United States International University-Africa

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SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF DATA SCIENCE AND ANALYTICS

SUMMER 2024 – MID-SEMESTER EXAM

COURSE CODE: STA 4020A **UNIT NAME:** DESIGN AND ANALYSIS OF EXPERIMENTS

DATE: 24TH JUNE 2024 **TOTAL MARKS**: 40 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

QUESTION 1: [20 MARKS]

Given the field layout and yields in bushels per acre from an experiment on dusting wheat with sulfur to control stem rust, analyze the data using advanced statistical methods. Following a Latin square design, the treatments applied are:

A = Dusted before rains
B = Dusted after rains
C = Dusted once each week
D = Drifting once each week
E = Control or check

The yields for each treatment are as follows:

B (4.9)	D (6.4)	E (3.3)	A (9.5)	C (11.8)
C (9.3)	A (4.0)	B (6.2)	E (5.1)	D (5.4)
D (7.6)	C (15.4)	A (6.5)	B (6.0)	E (4.6)
E (6.3)	B (7.6)	C (13.2)	D (8.6)	A (4.9)
A (9.3)	E (6.3)	D (11.8)	C (15.9)	B (7.6)

1. Evaluate the effects of the different treatments on the wheat yield, considering the potential random effects due to environmental variation.
2. If statistically necessary, determine which specific treatments significantly differ from each other in terms of yield. Include a visual output to compare the treatments.
3. Interpret the results in the context of agricultural practices for controlling stem rust, considering both statistical significance and practical implications.

QUESTION 2: [20 MARKS]

In a digestion trial carried out with 6 shorthorn steers, each animal received one of 6 rations in 6 successive periods following a Latin square design. The coefficients of digestibility of nitrogen for each steer and period are as follows:

Steer	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
1	61.1 (B)	69.3 (D)	67.6 (C)	61.9 (F)	58.8 (A)	65.2 (E)
2	56.9 (A)	59.1 (F)	64.0 (D)	61.0 (C)	65.7 (E)	56.6 (B)
3	66.5 (C)	62.2 (A)	61.1 (B)	66.2 (E)	62.0 (F)	62.2 (D)
4	66.7 (E)	67.4 (B)	65.1 (F)	65.1 (D)	69.6 (C)	52.7 (A)
5	67.8 (D)	64.7 (C)	63.6 (E)	53.2 (A)	61.7 (B)	62.0 (F)
6	71.4 (F)	67.5 (E)	55.8 (A)	63.2 (B)	68.0 (D)	62.9 (C)

The rations consist of: - A: Hay alone - B: Various mixtures of hay and barley (Rations B, C, D, E, F)

1. Assess the effects of different rations on the digestibility of nitrogen. Include an analysis of variance (ANOVA) to test the significance of the ration effects, period effects, and steer effects.
2. Where necessary, identify which specific rations differ significantly from each other in terms of digestibility. Include a visual output to compare the treatments.
3. Discuss the implications of your findings for nutritional strategies in cattle farming, highlighting any potential benefits or drawbacks of specific rations based on the digestibility results.