Workshop 10 Solutions

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null

We'll begin by loading some packages.

```
library(MASS)
library(plyr)
```

Interaction terms in regression

```
# Building up the familiar birthwt data...

# Rename the columns to have more descriptive names
colnames(birthwt) <- c("birthwt.below.2500", "mother.age", "mother.weight",
    "race", "mother.smokes", "previous.prem.labor", "hypertension", "uterine.irr",
    "physician.visits", "birthwt.grams")

# Transform variables to factors with descriptive levels
birthwt <- transform(birthwt,
            race = as.factor(mapvalues(race, c(1, 2, 3),
                             c("white","black", "other"))),
            mother.smokes = as.factor(mapvalues(mother.smokes,
                             c(0,1), c("no", "yes"))),
            hypertension = as.factor(mapvalues(hypertension,
                             c(0,1), c("no", "yes"))),
            uterine.irr = as.factor(mapvalues(uterine.irr,
                             c(0,1), c("no", "yes")))
            )
```

(a) Run a linear regression to better understand how birthweight varies with the mother's age and smoking status (do not include interaction terms).

```
# Run regression model
birthwt.lm <- lm(birthwt.grams ~ mother.age + mother.smokes, data = birthwt)
# Output coefficients table
summary(birthwt.lm)
```

```
##
## Call:
## lm(formula = birthwt.grams ~ mother.age + mother.smokes, data = birthwt)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2119.98  -442.66    52.92   532.38  1690.74
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      2791.224    240.950  11.584   <2e-16 ***
## mother.age         11.290      9.881   1.143    0.255
## mother.smokesyes -278.356    106.987  -2.602    0.010 *
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 717.2 on 186 degrees of freedom
## Multiple R-squared:  0.04299,    Adjusted R-squared:  0.0327
## F-statistic: 4.177 on 2 and 186 DF,  p-value: 0.0168
```

(b) What is the coefficient of mother.age in your regression? How do you interpret this coefficient?

```
coef(birthwt.lm)["mother.age"]
```

```
## mother.age
##   11.28961
```

```
age.coef <- round(coef(birthwt.lm)["mother.age"], 1)
```

Note: This solution uses inline code chunks. The coefficient is 11.3. This means that among mothers with the same smoking status, each additional year of age is on average associated with a 11.3g increase in birthweight.

(c) How many coefficients are estimated for the mother's smoking status variable? How do you interpret these coefficients?

```
coef(birthwt.lm)["mother.smokesyes"]
```

```
## mother.smokesyes
##        -278.3561
```

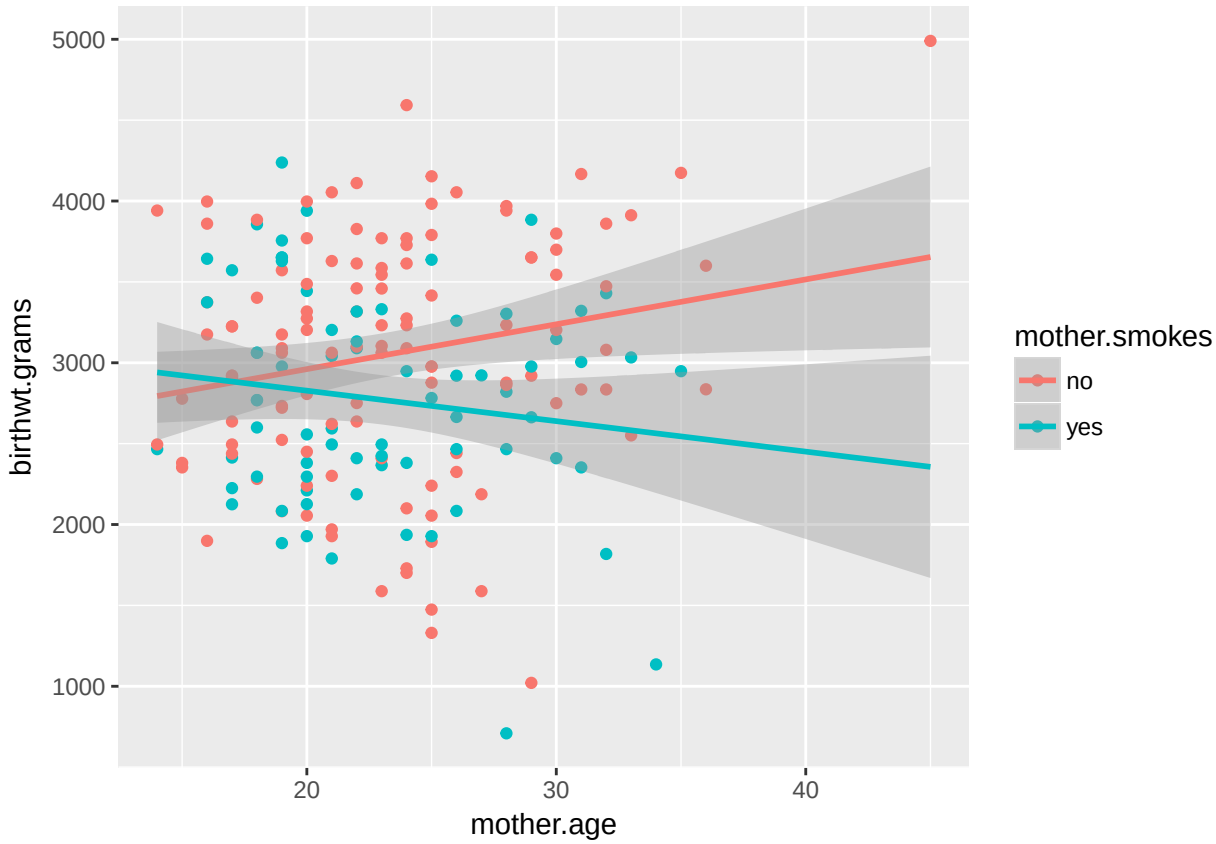
```
smoke.coef <- abs(round(coef(birthwt.lm)["mother.smokesyes"], 1))
```

Note: This solution uses inline code chunks. There is just one coefficient estimated. This coefficient gives us the average difference in birthweight between mothers that smoke and mother's that don't, in a model that adjusts for the effect of mother's age. That is, after we adjust for the effect of age, smoking leads to an average 278.4 decrease in birthweight.

(d) Using ggplot, construct a scatterplot with birthweight on the y-axis and mother's age on the x-axis. Color the points by mother's smoking status, and add smoking status-specific linear regression lines using the `stat_smooth` layer.

```
library(ggplot2)

# Note fullrange = TRUE is used here to extend the 'mother.smokes = yes' line beyond the maximum age (3
qplot(data = birthwt, x = mother.age, y = birthwt.grams, colour = mother.smokes) + stat_smooth(method =
```




```
birthwt.lm$model
```

```
##     birthwt.grams mother.age mother.smokes
## 85           2523         19            no
## 86           2551         33            no
## 87           2557         20           yes
## 88           2594         21           yes
## 89           2600         18           yes
## 91           2622         21            no
## 92           2637         22            no
## 93           2637         17            no
## 94           2663         29           yes
## 95           2665         26           yes
## 96           2722         19            no
## 97           2733         19            no
## 98           2751         22            no
## 99           2750         30            no
## 100          2769         18           yes
## 101          2769         18           yes
## 102          2778         15            no
## 103          2782         25           yes
## 104          2807         20            no
## 105          2821         28           yes
## 106          2835         32            no
## 107          2835         31            no
## 108          2836         36            no
## 109          2863         28            no
```

```
## 111          2877          25           no
## 112          2877          28           no
## 113          2906          17          yes
## 114          2920          29           no
## 115          2920          26          yes
## 116          2920          17           no
## 117          2920          17           no
## 118          2948          24          yes
## 119          2948          35          yes
## 120          2977          25           no
## 121          2977          25           no
## 123          2977          29          yes
## 124          2977          19          yes
## 125          2922          27          yes
## 126          3005          31          yes
## 127          3033          33          yes
## 128          3042          21          yes
## 129          3062          19           no
## 130          3062          23           no
## 131          3062          21           no
## 132          3062          18          yes
## 133          3062          18          yes
## 134          3080          32           no
## 135          3090          19           no
## 136          3090          24           no
## 137          3090          22          yes
## 138          3100          22           no
## 139          3104          23           no
## 140          3132          22          yes
## 141          3147          30          yes
## 142          3175          19           no
## 143          3175          16           no
## 144          3203          21          yes
## 145          3203          30           no
## 146          3203          20           no
## 147          3225          17           no
## 148          3225          17           no
## 149          3232          23           no
## 150          3232          24           no
## 151          3234          28           no
## 154          3260          26          yes
## 155          3274          20           no
## 156          3274          24           no
## 159          3303          28          yes
## 160          3317          20           no
## 161          3317          22           no
## 162          3317          22          yes
## 163          3321          31          yes
## 164          3331          23          yes
## 166          3374          16           no
## 167          3374          16          yes
## 168          3402          18           no
## 169          3416          25           no
## 170          3430          32          yes
```

```
## 172          3444          20          yes
## 173          3459          23           no
## 174          3460          22           no
## 175          3473          32           no
## 176          3544          30           no
## 177          3487          20           no
## 179          3544          23           no
## 180          3572          17          yes
## 181          3572          19           no
## 182          3586          23           no
## 183          3600          36           no
## 184          3614          22           no
## 185          3614          24           no
## 186          3629          21           no
## 187          3629          19          yes
## 188          3637          25          yes
## 189          3643          16          yes
## 190          3651          29           no
## 191          3651          29           no
## 192          3651          19          yes
## 193          3651          19          yes
## 195          3699          30           no
## 196          3728          24           no
## 197          3756          19          yes
## 199          3770          24           no
## 200          3770          23           no
## 201          3770          20           no
## 202          3790          25           no
## 203          3799          30           no
## 204          3827          22           no
## 205          3856          18          yes
## 206          3860          16           no
## 207          3860          32           no
## 208          3884          18           no
## 209          3884          29          yes
## 210          3912          33           no
## 211          3940          20          yes
## 212          3941          28           no
## 213          3941          14           no
## 214          3969          28           no
## 215          3983          25           no
## 216          3997          16           no
## 217          3997          20           no
## 218          4054          26           no
## 219          4054          21           no
## 220          4111          22           no
## 221          4153          25           no
## 222          4167          31           no
## 223          4174          35           no
## 224          4238          19          yes
## 225          4593          24           no
## 226          4990          45           no
## 4             709          28          yes
## 10           1021          29           no
```

```
## 11          1135          34          yes
## 13          1330          25           no
## 15          1474          25           no
## 16          1588          27           no
## 17          1588          23           no
## 18          1701          24           no
## 19          1729          24           no
## 20          1790          21          yes
## 22          1818          32          yes
## 23          1885          19          yes
## 24          1893          25           no
## 25          1899          16           no
## 26          1928          25          yes
## 27          1928          20          yes
## 28          1928          21           no
## 29          1936          24          yes
## 30          1970          21           no
## 31          2055          20           no
## 32          2055          25           no
## 33          2082          19           no
## 34          2084          19          yes
## 35          2084          26          yes
## 36          2100          24           no
## 37          2125          17          yes
## 40          2126          20          yes
## 42          2187          22          yes
## 43          2187          27           no
## 44          2211          20          yes
## 45          2225          17          yes
## 46          2240          25           no
## 47          2240          20           no
## 49          2282          18           no
## 50          2296          18          yes
## 51          2296          20          yes
## 52          2301          21           no
## 54          2325          26           no
## 56          2353          31          yes
## 57          2353          15           no
## 59          2367          23          yes
## 60          2381          20          yes
## 61          2381          24          yes
## 62          2381          15           no
## 63          2410          23           no
## 65          2410          30          yes
## 67          2410          22          yes
## 68          2414          17          yes
## 69          2424          23          yes
## 71          2438          17           no
## 75          2442          26           no
## 76          2450          20           no
## 77          2466          26          yes
## 78          2466          14          yes
## 79          2466          28          yes
## 81          2495          14           no
```

```
## 82           2495         23           yes
## 83           2495         17            no
## 84           2495         21           yes
```

Predict record # 20

```
pd <- predict(birthwt.lm, birthwt[20,], level = 0.99)
pd
```

```
##      105
## 2828.977
```

Actual

```
birthwt[20,]
```

```
##     birthwt.below.2500 mother.age mother.weight  race mother.smokes
## 105                  0         28           120 white           yes
##     previous.prem.labor hypertension uterine.irr physician.visits
## 105                   0           no          no                1
##     birthwt.grams
## 105          2821
```