STA 674

Regression Analysis And Design Of Experiments

Advanced Concepts – Lecture 1

Split Plot Designs

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Split Plot Designs

- Where does it fit in?
- What is it?
- What's next?

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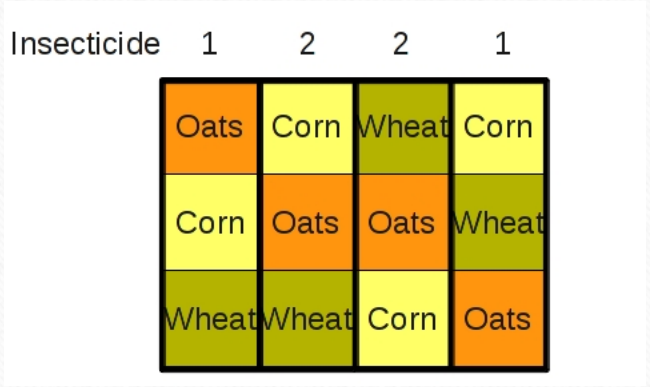
Example – aerial spraying of crop types

- An agricultural scientist wants to test the effects of 2 aerially sprayed insecticides on the control of pests for corn, wheat, and oats using plots in a 75m ×100m field. He can plant each crop in 25m × 25m squares, but he can only spray the insecticides in continuous strips that are 25 m wide.
- How should he arrange his treatments?

1. randomly assign vertical strips to spray 2 for each insecticide
2. randomly assign plots of each crop within those strips



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Split-plot design

A split-plot design arises when the assignment of treatments occurs on two different scales:

- one factor is first assigned to large, primary units (**whole plots**)
- another factor is the assigned to smaller, secondary units within each primary unit

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Split-plot design

A split-plot design arises when the assignment of treatments occurs on two different scales:

- one factor is first assigned to large, primary units
- another factor is the assigned to smaller, secondary units **within** each primary unit (**subplots**)

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Split-plot design

A split-plot design arises when the assignment of treatments occurs on two different scales.

Randomization

In a split-plot design randomization occurs in two stages:

1. Randomize levels of whole plot factor to whole plots.
2. Randomize levels of subplot factor to subplots separately within each whole plot.

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Key Concept

Randomizing in two steps introduces two sources of variation:

1. variation between whole plots
2. variation between subplots within whole plots

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Two sources of Error

Errors allow for differences in the observations from experimental units with the same treatment. To account for these two types of variation we need to include two error terms in our model:

$$y_{ijk} = \mu_{ij} + \delta_{ik} + \epsilon_{ijk}$$

where:

- y_{ijk} – observation from k^{th} replicate of treatment i, j
- μ_{ij} – mean of treatment i, j
- δ_{ik} – whole plot error
- ϵ_{ijk} – subplot error

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Model

To account for these **two** types of variation we need to include **two** error terms in our model:

$$y_{ijk} = \mu_{ij} + \delta_{ik} + \epsilon_{ijk}$$

- δ_{ik} – whole plot error

Allows for differences in the response from two whole plots with the same level of the whole plot factor.

- ϵ_{ijk} – subplot error

Allows for differences in the response from two subplots in the same whole plot and with the same level of the subplot factor.

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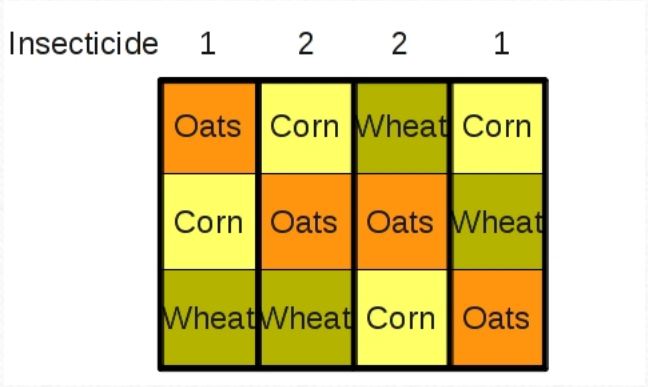
Example – aerial spraying of crop types



- δ_{ik} – whole plot (strip) effect

models differences in effectiveness between two strips sprayed with the same insecticide

- ϵ_{ijk} – subplot (square) effect

models differences in effectiveness of two plots within the same strip planted with the same grain