

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 a ten-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 Weibull curve fit method, is a commonly used distribution for fitting Workers Compensation data. A number of Weibull 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. A Weibull 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 Weibull models is shown on Page 3.

Pages 4 (indemnity) and 5 (medical) show the selected curves for the 20-ult incurred to paid loss development factors ("bridge" factors) and the development periods used to select the curve. The average of the fitted factors from 20-21 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 6 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) Average of Incurred 20th-Ultimate Loss Development Factors (Page 2)

Indemnity	0.9934	Medical	1.0041
Based on:		Based on:	
Average	10-Year	Average	10-Year (x H/L)
Data Points Used	20-29+	Data Points Used	20-29+

### (2) Incurred Tail Selections using a Weibull Curve Fit (Page 3)

Indemnity	1.0015	Medical	1.0105
Based on:		Based on:	
Average	8-Year	Average	8-Year
Data Points Used	1-19	Data Points Used	1-19

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

Indemnity	<input type="text" value="0.9975"/>	Medical	<input type="text" value="1.0073"/>
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### (4) Paid to Incurred Bridge Factors (Pages 4 through 5)

Indemnity	1.0038	Medical	1.0290
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### (5) Paid Tail Selections ( (3) \* (4) )

Indemnity	<input type="text" value="1.0013"/>	Medical	<input type="text" value="1.0365"/>
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### 10-Year Average of Incurred 20th-Ultimate Loss Development Factors

INDEMNITY	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	10-Year Average LDF
	LDF 11-12	LDF 12-13	LDF 13-14	LDF 14-15	LDF 15-16	LDF 16-17	LDF 17-18	LDF 18-19	LDF 19-20	LDF 20-21	LDF 21-22	
20-ULT	0.9915	0.9808	0.9911	1.0228	0.9707	1.0066	0.9738	0.9939	1.0031	0.9941	0.9966	0.9934
Beyond	0.9939	0.9941	0.9896	0.9994	1.0004	1.0016	0.9820	0.9956	1.0001	0.9966	1.0031	0.9963
29-30					0.9939	1.0068	0.9996	1.0013	1.0006	0.9988	0.9999	1.0001
28-29				0.9993	0.9989	0.9994	0.9999	0.9993	0.9988	0.9997	1.0000	0.9994
27-28			1.0005	0.9990	0.9988	0.9976	1.0010	0.9989	0.9987	0.9999	0.9989	0.9993
26-27		0.9984	0.9997	1.0017	0.9993	1.0029	0.9989	0.9982	1.0013	0.9959	0.9983	0.9995
25-26	1.0008	0.9901	0.9990	0.9954	0.9987	0.9970	0.9989	0.9998	1.0008	1.0001	0.9988	0.9979
24-25	1.0001	1.0041	0.9978	1.0149	0.9966	0.9985	0.9964	1.0022	1.0021	1.0009	0.9998	1.0013
23-24	1.0009	1.0022	0.9988	1.0008	0.9979	1.0005	1.0044	0.9986	0.9993	1.0000	0.9996	1.0002
22-23	0.9987	0.9986	1.0086	0.9991	0.9990	1.0024	1.0005	0.9979	1.0014	1.0003	1.0000	1.0008
21-22	0.9993	0.9968	0.9983	1.0029	0.9942	0.9998	0.9915	1.0024	1.0000	1.0000	0.9990	0.9985
20-21	0.9978	0.9964	0.9989	1.0102	0.9926	1.0001	1.0006	0.9997	1.0000	1.0019	0.9992	1.0000

MEDICAL	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	Incurred	10-Year Average LDF
	LDF 11-12	LDF 12-13	LDF 13-14	LDF 14-15	LDF 15-16	LDF 16-17	LDF 17-18	LDF 18-19	LDF 19-20	LDF 20-21	LDF 21-22	
20-ULT	1.0260	1.0477	1.0328	1.0526	1.0339	0.9962	1.0528	0.9990	0.8932	0.9262	0.9445	1.0041*
Beyond	1.0072	1.0553	1.0165	0.9826	1.0067	1.0318	0.9970	1.0084	0.9598	0.9754	0.9953	1.0029
29-30					1.0004	0.9915	1.0016	1.0021	0.9857	1.0027	1.0015	0.9979
28-29				1.0013	1.0077	1.0013	0.9971	1.0009	1.0040	0.9992	1.0025	1.0018
27-28			1.0056	1.0083	1.0017	1.0068	1.0106	1.0004	0.9966	1.0000	0.9983	1.0031
26-27		0.9757	1.0041	1.0040	1.0050	0.9929	1.0069	1.0030	0.9776	0.9823	1.0028	0.9954
25-26	1.0013	1.0281	0.9967	1.0121	1.0134	1.0019	0.9955	1.0126	0.9881	0.9954	0.9773	1.0021
24-25	1.0090	0.9995	1.0077	1.0115	0.9996	1.0000	1.0081	1.0129	0.9974	0.9950	0.9997	1.0031
23-24	1.0022	1.0027	1.0027	1.0039	1.0083	0.9994	1.0152	0.9966	0.9965	1.0015	0.9999	1.0027
22-23	1.0001	0.9917	0.9838	1.0153	1.0001	1.0041	1.0037	0.9798	0.9976	0.9884	0.9888	0.9953
21-22	1.0065	0.9944	1.0034	1.0070	0.9865	0.9735	1.0010	0.9870	0.9884	0.9866	0.9903	0.9918
20-21	0.9995	1.0014	1.0122	1.0058	1.0042	0.9940	1.0151	0.9958	0.9967	0.9975	0.9870	1.0010

\*10-Year Average excluding High-Low

## The Estimation of Loss Development Tail Factors: Weibull Curve Fit

### Eight-Year Average of Incurred Development Factors

Development Period	Average Age of Claim (x)	Unfitted Indemnity LDF	Fitted Cumulative Indemnity LDF *	Unfitted Medical LDF	Fitted Cumulative Medical LDF *
(2)	(3)	(4)	(5)	(6)	(7)
1/2	1.5	1.3551	1.3040	1.1178	1.4135
2/3	2.5	1.1126	1.2179	1.0549	1.3253
3/4	3.5	1.0529	1.1591	1.0163	1.2593
4/5	4.5	1.0192	1.1178	1.0172	1.2088
5/6	5.5	1.0123	1.0880	1.0223	1.1695
6/7	6.5	1.0135	1.0662	1.0136	1.1384
7/8	7.5	1.0089	1.0500	1.0177	1.1136
8/9	8.5	1.0085	1.0379	1.0121	1.0936
9/10	9.5	1.0051	1.0289	1.0078	1.0774
10/11	10.5	1.0015	1.0220	1.0029	1.0641
11/12	11.5	1.0033	1.0168	0.9991	1.0532
12/13	12.5	1.0004	1.0128	1.0050	1.0443
13/14	13.5	1.0017	1.0098	1.0110	1.0369
14/15	14.5	1.0001	1.0075	1.0050	1.0308
15/16	15.5	0.9976	1.0058	1.0053	1.0257
16/17	16.5	1.0008	1.0044	0.9987	1.0215
17/18	17.5	1.0000	1.0034	0.9955	1.0179
18/19	18.5	0.9997	1.0026	0.9983	1.0150
19/20	19.5	1.0000	1.0020	1.0025	1.0126
20/21	20.5	1.0005	1.0015	0.9995	1.0105

#### Curve Fit Parameters

	Data Points Used	# of Data Points Used	Selected Parameters			Tail Factor 20th - Ult
			$\lambda$	c	t	
Indemnity	1-19	19	0.265	4.000	1.000	1.0015
Medical	1-19	19	0.176	5.500	1.000	1.0105

\* Fitted Cumulative LDF (5) & (7) =  $1 / e^{(-\lambda*(x+c)^t)}$

**INDEMNITY PAID TO INCURRED BRIDGE FACTOR**

	Model	$Y = a \cdot (1+x)^b$
<b><u>EQUATION</u></b> <b><u>COEFFICIENTS</u></b>	a	5.335436414
	b	(2.086886013)

R^2                      0.9972

<b><u>Report</u></b>	<b><u>4 Year Average</u></b>	<b><u>Points Used</u></b>	<b><u>Fitted Value</u></b>	<b><u>Selected</u></b>
1st	2.2431	2.2431	2.2559	
2nd	1.5906	1.5906	1.5389	
3rd	1.2886	1.2886	1.2956	
4th	1.1604	1.1604	1.1856	
5th	1.1023	1.1023	1.1268	
6th	1.0729	1.0729	1.0919	
7th	1.0599	1.0599	1.0696	
8th	1.0483	1.0483	1.0544	
9th	1.0443	1.0443	1.0437	
10th	1.0420	1.0420	1.0358	
11th	1.0328	1.0328	1.0299	
12th	1.0354	1.0354	1.0253	
13th	1.0313	1.0313	1.0216	
14th	1.0201	1.0201	1.0187	
15th	1.0175	1.0175	1.0164	
16th	1.0160	1.0160	1.0144	
17th	1.0092	1.0092	1.0128	
18th	1.0121	1.0121	1.0114	
19th	1.0132	1.0132	1.0103	
20th	1.0086	1.0086	1.0093	1.0093
21st	1.0086	1.0086	1.0084	1.0084
22nd	1.0062	1.0062	1.0077	1.0077
23rd	1.0032	1.0032	1.0070	1.0070
24th	1.0036	1.0036	1.0065	1.0065
25th	1.0076	1.0076	1.0059	1.0059
26th	1.0067	1.0067	1.0055	1.0055
27th	1.0044	1.0044	1.0051	1.0051
28th	1.0027	1.0027	1.0047	1.0047
29th	1.0063	1.0063	1.0044	1.0044
30th	1.0045	1.0045	1.0041	1.0041
31st			1.0039	1.0039
32nd			1.0036	1.0036
33rd			1.0034	1.0034
34th			1.0032	1.0032
35th			1.0030	1.0030
36th			1.0028	1.0028
37th			1.0027	1.0027
38th			1.0026	1.0026
39th			1.0024	1.0024
40th			1.0023	1.0023
41st			1.0022	1.0022
42nd			1.0021	1.0021
43rd			1.0020	1.0020
44th			1.0019	1.0019
45th			1.0018	1.0018
46th			1.0017	1.0017
47th			1.0017	1.0017
48th			1.0016	1.0016
49th			1.0015	1.0015
50-Ult *	1.0000	1.0000	1.0015	1.0015

Bridge Factor (Average of Selected Factors)

1.0038

\* Selected

**MEDICAL PAID TO INCURRED BRIDGE FACTOR**

<b><u>EQUATION</u></b>	Model	$Y = a+b*x^{1.5}*\ln(x)+c/x^{1.5}$
<b><u>COEFFICIENTS</u></b>	a	0.097658731
	b	(0.003467156)
	c	0.663792781
	R^2	0.9763

<b><u>Report</u></b>	<b><u>4 Year Average</u></b>	<b><u>Points Used</u></b>	<b><u>Fitted Value</u></b>	<b><u>Selected</u></b>
1st	1.7698	1.7698	1.7615	
2nd	1.3286	1.3286	1.3289	
3rd	1.2191	1.2191	1.2188	
4th	1.1196	1.1196	1.1710	
5th	1.1229	1.1229	1.1446	
6th	1.1072	1.1072	1.1276	
7th	1.0850	1.0850	1.1156	
8th	1.0914	1.0914	1.1066	
9th	1.1032	1.1032	1.0994	
10th	1.1108	1.1108	1.0934	
11th	1.1111	1.1111	1.0883	
12th	1.1064	1.1064	1.0838	
13th	1.0937	1.0937	1.0798	
14th	1.0892	1.0892	1.0761	
15th	1.0980	1.0980	1.0727	
16th	1.1168	1.1168	1.0696	
17th	1.0939	1.0939	1.0666	
18th	1.0959	1.0959	1.0638	
19th	1.0699	1.0699	1.0612	
20th	1.0645	1.0645	1.0586	1.0586
21st	1.0567	1.0567	1.0562	1.0562
22nd	1.0409	1.0409	1.0538	1.0538
23rd	1.0433	1.0433	1.0515	1.0515
24th	1.0461	1.0461	1.0493	1.0493
25th	1.0548	1.0548	1.0472	1.0472
26th	1.0414	1.0414	1.0451	1.0451
27th	1.0206	1.0206	1.0430	1.0430
28th	1.0145	1.0145	1.0410	1.0410
29th	1.0271	1.0271	1.0390	1.0390
30th	1.0124	1.0124	1.0371	1.0371
31st			1.0352	1.0352
32nd			1.0334	1.0334
33rd			1.0315	1.0315
34th			1.0297	1.0297
35th			1.0279	1.0279
36th			1.0262	1.0262
37th			1.0245	1.0245
38th			1.0227	1.0227
39th			1.0211	1.0211
40th			1.0194	1.0194
41st			1.0177	1.0177
42nd			1.0161	1.0161
43rd			1.0145	1.0145
44th			1.0129	1.0129
45th			1.0113	1.0113
46th			1.0098	1.0098
47th			1.0082	1.0082
48th			1.0067	1.0067
49th			1.0051	1.0051
50-Ult *	1.0000	1.0000	1.0036	1.0036

Bridge Factor (Average of Selected Factors)

1.0290

\* Selected

