STAT 217: Quiz 27

1. **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 Hemigrapsus nudus, 12 from Lophphanopeus bells, and 12 from Cancer productus. (Data read from Figure 3 in Yamada & Boulding, Claw morphology, prey size selection, and foraging efficiency in generalist and specialist shell-breaking crabs, Journal of Experimental Marine Biology and Ecology, 220, pp. $191 - 211$.)

```
##
## 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
## Analysis of Variance Table
##
## Response: Force
##                Df Sum Sq Mean Sq F value  Pr(>F)
## Height          1   1273    1273   64.43 3.7e-09
## Species         2    736     368   18.62 4.3e-06
## Height:Species  2    342     171    8.64   0.001
## Residuals      32    632      20
```

(a) Write out the response variable and the explanatory variable(s). Identify each as categorical or quantitative.

(b) Is this multiple linear regression or simple linear regression? Briefly justify.

(c) Write out the model that was fit above.

(d) What is the reference level?

(e) Would you allow different slopes for each species? Write a conclusion to answer this question.

2. Now let's look at the same question using AIC-based model comparisons.

```
lm.add <- lm(Force~Height+Species, data=crab.data)
lm.int <- lm(Force~Height+Species+Height*Species, data=crab.data)
AIC(lm.add,lm.int)

##          df AIC
## lm.add   5 241
## lm.int   7 229
```

(a) According to the AIC, which model would you choose and why?

(b) Is this consistent with the answer you gave in 1e? Briefly justify.