MTH 324, Homework #6, Fall 2022 Name _____

Instructions: Show work or attach R code used to perform calculations (or any other technology used). Be sure to answer all parts of each problem as completely as possible, and attach work to this cover sheet with a staple.

1. The following data refers to yield of tomatoes (kg/plot) for four different levels of salinity. Salinity level here refers to electrical conductivity (EC) where the chosen levels were EC = 1.6, 3.8, 6.0, 10.2 nmhos/cm.

Salinity	*Yield*				
1.6	59.5	53.3	56.8	63.1	58.7
3.8	55.2	59.1	52.8	54.5	
6.0	51.7	48.8	53.9	49.0	
10.2	44.6	48.5	41.0	47.3	46.1

   a. Use the F test (ANOVA) at level α=0.05 to test or any differences in true average yield due to the different salinity levels.
   b. Apply the modified Tukey's method to identify significant differences among the μ_i's.

2. How is the F-test for ANOVA related to the t-test?

3. Four different coatings were being considered for corrosion protection of metal pipe. The pipe will be buried in three different types of soil. To investigate whether the amount of corrosion depends either on the coating or on the type of soil, 12 pieces of pipe are selected. Each piece is coated with one of the four coatings and buried in one of the three types of soil for a fixed time, after which the amount of corrosion (depth of maximum pits in 0.0001 in) is determined. The data appears in the table.

		Type of Soil (B)		
		1	**2**	**3**
Coating (A)	**1**	64	49	50
	2	53	51	48
	3	47	45	50
	4	51	43	52

   Assuming the validity of the additive model, carry out the ANOVA analysis (two-way) using an ANOVA table to see whether the amount of corrosion depends on either the soil type or the coating. Use $\alpha = 0.05$.

4. In an experiment to see whether the amount of coverage of light-blue interior latex paint depends on either of the brand of paint or the brand of roller used, one gallon of each of four brands of paint was applied to each of three brands of roller, resulting in the following data (number of square feet covered).

		Roller Brand		
		1	**2**	**3**
Paint Brand	**1**	454	446	451
	2	446	444	447
	3	439	442	444
	4	444	437	443

a. Construct the ANOVA table.
b. State and test hypotheses appropriate for deciding whether paint brand has any effect on coverage. Use $\alpha = 0.05$.
c. Repeat for roller brand.
d. Use Tukey's method to identify significant differences among brands. Is there one brand that seems clearly preferable to the others.

5. The accompanying data resulted from an experiment to investigate whether yield from a certain chemical process depended either on the formulation of the particular input or on mixer speed.

		Speed		
		60	**70**	**80**
Formulation	**1**	189.7	185.1	189.0
		188.6	179.4	193.0
		190.1	177.3	191.1
	2	165.1	161.7	163.3
		165.9	159.8	166.6
		167.6	161.6	170.3

a. Does there appear to be an interaction between factors?
b. Does yield appear to depend on either formulation or speed?
c. Calculate estimates of the main effects.
d. Construct normal probability plots from the residuals. Do they appear to be normally distributed?

6. An article describes an experiment to investigate how the length of steel bars was affected by time of day (A), heat treatment applied (B) and screw machine used (C). The three times were 8:00 am, 11:00 am and 3:00 pm, and there were two treatments and four machines (a 3x2x4 factorial experiment), resulting in the accompanying data (encoded as 1000(length – 4.380).

	B_1			
A_1	C_1	C_2	C_3	C_4
	6	7	1	6
	9	9	2	6
	1	5	0	7
	3	5	4	3
A_2	6	8	3	7
	3	7	2	9
	1	4	1	11
	-1	8	0	6
A_3	5	10	-1	10
	4	11	2	5
	9	6	6	4
	6	4	1	8

	B_2			
A_1	C_1	C_2	C_3	C_4
	4	6	-1	4
	6	5	0	5
	0	3	0	5
	1	4	1	4

A_2	3	6	2	9
	1	4	0	4
	1	1	-1	6
	-2	3	1	3
A_3	6	8	0	4
	0	7	-2	3
	3	10	4	7
	7	0	-4	0

a. Construct the ANOVA table for this data.
b. Test to see whether any of the interaction effects are significant to the level of $\alpha = 0.05$.
c. Test to whether any of the main effects are significant at the same level.
d. Use Tukey's procedure to investigate differences among the 4 machines.

35. An article uses a Latin square design in which factor A is plant, factor B is leaf size and factor C is time of weighing, and the response variable is moisture content.

Plant	**Leaf Size**	**Time of Day**	**Moisture Content**
1	1	5	6.67
1	2	4	7.15
1	3	1	8.29
1	4	3	8.95
1	5	2	9.62
2	1	2	5.40
2	2	5	4.77
2	3	4	5.40
2	4	1	7.54
2	5	3	6.93
3	1	3	7.32
3	2	2	8.53
3	3	5	8.50
3	4	4	9.99
3	5	1	9.68
4	1	1	4.92
4	2	3	5.00
4	3	2	7.29
4	4	5	7.85
4	5	4	7.08
5	1	4	4.88
5	2	1	6.16
5	3	3	7.83
5	4	2	5.83
5	5	5	8.51

Obtain an ANOVA table and test at level 0.05 to see whether there is any variation in moisture content due to the factors.