Report

November 3, 2022

[ ]:
```
#currently including any and all Imports that maybe needed for the project.
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

1 Importing all CSVs

[ ]:
```
pulsar1_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR1_Tested_All.csv")
pulsar1_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR1_Tested_5ths.csv")
pulsar2_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR2_Tested_All.csv")
pulsar2_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR2_Tested_5ths.csv")
pulsar3_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR3_Tested_All.csv")
pulsar3_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR3_Tested_5ths.csv")
pulsar4_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR4_Tested_All.csv")
pulsar4_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR4_Tested_5ths.csv")
pulsar5_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR5_Tested_All.csv")
pulsar5_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR5_Tested_5ths.csv")
pulsar4_10th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR4_Tested_10ths.
↪csv")
pulsar6_all = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR6_Tested_All.csv")
pulsar6_5th = pd.read_csv("pulsaryBinaryDataResultsCSV/PULSAR6_Tested_5ths.csv")

RandTestResults = pd.read_csv("RandTestResults.csv")
```

2 Key for Outcome Column

Absolute = value of 1.0 (Positive) Error = Value of -1.0 - P-values are never negative therefore indicates an error Random = P-values match the random proof Non-Random = P-values match the non-random proof

3 All Emissions

[ ]:
```
AllofAll = pulsar1_all
pulsar2_all = pulsar2_all.set_axis(['Test Name','P-Value','Outcome2'], axis =␣
↪1, inplace= False)
pulsar3_all = pulsar3_all.set_axis(['Test Name','P-Value','Outcome3'], axis =␣
↪1, inplace= False)
pulsar4_all = pulsar4_all.set_axis(['Test Name','P-Value','Outcome4'], axis =␣
↪1, inplace= False)
pulsar5_all = pulsar5_all.set_axis(['Test Name','P-Value','Outcome5'], axis =␣
↪1, inplace= False)
pulsar6_all = pulsar6_all.set_axis(['Test Name','P-Value','Outcome6'], axis =␣
↪1, inplace= False)
AllofAll['Outcome2'] = pulsar2_all['Outcome2'].values
AllofAll['Outcome3'] = pulsar3_all['Outcome3'].values
AllofAll['Outcome4'] = ''
AllofAll['Outcome5'] = pulsar5_all['Outcome5'].values
AllofAll['Outcome6'] = pulsar6_all['Outcome6'].values
pulse4 = np.array(pulsar4_all['Outcome4'].values)
AllofAll['Outcome4'] = pd.Series(pulse4)
AllofAll = AllofAll.drop(columns='P-Value')
AllofAll
```

[ ]:

	Test Name	Outcome	Outcome2
0	Frequency Test (Monobit)	Absolute	Random
1	Frequency Test within a Block	Non-Random	Non-Random
2	Run Test	Non-Random	Non-Random
3	Longest Run of Ones in a Block	Random	Non-Random
4	Binary Matrix Rank Test	Random	Random
5	Discrete Fourier Transform (Spectral) Test	Random	Non-Random
6	Non-Overlapping Template Matching Test	Non-Random	Non-Random
7	Overlapping Template Matching Test	Non-Random	Non-Random
8	Maurer's Universal Statistical Test	Error	Error
9	Linear Complexity Test	Random	Random
10	Serial Test A	Non-Random	Non-Random
11	Serial Test B	Non-Random	Random
12	Approximate Entropy Test	Non-Random	Non-Random
13	Cumulative Sums (Forward) Test	Random	Random
14	Cumulative Sums (Reverse) Test	Random	Random
15	Random Excursions Test State -4	Random	Random
16	Random Excursions Test State -3	Random	Non-Random
17	Random Excursions Test State -2	Random	Non-Random
18	Random Excursions Test State -1	Random	Random
19	Random Excursions Test State +1	Random	Random
20	Random Excursions Test State +2	Random	Random
21	Random Excursions Test State +3	Random	Random
22	Random Excursions Test State +4	Random	Random

23	Random Exursions Variant Test State -9	Random	Random
24	Random Exursions Variant Test State -8	Random	Random
25	Random Exursions Variant Test State -7	Random	Random
26	Random Exursions Variant Test State -6	Random	Random
27	Random Exursions Variant Test State -5	Random	Random
28	Random Exursions Variant Test State -4	Random	Random
29	Random Exursions Variant Test State -3	Random	Random
30	Random Exursions Variant Test State -2	Random	Random
31	Random Exursions Variant Test State -1	Random	Random
32	Random Exursions Variant Test State +1	Random	Random
33	Random Exursions Variant Test State +2	Random	Random
34	Random Exursions Variant Test State +3	Random	Random
35	Random Exursions Variant Test State +4	Random	Random
36	Random Exursions Variant Test State +5	Random	Random
37	Random Exursions Variant Test State +6	Random	Random
38	Random Exursions Variant Test State +7	Random	Random
39	Random Exursions Variant Test State +8	Random	Random
40	Random Exursions Variant Test State +9	Random	Random

	Outcome3	Outcome4	Outcome5	Outcome6
0	Random	Random	Random	Absolute
1	Random	Non-Random	Random	Random
2	Random	Non-Random	Non-Random	Non-Random
3	Random	Non-Random	Random	Non-Random
4	Random	Random	Random	Error
5	Random	Random	Random	Random
6	Random	Random	Random	Random
7	Random	Random	Random	Error
8	Error	Error	Error	Error
9	Random	Random	Random	Error
10	Random	Non-Random	Random	Random
11	Random	Non-Random	Random	Random
12	Random	Non-Random	Random	Absolute
13	Random	Non-Random	Random	Random
14	Random	Non-Random	Random	Random
15	Random	Random	Non-Random	Random
16	Random	Random	Random	Random
17	Random	Random	Random	Random
18	Random	Random	Random	Random
19	Random	Random	Random	Random
20	Random	Random	Random	Random
21	Random	Random	Random	Random
22	Random	Random	Random	Non-Random
23	Random	Random	Random	Random
24	Random	Random	Random	Random
25	Random	Random	Random	Random
26	Random	Random	Random	Random

27	Random	Random	Random	Random
28	Random	Random	Random	Random
29	Random	Random	Random	Random
30	Random	Random	Random	Random
31	Random	Random	Random	Random
32	Random	Random	Random	Random
33	Random	NaN	Random	Random
34	Random	NaN	Random	Random
35	Random	NaN	Absolute	Random
36	Random	NaN	Random	Random
37	Random	NaN	Random	Random
38	Random	NaN	Random	Random
39	Random	NaN	Random	Random
40	Random	NaN	Random	Random

4 Every 5th

[ ]:
```
Allof5th = pulsar1_5th
pulsar2_5th = pulsar2_5th.set_axis(['Test Name','P-Value','Outcome2'], axis =␣
 ↪1, inplace= False)
pulsar3_5th = pulsar3_5th.set_axis(['Test Name','P-Value','Outcome3'], axis =␣
 ↪1, inplace= False)
pulsar4_5th = pulsar4_5th.set_axis(['Test Name','P-Value','Outcome4'], axis =␣
 ↪1, inplace= False)
pulsar5_5th = pulsar5_5th.set_axis(['Test Name','P-Value','Outcome5'], axis =␣
 ↪1, inplace= False)
pulsar6_5th = pulsar6_5th.set_axis(['Test Name','P-Value','Outcome6'], axis =␣
 ↪1, inplace= False)
Allof5th['Outcome2'] = ''
Allof5th['Outcome3'] = ''
Allof5th['Outcome4'] = ''
Allof5th['Outcome5'] = ''
Allof5th['Outcome6'] = ''
pulse2 = np.array(pulsar2_5th['Outcome2'].values)
Allof5th['Outcome2'] = pd.Series(pulse2)
pulse3 = np.array(pulsar3_5th['Outcome3'].values)
Allof5th['Outcome3'] = pd.Series(pulse3)
pulse4 = np.array(pulsar4_5th['Outcome4'].values)
Allof5th['Outcome4'] = pd.Series(pulse4)
pulse5 = np.array(pulsar5_5th['Outcome5'].values)
Allof5th['Outcome5'] = pd.Series(pulse5)
pulse6 = np.array(pulsar6_5th['Outcome6'].values)
Allof5th['Outcome6'] = pd.Series(pulse6)
Allof5th = Allof5th.drop(columns='P-Value')
Allof5th
```

[ ]:

	Test Name	Outcome	Outcome2
0	Frequency Test (Monobit)	Random	Random
1	Frequency Test within a Block	Random	Random
2	Run Test	Random	Random
3	Longest Run of Ones in a Block	Random	Random
4	Binary Matrix Rank Test	Random	Random
5	Discrete Fourier Transform (Spectral) Test	Random	Random
6	Non-Overlapping Template Matching Test	Random	Random
7	Overlapping Template Matching Test	Random	Random
8	Maurer's Universal Statistical Test	Error	Error
9	Linear Complexity Test	Random	Random
10	Serial Test A	Random	Random
11	Serial Test B	Random	Random
12	Approximate Entropy Test	Non-Random	Non-Random
13	Cumulative Sums (Forward) Test	Random	Random
14	Cumulative Sums (Reverse) Test	Random	Random
15	Random Excursions Test State -4	Random	Random
16	Random Excursions Test State -3	Random	Random
17	Random Excursions Test State -2	Random	Random
18	Random Excursions Test State -1	Random	Random
19	Random Excursions Test State +1	Random	Non-Random
20	Random Excursions Test State +2	Non-Random	Non-Random
21	Random Excursions Test State +3	Non-Random	Random
22	Random Excursions Test State +4	Random	Random
23	Random Exursions Variant Test State +1	Random	Random
24	Random Exursions Variant Test State +2	Random	Random
25	Random Exursions Variant Test State +3	Random	Random
26	Random Exursions Variant Test State +4	Non-Random	Random
27	Random Exursions Variant Test State +5	Non-Random	Random
28	Random Exursions Variant Test State +6	Non-Random	Random
29	Random Exursions Variant Test State +7	Non-Random	Random
30	Random Exursions Variant Test State +8	Random	Random
31	Random Exursions Variant Test State +9	Random	Random

	Outcome3	Outcome4	Outcome5	Outcome6
0	Random	Random	Random	Random
1	Random	Non-Random	Random	Random
2	Random	Non-Random	Random	Random
3	Random	Random	Random	Random
4	Error	Error	Error	Error
5	Non-Random	Random	Random	Random
6	Random	Absolute	Absolute	Random
7	Error	Error	Error	Error
8	Error	Error	Error	Error
9	Error	Error	Error	Error
10	Random	Non-Random	Random	Random
11	Random	Non-Random	Random	Random

12	Absolute	Absolute	Absolute	Absolute
13	Random	Non-Random	Random	Random
14	Random	Non-Random	Random	Random
15	Random	Random	Random	Random
16	Random	Random	Random	Random
17	Random	Random	Random	Random
18	Random	Random	Random	Random
19	Random	Non-Random	Random	Random
20	Random	Non-Random	Random	Random
21	Random	Non-Random	Random	Random
22	Random	Non-Random	Random	Random
23	Random	Random	Random	Random
24	Random	Non-Random	Random	Random
25	Random	Non-Random	Random	Random
26	Random	Non-Random	Random	Random
27	Random	Random	Random	Random
28	Random	Random	Random	Random
29	Random	Random	Random	Random
30	Random	Random	Random	Random
31	Random	Random	Random	Random

5 Edge Case Pulsar analysis

[ ]:
```
pulsar4_10th = pulsar4_10th.drop(columns='P-Value')
pulsar4_10th
```

[ ]:

	Test Name	Outcome
0	Frequency Test (Monobit)	Random
1	Frequency Test within a Block	Random
2	Run Test	Non-Random
3	Longest Run of Ones in a Block	Random
4	Binary Matrix Rank Test	Error
5	Discrete Fourier Transform (Spectral) Test	Random
6	Non-Overlapping Template Matching Test	Absolute
7	Overlapping Template Matching Test	Error
8	Maurer's Universal Statistical Test	Error
9	Linear Complexity Test	Error
10	Serial Test A	Non-Random
11	Serial Test B	Non-Random
12	Approximate Entropy Test	Absolute
13	Cumulative Sums (Forward) Test	Random
14	Cumulative Sums (Reverse) Test	Random
15	Random Excursions Test State -4	Random
16	Random Excursions Test State -3	Random
17	Random Excursions Test State -2	Random
18	Random Excursions Test State -1	Random

```
19             Random Excursions Test State +1      Random
20             Random Excursions Test State +2      Random
21             Random Excursions Test State +3      Random
22             Random Excursions Test State +4      Random
23      Random Exursions Variant Test State -3      Random
24      Random Exursions Variant Test State -2      Random
25      Random Exursions Variant Test State -1      Random
26      Random Exursions Variant Test State +1    Absolute
27      Random Exursions Variant Test State +2      Random
28      Random Exursions Variant Test State +3      Random
29      Random Exursions Variant Test State +4      Random
30      Random Exursions Variant Test State +5      Random
31      Random Exursions Variant Test State +6      Random
32      Random Exursions Variant Test State +7      Random
33      Random Exursions Variant Test State +8      Random
34      Random Exursions Variant Test State +9      Random
```

6 Looking at Pulsars with RandTest Lib

[ ]:
```
RandTestResults
```

[ ]:
```
   RandTestAll  RandTest5ths RandTestElse
0         True          True         Null
1         True          True         Null
2         True          True         Null
3         True          True         True
4         True          True         Null
5         True          True         Null
```

6.1 Analysis of RandTest Results

The RandTest suite uses an algorithm called "exponentially-decaying moment prediction" to determine the net deviation between predicted and actual elements in sequences. It evaluated whether or not a sequence of numbers are random or not.

It has a stated accuracy of 99.85% for non random sequences and 96.82% for random sequences. This means the test will typically sustain a high degree of accuracy especially at a 0.05 cut off. But does falter at meeting the cyber security standard of 0.01. This means we will use this in conjunction with the overall statement from the NIST suite on the specific tests as extra evidence to prove or disprove randomness.

In the case above we can clearly see that RandTest labels all binary sequences as random with no prediction this means we can confidently say with 96% certainty of this truth, this meets most standards of prediction. But fails to meet the industry standard of 99% accuracy with cybersecurity.

7 Important results from NIST

The first five tests are interpreted as the most important.

1. The Frequency (Monobit) Test is the first test in the NIST suite, and the remainder of the tests are dependent upon this test retaining the null hypothesis. The test determines the closeness of the fraction of 1's to 1/2. For the test to pass, the number of 1's and 0's in the sequence should be similar.

For the datasets containing every observation, the binary sequence has been created based on the median of the dataset, so by the nature of median (the middle value), the number of 0's and 1's will be equal (or different by 1 in the case of an odd number of observations), hence running the test on these sequences will return a p-value of 1 (or very close to 1 for odd number of observations), providing strong evidence to retain the null hypothesis, the expected outcome.

Of more interest is the same test on the datasets of every 5th observation (pulsars 1, 2, 3, 4 ,5, 6) and the test on every 10th observation (pulsar 4), where there isn't the same guarantee of an equal amount of 0's and 1's. Analysing the results of each test, every number sequence passes. The lowest p-value observed is 0.096872 for pulsar 1 for every 5th observation, however it is still well above the 0.01 significance level. Now that each dataset has passed this test, further testing can be undertaken.

2. The next test, Frequency Test within a Block, applies a similar logic to the previous test, but instead tests the proportion of 1's in a bit block of length M, expecting the frequency of 1's to be close to M/2 for the test to pass.

For the datasets with every observation, pulsars 1,2 and 4 fail this test (extremely small p-values). On the other hand, pulsars 3 and 6 provide extremely strong evidence (high p-value) that the fraction of 1's with the M length bit blocks is close to 1/2. While pulsar 5 has provides moderate evidence, p-value = 0.0398, just over the alpha of 0.01, that there is an equal proportion of 1's and 0's.

Looking to the datasets with every 5th observation, pulsars 1,2,3,5 and 6 pass with fairly strong evidence, while pulsar 4 fails. Then for pulsar 4 with every 10th observation it just passes with a p-value of 0.0216.

3. The Runs Test focuses on the number of runs in a sequence, where a run is the number of identical bits in a row. E.g., a run of length 25 is a sequence of 25 zeroes (or ones) in a row. The test determines if the number of runs is as would be expected in a random sequence.

For datasets containing every observation, pulsar 1,2,4,5 and 6 fail to pass this test, while pulsar 3 passes.

For the datasets on every 5th observation, there is a large shift in the number of sequences that pass, pulsar 1, 2, 3, 5 and 6 all pass, while only pulsar 4 fails. For every 10th observation on pulsar 4 the test also fails.

4. The Test for the Longest Run of Ones in a Block provides a similar approach as the previous Runs Test; however, it instead focuses on the longest run of ones within M-bit blocks and compares it with what would be expected of a random sequence.

For the datasets containing all observations, pulsar 1, 3 and 5 passes pulsar 2, 4 and 6 fails.

When we look at the datasets containing every 5th observation, all six pulsars pass. In addition, the test on every 10th observation of pulsar 4 also passes.

5. The fifth test is the Binary Matric Rank Test, this test breaks the binary sequence down into 32x32 matrices. Then it tests for linear dependence within the matrices. Given the nature

of this test, the datasets need to be quite large for the test to be able to run, some of the datasets, especially those with every 5th or 10th observation may not have had enough data to run. If this situation occurs, the test will return a p-value of –1, which is an indicator that the test was unable to run, based on too little data.

For pulsars with every observation included pulsars 1, 2, 3, 4 and 5 pass and pulsar 6 doesn't have enough data to run (hence p-value = -1).

For the datasets containing every 5th observation, 1 and 2 pass while pulsars 3, 4, 5 and 6 can't run due to too little data.

7.1 Summary Table of these 5 important tests per test

7.1.1 Pulsar 1 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Fail
Runs Test	Fail
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	Pass
Total	3/5

7.1.2 Pulsar 1 5ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	Pass
Total	5/5

7.1.3 Pulsar 2 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Fail
Runs Test	Fail
Logest Run of Ones in a Block	Fail
Binary Matrix Rank Test	Pass
Total	2/5

7.1.4 Pulsar 2 5ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	Pass
Total	5/5

7.1.5 Pulsar 3 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	Pass
Total	5/5

7.1.6 Pulsar 3 5ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	N/A
Total	4/5

7.1.7 Pulsar 4 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Fail
Runs Test	Fail
Logest Run of Ones in a Block	Fail
Binary Matrix Rank Test	Pass
Total	2/5

7.1.8 Pulsar 4 5ths

Test	Result
Frequency Test (Monobit)	Pass

Test	Result
Frequencey Test within a Block	Fail
Runs Test	Fail
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	N/A
Total	2/5

7.1.9 Pulsar 4 10ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Fail
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	N/A
Total	3/5

7.1.10 Pulsar 5 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Fail
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	Pass
Total	4/5

7.1.11 Pulsar 5 5ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	N/A
Total	4/5

7.1.12 Pulsar 6 ALL

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass

Test	Result
Runs Test	Fail
Logest Run of Ones in a Block	Fail
Binary Matrix Rank Test	N/A
Total	2/5

7.1.13 Pulsar 6 5ths

Test	Result
Frequency Test (Monobit)	Pass
Frequencey Test within a Block	Pass
Runs Test	Pass
Logest Run of Ones in a Block	Pass
Binary Matrix Rank Test	N/A
Total	4/5

8 Final Summary of Data

We can see here that the majority of the tests passed the first 2 most crucial tests except for Pulsar 4 which immediately disqualifies it from further evaluation. The same expectation can be said for the Pulsar binary datasets that do fail the Runs Test. However, Pulsar 5 is seen as a bit of an exception due to the fact that it is the only pulsar that fails the Runs test but none of the other tests outside of the Random Excursions test at state -4. We pass 5 as random due to the sheer weighting of all the other evidence stacked against the runs test, this strongly indicates that the pulsar 5 should be more deeply investigate for a true determination.

We can come to the summary conclusion that for all emissions, only Pulsar 3 is truly random and Pulsar 5 is seen to be random pending further investigation.

For Auto-Correlated observations at every 5th we can determine that the random pulsars are all of them except for 4 so this means Pulsars 1,2,3,5,6 at every 5th emission is random.

At ACF 10th lags we find that the Pulsar 4 observations indeed become random, but due to the distance from the original emissions it is still seen as a non-random pulsar with some underlying structure uniforming it.

9 Appendix Individual Table Results

You can also find the individual results in the pulsarBinaryDataResults file. With each txt corresponding with each test and their P-values.

Note most P-values below were reformatted by the excel program to not be a decimal

9.1 Pulsar 1 All

[ ]:
```
pulsar1_all
```

[ ]:

	Test Name	P-Value	Outcome	\
0	Frequency Test (Monobit)	1.000000e+00	Absolute	
1	Frequency Test within a Block	9.050000e-08	Non-Random	
2	Run Test	3.353164e-03	Non-Random	
3	Longest Run of Ones in a Block	4.782901e-02	Random	
4	Binary Matrix Rank Test	1.020085e-01	Random	
5	Discrete Fourier Transform (Spectral) Test	5.765222e-01	Random	
6	Non-Overlapping Template Matching Test	4.860000e-07	Non-Random	
7	Overlapping Template Matching Test	5.365440e-04	Non-Random	
8	Maurer's Universal Statistical Test	-1.000000e+00	Error	
9	Linear Complexity Test	8.177284e-01	Random	
10	Serial Test A	2.420000e-19	Non-Random	
11	Serial Test B	1.600000e-06	Non-Random	
12	Approximate Entropy Test	1.840000e-13	Non-Random	
13	Cumulative Sums (Forward) Test	6.250000e-01	Random	
14	Cumulative Sums (Reverse) Test	6.250000e-01	Random	
15	Random Excursions Test State -4	1.210000e-01	Random	
16	Random Excursions Test State -3	3.158609e-01	Random	
17	Random Excursions Test State -2	3.590000e-01	Random	
18	Random Excursions Test State -1	7.280000e-01	Random	
19	Random Excursions Test State +1	2.730000e-01	Random	
20	Random Excursions Test State +2	1.640000e-01	Random	
21	Random Excursions Test State +3	3.070000e-01	Random	
22	Random Excursions Test State +4	1.160000e-01	Random	
23	Random Exursions Variant Test State -9	1.503674e-01	Random	
24	Random Exursions Variant Test State -8	2.508288e-01	Random	
25	Random Exursions Variant Test State -7	2.850494e-01	Random	
26	Random Exursions Variant Test State -6	2.685964e-01	Random	
27	Random Exursions Variant Test State -5	4.008621e-01	Random	
28	Random Exursions Variant Test State -4	7.261831e-01	Random	
29	Random Exursions Variant Test State -3	9.471395e-01	Random	
30	Random Exursions Variant Test State -2	7.808785e-01	Random	
31	Random Exursions Variant Test State -1	9.114677e-01	Random	
32	Random Exursions Variant Test State +1	7.110000e-01	Random	
33	Random Exursions Variant Test State +2	7.320000e-01	Random	
34	Random Exursions Variant Test State +3	6.430000e-01	Random	
35	Random Exursions Variant Test State +4	5.100000e-01	Random	
36	Random Exursions Variant Test State +5	8.140000e-01	Random	
37	Random Exursions Variant Test State +6	9.820000e-01	Random	
38	Random Exursions Variant Test State +7	9.340000e-01	Random	
39	Random Exursions Variant Test State +8	6.670000e-01	Random	
40	Random Exursions Variant Test State +9	7.260000e-01	Random	

Outcome2	Outcome3	Outcome4	Outcome5	Outcome6

0	Random	Random	Random	Random	Absolute
1	Non-Random	Random	Non-Random	Random	Random
2	Non-Random	Random	Non-Random	Non-Random	Non-Random
3	Non-Random	Random	Non-Random	Random	Non-Random
4	Random	Random	Random	Random	Error
5	Non-Random	Random	Random	Random	Random
6	Non-Random	Random	Random	Random	Random
7	Non-Random	Random	Random	Random	Error
8	Error	Error	Error	Error	Error
9	Random	Random	Random	Random	Error
10	Non-Random	Random	Non-Random	Random	Random
11	Random	Random	Non-Random	Random	Random
12	Non-Random	Random	Non-Random	Random	Absolute
13	Random	Random	Non-Random	Random	Random
14	Random	Random	Non-Random	Random	Random
15	Random	Random	Random	Non-Random	Random
16	Non-Random	Random	Random	Random	Random
17	Non-Random	Random	Random	Random	Random
18	Random	Random	Random	Random	Random
19	Random	Random	Random	Random	Random
20	Random	Random	Random	Random	Random
21	Random	Random	Random	Random	Random
22	Random	Random	Random	Random	Non-Random
23	Random	Random	Random	Random	Random
24	Random	Random	Random	Random	Random
25	Random	Random	Random	Random	Random
26	Random	Random	Random	Random	Random
27	Random	Random	Random	Random	Random
28	Random	Random	Random	Random	Random
29	Random	Random	Random	Random	Random
30	Random	Random	Random	Random	Random
31	Random	Random	Random	Random	Random
32	Random	Random	Random	Random	Random
33	Random	Random	NaN	Random	Random
34	Random	Random	NaN	Random	Random
35	Random	Random	NaN	Absolute	Random
36	Random	Random	NaN	Random	Random
37	Random	Random	NaN	Random	Random
38	Random	Random	NaN	Random	Random
39	Random	Random	NaN	Random	Random
40	Random	Random	NaN	Random	Random

9.2 Pulsar 1 5ths

[ ]:
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pulsar1_5th
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[ ]:

	Test Name	P-Value	Outcome
0	Frequency Test (Monobit)	0.096872	Random
1	Frequency Test within a Block	0.273011	Random
2	Run Test	0.295998	Random
3	Longest Run of Ones in a Block	0.143727	Random
4	Binary Matrix Rank Test	0.858290	Random
5	Discrete Fourier Transform (Spectral) Test	0.453695	Random
6	Non-Overlapping Template Matching Test	0.424735	Random
7	Overlapping Template Matching Test	0.418207	Random
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	0.757153	Random
10	Serial Test A	0.148533	Random
11	Serial Test B	0.445237	Random
12	Approximate Entropy Test	0.000145	Non-Random
13	Cumulative Sums (Forward) Test	0.072222	Random
14	Cumulative Sums (Reverse) Test	0.193743	Random
15	Random Excursions Test State -4	0.997903	Random
16	Random Excursions Test State -3	0.995330	Random
17	Random Excursions Test State -2	0.984748	Random
18	Random Excursions Test State -1	0.849145	Random
19	Random Excursions Test State +1	0.156236	Random
20	Random Excursions Test State +2	0.000354	Non-Random
21	Random Excursions Test State +3	0.000475	Non-Random
22	Random Excursions Test State +4	0.369569	Random
23	Random Exursions Variant Test State +1	0.317311	Random
24	Random Exursions Variant Test State +2	0.386476	Random
25	Random Exursions Variant Test State +3	0.013906	Random
26	Random Exursions Variant Test State +4	0.000670	Non-Random
27	Random Exursions Variant Test State +5	0.007661	Non-Random
28	Random Exursions Variant Test State +6	0.000526	Non-Random
29	Random Exursions Variant Test State +7	0.002282	Non-Random
30	Random Exursions Variant Test State +8	0.038867	Random
31	Random Exursions Variant Test State +9	0.015293	Random

	Outcome2	Outcome3	Outcome4	Outcome5	Outcome6
0	Random	Random	Random	Random	Random
1	Random	Random	Non-Random	Random	Random
2	Random	Random	Non-Random	Random	Random
3	Random	Random	Random	Random	Random
4	Random	Error	Error	Error	Error
5	Random	Non-Random	Random	Random	Random
6	Random	Random	Absolute	Absolute	Random
7	Random	Error	Error	Error	Error
8	Error	Error	Error	Error	Error
9	Random	Error	Error	Error	Error
10	Random	Random	Non-Random	Random	Random
11	Random	Random	Non-Random	Random	Random

12	Non-Random	Absolute	Absolute	Absolute	Absolute
13	Random	Random	Non-Random	Random	Random
14	Random	Random	Non-Random	Random	Random
15	Random	Random	Random	Random	Random
16	Random	Random	Random	Random	Random
17	Random	Random	Random	Random	Random
18	Random	Random	Random	Random	Random
19	Non-Random	Random	Non-Random	Random	Random
20	Non-Random	Random	Non-Random	Random	Random
21	Random	Random	Non-Random	Random	Random
22	Random	Random	Non-Random	Random	Random
23	Random	Random	Random	Random	Random
24	Random	Random	Non-Random	Random	Random
25	Random	Random	Non-Random	Random	Random
26	Random	Random	Non-Random	Random	Random
27	Random	Random	Random	Random	Random
28	Random	Random	Random	Random	Random
29	Random	Random	Random	Random	Random
30	Random	Random	Random	Random	Random
31	Random	Random	Random	Random	Random

9.3 Pulsar 2 All

[ ]:
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pulsar2_all
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[ ]:

	Test Name	P-Value	Outcome2
0	Frequency Test (Monobit)	9.933346e-01	Random
1	Frequency Test within a Block	9.910000e-12	Non-Random
2	Run Test	3.200000e-94	Non-Random
3	Longest Run of Ones in a Block	3.810000e-36	Non-Random
4	Binary Matrix Rank Test	2.570000e-01	Random
5	Discrete Fourier Transform (Spectral) Test	6.140000e-05	Non-Random
6	Non-Overlapping Template Matching Test	3.830000e-26	Non-Random
7	Overlapping Template Matching Test	4.630000e-13	Non-Random
8	Maurer's Universal Statistical Test	-1.000000e+00	Error
9	Linear Complexity Test	5.807496e-01	Random
10	Serial Test A	2.350000e-17	Non-Random
11	Serial Test B	9.520000e-01	Random
12	Approximate Entropy Test	8.310000e-34	Non-Random
13	Cumulative Sums (Forward) Test	5.600000e-01	Random
14	Cumulative Sums (Reverse) Test	5.530000e-01	Random
15	Random Excursions Test State -4	2.050000e-01	Random
16	Random Excursions Test State -3	7.680000e-03	Non-Random
17	Random Excursions Test State -2	1.610000e-03	Non-Random
18	Random Excursions Test State -1	1.780000e-02	Random
19	Random Excursions Test State +1	3.980000e-01	Random
20	Random Excursions Test State +2	4.020000e-01	Random

21	Random Excursions Test State +3	1.520000e-01	Random
22	Random Excursions Test State +4	4.760000e-01	Random
23	Random Exursions Variant Test State -9	8.054226e-01	Random
24	Random Exursions Variant Test State -8	8.514120e-01	Random
25	Random Exursions Variant Test State -7	9.198637e-01	Random
26	Random Exursions Variant Test State -6	9.651054e-01	Random
27	Random Exursions Variant Test State -5	9.037602e-01	Random
28	Random Exursions Variant Test State -4	6.808479e-01	Random
29	Random Exursions Variant Test State -3	5.164123e-01	Random
30	Random Exursions Variant Test State -2	3.147768e-01	Random
31	Random Exursions Variant Test State -1	1.467931e-01	Random
32	Random Exursions Variant Test State +1	3.100000e-01	Random
33	Random Exursions Variant Test State +2	7.060000e-01	Random
34	Random Exursions Variant Test State +3	8.460000e-01	Random
35	Random Exursions Variant Test State +4	9.560000e-01	Random
36	Random Exursions Variant Test State +5	7.170000e-01	Random
37	Random Exursions Variant Test State +6	8.100000e-01	Random
38	Random Exursions Variant Test State +7	9.680000e-01	Random
39	Random Exursions Variant Test State +8	9.550000e-01	Random
40	Random Exursions Variant Test State +9	8.880000e-01	Random

9.4 Pulsar 2 5ths

[ ]:
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pulsar2_5th
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[ ]:

	Test Name	P-Value	Outcome2
0	Frequency Test (Monobit)	0.736699	Random
1	Frequency Test within a Block	0.753000	Random
2	Run Test	0.018694	Random
3	Longest Run of Ones in a Block	0.092363	Random
4	Binary Matrix Rank Test	0.481248	Random
5	Discrete Fourier Transform (Spectral) Test	0.565809	Random
6	Non-Overlapping Template Matching Test	0.526000	Random
7	Overlapping Template Matching Test	0.248594	Random
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	0.543779	Random
10	Serial Test A	0.123000	Random
11	Serial Test B	0.224000	Random
12	Approximate Entropy Test	0.000025	Non-Random
13	Cumulative Sums (Forward) Test	0.604000	Random
14	Cumulative Sums (Reverse) Test	0.904000	Random
15	Random Excursions Test State -4	0.332000	Random
16	Random Excursions Test State -3	0.161000	Random
17	Random Excursions Test State -2	0.625000	Random
18	Random Excursions Test State -1	0.719000	Random
19	Random Excursions Test State +1	0.008430	Non-Random
20	Random Excursions Test State +2	0.000040	Non-Random

21	Random Excursions Test State +3	0.152000	Random
22	Random Excursions Test State +4	0.383000	Random
23	Random Exursions Variant Test State -5	0.226919	Random
24	Random Exursions Variant Test State -4	0.237548	Random
25	Random Exursions Variant Test State -3	0.263552	Random
26	Random Exursions Variant Test State -2	0.193931	Random
27	Random Exursions Variant Test State -1	0.133614	Random
28	Random Exursions Variant Test State +1	0.261000	Random
29	Random Exursions Variant Test State +2	0.516000	Random
30	Random Exursions Variant Test State +3	0.576000	Random
31	Random Exursions Variant Test State +4	0.450000	Random
32	Random Exursions Variant Test State +5	0.739000	Random
33	Random Exursions Variant Test State +6	0.792000	Random
34	Random Exursions Variant Test State +7	0.533000	Random
35	Random Exursions Variant Test State +8	0.561000	Random
36	Random Exursions Variant Test State +9	0.649000	Random

9.5 Pulsar 3 All

[ ]:
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pulsar3_all
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[ ]:

	Test Name	P-Value	Outcome3
0	Frequency Test (Monobit)	0.978133	Random
1	Frequency Test within a Block	0.843000	Random
2	Run Test	0.051600	Random
3	Longest Run of Ones in a Block	0.206000	Random
4	Binary Matrix Rank Test	0.694000	Random
5	Discrete Fourier Transform (Spectral) Test	0.655000	Random
6	Non-Overlapping Template Matching Test	0.771000	Random
7	Overlapping Template Matching Test	0.887000	Random
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	0.320837	Random
10	Serial Test A	0.876000	Random
11	Serial Test B	0.553000	Random
12	Approximate Entropy Test	0.767000	Random
13	Cumulative Sums (Forward) Test	0.943000	Random
14	Cumulative Sums (Reverse) Test	0.926000	Random
15	Random Excursions Test State -4	0.339000	Random
16	Random Excursions Test State -3	0.590000	Random
17	Random Excursions Test State -2	0.573000	Random
18	Random Excursions Test State -1	0.590000	Random
19	Random Excursions Test State +1	0.491000	Random
20	Random Excursions Test State +2	0.565000	Random
21	Random Excursions Test State +3	0.448000	Random
22	Random Excursions Test State +4	0.643000	Random
23	Random Exursions Variant Test State -9	0.215330	Random
24	Random Exursions Variant Test State -8	0.180652	Random

25	Random Exursions Variant Test State -7	0.150421	Random
26	Random Exursions Variant Test State -6	0.174968	Random
27	Random Exursions Variant Test State -5	0.232254	Random
28	Random Exursions Variant Test State -4	0.286278	Random
29	Random Exursions Variant Test State -3	0.322716	Random
30	Random Exursions Variant Test State -2	0.332797	Random
31	Random Exursions Variant Test State -1	0.541866	Random
32	Random Exursions Variant Test State +1	0.493000	Random
33	Random Exursions Variant Test State +2	0.509000	Random
34	Random Exursions Variant Test State +3	0.759000	Random
35	Random Exursions Variant Test State +4	0.863000	Random
36	Random Exursions Variant Test State +5	0.780000	Random
37	Random Exursions Variant Test State +6	0.629000	Random
38	Random Exursions Variant Test State +7	0.410000	Random
39	Random Exursions Variant Test State +8	0.288000	Random
40	Random Exursions Variant Test State +9	0.309000	Random

9.6 Pulsar 3 5ths

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pulsar3_5th
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[ ]:

	Test Name	P-Value	Outcome3
0	Frequency Test (Monobit)	0.951201	Random
1	Frequency Test within a Block	0.925000	Random
2	Run Test	0.126000	Random
3	Longest Run of Ones in a Block	0.957000	Random
4	Binary Matrix Rank Test	-1.000000	Error
5	Discrete Fourier Transform (Spectral) Test	0.003660	Non-Random
6	Non-Overlapping Template Matching Test	1.000000	Random
7	Overlapping Template Matching Test	-1.000000	Error
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	-1.000000	Error
10	Serial Test A	0.499000	Random
11	Serial Test B	0.499000	Random
12	Approximate Entropy Test	1.000000	Absolute
13	Cumulative Sums (Forward) Test	0.763000	Random
14	Cumulative Sums (Reverse) Test	0.705000	Random
15	Random Excursions Test State -4	0.886000	Random
16	Random Excursions Test State -3	0.347000	Random
17	Random Excursions Test State -2	0.735000	Random
18	Random Excursions Test State -1	0.700000	Random
19	Random Excursions Test State +1	0.659000	Random
20	Random Excursions Test State +2	0.258000	Random
21	Random Excursions Test State +3	0.018600	Random
22	Random Excursions Test State +4	0.783000	Random
23	Random Exursions Variant Test State -9	0.490920	Random
24	Random Exursions Variant Test State -8	0.463355	Random

25	Random Exursions Variant Test State -7	0.410205	Random
26	Random Exursions Variant Test State -6	0.413686	Random
27	Random Exursions Variant Test State -5	0.438578	Random
28	Random Exursions Variant Test State -4	0.406813	Random
29	Random Exursions Variant Test State -3	0.603332	Random
30	Random Exursions Variant Test State -2	0.765594	Random
31	Random Exursions Variant Test State -1	0.605577	Random
32	Random Exursions Variant Test State +1	0.699000	Random
33	Random Exursions Variant Test State +2	0.502000	Random
34	Random Exursions Variant Test State +3	0.326000	Random
35	Random Exursions Variant Test State +4	0.262000	Random
36	Random Exursions Variant Test State +5	0.263000	Random
37	Random Exursions Variant Test State +6	0.259000	Random
38	NaN	NaN	NaN
39	NaN	NaN	NaN
40	NaN	NaN	NaN

9.7 Pulsar 4 All

[ ]:
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pulsar4_all
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[ ]:

	Test Name	P-Value	Outcome4
0	Frequency Test (Monobit)	9.812939e-01	Random
1	Frequency Test within a Block	3.910000e-53	Non-Random
2	Run Test	3.420000e-21	Non-Random
3	Longest Run of Ones in a Block	3.930000e-08	Non-Random
4	Binary Matrix Rank Test	6.940000e-01	Random
5	Discrete Fourier Transform (Spectral) Test	1.820000e-02	Random
6	Non-Overlapping Template Matching Test	7.120000e-02	Random
7	Overlapping Template Matching Test	2.960000e-01	Random
8	Maurer's Universal Statistical Test	-1.000000e+00	Error
9	Linear Complexity Test	4.620000e-01	Random
10	Serial Test A	0.000000e+00	Non-Random
11	Serial Test B	0.000000e+00	Non-Random
12	Approximate Entropy Test	2.100000e-12	Non-Random
13	Cumulative Sums (Forward) Test	1.040000e-09	Non-Random
14	Cumulative Sums (Reverse) Test	8.930000e-10	Non-Random
15	Random Excursions Test State -4	9.730000e-01	Random
16	Random Excursions Test State -3	9.450000e-01	Random
17	Random Excursions Test State -2	8.490000e-01	Random
18	Random Excursions Test State -1	3.060000e-01	Random
19	Random Excursions Test State +1	9.310000e-01	Random
20	Random Excursions Test State +2	5.080000e-01	Random
21	Random Excursions Test State +3	1.770000e-01	Random
22	Random Excursions Test State +4	1.180000e-02	Random
23	Random Exursions Variant Test State -1	5.637029e-01	Random
24	Random Exursions Variant Test State +1	3.860000e-01	Random

25	Random Exursions Variant Test State +2	6.170000e-01	Random
26	Random Exursions Variant Test State +3	6.990000e-01	Random
27	Random Exursions Variant Test State +4	8.270000e-01	Random
28	Random Exursions Variant Test State +5	8.470000e-01	Random
29	Random Exursions Variant Test State +6	7.280000e-01	Random
30	Random Exursions Variant Test State +7	8.100000e-01	Random
31	Random Exursions Variant Test State +8	8.810000e-01	Random
32	Random Exursions Variant Test State +9	8.340000e-01	Random

9.8 Pulsar 4 5ths

[ ]:
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pulsar4_5th
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[ ]:

	Test Name	P-Value	Outcome4
0	Frequency Test (Monobit)	8.339354e-01	Random
1	Frequency Test within a Block	3.340000e-03	Non-Random
2	Run Test	3.350000e-03	Non-Random
3	Longest Run of Ones in a Block	4.350000e-01	Random
4	Binary Matrix Rank Test	-1.000000e+00	Error
5	Discrete Fourier Transform (Spectral) Test	3.120000e-01	Random
6	Non-Overlapping Template Matching Test	1.000000e+00	Absolute
7	Overlapping Template Matching Test	-1.000000e+00	Error
8	Maurer's Universal Statistical Test	-1.000000e+00	Error
9	Linear Complexity Test	-1.000000e+00	Error
10	Serial Test A	0.000000e+00	Non-Random
11	Serial Test B	0.000000e+00	Non-Random
12	Approximate Entropy Test	1.000000e+00	Absolute
13	Cumulative Sums (Forward) Test	3.970000e-03	Non-Random
14	Cumulative Sums (Reverse) Test	7.880000e-03	Non-Random
15	Random Excursions Test State -4	9.980000e-01	Random
16	Random Excursions Test State -3	9.950000e-01	Random
17	Random Excursions Test State -2	9.850000e-01	Random
18	Random Excursions Test State -1	8.490000e-01	Random
19	Random Excursions Test State +1	6.840000e-03	Non-Random
20	Random Excursions Test State +2	2.980000e-04	Non-Random
21	Random Excursions Test State +3	3.550000e-04	Non-Random
22	Random Excursions Test State +4	1.220000e-04	Non-Random
23	Random Exursions Variant Test State +1	1.240000e-02	Random
24	Random Exursions Variant Test State +2	1.490000e-05	Non-Random
25	Random Exursions Variant Test State +3	2.700000e-07	Non-Random
26	Random Exursions Variant Test State +4	1.570000e-04	Non-Random
27	Random Exursions Variant Test State +5	6.680000e-02	Random
28	Random Exursions Variant Test State +6	1.320000e-01	Random
29	Random Exursions Variant Test State +7	3.750000e-02	Random
30	Random Exursions Variant Test State +8	5.280000e-02	Random
31	Random Exursions Variant Test State +9	2.750000e-01	Random

9.9 Pulsar 4 10ths

[ ]:
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pulsar4_10th
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[ ]:

	Test Name	Outcome
0	Frequency Test (Monobit)	Random
1	Frequency Test within a Block	Random
2	Run Test	Non-Random
3	Longest Run of Ones in a Block	Random
4	Binary Matrix Rank Test	Error
5	Discrete Fourier Transform (Spectral) Test	Random
6	Non-Overlapping Template Matching Test	Absolute
7	Overlapping Template Matching Test	Error
8	Maurer's Universal Statistical Test	Error
9	Linear Complexity Test	Error
10	Serial Test A	Non-Random
11	Serial Test B	Non-Random
12	Approximate Entropy Test	Absolute
13	Cumulative Sums (Forward) Test	Random
14	Cumulative Sums (Reverse) Test	Random
15	Random Excursions Test State -4	Random
16	Random Excursions Test State -3	Random
17	Random Excursions Test State -2	Random
18	Random Excursions Test State -1	Random
19	Random Excursions Test State +1	Random
20	Random Excursions Test State +2	Random
21	Random Excursions Test State +3	Random
22	Random Excursions Test State +4	Random
23	Random Exursions Variant Test State -3	Random
24	Random Exursions Variant Test State -2	Random
25	Random Exursions Variant Test State -1	Random
26	Random Exursions Variant Test State +1	Absolute
27	Random Exursions Variant Test State +2	Random
28	Random Exursions Variant Test State +3	Random
29	Random Exursions Variant Test State +4	Random
30	Random Exursions Variant Test State +5	Random
31	Random Exursions Variant Test State +6	Random
32	Random Exursions Variant Test State +7	Random
33	Random Exursions Variant Test State +8	Random
34	Random Exursions Variant Test State +9	Random

9.10 Pulsar 5 All

[ ]:
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pulsar5_all
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[ ]:

	Test Name	P-Value	Outcome5
0	Frequency Test (Monobit)	0.977150	Random
1	Frequency Test within a Block	0.039800	Random

2	Run Test	0.000020	Non-Random
3	Longest Run of Ones in a Block	0.085500	Random
4	Binary Matrix Rank Test	0.694000	Random
5	Discrete Fourier Transform (Spectral) Test	0.064800	Random
6	Non-Overlapping Template Matching Test	0.032300	Random
7	Overlapping Template Matching Test	0.296000	Random
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	0.029600	Random
10	Serial Test A	0.853000	Random
11	Serial Test B	0.963000	Random
12	Approximate Entropy Test	0.956000	Random
13	Cumulative Sums (Forward) Test	0.761000	Random
14	Cumulative Sums (Reverse) Test	0.761000	Random
15	Random Excursions Test State -4	0.000254	Non-Random
16	Random Excursions Test State -3	0.019100	Random
17	Random Excursions Test State -2	0.162000	Random
18	Random Excursions Test State -1	0.067300	Random
19	Random Excursions Test State +1	0.941000	Random
20	Random Excursions Test State +2	0.951000	Random
21	Random Excursions Test State +3	0.155000	Random
22	Random Excursions Test State +4	0.027100	Random
23	Random Exursions Variant Test State -9	0.867859	Random
24	Random Exursions Variant Test State -8	0.790482	Random
25	Random Exursions Variant Test State -7	0.668588	Random
26	Random Exursions Variant Test State -6	0.569494	Random
27	Random Exursions Variant Test State -5	0.331137	Random
28	Random Exursions Variant Test State -4	0.194835	Random
29	Random Exursions Variant Test State -3	0.145052	Random
30	Random Exursions Variant Test State -2	0.092327	Random
31	Random Exursions Variant Test State -1	0.229949	Random
32	Random Exursions Variant Test State +1	0.170000	Random
33	Random Exursions Variant Test State +2	0.166000	Random
34	Random Exursions Variant Test State +3	0.645000	Random
35	Random Exursions Variant Test State +4	1.000000	Absolute
36	Random Exursions Variant Test State +5	0.775000	Random
37	Random Exursions Variant Test State +6	0.642000	Random
38	Random Exursions Variant Test State +7	0.812000	Random
39	Random Exursions Variant Test State +8	0.965000	Random
40	Random Exursions Variant Test State +9	0.835000	Random

9.11 Pulsar 5 5ths

[ ]:
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pulsar5_5th
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[ ]:

	Test Name	P-Value	Outcome5
0	Frequency Test (Monobit)	0.898120	Random
1	Frequency Test within a Block	0.860000	Random

2	Run Test	0.095800	Random
3	Longest Run of Ones in a Block	0.693000	Random
4	Binary Matrix Rank Test	-1.000000	Error
5	Discrete Fourier Transform (Spectral) Test	0.217000	Random
6	Non-Overlapping Template Matching Test	1.000000	Absolute
7	Overlapping Template Matching Test	-1.000000	Error
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	-1.000000	Error
10	Serial Test A	0.853000	Random
11	Serial Test B	0.932000	Random
12	Approximate Entropy Test	1.000000	Absolute
13	Cumulative Sums (Forward) Test	0.894000	Random
14	Cumulative Sums (Reverse) Test	0.786000	Random
15	Random Excursions Test State -4	0.728000	Random
16	Random Excursions Test State -3	0.900000	Random
17	Random Excursions Test State -2	0.755000	Random
18	Random Excursions Test State -1	0.968000	Random
19	Random Excursions Test State +1	0.383000	Random
20	Random Excursions Test State +2	0.542000	Random
21	Random Excursions Test State +3	0.568000	Random
22	Random Excursions Test State +4	0.796000	Random
23	Random Exursions Variant Test State -9	0.638822	Random
24	Random Exursions Variant Test State -8	8.415830	Random
25	Random Exursions Variant Test State -7	0.382103	Random
26	Random Exursions Variant Test State -6	0.500924	Random
27	Random Exursions Variant Test State -5	0.630192	Random
28	Random Exursions Variant Test State -4	0.655119	Random
29	Random Exursions Variant Test State -3	0.597154	Random
30	Random Exursions Variant Test State -2	0.820090	Random
31	Random Exursions Variant Test State -1	0.599426	Random
32	Random Exursions Variant Test State +1	0.237000	Random
33	Random Exursions Variant Test State +2	0.225000	Random
34	Random Exursions Variant Test State +3	0.159000	Random
35	Random Exursions Variant Test State +4	0.234000	Random
36	Random Exursions Variant Test State +5	0.294000	Random
37	Random Exursions Variant Test State +6	0.285000	Random
38	Random Exursions Variant Test State +7	0.382000	Random
39	Random Exursions Variant Test State +8	0.416000	Random
40	Random Exursions Variant Test State +9	0.390000	Random

9.12 Pulsar 6 All

[ ]:
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pulsar6_all
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[ ]:

	Test Name	P-Value	Outcome6
0	Frequency Test (Monobit)	1.000000	Absolute
1	Frequency Test within a Block	0.836000	Random

2	Run Test	0.000011	Non-Random
3	Longest Run of Ones in a Block	0.000178	Non-Random
4	Binary Matrix Rank Test	-1.000000	Error
5	Discrete Fourier Transform (Spectral) Test	0.218000	Random
6	Non-Overlapping Template Matching Test	0.087500	Random
7	Overlapping Template Matching Test	-1.000000	Error
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	-1.000000	Error
10	Serial Test A	0.356000	Random
11	Serial Test B	0.697000	Random
12	Approximate Entropy Test	1.000000	Absolute
13	Cumulative Sums (Forward) Test	0.679000	Random
14	Cumulative Sums (Reverse) Test	0.679000	Random
15	Random Excursions Test State -4	0.196000	Random
16	Random Excursions Test State -3	0.398000	Random
17	Random Excursions Test State -2	0.760000	Random
18	Random Excursions Test State -1	0.845000	Random
19	Random Excursions Test State +1	0.272000	Random
20	Random Excursions Test State +2	0.135000	Random
21	Random Excursions Test State +3	0.076700	Random
22	Random Excursions Test State +4	0.002160	Non-Random
23	Random Exursions Variant Test State -9	0.324324	Random
24	Random Exursions Variant Test State -8	0.338728	Random
25	Random Exursions Variant Test State -7	0.388747	Random
26	Random Exursions Variant Test State -6	0.449177	Random
27	Random Exursions Variant Test State -5	0.449063	Random
28	Random Exursions Variant Test State -4	0.366256	Random
29	Random Exursions Variant Test State -3	0.335979	Random
30	Random Exursions Variant Test State -2	0.407626	Random
31	Random Exursions Variant Test State -1	0.719918	Random
32	Random Exursions Variant Test State +1	0.720000	Random
33	Random Exursions Variant Test State +2	0.730000	Random
34	Random Exursions Variant Test State +3	0.364000	Random
35	Random Exursions Variant Test State +4	0.442000	Random
36	Random Exursions Variant Test State +5	0.605000	Random
37	Random Exursions Variant Test State +6	0.719000	Random
38	Random Exursions Variant Test State +7	0.947000	Random
39	Random Exursions Variant Test State +8	0.975000	Random
40	Random Exursions Variant Test State +9	0.908000	Random

9.13 Pulsar 6 5ths

[ ]:
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pulsar6_5th
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[ ]:

	Test Name	P-Value	Outcome6
0	Frequency Test (Monobit)	0.498962	Random
1	Frequency Test within a Block	0.596000	Random

2	Run Test	0.835000	Random
3	Longest Run of Ones in a Block	0.833000	Random
4	Binary Matrix Rank Test	-1.000000	Error
5	Discrete Fourier Transform (Spectral) Test	0.698000	Random
6	Non-Overlapping Template Matching Test	1.000000	Random
7	Overlapping Template Matching Test	-1.000000	Error
8	Maurer's Universal Statistical Test	-1.000000	Error
9	Linear Complexity Test	-1.000000	Error
10	Serial Test A	0.499000	Random
11	Serial Test B	0.098400	Random
12	Approximate Entropy Test	1.000000	Absolute
13	Cumulative Sums (Forward) Test	0.473000	Random
14	Cumulative Sums (Reverse) Test	0.849000	Random
15	Random Excursions Test State -4	0.431000	Random
16	Random Excursions Test State -3	0.494000	Random
17	Random Excursions Test State -2	0.221000	Random
18	Random Excursions Test State -1	0.149000	Random
19	Random Excursions Test State +1	0.570000	Random
20	Random Excursions Test State +2	0.801000	Random
21	Random Excursions Test State +3	0.924000	Random
22	Random Excursions Test State +4	0.963000	Random
23	Random Exursions Variant Test State -9	0.845815	Random
24	Random Exursions Variant Test State -8	0.944984	Random
25	Random Exursions Variant Test State -7	0.766848	Random
26	Random Exursions Variant Test State -6	0.808976	Random
27	Random Exursions Variant Test State -5	0.929013	Random
28	Random Exursions Variant Test State -4	0.613505	Random
29	Random Exursions Variant Test State -3	0.473289	Random
30	Random Exursions Variant Test State -2	0.643429	Random
31	Random Exursions Variant Test State -1	0.422678	Random
32	Random Exursions Variant Test State +1	0.109000	Random