SSGS 6111 BIOSTATISTICAL ANALYSIS & INTERPRETATION

SOLUTION 2

1. a) No. Juveniles and adults differ in many physiological aspects, which can be an important source of variation for response to the treatment.
b) Preferably no. Sex-specific hormones in males and females may interact with the treatment. Possible to mix if there is strong theoretical argument to rule out hormone-treatment interaction.
c) No. Mixing strains would increase genetic variation and introduce an uncontrollable source of variation into the study.
An optimal design should use rats from the same strain, same sex and same growth stage. There are eight such combinations.

2. The ecologist should first get an aerial map of the mangrove swamp that he wishes to study, along with GPS coordinates. He could then divide the map into N equally sized blocks, where the size of each block is such that it is possible to check the block thoroughly for the presence of horseshoe crabs. Each block should be labelled with a number (say 1,2,...,N). Pick k random numbers, which correspond to the blocks. He should then check those randomly chosen blocks. The estimate of the density of the latter is given by

$$\text{Density} = \frac{\sum_{i=1}^{k} X_i}{kA},$$

where X_i is the number of horseshoe crabs in the ith block, and A is the area of a block. The standard error of the density estimate is given by

$$\text{SE} = \frac{1}{A\sqrt{k}} S,$$

where

$$S = \sqrt{\frac{\sum_{i=1}^{k}(X_i - \bar{X})^2}{k-1}},$$

is the sample standard deviation of the number of crabs in the blocks.

Remarks: when sampling, it is important to also consider the timings for high and low tides. You don't want to be caught sampling while the water level is rising!

3.The doctor should match patients of the same age group and smoking history first (stratification), before random allocation of the treatments. This would reduce the variation in response to treatment caused by variation in these two factors. The doctor should blind-fold the patient before giving the treatment. This is to avoid the placebo effect, whereby improvement is sometimes seen in patients who psychologically believe that the substance given to them is potent.