!Kung

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June 20, 2016

Contents

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reference:
- McElreath, Statistical Rethinking, chap 5, pp.119-164

Dobe !Kung

```
library(rethinking)
library(ggplot2)
library(cowplot)
theme_set(theme_gray())
```

data

```
## R code 5.44
data(Howell1)
d <- Howell1
str(d)
```

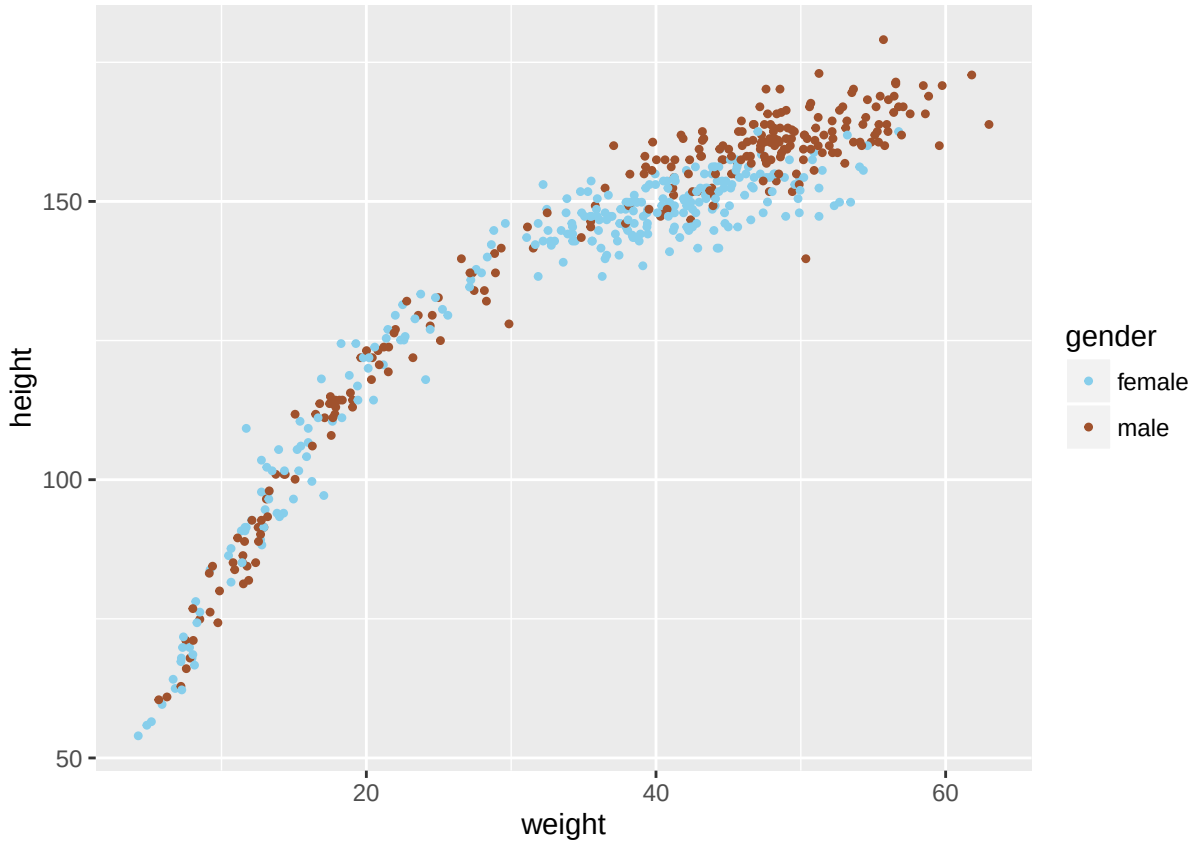
```
## 'data.frame':    544 obs. of  4 variables:
##  $ height: num  152 140 137 157 145 ...
##  $ weight: num  47.8 36.5 31.9 53 41.3 ...
##  $ age   : num  63 63 65 41 51 35 32 27 19 54 ...
##  $ male  : int  1 0 0 1 0 1 0 1 0 1 ...
```

exploratory data analysis

```
d2 <- d
d2$gender <- factor(d2$male, labels = c("female", "male"))
str(d2)
```

```
## 'data.frame':    544 obs. of  5 variables:
##  $ height: num  152 140 137 157 145 ...
##  $ weight: num  47.8 36.5 31.9 53 41.3 ...
##  $ age   : num  63 63 65 41 51 35 32 27 19 54 ...
##  $ male  : int  1 0 0 1 0 1 0 1 0 1 ...
##  $ gender: Factor w/ 2 levels "female","male": 2 1 1 2 1 2 1 2 1 2 ...
```

```
ggplot(d2, aes(weight, height, color = gender)) +
  geom_point(shape = 20) +
  scale_color_manual(values = c("skyblue", "sienna"))
```



model

$$
\begin{aligned}
h_i &\sim Normal(\mu_i, \sigma) \\
\mu_i &= \alpha + \beta_m m_i \\
\alpha &\sim Normal(178, 100) \\
\beta_m &\sim Normal(0, 10) \\
\sigma &\sim Uniform(0, 50)
\end{aligned}
$$

map

```
## R code 5.45
m5.15 <- map(
    alist(
```

```
        height ~ dnorm( mu , sigma ) ,
        mu <- a + bm*male ,
        a ~ dnorm( 178 , 100 ) ,
        bm ~ dnorm( 0 , 10 ) ,
        sigma ~ dunif( 0 , 50 )
    ) ,
    data=d,
    start = list(a = mean(d$height)))
precis(m5.15)
```

```
##         Mean StdDev   5.5%  94.5%
## a     134.83   1.59 132.29 137.38
## bm      7.28   2.28   3.63  10.93
## sigma  27.31   0.83  25.99  28.63
```

PI for male height

```
## R code 5.46
post <- extract.samples(m5.15)
mu.male <- post$a + post$bm
PI(mu.male)
```

```
##       5%      94%
## 139.4086 144.7886
```

reparametrize the model

model

$$
\begin{aligned}
h_i &\sim Normal(\mu_i, \sigma) \\
\mu_i &= \beta_f f_i + \beta_m m_i \\
\beta_f &\sim Normal(178, 100) \\
\beta_m &\sim Normal(178, 100) \\
\sigma &\sim Uniform(0, 50)
\end{aligned}
$$

map

```
## R code 5.47
m5.15b <- map(
    alist(
        height ~ dnorm( mu , sigma ) ,
        mu <- af*(1-male) + am*male ,
        af ~ dnorm( 178 , 100 ) ,
        am ~ dnorm( 178 , 100 ) ,
        sigma ~ dunif( 0 , 50 )
    ) ,
    data=d,
    start = list(af = mean(d$height),
```

```
                  am = mean(d$height)))
precis(m5.15b)
```

```
##          Mean StdDev   5.5%  94.5%
## af    134.64   1.61 132.07 137.22
## am    142.33   1.70 139.61 145.05
## sigma  27.31   0.83  25.99  28.63
```

parameter distributions

```
# extract samples
post <- extract.samples( m5.15b )
str(post)
```

```
## 'data.frame':    10000 obs. of  3 variables:
##  $ af   : num  134 136 138 135 134 ...
##  $ am   : num  145 143 145 139 142 ...
##  $ sigma: num  26.8 28.8 26.3 29.1 26.3 ...
```

```
# plot each parameter distribution
af.plot <- parameter.dist(parameter = "af", values = post$af)
am.plot <- parameter.dist(parameter = "am", values = post$am)
# display parameter distributions
plot_grid(af.plot, am.plot,
          labels=c("af", "am"), ncol = 2, nrow = 1)
```