Casualty Actuarial Society

Cash Flow Case Reserving and Triangle Restatements

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Costs Considered in Case Reserving for Severe Injury Workers' Comp Claims

- Indemnity
  - Prescribed based upon state benefits
  - Calculators can be used to readily estimate
- Medical costs
  - Less predictable
  - Volatile, may change over time due to medical setbacks or recurrences
- Custodial care costs

Items Considered in Case Reserving for Severe Injury Workers' Comp Claims

- Medical cost provisions
  - First year/non-recurring
    - Acute care
    - Physical rehab
    - Prescriptions
  - Recurring
    - Physicians
    - Prescriptions
    - Durable medical equipment/prosthetics

Case Reserve Practices Observed

- Fixed $ amount for fixed number of years/expected life remaining
- Trended $ amount for fixed number of years/expected life remaining
- Cash flow modeling
- All methods are “cash flow” models, but levels of sophistication differ

Cash Flow Modeling Key Assumptions

- Claim attributes
  - Injured worker date of birth
  - Accident date
  - Retention/limit
- Payments
  - Annual indemnity payments
  - Annual medical payments
  - Annual custodial care payments

Cash Flow Modeling Key Assumptions

- Escalation/Inflation/Discount Factors
  - Indemnity
  - Medical
  - Custodial Care
  - Annual investment return
- Mortality
  - Trended or static table
  - Implicit mortality via rated age or expected life remaining assumption

Discussion Topics

- Payment Projections
- Medical Trends
- Mortality Tables

Payment Projections

- Lifetime medical payments for WC PTD claims
- Studies of historical payments or similar claims may provide guidance
- Difficulty in forecasting treatment changes (new technologies, prescriptions, etc.)
- Difficulty in predicting medical complications or improvements

Medical Trends

- Different for large vs. small WC claims?
  - CPI effect, utilization, technology, prescriptions
- How to determine trend when claims stay open for long periods?
- When reviewing history, how to determine cost changes from treatment changes from utilization?
- Highly leveraged effect, particularly for excess layers

Mortality

- Expected life remaining vs. mortality tables
- Which mortality table is appropriate?
  - State versus countrywide
  - Substandard mortality reflecting reduced life expectancy from injury or co-morbidities
  - Trended mortality using Social Security Administration projections
- Is there a need for a WC mortality table?

Reserves: Fixed amount for expected life remaining as of 12/31/2018

- Assumptions:
  - Claimant ~45 years old
  - Annual costs:
    - Indemnity: $35,000 (benefits until age 67)
    - Medical: $4,000
    - Custodial Care: $10,000
  - Life expectancy normal (43 more years)
  - Ground Up Reserve: 22 x $35,000 + ($4,000 + $10,000) x 43 = $1,372,000
  - Implicitly assumes inflation is offset by discount
    - Statutory accounting typically allows only for the discounting of indemnity

Reserves: Trended amount for expected life remaining as of 12/31/2018

- Assumptions:
  - Same assumptions as previous slide:
    - Claimant ~45 years old
    - Annual costs: indemnity-$35,000 (until age 67); medical-$4,000; cc-$10,000
    - Expected life remaining = 43 years
  - Trend: 4%
  - Reserve: [$35,000 x {[(1.04)^22 – 1]/.04} + ($4,000 + $10,000) x {[(1.04)^43 – 1]/.04}] x (1.04)^.5 = $2,793,092
    - Assumes mid-year payments
    - Calculated using annuity formulas

Cash Flow Case Reserve Model

- Review of simplified version of WCRA case reserve cash flow model

Summary Results

		Ground-Up	Retention	Layer 1	Layer 2	Total Reinsurance Reserve
	Undisc Inc Loss w/o Mortality	6,895,898	1,000,000	5,895,898	0	5,895,898
Inc Loss	Undisc Inc Loss	2,942,981	985,628	1,957,353	0	1,957,353
Inc Loss	Disc Inc Loss	1,117,744	742,214	375,530	0	375,530
Case Rsrv	Undisc Loss Reserve	**2,743,481**	**786,128**	**1,957,353**	**0**	1,957,353
Case Rsrv	Disc Loss Reserve	**918,244**	**542,714**	**375,530**	**0**	375,530

	Layer 1	Layer 2
Reinsurance Limit	20,000,000	999,999,999
Reinsurance Retention	1,000,000	21,000,000

Indemnity Benefit Age Cutoff	67	
Claimant Age	45	
Implied Life Expectancy Age	87	

Inflation and Escalation Rates

a) Professional medical inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
b) Custodial care inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
c) Indemnity inflation rate		2.7%
d) Social Security escalation		2.8%
e) Present value discount rate		6.5%

Other Inputs

f) Valuation date	12/31/2018
g) Claimant Birthdate	1/18/1974
h) Mortality Adjustment	3
1 = # years life remaining, 2= static, 3 = trended	
i) # expected years remaining	43
enter for Mortality option 1, else N/A	
j) Life Table (0…8); enter for Mortality options 2 & 3	1
0 or 1=Std, 2=2x, 3=3.5x, 4=5x, 5=7.5x, 6=10x, 7=25x, 8=50x	
k) Accident date	3/1/2017

		Uninflated Ground-Up Payments					Inflation Factors				Inflated Ground-Up Payments					Cumulative Inflated Payments				Incremental Inflat	
		Indemnity	Professional Medical	Custodial Care	Social Security	Total Payments	Indemnity	Professional Medical	Custodial Care	Social Security	Indemnity	Professional Medical	Custodial Care	Social Security	Total Payments	Ground-Up	Retention	Layer 1	Layer 2	Ground-Up	Retention
	Totals	841,250	383,000	680,000	0	1,904,250					1,119,699	1,471,748	4,304,452	0	6,895,898					6,895,898	1,000,000
Pd Loss Thru Val. Date		69,500	130,000	0		199,500	1.0000	1.0000	1.0000	1.0000	69,500	130,000	0	0	199,500	199,500	199,500	0	0	199,500	199,500
Payment Periods																					
1	2019	35,000	45,000	10,000	-	90,000	1.0134	1.0223	1.0223	1.0139	35,469	46,001	10,223	-	91,693	291,193	291,193	-	-	91,693	91,693
2	2020	35,000	10,000	10,000	-	55,000	1.0408	1.0683	1.0683	1.0423	36,427	10,683	10,683	-	57,792	348,985	348,985	-	-	57,792	57,792
3	2021	35,000	3,000	10,000	-	48,000	1.0689	1.1163	1.1163	1.0715	37,411	3,349	11,163	-	51,923	400,908	400,908	-	-	51,923	51,923
4	2022	35,000	3,000	10,000	-	48,000	1.0977	1.1666	1.1666	1.1015	38,421	3,500	11,666	-	53,586	454,494	454,494	-	-	53,586	53,586
5	2023	35,000	3,000	10,000	-	48,000	1.1274	1.2191	1.2191	1.1323	39,458	3,657	12,191	-	55,306	509,800	509,800	-	-	55,306	55,306
6	2024	35,000	3,000	10,000	-	48,000	1.1578	1.2739	1.2739	1.1640	40,523	3,822	12,739	-	57,084	566,884	566,884	-	-	57,084	57,084
7	2025	35,000	3,000	10,000	-	48,000	1.1891	1.3312	1.3312	1.1966	41,617	3,994	13,312	-	58,924	625,808	625,808	-	-	58,924	58,924
8	2026	35,000	3,000	10,000	-	48,000	1.2212	1.3911	1.3911	1.2301	42,741	4,173	13,911	-	60,826	686,634	686,634	-	-	60,826	60,826
9	2027	35,000	3,000	10,000	-	48,000	1.2541	1.4537	1.4537	1.2646	43,895	4,361	14,537	-	62,794	749,427	749,427	-	-	62,794	62,794
10	2028	35,000	3,000	10,000	-	48,000	1.2880	1.5192	1.5192	1.3000	45,080	4,557	15,192	-	64,829	814,257	814,257	-	-	64,829	64,829

Cash Flow Case Reserve Model

➢ Inputs

	Layer 1	Layer 2
Reinsurance Limit	20,000,000	999,999,999
Reinsurance Retention	1,000,000	21,000,000

Inflation and Escalation Rates		
a) Professional medical inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
b) Custodial care inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
c) Indemnity inflation rate		2.7%
d) Social Security escalation		2.8%
e) Present value discount rate		6.5%

Other Inputs	
f) Valuation date	12/31/2018
g) Claimant Birthdate	1/18/1974
h) Mortality Adjustment	3
1 = # years life remaining, 2= static, 3 = trended	
i) # expected years remaining	43
enter for Mortality option 1, else N/A	
j) Life Table (0…8); enter for Mortality options 2 & 3	1
0 or 1=Std, 2=2x, 3=3.5x, 4=5x, 5=7.5x, 6=10x, 7=25x, 8=50x	
k) Accident date	3/1/2017

Cash Flow Case Reserve Model

- Step 1—cost projections input

		Uninflated Ground-Up Payments				
		Indemnity	Professional Medical	Custodial Care	Social Security	Total Payments
	Totals	841,250	383,000	680,000	0	1,904,250
Pd Loss Thru Val. Date		69,500	130,000	0		199,500
Payment Periods						
1	2019	35,000	45,000	10,000	-	90,000
2	2020	35,000	10,000	10,000	-	55,000
3	2021	35,000	3,000	10,000	-	48,000
4	2022	35,000	3,000	10,000	-	48,000
5	2023	35,000	3,000	10,000	-	48,000
6	2024	35,000	3,000	10,000	-	48,000
7	2025	35,000	3,000	10,000	-	48,000
8	2026	35,000	3,000	10,000	-	48,000
9	2027	35,000	3,000	10,000	-	48,000
10	2028	35,000	3,000	10,000	-	48,000
11	2029	35,000	3,000	10,000	-	48,000
12	2030	35,000	3,000	10,000	-	48,000
13	2031	35,000	3,000	10,000	-	48,000
68	2086	-	3,000	10,000	-	13,000
	Total	841,250	383,000	680,000	0	1,904,250

Cash Flow Case Reserve Model

- Step 2—inflation factors applied to cost projections

		Inflation Factors				Inflated Ground-Up Payments				
		Indemnity	Professional Medical	Custodial Care	Social Security	Indemnity	Professional Medical	Custodial Care	Social Security	Total Payments
	Totals					1,119,699	1,471,748	4,304,452	0	6,895,898
Pd Loss Thru Val. Date		1.0000	1.0000	1.0000	1.0000	69,500	130,000	0	0	199,500
Payment Periods										
1	2019	1.0134	1.0223	1.0223	1.0139	35,469	46,001	10,223	-	91,693
2	2020	1.0408	1.0683	1.0683	1.0423	36,427	10,683	10,683	-	57,792
3	2021	1.0689	1.1163	1.1163	1.0715	37,411	3,349	11,163	-	51,923
4	2022	1.0977	1.1666	1.1666	1.1015	38,421	3,500	11,666	-	53,586
5	2023	1.1274	1.2191	1.2191	1.1323	39,458	3,657	12,191	-	55,306
6	2024	1.1578	1.2739	1.2739	1.1640	40,523	3,822	12,739	-	57,084
7	2025	1.1891	1.3312	1.3312	1.1966	41,617	3,994	13,312	-	58,924
8	2026	1.2212	1.3911	1.3911	1.2301	42,741	4,173	13,911	-	60,826
9	2027	1.2541	1.4537	1.4537	1.2646	43,895	4,361	14,537	-	62,794
10	2028	1.2880	1.5192	1.5192	1.3000	45,080	4,557	15,192	-	64,829
11	2029	1.3228	1.5875	1.5875	1.3364	46,298	4,763	15,875	-	66,935
12	2030	1.3585	1.6590	1.6590	1.3738	47,548	4,977	16,590	-	69,114
13	2031	1.3952	1.7336	1.7336	1.4123	48,831	5,201	17,336	-	71,368
68	2086	6.0396	19.5141	19.5141	6.4496	-	58,542	195,141	-	253,684
	Total					1,119,699	1,471,748	4,304,452	0	6,895,898

Cash Flow Case Reserve Model

- Step 3—cash flows accumulated and layered

		Cumulative Inflated Payments				Incremental Inflated Payments			
		Ground-Up	Retention	Layer 1	Layer 2	Ground-Up	Retention	Layer 1	Layer 2
	Totals					6,895,898	1,000,000	5,895,898	0
Pd Loss Thru Val. Date		199,500	199,500	0	0	199,500	199,500	0	0
Payment Periods									
1	2019	291,193	291,193	-	-	91,693	91,693	-	-
2	2020	348,985	348,985	-	-	57,792	57,792	-	-
3	2021	400,908	400,908	-	-	51,923	51,923	-	-
4	2022	454,494	454,494	-	-	53,586	53,586	-	-
5	2023	509,800	509,800	-	-	55,306	55,306	-	-
6	2024	566,884	566,884	-	-	57,084	57,084	-	-
7	2025	625,808	625,808	-	-	58,924	58,924	-	-
8	2026	686,634	686,634	-	-	60,826	60,826	-	-
9	2027	749,427	749,427	-	-	62,794	62,794	-	-
10	2028	814,257	814,257	-	-	64,829	64,829	-	-
11	2029	881,192	881,192	-	-	66,935	66,935	-	-
12	2030	950,306	950,306	-	-	69,114	69,114	-	-
13	2031	1,021,675	1,000,000	21,675	-	71,368	49,694	21,675	-
68	2086	6,895,898	1,000,000	5,895,898	-	253,684	-	253,684	-
	Total					6,895,898	1,000,000	5,895,898	0

Cash Flow Case Reserve Model

- Step 4—mortality applied to layered cash flows

		Mortality Factors		Mortality Adjusted Payments			
		Cumulative Year-End	Average Mid-Year	Ground-Up	Retention	Layer 1	Layer 2
	Totals			2,942,981	985,628	1,957,353	0
Pd Loss Thru Val. Date			1.0000	199,500	199,500	0	0
Payment Periods		1.0000					
1	2019	0.9982	0.9991	91,610	91,610	-	-
2	2020	0.9961	0.9972	57,628	57,628	-	-
3	2021	0.9940	0.9951	51,666	51,666	-	-
4	2022	0.9911	0.9926	53,187	53,187	-	-
5	2023	0.9883	0.9897	54,738	54,738	-	-
6	2024	0.9853	0.9868	56,333	56,333	-	-
7	2025	0.9820	0.9837	57,961	57,961	-	-
8	2026	0.9782	0.9801	59,617	59,617	-	-
9	2027	0.9744	0.9763	61,308	61,308	-	-
10	2028	0.9702	0.9723	63,034	63,034	-	-
11	2029	0.9658	0.9680	64,791	64,791	-	-
12	2030	0.9615	0.9636	66,600	66,600	-	-
13	2031	0.9565	0.9590	68,440	47,655	20,786	-
68	2086	-	0.0003	67	-	67	-
	Total			2,942,981	985,628	1,957,353	-

Cash Flow Case Reserve Model

- Step 5—discount applied to cash flows

		Mortality Adjusted Payments				PV Discount Factors	Discounted Payments			
		Ground-Up	Retention	Layer 1	Layer 2		Ground-Up	Retention	Layer 1	Layer 2
	Totals	2,942,981	985,628	1,957,353	0		1,117,744	742,214	375,530	0
Pd Loss Thru Val. Date		199,500	199,500	0	0	1.0000	199,500	199,500	0	0
Payment Periods										
1	2019	91,610	91,610	-	-	0.969	88,770	88,770	-	-
2	2020	57,628	57,628	-	-	0.910	52,434	52,434	-	-
3	2021	51,666	51,666	-	-	0.854	44,140	44,140	-	-
4	2022	53,187	53,187	-	-	0.802	42,666	42,666	-	-
5	2023	54,738	54,738	-	-	0.753	41,230	41,230	-	-
6	2024	56,333	56,333	-	-	0.707	39,842	39,842	-	-
7	2025	57,961	57,961	-	-	0.664	38,492	38,492	-	-
8	2026	59,617	59,617	-	-	0.624	37,175	37,175	-	-
9	2027	61,308	61,308	-	-	0.586	35,896	35,896	-	-
10	2028	63,034	63,034	-	-	0.550	34,654	34,654	-	-
11	2029	64,791	64,791	-	-	0.516	33,446	33,446	-	-
12	2030	66,600	66,600	-	-	0.485	32,281	32,281	-	-
13	2031	68,440	47,655	20,786	-	0.455	31,149	21,689	9,460	-
68	2086	67	-	67	-	0.014	1	-	1	-
	Total	2,942,981	985,628	1,957,353	-		1,117,744	742,214	375,530	0

Cash Flow Case Reserve Model

- Outputs

Summary Results

				Indemnity Benefit Age Cutoff	67	
				Claimant Age	45	
				Implied Life Expectancy Age	87	
						Total Reinsurance Reserve
		Ground-Up	Retention	Layer 1	Layer 2	
	Undisc Inc Loss w/o Mortality	6,895,898	1,000,000	5,895,898	0	5,895,898
Inc Loss	Undisc Inc Loss	2,942,981	985,628	1,957,353	0	1,957,353
Inc Loss	Disc Inc Loss	1,117,744	742,214	375,530	0	375,530
Case Rsrv	Undisc Loss Reserve	**2,743,481**	**786,128**	**1,957,353**	**0**	1,957,353
Case Rsrv	Disc Loss Reserve	**918,244**	**542,714**	**375,530**	**0**	375,530

Sensitivity Examples
Base Case Assumptions

- Base case assumptions:
  - Accident Date: 3/1/2017
  - Claimant ~45 years old
  - Payments through 12/31/2018: $69,500 indemnity; $130,000 medical
  - Annual costs: $35k indemnity, $45k/$10k/$3k+ medical, $10k custodial care
  - Retention: $1,000,000
  - Mortality assumption: standard/trended mortality
  - Trends: 4.5% medical, 4.5% custodial care
  - Discount: 6.5%

Sensitivity Examples
Base Case Results

- Base case results:

Summary Results

		Ground-Up	Retention	Layer 1	Layer 2	Total Reinsurance Reserve
	Undisc Inc Loss w/o Mortality	6,895,898	1,000,000	5,895,898	0	5,895,898
Inc Loss	Undisc Inc Loss	2,942,981	985,628	1,957,353	0	1,957,353
Inc Loss	Disc Inc Loss	1,117,744	742,214	375,530	0	375,530
Case Rsrv	Undisc Loss Reserve	**2,743,481**	**786,128**	**1,957,353**	**0**	1,957,353
Case Rsrv	Disc Loss Reserve	**918,244**	**542,714**	**375,530**	**0**	375,530

	Layer 1	Layer 2
Reinsurance Limit	20,000,000	999,999,999
Reinsurance Retention	1,000,000	21,000,000

Indemnity Benefit Age Cutoff 67
Claimant Age 45
Implied Life Expectancy Age 87

Inflation and Escalation Rates

a) Professional medical inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
b) Custodial care inflation rate		4.5%
Revised inflation rate beginning	2028	4.5%
c) Indemnity inflation rate		2.7%
d) Social Security escalation		2.8%
e) Present value discount rate		6.5%

Other Inputs

f) Valuation date	12/31/2018
g) Claimant Birthdate	1/18/1974
h) Mortality Adjustment	3
1 = # years life remaining, 2= static, 3 = trended	
i) # expected years remaining	43
enter for Mortality option 1, else N/A	
j) Life Table (0…8); enter for Mortality options 2 & 3	1
0 or 1=Std, 2=2x, 3=3.5x, 4=5x, 5=7.5x, 6=10x, 7=25x, 8=50x	
k) Accident date	3/1/2017

- Undiscounted ground up reserve (000's): $2,743
- Discounted ground up reserve (000's): $918
- Undiscounted reinsurance reserve (000's): $1,957
- Discounted reinsurance reserve (000's): $376

Sensitivity Examples
Claimant Age

Reinsurance Reserve

(000's)

Age	Undisc. Reserve	Disc. Reserve
25	$ 6,552	$ 698
45	$ 1,957	$ 376
65	$ 81	$ 11

Sensitivity Examples
Mortality

Reinsurance Reserve

(000's)

Mortality	Undisc. Reserve	Disc. Reserve	Life Expectancy
42 years ELR	$1,840	$ 402	87
Std. Mort Static	$1,673	$ 354	84
Std. Mort Trended	$1,957	$ 376	87
3.5x's Mort Trended	$1,031	$ 268	73
25x's Mort Trended	$ 134	$ 47	59

Sensitivity Examples
Medical Trend

Reinsurance Reserve

(000's)

Trend	Undisc. Reserve	Disc. Reserve	Life Expectancy
2.0%	$ 1,789	$ 353	87
3.5%	$ 1,859	$ 363	87
4.5%	$ 1,957	$ 376	87
6.0%	$ 2,188	$ 402	88

Sensitivity Examples
Discount

Reinsurance Reserve

(000's)

Discount Rate	Undisc. Reserve	Disc. Reserve
4.5%	$1,957	$ 588
5.5%	$1,957	$ 467
6.5%	$1,957	$ 376
7.5%	$1,957	$ 305

Refinements

- Indemnity calculations that incorporate SAWW changes, caps, and other recoveries
- Other reinsurance contracts
- Additional payment categories if trends differ (e.g. pharmaceuticals)
- Reflect calculations for different states or law periods

Observations from Model

- Sensitive to claimant age, medical trend, discount rate, mortality table
- Reserves for young claimants with high payments; have tended to show downward development
- Medical/indemnity mix in excess layers highly skewed toward medical due to higher trend rates and indemnity benefit cutoff

Cash Flow Case Reserving

Questions on Cash Flow Case Reserving??

Case Reserve Restatements for Loss Triangles

WCRA Case Reserving Approach

- WCRA case reserves are determined using a much more complex version of the cash flow model presented
- Two types of inputs
  - Adjuster/claim specific inputs
  - System inputs

WCRA Case Reserving Approach

- Adjuster/claim specific inputs:
  - Date of loss
  - Claimant date of birth
  - Average weekly wage
  - PTD/PPD/TTD indicator and associated information (e.g. PPD %)
  - Social security offsets
  - Projected medical payments next ten years
  - Projected custodial care payments next ten years
  - Contribution % if applicable
  - Indemnity settlement indicator

WCRA Case Reserving Approach

- System inputs:
  - Indemnity benefit calculations as determined by law
  - Medical escalation rate assumptions
  - Custodial care escalation rate assumptions
  - Mortality tables
  - Retention level that applies to claim

Restating Losses
Key Advantages

- The history for each of the inputs is retained, which allows for the application of new assumptions to restate individual case reserves historically
    - This is the claims equivalent of an extension of exposure technique
- Re-reserving claims can minimize/adjust out bias in case reserves caused by benefit adjustments, case law changes, inflation changes, and mortality table updates

Restated Losses
Key Advantages (cont'd)

- Adjusts for case reserve adequacy changes at the claim level resulting in a higher level of accuracy than using an aggregate adjustment technique
- Removing distortions allows for using as much history as possible in triangles for developing any given accident year
- The restatement process also provides the ability to create triangle history for newly introduced retentions or deductibles

Restated Loss Triangle Example

- Accident year 1991-2000 section of triangle; valuation periods 2009-2018
- Mortality tables and medical escalation rate assumptions updated with 2017 valuation
- Law change effective 1/1/1996 instituting age 67 indemnity benefit cutoff

Excess Loss Triangle Raw

Trend/mortality updated 2017

AY	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28
1991	87,890	92,712	99,038	102,891	98,756	97,755	92,387	92,917	88,001	92,772
1992	88,644	95,549	97,795	106,868	96,462	93,433	89,557	89,364	85,733	
1993	72,151	60,266	61,812	64,134	60,560	57,773	57,951	58,903		
1994	57,025	60,223	60,434	62,893	59,384	55,647	52,473			
1995	74,348	80,217	71,523	69,642	67,796	68,945				
1996	28,515	26,066	30,104	28,020	27,609					
1997	36,252	34,537	27,131	28,658						
1998	39,230	35,332	32,282							
1999	35,834	36,716								
2000	44,475									

Law change in 1996

Excess Loss LDFs Raw

AY	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28
1991	1.05	1.07	1.04	0.96	0.99	0.95	1.01	0.95	1.05
1992	1.08	1.02	1.09	0.90	0.97	0.96	1.00	0.96	
1993	0.84	1.03	1.04	0.94	0.95	1.00	1.02		
1994	1.06	1.00	1.04	0.94	0.94	0.94			
1995	1.08	0.89	0.97	0.97	1.02				
1996	0.91	1.15	0.93	0.99					
1997	0.95	0.79	1.06						
1998	0.90	0.91							
1999	1.02								
Wtd Avg	1.00	0.99	1.03	0.95	0.98	0.96	1.01	0.95	1.05
Cum	0.92	0.92	0.92	0.89	0.95	0.97	1.01	1.00	1.05

Restatement #1
Excess Loss Triangle Restated for Current Trend and Mortality Assumptions

AY	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28
1991	94,283	97,060	95,487	99,926	95,869	94,341	89,444	88,794	88,001	92,772
1992	96,334	98,066	100,740	106,128	95,452	89,769	86,917	89,364	85,733	
1993	67,415	56,312	57,874	60,138	57,529	54,619	57,951	58,903		
1994	52,354	55,574	55,870	59,954	55,498	55,647	52,473			
1995	69,431	75,134	67,437	65,596	67,796	68,945				
1996	25,638	24,277	28,164	28,020	27,609					
1997	32,928	31,345	27,131	28,658						
1998	35,761	35,332	32,282							
1999	35,834	36,716								
2000	44,475									

Law change in 1996

Excess Loss Triangle
Difference: Restatement #1 - Raw

AY	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28
1991	6,393	4,348	(3,551)	(2,965)	(2,887)	(3,414)	(2,943)	(4,123)	0	0
1992	7,690	2,517	2,945	(740)	(1,010)	(3,664)	(2,640)	0	0	
1993	(4,736)	(3,954)	(3,938)	(3,996)	(3,031)	(3,154)	0	0		
1994	(4,671)	(4,649)	(4,564)	(2,939)	(3,886)	0	0			
1995	(4,917)	(5,083)	(4,086)	(4,046)	0	0				
1996	(2,877)	(1,789)	(1,940)	0	0					
1997	(3,324)	(3,192)	0	0						
1998	(3,469)	0	0							
1999	0	0								
2000	0									

Restatement #1
Current Trend/Mortality
Excess LDFs (AY's 1992-1995)

AY	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28
1991	1.03	0.98	1.05	0.96	0.98	0.95	0.99	0.99	1.05
1992	1.02	1.03	1.05	0.90	0.94	0.97	1.03	0.96	
1993	0.84	1.03	1.04	0.96	0.95	1.06	1.02		
1994	1.06	1.01	1.07	0.93	1.00	0.94			
1995	1.08	0.90	0.97	1.03	1.02				
1996	0.95	1.16	0.99	0.99					
1997	0.95	0.87	1.06						
1998	0.99	0.91							
1999	1.02								
Wtd Avg	1.00	0.98	1.04	0.95	0.98	0.97	1.01	0.98	1.05
Cum	0.96	0.96	0.98	0.94	0.99	1.01	1.04	1.03	1.05

Restatement #2
Excess Loss Triangle Restated for Current Trend/Mortality, 1996 Law Change

AY	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28
1991	51,993	54,165	53,455	57,688	55,047	56,485	54,319	55,743	53,785	58,107
1992	48,548	54,832	58,109	61,213	52,549	50,015	49,320	52,448	51,371	
1993	54,698	42,929	44,287	49,424	47,422	44,447	47,195	47,606		
1994	40,215	42,814	42,557	47,151	43,458	43,386	38,371			
1995	57,658	64,136	57,456	54,806	53,866	55,317				
1996	25,638	24,277	28,164	28,020	27,609					
1997	32,928	31,345	27,131	28,658						
1998	35,761	35,332	32,282							
1999	35,834	36,716								
2000	44,475									

Excess Loss Triangle
Difference: Restatement #2 – Restatement #1

AY	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28
1991	(42,290)	(42,895)	(42,032)	(42,238)	(40,822)	(37,856)	(35,125)	(33,051)	(34,216)	(34,665)
1992	(47,786)	(43,234)	(42,631)	(44,915)	(42,903)	(39,754)	(37,597)	(36,916)	(34,362)	
1993	(12,717)	(13,383)	(13,587)	(10,714)	(10,107)	(10,172)	(10,756)	(11,297)		
1994	(12,139)	(12,760)	(13,313)	(12,803)	(12,040)	(12,261)	(14,102)			
1995	(11,773)	(10,998)	(9,981)	(10,790)	(13,930)	(13,628)				
1996	0	0	0	0	0					
1997	0	0	0	0						
1998	0	0	0							
1999	0	0								
2000	0									

Restatement #2
Current Trend/Mortality, 1996 Law Change
Excess LDFs (AY's 1996-2000)

AY	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28
1991	1.04	0.99	1.08	0.95	1.03	0.96	1.03	0.96	1.08
1992	1.13	1.06	1.05	0.86	0.95	0.99	1.06	0.98	
1993	0.78	1.03	1.12	0.96	0.94	1.06	1.01		
1994	1.06	0.99	1.11	0.92	1.00	0.88			
1995	1.11	0.90	0.95	0.98	1.03				
1996	0.95	1.16	0.99	0.99					
1997	0.95	0.87	1.06						
1998	0.99	0.91							
1999	1.02								
Wtd Avg	1.01	0.98	1.05	0.94	0.99	0.97	1.03	0.97	1.08
Cum	1.02	1.01	1.03	0.98	1.04	1.06	1.08	1.05	1.08

LDF Impact of Restating for Current Trend/Mortality and 1996 Law

Cumulative LDFs

AY	Cum LDF Age	Raw	Res #1	% Diff	Res #2	% Diff
1992	27-28	1.05	1.05	0%		
1993	26-28	1.00	1.03	2%		
1994	25-28	1.01	1.04	3%		
1995	24-28	0.97	1.01	5%		
1996	23-28	0.94			1.04	10%
1997	22-28	0.89			0.98	10%
1998	21-28	0.92			1.03	11%
1999	20-28	0.92			1.01	11%
2000	19-28	0.93			1.02	11%

Restated LDF Application

- LDFs from restated triangles applied only to the applicable accident year. In this example:
  - Restated LDFs from the 1st restatement apply only to pre-1996 accident years
  - Restated LDFs from the 2nd restatement apply to post 1996 accident years

Other Applications
Layering Losses

- Re-layer excess losses to reflect a higher retention
  - New retentions have been introduced at the WCRA and having the ability to re-layer existing losses as if the new retention applied has provided history where there otherwise was none.
  - May need to adjust for different claim reporting patterns

Restated Loss Triangles

- Most useful in these situations:
  - Long-tail lines like WC
  - Frequent triangle distortions due to law changes, judicial rulings, etc.
  - Formulaic approach to case reserves
  - Common assumptions underlying case reserves
- Create as many restatements as necessary

Cash Flow Case Reserving and Triangle Restatements

Questions??