STATISTICS 402 – Assignment 10
Due April 27, 2009

1. What is a picnic without ants? A student in a statistics class in Australia designed an experiment to see if different types of sandwiches attract different numbers of meat ants (a scavenger ant found throughout Australia). The results were reported by Margaret Mackasack (1994), "Favourite Experiments: An Addendum to What is the Use of Experiments Conducted by Statistics Students?" in the *Journal of Statistics Education*, v2n1. The experiment involved different combinations of bread, filling and butter to make a sandwich. The sandwich was then left next to a meat ant hill. After 5 minutes the experimenter counted the number of ants within a specified radius of the sandwich. The factors of interest were; type of bread (rye, whole meal, multi-grain, or white); the type of filling (Vegemite, Peanut Butter or Ham and Pickle, and whether butter was put on the bread (yes or no). Two sandwiches were made for each combination and the order in which sandwiches were placed near the meat ant hill was completely randomized. Each sandwich was cleaned up and the ants were allowed to return to the hill before placing another sandwich. Below are the data.

		Filling					
		Vegemite		Peanut Butter		Ham and Pickle	
Bread	Butter	Yes	No	Yes	No	Yes	No
Rye		22	18	27	43	68	44
		45	31	50	36	65	54
Whole meal		57	29	42	59	58	34
		42	21	36	47	77	65
Multi-grain		26	42	60	22	63	36
		28	38	47	19	76	59
White		52	42	57	24	66	48
		40	25	51	21	59	53

   a. Use the sample size tables from earlier in the semester to determine the size of the difference in mean quality that can be detected when comparing the:
      - Two levels of butter.
      - Three levels of filling.
      - Four levels of bread.

      For all determinations use Alpha=0.05 and Beta=0.10.
   b. Construct a **complete** ANOVA table (you can, and should, use JMP to do the calculations).
   c. What factors and/or interactions are statistically significant at the 1% level?
   d. Compute means for those factors that are statistically significant. Indicate which means are significantly different for the significant factors. Be sure to include the value of the LSD or HSD used.
   e. Compute means for the significant interactions. Construct and interpret interaction plots for the significant interactions.
   f. Based on your analysis, what sandwich attracts the most meat ants? The fewest meat ants? Support your answer statistically.

2. An experiment is conducted to explore the relationship between height of step (5.75 in or 11.5 in) and rate of stepping (14 steps/min, 21 steps/min or 28 steps/min) on the heart rate of college students. Six college students were used in the study. There are 6 combinations of step height and stepping rate. Each student experienced each combination. The order was randomized for each student and enough time separated the trials so that students' heart rates could return to a resting rate. The resting heart rate for each student is taken before each trial and the heart rate at the end of the 3 minutes of the stepping regimen is also measured. Below are the data. The values are the change in heart rate from resting to after stepping.

		Stepping Frequency					
		14 steps/min		21 steps/min		28 steps/min	
Student	Step Height	5.75 in	11.5 in	5.75 in	11.5 in	5.75 in	11.5 in
1		16	39	21	52	24	66
2		9	33	21	50	42	60
3		8	18	24	27	27	51
4		9	15	15	28	18	40
5		16	26	28	49	43	59
6		4	15	15	16	20	40

a. Construct a **complete** ANOVA table for the analysis of the change in heart rate. You can use JMP to do the calculations.
b. What, if any, factors and interactions are significant? Support your answers statistically.
c. If a factor is significant, what levels are significantly different from other levels? Be sure to include the value of the LSD or HSD used.
d. Construct and interpret an appropriate interaction plot.
e. Based on your analysis, comment on the effects of step height and rate of stepping on the change in heart rate.
f. How important was blocking on the student in this experiment? Support your answer with a statistical argument. This may involve additional analysis.
g. If the response had been pulse rate after stepping rather than change in pulse rate, would blocking on student have been more or less important? Explain your reasoning.