Sean MacBride

John Mikosz

E&M Writeup 1

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**PROCEDURE**

1. Obtain Multimeter and 220 Ohm resistors
2. Set multimeter to 2 kilo-ohms
3. Take resistance on 220-ohm resistors using multimeter and record in a spreadsheet
4. Prepare 220-ohm resistors in series for data collection
   1. Wire ends of resistors were bent at 90º and held down by fingers to ensure proper data collection
5. Take resistance on 220-ohm resistors in series using multimeter and record in a spreadsheet
6. Obtain 10 kilo-ohm resistors
7. Take resistance of 10 kilo-ohm resistors using multimeter and record in a spreadsheet

**ANALYSIS**

While analyzing the data it was obvious that every measurement we got wasn't exactly the same among each trial. This was because the resistors had a 5 % standard deviation, meaning the resistance could vary by 5 %, otherwise known as a “tolerence” which was color-coded on the resistor with a gold or silver band. Next, when we evaluated the standard deviation from the mean, this number thus gave us a unit amount describing the range from the mean or average. When our group put the two 220 ohm resistors in series we did have a little bit of trouble putting them together and getting a measurement. Therefore there may be some uncertainty there but as we went on the data supported that the range was slightly more because the standard deviation went up to 1.26 from 1.10. The reasoning behind this is because

**DISCUSSION**

In the 220 Ohm resistors, the mean resistance was 217.27 Ohms, with an uncertainty of 0.665 ohms. This number falls within the 5% accuracy labeled on the resistors (220±11 ohms).

2. In order to measure the mean resistance to a precision of plus or minus 0.1 ohms with a 95 % confidence interval, you need to solve 0.1 = for N and plug in each resistor standard deviation in the numerator. It is crucial to remember that when evaluating within a 95 % confidence interval the standard deviation will then lie 2 times the sigma.

220 ohm- 43.56 (44 resistors )

220 ohm in series - 57.76 ( 58 resistors)

10000 ohm- 324 resistors

Doubling the number of resistors in the circuit has an effect on the uncertainty of the mean. It increases the uncertainty by a factor of ~1.14. This is an intriguing answer, as you intuitively would expect the uncertainty to increase proportionally with the number of resistors. Upon inspecting the propagation of uncertainty rules, the uncertainty in two resistors in series compared to one should have increased by a factor of , or ~1.414. The observed uncertainty was slightly lower than the expected uncertainty.

The 10,000-ohm resistors are more precise than the 220-ohm resistors due to the fact that the standard deviation is 3.01 among 10,000 ohms as compared to 1.03 among 220 ohms. This, therefore, makes the 10,000-ohm resistor almost 50 times more accurate than the 220-ohm ones.

Of the 220 ohm resistors alone, 7 of the 12 resistors fell outside of the 95% confidence limit. Of the 220 ohm resistors in series, 7 of the 12 fell outside of the 95% confidence limit. Of the 10 kilo-ohm resistors, 1 of the 12 resistors fell outside of the 95% confidence limit. Although a substantial number of resistors fall outside of the 95% confidence limit, none of them are significantly different from their labeled value.

Both of the resistors produced data that supported that their tolerances did fall within the labeled tolerance. The way to calculate this would be to set up a simple proportion to show those percentages.

At any resistance, touching a resistor will result in the measurement being that of the parallel combination of the resistor and your body. At low resistance, this is a negligible effect and does not result in a large impact on the resistance reading. However, at high resistances (such as 10 kilo-ohms) the resistance reading would be significantly less than the true value.