**ETM 421/621 (Spring 2021)**

**Homework 7**

**Total Points: 5**

**Assignment Objectives:**

1. Apply the ANOVA techniques to two factor factorial experiments with interactions.
2. Learn how to check model assumptions such as *normality*, *constant variance*, and *independence* in factorial experiments.
3. Perform data transformation using natural log values.

**Problems:**

1. ***(2.5 points)*** An article in Industrial Quality Control (1956, pp. 5-8) describes an experiment to investigate the effect of the type of glass and the type of phosphor on the brightness of a television tube. The response variable is the current necessary (in microamps) to obtain a specified brightness level. The data are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Phosphor Type** | | |
| **Glass Type** | **1** | **2** | **3** |
|  | 280 | 300 | 290 |
| **1** | 290 | 310 | 285 |
|  | 285 | 295 | 290 |
|  | 230 | 260 | 220 |
| **2** | 235 | 240 | 225 |
|  | 240 | 235 | 230 |

1. Is there any indication that either factor influences brightness? Show your ANOVA table. Use *α* = 0.05.
2. Do the two factors interact? Use *α* = 0.05.
3. Analyze the residuals from this experiment. Show the residual plots.
4. ***(2.5 points)*** A study investigated the effects of cyclic loading and environmental conditions on fatigue crack growth at a constant 22 MPa stress for a particular material.  The data from this experiment are shown below (the response is crack growth rate).

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency** | **Environment** | | |
| **Air** | **H2O** | **Salt H2O** |
| 10 | 2.29 | 2.06 | 1.90 |
| 2.47 | 2.05 | 1.93 |
| 2.48 | 2.23 | 1.75 |
| 2.12 | 2.03 | 2.06 |
|  |  |  |  |
| 1 | 2.65 | 3.20 | 3.10 |
| 2.68 | 3.18 | 3.24 |
| 2.06 | 3.96 | 3.98 |
| 2.38 | 3.64 | 3.24 |
|  |  |  |  |
| 0.1 | 2.24 | 11.00 | 9.96 |
| 2.71 | 11.00 | 10.01 |
| 2.81 | 9.06 | 9.36 |
| 2.08 | 11.30 | 10.40 |

1. Analyze the data from this experiment (use *α* = 0.05). Show the ANOVA table.
2. Analyze the residuals. Show the residual plots.

Repeat the analyses from parts (a) and (b) using ln(*y*) - *natural log* as the response.  Comment on the results.