Online CDS 101 *Introduction to Computational and Data Sciences*

Inference and simulation

Gender discrimation case study

Study description and data

- In 1972, as a part of a study on gender discrimination, 48 male bank supervisors were each given the same personnel file and asked to judge whether the person should be promoted to a branch manager job that was described as "routine".
- The files were identical except that half of the supervisors had files showing the person was male while the other half had files showing the person was female.
- It was randomly determined which supervisors got "male" applications and which got "female" applications.
- Of the 48 files reviewed, 35 were promoted.
- The study is testing whether females are unfairly discriminated against.

B.Rosen and T. Jerdee (1974), "Influence of sex role stereotypes on personnel decisions", J.Applied Psychology, 59:9-14.

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*This is an example of an **experiment***

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Data

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	Promoted	Not Promoted	Total
Male	21	3	24
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Total	35	13	48

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% of males promoted: 21 / 24 = 0.875

% of females promoted: 14 / 24 = 0.583

Practice

We saw a difference of almost 30% (29.2% to be exact) between the proportion of male and female files that are promoted. Based on this information, which of the below is true?

1. If we were to repeat the experiment we will definitely see that more female files get promoted. This was a fluke.
2. Promotion is dependent on gender, males are more likely to be promoted, and hence there is gender discrimination against women in promotion decisions.
3. The difference in the proportions of promoted male and female files is due to chance, this is not evidence of gender discrimination against women in promotion decisions.
4. Women are less qualified than men, and this is why fewer females get promoted.

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4. Women are less qualified than men, and this is why fewer females get promoted.

Two competing claims

1. "There is nothing going on."

   Promotion and gender are **independent**, no gender discrimination, observed difference in proportions is simply due to chance. → **Null hypothesis**

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   Promotion and gender are **independent**, no gender discrimination, observed difference in proportions is simply due to chance. → **Null hypothesis**

2. "There is something going on."

   Promotion and gender are **dependent**, there is gender discrimination, observed difference in proportions is not due to chance. → **Alternative hypothesis**

A trial as a hypothesis test

- As a process, hypothesis testing is analogous to a court trial
- H_0: Defendant is innocent

  H_A: Defendant is guilty
- We then present the evidence – collect data.

- Then we judge the evidence – "Could these data plausibly have happened by chance if the null hypothesis were true?"
- If they were very unlikely to have occurred, then the evidence raises more than a reasonable doubt in our minds about the null hypothesis
- Ultimately we must make a decision. How unlikely is unlikely?

Image from http://www.nwherald.com/_internal/cimg!0/oo1il4sf8zzaqbboq25oevvbg99wpot

A trial as a hypothesis test

- If the evidence is not strong enough to reject the assumption of innocence, the jury returns with a verdict of "not guilty"
- The jury does not say that the defendant is innocent, just that there is not enough evidence to convict
- The defendant may, in fact, be innocent, but the jury has no way of being sure
- Said statistically, we fail to reject the null hypothesis
- We never declare the null hypothesis to be true, because we simply do not know whether it's true or not, therefore we never "accept the null hypothesis"
- In a trial, the burden of proof is on the prosecution.
- In a hypothesis test, the burden of proof is on the unusual claim.
- The null hypothesis is the ordinary state of affairs, so it's the alternative hypothesis that we consider unusual and for which we must gather evidence.

Recap: hypothesis testing framework

- We start with a null hypothesis (H_0) that represents the status quo
- We also have an alternative hypothesis (H_A) that represents our research question, i.e. what we're testing for
- We conduct a hypothesis test under the assumption that the null hypothesis is true, either via simulation or theoretical methods
    - If the test results suggest that the data do not provide convincing evidence for the alternative hypothesis, we stick with the null hypothesis
    - If they do, then we reject the null hypothesis in favor of the alternative

Simulating the experiment

Let's simulate the scenario from the case study under the assumption of independence, i.e. leave things up to chance.

- If results from the simulations based on the **chance model** look like the data, then we can determine that the difference between the proportions of promoted files between males and females was simply **due to chance** (promotion and gender are independent).
- If the results from the simulations based on the chance model do not look like the data, then we can determine that the difference between the proportions of promoted files between males and females was not due to chance, but **due to an actual effect of gender** (promotion and gender are dependent).

Simulating the experiment with a deck of cards

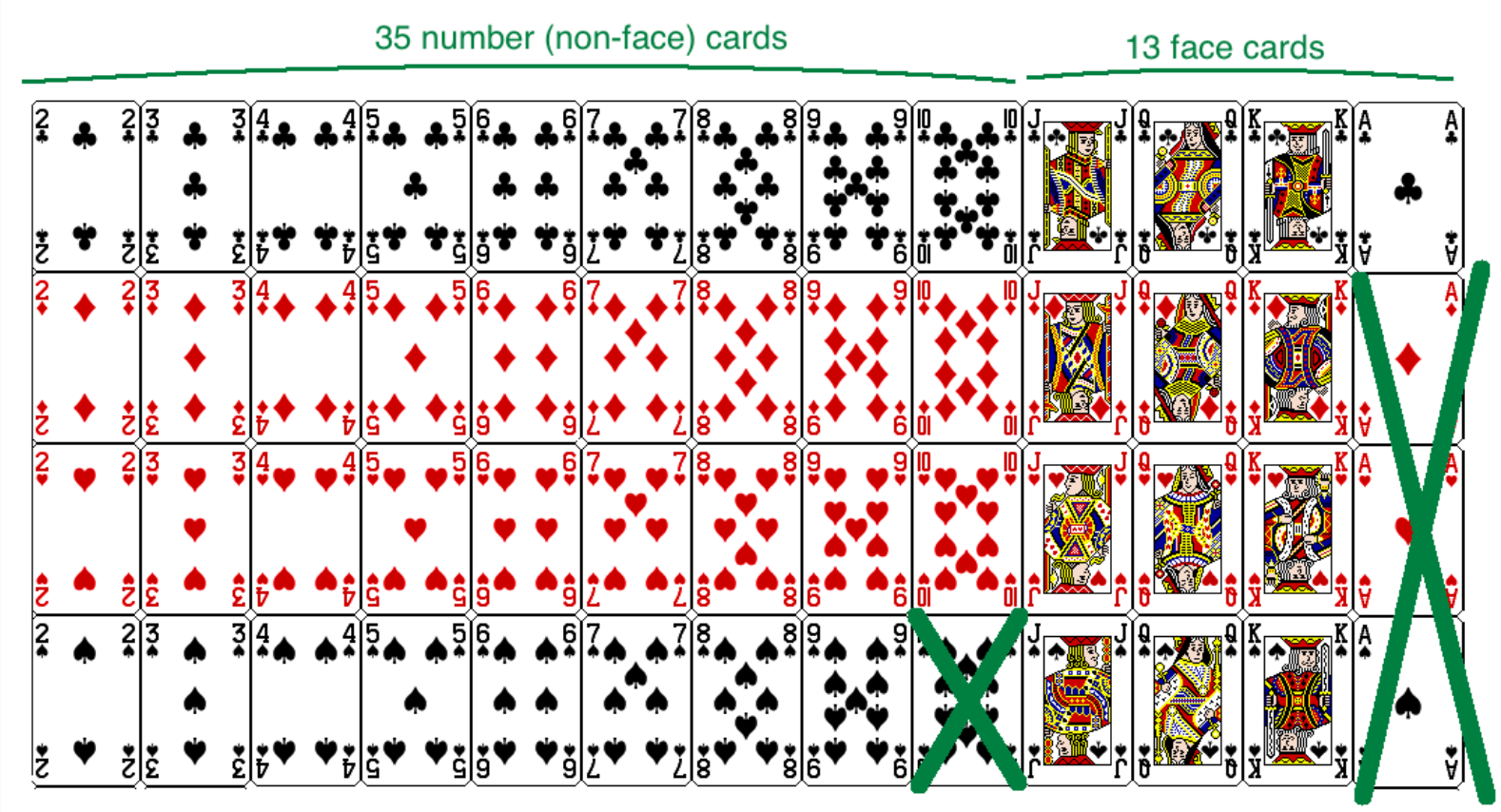
Pretend for a moment that we didn't have a computer available, how could we simulate this experiment using playing cards?

Simulating the experiment with a deck of cards

Pretend for a moment that we didn't have a computer available, how could we simulate this experiment using playing cards?

1. Let a face card represent *not promoted* and a non-face card represent *promoted*
    - Consider aces as face cards
    - Set aside the jokers
    - Take out 3 aces → there are exactly 13 face cards left in the deck (face cards: A, K, Q, J)
    - Take out a number card → there are exactly 35 number (non-face) cards left in the deck (number cards: 2-10)
2. Shuffle the cards and deal them intro two groups of size 24, representing males and females
3. Count and record how many files in each group are promoted (number cards)
4. Calculate the proportion of promoted files in each group and take the difference (male - female), and record this value
5. Repeat steps 2 – 4 many times

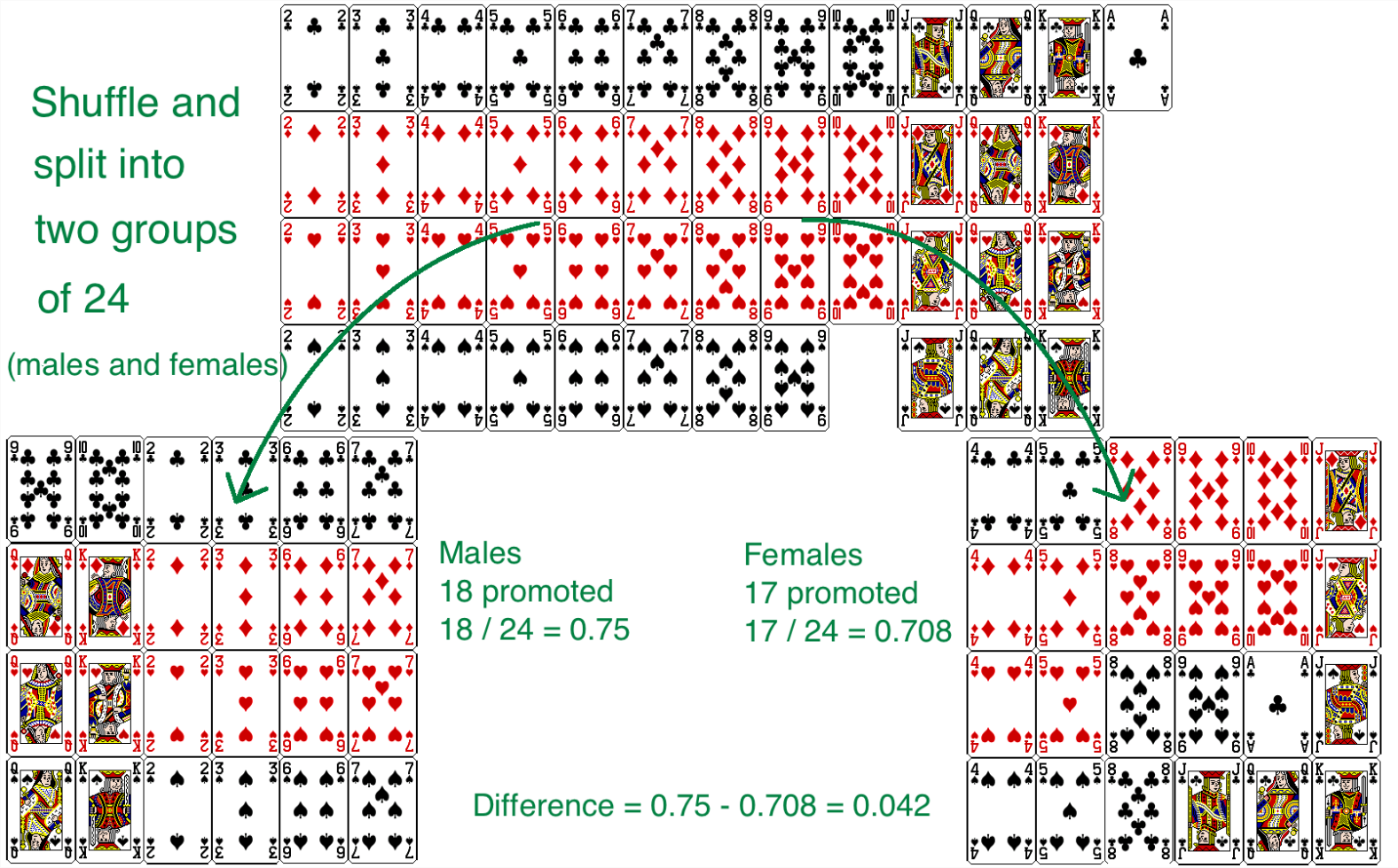
Step 1



Step 2

Shuffle and split into two groups of 24

(males and females)



Males
18 promoted
18 / 24 = 0.75

Females
17 promoted
17 / 24 = 0.708

Difference = 0.75 - 0.708 = 0.042

Credits

License

Acknowledgments

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