



CAS Public Loss Simulator and R

2013 CAS Spring Meeting

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VP Technology

<http://www.gooouon.com>



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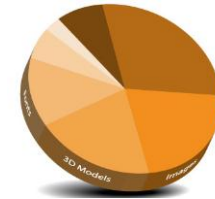


1. CAS Public Loss Simulator

2. Loss Simulator Enhancement

3. Markov's Chain in R

4. Hanoi Tower in R (Object Oriented Concept, not actuarial related)



1. Public Loss Simulator



What can it do? Answer: Simulate Raw Claims

- Occurrences
- Claims
- Transactions (such as case reserve, payments, adjustments, etc)



Start Simulation

Summary Claims Loss Triangles

Occurrence No.	Date	Claim No.	Accident Date	Report Date	State	Line	Type
Occurrence 2	3-2000	1	6/16/2000	6/26/2000	0	Line 1	Type 1
Occurrence 3	3-2000						
Occurrence 4	4-2000						
Occurrence 5	5-2000						
Occurrence 6	6-2000						
Occurrence 7	6-2000						
Occurrence 8	8-2000						
Occurrence 9	9-2000						
Occurrence 10	10-2000						

1

Transaction Date	Description	Case Reserve	Payment
6/26/2000	REP	2000	0
8/31/2000	RES	117721	0
9/8/2000	RES	3114	0
12/7/2000	RES	-20821	0
1/12/2001	CLS	-102014	136997

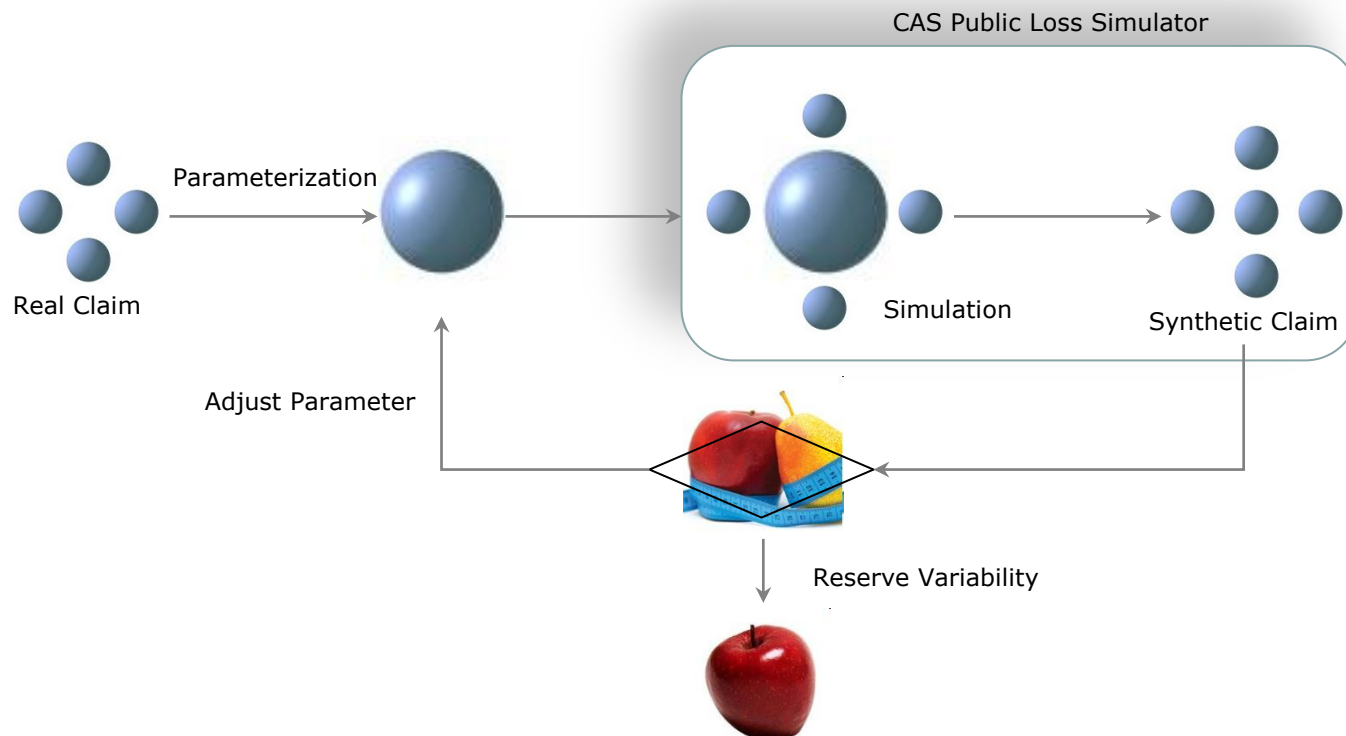
Number of Iterations: 1

Run Stop Close

1. Public Loss Simulator



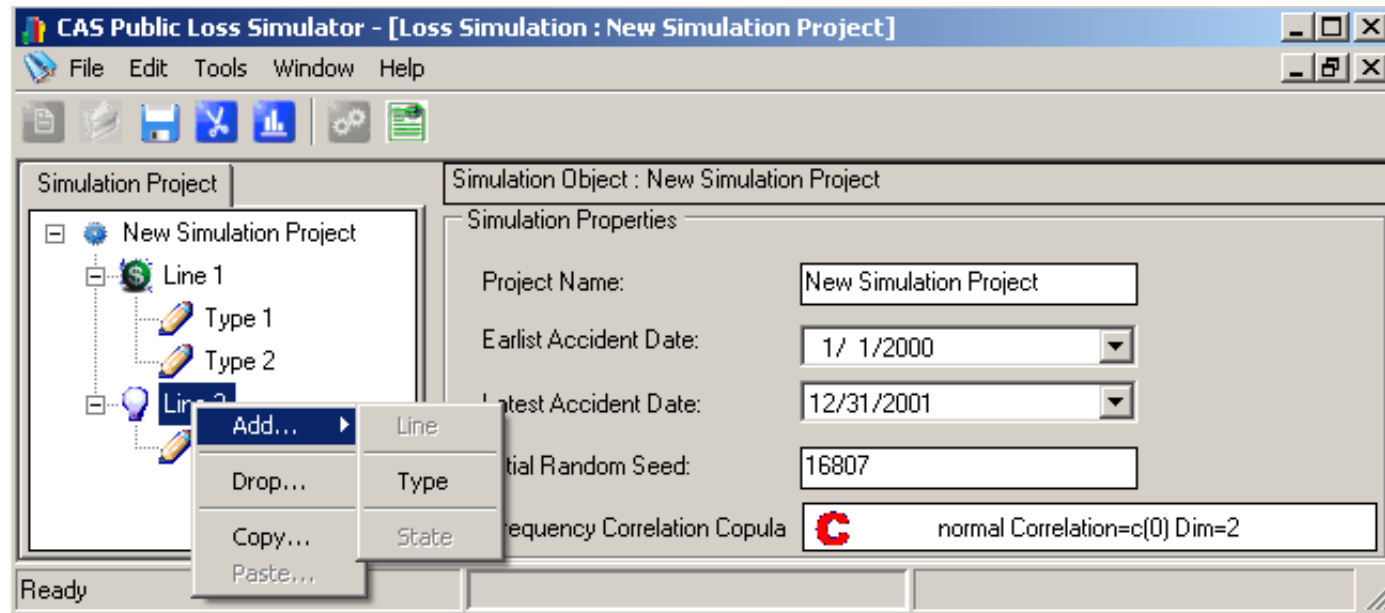
Where does it stand?



1. Public Loss Simulator



How do we run it?



- Windows Standard UI
- Tree Structure
- Accident Year Range
- Line Level Frequency Correlations from Copula
- etc, etc.



2. Enhancement in Public Loss Simulator



- Markov's Chain

The screenshot shows a software window for configuring a Markov Chain model. It includes fields for Stage 1 (Lognormal) and Stage 2 (Weibull) distributions, a Stage Switching Frequency selector (Monthly, Quarterly, Yearly), and a Markov Chain Transition Matrix section. The transition matrix section has two tabs: 'Matrix Define' and 'How It Works'. Under 'Matrix Define', there are input fields for Stage 1 Persistency Value P11 (0.5) and Stage 2 Persistency Value P22 (0.7). To the right, the 'Transition Matrix P' is displayed as a 2x2 matrix: $\begin{pmatrix} 0.5 & 0.5 \\ 0.3 & 0.7 \end{pmatrix}$. Below this, the 'Steady Stage Probability (at Simulation Start Date)' is shown as a 1x2 matrix: $\begin{pmatrix} 0.375 & 0.625 \end{pmatrix}$. At the bottom, there are radio buttons for 'Monthly' and 'Stage Switching' (which is selected), and an 'OK' button.

Stage 1 Lognormal meanlog=11.1 sdlog=0.8

Stage 2 Weibull (shape=10.5, scale=100.5)

Stage Switching Frequency

☐ Monthly ☒ Quarterly ☐ Yearly

Markov Chain Transition Matrix

Matrix Define How It Works

Stage 1 Persistency Value P11

Stage 2 Persistency Value P22

Transition Matrix P

$$\begin{pmatrix} 0.5 & 0.5 \\ 0.3 & 0.7 \end{pmatrix}$$

Steady Stage Probability (at Simulation Start Date)

$$\begin{pmatrix} 0.375 & 0.625 \end{pmatrix}$$

☐ Monthly ☒ Stage Switching

2. Enhancement in Public Loss Simulator



- Case Reserve Interpolation by Incurred Loss
Case Reserve Valuation Frequency

Valuation Frequency

☐ Monthly ☒ Quarterly ☐ Yearly

Valuation Starting Month:

Example: Report Date: 2012-02-03, Payment Date: 2012-10-23

2012-02-03 (report date)

2012-02-29 (valuation date 1)

2012-03-31 (valuation date 2)

2012-04-30 (valuation date 3)

2012-05-18 (INT 40)

2012-05-31 (valuation date 4)

2012-06-30 (valuation date 5)

2012-07-31 (valuation date 6)

2012-08-05 (INT 70)

2012-08-31 (valuation date 7)

2012-09-26 (INT 90)

2012-09-30 (valuation date 8)

2012-10-23 (payment date, also the claim close date)

--month end will be chosen

Payment Lag $T = \text{"2012-10-23"} - \text{"2012-02-03"} = 263$ (days)

0.40 date: $0.4 * 263 + \text{"2012-02-03"} = \text{"2012-05-18"}$

0.70 date: $0.7 * 263 + \text{"2012-02-03"} = \text{"2012-08-05"}$

0.90 date: $0.9 * 263 + \text{"2012-02-03"} = \text{"2012-09-26"}$

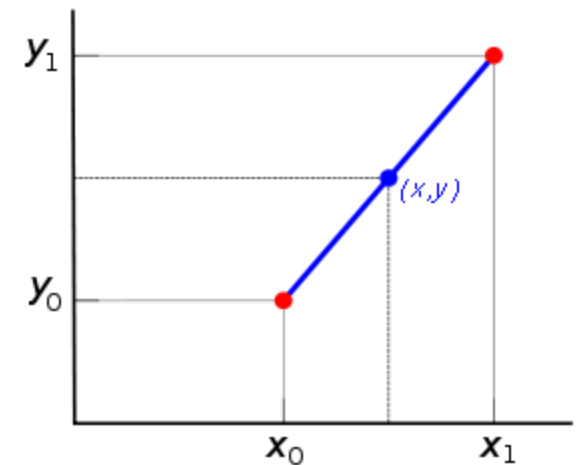
2. Enhancement in Public Loss Simulator



- Case Reserve Interpolation by Incurred Loss.
Incurred Loss Interpolation

This excel sheet explains the whole story:

http://www.gooouon.com/loss_simulator/doc/CaseReserve.xls



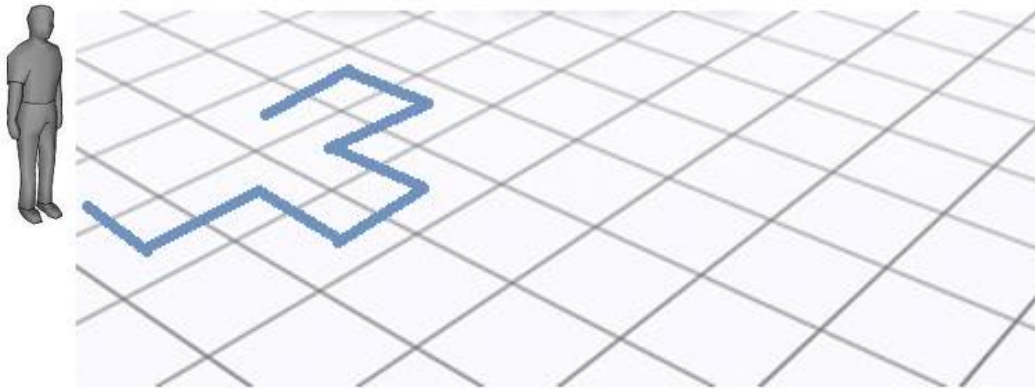
3. Markov's Chain



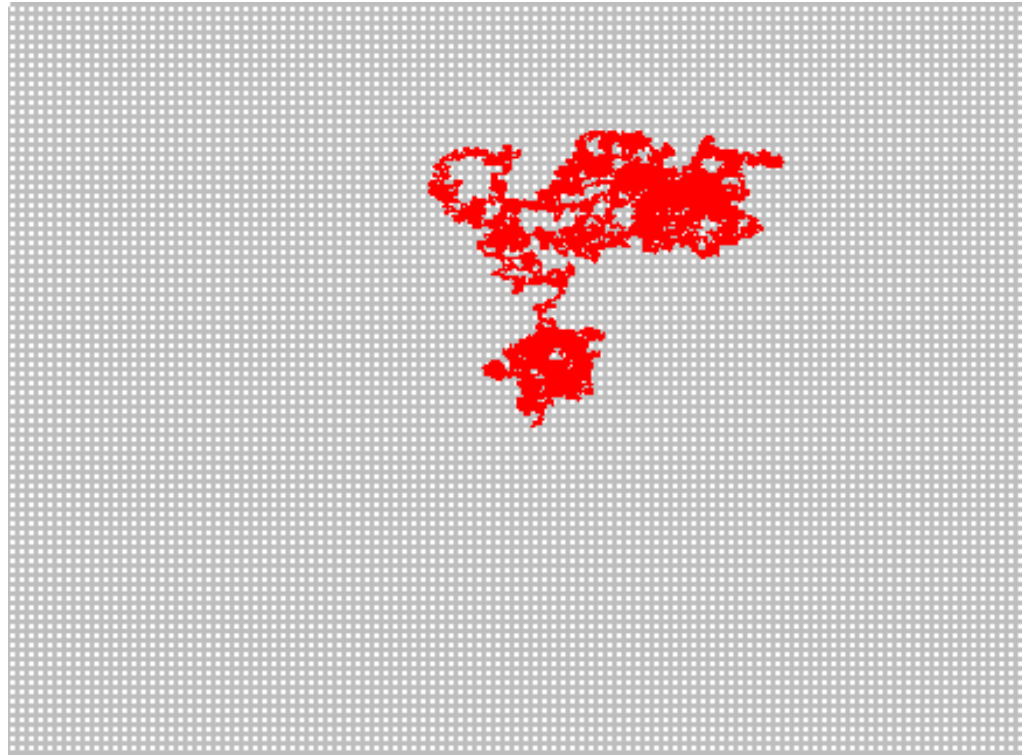
- What Is Markov's Chain

We have a chain of *states*, $S = \{s_1, s_2, \dots, s_n\}$. The process starts in s_1 and moves to next state. Each move is called a *step*. If the chain is currently in state s_i , then it moves to state s_j at the next step with a probability denoted by p_{ij} , which solely depends upon s_i .

For example, let us define a simple Random Walk as a Markov's Chain (4 staged, left, right, forward, and backward, $p_{ij}=0.25$)

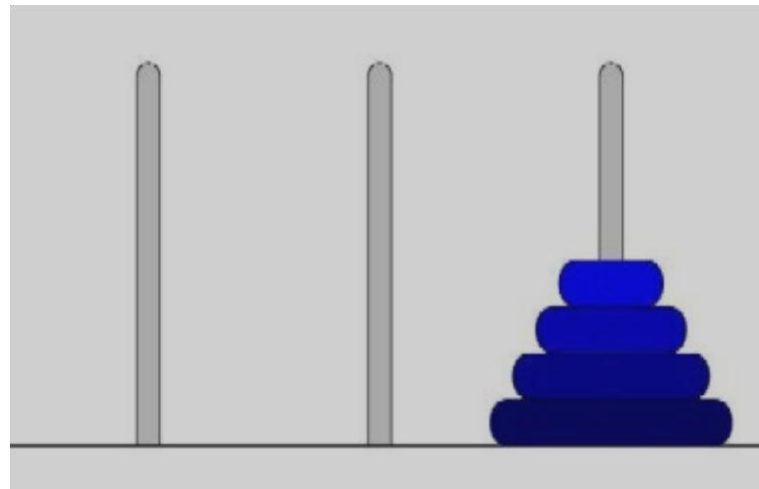
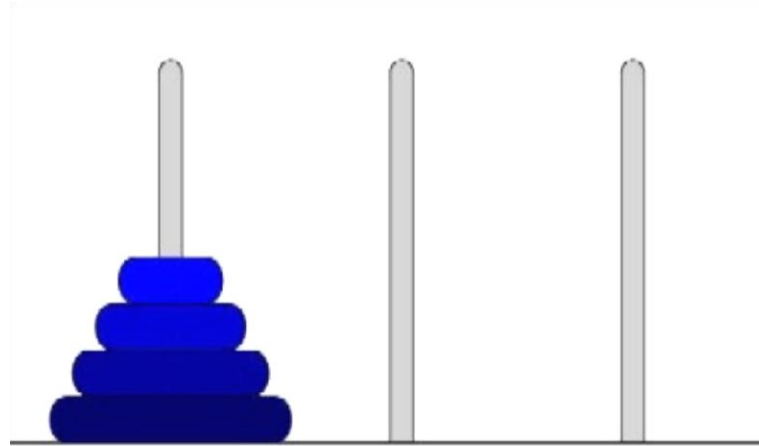


3. Markov's Chain (Random Walk) in R



You Can Download Code from <http://www.gouon.com/downloads/randomWalk.R>

4. Hanoi Tower (none actuarial related)



4. Hanoi Tower (Object Oriented Design)

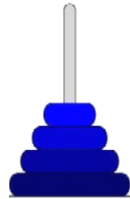


Object 1: Block



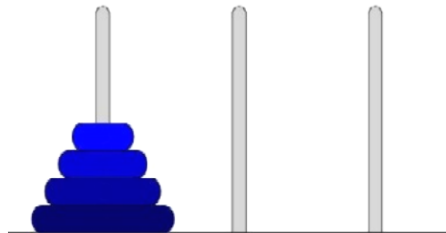
Dumb. Can only draw its self

Object 2: Tower (Stack)



Smart. Manage blocks in stack.

Object 3: Hanoi Tower



Wise. Do the Hanoi move, and manage the towers.

You can download code from <http://www.gooouon.com/downloads/hanoi.R>

4. Define Triangle in R (actuarial related)



```
setClass("Triangle",
        representation (data="matrix", name="character", accumulated="logical",
                        point="logical"),

        prototype(data=matrix(nrow=0, ncol=0), name="paid", accumulated=TRUE,
                        point=FALSE)
)

#####
#Methods: getYears, getAges
#####
setGeneric("getYears", function(object, ...) standardGeneric("getYears"))
setMethod("getYears", signature("Triangle"), function(object){
    return (dimnames(object@data)[[1]])
})

setGeneric("getAges", function(object, ...) standardGeneric("getAges"))
setMethod("getAges", signature("Triangle"), function(object){
    return (dimnames(object@data)[[2]])
})
```