Poker Cards Analysis – January 2025

The Directors
Entain Plc

This is to confirm that iTech Labs has examined the game logs for Poker games for the period **January 01, 2025,** to **January 31, 2025** as recorded by the respective game servers and analyzed the Poker cards for statistical randomness. The results of the analysis are given below.

For details on the gaming sites serviced by the Entain Plc game servers and used in this audit refer to the List.

1. Poker hand types statistics

These calculations were done for Royal Flush, Straight Flush, Four of a Kind, Full House, Flush, Straight, 3 of a Kind, 2 pairs, 1 Pair, High Card.

The Poker hand types analysis involved creating subsets of data and conducting Chi-square tests on each subset.

The null hypothesis for the chi-square test is that the observed frequencies of each type of hand matches the theoretical values for a deck that has been shuffled using a perfect random number generator. The p-values observed in these multiple tests are expected to follow a uniform distribution for the range 0.0 to 1.0.

The analysis performs a KS Test (Kolmogorov-Smirnov test) for uniform distribution on the observed p-values, and the combined p-value result of this test is taken as the final result of the Poker hand types statistics tests.

1.1 Poker hand types statistics for 52 cards deck:

Test No.	DOF	ChiSqr	P-Value
1	9	10.47	0.31391
2	9	8.48	0.48675
3	9	5.47	0.79197
4	9	3.45	0.94399
5	9	13.40	0.14533
6	9	8.09	0.52479
7	9	5.88	0.75181
8	9	11.17	0.26409
9	9	17.21	0.04549
10	9	5.90	0.74945
11	9	12.03	0.21165
12	9	10.40	0.31916
13	9	9.01	0.43666
14	9	4.85	0.84739
15	9	15.33	0.08234
16	9	9.05	0.43287
17	9	7.03	0.63439
18	9	11.33	0.25372
19	9	3.33	0.94966
20	9	13.43	0.14414
21	9	8.12	0.52181
22	9	15.84	0.07037
23	9	10.41	0.31818
24	9	1.41	0.99774
25	9	4.37	0.88512
26	9	9.55	0.38852
27	9	6.13	0.72693

28	9	13.71	0.13286
29	9	7.24	0.61209
30	9	10.68	0.29818
31	9	11.74	0.22815
32	9	14.74	0.09845
33	9	3.84	0.92162
34	9	3.75	0.92722
35	9	1.56	0.99670
36	9	11.73	0.22919
37	9	11.29	0.25648
38	9	6.99	0.63815
39	9	7.16	0.62003
40	9	4.63	0.86517
41	9	3.71	0.92920
42	9	5.66	0.77334
43	9	12.02	0.21242
44	9	11.84	0.22236
45	9	11.32	0.25419
46	9	11.64	0.23408
47	9	5.84	0.75605
48	9	6.47	0.69185
49	9	5.89	0.75113
50	9	2.04	0.99088
51	9	11.84	0.22248
52	9	7.49	0.58601
53	9	9.07	0.43077
54	9	7.31	0.60455
55	9	7.41	0.59420
56	9	8.58	0.47735
57	9	9.74	0.37217
58	9	11.37	0.25108
59	9	7.07	0.62942
60	9	11.89	0.21977
61	9	4.80	0.85102
62	9	9.02	0.43578
63	9	1.60	0.99636
64	9	7.92	0.54178
65	9	10.52	0.31019
66	9	12.29	0.19726
67	9	12.46	0.18843
68	9	12.42	0.19040
69	9	7.04	0.63320
70	9	5.38	0.79994
71	9	4.64	0.86447
72	9	8.41	0.49370
73	9	3.40	0.94609
74	9	23.13	0.00592
75	9	11.03	0.27348
76	9	9.09	0.42943
77	9	8.82	0.45360
78	9	14.00	0.12248
79	9	18.45	0.03032
80	9	12.97	0.16417
81	9	5.10	0.82525
82	9	6.17	0.72249
83	9	13.35	0.14734

84	9	9.75	0.37126
85	9	14.34	0.11058
86	9	7.59	0.57562
87	9	5.28	0.80962
88	9	13.43	0.14430
89	9	10.84	0.28688
90	9	19.42	0.02186
91	9	8.06	0.52800
92	9	3.24	0.95400
93	9	8.84	0.45232
94	9	5.88	0.75146
95	9	22.06	0.00868
96	9	5.40	0.79830
97	9	11.86	0.22115
98	9	5.46	0.79234
99	9	11.44	0.24654
100	9	4.46	0.87835
Combined P-value for all tests (Using KS method)			0.51357

Notes:

1) The P-values are observed probabilities from the Chi-Square tests. The last row shows the result of the KS Test performed on the p-values for all Chi-Square tests, where there are sufficient data.

2. Poker rank statistics

The Poker rank analysis aims to establish that the rank of the cards in each position was equally distributed in one of the 13 possible ranks (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A) for a 52 card deck.

The Poker rank analysis involved creating subsets of data and conducting Chi-square tests on each subset. The analysis performs a KS Test (Kolmogorov-Smirnov test) for uniform distribution on the observed p-values, and the combined p-value result of this test is taken as the final result of the Ranks statistics tests.

2.1 Poker rank statistics for 52 cards deck:

Test No.	DOF	ChiSqr	P-Value
1	84	99.49	0.11910
2	84	89.41	0.32290
3	84	66.71	0.91709
4	84	81.58	0.55452
5	84	61.67	0.96797
6	84	87.41	0.37806
7	84	86.65	0.39986
8	84	88.64	0.34350
9	84	80.25	0.59552
10	84	90.66	0.29039
11	84	63.82	0.95054
12	84	85.57	0.43178
13	84	87.75	0.36832
14	84	81.33	0.56209
15	84	87.79	0.36714
16	84	97.93	0.14203
17	84	81.71	0.55030
18	84	88.00	0.36112
19	84	83.50	0.49478
20	84	78.52	0.64840
21	84	73.51	0.78636
22	84	83.53	0.49389
23	84	99.09	0.12468
24	84	95.38	0.18619

25	84	71.56	0.83143
26	84	80.42	0.59054
27	84	72.44	0.81172
28	84	80.90	0.57542
29	84	59.33	0.98109
30	84	80.49	0.58825
31	84	82.90	0.51360
32	84	72.06	0.82033
33	84	56.06	0.99186
34	84	77.88	0.66731
35	84	105.78	0.05435
36	84	86.12	0.41546
37	84	76.27	0.71366
38	84	82.16	0.53631
39	84	73.55	0.78544
40	84	83.43	0.49694
41	84	77.45	0.67988
42	84	85.06	0.44713
43	84	103.66	0.07179
44	84	103.78	0.07069
45	84	86.37	0.40796
46	84	93.64	0.22119
47	84	76.69	0.70173
48	84	95.33	0.18707
49	84	72.83	0.80276
50	84	82.28	0.53273
51	84	94.46	0.20427
52	84	82.77	0.51757
53	84	81.43	0.55898
54	84	90.41	0.29681
55	84	74.50	0.76124
56	84	67.71	0.90260
57	84	73.72	0.78104
58	84	83.78	0.48638
59	84	90.06	0.30575
60	84	69.34	0.87530
61	84	86.56	0.40246
62	84	83.55	0.49329
63	84	82.59	0.52304
64	84	90.97	0.28276
65	84	76.14	0.71728
66	84	100.82	0.10187
67	84	57.67	0.98747
68	84	101.15	0.09799
69	84	66.34	0.92215
70	84	91.70	0.26495
71	84	81.81	0.54739
72	84	58.60	0.98416
73	84	91.30	0.27455
74	84	76.15	0.71700
75	84	92.60	0.24422
76	84	70.79	0.84747
77	84	81.51	0.55672
78	84	83.09	0.50755
79	84	56.41	0.99103
80	84	74.28	0.76705

81	84	86.92	0.39210
82	84	88.07	0.35926
83	84	66.98	0.91329
84	84	71.65	0.82947
85	84	79.43	0.62089
86	84	75.51	0.73457
87	84	62.45	0.96232
88	84	74.61	0.75835
89	84	89.29	0.32605
90	84	78.24	0.65664
91	84	89.14	0.33002
92	84	74.17	0.76989
93	84	67.16	0.91082
94	84	75.09	0.74579
95	84	88.35	0.35157
96	84	73.42	0.78857
97	84	97.25	0.15291
98	84	79.05	0.63237
99	84	80.06	0.60158
100	84	102.76	0.08036
Combined P-value for all tests (Using KS method)			0.13274

Notes:

1) The P-values are observed probabilities from the Chi-Square tests. The last row shows the result of the KS Test performed on the p-values for all Chi-Square tests, where there are sufficient data.

3. Poker suits statistics

The Poker suits analysis aims to verify that that the cards dealt exhibit an equal probability of all 4 suits (Clubs, Diamonds, Hearts and Spades) in all positions.

The Poker suits analysis involved creating subsets of data and conducting Chi-square tests on each subset. The analysis performs a KS Test (Kolmogorov-Smirnov test) for uniform distribution on the observed p-values, and the combined p-value result of this test is taken as the final result of the Suits statistics tests.

3.1 Poker suits statistics for 52 cards deck:

Test No.	Positions	DOF	ChiSqr	P-Value
1	7	21	40.01	0.00742
2	7	21	16.39	0.74749
3	7	21	9.57	0.98396
4	7	21	17.71	0.66739
5	7	21	22.25	0.38547
6	7	21	35.65	0.02393
7	7	21	14.93	0.82628
8	7	21	25.03	0.24594
9	7	21	39.70	0.00809
10	7	21	15.87	0.77683
11	7	21	27.04	0.16968
12	7	21	19.81	0.53333
13	7	21	16.79	0.72390
14	7	21	25.06	0.24442
15	7	21	23.49	0.31828
16	7	21	14.04	0.86802
17	7	21	23.05	0.34116
18	7	21	12.66	0.91999
19	7	21	21.31	0.43991
20	7	21	13.31	0.89724
21	7	21	15.92	0.77434
22	7	21	10.54	0.97103

23	7	21	39.00	0.00982
24	7	21	15.77	0.78268
25	7	21	18.24	0.63349
26	7	21	22.39	0.37711
27	7	21	18.86	0.59421
28	7	21	27.64	0.15053
29	7	21	24.67	0.26158
30	7	21	16.13	0.76250
31	7	21	30.81	0.07693
32	7	21	14.12	0.86452
33	7	21	21.72	0.41551
34	7	21	24.08	0.28907
35	7	21	19.37	0.56170
36	7	21	16.39	0.74719
37	7	21	17.13	0.70295
38	7	21	22.02	0.39837
39	7	21	25.24	0.23686
40	7	21	21.04	0.45659
41	7	21	22.34	0.37992
42	7	21	41.79	0.00448
43	7	21	14.09	0.86549
44	7	21	20.56	0.48629
45	7	21	23.99	0.29375
46	7	21	12.61	0.92178
47	7	21	23.44	0.32084
48	7	21	10.80	0.96650
49	7	21	20.29	0.50270
50	7	21	18.18	0.63753
51	7	21	17.50	0.68017
52	7	21	18.83	0.59625
53	7	21	33.26	0.04342
54	7	21	15.88	0.77618
55	7	21	19.28	0.56702
56	7	21	20.27	0.50430
57	7	21	14.89	0.82849
58	7	21	30.75	0.07792
59	7	21	34.41	0.03274
60	7	21	13.29	0.89798
61	7	21	8.81	0.99066
62	7	21	19.98	0.52273
63	7	21	21.57	0.42485
64	7	21	16.78	0.72441
65	7	21	32.61	0.05072
66	7	21	22.35	0.37942
67	7	21	19.66	0.54307
68	7	21	24.50	0.26948
69	7	21	17.29	0.69363
70	7	21	18.83	0.59597
71	7	21	9.65	0.98313
72	7	21	27.64	0.15059
73	7	21	36.92	0.01719
74	7	21	33.26	0.04342
75	7	21	20.14	0.51271
76	7	21	20.40	0.49581
77	7	21	27.08	0.16809
78	7	21	11.35	0.95549

79	7	21	17.66	0.67051
80	7	21	11.77	0.94551
81	7	21	20.30	0.50206
82	7	21	12.18	0.93469
83	7	21	15.30	0.80777
84	7	21	19.86	0.52997
85	7	21	25.83	0.21297
86	7	21	19.69	0.54088
87	7	21	14.94	0.82579
88	7	21	31.82	0.06110
89	7	21	31.71	0.06262
90	7	21	31.60	0.06427
91	7	21	17.68	0.66924
92	7	21	18.44	0.62093
93	7	21	22.61	0.36520
94	7	21	30.09	0.09013
95	7	21	19.50	0.55322
96	7	21	23.00	0.34385
97	7	21	16.12	0.76284
98	7	21	16.57	0.73703
99	7	21	21.56	0.42534
100	7	21	31.35	0.06806
Combined P-value for all tests (Using KS method)				0.66056

*Not*es:

1) The P-values are observed probabilities from the Chi-Square tests. The last row shows the result of the KS Test performed on the p-values for all Chi-Square tests, where there are sufficient data.

4. Summary of the analysis

4.1 Summary of the analysis of 52 cards deck:

The analysis of 52 cards completes by combining the result of the KS Test performed in the 3 types of analysis (Hand Types, Ranks and Suits) for 52 card decks using the Holm's method and producing a single Combined P -value.

The combined p-value produced using the Holm's method is used as indication for statistical randomness.

Combination of p-values using Holm's Method		
Test	**P-Value**	**P-Adjusted**
Ranks Test	0.13274	0.39823
Suits Test	0.66056	1.00000
Hand Types Test	0.51357	1.00000
Combined P-Value using Holm's Method		0.39823

Notes:

1) The combined p-value of all statistical tests using Holm's Method conducted for 52 card decks is greater than the minimum value of 0.05 which indicates that the randomness of the observed data falls within 95% confidence limits.

The final outcome of the analysis of 52 cards deck indicates that the RNG is working correctly.

4. Conclusion

Analysis of actual data from game logs for 'Hand Types, 'Ranks' and 'Suits' for **52-card decks** indicated statistical randomness. Since there is no data in the case of 36 card deck, this report does not contain the details of 36 card deck.

iTech Labs has done limited sanity checks to verify the integrity of the game logs. iTech Labs also maintains a copy of the game logs for verification purposes. There were a large enough number of game records to give the calculations sufficient statistical power.

We conclude that the Random Number Generator (RNG) is working correctly.

Please click here to see the Original report.

Signed:	**Signed:**
	
Alvin Rizaldi **Chief Executive Officer** **iTech Labs** Date: 13 February 2025	**Divya Bhargava** **Project Manager** **iTech Labs** Date: 13 February 2025

Disclaimer.
While it is not possible to test all possible scenarios in a laboratory environment, iTech Labs has conducted a level of testing appropriate for a component test of this type.