

Analysis of Michelson Data

Background

In this illustrative example, we explore the data from the 1879 experiment of Michelson to measure the speed of light.

The Data Set

The data set consists of 5 experiments (column Expt); each has 20 runs (column Run) and Speed (column Speed) is the recorded speed of light, in km/sec, less 299,000.

The Analysis

We first compare the five experiments with simple boxplots. The R-platform data-analysis instructions are shown on the left and the data-analysis results are shown on the right below:

| | |
|---|--|
| <pre style="font-family: monospace; font-size: 0.9em;"> boxplot(Speed ~ Expt, data=MichelsonData, main="Speed of Light Data", xlab="Experiment No.", col="yellow") </pre> | |
|---|--|

We second analyze the data via analysis of variance as a randomized block design with runs and experiments as experimental factors. The data-analysis results are shown below:

| | Df | Sum Sq | Mean Sq | F value | Pr(> F) |
|-----------|-----------|---------------|----------------|----------------|-------------------|
| Run | 1 | 411.70 | 411.70 | 0.07 | 0.7872 |
| Expt | 1 | 72580.50 | 72580.50 | 12.92 | 0.0005 |
| Residuals | 97 | 545031.80 | 5618.88 | | |

This concludes the data analysis.