



Blackjack Cards Analysis – May 2025

The Directors

Entain Plc

This confirms that iTech Labs has examined the game logs for blackjack games from **May 1, 2025, to May 31, 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	17.90	0.39526
2	17	26.31	0.06898
3	17	15.52	0.55794
4	17	15.48	0.56082
5	17	11.85	0.80933
6	17	22.98	0.15001
7	17	26.14	0.07193
8	17	17.24	0.43836
9	17	16.55	0.48502
10	17	29.42	0.03086
11	17	23.05	0.14756
12	17	17.26	0.43695
13	17	30.93	0.02034
14	17	17.19	0.44125
15	17	20.91	0.23041
16	17	27.29	0.05396
17	17	13.13	0.72726
18	17	10.75	0.86942
19	17	21.75	0.19466
20	17	12.74	0.75309
21	17	21.46	0.20639
22	17	19.06	0.32510
23	17	15.91	0.52998
24	17	13.71	0.68721
25	17	9.78	0.91249

26	17	15.77	0.54033
27	17	34.30	0.00767
28	17	20.77	0.23691
29	17	15.38	0.56796
30	17	21.29	0.21367
31	17	14.53	0.62954
32	17	24.53	0.10567
33	17	14.32	0.64413
34	17	19.72	0.28887
35	17	6.18	0.99188
36	17	7.95	0.96765
37	17	37.10	0.00326
38	17	15.03	0.59322
39	17	14.65	0.62096
40	17	15.97	0.52604
41	17	9.62	0.91895
42	17	11.04	0.85454
43	17	14.26	0.64873
44	17	15.17	0.58355
45	17	19.93	0.27796
46	17	22.33	0.17228
47	17	7.07	0.98264
48	17	9.17	0.93490
49	17	12.17	0.78950
50	17	19.58	0.29649
51	17	18.62	0.35090
52	17	25.89	0.07656
53	17	20.86	0.23277
54	17	10.82	0.86578
55	17	21.62	0.19961
56	17	16.82	0.46673
57	17	17.75	0.40447
58	17	12.26	0.78434
59	17	18.93	0.33267
60	17	11.43	0.83357
61	17	17.96	0.39160
62	17	11.53	0.82768
63	17	19.01	0.32771
64	17	12.54	0.76639
65	17	25.64	0.08118
66	17	24.84	0.09830
67	17	18.23	0.37456
68	17	17.44	0.42500
69	17	18.85	0.33724
70	17	21.20	0.21753
71	17	20.82	0.23432
72	17	12.27	0.78380
73	17	11.77	0.81368
74	17	8.49	0.95505
75	17	11.97	0.80218
76	17	14.95	0.59874
77	17	18.06	0.38502
78	17	8.07	0.96504
79	17	18.29	0.37093
80	17	14.70	0.61699
81	17	22.18	0.17803
82	17	19.10	0.32281

83	17	17.71	0.40762
84	17	18.77	0.34191
85	17	23.38	0.13717
86	17	14.50	0.63174
87	17	17.44	0.42520
88	17	10.05	0.90160
89	17	9.49	0.92359
90	17	17.44	0.42476
91	17	14.84	0.60693
92	17	16.68	0.47646
93	17	16.37	0.49786
94	17	15.06	0.59095
95	17	34.58	0.00707
96	17	6.23	0.99147
97	17	9.38	0.92747
98	17	13.77	0.68362
99	17	14.71	0.61661
100	17	25.70	0.08014
Combined P-Value for 100 tests (Using KS method)			0.83578

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	14.94	0.60008
2	17	22.31	0.17315
3	17	12.82	0.74832
4	17	17.48	0.42258
5	17	11.59	0.82407
6	17	8.89	0.94380
7	17	15.89	0.53132
8	17	23.51	0.13336
9	17	15.90	0.53100
10	17	14.66	0.62030
11	17	26.98	0.05834
12	17	26.48	0.06614
13	17	24.36	0.11006
14	17	10.65	0.87433
15	17	38.14	0.00235
16	17	15.77	0.54018
17	17	14.78	0.61103
18	17	11.25	0.84337
19	17	26.86	0.06016
20	17	11.25	0.84307
21	17	26.36	0.06809
22	17	20.61	0.24423
23	17	8.53	0.95374
24	17	11.55	0.82669
25	17	24.48	0.10695
26	17	15.96	0.52645
27	17	23.38	0.13717
28	17	12.18	0.78922

29	17	23.23	0.14186
30	17	9.16	0.93502
31	17	22.35	0.17175
32	17	19.88	0.28023
33	17	7.44	0.97709
34	17	10.77	0.86840
35	17	16.66	0.47766
36	17	16.22	0.50832
37	17	21.82	0.19166
38	17	26.66	0.06329
39	17	22.79	0.15606
40	17	13.43	0.70691
41	17	28.19	0.04272
42	17	18.71	0.34567
43	17	15.32	0.57260
44	17	19.41	0.30556
45	17	25.25	0.08918
46	17	15.20	0.58112
47	17	5.94	0.99360
48	17	14.40	0.63861
49	17	15.93	0.52850
50	17	20.51	0.24906
51	17	12.63	0.76070
52	17	24.04	0.11826
53	17	20.82	0.23442
54	17	25.44	0.08532
55	17	5.50	0.99595
56	17	24.29	0.11173
57	17	7.15	0.98151
58	17	30.01	0.02625
59	17	10.75	0.86943
60	17	7.93	0.96807
61	17	15.45	0.56294
62	17	18.54	0.35539
63	17	24.92	0.09653
64	17	18.49	0.35886
65	17	14.66	0.62005
66	17	15.30	0.57403
67	17	10.71	0.87123
68	17	19.62	0.29428
69	17	13.38	0.71066
70	17	12.99	0.73712
71	17	14.55	0.62764
72	17	28.94	0.03507
73	17	19.85	0.28199
74	17	24.05	0.11817
75	17	29.81	0.02778
76	17	17.32	0.43317
77	17	14.89	0.60342
78	17	27.36	0.05304
79	17	21.79	0.19278
80	17	13.96	0.66986
81	17	20.85	0.23304
82	17	10.93	0.86018
83	17	19.97	0.27579
84	17	12.29	0.78254
85	17	11.12	0.85010

86	17	13.57	0.69703
87	17	14.81	0.60891
88	17	15.59	0.55325
89	17	9.63	0.91857
90	17	21.69	0.19706
91	17	10.37	0.88731
92	17	21.49	0.20516
93	17	12.25	0.78492
94	17	22.48	0.16688
95	17	21.08	0.22274
96	17	20.33	0.25750
97	17	14.59	0.62481
98	17	15.40	0.56672
99	17	15.91	0.53004
100	17	8.36	0.95821
Combined P-Value for 100 tests (Using KS method)			0.27769

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	49.80	0.48119
2	50	42.13	0.77775
3	50	56.49	0.24551
4	50	37.18	0.91041
5	50	40.85	0.81861
6	50	50.66	0.44730
7	50	36.47	0.92370
8	50	49.98	0.47412
9	50	54.71	0.30034
10	50	55.31	0.28124
11	50	38.25	0.88755
12	50	67.50	0.05002
13	50	45.51	0.65411
14	50	80.80	0.00377
15	50	49.39	0.49794
16	50	47.97	0.55511
17	50	44.51	0.69251
18	50	49.20	0.50526
19	50	51.76	0.40488
20	50	66.13	0.06289
21	50	47.51	0.57403
22	50	65.45	0.07010
23	50	35.31	0.94238
24	50	58.79	0.18458
25	50	54.34	0.31253
26	50	45.06	0.67146
27	50	59.11	0.17705
28	50	42.71	0.75811
29	50	53.07	0.35655
30	50	81.70	0.00310
31	50	38.26	0.88748

32	50	46.94	0.59673
33	50	56.88	0.23425
34	50	51.71	0.40688
35	50	41.81	0.78843
36	50	54.27	0.31487
37	50	38.73	0.87633
38	50	59.87	0.16007
39	50	42.49	0.76575
40	50	43.54	0.72856
41	50	52.26	0.38638
42	50	44.77	0.68268
43	50	49.28	0.50233
44	50	31.97	0.97792
45	50	49.00	0.51348
46	50	46.18	0.62760
47	50	33.41	0.96559
48	50	62.22	0.11507
49	50	43.14	0.74314
50	50	40.54	0.82777
51	50	48.82	0.52058
52	50	58.37	0.19490
53	50	54.85	0.29582
54	50	28.68	0.99332
55	50	37.13	0.91139
56	50	48.39	0.53804
57	50	40.59	0.82626
58	50	73.53	0.01678
59	50	49.43	0.49629
60	50	54.80	0.29756
61	50	70.74	0.02835
62	50	41.58	0.79574
63	50	35.66	0.93716
64	50	51.94	0.39836
65	50	76.95	0.00851
66	50	39.02	0.86917
67	50	57.99	0.20434
68	50	42.78	0.75554
69	50	51.42	0.41787
70	50	48.24	0.54425
71	50	46.58	0.61134
72	50	56.16	0.25516
73	50	37.19	0.91022
74	50	66.70	0.05718
75	50	49.11	0.50887
76	50	47.91	0.55759
77	50	64.50	0.08149
78	50	42.66	0.75971
79	50	55.69	0.26944
80	50	55.95	0.26127
81	50	51.52	0.41403
82	50	49.28	0.50224
83	50	35.95	0.93262
84	50	36.02	0.93135
85	50	61.95	0.11965
86	50	58.70	0.18667
87	50	34.39	0.95474
88	50	47.98	0.55478

89	50	46.55	0.61255
90	50	49.31	0.50082
91	50	46.25	0.62461
92	50	68.61	0.04138
93	50	46.57	0.61172
94	50	45.87	0.63987
95	50	55.31	0.28122
96	50	43.80	0.71921
97	50	45.27	0.66346
98	50	31.16	0.98311
99	50	44.58	0.68982
100	50	71.27	0.02568
Combined P-Value for 100 tests (Using KS method)			0.58884

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	8.86	0.71525
2	12	6.72	0.87581
3	12	9.25	0.68128
4	12	27.89	0.00573
5	12	28.40	0.00483
6	12	21.07	0.04942
7	12	7.90	0.79297
8	12	9.90	0.62496
9	12	11.39	0.49609
10	12	5.69	0.93080
11	12	15.51	0.21463
12	12	6.69	0.87769
13	12	9.52	0.65812
14	12	6.75	0.87374
15	12	14.75	0.25520
16	12	13.33	0.34556
17	12	13.64	0.32429
18	12	12.29	0.42244
19	12	10.84	0.54293
20	12	11.32	0.50178
21	12	12.58	0.40002
22	12	11.60	0.47862
23	12	15.22	0.22947
24	12	9.41	0.66756
25	12	9.71	0.64105
26	12	6.32	0.89907
27	12	9.90	0.62444

28	12	22.41	0.03314
29	12	5.76	0.92750
30	12	19.48	0.07753
31	12	6.11	0.91030
32	12	17.64	0.12699
33	12	8.81	0.71908
34	12	5.34	0.94577
35	12	18.87	0.09167
36	12	14.75	0.25562
37	12	7.19	0.84508
38	12	6.98	0.85902
39	12	11.39	0.49597
40	12	12.14	0.43432
41	12	13.16	0.35725
42	12	18.16	0.11098
43	12	9.50	0.65974
44	12	13.02	0.36783
45	12	11.49	0.48770
46	12	23.82	0.02151
47	12	12.56	0.40200
48	12	22.49	0.03237
49	12	12.42	0.41244
50	12	12.86	0.37909
51	12	4.13	0.98096
52	12	22.27	0.03457
53	12	9.94	0.62105
54	12	3.44	0.99152
55	12	7.22	0.84258
56	12	9.73	0.63935
57	12	9.28	0.67916
58	12	8.83	0.71770
59	12	4.29	0.97758
60	12	9.41	0.66763
61	12	13.42	0.33921
62	12	28.41	0.00481
63	12	6.83	0.86882
64	12	11.85	0.45820
65	12	13.85	0.31038
66	12	13.90	0.30734
67	12	13.95	0.30384
68	12	9.04	0.69982
69	12	9.51	0.65903
70	12	15.52	0.21418
71	12	11.55	0.48226
72	12	8.50	0.74469
73	12	6.99	0.85804
74	12	9.97	0.61819
75	12	6.65	0.87987
76	12	13.74	0.31741
77	12	6.21	0.90498
78	12	16.32	0.17717
79	12	17.67	0.12611
80	12	10.31	0.58849
81	12	10.15	0.60313
82	12	6.91	0.86329
83	12	3.36	0.99238
84	12	14.66	0.26036

85	12	9.56	0.65411
86	12	8.43	0.75099
87	12	12.84	0.38063
88	12	13.80	0.31378
89	12	9.78	0.63553
90	12	7.21	0.84372
91	12	12.73	0.38908
92	12	16.34	0.17611
93	12	4.72	0.96677
94	12	12.00	0.44552
95	12	14.52	0.26880
96	12	7.66	0.81094
97	12	8.10	0.77700
98	12	15.53	0.21394
99	12	10.00	0.61615
100	12	21.59	0.04235
Combined P-Value for 100 tests (Using KS method)			0.43137

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	10.76	0.54928
2	12	15.36	0.22228
3	12	5.21	0.95067
4	12	8.21	0.76818
5	12	12.28	0.42352
6	12	7.83	0.79790
7	12	5.53	0.93780
8	12	8.11	0.77641
9	12	4.08	0.98186
10	12	10.79	0.54709
11	12	11.05	0.52428
12	12	11.87	0.45598
13	12	11.74	0.46714
14	12	17.75	0.12337
15	12	14.00	0.30101
16	12	7.24	0.84142
17	12	4.38	0.97548
18	12	16.62	0.16428
19	12	6.64	0.88058
20	12	9.82	0.63182
21	12	9.09	0.69486
22	12	19.26	0.08244
23	12	6.69	0.87726
24	12	16.50	0.16941
25	12	7.52	0.82111
26	12	10.43	0.57787
27	12	10.06	0.61082
28	12	13.93	0.30548
29	12	18.22	0.10927
30	12	5.35	0.94521
31	12	20.17	0.06390

32	12	9.25	0.68102
33	12	6.01	0.91580
34	12	25.75	0.01165
35	12	17.06	0.14735
36	12	8.72	0.72706
37	12	10.99	0.53017
38	12	6.28	0.90156
39	12	6.00	0.91626
40	12	10.48	0.57400
41	12	11.93	0.45139
42	12	12.21	0.42923
43	12	17.42	0.13451
44	12	8.88	0.71319
45	12	13.09	0.36276
46	12	17.21	0.14192
47	12	7.68	0.80930
48	12	5.48	0.94008
49	12	8.90	0.71138
50	12	13.73	0.31839
51	12	9.84	0.62987
52	12	8.29	0.76240
53	12	12.04	0.44284
54	12	10.67	0.55696
55	12	6.14	0.90893
56	12	11.43	0.49256
57	12	16.42	0.17282
58	12	13.14	0.35863
59	12	8.11	0.77659
60	12	13.73	0.31825
61	12	14.05	0.29739
62	12	11.48	0.48801
63	12	10.30	0.58940
64	12	7.45	0.82631
65	12	1.78	0.99968
66	12	5.19	0.95142
67	12	10.92	0.53576
68	12	10.75	0.55006
69	12	6.65	0.87997
70	12	13.31	0.34660
71	12	13.59	0.32759
72	12	8.88	0.71280
73	12	6.82	0.86948
74	12	20.34	0.06086
75	12	10.20	0.59851
76	12	8.34	0.75782
77	12	28.80	0.00422
78	12	16.26	0.17968
79	12	16.69	0.16169
80	12	6.99	0.85858
81	12	12.74	0.38825
82	12	8.41	0.75249
83	12	7.89	0.79337
84	12	5.59	0.93551
85	12	14.87	0.24850
86	12	12.91	0.37537
87	12	7.44	0.82754
88	12	7.46	0.82556

89	12	20.36	0.06066
90	12	4.45	0.97399
91	12	12.45	0.41032
92	12	8.81	0.71940
93	12	13.34	0.34452
94	12	5.90	0.92114
95	12	6.89	0.86473
96	12	12.97	0.37113
97	12	18.11	0.11234
98	12	11.03	0.52614
99	12	9.88	0.62607
100	12	12.20	0.42974
Combined P-Value for 100 tests (Using KS method)			0.15665

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)	0.83578	1.00000
Opening Score (Dealer)	0.27769	1.00000
Dealer's Final Score	0.58884	1.00000
Player Cards Rank	0.43137	1.00000
Dealer Cards Rank	0.15665	0.78325
Combined P-Value using Holm's Method		0.78325

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

Date: 20 June 2025

Signed:



Alvin Rizaldi
Chief Executive Officer
iTech Labs

Date: 20 June 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.