Experimental design

How would you evaluate fertilizer effect?

Discuss with partner (5')

Experimental design principles

Replication

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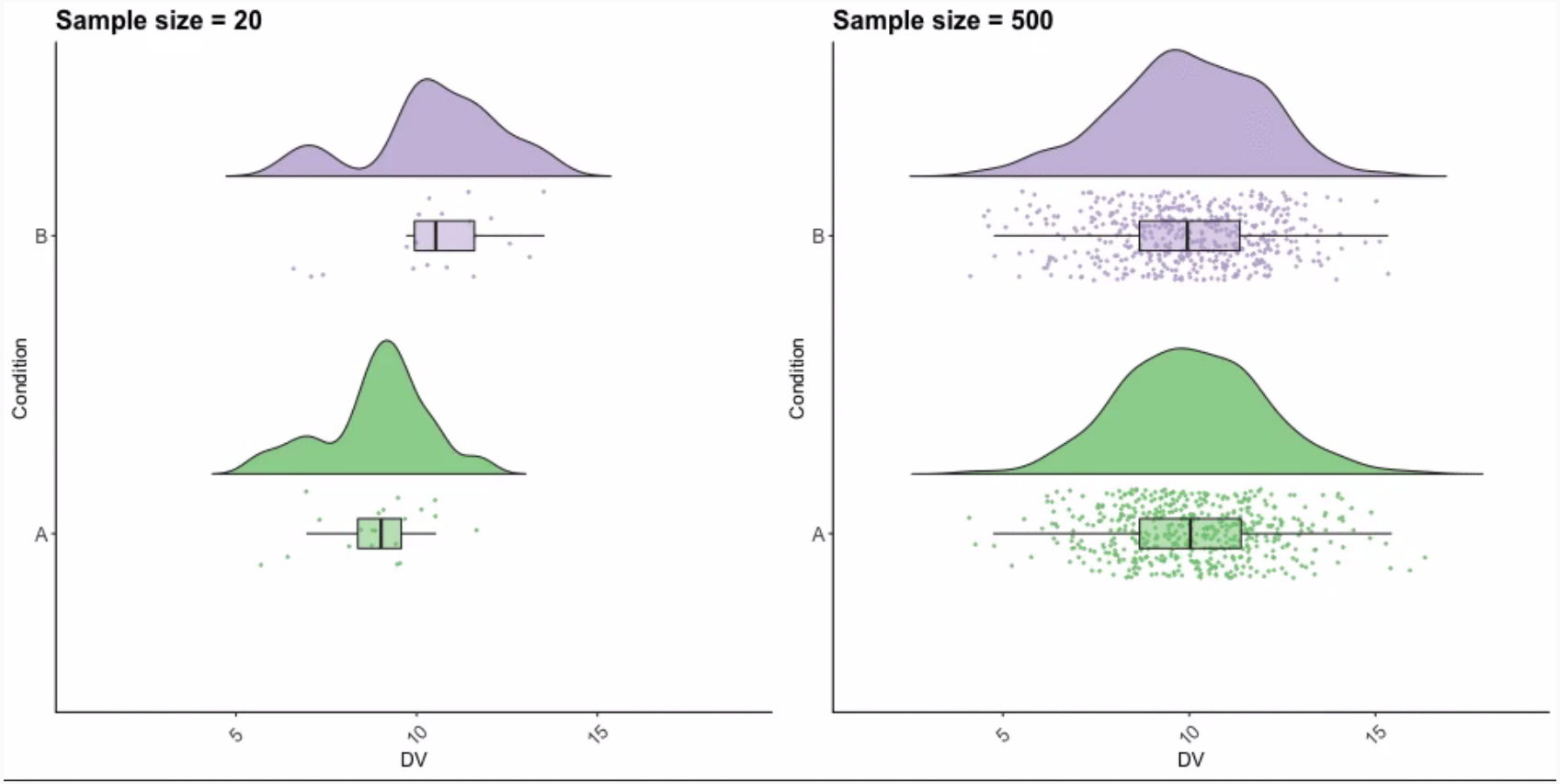
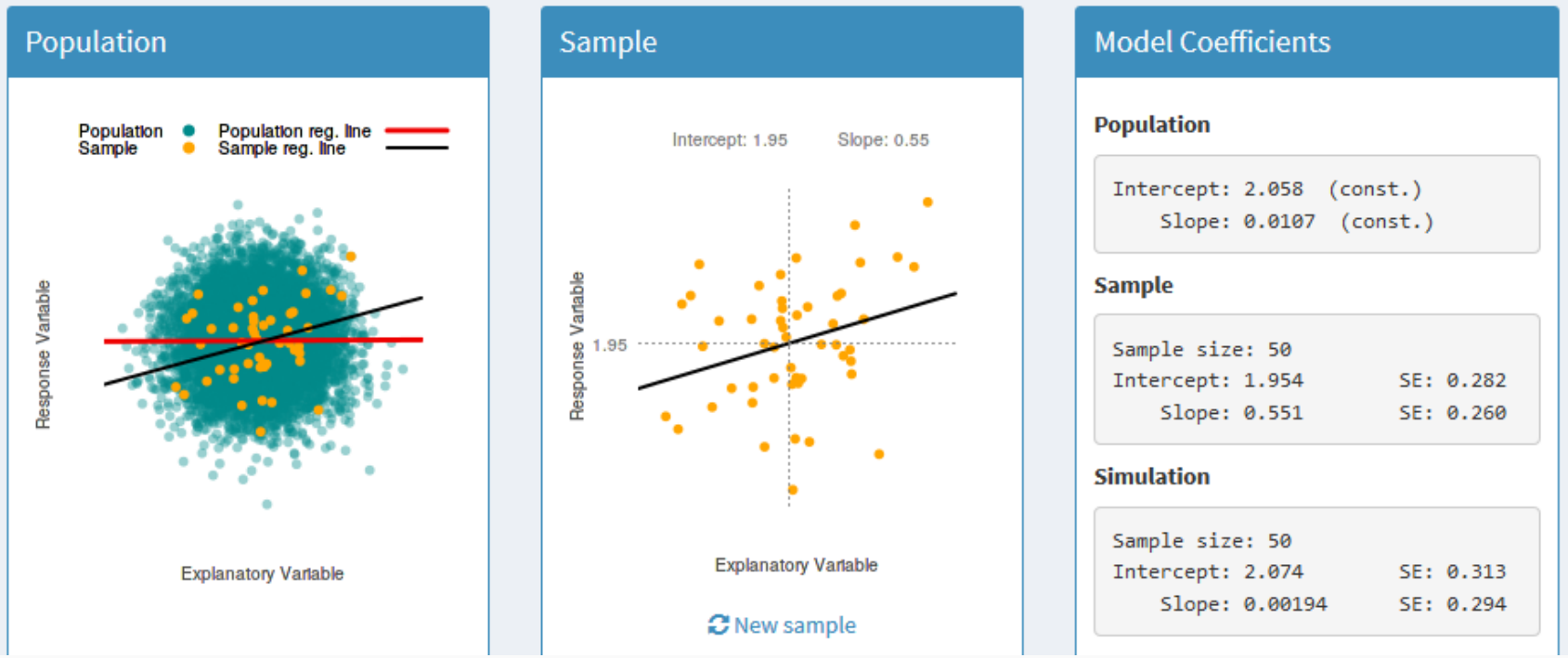
- How many? As much as you can! See Gelman & Carlin 2014.
- Traditionally, ecology studies have had **too low sample sizes**.
- Low sample sizes miss subtle effects, but also **prone to bias**.

Low sample sizes very sensitive to random noise



https://twitter.com/ajstewart_lang/status/1020038488278945797

Low sample sizes may bias inferences about population



http://statisticalgate.com/regression-simulation/

Low sample sizes may bias inferences

See *The evolution of correlations*

Stopping rules

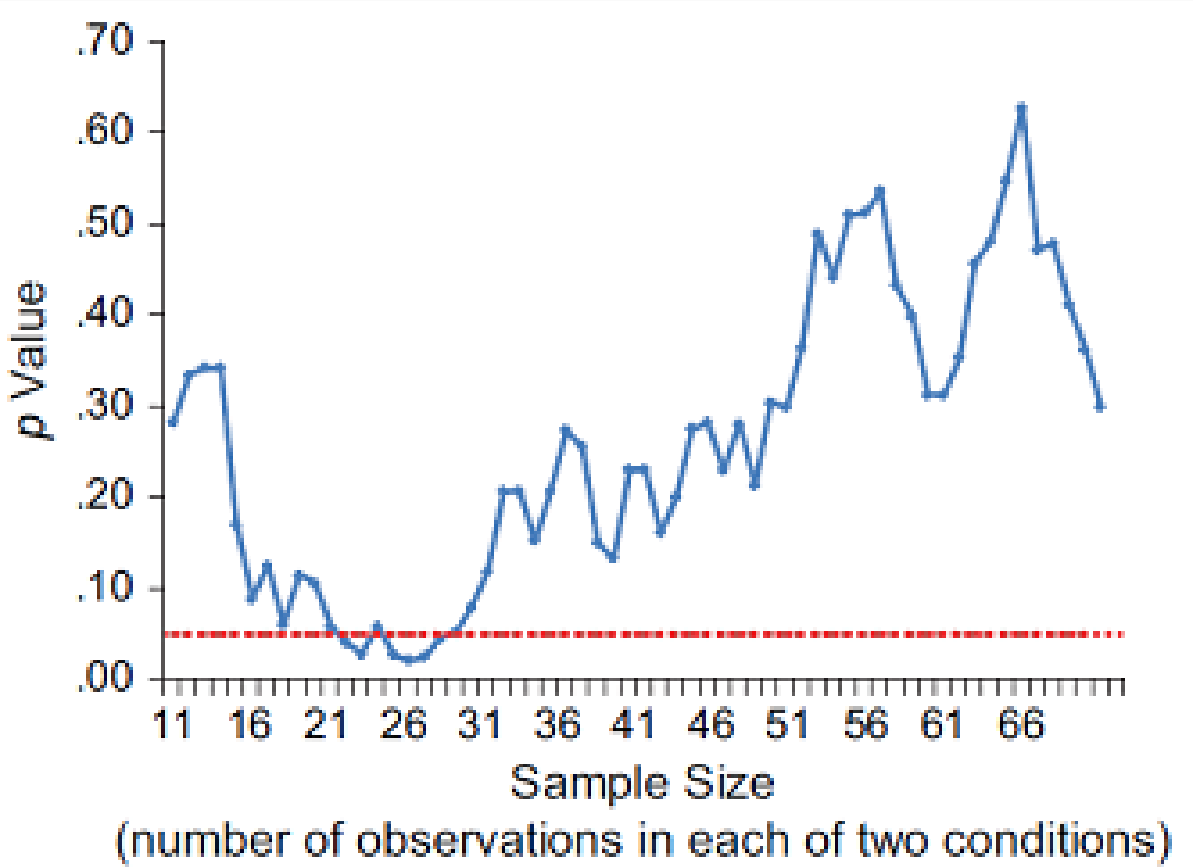


Fig. 2. Illustrative simulation of *p* values obtained by a researcher who continuously adds an observation to each of two conditions, conducting a *t* test after each addition. The dotted line highlights the conventional significance criterion of $p \leq .05$.

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- **Do simulations**. Power/Sample size/Precision analyses (e.g.this, this or this).
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- Complex models (w/ many predictors, interactions etc) require **high** sample sizes.

Randomization

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- Stratify: randomize within groups (e.g. species, soil types)

Controls

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- Consider **blind designs** to avoid observer bias.

Experimental design principles

1. Replication

Experimental design principles

1. Replication
2. Randomization

Experimental design principles

1. Replication
2. Randomization
3. Controls

To read more

- Ruxton & Colegrave. Experimental Design for the Life Sciences. OUP