



# CAS Public Loss Simulator and R

2013 CAS Spring Meeting

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VP Technology

<http://www.gououon.com>



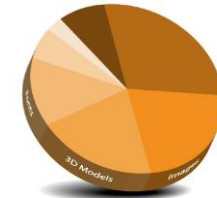


1. CAS Public Loss Simulator

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						
<b>Occurrence 7</b>	<b>6-2000</b>						
Occurrence 8	8-2000						
Occurrence 9	9-2000						
Occurrence 10	10-2000						

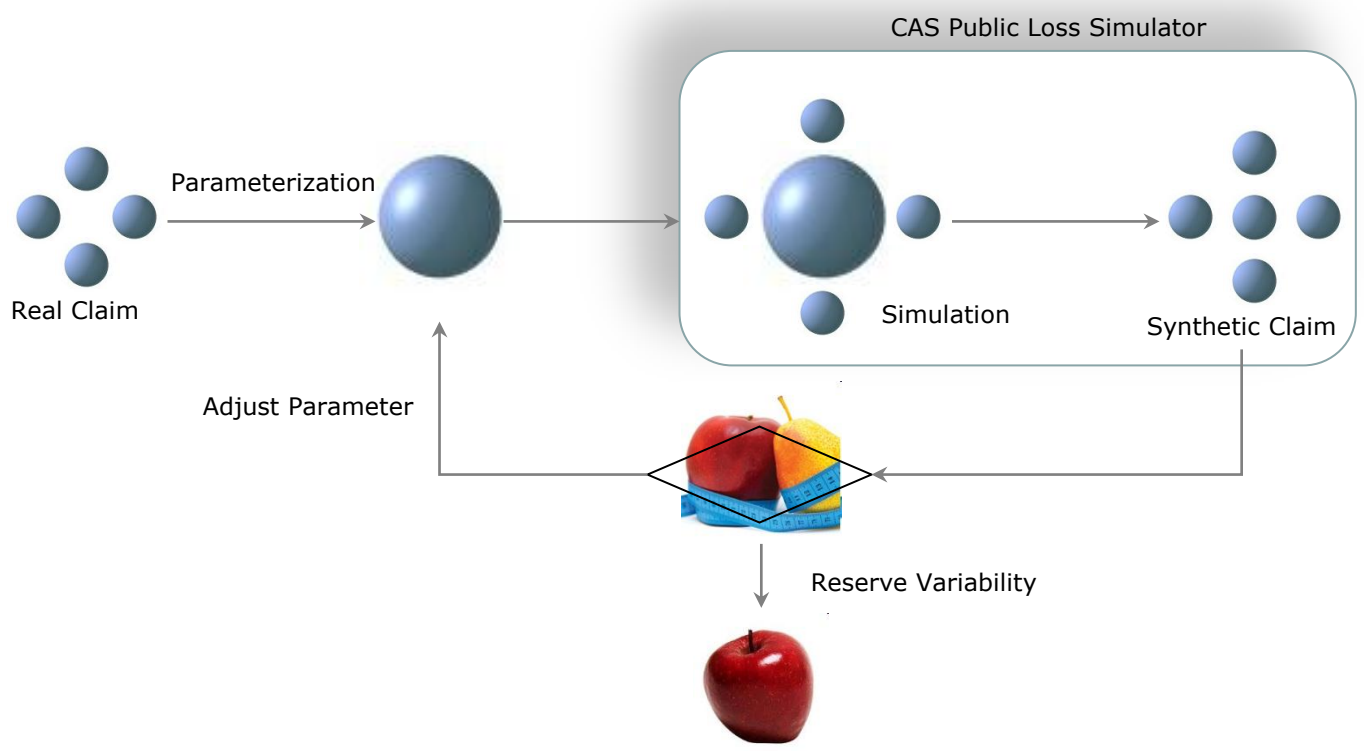
Transaction Date	Description	Case Reserve	Payment
6/26/2000	REP	2000	0
8/31/2000	RES	117721	0
9/8/2000	RES	3114	0
12/7/2000	RES	-20821	0
1/12/2001	CLS	-102014	136997

Number of Iterations:

# 1. Public Loss Simulator



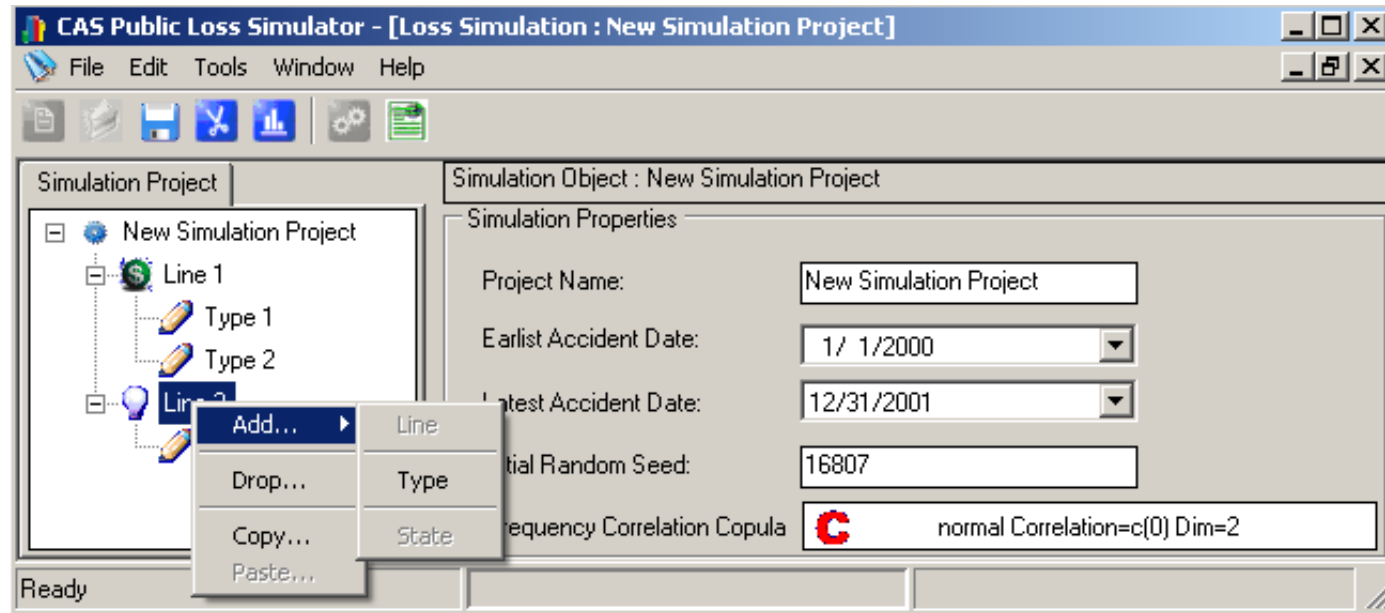
Where does it stand?



# 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

Stage 1

Stage 2

Stage Switching Frequency

Monthly  Quarterly  Yearly

Markov Chain Transition Matrix

Matrix Define

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="2012-10-23" – "2012-02-03" =263 (days)

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

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

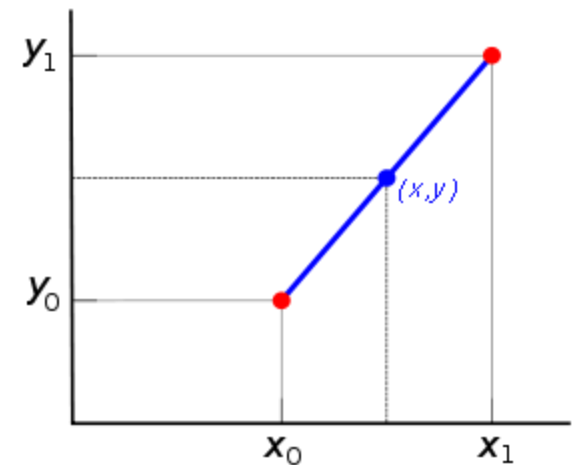
0.90 date:  $0.9 * 263 + "2012-02-03" = "2012-09-26"$

## 2. Enhancement in Public Loss Simulator

- Case Reserve Interpolation by Incurred Loss.  
Incurred Loss Interpolation

This excel sheet explains the whole story:

[http://www.gououon.com/loss\\_simulator/doc/CaseReserve.xls](http://www.gououon.com/loss_simulator/doc/CaseReserve.xls)





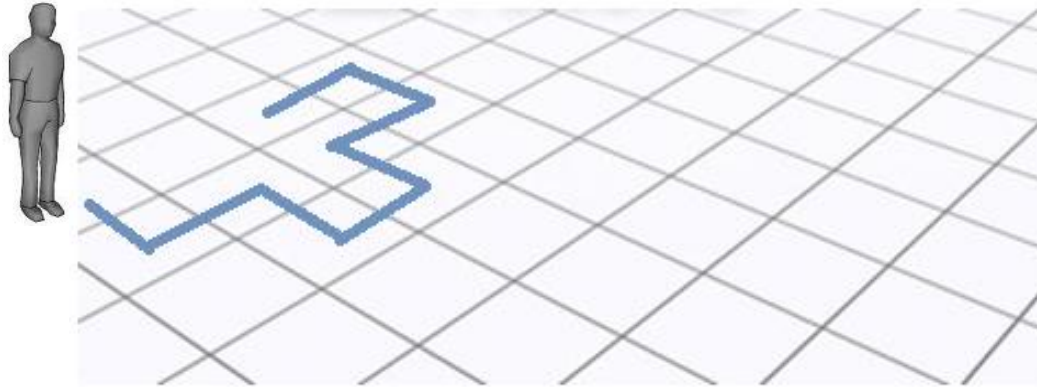
### 3. Markov's Chain



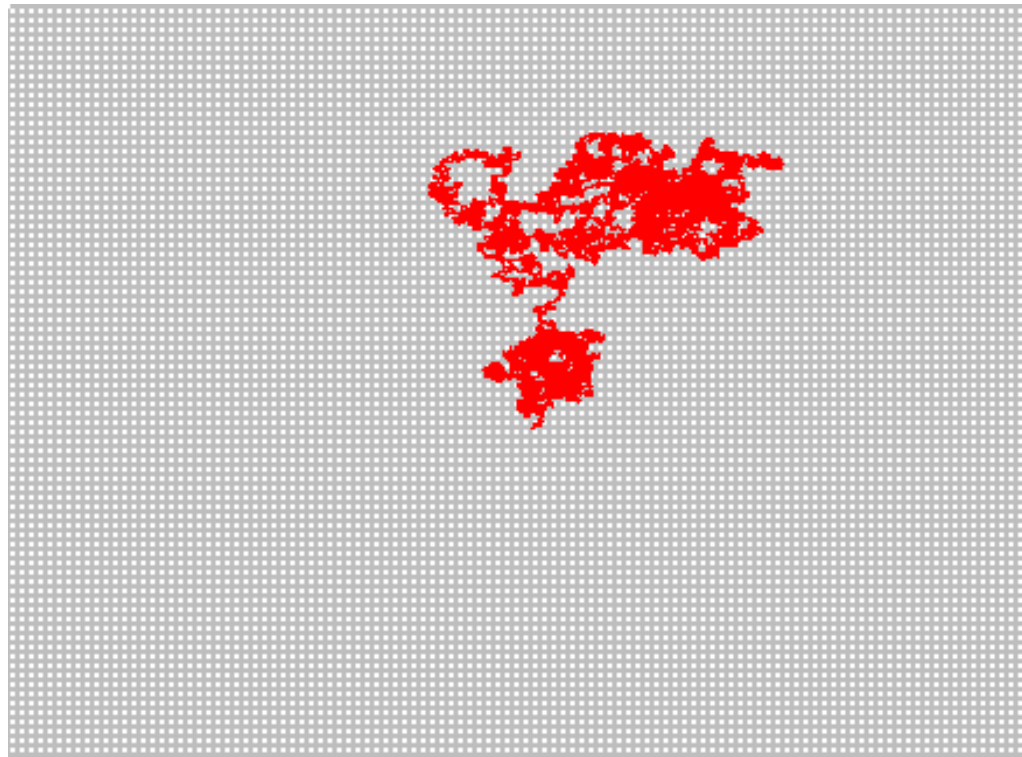
- What Is Markov's Chain

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,  $p_{ij}=0.25$ )

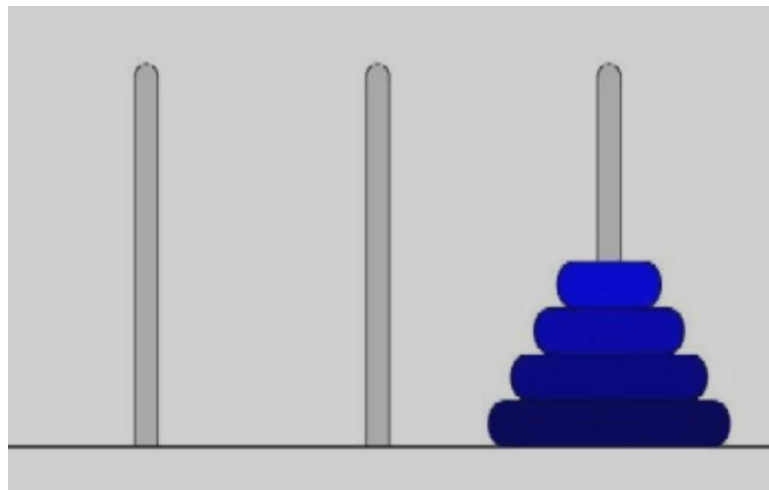
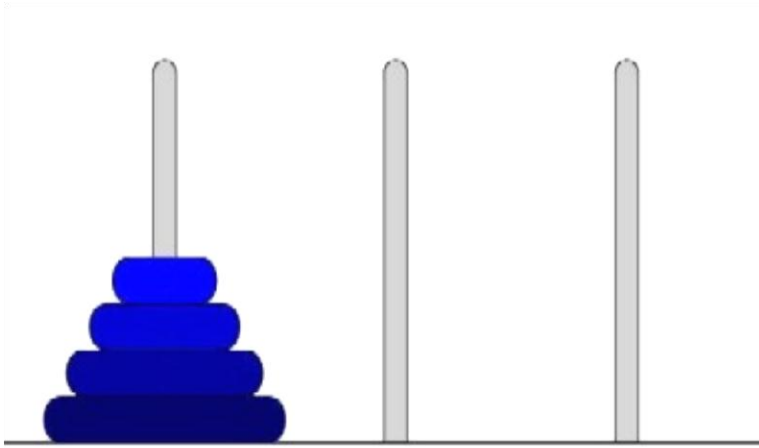


### 3. Markov's Chain (Random Walk) in R



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

# 4. Hanoi Tower (none actuarial related)



## 4. Hanoi Tower (Object Oriented Design)

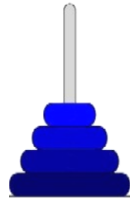


Object 1: Block



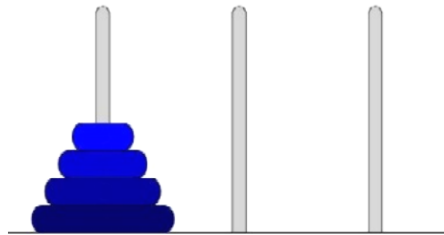
Dumb. Can only draw its self

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.gouon.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]])
})
```