Homework 4 - Forecasting Numeric Data - Regression Methods

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Homework

1.Using the dataset provided (insurance.csv), follow the steps described in Chapter 6 (Forecasting Numeric Data - Regression Methods) (pages 172-186) "Example - predicting medical expenses using linear regression" and upload a document with your steps and results.

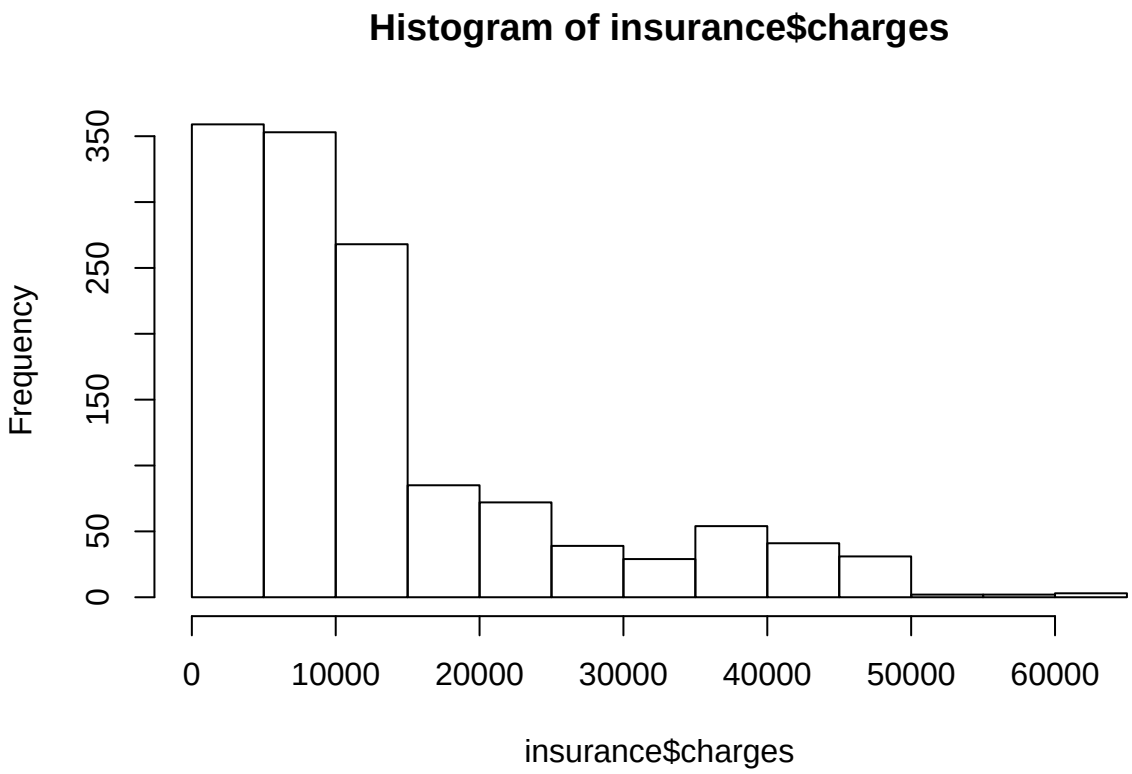
```
# Loads the dataset. Obs: stringsAsFactors are defaulted to TRUE so the option is not necessary.
insurance <- read.csv("insurance.csv")

# Confirming the dataset was loaded correctly.
str(insurance)
```

```
## 'data.frame':    1338 obs. of  7 variables:
##  $ age     : int  19 18 28 33 32 31 46 37 37 60 ...
##  $ sex     : Factor w/ 2 levels "female","male": 1 2 2 2 2 1 1 1 2 1 ...
##  $ bmi     : num  27.9 33.8 33 22.7 28.9 ...
##  $ children: int  0 1 3 0 0 0 1 3 2 0 ...
##  $ smoker  : Factor w/ 2 levels "no","yes": 2 1 1 1 1 1 1 1 1 1 ...
##  $ region  : Factor w/ 4 levels "northeast","northwest",..: 4 3 3 2 2 3 3 2 1 2 ...
##  $ charges : num  16885 1726 4449 21984 3867 ...
```

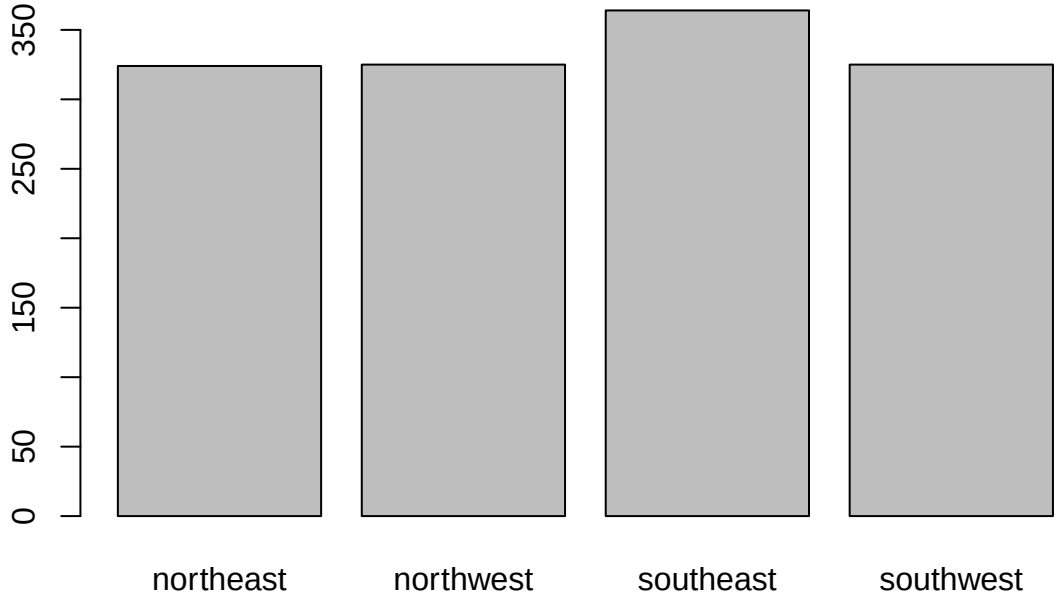
```
# Checking the basic statistics on the y (dependent) variable.
summary(insurance$charges)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1122    4740    9382   13270   16640   63770
```

```
# Checking the distribution. Obs.: The book's author states since the mean is different than the median
# the author premise is justified, as the y variable ideally should have a normal distribution and this
# Poisson distribution. This may require future adjustments or the use of the Poisson regression instea
hist(insurance$charges)
```



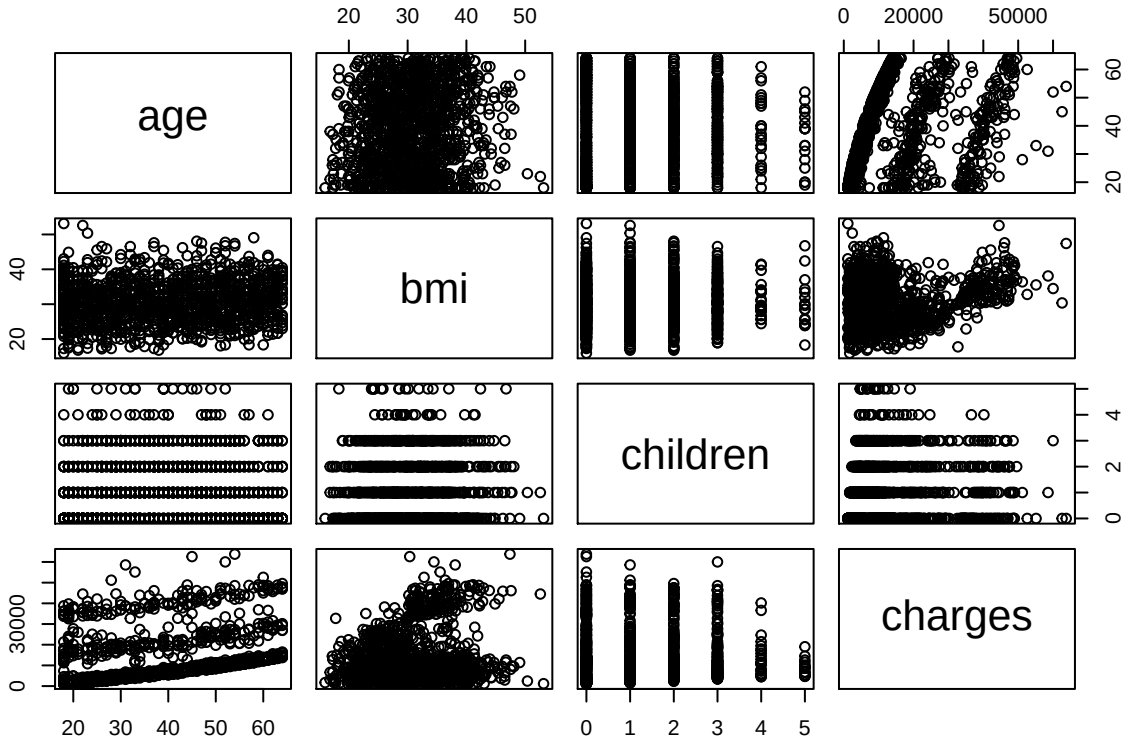

```
# Checking the distribuion of the data points through the regions.
barplot((table(insurance$region)))
```



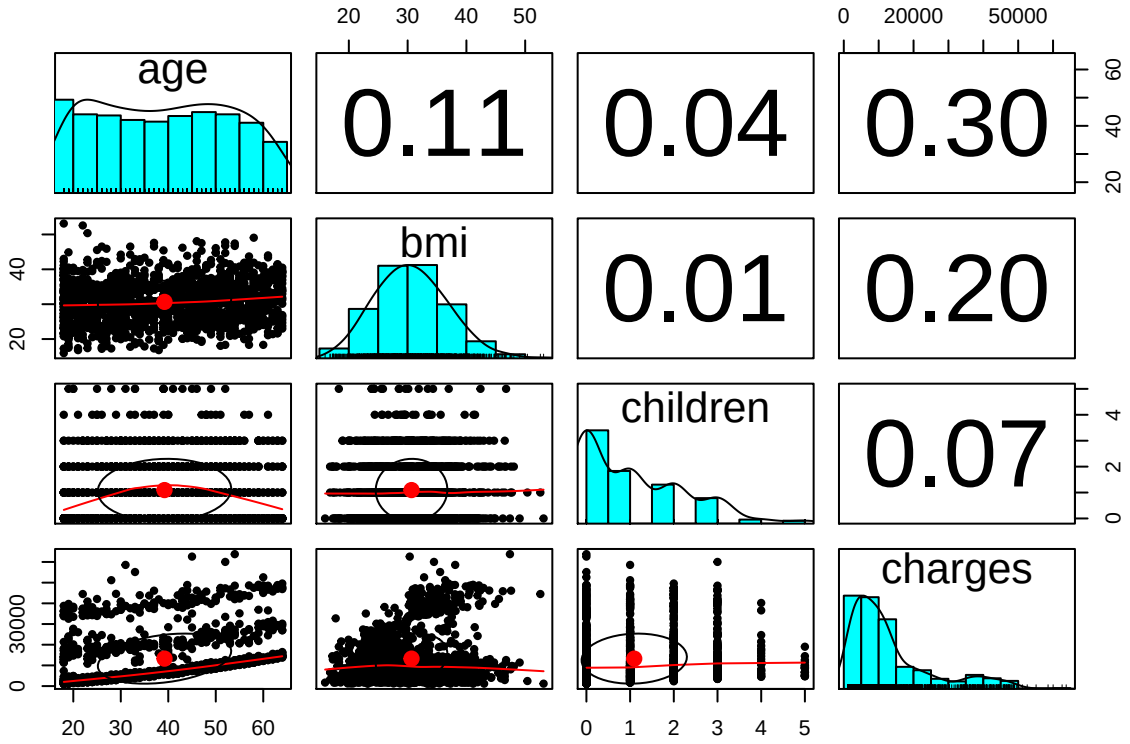

```
# Creating the correlation matrix, which can provide a good idea on what variables are or aren't suitab
cor(insurance[c("age", "bmi", "children", "charges")])
```

```
##                age       bmi   children    charges
## age      1.0000000 0.1092719 0.04246900 0.29900819
## bmi      0.1092719 1.0000000 0.01275890 0.19834097
## children 0.0424690 0.0127589 1.00000000 0.06799823
## charges  0.2990082 0.1983410 0.06799823 1.00000000
```

```
# Creating a scatterplot matrix (SPLOM) so that we can get insights on the relation between variables.
pairs(insurance[c("age", "bmi", "children", "charges")])
```




```
# This creates a combination of the correlation matrix and the SPLOM.
pairs.panels(insurance[c("age", "bmi", "children", "charges")])
```




```
# Building the linear model object in R. Note: it seems R automatically applies dummy variables for the
ins_model <- lm(charges ~ ., data = insurance)

# Checking the angular coefficients and significance levels.
summary(ins_model)
```

```
##
## Call:
## lm(formula = charges ~ ., data = insurance)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -11304.9  -2848.1   -982.1   1393.9  29992.8
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -11938.5      987.8 -12.086  < 2e-16 ***
## age                256.9       11.9  21.587  < 2e-16 ***
## sexmale           -131.3      332.9  -0.394 0.693348
## bmi                339.2       28.6  11.860  < 2e-16 ***
## children           475.5      137.8   3.451 0.000577 ***
## smokeryes        23848.5      413.1  57.723  < 2e-16 ***
## regionnorthwest   -353.0      476.3  -0.741 0.458769
## regionsoutheast  -1035.0      478.7  -2.162 0.030782 *
## regionsouthwest   -960.0      477.9  -2.009 0.044765 *
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6062 on 1329 degrees of freedom
## Multiple R-squared:  0.7509, Adjusted R-squared:  0.7494
## F-statistic: 500.8 on 8 and 1329 DF,  p-value: < 2.2e-16
```

```r
# Adding a quadratic factor for age to the equation
insurance$age2 <- insurance$age ^ 2

# Converting BMI to a binary variable
insurance$bmi30 <- ifelse(insurance$bmi >= 30, 1, 0)

# USEFUL NOTE: a*b operator is a shorthand for y ~ a + b + a:b
# Now, add the previous modifications together for the new model
ins_model2 <- lm(charges ~ age + age2 + children + bmi + sex + bmi30*smoker + region, data = insurance)

# Checking the angular coefficients and significance levels for the new model
summary(ins_model2)
```

```
##
## Call:
## lm(formula = charges ~ age + age2 + children + bmi + sex + bmi30 *
##     smoker + region, data = insurance)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -17296.4  -1656.0  -1263.3   -722.1  24160.2
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       134.2509  1362.7511   0.099 0.921539
## age               -32.6851    59.8242  -0.546 0.584915
## age2                3.7316     0.7463   5.000 6.50e-07 ***
## children          678.5612   105.8831   6.409 2.04e-10 ***
## bmi               120.0196    34.2660   3.503 0.000476 ***
## sexmale          -496.8245   244.3659  -2.033 0.042240 *
## bmi30           -1000.1403   422.8402  -2.365 0.018159 *
## smokeryes       13404.6866   439.9491  30.469  < 2e-16 ***
## regionnorthwest  -279.2038   349.2746  -0.799 0.424212
## regionsoutheast  -828.5467   351.6352  -2.356 0.018604 *
## regionsouthwest -1222.6437   350.5285  -3.488 0.000503 ***
## bmi30:smokeryes 19810.7533   604.6567  32.764  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4445 on 1326 degrees of freedom
## Multiple R-squared:  0.8664, Adjusted R-squared:  0.8653
## F-statistic: 781.7 on 11 and 1326 DF,  p-value: < 2.2e-16
```