

PENNSYLVANIA COMPENSATION RATING BUREAU

Tail Factors for Loss Development

For a given calendar year, the PCRБ 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 PCRБ'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 both methods is shown on Page 1.

The first method, the historical Linear Decay method, is outlined below.

1. A starting policy year loss amount based on the average reported incurred loss for the three earliest available policy years was computed.
2. An annual loss inflation factor was selected based on observed changes in incurred losses by policy year for the older policy years having separate experience data reported.
3. A historical series of estimated incurred losses by policy year beginning with the policy year immediately prior to the earliest available policy year was computed using the starting point from #1 and the selected inflation factor from #2.
4. A calendar year loss development factor was selected for that policy year based on observed developments for the oldest years with actual separate experience available.
5. A rate of decline in calendar year loss development factors by policy year was then computed such that when the resulting series of loss development factors was applied to the historical series of estimated incurred losses in #3, the total implied dollar amount of loss development for the calendar year balanced to the observed amount of development on policy years prior to the earliest available policy year.
6. The "tail factor" applicable to maturities in those prior policy years based on that calendar year of experience was then computed as the cumulative product of the series of loss development factors constructed in #5 as well as the actual loss development factors from the 20th to 30th development periods to calculate a 20th to ultimate incurred tail factor.

Recognizing the volatility of observed calendar year development for the prior policy years in the aggregate, the PCRБ elected to use an experience period comprising four calendar years of loss development in computing indicated tail factors for this method.

A summary exhibit on Page 2 presents results of the Linear Decay tail development factor calculations. On Pages 3 through 10, eight exhibits presenting the derivation of indicated tail factors using the procedure outlined above are attached (four for indemnity and four for medical).

The second 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 11 through 12.

Incurred Tail Factor Summary

(1) Incurred Tail Selections using Linear Decay Method (Pages 2 through 10)

Indemnity

Medical

Based on:
Average 4-Year
Data Points Used 20-29

Based on:
Average 4-Year
Data Points Used 20-29

(2) Incurred Tail Selections using Exponential Decay Method (Pages 11 through 12)

Indemnity

Medical

Based on:
Average 3-Year
Data Points Used 10-29

Based on:
Average 5-Year
Data Points Used 20-29

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

Indemnity

Medical

SUMMARY OF INCURRED TAIL FACTOR CALCULATIONS USING LINEAR DECAY METHOD

VALUATION	MATURITY	INDEMNITY	MEDICAL
		Tail Factor	Tail Factor
18V19	20TH TO ULT.	1.0051	1.0182
17V18	20TH TO ULT.	1.0027	1.0701
16V17	20TH TO ULT.	1.0017	1.0474
15V16	20TH TO ULT.	1.0038	1.0534
AVERAGE OF LATEST 4 VALUATIONS		1.0033	1.0473

INDEMNITY 18 vs 19

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1989 PYs Incurred	7,330,112,987
Next Latest 12/31 Prior to 1989 PYs Incurred	7,328,022,613
CY Development of Prior to 1989 PYs	2,090,374
Next Latest PY 1989 Incurred	1,160,484,070
# of 1989 PYs in Prior to 1989 PYs Data	6.32
Selected Decrement Development Factor	0.75
Selected Average PY Deflation Factor	0.95

- 1 PY 1988 Incurred = (Average of 1989, 1990, 1991) x (PY Deflation Factor ^ 2)
- 2 PY 1987 & Prior Incurred = Subsequent Year x PY Deflation
- 3 PY 1988 LDF selected based on balancing Prior to 1989 PYs Total Dollar Dev. to Actual CY Dev.
- 4 PY 1987 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0

CY Development of Prior to 1989 PYs:	2,090,374
Total Dollar Development:	2,090,373
Difference:	1

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/19	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/19	Prior Year LDF	Dollar Development	Cumulative LDF	
1948	*	130,392,720	1.000000	1	1.0000	1984	*	826,425,206	1.000187	154,910	1.0008	34TH TO ULT
1949	*	137,255,495	1.000000	1	1.0000	1985	*	869,921,270	1.000250	217,404	1.0010	33RD TO ULT
1950	*	144,479,468	1.000000	2	1.0000	1986	*	915,706,600	1.000333	305,103	1.0013	32ND TO ULT
1951	*	152,083,651	1.000000	2	1.0000	1987	*	963,901,684	1.000444	428,167	1.0018	31ST TO ULT
1952	*	160,088,053	1.000000	3	1.0000	1988	*	1,014,633,351	1.00059253	600,847	1.0024	30TH TO ULT
1953	*	168,513,740	1.000000	4	1.0000	1989		1,160,217,751	0.9998		1.0022	29th TO ULT
1954	*	177,382,885	1.000000	6	1.0000	1990		1,185,020,691	0.9992		1.0014	28th TO ULT
1955	*	186,718,826	1.000000	8	1.0000	1991		1,027,504,000	0.9995		1.0009	27th TO ULT
1956	*	196,546,133	1.000000	12	1.0000	1992		873,784,851	1.0031		1.0040	26th TO ULT
1957	*	206,890,666	1.000000	16	1.0000	1993		757,599,518	1.0002		1.0042	25th TO ULT
1958	*	217,779,648	1.000000	23	1.0000	1994		700,530,084	0.9990		1.0032	24th TO ULT
1959	*	229,241,735	1.000000	32	1.0000	1995		596,445,615	1.0003		1.0035	23rd TO ULT
1960	*	241,307,090	1.000000	45	1.0000	1996		513,054,683	0.9995		1.0030	22nd TO ULT
1961	*	254,007,463	1.000000	64	1.0000	1997		522,470,276	1.0011		1.0041	21st TO ULT
1962	*	267,376,277	1.000000	89	1.0000	1998		522,905,685	1.0010		1.0051	20th TO ULT
1963	*	281,448,712	1.000000	125	1.0000	1999		595,551,476	0.9995			
1964	*	296,261,802	1.000001	176	1.0000	2000		632,598,483	1.0004			
1965	*	311,854,529	1.000001	247	1.0000	2001		642,911,063	1.0000			
1966	*	328,267,925	1.000001	347	1.0000	2002		675,841,424	0.9998			
1967	*	345,545,184	1.000001	487	1.0000	2003		651,694,528	0.9977			
1968	*	363,731,773	1.000002	683	1.0000	2004		683,162,973	0.9997			
1969	*	382,875,550	1.000003	959	1.0000	2005		683,276,666	0.9989			
1970	*	403,026,895	1.000003	1,346	1.0000	2006		707,994,272	1.0006			
1971	*	424,238,837	1.000004	1,890	1.0000	2007		739,047,026	0.9997			
1972	*	446,567,197	1.000006	2,652	1.0000	2008		690,684,928	0.9985			
1973	*	470,070,733	1.000008	3,722	1.0000	2009		629,420,631	1.0017			
1974	*	494,811,298	1.000011	5,224	1.0000	2010		646,818,728	1.0002			
1975	*	520,853,998	1.000014	7,332	1.0001	2011		622,923,074	1.0025			
1976	*	548,267,367	1.000019	10,290	1.0001	2012		572,008,724	1.0036			
1977	*	577,123,544	1.000025	14,443	1.0001	2013		570,986,097	0.9963			
1978	*	607,498,467	1.000033	20,270	1.0001	2014		571,805,864	1.0036			
1979	*	639,472,071	1.000044	28,449	1.0002	2015		559,829,418	1.0204			
1980	*	673,128,496	1.000059	39,928	1.0002	2016		529,190,466	1.0834			
1981	*	708,556,311	1.000079	56,038	1.0003	2017		530,082,955	1.3455			
1982	*	745,848,748	1.000105	78,647	1.0004	2018		422,229,908	3.5347			
1983	*	785,103,946	1.000141	110,379	1.0006	2019		126,016,982				

MEDICAL 18 vs 19

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1989 PYs Incurred	3,159,471,440
Next Latest 12/31 Prior to 1989 PYs Incurred	3,153,223,207
CY Development of Prior to 1989 PYs	6,248,233
Next Latest PY 1989 Incurred	655,473,249
# of 1989 PYs in Prior to 1989 PYs Data	4.82
Selected Decrement Development Factor	0.75
Selected Average PY Deflation Factor	0.93

- 1 PY 1988 Incurred = (Average of 1989, 1990, 1991) x (PY Deflation Factor ^ 2)
- 2 PY 1987 & Prior Incurred = Subsequent Year x PY Deflation
- 3 PY 1988 LDF selected based on balancing Prior to 1989 PYs Total Dollar Dev. to Actual CY Dev.
- 4 PY 1987 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0

CY Development of Prior to 1989 PYs:	6,248,233
Total Dollar Development:	6,248,233
Difference:	0

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/19	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/19	Prior Year LDF	Dollar Development	Cumulative LDF	
1948	*	30,994,713	1.000000	1	1.0000	1984	*	422,572,738	1.001061	447,839	1.0043	34TH TO ULT
1949	*	33,327,649	1.000000	1	1.0000	1985	*	454,379,288	1.001415	641,836	1.0057	33RD TO ULT
1950	*	35,836,181	1.000000	2	1.0000	1986	*	488,579,879	1.001886	919,762	1.0076	32ND TO ULT
1951	*	38,533,528	1.000000	3	1.0000	1987	*	525,354,709	1.002515	1,317,828	1.0101	31ST TO ULT
1952	*	41,433,901	1.000000	4	1.0000	1988	*	564,897,537	1.00335302	1,887,780	1.0135	30TH TO ULT
1953	*	44,552,582	1.000000	6	1.0000	1989		654,445,740	0.9984		1.0119	29th TO ULT
1954	*	47,906,002	1.000000	9	1.0000	1990		677,560,802	1.0026		1.0145	28th TO ULT
1955	*	51,511,831	1.000000	13	1.0000	1991		627,402,187	1.0023		1.0168	27th TO ULT
1956	*	55,389,065	1.000000	19	1.0000	1992		556,747,561	1.0064		1.0233	26th TO ULT
1957	*	59,558,134	1.000000	27	1.0000	1993		429,685,191	0.9988		1.0221	25th TO ULT
1958	*	64,041,005	1.000001	38	1.0000	1994		410,946,338	1.0023		1.0245	24th TO ULT
1959	*	68,861,296	1.000001	55	1.0000	1995		376,584,348	1.0008		1.0253	23rd TO ULT
1960	*	74,044,404	1.000001	79	1.0000	1996		375,255,756	0.9927		1.0178	22nd TO ULT
1961	*	79,617,638	1.000001	113	1.0000	1997		393,565,500	0.9983		1.0161	21st TO ULT
1962	*	85,610,364	1.000002	162	1.0000	1998		429,416,574	1.0021		1.0182	20th TO ULT
1963	*	92,054,155	1.000003	232	1.0000	1999		452,822,936	1.0022			
1964	*	98,982,962	1.000003	333	1.0000	2000		487,334,677	1.0026			
1965	*	106,433,293	1.000004	477	1.0000	2001		476,081,195	1.0010			
1966	*	114,444,401	1.000006	685	1.0000	2002		546,351,342	0.9974			
1967	*	123,058,495	1.000008	981	1.0000	2003		551,789,182	0.9997			
1968	*	132,320,963	1.000011	1,407	1.0000	2004		603,652,478	1.0002			
1969	*	142,280,605	1.000014	2,017	1.0001	2005		628,421,557	1.0066			
1970	*	152,989,898	1.000019	2,892	1.0001	2006		639,198,384	1.0006			
1971	*	164,505,267	1.000025	4,146	1.0001	2007		679,748,547	1.0008			
1972	*	176,887,383	1.000034	5,944	1.0001	2008		614,568,579	1.0016			
1973	*	190,201,488	1.000045	8,522	1.0002	2009		541,604,521	0.9996			
1974	*	204,517,729	1.000060	12,218	1.0002	2010		596,324,574	1.0018			
1975	*	219,911,536	1.000080	17,516	1.0003	2011		585,251,121	1.0041			
1976	*	236,464,017	1.000106	25,112	1.0004	2012		551,673,973	1.0147			
1977	*	254,262,384	1.000142	36,002	1.0006	2013		558,458,966	0.9939			
1978	*	273,400,413	1.000189	51,614	1.0008	2014		564,985,515	0.9942			
1979	*	293,978,939	1.000252	73,994	1.0010	2015		538,919,903	1.0017			
1980	*	316,106,386	1.000336	106,075	1.0013	2016		524,445,573	1.0136			
1981	*	339,899,340	1.000448	152,062	1.0018	2017		575,170,843	1.0454			
1982	*	365,483,161	1.000597	217,977	1.0024	2018		628,654,339	2.1578			
1983	*	392,992,646	1.000796	312,450	1.0032	2019		290,531,700				

INDEMNITY 17 vs 18

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1988 PYs Incurred	6,303,711,141	1 PY 1987 Incurred = (Average of 1988, 1989, 1990) x (PY Deflation Factor ^ 2)
Next Latest 12/31 Prior to 1988 PYs Incurred	6,304,174,763	2 PY 1986 & Prior Incurred = Subsequent Year x PY Deflation
CY Development of Prior to 1988 PYs	-463,622	3 PY 1987 LDF selected based on balancing Prior to 1988 PYs Total Dollar Dev. to Actual CY Dev.
Next Latest PY 1988 Incurred	994,707,604	4 PY 1986 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0
# of 1988 PYs in Prior to 1988 PYs Data	6.34	
Selected Decrement Development Factor	0.75	CY Development of Prior to 1988 PYs: -463,622
Selected Average PY Deflation Factor	0.95	Total Dollar Development: -463,622
		Difference: 0

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/18	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/18	Prior Year LDF	Dollar Development	Cumulative LDF	
1947	*	129,126,361	1.000000	0	1.0000	1983	*	818,399,057	0.999958	-34,350	0.9998	34TH TO ULT
1948	*	135,922,485	1.000000	0	1.0000	1984	*	861,472,692	0.999944	-48,211	0.9998	33RD TO ULT
1949	*	143,076,300	1.000000	0	1.0000	1985	*	906,813,360	0.999925	-67,666	0.9997	32ND TO ULT
1950	*	150,606,631	1.000000	0	1.0000	1986	*	954,540,379	0.999901	-94,972	0.9996	31ST TO ULT
1951	*	158,533,296	1.000000	-1	1.0000	1987	*	1,004,779,346	0.99986735	-133,298	0.9995	30TH TO ULT
1952	*	166,877,154	1.000000	-1	1.0000	1988		994,106,481	0.9994		0.9989	29th TO ULT
1953	*	175,660,162	1.000000	-1	1.0000	1989		1,160,177,865	1.0002		0.9991	28th TO ULT
1954	*	184,905,434	1.000000	-2	1.0000	1990		1,185,702,400	1.0006		0.9997	27th TO ULT
1955	*	194,637,299	1.000000	-3	1.0000	1991		1,028,042,580	1.0004		1.0001	26th TO ULT
1956	*	204,881,367	1.000000	-4	1.0000	1992		871,251,371	1.0023		1.0024	25th TO ULT
1957	*	215,664,597	1.000000	-5	1.0000	1993		757,923,969	1.0000		1.0024	24th TO ULT
1958	*	227,015,365	1.000000	-7	1.0000	1994		701,921,392	0.9999		1.0023	23rd TO ULT
1959	*	238,963,542	1.000000	-10	1.0000	1995		596,366,407	1.0002		1.0025	22nd TO ULT
1960	*	251,540,571	1.000000	-14	1.0000	1996		513,368,363	0.9996		1.0021	21st TO ULT
1961	*	264,779,548	1.000000	-20	1.0000	1997		522,336,131	1.0006		1.0027	20th TO ULT
1962	*	278,715,314	1.000000	-28	1.0000	1998		522,907,154	1.0007			
1963	*	293,384,541	1.000000	-39	1.0000	1999		596,380,725	1.0009			
1964	*	308,825,833	1.000000	-55	1.0000	2000		632,717,334	1.0000			
1965	*	325,079,824	1.000000	-77	1.0000	2001		643,323,781	1.0009			
1966	*	342,189,288	1.000000	-108	1.0000	2002		675,956,444	1.0011			
1967	*	360,199,251	1.000000	-152	1.0000	2003		653,759,793	0.9992			
1968	*	379,157,106	0.999999	-213	1.0000	2004		683,860,179	1.0005			
1969	*	399,112,743	0.999999	-298	1.0000	2005		684,213,253	1.0020			
1970	*	420,118,677	0.999999	-419	1.0000	2006		707,864,330	1.0025			
1971	*	442,230,186	0.999999	-588	1.0000	2007		739,583,218	1.0022			
1972	*	465,505,459	0.999998	-825	1.0000	2008		691,742,383	0.9995			
1973	*	490,005,747	0.999998	-1,158	1.0000	2009		628,405,905	1.0029			
1974	*	515,795,523	0.999997	-1,625	1.0000	2010		646,714,296	1.0020			
1975	*	542,942,656	0.999996	-2,281	1.0000	2011		621,590,866	1.0000			
1976	*	571,518,585	0.999994	-3,202	1.0000	2012		570,018,890	1.0034			
1977	*	601,598,510	0.999993	-4,494	1.0000	2013		573,163,467	0.9976			
1978	*	633,261,590	0.999990	-6,307	1.0000	2014		570,064,841	1.0170			
1979	*	666,591,147	0.999987	-8,852	0.9999	2015		548,712,251	1.0791			
1980	*	701,674,892	0.999982	-12,424	0.9999	2016		488,551,343	1.3284			
1981	*	738,605,149	0.999976	-17,438	0.9999	2017		394,220,080	3.3940			
1982	*	777,479,104	0.999969	-24,474	0.9999	2018		119,495,366				

MEDICAL 17 vs 18

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1988 PYs Incurred	2,614,306,665	1 PY 1987 Incurred = (Average of 1988, 1989, 1990) x (PY Deflation Factor ^ 2)
Next Latest 12/31 Prior to 1988 PYs Incurred	2,598,041,698	2 PY 1986 & Prior Incurred = Subsequent Year x PY Deflation
CY Development of Prior to 1988 PYs	16,264,967	3 PY 1987 LDF selected based on balancing Prior to 1988 PYs Total Dollar Dev. to Actual CY Dev.
Next Latest PY 1988 Incurred	531,512,303	4 PY 1986 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0
# of 1988 PYs in Prior to 1988 PYs Data	4.92	
Selected Decrement Development Factor	0.75	CY Development of Prior to 1988 PYs:
Selected Average PY Deflation Factor	0.93	Total Dollar Development:
		Difference:
		0

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/18	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/18	Prior Year LDF	Dollar Development	Cumulative LDF	
1947	*	29,493,528	1.000000	3	1.0000	1983	*	402,106,023	1.002913	1,167,932	1.0117	34TH TO ULT
1948	*	31,713,471	1.000000	4	1.0000	1984	*	432,372,068	1.003884	1,672,836	1.0156	33RD TO ULT
1949	*	34,100,506	1.000000	6	1.0000	1985	*	464,916,202	1.005179	2,395,241	1.0209	32ND TO ULT
1950	*	36,667,211	1.000000	8	1.0000	1986	*	499,909,895	1.006905	3,428,151	1.0279	31ST TO ULT
1951	*	39,427,109	1.000000	12	1.0000	1987	*	537,537,521	1.00920652	4,903,702	1.0374	30TH TO ULT
1952	*	42,394,741	1.000000	17	1.0000	1988		533,169,876	1.0031		1.0406	29th TO ULT
1953	*	45,585,743	1.000001	24	1.0000	1989		655,442,233	1.0050		1.0458	28th TO ULT
1954	*	49,016,928	1.000001	34	1.0000	1990		675,895,422	1.0017		1.0476	27th TO ULT
1955	*	52,706,374	1.000001	49	1.0000	1991		626,111,547	1.0024		1.0501	26th TO ULT
1956	*	56,673,520	1.000001	70	1.0000	1992		553,309,205	1.0023		1.0525	25th TO ULT
1957	*	60,939,269	1.000002	100	1.0000	1993		430,468,373	0.9961		1.0484	24th TO ULT
1958	*	65,526,096	1.000002	144	1.0000	1994		410,498,121	1.0088		1.0577	23rd TO ULT
1959	*	70,458,168	1.000003	206	1.0000	1995		376,438,471	1.0046		1.0625	22nd TO ULT
1960	*	75,761,470	1.000004	295	1.0000	1996		378,070,875	1.0031		1.0658	21st TO ULT
1961	*	81,463,947	1.000005	423	1.0000	1997		394,997,939	1.0040		1.0701	20th TO ULT
1962	*	87,595,642	1.000007	607	1.0000	1998		428,762,410	1.0045			
1963	*	94,188,862	1.000009	870	1.0000	1999		452,101,414	1.0012			
1964	*	101,278,346	1.000012	1,247	1.0000	2000		486,596,378	1.0081			
1965	*	108,901,448	1.000016	1,788	1.0001	2001		475,812,863	1.0016			
1966	*	117,098,331	1.000022	2,564	1.0001	2002		547,746,192	1.0196			
1967	*	125,912,184	1.000029	3,676	1.0001	2003		552,415,916	1.0069			
1968	*	135,389,445	1.000039	5,270	1.0002	2004		604,026,665	1.0101			
1969	*	145,580,048	1.000052	7,556	1.0002	2005		624,663,654	1.0048			
1970	*	156,537,686	1.000069	10,832	1.0003	2006		639,077,350	1.0074			
1971	*	168,320,092	1.000092	15,530	1.0004	2007		679,396,727	1.0030			
1972	*	180,989,347	1.000123	22,265	1.0005	2008		613,725,788	1.0034			
1973	*	194,612,201	1.000164	31,919	1.0007	2009		541,854,119	0.9989			
1974	*	209,260,431	1.000219	45,760	1.0009	2010		595,291,755	1.0089			
1975	*	225,011,216	1.000292	65,601	1.0012	2011		583,087,922	1.0007			
1976	*	241,947,544	1.000389	94,042	1.0016	2012		543,742,256	1.0003			
1977	*	260,158,650	1.000518	134,810	1.0021	2013		561,898,894	0.9866			
1978	*	279,740,484	1.000691	193,242	1.0028	2014		568,597,852	1.0018			
1979	*	300,796,219	1.000922	276,986	1.0037	2015		538,049,539	0.9999			
1980	*	323,436,794	1.001229	396,991	1.0049	2016		517,512,602	1.0466			
1981	*	347,781,499	1.001639	568,929	1.0066	2017		550,490,869	2.1862			
1982	*	373,958,602	1.002185	815,225	1.0088	2018		291,707,133				

INDEMNITY 16 vs 17

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1987 PYs Incurred	5,287,930,388	1 PY 1986 Incurred = (Average of 1987, 1988, 1989) x (PY Deflation Factor ^ 2)
Next Latest 12/31 Prior to 1987 PYs Incurred	5,286,913,916	2 PY 1985 & Prior Incurred = Subsequent Year x PY Deflation
CY Development of Prior to 1987 PYs	1,016,472	3 PY 1986 LDF selected based on balancing Prior to 1987 PYs Total Dollar Dev. to Actual CY Dev.
Next Latest PY 1987 Incurred	868,247,305	4 PY 1985 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0
# of 1987 PYs in Prior to 1987 PYs Data	6.09	
Selected Decrement Development Factor	0.75	CY Development of Prior to 1987 PYs: 1,016,472
Selected Average PY Deflation Factor	0.95	Total Dollar Development: 1,016,472
		Difference: 0

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/17	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/17	Prior Year LDF	Dollar Development	Cumulative LDF	
1946	*	115,674,653	1.000000	0	1.0000	1982	*	733,142,534	1.000103	75,321	1.0004	34TH TO ULT
1947	*	121,762,793	1.000000	1	1.0000	1983	*	771,728,983	1.000137	105,710	1.0005	33RD TO ULT
1948	*	128,171,361	1.000000	1	1.0000	1984	*	812,346,298	1.000183	148,358	1.0007	32ND TO ULT
1949	*	134,917,222	1.000000	1	1.0000	1985	*	855,101,367	1.000244	208,209	1.0010	31ST TO ULT
1950	*	142,018,129	1.000000	1	1.0000	1986	*	900,106,702	1.000325	292,199	1.0013	30TH TO ULT
1951	*	149,492,767	1.000000	2	1.0000	1987		868,590,440	1.0004		1.0017	29th TO ULT
1952	*	157,360,807	1.000000	3	1.0000	1988		980,512,306	0.9995		1.0012	28th TO ULT
1953	*	165,642,955	1.000000	4	1.0000	1989		1,142,941,692	1.0003		1.0015	27th TO ULT
1954	*	174,361,005	1.000000	6	1.0000	1990		1,165,153,522	1.0003		1.0018	26th TO ULT
1955	*	183,537,900	1.000000	8	1.0000	1991		1,006,254,873	0.9995		1.0013	25th TO ULT
1956	*	193,197,790	1.000000	11	1.0000	1992		843,389,302	1.0000		1.0013	24th TO ULT
1957	*	203,366,095	1.000000	16	1.0000	1993		736,272,214	0.9999		1.0012	23rd TO ULT
1958	*	214,069,573	1.000000	22	1.0000	1994		686,497,154	0.9998		1.0010	22nd TO ULT
1959	*	225,336,393	1.000000	31	1.0000	1995		580,597,103	1.0009		1.0019	21st TO ULT
1960	*	237,196,203	1.000000	43	1.0000	1996		497,365,687	0.9998		1.0017	20th TO ULT
1961	*	249,680,214	1.000000	61	1.0000	1997		504,496,406	1.0004			
1962	*	262,821,278	1.000000	86	1.0000	1998		499,164,890	0.9999			
1963	*	276,653,976	1.000000	120	1.0000	1999		563,723,401	1.0006			
1964	*	291,214,712	1.000001	169	1.0000	2000		597,954,900	1.0012			
1965	*	306,541,802	1.000001	237	1.0000	2001		627,958,455	1.0001			
1966	*	322,675,581	1.000001	332	1.0000	2002		674,041,682	1.0014			
1967	*	339,658,507	1.000001	466	1.0000	2003		658,465,461	1.0016			
1968	*	357,535,270	1.000002	655	1.0000	2004		695,881,890	1.0009			
1969	*	376,352,916	1.000002	919	1.0000	2005		699,947,489	1.0011			
1970	*	396,160,964	1.000003	1,289	1.0000	2006		720,191,112	1.0011			
1971	*	417,011,541	1.000004	1,810	1.0000	2007		758,126,829	1.0033			
1972	*	438,959,517	1.000006	2,540	1.0000	2008		706,470,506	1.0015			
1973	*	462,062,649	1.000008	3,565	1.0000	2009		639,234,796	1.0043			
1974	*	486,381,736	1.000010	5,003	1.0000	2010		660,206,261	1.0068			
1975	*	511,980,775	1.000014	7,022	1.0001	2011		635,550,757	1.0078			
1976	*	538,927,132	1.000018	9,855	1.0001	2012		577,924,257	1.0050			
1977	*	567,291,717	1.000024	13,832	1.0001	2013		581,154,570	1.0105			
1978	*	597,149,176	1.000033	19,413	1.0001	2014		556,791,346	1.0864			
1979	*	628,578,080	1.000043	27,245	1.0002	2015		498,025,442	1.3372			
1980	*	661,661,137	1.000058	38,239	1.0002	2016		364,613,082	3.3664			
1981	*	696,485,408	1.000077	53,667	1.0003	2017		114,741,844				

MEDICAL 16 vs 17

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1987 PYs Incurred	2,095,988,490	1 PY 1986 Incurred = (Average of 1987, 1988, 1989) x (PY Deflation Factor ^ 2)
Next Latest 12/31 Prior to 1987 PYs Incurred	2,092,785,573	2 PY 1985 & Prior Incurred = Subsequent Year x PY Deflation
CY Development of Prior to 1987 PYs	3,202,917	3 PY 1986 LDF selected based on balancing Prior to 1987 PYs Total Dollar Dev. to Actual CY Dev.
Next Latest PY 1987 Incurred	437,638,844	4 PY 1985 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0
# of 1987 PYs in Prior to 1987 PYs Data	4.79	
Selected Decrement Development Factor	0.75	CY Development of Prior to 1987 PYs:
Selected Average PY Deflation Factor	0.93	Total Dollar Development:
		Difference:
		0

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/17	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/17	Prior Year LDF	Dollar Development	Cumulative LDF	
1946	*	25,521,630	1.000000	1	1.0000	1982	*	347,954,337	1.000660	229,475	1.0026	34TH TO ULT
1947	*	27,442,613	1.000000	1	1.0000	1983	*	374,144,448	1.000880	328,924	1.0035	33RD TO ULT
1948	*	29,508,185	1.000000	1	1.0000	1984	*	402,305,858	1.001173	471,438	1.0047	32ND TO ULT
1949	*	31,729,232	1.000000	2	1.0000	1985	*	432,586,945	1.001564	675,632	1.0063	31ST TO ULT
1950	*	34,117,453	1.000000	2	1.0000	1986	*	465,147,252	1.00208571	968,144	1.0084	30th TO ULT
1951	*	36,685,434	1.000000	3	1.0000	1987		445,607,513	1.0182		1.0267	29th TO ULT
1952	*	39,446,703	1.000000	5	1.0000	1988		524,711,194	0.9981		1.0248	28th TO ULT
1953	*	42,415,810	1.000000	7	1.0000	1989		643,095,279	1.0015		1.0263	27th TO ULT
1954	*	45,608,398	1.000000	10	1.0000	1990		663,442,072	1.0018		1.0282	26th TO ULT
1955	*	49,041,288	1.000000	14	1.0000	1991		610,953,160	1.0021		1.0303	25th TO ULT
1956	*	52,732,567	1.000000	20	1.0000	1992		536,685,035	1.0007		1.0310	24th TO ULT
1957	*	56,701,685	1.000000	28	1.0000	1993		419,832,793	1.0035		1.0346	23rd TO ULT
1958	*	60,969,554	1.000001	40	1.0000	1994		398,732,142	1.0028		1.0375	22nd TO ULT
1959	*	65,558,660	1.000001	58	1.0000	1995		366,032,892	1.0016		1.0392	21st TO ULT
1960	*	70,493,183	1.000001	83	1.0000	1996		367,707,346	1.0079		1.0474	20th TO ULT
1961	*	75,799,122	1.000002	119	1.0000	1997		382,301,878	0.9982			
1962	*	81,504,432	1.000002	171	1.0000	1998		402,951,814	1.0153			
1963	*	87,639,174	1.000003	245	1.0000	1999		432,265,047	0.9984			
1964	*	94,235,671	1.000004	351	1.0000	2000		462,045,801	1.0026			
1965	*	101,328,679	1.000005	503	1.0000	2001		466,305,560	1.0017			
1966	*	108,955,568	1.000007	721	1.0000	2002		536,277,184	1.0057			
1967	*	117,156,525	1.000009	1,033	1.0000	2003		552,047,850	1.0046			
1968	*	125,974,758	1.000012	1,481	1.0000	2004		605,522,820	1.0032			
1969	*	135,456,729	1.000016	2,124	1.0001	2005		634,622,287	1.0073			
1970	*	145,652,397	1.000021	3,045	1.0001	2006		644,541,197	1.0046			
1971	*	156,615,481	1.000028	4,365	1.0001	2007		692,152,336	1.0022			
1972	*	168,403,743	1.000037	6,258	1.0001	2008		623,411,445	0.9978			
1973	*	181,079,293	1.000050	8,972	1.0002	2009		552,881,259	0.9971			
1974	*	194,708,918	1.000066	12,863	1.0003	2010		601,930,105	1.0082			
1975	*	209,364,427	1.000088	18,441	1.0004	2011		593,729,286	1.0084			
1976	*	225,123,040	1.000117	26,438	1.0005	2012		553,227,436	1.0309			
1977	*	242,067,785	1.000157	37,903	1.0006	2013		574,658,775	0.9973			
1978	*	260,287,941	1.000209	54,339	1.0008	2014		565,563,887	1.0202			
1979	*	279,879,507	1.000278	77,899	1.0011	2015		528,855,104	1.0478			
1980	*	300,945,706	1.000371	111,673	1.0015	2016		490,693,171	2.1990			
1981	*	323,597,533	1.000495	160,085	1.0020	2017		248,019,525				

INDEMNITY 15 vs 16

Inputs and Notes for Tail Factor Estimation

Latest 12/31 Prior to 1986 PYs Incurred	4,745,489,731	1 PY 1985 Incurred = (Average of 1986, 1987, 1988) x (PY Deflation Factor ^ 2)
Next Latest 12/31 Prior to 1986 PYs Incurred	4,745,177,980	2 PY 1984 & Prior Incurred = Subsequent Year x PY Deflation
CY Development of Prior to 1986 PYs	311,751	3 PY 1985 LDF selected based on balancing Prior to 1986 PYs Total Dollar Dev. to Actual CY Dev.
Next Latest PY 1986 Incurred	721,153,650	4 PY 1984 & Prior LDFs = (Subsequent Year - 1.0) x Selected Decrement + 1.0
# of 1986 PYs in Prior to 1986 PYs Data	6.58	
Selected Decrement Development Factor	0.75	CY Development of Prior to 1986 PYs:
Selected Average PY Deflation Factor	0.95	Total Dollar Development:
		Difference:
		311,751
		311,752
		-1

Tail Factor Model - 2021 Loss Cost Filing

Policy Year	(*=Estimate)	Incurred as of 12/31/16	Prior Year LDF	Dollar Development	Cumulative LDF	Policy Year	(*=Estimate)	Incurred as of 12/31/16	Prior Year LDF	Dollar Development	Cumulative LDF	
1945	*	99,789,611	1.000000	0	1.0000	1981	*	632,463,603	1.000037	23,100	1.0001	34TH TO ULT
1946	*	105,041,695	1.000000	0	1.0000	1982	*	665,751,161	1.000049	32,420	1.0002	33RD TO ULT
1947	*	110,570,206	1.000000	0	1.0000	1983	*	700,790,696	1.000065	45,501	1.0003	32ND TO ULT
1948	*	116,389,690	1.000000	0	1.0000	1984	*	737,674,417	1.000087	63,860	1.0003	31ST TO ULT
1949	*	122,515,463	1.000000	0	1.0000	1985	*	776,499,386	1.00011544	89,625	1.0005	30TH TO ULT
1950	*	128,963,646	1.000000	1	1.0000	1986		721,423,366	1.0004		1.0009	29TH TO ULT
1951	*	135,751,206	1.000000	1	1.0000	1987		872,323,486	0.9992		1.0001	28th TO ULT
1952	*	142,896,006	1.000000	1	1.0000	1988		987,414,544	1.0004		1.0005	27th TO ULT
1953	*	150,416,849	1.000000	2	1.0000	1989		1,148,185,169	1.0005		1.0010	26th TO ULT
1954	*	158,333,525	1.000000	2	1.0000	1990		1,173,634,949	1.0006		1.0016	25th TO ULT
1955	*	166,666,868	1.000000	3	1.0000	1991		1,013,820,336	1.0008		1.0024	24th TO ULT
1956	*	175,438,809	1.000000	5	1.0000	1992		851,993,670	1.0011		1.0035	23rd TO ULT
1957	*	184,672,430	1.000000	7	1.0000	1993		743,375,567	1.0002		1.0037	22nd TO ULT
1958	*	194,392,032	1.000000	9	1.0000	1994		679,124,242	1.0017		1.0054	21st TO ULT
1959	*	204,623,192	1.000000	13	1.0000	1995		572,479,411	0.9984		1.0038	20th TO ULT
1960	*	215,392,833	1.000000	19	1.0000	1996		489,052,264	0.9999			
1961	*	226,729,298	1.000000	26	1.0000	1997		499,333,753	1.0021			
1962	*	238,662,419	1.000000	37	1.0000	1998		496,989,793	1.0003			
1963	*	251,223,599	1.000000	52	1.0000	1999		564,142,781	1.0005			
1964	*	264,445,894	1.000000	73	1.0000	2000		600,237,959	0.9999			
1965	*	278,364,099	1.000000	102	1.0000	2001		603,932,408	1.0013			
1966	*	293,014,841	1.000000	143	1.0000	2002		629,926,963	1.0016			
1967	*	308,436,675	1.000001	201	1.0000	2003		613,382,480	1.0007			
1968	*	324,670,184	1.000001	282	1.0000	2004		662,136,395	1.0014			
1969	*	341,758,088	1.000001	395	1.0000	2005		676,903,388	1.0014			
1970	*	359,745,356	1.000002	555	1.0000	2006		703,215,817	1.0025			
1971	*	378,679,322	1.000002	779	1.0000	2007		742,284,269	1.0013			
1972	*	398,609,813	1.000003	1,093	1.0000	2008		686,046,358	0.9999			
1973	*	419,589,276	1.000004	1,534	1.0000	2009		625,080,978	1.0058			
1974	*	441,672,923	1.000005	2,153	1.0000	2010		646,464,468	1.0002			
1975	*	464,918,866	1.000007	3,022	1.0000	2011		618,761,328	1.0040			
1976	*	489,388,280	1.000009	4,242	1.0000	2012		549,092,227	1.0319			
1977	*	515,145,558	1.000012	5,953	1.0000	2013		550,876,199	1.0948			
1978	*	542,258,482	1.000015	8,355	1.0001	2014		491,422,631	1.3303			
1979	*	570,798,402	1.000021	11,727	1.0001	2015		349,068,153	3.2468			
1980	*	600,840,423	1.000027	16,459	1.0001	2016		99,813,347				

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

Exponential Curve Fit

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(6)	(7)
Development Period	Selected LDF	v(d) = (3) - 1	ln [v(d)] = ln(4)	Using Last 20 Periods Fitted LDF	Fit Error	Development Period (Continued)	Using Last 20 Periods Fitted LDF	Fit Error		
1	12-24	1.3370	0.337	-1.088		41	492-504	1.0001		
2	24-36	1.0830	0.083	-2.489		42	504-516	1.0001		
3	36-48	1.0160	0.016	-4.137		43	516-528	1.0001		
4	48-60	1.0021	0.002	-6.182		44	528-540	1.0001		
5	60-72	1.0025	0.003	-5.991		45	540-552	1.0001		
6	72-84	1.0035	0.003	-5.665		46	552-564	1.0001		
7	84-96	1.0029	0.003	-5.832		47	564-576	1.0001		
8	96-108	1.0015	0.002	-6.480		48	576-588	1.0001		
9	108-120	1.0015	0.002	-6.502		49	588-600	1.0001		
10	120-132	1.0006	0.001	-7.419	1.001	0.000	50	600-612	1.0001	
11	132-144	1.0011	0.001	-6.812	1.001	0.001	51	612-624	1.0001	
12	144-156	1.0012	0.001	-6.754	1.000	0.001	52	624-636	1.0001	
13	156-168	1.0003	0.000	-8.006	1.000	0.000	53	636-648	1.0001	
14	168-180	1.0001	0.000	-9.210	1.000	0.000	54	648-660	1.0001	
15	180-192	0.9996	0.000		1.0004	-0.0008	55	660-672	1.0001	
16	192-204	1.0006	0.001	-7.365	1.0004	0.0002	56	672-684	1.0001	
17	204-216	1.0002	0.000	-8.517	1.0004	-0.0002	57	684-696	1.0001	
18	216-228	1.0004	0.000	-7.824	1.0004	0.0000	58	696-708	1.0001	
19	228-240	1.0002	0.000	-8.517	1.0003	-0.0001	59	708-720	1.0001	
20	240-252	1.0005	0.000	-7.670	1.0003	0.0001	60	720-732	1.0001	
21	252-264	1.0005	0.001	-7.536	1.0003	0.0002	61	732-744	1.0001	
22	264-276	0.9998	0.000		1.0003	-0.0005	62	744-756	1.0000	
23	276-288	1.0000	0.000	-10.309	1.0003	-0.0003	63	756-768	1.0000	
24	288-300	0.9997	0.000		1.0003	-0.0006	64	768-780	1.0000	
25	300-312	1.0007	0.001	-7.313	1.0003	0.0004	65	780-792	1.0000	
26	312-324	1.0013	0.001	-6.671	1.0003	0.0010	66	792-804	1.0000	
27	324-336	1.0001	0.000	-8.923	1.0002	-0.0001	67	804-816	1.0000	
28	336-348	0.9996	0.000		1.0002	-0.0006	68	816-828	1.0000	
29	348-360	0.9999	0.000		1.0002	-0.0004	69	828-840	1.0000	
30	360-372				1.0002		70	840-852	1.0000	
31	372-384				1.0002		71	852-864	1.0000	
32	384-396				1.0002		72	864-876	1.0000	
33	396-408				1.0002		73	876-888	1.0000	
34	408-420				1.0002		74	888-900	1.0000	
35	420-432				1.0002		75	900-912	1.0000	
36	432-444				1.0002		76	912-924	1.0000	
37	444-456				1.0002		77	924-936	1.0000	
38	456-468				1.0001		78	936-948	1.0000	
39	468-480				1.0001		79	948-960	1.0000	
40	480-492				1.0001		80	960-972	1.0000	

Curve Fit Parameters

Data Points Used	#of Data Points Used	Decay Rate	Coefficient	Truncated Tail Factor At 20th
10-29	20	0.956	0.001	1.0071

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 Five-Year Average of Medical Incurred Development Factors

Exponential Curve Fit

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(6)	(7)
Development Period	Selected LDF	v(d) = (3) - 1	ln [v(d)] = ln(4)	Using Last 10 Periods Fitted LDF	Fit Error	Development Period (Continued)	Using Last 10 Periods Fitted LDF	Fit Error		
1	12-24	1.0598	0.060	-2.817		41	492-504	1.0013		
2	24-36	1.0158	0.016	-4.148		42	504-516	1.0012		
3	36-48	0.9996	0.000			43	516-528	1.0012		
4	48-60	1.0053	0.005	-5.240		44	528-540	1.0012		
5	60-72	0.9999	0.000			45	540-552	1.0011		
6	72-84	1.0096	0.010	-4.646		46	552-564	1.0011		
7	84-96	1.0016	0.002	-6.425		47	564-576	1.0011		
8	96-108	1.0024	0.002	-6.041		48	576-588	1.0010		
9	108-120	1.0025	0.002	-5.991		49	588-600	1.0010		
10	120-132	1.0037	0.004	-5.589		50	600-612	1.0010		
11	132-144	1.0043	0.004	-5.454		51	612-624	1.0009		
12	144-156	1.0050	0.005	-5.302		52	624-636	1.0009		
13	156-168	1.0057	0.006	-5.171		53	636-648	1.0009		
14	168-180	1.0040	0.004	-5.516		54	648-660	1.0008		
15	180-192	1.0051	0.005	-5.275	1.0030	0.0022	55	660-672	1.0008	
16	192-204	1.0010	0.001	-6.869	1.0029	-0.0018	56	672-684	1.0008	
17	204-216	1.0022	0.002	-6.110	1.0028	-0.0006	57	684-696	1.0008	
18	216-228	1.0035	0.004	-5.655	1.0027	0.0008	58	696-708	1.0007	
19	228-240	1.0045	0.004	-5.408	1.0026	0.0019	59	708-720	1.0007	
20	240-252	1.0042	0.004	-5.473	1.0025	0.0017	60	720-732	1.0007	
21	252-264	1.0030	0.003	-5.816	1.0024	0.0005	61	732-744	1.0007	
22	264-276	1.0015	0.002	-6.489	1.0024	-0.0008	62	744-756	1.0006	
23	276-288	1.0043	0.004	-5.440	1.0023	0.0021	63	756-768	1.0006	
24	288-300	1.0003	0.000	-8.047	1.0022	-0.0019	64	768-780	1.0006	
25	300-312	1.0036	0.004	-5.616	1.0021	0.0015	65	780-792	1.0006	
26	312-324	1.0033	0.003	-5.708	1.0021	0.0012	66	792-804	1.0006	
27	324-336	1.0018	0.002	-6.298	1.0020	-0.0002	67	804-816	1.0005	
28	336-348	1.0011	0.001	-6.849	1.0019	-0.0009	68	816-828	1.0005	
29	348-360	1.0039	0.004	-5.551	1.0019	0.0020	69	828-840	1.0005	
30	360-372				1.0018		70	840-852	1.0005	
31	372-384				1.0018		71	852-864	1.0005	
32	384-396				1.0017		72	864-876	1.0005	
33	396-408				1.0017		73	876-888	1.0005	
34	408-420				1.0016		74	888-900	1.0004	
35	420-432				1.0016		75	900-912	1.0004	
36	432-444				1.0015		76	912-924	1.0004	
37	444-456				1.0015		77	924-936	1.0004	
38	456-468				1.0014		78	936-948	1.0004	
39	468-480				1.0014		79	948-960	1.0004	
40	480-492				1.0013		80	960-972	1.0004	

Curve Fit Parameters

Data Points Used	#of Data Points Used	Decay Rate	Coefficient	Truncated Tail Factor At 20th
20-29	10	0.968	0.005	1.0704

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