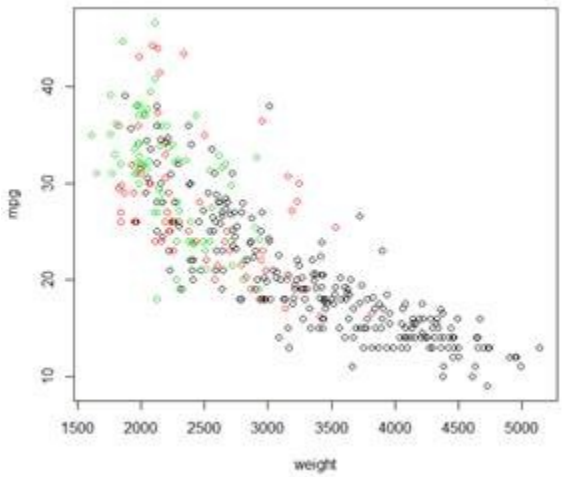
Regression with Categorical Predictors. Dummy Variables and Interactions

```
> load("Auto.rda")
> attach(Auto)
> country = as.factor(origin)

> plot(weight,mpg)
> plot(weight,mpg,col=country)
```



 # Country appears to be an important variable that is not numerical.

```
> reg = lm(mpg ~ country)
> summary(reg)

Call:
lm(formula = mpg ~ country)

Residuals:
    Min      1Q Median      3Q     Max
-12.451  -5.034  -1.034  3.649  18.966

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  20.0335     0.4086  49.025   <2e-16 ***
country2      7.5695     0.8767   8.634   <2e-16 ***
country3     10.4172     0.8276 12.588   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.396 on 389 degrees of freedom
Multiple R-squared:  0.3318,    Adjusted R-squared:  0.3284
F-statistic:  96.6 on 2 and 389 DF,  p-value: < 2.2e-16
```

 # R created dummy variables country2 and contry3

 # Including INTERACTIONS

```
> reg = lm(mpg ~ weight*country)
```

 # This is a short way to include weight, country, and all interactions

```
> summary(reg)

Call:
lm(formula = mpg ~ weight * country)

Residuals:
     Min       1Q   Median       3Q      Max
-13.4928  -2.7715  -0.3895   2.2397  15.5163

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)      4.315e+01  1.186e+00  36.378 < 2e-16 ***
weight          -6.854e-03  3.423e-04 -20.020  < 2e-16 ***
country2         1.125e+00  2.878e+00   0.391 0.69616
country3         1.111e+01  3.574e+00   3.109  0.00202 **
weight:country2  3.575e-06  1.111e-03   0.003 0.99743
weight:country3 -3.865e-03  1.541e-03  -2.508  0.01255 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

> reg = lm(mpg ~ weight*country)

> Yhat = fitted.values(reg) **# Save Y-hat, the miles per gallon predicted by our new model**

> points(weight,Yhat,col=country,lwd=3)

 # Adding 3 fitted regression lines to the plot, one for each country! Col = color, lwd = line width