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10 December 2025

Suresh Yellayi
Entain Operations Limited
Suite 6, Atlantic Suites
Europort Avenue, Gibraltar

Re: Mathematical Analysis of *Blackjack*

File Number: MA-00-GSV-25-07

Dear Mr. Yellayi,

As per Entain Operations Limited's request, please find **Gaming Laboratories International, LLC's (GLI)** mathematical analysis of Blackjack:

This is to confirm that GLI has examined the Blackjack game logs in the gaming system of Entain Plc for the month of **October 2025** as recorded by the respective game servers and analyzed the Blackjack cards for statistical randomness.

1. Blackjack

This report only verifies the mathematical aspects of these games and DOES NOT offer an opinion as to whether or not these games are currently authorized for use in any jurisdiction.

Mathematical Analysis

Gaming Laboratories International, LLC (GLI) was requested by Entain Operations Limited to independently calculate the expected payback for the mentioned games and confirm that the returns are within the requirements. On the following page, please find a table containing the summary of our results.

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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	19.67	0.29138
2	17	11.24	0.84364
3	17	18.46	0.36041
4	17	23.86	0.12326
5	17	22.00	0.18482
6	17	16.27	0.50482
7	17	18.10	0.38240
8	17	23.48	0.13438
9	17	14.24	0.65033
10	17	21.13	0.22053
11	17	12.75	0.75275
12	17	17.68	0.40939

Test No.	DOF	ChiSqr	P-Value
13	17	18.18	0.37780
14	17	10.59	0.87698
15	17	13.51	0.70143
16	17	10.95	0.85916
17	17	13.18	0.72374
18	17	20.95	0.22876
19	17	6.47	0.98944
20	17	34.66	0.00689
21	17	19.53	0.29906
22	17	9.53	0.92226
23	17	7.71	0.97236
24	17	26.09	0.07290
25	17	13.16	0.72522
26	17	21.13	0.22043
27	17	12.25	0.78452
28	17	25.25	0.08927
29	17	15.15	0.58479
30	17	29.44	0.03066
31	17	18.64	0.34956
32	17	16.72	0.47376
33	17	26.89	0.05967
34	17	13.56	0.69762
35	17	11.37	0.83672

Test No.	DOF	ChiSqr	P-Value
36	17	22.01	0.18421
37	17	8.09	0.96455
38	17	13.47	0.70395
39	17	14.41	0.63817
40	17	14.09	0.66049
41	17	29.58	0.02956
42	17	11.55	0.82653
43	17	27.10	0.05662
44	17	17.73	0.40588
45	17	15.47	0.56193
46	17	24.15	0.11550
47	17	16.40	0.49571
48	17	19.87	0.28098
49	17	14.14	0.65705
50	17	8.04	0.96572
51	17	15.11	0.58731
52	17	13.05	0.73271
53	17	11.27	0.84238
54	17	18.54	0.35545
55	17	15.11	0.58730
56	17	22.72	0.15860
57	17	10.76	0.86894
58	17	14.46	0.63418

Test No.	DOF	ChiSqr	P-Value
59	17	19.87	0.28110
60	17	21.50	0.20461
61	17	11.26	0.84279
62	17	19.97	0.27575
63	17	13.09	0.72993
64	17	15.41	0.56564
65	17	15.96	0.52691
66	17	12.07	0.79577
67	17	16.44	0.49285
68	17	16.95	0.45782
69	17	15.84	0.53520
70	17	24.51	0.10616
71	17	12.02	0.79882
72	17	22.71	0.15885
73	17	14.86	0.60566
74	17	9.60	0.91955
75	17	13.06	0.73232
76	17	15.54	0.55694
77	17	18.24	0.37357
78	17	10.84	0.86496
79	17	6.84	0.98552
80	17	14.70	0.61740
81	17	3.59	0.99975

Test No.	DOF	ChiSqr	P-Value
82	17	11.21	0.84537
83	17	10.98	0.85746
84	17	12.44	0.77258
85	17	12.38	0.77632
86	17	12.85	0.74616
87	17	7.76	0.97151
88	17	31.74	0.01623
89	17	18.95	0.33117
90	17	16.68	0.47601
91	17	14.77	0.61170
92	17	11.20	0.84597
93	17	23.89	0.12253
94	17	19.89	0.27966
95	17	30.73	0.02151
96	17	15.56	0.55522
97	17	23.83	0.12415
98	17	19.02	0.32760
99	17	19.02	0.32717
100	17	14.87	0.60452
Combined P-Value for 100 tests (Using KS method)			0.60696

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 are sufficient data.

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

Test No.	DOF	ChiSqr	P-Value
1	17	32.35	0.01360
2	17	20.75	0.23777
3	17	14.96	0.59830
4	17	12.70	0.75632
5	17	16.30	0.50296
6	17	13.30	0.71605
7	17	19.63	0.29342
8	17	13.99	0.66801
9	17	20.88	0.23159
10	17	13.48	0.70326
11	17	12.22	0.78644
12	17	20.76	0.23727
13	17	19.10	0.32281
14	17	27.44	0.05188
15	17	23.82	0.12454
16	17	9.54	0.92197
17	17	23.01	0.14908
18	17	13.24	0.71981
19	17	13.96	0.66981
20	17	21.26	0.21473
21	17	29.47	0.03040
22	17	17.58	0.41576
23	17	16.22	0.50856

Test No.	DOF	ChiSqr	P-Value
24	17	7.31	0.97917
25	17	18.70	0.34617
26	17	19.87	0.28115
27	17	19.82	0.28354
28	17	26.15	0.07181
29	17	15.91	0.53014
30	17	25.40	0.08621
31	17	16.01	0.52330
32	17	13.47	0.70396
33	17	14.01	0.66615
34	17	11.79	0.81247
35	17	18.72	0.34469
36	17	21.69	0.19679
37	17	13.83	0.67896
38	17	15.07	0.59065
39	17	9.05	0.93865
40	17	12.55	0.76585
41	17	22.17	0.17834
42	17	10.38	0.88711
43	17	3.42	0.99982
44	17	13.07	0.73181
45	17	16.74	0.47182
46	17	15.55	0.55557

Test No.	DOF	ChiSqr	P-Value
47	17	9.05	0.93866
48	17	7.26	0.97999
49	17	10.08	0.90037
50	17	28.20	0.04265
51	17	11.45	0.83244
52	17	17.38	0.42912
53	17	21.65	0.19868
54	17	17.51	0.42067
55	17	14.39	0.63937
56	17	20.17	0.26567
57	17	18.75	0.34323
58	17	9.26	0.93176
59	17	18.38	0.36511
60	17	22.84	0.15451
61	17	12.42	0.77404
62	17	15.78	0.53935
63	17	12.80	0.74934
64	17	22.51	0.16599
65	17	13.37	0.71105
66	17	31.89	0.01553
67	17	21.00	0.22645
68	17	12.19	0.78827
69	17	14.30	0.64605

Test No.	DOF	ChiSqr	P-Value
70	17	20.58	0.24546
71	17	23.26	0.14104
72	17	14.31	0.64475
73	17	11.00	0.85673
74	17	11.13	0.84965
75	17	14.25	0.64967
76	17	14.66	0.61972
77	17	13.05	0.73264
78	17	20.10	0.26915
79	17	13.68	0.68955
80	17	17.31	0.43370
81	17	19.90	0.27954
82	17	17.55	0.41805
83	17	15.19	0.58184
84	17	12.58	0.76408
85	17	28.44	0.04007
86	17	19.88	0.28038
87	17	15.69	0.54607
88	17	18.13	0.38051
89	17	10.78	0.86798
90	17	15.38	0.56824
91	17	26.00	0.07450
92	17	14.96	0.59842

Test No.	DOF	ChiSqr	P-Value
93	17	15.96	0.52683
94	17	15.13	0.58645
95	17	25.93	0.07565
96	17	14.11	0.65963
97	17	26.84	0.06051
98	17	12.05	0.79739
99	17	20.28	0.26028
100	17	18.26	0.37290
Combined P-Value for 100 tests (Using KS method)			0.93884

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 are 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	63.06	0.10165
2	50	42.20	0.77563
3	50	53.24	0.35077
4	50	46.31	0.62235
5	50	75.71	0.01094
6	50	58.46	0.19258
7	50	28.88	0.99275
8	50	38.78	0.87517
9	50	63.42	0.09619
10	50	55.06	0.28893
11	50	48.54	0.53218

Test No.	DOF	ChiSqr	P-Value
12	50	50.92	0.43710
13	50	78.14	0.00666
14	50	61.80	0.12224
15	50	34.94	0.94766
16	50	43.62	0.72575
17	50	47.44	0.57683
18	50	52.11	0.39179
19	50	46.33	0.62124
20	50	54.53	0.30626
21	50	50.78	0.44279
22	50	51.29	0.42289
23	50	43.96	0.71312
24	50	43.25	0.73900
25	50	59.51	0.16796
26	50	58.31	0.19640
27	50	31.27	0.98247
28	50	43.03	0.74690
29	50	67.22	0.05242
30	50	43.95	0.71366
31	50	67.61	0.04915
32	50	52.24	0.38712
33	50	48.86	0.51933
34	50	58.75	0.18565

Test No.	DOF	ChiSqr	P-Value
35	50	50.72	0.44498
36	50	41.01	0.81372
37	50	53.94	0.32638
38	50	49.00	0.51345
39	50	55.27	0.28237
40	50	47.56	0.57198
41	50	41.14	0.80953
42	50	50.75	0.44365
43	50	34.75	0.95021
44	50	35.72	0.93618
45	50	57.71	0.21166
46	50	51.44	0.41705
47	50	32.36	0.97500
48	50	55.61	0.27165
49	50	43.93	0.71437
50	50	76.25	0.00980
51	50	68.69	0.04078
52	50	46.40	0.61866
53	50	44.88	0.67850
54	50	46.30	0.62253
55	50	45.38	0.65903
56	50	64.12	0.08645
57	50	38.95	0.87095

Test No.	DOF	ChiSqr	P-Value
58	50	46.38	0.61929
59	50	77.73	0.00724
60	50	39.34	0.86109
61	50	58.45	0.19287
62	50	37.83	0.89697
63	50	47.96	0.55565
64	50	50.84	0.44030
65	50	40.57	0.82685
66	50	59.72	0.16323
67	50	59.06	0.17814
68	50	59.36	0.17132
69	50	33.85	0.96100
70	50	43.21	0.74063
71	50	47.73	0.56477
72	50	40.21	0.83718
73	50	50.88	0.43866
74	50	51.79	0.40400
75	50	42.50	0.76525
76	50	65.36	0.07122
77	50	88.31	0.00068
78	50	66.80	0.05623
79	50	55.12	0.28728
80	50	49.39	0.49767

Test No.	DOF	ChiSqr	P-Value
81	50	44.22	0.70351
82	50	40.30	0.83462
83	50	53.57	0.33904
84	50	46.80	0.60253
85	50	43.04	0.74638
86	50	46.78	0.60341
87	50	49.29	0.50186
88	50	56.66	0.24055
89	50	47.35	0.58047
90	50	36.60	0.92145
91	50	59.42	0.16996
92	50	69.93	0.03277
93	50	34.28	0.95610
94	50	41.59	0.79556
95	50	53.54	0.34012
96	50	34.80	0.94959
97	50	49.43	0.49619
98	50	62.28	0.11406
99	50	59.96	0.15803
100	50	58.68	0.18729
Combined P-Value for 100 tests (Using KS method)			0.80067

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 are 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	8.48	0.74640
2	12	9.34	0.67345
3	12	6.54	0.88634
4	12	12.28	0.42338
5	12	11.63	0.47592
6	12	8.98	0.70466
7	12	7.80	0.80078
8	12	15.66	0.20753
9	12	14.42	0.27486
10	12	10.25	0.59420
11	12	12.72	0.38981
12	12	8.14	0.77376
13	12	6.49	0.88915
14	12	11.97	0.44823
15	12	4.65	0.96873
16	12	19.56	0.07583

Test No.	DOF	ChiSqr	P-Value
17	12	14.17	0.28990
18	12	14.72	0.25690
19	12	9.64	0.64736
20	12	18.32	0.10639
21	12	3.43	0.99172
22	12	16.23	0.18073
23	12	9.00	0.70280
24	12	11.25	0.50743
25	12	13.03	0.36696
26	12	4.93	0.96012
27	12	14.11	0.29377
28	12	15.66	0.20753
29	12	12.38	0.41571
30	12	17.78	0.12252
31	12	18.94	0.08989
32	12	9.37	0.67113
33	12	15.12	0.23475
34	12	13.08	0.36346
35	12	12.27	0.42421
36	12	8.82	0.71844
37	12	9.45	0.66447
38	12	13.30	0.34728
39	12	13.89	0.30759
40	12	9.16	0.68936

Test No.	DOF	ChiSqr	P-Value
41	12	10.71	0.55406
42	12	5.30	0.94727
43	12	12.80	0.38372
44	12	12.15	0.43402
45	12	11.33	0.50049
46	12	10.20	0.59833
47	12	8.94	0.70789
48	12	18.67	0.09688
49	12	17.07	0.14683
50	12	10.65	0.55925
51	12	7.45	0.82620
52	12	14.96	0.24365
53	12	14.93	0.24547
54	12	15.70	0.20535
55	12	9.97	0.61836
56	12	9.95	0.62021
57	12	16.41	0.17314
58	12	19.49	0.07738
59	12	16.62	0.16459
60	12	12.23	0.42719
61	12	19.07	0.08682
62	12	11.94	0.45089
63	12	11.56	0.48180
64	12	7.02	0.85606

Test No.	DOF	ChiSqr	P-Value
65	12	26.91	0.00795
66	12	6.86	0.86675
67	12	9.86	0.62822
68	12	12.94	0.37330
69	12	8.98	0.70424
70	12	5.31	0.94689
71	12	12.06	0.44112
72	12	12.33	0.41970
73	12	15.26	0.22750
74	12	17.73	0.12405
75	12	12.85	0.37987
76	12	9.17	0.68845
77	12	13.65	0.32372
78	12	7.59	0.81662
79	12	14.78	0.25386
80	12	13.73	0.31819
81	12	18.16	0.11092
82	12	10.25	0.59383
83	12	26.23	0.00997
84	12	3.63	0.98927
85	12	12.28	0.42322
86	12	18.37	0.10483
87	12	6.59	0.88349
88	12	13.08	0.36351

Test No.	DOF	ChiSqr	P-Value
89	12	9.50	0.65976
90	12	18.97	0.08924
91	12	10.71	0.55400
92	12	9.07	0.69667
93	12	12.18	0.43112
94	12	9.31	0.67637
95	12	21.82	0.03958
96	12	6.52	0.88775
97	12	18.56	0.09980
98	12	13.93	0.30550
99	12	10.11	0.60635
100	12	7.92	0.79101
Combined P-Value for 100 tests (Using KS method)			0.34865

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 are sufficient data.

2.2 Blackjack rank statistics for all dealer cards:

Test No.	DOF	ChiSqr	P-Value
1	12	26.96	0.00784
2	12	8.04	0.78215
3	12	1.85	0.99961
4	12	11.05	0.52506
5	12	12.23	0.42745
6	12	7.65	0.81222
7	12	7.96	0.78825

Test No.	DOF	ChiSqr	P-Value
8	12	16.68	0.16196
9	12	8.96	0.70665
10	12	11.16	0.51551
11	12	10.83	0.54387
12	12	14.22	0.28675
13	12	16.87	0.15439
14	12	13.56	0.32999
15	12	12.85	0.37972
16	12	9.04	0.69968
17	12	2.98	0.99571
18	12	12.06	0.44089
19	12	13.25	0.35119
20	12	10.76	0.54955
21	12	9.56	0.65480
22	12	12.49	0.40715
23	12	6.10	0.91088
24	12	9.33	0.67435
25	12	20.25	0.06245
26	12	13.02	0.36756
27	12	17.63	0.12734
28	12	11.71	0.46916
29	12	8.87	0.71389
30	12	12.13	0.43548

Test No.	DOF	ChiSqr	P-Value
31	12	8.48	0.74673
32	12	6.07	0.91275
33	12	9.88	0.62667
34	12	5.64	0.93333
35	12	9.38	0.67021
36	12	10.69	0.55549
37	12	8.34	0.75788
38	12	12.16	0.43319
39	12	8.12	0.77608
40	12	8.95	0.70684
41	12	16.68	0.16184
42	12	4.95	0.95976
43	12	10.78	0.54749
44	12	18.00	0.11569
45	12	6.31	0.89977
46	12	8.16	0.77241
47	12	22.42	0.03307
48	12	11.78	0.46366
49	12	12.61	0.39800
50	12	12.01	0.44500
51	12	4.32	0.97692
52	12	8.98	0.70437
53	12	6.80	0.87083

Test No.	DOF	ChiSqr	P-Value
54	12	5.98	0.91715
55	12	11.79	0.46272
56	12	5.98	0.91730
57	12	6.07	0.91245
58	12	5.44	0.94156
59	12	18.28	0.10748
60	12	8.44	0.74975
61	12	14.28	0.28324
62	12	18.67	0.09671
63	12	3.91	0.98497
64	12	11.13	0.51748
65	12	12.13	0.43560
66	12	15.96	0.19289
67	12	12.12	0.43588
68	12	8.21	0.76849
69	12	10.68	0.55668
70	12	18.27	0.10783
71	12	12.12	0.43623
72	12	8.92	0.70960
73	12	16.31	0.17744
74	12	17.50	0.13190
75	12	13.46	0.33645
76	12	21.57	0.04269
77	12	16.34	0.17626

Test No.	DOF	ChiSqr	P-Value
78	12	11.59	0.47929
79	12	13.51	0.33323
80	12	8.47	0.74762
81	12	7.24	0.84143
82	12	11.81	0.46124
83	12	14.12	0.29337
84	12	13.42	0.33949
85	12	6.69	0.87735
86	12	14.43	0.27426
87	12	12.68	0.39260
88	12	2.86	0.99645
89	12	12.43	0.41155
90	12	13.27	0.35001
91	12	8.07	0.77956
92	12	19.48	0.07751
93	12	16.46	0.17111
94	12	9.54	0.65619
95	12	9.34	0.67385
96	12	13.78	0.31487
97	12	18.93	0.09015
98	12	14.20	0.28809
99	12	14.29	0.28244
100	12	17.08	0.14669
Combined P-Value for 100 tests (Using KS method)			0.62321

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 are sufficient data.

3. 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)	0.60696	1.00000
Opening Score (Dealer)	0.93884	1.00000
Dealer's Final Score	0.80067	1.00000
Player Cards Rank	0.34865	1.00000
Dealer Cards Rank	0.62321	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.

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.

GLI has done limited sanity checks to verify the integrity of the game logs. GLI 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.

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

Please note, the results contained herein are based on game design documentation provided to GLI by the manufacturer. It is the responsibility of the manufacturer to ensure that the gaming software performs in the same way as the documentation.

Please visit Gaminglabs.com to view the applicable Terms and Conditions and GLI Product Certification Scheme.

Should you have any questions or need any additional information, please feel free to contact our office.

Sincerely,

GAMING LABORATORIES INTERNATIONAL, LLC



Christine M. Gallo

Senior Vice President, Quality and Technical Compliance

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