

Assignment 4

Due Wed, Oct 27.

1. Michelson's measurements of the velocity of light in air

File: MichelsonExper.csv (velocity, trial)

Description: In 1879, A. A. Michelson made 100 determinations of the velocity of light in air using a modification of a method proposed by the French physicist Foucault. The file MichelsonExper.csv on the course web page contains the measured velocities of light (first column) in km/sec and have had 299,000 subtracted from them. The currently accepted "true" velocity of light in vacuum is 299,792.5 km/sec. Because of certain corrections that Michelson used in his data, the "true" value appropriate for the comparison to these measurements is 734.5. Michelson has split his experiments into several trials (second column in the data file). Experimental conditions were supposed to be the same within each trial but could vary slightly between trials.

1. Make a box plot of the data. Use the ANOVA analysis to investigate the consistency of Michelson's measurements. Is there any evidence of experimental trouble?
2. State the hypothesis that you were testing with ANOVA
3. Using the pairwise comparisons of the means, identify the trials that are statistically different from the rest.
4. Knowing the modern accepted value for the speed of light, we know the "true" value (734.5) that Michelson was trying to measure. It is therefore possible to test the null hypothesis that the true mean was 734.5 for each of the trials, or for all 100 determinations taken together. Test this hypothesis using a t-test.
5. Based on the experimental data, what is the uncertainty in the mean measured speed of light?
6. What can you conclude about the experiment? Was there bias in the data? Were the experimental errors distributed normally, as random errors should be? To answer the latter question, perform the appropriate statistical tests. Visualize your results using the 'normplot' command (read Matlab help for the description of this command).

2. The file 'oecd.mat' contains the 1960 economic data for 20 different countries. The first column is the per capita Income (in \$); the last three columns are the percentages of workforce in three different sectors: Agriculture (second column), Industry (third column), and Services (fourth column). Using regression, find out whether the per capita income of a country can be predicted from the distribution of its workforce among these sectors.

3. A research study was conducted to examine the clinical efficacy of a new antidepressant. Depressed patients were randomly assigned to one of three groups: a placebo group, a group that received a low dose of the drug, and a group that received a moderate dose of the drug. After four weeks of treatment, the patients completed a psychological test. The higher the score, the more depressed the patient. The data are presented below.

<u>Placebo</u>	<u>Low Dose</u>	<u>Moderate Dose</u>
38	22	14
47	19	26
39	8	11
25	23	18
42	31	5

- a) Conclude on the efficiency of the drug and suggest the best dosage level. Visualize the data and your findings.

- b) What would be the null hypothesis in this study? What would be the alternate hypothesis? What probability level would be appropriate and why?