Last updated on September 20, 2023

BM5033 Statistical Inference Methods in Bioengineering

Assignment 3

To be submitted before the class on 29th Sept. **Total marks: 100**

Instructions

1. You can use R for this assignment. As a part of the answer to the question also copy the R code if you have used it.
2. This assignment has to be submitted in PDF format. Answers are supposed to be **typed** and **NOT** handwritten.
3. The data for this assignment can be downloaded from **this link**.
4. Please name the file containing your answers <Your-Roll_No>.pdf and upload it **here**.
5. You are expected to work on these problems on your own. **Any reasonable signs of 'copying/plagiarism' will attract penalties.**

Questions

1. Suppose you wish to study the effect of different food supplements (`feed`) on the weights of the chicken (`weight`).
   (a) **(5)** Use boxplots and a plot of means to visualize the difference between feed types.
   (b) **(5)** Test for the assumptions required for the analysis of variance.
   (c) **(5)** Perform an appropriate version of the ANOVA to compare the effectiveness of different feeds.
   (d) **(10)** If ANOVA shows a difference in the group means, perform post-hoc analysis to identify the feed that results in the highest weight gain for the chicken.
2. Cushing's syndrome is a hypertensive disorder that has been shown to be associated with a higher amount of cortisol secretion by the adrenal gland. In the data for this question, the observations are urinary excretion rates (mg/24hr) of two steroid metabolites `Pregnanetriol` and `Tetrahydrocortisone`. Based on some experiments it has been hypothesized that the excretion rate of `Pregnanetriol` changes based on the underlying type (coded `a` (adenoma), `b` (bilateral hyperplasia), `c` (carcinoma) or `u` for unknown) of Cushing's syndrome.
   (a) **(5)** Use boxplots and a plot of means to visualize the difference between excretion rates of the two steroid metabolites for different Cushing's type.
   (b) **(5)** Test for the assumptions required for the analysis of variance.
   (c) **(5)** Perform an appropriate version of the ANOVA to compare `Pregnanetriol` secretion rates in different syndrome types.
   (d) **(5)** Perform an appropriate version of the ANOVA to compare `Tetrahydrocortisone` secretion rates in different syndrome types.
   (e) **(10)** If ANOVA shows a difference in the group means in the last two questions, perform a post-hoc analysis for each.
3. `Anorexia` is characterized by an unwarranted fear of being overweight. Its symptoms include attempts to maintain a below-normal weight through various means. In the data for this question, the weights (in lbs) of the subjects are listed before (`PreWt`) and after (`PostWt`) a couple of treatment methodologies (Cognitive Behavioural treatment `CBT` and family treatment `FT`) along with a control (`Cont`) group where no treatment was given.
   (a) **(5)** Use boxplots and a plot of means to visualize the difference between different groups.

(b) **(5)** Calculate the difference in body weight for each subject.

(c) **(5)** Test for the assumptions required for the analysis of variance.

(d) **(10)** Perform ANOVA and post-hoc analysis and comment on the effectiveness of the therapies.

4. **(20)** Suppose you are designing an experiment to study the effect of a nano-particle-based drug delivery method. For this, you have planned to synthesize Poly (lactic-co-glycolic acid) (PLGA) nanoparticles, Poly-lactic acid nanoparticles, and gold nanoparticles. For a comparison of the effectiveness of the delivery method, you also plan to administer the drug without loading it into the nanoparticles. In experiments, you intend to measure the number of cells after 4 hours of drug administration using different delivery modes. From some preliminary observations, you have seen that the variance in the cell numbers is 1000. What should be your sample sizes to achieve a statistical power of 80% at 0.05 level of significance if you want to detect a difference of 100 cells?