**Homework 1 Answer key**

Question 2

1. β*0* is the mean (average) birthweight for children whose mother’s did not complete high school. β*1* is the difference in mean (average) birthweights between children whose mothers’ did and di not complete high school.
2. If income is measured in logs, a 1% increase in income is associated with a *β*1 increase in ounces of birthweight. For example, if $\hat{β}\_{1}$=.3, a 1% increase in income is associated with a .3 ounce increase in birthweight.
3. To interpret quadratic specifications, take a partial derivative. The effect of family income on birthweight = ∂birthweight/∂family income = β*3+*β*4faminc*. You will need to choose a level of family income to report a specific marginal effect. Often this is reported at the mean.

For questions 3-5, see the log file.

Question 6

Show that the estimated *coefficient* $\hat{β}\_{1} $and estimated *standard errors* for $\hat{β}\_{1} $in this 2 variable regression model

1. $\left(y\_{i}\right)= \hat{β}\_{0}+\hat{β}\_{1}\left(x\_{i}\right)+\hat{u}\_{i}$

are equivalent to those in this model

(b)$ \left(y\_{i}-\overbar{y}\right)= \hat{β}\_{1}\left(x\_{i}-\overbar{x}\right)+\hat{u}\_{i}$

If you need to draw on other assumptions/properties of the OLS estimator in your derivation, state these.

* To show the **coefficients** are the same, use property that regression line runs through mean of data: $\hat{β}\_{0}=\overbar{y}-\hat{β}\_{1}\overbar{x}$

This is derived in the handout showing the derivation of the OLS estimators $\hat{β}\_{0},\hat{β}\_{1}$ from minimizing the sum of squared errors. (Review that handout if needed.)

Plug this in and simplify to get the second expression

* To show that the standard errors are the same, recall that for the first regression model,

$se(\hat{β}\_{1})=\left[\frac{\left(\frac{1}{n-2}\sum\_{}^{}\hat{u}\_{i}^{2}\right)^{1/2}}{\left(\sum\_{}^{}\left(x\_{i}-\overbar{x}\right)^{2}\right)^{1/2}}\right]$

For the numerator, note that the $\hat{u}\_{i}$ will be the same in (a) and (b) (this is also true because the mean of the estimated errors is zero). Therefore the numerator of the standard errors for (a) and (b) will be the same.

To show that denominators in the standard errors are the same, show that

 $\sum\_{}^{}\left(x\_{i}-\overbar{x}\right)^{2}^{}=\sum\_{}^{}(\left(x\_{i}-\overbar{x}\right)-\overbar{\left(x\_{i}-\overbar{x}\right)})^{2}^{}$

I’ll let you work through that algebra on your own.