# Statisitcal Thinking in Biology Research

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# Acknowledgemnts and warning

# Key ideas for today

- Statistics in biology is the study of biological variation

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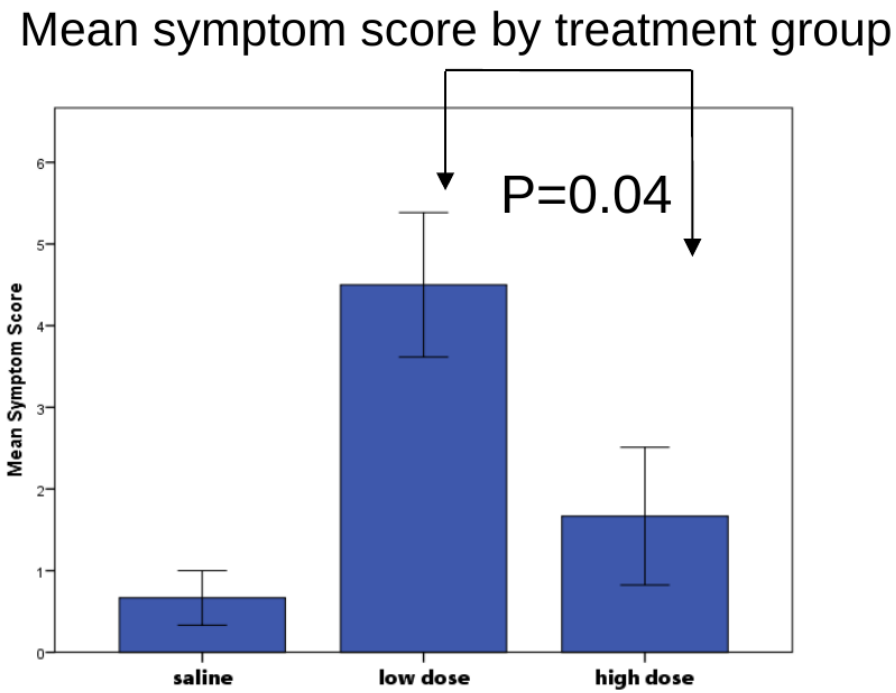
- Statistical ideas about biological variation inform the design of experiments
- Statistical ideas about biological variation inform the analysis of experiments
- Statistical thinking is an essential component of scientific thinking

# Cautionary tales from the front

# Message 1: A small p-value is not always evidence of a treatment effect




## Vaccine challenge experiment:

- 6 mice/group (saline/low dose/high dose)
- All mice challenged with Shigella
- Followed for 14 days
- Outcome: Symptom score average Days 2 - 8

One-way ANOVA (post-hoc Bonferroni) p=0.04

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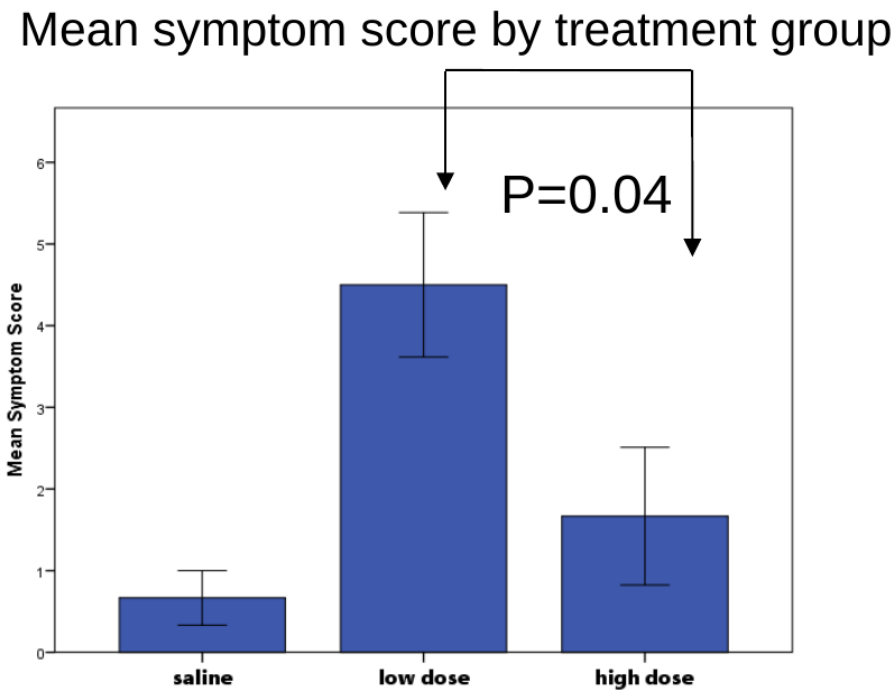


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*Do you think the vaccine works? What is strange?*

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**Experimental design**

The observed difference in outcome could be the result of:

- Cage effects
- Mouse strain effects

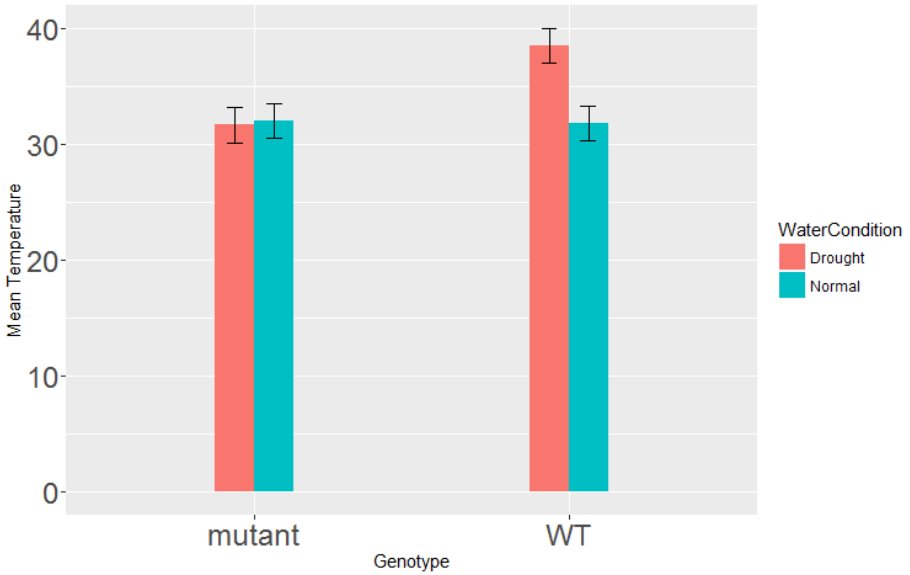
These effects are CONFOUNDED with treatment effect

Cage 1:
saline

Cage 2:
Low Dose

Cage 3:
High Dose

# Message 2: p-values from simple comparisons cannot tell us when differences are "different"




**Are temperature mechanisms modified in a genetically modified tomato plant?**

- Genotypes: WT/mutant
- Water condition: Normal/Drought
- Leaf temperature measured

**Comparisons made using t-tests**

Evidence of difference + No evidence of difference $\neq$ Evidence that differences are different.