Interpolation Hack and Their Efficacy

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CAS Annual Meeting

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Overview of Discussion

- Formulae Not Fun
- Polling Questions
- So read the paper
- Use the spreadsheet!

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Purpose of Paper

- I observed documentation standards could possibly be more rigid
  - In reviewing many third party reviews method if not often disclosed
- I noticed a tendency for staff to use black boxes in reserving software
- Wanted to ask the questions – how much does it matter? How careful should we be?
- Ultimately I believe we should know what we are using and why even when it may not be material
  - Gives us credibility
  - Makes it easier for other actuaries to review work
  - Makes it easier for younger actuaries to understand reasons

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Purpose of Paper

- Paper can be used as a guide for new actuaries and a reference for all actuaries
- Method of testing in the paper is a basis on which to make informed decisions based on knowledge of the book of business and claims department
  - Does not give a method as “the perfect method”

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Polling Question 1

- Which Method do you use?
  - Linear
  - Curve Fit or regression
  - Shortcut formula
  - Software
  - None of the above

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Polling Question 2

- How important is it to you?
  - I try and use the “right” method because it can impact results
  - I use anything I can say is generally accepted
  - It never comes up
  - I use software and I am unaware exactly how it works
  - It’s immaterial to me

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Polling Question 3

- How often do you need to interpolate?
  - Doesn't come up I have quarterly data
  - I use it in main analysis
  - I use it to "roll forward" results only
  - I use it predominantly for AVE Analyses
  - I use it all the time

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Polling Question 4

- How do you document
  - "Based on pattern in Exhibit . . ." No further explanation
  - "Interpolated 3 months based on pattern in Exhibit . . ."
  - I show formulae
  - I don't say anything because other actuaries know
  - Documentation not an issue in my job

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What I did

- Used Methods I knew for interpolation
  1. Linear
  2. Inverse Power Curves using cumulative and remaining development
  3. Weibull
  4. Exponential Curves using cumulative and remaining development
  5. Two shortcuts that have been passed on to me
     1. Logarithmic Proportions
     2. Exponential Weighted

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What I did

- Used Methods I knew for Extrapolation
  1. Linear
  2. Three shortcuts that have been passed on to me
     1. The Plus 12 Method
     2. The Power Ratio Method
     3. The Natural Log Method

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What I did

- Used Quarterly data with the following groupings:
  - Short Tailed
  - Medium Tailed
  - Long Tailed
  - Very Long Tailed

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What I did

- Short Tailed
  - Incurred development factor at 12 months was not greater than 2.0.
  - Primarily various types of personal auto business
  - Average incurred loss development factor at 12 months was roughly 1.09
  - Typical development dropped off at about 84 months
  - The average paid loss development factor at 12 months was approximately 1.5

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What I did

- Medium Tailed
  - Average 12 month incurred development factor of approximately 7.00
  - Average paid development factor of approximately 25.00
  - Consists primarily of claims made liability
  - The pattern becomes negligible after 96 months.

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What I did

- Long Tailed
  - Average 12 month incurred development factor of approximately 15.00
  - Paid data was unavailable
  - The pattern has a tail of 1% at 126 months
  - Mainly comprised of high layer property lines.

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What I did

- Very Long Tailed
  - Average 12 month incurred development factor greater than 20.00
  - Average paid development factor nearing 90.00
  - Age to age paid factors are around 3% at 120 months
  - This data set is mainly comprised of casualty lines.

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What I did

- Tested
  - Accuracy of both interpolation and extrapolation methods vs actual quarterly data
    - Tested variety of Targets 3, 6, 9 months away
    - Tested extrapolations from different points as well.
  - Tested for mitigation of impact using exposure based methods
    - More recent year with high development factors would be less impacted by errors in LDF when using a BF or cape cod.
  - Also added a method I used recently to model seasonal effects at company

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Main Objective

- Data limited obviously not exhaustive
- Objective was not to find a catch all method but to demonstrate which methods are right at different times
- Practitioner must determine which is appropriate
- Not so much about accuracy as transparency

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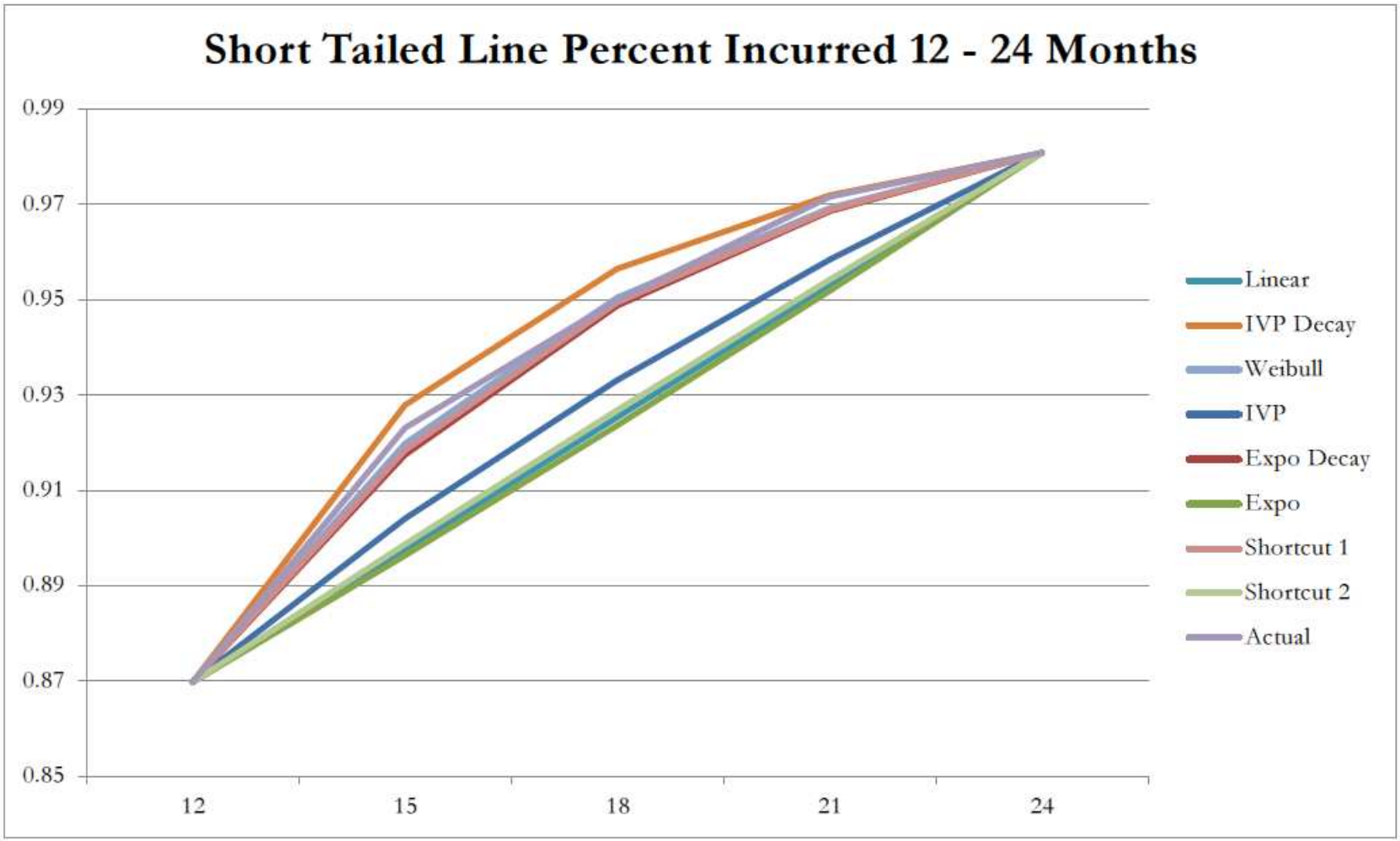
Interpolation Testing

Ages	12	24	36	48	60	72
	12 - 24	24 - 36	36 - 48	48-60	60-72	72-84
Selected Result	1.500	1.200	1.050	1.025	1.020	1.010
FacToUlt	1.996	1.331	1.109	1.056	1.030	1.010
Percent of Ult	50.11%	75.16%	90.19%	94.70%	97.07%	99.01%
Interim Ages		15	27	39	51	63
Linear		1.774	1.267	1.095	1.049	1.025
IVP Decay		1.698	1.239	1.090	1.047	1.022
Weibull		1.722	1.248	1.092	1.048	1.023
IVP		1.752	1.262	1.094	1.049	1.025
Expo Decay		1.756	1.250	1.092	1.048	1.023
Expo		1.803	1.271	1.095	1.049	1.025
Logarithimic Proportions Shortcut 1		1.740	1.248	1.092	1.048	1.023
Exponential Weighting Shortcut 2		1.755	1.264	1.095	1.049	1.025

Interpolation Testing



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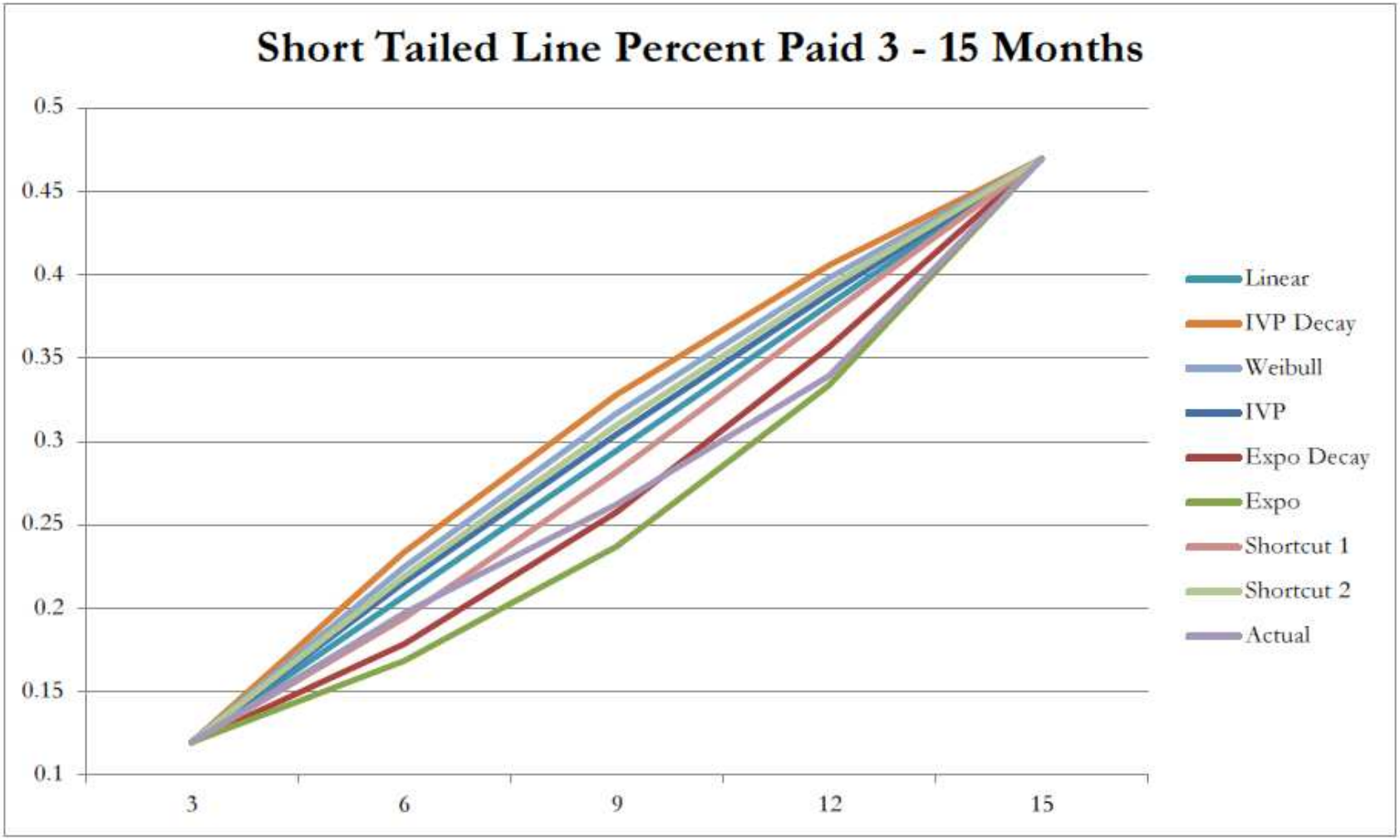

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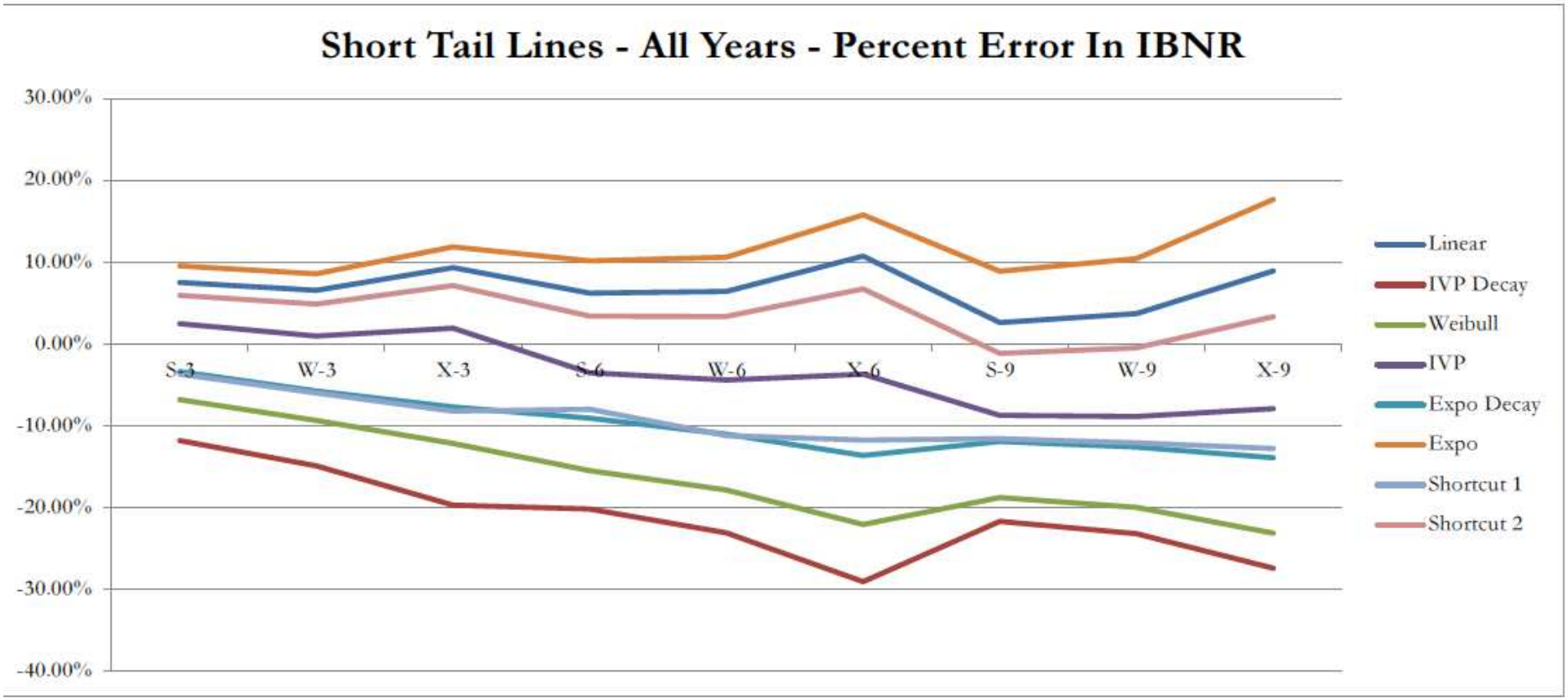

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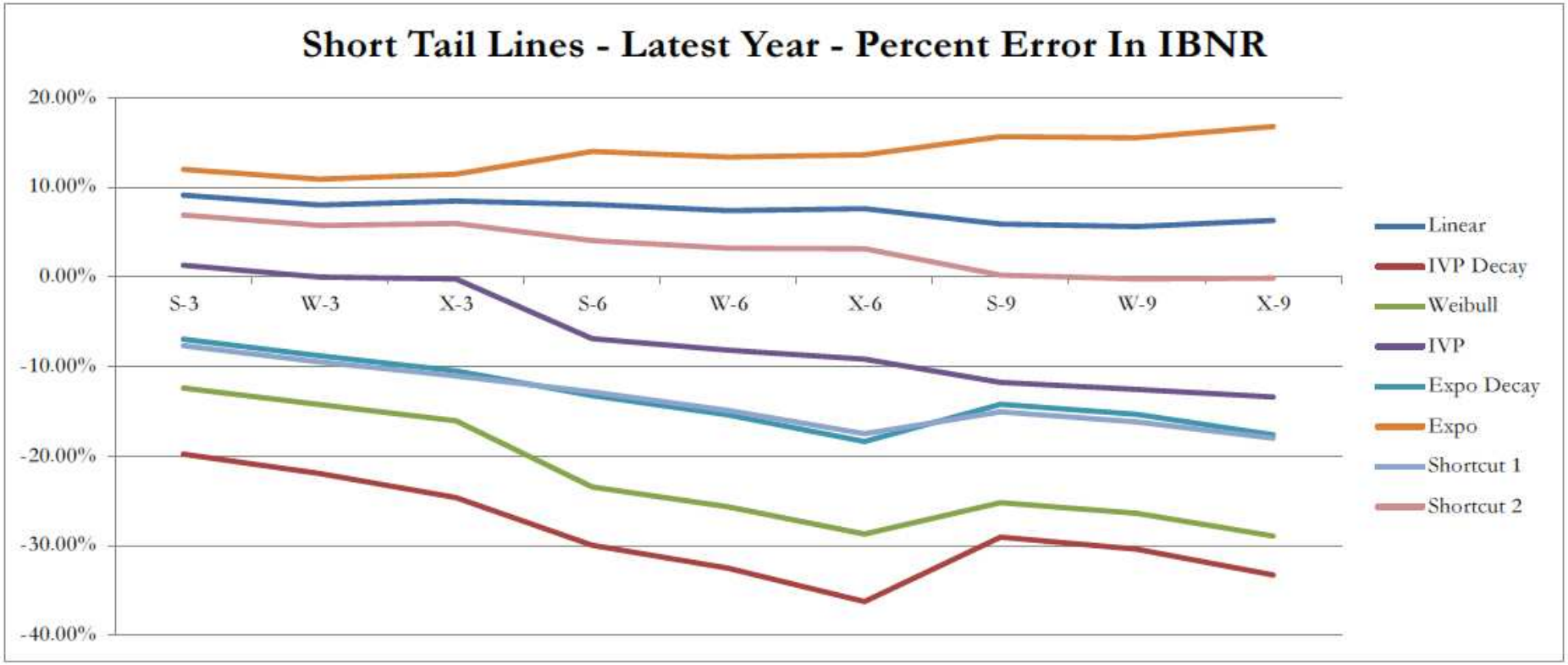

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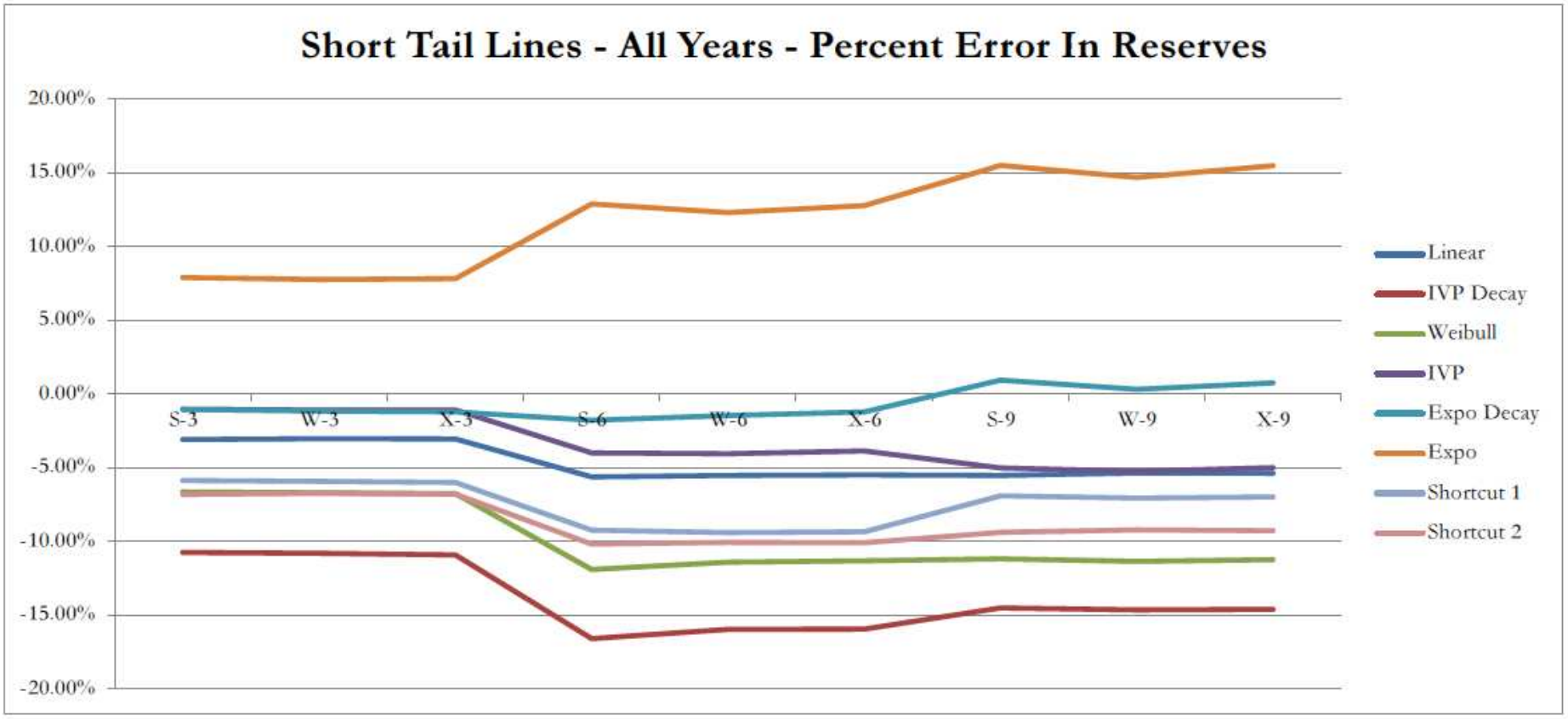

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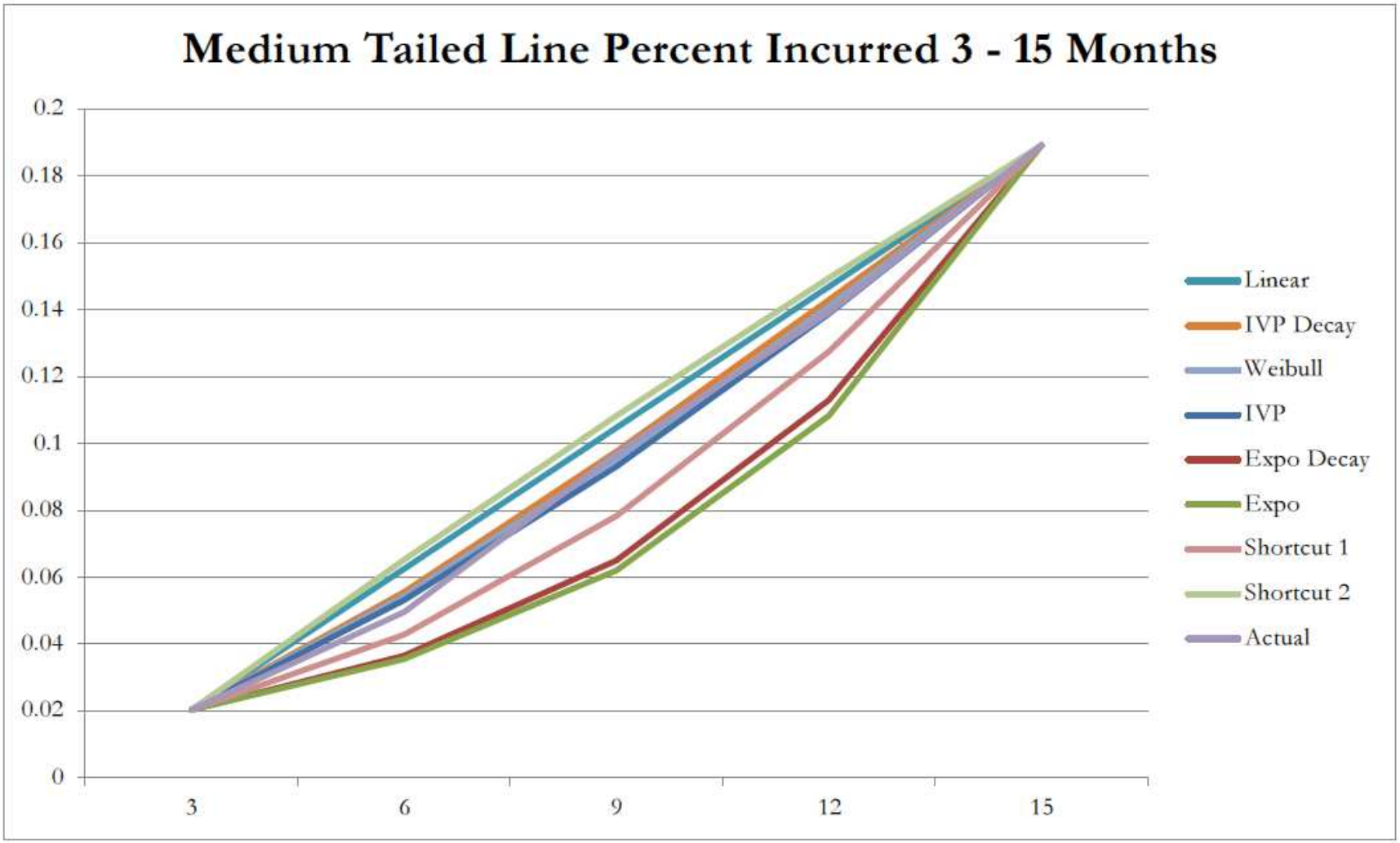

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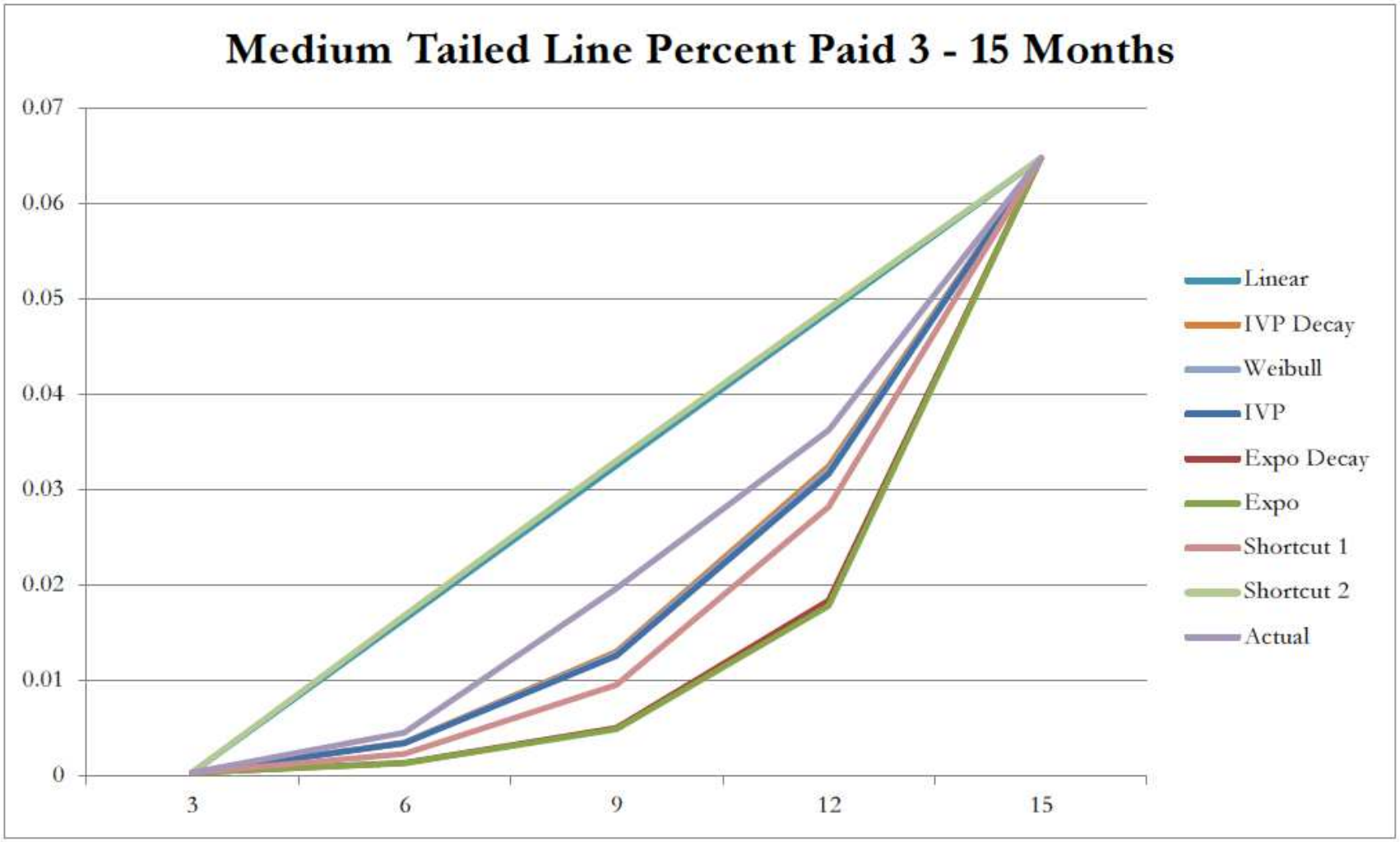

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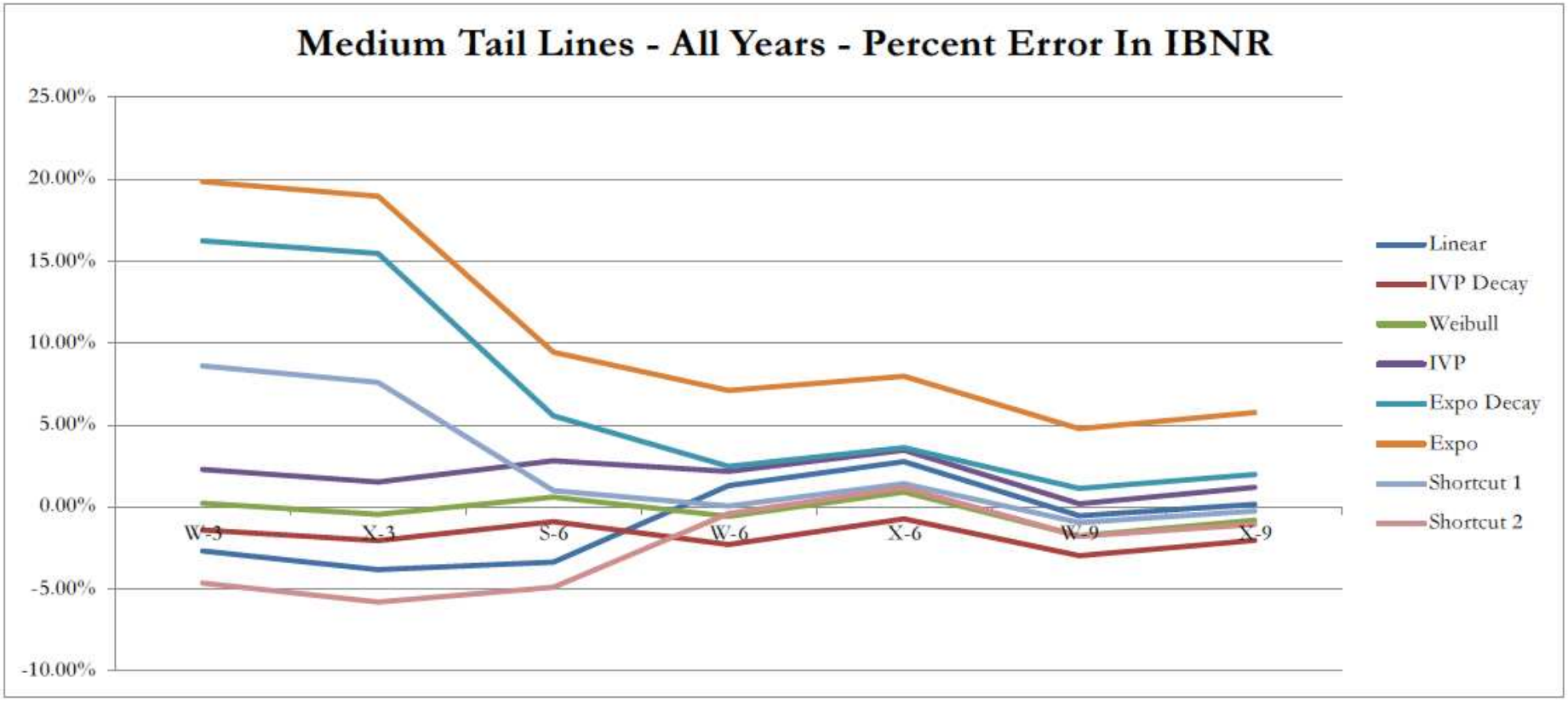

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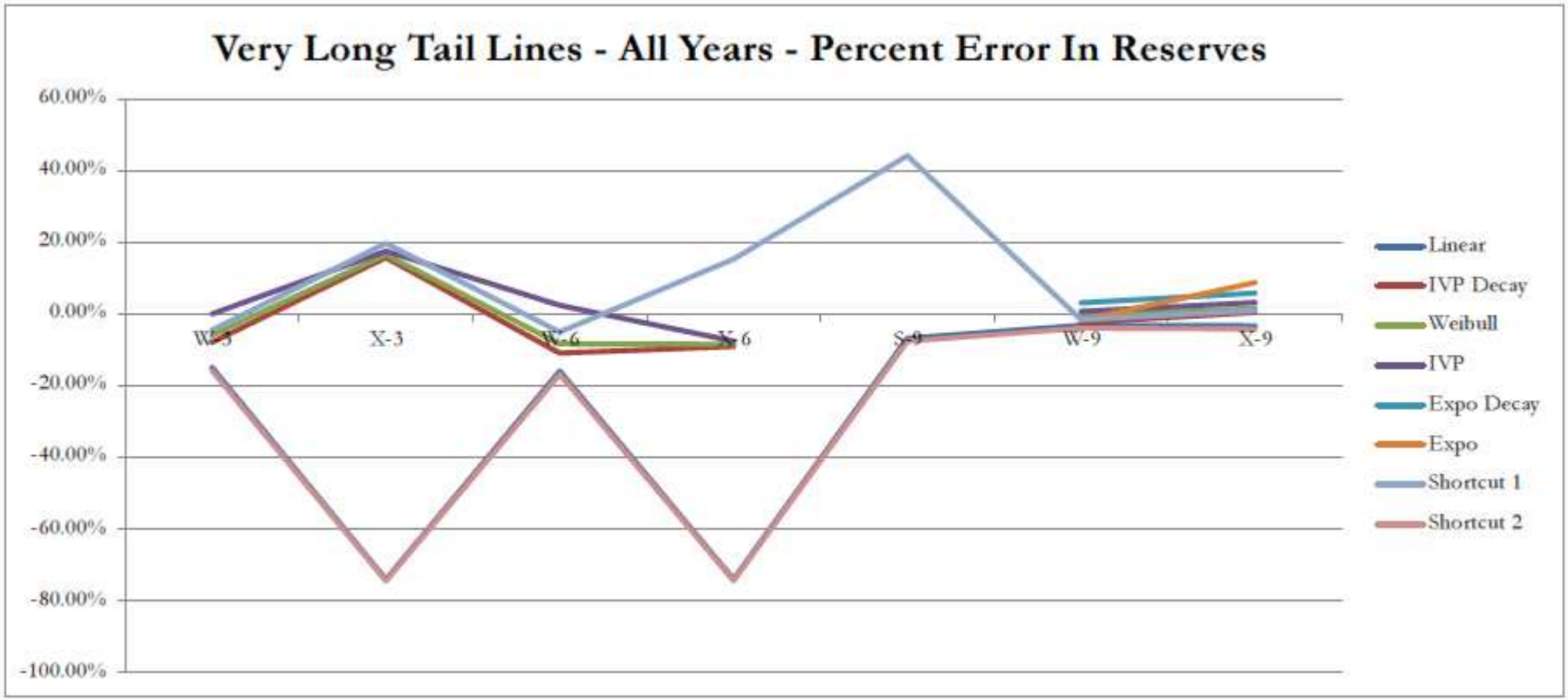

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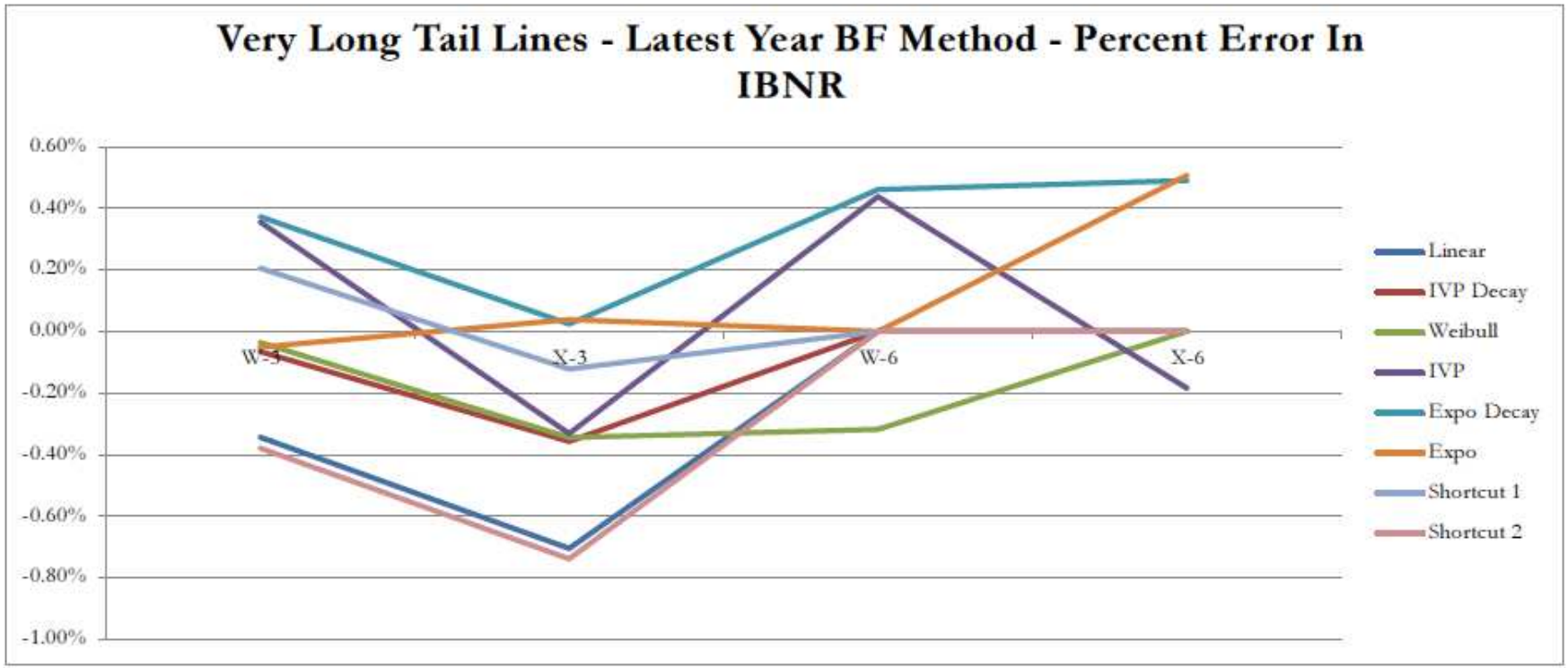

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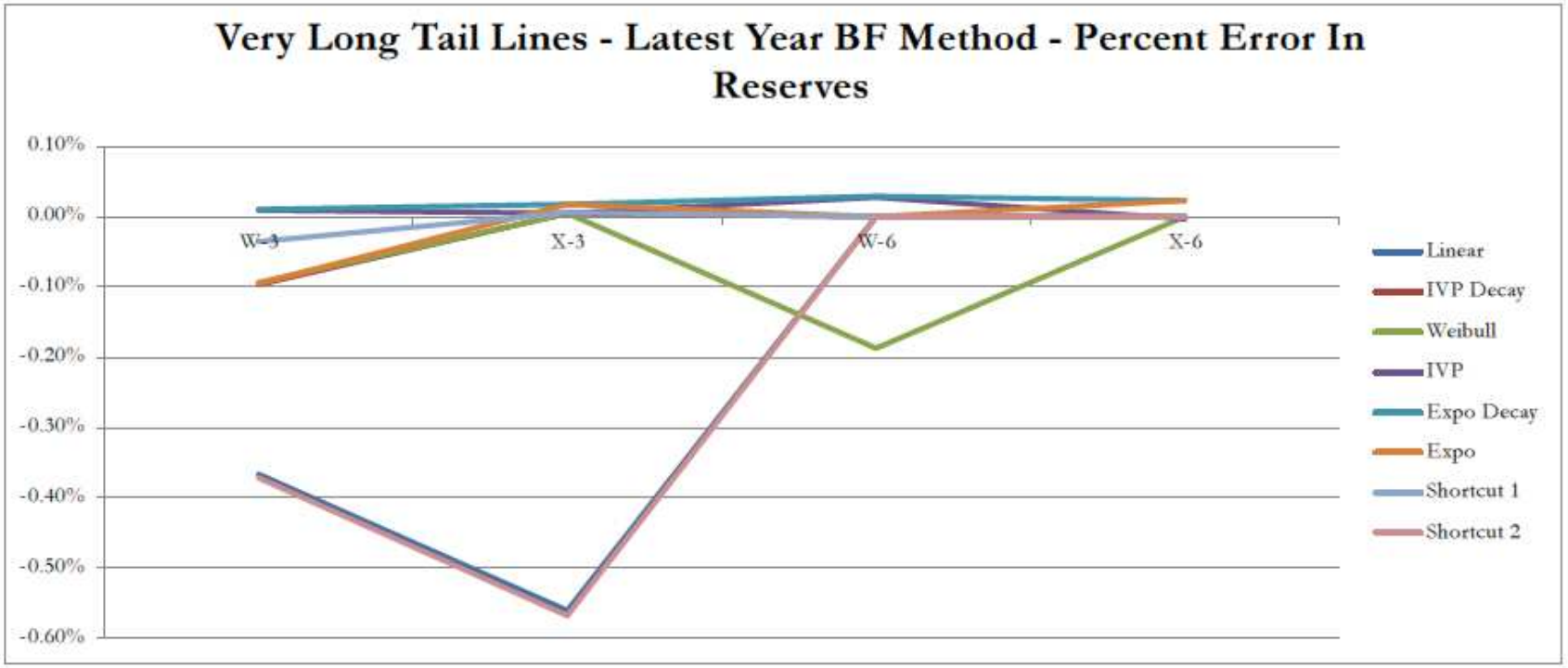

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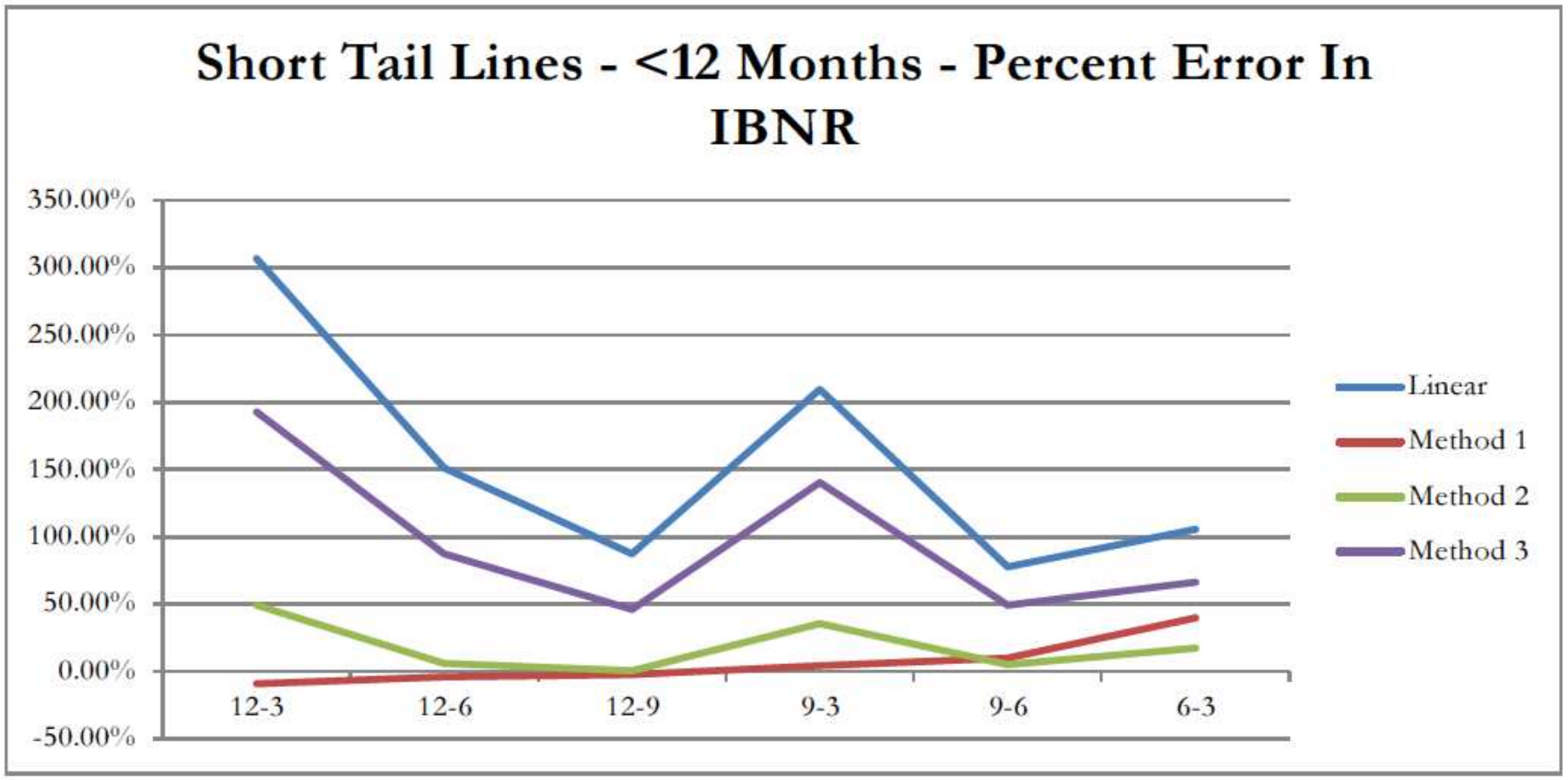
Extrapolation Testing



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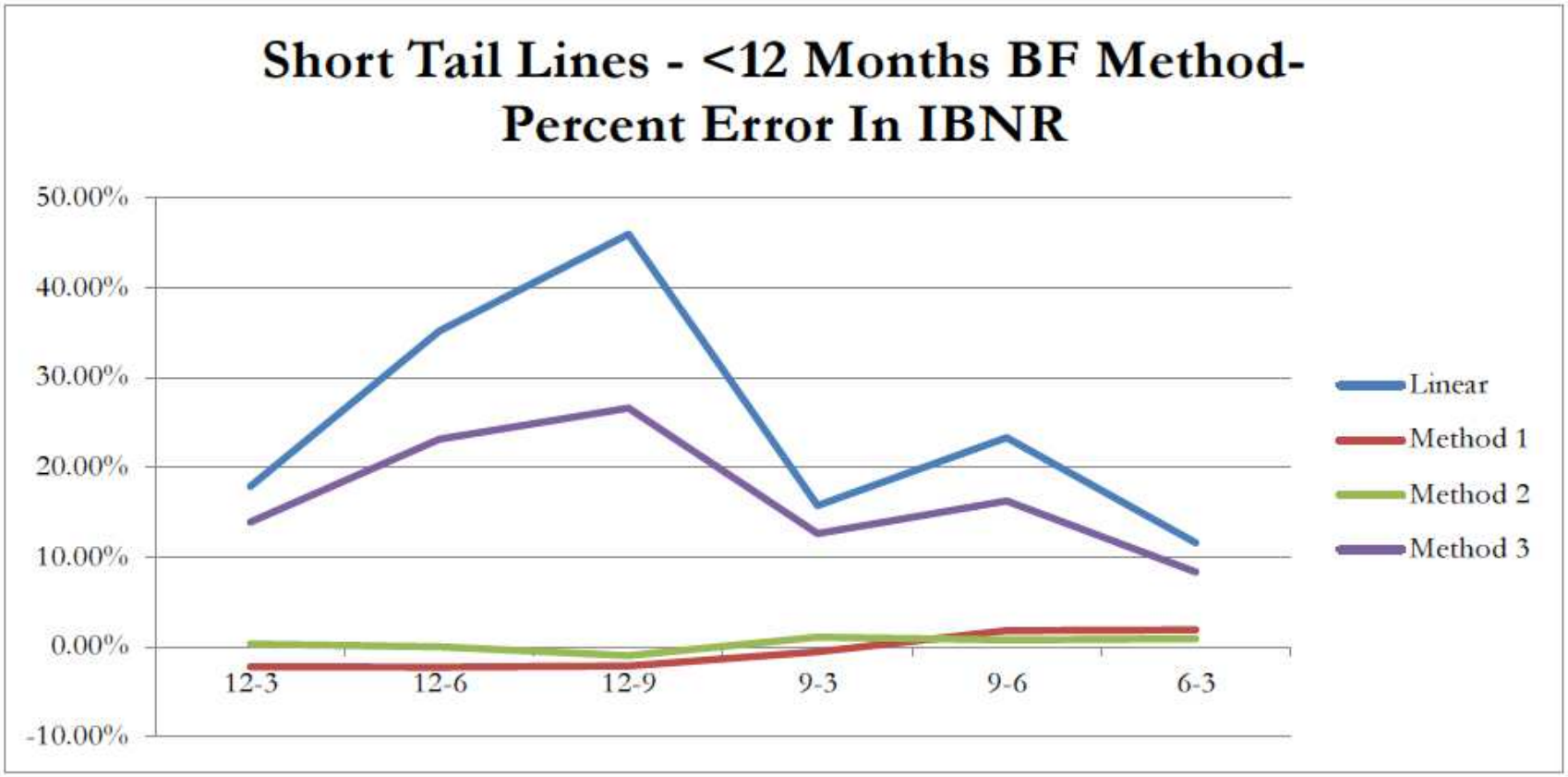

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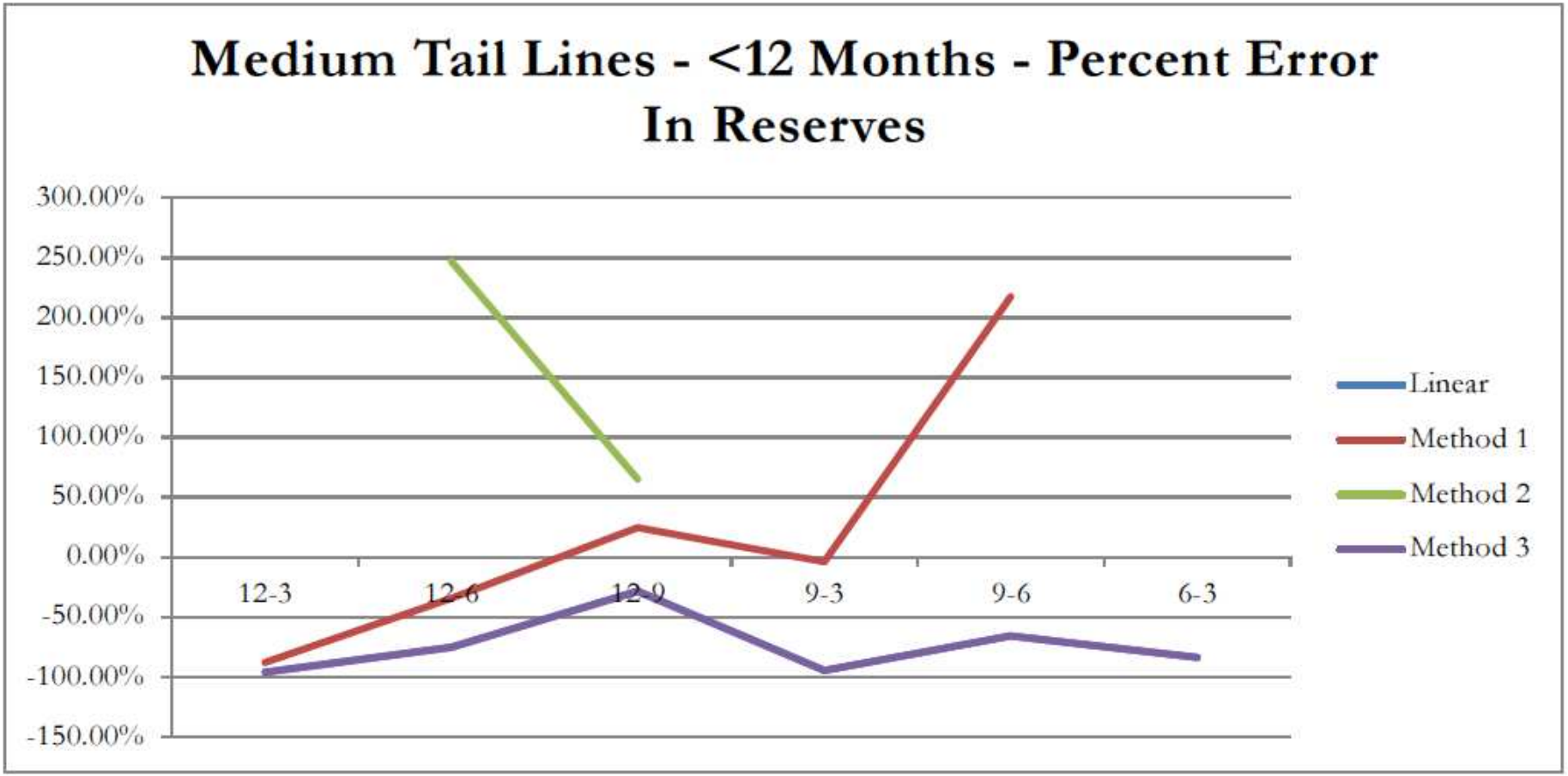

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Testing Conclusions - Interpolation

- Sophisticated methods don't seem to provide much advantage over simple shortcuts.
- For short tailed lines or lines with development factors less than 2.00 at 12 months, Shortcut 2 seems to perform relatively well
- Shortcut 1 seems to perform better on paid data or once development is greater than 2.00
- Shortcut 1 also seems to perform well once the second year of development is reached.
- Exponential curves seem to regularly overstate reserves by large amounts.
- Weighted average development factors also seem to work much better and are not prone to unusual swings which may distort interpolation methods.

Testing Conclusions - Extrapolation

- Extrapolated values, especially for long tailed lines, are predictability overstated and distorted
- However the BF method seems to mitigate this risk almost entirely.
- Extrapolation Methods 1 and 2 seem to perform the best without understating reserves on shorter tailed lines
- Method 3 performs well on longer tailed lines

Seasonal Method

- Suppose a company has unusually high payments during the fourth quarter
- Assume they estimate these payments are 50% higher than they would be otherwise
- Alternative assumptions possible (payments are 50% higher than other quarters)

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Seasonal Method

(a) 4th quarter increase factor	**50%**

Percent of Year Paid in					Restated Percent			
3Q2014	4Q 2014	1Q 2015	2Q 2015	Total	3Q2014	4Q 2014	1Q 2015	2Q 2015
(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
36.0%	27.4%	20.8%	15.8%	100.0%	31.7%	36.1%	18.3%	13.9%
34.7%	27.2%	21.3%	16.7%	100.0%	28.2%	40.8%	17.3%	13.6%
32.9%	27.0%	22.1%	18.1%	100.0%	26.8%	40.4%	18.0%	14.7%
32.1%	26.8%	22.4%	18.7%	100.0%	26.2%	40.2%	18.3%	15.2%
29.6%	26.3%	23.3%	20.7%	100.0%	24.3%	39.5%	19.2%	17.0%
29.4%	26.3%	23.4%	20.9%	100.0%	24.2%	39.4%	19.3%	17.2%
29.4%	26.3%	23.4%	20.8%	100.0%	24.2%	39.4%	19.2%	17.1%
28.7%	26.1%	23.7%	21.5%	100.0%	23.6%	39.2%	19.5%	17.7%
29.4%	26.7%	23.6%	20.3%	100.0%	24.1%	40.0%	19.3%	16.6%
25.3%	25.2%	24.9%	24.5%	100.0%	21.1%	37.9%	20.7%	20.4%

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Questions??