MATHEMAGIC

- THE RACETRACK -

How to do the Magic Trick

Materials:

- Magic trick video
- 1 deck of playing cards
- 1 die
- 1 pawn

Goal:

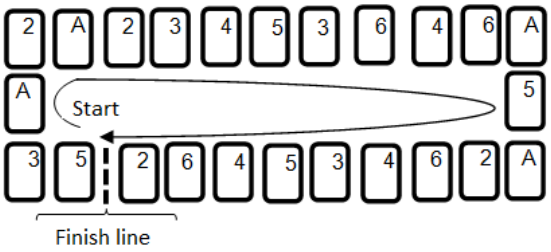
Find the card on which the spectator's pawn will stop after crossing the finish line.

Preparation:

Select the Aces, the 2s, 3s, 4s, 5s, and 6s of the deck of cards to use a total of 24 cards.

Trick:

1. The magician asks the spectator to arrange the 24 cards in order to form a loop. This loop represents a racetrack. The spectator places the finish line (which may be delimited by any object) after the last card put down.



2. The magician writes on a piece of paper the card on which the spectator's pawn will stop after crossing the finish line.

   (*To do this, in his head, he looks at the first card of the game and makes the number of moves corresponding to the value of the card. When he stops on a card, he always makes the number of moves correspond to it's value until it crosses the finish line, and marks the box on which it stops)*

3. The magician turns around to not see the movements. The spectator rolls a die and places the pawn on the cards to the position corresponding to the value of the die from the beginning of the loop. He then makes moves by looking at the value of the card on which he falls and advances his pawn according to this value, until he crosses the finish line.
4. The magician shows his prediction to the spectator: he guessed which card the pawn would stop on, after crossing the finish line.

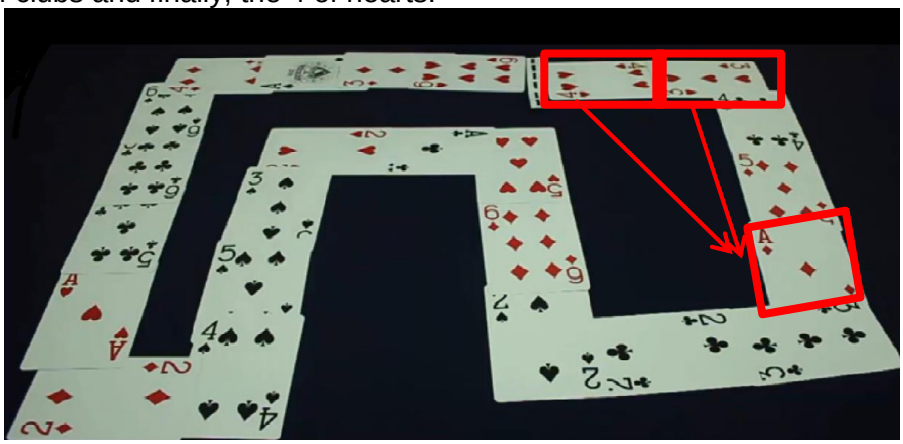
MATHEMATICAL EXPLANATION

Why this trick works.

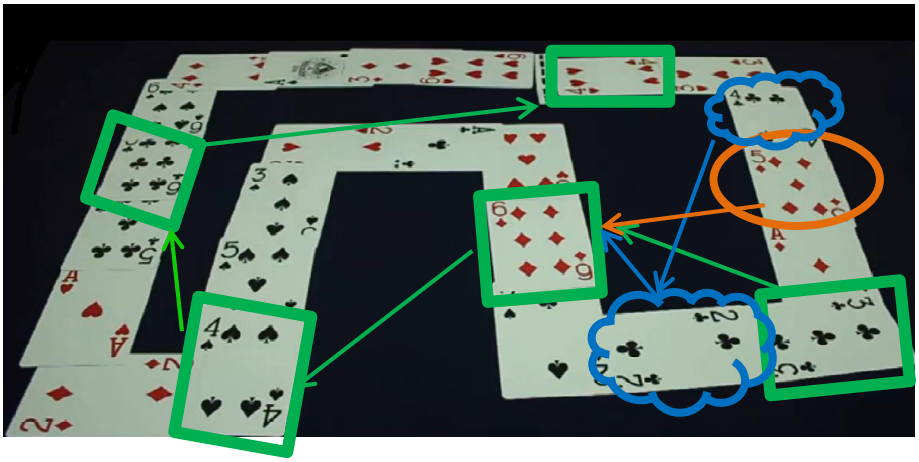
To begin, let's keep in mind that the spectator rolls a die to determine the first card on which he will place his pawn. Thus, there are 6 possibilities of starting positions. Let's look at them one by one.

- If the spectator got a 1, he would have started on the 4 of hearts. Thus, he would have made a move of 4 cards and would have landed on the ace of diamonds. He would then have made a move of one card, and so on.
- If the spectator got a 2, he would have started on the 3 of hearts. Thus, he would have made a move of 3 cards and would have landed on the ace of diamonds. He would then have moved one card, and so on.
- If the spectator got a 5, he would have started on the ace of diamonds. He would then have moved one card, and so on.

  We can therefore notice that, whatever the number indicated by the die between 1, 2, and 5, the spectator will eventually cross the same card. So, their route will meet at the ace of diamonds. These three tracks then fall on the 3 of clubs, the 6 of diamonds, the 4 of spades, the 6 of clubs and finally, the 4 of hearts.



- If the spectator got a 6, he would have started on the 3 of clubs (green rectangle). Now, we know that the first 3 routes are also found on this card. So, we have 4 routes that come together.
- If the spectator got a 3, he would have started on the 4 of clubs (blue cloud). He would thus have made a move of 4 cards and would have landed on the 6 of diamonds. In addition, the 6 of diamonds is a destination of the 4 previous routes, so they meet on this card.
- If the spectator got a 4, he would have started from the 5 of diamonds (orange circle). He would have made a move of 5 and would have landed on the 6 of diamonds. So, we can see that all routes meet this card.



MATHEMATICAL EXPLANATION

Why this trick works (continued)

We can conclude that, regardless of the outcome of the die, the pawn will land on the same card (in this instance, on the 4 of hearts), since each route is linked in one way or another. We have seen this in the example used above, but this fact can be seen in most cases. The probability of falling on two routes that do not meet is very low. Thus, the probability that the routes meet is not 100%, but it is very likely.

While the spectator puts down the 24 cards to form a racetrack, the magician only has to look at how the cards are placed and make the route from the first card that the spectator puts down. This corresponds to the route the spectator would take if he rolled a 1 with the die.

Thus, all is needed is that the magician's route and the spectator's route meet at some point. The route starting from the first card is more likely to join another, since it still has another 23 cards to go. Using this strategy, the magician has a high probability of arriving at the same card as the spectator.