



Poker Cards Analysis – December 2024

The Directors

Entain Plc

This is to confirm that iTech Labs has examined the game logs for Poker games for the period **December 01, 2024, to December 31, 2024** 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	8.18	0.51653
2	9	5.30	0.80700
3	9	7.51	0.58439
4	9	7.31	0.60499
5	9	7.07	0.62985
6	9	9.91	0.35762
7	9	8.42	0.49225
8	9	3.43	0.94479
9	9	3.51	0.94038
10	9	6.85	0.65321
11	9	4.14	0.90211
12	9	4.02	0.91014
13	9	11.12	0.26754
14	9	9.80	0.36701
15	9	3.51	0.94088
16	9	6.70	0.66805
17	9	12.53	0.18499
18	9	7.38	0.59733
19	9	2.32	0.98525
20	9	9.65	0.37955
21	9	9.88	0.35998
22	9	9.32	0.40812
23	9	9.96	0.35392
24	9	15.54	0.07722
25	9	10.02	0.34897
26	9	4.63	0.86557
27	9	11.27	0.25797

28	9	8.52	0.48261
29	9	8.14	0.51980
30	9	1.47	0.99734
31	9	8.42	0.49291
32	9	12.65	0.17893
33	9	7.44	0.59101
34	9	4.44	0.88003
35	9	8.50	0.48444
36	9	8.03	0.53142
37	9	10.31	0.32622
38	9	12.97	0.16383
39	9	10.16	0.33808
40	9	11.54	0.24046
41	9	7.54	0.58103
42	9	11.29	0.25652
43	9	7.24	0.61239
44	9	9.45	0.39676
45	9	2.96	0.96592
46	9	6.67	0.67092
47	9	9.53	0.38947
48	9	9.51	0.39189
49	9	2.41	0.98326
50	9	6.67	0.67144
51	9	8.02	0.53186
52	9	13.94	0.12432
53	9	7.50	0.58548
54	9	7.55	0.58023
55	9	9.70	0.37509
56	9	10.88	0.28421
57	9	7.01	0.63645
58	9	7.24	0.61175
59	9	9.39	0.40167
60	9	11.66	0.23316
61	9	6.36	0.70359
62	9	4.50	0.87571
63	9	6.93	0.64433
64	9	10.19	0.33568
65	9	7.72	0.56273
66	9	11.08	0.27007
67	9	9.38	0.40302
68	9	4.58	0.86912
69	9	26.50	0.00169
70	9	15.16	0.08673
71	9	5.01	0.83304
72	9	13.78	0.13021
73	9	6.35	0.70494
74	9	9.48	0.39426
75	9	3.73	0.92806
76	9	12.51	0.18592
77	9	9.32	0.40831
78	9	6.69	0.66921
79	9	9.00	0.43759
80	9	4.68	0.86157
81	9	12.63	0.18000
82	9	10.42	0.31723
83	9	8.64	0.47081

84	9	7.61	0.57338
85	9	8.07	0.52671
86	9	24.89	0.00309
87	9	5.85	0.75486
88	9	3.76	0.92672
89	9	8.08	0.52617
90	9	14.26	0.11336
91	9	7.49	0.58658
92	9	8.84	0.45215
93	9	13.17	0.15513
94	9	3.75	0.92715
95	9	12.01	0.21253
96	9	1.50	0.99712
97	9	5.41	0.79736
98	9	4.12	0.90313
99	9	12.62	0.18044
100	9	9.00	0.43748
Combined P-value for all tests (Using KS method)			0.28641

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	96.72	0.16183
2	84	67.40	0.90732
3	84	91.37	0.27303
4	84	84.61	0.46092
5	84	80.56	0.58617
6	84	74.45	0.76260
7	84	81.77	0.54848
8	84	89.05	0.33238
9	84	81.76	0.54883
10	84	106.75	0.04763
11	84	108.01	0.04000
12	84	110.68	0.02720
13	84	69.97	0.86380
14	84	68.55	0.88911
15	84	78.79	0.64001
16	84	72.33	0.81431
17	84	82.26	0.53334
18	84	108.60	0.03676
19	84	69.69	0.86906
20	84	93.01	0.23488
21	84	69.54	0.87168
22	84	91.82	0.26213
23	84	64.40	0.94475
24	84	71.95	0.82281

25	84	84.96	0.45007
26	84	93.04	0.23421
27	84	89.37	0.32391
28	84	80.90	0.57541
29	84	104.71	0.06262
30	84	74.51	0.76108
31	84	92.65	0.24294
32	84	83.37	0.49897
33	84	77.79	0.66982
34	84	69.14	0.87903
35	84	82.56	0.52415
36	84	93.48	0.22460
37	84	77.98	0.66421
38	84	87.36	0.37926
39	84	71.63	0.82986
40	84	65.78	0.92923
41	84	70.16	0.85999
42	84	86.39	0.40735
43	84	73.34	0.79056
44	84	64.67	0.94200
45	84	93.39	0.22662
46	84	71.74	0.82752
47	84	92.93	0.23678
48	84	85.61	0.43058
49	84	74.05	0.77296
50	84	81.26	0.56449
51	84	68.19	0.89495
52	84	90.56	0.29305
53	84	68.03	0.89765
54	84	100.10	0.11104
55	84	81.59	0.55420
56	84	101.73	0.09128
57	84	84.58	0.46184
58	84	89.90	0.30994
59	84	75.76	0.72768
60	84	71.16	0.83989
61	84	89.42	0.32249
62	84	70.85	0.84625
63	84	101.86	0.08993
64	84	84.52	0.46348
65	84	91.38	0.27263
66	84	73.83	0.77831
67	84	74.71	0.75599
68	84	74.14	0.77047
69	84	87.17	0.38491
70	84	90.88	0.28489
71	84	69.02	0.88110
72	84	72.75	0.80444
73	84	101.83	0.09019
74	84	95.19	0.18973
75	84	105.46	0.05671
76	84	74.99	0.74836
77	84	110.36	0.02848
78	84	74.66	0.75726
79	84	69.83	0.86632
80	84	82.25	0.53374

81	84	69.51	0.87221
82	84	96.64	0.16333
83	84	98.47	0.13380
84	84	96.60	0.16399
85	84	51.95	0.99767
86	84	68.07	0.89687
87	84	81.52	0.55642
88	84	79.73	0.61163
89	84	96.10	0.17277
90	84	76.20	0.71554
91	84	86.73	0.39767
92	84	86.24	0.41181
93	84	86.66	0.39962
94	84	72.21	0.81708
95	84	89.83	0.31164
96	84	88.56	0.34575
97	84	77.58	0.67599
98	84	95.95	0.17555
99	84	93.66	0.22077
100	84	103.01	0.07794
Combined P-value for all tests (Using KS method)			0.39950

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 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	13.22	0.90088
2	7	21	17.88	0.65685
3	7	21	21.07	0.45456
4	7	21	19.66	0.54264
5	7	21	26.11	0.20234
6	7	21	21.92	0.40408
7	7	21	33.58	0.04014
8	7	21	30.34	0.08542
9	7	21	9.65	0.98311
10	7	21	13.64	0.88474
11	7	21	17.72	0.66654
12	7	21	29.44	0.10382
13	7	21	36.13	0.02112
14	7	21	16.08	0.76538
15	7	21	16.13	0.76227
16	7	21	12.95	0.91028
17	7	21	26.75	0.17924
18	7	21	14.36	0.85359
19	7	21	12.34	0.92985
20	7	21	23.55	0.31558
21	7	21	26.45	0.18984
22	7	21	10.06	0.97810

23	7	21	12.59	0.92229
24	7	21	26.15	0.20088
25	7	21	11.64	0.94891
26	7	21	19.19	0.57288
27	7	21	22.99	0.34461
28	7	21	11.05	0.96172
29	7	21	20.60	0.48369
30	7	21	15.34	0.80573
31	7	21	23.37	0.32469
32	7	21	26.65	0.18272
33	7	21	22.96	0.34604
34	7	21	18.97	0.58724
35	7	21	21.85	0.40808
36	7	21	20.03	0.51957
37	7	21	31.72	0.06249
38	7	21	36.78	0.01784
39	7	21	11.38	0.95490
40	7	21	17.69	0.66830
41	7	21	31.39	0.06746
42	7	21	42.14	0.00404
43	7	21	33.10	0.04510
44	7	21	24.08	0.28913
45	7	21	16.40	0.74658
46	7	21	25.63	0.22099
47	7	21	26.17	0.19994
48	7	21	11.91	0.94196
49	7	21	17.62	0.67314
50	7	21	24.65	0.26268
51	7	21	24.91	0.25098
52	7	21	20.29	0.50322
53	7	21	28.35	0.13048
54	7	21	23.90	0.29781
55	7	21	11.99	0.93985
56	7	21	23.30	0.32795
57	7	21	24.82	0.25507
58	7	21	19.20	0.57212
59	7	21	23.08	0.33984
60	7	21	20.39	0.49666
61	7	21	18.10	0.64244
62	7	21	17.94	0.65264
63	7	21	24.29	0.27901
64	7	21	15.36	0.80421
65	7	21	19.23	0.57031
66	7	21	26.54	0.18660
67	7	21	25.65	0.22020
68	7	21	16.13	0.76225
69	7	21	27.58	0.15246
70	7	21	11.87	0.94313
71	7	21	20.57	0.48552
72	7	21	16.87	0.71888
73	7	21	27.83	0.14505
74	7	21	33.11	0.04501
75	7	21	17.74	0.66557
76	7	21	27.05	0.16923
77	7	21	16.45	0.74403
78	7	21	18.75	0.60108

79	7	21	23.96	0.29524
80	7	21	23.67	0.30951
81	7	21	29.26	0.10791
82	7	21	23.04	0.34198
83	7	21	25.59	0.22264
84	7	21	30.69	0.07890
85	7	21	39.60	0.00832
86	7	21	22.18	0.38938
87	7	21	13.61	0.88575
88	7	21	16.32	0.75129
89	7	21	21.91	0.40471
90	7	21	23.51	0.31723
91	7	21	17.22	0.69784
92	7	21	29.63	0.09963
93	7	21	24.91	0.25128
94	7	21	15.05	0.82026
95	7	21	27.06	0.16884
96	7	21	20.67	0.47939
97	7	21	28.87	0.11708
98	7	21	22.72	0.35913
99	7	21	9.25	0.98714
100	7	21	23.82	0.30195
Combined P-value for all tests (Using KS method)				0.08534

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.

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	0.39950	0.57282
Suits Test	0.08534	0.25601
Hand Types Test	0.28641	0.57282
Combined P-Value using Holm's Method		0.25601

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:



Alvin Rizaldi
Chief Executive Officer
iTech Labs

Date: 04 February 2025

Signed:



Divya Bhargava
Project Manager
iTech Labs

Date: 04 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.

