

Modeling the Starting Values for the Textile Industry: The Application of Nonlinear Regression Analysis

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Abstract

In this study we will determine the starting values using nonlinear regression. However, we got a result of prediction is submitted to professional workers in the company to give an exact response for each run based on the real process to Plot the data to estimate and validate the response as Y vs X to find intercepts at X equal to zero then replot the data. However, we are using Minitab to compute values pf the model by using the trial estimates and plot the predicted values versus the original data we have. We will go through that the Libyan textile company has five industrial units, Woven carpet, Tufted carpet, Needlefelt carpet, Trico, and Matters. The capacity of annual productivity for Woven carpet is 284000 m², Tufted carpet is 620000 m², Needlefelt carpet is 2000000 m², and Matters is 70000 matters annually. The company should implant the Layout and Cycle time analysis and we have it in three points, first is the Minimize transit time, Simplify workflow, and Functionality.

Keywords

Nonlinear Regression, Starting Values, Textile industry.

Intduction

In previous research back in 2018 by Hamaza used the extracted equation to find multiple linear regression to solve one concern in Libyan textile using the extracted equation. Now we are going to determine the starting values using nonlinear regression. The result of prediction is submitted to professional workers in the company to give an exact response for each run based on the real process. We are going to plot the data as showing in Table 1. estimate and validate the response, as (y) vs (x) to asymptotes at (x = zero), or (x = Infinity). We are going to find out intercepts at x= zero and then replot the data as:-

$\frac{1}{y}$	vs	x	----- (1)
$\ln(y)$	vs	x	----- (2)
$\frac{1}{y}$	vs	$\ln(x)$	----- (3)
$\ln(y)$	vs	$\ln(x)$	----- (4)

Then again we going to look for the plots for indications of asymptotic values or intercepts then once we've got some idea that some of these exist, we're going to reduce the form of the equation at (x=0) and (x=infinity) to see the

parameter shakes out as an asymptote or as an intercept, straight lines can be interpreted as slopes we can calculate the slope from the chart and reinterpret those in some of the models often a long (y) vs log(x) if the model is as willing can show parameter shaking out as a slope and we can get an estimate of the value from hand computing a slope. We will use Minitab to compute the values of the model using the trial estimates and plot the predicted values vs the original data. The Model equation at infinity presenting as:-

$$y = \frac{k_1}{(1 + \exp(k_2 - k_3x))^{\frac{1}{k_4}}} \quad \text{----- (5)}$$

When x goes to infinity, then exp (k2-k3x) goes to zero, , K1 the asymptote = 700

$$y = \frac{k_1}{(1+0)^{\frac{1}{k_4}}} = k_1 \quad \text{----- (6)}$$

By assuming for simplicity that k4=1, it probably isn't too far different and makes the math simpler, it's probably not too far different because that would make that denominator term much more powerful if (K4) were bigger or smaller than one, the equation reduces to:-

$$y = \frac{k_1}{(1 + \exp(k_2 - k_3x))} \quad \text{----- (7)}$$

From simplicity assume k4=1

$$x=0, y(0) = \frac{k_1}{(1 + \exp(k_2 - k_3x))} = \frac{k_1}{(1 + \exp(k_2))} \quad \text{----- (8)}$$

if we assume exp (k2) is large compared to 1

$$y(0) = \frac{k_1}{(1 + \exp(k_2))} \sim \frac{k_1}{\exp(k_2)} \quad \text{----- (9)}$$

$$y(0) = k_1 \exp(-k_2) \quad \text{----- (10)}$$

$$\ln(y(0)) = \ln(k_1) + \ln(\exp(-k_2)) = \ln(k_1) - k_2 \text{ thus} \quad \text{----- (11)}$$

$$k_2 - \ln(k_1) - \ln(y(0)) \quad \text{----- (12)}$$

Intercept of ln(y) at x= 0 is 2,
ln (k1) = (700)= 6.55
K2 = 6.55 -2, therefore K2= 4.55

K1= 700, K2 = 4.55, K4= 1 , by assuming for simplicity that k3 = 0.75 by start using Minitab to run nonlinear regression with these home grown estimates, resultant parameter values are as precise as NIST (starting values) listed values K1= 100, K2 = 10, K4= 1, and k3 = 1

Table 1. Estimate and validate the response

Estimated by equation (y)	workers Residual
10.651	0.0005
15.265	0.002307
17.798	-0.00051
25.331	0.000422
36.946	-0.00032
57.050	0.000494
77.357	0.000355
84.357	0.000536
144.357	0.002012
174.665	0.003349
245.769	0.000422
435.383	0.000344
452.916	0.000162
579.4	0.000422
700.064	0.000831

Under command line editor in Minitab we will submit:-

- let c3=1/c1
- name c3 '1/y'
- let c4=ln(c1)
- name c4 'ln/(y)'
- let c5= ln(c2)
- name c5 'ln(x)'

Plot 'y'*x' '1/y'*x' 'ln/(y)*x' 'y'*ln(x)' '1/y'*ln(x)' 'ln/(y)*ln(x)';

Table

Y	X	1/y	ln/(y)	ln(x)	Y Predict
10.651	1	0.0655068	2.72560	0.69315	11.987
15.265	2	0.0561836	2.87913	1.09861	19.546
17.798	3	0.0394759	3.23206	1.38629	31.652
25.331	4	0.0270662	3.60947	1.60944	50.699
36.946	5	0.0175283	4.04394	1.79176	79.837
57.050	6	0.0129269	4.34844	1.94591	122.560
77.357	7	0.0118543	4.43507	2.07944	181.458
84.357	8	0.0069272	4.97229	2.19722	256.105
144.357	9	0.0057252	5.16287	2.30259	341.252
174.665	10	0.0040689	5.50439	2.39790	427.447
245.769	11	0.0022968	6.07623	2.48491	504.781
435.383	12	0.0022079	6.11571	2.56495	566.999
452.916	13	0.0017258	6.36208	2.63906	612.813
579.4	14	0.0014284	6.55117	2.70805	644.393
700.064	15	0.0655068	2.72560	0.69315	665.184

2.

Validate the response

Now we want to plot these values t to the graph scatterplot with the connecting line. We can get these charts as showing in Figure 1. asymptote at x equals infinity of 700. By going back to the main Minitab interface with the idea of how to simulate the values of K3. We flip back to NIST and copy the equation # (5) of the model that we're going to use.

$$y = \frac{k1}{(1 + \exp(k2 - k3x))^{\frac{1}{k4}}} \text{ ----- (5)}$$

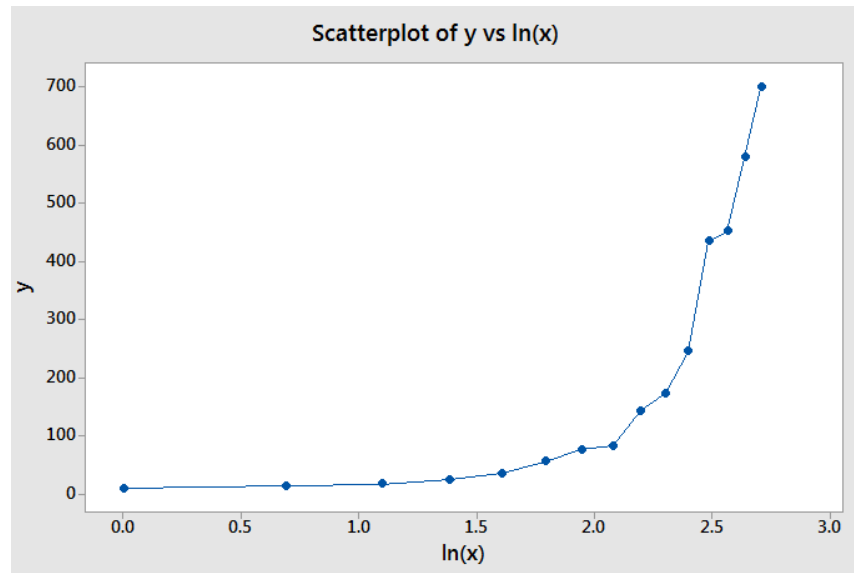


Figure 1. Scatterplot of y Vs Ln

Under command line dialog we going to add the equation # (5) and submit these commands:-

```
let k1=700
let k2=4.55
let k4=1
let k3=0.50
let c6= k1 / ((1+exp(k2-k3*x))**(1/k4))
```

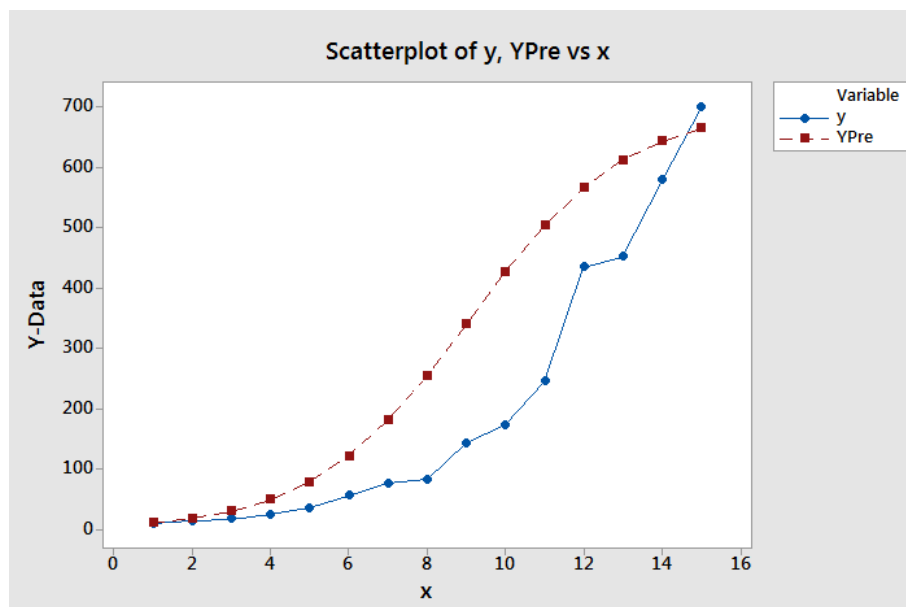


Figure 2. Scatterplot of y, yPre Vs X

As showing in Figure 2. we plot to the graph by going to scatterplot and use with connect (Y) variables and (Y predict) versus (X) in (X) variables. The best value we had is 0.75 to estimate the parameters. For nonlinear regression, the initial objective we do is to flip back and use equation # (5) and inserted to Minitab under stat regression on linear

regression and the response is going to be (Y) and insert the model value. Next object we have to insert the values of the parameters and click okay. Starting Values for Parameters showing on Table 2,3,4 and 5

$$y = \frac{k1}{(1 + \exp(k2 - k3x))^{\frac{1}{k4}}} \text{----- (5)}$$

Table 3

Parameter	Value
K1	700
K2	4.55
K3	1
K4	0.75

Our new Equation and new parameter estimates with the same values precisely have certified as showing in Figure 3.

$$y = \frac{668.433}{(1 + \exp(2.26561 - 0.545366 * x))^{\frac{1}{0.0194529}}} \text{----- (13)}$$

Table 4

Parameter	Estimate	SE Estimate
K1	668.433	354.039
K2	2.266	125.492
K3	0.545	1.006
K4	0.019	2.214

Table 5

Iterations	200
Final SSE	72929.3
DFE	11
MSE	6629.94
S	81.4244

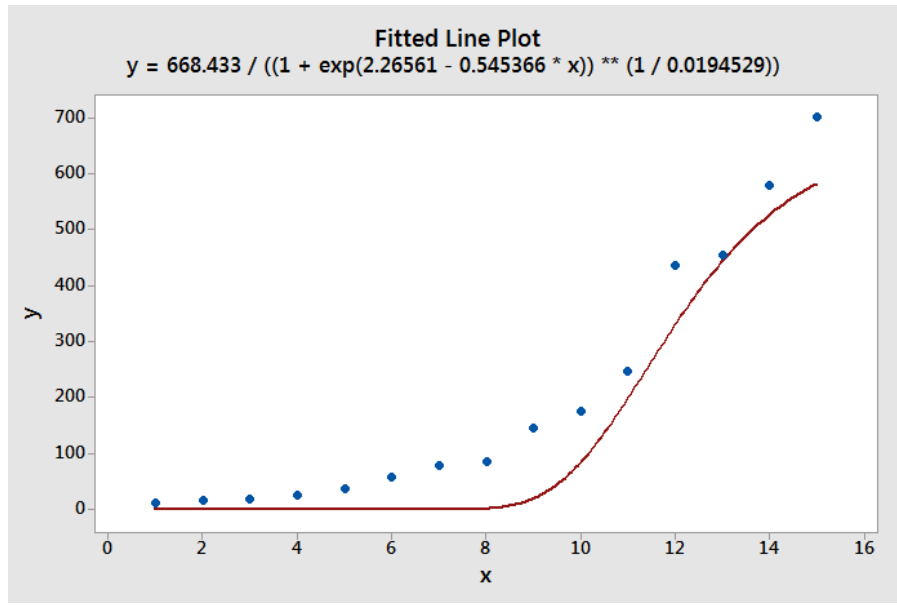


Figure 3. Fitted line plot

Conclusion

This study determined the starting values using nonlinear regression. However, we got a result of prediction is submitted to professional workers in the company to give an exact response for each run based on the real process to Plot the data to estimate and validate the response as Y vs X to find intercepts at X equal to zero then replot the data. However, we are using Minitab to compute values of the model by using the trial estimates and plot the predicted values versus the original data we have.

References

- Hamza Saad. The Application of Data Mining in the Production Processes. *Industrial Engineering*. Vol. 2, No. 1, 2018, pp. 26-33. doi: 10.11648/j.ie.20180201.14
- Yame, A., Ali, A., Jawad, B., Nasser, D.A.W.M. and Abro, S., 2016. *Optimization of Lean Methodologies in the Textile Industry Using Design of Experiments*. World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 10(9), pp.3208-3212.
- Yame, A., Alwerfalli, D., Jawad, B., Ali, A., Abro, S. and Nasser, M., 2016. *Applications of Lean methodologies and Quality improvement in the Industry* (No. 2016-01-0343). SAE Technical Paper.
- Yame, A. *Tufted Woven Carpet with Enhanced Machine Mechanism Properties Using Response Surface Design Analysis*. Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020
- Yame, A. *Method for Producing advanced Carpeting Using a HTC factor*. Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Ahmad Yame, "System Throughput Optimization and its Interaction with Waste under Lean Manufacturing Considerations" Ph.D. dissertation, Doctor of Engineering in Manufacturing Systems (DEMS). Lawrence Technological University. 2020

Yame. A. *An implementation of the variance analysis (ANOVA) for Mattresse factory at Fisher Pairwise Comparisons Level.* Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Yame. A. *Production Stages and Data of Study are analyzed as System Throughput Optimization.* Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Yame. A. *Applications and Theoretical Research for Fabric Manufacturing and Influence of Descriptive Statistics.* Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Yame. A. Survey-based statistical data and totaling long columns of numbers on Lean Manufacturing; Case Study. Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Yame. A. *Heating and Cooling Loading Processes and Optimizes Material Properties for the Best Thermal Performances using CES.* Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Ahmad Yame. *Advances on design and materials of solar Trombe Wall.* Thesis Master of Science (MSc), University Kebangsaan Malaysia, Bangi 2007

Biography

Dr. Ahmad Yame earned his Bachelor degree in Engineering Technology from the Lawrence Technological University in 2010, Mr. Yame has three master degree, the latest was in 2015 in Industrial Engineering from Lawrence Technological University, second MSc was in Engineering Management 2011 from the Lawrence Technological University and his first MSc was in Mechanical Engineering back in 2007 from the National University of Malaysia. He earned his Associate's degree in Mechanical Engineering 2004 from the Libyan Higher Professional Center for Comprehensive Professions. He primarily develops engineers but also has experience with software and testing. Dr.Yame has tested many enterprise applications for automotive MAHLE Laboratories in 2013, he working with Panasonic automotive in North America since 2016 to test vehicles for AHU/Sync and diagnostic functionalities of engine control systems. He has organized several simulations, in order to test the engine control software and the diagnostic functionality on a CANlog, respectively, through non-regression and diagnostic tests.