STATISTICS 642 - ASSIGNMENT 2

DUE DATE: 8am Central, THURSDAY, February 10, 2022

Name (**Typed**) _____

Email Address (**Typed**) _____

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STATISTICS 642 - ASSIGNMENT #2

- Due 8am Central, THURSDAY, February 10, 2022
- Read Handout 2
- Supplemental Reading: Chapters 1 & 2 from the Design & ANOVA book
- Hand in the following:

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 Experimental Units and Measurement Units:
5. Describe the Measurement Process: Response Variable, Covariates, SubSampling, Repeated Measures

(20 points) Experiment 1: An experiment was conducted to study the effects of irrigation (Yes or No) and three levels of aerially sprayed pesticide (P_1, P_2, P_3) on the yields of three varieties of corn (V_1, V_2, V_3). There were six fields available for the experiment with two fields randomly assigned to each of the levels of pesticide. Each field was then divided into halves (east-west); one of these halves was randomly assigned to be irrigated, and the other was left without irrigation. Each east-west half of a field was then divided into three regions and the three varieties were randomly assigned to these regions. The number of bushels of corn produced and the total rainfall during the growing season were recorded in each of the regions.

Field							
F1	F2	F3	F4	F5	F6		
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	52.1	45.1	46.7	55.9	NO	V_1
55.4	54.3	56.9	49.8	45.0	58.0	NO	V_2
57.8	57.9	55.2	47.0	47.2	51.2	NO	V_3

(20 points) Experiment 2: A steel manufacturer wanted to study the effect that four sizes of roller gaps, (2 cm, 4 cm, 6 cm, 8 cm), have on a steel manufacturing process with respect to 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 with 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 twenty runs could be accomplished during a single day. The researcher was thus able to observe all five alloys under each of the four roller gaps during a single day. The whole process was repeated on three consecutive days. The carbon content of the alloy may have an affect on the tensile strength of the rolled steel. Therefore, the carbon content of each batch was measured prior to the rolling of the steel.

(20 points) Experiment 3: A microbiologist designed an experiment to evaluate four species of fish on the basis of the amounts of mercury that is transferred to the kidneys of experimental rats that were fed the fish as a part of their diet. The investigators were also interested in comparing three techniques for measuring the amount of mercury in the rats. Five litters, each containing four rats, were randomly selected for use in the experiment. Within each litter, the four rats were randomly assigned to the four species of fish, one species to each rat. After a month of consuming the fish diet, the rats were sacrificed and three sections were randomly selected from the rat's kidney. The three sections were randomly assigned to the three techniques, and the amount of absorbed mercury was measured in each section using the assigned technique. The data (percentage of mercury absorbed) are given in the following table:

		Litter				
Species	Technique	1	2	3	4	5
1	1	26.97	26.12	27.83	27.47	26.98
	2	22.60	22.91	19.85	21.63	21.77
	3	30.71	29.53	27.51	28.62	30.28
2	1	17.47	18.13	18.01	17.97	23.67
	2	16.90	16.31	16.52	15.93	20.67
	3	23.95	22.84	23.84	23.45	30.82
3	1	20.72	20.41	21.01	21.34	25.64
	2	24.32	25.06	25.92	25.33	23.57
	3	28.31	29.02	29.13	29.36	2948
4	1	20.93	22.64	20.64	19.47	20.67
	2	24.53	23.54	18.99	20.33	22.22
	3	21.41	22.84	24.13	21.49	19.62

(20 points) Experiment 4: An experiment was designed to compare three different methods of assessing the knowledge obtained by students in an undergraduate statistics course:

- Method 1: Multiple choice questions
- Method 2: Student provides detailed solutions to problems
- Method 3: Individual oral examinations

To conduct the experiment, four sections of STAT 303 will be randomly selected. The four sections are taught by four different instructors. Six students will be randomly selected from each of four different sections of STAT 303. Each student will take all three exams (a total of 72 observations). The researcher is interested in the difference in average scores on the three exams and whether the size of the differences between average scores is consistent across the various sections of STAT 303. There is concern that there may be an effect based on whether a test is taken during the first, second, or third testing period. Hence, each type of testing appears in each testing period. The 6 orders in which the students take the three types of Test Methods are randomly assigned to the students.

Part II - Selecting the Design

(20 points) 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 aquaria. The three factors are:

T = Water Temperature ($25°C$, $35°C$)

S = Water Salinity (10%, 25%, 40%)

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

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

Two possible experimental designs are listed 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. Suppose there are 36 aquaria available for the study. If it helps, you can sketch the experimental layout.

D1. Each aquarium can be partitioned into two sections, but the water in the two sections is common to both sections (i.e., the water in one section circulates through the entire aquarium).

D2. It is not possible to partition the aquaria into sections.