

DELAWARE COMPENSATION RATING BUREAU, INC.

Tail Factors and Paid Bridge Factors for Loss Development

For a given calendar year, the DCRB collects financial loss development data for the current policy year and the thirty previous individual policy years. A single aggregate line of experience is reported for all older policy years combined.

The DCRB's incurred tail factor methodology is applied separately for indemnity and medical loss experience using two separate methods. These two methods, which are described below, are averaged to generate the selected tail factors. A summary of the results of both methods is shown on Page 1.

The first tail method uses an eight-year arithmetic average of loss development factors from 20th and beyond. The derivation of the tail factors using this approach are shown on Page 2.

The second tail method, the Exponential Decay method, is a commonly used distribution for fitting Workers Compensation data. A number of exponential models were generated and reviewed using various data points and calendar years to fit the data to project the 20th to ultimate incurred tail factor. An exponential fit was selected for indemnity and medical from the various models generated. The model selections for indemnity and medical were considered separately to contemplate their unique characteristics relating to model fit, the stability of the data points and consistency of the development patterns before and after the tail attachment point. The detail of each of the selected exponential models is shown on Pages 3 and 4.

Pages 5 (indemnity) and 6 (medical) show the selected curves for the 19-20 incurred to paid loss development factors ("bridge" factors) and the development periods used to select the curve. The average of the fitted factors from 19-20 to 50th-Ultimate was selected for both indemnity and medical. The 50th point was selected as the cutoff as the data shows that is the point where virtually all claims have been historically settled.

Page 7 shows graphically the two selected curve fits, and the resulting bridge factors based on the average of the points between the 20th and 50th reports.

Limited Incurred Tail Factor Summary

(1) 8-Year Average of Incurred 20th-Ultimate Loss Development Factors (Page 2)

Indemnity

Medical

Based on:

Average 8-Year
Data Points Used 20-29+

Based on:

Average 8-Year
Data Points Used 20-29+

(2) Incurred Tail Selections using Exponential Decay Method (Pages 3 through 4)

Indemnity

Medical

Based on:

Average 8-Year
Data Points Used All

Based on:

Average 8-Year
Data Points Used All

(3) Incurred Tail Selections using a 50/50 Weight Between (1) and (2)

Indemnity

Medical

8-Year Average of Incurred 20th-Ultimate Loss Development Factors

INDEMNITY	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	8-Year
	LDF	LDF	LDF	LDF	LDF	LDF	LDF	LDF	Average
	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	LDF
20-ULT	0.9808	0.9911	1.0228	0.9707	1.0066	0.9723	0.9950	1.0044	0.9930
Beyond	0.9941	0.9896	0.9994	1.0004	1.0016	0.9805	0.9980	1.0014	0.9956
29-30				0.9939	1.0068	0.9996	1.0000	1.0006	1.0002
28-29			0.9993	0.9989	0.9994	0.9999	0.9993	0.9988	0.9993
27-28		1.0005	0.9990	0.9988	0.9976	1.0010	0.9989	0.9987	0.9992
26-27	0.9984	0.9997	1.0017	0.9993	1.0029	0.9989	0.9982	1.0013	1.0001
25-26	0.9901	0.9990	0.9954	0.9987	0.9970	0.9989	0.9998	1.0008	0.9975
24-25	1.0041	0.9978	1.0149	0.9966	0.9985	0.9964	1.0022	1.0021	1.0016
23-24	1.0022	0.9988	1.0008	0.9979	1.0005	1.0044	0.9986	0.9993	1.0003
22-23	0.9986	1.0086	0.9991	0.9990	1.0024	1.0005	0.9979	1.0014	1.0009
21-22	0.9968	0.9983	1.0029	0.9942	0.9998	0.9915	1.0024	1.0000	0.9982
20-21	0.9964	0.9989	1.0102	0.9926	1.0001	1.0006	0.9997	1.0000	0.9998

MEDICAL	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	8-Year
	LDF	LDF	LDF	LDF	LDF	LDF	LDF	LDF	Average
	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	LDF
20-ULT	1.0477	1.0328	1.0526	1.0339	0.9962	1.0517	1.0092	0.9813	1.0257
Beyond	1.0553	1.0165	0.9826	1.0067	1.0318	0.9960	1.0187	1.0545	1.0203
29-30				1.0004	0.9915	1.0016	1.0021	0.9857	0.9963
28-29			1.0013	1.0077	1.0013	0.9971	1.0009	1.0040	1.0021
27-28		1.0056	1.0083	1.0017	1.0068	1.0106	1.0004	0.9966	1.0043
26-27	0.9757	1.0041	1.0040	1.0050	0.9929	1.0069	1.0030	0.9776	0.9962
25-26	1.0281	0.9967	1.0121	1.0134	1.0019	0.9955	1.0126	0.9881	1.0061
24-25	0.9995	1.0077	1.0115	0.9996	1.0000	1.0081	1.0129	0.9974	1.0046
23-24	1.0027	1.0027	1.0039	1.0083	0.9994	1.0152	0.9966	0.9965	1.0032
22-23	0.9917	0.9838	1.0153	1.0001	1.0041	1.0037	0.9798	0.9976	0.9970
21-22	0.9944	1.0034	1.0070	0.9865	0.9735	1.0010	0.9870	0.9884	0.9927
20-21	1.0014	1.0122	1.0058	1.0042	0.9940	1.0151	0.9958	0.9967	1.0032

The Estimation of Loss Development Tail Factors: Exponential Decay Eight-Year Average of Indemnity Incurred Development Factors

Exponential Curve Fit

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(6)	(7)
Development Period	Unfitted LDF	v(d) = (3) - 1	ln [v(d)] = ln(4)	Using Last All Periods		Development Period (Continued)		Using Last All Periods		
				Fitted LDF	Fit Error	Fitted LDF	Fit Error			
1	12-24	1.3369	0.337	-1.088	1.065	0.272	41	492-504	1.0000	
2	24-36	1.1309	0.131	-2.034	1.051	0.080	42	504-516	1.0000	
3	36-48	1.0533	0.053	-2.933	1.040	0.013	43	516-528	1.0000	
4	48-60	1.0311	0.031	-3.470	1.032	-0.001	44	528-540	1.0000	
5	60-72	1.0210	0.021	-3.862	1.025	-0.004	45	540-552	1.0000	
6	72-84	1.0209	0.021	-3.870	1.020	0.001	46	552-564	1.0000	
7	84-96	1.0086	0.009	-4.752	1.016	-0.007	47	564-576	1.0000	
8	96-108	1.0096	0.010	-4.645	1.012	-0.003	48	576-588	1.0000	
9	108-120	1.0068	0.007	-4.998	1.010	-0.003	49	588-600	1.0000	
10	120-132	1.0045	0.005	-5.395	1.008	-0.003	50	600-612	1.0000	
11	132-144	1.0025	0.002	-6.002	1.006	-0.004	51	612-624	1.0000	
12	144-156	1.0028	0.003	-5.892	1.005	-0.002	52	624-636	1.0000	
13	156-168	1.0008	0.001	-7.100	1.004	-0.003	53	636-648	1.0000	
14	168-180	0.9992	-0.001		1.003	-0.004	54	648-660	1.0000	
15	180-192	0.9981	-0.002		1.0024	-0.0043	55	660-672	1.0000	
16	192-204	1.0010	0.001	-6.895	1.0019	-0.0009	56	672-684	1.0000	
17	204-216	0.9991	-0.001		1.0015	-0.0024	57	684-696	1.0000	
18	216-228	1.0038	0.004	-5.579	1.0012	0.0026	58	696-708	1.0000	
19	228-240	0.9975	-0.002		1.0009	-0.0034	59	708-720	1.0000	
20	240-252	0.9998	0.000		1.0007	-0.0009	60	720-732	1.0000	
21	252-264	0.9982	-0.002		1.0006	-0.0024	61	732-744	1.0000	
22	264-276	1.0009	0.001	-6.972	1.0005	0.0005	62	744-756	1.0000	
23	276-288	1.0003	0.000	-8.071	1.0004	-0.0001	63	756-768	1.0000	
24	288-300	1.0016	0.002	-6.454	1.0003	0.0013	64	768-780	1.0000	
25	300-312	0.9975	-0.003		1.0002	-0.0028	65	780-792	1.0000	
26	312-324	1.0001	0.000	-9.903	1.0002	-0.0001	66	792-804	1.0000	
27	324-336	0.9992	-0.001		1.0001	-0.0009	67	804-816	1.0000	
28	336-348	0.9993	-0.001		1.0001	-0.0008	68	816-828	1.0000	
29	348-360	1.0002	0.000	-8.623	1.0001	0.0001	69	828-840	1.0000	
30	360-372				1.0001		70	840-852	1.0000	
31	372-384				1.0001		71	852-864	1.0000	
32	384-396				1.0000		72	864-876	1.0000	
33	396-408				1.0000		73	876-888	1.0000	
34	408-420				1.0000		74	888-900	1.0000	
35	420-432				1.0000		75	900-912	1.0000	
36	432-444				1.0000		76	912-924	1.0000	
37	444-456				1.0000		77	924-936	1.0000	
38	456-468				1.0000		78	936-948	1.0000	
39	468-480				1.0000		79	948-960	1.0000	
40	480-492				1.0000		80	960-972	1.0000	

Curve Fit Parameters

Data Points Used	#of Data Points Used	Decay Rate	Coefficient	Truncated Tail Factor At 20th
All	29	0.791	0.082	1.0036

Decay Rate = $e^{\text{slope of the linear fit of (1) and (5)}}$

Coefficient = intercept of linear fit of (1) and (5)

Fitted LDF (6) = $1 + \text{Coefficient} \times \text{Decay}^{\text{[Period]}}$

Truncated Tail Factor = Product of Fitted LDFs from development periods 20-80

The Estimation of Loss Development Tail Factors: Exponential Decay Eight-Year Average of Medical Incurred Development Factors

Exponential Curve Fit

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(6)	(7)
Development Period	Unfitted LDF	v(d) = (3) - 1	ln [v(d)] = ln(4)	Using All Periods		Development Period (Continued)		Using Last All Periods		
				Fitted LDF	Fit Error			Fitted LDF	Fit Error	
1	12-24	1.1566	0.157	-1.854	1.0389	0.1177	41	492-504	1.0004	
2	24-36	1.0840	0.084	-2.477	1.0346	0.0493	42	504-516	1.0003	
3	36-48	1.0406	0.041	-3.205	1.0308	0.0097	43	516-528	1.0003	
4	48-60	1.0432	0.043	-3.143	1.0274	0.0158	44	528-540	1.0003	
5	60-72	1.0396	0.040	-3.229	1.0244	0.0152	45	540-552	1.0002	
6	72-84	1.0229	0.023	-3.778	1.0217	0.0012	46	552-564	1.0002	
7	84-96	1.0244	0.024	-3.714	1.0193	0.0051	47	564-576	1.0002	
8	96-108	1.0132	0.013	-4.329	1.0172	-0.0040	48	576-588	1.0002	
9	108-120	1.0150	0.015	-4.202	1.0153	-0.0003	49	588-600	1.0001	
10	120-132	1.0042	0.004	-5.479	1.0136	-0.0094	50	600-612	1.0001	
11	132-144	1.0007	0.001	-7.264	1.0121	-0.0114	51	612-624	1.0001	
12	144-156	1.0114	0.011	-4.475	1.0107	0.0007	52	624-636	1.0001	
13	156-168	1.0088	0.009	-4.736	1.0096	-0.0008	53	636-648	1.0001	
14	168-180	1.0026	0.003	-5.952	1.0085	-0.0059	54	648-660	1.0001	
15	180-192	1.0062	0.006	-5.081	1.0076	-0.0013	55	660-672	1.0001	
16	192-204	1.0045	0.004	-5.404	1.0067	-0.0022	56	672-684	1.0001	
17	204-216	0.9955	-0.005		1.0060	-0.0105	57	684-696	1.0001	
18	216-228	0.9998	0.000		1.0053	-0.0055	58	696-708	1.0000	
19	228-240	0.9969	-0.003		1.0047	-0.0078	59	708-720	1.0000	
20	240-252	1.0032	0.003	-5.760	1.0042	-0.0011	60	720-732	1.0000	
21	252-264	0.9927	-0.007		1.0037	-0.0111	61	732-744	1.0000	
22	264-276	0.9970	-0.003		1.0033	-0.0063	62	744-756	1.0000	
23	276-288	1.0032	0.003	-5.756	1.0030	0.0002	63	756-768	1.0000	
24	288-300	1.0046	0.005	-5.384	1.0026	0.0020	64	768-780	1.0000	
25	300-312	1.0061	0.006	-5.108	1.0023	0.0037	65	780-792	1.0000	
26	312-324	0.9962	-0.004		1.0021	-0.0059	66	792-804	1.0000	
27	324-336	1.0043	0.004	-5.452	1.0019	0.0024	67	804-816	1.0000	
28	336-348	1.0021	0.002	-6.190	1.0016	0.0004	68	816-828	1.0000	
29	348-360	0.9963	-0.004		1.0015	-0.0052	69	828-840	1.0000	
30	360-372				1.0013		70	840-852	1.0000	
31	372-384				1.0012		71	852-864	1.0000	
32	384-396				1.0010		72	864-876	1.0000	
33	396-408				1.0009		73	876-888	1.0000	
34	408-420				1.0008		74	888-900	1.0000	
35	420-432				1.0007		75	900-912	1.0000	
36	432-444				1.0006		76	912-924	1.0000	
37	444-456				1.0006		77	924-936	1.0000	
38	456-468				1.0005		78	936-948	1.0000	
39	468-480				1.0005		79	948-960	1.0000	
40	480-492				1.0004		80	960-972	1.0000	

Curve Fit Parameters

Data Points Used	#of Data Points Used	Decay Rate	Coefficient	Truncated Tail Factor At 20th
All	29	0.889	0.044	1.0387

Decay Rate = $e^{\text{slope of the linear fit of (1) and (5)}}$

Coefficient = intercept of linear fit of (1) and (5)

Fitted LDF (6) = $1 + \text{Coefficient} \times \text{Decay}^{\text{[Period]}}$

Truncated Tail Factor = Product of Fitted LDFs from development periods 20-80

INDEMNITY PAID TO INCURRED LOSS DEVELOPMENT

<u>EQUATION</u>	Model	$Y = a+b*\ln(x)/x^2+c/x^2$
<u>COEFFICIENTS</u>	a	(0.002493292)
	b	1.217635896
	c	2.212903339

R^2 0.9994

<u>Development</u>	<u>4 Year Average</u>	<u>Points Used</u>	<u>Fitted Value</u>	<u>Selected</u>
1-2	3.2080	3.2080	3.2104	
2-3	1.7829	1.7829	1.7617	
3-4	1.3867	1.3867	1.3920	
4-5	1.2110	1.2110	1.2413	
5-6	1.1418	1.1418	1.1644	
6-7	1.1183	1.1183	1.1196	
7-8	1.1035	1.1035	1.0910	
8-9	1.0723	1.0723	1.0716	
9-10	1.0722	1.0722	1.0579	
10-11	1.0662	1.0662	1.0477	
11-12	1.0385	1.0385	1.0399	
12-13	1.0292	1.0292	1.0339	
13-14	1.0300	1.0300	1.0291	
14-15	1.0204	1.0204	1.0252	
15-16	1.0181	1.0181	1.0220	
16-17	1.0211	1.0211	1.0193	
17-18	1.0132	1.0132	1.0171	
18-19	1.0136	1.0136	1.0152	
19-20	1.0093	1.0093	1.0136	1.0136
20-21	1.0102	1.0102	1.0122	1.0122
21-22	1.0092	1.0092	1.0109	1.0109
22-23	1.0116	1.0116	1.0099	1.0099
23-24	1.0121	1.0121	1.0089	1.0089
24-25	1.0087	1.0087	1.0081	1.0081
25-26	1.0070	1.0070	1.0073	1.0073
26-27	1.0083	1.0083	1.0066	1.0066
27-28	1.0079	1.0079	1.0060	1.0060
28-29	1.0085	1.0085	1.0055	1.0055
29-30	1.0139	1.0139	1.0050	1.0050
30-31			1.0046	1.0046
31-32			1.0042	1.0042
32-33			1.0038	1.0038
33-34			1.0034	1.0034
34-35			1.0031	1.0031
35-36			1.0028	1.0028
36-37			1.0026	1.0026
37-38			1.0023	1.0023
38-39			1.0021	1.0021
39-40			1.0019	1.0019
40-41			1.0017	1.0017
41-42			1.0015	1.0015
42-43			1.0013	1.0013
43-44			1.0012	1.0012
44-45			1.0010	1.0010
45-46			1.0009	1.0009
46-47			1.0008	1.0008
47-48			1.0006	1.0006
48-49			1.0005	1.0005
49-50			1.0004	1.0004
50-Ult *	1.0000	1.0000	1.0003	1.0003

Bridge Factor (Average of Selected Factors)

1.0042

* Selected

MEDICAL PAID TO INCURRED LOSS DEVELOPMENT

	Model	$Y = a+b*x^2+c/x$
<u>EQUATION</u>	a	(0.080580203)
<u>COEFFICIENTS</u>	b	7.89191E-06
	c	3.044420348

R^2 0.9334

<u>Development</u>	<u>4 Year Average</u>	<u>Points Used</u>	<u>Fitted Value</u>	<u>Selected</u>
1-2	1.7475		3.9638	
2-3	1.3422		2.4417	
3-4	1.2274		1.9343	
4-5	1.1811		1.6807	
5-6	1.1791		1.5285	
6-7	1.1698		1.4271	
7-8	1.1643		1.3547	
8-9	1.1846		1.3005	
9-10	1.1876		1.2583	
10-11	1.1694		1.2247	
11-12	1.1433		1.1971	
12-13	1.1429		1.1743	
13-14	1.1692		1.1549	
14-15	1.1466		1.1384	
15-16	1.1495		1.1242	
16-17	1.1216	1.1216	1.1117	
17-18	1.0908	1.0908	1.1008	
18-19	1.0852	1.0852	1.0911	
19-20	1.0709	1.0709	1.0825	1.0825
20-21	1.0875	1.0875	1.0748	1.0748
21-22	1.0730	1.0730	1.0679	1.0679
22-23	1.0660	1.0660	1.0616	1.0616
23-24	1.0653	1.0653	1.0560	1.0560
24-25	1.0493	1.0493	1.0508	1.0508
25-26	1.0365	1.0365	1.0461	1.0461
26-27	1.0367	1.0367	1.0418	1.0418
27-28	1.0352	1.0352	1.0379	1.0379
28-29	1.0308	1.0308	1.0343	1.0343
29-30	1.0397	1.0397	1.0310	1.0310
30-31			1.0280	1.0280
31-32			1.0252	1.0252
32-33			1.0226	1.0226
33-34			1.0203	1.0203
34-35			1.0181	1.0181
35-36			1.0161	1.0161
36-37			1.0142	1.0142
37-38			1.0125	1.0125
38-39			1.0109	1.0109
39-40			1.0095	1.0095
40-41			1.0082	1.0082
41-42			1.0069	1.0069
42-43			1.0058	1.0058
43-44			1.0048	1.0048
44-45			1.0039	1.0039
45-46			1.0031	1.0031
46-47			1.0023	1.0023
47-48			1.0016	1.0016
48-49			1.0010	1.0010
49-50			1.0005	1.0005
50-Ult *	1.0000	1.0000	1.0000	1.0000

Bridge Factor (Average of Selected Factors) 1.0250

* Selected

Paid Tail Bridge Factors

