STAT 217: Separate Lines Model (4-22)

 Crab Claw Force and Size: As part of a study of the relationship between predatory intertidal crab species and snail populations, researchers measured the average closing forces (newtons) and propodus heights (mm) of the claws on several crabs of three species. They collected data on 14 crabs from the species *nudus*, 12 from species *bellus*, and 12 from species *productus*.

```
parallel.out <- lm(Force ~ Height+Species, data=crab.data)
separate.out <- lm(Force ~ Height*Species, data=crab.data)
summary(separate.out)

##
## Call:
## lm(formula = Force ~ Height * Species, data = crab.data)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -7.146 -2.100 -0.501  1.841 13.094
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             -17.252      6.096   -2.83   0.0080
## Height                    3.849      0.723    5.32  7.8e-06
## Speciesnudus             20.413      7.794    2.62   0.0134
## Speciesproductus          8.248      9.394    0.88   0.3865
## Height:Speciesnudus      -3.704      0.936   -3.96   0.0004
## Height:Speciesproductus  -1.169      0.989   -1.18   0.2459
##
## Residual standard error: 4.45 on 32 degrees of freedom
## Multiple R-squared:  0.788,Adjusted R-squared:  0.755
## F-statistic: 23.8 on 5 and 32 DF,  p-value: 6.42e-10
```

1. Write out the true model. Choose the same indicator variables that R chose!

2. Using the R output, write out the estimated model.

3. What is the reference level?

4. Write out the estimated model for the *nudus* species.

5. What is the estimated y-intercept for the *nudus* species? slope?

6. Write out the estimated model for the *bellus* species.

7. What is the estimated y-intercept for the *bellus* species? slope?

8. Write out the model for the *productus* species.

9. What is the estimated y-intercept for the *productus* species? slope?

10. Plot the three estimated regression lines on the same graph. Why is this called a "separate lines" model?

11. What hypotheses are being tested in the Height:Speciesproductus row of the output? Write the hypotheses in symbols and words.