



Blackjack Cards Analysis – March 2025

The Directors

Entain Plc

This confirms that iTech Labs has examined the game logs for blackjack games from **March 1, 2025, to March 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	21.77	0.19377
2	17	24.28	0.11211
3	17	21.68	0.19742
4	17	18.77	0.34193
5	17	16.52	0.48717
6	17	15.60	0.55222
7	17	10.85	0.86444
8	17	16.51	0.48832
9	17	27.65	0.04924
10	17	28.15	0.04322
11	17	7.44	0.97706
12	17	14.00	0.66743
13	17	18.88	0.33553
14	17	21.61	0.20002
15	17	14.62	0.62301
16	17	19.10	0.32266
17	17	23.59	0.13101
18	17	6.48	0.98931
19	17	11.87	0.80784
20	17	15.09	0.58868
21	17	11.12	0.85009
22	17	16.38	0.49688
23	17	17.01	0.45391
24	17	8.84	0.94527
25	17	14.20	0.65257

26	17	28.71	0.03726
27	17	22.98	0.14988
28	17	19.46	0.30291
29	17	22.52	0.16554
30	17	11.21	0.84533
31	17	22.37	0.17090
32	17	16.38	0.49690
33	17	17.36	0.43006
34	17	16.83	0.46564
35	17	12.23	0.78604
36	17	17.11	0.44682
37	17	10.35	0.88828
38	17	14.59	0.62465
39	17	22.46	0.16755
40	17	22.56	0.16399
41	17	14.39	0.63938
42	17	17.99	0.38948
43	17	13.85	0.67774
44	17	18.61	0.35112
45	17	15.01	0.59462
46	17	20.12	0.26800
47	17	13.93	0.67236
48	17	11.72	0.81696
49	17	9.71	0.91526
50	17	14.81	0.60897
51	17	25.39	0.08635
52	17	24.23	0.11333
53	17	23.36	0.13792
54	17	18.85	0.33728
55	17	14.12	0.65866
56	17	11.08	0.85229
57	17	18.72	0.34488
58	17	20.84	0.23349
59	17	12.16	0.79043
60	17	15.62	0.55060
61	17	15.42	0.56532
62	17	20.28	0.26008
63	17	4.98	0.99783
64	17	15.94	0.52834
65	17	11.61	0.82317
66	17	36.42	0.00403
67	17	6.16	0.99202
68	17	13.11	0.72891
69	17	11.59	0.82426
70	17	20.72	0.23887
71	17	13.20	0.72258
72	17	19.36	0.30821
73	17	15.71	0.54427
74	17	15.92	0.52932
75	17	13.74	0.68551
76	17	13.24	0.71986
77	17	13.75	0.68475
78	17	18.35	0.36721
79	17	13.90	0.67404
80	17	18.91	0.33369
81	17	11.01	0.85590
82	17	12.43	0.77316

83	17	18.87	0.33591
84	17	21.92	0.18788
85	17	21.60	0.20046
86	17	21.53	0.20354
87	17	17.29	0.43465
88	17	11.86	0.80858
89	17	18.16	0.37861
90	17	14.39	0.63912
91	17	16.38	0.49712
92	17	29.78	0.02796
93	17	20.65	0.24218
94	17	14.05	0.66322
95	17	26.57	0.06461
96	17	16.46	0.49123
97	17	13.50	0.70220
98	17	12.82	0.74848
99	17	19.34	0.30956
100	17	34.67	0.00687
Combined P-Value for 100 tests (Using KS method)			0.90933

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	23.61	0.13054
2	17	9.27	0.93135
3	17	26.17	0.07150
4	17	24.66	0.10263
5	17	11.58	0.82504
6	17	16.28	0.50410
7	17	16.07	0.51912
8	17	21.27	0.21430
9	17	11.16	0.84830
10	17	19.15	0.31984
11	17	26.06	0.07329
12	17	26.11	0.07257
13	17	19.54	0.29824
14	17	24.55	0.10524
15	17	16.39	0.49628
16	17	14.30	0.64544
17	17	9.86	0.90944
18	17	19.03	0.32669
19	17	10.87	0.86339
20	17	18.98	0.32943
21	17	11.30	0.84032
22	17	14.67	0.61957
23	17	11.21	0.84518
24	17	30.57	0.02250
25	17	9.84	0.91008
26	17	13.49	0.70294
27	17	12.84	0.74708
28	17	18.89	0.33461
29	17	16.56	0.48421

30	17	8.74	0.94795
31	17	14.24	0.65034
32	17	17.75	0.40459
33	17	18.86	0.33685
34	17	17.21	0.44024
35	17	20.21	0.26348
36	17	20.47	0.25071
37	17	10.34	0.88872
38	17	18.66	0.34856
39	17	14.26	0.64865
40	17	13.49	0.70281
41	17	14.22	0.65127
42	17	11.12	0.85043
43	17	18.20	0.37602
44	17	8.22	0.96161
45	17	16.76	0.47077
46	17	16.01	0.52339
47	17	8.12	0.96394
48	17	20.50	0.24950
49	17	12.60	0.76282
50	17	16.10	0.51710
51	17	13.41	0.70866
52	17	13.63	0.69289
53	17	13.35	0.71220
54	17	29.78	0.02795
55	17	16.26	0.50514
56	17	14.03	0.66502
57	17	13.38	0.71009
58	17	19.08	0.32421
59	17	18.90	0.33454
60	17	27.05	0.05732
61	17	17.09	0.44817
62	17	12.39	0.77591
63	17	10.76	0.86868
64	17	18.57	0.35397
65	17	20.22	0.26336
66	17	15.68	0.54636
67	17	16.68	0.47599
68	17	24.58	0.10442
69	17	19.82	0.28332
70	17	21.94	0.18707
71	17	16.15	0.51300
72	17	18.63	0.35001
73	17	15.04	0.59239
74	17	18.57	0.35359
75	17	17.59	0.41496
76	17	15.62	0.55112
77	17	19.62	0.29424
78	17	23.09	0.14622
79	17	13.86	0.67684
80	17	19.51	0.30007
81	17	22.17	0.17845
82	17	15.63	0.54986
83	17	20.71	0.23934
84	17	15.28	0.57530
85	17	16.75	0.47149
86	17	26.80	0.06114

87	17	18.37	0.36579
88	17	31.61	0.01683
89	17	10.90	0.86196
90	17	14.62	0.62295
91	17	15.93	0.52909
92	17	11.79	0.81266
93	17	26.90	0.05961
94	17	11.30	0.84050
95	17	14.86	0.60550
96	17	21.26	0.21477
97	17	17.71	0.40724
98	17	14.10	0.66004
99	17	11.44	0.83297
100	17	23.56	0.13198
Combined P-Value for 100 tests (Using KS method)			0.73303

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	48.25	0.54366
2	50	47.48	0.57511
3	50	48.33	0.54051
4	50	66.40	0.06009
5	50	43.89	0.71596
6	50	49.82	0.48059
7	50	44.11	0.70769
8	50	39.66	0.85253
9	50	53.75	0.33290
10	50	37.36	0.90681
11	50	35.55	0.93889
12	50	35.01	0.94672
13	50	43.00	0.74784
14	50	55.21	0.28431
15	50	32.82	0.97118
16	50	45.39	0.65881
17	50	40.11	0.84015
18	50	44.58	0.68978
19	50	33.62	0.96350
20	50	39.60	0.85426
21	50	48.27	0.54293
22	50	43.28	0.73816
23	50	57.91	0.20643
24	50	56.10	0.25703
25	50	54.93	0.29317
26	50	28.42	0.99400
27	50	41.94	0.78421
28	50	47.63	0.56916
29	50	45.13	0.66857
30	50	57.49	0.21760
31	50	44.31	0.70029
32	50	58.27	0.19739
33	50	53.19	0.35250

34	50	52.02	0.39525
35	50	45.85	0.64049
36	50	60.97	0.13749
37	50	52.37	0.38213
38	50	60.16	0.15378
39	50	41.80	0.78875
40	50	40.03	0.84231
41	50	60.56	0.14570
42	50	59.90	0.15929
43	50	42.54	0.76408
44	50	70.13	0.03165
45	50	36.84	0.91696
46	50	46.53	0.61338
47	50	35.98	0.93201
48	50	35.73	0.93611
49	50	43.09	0.74488
50	50	47.07	0.59179
51	50	57.21	0.22520
52	50	61.56	0.12660
53	50	63.26	0.09858
54	50	46.89	0.59899
55	50	52.25	0.38671
56	50	72.13	0.02189
57	50	55.42	0.27764
58	50	54.92	0.29351
59	50	36.99	0.91414
60	50	50.35	0.45936
61	50	48.63	0.52826
62	50	75.61	0.01115
63	50	41.97	0.78315
64	50	35.49	0.93971
65	50	61.66	0.12471
66	50	39.38	0.85996
67	50	50.64	0.44828
68	50	63.11	0.10088
69	50	56.85	0.23529
70	50	58.29	0.19680
71	50	35.27	0.94294
72	50	45.64	0.64878
73	50	59.56	0.16679
74	50	45.93	0.63733
75	50	39.63	0.85335
76	50	53.42	0.34435
77	50	69.74	0.03392
78	50	55.36	0.27950
79	50	54.69	0.30105
80	50	43.00	0.74785
81	50	56.99	0.23113
82	50	51.36	0.42022
83	50	42.54	0.76402
84	50	50.78	0.44257
85	50	51.36	0.42005
86	50	47.16	0.58810
87	50	48.01	0.55359
88	50	50.11	0.46909
89	50	42.94	0.74993
90	50	61.88	0.12080

91	50	46.71	0.60623
92	50	36.73	0.91904
93	50	60.60	0.14478
94	50	50.73	0.44462
95	50	44.76	0.68312
96	50	51.11	0.42990
97	50	71.50	0.02464
98	50	49.56	0.49108
99	50	54.61	0.30382
100	50	41.93	0.78449
Combined P-Value for 100 tests (Using KS method)			0.95598

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	7.07	0.85302
2	12	6.84	0.86825
3	12	14.58	0.26517
4	12	6.05	0.91374
5	12	8.06	0.78031
6	12	6.93	0.86241
7	12	10.43	0.57823
8	12	8.18	0.77115
9	12	8.95	0.70707
10	12	20.27	0.06207
11	12	7.87	0.79482
12	12	4.58	0.97054
13	12	5.31	0.94686
14	12	7.20	0.84415
15	12	8.17	0.77168
16	12	8.05	0.78092
17	12	6.30	0.90039
18	12	11.65	0.47455
19	12	6.86	0.86677
20	12	4.51	0.97243
21	12	11.54	0.48366
22	12	6.89	0.86510
23	12	8.85	0.71546
24	12	8.45	0.74872
25	12	22.69	0.03052
26	12	13.22	0.35348
27	12	20.93	0.05143
28	12	3.35	0.99248
29	12	17.90	0.11891

30	12	10.71	0.55434
31	12	10.95	0.53284
32	12	6.86	0.86666
33	12	4.43	0.97432
34	12	9.08	0.69630
35	12	9.17	0.68834
36	12	9.53	0.65738
37	12	5.30	0.94737
38	12	12.03	0.44348
39	12	13.89	0.30760
40	12	11.90	0.45409
41	12	16.86	0.15485
42	12	12.23	0.42756
43	12	6.95	0.86098
44	12	10.19	0.59915
45	12	11.68	0.47174
46	12	13.50	0.33372
47	12	14.00	0.30049
48	12	8.81	0.71926
49	12	6.56	0.88519
50	12	9.92	0.62281
51	12	20.13	0.06471
52	12	21.28	0.04645
53	12	11.66	0.47339
54	12	13.21	0.35421
55	12	9.41	0.66742
56	12	5.43	0.94224
57	12	20.83	0.05288
58	12	5.91	0.92077
59	12	9.66	0.64545
60	12	9.74	0.63919
61	12	11.23	0.50931
62	12	9.95	0.62001
63	12	5.76	0.92755
64	12	4.75	0.96568
65	12	10.92	0.53554
66	12	18.53	0.10049
67	12	4.75	0.96584
68	12	16.87	0.15443
69	12	4.20	0.97952
70	12	11.71	0.46965
71	12	11.48	0.48818
72	12	14.68	0.25947
73	12	9.38	0.67058
74	12	10.96	0.53200
75	12	9.53	0.65709
76	12	15.73	0.20401
77	12	9.34	0.67345
78	12	14.42	0.27467
79	12	14.51	0.26953
80	12	7.00	0.85778
81	12	15.62	0.20920
82	12	14.13	0.29251
83	12	7.92	0.79098
84	12	11.31	0.50245
85	12	7.97	0.78762
86	12	14.72	0.25732

87	12	4.47	0.97333
88	12	7.75	0.80448
89	12	10.68	0.55683
90	12	18.63	0.09792
91	12	10.85	0.54179
92	12	22.47	0.03257
93	12	11.95	0.44967
94	12	16.91	0.15283
95	12	13.83	0.31159
96	12	13.48	0.33506
97	12	16.39	0.17423
98	12	10.90	0.53754
99	12	9.63	0.64881
100	12	23.91	0.02094
Combined P-Value for 100 tests (Using KS method)			0.05159

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	25.11	0.01430
2	12	14.75	0.25519
3	12	9.02	0.70088
4	12	8.32	0.75981
5	12	9.84	0.63042
6	12	19.20	0.08386
7	12	9.36	0.67208
8	12	13.64	0.32408
9	12	13.40	0.34065
10	12	15.27	0.22687
11	12	18.66	0.09718
12	12	17.07	0.14697
13	12	20.26	0.06230
14	12	12.51	0.40574
15	12	15.09	0.23668
16	12	8.34	0.75843
17	12	8.55	0.74087
18	12	14.80	0.25246
19	12	10.68	0.55681
20	12	12.21	0.42877
21	12	10.06	0.61029
22	12	5.67	0.93164
23	12	7.61	0.81474
24	12	16.14	0.18498
25	12	4.40	0.97505
26	12	16.96	0.15118
27	12	11.74	0.46716
28	12	10.47	0.57456
29	12	11.27	0.50606
30	12	12.22	0.42806
31	12	21.54	0.04299
32	12	12.34	0.41841
33	12	14.05	0.29757
34	12	15.26	0.22767
35	12	4.78	0.96481

36	12	6.55	0.88576
37	12	21.63	0.04192
38	12	7.23	0.84236
39	12	13.64	0.32405
40	12	8.30	0.76131
41	12	12.36	0.41709
42	12	18.15	0.11108
43	12	11.42	0.49293
44	12	22.36	0.03367
45	12	13.02	0.36750
46	12	12.62	0.39700
47	12	10.33	0.58736
48	12	11.51	0.48580
49	12	13.70	0.32046
50	12	10.66	0.55809
51	12	11.98	0.44718
52	12	17.28	0.13937
53	12	9.88	0.62680
54	12	5.95	0.91853
55	12	6.64	0.88031
56	12	9.02	0.70121
57	12	8.63	0.73448
58	12	16.19	0.18286
59	12	11.00	0.52859
60	12	14.96	0.24383
61	12	17.03	0.14838
62	12	15.71	0.20510
63	12	19.93	0.06841
64	12	10.76	0.54975
65	12	9.92	0.62316
66	12	13.11	0.36099
67	12	7.90	0.79295
68	12	16.37	0.17493
69	12	12.11	0.43669
70	12	19.99	0.06725
71	12	9.67	0.64512
72	12	7.82	0.79936
73	12	14.77	0.25429
74	12	24.15	0.01939
75	12	18.39	0.10435
76	12	11.90	0.45406
77	12	19.51	0.07696
78	12	18.18	0.11045
79	12	21.75	0.04047
80	12	8.30	0.76115
81	12	14.23	0.28647
82	12	9.42	0.66679
83	12	7.44	0.82701
84	12	15.12	0.23493
85	12	17.59	0.12888
86	12	12.25	0.42585
87	12	13.75	0.31722
88	12	12.83	0.38181
89	12	13.68	0.32145
90	12	15.25	0.22793
91	12	12.82	0.38210
92	12	8.64	0.73319

93	12	14.96	0.24383
94	12	7.61	0.81453
95	12	16.35	0.17552
96	12	9.78	0.63568
97	12	13.44	0.33815
98	12	13.80	0.31339
99	12	2.56	0.99794
100	12	14.96	0.24383
Combined P-Value for 100 tests (Using KS method)			0.04503

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)	0.90933	1.00000
Opening Score (Dealer)	0.73303	1.00000
Dealer's Final Score	0.95598	1.00000
Player Cards Rank	0.05159	0.22515
Dealer Cards Rank	0.04503	0.22515
Combined P-Value using Holm's Method		0.22515

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: 05 May 2025

Signed:



Alvin Rizaldi
Chief Executive Officer
iTech Labs Australia
Date: 05 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.