STA 674

Regression Analysis And Design Of Experiments

Fitting Simple Linear Regression Models – Lecture 7

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Fitting Simple Linear Regression Models

- Last time: we reviewed confidence interval theory, interpretation
- Now we'll the apply this to building confidence intervals for the linear regression parameters, β_0, β_1.

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Confidence intervals for LS Estimates of the Regression Parameter β_0

A $(1-\alpha)100\%$ confidence interval for the population intercept, β_0 , is given by:

$$L = b_0 - s_{b_0} t_{\alpha/2, n-2} \text{ and } U = b_0 + s_{b_0} t_{\alpha/2, n-2}$$

where

degrees of freedom = n-2
because there are two variables associated with regression b1 and b0?

$$s_{b_0} = \sqrt{s_e^2 \left(\frac{1}{n} + \frac{\bar{x}^2}{(n-1)s_x^2} \right)}$$

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Confidence intervals for LS Estimates of the Regression Parameter β_1

A $(1-\alpha)100\%$ confidence interval for the population intercept, β_1 , is given by:

$$L = b_1 - s_{b_1} t_{\alpha/2,n-2} \text{ and } U = b_1 + s_{b_1} t_{\alpha/2,n-2}$$

where

$$s_{b_1} = \sqrt{\frac{s_e^2}{(n-1)s_x^2}}$$

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Interpretation of confidence intervals for β_0 and β_1

- A ***probability*** interpretation: if you were to repeat the experiment many, many times and compute the $(1-\alpha)100\%$ interval for the intercept and slope for each data set then $(1-\alpha)100\%$ of the intervals would cover the population ("true") values of β_0 and β_1.

- A ***heuristic*** Interpretation: the values inside the 95% confidence interval represent a *reasonable* range of guesses for the *population* intercept and slope.

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- Example: Hooker's data

The following table provides least squares parameter estimates for the linear regression of temperature to pressure for Hooker's boiling point data computed by SAS.

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	146.67290	0.77641	188.91	<.0001
pressure	1	2.25260	0.03809	59.14	<.0001

Use this information and that $t_{0.025,29} = 2.05$ to compute 95% confidence intervals for both β_0 and β_1 and interpret these CIs.

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- Example: Hooker's data

Use SAS to compute 95% confidence intervals for both β_0 and β_1.

```
/* Fit regression model */;
PROC REG DATA=HOOKER;
MODEL temperature=pressure / CLB;
RUN;
```

Interpretation of result of CI...
2.17 to 2.33 is how much boiling point increases for each unit of pressure is a reasonable set of values to infer

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	95% Confidence Limits	
Intercept	1	146.67290	0.77641	188.91	<.0001	145.08495	148.26084
pressure	1	2.25260	0.03809	59.14	<.0001	2.17470	2.33049