OVERVIEW

In certain scenarios smoothing can result in a more stable reserve estimate, such as age-to-age factor triangles where there is an erratic development pattern. Smoothing is also useful when applied where data is limited or unreliable.

In any of your Arius exhibits you can apply smoothing using a *linear* or an *exponential* smoothing algorithm. Either smoothing algorithm can be applied to triangles at the top of your exhibits or to the Default row on exhibits with **Selected** rows.

HOW TO APPLY SMOOTHING

Note that smoothing can be applied to any type of exhibit (e.g., development, ratio, average, other).

- 1. In your exhibit select two or more contiguous factors on a row in the calculated triangle or in the Default row.
 - Note that the Default row tail factor/final cell cannot be selected for smoothing.
- 2. Right-click on these factors and choose Smoothing, then choose Smooth Linear or Smooth Exponential.
 - If your selection includes the final cell of the Default row, less than 2 factors, or cells that are not from the calculated triangle or Default row, then these choices will appear greyed-out and will be unavailable.
- 3. Purple borders are displayed around the set of smoothed factors.
 - When smoothing factors in the exhibit's triangle, these smoothed factors are used in the calculation of applicable statistics rows on the exhibit.
 - When smoothing factors in the Default row, these factors will become your Selected factors (unless an over-riding factor is entered into the Manual Selected row).

Example 1: Linear smoothing - applied to age-to-age factors

	PP AutoLiab > Exhibits > Incurred Loss Development - X												
	🗴 🖹 🕐 🖎 📰 🖉 🖉 🔚 🛣												
	Incurred Loss Development										-		
	Accident												
-	Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	120-Ult		
	2011	1.6633	1.2568	1.1558	1.0627	1.0348	1.0196	0.9987	0.9996	0.9998			
	2012	1.7333	1.1980	1.1194	1.0566	1.0426	1.0038	Se	t as Defaul	t			
	2013	1.7892	1.1839	1.1781	1.0822	1.0192	1.0091		Remove as Default				
	2014	1.8929	1.2366	1.1358	1.0147	1.0375	1.0198	Re					
	2015	2.0762	1.1624	1.1152	1.0731	1.0348	Co	Copy Value To Manual Selected					
	2016	1.5963	1.2274	1.1435	1.0556			Exc	Exclude Factor(s) from Statistics				
	2017	1.5922	1.2225	1.1209				Inc	lude Facto	r(s) in Stat	stics		
	2018	1.8060	1.2026	S	mooth Lir	near	N	Sm	oothing				
	2019	1.8130			month Ev			Ch.	au Earmul	-			
	2020			Smooth Exponential				Sh	ow Formul	a			
	2020			Remove Smoothing				So	urce Data				
	Malura Mainhead Augus	1 7505	1 21/2	1 1 4 1 6	1.0505	1 0 2 2 0	1 0122	Ed	it Cell Note	2			
1	volume weighted Average	1./292	1.2 42	1.1410	1.0090	1.0338	1.0133						

Results:

Incurred Loss Development										-
Accident										
Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	120-Ult
2011	1.6633	1.2568	1.1558	1.0627	1.0348	1.0044	1.0044	1.0044	1.0044	
2012	1.7333	1.1980	1.1194	1.0566	1.0426	1.0038	1.0001	1.0002		
2013	1.7892	1.1839	1.1781	1.0822	1.0192	1.0091	1.0281			
2014	1.8929	1.2366	1.1358	1.0147	1.0375	1.0198				

	Sample P&C Industry - Oth_Liab_Occ	1.7315	1.3212	1.1739	1.1009	1.0568	1.0372	1.0274	1.0179	1.0136	1.0804	
	Inverse Power Curve	2.3413	1.4412	1.2302	1.1451	1.1014	1.0757	1.0591	1.0477	1.0395	1.2193	
	Exponential Curve	1.7718	1.4967	1.3197	1.2058	1.1324	1.0852	1.0548	1.0353	1.0227	1.0412	
	Weibull Curve	2.0158	1.4754	1.2802	1.1819	1.1246	1.0884	1.0642	1.0475	1.0357	1.1170	
	Default	1.6972	1.6987	1.4853	1.1721	1.1495	1.0660	1.0128	1.0000	1.0688	1.0412	
	Manual Selected							Set a	as Default			
								Rem	ove as De	fault		
	Selected	1.6972	1.6987	1.4853	1.1721	1.1495	1.0660					
	Cumulative	6.9324	4.0846	2.4045	1.6189	1.3812	1.2015	Cop	y Value To	Manual S	elected	
	Ratio to Ultimate	0.1443	0.2448	0.4159	0.6177	0.7240	0.8323	Exclu	ude Factor	r(s) from Si	tatistics	
								Include Factor(s) in Statistics				
				Smooth Linear				Smoothing				•
				Sr	mooth Exp	onential		Show Formula				
	Poculto			Re	Remove Smoothing				Source Data			
results.												
	Weibull Curve	2.0158	1.4754	1.2802	1.1819	1.1246	1.0884	1.0642	1.0475	1.0357	1.1170	
	Default	1.6972	1.6987	1.4853	1.1721	1.1495	1.0590	1.0439	1.0291	1.0144	1.0412	
	Manual Selected											
	Selected	1.6972	1.6987	1.4853	1.1721	1.1495	1.0590	1.0439	1.0291	1.0144	1.0412	

Example 2: Exponential smoothing - applied to Default row factors

HOW TO REMOVE SMOOTHING

To remove smoothing from your factors, right-click on any factor in the set of smoothed factors within the purple border and choose **Remove Smoothing**. This will remove all smoothing from the set of contiguous smoothed factors and remove the purple border.

NOTE: If the structure of your file is modified to remove exposure and/or development periods, resulting in the removal of a factor or factors which were included in a contiguous set of smoothed factors, then smoothing is removed from the entire group of contiguous factors in the set.

THE ALGORITHMS

Linear Smoothing

- X = Product of highlighted factors = 1.0196 x .9987 x .9996 x .9998 = 1.0177
- N = Number of highlighted factors = 4
- Z = Replacement factors = X ^ (1/N) = 1.0044

Exponential Smoothing

- X = Product of highlighted factors = 1.0660 x 1.0128 x 1.000 x 1.0688 = 1.1539
- N = Number of highlighted factors = 4
- M = Number of Interpolation Units = $N \times (N+1)/2 = 10$
- $Z_N = X^{(1/M)} = 1.0144$
- Z_M = Z_N x Z_M+1 (M from 1 to N-1) = 1.0590 1.0439 1.0291 1.0144

These algorithms can also be understood as follows:

Let LDF_i represent the empirical (incremental) LDFs, and let LDF_i^S represent the smoothed (incremental) LDF for development period *i*. Suppose you want to smooth development periods *i* through i + n.

Linear Smoothing:

$$X = \prod_{i=i}^{n} LDF_i$$
; $LDF_i^s = X^{\frac{1}{n}}$

Exponential Smoothing:

$$X = \prod_{j=i}^{n} LDF_{j}; \ M = n \times \frac{n+1}{2}; \ LDF_{i+n}^{s} = X^{\frac{1}{M}}; \ LDF_{i+n-1}^{s} = LDF_{i+n}^{s} * X^{\frac{1}{M}}$$

For all development periods k outside of i to i + n, $LDF_i^s = LDF_i$.

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