Reading: Friedland 13 (Berquist-Sherman Methods)
Model: 2013.Fall #21
Problem Type: Reserving Methods - PBS (Paid Berq-Sherm)

F-13 (020) 2013.Fall Q21 (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	250	400	450	500	500
2023	225	360	405		450
2024	250	500			625
2025	175				700

** Assume no development past 48 mths.*

	Cumulative Paid Loss ($000s) **(CPL)**			
AY	12	24	36	48
2022	2,000	2,800	4,340	5,425
2023	2,100	3,360	4,872	
2024	2,000	3,750		
2025	1,600			

	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		1,142	0.00225	84	0.00880	583	0.00447	not needed	
2023	use 12 - 24 values		959	0.00349	172	0.00829				
2024	use 12 - 24 values		1,067	0.00252						
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)*

F-13 (020) 2013.Fall Q21 (Solution)

AY	Claims DIsposal Rate (CDR) 12	24	36	48
2022	0.500	0.800	0.900	1.000
2023	0.500	0.800	0.900	
2024	0.400	0.800		
2025	0.250			
last CY	0.250	0.800	0.900	1.000

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

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.

Step 1b restate CPC using CDRs from last CY

This "range" table is just a visual aid

AY	Restated Cumulative Paid Counts (CPC) 12	24	36	48
2025	125	400	450	500
2026	113	360	405	
2027	156	500		
2028	175			

===>

AY	Range Relative to Original Paid Counts 12	24	36	48
2022	0-12	24-36	36-48	48-60
2023	0-12	24-36	36-48	
2024	0-12	24-36		
2025	12-24			

Ex: 125 = 0.25 x 500
Ex: 360 = 0.8 x 450

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

AY	Restated Cumulative Paid Loss (CPL) 12	24	36	48
2022	1,000	2,800	4,340	5,425
2023	1,055	3,360	4,872	
2024	1,248	3,750		
2025	1,600			

AY	Restated Cumulative Paid Loss (CPL) 12	24	36	48
2022	1,513	2,838	4,358	5,425
2023	1,423	3,401	4,872	
2024	1,581	3,750		
2025	1,600			

Exs:

1,000 = (125-0)/(250-0)x(2000-0)+0
3,360 = (360-360)/(405-360)x(4872-3360)+3360
4,340 = (450-450)/(500-450)x(5425-4340)+4340

1,513 = 1142 x EXP(0.00225 x 125)
3,401 = 172 x EXP(0.00829 x 360)
4,358 = 583 x EXP(0.00447 x 450)

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

LDFs

AY	12-24	24-36	36-48	48-ult
2022	2.800	1.550	1.250	
2023	3.185	1.450		
2024	3.005			*tail*
2025				*factor:*
selected	2.997	1.500	1.250	1.000

or...

AY	12-24	24-36	36-48	48-ult
2022	1.876	1.536	1.245	
2023	2.390	1.433		
2024	2.372			*tail*
2025				*factor:*
selected	2.213	1.485	1.245	1.000

CDFs

	12-24	24-36	36-48	48-ult
age -> ult	5.619	1.875	1.250	1.000

	12-24	24-36	36-48	48-ult
age -> ult	4.089	1.848	1.245	1.000

Ults.

	'25@12	'24@24	'23@36	'22@48
diagonal	1,600	3,750	4,872	5,425
ultimate	8,990	7,031	6,090	5,425

	'25@12	'24@24	'23@36	'22@48
diagonal	1,600	3,750	4,872	5,425
ultimate	6,543	6,931	6,066	5,425

Step 3b ultimate for AY 2025 = 8,990 *<-- estimate based on LINEAR INTERPOLATION*
ultimate for AY 2025 = 6,543 *<-- estimate based on EXPONENTIAL REGRESSION INTERPOLATION*

Step 3c The estimate of ultimate using exponential regression differs from the estimate using liner interpolation by: -27.22%
(Step 3c was just for fun to see if there is any real difference between linear and exponential interpolation.)