

## Blackjack Cards Analysis – June 2025

### The Directors

Entain Plc

This confirms that iTech Labs has examined the game logs for blackjack games from **June 1, 2025, to June 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	19.75	0.28696
2	17	9.59	0.91976
3	17	15.68	0.54696
4	17	25.12	0.09206
5	17	9.84	0.91033
6	17	20.87	0.23204
7	17	24.50	0.10643
8	17	19.84	0.28239
9	17	19.65	0.29265
10	17	15.65	0.54845
11	17	21.26	0.21506
12	17	32.30	0.01379
13	17	32.07	0.01475
14	17	17.75	0.40464
15	17	18.74	0.34346
16	17	29.07	0.03388
17	17	12.59	0.76298
18	17	7.67	0.97305
19	17	19.47	0.30227
20	17	14.33	0.64329
21	17	23.96	0.12063
22	17	16.60	0.48188
23	17	7.69	0.97271
24	17	17.48	0.42238
25	17	14.60	0.62437

26	17	14.01	0.66630
27	17	11.82	0.81086
28	17	15.72	0.54407
29	17	15.30	0.57373
30	17	11.73	0.81597
31	17	13.23	0.72072
32	17	11.40	0.83505
33	17	8.92	0.94278
34	17	23.95	0.12082
35	17	10.49	0.88176
36	17	24.59	0.10422
37	17	15.70	0.54551
38	17	17.56	0.41681
39	17	13.73	0.68600
40	17	10.91	0.86107
41	17	12.41	0.77446
42	17	18.54	0.35530
43	17	15.04	0.59245
44	17	11.86	0.80840
45	17	17.86	0.39780
46	17	13.82	0.67985
47	17	23.78	0.12560
48	17	20.84	0.23335
49	17	14.65	0.62050
50	17	12.55	0.76591
51	17	26.18	0.07130
52	17	17.50	0.42073
53	17	20.49	0.25005
54	17	13.56	0.69786
55	17	10.54	0.87964
56	17	18.14	0.37997
57	17	8.88	0.94381
58	17	14.52	0.63030
59	17	10.93	0.85994
60	17	13.68	0.68980
61	17	17.07	0.44938
62	17	20.55	0.24693
63	17	25.55	0.08305
64	17	11.66	0.82017
65	17	10.21	0.89446
66	17	20.75	0.23788
67	17	14.33	0.64391
68	17	12.94	0.74049
69	17	15.15	0.58468
70	17	7.75	0.97161
71	17	10.74	0.86997
72	17	11.83	0.81013
73	17	22.21	0.17682
74	17	15.44	0.56365
75	17	22.09	0.18146
76	17	12.12	0.79275
77	17	26.72	0.06229
78	17	18.51	0.35740
79	17	14.37	0.64057
80	17	15.50	0.55968
81	17	12.02	0.79900
82	17	15.26	0.57672

83	17	9.39	0.92710
84	17	18.03	0.38685
85	17	15.07	0.59041
86	17	9.28	0.93122
87	17	17.76	0.40386
88	17	21.40	0.20894
89	17	12.96	0.73873
90	17	19.74	0.28772
91	17	12.63	0.76054
92	17	8.72	0.94858
93	17	9.95	0.90556
94	17	21.34	0.21141
95	17	8.57	0.95288
96	17	17.69	0.40890
97	17	15.15	0.58495
98	17	14.99	0.59652
99	17	25.12	0.09215
100	17	14.78	0.61137
Combined P-Value for 100 tests (Using KS method)			0.08487

*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	29.53	0.02993
2	17	12.25	0.78503
3	17	11.42	0.83410
4	17	14.65	0.62086
5	17	17.04	0.45189
6	17	28.10	0.04380
7	17	8.62	0.95131
8	17	26.74	0.06194
9	17	19.33	0.30991
10	17	21.53	0.20347
11	17	17.69	0.40863
12	17	35.84	0.00482
13	17	15.30	0.57417
14	17	9.03	0.93916
15	17	11.38	0.83637
16	17	15.29	0.57469
17	17	12.88	0.74416
18	17	16.10	0.51695
19	17	21.84	0.19099
20	17	15.18	0.58246
21	17	12.83	0.74762
22	17	12.07	0.79583
23	17	20.22	0.26336
24	17	16.16	0.51240
25	17	12.62	0.76092
26	17	22.63	0.16156
27	17	15.03	0.59364
28	17	17.05	0.45084

29	17	7.24	0.98021
30	17	12.68	0.75745
31	17	22.79	0.15610
32	17	9.21	0.93341
33	17	11.91	0.80560
34	17	13.28	0.71734
35	17	8.87	0.94411
36	17	15.67	0.54737
37	17	22.20	0.17700
38	17	11.91	0.80528
39	17	22.48	0.16696
40	17	13.80	0.68147
41	17	17.78	0.40290
42	17	20.22	0.26317
43	17	21.03	0.22496
44	17	25.45	0.08508
45	17	19.66	0.29195
46	17	13.45	0.70589
47	17	21.67	0.19771
48	17	10.25	0.89279
49	17	20.63	0.24318
50	17	12.29	0.78219
51	17	17.68	0.40926
52	17	26.23	0.07043
53	17	19.95	0.27694
54	17	12.99	0.73659
55	17	13.49	0.70282
56	17	13.46	0.70466
57	17	19.65	0.29238
58	17	18.51	0.35755
59	17	20.07	0.27086
60	17	22.00	0.18473
61	17	31.96	0.01520
62	17	11.14	0.84917
63	17	12.94	0.74039
64	17	27.26	0.05433
65	17	17.73	0.40576
66	17	32.51	0.01301
67	17	16.88	0.46254
68	17	15.79	0.53869
69	17	23.39	0.13710
70	17	11.98	0.80120
71	17	6.64	0.98773
72	17	19.47	0.30206
73	17	24.75	0.10037
74	17	10.00	0.90378
75	17	11.93	0.80444
76	17	11.35	0.83778
77	17	31.32	0.01824
78	17	22.16	0.17860
79	17	22.68	0.16008
80	17	13.39	0.70972
81	17	16.73	0.47260
82	17	29.69	0.02865
83	17	18.83	0.33831
84	17	11.53	0.82785
85	17	21.22	0.21639

86	17	19.40	0.30612
87	17	18.01	0.38837
88	17	24.13	0.11584
89	17	14.51	0.63052
90	17	23.00	0.14933
91	17	18.55	0.35475
92	17	20.72	0.23904
93	17	28.25	0.04207
94	17	18.35	0.36727
95	17	14.04	0.66444
96	17	22.37	0.17104
97	17	8.30	0.95976
98	17	12.89	0.74328
99	17	25.07	0.09323
100	17	15.82	0.53667
Combined P-Value for 100 tests (Using KS method)			0.37539

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	46.04	0.63298
2	50	61.87	0.12110
3	50	45.14	0.66843
4	50	60.96	0.13770
5	50	39.51	0.85644
6	50	55.00	0.29090
7	50	47.39	0.57861
8	50	57.97	0.20503
9	50	41.18	0.80846
10	50	36.01	0.93157
11	50	63.08	0.10136
12	50	48.74	0.52415
13	50	50.55	0.45182
14	50	71.56	0.02437
15	50	58.96	0.18053
16	50	41.36	0.80292
17	50	45.66	0.64819
18	50	54.40	0.31061
19	50	45.50	0.65449
20	50	53.55	0.33967
21	50	61.77	0.12282
22	50	56.66	0.24062
23	50	40.69	0.82348
24	50	75.87	0.01060
25	50	32.41	0.97460
26	50	35.62	0.93775
27	50	36.65	0.92048
28	50	50.03	0.47236
29	50	65.39	0.07083
30	50	49.84	0.47968
31	50	45.93	0.63725

32	50	48.73	0.52441
33	50	52.61	0.37320
34	50	55.51	0.27490
35	50	49.79	0.48184
36	50	40.41	0.83161
37	50	53.31	0.34819
38	50	43.47	0.73128
39	50	51.44	0.41715
40	50	50.32	0.46073
41	50	54.43	0.30981
42	50	53.91	0.32729
43	50	51.74	0.40583
44	50	65.45	0.07009
45	50	46.23	0.62528
46	50	58.30	0.19660
47	50	57.88	0.20730
48	50	55.13	0.28700
49	50	56.96	0.23218
50	50	47.30	0.58239
51	50	34.24	0.95660
52	50	63.63	0.09322
53	50	47.41	0.57777
54	50	55.82	0.26543
55	50	53.68	0.33509
56	50	46.17	0.62790
57	50	52.83	0.36543
58	50	55.20	0.28447
59	50	53.91	0.32739
60	50	47.32	0.58142
61	50	55.86	0.26411
62	50	69.33	0.03650
63	50	47.23	0.58510
64	50	40.83	0.81917
65	50	48.42	0.53700
66	50	47.86	0.55957
67	50	45.09	0.67021
68	50	56.48	0.24575
69	50	59.50	0.16820
70	50	39.57	0.85508
71	50	45.56	0.65197
72	50	50.58	0.45029
73	50	40.38	0.83254
74	50	36.99	0.91419
75	50	37.71	0.89957
76	50	59.10	0.17732
77	50	55.98	0.26060
78	50	68.82	0.03988
79	50	54.24	0.31592
80	50	43.81	0.71871
81	50	52.21	0.38817
82	50	42.93	0.75037
83	50	44.61	0.68870
84	50	63.73	0.09187
85	50	55.90	0.26296
86	50	50.06	0.47111
87	50	39.79	0.84895
88	50	57.54	0.21635

89	50	56.57	0.24306
90	50	59.04	0.17864
91	50	50.12	0.46866
92	50	81.60	0.00317
93	50	50.51	0.45318
94	50	37.90	0.89540
95	50	41.40	0.80159
96	50	49.64	0.48774
97	50	64.54	0.08107
98	50	46.59	0.61114
99	50	47.01	0.59405
100	50	61.18	0.13350
Combined P-Value for 100 tests (Using KS method)			0.25845

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	10.36	0.58411
2	12	8.58	0.73846
3	12	11.73	0.46755
4	12	11.41	0.49380
5	12	10.80	0.54613
6	12	9.07	0.69689
7	12	7.07	0.85299
8	12	9.10	0.69474
9	12	20.19	0.06360
10	12	13.05	0.36513
11	12	4.43	0.97439
12	12	24.79	0.01587
13	12	5.13	0.95349
14	12	9.55	0.65575
15	12	11.44	0.49162
16	12	9.25	0.68153
17	12	22.76	0.02980
18	12	16.42	0.17295
19	12	16.05	0.18911
20	12	9.56	0.65434
21	12	18.35	0.10535
22	12	5.63	0.93367
23	12	7.47	0.82498
24	12	4.86	0.96240
25	12	4.51	0.97245
26	12	6.02	0.91527
27	12	11.60	0.47856

28	12	9.18	0.68757
29	12	6.83	0.86864
30	12	2.40	0.99849
31	12	7.96	0.78848
32	12	7.33	0.83491
33	12	10.53	0.56948
34	12	12.57	0.40100
35	12	9.42	0.66699
36	12	16.47	0.17070
37	12	19.37	0.08003
38	12	8.43	0.75087
39	12	17.44	0.13371
40	12	13.39	0.34156
41	12	8.95	0.70760
42	12	9.67	0.64499
43	12	6.51	0.88808
44	12	17.63	0.12751
45	12	14.27	0.28385
46	12	14.53	0.26795
47	12	9.75	0.63801
48	12	22.94	0.02826
49	12	21.97	0.03781
50	12	8.39	0.75420
51	12	10.43	0.57793
52	12	7.78	0.80205
53	12	19.96	0.06789
54	12	5.77	0.92704
55	12	4.70	0.96740
56	12	4.54	0.97166
57	12	6.08	0.91191
58	12	12.68	0.39249
59	12	8.03	0.78292
60	12	7.90	0.79296
61	12	10.46	0.57589
62	12	12.52	0.40519
63	12	9.80	0.63330
64	12	9.73	0.63975
65	12	10.12	0.60555
66	12	20.32	0.06134
67	12	12.45	0.41058
68	12	8.82	0.71812
69	12	7.82	0.79895
70	12	14.47	0.27164
71	12	8.13	0.77464
72	12	12.05	0.44205
73	12	7.47	0.82505
74	12	18.58	0.09907
75	12	17.94	0.11767
76	12	6.77	0.87244
77	12	24.10	0.01969
78	12	10.54	0.56848
79	12	6.42	0.89341
80	12	13.72	0.31879
81	12	4.43	0.97439
82	12	16.27	0.17932
83	12	4.64	0.96897
84	12	17.86	0.12004



85	12	9.66	0.64559
86	12	4.05	0.98248
87	12	12.94	0.37312
88	12	20.80	0.05338
89	12	8.75	0.72381
90	12	26.08	0.01046
91	12	5.24	0.94944
92	12	5.22	0.95021
93	12	15.49	0.21589
94	12	8.01	0.78468
95	12	10.80	0.54599
96	12	6.75	0.87347
97	12	18.24	0.10869
98	12	6.37	0.89618
99	12	10.93	0.53531
100	12	13.50	0.33392
Combined P-Value for 100 tests (Using KS method)			0.02954

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	13.62	0.32565
2	12	10.43	0.57855
3	12	4.23	0.97894
4	12	18.84	0.09239
5	12	10.91	0.53678
6	12	8.83	0.71735
7	12	8.30	0.76153
8	12	16.31	0.17759
9	12	7.12	0.84961
10	12	8.27	0.76355
11	12	24.99	0.01489
12	12	15.89	0.19630
13	12	11.86	0.45665
14	12	18.19	0.11009
15	12	7.96	0.78848
16	12	8.45	0.74882
17	12	6.40	0.89461
18	12	9.06	0.69751
19	12	12.99	0.36955
20	12	15.06	0.23805
21	12	10.28	0.59165
22	12	19.41	0.07921
23	12	3.15	0.99438
24	12	16.16	0.18423
25	12	8.75	0.72416
26	12	18.66	0.09705
27	12	7.67	0.81001
28	12	7.29	0.83787
29	12	14.12	0.29306
30	12	19.29	0.08178
31	12	4.31	0.97713

32	12	15.67	0.20678
33	12	7.24	0.84112
34	12	12.61	0.39834
35	12	18.33	0.10610
36	12	5.73	0.92895
37	12	12.98	0.37060
38	12	7.33	0.83503
39	12	10.11	0.60595
40	12	7.43	0.82782
41	12	20.90	0.05188
42	12	9.51	0.65919
43	12	13.70	0.32025
44	12	10.78	0.54760
45	12	13.03	0.36701
46	12	5.90	0.92120
47	12	9.21	0.68502
48	12	8.63	0.73406
49	12	3.97	0.98391
50	12	12.63	0.39671
51	12	6.05	0.91358
52	12	8.93	0.70861
53	12	12.15	0.43391
54	12	8.25	0.76514
55	12	31.13	0.00188
56	12	5.83	0.92422
57	12	8.66	0.73167
58	12	11.93	0.45135
59	12	7.21	0.84360
60	12	13.97	0.30256
61	12	9.18	0.68772
62	12	12.98	0.37079
63	12	8.43	0.75029
64	12	19.28	0.08188
65	12	8.11	0.77666
66	12	6.71	0.87623
67	12	13.49	0.33472
68	12	12.81	0.38320
69	12	7.02	0.85604
70	12	11.11	0.51928
71	12	18.91	0.09070
72	12	5.74	0.92856
73	12	15.86	0.19776
74	12	6.00	0.91589
75	12	13.96	0.30306
76	12	5.57	0.93621
77	12	10.39	0.58164
78	12	10.32	0.58771
79	12	11.92	0.45223
80	12	13.31	0.34681
81	12	14.63	0.26201
82	12	15.46	0.21742
83	12	22.29	0.03441
84	12	12.42	0.41239
85	12	4.95	0.95975
86	12	12.43	0.41206
87	12	12.12	0.43597
88	12	8.28	0.76313

89	12	22.19	0.03542
90	12	7.86	0.79576
91	12	11.48	0.48820
92	12	21.73	0.04065
93	12	8.69	0.72883
94	12	14.61	0.26332
95	12	13.91	0.30670
96	12	13.17	0.35667
97	12	13.07	0.36375
98	12	6.00	0.91585
99	12	13.05	0.36512
100	12	14.18	0.28945
Combined P-Value for 100 tests (Using KS method)			0.31226

*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)	0.08487	0.33949
Opening Score (Dealer)	0.37539	0.77534
Dealer's Final Score	0.25845	0.77534
Player Cards Rank	0.02954	0.14771
Dealer Cards Rank	0.31226	0.77534
Combined P-Value using Holm's Method		0.14771

*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.

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**Signed:**



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**Divya Bhargava**  
**Project Manager**  
**iTech Labs**  
Date: 22 July 2025

**Signed:**



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**Alvin Rizaldi**  
**Chief Executive Officer**  
**iTech Labs**  
Date: 22 July 2025

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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.