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Isn’t it True…?

James Ely, FCAS

2019 CAS Annual Meeting

Question 1

Which of the following is your preferred method of loss reserving?

1. Traditional methods (link ratio, BF etc.)

2. GLMs

3. Other methods

Why Study Other Methods?

We seek new perspectives that can provide clarity where the traditional perspective does not.

This new perspective can help to confirm a “gut feeling” or debunk a common misconception.

Wherever possible, we look for methods that have been proven in other disciplines.

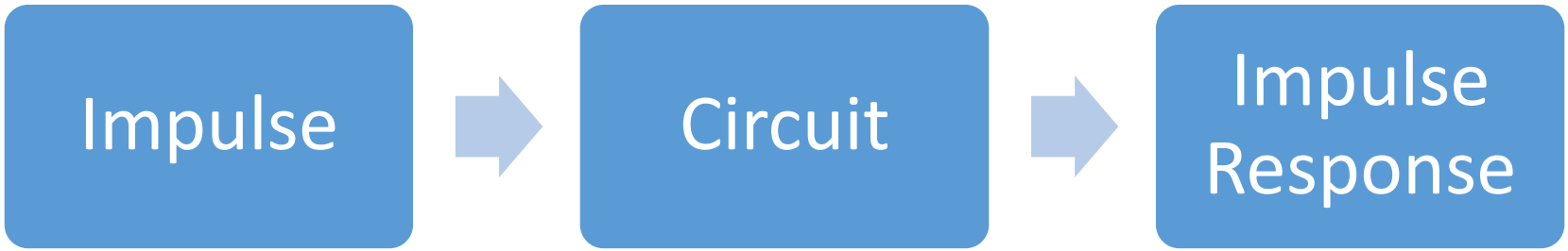
Discrete-Time Signal Processing (DSP)

DSP methods are used in the processing of signals in electronic communications as well as in the testing of electronic circuits.

The basic formulation of the problem has three components:

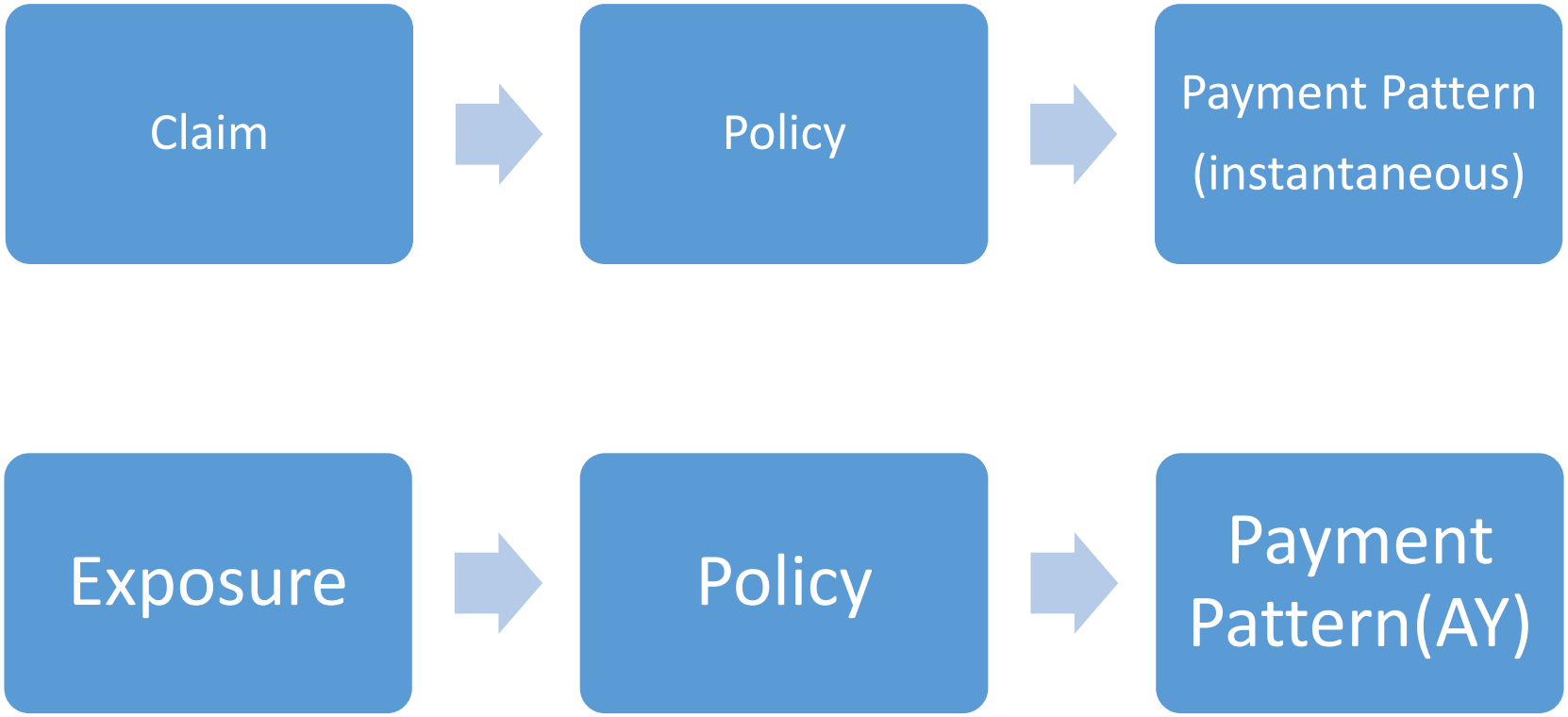
1. A linear system to be tested
2. An impulse is applied to the system
3. The response of the system is recorded

Discrete-Time Signal Processing (DSP)

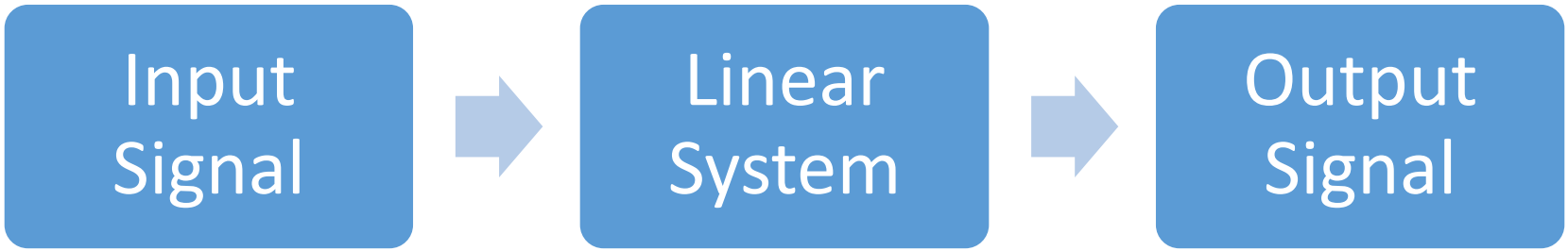


A Simple Circuit

Insurance Analogies



Noiseless DSP System

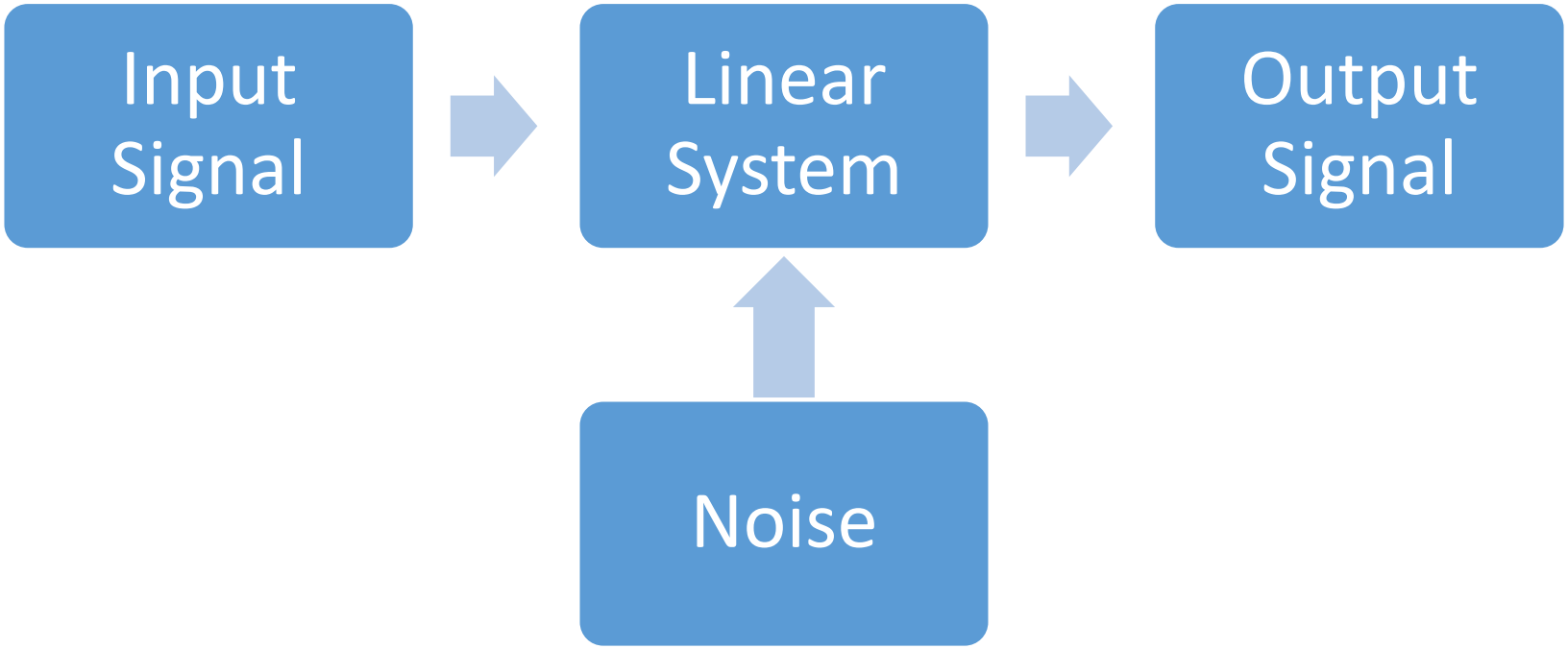


Output Signal of a Noiseless System

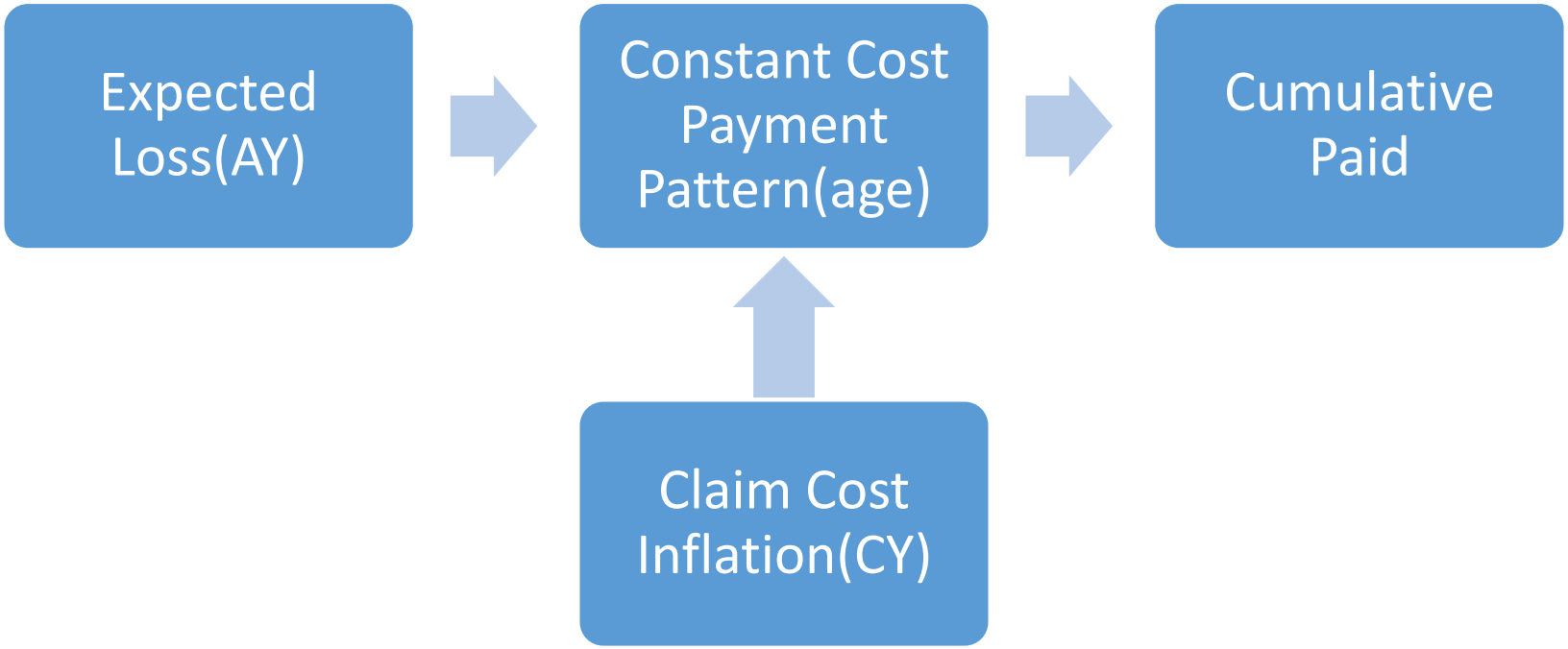
$$Output\ Signal = Input\ Signal * Impulse\ Response$$

$$Paid(CY) = \sum_{AY=0}^{CY} Ultimate\ Loss(AY)\%Paid(CY - AY)$$

DSP System with Noise



Variability of CY Trend is Analogous to the Noise Component



Log-Linear GLM Assumption

Assume that incremental losses display exponential trends in three dimensions:

$$P = Incremental\ Paid(AY, CY, age) = Ae^{xAY+yCY+z(CY-AY)}$$

If we take partial derivatives we find that the GLM assumption satisfies the wave equation:

$$\frac{\partial^2 P}{\partial AY^2} = \frac{(x-z)^2}{(y+z)^2}\frac{\partial^2 P}{\partial CY^2}$$

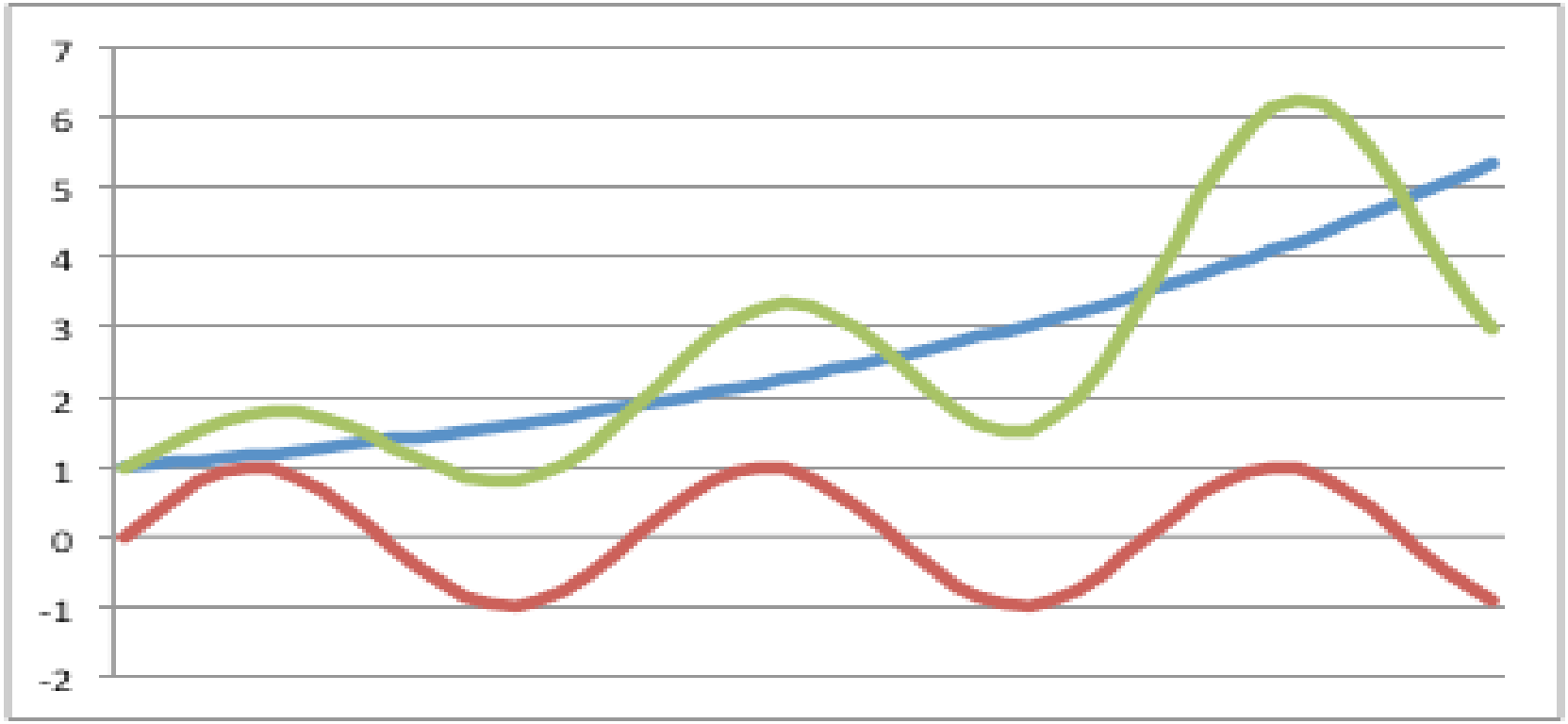
Waves in Loss Reserving?

We don't normally think about waves in loss reserving, but we do talk about reserving cycles.

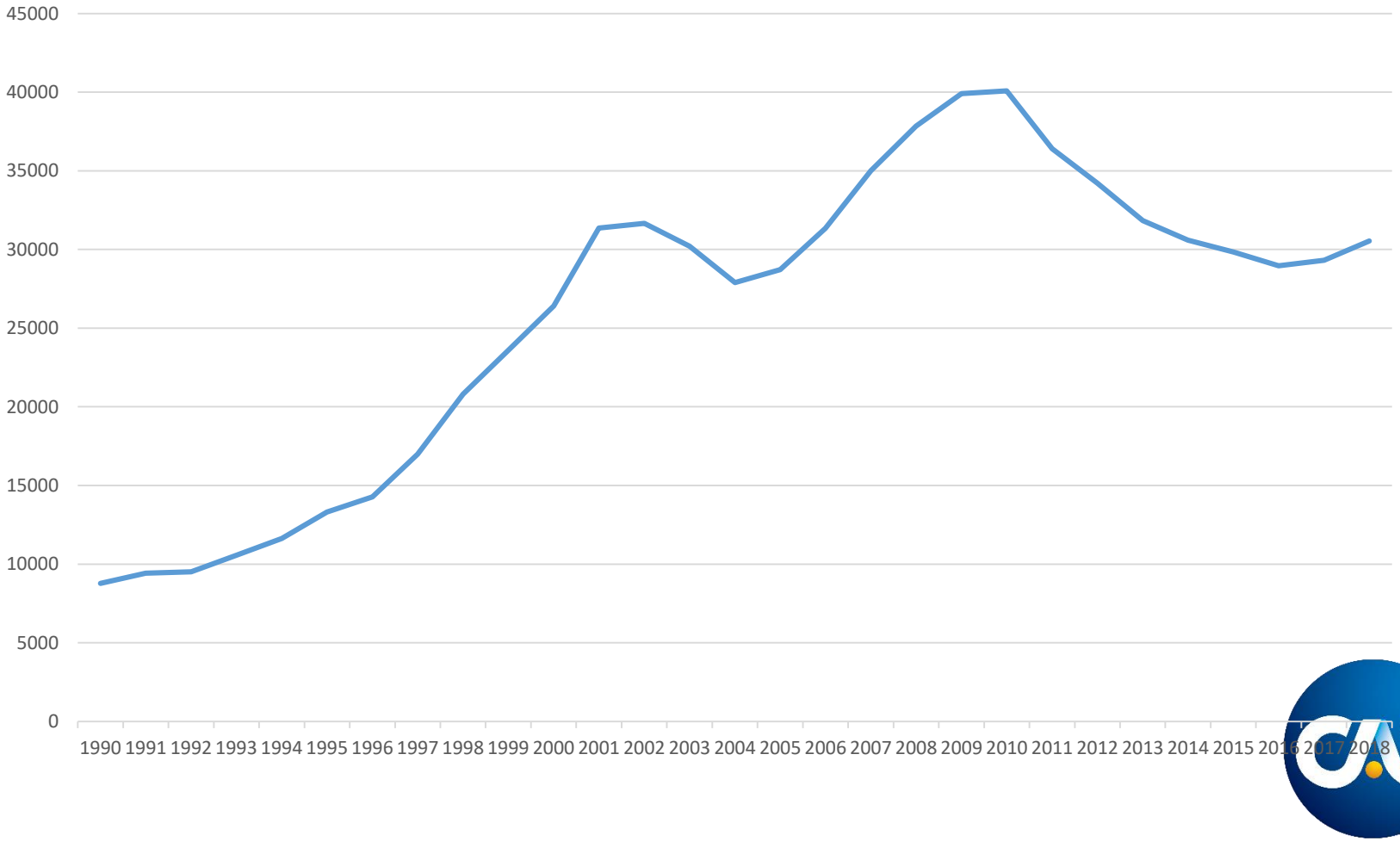
Reserving cycles are caused by variations in loss cost inflation caused by:

- The business cycle.
- Social inflationary cycles of liberalization and reform.

Inflationary Trend-Cycle



WCIRB Medical Severities



Conclusion: Loss reserving is completely analogous to a DSP problem.

1. DSP is like loss reserving in that it produces runoff patterns (including exponential).
2. Loss reserving is like DSP in that patterns combine by convolution.
3. Variations in inflation are analogous to noise.
4. GLM assumptions satisfy the wave equation.

Trends in DSP

Traditional DSP uses transform analysis. But with the advent of cheap, fast computers this has given way in favor of AI. For example see “Convolutional Neural Networks” in image processing.

The analogy for actuarial science is that time series analysis of severities and/or individual claim reserving methods utilizing AI will likely emerge as serious competition to current methods.

Question 2

Is the BF method deterministic or stochastic?

a. Deterministic

b. Stochastic

Bornhuetter-Ferguson Method

$$IBNR(CY) = \sum_{AY=0}^{CY} Expected\ Loss(AY)\ \%Unreported(CY - AY)$$

The BF method is a convolution equation.

It fits the DSP model.

Incurred BF Method

Noisy Components

Error Terms

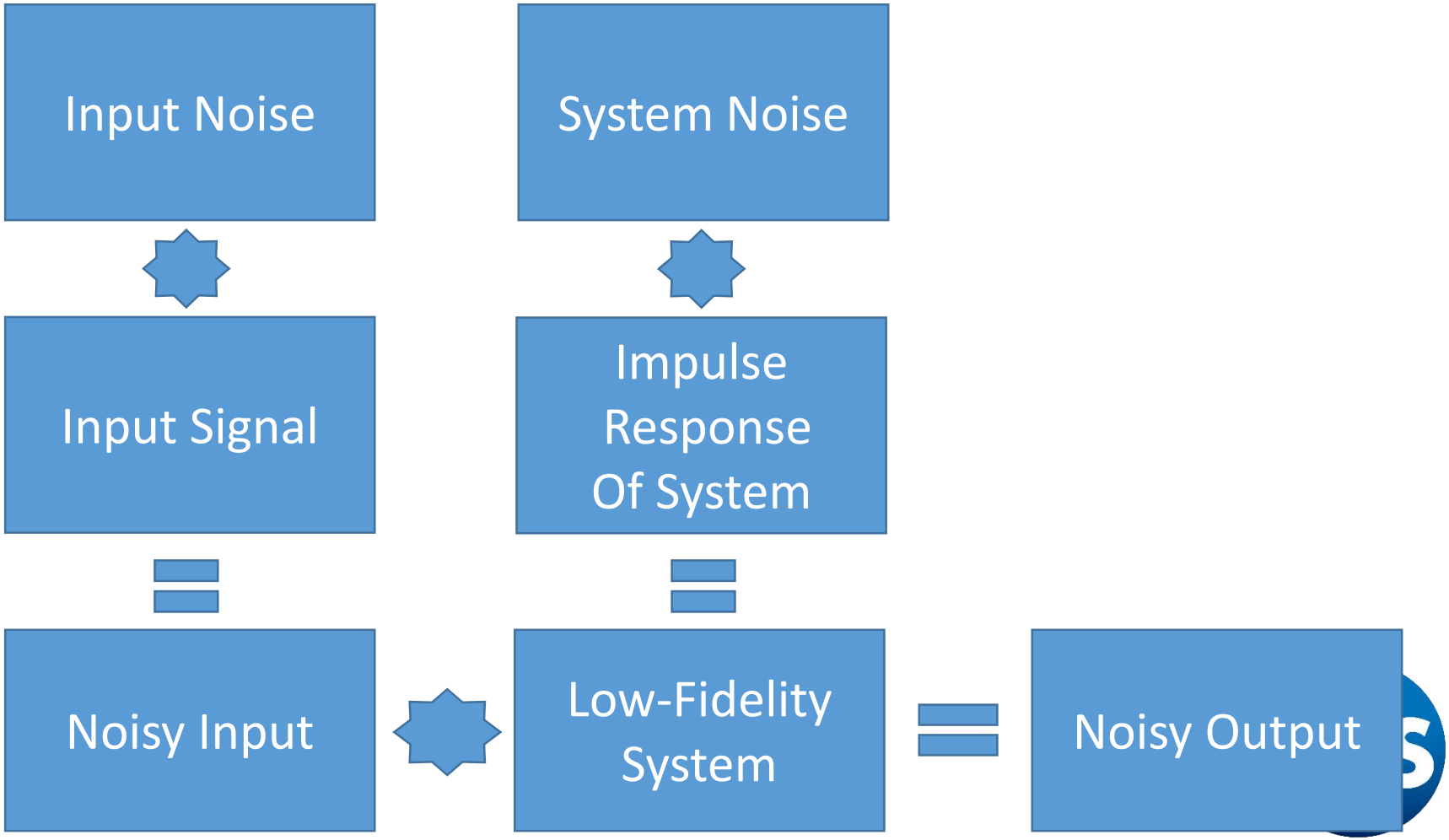
Additive: $f(x) + \varepsilon_f$

Multiplicative: $f(x)\varepsilon_f$

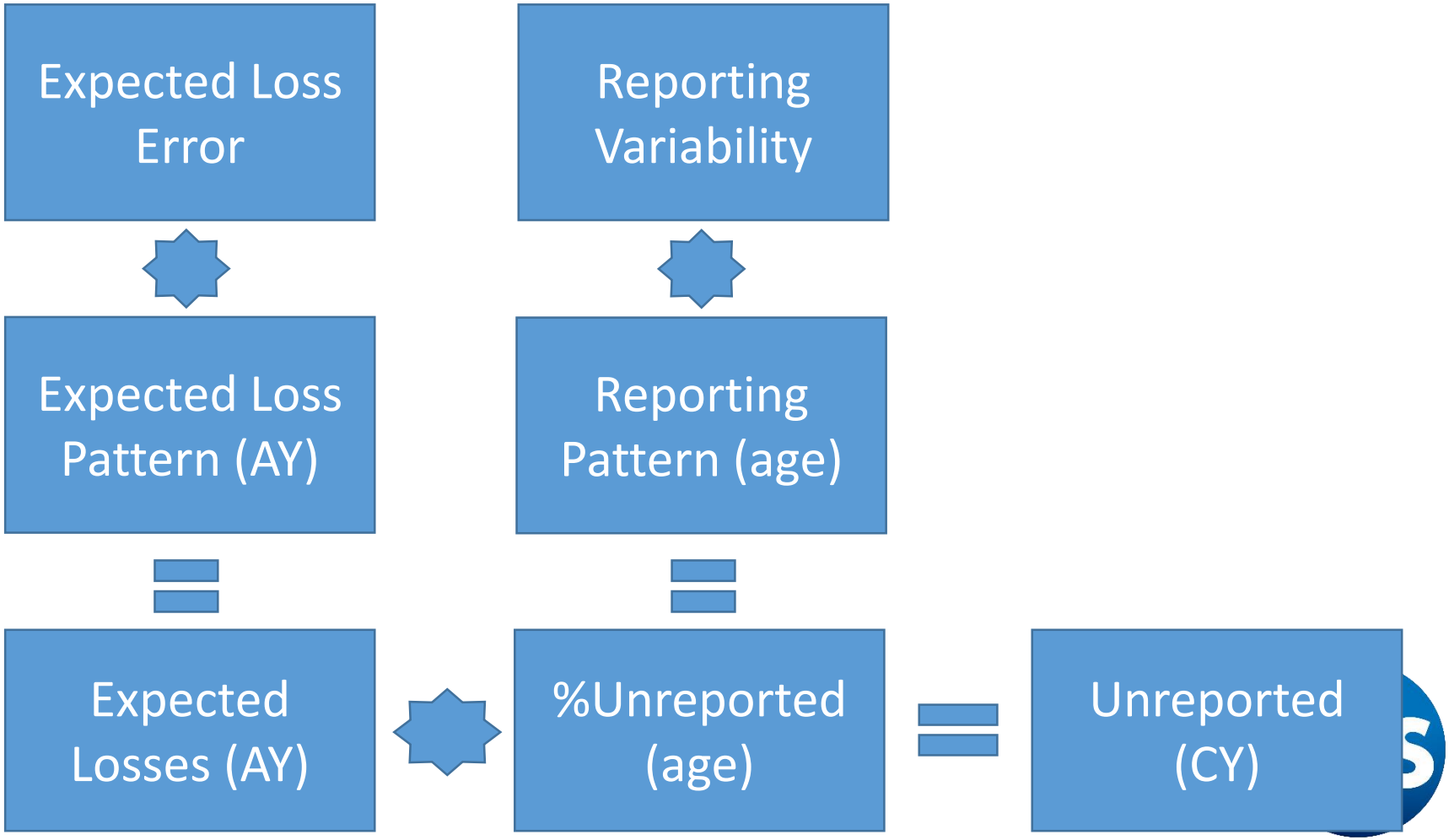
By Convolution: $f(x) * \varepsilon_f$

Noisy Components

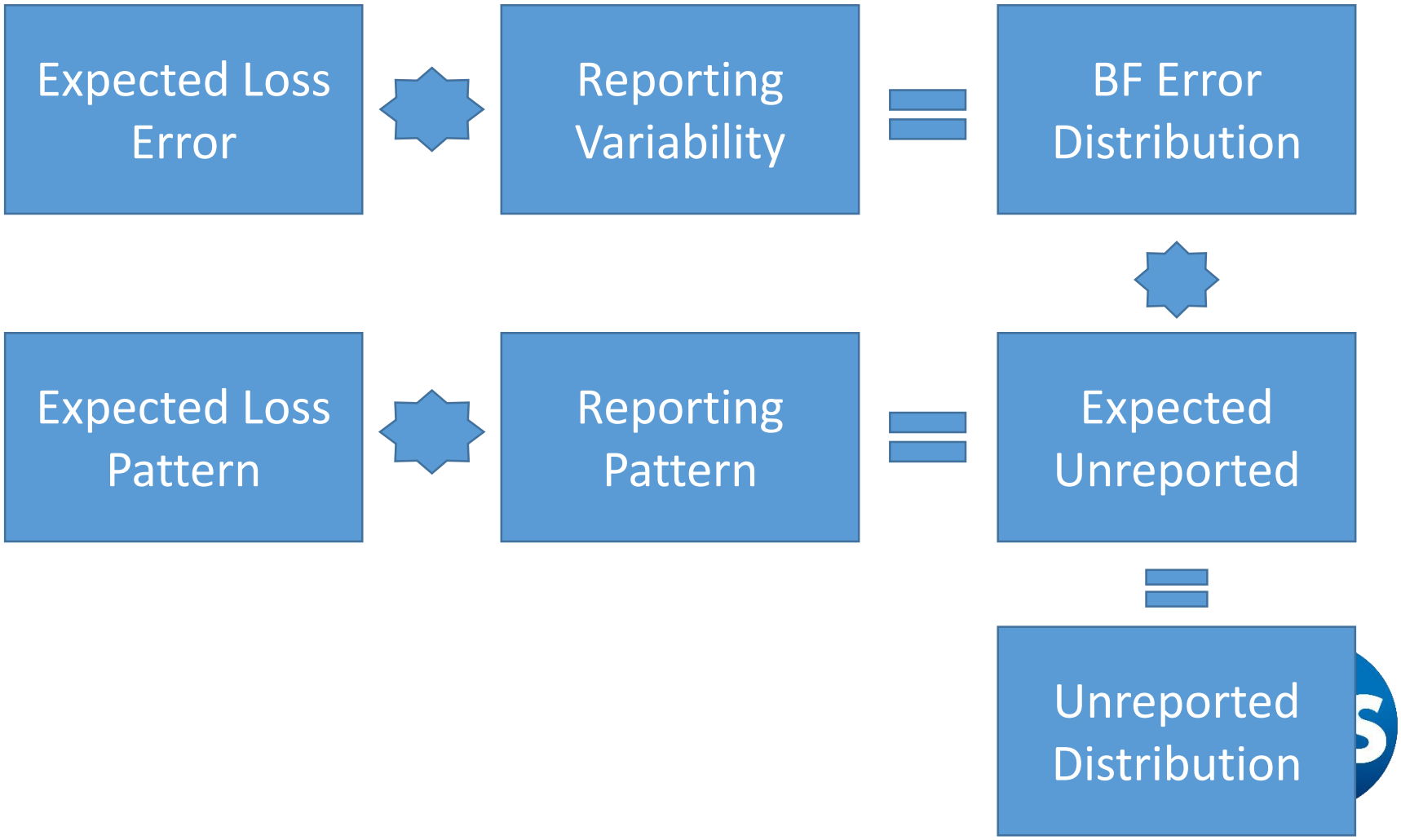
Noisy Components (Expanded)



BF Method


Expected Loss Error
Reporting Variability
Expected Loss Pattern (AY)
Reporting Pattern (age)
Expected Losses (AY)
%Unreported (age)
Unreported (CY)

BF Method


Expected Loss Error
Reporting Variability
BF Error Distribution
Expected Loss Pattern
Reporting Pattern
Expected Unreported
Unreported Distribution

Moving from Theory to Practice

If your reserving software provided an error estimate would you use it?

Who should solve the technical problem?

- An independent researcher
- A software vendor
- Your company
- A CAS research group

Casualty Actuarial Society
4350 North Fairfax Drive, Suite 250
Arlington, Virginia 22203

www.casact.org