

Mathematical Card Tricks

University of Arizona, SK Day 2014¹



A Magician Never Reveals Her Secrets...

... so be careful to not perform the same card trick multiple times in a row. Also, remember that audience misdirection and “patter” are just as important as the mathematical workings of the trick itself.

Another aspect is forcing a choice—the audience member thinks that the selection is her own, but really, the magician is directing all the steps.

The Math Behind the Magic

Keeping these principles in mind, it’s important to separate audience distraction from the trick itself.

- ♠ Beware of _____ .
- ◇ Watch for _____ .
- ♣ _____ the problem down into _____ .
- ♥ Work _____ .

¹Workshop by M. Hine, special thanks to M. Stone.
Image from http://www.freepik.com/free-vector/four-aces-poker-cards-clip-art_688687.htm

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Effect:

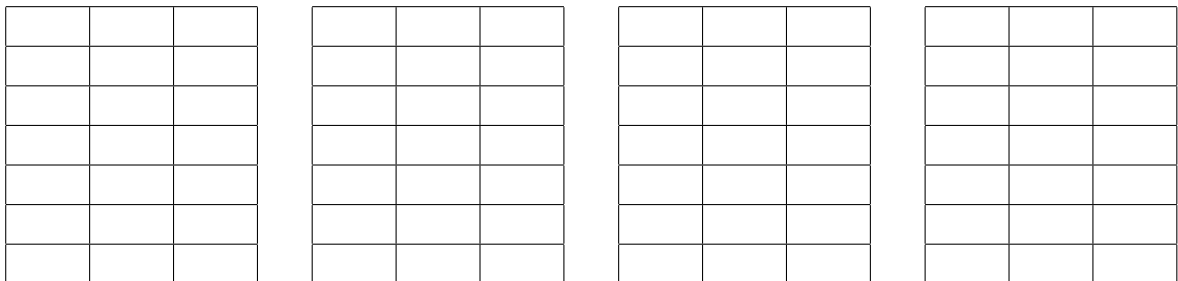
The magician starts with 21 cards and has a volunteer choose one card. Without showing the magician, the volunteer replaces the card anywhere in the pile. The magician then deals the cards face up into three columns, with seven cards in each column. The volunteer tells the magician which column contains the card. The magician gathers the cards and repeats the dealing/choosing of columns two more times. Finally, the magician reveals the chosen card to the audience.

Observations:

What patterns did you see? Was there anything special about how the magician placed the cards into columns?

How it's done:

Try keeping track of what happens to the cards in the same column as the chosen card. Can you figure out how the magician knows which card was chosen?



Other Questions:

How many possibilities of three sorts are there? Why?

How can we sort the piles differently if we want the chosen card be the first card in the final stack? The last card?

Why might sorting the chosen card to be the first card in the final stack be a bad idea when performing for an audience?

Extensions:

What goes wrong if we sort middle-last-first? How could we fix the trick while keeping that same sort order?

How many sort options are there that let you determine the card position after exactly three sorts?

Create your own sorting algorithm to put the chosen card in a different spot.

The Final Three

Effect:

The audience chooses three cards. The magician deals out four piles of cards, but does not use all of the cards in the deck.

- ★ The first volunteer places one of the selected cards on top of the first pile, then places as many cards as she wishes from the second pile on top of her card.
- ★ The second volunteer places another of the selected cards on top of the (now smaller) second pile, then places as many cards as she wishes from the third pile on top of her card.
- ★ The third volunteer places the last of the selected cards on top of the (now smaller) third pile, then places as many cards as she wishes from the fourth pile on top of her card.

The magician gathers up all of the piles, and tells the audience to watch for their cards, interrupting the magician with “STOP!” when their card is shown. The magician alternately deals the cards into a face-up and a face-down pile. The magician repeats this process with the face-down pile until there are only three cards left. (There are three sorts—start with face-up every time.) The last three cards are the final cards!

Observations:

What patterns did you see? Was there anything special about how the magician directed the trick? What parts of the trick are important, and what parts are distractions?

How it's done:

Let's work backwards...

Extension:

Change the sorting algorithm and the pile sizes to make a new card trick.

Performance tip—have the spectator write the cards down, or choose cards that are easy to remember. For example, choose the Ace, King, Queen of Hearts.

FANCY Final Three²

Effect:

The audience chooses three cards. The magician deals out four piles of cards, using all of the remaining 52 cards in the deck.

- ★ The first volunteer places one of the selected cards on top of the first pile, then places as many cards as she wishes from the second pile on top of her card.
- ★ The second volunteer places another of the selected cards on top of the (now smaller) second pile, then places as many cards as she wishes from the third pile on top of her card.
- ★ The third volunteer places the last of the selected cards on top of the (now smaller) third pile, then places as many cards as she wishes from the fourth pile on top of her card.

The magician gathers up all of the piles, and tells the volunteers to watch for their cards, interrupting the magician with “STOP!” when their card is shown. The magician alternately deals the cards into a face-up and a face-down pile. The magician repeats this process with the face-down pile until there are only three cards left. (There are four sorts—start with face-up, start with face-up, start with face-down, start with face-up.) The last three cards are the final cards!

Observations:

What patterns did you see? Was there anything special about how the magician directed the trick? What parts of the trick are important, and what parts are distractions?

²<https://www.youtube.com/watch?v=fJ8VA9ICq8Q>

How it's done:

Let's work backwards...

Performance tips—Have the spectator write the cards down, or choose cards that are easy to remember. Be very careful. One wrong move and you're finished! But a sense of humor rescues any situation. “And that's your card! Ta-da!” Move onto your next trick quickly. :)

Three Piles³

Effect:

The magician deals out piles of cards, using all or almost all 52 cards in the deck. She flips all of the piles over, then has a volunteer choose three piles. The magician gathers all of the other piles and any extra cards. The volunteer flips over the top card on two of the chosen piles. The magician quickly scans through the deck, and reveals the value of the top card on the third pile.

Observations:

What patterns did you see? Was there anything special about how the magician directed the trick? What parts of the trick are important, and what parts are distractions?

³A good explanation of the math behind this trick
<http://www.pleacher.com/mp/puzzles/tricks/piles3.html>

How it's done:

How can you encode the value of the card in the pile? Write an algebraic expression for each pile.

Extension:

Change the value of the piles to make a new trick.

Flourishes

♠ Mix it up!

- Make the trick look random. How?

- Cut/shuffle the deck. Better yet, have the audience help.
When can you do this for real without messing up the order?

How can you do this without messing up the order?

◇ Order matters

- Build audience expectation.
Is there a better order in which to present the tricks? Why?

♣ Patter

- “Watch for your card.”
- “Am I going too fast?”
- “Are you sure?”

♡ Showmanship and the final reveal

- SIM-SALA-BIM
This is a way to count out 10 cards, one for each letter. The next card is the 11th card, which works well for 21.
- Florets
Make circles of 4 cards, remembering where you put the 11th card. Again this works for 21. Let the audience pick 2 piles, then 1 pile, then 2 cards, then one card, each time removing either the piles they chose, or those they did not choose, whichever leaves the chosen card on the table. It’s a forced choice, and works beautifully. Don’t repeat this, or else they’ll be on to you!

