MATH 141

Hypothesis Testing III, Confidence Intervals

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- Hypothesis tests have been shown to be valuable contributors to science ($p < 0.05$) but...
  are sometimes abused ($p < 0.05$).
- Used to assess the degree to which data is consistent with a particular model.
- The most widely used tool in statistical inference.

Step 1

Lay out your model(s).
H_0: null model, business as usual
H_A: alternative model, business not as usual

- Hypotheses are statments about the TRUE STATE of the world and should involve *parameters*, not *statistics*.

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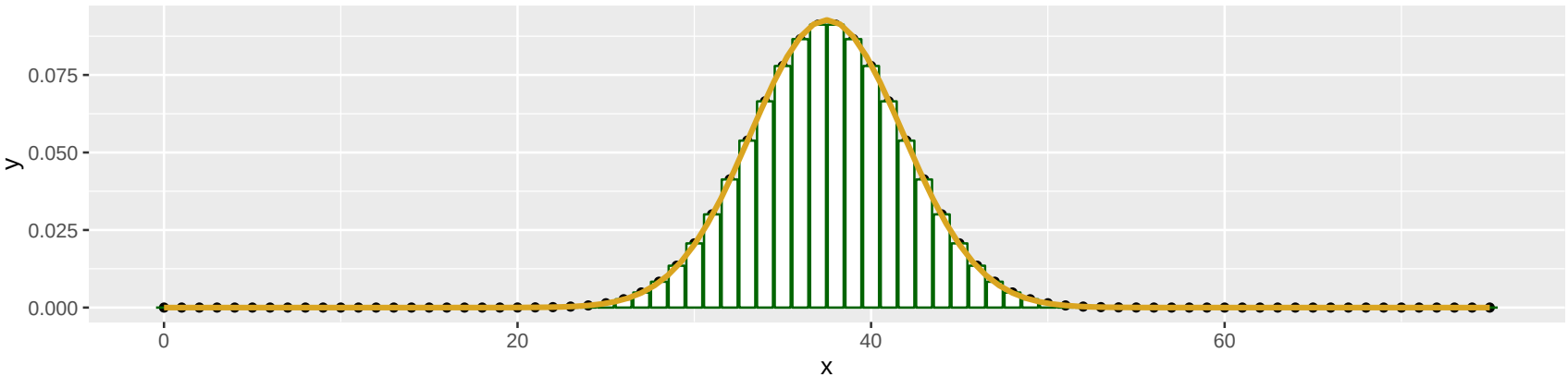
- Hypotheses should suggest a *test statistic* that has some bearing on the claim.
- Always use two-tailed tests.

Step 2

Contruct the appropriate null distribution.



1. Randomization

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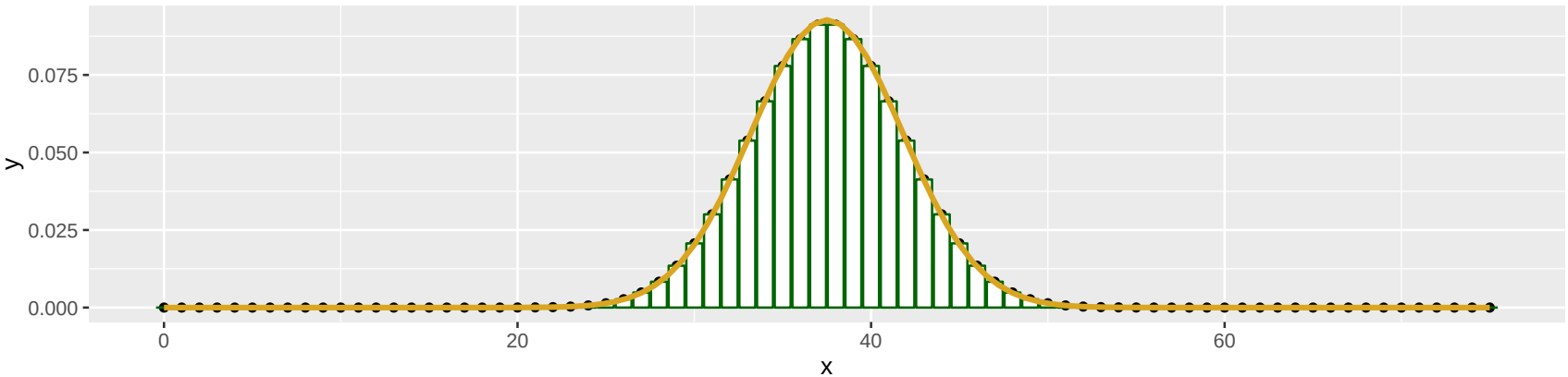

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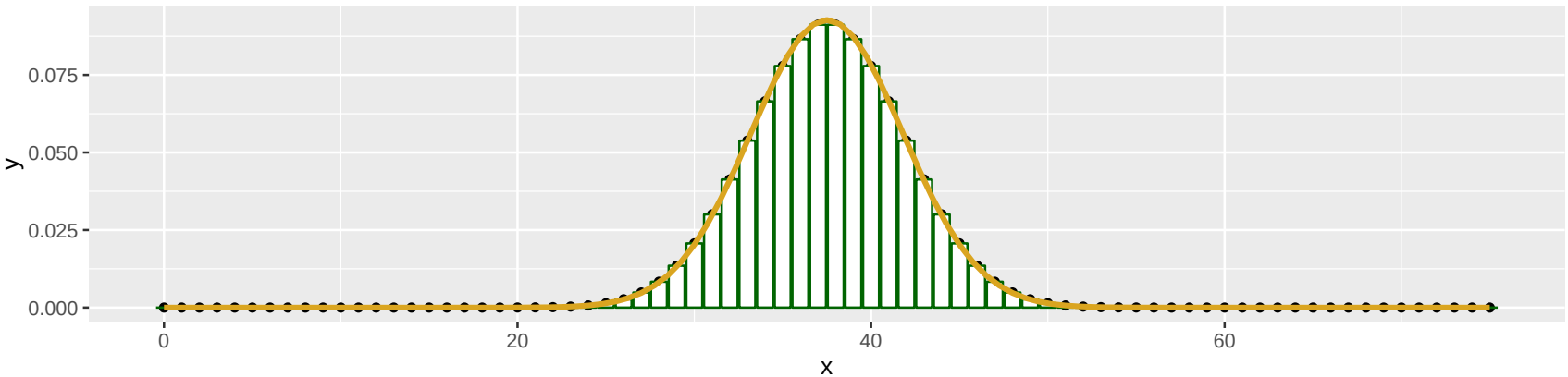

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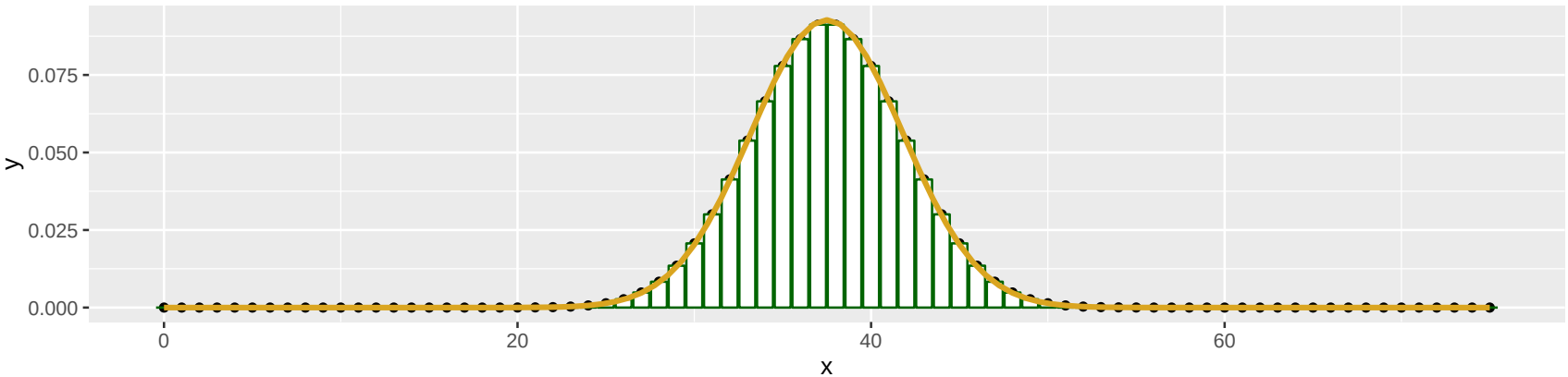

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2. Simulation
3. Exact Probability Theory
4. Normal Approximation

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Calculate a measure of consistency between the observed test statistic (the data) and the null distribution (i.e., a p-value).

- If your observed test stat is in the tails $>$ low p-val $>$ data is inconsistent with null hypothesis $>$ "reject null hypothesis".

What can go wrong?

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- If your observed test stat is in the tails $>$ low p-val $>$ data is inconsistent with null hypothesis $>$ "reject null hypothesis".
- If your observed test stat is in the body $>$ high p-val $>$ data is consistent with the null hypothesis $>$ "fail to reject the null hypothesis".

What can go wrong?

Confidence Intervals

Confidence Interval: a plausible range of values for a population parameter.

Construction of a CI

If the distribution of the point estimate can be well approximated by the Normal:

$$\text{point estimate} \pm \text{margin of error}$$

$$\text{point estimate} \pm 1.96 \times SE$$

- *point estimate*: $\hat{p}$, $\bar{x}$

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- *point estimate*: $\hat{p}$, $\bar{x}$
- *standard error (SE)*: standard deviation of the sampling distribution.

Question

"The proportion of Americans who want to maintain planned parenthood is estimated to be between 57.1% and 62.9% with 95% confidence." Which of the following interpretations are reasonable?

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1. The interval [.571, .629] provides a plausible range for $\hat{p}$
2. We are certain that the population proportion lies within this interval.
3. If we took many more samples of the same size and computed many $\hat{p}$s and many CIs, around 95% of those CIs would contain the population proportion.