

ST 411 Homework 8

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Just mentioning I've had trouble with the textbook publisher in regards to the ST 421 textbook (yes, I mean 421). So, to be clear, I am using the US Student Edition of the textbook with ISBN 978-1-133-49067-8 (for ST 421, there were at least two different versions of the textbook with same ISBN, an international & US student one).

1

Produce a scatterplot of T-cell response vs. mean stone mass with fitted regression line and confidence band. Include R code and the plot. Does the linearity assumption appear to be met? Note: Its customary to give the response variable first: a scatterplot of Y vs. X.

I will use the 95% confidence band that shows up by default. My code:

```
ggplot(ex0727, aes(x=Mass, y=Tcell)) +  
  geom_point() +  
  geom_smooth(method=lm)+  
  xlab("Mean Stone Mass (g)") +  
  ylab("T-cell Response (nm)")
```

. My plot:

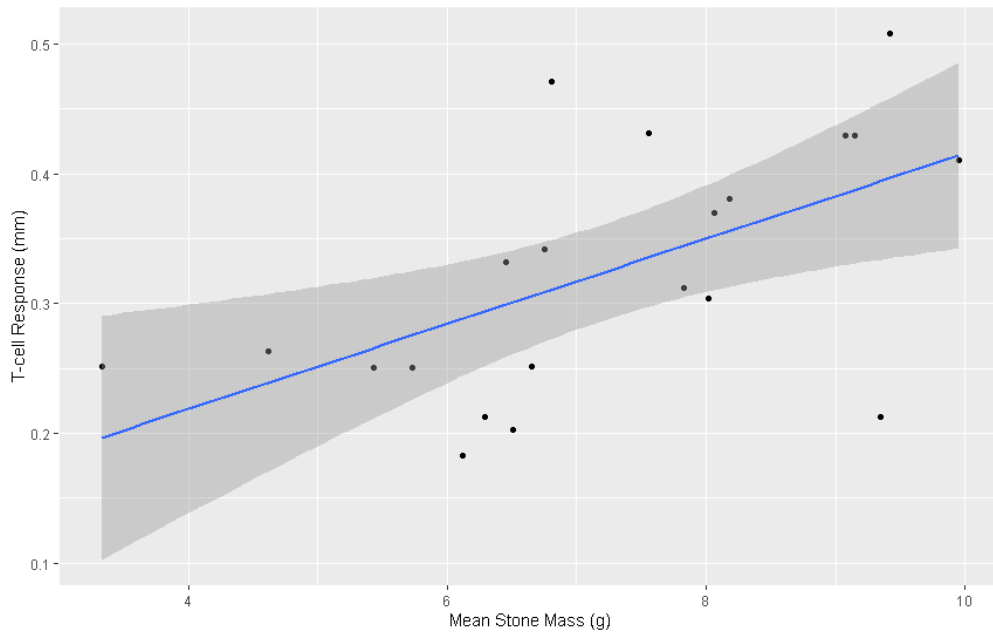


Figure 1: T-cell Response (mm) vs Mean Stone Mass (g)

The data does not seem to be notably linear though a linear relationship does not seem extremely divergent from the data, with a notable number of data points being outside of the 95% confidence band of the fitted line, but also a notable number within the confidence band. I also computed R^2 values to get a quantification of a linear fit to the data & the multiple R^2 outputted was 0.336 (adjusted R^2 0.2986), which I feel matches my interpretation of how much the data follows a linear fit (since the fitted line has a positive slope, this means the R value is roughly 0.580).

2

Estimate the regression of T-cell response on mean stone mass. Give the estimated regression equation with standard errors of the coefficients below the coefficients in parentheses, as at the bottom of page 187 in the Sleuth or as we did on page 9 of Outline 7 when we discussed it in lecture on November 17. Please include R code but not output. R code:

```
ex0727_lm<-lm( Tcell~Mass, data=ex0727)
summary( ex0727_lm)
```

$$\begin{array}{l} \hat{\mu}\{\text{T-cell Response}|\text{Mean Stone Mass}\} \\ \text{Standard Error} \end{array} = \begin{array}{l} \left\{ \begin{array}{l} 0.08750 + 0.03282(\text{Mean Stone Mass}) \\ 0.07868 \quad 0.01064 \end{array} \right.$$

3

Calculate 95% confidence intervals for the intercept and slope parameters of the regression equation. State the two intervals. Indicate which estimates the slope parameter and which estimates the intercept parameter. Statistical conclusions are not necessary for this question. Please include your R code but not output. Code:

```
c(0.08750-qt(1-.05/2,19)*0.07868,0.08750+qt(1-.05/2,19)*0.07868)
c(0.03282-qt(1-.05/2,19)*0.01064,0.03282+qt(1-.05/2,19)*0.01064)
```

. My 95% CI for the intercept parameter was [-0.07717913,0.25217913] (units are mm) & my 95% CI for the slope parameter was [0.01055022,0.05508978] (units are mm/g).

4

On page 10 of Outline 7, we interpreted β_0 as the population mean pH when $\log(\text{Time}) = 0$. What is the interpretation of β_0 in our simple linear regression model for the black wheatear data? Our interpretation of β_0 in our simple linear regression model for the black wheatear data is as the (estimated) population mean T-cell Response (in mm) when Mean Stone Mass is 0g, which I suppose doesn't make sense in this context exactly since it's not possible for a stone to be massless (though if the mean stone mass approached 0g, then we would estimate that the population mean T-cell Response (in mm) approaches β_0 based on continuity of our linear model).

5

Calculate a 95% confidence interval for the population mean T-cell response for male black wheatears who transport stones averaging 5 grams. Include R code and output, and write a statistical conclusion reporting this interval. Code:

```
predict(ex0727_lm, data.frame(Mass=5), se.fit=TRUE,
       interval="confidence")
```

. Output:

```
$fit
      fit      lwr      upr
1 0.2516044 0.1901249 0.3130839
```

```
$se.fit
[1] 0.02937352
```

```
$df
[1] 19
```

```
$residual.scale
[1] 0.08101947
```

. We estimate that the population mean T-cell response of a Black Wheatear that transports a mean stone mass of 5g is 0.190 mm to 0.313mm (95% CI, SLR).

6

Calculate a 95% prediction interval for T-cell response for male black wheatears who transport stones averaging 6 grams. Include R code and output, and write a statistical conclusion reporting this interval. Code:

```
predict(ex0727_lm, data.frame(Mass=6), se.fit=TRUE,
       interval="prediction")
```

. Output:

```
$fit
      fit      lwr      upr
1 0.2844259 0.1087993 0.4600526
```

```
$se.fit
[1] 0.02183605
```

```
$df
[1] 19
```

```
$residual.scale
[1] 0.08101947
```

. We predict that the T-cell response of a Black Wheatear that transports a mean stone mass of 6g is 0.109 mm to 0.460mm (95% PI, SLR).