# Poker Cards Analysis - April 2019

**The Directors**
GVC Plc

This is to confirm that iTech Labs has examined the game logs for Poker games for the period **April 01, 2019** to **April 30, 2019** as recorded by the respective game servers and analyzed the Poker cards for statistical randomness. The results of the analysis are given below.

**URLs:** https://www.bwin.be/, https://www.bwin.dk/, https://www.bwin.es/, https://www.bwin.fr/, https://www.bwin.it/, https://www.premiumbull.com/, https://www.bwin.gr/, https://www.bwin.com/, https://www.partypoker.cz/, https://da.partypoker.com/, https://danskespil.dk/, https://www.partypoker.fr/, https://www.giocodigitale.it/, https://www.br.betboo.com/en, https://www.partypremium.com, https://www.partypoker.es/en, https://www.partypoker.com/, https://sports.premium.com/en/sports, https://poker.partypoker.se/sv/poker, https://sports.sportingbet.com/en/sports, https://sports.sportingbet.gr/el/sports, https://www.sh.bwin.de/, https://sports.vistabet.com/el/sports, https://sports.sportingbet.co.za/en/sports

## 1. Actual and theoretical probabilities for various Poker hands

These calculations were done for Royal Flush, Straight Flush, Four of a Kind, Full House, Flush, Straight, 3 of a Kind, 2 pairs, 1 Pair, High Card. The following table compares the observed proportion of times the various types of hands occurred (**Sample** column). **Probability** column shows the theoretical values. **Lower** and **Upper** are the 95% confidence limits.

### 1.1 Actual and theoretical probabilities for various Poker hands for 52 cards deck:

| Hands | Probability | Lower | Sample | Upper |
|---|---|---|---|---|
| Royal Flush | 0.00003 | 0.00003 | 0.00003 | 0.00003 |
| Straight Flush | 0.00028 | 0.00028 | 0.00028 | 0.00028 |
| 4 of a kind | 0.00168 | 0.00167 | 0.00167 | 0.00169 |
| Full House | 0.02596 | 0.02593 | 0.02598 | 0.02599 |
| Flush | 0.03025 | 0.03022 | 0.03024 | 0.03029 |
| Straight | 0.04619 | 0.04615 | 0.04623 | 0.04624 |
| 3 of a kind | 0.04830 | 0.04826 | 0.04829 | 0.04834 |
| 2 pairs | 0.23496 | 0.23487 | 0.23496 | 0.23504 |
| 1 pair | 0.43823 | 0.43813 | 0.43822 | 0.43832 |
| High Card | 0.17412 | 0.17404 | 0.17409 | 0.17419 |
| | 1.00000 | | | |

*Notes:*
a)  In the above table, all observed probabilities (**Sample** column) are within the 95% confidence limits.
b)  The probability of 0. 43823 means there are 43,823 chances in 100,000 for getting a pair.

### 1.2 Actual and theoretical probabilities for various Poker hands for 36 cards deck:

| Hands | Probability | Lower | Sample | Upper |
|---|---|---|---|---|
| Royal Flush | 0.00022 | 0.00016 | 0.00025 | 0.00029 |
| Straight Flush | 0.00104 | 0.00090 | 0.00101 | 0.00118 |
| 4 of a kind | 0.00535 | 0.00503 | 0.00551 | 0.00567 |
| Full House | 0.07583 | 0.07467 | 0.07486 | 0.07700 |
| Flush | 0.02103 | 0.02040 | 0.02110 | 0.02166 |
| Straight | 0.13651 | 0.13500 | 0.13607 | 0.13803 |
| 3 of a kind | 0.07638 | 0.07521 | 0.07742 | 0.07755 |
| 2 pairs | 0.37820 | 0.37606 | 0.37888 | 0.38033 |
| 1 pair | 0.27751 | 0.27554 | 0.27661 | 0.27949 |
| High Card | 0.02792 | 0.02720 | 0.02829 | 0.02865 |
| | 1.00000 | | | |

*Notes:*

a) In the above table, all observed probabilities (**Sample** column) are within the 95% confidence limits.
b) The probability of 0. 27751 means there are 27,751 chances in 100,000 for getting a pair.

## 2. Actual and theoretical probabilities for Ranks

The theoretical probabilities for the ranks are shown in the **Probability** column. The **Sample** column shows observed probabilities. **Lower** and **Upper** are the 95% confidence limits.

### 2.1 Actual and theoretical probabilities for Ranks for 52 cards deck:

| Rank | Probability | Lower | Sample | Upper |
|------|-------------|----------|----------|----------|
| A | 0.076923 | 0.076903 | 0.076938 | 0.076943 |
| 2 | 0.076923 | 0.076903 | 0.076920 | 0.076943 |
| 3 | 0.076923 | 0.076903 | 0.076913 | 0.076943 |
| 4 | 0.076923 | 0.076903 | 0.076920 | 0.076943 |
| 5 | 0.076923 | 0.076903 | 0.076914 | 0.076943 |
| 6 | 0.076923 | 0.076903 | 0.076923 | 0.076943 |
| 7 | 0.076923 | 0.076903 | 0.076933 | 0.076943 |
| 8 | 0.076923 | 0.076903 | 0.076909 | 0.076943 |
| 9 | 0.076923 | 0.076903 | 0.076925 | 0.076943 |
| 10 | 0.076923 | 0.076903 | 0.076921 | 0.076943 |
| J | 0.076923 | 0.076903 | 0.076915 | 0.076943 |
| Q | 0.076923 | 0.076903 | 0.076927 | 0.076943 |
| K | 0.076923 | 0.076903 | 0.076942 | 0.076943 |

*Notes:*

a) In the above table, all observed probabilities (**Sample** column) are within the 95% confidence limits.

b) Theoretical probability of 0.07692 means, there are 7,692 chances for any particular rank to occur in 100,000 cards.

### 2.2 Actual and theoretical probabilities for Ranks for 36 cards deck:

| Rank | Probability | Lower | Sample | Upper |
|------|-------------|----------|----------|----------|
| A | 0.111111 | 0.110588 | 0.111363 | 0.111634 |
| 6 | 0.111111 | 0.110588 | 0.111300 | 0.111634 |
| 7 | 0.111111 | 0.110588 | 0.111390 | 0.111634 |
| 8 | 0.111111 | 0.110588 | 0.110657 | 0.111634 |
| 9 | 0.111111 | 0.110588 | 0.111186 | 0.111634 |
| 10 | 0.111111 | 0.110588 | 0.111012 | 0.111634 |
| J | 0.111111 | 0.110588 | 0.110883 | 0.111634 |
| Q | 0.111111 | 0.110588 | 0.111088 | 0.111634 |
| K | 0.111111 | 0.110588 | 0.111120 | 0.111634 |

*Notes:*

c) In the above table, all observed probabilities (**Sample** column) are within the 95% confidence limits.

d) Theoretical probability of 0.11111 means, there are 1,111 chances for any particular rank to occur in 100,000 cards.

## 3. Actual and theoretical probabilities for Suits

The theoretical probabilities for the suits are shown in the **Probability** column. The **Sample** column shows observed probabilities. **Lower** and **Upper** are the 95% confidence limits.

### 3.1 Actual and theoretical probabilities for Ranks for 52 cards deck:

| Suit | Probability | Lower | Sample | Upper |
|------|-------------|---------|---------|---------|
| Clubs | 0.25000 | 0.24997 | 0.25000 | 0.25003 |
| Diamonds | 0.25000 | 0.24997 | 0.25003 | 0.25003 |
| Hearts | 0.25000 | 0.24997 | 0.24999 | 0.25003 |
| Spade | 0.25000 | 0.24997 | 0.24998 | 0.25003 |

*Notes*:

a) In the above table, all numbers in the **Sample** column (observed probabilities) lie within 95% confidence intervals.

b) Theoretical probability of 0.25 means, there are 25 chances for any particular suite to occur in 100 cards.

### 3.2 Actual and theoretical probabilities for Ranks for 36 cards deck:

| Suit | Probability | Lower | Sample | Upper |
|---|---|---|---|---|
| Clubs | 0.25000 | 0.24928 | 0.24945 | 0.25072 |
| Diamonds | 0.25000 | 0.24928 | 0.24990 | 0.25072 |
| Hearts | 0.25000 | 0.24928 | 0.24997 | 0.25072 |
| Spade | 0.25000 | 0.24928 | 0.25069 | 0.25072 |

*Notes*:

c) In the above table, all numbers in the **Sample** column (observed probabilities) lie within 95% confidence intervals.

d) Theoretical probability of 0.25 means, there are 25 chances for any particular suite to occur in 100 cards.

## Comments on analysis

> ### Analysis of 52 cards deck:

In the calculations for 'Actual and theoretical probabilities for various Poker hands', 'Actual and theoretical probabilities for Ranks' and 'Actual and theoretical probabilities for Suits', all 27 sample values lie inside the 95% confidence limits. It is acceptable for about 5% of the confidence limits to be exceeded.

> ### Analysis of 36 cards deck:

In the calculations for 'Actual and theoretical probabilities for various Poker hands', 'Actual and theoretical probabilities for Ranks' and 'Actual and theoretical probabilities for Suits', all 23 sample values lie inside the 95% confidence limits. It is acceptable for about 5% of the confidence limits to be exceeded.

The above results for Poker indicate that the RNG is working correctly.

## 4. Conclusion

Analysis for 'Odds on various hands', 'Ranks' and 'Suits' for **52 cards deck and 36 cards deck** indicated statistical randomness.

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.

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

Please click here to see the Original report.

Signed:

Signed:

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Date: June 05, 2019

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