**Reading:** Friedland 13 (Berquist-Sherman Methods)
**Model:** 2016.Spring #20
**Problem Type:** Reserving Methods - PBS (Paid Berq-Sherm)

F-13 (020) 2016.Spring Q20 (Problem)

**Find** Use the paid Berquist-Sherman method to calculate the ultimate for AY 2025 using both linear interpolation and exponential regression to restate the cumulative paid losses.

**Given**

| | Cumulative Paid Counts **(CPC)** | | | | Ultimate |
|---|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 | Counts |
| 2022 | 3,314 | 4,260 | 4,340 | 4,380 | 4,380 |
| 2023 | 3,390 | 4,404 | 4,550 | | 4,596 |
| 2024 | 3,342 | 4,365 | | | 4,454 |
| 2025 | 3,607 | | | | 4,509 |

| | Cumulative Paid Loss ($000s) **(CPL)** | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 7,760 | 13,664 | 15,515 | 16,484 |
| 2023 | 8,797 | 13,543 | 16,824 | |
| 2024 | 7,821 | 13,928 | | |
| 2025 | 9,113 | | | |

| | parameters for 2-point exponential fit: $y = ae^{bx}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 - 12 | | 12 - 24 | | 24 - 36 | | 36 - 48 | | 48 - 60 | |
| AY | a | b | a | b | a | b | a | b | a | b |
| 2022 | use 12 - 24 values | | 1,069 | 0.00060 | 16 | 0.00159 | 22 | 0.00152 | not needed | |
| 2023 | use 12 - 24 values | | 2,079 | 0.00043 | 19 | 0.00149 | | | | |
| 2024 | use 12 - 24 values | | 1,187 | 0.00056 | | | | | | |
| 2025 | use 12 - 24 values | | | | | | | | | |

** My solution rounds the adjusted counts to the nearest integer for clarity of presentation, but this is not a requirement. It might be better to keep 1 decimal place because the restated losses should then be more accurate.*

**Step 1a** calculate CDR as: CPC / UC *(UC = Ultimate Counts)*

| | Claims DIsposal Rate **(CDR)** | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 0.757 | 0.973 | 0.991 | **1.000** |
| 2023 | 0.738 | 0.958 | **0.990** | |
| 2024 | 0.750 | **0.980** | | |
| 2025 | **0.800** | | | |
| **last CY** | **0.800** | **0.980** | **0.990** | **1.000** |

*We assume the latest diagonal reflects current disposal rates. (This is the most recent CY.)*
*We will restate all AYs to be at the level of this most recent CY.*

*<-- select LATEST DIAGONAL ( not all-period-average)*

**Step 1b** restate CPC using CDRs from last CY

*This "range" table is just a visual aid*

| | Restated Cumulative Paid Counts **(CPC)** | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2025 | 3,504 | 4,292 | 4,336 | 4,380 |
| 2026 | 3,677 | 4,504 | 4,550 | |
| 2027 | 3,563 | 4,365 | | |
| 2028 | 3,607 | | | |

===>

| | Range Relative to Original Paid Counts | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 12-24 | 24-36 | 24-36 | 48-60 |
| 2023 | 12-24 | 24-36 | 36-48 | |
| 2024 | 12-24 | 24-36 | | |
| 2025 | 12-24 | | | |

Ex: 3,504 = 0.8 x 4380
Ex: 4,504 = 0.98 x 4596

*The range table is helpful in visualizing which data points or which regression parameters to use in Step 2.*

**Step 2** restate CPL using linear interpolation **or...** restate CPL using exponential regression interpolation

| | Restated Cumulative Paid Loss **(CPL)** | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 8,946 | 14,404 | 15,422 | 16,484 |
| 2023 | 10,140 | 15,790 | 16,824 | |
| 2024 | 9,140 | 13,928 | | |
| 2025 | 9,113 | | | |

| | Restated Cumulative Paid Loss **(CPL)** | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 8,751 | 14,719 | 15,785 | 16,484 |
| 2023 | 10,105 | 15,606 | 16,824 | |
| 2024 | 8,730 | 13,928 | | |
| 2025 | 9,113 | | | |

Exs:

8,946 = (3504-3314)/(4260-3314)x(13664-7760)+7760
15,790 = (4504-4404)/(4550-4404)x(16824-13543)+13543
15,422 = (4336-4260)/(4340-4260)x(15515-13664)+13664

8,751 = 1069 x EXP(0.0006 x 3504)
15,606 = 19 x EXP(0.00149 x 4504)
15,785 = 16 x EXP(0.00159 x 4336)

**Step 3a** apply development method to restated CPL (Linear)

**LDFs**

| AY | 12-24 | 24-36 | 36-48 | **48-ult** |
|---|---|---|---|---|
| 2022 | 1.610 | 1.071 | 1.069 | |
| 2023 | 1.557 | 1.065 | | |
| 2024 | 1.524 | | | *tail* |
| 2025 | | | | *factor:* |
| **selected** | 1.564 | 1.068 | 1.069 | **1.000** |

**CDFs**

| | 12-24 | 24-36 | 36-48 | 48-ult |
|---|---|---|---|---|
| age -> ult | 1.785 | 1.142 | 1.069 | **1.000** |

**Ults.**

| | **'25@12** | **'24@24** | **'23@36** | **'22@48** |
|---|---|---|---|---|
| **diagonal** | 9,113 | 13,928 | 16,824 | 16,484 |
| ultimate | 16,269 | 15,901 | 17,985 | 16,484 |

or...

**LDFs**

| AY | 12-24 | 24-36 | 36-48 | **48-ult** |
|---|---|---|---|---|
| 2022 | 1.682 | 1.072 | 1.044 | |
| 2023 | 1.544 | 1.078 | | |
| 2024 | 1.595 | | | *tail* |
| 2025 | | | | *factor:* |
| **selected** | 1.607 | 1.075 | 1.044 | **1.000** |

**CDFs**

| | 12-24 | 24-36 | 36-48 | 48-ult |
|---|---|---|---|---|
| age -> ult | 1.804 | 1.122 | 1.044 | **1.000** |

**Ults.**

| | **'25@12** | **'24@24** | **'23@36** | **'22@48** |
|---|---|---|---|---|
| **diagonal** | 9,113 | 13,928 | 16,824 | 16,484 |
| ultimate | 16,436 | 15,631 | 17,564 | 16,484 |

**Step 3b** ultimate for AY 2025 = 16,269 *<-- estimate based on LINEAR INTERPOLATION*
ultimate for AY 2025 = 16,436 *<-- estimate based on EXPONENTIAL REGRESSION INTERPOLATION*

**Step 3c** The estimate of ultimate using exponential regression differs from the estimate using liner interpolation by: 1.03%
*(Step 3c was just for fun to see if there is any real difference between linear and exponential interpolation.)*