

WDCS 422 Homework-Assignment 1
Time Studies and Production Estimation
Harvesting Forest products

Due Date:

Home work assignment

Recently, a portion of the University research forest was harvested using a Timbco feller-buncher. During the harvesting operation, the felling time of some sampled trees were collected together with its respective DBH. With this given data, develop an equation to estimate felling time per tree for this feller-buncher based on tree size. You need to describe how the model is developed and how good the model is in terms of R^2 , root MSE, and P-value. You also need to include attachments as shown in Figures 3 and 5.

Table 1.

DBH (in.)	Time per tree (min.)
4	0.460
5	0.563
6	0.436
7	0.425
8	0.616
9	0.444
10	0.621
11	0.467
12	0.634
13	0.564
14	0.526
15	0.632
16	0.556
17	0.641
18	0.688
19	0.697
22	0.682

Background

Least squares regression modeling has long been an efficient, accurate method of estimating and predicting forestry data. Estimation involves the calculation parameters of a population (e.g. mean). Developing a production model requires the combination of a variables (dependent and independent) affecting the harvesting activities of a particular machine such as work conditions surrounding harvesting operation like tree size, slope, and other terrain conditions. The procedure for developing harvesting equations is as follows;

1. Means calculation
2. Plotting data
3. Fitting models
4. Testing fits

Mean: It gives an overall average of productivity. It is calculated by summing up all individual observations and dividing it by the number of observations.

Plotting data:

- Calculate the average time for each-inch DBH and draw the plot.
- Now, instead of having the overall average time per tree, we have average time for each DBH class
- Investigate outliers before removal from the data set

Fitting the model: The best line of fit is plotted using appropriate software like SAS, MS Excel, or others.

Testing the model:

Procedure for developing equations:

A. Running your data in MS excel to get means of your variables

1. Type and save data in MS excel
2. Click on “**Data analysis**” icon on the tool bar
3. Select **Regression** from the dialogue box, click **OK**

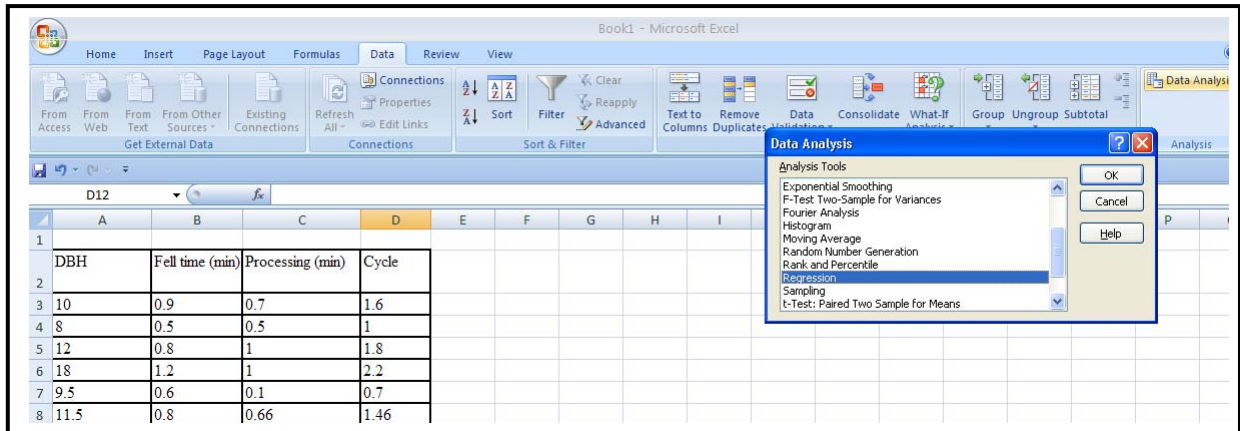


Figure 1.

4. Time “Input Y Range” box and Dbh values into “Input X Range:” box

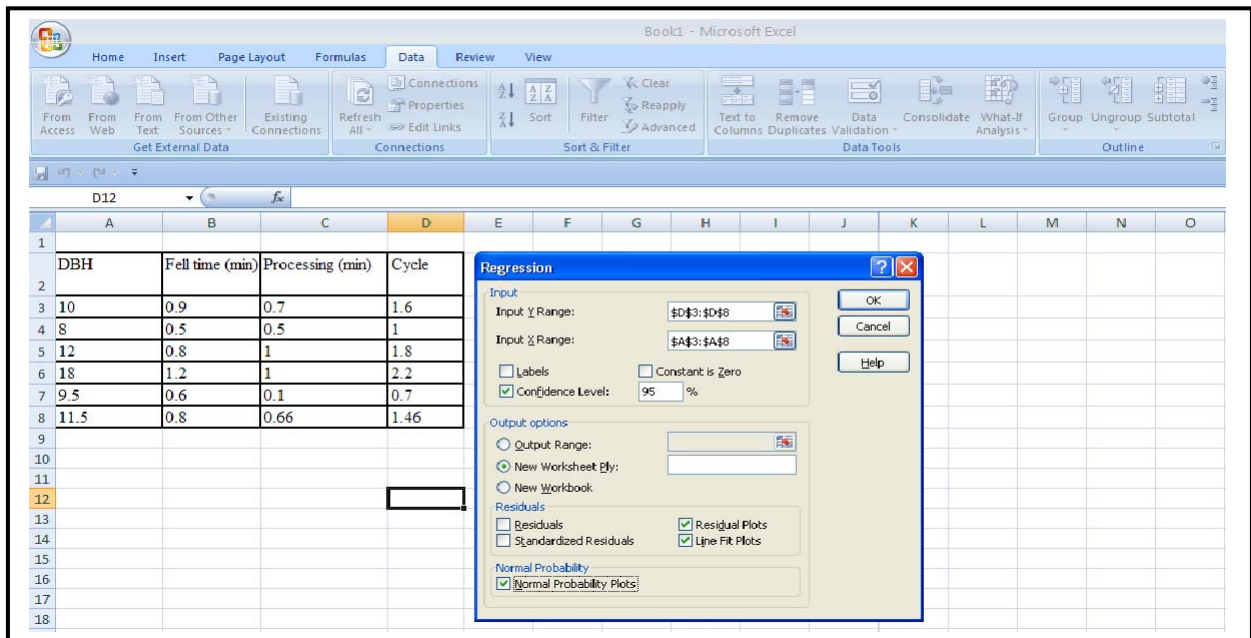


Figure 2.

5. Check confidence level box, Residual plot, Line fit plot and normal probability plots. Finally click OK

a. Output: your output should look like this:

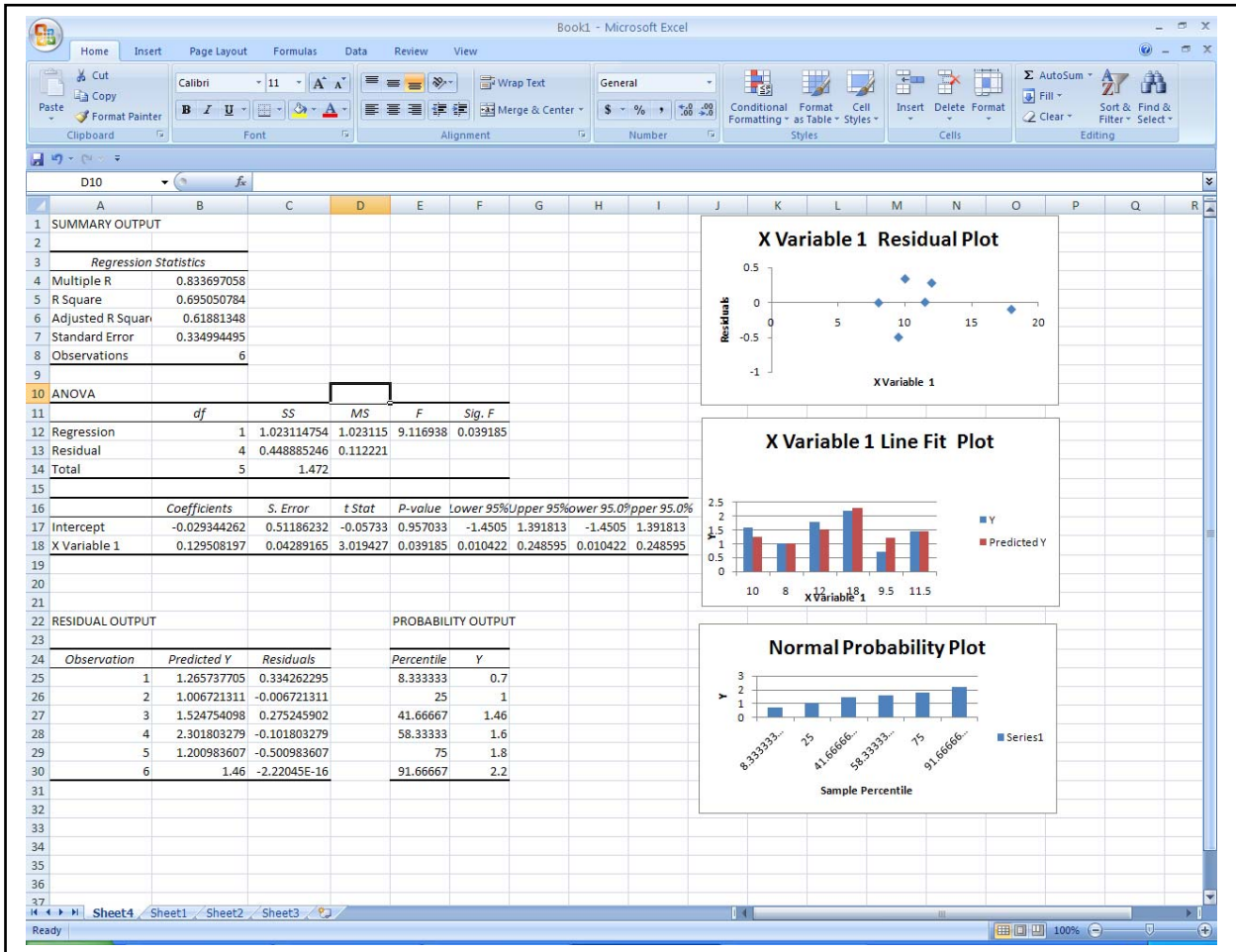


Figure 3.

B. Extract out the mean of X, Y, and intercept variables together with their P and F-values into a table like the one shown below.

Computer output of regression results

	Coeff.	S.E	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.02934	0.59525	-0.0493	0.96378	-1.9237	1.86501	-1.9237	1.86501
DBH	0.129508	0.04952	2.6149	0.07934	0.0281	0.28712	0.0281	0.28712

C. Write out the equation on the form shown below:

Equation: Y (average cycle time) = $-0.029 + 0.129DBH$, R-square 0.69. (1)

D. Plot the data and include equation developed.

1. Highlight the DBH and time data in your excel spread sheet
2. Click on **Scatter** from the menu bar, choose scatter with marker option

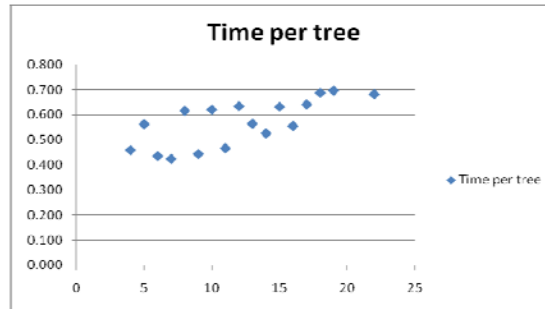


Figure 4.

3. Click on **layout3**, add trend line, line equation, and R^2 via trend line options dialogue box. (add equatioins and R-square by checking on the appropraite boxes at the bottom of the trend line dialogue box).

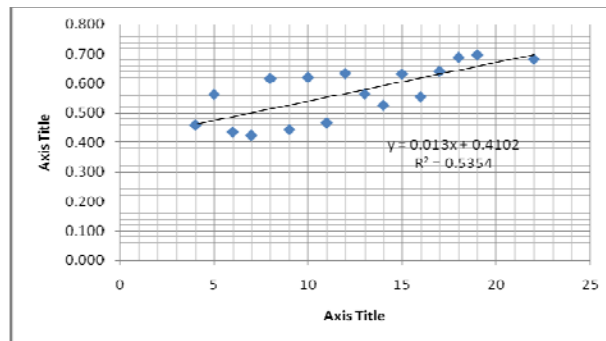


Figure 5.

Data Analysis with Analysis ToolPak

The Analysis ToolPak is an add-in that provides analytical capability that normally is not available. The following analyses are provided by ToolPak:

- Analysis of variance (three types)
- Correlation
- Covariance
- Descriptive statistics
- Exponential smoothing
- F-test
- Fourier analysis
- Histogram
- Moving average
- Random number generation
- Rank and percentile
- Regression
- Sampling
- t-test (three types)
- z-test

(1) Install and use the Analysis ToolPak

Before using an analysis tool, you must arrange the data you want to analyze in columns or rows on your worksheet. This is your input range. If the **Data Analysis** command is not on the **Tools** menu, you need to install the Analysis ToolPak in Microsoft Excel.

To install the Analysis ToolPak:

- Click the Microsoft Office Button , and then click Excel Options. .
- Click Add-Ins, and then in the Manage box, select Excel Add-ins. and hit GO.
- In the Add-Ins available box (Figure 6), select the Analysis ToolPak check box, and then click OK.
- After you load the Analysis ToolPak, the Data Analysis command is available in the Analysis group on the Data tab.

To use the Analysis ToolPak:

- (a) On the **Data** menu, click **Data Analysis** (Figure 7).
- (b) In the **Analysis Tools** box, click the tool you want to use.
- (c) Enter the input range and the output range, and then select the options you want.

To remove an add-in program from Microsoft Excel:

- (a) Click the Microsoft Office Button , and then click Excel Options .
- (b) Click Add-Ins, and then in the Manage box, select Excel Add-ins. and hit GO.
- (c) In the **Add-Ins available** box, clear the check box next to the add-in you want to unload.
- (d) To remove the add-in from memory, restart Excel.

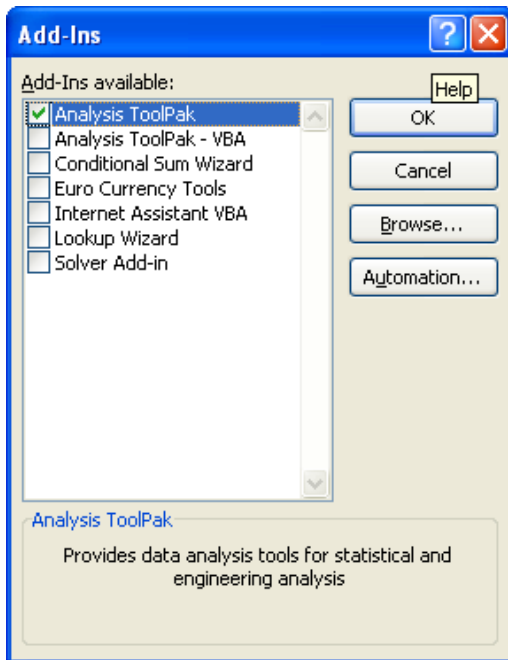


Figure 6. Add-ins dialog box.

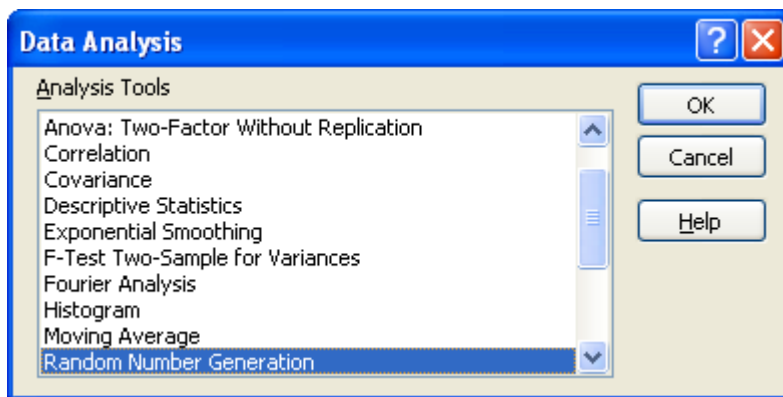


Figure 7. Data analysis dialog box.