## Latin squares

EXPERIMENTAL DESIGN IN R





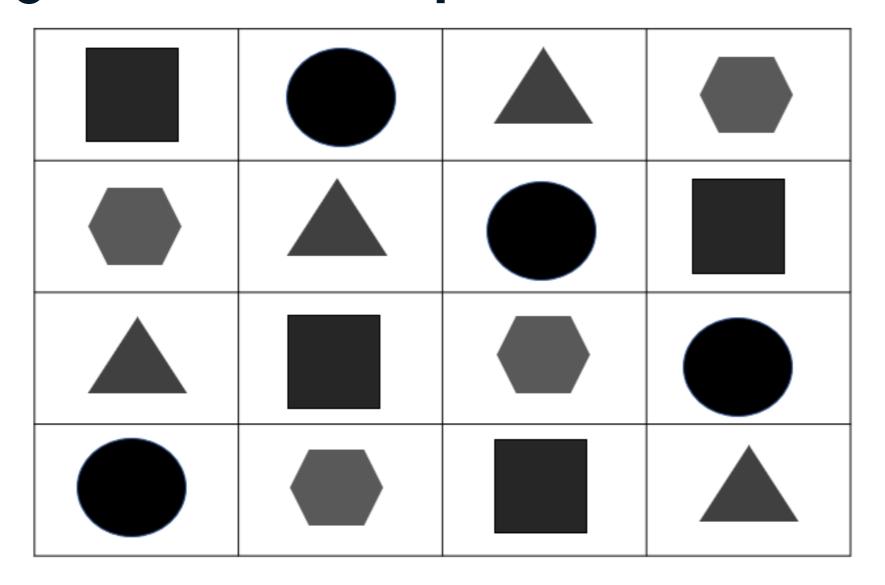
#### Latin squares

- Two blocking factors (instead of one)
- All factors must have the same number of levels
- Key assumption: the treatment and two blocking factors do not interact
- Analyze like a RCBD

## Latin square diagram

В	Α	С	D
D	С	Α	В
С	В	D	Α
Α	D	В	С

## Why is it a Latin square?



#### Intro to NYC scores

- nyc\_scores is an NYC open dataset
  - Downloaded from Kaggle
- Includes:
  - All accredited NYC high schools
  - SAT scores (Reading, Writing, and Math)
  - 2014-2015 school year

## Let's practice!



## Graeco-Latin squares

EXPERIMENTAL DESIGN IN R





#### Graeco-Latin squares

- Three blocking factors
- All factors must have the same number of levels
- Key assumption: the treatment and three blocking factors do not interact
- Analyze like a RCDB

## Graeco-Latin squares

Сα	Αδ	Ββ	Dγ
Αβ	Сγ	Dα	Βδ
Вγ	Dβ	Сδ	Αα
Dδ	Βα	Αγ	Сβ

## **GLS** - explanation

Δα	Φδ	β	Υ
Ββ	Αγ	Φα	δ
Υ	β	Δδ	Φα
δ	α	● Y	β

## Let's practice!



# Factorial experiments

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### Factorial designs

- 2 or more factor variables are combined and crossed
- All of the possible interactions between levels of factors are considered as effects on the outcome
  - Example: high/low water and high/low sunlight's effect on plant growth.

### Factorial example

Low light High light Low water Mean of Growth 1 Mean of Growth 2 High water Mean of Growth 3 Mean of Growth 4



### 2<sup>k</sup> factorial experiments

- 2<sup>k</sup> factorial experiments involve k factor variables with 2 levels
- It results in 2<sup>k</sup> number of combinations of effects to test
- Analyzed with a linear model and ANOVA
- Also use TukeyHSD() to determine which combinations are significantly different

## Let's practice!



# What's next in experimental design

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#### What's next?

- Other factorial designs (besides 2<sup>k</sup>)
  - including fractional factorial designs
- Experiments with random factors
- Nested designs
- Split plot designs
- Lattice designs

# Go forth and design experiments!

