Wulfing_HW04

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R Question 1

Using either the Swiss hare dataset or your own data, run a Bayesian t-test OR a simple linear regression using JAGS.

Hi sorry, I know you said to use our own data but I'm still in the middle of a data pull. I'll hopefully have some for next assignment but for now, hares. Also turns out elevation is not a very good predictor of hare density lol.

```r
hares <- hares_data %>% drop_na(elevation) %>% drop_na(mean.density)


#sink("HW4_model.txt") #Had to comment this out so markdown would knit
 cat("model { #always start JAGS with this model line

     # Priors-all things we don't know
     beta0 ~ dnorm(0,0.01)      # precision inverse of variance. This means huge variance
     beta1 ~ dnorm(0,0.01)
     precision <- 1 / variance  #Priors are unknown. We only know mass and svl
     variance <- sigma^2
     sigma ~ dunif(0,15) #I just kept 15 cause that's what I've been using
     #No prior for mew. We will calc further down. We've covered mew using priors for b0 and b1

     # Likelihood
     for(i in 1:nobs){
     mean.density[i] ~ dnorm(mu[i], precision) #mass - > density

     mu[i] <- beta0 + beta1 * elevation[i] #svl-> elevation

     } # i loop

     } # end of the model.
     ",fill=TRUE)
```

```
## model { #always start JAGS with this model line
##
##      # Priors-all things we don't know
##      beta0 ~ dnorm(0,0.01)       # precision inverse of variance. This means huge variance
##      beta1 ~ dnorm(0,0.01)
##      precision <- 1 / variance   #Priors are unknown. We only know mass and svl
##      variance <- sigma^2
```

```
##      sigma ~ dunif(0,15) #I just kept 15 cause that's what I've been using
##      #No prior for mew. We will calc further down. We've covered mew using priors for b0 and b1
##
##
##      # Likelihood
##      for(i in 1:nobs){
##      mean.density[i] ~ dnorm(mu[i], precision) #mass - > density
##
##      mu[i] <- beta0 + beta1 * elevation[i] #svl-> elevation
##
##      } # i loop
##
##      } # end of the model.
##
```

```r
#sink() #I had to comment this out to get markdown to knit

# Bundle data
win.data <- list(mean.density = hares$mean.density,
                 elevation = hares$elevation,
                 nobs = nrow(hares))

# Function to generate starting values aka initial values. Supply init vals
inits <- function()list(beta0 = rnorm(1),
                        sigma = runif(1, 0, 15))

# Parameters to be monitored (= to estimate)
params <- c("beta0",
            "beta1",
            "sigma")

# MCMC settings
nc <- 3
ni <- 1000
nb <- 1
nt <- 1

out <- jags(win.data, inits, params, "HW4_model.txt", n.chains = nc,
            n.thin = nt, n.iter = ni, n.burnin = nb, working.directory = getwd())
```

```
## module glm loaded
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 608
##    Unobserved stochastic nodes: 3
##    Total graph size: 1307
##
## Initializing model
```

```r
print(out, dig =2)
```

```
## Inference for Bugs model at "HW4_model.txt", fit using jags,
##  3 chains, each with 1000 iterations (first 1 discarded)
##  n.sims = 2997 iterations saved
##          mu.vect sd.vect    2.5%     25%     50%     75%   97.5% Rhat n.eff
## beta0       4.77    1.25    2.41    3.93    4.76    5.60    7.34 1.00  3000
## beta1       0.00    0.00   -0.01    0.00    0.00    0.00    0.01 1.00  3000
## sigma       3.96    0.12    3.74    3.87    3.95    4.03    4.19 1.00  2700
## deviance 3397.08    3.87 3394.30 3395.24 3396.39 3398.14 3403.03 1.12  3000
##
## For each parameter, n.eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor (at convergence, Rhat=1).
##
## DIC info (using the rule, pD = var(deviance)/2)
## pD = 7.5 and DIC = 3404.6
## DIC is an estimate of expected predictive error (lower deviance is better).
```

```r
m <- lm(mean.density ~ elevation, hares)
summary(m)
```

```
##
## Call:
## lm(formula = mean.density ~ elevation, data = hares)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -4.636 -2.804 -1.121  1.664 17.294
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.8932139  1.2907686   3.791 0.000165 ***
## elevation   -0.0002183  0.0028707  -0.076 0.939405
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.951 on 606 degrees of freedom
## Multiple R-squared:  9.544e-06,  Adjusted R-squared:  -0.001641
## F-statistic: 0.005783 on 1 and 606 DF,  p-value: 0.9394
```

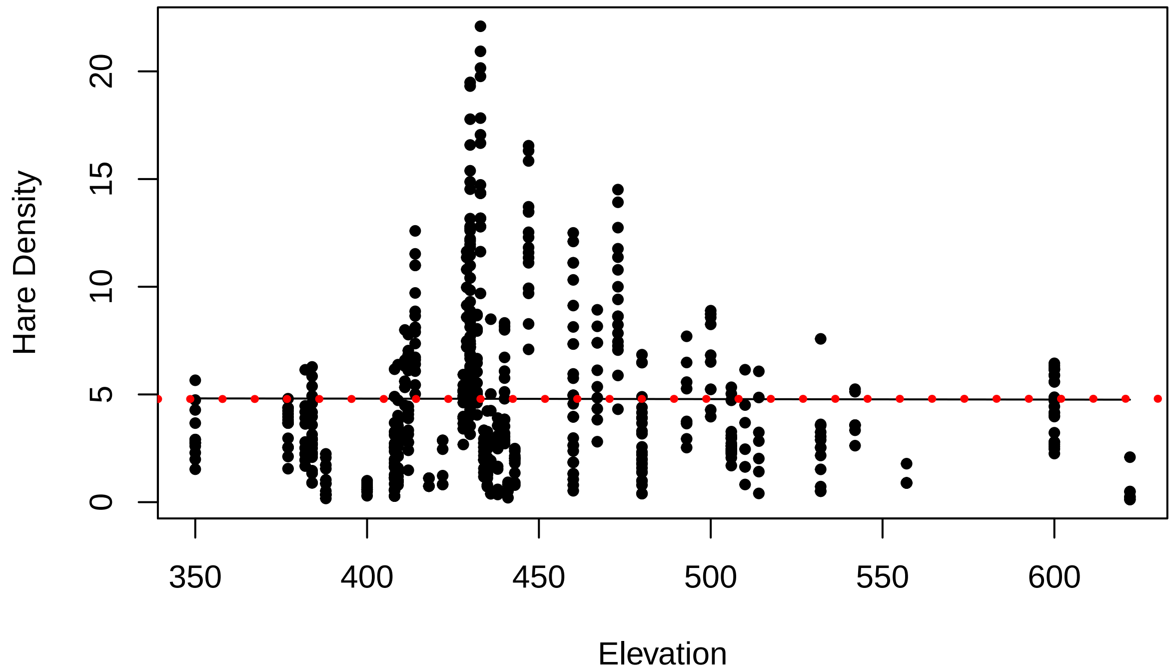
```r
elevation_p <- seq(min(hares$elevation), max(hares$elevation),length.out = length(hares$elevation))

elevation_preds <- m$coefficients[1] + m$coefficients[2]*elevation_p



plot(hares$mean.density ~ hares$elevation,
     ylab = "Hare Density",
     xlab = "Elevation",
     pch = 20)
lines(elevation_preds ~ elevation_p)
abline(a =out$BUGSoutput$mean$beta0,
```

```r
       b = out$BUGSoutput$mean$beta1,
       lwd = 4,lty = 3, col = "red")
```




```r
# plot. Bayes vs linear mocel from above. Black is truth, blue is lm, red is bayes
```

BONUS

Fit a means parameterization of a t-test in JAGS, either to the Swiss hares data, simulation data, or your own data. Hint: see page 120-121 of Kéry 2010 regarding double indexing syntax

Ok I have no idea how to actually do this. I figured out the alpha indexing thing but couldn't get the equation quite right until class today. However, when I set up the matrix (d) it still down't look right. Is it a model issue or am I just setting up that matrix incorrectly?

```
bonus_hares <- hares_data %>%
        drop_na(landuse) %>%
        drop_na(mean.density )

for(i in 1:nrow(bonus_hares)){
        if(bonus_hares$landuse[i] == "arable"){
                bonus_hares$x[i] <- 1
        }
        else{ # if(bonus_hares$landuse[i] == "grass")
                bonus_hares$x[i] <- 2
        }
}

# bonus_hares
#
# data_sum <- bonus_hares  %>%
#         group_by(landuse) %>%
#         summarise_at(vars(mean.density), list(name = mean, sd))
#
# mu1 <- as.numeric(data_sum[1,2]) #Arable land mean
# mu2 <- as.numeric(data_sum[2,2]) #Grassland mean
#
# sigma1 <- as.numeric(data_sum[1,3]) #Arable land sd
# sigma2 <- as.numeric(data_sum[2,3]) #Grassland sd

#sink("HW4_bonusModel.txt")
cat("
    model {

    # PRIORS
    for(j in 1:nsites){
      alpha[j] ~ dnorm(0,0.001)
      tau[j] <- 1/sigma[j]^2
      sigma[j] ~ dunif(0,10)
    }

    # LIKELIHOOD
    for(i in 1:n){
      y[i] ~ dnorm(mu[i],tau[x[i]])

      #mu[i] <- alpha0 + alpha1*x[i]
      mu[i] <-  alpha[x[i]]

    }
```

```
    diff12 <- alpha[2] - alpha[1]

    for(i in 1:nsites){
    avg[i] <- (alpha[i]*stdev_data) + mean_data
    stan_dev[i] <- (sigma[i]*stdev_data)

    }
    } # end of model
    ",fill = TRUE)
```

```
##
##     model {
##
##     # PRIORS
##     for(j in 1:nsites){
##       alpha[j] ~ dnorm(0,0.001)
##       tau[j] <- 1/sigma[j]^2
##       sigma[j] ~ dunif(0,10)
##     }
##
##     # LIKELIHOOD
##     for(i in 1:n){
##       y[i] ~ dnorm(mu[i],tau[x[i]])
##
##       #mu[i] <- alpha0 + alpha1*x[i]
##       mu[i] <-  alpha[x[i]]
##
##     }
##
##     diff12 <- alpha[2] - alpha[1]
##
##     for(i in 1:nsites){
##     avg[i] <- (alpha[i]*stdev_data) + mean_data
##     stan_dev[i] <- (sigma[i]*stdev_data)
##
##     }
##     } # end of model
##
```

```
#sink()

win.data <- list(y= bonus_hares$mean.density,
                 n = nrow(bonus_hares),
                 x = bonus_hares$x,
                 nsites = length(unique(bonus_hares$x)),#This is just going to be 2
                 stdev_data = sd(bonus_hares$mean.density),
                 mean_data = mean(bonus_hares$mean.density))

# Initial values
inits <- function()list(alpha = rnorm(length(unique(bonus_hares$x))),
                        sigma = rlnorm(length(unique(bonus_hares$x))))

# Parameters monitored
```

```r
params <- c("alpha",
            "sigma",
            "diff12",
            "avg",
            "stan_dev"
)

# MCMC settings
ni <- 10000; nt <- 1; nb <- 1000; nc <- 3


out <- jags(win.data, inits, params, "HW4_bonusModel.txt",
            n.chains = nc, n.thin = nt, n.iter = ni, n.burnin = nb,
            working.directory = getwd())
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 677
##    Unobserved stochastic nodes: 4
##    Total graph size: 1378
##
## Initializing model
```

```r
print(out, dig = 2)
```

```
## Inference for Bugs model at "HW4_bonusModel.txt", fit using jags,
##  3 chains, each with 10000 iterations (first 1000 discarded)
##  n.sims = 27000 iterations saved
##             mu.vect sd.vect    2.5%     25%     50%     75%   97.5% Rhat n.eff
## alpha[1]       5.33    0.18    4.98    5.21    5.33    5.46    5.69    1 27000
## alpha[2]       3.19    0.18    2.83    3.06    3.19    3.31    3.55    1 27000
## avg[1]        25.09    0.70   23.74   24.62   25.08   25.56   26.46    1 27000
## avg[2]        16.91    0.70   15.53   16.43   16.91   17.38   18.28    1 27000
## diff12        -2.14    0.26   -2.65   -2.32   -2.14   -1.97   -1.64    1 27000
## sigma[1]       4.07    0.13    3.82    3.98    4.07    4.16    4.34    1 16000
## sigma[2]       2.53    0.13    2.28    2.44    2.52    2.61    2.80    1 10000
## stan_dev[1]   15.54    0.50   14.59   15.20   15.53   15.87   16.56    1 16000
## stan_dev[2]    9.64    0.51    8.71    9.30    9.62    9.97   10.71    1 10000
## deviance    3639.88    2.90 3636.31 3637.78 3639.21 3641.25 3647.26    1  5000
##
## For each parameter, n.eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor (at convergence, Rhat=1).
##
## DIC info (using the rule, pD = var(deviance)/2)
## pD = 4.2 and DIC = 3644.1
## DIC is an estimate of expected predictive error (lower deviance is better).
```

```r
# FIX THISsee the full columns of the design matrix and linear algebra
d <- data.frame(density = round(bonus_hares$mean.density,1),
          int = rep(1,length(bonus_hares$mean.density)),
```

```r
          alpha1 = round(rep(out$BUGSoutput$mean$alpha[1], length(bonus_hares$mean.density)),1),
          landuse = bonus_hares$x,
          alpha2 = round(rep(out$BUGSoutput$mean$alpha[2], length(bonus_hares$mean.density)),1))
          #resid = round(out$BUGSoutput$mean$resid,1))

print(d)
```

```
##     density int alpha1 landuse alpha2
## 1       2.7   1    5.3       1    3.2
## 2       3.1   1    5.3       1    3.2
## 3       1.3   1    5.3       1    3.2
## 4       0.9   1    5.3       1    3.2
## 5       1.3   1    5.3       1    3.2
## 6       2.7   1    5.3       1    3.2
## 7       2.2   1    5.3       1    3.2
## 8       3.6   1    5.3       1    3.2
## 9       5.4   1    5.3       1    3.2
## 10      6.3   1    5.3       1    3.2
## 11      4.9   1    5.3       1    3.2
## 12      2.7   1    5.3       1    3.2
## 13      2.2   1    5.3       1    3.2
## 14      0.9   1    5.3       1    3.2
## 15      2.8   1    5.3       1    3.2
## 16      2.5   1    5.3       1    3.2
## 17      2.0   1    5.3       1    3.2
## 18      2.0   1    5.3       1    3.2
## 19      2.2   1    5.3       1    3.2
## 20      3.9   1    5.3       1    3.2
## 21      4.5   1    5.3       1    3.2
## 22      6.1   1    5.3       1    3.2
## 23      3.6   1    5.3       1    3.2
## 24      4.2   1    5.3       1    3.2
## 25      2.2   1    5.3       1    3.2
## 26      2.5   1    5.3       1    3.2
## 27      1.7   1    5.3       1    3.2
## 28      2.2   1    5.3       1    3.2
## 29      5.8   1    5.3       1    3.2
## 30      4.0   1    5.3       1    3.2
## 31      2.9   1    5.3       1    3.2
## 32      1.5   1    5.3       1    3.2
## 33      2.9   1    5.3       1    3.2
## 34      2.7   1    5.3       1    3.2
## 35      2.1   1    5.3       1    3.2
## 36      2.5   1    5.3       1    3.2
## 37      4.6   1    5.3       1    3.2
## 38      4.6   1    5.3       1    3.2
## 39      2.9   1    5.3       1    3.2
## 40      2.3   1    5.3       1    3.2
## 41      2.9   1    5.3       1    3.2
## 42      4.2   1    5.3       1    3.2
## 43      2.1   1    5.3       1    3.2
## 44      0.9   1    5.3       1    3.2
## 45      0.2   1    5.3       1    3.2
```

```
## 46       0.3   1    5.3        1    3.2
## 47       0.3   1    5.3        1    3.2
## 48       0.3   1    5.3        1    3.2
## 49       0.5   1    5.3        1    3.2
## 50       1.7   1    5.3        1    3.2
## 51       1.0   1    5.3        1    3.2
## 52       1.6   1    5.3        1    3.2
## 53       0.9   1    5.3        1    3.2
## 54       2.2   1    5.3        1    3.2
## 55       4.5   1    5.3        1    3.2
## 56       6.1   1    5.3        1    3.2
## 57       2.5   1    5.3        1    3.2
## 58       1.6   1    5.3        1    3.2
## 59       3.7   1    5.3        1    3.2
## 60       1.6   1    5.3        1    3.2
## 61       0.8   1    5.3        1    3.2
## 62       4.9   1    5.3        1    3.2
## 63       6.1   1    5.3        1    3.2
## 64       2.8   1    5.3        1    3.2
## 65       3.2   1    5.3        1    3.2
## 66       1.4   1    5.3        1    3.2
## 67       2.0   1    5.3        1    3.2
## 68       0.4   1    5.3        1    3.2
## 69       0.9   1    5.3        2    3.2
## 70       0.9   1    5.3        2    3.2
## 71       0.9   1    5.3        2    3.2
## 72       0.9   1    5.3        2    3.2
## 73       1.8   1    5.3        2    3.2
## 74       2.5   1    5.3        1    3.2
## 75       3.6   1    5.3        1    3.2
## 76       2.2   1    5.3        1    3.2
## 77       3.2   1    5.3        1    3.2
## 78       2.9   1    5.3        1    3.2
## 79       7.6   1    5.3        1    3.2
## 80       0.7   1    5.3        1    3.2
## 81       3.0   1    5.3        2    3.2
## 82       2.5   1    5.3        2    3.2
## 83       0.5   1    5.3        2    3.2
## 84       3.6   1    5.3        2    3.2
## 85       0.5   1    5.3        2    3.2
## 86       1.5   1    5.3        2    3.2
## 87       3.3   1    5.3        2    3.2
## 88       3.6   1    5.3        2    3.2
## 89       5.1   1    5.3        2    3.2
## 90       5.2   1    5.3        2    3.2
## 91       3.6   1    5.3        2    3.2
## 92       3.6   1    5.3        2    3.2
## 93       2.6   1    5.3        2    3.2
## 94       2.9   1    5.3        1    3.2
## 95       3.3   1    5.3        1    3.2
## 96       3.3   1    5.3        1    3.2
## 97       1.6   1    5.3        1    3.2
## 98       2.5   1    5.3        1    3.2
## 99       2.0   1    5.3        1    3.2
```

```
## 100      2.4   1     5.3         1     3.2
## 101      2.0   1     5.3         1     3.2
## 102      2.7   1     5.3         1     3.2
## 103      2.5   1     5.3         1     3.2
## 104      1.2   1     5.3         1     3.2
## 105      2.2   1     5.3         1     3.2
## 106      1.4   1     5.3         1     3.2
## 107      2.0   1     5.3         1     3.2
## 108      2.0   1     5.3         1     3.2
## 109      2.7   1     5.3         1     3.2
## 110      8.0   1     5.3         1     3.2
## 111      8.0   1     5.3         1     3.2
## 112      8.7   1     5.3         1     3.2
## 113      8.7   1     5.3         1     3.2
## 114      7.9   1     5.3         1     3.2
## 115      5.5   1     5.3         1     3.2
## 116      5.0   1     5.3         1     3.2
## 117      5.1   1     5.3         1     3.2
## 118      4.0   1     5.3         1     3.2
## 119      5.0   1     5.3         1     3.2
## 120      6.0   1     5.3         1     3.2
## 121      6.7   1     5.3         1     3.2
## 122      4.6   1     5.3         1     3.2
## 123      6.5   1     5.3         1     3.2
## 124     19.8   1     5.3         1     3.2
## 125     13.2   1     5.3         1     3.2
## 126     20.9   1     5.3         1     3.2
## 127     17.1   1     5.3         1     3.2
## 128     14.3   1     5.3         1     3.2
## 129     17.8   1     5.3         1     3.2
## 130     20.2   1     5.3         1     3.2
## 131     22.1   1     5.3         1     3.2
## 132     14.3   1     5.3         1     3.2
## 133     13.2   1     5.3         1     3.2
## 134     14.7   1     5.3         1     3.2
## 135     16.7   1     5.3         1     3.2
## 136     14.3   1     5.3         1     3.2
## 137     12.8   1     5.3         1     3.2
## 138     12.8   1     5.3         1     3.2
## 139      9.7   1     5.3         1     3.2
## 140     11.6   1     5.3         1     3.2
## 141      3.2   1     5.3         1     3.2
## 142      4.6   1     5.3         1     3.2
## 143      4.0   1     5.3         1     3.2
## 144      4.6   1     5.3         1     3.2
## 145      5.7   1     5.3         1     3.2
## 146      6.9   1     5.3         1     3.2
## 147     11.5   1     5.3         1     3.2
## 148      8.9   1     5.3         1     3.2
## 149      8.6   1     5.3         1     3.2
## 150      7.2   1     5.3         1     3.2
## 151      6.3   1     5.3         1     3.2
## 152      4.3   1     5.3         1     3.2
## 153      6.3   1     5.3         1     3.2
```

```
## 154      4.9   1    5.3        1    3.2
## 155      5.4   1    5.3        1    3.2
## 156      4.6   1    5.3        1    3.2
## 157      5.4   1    5.3        1    3.2
## 158      3.5   1    5.3        1    3.2
## 159      4.7   1    5.3        1    3.2
## 160      4.8   1    5.3        1    3.2
## 161      4.2   1    5.3        1    3.2
## 162      4.7   1    5.3        1    3.2
## 163      6.8   1    5.3        1    3.2
## 164      8.1   1    5.3        1    3.2
## 165      9.3   1    5.3        1    3.2
## 166      7.5   1    5.3        1    3.2
## 167      7.2   1    5.3        1    3.2
## 168      7.2   1    5.3        1    3.2
## 169      7.3   1    5.3        1    3.2
## 170      6.2   1    5.3        1    3.2
## 171      7.2   1    5.3        1    3.2
## 172      4.8   1    5.3        1    3.2
## 173      2.0   1    5.3        1    3.2
## 174      1.8   1    5.3        1    3.2
## 175      0.8   1    5.3        1    3.2
## 176      1.4   1    5.3        1    3.2
## 177      1.8   1    5.3        1    3.2
## 178      3.2   1    5.3        1    3.2
## 179      1.6   1    5.3        1    3.2
## 180      1.0   1    5.3        1    3.2
## 181      1.4   1    5.3        1    3.2
## 182      2.0   1    5.3        1    3.2
## 183      1.0   1    5.3        1    3.2
## 184      0.4   1    5.3        1    3.2
## 185      0.4   1    5.3        1    3.2
## 186      2.2   1    5.3        1    3.2
## 187      3.9   1    5.3        1    3.2
## 188      4.4   1    5.3        1    3.2
## 189      3.9   1    5.3        1    3.2
## 190      6.5   1    5.3        1    3.2
## 191      6.5   1    5.3        1    3.2
## 192      6.8   1    5.3        1    3.2
## 193      4.2   1    5.3        1    3.2
## 194      4.9   1    5.3        1    3.2
## 195      3.3   1    5.3        1    3.2
## 196      2.3   1    5.3        1    3.2
## 197      2.6   1    5.3        1    3.2
## 198      3.7   1    5.3        1    3.2
## 199      2.5   1    5.3        1    3.2
## 200      2.9   1    5.3        1    3.2
## 201      3.7   1    5.3        1    3.2
## 202      5.3   1    5.3        1    3.2
## 203      5.6   1    5.3        1    3.2
## 204      7.7   1    5.3        1    3.2
## 205      6.5   1    5.3        1    3.2
## 206      3.6   1    5.3        1    3.2
## 207      8.5   1    5.3        1    3.2
```

```
## 208      5.0   1    5.3        1    3.2
## 209      4.2   1    5.3        1    3.2
## 210      5.0   1    5.3        1    3.2
## 211      2.7   1    5.3        1    3.2
## 212      1.9   1    5.3        1    3.2
## 213      0.4   1    5.3        1    3.2
## 214      2.9   1    5.3        1    3.2
## 215      2.5   1    5.3        1    3.2
## 216      1.2   1    5.3        1    3.2
## 217      0.8   1    5.3        1    3.2
## 218      0.8   1    5.3        1    3.2
## 219      2.9   1    5.3        1    3.2
## 220      2.8   1    5.3        1    3.2
## 221      2.3   1    5.3        1    3.2
## 222      2.8   1    5.3        1    3.2
## 223      2.9   1    5.3        1    3.2
## 224      4.7   1    5.3        1    3.2
## 225      5.7   1    5.3        1    3.2
## 226      4.3   1    5.3        1    3.2
## 227      3.7   1    5.3        1    3.2
## 228      2.6   1    5.3        1    3.2
## 229      2.9   1    5.3        1    3.2
## 230      1.5   1    5.3        1    3.2
## 231      2.8   1    5.3        1    3.2
## 232      2.0   1    5.3        1    3.2
## 233      4.7   1    5.3        2    3.2
## 234      4.7   1    5.3        2    3.2
## 235      4.2   1    5.3        2    3.2
## 236      4.7   1    5.3        2    3.2
## 237      4.9   1    5.3        2    3.2
## 238      4.2   1    5.3        2    3.2
## 239      4.0   1    5.3        2    3.2
## 240      6.2   1    5.3        2    3.2
## 241      5.9   1    5.3        2    3.2
## 242      4.4   1    5.3        2    3.2
## 243      6.2   1    5.3        2    3.2
## 244      5.6   1    5.3        2    3.2
## 245      6.2   1    5.3        2    3.2
## 246      0.8   1    5.3        2    3.2
## 247      0.5   1    5.3        2    3.2
## 248      0.3   1    5.3        2    3.2
## 249      0.5   1    5.3        2    3.2
## 250      0.7   1    5.3        2    3.2
## 251      0.6   1    5.3        2    3.2
## 252      0.6   1    5.3        2    3.2
## 253      0.6   1    5.3        2    3.2
## 254      0.9   1    5.3        2    3.2
## 255      0.7   1    5.3        2    3.2
## 256      0.6   1    5.3        2    3.2
## 257      1.0   1    5.3        2    3.2
## 258      1.0   1    5.3        2    3.2
## 259      0.9   1    5.3        1    3.2
## 260      0.8   1    5.3        1    3.2
## 261      1.8   1    5.3        1    3.2
```

```
## 262      1.9   1    5.3        1    3.2
## 263      2.4   1    5.3        1    3.2
## 264      1.4   1    5.3        1    3.2
## 265      2.5   1    5.3        1    3.2
## 266      2.1   1    5.3        1    3.2
## 267      2.0   1    5.3        1    3.2
## 268      2.0   1    5.3        1    3.2
## 269      0.2   1    5.3        1    3.2
## 270      0.9   1    5.3        1    3.2
## 271      0.8   1    5.3        1    3.2
## 272      0.8   1    5.3        1    3.2
## 273      0.5   1    5.3        1    3.2
## 274      0.6   1    5.3        1    3.2
## 275      0.4   1    5.3        1    3.2
## 276      1.5   1    5.3        1    3.2
## 277      1.7   1    5.3        1    3.2
## 278      3.0   1    5.3        1    3.2
## 279      2.5   1    5.3        1    3.2
## 280      3.9   1    5.3        1    3.2
## 281      3.6   1    5.3        1    3.2
## 282      3.1   1    5.3        1    3.2
## 283      2.8   1    5.3        1    3.2
## 284      7.4   1    5.3        1    3.2
## 285      7.7   1    5.3        1    3.2
## 286      8.7   1    5.3        1    3.2
## 287      8.5   1    5.3        1    3.2
## 288      4.6   1    5.3        1    3.2
## 289      6.7   1    5.3        1    3.2
## 290      8.4   1    5.3        1    3.2
## 291     12.1   1    5.3        1    3.2
## 292     16.6   1    5.3        1    3.2
## 293     17.8   1    5.3        1    3.2
## 294     14.9   1    5.3        1    3.2
## 295     12.0   1    5.3        1    3.2
## 296     15.4   1    5.3        1    3.2
## 297     19.5   1    5.3        1    3.2
## 298     19.3   1    5.3        1    3.2
## 299     14.5   1    5.3        1    3.2
## 300     13.2   1    5.3        1    3.2
## 301      8.6   1    5.3        1    3.2
## 302     11.4   1    5.3        1    3.2
## 303      9.4   1    5.3        1    3.2
## 304     10.8   1    5.3        1    3.2
## 305      7.3   1    5.3        1    3.2
## 306      7.5   1    5.3        1    3.2
## 307      7.1   1    5.3        1    3.2
## 308      8.6   1    5.3        1    3.2
## 309      7.8   1    5.3        1    3.2
## 310      5.9   1    5.3        1    3.2
## 311      4.3   1    5.3        1    3.2
## 312      8.2   1    5.3        1    3.2
## 313     10.0   1    5.3        1    3.2
## 314     11.8   1    5.3        1    3.2
## 315     13.9   1    5.3        1    3.2
```

```
## 316    12.7   1    5.3        1    3.2
## 317    14.5   1    5.3        1    3.2
## 318     9.7   1    5.3        1    3.2
## 319    11.1   1    5.3        1    3.2
## 320    11.6   1    5.3        1    3.2
## 321     8.3   1    5.3        1    3.2
## 322     7.1   1    5.3        1    3.2
## 323    11.3   1    5.3        1    3.2
## 324    12.5   1    5.3        1    3.2
## 325     9.9   1    5.3        1    3.2
## 326    11.8   1    5.3        1    3.2
## 327    13.7   1    5.3        1    3.2
## 328    13.5   1    5.3        1    3.2
## 329    15.8   1    5.3        1    3.2
## 330    13.5   1    5.3        1    3.2
## 331    16.3   1    5.3        1    3.2
## 332    16.5   1    5.3        1    3.2
## 333    12.3   1    5.3        1    3.2
## 334     1.2   1    5.3        2    3.2
## 335     1.4   1    5.3        2    3.2
## 336     2.6   1    5.3        2    3.2
## 337     2.8   1    5.3        2    3.2
## 338     1.0   1    5.3        2    3.2
## 339     0.8   1    5.3        2    3.2
## 340     1.4   1    5.3        2    3.2
## 341     1.0   1    5.3        2    3.2
## 342     1.4   1    5.3        2    3.2
## 343     1.0   1    5.3        2    3.2
## 344     2.2   1    5.3        2    3.2
## 345     1.0   1    5.3        2    3.2
## 346     1.4   1    5.3        2    3.2
## 347     1.6   1    5.3        2    3.2
## 348     2.0   1    5.3        2    3.2
## 349     1.1   1    5.3        2    3.2
## 350     3.7   1    5.3        2    3.2
## 351     2.5   1    5.3        2    3.2
## 352     3.1   1    5.3        2    3.2
## 353     0.6   1    5.3        2    3.2
## 354     1.1   1    5.3        2    3.2
## 355     1.1   1    5.3        2    3.2
## 356     0.6   1    5.3        2    3.2
## 357     0.3   1    5.3        2    3.2
## 358     0.3   1    5.3        2    3.2
## 359     0.8   1    5.3        2    3.2
## 360     1.1   1    5.3        2    3.2
## 361     0.6   1    5.3        2    3.2
## 362     0.6   1    5.3        2    3.2
## 363     0.3   1    5.3        2    3.2
## 364     6.2   1    5.3        2    3.2
## 365     4.9   1    5.3        2    3.2
## 366     2.4   1    5.3        2    3.2
## 367     1.3   1    5.3        2    3.2
## 368     2.5   1    5.3        2    3.2
## 369     1.6   1    5.3        2    3.2
```

```
## 370      2.7   1    5.3        2    3.2
## 371      1.6   1    5.3        2    3.2
## 372      3.3   1    5.3        2    3.2
## 373      1.6   1    5.3        2    3.2
## 374      1.8   1    5.3        2    3.2
## 375      2.5   1    5.3        2    3.2
## 376      0.5   1    5.3        2    3.2
## 377      1.1   1    5.3        2    3.2
## 378      0.5   1    5.3        2    3.2
## 379      1.6   1    5.3        2    3.2
## 380      4.7   1    5.3        2    3.2
## 381      5.3   1    5.3        2    3.2
## 382      5.0   1    5.3        2    3.2
## 383      3.1   1    5.3        2    3.2
## 384      2.7   1    5.3        2    3.2
## 385      1.7   1    5.3        2    3.2
## 386      2.5   1    5.3        2    3.2
## 387      2.4   1    5.3        2    3.2
## 388      2.6   1    5.3        2    3.2
## 389      2.3   1    5.3        2    3.2
## 390      2.2   1    5.3        2    3.2
## 391      2.1   1    5.3        2    3.2
## 392      2.4   1    5.3        2    3.2
## 393      2.6   1    5.3        2    3.2
## 394      3.3   1    5.3        2    3.2
## 395      3.0   1    5.3        2    3.2
## 396      3.0   1    5.3        2    3.2
## 397      0.7   1    5.3        2    3.2
## 398      1.9   1    5.3        2    3.2
## 399      2.2   1    5.3        2    3.2
## 400      1.4   1    5.3        2    3.2
## 401      1.2   1    5.3        2    3.2
## 402      1.5   1    5.3        2    3.2
## 403      1.9   1    5.3        2    3.2
## 404      2.4   1    5.3        2    3.2
## 405      6.2   1    5.3        2    3.2
## 406      5.0   1    5.3        2    3.2
## 407      3.8   1    5.3        2    3.2
## 408      1.2   1    5.3        2    3.2
## 409      4.7   1    5.3        2    3.2
## 410      3.5   1    5.3        2    3.2
## 411      1.8   1    5.3        2    3.2
## 412      1.6   1    5.3        2    3.2
## 413      2.1   1    5.3        2    3.2
## 414      1.2   1    5.3        2    3.2
## 415      1.4   1    5.3        2    3.2
## 416      1.8   1    5.3        2    3.2
## 417      2.9   1    5.3        2    3.2
## 418      1.8   1    5.3        2    3.2
## 419      8.0   1    5.3        2    3.2
## 420      6.6   1    5.3        2    3.2
## 421      4.5   1    5.3        2    3.2
## 422      5.6   1    5.3        2    3.2
## 423      5.6   1    5.3        2    3.2
```

```
## 424      6.3   1     5.3         2    3.2
## 425      5.3   1     5.3         2    3.2
## 426      3.2   1     5.3         2    3.2
## 427      2.9   1     5.3         2    3.2
## 428     12.6   1     5.3         2    3.2
## 429      8.1   1     5.3         2    3.2
## 430      7.4   1     5.3         2    3.2
## 431      8.1   1     5.3         2    3.2
## 432      6.6   1     5.3         2    3.2
## 433      5.0   1     5.3         2    3.2
## 434      6.1   1     5.3         2    3.2
## 435      5.4   1     5.3         2    3.2
## 436      6.4   1     5.3         2    3.2
## 437      6.7   1     5.3         2    3.2
## 438      8.6   1     5.3         2    3.2
## 439      8.9   1     5.3         2    3.2
## 440      7.9   1     5.3         2    3.2
## 441      9.7   1     5.3         2    3.2
## 442     11.0   1     5.3         2    3.2
## 443     11.5   1     5.3         2    3.2
## 444     11.0   1     5.3         2    3.2
## 445      3.8   1     5.3         2    3.2
## 446      4.7   1     5.3         2    3.2
## 447      6.4   1     5.3         2    3.2
## 448      3.5   1     5.3         2    3.2
## 449      4.0   1     5.3         2    3.2
## 450      3.3   1     5.3         2    3.2
## 451      2.1   1     5.3         2    3.2
## 452      2.1   1     5.3         2    3.2
## 453      0.9   1     5.3         2    3.2
## 454      7.0   1     5.3         2    3.2
## 455      3.9   1     5.3         2    3.2
## 456      4.1   1     5.3         2    3.2
## 457      6.5   1     5.3         2    3.2
## 458      7.8   1     5.3         2    3.2
## 459      6.9   1     5.3         2    3.2
## 460      6.3   1     5.3         2    3.2
## 461      4.4   1     5.3         2    3.2
## 462      6.1   1     5.3         2    3.2
## 463      3.3   1     5.3         2    3.2
## 464      4.3   1     5.3         2    3.2
## 465      2.4   1     5.3         2    3.2
## 466      2.8   1     5.3         2    3.2
## 467      1.5   1     5.3         2    3.2
## 468      4.3   1     5.3         2    3.2
## 469      3.1   1     5.3         2    3.2
## 470      2.8   1     5.3         2    3.2
## 471      5.1   1     5.3         1    3.2
## 472      4.6   1     5.3         1    3.2
## 473      3.9   1     5.3         1    3.2
## 474      3.4   1     5.3         1    3.2
## 475      3.6   1     5.3         1    3.2
## 476      2.7   1     5.3         1    3.2
## 477      4.0   1     5.3         1    3.2
```

```
## 478      4.9   1    5.3         1    3.2
## 479      5.2   1    5.3         1    3.2
## 480      4.9   1    5.3         1    3.2
## 481      5.2   1    5.3         1    3.2
## 482      5.9   1    5.3         1    3.2
## 483      5.4   1    5.3         1    3.2
## 484      4.6   1    5.3         1    3.2
## 485      6.0   1    5.3         1    3.2
## 486      7.3   1    5.3         1    3.2
## 487      5.0   1    5.3         1    3.2
## 488      5.0   1    5.3         1    3.2
## 489      5.8   1    5.3         1    3.2
## 490      4.0   1    5.3         1    3.2
## 491      3.0   1    5.3         1    3.2
## 492      5.0   1    5.3         1    3.2
## 493      7.3   1    5.3         1    3.2
## 494      8.1   1    5.3         1    3.2
## 495     10.3   1    5.3         1    3.2
## 496     12.1   1    5.3         1    3.2
## 497     11.1   1    5.3         1    3.2
## 498      9.1   1    5.3         1    3.2
## 499     11.1   1    5.3         1    3.2
## 500     12.5   1    5.3         1    3.2
## 501      0.5   1    5.3         1    3.2
## 502      1.8   1    5.3         1    3.2
## 503      0.8   1    5.3         1    3.2
## 504      1.8   1    5.3         1    3.2
## 505      2.6   1    5.3         1    3.2
## 506      1.3   1    5.3         1    3.2
## 507      1.3   1    5.3         1    3.2
## 508      1.1   1    5.3         1    3.2
## 509      4.0   1    5.3         1    3.2
## 510      1.8   1    5.3         1    3.2
## 511      2.6   1    5.3         1    3.2
## 512      2.4   1    5.3         1    3.2
## 513      4.0   1    5.3         1    3.2
## 514      6.8   1    5.3         1    3.2
## 515      4.3   1    5.3         1    3.2
## 516      4.0   1    5.3         1    3.2
## 517      5.2   1    5.3         1    3.2
## 518      5.2   1    5.3         1    3.2
## 519      8.9   1    5.3         1    3.2
## 520      6.5   1    5.3         1    3.2
## 521      8.3   1    5.3         1    3.2
## 522      8.7   1    5.3         1    3.2
## 523      8.6   1    5.3         1    3.2
## 524      4.0   1    5.3         1    3.2
## 525      4.2   1    5.3         1    3.2
## 526      2.7   1    5.3         1    3.2
## 527      5.0   1    5.3         1    3.2
## 528      5.5   1    5.3         1    3.2
## 529      4.2   1    5.3         1    3.2
## 530      4.8   1    5.3         1    3.2
## 531      5.0   1    5.3         1    3.2
```

```
## 532      6.7   1    5.3        1    3.2
## 533      5.7   1    5.3        1    3.2
## 534      5.9   1    5.3        1    3.2
## 535      6.9   1    5.3        1    3.2
## 536      3.8   1    5.3        1    3.2
## 537      4.4   1    5.3        1    3.2
## 538      2.7   1    5.3        1    3.2
## 539      7.0   1    5.3        1    3.2
## 540     10.0   1    5.3        1    3.2
## 541      8.6   1    5.3        1    3.2
## 542      5.5   1    5.3        1    3.2
## 543     11.4   1    5.3        1    3.2
## 544      5.3   1    5.3        1    3.2
## 545      7.5   1    5.3        1    3.2
## 546     10.8   1    5.3        1    3.2
## 547     11.6   1    5.3        1    3.2
## 548      9.1   1    5.3        1    3.2
## 549      7.2   1    5.3        1    3.2
## 550      9.8   1    5.3        1    3.2
## 551      8.7   1    5.3        1    3.2
## 552     11.0   1    5.3        1    3.2
## 553     12.2   1    5.3        1    3.2
## 554     11.8   1    5.3        1    3.2
## 555     12.8   1    5.3        1    3.2
## 556     12.7   1    5.3        1    3.2
## 557     10.4   1    5.3        1    3.2
## 558     12.6   1    5.3        1    3.2
## 559     10.4   1    5.3        1    3.2
## 560      8.4   1    5.3        1    3.2
## 561      7.8   1    5.3        1    3.2
## 562      5.0   1    5.3        1    3.2
## 563      5.8   1    5.3        1    3.2
## 564      6.0   1    5.3        1    3.2
## 565      4.3   1    5.3        1    3.2
## 566      6.2   1    5.3        1    3.2
## 567      7.0   1    5.3        1    3.2
## 568      8.3   1    5.3        1    3.2
## 569     10.5   1    5.3        1    3.2
## 570      9.0   1    5.3        1    3.2
## 571      6.0   1    5.3        1    3.2
## 572      5.6   1    5.3        1    3.2
## 573      4.9   1    5.3        1    3.2
## 574      2.3   1    5.3        1    3.2
## 575      2.6   1    5.3        1    3.2
## 576      1.9   1    5.3        1    3.2
## 577      3.4   1    5.3        1    3.2
## 578      1.9   1    5.3        1    3.2
## 579      1.1   1    5.3        1    3.2
## 580      0.8   1    5.3        1    3.2
## 581      3.0   1    5.3        1    3.2
## 582      3.8   1    5.3        1    3.2
## 583      5.6   1    5.3        1    3.2
## 584      0.7   1    5.3        1    3.2
## 585      0.7   1    5.3        1    3.2
```

```
## 586     1.1   1    5.3        1    3.2
## 587     1.1   1    5.3        1    3.2
## 588     0.7   1    5.3        1    3.2
## 589     1.1   1    5.3        1    3.2
## 590     6.7   1    5.3        1    3.2
## 591     6.1   1    5.3        1    3.2
## 592     8.0   1    5.3        1    3.2
## 593     8.3   1    5.3        1    3.2
## 594     5.8   1    5.3        1    3.2
## 595     4.8   1    5.3        1    3.2
## 596     2.9   1    5.3        1    3.2
## 597     2.7   1    5.3        1    3.2
## 598     2.7   1    5.3        1    3.2
## 599     3.0   1    5.3        1    3.2
## 600     3.8   1    5.3        1    3.2
## 601     3.8   1    5.3        1    3.2
## 602     3.5   1    5.3        1    3.2
## 603     3.2   1    5.3        1    3.2
## 604     3.8   1    5.3        1    3.2
## 605     5.1   1    5.3        1    3.2
## 606     8.2   1    5.3        1    3.2
## 607     3.0   1    5.3        1    3.2
## 608     1.8   1    5.3        1    3.2
## 609     1.8   1    5.3        1    3.2
## 610     1.6   1    5.3        1    3.2
## 611     1.1   1    5.3        1    3.2
## 612     1.8   1    5.3        1    3.2
## 613     0.7   1    5.3        1    3.2
## 614     0.8   1    5.3        1    3.2
## 615     1.4   1    5.3        1    3.2
## 616     1.4   1    5.3        1    3.2
## 617     1.3   1    5.3        1    3.2
## 618     1.3   1    5.3        1    3.2
## 619     2.5   1    5.3        1    3.2
## 620     3.3   1    5.3        1    3.2
## 621     3.0   1    5.3        1    3.2
## 622     2.1   1    5.3        1    3.2
## 623     4.2   1    5.3        1    3.2
## 624     2.6   1    5.3        1    3.2
## 625     2.5   1    5.3        1    3.2
## 626     2.8   1    5.3        1    3.2
## 627     2.8   1    5.3        1    3.2
## 628     6.4   1    5.3        1    3.2
## 629     5.6   1    5.3        1    3.2
## 630     6.2   1    5.3        1    3.2
## 631     4.0   1    5.3        1    3.2
## 632     3.2   1    5.3        1    3.2
## 633     2.3   1    5.3        1    3.2
## 634     2.7   1    5.3        1    3.2
## 635     5.9   1    5.3        1    3.2
## 636     4.8   1    5.3        1    3.2
## 637     6.3   1    5.3        1    3.2
## 638     4.4   1    5.3        1    3.2
## 639     4.4   1    5.3        1    3.2
```

```
## 640      3.7   1    5.3        1    3.2
## 641      2.1   1    5.3        1    3.2
## 642      3.0   1    5.3        1    3.2
## 643      1.6   1    5.3        1    3.2
## 644      4.0   1    5.3        1    3.2
## 645      3.7   1    5.3        1    3.2
## 646      2.5   1    5.3        1    3.2
## 647      4.1   1    5.3        1    3.2
## 648      3.7   1    5.3        1    3.2
## 649      3.8   1    5.3        1    3.2
## 650      4.8   1    5.3        1    3.2
## 651      4.2   1    5.3        1    3.2
## 652      2.5   1    5.3        1    3.2
## 653      8.2   1    5.3        1    3.2
## 654      8.9   1    5.3        1    3.2
## 655      2.8   1    5.3        1    3.2
## 656      4.3   1    5.3        1    3.2
## 657      7.4   1    5.3        1    3.2
## 658      6.1   1    5.3        1    3.2
## 659      4.8   1    5.3        1    3.2
## 660      7.4   1    5.3        1    3.2
## 661      5.4   1    5.3        1    3.2
## 662      3.8   1    5.3        1    3.2
## 663      2.1   1    5.3        2    3.2
## 664      0.5   1    5.3        2    3.2
## 665      0.2   1    5.3        2    3.2
## 666      0.1   1    5.3        2    3.2
## 667      0.5   1    5.3        2    3.2
## 668      0.2   1    5.3        2    3.2
## 669      0.1   1    5.3        2    3.2
## 670      4.4   1    5.3        1    3.2
## 671      3.4   1    5.3        1    3.2
## 672      5.0   1    5.3        1    3.2
## 673      4.1   1    5.3        1    3.2
## 674      7.9   1    5.3        1    3.2
## 675      6.9   1    5.3        1    3.2
## 676      6.4   1    5.3        1    3.2
## 677      9.7   1    5.3        1    3.2
```