



Blackjack Cards Analysis – February 2025

The Directors

Entain Plc

This is to confirm that iTech Labs has examined the game logs for blackjack games for the period **February 01, 2025, to February 28, 2025**, as recorded by the respective game servers. The game logs were for blackjack games using 8 decks. iTech Labs has 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. Dealer final hand value is based on the fixed rules of the game. Player final hand value is dependent on player strategy choice, so has no theoretical basis for comparison.

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 blackjack opening hand value statistics tests.

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

Test No.	DOF	ChiSqr	P-Value
1	17	13.81	0.68019
2	17	15.80	0.53794
3	17	15.12	0.58653
4	17	17.97	0.39055
5	17	15.80	0.53780
6	17	16.35	0.49902
7	17	16.63	0.47944
8	17	13.62	0.69354
9	17	13.23	0.72083
10	17	15.87	0.53296
11	17	16.63	0.47944
12	17	23.17	0.14372
13	17	20.24	0.26230
14	17	16.00	0.52362
15	17	12.43	0.77355
16	17	7.93	0.96805
17	17	25.31	0.08792
18	17	20.91	0.23022
19	17	23.92	0.12158
20	17	8.75	0.94770
21	17	16.16	0.51266

22	17	27.20	0.05515
23	17	10.45	0.88366
24	17	24.52	0.10601
25	17	18.50	0.35778
26	17	24.91	0.09676
27	17	11.94	0.80373
28	17	8.75	0.94775
29	17	17.51	0.42042
30	17	22.59	0.16301
31	17	12.68	0.75747
32	17	7.54	0.97546
33	17	24.94	0.09600
34	17	17.03	0.45267
35	17	6.95	0.98421
36	17	16.60	0.48156
37	17	9.39	0.92710
38	17	20.03	0.27290
39	17	15.13	0.58622
40	17	21.94	0.18713
41	17	17.76	0.40381
42	17	11.66	0.82045
43	17	6.90	0.98481
44	17	10.92	0.86084
45	17	13.05	0.73258
46	17	12.60	0.76258
47	17	15.85	0.53475
48	17	19.12	0.32163
49	17	11.64	0.82156
50	17	16.78	0.46905
51	17	15.04	0.59288
52	17	28.54	0.03898
53	17	17.36	0.43049
54	17	19.51	0.30006
55	17	18.37	0.36617
56	17	13.73	0.68578
57	17	15.36	0.56972
58	17	7.15	0.98147
59	17	20.43	0.25269
60	17	16.21	0.50882
61	17	8.46	0.95568
62	17	21.46	0.20650
63	17	13.29	0.71632
64	17	14.21	0.65246
65	17	20.22	0.26292
66	17	23.23	0.14194
67	17	11.11	0.85063
68	17	23.75	0.12647
69	17	13.76	0.68378
70	17	19.07	0.32460

71	17	14.60	0.62428
72	17	13.75	0.68437
73	17	26.78	0.06139
74	17	12.43	0.77349
75	17	12.90	0.74290
76	17	10.84	0.86495
77	17	13.92	0.67246
78	17	19.13	0.32118
79	17	35.40	0.00552
80	17	6.46	0.98957
81	17	23.76	0.12605
82	17	9.49	0.92356
83	17	27.47	0.05153
84	17	13.89	0.67495
85	17	16.72	0.47339
86	17	16.38	0.49676
87	17	10.36	0.88785
88	17	20.75	0.23752
89	17	13.80	0.68154
90	17	14.39	0.63907
91	17	14.63	0.62215
92	17	18.30	0.37009
93	17	26.75	0.06180
94	17	12.22	0.78680
95	17	19.83	0.28277
96	17	10.75	0.86916
97	17	17.03	0.45223
98	17	28.56	0.03884
99	17	16.42	0.49398
100	17	14.74	0.61396
Combined P-value for all tests (Using KS method)			0.49134

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	11.17	0.84776
2	17	13.47	0.70443
3	17	26.87	0.06000
4	17	19.41	0.30557
5	17	17.27	0.43627
6	17	17.29	0.43513
7	17	13.45	0.70537
8	17	14.59	0.62491
9	17	21.01	0.22575
10	17	9.91	0.90716
11	17	8.90	0.94320
12	17	20.17	0.26586

13	17	17.97	0.39071
14	17	16.90	0.46136
15	17	18.63	0.35043
16	17	13.74	0.68569
17	17	11.47	0.83097
18	17	9.07	0.93808
19	17	27.35	0.05307
20	17	18.83	0.33865
21	17	28.46	0.03986
22	17	18.13	0.38090
23	17	13.89	0.67499
24	17	14.51	0.63075
25	17	11.60	0.82363
26	17	19.85	0.28192
27	17	24.57	0.10474
28	17	12.19	0.78879
29	17	16.47	0.49053
30	17	17.96	0.39118
31	17	10.59	0.87727
32	17	19.33	0.31000
33	17	17.21	0.44000
34	17	13.13	0.72758
35	17	19.72	0.28855
36	17	26.61	0.06410
37	17	20.57	0.24600
38	17	30.05	0.02595
39	17	23.80	0.12488
40	17	16.14	0.51420
41	17	16.26	0.50515
42	17	15.09	0.58866
43	17	9.69	0.91611
44	17	10.24	0.89343
45	17	18.99	0.32925
46	17	17.38	0.42890
47	17	28.77	0.03672
48	17	17.28	0.43548
49	17	8.67	0.95004
50	17	10.94	0.85946
51	17	22.32	0.17256
52	17	12.43	0.77341
53	17	24.65	0.10283
54	17	25.56	0.08279
55	17	26.30	0.06922
56	17	13.00	0.73649
57	17	7.55	0.97526
58	17	15.78	0.53955
59	17	23.73	0.12682
60	17	20.59	0.24502
61	17	15.87	0.53341

62	17	7.92	0.96828
63	17	23.03	0.14839
64	17	14.58	0.62595
65	17	9.19	0.93401
66	17	10.20	0.89522
67	17	22.86	0.15392
68	17	10.49	0.88190
69	17	37.67	0.00273
70	17	14.48	0.63309
71	17	11.05	0.85378
72	17	13.26	0.71893
73	17	23.98	0.11992
74	17	21.73	0.19521
75	17	25.07	0.09323
76	17	18.40	0.36393
77	17	13.06	0.73208
78	17	5.27	0.99691
79	17	21.51	0.20433
80	17	22.09	0.18126
81	17	10.49	0.88162
82	17	16.44	0.49306
83	17	17.56	0.41730
84	17	16.49	0.48919
85	17	9.97	0.90474
86	17	17.16	0.44373
87	17	11.13	0.84989
88	17	14.90	0.60254
89	17	18.21	0.37575
90	17	11.74	0.81546
91	17	28.97	0.03478
92	17	19.25	0.31419
93	17	15.66	0.54833
94	17	16.55	0.48511
95	17	19.00	0.32868
96	17	12.87	0.74513
97	17	20.57	0.24604
98	17	10.83	0.86505
99	17	17.87	0.39708
100	17	26.81	0.06097
Combined P-value for all tests (Using KS method)			0.97334

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	37.64	0.90094
2	50	60.14	0.15438
3	50	42.02	0.78165

4	50	41.86	0.78686
5	50	55.77	0.26690
6	50	49.61	0.48908
7	50	66.48	0.05936
8	50	40.63	0.82515
9	50	45.39	0.65865
10	50	43.56	0.72795
11	50	48.50	0.53376
12	50	55.27	0.28233
13	50	43.65	0.72467
14	50	32.07	0.97716
15	50	56.29	0.25141
16	50	53.94	0.32611
17	50	66.24	0.06173
18	50	53.77	0.33222
19	50	44.68	0.68600
20	50	62.43	0.11152
21	50	49.00	0.51364
22	50	81.35	0.00335
23	50	57.06	0.22921
24	50	52.16	0.38999
25	50	53.34	0.34699
26	50	52.21	0.38826
27	50	33.11	0.96856
28	50	60.53	0.14615
29	50	52.64	0.37231
30	50	60.94	0.13811
31	50	52.66	0.37143
32	50	41.46	0.79972
33	50	46.93	0.59735
34	50	50.91	0.43742
35	50	44.82	0.68060
36	50	44.55	0.69115
37	50	43.77	0.72039
38	50	56.85	0.23511
39	50	54.45	0.30907
40	50	52.28	0.38565
41	50	47.88	0.55900
42	50	47.38	0.57928
43	50	45.62	0.64965
44	50	35.16	0.94460
45	50	49.04	0.51189
46	50	64.72	0.07871
47	50	36.32	0.92632
48	50	63.73	0.09180
49	50	47.33	0.58125
50	50	61.47	0.12817
51	50	56.62	0.24182
52	50	36.76	0.91843

53	50	51.72	0.40641
54	50	50.81	0.44165
55	50	53.24	0.35075
56	50	46.66	0.60828
57	50	45.76	0.64420
58	50	36.91	0.91560
59	50	47.49	0.57462
60	50	37.28	0.90847
61	50	51.03	0.43285
62	50	50.25	0.46344
63	50	50.29	0.46206
64	50	62.34	0.11302
65	50	69.93	0.03279
66	50	40.93	0.81627
67	50	57.66	0.21296
68	50	34.12	0.95794
69	50	65.10	0.07421
70	50	49.55	0.49126
71	50	65.67	0.06775
72	50	48.34	0.54036
73	50	53.10	0.35567
74	50	42.38	0.76942
75	50	51.30	0.42251
76	50	45.02	0.67312
77	50	51.36	0.42014
78	50	41.77	0.78963
79	50	49.95	0.47552
80	50	46.76	0.60436
81	50	54.52	0.30667
82	50	40.33	0.83389
83	50	50.50	0.45356
84	50	35.00	0.94689
85	50	42.23	0.77434
86	50	44.12	0.70727
87	50	61.72	0.12374
88	50	35.57	0.93851
89	50	45.41	0.65773
90	50	47.07	0.59159
91	50	43.59	0.72679
92	50	46.21	0.62623
93	50	42.26	0.77350
94	50	58.03	0.20347
95	50	52.99	0.35945
96	50	55.93	0.26209
97	50	45.92	0.63764
98	50	58.43	0.19331
99	50	29.64	0.99027
100	50	44.69	0.68566
Combined P-value for all tests			0.89274

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	9.43	0.66571
2	12	10.82	0.54422
3	12	11.41	0.49412
4	12	10.68	0.55677
5	12	4.82	0.96375
6	12	5.63	0.93339
7	12	12.21	0.42888
8	12	25.30	0.01346
9	12	24.09	0.01977
10	12	14.36	0.27860
11	12	10.10	0.60679
12	12	8.39	0.75422
13	12	25.99	0.01077
14	12	9.77	0.63578
15	12	18.06	0.11402
16	12	21.34	0.04559
17	12	13.23	0.35257
18	12	9.03	0.70077
19	12	3.73	0.98785
20	12	17.14	0.14423
21	12	19.56	0.07588
22	12	9.82	0.63178
23	12	10.42	0.57906
24	12	10.94	0.53402
25	12	19.05	0.08727
26	12	8.77	0.72260
27	12	11.81	0.46142
28	12	15.84	0.19859
29	12	11.06	0.52377
30	12	6.57	0.88469
31	12	9.70	0.64266
32	12	9.04	0.69954
33	12	5.38	0.94423
34	12	15.79	0.20089
35	12	4.89	0.96144
36	12	11.66	0.47370
37	12	9.92	0.62321

38	12	5.88	0.92210
39	12	7.03	0.85550
40	12	9.71	0.64139
41	12	7.49	0.82352
42	12	7.44	0.82694
43	12	12.29	0.42239
44	12	10.22	0.59641
45	12	4.24	0.97863
46	12	5.75	0.92808
47	12	20.62	0.05619
48	12	26.63	0.00873
49	12	8.89	0.71205
50	12	17.44	0.13362
51	12	11.51	0.48567
52	12	3.75	0.98753
53	12	7.89	0.79394
54	12	3.84	0.98621
55	12	11.64	0.47489
56	12	20.50	0.05817
57	12	5.01	0.95752
58	12	9.36	0.67233
59	12	4.41	0.97495
60	12	15.93	0.19424
61	12	12.35	0.41819
62	12	10.18	0.59975
63	12	12.30	0.42157
64	12	20.58	0.05689
65	12	17.27	0.13959
66	12	17.04	0.14824
67	12	9.65	0.64700
68	12	18.89	0.09121
69	12	17.13	0.14495
70	12	4.54	0.97158
71	12	7.12	0.84960
72	12	12.98	0.37044
73	12	7.43	0.82773
74	12	11.04	0.52550
75	12	12.92	0.37509
76	12	5.52	0.93845
77	12	9.87	0.62711
78	12	16.00	0.19110
79	12	12.81	0.38302
80	12	11.51	0.48577
81	12	13.86	0.30966
82	12	8.74	0.72527
83	12	9.21	0.68480
84	12	11.51	0.48571
85	12	19.28	0.08208
86	12	18.17	0.11075

87	12	5.90	0.92081
88	12	15.82	0.19961
89	12	14.04	0.29818
90	12	7.06	0.85344
91	12	15.95	0.19355
92	12	7.45	0.82659
93	12	13.83	0.31191
94	12	14.66	0.26060
95	12	13.20	0.35444
96	12	12.13	0.43553
97	12	20.29	0.06188
98	12	10.61	0.56270
99	12	10.56	0.56703
100	12	9.29	0.67788
Combined P-value for all tests (Using KS method)			0.68208

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	9.06	0.69804
2	12	6.91	0.86374
3	12	15.70	0.20536
4	12	13.93	0.30495
5	12	10.01	0.61511
6	12	19.13	0.08554
7	12	10.71	0.55403
8	12	9.52	0.65759
9	12	10.07	0.60998
10	12	11.48	0.48805
11	12	8.93	0.70924
12	12	8.64	0.73358
13	12	7.33	0.83477
14	12	15.05	0.23851
15	12	13.00	0.36880
16	12	12.30	0.42212
17	12	10.12	0.60500
18	12	10.33	0.58662
19	12	13.08	0.36329
20	12	12.70	0.39099
21	12	11.41	0.49418
22	12	16.89	0.15395
23	12	13.95	0.30388
24	12	6.82	0.86913
25	12	7.34	0.83414
26	12	15.16	0.23267
27	12	17.39	0.13534
28	12	13.25	0.35141
29	12	9.12	0.69282
30	12	19.48	0.07754
31	12	14.21	0.28780
32	12	12.25	0.42587

33	12	6.74	0.87422
34	12	7.53	0.82055
35	12	11.97	0.44782
36	12	9.19	0.68692
37	12	6.85	0.86705
38	12	13.22	0.35333
39	12	16.22	0.18118
40	12	20.17	0.06399
41	12	10.50	0.57212
42	12	8.66	0.73141
43	12	13.09	0.36218
44	12	9.23	0.68314
45	12	6.10	0.91113
46	12	7.84	0.79783
47	12	7.79	0.80116
48	12	10.35	0.58491
49	12	15.28	0.22657
50	12	6.18	0.90651
51	12	7.80	0.80049
52	12	17.41	0.13478
53	12	13.44	0.33756
54	12	18.69	0.09635
55	12	17.54	0.13046
56	12	9.83	0.63055
57	12	6.25	0.90323
58	12	5.78	0.92660
59	12	11.59	0.47940
60	12	6.88	0.86519
61	12	17.22	0.14168
62	12	7.88	0.79447
63	12	13.80	0.31383
64	12	4.24	0.97875
65	12	5.61	0.93455
66	12	17.05	0.14764
67	12	14.44	0.27349
68	12	11.09	0.52145
69	12	6.53	0.88699
70	12	8.67	0.73084
71	12	18.47	0.10209
72	12	6.33	0.89858
73	12	6.42	0.89361
74	12	19.36	0.08014
75	12	14.07	0.29645
76	12	27.29	0.00701
77	12	9.23	0.68339
78	12	8.12	0.77583
79	12	9.55	0.65554
80	12	9.08	0.69582
81	12	5.51	0.93877
82	12	5.58	0.93574
83	12	7.31	0.83619
84	12	15.50	0.21538
85	12	5.83	0.92443
86	12	16.94	0.15173
87	12	9.13	0.69190
88	12	10.52	0.57054

89	12	19.97	0.06761
90	12	11.09	0.52135
91	12	16.72	0.16034
92	12	16.84	0.15568
93	12	7.80	0.80035
94	12	20.44	0.05929
95	12	9.24	0.68259
96	12	6.42	0.89335
97	12	13.35	0.34397
98	12	4.96	0.95932
99	12	8.38	0.75507
100	12	10.49	0.57327
Combined P-value for all tests (Using KS method)			0.23019

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 the Holm's method and producing a single Combined P -value.

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

Combination of p-values using Holm's Method		
Test	P-Value	P-Adjusted
Opening Score (Player)	0.49134	1.00000
Opening Score (Dealer)	0.97334	1.00000
Dealer's Final Score	0.89274	1.00000
Player Cards Rank	0.68208	1.00000
Dealer Cards Rank	0.23019	1.00000
Combined P-Value using Holm's Method		1.00000

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
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iTech Labs Australia
Date: 20 March 2025

Signed:



Alvin Rizaldi
Chief Executive Officer
iTech Labs Australia
Date: 20 March 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.

