MAR504 Experimental Design and Statistics

Assignment 1 – Basics of Experimental Design, Descriptive Statistics, and Probability Theory

Submit as a word document via email to oliver.shipley@stonybrook.edu by Tuesday 30th September by 17:00 EST.

Part A – Experimental Design and Descriptive Statistics (30 Points)

1. A) Describe the major differences between simple random, stratified random, and systematic random sampling designs. (6) Provide an example of when you might use each. (3)
2. What is meant by a "control"? Do all experiments require controls? Explain your answer. (4)
3. What is pseudoreplication and why is it a problem (2)? Describe a brief experimental design that would be considered "pseudoreplicated". (4)
4. Describe two ways to reduce bias while testing for treatment effects (4).
5. From the data table below, manually calculate the mean, average deviation, sum of squares, degrees of freedom, sample variance, standard deviation, and standard error. Clearly show your work for each step. (7)

5
7
4
32
6
8
16
50
14
65
3

Part B – Probability Theory and Distributions (20 Points)

1. Build a histogram with some simulated data (i.e., data you have used R to generate for you) to illustrate a normal distribution. Run a normality test to confirm this and report the associated statistics. Justify your choice of normality test. (6)
2. Plot the corresponding probability density function and cumulative distribution function. (4)

3. Make a box and whisker plot of your data that clearly highlights the mean, median, interquartile range, and outliers (if any). (4)
4. Define a binomial and poisson distribution (2). Describe the major differences and provide an example of an associated data type for each (4).

Part C – Critical Evaluation (50 points)

1. Read the paper by Rummer et al (2020) and provide a ~half page (single space, 12 pt font) general overview of the premise, experimental approach, and findings (10).
2. Provide a ~1-page critical evaluation of the experimental design, by discussing positive and negative aspects of the work (20).
3. Describe a ~ half page revised experimental setup that could improve the overall study design based on your answers to question 2 (10).