HW1 Solution

Problem 1

```
library(alr4)
data(UN11)
```

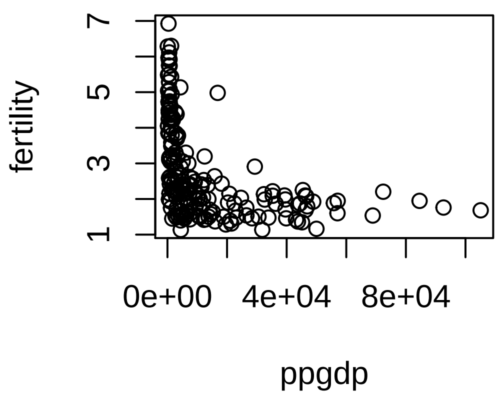
(a)

```
y = UN11$fertility
x = UN11$ppgdp
```

The response is fertility and the predictor is ppgdp.

(b)

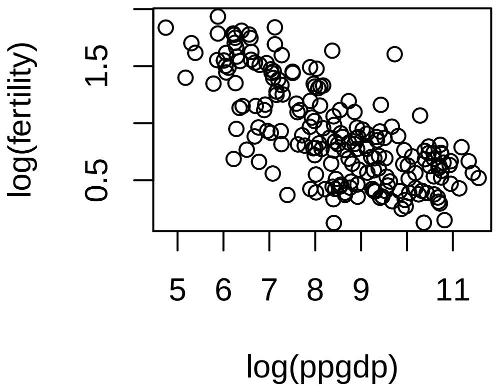
```
plot(x, y, xlab = 'ppgdp', ylab = 'fertility')
```



The trend between fertility and the predictor is decreasing, but it's not linear. The decreasing rate is much larger when ppgdp have small values.

(c)

```
plot(log(x), log(y), xlab = 'log(ppgdp)', ylab = 'log(fertility)')
```



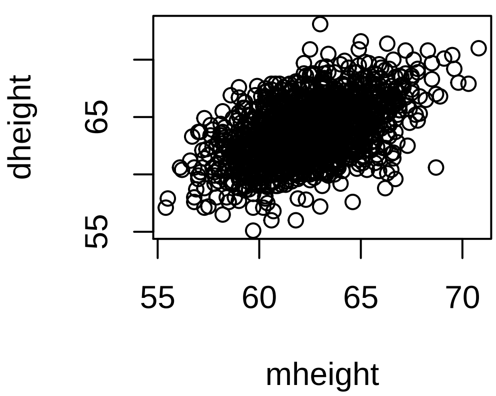
Yes, a simple linear regression model is plausible now.

Problem 2

```
data(Heights)
y = Heights$dheight
x = Heights$mheight
n = length(y)
```

(a)

```
plot(x, y, xlab = 'mheight', ylab = 'dheight')
```



Yes, a simple linear regression model is reasonable.

(b)

```
xbar = mean(x)
xbar
```

```
## [1] 62.4528
```

```
ybar = mean(y)
ybar
```

```
## [1] 63.75105
```

```r
Sxx = sum((x - xbar)^2)
Syy = sum((y - ybar)^2)
Sxy = sum((x - xbar)*(y - ybar))
Sxx
```

```
## [1] 7620.907
```

```r
Syy
```

```
## [1] 9288.616
```

```r
Sxy
```

```
## [1] 4128.603
```

The answers are $\bar{x} = 62.4528$, $\bar{Y} = 63.751052$, $S_{xx} = 7620.907$, $S_{yy} = 9288.616$, $S_{xy} = 4128.603$.

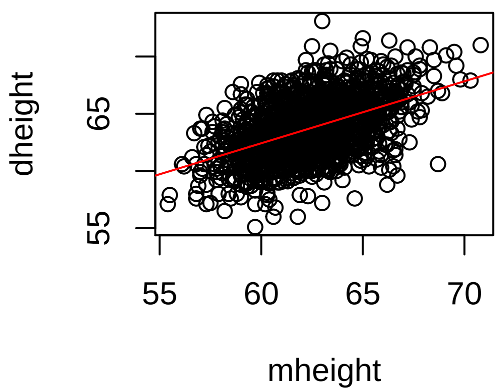
```r
b1 = Sxy / Sxx
b0 = ybar - b1*xbar
b0
```

```
## [1] 29.91744
```

```r
b1
```

```
## [1] 0.541747
```

```r
plot(x, y, xlab = 'mheight', ylab = 'dheight')
abline(b0, b1, col = 2)
```



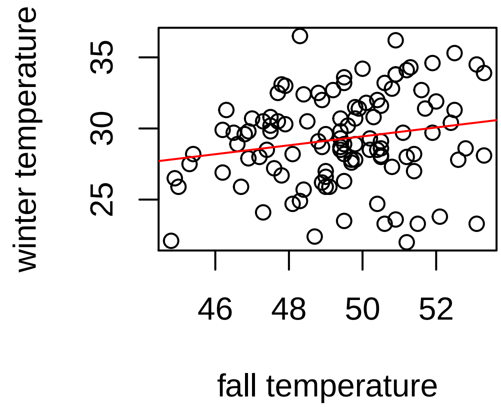
The answers are $b_0 = 29.91744$ and $b_1 = 0.541747$.

Problem 3

```r
data(ftcollinstemp)
x = ftcollinstemp$fall
y = ftcollinstemp$winter
```

(a)

```
fit = lm(y ~ x)
plot(x, y, xlab = 'fall temperature', ylab = 'winter temperature')
abline(coef(fit), col = 2)
```



(b)

```
xbar = mean(x)
xbar
```

```
## [1] 49.3973
```

```
ybar = mean(y)
ybar
```

```
## [1] 29.25405
```

```
Sxx = sum((x - xbar)^2)
Syy = sum((y - ybar)^2)
Sxy = sum((x - xbar)*(y - ybar))
Sxx
```

```
## [1] 432.7892
```

```
Syy
```

```
## [1] 1144.136
```

```
Sxy
```

```
## [1] 135.5362
```

The answers are $\bar{x} = 49.3973$, $\bar{Y} = 29.25405$, $S_{xx} = 432.7892$, $S_{yy} = 1144.136$, $S_{xy} = 135.5362$.

(c)

```
rxy = Sxy/sqrt(Sxx)/sqrt(Syy)
rxy
```

```
## [1] 0.1926098
```

The answer is $r_{xy} = 0.1926098$.