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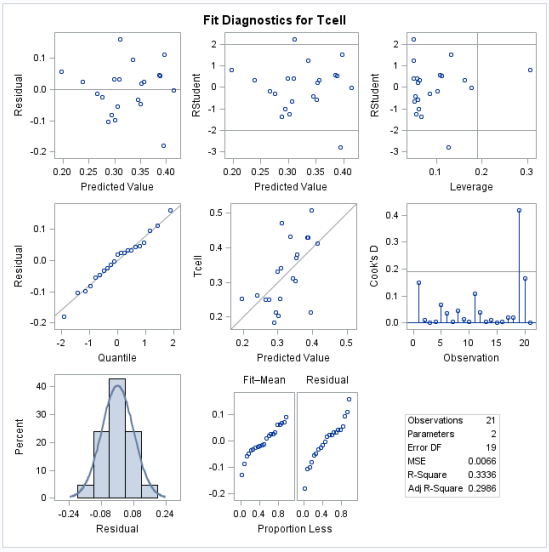
Section: MSDS6371-401
Date: 11/07/15

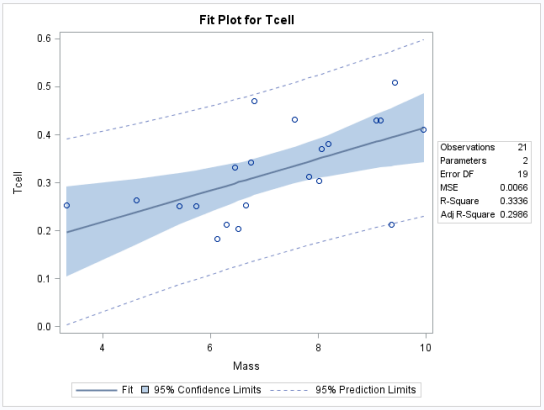
Problem Statement

Analyze the evidence supporting whether the black wheatears' health – as measured by Tcell response – is associated with stone mass, and quantify the association.

Assumptions

- Linearity: Based on the scatter plot, there is not strong evidence against linearity.
- Normality: There is strong evidence to support normality based on the histogram as well as the QQ-plot.
- Equal SD: Based on the scatter plot, there are several questionable data points. However, most of the data looks close to equal SD.
- Independence: We will assume independence.
- Extra Caution: There appears to be at least one very influential point as evidenced by the Cook's D. Additional analysis should be focused on this point.





Equation of Regression Line

Tcell = 0.08750 + 0.03282(mass)

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.08750	0.07868	1.11	0.2800
Mass	1	0.03282	0.01064	3.08	0.0061

$ß_0 = 0.08750$, $ß_1 = 0.03282$

Interpretation of Equation of Regression Line

For every increase in 1 gram in mass of stone, the estimated Tcell increases respond increases by 0.12032 mm. When the mass of the stone is zero, the Tcell response is 0.08750; there is no practical interpretation for this data point.

6-Step Hypothesis Test

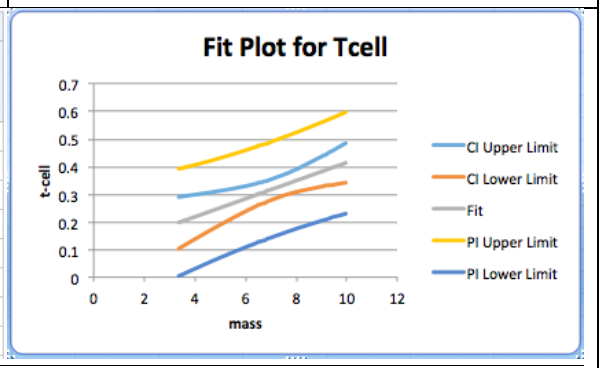
1. H_0: ß1 = 0, H_A: ß1 ≠ 0 2. df = 19, CV: 2.093	3. t = 3.08 4. p-value: 0.0061	5. Reject H_0

6. Conclusion: There is sufficient evidence at alpha = 0.05 level of significance (p-value = 0.0061) to suggest that the slope of the linear regression line is significantly different than zero.

Confidence Interval	Prediction Interval
A 95% confidence interval for the mean Tcell response conditional on 6.51 grams is between 0.2611 and 0.3413.	A 95% confidence interval for the predicted Tcell response conditional on 6.51 grams is between 0.1259 and 0.4754.

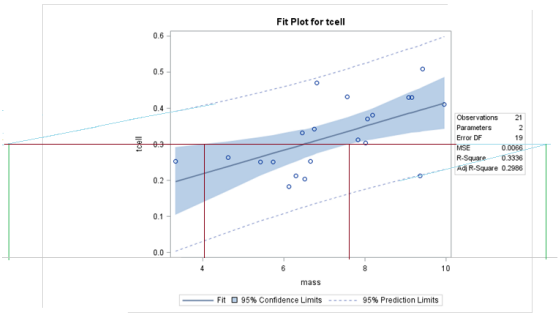
Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Mean		95% CL Predict		Residual
1	0.252	0.1968	0.0449	0.1029	0.2907	0.002959	0.3906	0.0552
2	0.263	0.2391	0.0327	0.1707	0.3076	0.0563	0.4220	0.0239
3	0.251	0.2657	0.0259	0.2116	0.3199	0.0877	0.4437	-0.0147
4	0.251	0.2756	0.0236	0.2261	0.3250	0.0989	0.4522	-0.0246
5	0.183	0.2884	0.0211	0.2442	0.3326	0.1131	0.4636	-0.1054
6	0.213	0.2939	0.0202	0.2517	0.3362	0.1192	0.4687	-0.0809
7	0.332	0.2992	0.0194	0.2586	0.3398	0.1248	0.4736	0.0328
8	0.203	0.3012	0.0192	0.2611	0.3413	0.1269	0.4754	-0.0982



Calibration Intervals

Judging from the fit plot for Tcell, the 95% calibration interval for the mean Tcell response of 0.3 is (4.0, 7.7). We have 95% confidence that the estimated stone mass would indicate a mean Tcell of 0.3 mm is between 4.0 and 7.7. The best estimate is 6.47 grams.
The 95% calibration interval for a single Tcell response of 0.3 is (-1.8, 13.7). We have a 95% confidence that the stone mass that would indicate a Tcell of 0.3 mm is between -1.8 and 13.7. The best estimate is 6.47 grams.



Calibration Using SE Equations

$$\hat{X} = (Y_0 - \hat{\beta}_0)/\hat{\beta}_1$$

$\beta_0 = 0.08750$, $\beta_1 = 0.03282$
X = (0.3 – 0.08750)/.03282 = 6.47

$$\mathrm{SE}[\hat{\mu}\{Y|X_0\}] = \hat{\sigma}\sqrt{\frac{1}{n} + \frac{(X_0 - \overline{X})^2}{(n-1)s_X{}^2}}, \quad \text{d.f.} = n = 2.$$

$$\mathrm{SE}(\hat{X}) = \frac{\mathrm{SE}(\hat{\mu}\{Y|\hat{X}\})}{|\hat{\beta}_1|}$$

Standard Error CI

SE[$\hat{\mu}$] = 0.019248
SE(X) = 0.586411

$$\mathrm{SE}[\mathrm{Pred}\{Y|X_0\}] = \sqrt{\hat{\sigma}^2 + \mathrm{SE}[\hat{\mu}\{Y|X_0\}]^2}.$$

$$\mathrm{SE}(\hat{X}) = \frac{\mathrm{SE}(\mathrm{Pred}\{Y|\hat{X}\})}{|\hat{\beta}_1|}$$

Standard Error PI

SE[Pred] = 0.08327
SE(X)[Pred] = 2.5327

Calibration Intervals for Mean Tcell Response	$6.47 \pm 0.586411(2.093) = (5.243, 7.697)$
Calibration Intervals for Single Tcell Response	$6.47 \pm 2.5327(2.093) = (1.169, 11.771)$