August 20, 2021

Match 52 Inc.

Re:    Mathematical Analysis of *Match 52* (Proposal #LO-20210730-7145 dated July 30, 2021)

File Nr:    LO-00-M52-21-01

Dear Mr. Mastroianni,

As per Match 52 Inc.'s request, please find **Gaming Laboratories International, LLC's (GLI)** math analysis for the table game, *Match 52*.

**This report only verifies the mathematical aspects of this game and DOES NOT offer an opinion as to whether or not this game is currently authorized for use in any jurisdiction.**

## Game Description

### DEALING AND GAMEPLAY

*Match52* is a table game played with a standard deck of 52 cards. The player begins by placing one or more of the available wagers on the table, as given below:
- Card
- Row
- Column
- Color
- Suit
- No Match

After all wagering is complete, cards are dealt one at a time to a tableau on the table. The tableau consists of 4 rows of 13 ranked spots, each increasing in rank from Ace to King. The cards are then dealt, from left to right across each row, proceeding to the next row as necessary, until either a card matches in rank with the spot it is dealt to or until all cards have been dealt. All wagers are then resolved.

## CARD WAGER

The Card wager is placed on one of the 52 spots in the tableau. (A player may place multiple separate Card wagers on different spots). If a match is dealt to the wagered spot, the wager wins and pays according to spot, as given in Table 1. Otherwise, the wager loses.

**Table 1. Pays — Card Wager**

| A | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | J | Q | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.75 to 1 | 12.75 to 1 | 14 to 1 | 15 to 1 | 16.5 to 1 | 18 to 1 | 19.5 to 1 | 21.25 to 1 | 23 to 1 | 25 to 1 | 27.5 to 1 | 30 to 1 | 32.5 to 1 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 34.5 to 1 | 37.5 to 1 | 40.5 to 1 | 44 to 1 | 48 to 1 | 52 to 1 | 56 to 1 | 61.5 to 1 | 67 to 1 | 72.5 to 1 | 79 to 1 | 85.5 to 1 | 92 to 1 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 98 to 1 | 106 to 1 | 115 to 1 | 125 to 1 | 135 to 1 | 147 to 1 | 160 to 1 | 174 to 1 | 188 to 1 | 205 to 1 | 222 to 1 | 240 to 1 | 258 to 1 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 275 to 1 | 300 to 1 | 325 to 1 | 350 to 1 | 375 to 1 | 400 to 1 | 435 to 1 | 475 to 1 | 525 to 1 | 575 to 1 | 625 to 1 | 675 to 1 | 725 to 1 |

## ROW WAGER

The Row wager is placed on one of the four available rows. (A player may place multiple separate Row wagers on different rows.) If a match is dealt to the wagered row, the wager wins and pays according to row, as given in Table 2. Otherwise, the wager loses.

**Table 2. Pays — Row Wager**

| Wager | Pay |
|---|---|
| Row 1 | 0.5 to 1 |
| Row 2 | 3 to 1 |
| Row 3 | 10 to 1 |
| Row 4 | 30 to 1 |

## COLUMN WAGER

The Column wager is placed on one of the 13 ranks. (A player may place multiple separate Column wagers on different ranks). If a match is dealt in the wagered rank, the wager wins and pays according to rank, as given in Table 3. Otherwise, the wager loses.

**Table 3. Pays — Column Wager**

| Wager | Pay |
|:-----:|----:|
| A | 7.25 to 1 |
| 2 | 8 to 1 |
| 3 | 8.75 to 1 |
| 4 | 9.5 to 1 |
| 5 | 10.5 to 1 |
| 6 | 11.5 to 1 |
| 7 | 12.5 to 1 |
| 8 | 13.5 to 1 |
| 9 | 14.8 to 1 |
| 10 | 16 to 1 |
| J | 17.5 to 1 |
| Q | 19 to 1 |
| K | 21 to 1 |

### COLOR WAGER

The Color wager is placed on red or black. If a match is dealt in a suit of the wagered color, the wager wins and pays 1 to 1. Otherwise, the wager loses.

### SUIT WAGER

The Suit wager is placed on one of the four suits. (A player may place multiple separate Suit wagers on different suits). If a match is dealt in the wagered suit, the wager wins and pays 3 to 1. Otherwise, the wager loses.

### NO MATCH WAGER

If all 52 cards are dealt without any match being made, the No Match wager wins and pays 52 to 1. Otherwise, the wager loses.

## Mathematical Analysis

The analysis was conducted by a combination of direct calculation and simulation. For the first row in the tableau, the probability of each match was directly computed. For the other rows, a simulation was used to measure the frequency of matches to produce a probability. See Table 4. These probabilities were combined with pay information to produce a Return to Player (RTP) and House Edge (HE) for each Card wager. Because of the large number of wagers, only the RTPs are presented in Table 5 — the HEs can be found by subtracting each RTP from 100%.

**Table 4. Probability Summary — Tableau**

| A | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | J | Q | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0769 | 0.0709 | 0.0653 | 0.0602 | 0.0555 | 0.0512 | 0.0472 | 0.0436 | 0.0402 | 0.0371 | 0.0342 | 0.0316 | 0.0291 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 0.0275 | 0.0253 | 0.0233 | 0.0215 | 0.0198 | 0.0183 | 0.0169 | 0.0155 | 0.0143 | 0.0132 | 0.0122 | 0.0113 | 0.0104 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 0.0098 | 0.0090 | 0.0083 | 0.0077 | 0.0071 | 0.0065 | 0.0060 | 0.0055 | 0.0051 | 0.0047 | 0.0044 | 0.0040 | 0.0037 |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 0.0035 | 0.0032 | 0.0030 | 0.0027 | 0.0025 | 0.0023 | 0.0021 | 0.0020 | 0.0018 | 0.0017 | 0.0016 | 0.0014 | 0.0013 |

**Table 5. RTP Summary — Card Wager**

| A | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | J | Q | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98.08% | 97.47% | 98.01% | 96.37% | 97.18% | 97.29% | 96.81% | 96.91% | 96.43% | 96.38% | 97.49% | 97.86% | 97.61% |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 97.48% | 97.42% | 96.81% | 96.72% | 97.13% | 96.90% | 96.11% | 97.16% | 97.51% | 97.27% | 97.65% | 97.47% | 96.68% |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 97.00% | 96.66% | 96.58% | 96.71% | 96.22% | 96.52% | 96.85% | 97.04% | 96.68% | 97.31% | 97.15% | 96.88% | 96.12% |
| **A** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **J** | **Q** | **K** |
| 96.54% | 96.97% | 96.79% | 96.16% | 95.11% | 93.40% | 93.69% | 94.25% | 96.14% | 97.05% | 97.31% | 97.09% | 96.27% |

For the Row and Column wagers, the same probabilities were used. The returns for these wagers are summarized in Table 6 and Table 7.

**Table 6. Return Summary — Row Wager**

| Wager | RTP | HE |
|---|---|---|
| Row 1 | 96.46% | 3.54% |
| Row 2 | 91.82% | 8.18% |
| Row 3 | 90.11% | 9.89% |
| Row 4 | 90.66% | 9.34% |

**Table 7. Return Summary — Column Wager**

| Wager | RTP | HE |
|---|---|---|
| A | 97.09% | 2.91% |
| 2 | 97.60% | 2.40% |
| 3 | 97.46% | 2.54% |
| 4 | 96.75% | 3.25% |
| 5 | 97.70% | 2.30% |
| 6 | 97.93% | 2.07% |
| 7 | 97.54% | 2.46% |
| 8 | 96.61% | 3.39% |
| 9 | 97.11% | 2.89% |
| 10 | 96.41% | 3.59% |
| J | 96.80% | 3.20% |
| Q | 96.59% | 3.41% |
| K | 98.05% | 1.95% |

For the Color and Suit wagers, the aggregate probability of making a match was used, combined with the observation that each color (or each suit) is equally likely to feature in a match. Finally, for the No Match wager, the probability of having no match was combined with the pay for the wager. The probabilities and returns for these wagers are given in Table 8.

**Table 8. Wager Summary — Color, Suit, and No Match Wagers**

| Wager | Win Probability | RTP | HE |
|---|---|---|---|
| Color | 0.491885 | 98.38% | 1.62% |
| Suit | 0.245943 | 98.38% | 1.62% |
| No Match | 0.016230 | 86.02% | 13.98% |

## Summary

Overall, the maximum RTP is 98.38%, from the Color or Suit wager. The minimum RTP is 86.02%, from the No Match wager.

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Should you have any questions, 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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