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STAT 642
Assignment 2
2/10/22

Read H.O.2, Chps 1 & 2 from Design & Anova book.

Part I - Identifying the Design

- For each of the following four experiments, identify the following components of the experimental design:
  - (1) Type of Randomization: CRD, RCBD, LSD, Split-plot, crossover etc
  - (2) Type of treatment structure: single factor, crossed, nested, fractional, etc
  - (3) Identify each of the factors as being Fixed or Random
  - (4) Describe the EU's & the MUs.
  - (5) Describe the measurement process: Response variable, covariates, Subsampling, Repeated Measures

(see pg 40, H.O.2)*

EU - field (pesticide) Half field for irr Sub plot for variety
MU - Subplot of field.

fields are blocks I think (2/9/22)

Experiment 1. An experiment was conducted to study the effects of irrigation (yes or No) and three levels of pesticide (P_1, P_2, P_3) on the yields of three varieties of corn (V_1, V_2, V_3). 6 fields available for the experiment, w/ two fields randomly assigned to each of the levels of pesticide. Each field was divided into halves (E, W), one of these halves was randomly assigned to be irrigated and the other was left w/o irrigation. Each E, W half of a field was then divided into three regions and the three varieties were randomly assigned to these regions. The # of bushels of corn produced & total rainfall during the growing season were recorded in each of the regions.

Field: F_1	F_2	F_3	F_4	F_5	F_6		
P_2	P_1	P_3	P_3	P_1	P_2	Irrig.	Var
53.4	49.3	55.9	46.1	47.2	52.1	Yes	V_1
53.8	50.2	51.6	56.5	46.1	55.5	Yes	V_2
58.2	51.1	52.4	56.4	47.3	53.8	Yes	V_3
53.1	52.8	57.1	45.1	46.7	55.9	NO	V_1
55.4	54.3	56.9	49.8	45.0	54.0	NO	V_2
57.8	57.9	55.2	47.0	47.2	51.2	NO	V_3

see H.O.1 pg a — I think block
see H.O.2 pg 20 — or a treatment?

- A variety is a blocking factor
- irr. a blocking factor? no I think it is a treatment factor
- is east-west a factor?
- rainfall is a random factor. covariate
- Treatment: Irr * pest * variety.
- field is a block, E/W is a block

are covariates factors?

(1) CRD w/ a split-split plot treatment assignment

(2) Whole plot treatment - Pesticide; split-plot treatment - Irrigation
split-split plot treatment - variety.

Is field a factor?

(3) ~~Treatment factors~~: Pesticide (3 levels - fixed), variety (3 levels - fixed), Irrigation (2 levels - fixed)
~~Blocking factors~~: Field (6 levels - fixed)

(4) Whole plot EU - field, split-plot EU is E or W half of field,
split-split EU = MU is the subplot of the field (1/6th of field.)

(5) Response: Corn yield, covariates: rainfall, subsampling/repeated measures: none.

pg 34 !!!

(Sec 11.0.2 pgs 38, 40, 53)*

Experiment 2: A steel manufacturer wanted to study the effect that 4 sizes of roller gaps (2 cm, 4 cm, 6 cm, 8 cm) have on a steel manufacturing process w.r.t. the tensile strength (lbs/in^2) of the steel obtained from five different blended alloys (A_1, A_2, A_3, A_4, A_5). The process consisted of taking a batch of metal from one of the alloys, dividing the batch into 4 equal portions and rolling one of the portions w/ each of the roller gaps. The tensile strength was then determined for the resulting rolled steel. This was repeated for each of the five alloys. The order in which the roller gaps were implemented was randomized for each batch of alloy and the order in which the alloys were run was randomized. Only 20 runs could be accomplished during a single day. The researcher was then able to observe all 5 alloys under each of the 4 roller gaps during a single day. The whole process was repeated on three consecutive days. The carbon content of the alloy may have an effect on the tensile strength of the rolled steel. Therefore the carbon content of each batch was measured prior to the rolling of the steel.

	Day 1					Day 2					Day 3				
	B_1	B_2	B_3	B_4	B_5	B_1	B_2	B_3	B_4	B_5	B_1	B_2	B_3	B_4	B_5
	A_1	A_3	A_2	A_5	A_4	A_5	A_2	A_3	A_4	A_1	A_3	A_5	A_2	A_1	A_4
run1	6cm	2cm	6cm	8cm	4cm	12cm	8cm	6cm	4cm	2cm	6cm	2cm	4cm	2cm	6cm
run2	2cm	6cm	4cm	2cm	8cm	6cm	6cm	4cm	6cm	4cm	4cm	4cm	6cm	4cm	6cm
run3	4cm	8cm	2cm	6cm	2cm	8cm	4cm	8cm	8cm	8cm	8cm	6cm	6cm	8cm	4cm
run4	8cm	4cm	8cm	4cm	6cm	14cm	2cm	2cm	2cm	6cm	2cm	8cm	2cm	6cm	8cm

(1) RCBD w/ split-plot treatment assignment

(2) Block factor is Day, Treatment factors are Alloy crossed w/ roller gaps.

(3) Day (fixed - 3 levels), Alloy (fixed - 5 levels), Roller gaps (fixed - 4 levels)

(4) Whole plot EU - 5 batches of alloy

Split plot EU = MU - 4 portions of alloy from each of the 5 units.

(5) Response variable is tensile strength of the rolled steel.

Covariate is the carbon content of each batch.

Experiment 3:

(1) RCBD w/ a strip plot treatment assignment

(2) Blocking factor: Litter

Treatment factors: species, crossed w/ technique.

(3) • Litter – (5 levels - random)

• Rat(Litter) – (4 levels - Fixed)

• Species of fish (4 levels - Random)

• Technique (3 levels - Fixed)

(4) • EU for the species is Rat(Litter) } see H.0.2 pg 41

• EU for the technique is the kidney of a rat

• MU - kidney of Rat(Litter)

(5) Response variable: % of mercury absorbed by the rats

No covariates

No subsampling/repeated measures

Experiment 4: – are students a blocking factor?

(1) Crossover Design

(2) Instructor * Assessment Method

(3) Instructor (Random - 4 levels), Assessment Method (3 levels - Fixed)

Period (Random - 3 levels)

(4) EU's = MU's = Student

(5) Response variable: Exam score, no covariates,

no subsampling; repeated measures (3 per student)

Part II - selecting the Design:

- A researcher is developing a commercial shrimp farming operation. She has sought your help in designing and analyzing a study to investigate the influence of three factors on the growth rate of shrimp raised in aqueous. The three factors are:

  T = Water Temperature (25°C, 35°C)

  S = Water Salinity (10‰, 25‰, 40‰)

  D = Density of shrimp in the aqueous (2 shrimp/liter, 4 shrimp/liter)

The response variable is the four week weight gain on per shrimp basis.

Two possible experimental designs are below. For each design, discuss the advantages and disadvantages of the design. In addition, give a brief description of how you would assign the levels of the three factors or combinations of factor levels to the experimental material. If there are 36 aqueous available for the study.

D1: Each aqueous can be partitioned into two sections

- Randomly assign 6 aqueous to each of the 6 water temp - salinity combinations. Then randomly assign a density level to a partition within each of the 36 aqueous.
- Whole plot EUs (EUs for temp-salinity combinations) are the 36 aqueous
  Split-plot EUs (EU's for shrimp density) are the 72 partitions of the aqueous

Advantages: • greater replication. There are 6 replications for each of the Temp-salinity-density combinations as opposed to 3 replicates of each in D2.

Disadvantages: harder to implement

D2: No partitioning of Aqueous.

- Randomly assign 3 aqueous to each of the 12 temp-salinity-density combinations. In a completely randomized design.

Advantages: easier to implement

Disadvantages: fewer replications