

STATISTICS 642 - ASSIGNMENT 2 - SOLUTIONS

(20 points) Experiment 1:

1. Type of Randomization:

Complete Randomized Design with a Split-Split Plot Treatment Assignment

2. Type of Treatment Structure:

$2 \times 3 \times 3$ crossed factorial structure

3. Identify each of the factors as being Fixed or Random:

Treatment factors: Irrigation with 2 fixed levels; Pesticide with 3 fixed levels; Variety with 3 fixed levels

4. Describe the experimental units:

EU for Pesticide is Field; EU for Irrigation is Half-Field; EU for Variety is Region in a Half-Field

Describe the measurement units: MU is region

5. Response Variable: number of bushels of corn

Covariates: Total rainfall during growing season

No subsampling or repeated sampling

(20 points) Experiment 2:

1. Type of Randomization:

RCBD with A Split-Plot Treatment Structure

2. Type of Treatment Structure:

5×4 Split Plot Treatment Structure: Whole Plot treatment-Alloy and Split Plot treatment-Roller Gaps

3. Identify each of the factors as being Fixed or Random:

- Blocking Factor: Days with 3 Random levels
- Treatment Factors: Whole Plot Factor: Alloys with 5 Fixed levels; Split Plot Factor: Roller Gaps with 4 Fixed levels

4. Describe the experimental units and/or measurement units:

- Whole Plot EU: Batch of Steel; Split Plot EU: Portion of Batch;

Describe the measurement units: MU = Portion of Rolled Steel

5. Response Variable: Tensile strength of steel

Covariates: Carbon content of Batch

No subsampling or repeated sampling

(20 points) Experiment 3:

1. Type of Randomization:
 - RCBD with Split-plot treatment assignment; blocks are litters
2. Type of Treatment Structure:
 - Species crossed with Technique - 4×3 Factorial treatment structure
3. Identify each of the Factors as being Fixed or Random:
 - Blocking Factor - Litters with 5 Random Levels
 - Treatment Factors: Species with 4 Fixed Levels; Techniques with 3 Fixed Levels;
4. Describe the Experimental Units and Measurement Units:
 - EU for Species is a Rat; EU for Technique is a portion of Rat's Kidney
 - MU is a portion of Rat's Kidney
5. Describe the Measurement Process: Response Variable, Covariates, SubSampling, Repeated Measures
 - The response is the percentage of mercury absorbed in the Rat's kidney.
 - There are no covariates, subsamples, or repeated measures.

(20 points) Experiment 4:

1. Type of Randomization:
 - This is a RCBD with blocks being the Sections (or Instructors, in that, Instructor and Section are confounded) and a Crossover Treatment Design
2. Type of Treatment Structure:
 - 3 treatments consisting of the three Assessment Methods
3. Identify each of the Factors as being Fixed or Random:
 - Blocking Factors: Instructor (or Section) with 4 Random Levels; Period with 3 Fixed Levels; Sequence with 6 Fixed levels; Student with 24 Random levels
 - Treatment Factor: Assessment Method with 3 Fixed Levels
4. Describe the Experimental Units and Measurement Units:
 - EU is Student nested within a Sequence
 - MU is a Student evaluated with a particular Assessment Method during a particular Period
5. Describe the Measurement Process: Response Variable, Covariates, SubSampling, Repeated Measures
 - The response is the score from a student from a particular Assessment Method
 - There are no covariates or subsamples
 - Repeated measures are taken on Each student, one during each Assessment Period

(20 points) **Part II - Selecting the Design**

Design 1 Randomly assign 6 aquaria to each of the 6 Temperature-Salinity Combinations. Next, partition each aquarium into two sections and randomly assign the two Density levels to a section within each of the 36 aquaria with a new randomization for each of the 36 aquaria. This is a split plot design. The aquaria would next be arranged in the room used for the experiment so that the 6 Temperature - Salinity levels are "equally distributed" about the room.

- Advantages: There will be twice as many experimental units for comparing the 12 treatments compared to Design 2. The F-test for testing main effects and interactions would have $df = 30$ in Design 1, whereas in Design 2 the F test would have $df = 24$ for these tests.
- Disadvantages: Fewer shrimp within the aquaria in comparison to Design 2 because each aquarium has only half the volume.

Design 2 Randomly assign 3 aquaria to each of the 12 Temperature-Salinity-Density Combinations in a Completely Randomized Design. The aquaria would next be arranged about the room so that the 6 Temperature - Salinity levels are "equally distributed" about the room.

- Advantages: Design 2 has more shrimp in each aquarium relative to the number of shrimp per aquarium in Design 1.
- Disadvantages: There are fewer EU's for the evaluation of the 12 treatment combinations in comparison to Design 1.

Design 1		Design 2	
Source	D.F.	Source	D.F.
Temp	1	Temp	1
Salinity	2	Salinity	2
Temp*Sal	2	Temp*Sal	2
Error(A)=	30	Den	1
Aqu(T,S)		Den*Temp	1
Den	1	Den*Sal	2
Den*Temp	1	Den*Temp*Sal	2
Den*Sal	2	Error	24
Den*Temp*Sal	2	Total	35
Error(B)	30		
Total	71		