

Ohm's Law

GROUP ASSIGNMENT

LINEAR MODELLING

You are given the assignment to verify Ohm's law in the lab. In one form, Ohm's Law states that voltage divided by resistance is equal to current:

$$\frac{U}{R} = I$$

You have a $R = 100\Omega$ Resistor, and measure the current going through the resistor at different voltages:

$$U = [-10, -5, 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75]$$

$$I = [-0.118, -0.048, 0.011, 0.056, 0.088, 0.160, 0.215, 0.284, 0.296, 0.307, 0.383, 0.477, 0.479, 0.01, 0.03, 0.05, -0.01, 0.0]$$

Based on the measured data:

1. Plot the data for voltage and current.
2. Formulate a hypothesis test based on Ohm's law for the slope.
3. Determine a linear model for the data (slope and interception with the y-axis).
4. Plot the linear model together with the data.
5. Can you reject the NULL hypothesis?
6. Calculate the residuals and make the residual plot.
7. Based on the residual plot, is the linear model at good fit?
8. Find the 95% confidence interval for the estimate of the slope.
9. Plot the 95% confidence interval together with the data.
10. Are there any outliers in the experiment? Why is that?
11. Based on the residual plot would you conclude that Ohm's Law is true (that there is a linear connection between Voltage and Current)?
12. Redesign your experiment to avoid outliers.
13. Make a Matlab program that generates data for your new experiment. Assume that current is measured with a measurement noise that is Gaussian distributed with a mean of 0 and standard deviation of 0.02A.
14. With the new data, repeat question 1-9.