Power Calculation Questions

Please include all hand calculations as well as any code used to do these calculations

1. Reconsider the rat study from class but assume the researcher decides to reduce the number of treatments down to three, thereby allowing 13 rats per group. What is the power to detect a treatment difference of 10 under this new design?

2. Reconsider the rat study from class but assume the researcher obtains a baseline response for each rat prior to treatment. This allows the researcher to consider the change from this baseline measure as the response variable. How does this change the power when there are four treatments and \( n = 10 \) rats per group?

3. A researcher is planning a three-arm clinical trial with a time-to-event endpoint measured in days. In an earlier study involving the current standard-of-care treatment, the logarithm of time-to-event was approximately Normal with mean 3.4 and standard deviation 0.5. The research thinks two new treatments might increase the time-to-event by two or more weeks and wants to make sure he can detect this. How many patients per group do you recommend he consider?

4. An animal science researcher is planning a three-period crossover design to compare diets on milk production. Previous studies have suggested milk production to be Normally distributed with a mean of 2000 liters and a standard deviation of 45 liters and that the intraclass correlation of milkings within a cow is 0.60. How many cows are needed if the researcher wants to detect differences in means of 15 liters?

5. Turns out the animal researcher in #2 does not have the time to assess a third lactation period. How many cows would be needed if he instead ran a two-period three treatment crossover experiment?