

STATISTICS 642 - ASSIGNMENT 6

DUE DATE: 8am Central, Thursday, March 24, 2022

Name (**Typed**) _____

Email Address (**Typed**) _____

Make this cover sheet the first page of your Solutions.

STATISTICS 642 - ASSIGNMENT #6

- Read Handouts 6
- Supplemental Reading: Chapter 5 in the Design & ANOVA book
- Hand in the following problems by 8am Central, Thursday, March 24, 2022

1. (**60 points**) The porosity index is a measure used by soil scientists to assist in the prediction of water movement, storage, availability, and aeration conditions of soils. A soil scientist utilized a special sampling design to take soil samples from one of the university experimental farms to measure the porosity index of the farm soil. The farm was partitioned into fields of approximately 4 hectares each and then divided into eight sections. The sampling plan included a random selection of fields from which sections were randomly selected. Locations for soil subsamples were randomly selected within the sections. The porosity index of each soil subsample is displayed in the following table. More than one random location was measured for only 6 of the 30 sections.

Field	Section	Porosity	Field	Section	Porosity	Field	Section	Porosity
1	1	3.846, 3.712	6	11	4.355, 6.292	11	21	3.835, 2.964
	2	5.629, 2.021		12	4.940, 4.810		22	4.584, 4.398
2	3	5.087	7	13	2.983	12	23	4.193
	4	4.621		14	4.396		24	4.125
3	5	4.411	8	15	5.603	13	25	3.074
	6	3.357		16	3.683		26	3.483
4	7	3.991	9	17	5.942	14	27	3.867
	8	5.766		18	5.014		28	4.212
5	9	5.677	10	19	5.143	15	29	6.247
	10	3.333		20	4.061		30	4.730

- a. Write a linear model for this experiment. Make sure to explain each term in your model along with any distributional requirements for the term.
 - b. Display the AOV table for this experiment in which you display the expected mean squares.
 - c. Display the proportion of the variance in the porosity readings due to Fields, Sections, and Residuals.
 - d. Test at the $\alpha = .05$ level whether or not the fields variance is greater than zero.
 - e. Test at the $\alpha = .05$ level whether or not the sections variance is greater than zero.
2. (**20 points**) A plant pathologist wants to evaluate cottonseed stored at various cotton gins for Aflatoxin, a toxin produced by organisms associated with cottonseed. The pathologist will randomly select eight cotton gins for analysis. Then at each cotton gin, she will take a 3-pound sample from r randomly selected 50-ton lots of cottonseed.
 - a. Would a test of the difference in the mean Aflatoxin levels over the eight cotton gins be a reasonable test to conduct? Justify your answer.
 - b. What is the minimum number of 50-ton lots of cottonseed per cotton gin, r , that the plant pathologist would have to take from each of the eight cotton gins in order to have power of at least 90% to detect a ratio $\sigma_A^2/\sigma_e^2 = 2$ at the .01 significance level, where σ_A^2 is the variance associated with differences in Aflatoxin level from cotton gin to cotton gin and σ_e^2 is the variance across 50-ton lots of cottonseed within each cotton gin.
3. (**20 points**) A chemical company wishes to study the difference in response times (in milliseconds) for a number of different types of circuits used in an automatic value shutoff mechanism. From past studies, the value of σ_e is taken to be 2 milliseconds. The researcher has a list of over 100 Types of Circuits that are of interest to the company. The company wants to determine if there is a significant variation in the performance of the 100 Types of circuits. In order to control for the variation within each Type of Circuit, she decides it is necessary to evaluate 5 circuits of each Type selected for the study. How many different Types of Circuits must be selected for use in the experiment in order to obtain an $\alpha=.01$ test having power of at least 0.90 whenever the standard deviation in the Types of circuits is greater than 2.1 milliseconds.