



Blackjack Cards Analysis – April 2025

The Directors

Entain Plc

This confirms that iTech Labs has examined the game logs for blackjack games from **April 1, 2025, to April 30, 2025**, as recorded by the respective game servers. The game logs were for blackjack games using 8 decks. iTech Labs analysed the blackjack 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. Blackjack hand value

Blackjack hand value analysis involved creating subsets of data and conducting Chi-square tests on each subset. Opening hands are the value of the first two cards dealt. Final hand value is the hand value at the end of the game. The dealer's final hand value is based on the fixed rules of the game. The player's final hand value is dependent on the player's strategy choice, so it has no theoretical basis for comparison.

The null hypothesis for the chi-square test is that the observed frequencies of each type of hand match 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 blackjack opening hand value statistics tests.

1.1 Player's opening score (from first two cards):

Test No.	DOF	ChiSqr	P-Value
1	17	20.49	0.24976
2	17	16.78	0.46934
3	17	17.09	0.44815
4	17	6.36	0.99040
5	17	16.89	0.46182
6	17	20.95	0.22845
7	17	15.36	0.56971
8	17	34.11	0.00813
9	17	15.48	0.56070
10	17	11.61	0.82343
11	17	15.59	0.55333
12	17	17.16	0.44337
13	17	16.56	0.48479
14	17	24.26	0.11262
15	17	24.84	0.09826
16	17	18.95	0.33137
17	17	19.10	0.32304
18	17	22.93	0.15139
19	17	10.01	0.90310
20	17	22.27	0.17466
21	17	30.82	0.02102
22	17	37.69	0.00271
23	17	17.15	0.44412
24	17	8.15	0.96313
25	17	18.85	0.33732

26	17	8.75	0.94792
27	17	14.24	0.64997
28	17	13.31	0.71498
29	17	18.23	0.37477
30	17	20.68	0.24076
31	17	18.16	0.37894
32	17	23.62	0.13025
33	17	20.64	0.24300
34	17	8.84	0.94508
35	17	20.60	0.24488
36	17	24.62	0.10364
37	17	26.58	0.06452
38	17	20.46	0.25137
39	17	15.85	0.53425
40	17	17.89	0.39574
41	17	13.92	0.67260
42	17	9.18	0.93446
43	17	17.35	0.43069
44	17	11.83	0.81029
45	17	15.69	0.54575
46	17	31.62	0.01677
47	17	12.50	0.76884
48	17	15.05	0.59212
49	17	18.86	0.33657
50	17	12.20	0.78795
51	17	12.76	0.75184
52	17	11.08	0.85239
53	17	6.86	0.98527
54	17	25.09	0.09268
55	17	15.12	0.58700
56	17	21.80	0.19249
57	17	12.83	0.74764
58	17	13.29	0.71672
59	17	19.95	0.27679
60	17	12.33	0.77945
61	17	15.58	0.55384
62	17	20.94	0.22879
63	17	17.49	0.42143
64	17	9.96	0.90513
65	17	19.50	0.30084
66	17	9.57	0.92055
67	17	15.47	0.56184
68	17	11.81	0.81141
69	17	14.22	0.65147
70	17	19.87	0.28108
71	17	23.22	0.14209
72	17	10.32	0.88976
73	17	13.06	0.73188
74	17	8.77	0.94724
75	17	27.90	0.04614
76	17	19.38	0.30724
77	17	17.75	0.40460
78	17	17.73	0.40604
79	17	13.82	0.67982
80	17	11.65	0.82100
81	17	11.86	0.80837
82	17	15.26	0.57645

83	17	10.09	0.89979
84	17	12.32	0.78058
85	17	12.44	0.77297
86	17	9.73	0.91463
87	17	16.43	0.49378
88	17	17.97	0.39090
89	17	16.50	0.48899
90	17	12.58	0.76359
91	17	24.43	0.10810
92	17	23.37	0.13745
93	17	19.74	0.28751
94	17	16.76	0.47072
95	17	6.29	0.99100
96	17	9.89	0.90809
97	17	6.19	0.99182
98	17	20.93	0.22940
99	17	18.04	0.38638
100	17	21.36	0.21070
Combined P-Value for 100 tests (Using KS method)			0.96106

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 is sufficient data.

1.2 Dealer's opening score (from first two cards):

Test No.	DOF	ChiSqr	P-Value
1	17	14.81	0.60903
2	17	37.08	0.00328
3	17	20.97	0.22747
4	17	14.80	0.61014
5	17	9.17	0.93470
6	17	29.01	0.03439
7	17	21.98	0.18537
8	17	23.77	0.12576
9	17	11.83	0.81052
10	17	16.15	0.51291
11	17	16.30	0.50288
12	17	21.99	0.18525
13	17	17.49	0.42180
14	17	17.83	0.39975
15	17	20.36	0.25605
16	17	25.85	0.07723
17	17	20.22	0.26335
18	17	14.51	0.63077
19	17	20.80	0.23528
20	17	8.22	0.96162
21	17	12.02	0.79884
22	17	10.85	0.86430
23	17	16.78	0.46915
24	17	29.75	0.02823
25	17	8.89	0.94378
26	17	11.27	0.84230
27	17	8.09	0.96451
28	17	13.78	0.68253

29	17	24.08	0.11739
30	17	6.71	0.98700
31	17	22.90	0.15242
32	17	15.44	0.56363
33	17	8.38	0.95776
34	17	7.58	0.97467
35	17	24.16	0.11518
36	17	14.15	0.65676
37	17	18.72	0.34474
38	17	37.84	0.00259
39	17	29.69	0.02865
40	17	23.42	0.13599
41	17	29.42	0.03082
42	17	15.10	0.58825
43	17	17.65	0.41110
44	17	16.55	0.48499
45	17	14.06	0.66284
46	17	12.92	0.74128
47	17	14.07	0.66238
48	17	14.37	0.64102
49	17	9.91	0.90753
50	17	28.78	0.03657
51	17	18.86	0.33651
52	17	24.50	0.10651
53	17	8.64	0.95079
54	17	19.31	0.31078
55	17	21.96	0.18619
56	17	12.68	0.75765
57	17	18.24	0.37380
58	17	31.08	0.01955
59	17	15.35	0.57012
60	17	23.61	0.13044
61	17	21.58	0.20151
62	17	17.98	0.39007
63	17	25.35	0.08708
64	17	15.23	0.57890
65	17	29.17	0.03298
66	17	15.77	0.54047
67	17	9.25	0.93223
68	17	33.64	0.00934
69	17	17.55	0.41771
70	17	31.61	0.01684
71	17	11.83	0.81053
72	17	16.36	0.49880
73	17	11.33	0.83898
74	17	11.41	0.83425
75	17	17.46	0.42385
76	17	15.05	0.59169
77	17	23.27	0.14054
78	17	10.42	0.88524
79	17	14.67	0.61894
80	17	17.29	0.43479
81	17	12.71	0.75541
82	17	14.47	0.63325
83	17	19.15	0.32012
84	17	12.87	0.74514
85	17	16.03	0.52188

86	17	22.57	0.16371
87	17	16.48	0.49004
88	17	30.74	0.02146
89	17	7.19	0.98098
90	17	17.27	0.43627
91	17	15.45	0.56290
92	17	18.64	0.34951
93	17	22.80	0.15583
94	17	11.98	0.80152
95	17	10.13	0.89801
96	17	17.11	0.44727
97	17	13.40	0.70922
98	17	13.51	0.70139
99	17	21.03	0.22511
100	17	16.14	0.51378
Combined P-Value for 100 tests (Using KS method)			0.63093

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 is sufficient data.

1.3 Dealer's final score (total of all cards for hands with 3 or more cards):

Test No.	DOF	ChiSqr	P-Value
1	50	37.35	0.90707
2	50	57.75	0.21075
3	50	52.93	0.36170
4	50	41.13	0.80996
5	50	46.72	0.60588
6	50	42.81	0.75449
7	50	27.44	0.99607
8	50	74.12	0.01498
9	50	33.57	0.96402
10	50	42.25	0.77376
11	50	42.09	0.77903
12	50	40.33	0.83388
13	50	54.66	0.30199
14	50	44.20	0.70407
15	50	44.17	0.70555
16	50	37.65	0.90087
17	50	44.61	0.68891
18	50	44.21	0.70392
19	50	47.48	0.57514
20	50	51.14	0.42861
21	50	63.97	0.08854
22	50	47.53	0.57300
23	50	67.93	0.04653
24	50	54.71	0.30032
25	50	50.53	0.45243
26	50	49.18	0.50617
27	50	55.76	0.26732
28	50	52.76	0.36796
29	50	47.90	0.55806
30	50	44.32	0.69993
31	50	44.48	0.69374

32	50	69.28	0.03677
33	50	50.47	0.45476
34	50	50.64	0.44798
35	50	47.75	0.56428
36	50	49.38	0.49825
37	50	35.90	0.93332
38	50	49.83	0.48024
39	50	51.06	0.43169
40	50	46.37	0.61998
41	50	50.22	0.46456
42	50	61.90	0.12059
43	50	44.44	0.69517
44	50	36.73	0.91900
45	50	54.70	0.30075
46	50	43.11	0.74402
47	50	66.76	0.05660
48	50	60.22	0.15255
49	50	47.37	0.57973
50	50	44.09	0.70837
51	50	41.49	0.79871
52	50	55.65	0.27062
53	50	43.87	0.71670
54	50	38.83	0.87385
55	50	43.00	0.74795
56	50	44.66	0.68703
57	50	46.08	0.63154
58	50	26.57	0.99736
59	50	49.88	0.47803
60	50	43.42	0.73286
61	50	56.18	0.25444
62	50	55.49	0.27542
63	50	35.93	0.93282
64	50	41.85	0.78713
65	50	38.36	0.88522
66	50	44.62	0.68833
67	50	55.24	0.28349
68	50	50.41	0.45703
69	50	41.07	0.81192
70	50	52.37	0.38210
71	50	38.99	0.87002
72	50	52.43	0.37995
73	50	51.52	0.41414
74	50	59.74	0.16293
75	50	38.66	0.87803
76	50	48.77	0.52284
77	50	46.08	0.63122
78	50	51.84	0.40179
79	50	54.00	0.32416
80	50	74.44	0.01406
81	50	43.05	0.74632
82	50	61.66	0.12471
83	50	35.85	0.93410
84	50	48.22	0.54500
85	50	44.40	0.69675
86	50	40.63	0.82527
87	50	49.17	0.50671
88	50	41.55	0.79682

89	50	39.51	0.85645
90	50	38.83	0.87398
91	50	52.43	0.37995
92	50	45.98	0.63520
93	50	59.97	0.15783
94	50	44.71	0.68476
95	50	48.99	0.51376
96	50	65.74	0.06696
97	50	37.78	0.89804
98	50	64.99	0.07550
99	50	48.42	0.53706
100	50	58.07	0.20226
Combined P-Value for 100 tests (Using KS method)			0.09562

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 is sufficient data.

2. Blackjack rank statistics

The blackjack rank analysis aims to establish that the rank of the cards to player and dealer was equally distributed in one of the 13 possible ranks (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A).

The blackjack 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 Blackjack rank statistics for all player cards:

Test No.	DOF	ChiSqr	P-Value
1	12	13.00	0.36892
2	12	6.89	0.86473
3	12	8.71	0.72740
4	12	3.37	0.99230
5	12	10.19	0.59915
6	12	22.87	0.02886
7	12	14.23	0.28619
8	12	10.30	0.59004
9	12	19.28	0.08188
10	12	15.08	0.23685
11	12	12.67	0.39385
12	12	7.95	0.78918
13	12	18.45	0.10275
14	12	18.50	0.10138
15	12	14.67	0.25994
16	12	7.94	0.78949
17	12	11.92	0.45180
18	12	11.60	0.47859
19	12	13.12	0.36033
20	12	7.95	0.78934
21	12	14.28	0.28339
22	12	16.29	0.17811
23	12	19.37	0.07992
24	12	14.94	0.24455
25	12	16.51	0.16901
26	12	9.20	0.68564
27	12	10.90	0.53728

28	12	19.50	0.07707
29	12	19.19	0.08398
30	12	17.09	0.14637
31	12	10.64	0.56017
32	12	7.30	0.83689
33	12	10.53	0.56980
34	12	9.27	0.67948
35	12	19.29	0.08184
36	12	9.07	0.69688
37	12	11.13	0.51815
38	12	5.79	0.92633
39	12	7.22	0.84302
40	12	20.12	0.06491
41	12	8.44	0.74954
42	12	7.79	0.80137
43	12	20.81	0.05320
44	12	9.27	0.67937
45	12	8.75	0.72401
46	12	17.30	0.13868
47	12	6.74	0.87426
48	12	8.63	0.73383
49	12	10.29	0.59036
50	12	24.69	0.01635
51	12	9.13	0.69179
52	12	11.66	0.47352
53	12	12.01	0.44461
54	12	10.98	0.53029
55	12	15.96	0.19286
56	12	11.91	0.45315
57	12	11.94	0.45051
58	12	7.38	0.83123
59	12	6.85	0.86715
60	12	13.18	0.35638
61	12	11.78	0.46345
62	12	12.14	0.43434
63	12	10.11	0.60608
64	12	15.36	0.22227
65	12	12.69	0.39177
66	12	3.66	0.98885
67	12	8.19	0.76979
68	12	12.03	0.44311
69	12	6.44	0.89222
70	12	17.92	0.11812
71	12	5.13	0.95366
72	12	4.20	0.97952
73	12	7.80	0.80020
74	12	18.07	0.11346
75	12	23.22	0.02588
76	12	11.90	0.45369
77	12	13.83	0.31183
78	12	8.45	0.74883
79	12	7.68	0.80926
80	12	5.06	0.95599
81	12	14.36	0.27807
82	12	8.77	0.72205
83	12	5.78	0.92683
84	12	10.30	0.58954

85	12	20.63	0.05611
86	12	13.38	0.34176
87	12	23.35	0.02490
88	12	11.41	0.49454
89	12	7.73	0.80596
90	12	3.23	0.99373
91	12	13.39	0.34120
92	12	9.68	0.64384
93	12	16.43	0.17235
94	12	15.65	0.20757
95	12	5.62	0.93416
96	12	7.66	0.81100
97	12	7.60	0.81585
98	12	10.16	0.60187
99	12	16.42	0.17266
100	12	11.67	0.47272
Combined P-Value for 100 tests (Using KS method)			0.96386

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 is sufficient data.

2.2 Blackjack rank statistics for all dealer cards:

Test No.	DOF	ChiSqr	P-Value
1	12	9.18	0.68786
2	12	9.54	0.65652
3	12	12.75	0.38773
4	12	11.83	0.45979
5	12	17.78	0.12251
6	12	12.22	0.42853
7	12	15.82	0.19978
8	12	20.59	0.05669
9	12	10.90	0.53723
10	12	4.61	0.96987
11	12	6.31	0.89957
12	12	12.88	0.37793
13	12	11.04	0.52561
14	12	13.91	0.30669
15	12	18.26	0.10797
16	12	23.62	0.02292
17	12	3.25	0.99350
18	12	5.98	0.91704
19	12	5.89	0.92162
20	12	9.06	0.69786
21	12	8.91	0.71100
22	12	11.35	0.49947
23	12	22.76	0.02983
24	12	6.49	0.88924
25	12	13.64	0.32410
26	12	10.20	0.59825
27	12	9.79	0.63450
28	12	13.43	0.33843
29	12	12.31	0.42080
30	12	4.37	0.97588
31	12	17.96	0.11703

32	12	9.25	0.68125
33	12	8.63	0.73449
34	12	5.91	0.92066
35	12	19.40	0.07931
36	12	9.57	0.65336
37	12	7.71	0.80757
38	12	15.77	0.20177
39	12	16.94	0.15187
40	12	7.08	0.85211
41	12	13.32	0.34647
42	12	5.33	0.94608
43	12	3.43	0.99171
44	12	14.88	0.24819
45	12	7.58	0.81668
46	12	12.20	0.42950
47	12	23.25	0.02572
48	12	19.02	0.08816
49	12	8.65	0.73260
50	12	11.29	0.50449
51	12	3.53	0.99047
52	12	10.64	0.55984
53	12	10.12	0.60563
54	12	12.60	0.39872
55	12	19.01	0.08839
56	12	11.73	0.46740
57	12	23.17	0.02630
58	12	8.43	0.75093
59	12	6.99	0.85844
60	12	9.13	0.69163
61	12	8.83	0.71720
62	12	11.69	0.47060
63	12	16.22	0.18145
64	12	7.61	0.81496
65	12	11.13	0.51766
66	12	11.69	0.47094
67	12	17.76	0.12315
68	12	17.94	0.11757
69	12	7.88	0.79454
70	12	10.50	0.57183
71	12	4.44	0.97421
72	12	5.63	0.93363
73	12	5.99	0.91672
74	12	5.65	0.93260
75	12	9.22	0.68398
76	12	5.70	0.93062
77	12	13.53	0.33195
78	12	13.02	0.36754
79	12	8.67	0.73122
80	12	7.74	0.80546
81	12	12.18	0.43128
82	12	13.52	0.33213
83	12	10.66	0.55826
84	12	9.22	0.68392
85	12	4.71	0.96684
86	12	13.64	0.32415
87	12	13.58	0.32819
88	12	17.75	0.12343

89	12	10.83	0.54314
90	12	15.43	0.21869
91	12	11.48	0.48812
92	12	9.28	0.67856
93	12	6.22	0.90452
94	12	7.78	0.80208
95	12	5.11	0.95411
96	12	21.14	0.04835
97	12	19.13	0.08535
98	12	17.75	0.12364
99	12	3.64	0.98905
100	12	29.93	0.00286
Combined P-Value for 100 tests (Using KS method)			0.38250

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 is sufficient data.

4. Summary of the analysis of blackjack tests

The Blackjack cards analysis is completed by combining the result of the KS Test performed in the two types of analysis (Hand Values and Ranks) for using Holm's method and producing a single Combined P-value.

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

Combination of p-values using Holm's Method		
Test	P-Value	P-Adjusted
Opening Score (Player)	0.96106	1.00000
Opening Score (Dealer)	0.63093	1.00000
Dealer's Final Score	0.09562	0.47808
Player Cards Rank	0.96386	1.00000
Dealer Cards Rank	0.38250	1.00000
Combined P-Value using Holm's Method		0.47808

Notes:

- 1) The combined p-value of all statistical tests using Holm's Method conducted for blackjack 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 blackjack indicates that the RNG is working correctly.

5. Conclusion

Analysis of actual data from game logs for 'player opening score', 'dealer opening score', 'dealer final score', 'player card rank' and 'dealer card rank' indicated statistical randomness. The results were satisfactory for 8 decks blackjack.

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

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.

The scope of the review did not include reviews of financial controls or casino operations. We believe that the probabilities were calculated correctly from the game logs.

Please click [here](#) to see the [Original](#) report.

Signed:



Divya Bhargava
Project Manager
iTech Labs Australia
Date: 26 May 2025

Signed:



Alvin Rizaldi
Chief Executive Officer
iTech Labs Australia
Date: 26 May 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.