

Statistics 101 – Homework 5

Due Wednesday, February 25, 2009

Homework is due on the due date at the end of the lab.

Reading: February 16 – February 18 Chapter 10
February 20 Chapter 11
February 23 Chapter 12

Assignment:

Note: For this homework use JMP whenever you wish. Turn in any JMP output along with the answers to the questions.

1. How old is a tree? Cutting a tree down and counting the number of growth rings can determine the age of a tree. It would be nice to have a non-destructive method for determining the age of a tree. A forester measured 27 trees of the same species that had been cut down and determined the age of each tree by counting the growth rings. Below are the data.

Diameter, cm	Age, years	Diameter, cm	Age, years	Diameter, cm	Age, years
4.6	4	14.0	14	33.5	30
4.6	5	25.1	16	39.1	30
5.6	8	25.7	18	34.7	33
11.2	8	30.7	20	36.3	34
16.8	8	32.5	22	39.1	35
11.2	10	26.2	16	37.9	38
19.6	10	36.3	25	39.1	38
27.4	12	33.5	28	41.9	40
19.6	13	35.1	29	41.9	42

- a) Plot the data. Use Age as your Y, Response and Diameter as your X, Factor. Describe the association between diameter and age. Be sure to include form, direction, strength and comment on any potential outliers.
- b) Find the correlation between age and diameter. What does this indicate about the strength of the linear association?
- c) Fit the least squares regression line relating age to diameter. Report the prediction equation and give an interpretation of the estimated slope coefficient.
- d) Describe the plot of residuals. Explain why a linear model is not an adequate model for the relationship between age and diameter.
- e) If you used the linear model, would you generally over-predict or under-predict the age of trees with large diameters, say greater than 45 cm? Explain briefly.

2. Cross-sectional area might be a better predictor of age. Cross-sectional area is proportional to the square of the diameter. Re-express the data by squaring the diameter, i.e. create a new variable $D_{sqr} = (\text{Diameter})^2$.
 - a) Plot Age as the Y, Response and D_{sqr} as the X, Factor. Does this scatter plot look better than the scatter plot in 1? Explain briefly.
 - b) Fit a least squares regression line relating Age and D_{sqr} . Report the prediction equation and give an interpretation of the estimated slope coefficient.
 - c) Use the equation in b) to predict the age of a tree that has a 45 cm diameter.
 - d) Describe the plot of residuals. Is this a more appropriate model than the one you fit in 1? Explain briefly.

3. Instead of re-expressing the diameter, re-express age by taking the square root of age, $\text{sqrt}(\text{Age})$.
 - a) Plot $\text{sqrt}(\text{Age})$ as the Y, Response and Diameter as the X, Factor. Does this scatter plot look better than the one in 1? Explain briefly.
 - b) Fit a least squares regression line relating $\text{sqrt}(\text{Age})$ and Diameter. Report the prediction equation and give an interpretation of the estimated slope coefficient.
 - c) Use the equation in b) to predict the age of a tree that has a 45 cm diameter.
 - d) Below is a plot of residual Age (using the equation in b)) versus Diameter. Describe the plot of residuals. Is this a more appropriate model than the one you fit in 1? Is this a more appropriate model than the one you fit in 2? Explain briefly.

