



LDF CURVE-FITTING AND STOCHASTIC RESERVING

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Agenda

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- 1. The Method: A Brief Overview
 - 2. Advantages/Disadvantages of the Model
 - 3. Example (Excel File)
 - 4. Appendix

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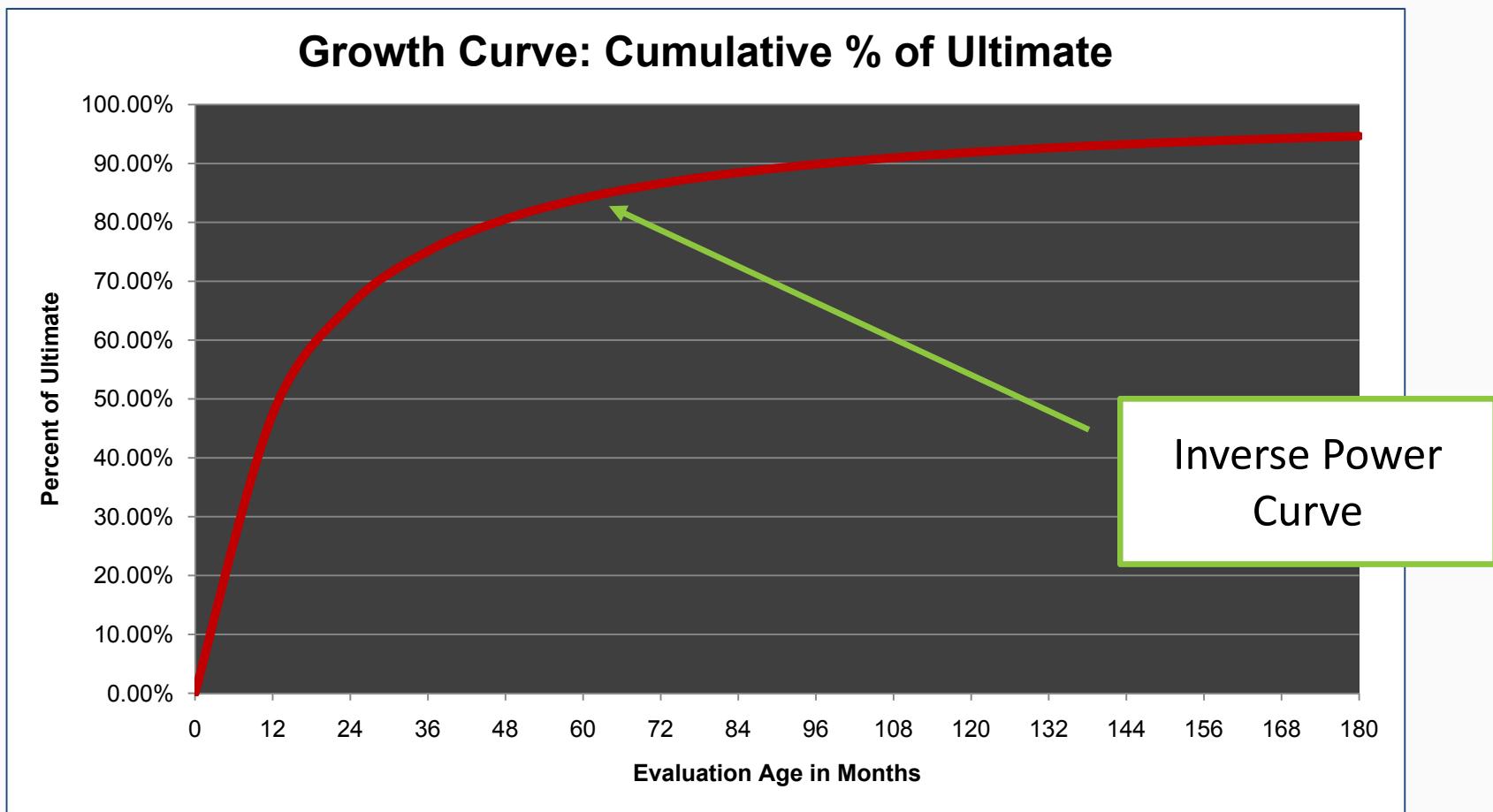
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The **goals** of the model are as follows:

1. Describe loss emergence in a mathematical model to assist in estimating needed reserves
2. Calculate the variability around the estimated reserves
3. Estimate tail factor



The model utilizes the **Inverse Power Curve**.



The **Model Game Plan** is as follows:

1. Convert loss development triangle to an incremental basis

The Model Game Plan is as follows:

2. For each “cell” of the triangle, we have

$c_{i,t}$ = actual loss for AY i , between ages t and $t-1$

$\mu_{i,t}$ = expected loss for AY i , between ages t and $t-1$



The Model Game Plan is as follows:

2. For each “cell” of the triangle, we have

	Actual			
AY	12	24	36	48
2006	$c_{2006,12}$	$c_{2006,24}$	$c_{2006,36}$	$c_{2006,48}$
2007	$c_{2007,12}$	$c_{2007,24}$	$c_{2007,36}$	
2008	$c_{2008,12}$	$c_{2008,24}$		
2009	$c_{2009,12}$			

	Expected			
AY	12	24	36	48
2006	$\mu_{2006,12}$	$\mu_{2006,24}$	$\mu_{2006,36}$	$\mu_{2006,48}$
2007	$\mu_{2007,12}$	$\mu_{2007,24}$	$\mu_{2007,36}$	
2008	$\mu_{2008,12}$	$\mu_{2008,24}$		
2009	$\mu_{2009,12}$			

The Model Game Plan is as follows:

3. These $\mu_{i,t}$ are treated as the mean of a distribution.

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How do we estimate these $\mu_{i,t}$?

- Cape Cod Method

Requires exposure base (more information → more accurate)

Number of Parameters: 3

The Model Game Plan is as follows:

3. These $\mu_{i,t}$ are treated as the mean of a distribution.

How do we estimate these $\mu_{i,t}$?

- LDF Method

Each AY reserve is estimated independently

Number of Parameters: $n + 2$

The Model Game Plan is as follows:

4. Parameters are estimated via Maximum Likelihood Estimation (MLE)

- *The distribution for each cell uses an Overdispersed-Poisson*
- *The Cape Cod and LDF method are exact MLE results*

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The use of a continuous curve gives this model some **advantages**:

1. Smoothing of Development Pattern
2. Interpolation & Extrapolation
3. Handle irregular evaluation dates
(e.g., latest diagonal less than 12 months from penultimate diagonal)
4. Avoid OverParameterization

The use of a continuous curve gives this model some **disadvantages**:

1. Need curve-fitting engine
(answers not in “real time”)
2. Less precise estimate of parameter variance
3. May not fit well unless the “right” curve form is used

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Let us look at an example in Excel.

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Parameterization of the Inverse Power Curve

$$G(t|\theta, \omega) = \frac{1}{1 + \left(\frac{\theta}{t}\right)^\omega}$$



Estimating the expected loss in each cell ($\mu_{i,t}$) for Cape Cod

Formulation:

$$\begin{aligned}\mu_{i,t} = & \text{Premium}_i \times ELR \\ & \times [G(t|\theta, \omega) - G(t-1|\theta, \omega)]\end{aligned}$$

Parameters:

- ELR expected loss ratio for all years
- θ “scale” parameter of $G(t)$
- ω “shape” parameter of $G(t)$



Estimating the expected loss in each cell ($\mu_{i,t}$) for **LDF Method**.

Formulation:

$$\mu_{i,t} = \text{Ultimate}_i \times [G(t|\theta, \omega) - G(t-1|\theta, \omega)]$$

Parameters:

Ultimate_i, expected ultimate loss for accident year *i*

θ “scale” parameter of $G(t)$

ω “shape” parameter of $G(t)$



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