Analysis of Experimental Data

Elizabeth Moran-Williams
Zachary Carroll

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.

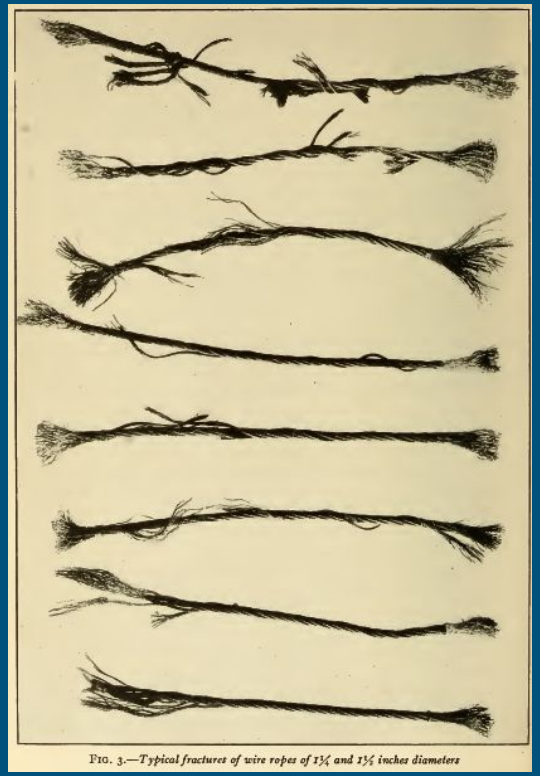
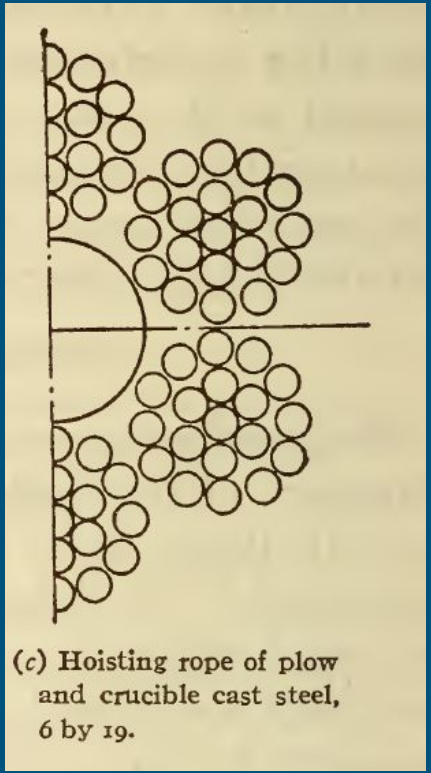
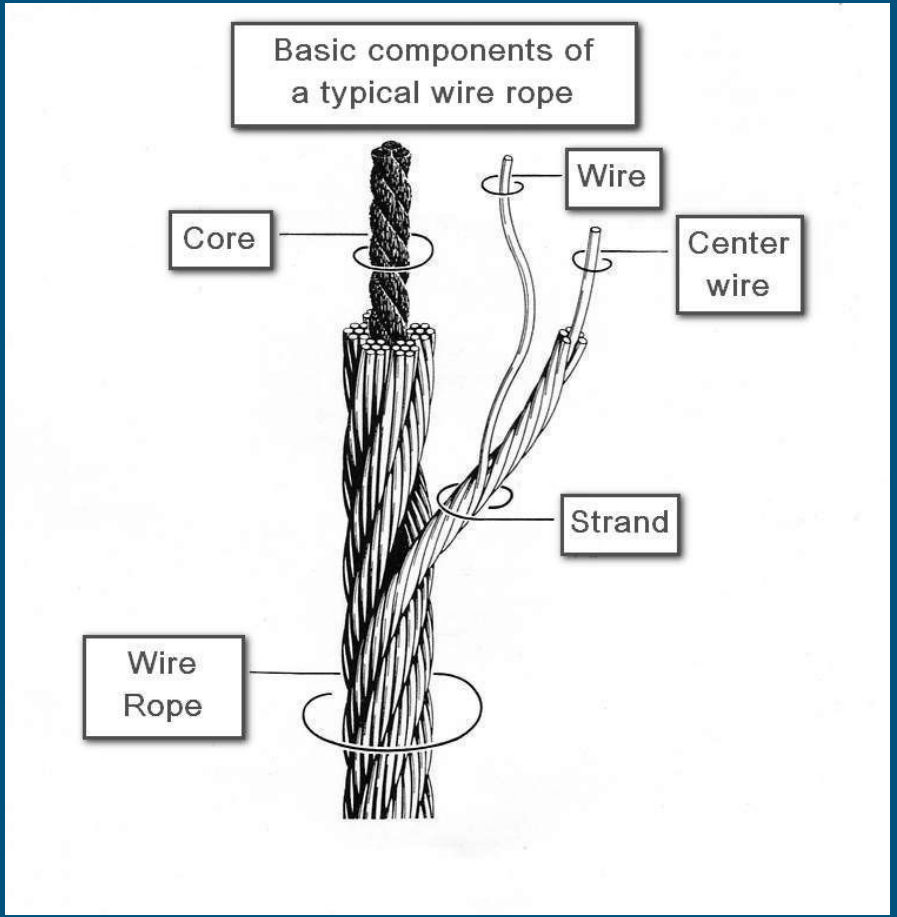


FIG. 3.—*Typical fractures of wire ropes of 1¼ and 1½ inches diameters*

6 by 19 Wire Rope



(*c*) Hoisting rope of plow and crucible cast steel, 6 by 19.



Testing the Rope Strength

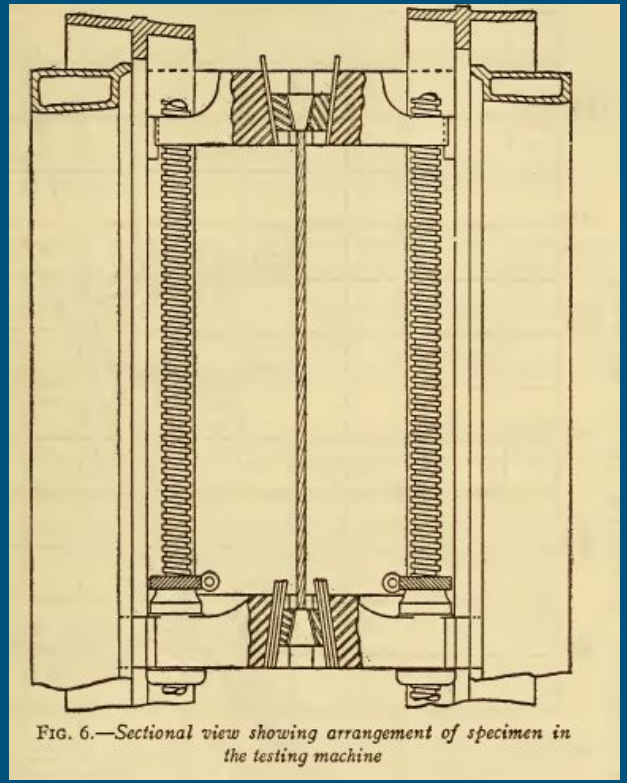


FIG. 6.—*Sectional view showing arrangement of specimen in the testing machine*

- 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*D^2 as well as the standard sized provided by manufacturer specifications.

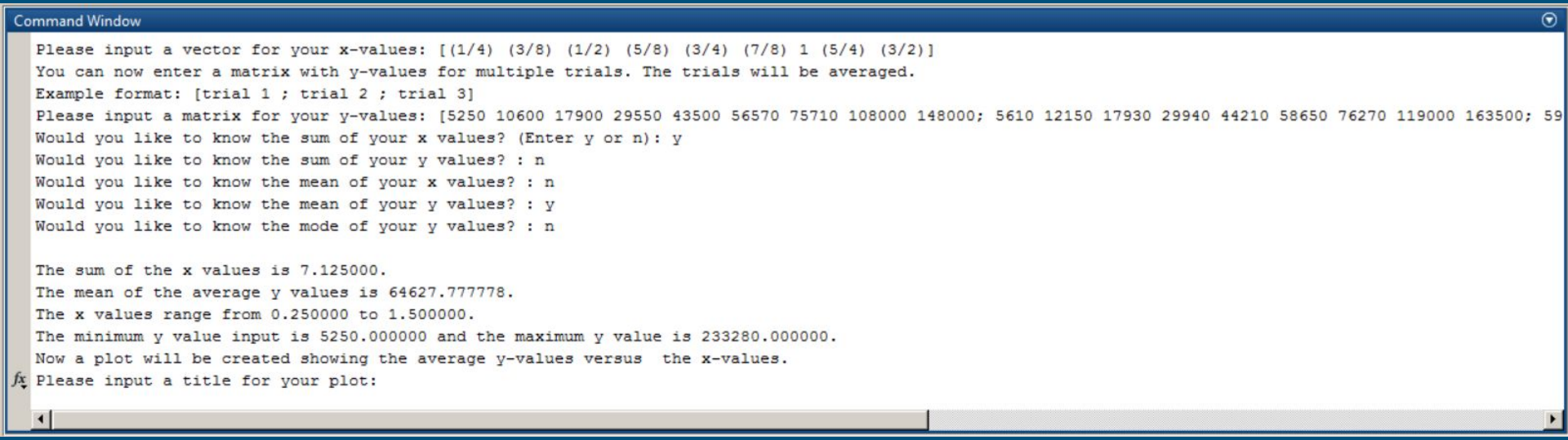
TABLE 2.—Relation of Observed Breaking Loads of 6 by 19 Plow-Steel Cables to 1910 Standard Strengths and the Formula $L=C\ 75\ 000\ D^2$

Diameter, in inches, D	Standard strengths—Isthmian Canal specifications, in pounds	Formula $L=C\ 75\ 000\ D^2$ $C=1$	Observed breaking loads from tests		
			First and second minimums	Maximums	Mean
¼	5300	4680	5250 5610	5970	5610
⅜	11 500	10 550	10 600 12 150	13 000	12 140
½	20 000	18 750	17 900 17 930	20 600	18 680
⅝	31 000	29 300	29 550 29 940	35 990	32 760
¾	46 000	42 200	43 500 44 210	52 620	47 920
⅞	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
1⅛	94 000	94 900	.....	.....	.....
1¼	116 000	117 000	108 000 119 000	164 800	128 800
1⅜	144 000	142 000	.....	.....	.....
1½	164 000	168 750	148 000 163 500	233 280	193 940

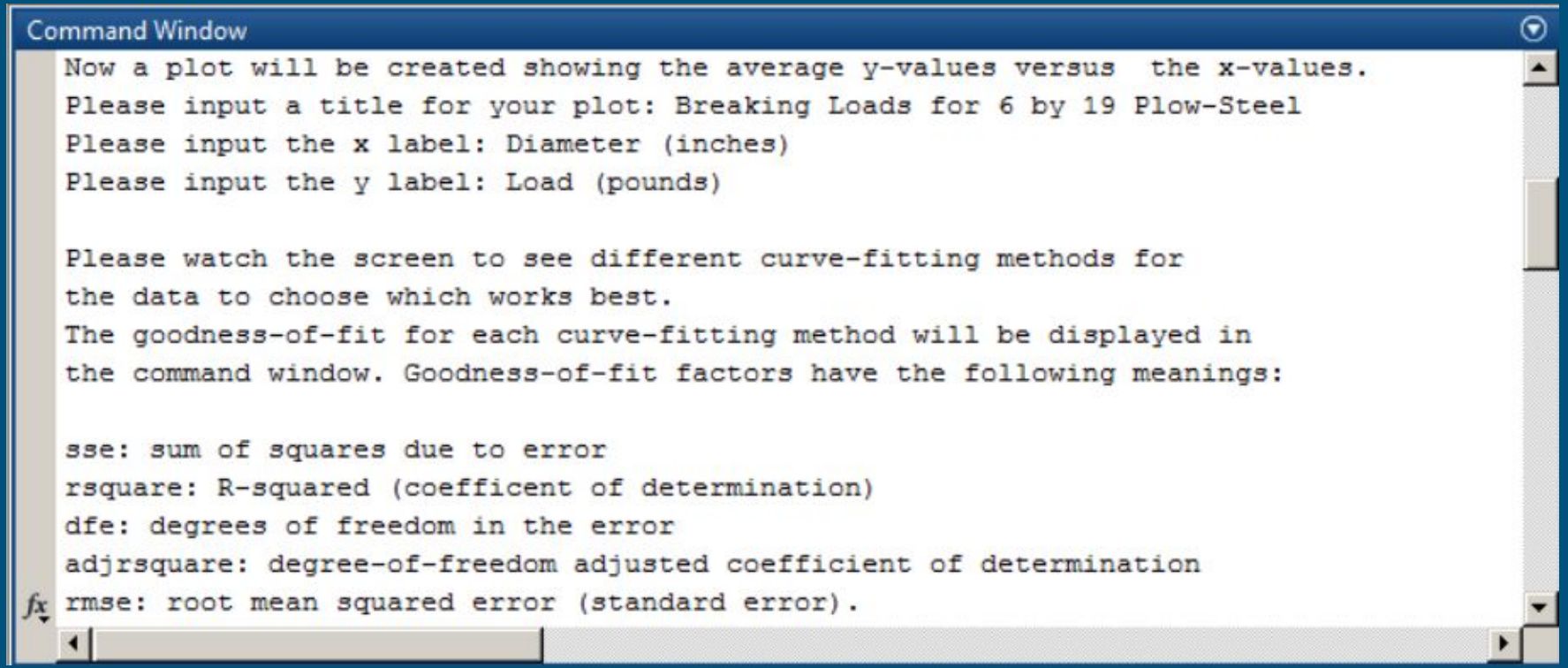

Oh gee, I've got all this data and I don't know what to do with it...
No worries, Friend! I have just the tool you need!

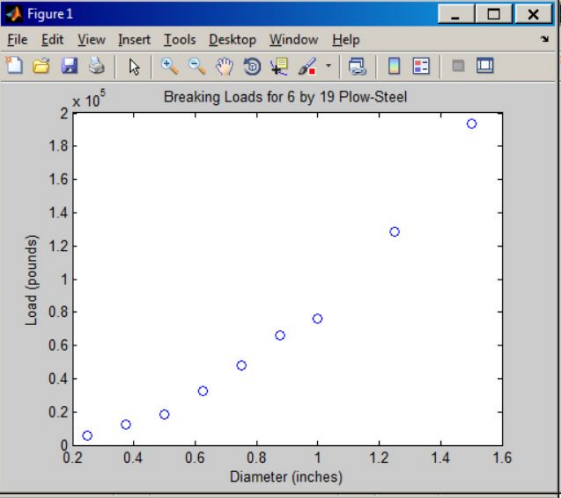
Using Matlab to Analyze Experimental Data

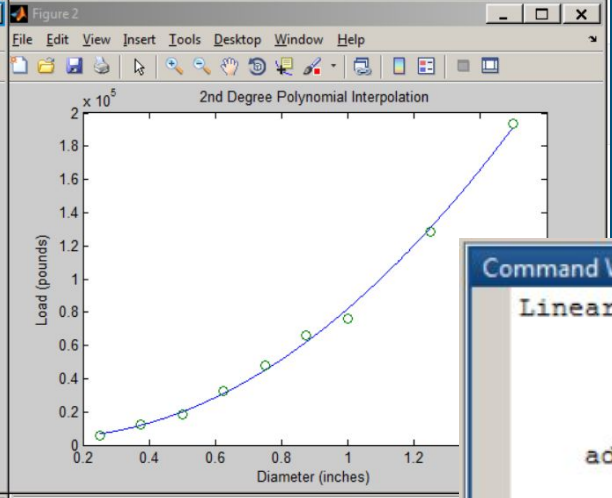
-User can input the diameters as vector, then the breaking point results as a matrix.
-Code is designed so it can analyze ANY type of 2D data, not all options are necessary with this particular problem.

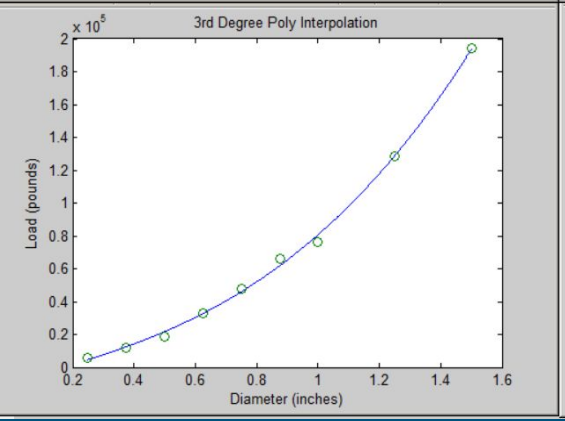


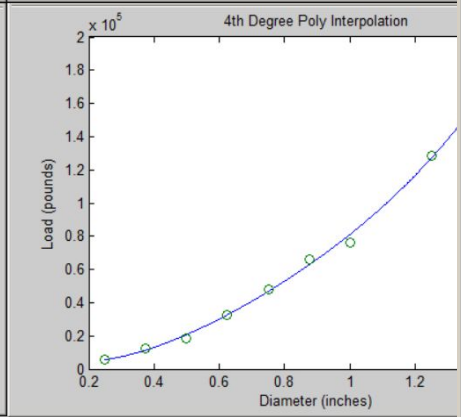
Command window asks user to give their plots a title, as well as labels for the x and y axises. It will use this information to create different curves for the data, as well as information on the goodness-of-fit.











Command Window

```
Linear regression goodness of fit:
           sse: 1.8147e+09
       rsquare: 0.9407
           dfe: 7
    adjrsquare: 0.9323
          rmse: 1.6101e+04

2nd degree poly interpolation goodness:
           sse: 7.4257e+07
       rsquare: 0.9976
           dfe: 6
    adjrsquare: 0.9968
          rmse: 3.5180e+03

3rd degree poly interpolation goodness:
           sse: 5.1261e+07
       rsquare: 0.9983
           dfe: 5
    adjrsquare: 0.9973
          rmse: 3.2019e+03
```

Figure 5

File Edit View Insert Tools Desktop Window Help

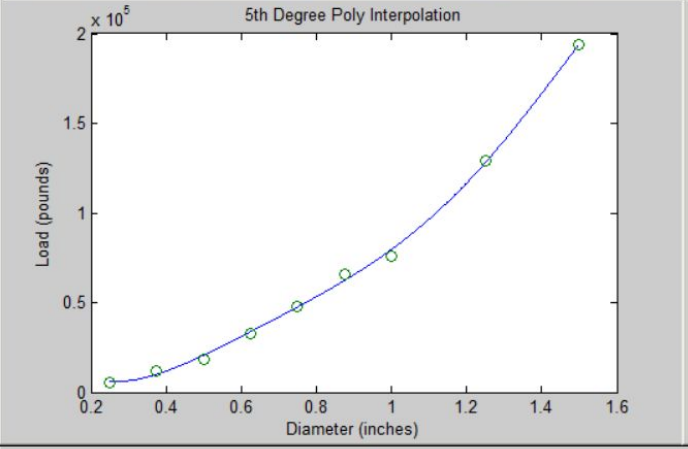
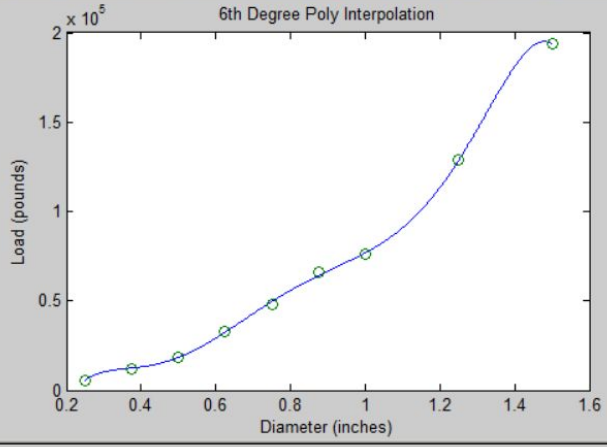
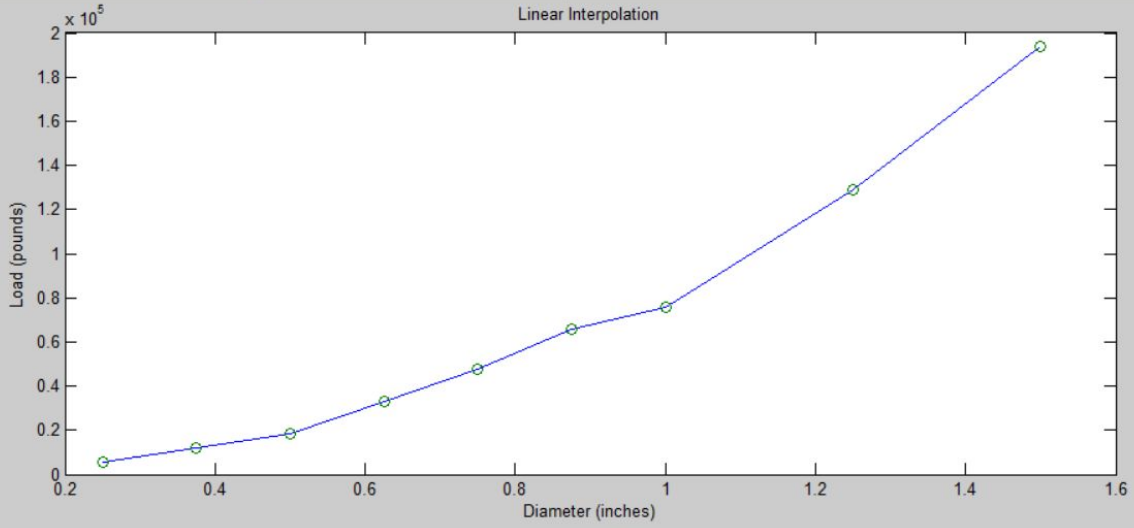
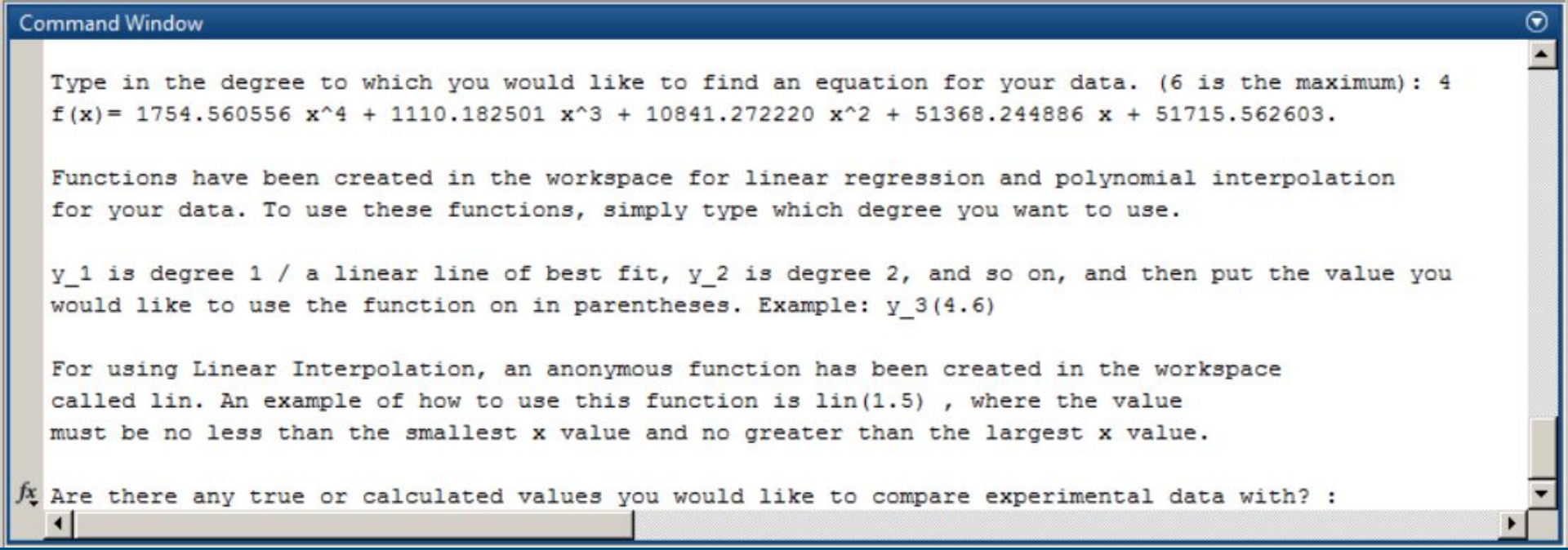


Figure 6

File Edit View Insert Tools Desktop Window Help



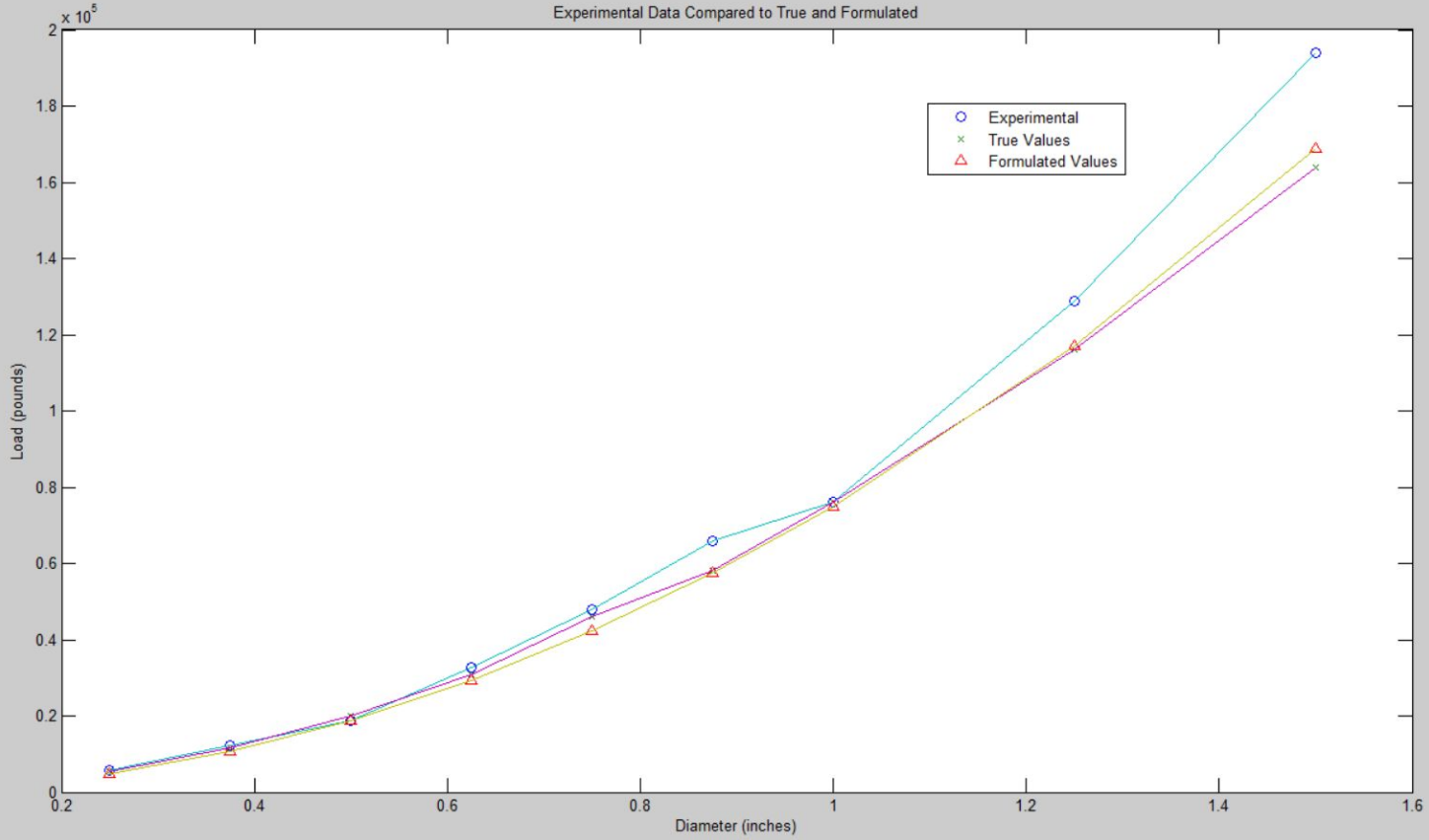




For the chosen degree of 4, a polynomial equation is given based off polynomial interpolation of the data. For example, to estimate the breaking load of a 1.3 inch wire rope using 4th degree polynomial interpolation, typing y_4(1.3) returns a value of 138380 lbs. Compare this to the formulated value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

Figure 10

File Edit View Insert Tools Desktop Window Help



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.