



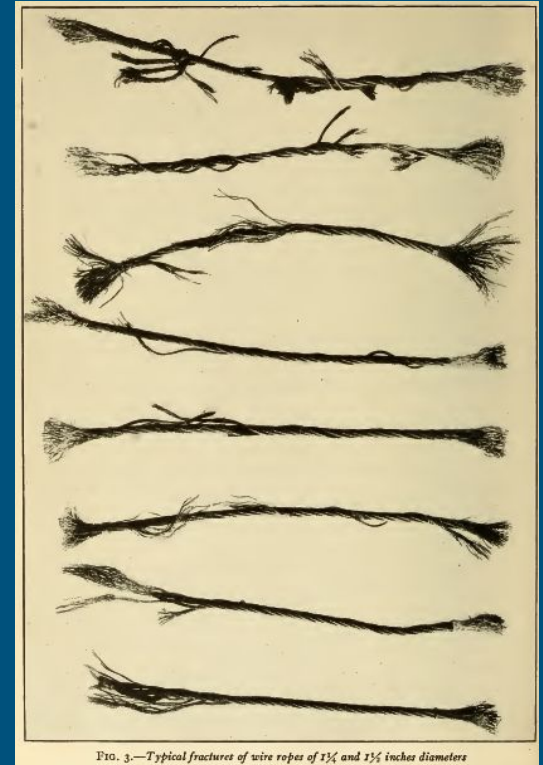
Analysis of Experimental Data

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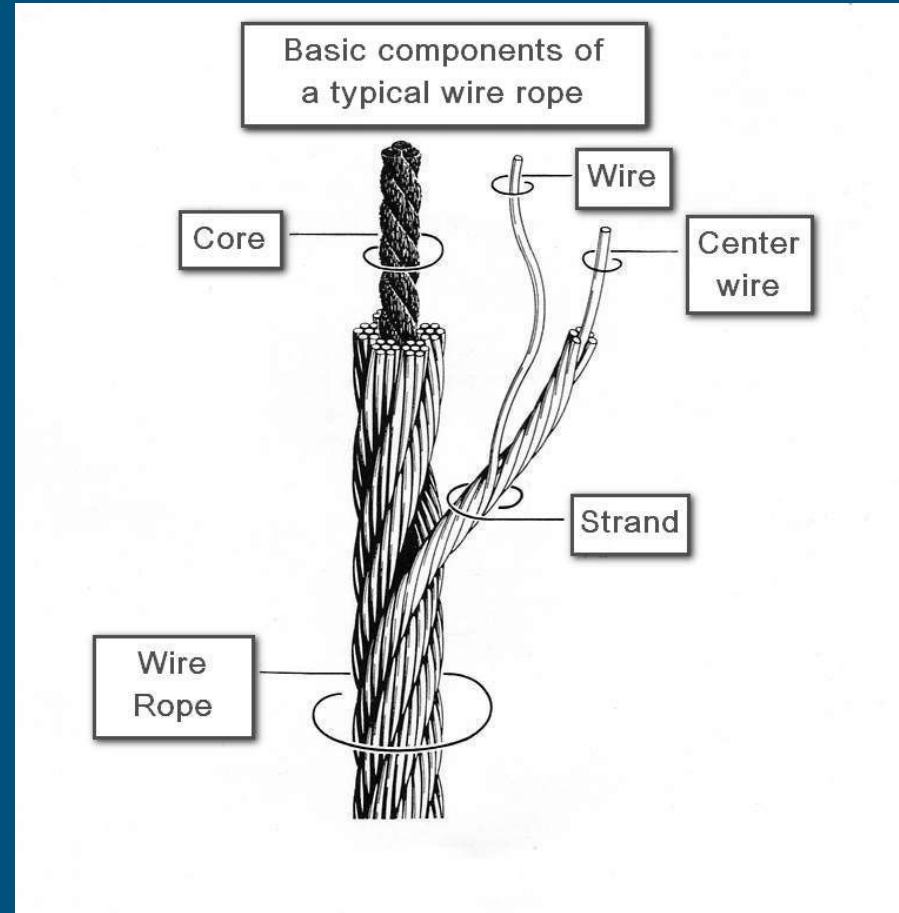
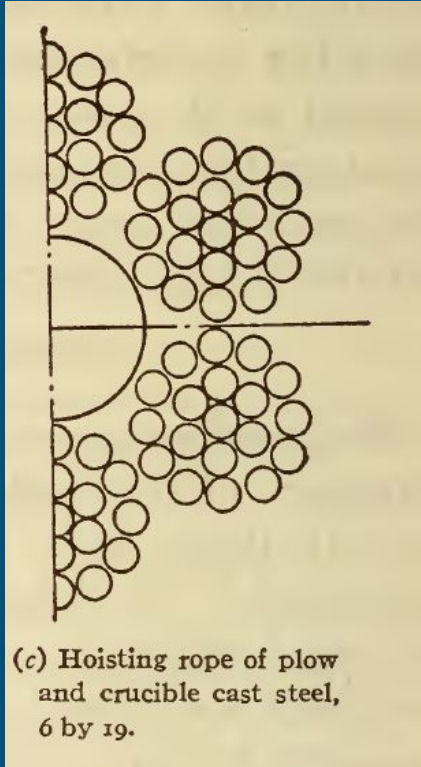


Tensile Strength of Plow-Steel Rope

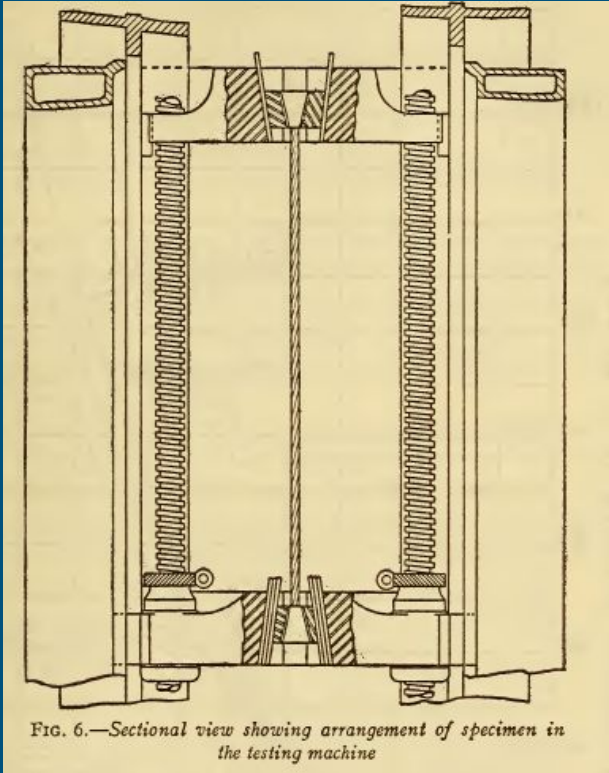
- The data analyzed for this project comes from a 1919 article entitled “Strength and Other Properties of Wire Rope”.
- Used results from multiple tests that observed the maximum amount of pounds that different diameters of 6 by 19 plow steel rope could withstand, then compared it to manufacturer's standard strength.



6 by 19 Wire Rope



Testing the Rope Strength



- Tested in a 100,000lb and 600,000lb Olsen Machine, which was designed in 1880 and the company, Tinius Olsen still specializes in manufacturing a variety of testers today!
- Power applied at slower speeds so there was opportunity for the strands and wires to properly bed upon one another while the load was being applied.

RESULTS

Using nine different diameter sizes, mean results were found for the tests of the loads that caused breaking.

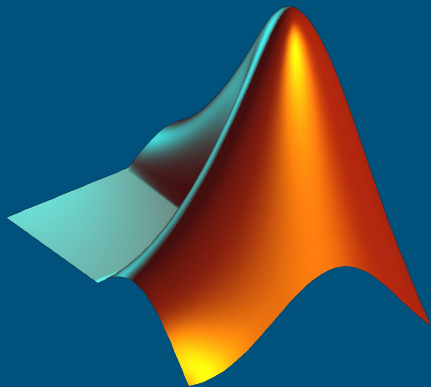
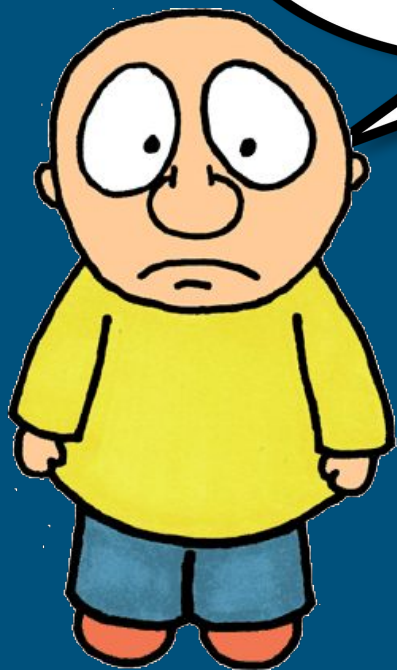
These results were compared to the formula $L=5000 \cdot D^2$ as well as the standard sized provided by manufacturer specifications.

TABLE 2.—Relation of Observed Breaking Loads of 6 by 19 Plow-Steel Cables to 1910 Standard Strengths and the Formula $L=C 75\ 000 D^2$

Diameter, in inches, <i>D</i>	Standard strengths= Isthmian Canal specifica- tions, in pounds	Formula $L=C 75\ 000 D^2$ <i>C</i> =1	Observed breaking loads from tests		
			First and second mini- mums	Maxi- mums	Mean
$\frac{3}{4}$	5300	4680	5250 5610	5970	5610
$\frac{7}{8}$	11 500	10 550	10 600 12 150	13 000	12 140
$\frac{1}{2}$	20 000	18 750	17 900 17 930	20 600	18 680
$\frac{5}{8}$	31 000	29 300	29 550 29 940	35 990	32 760
$\frac{3}{4}$	46 000	42 200	43 500 44 210	52 620	47 920
$\frac{7}{8}$	58 000	57 400	56 570 58 650	72 300	65 800
1	76 000	75 000	75 710 76 270	76 270	76 000
$1\frac{1}{4}$	94 000	94 900	108 000	164 800	128 800
$1\frac{1}{4}$	116 000	117 000	119 000		
$1\frac{3}{4}$	144 000	142 000	148 000	233 280	193 940
$1\frac{1}{2}$	164 000	168 750	163 500		

Oh gee, I've got all this data and I don't know what to do with it...

No worries, Friend! I have just the tool you need!



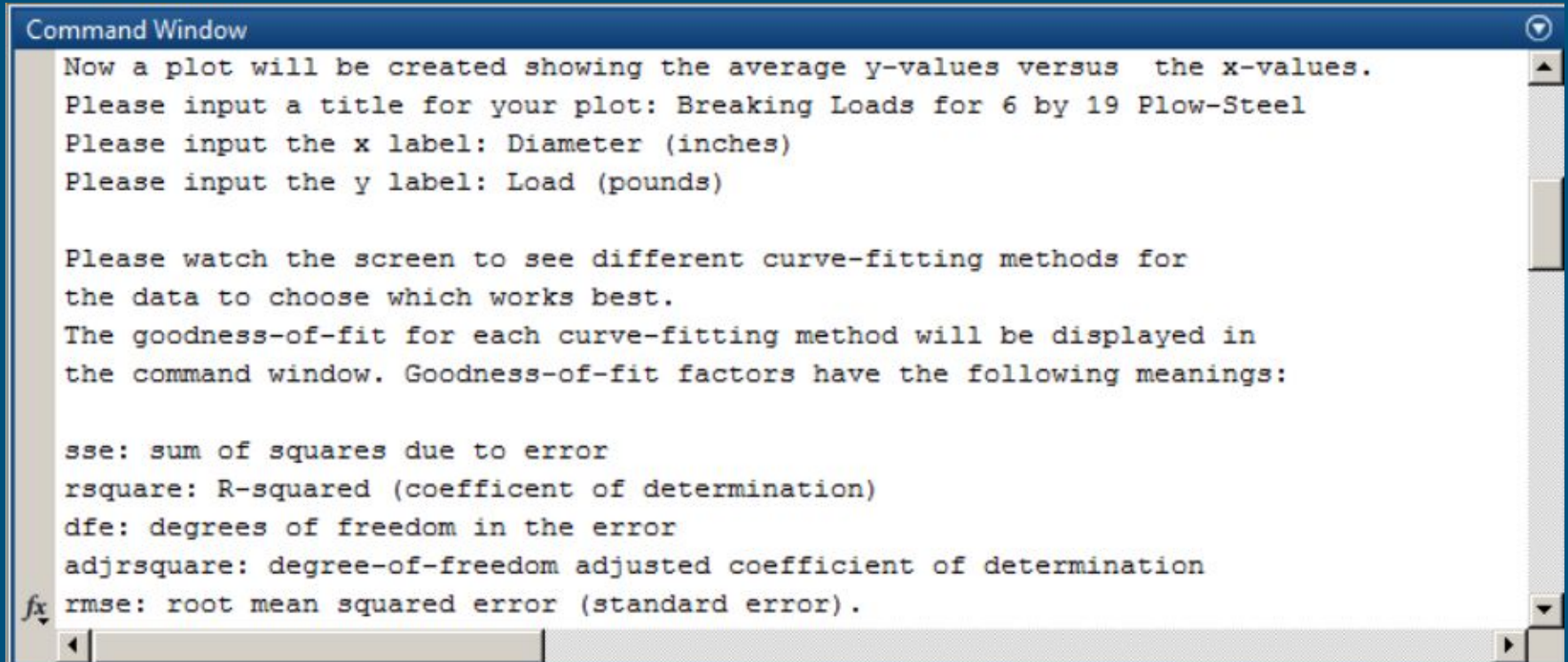
Using Matlab to Analyze Experimental Data

- User can input the diameters as vector, then the breaking point results as a matrix.
- Code is designed so it can analyze ANY type of 2D data, not all options are necessary with this particular problem.

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Command Window
Please input a vector for your x-values: [(1/4) (3/8) (1/2) (5/8) (3/4) (7/8) 1 (5/4) (3/2)]
You can now enter a matrix with y-values for multiple trials. The trials will be averaged.
Example format: [trial 1 ; trial 2 ; trial 3]
Please input a matrix for your y-values: [5250 10600 17900 29550 43500 56570 75710 108000 148000; 5610 12150 17930 29940 44210 58650 76270 119000 163500; 59
Would you like to know the sum of your x values? (Enter y or n): y
Would you like to know the sum of your y values? : n
Would you like to know the mean of your x values? : n
Would you like to know the mean of your y values? : y
Would you like to know the mode of your y values? : n

The sum of the x values is 7.125000.
The mean of the average y values is 64627.777778.
The x values range from 0.250000 to 1.500000.
The minimum y value input is 5250.000000 and the maximum y value is 233280.000000.
Now a plot will be created showing the average y-values versus the x-values.
Please input a title for your plot:
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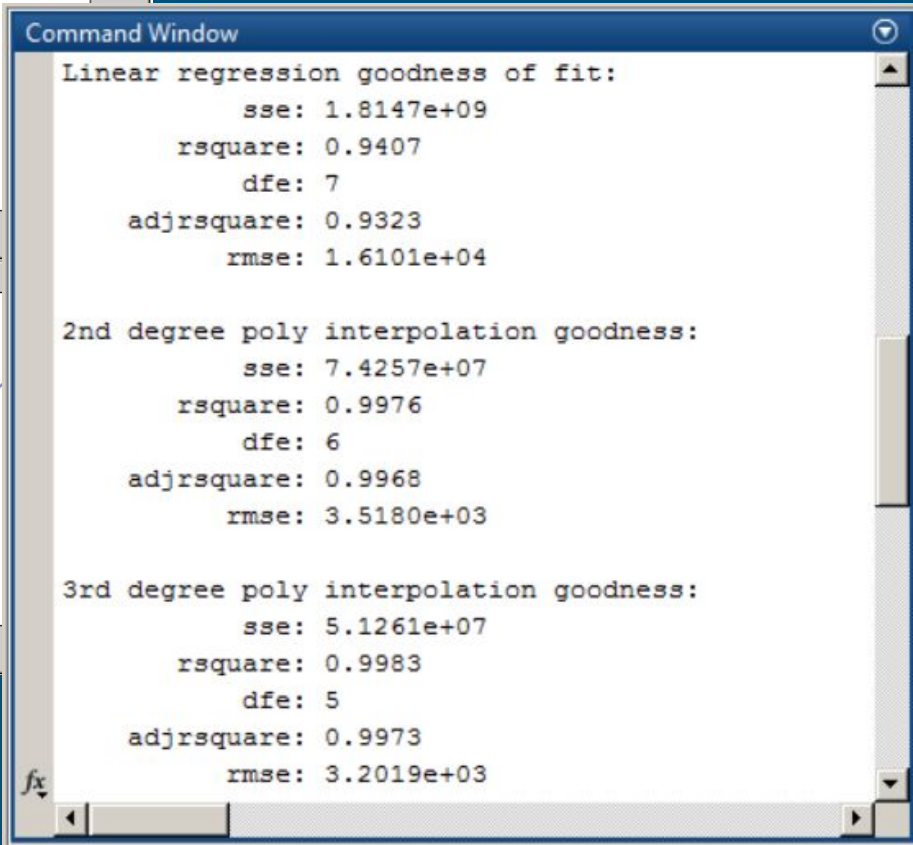
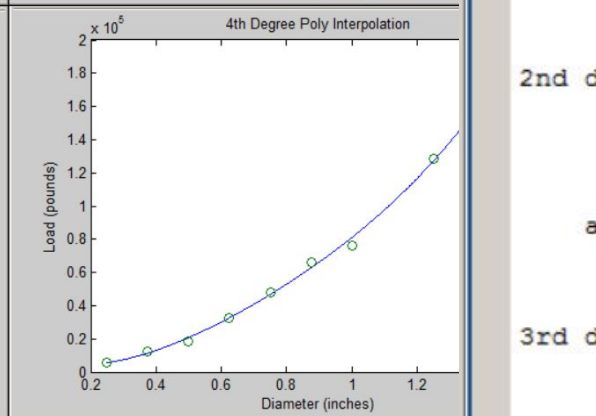
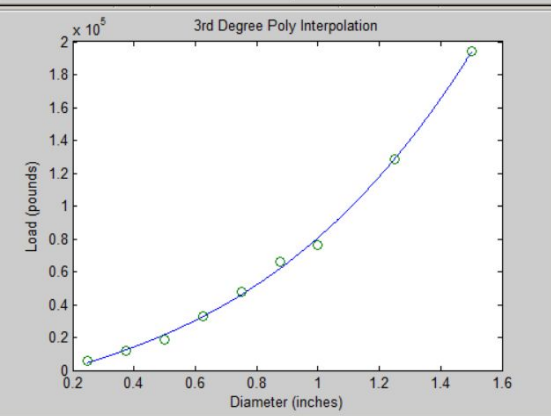
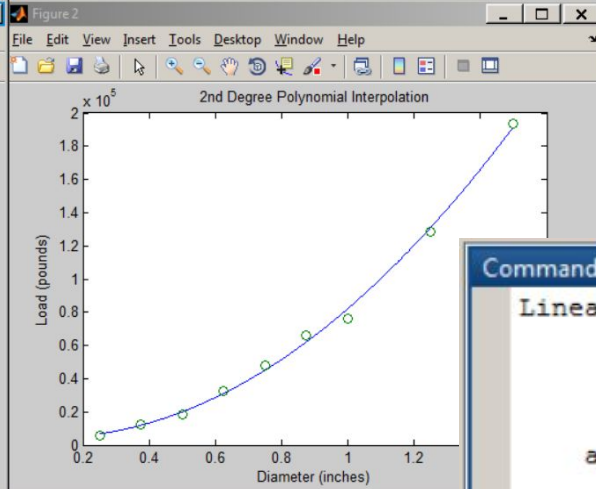
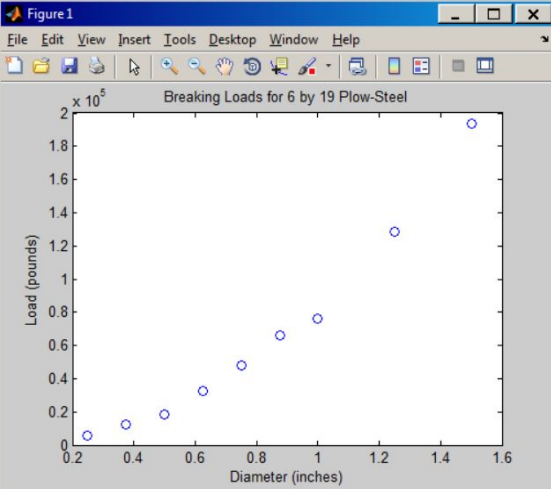
Command window asks user to give their plots a title, as well as labels for the x and y axes. It will use this information to create different curves for the data, as well as information on the goodness-of-fit.

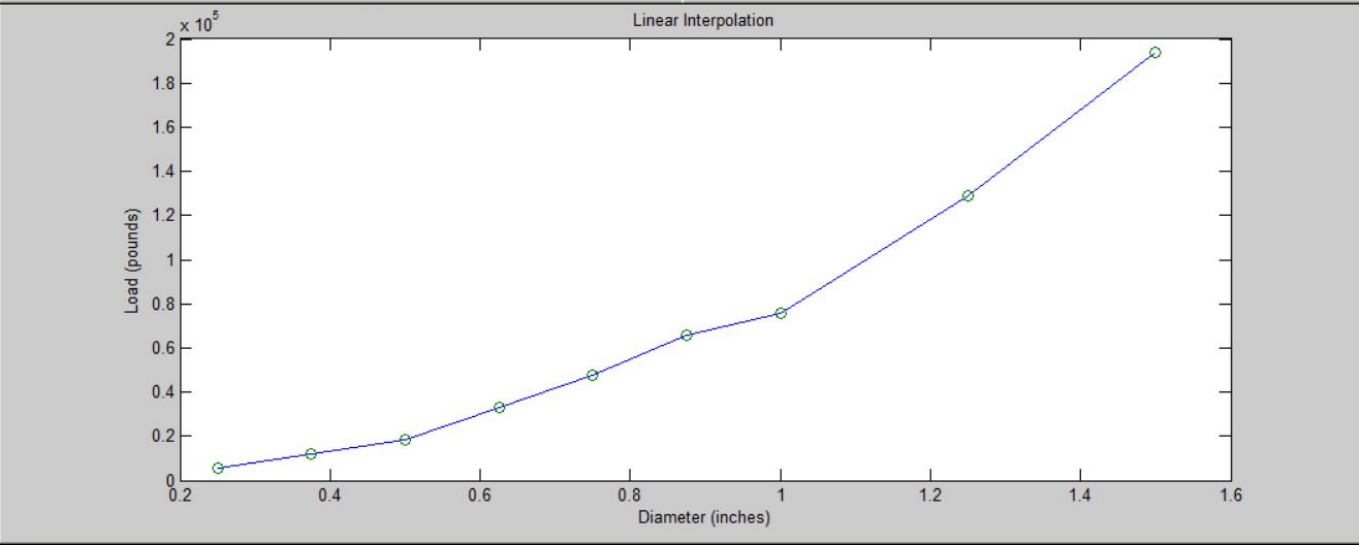
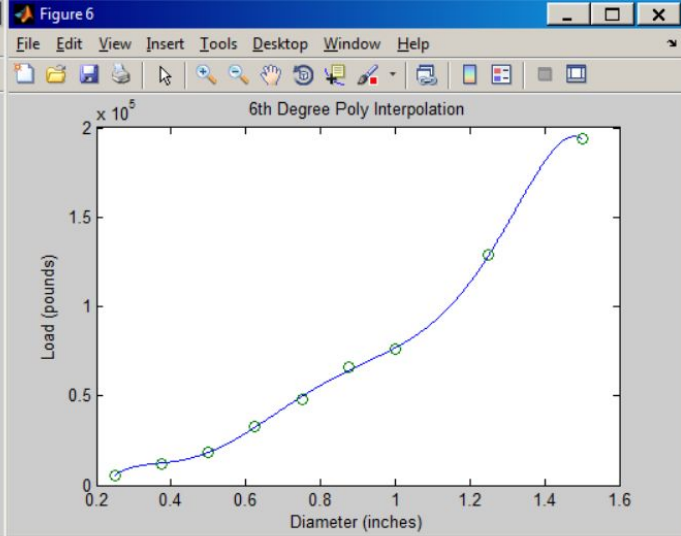
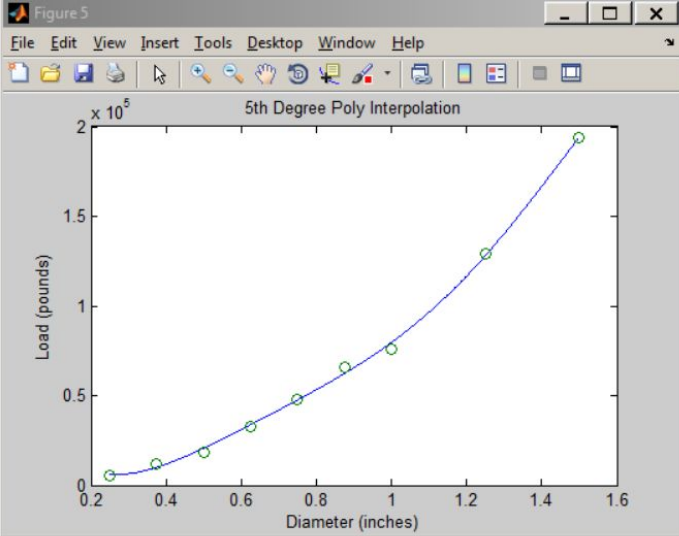


```
Command Window
Now a plot will be created showing the average y-values versus the x-values.
Please input a title for your plot: Breaking Loads for 6 by 19 Plow-Steel
Please input the x label: Diameter (inches)
Please input the y label: Load (pounds)

Please watch the screen to see different curve-fitting methods for
the data to choose which works best.
The goodness-of-fit for each curve-fitting method will be displayed in
the command window. Goodness-of-fit factors have the following meanings:

sse: sum of squares due to error
rsquare: R-squared (coefficient of determination)
dfe: degrees of freedom in the error
adjrsquare: degree-of-freedom adjusted coefficient of determination
rmse: root mean squared error (standard error).
```



```
Command Window
Type in the degree to which you would like to find an equation for your data. (6 is the maximum): 4
f(x)= 1754.560556 x^4 + 1110.182501 x^3 + 10841.272220 x^2 + 51368.244886 x + 51715.562603.

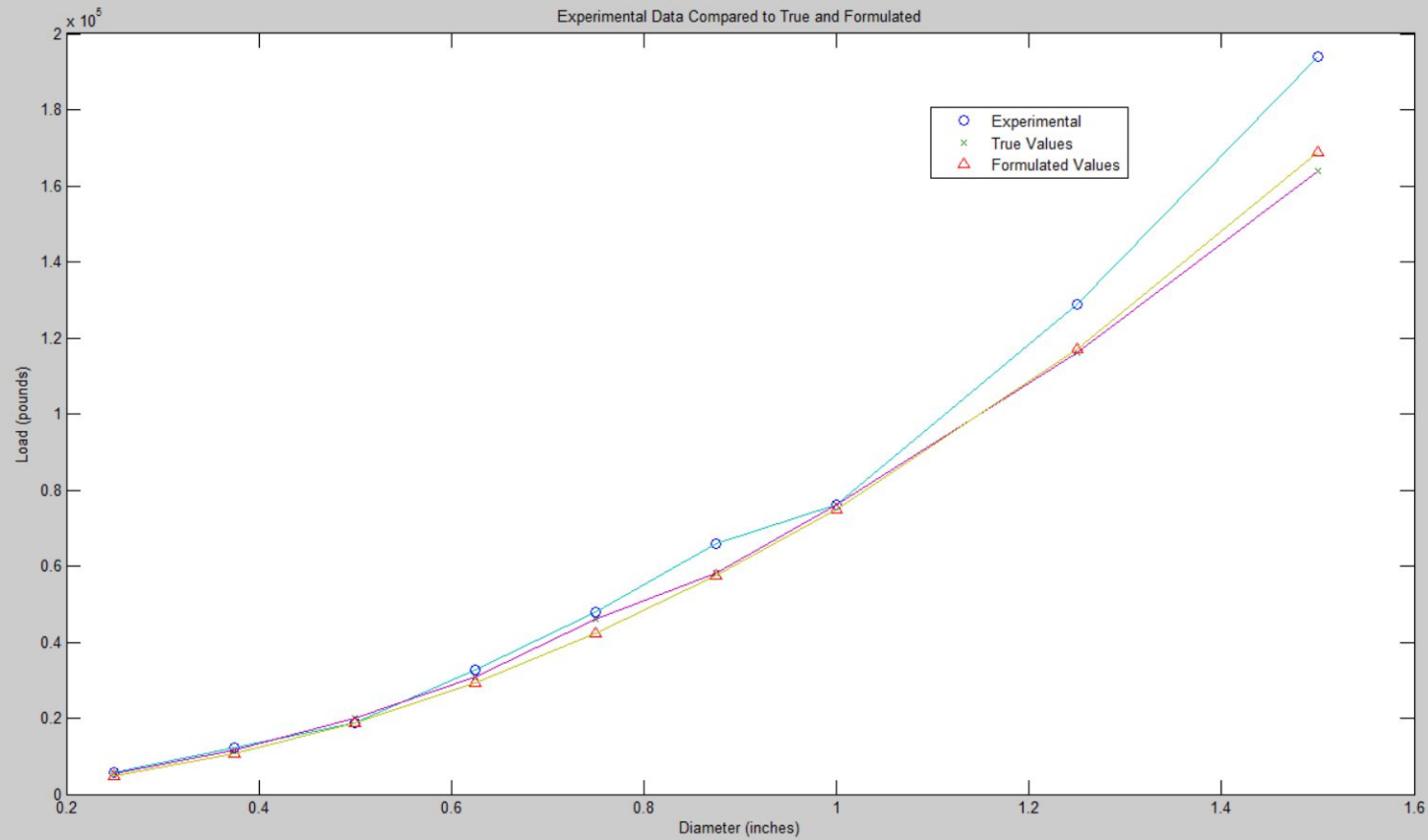
Functions have been created in the workspace for linear regression and polynomial interpolation
for your data. To use these functions, simply type which degree you want to use.

y_1 is degree 1 / a linear line of best fit, y_2 is degree 2, and so on, and then put the value you
would like to use the function on in parentheses. Example: y_3(4.6)

For using Linear Interpolation, an anonymous function has been created in the workspace
called lin. An example of how to use this function is lin(1.5) , where the value
must be no less than the smallest x value and no greater than the largest x value.

fx Are there any true or calculated values you would like to compare experimental data with? :
```

For the chosen degree of 4, a polynomial equation is given based off polynomial interpolation of the data. For example, to estimate the breaking load of a 1.3 inch wire rope using 4th degree polynomial interpolation, typing $y_4(1.3)$ returns a value of 138380 lbs. Compare this to the formulated value of 126750 lbs.



WOW

This isn't 1919 anymore...

- Griffith, J.H., and J.G. Bragg. "Strength And Other Properties Of Wire Rope." Journal Of The Franklin Institute 188.(1919): 123-126. ScienceDirect. Web.

