

## Índex

Enunciat.....	2
Implementació.....	2
Codi Fibonacci.....	2
Codi Randu.....	2
Codi GCL.....	3
Visualitzacions.....	3
Fibonacci.....	3
Randu.....	4
GCL.....	5
Anàlisi amb Rockwell Arena.....	6
Fibonacci.....	6
Randu.....	9
GCL.....	13
Comparació.....	16

## Enunciat

Implementar tres generadors de números aleatoris: Fibonacci, Randu i GCL.

## Implementació

Per implementar els generadors s'ha utilitzat el llenguatge C# i el compilador Mono sota un sistema GNU/Linux.

### *Codi Fibonacci*

```
using System;

class Fibonacci : Generador {

    public double[] Generar(int quantitat) {
        double[] numAleatoris = new double[quantitat];
        numAleatoris[0] = 0;
        numAleatoris[1] = 1;
        double m = Math.Pow(2, 31);

        for (int i = 2; i < quantitat; i++) {
            double n = numAleatoris[i - 1] + numAleatoris[i - 2];
            //numAleatoris[i] = modul(n, m);
            numAleatoris[i] = n % m;
        }

        for (int i = 0; i < quantitat; i++) {
            numAleatoris[i] = (double)numAleatoris[i] / m;
        }

        return numAleatoris;
    }
}
```

### *Codi Randu*

```
using System;

public class Randu : Generador {

    public double[] Generar(int quantitat) {
        double[] numAleatoris = new double[quantitat];

        double a = Math.Pow(2, 16) + 3;
        double m = Math.Pow(2, 31);
        numAleatoris[0] = a;

        for (int i = 1; i < quantitat; i++) {
            double n = a * numAleatoris[i - 1];
            numAleatoris[i] = n % m;
        }

        for (int i = 0; i < quantitat; i++) {
            numAleatoris[i] = (double)numAleatoris[i] / m;
        }

        return numAleatoris;
    }
}
```

***Codi GCL***

```
using System;

public class GCL : Generator {

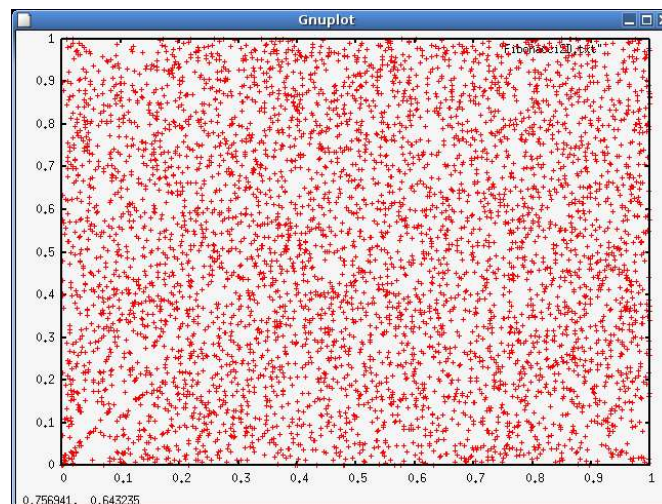
    public double[] Generar(int quantitat) {
        double[] numAleatoris = new double[quantitat];

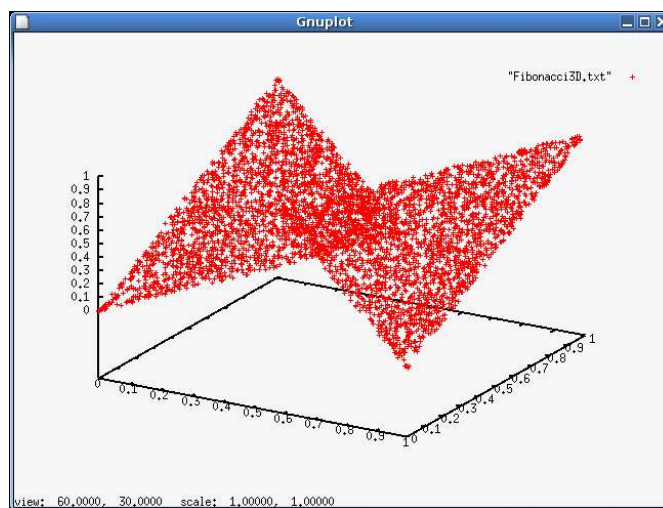
        double m = Math.Pow(2, 31);
        long a = 314159269;
        long c = 453806245;
        numAleatoris[0] = c;

        for (int i = 1; i < quantitat; i++) {
            double n = a * numAleatoris[i - 1] + c;
            numAleatoris[i] = n % m;
        }

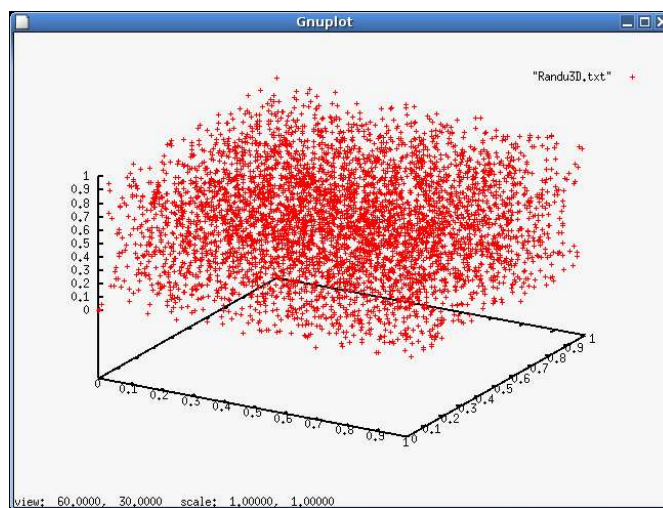
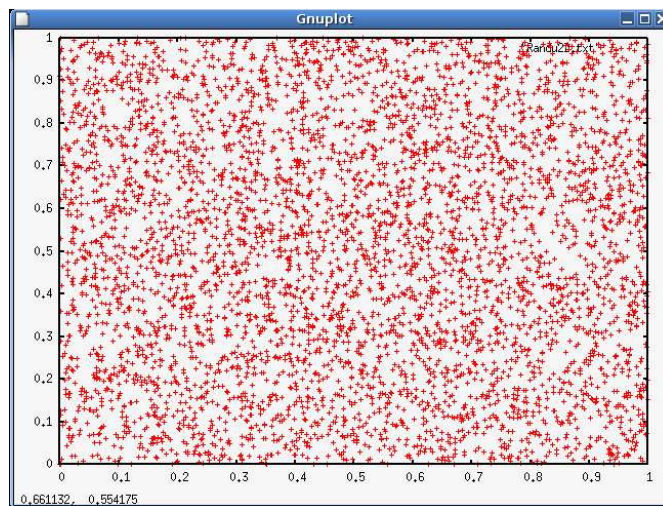
        for (int i = 0; i < quantitat; i++) {
            numAleatoris[i] = (double)numAleatoris[i] / m;
        }

        return numAleatoris;
    }
}
```

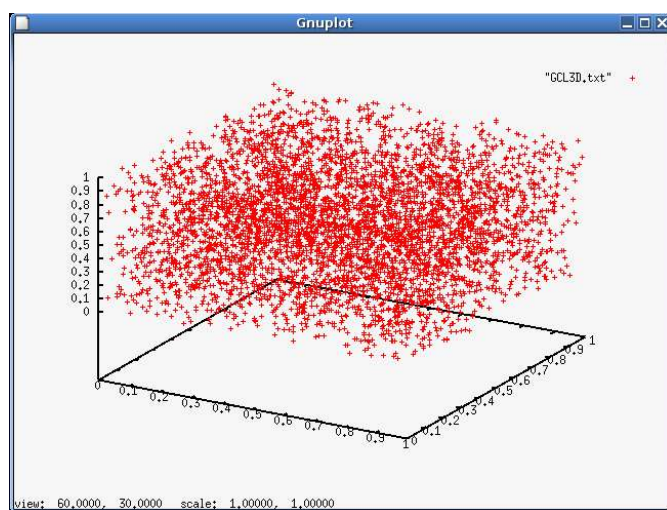
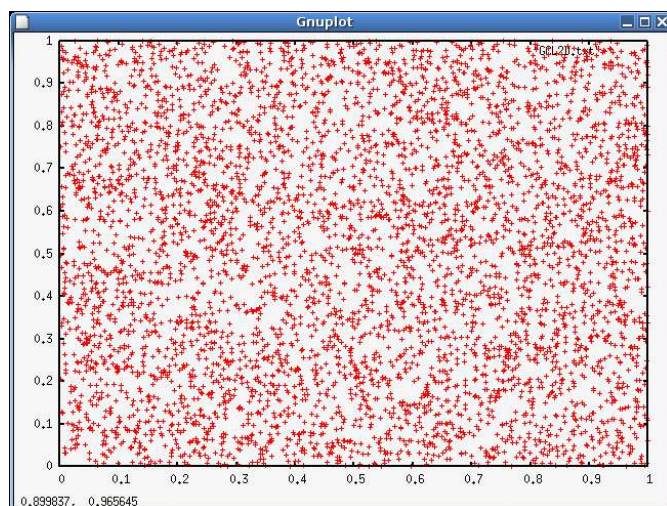
**Visualitzacions*****Fibonacci***



**Randu**



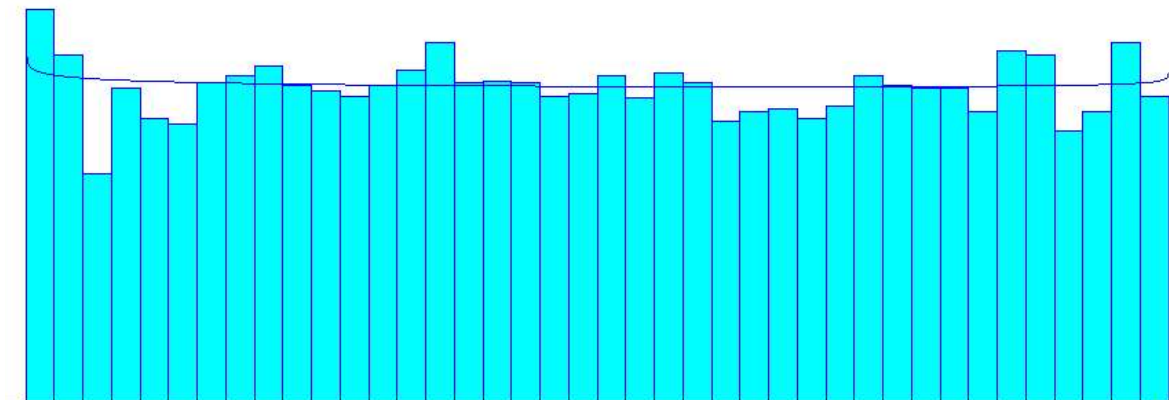
# GCL



## Anàlisi amb Rockwell Arena

### Fibonacci

Input analyzer:



#### Distribution Summary

Distribution: Beta  
 Expression:  $-0.001 + 1 * \text{BETA}(0.987, 0.994)$   
 Square Error: 0.000194

#### Chi Square Test

Number of intervals = 40  
 Degrees of freedom = 37  
 Test Statistic = 37.9  
 Corresponding p-value = 0.433

#### Kolmogorov-Smirnov Test

Test Statistic = 0.0155  
 Corresponding p-value > 0.15

#### Data Summary

Number of Data Points = 4999  
 Min Data Value = 0  
 Max Data Value = 1  
 Sample Mean = 0.498  
 Sample Std Dev = 0.29

#### Histogram Summary

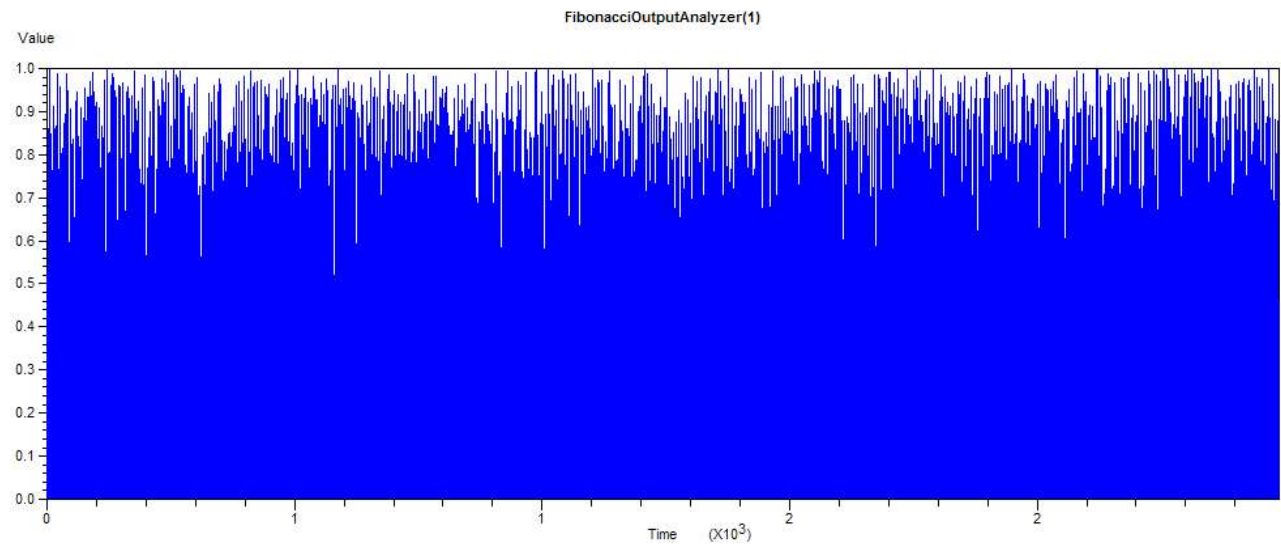
Histogram Range = -0.001 to 1  
 Number of Intervals = 40

#### Fit All Summary

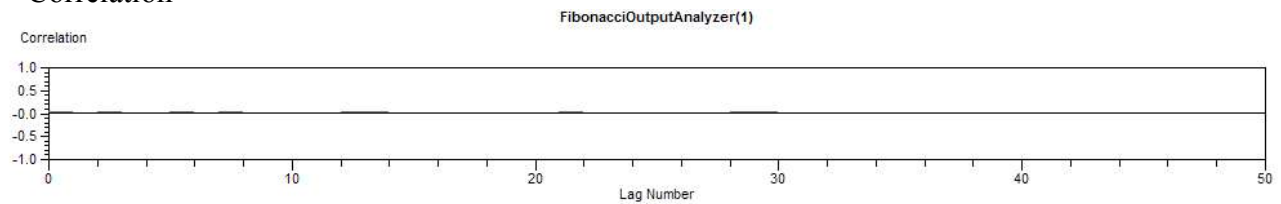
Function	Sq Error
Beta	0.000194
Uniform	0.000198
Normal	0.00347
Gamma	0.00434
Erlang	0.00454
Exponential	0.00638
Lognormal	0.00802
Weibull	0.00814
Triangular	0.00827

Output analyzer:

– Barchart



– Correlation

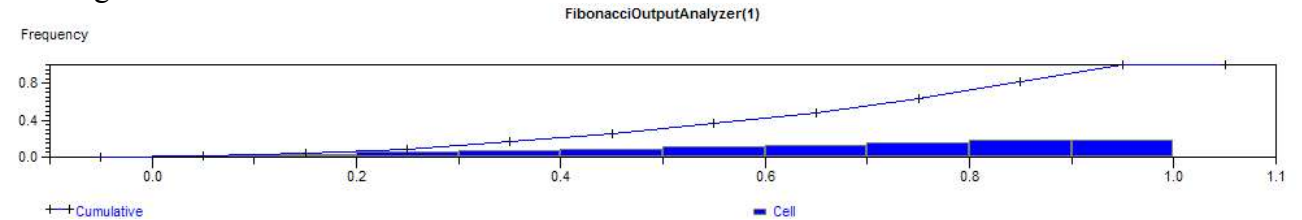


Correlogram Summary		
FibonacciOutputAnalyzer(1)		
	Sample Mean :	0.4979
	Sample Variance :	0.08402
	Sample Size :	4999
Weighted Sum of Cov. :		0.1159
Correlation/Covariance Values		
Lag	Covariance	Correlation
1	0.0034775	0.041389
2	0.0010453	0.012441
3	0.0034275	0.040794
4	0.0015751	0.018747
5	0.0022887	0.02724
6	0.002814	0.033492
7	0.0012218	0.014542
8	0.002731	0.032504
9	0.0019991	0.023793
10	0.002119	0.02522
11	0.00075757	0.0090166
12	0.0022898	0.027254
13	0.0034957	0.041606
14	0.0026898	0.032014
15	-0.0004905	-0.0058379
16	0.0014421	0.017164
17	0.0012546	0.014933
18	0.0005751	0.0068448
19	0.001635	0.01946
20	0.00031395	0.0037367



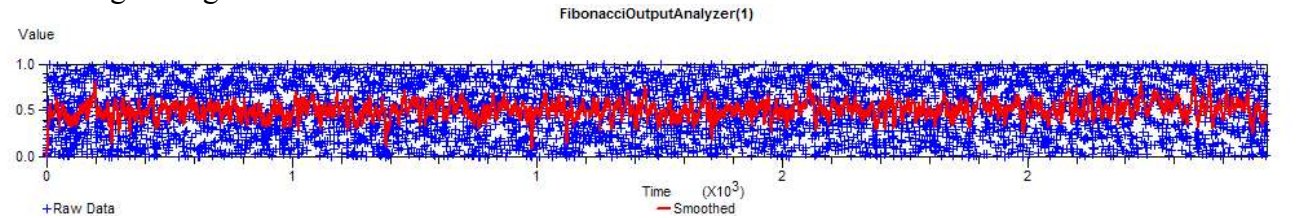
21	-0.00043838	-0.0052176
22	0.0024365	0.028999
23	0.0020385	0.024262
24	-0.00077619	-0.0092382
25	0.0012638	0.015042
26	0.00067283	0.008008
27	0.001232	0.014663
28	0.00092291	0.010984
29	0.002642	0.031445
30	0.0032633	0.03884
31	0.0019786	0.023549
32	0.0012248	0.014578
33	0.00077828	0.0092631
34	-0.0016618	-0.019779
35	0.0011333	0.013489
36	0.0016493	0.01963
37	-0.0015637	-0.018611
38	0.0023428	0.027884
39	0.0017532	0.020866
40	-0.001165	-0.013866
41	0.00023649	0.0028147
42	0.00052809	0.0062853
43	0.0010397	0.012374
44	0.0016743	0.019927
45	0.0002884	0.0034326
46	0.00045762	0.0054466
47	-0.00026071	-0.003103
48	0.00033083	0.0039375
49	-0.0016959	-0.020185
50	-0.00084021	-0.01

- Histogram



Histogram Summary FibonacciOutputAnalyzer(1)						
Cell	Cell Limits		Abs. Freq. (Time)		Rel. Freq.	
	From	To	Cell	Cumul.	Cell	Cumul.
1	-Infinity	0	0	0	0	0
2	0	0.1	23.37	23.37	0.009388	0.009388
3	0.1	0.2	73.71	97.07	0.02961	0.039
4	0.2	0.3	124.8	221.8	0.05013	0.08913
5	0.3	0.4	186.1	408	0.07479	0.1639
6	0.4	0.5	223.9	631.9	0.08996	0.2539
7	0.5	0.6	278.8	910.7	0.112	0.3659
8	0.6	0.7	298.4	1209	0.1199	0.4858
9	0.7	0.8	372.9	1582	0.1498	0.6356
10	0.8	0.9	441.3	2023	0.1773	0.8129
11	0.9	1	465.5	2489	0.1871	1
12	1	+Infinity	0	2489	0	1

- Moving average



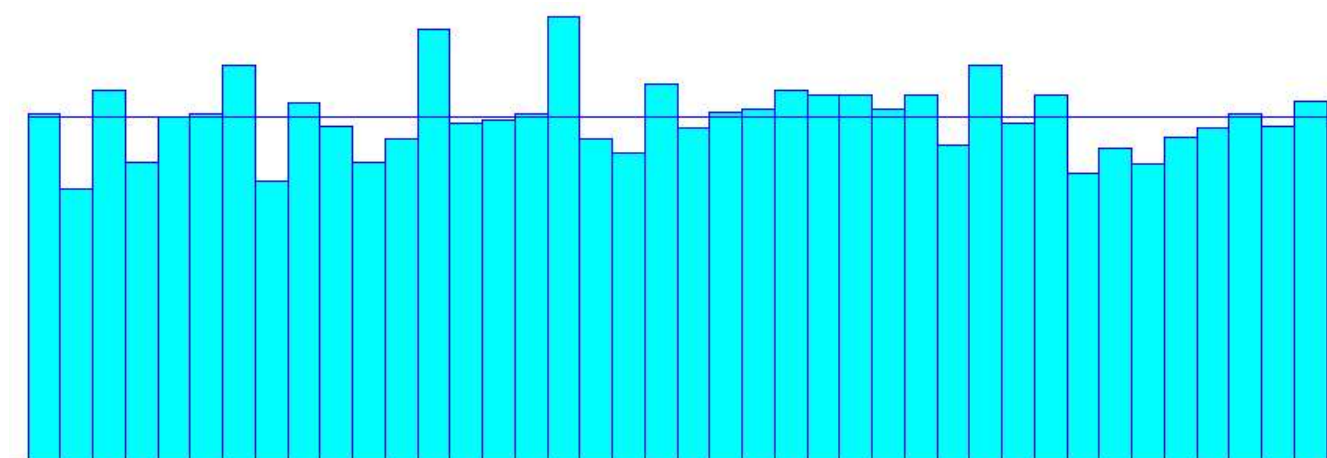


Display Forecasted Values Not Selected

TOTAL	ABS.DEVIATION	1272
MEAN	ABS.DEVIATION	0.2549
MEAN	BIAS	-0.0005129

## Randu

Input Analyzer:



### Distribution Summary

Distribution: Uniform  
Expression: UNIF(0, 1)  
Square Error: 0.000271

#### Chi Square Test

Number of intervals = 40  
Degrees of freedom = 39  
Test Statistic = 54.1  
Corresponding p-value = 0.0559

#### Kolmogorov-Smirnov Test

Test Statistic = 0.0123  
Corresponding p-value > 0.15

### Data Summary

Number of Data Points = 4999  
Min Data Value = 2.92e-005  
Max Data Value = 1  
Sample Mean = 0.5  
Sample Std Dev = 0.285

### Histogram Summary

Histogram Range = 0 to 1  
Number of Intervals = 40

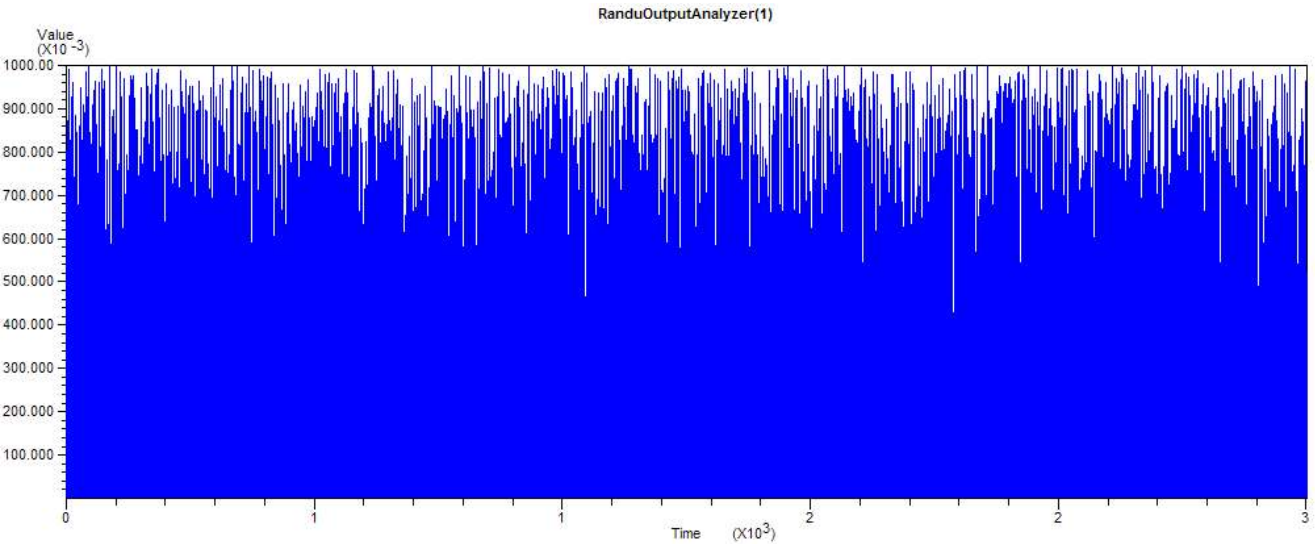
### Fit All Summary

Function	Sq Error
Uniform	0.000271
Beta	0.000275
Weibull	0.00296
Normal	0.00312
Gamma	0.00408

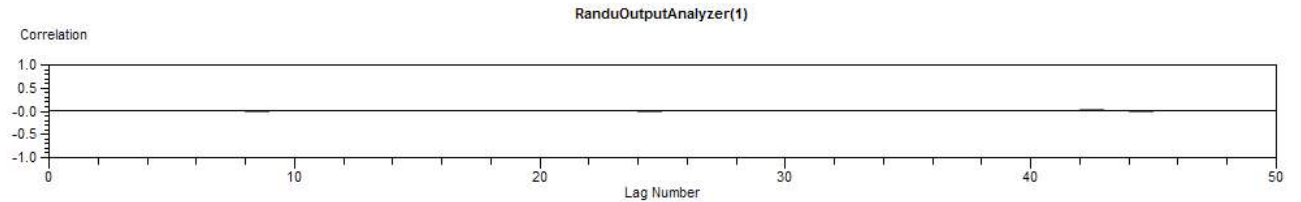
Erlang	0.00416
Exponential	0.00676
Lognormal	0.00714
Triangular	0.00774

Output Analyzer:

- Barchart



- Correlation



Correlogram Summary  
RanduOutputAnalyzer(1)

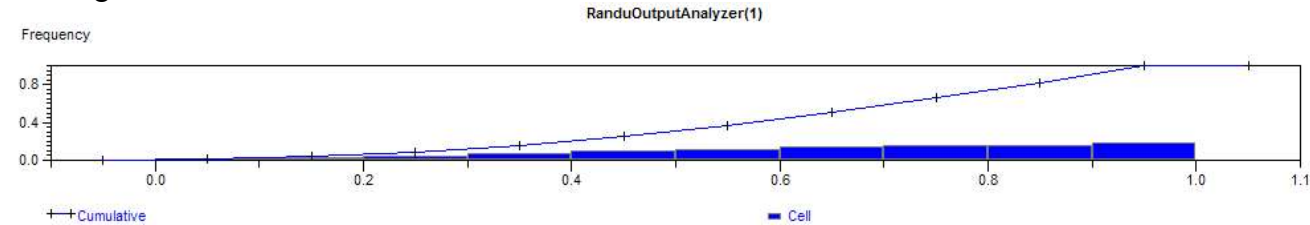
Sample Mean : 0.5004  
Sample Variance : 0.08127  
Sample Size : 4999  
Weighted Sum of Cov. : -0.01225

Correlation/Covariance Values

Lag	Covariance	Correlation
1	-0.00080687	-0.0099288
2	-0.00089499	-0.011013
3	-2.3183e-005	-0.00028528
4	0.0011485	0.014133
5	0.001965	0.02418
6	0.00027738	0.0034133
7	-0.0017223	-0.021194
8	-0.0011632	-0.014314
9	-0.0024813	-0.030533
10	0.001338	0.016464
11	-0.00128	-0.015751
12	-0.00093037	-0.011449
13	-0.00077539	-0.0095414
14	-0.00043659	-0.0053725
15	-0.0013311	-0.01638

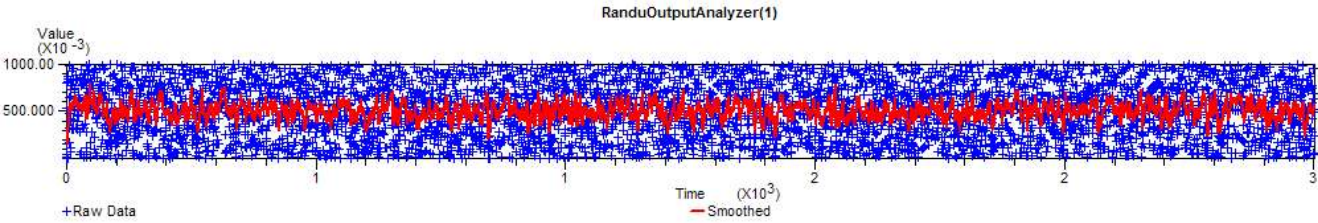
16	0.0015279	0.018801
17	0.0011231	0.01382
18	-0.0012212	-0.015027
19	0.00010548	0.001298
20	-0.00045943	-0.0056534
21	0.00036395	0.0044785
22	-0.00066863	-0.0082277
23	-0.00018489	-0.0022751
24	0.00077688	0.0095598
25	-0.0033666	-0.041427
26	8.3802e-005	0.0010312
27	0.00114	0.014028
28	0.00092201	0.011346
29	0.00032412	0.0039885
30	-0.0013581	-0.016712
31	-0.00069606	-0.0085653
32	0.0020352	0.025044
33	0.00081733	0.010058
34	0.00066671	0.0082041
35	0.00084248	0.010367
36	-0.0013011	-0.01601
37	0.0010309	0.012686
38	0.00083505	0.010276
39	-0.00076816	-0.0094526
40	-0.00021509	-0.0026468
41	0.0005573	0.0068577
42	0.00037042	0.0045582
43	0.0025127	0.03092
44	-0.0011388	-0.014013
45	-0.0023477	-0.028889
46	0.0007505	0.0092352
47	-0.0021858	-0.026897
48	-0.00041147	-0.0050634
49	0.0010209	0.012563
50	-0.00050674	-0.0062356

– Histogram



Histogram Summary							
RanduOutputAnalyzer(1)							
Cell Limits		Abs. Freq. (Time)		Rel. Freq.			
Cell	From	To	Cell	Cumul.	Cell	Cumul.	
1	-Infinity	0	0	0	0	0	
2	0	0.1	23.51	23.51	0.009398	0.009398	
3	0.1	0.2	73.87	97.38	0.02953	0.03893	
4	0.2	0.3	118.6	216	0.04742	0.08635	
5	0.3	0.4	184.5	400.5	0.07375	0.1601	
6	0.4	0.5	236.3	636.7	0.09446	0.2546	
7	0.5	0.6	281.5	918.3	0.1125	0.3671	
8	0.6	0.7	342.7	1261	0.137	0.5041	
9	0.7	0.8	386.5	1647	0.1545	0.6586	
10	0.8	0.9	378.6	2026	0.1513	0.81	
11	0.9	1	475.3	2501	0.19	1	
12	1	+Infinity	0	2501	0	1	

– Moving average

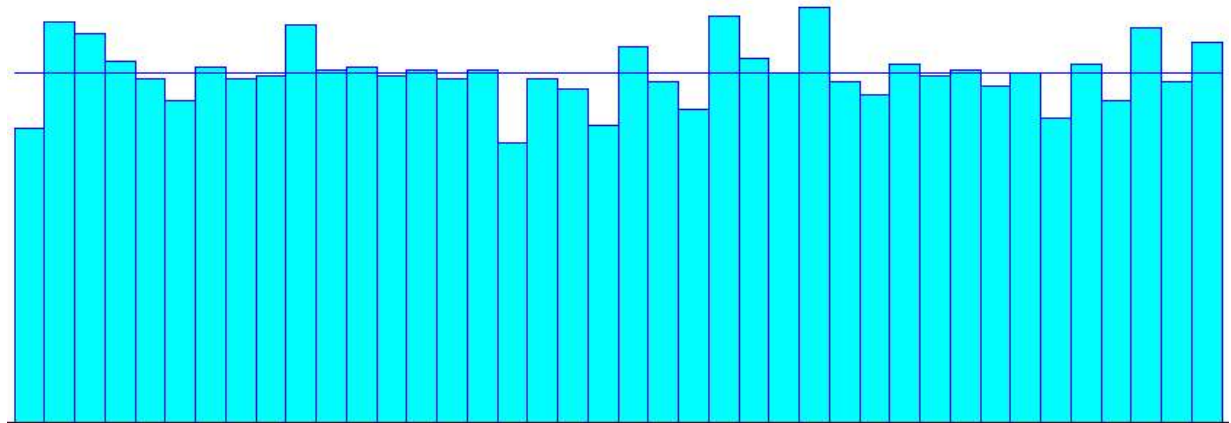


Display Forecasted Values Not Selected

TOTAL	ABS.DEVIATION	1271
MEAN	ABS.DEVIATION	0.2547
MEAN	BIAS	-0.0001874

## GCL

Input Analyzer:



### Distribution Summary

Distribution: Uniform  
Expression: UNIF(0, 1)  
Square Error: 0.000178

#### Chi Square Test

Number of intervals = 40  
Degrees of freedom = 39  
Test Statistic = 35.6  
Corresponding p-value = 0.622

#### Kolmogorov-Smirnov Test

Test Statistic = 0.0081  
Corresponding p-value > 0.15

### Data Summary

Number of Data Points = 4999  
Min Data Value = 0.000724  
Max Data Value = 1  
Sample Mean = 0.5  
Sample Std Dev = 0.29

### Histogram Summary

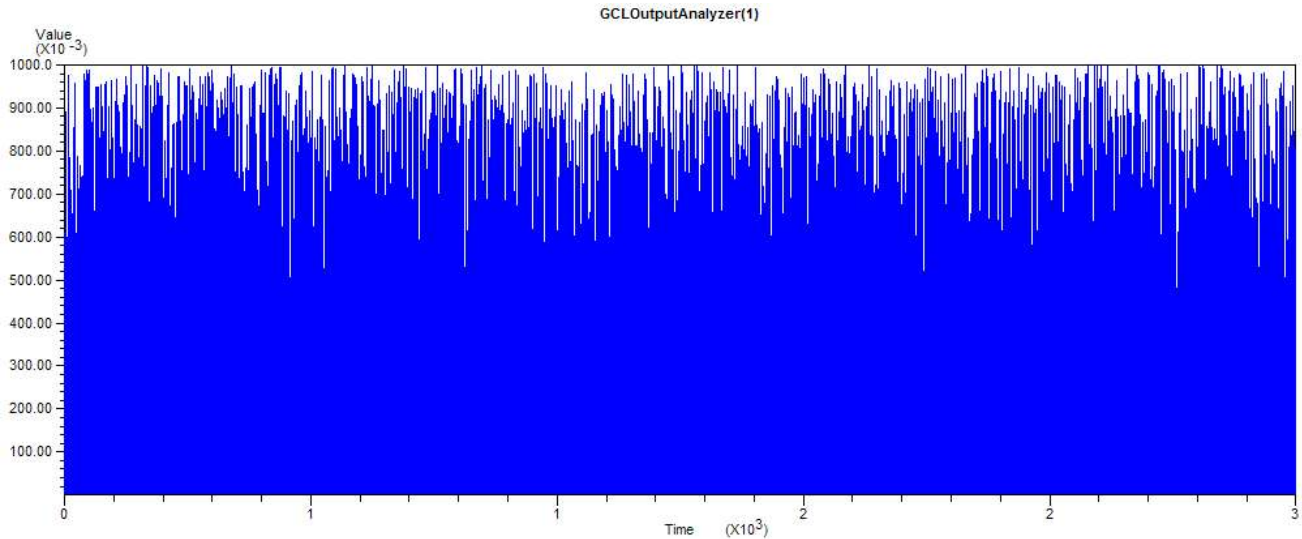
Histogram Range = 0 to 1  
Number of Intervals = 40

### Fit All Summary

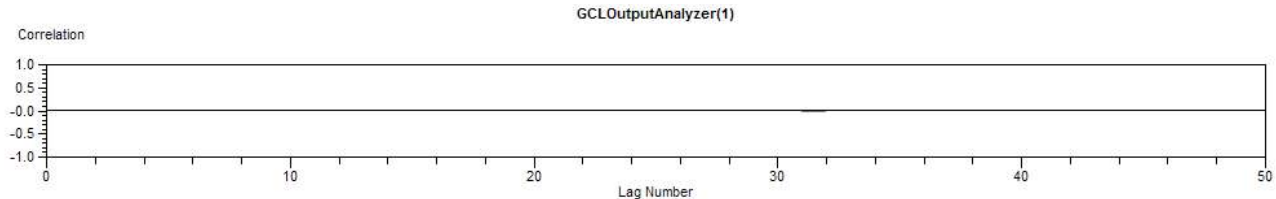
Function	Sq Error
Uniform	0.000178
Beta	0.000182
Weibull	0.00345
Normal	0.00354
Gamma	0.00424
Erlang	0.00445
Exponential	0.00644
Lognormal	0.00714
Triangular	0.00858

Output Analyzer:

– Barchart



– Correlation



Correlogram Summary  
GCLOutputAnalyzer(1)

Sample Mean : 0.4999  
Sample Variance : 0.08407  
Sample Size : 4999  
Weighted Sum of Cov. : -0.0233

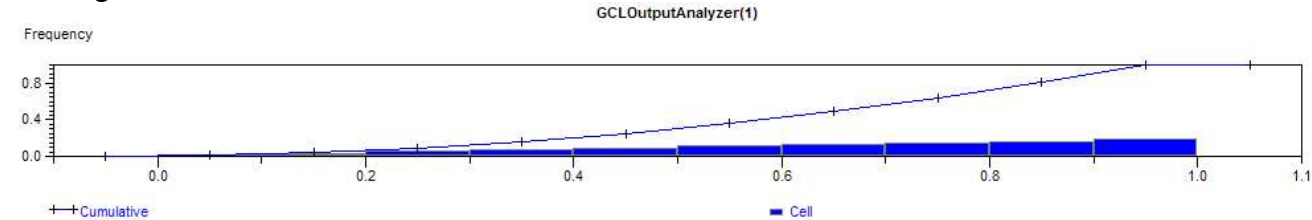
Correlation/Covariance Values

Lag	Covariance	Correlation
1	-0.00039739	-0.0047267
2	0.00088504	0.010527
3	0.00034431	0.0040953
4	0.00076936	0.009151
5	-0.0014845	-0.017657
6	-0.0023168	-0.027556
7	0.00017878	0.0021265
8	-0.0011845	-0.014089
9	-0.00071339	-0.0084853
10	-0.00018027	-0.0021441
11	0.0022464	0.026719
12	0.00057952	0.006893
13	0.0006414	0.007629
14	0.0011768	0.013997
15	0.00058413	0.0069478
16	0.00089834	0.010685
17	0.00023658	0.0028139
18	-0.0013461	-0.016011
19	-0.0010268	-0.012214
20	0.00024543	0.0029192
21	0.00029227	0.0034763
22	-0.00087021	-0.01035



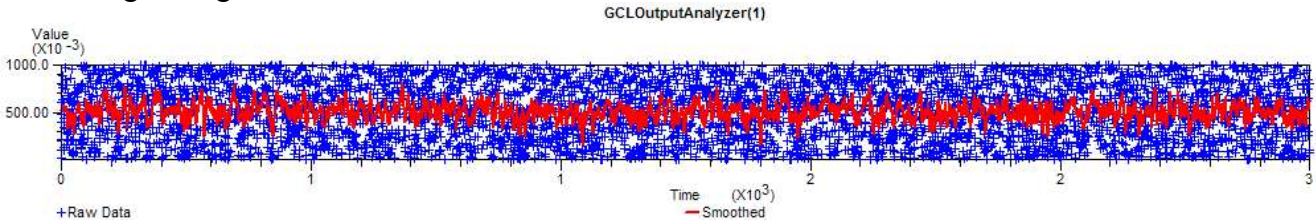
23	0.0016868	0.020064
24	-0.0014476	-0.017218
25	-0.00052142	-0.0062019
26	0.0012191	0.0145
27	-0.00031556	-0.0037533
28	0.0011825	0.014065
29	0.0015844	0.018845
30	0.0013376	0.01591
31	-0.00079485	-0.0094542
32	-0.0028413	-0.033796
33	-0.00038862	-0.0046223
34	0.00031561	0.003754
35	-0.0013636	-0.016219
36	-0.001989	-0.023658
37	-0.0012966	-0.015422
38	-0.0007818	-0.0092989
39	-0.001539	-0.018306
40	0.0011918	0.014175
41	0.00093702	0.011145
42	-0.0010924	-0.012994
43	-0.00051884	-0.0061712
44	-0.00043157	-0.0051332
45	2.9959e-005	0.00035634
46	-0.00080136	-0.0095316
47	-0.0016884	-0.020082
48	-0.0017051	-0.020281
49	-0.0011439	-0.013606
50	-0.00013516	-0.0016076

- Histogram



Histogram Summary GCLOutputAnalyzer(1)						
Cell	Cell Limits		Abs. Freq. (Time)		Rel. Freq.	
	From	To	Cell	Cumul.	Cell	Cumul.
1	-Infinity	0	0	0	0	0
2	0	0.1	26.48	26.48	0.0106	0.0106
3	0.1	0.2	73.31	99.79	0.02934	0.03993
4	0.2	0.3	129.4	229.2	0.05178	0.09171
5	0.3	0.4	174.8	404	0.06995	0.1617
6	0.4	0.5	201.7	605.6	0.08071	0.2424
7	0.5	0.6	282.1	887.7	0.1129	0.3553
8	0.6	0.7	341.1	1229	0.1365	0.4918
9	0.7	0.8	371.4	1600	0.1486	0.6404
10	0.8	0.9	409.9	2010	0.164	0.8044
11	0.9	1	488.7	2499	0.1956	1
12	1	+Infinity	0	2499	0	1

- Moving average



Display Forecasted Values Not Selected  
-----

TOTAL	ABS.DEVIATION	1301
MEAN	ABS.DEVIATION	0.2607
MEAN	BIAS	0.000248

Comparació

