Part 1: New Wine Development

A winemaster at a large winery is considering a new wine product and is considering 5 varieties of grapes for use in the wine. She plans to create 10 batches for each of the 5 grape varieties, and have a group of professional wine tasters each (blindly) rate each batch on a (continuous) visual analogue scale from 0-10, then average their scores for a single response for each batch.

- She can only use one machine to create the 50 batches. Provide a random assignment of grape varieties (A,B,C,D,E) to the sequence of 50 production runs. Describe how you did this assignment (computer generated, digits from a random # table, rolling of a die, etc).

- The datasets winescore.dat and winescore.xls provide the results of her experiment. Grape types and rating scores are given based on the actual sequence she ran (the chances of your answer to the previous part matching mine is approximately 1 in $4.8 \times 10^{31}$). Complete the following parts.
  - Plot the rating scores versus the grape type. Briefly describe the between and within grape variation pattern.
  - Obtain the Analysis of Variance. List all sources of variation, degrees of freedom, sums of squares, mean squares, and $F$-statistic
  - Test whether the true mean rating scores differ among the 5 varieties of grapes at the $\alpha=0.05$ significance level. Fully state all aspects of the test, as well as the observed significance level ($P$-value).
  - Use Tukey’s and Bonferroni’s procedures to compare all pairs of grape varieties (use an experiment-wise error rate of 0.05).
  - Use Levene’s test or any appropriate test available to you in your software package to determine whether the assumption of equal variances is appropriate ($\alpha=0.05$).
  - Obtain a histogram of the residuals $e_{ij} = y_{ij} - \bar{y}_i$. Does the assumption of normality seem appropriate?
  - Obtain a time series plot of the residuals. Does the assumption of independence over time order of production seem appropriate?
  - Write a brief, but thorough report of your findings, in journal article format.
Part 2: Interaction Between Theophylline and Heartburn Medication

A study was conducted to determine whether pepcid or tagamet interacted with theophylline in terms of the clearance (rate at which drug passes through blood system, in liters/hour) in healthy adults. The data are in the file theoph.dat and theoph.xls. A group of 14 adults were obtained, and each were given the following 3 treatments (in random order with sufficient time between dosing):

- Theophylline and Placebo
- Theophylline and Pepcid
- Theophylline and Tagamet

The response measured was the clearance rate of theophylline (slow rates mean the drug tends to stay in the body too long. Complete the following parts:

- Plot the scores by subject using a different plotting symbol for the 3 treatments. Do the subjects tend to vary with respect to the clearance rates? Within subjects does a discernible pattern appear?
- Obtain the Analysis of Variance. List all sources of variation, degrees of freedom, sums of squares, mean squares, and $F$-statistic
- Test whether the true mean rating scores differ among the 3 treatments at the $\alpha=0.05$ significance level. Fully state all aspects of the test, as well as the observed significance level ($P$-value).
- Use Tukey’s and Bonferroni’s procedures to compare all pairs of treatments (use an experiment-wise error rate of 0.05).
- Obtain a histogram of the residuals $e_{ij} = y_{ij} - \bar{y}_{i.} - \bar{y}_{.j} + \bar{y}_{..}$
- How many subjects per treatment would have been necessary had this been run as a completely randomized design to have the treatment means estimated with this level of precision.
- Write a brief but thorough report of your results in journal article format.