Do UPPER CASE YouTube videos get more (or less) views?

Probability and Statistics for Data Science

Carlos Fernandez-Granda

These slides are based on the book Probability and Statistics for Data Science by Carlos Fernandez-Granda, available for purchase here. A free preprint, videos, code, slides and solutions to exercises are available at https://www.ps4ds.net


Probability and Statistics
for Data Science
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DATA SCIE CE

Plan

Data acquisition

Selection of statistical metric

Hypothesis testing

Data acquisition

Selection of statistical metric

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Causal inference

Key question: Do upper case titles cause more (or less) views

If upper case titles have more (or less) views, does that imply a causal effect?

No!

There could be confounders

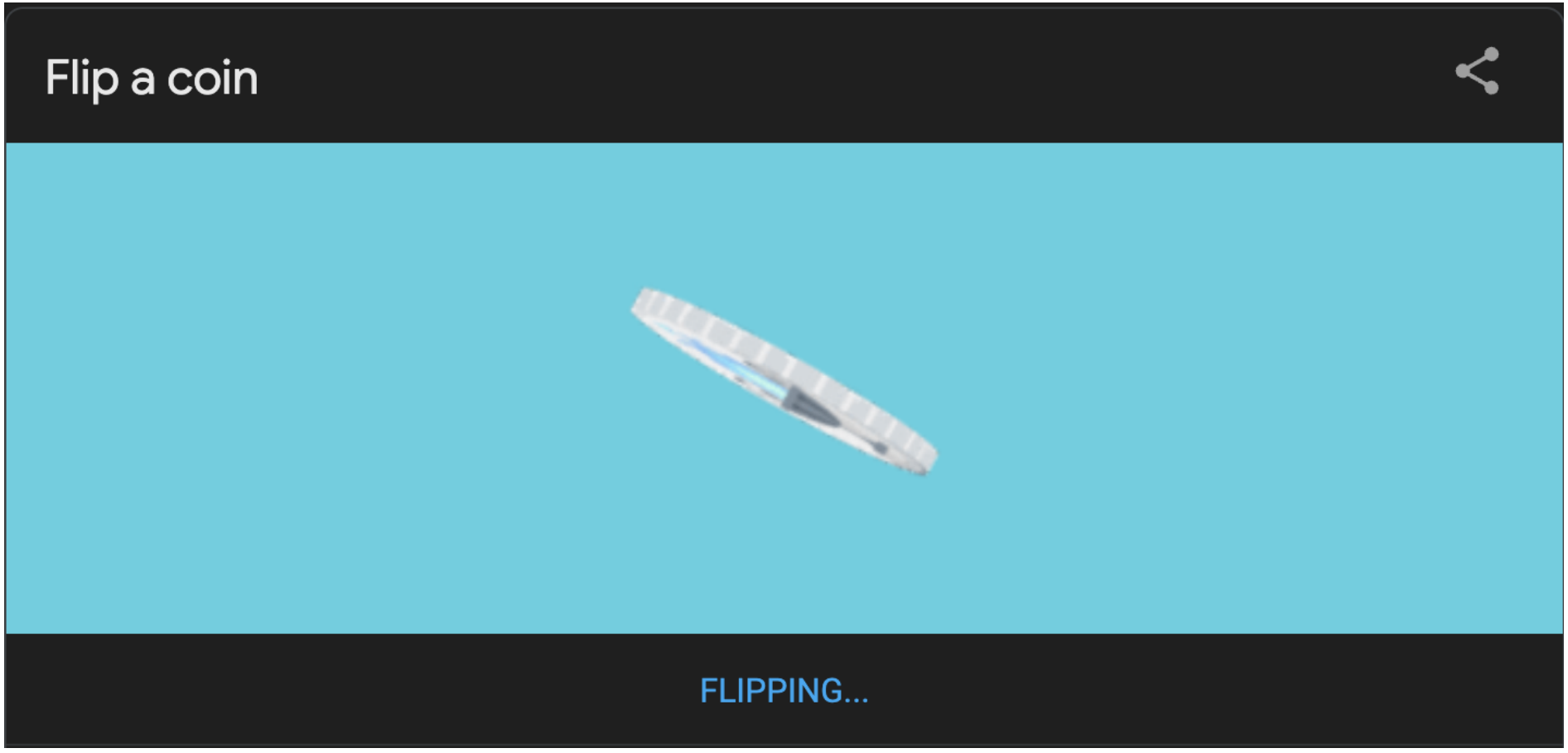
Upper case titles could correspond to:

- Older videos
- More exciting topics
- Prettier thumbnails

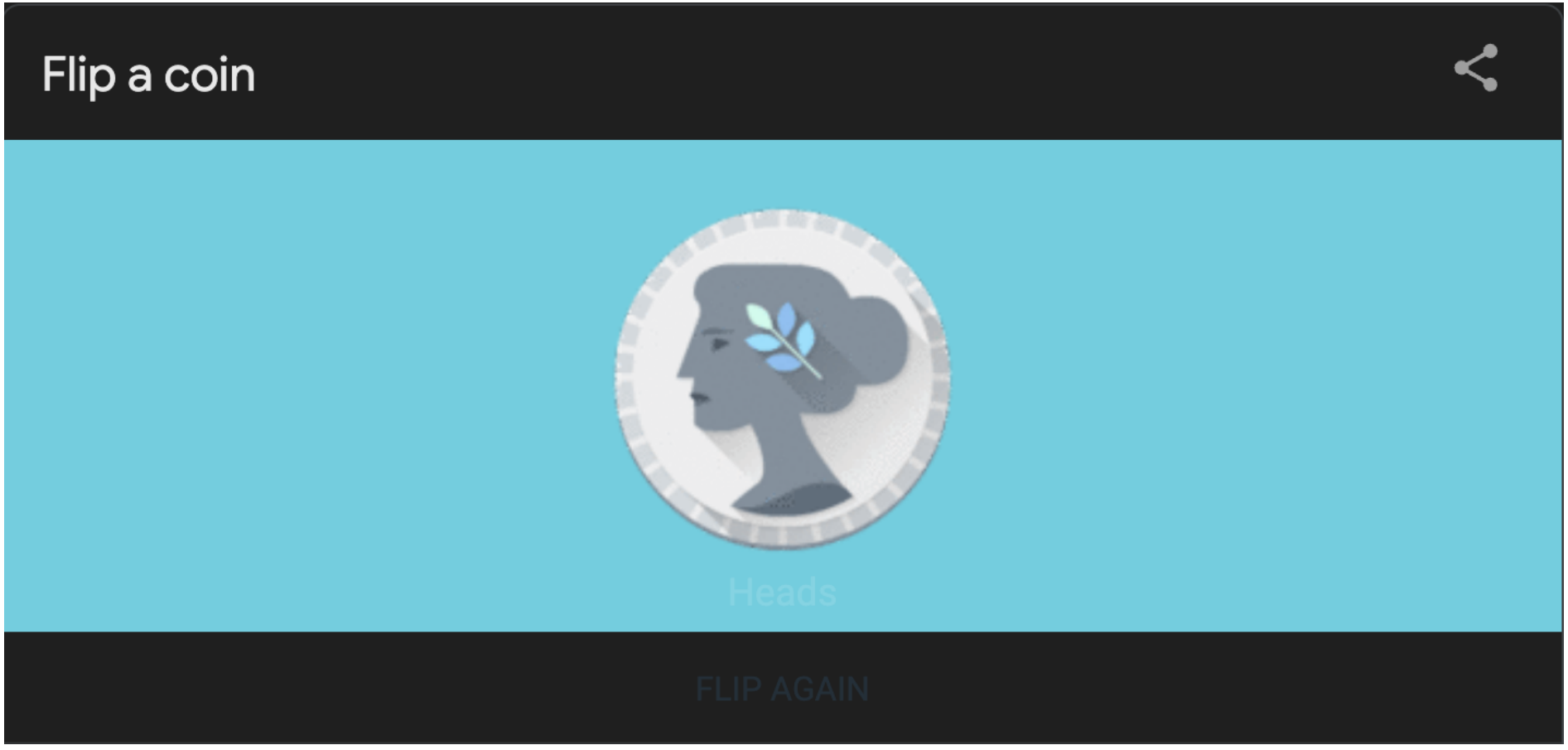
How can we avoid this?

Randomizing capitalization neutralizes confounders *even if they are* ***unknown*** *to us*!

Randomization



Randomization



Data acquisition

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What metric should we use?

Average treatment effect = Difference of means

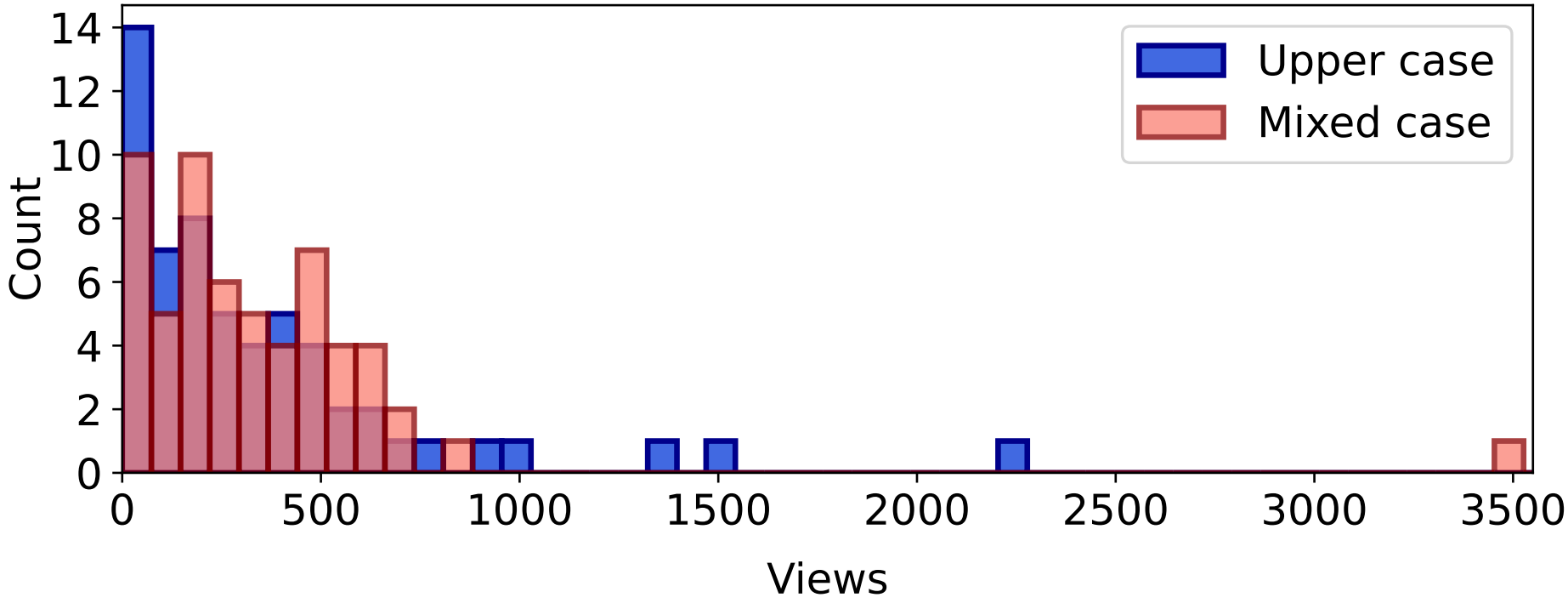
Possible concern? Mean is distorted by outliers

Some videos have a lot of views

Difference of medians is more robust to outliers

Views

	Mean	Mean w/o max	Median	Median w/o max
Upper case	349.5	316.3	229	214
Mixed case	359.8	305.3	281	268.5
Difference	**-10.3**	**11**	**-52**	**-54.5**



So mixed-case titles cause more views?

Not necessarily!

Maybe this is just random noise

Data acquisition

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Hypothesis testing

Hypothesis testing

1. Choose a conjecture: *Capitalization makes a difference*
2. Choose null hypothesis: *Capitalization makes no difference*
3. Choose test statistic: **Absolute difference of medians**
4. Decide significance level α: **0.05**
5. Gather data and compute test statistic: **52**
6. Compute p value
7. Reject the null hypothesis if p value $\leq \alpha := 0.05$

Computing the p value

Parametric testing requires modeling test statistic under null hypothesis

Distribution of absolute difference of medians?

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Solution: Nonparametric testing

Permutation test

Assumption: Under null hypothesis, treatment is **irrelevant** to the views

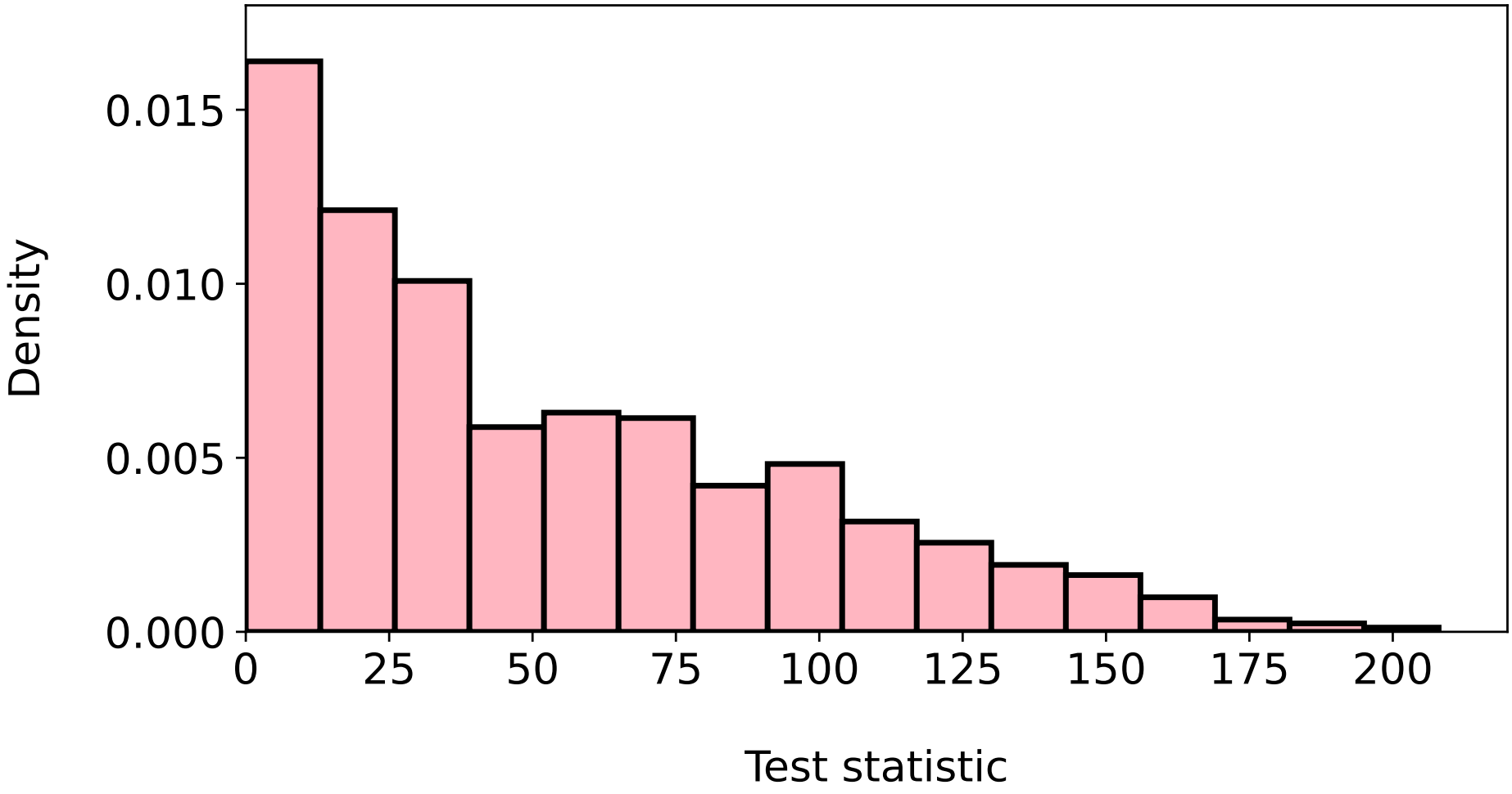
Switching treatment labels should make **no** difference

We permute the treatment labels and recompute test statistic many times

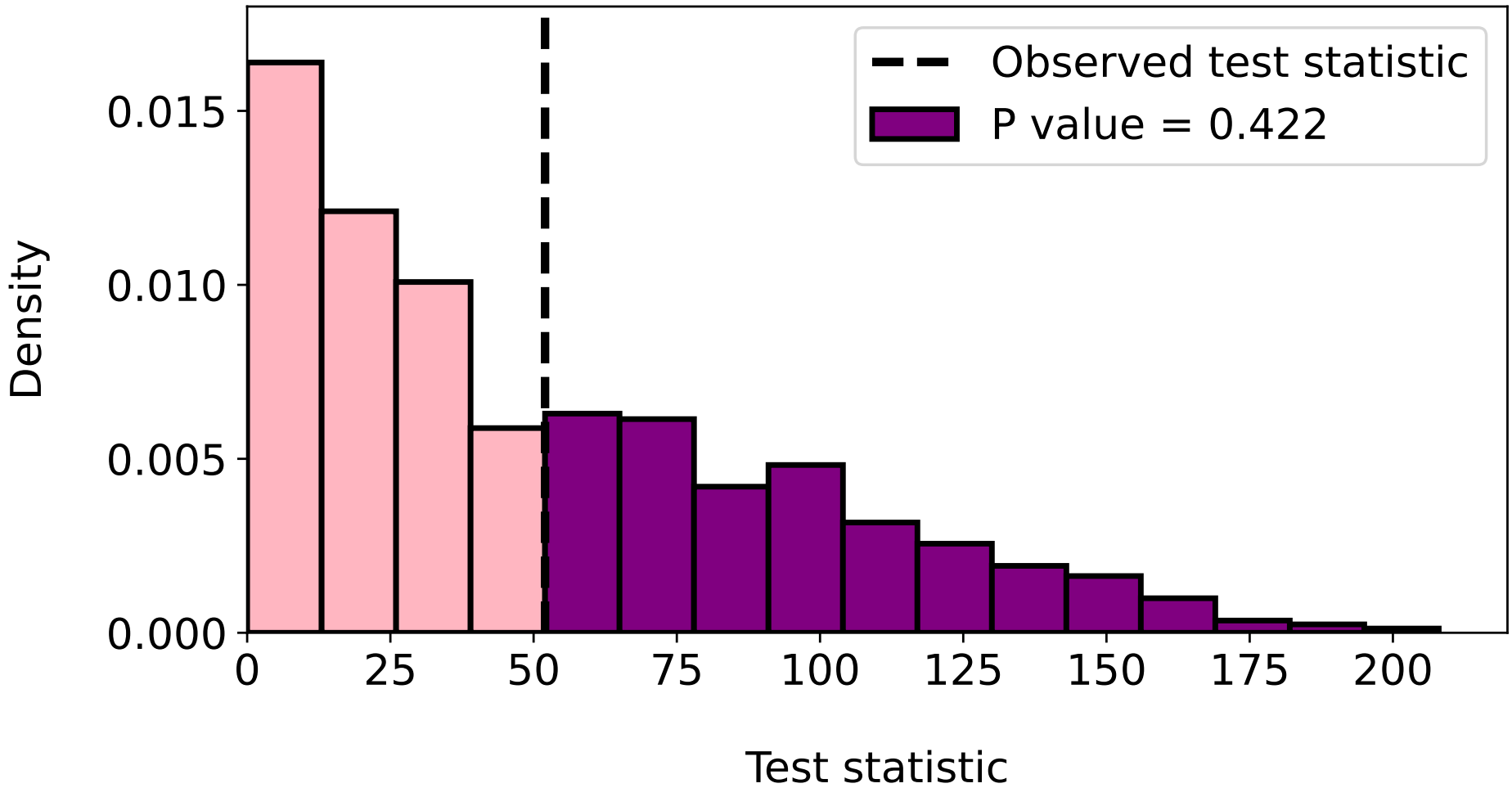
P value is fraction of permutations for which

$$\text{test statistic} \geq \text{observed test statistic}$$

One million permutations



P value



$0.422 \geq 0.05$: Not statistically significant

Conclusion

Data are not inconsistent with null hypothesis

We don't have enough evidence that capitalization has an effect

Recap

Treatment randomization enables **causal inference**

Statistic based on the median ensures **robustness to outliers**

Permutation testing determines **statistical significance**