625
	2011	0.9720	0.9396	1.0043
	2012	1.0109	0.9735	1.0480
	2013	1.0512	1.0087	1.0936
5 Point	2009	0.8871	0.8584	0.9156
	2010	0.9265	0.8952	0.9578
	2011	0.9678	0.9335	1.0019
	2012	1.0109	0.9735	1.0480
	2013	1.0558	1.0152	1.0963
6 Point	2008	0.8577	0.8290	0.8864
	2009	0.8935	0.8628	0.9241
	2010	0.9307	0.8981	0.9633
	2011	0.9695	0.9347	1.0042
	2012	1.0099	0.9729	1.0468
	2013	1.0520	1.0126	1.0913
7 Point	2007	0.8330	0.8081	0.8579
	2008	0.8654	0.8382	0.8925
	2009	0.8991	0.8696	0.9285
	2010	0.9341	0.9021	0.9659
	2011	0.9704	0.9358	1.0049
	2012	1.0081	0.9707	1.0454
	2013	1.0474	1.0070	1.0876
8 Point	2006	0.7844	0.7632	0.8056
	2007	0.8185	0.7950	0.8420
	2008	0.8541	0.8281	0.8800
	2009	0.8912	0.8625	0.9198
	2010	0.9300	0.8984	0.9614
	2011	0.9704	0.9358	1.0049
	2012	1.0126	0.9747	1.0503
	2013	1.0566	1.0152	1.0978
9 Point	2005	0.7522	0.7333	0.7712
	2006	0.7848	0.7637	0.8060
	2007	0.8188	0.7954	0.8423
	2008	0.8544	0.8283	0.8803
	2009	0.8914	0.8627	0.9200
	2010	0.9300	0.8985	0.9615
	2011	0.9704	0.9357	1.0048
	2012	1.0124	0.9745	1.0501
	2013	1.0563	1.0150	1.0975
10 Point	2004	0.7299	0.7124	0.7475
	2005	0.7601	0.7406	0.7796
	2006	0.7915	0.7699	0.8131
	2007	0.8242	0.8003	0.8481
	2008	0.8582	0.8320	0.8845
	2009	0.8937	0.8648	0.9225
	2010	0.9306	0.8990	0.9621
	2011	0.9691	0.9346	1.0035
	2012	1.0091	0.9715	1.0466
	2013	1.0508	1.0099	1.0916

INDEMNITY Linear RESIDUALS	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.0050	0.0057	0.0044
	2011	-0.0013	-0.0013	-0.0014
	2012	-0.0124	-0.0145	-0.0104
	2013	0.0087	0.0101	0.0074
5 Point	2009	0.0109	0.0065	0.0152
	2010	-0.0059	-0.0009	-0.0108
	2011	-0.0068	-0.0046	-0.0090
	2012	-0.0124	-0.0145	-0.0104
	2013	0.0141	0.0133	0.0150
6 Point	2008	0.0197	0.0160	0.0236
	2009	-0.0049	-0.0062	-0.0037
	2010	-0.0157	-0.0088	-0.0226
	2011	-0.0107	-0.0078	-0.0137
	2012	-0.0104	-0.0129	-0.0080
	2013	0.0220	0.0197	0.0244
7 Point	2007	-0.0042	-0.0048	-0.0036
	2008	0.0225	0.0192	0.0260
	2009	-0.0030	-0.0040	-0.0020
	2010	-0.0146	-0.0076	-0.0216
	2011	-0.0104	-0.0074	-0.0135
	2012	-0.0110	-0.0135	-0.0085
	2013	0.0206	0.0181	0.0232
8 Point	2006	-0.0279	-0.0287	-0.0269
	2007	0.0118	0.0116	0.0118
	2008	0.0344	0.0315	0.0375
	2009	0.0050	0.0042	0.0057
	2010	-0.0106	-0.0035	-0.0178
	2011	-0.0104	-0.0074	-0.0135
	2012	-0.0149	-0.0176	-0.0123
	2013	0.0126	0.0099	0.0155
9 Point	2005	-0.0148	-0.0201	-0.0096
	2006	-0.0205	-0.0187	-0.0222
	2007	0.0176	0.0195	0.0156
	2008	0.0387	0.0372	0.0403
	2009	0.0077	0.0078	0.0074
	2010	-0.0095	-0.0020	-0.0171
	2011	-0.0110	-0.0082	-0.0138
	2012	-0.0171	-0.0205	-0.0137
	2013	0.0089	0.0049	0.0131
10 Point	2004	0.0050	0.0025	0.0076
	2005	-0.0170	-0.0212	-0.0129
	2006	-0.0223	-0.0196	-0.0249
	2007	0.0162	0.0188	0.0134
	2008	0.0377	0.0367	0.0388
	2009	0.0071	0.0075	0.0065
	2010	-0.0097	-0.0021	-0.0173
	2011	-0.0107	-0.0080	-0.0134
	2012	-0.0164	-0.0201	-0.0126
	2013	0.0101	0.0055	0.0148

INDEMNITY Expon'l <b>RESIDUALS</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	0.0045	0.0054	0.0036
	2011	-0.0011	-0.0012	-0.0008
	2012	-0.0119	-0.0142	-0.0096
	2013	0.0087	0.0102	0.0070
5 Point	2009	0.0102	0.0063	0.0140
	2010	-0.0058	-0.0009	-0.0106
	2011	-0.0063	-0.0044	-0.0082
	2012	-0.0119	-0.0142	-0.0096
	2013	0.0142	0.0135	0.0149
6 Point	2008	0.0191	0.0158	0.0224
	2009	-0.0050	-0.0062	-0.0039
	2010	-0.0154	-0.0087	-0.0221
	2011	-0.0103	-0.0076	-0.0129
	2012	-0.0099	-0.0126	-0.0072
	2013	0.0223	0.0200	0.0247
7 Point	2007	-0.0048	-0.0049	-0.0050
	2008	0.0224	0.0192	0.0258
	2009	-0.0027	-0.0039	-0.0014
	2010	-0.0141	-0.0074	-0.0207
	2011	-0.0099	-0.0072	-0.0125
	2012	-0.0106	-0.0133	-0.0080
	2013	0.0205	0.0182	0.0228
8 Point	2006	-0.0283	-0.0285	-0.0283
	2007	0.0122	0.0121	0.0121
	2008	0.0354	0.0321	0.0389
	2009	0.0062	0.0048	0.0075
	2010	-0.0096	-0.0030	-0.0161
	2011	-0.0099	-0.0072	-0.0125
	2012	-0.0153	-0.0178	-0.0128
	2013	0.0111	0.0092	0.0129
9 Point	2005	-0.0157	-0.0200	-0.0117
	2006	-0.0202	-0.0181	-0.0222
	2007	0.0187	0.0204	0.0171
	2008	0.0403	0.0382	0.0426
	2009	0.0093	0.0087	0.0099
	2010	-0.0083	-0.0014	-0.0151
	2011	-0.0106	-0.0080	-0.0130
	2012	-0.0179	-0.0210	-0.0149
	2013	0.0063	0.0034	0.0092
10 Point	2004	0.0034	0.0021	0.0044
	2005	-0.0172	-0.0210	-0.0137
	2006	-0.0215	-0.0189	-0.0238
	2007	0.0177	0.0198	0.0157
	2008	0.0395	0.0377	0.0417
	2009	0.0088	0.0084	0.0094
	2010	-0.0084	-0.0015	-0.0152
	2011	-0.0103	-0.0079	-0.0127
	2012	-0.0174	-0.0207	-0.0141
	2013	0.0073	0.0040	0.0105

MEDICAL Linear RESIDUALS	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	-0.0061	-0.0018	-0.0105
	2011	0.0162	0.0129	0.0195
	2012	-0.0139	-0.0205	-0.0075
	2013	0.0039	0.0093	-0.0015
5 Point	2009	-0.0064	-0.0098	-0.0030
	2010	0.0003	0.0081	-0.0076
	2011	0.0194	0.0178	0.0210
	2012	-0.0139	-0.0205	-0.0075
	2013	0.0007	0.0044	-0.0030
6 Point	2008	0.0103	0.0077	0.0130
	2009	-0.0147	-0.0160	-0.0134
	2010	-0.0049	0.0042	-0.0141
	2011	0.0174	0.0163	0.0184
	2012	-0.0129	-0.0197	-0.0062
	2013	0.0048	0.0075	0.0022
7 Point	2007	0.0150	0.0169	0.0129
	2008	0.0004	-0.0036	0.0044
	2009	-0.0217	-0.0239	-0.0194
	2010	-0.0089	-0.0003	-0.0175
	2011	0.0164	0.0152	0.0176
	2012	-0.0109	-0.0174	-0.0045
	2013	0.0098	0.0131	0.0065
8 Point	2006	-0.0191	-0.0172	-0.0209
	2007	0.0258	0.0268	0.0248
	2008	0.0085	0.0038	0.0133
	2009	-0.0163	-0.0190	-0.0135
	2010	-0.0061	0.0021	-0.0145
	2011	0.0164	0.0152	0.0176
	2012	-0.0136	-0.0199	-0.0074
	2013	0.0044	0.0082	0.0006
9 Point	2005	0.0074	0.0067	0.0081
	2006	-0.0227	-0.0206	-0.0249
	2007	0.0230	0.0241	0.0217
	2008	0.0064	0.0019	0.0110
	2009	-0.0176	-0.0202	-0.0149
	2010	-0.0067	0.0017	-0.0151
	2011	0.0166	0.0154	0.0178
	2012	-0.0126	-0.0189	-0.0063
	2013	0.0062	0.0099	0.0026
10 Point	2004	0.0258	0.0238	0.0279
	2005	-0.0041	-0.0038	-0.0043
	2006	-0.0320	-0.0292	-0.0349
	2007	0.0158	0.0175	0.0139
	2008	0.0014	-0.0027	0.0056
	2009	-0.0204	-0.0228	-0.0180
	2010	-0.0074	0.0010	-0.0159
	2011	0.0180	0.0167	0.0194
	2012	-0.0090	-0.0156	-0.0024
	2013	0.0119	0.0152	0.0088

MEDICAL Expon'l <b>RESIDUALS</b>	Policy Year	Severity Ratio (Avg Pd & Inc)	Severity Ratio (Incur)	Severity Ratio (Pd-27)
4 Point	2010	-0.0067	-0.0025	-0.0110
	2011	0.0171	0.0135	0.0207
	2012	-0.0132	-0.0197	-0.0066
	2013	0.0031	0.0090	-0.0028
5 Point	2009	-0.0078	-0.0110	-0.0044
	2010	0.0015	0.0091	-0.0063
	2011	0.0213	0.0196	0.0231
	2012	-0.0132	-0.0197	-0.0066
	2013	-0.0015	0.0025	-0.0055
6 Point	2008	0.0078	0.0054	0.0102
	2009	-0.0142	-0.0154	-0.0129
	2010	-0.0027	0.0062	-0.0118
	2011	0.0196	0.0184	0.0208
	2012	-0.0122	-0.0191	-0.0054
	2013	0.0023	0.0051	-0.0005
7 Point	2007	0.0112	0.0135	0.0088
	2008	0.0001	-0.0038	0.0041
	2009	-0.0198	-0.0222	-0.0173
	2010	-0.0061	0.0022	-0.0144
	2011	0.0187	0.0173	0.0201
	2012	-0.0104	-0.0169	-0.0040
	2013	0.0069	0.0107	0.0032
8 Point	2006	-0.0237	-0.0214	-0.0260
	2007	0.0257	0.0266	0.0247
	2008	0.0114	0.0063	0.0166
	2009	-0.0119	-0.0151	-0.0086
	2010	-0.0020	0.0059	-0.0099
	2011	0.0187	0.0173	0.0201
	2012	-0.0149	-0.0209	-0.0089
	2013	-0.0023	0.0025	-0.0070
9 Point	2005	0.0008	0.0008	0.0008
	2006	-0.0241	-0.0219	-0.0264
	2007	0.0254	0.0262	0.0244
	2008	0.0111	0.0061	0.0163
	2009	-0.0121	-0.0153	-0.0088
	2010	-0.0020	0.0058	-0.0100
	2011	0.0187	0.0174	0.0202
	2012	-0.0147	-0.0207	-0.0087
	2013	-0.0020	0.0027	-0.0067
10 Point	2004	0.0173	0.0162	0.0185
	2005	-0.0071	-0.0065	-0.0076
	2006	-0.0308	-0.0281	-0.0335
	2007	0.0200	0.0213	0.0186
	2008	0.0073	0.0024	0.0121
	2009	-0.0144	-0.0174	-0.0113
	2010	-0.0026	0.0053	-0.0106
	2011	0.0200	0.0185	0.0215
	2012	-0.0114	-0.0177	-0.0052
	2013	0.0035	0.0078	-0.0008