

## MATH 111: Techniques of Calculus II

**Section 1: 110 Osmond Lab, TR 10:10 AM - 11:00 AM**

**Section 2: 106 Osmond Lab, TR 1:25 PM - 2:15 PM**

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Suppose you are a researcher who studies aquatic life around hydrothermal vents near the base of volcanos. Many in your field use electrical devices to gather data around these vents; however, the devices often fail due to heat damage.

Colleagues from the electrical engineering department believe they have developed wires that can withstand the temperatures typical of these vents (between  $60^\circ F$  and  $440^\circ F$ ). They have approached you to do an independent report for the scientific community based on your expertise. Below is the raw data on their wires (the 128 observations are listed in four separate tables).

The data compares the time in use (in weeks) and the temperature (in celsius) with the breakdown strength (in kilo-volts). In your experience, research studies can last anywhere from 6 weeks to 6 months. The voltage demands on these wires can be anywhere from 12 to 500 volts.

Write a 2+ page report (single-spaced) for the research community. This should be in the style of a research paper and should include an abstract before the introduction. Include your analysis of the data, what you believe is a best fit function, and some justification for your findings. Come up with a way to present your findings so researchers can quickly determine if this wire will suit their research project, given the project's duration and voltage demands.

As always, please refer to the grading rubric.

**Hint:** The data is believed to be of the form  $\ln(\ln(y)) = a + b \ln(x_1) + cx_2$ , where  $y$  is the breakdown voltage,  $x_1$  is the time and  $x_2$  is the temperature. To assess how well this function fits the data, you can study how well  $\ln(\ln(y)) = a + b \ln(x_1)$  and  $\ln(\ln(y)) = a + bx_2$  fits the data. You can make adjustments as you see fit. Refer the lectures 8, 9, and 10 for methods.

Breakdown	time	temperature	Breakdown	time	temperature
15.00E0	1E0	180E0	13.50E0	4E0	180E0
17.00E0	1E0	180E0	17.50E0	4E0	180E0
15.50E0	1E0	180E0	17.50E0	4E0	180E0
16.50E0	1E0	180E0	13.50E0	4E0	180E0
15.50E0	1E0	225E0	12.50E0	4E0	225E0
15.00E0	1E0	225E0	12.50E0	4E0	225E0
16.00E0	1E0	225E0	15.00E0	4E0	225E0
14.50E0	1E0	225E0	13.00E0	4E0	225E0
15.00E0	1E0	250E0	12.00E0	4E0	250E0
14.50E0	1E0	250E0	13.00E0	4E0	250E0
12.50E0	1E0	250E0	12.00E0	4E0	250E0
11.00E0	1E0	250E0	13.50E0	4E0	250E0
14.00E0	1E0	275E0	10.00E0	4E0	275E0
13.00E0	1E0	275E0	11.50E0	4E0	275E0
14.00E0	1E0	275E0	11.00E0	4E0	275E0
11.50E0	1E0	275E0	9.50E0	4E0	275E0
14.00E0	2E0	180E0	15.00E0	8E0	180E0
16.00E0	2E0	180E0	15.00E0	8E0	180E0
13.00E0	2E0	180E0	15.50E0	8E0	180E0
13.50E0	2E0	180E0	16.00E0	8E0	180E0
13.00E0	2E0	225E0	13.00E0	8E0	225E0
13.50E0	2E0	225E0	10.50E0	8E0	225E0
12.50E0	2E0	225E0	13.50E0	8E0	225E0
12.50E0	2E0	225E0	14.00E0	8E0	225E0
12.50E0	2E0	250E0	12.50E0	8E0	250E0
12.00E0	2E0	250E0	12.00E0	8E0	250E0
11.50E0	2E0	250E0	11.50E0	8E0	250E0
12.00E0	2E0	250E0	11.50E0	8E0	250E0
13.00E0	2E0	275E0	6.50E0	8E0	275E0
11.50E0	2E0	275E0	5.50E0	8E0	275E0
13.00E0	2E0	275E0	6.00E0	8E0	275E0
12.50E0	2E0	275E0	6.00E0	8E0	275E0

Breakdown	time	temperature	Breakdown	time	temperature
18.50E0	16E0	180E0	13.00E0	48E0	180E0
17.00E0	16E0	180E0	13.50E0	48E0	180E0
15.30E0	16E0	180E0	16.50E0	48E0	180E0
16.00E0	16E0	180E0	13.60E0	48E0	180E0
13.00E0	16E0	225E0	11.50E0	48E0	225E0
14.00E0	16E0	225E0	10.50E0	48E0	225E0
12.50E0	16E0	225E0	13.50E0	48E0	225E0
11.00E0	16E0	225E0	12.00E0	48E0	225E0
12.00E0	16E0	250E0	7.00E0	48E0	250E0
12.00E0	16E0	250E0	6.90E0	48E0	250E0
11.50E0	16E0	250E0	8.80E0	48E0	250E0
12.00E0	16E0	250E0	7.90E0	48E0	250E0
6.00E0	16E0	275E0	1.20E0	48E0	275E0
6.00E0	16E0	275E0	1.50E0	48E0	275E0
5.00E0	16E0	275E0	1.00E0	48E0	275E0
5.50E0	16E0	275E0	1.50E0	48E0	275E0
12.50E0	32E0	180E0	13.00E0	64E0	180E0
13.00E0	32E0	180E0	12.50E0	64E0	180E0
16.00E0	32E0	180E0	16.50E0	64E0	180E0
12.00E0	32E0	180E0	16.00E0	64E0	180E0
11.00E0	32E0	225E0	11.00E0	64E0	225E0
9.50E0	32E0	225E0	11.50E0	64E0	225E0
11.00E0	32E0	225E0	10.50E0	64E0	225E0
11.00E0	32E0	225E0	10.00E0	64E0	225E0
11.00E0	32E0	250E0	7.27E0	64E0	250E0
10.00E0	32E0	250E0	7.50E0	64E0	250E0
10.50E0	32E0	250E0	6.70E0	64E0	250E0
10.50E0	32E0	250E0	7.60E0	64E0	250E0
2.70E0	32E0	275E0	1.50E0	64E0	275E0
2.70E0	32E0	275E0	1.00E0	64E0	275E0
2.50E0	32E0	275E0	1.20E0	64E0	275E0
2.40E0	32E0	275E0	1.20E0	64E0	275E0