United States International University-Africa

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SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF DATA SCIENCE AND ANALYTICS

SUMMER 2024 – ASSIGNMENT 4

COURSE CODE: STA 4020A

UNIT NAME: DESIGN AND ANALYSIS OF EXPERIMENTS

DATE: 12TH JULY 2024 **TOTAL MARKS**: 100 MARKS

INSTRUCTIONS:

For this exercise:

1. ANSWER ALL QUESTIONS
2. Do all your working in the Rmarkdown (.rmd).
3. Submissions should be in either a **`.ipynb`** or **`.rmd`** **file**
4. NO SUBMISSIONS SHOULD BE DONE VIA EMAIL

TASK: Factorial and Split-Plot Arrangements with Random and Fixed Effects

Question 1: Factorial Arrangement

Consider a factorial experiment with the following factors and levels:

Factor A: Temperature (2 levels: Low and High) - **Fixed Effect**

Factor B: Humidity (2 levels: Low and High) - **Fixed Effect**

Factor C: Light Exposure (2 levels: Low and High) - **Fixed Effect**

a. How many treatment combinations are there in this factorial experiment?

b. Write down the full factorial design matrix including all treatment combinations.

c. Assume you have conducted the experiment and collected data on the response variable.

   - Perform a factorial ANOVA to analyze the effects of Factors A, B, and C on the response.
   - Provide the ANOVA table summarizing the results.
   - Interpret the p-values and determine which factors (if any) have statistically significant effects on the response variable.

Question 2: Split-Plot Arrangement

Consider a split-plot experiment where the main plots (whole plots) receive different treatments and subplots (split-plots) within each main plot receive additional treatments. The experiment has:

Main Plot Factor: Fertilizer Type (2 levels: Organic and Inorganic) - **Fixed Effect**

Subplot Factor: Irrigation Frequency (3 levels: Low, Medium, High) - **Random Effect**

a. Describe how the split-plot arrangement is structured in terms of whole plots and split-plots.

b. Write down the design matrix showing all treatment combinations.

c. Assume you have collected data on the response variable from the split-plot experiment.

   - Perform a split-plot ANOVA to analyze the effects of the Fertilizer Type (main plot factor) and Irrigation Frequency (subplot factor) on the response.
   - Provide the ANOVA table summarizing the results, including main effects and interaction effects.
   - Interpret the p-values and determine which factors (if any) have statistically significant effects on the response variable. Discuss any significant interactions.