3주차 과제

11기 명재성

August 28, 2020

```
rm(list=ls())
```

4.6.1 The Stock Market Data

```
library(ISLR)
names(Smarket)
```

```
## [1] "Year"      "Lag1"      "Lag2"      "Lag3"      "Lag4"      "Lag5"
## [7] "Volume"    "Today"     "Direction"
```

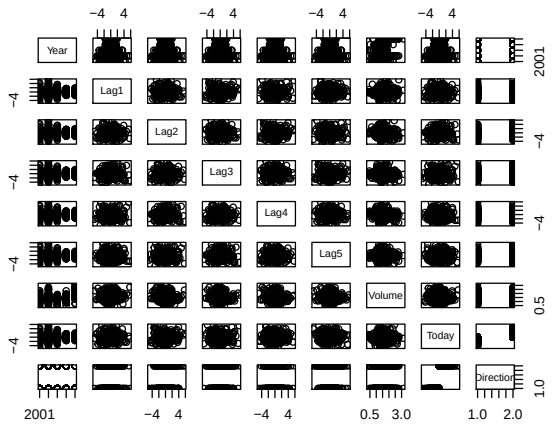
```
dim(Smarket)
```

```
## [1] 1250    9
```

```
summary(Smarket)
```

```
##       Year           Lag1                Lag2          
##  Min.   :2001   Min.   :-4.922000   Min.   :-4.922000  
##  1st Qu.:2002   1st Qu.:-0.639500   1st Qu.:-0.639500  
##  Median :2003   Median : 0.039000   Median : 0.039000  
##  Mean   :2003   Mean   : 0.003834   Mean   : 0.003919  
##  3rd Qu.:2004   3rd Qu.: 0.596750   3rd Qu.: 0.596750  
##  Max.   :2005   Max.   : 5.733000   Max.   : 5.733000  
##       Lag3                Lag4                Lag5          
##  Min.   :-4.922000   Min.   :-4.922000   Min.   :-4.92200  
##  1st Qu.:-0.640000   1st Qu.:-0.640000   1st Qu.:-0.64000  
##  Median : 0.038500   Median : 0.038500   Median : 0.03850  
##  Mean   : 0.001716   Mean   : 0.001636   Mean   : 0.00561  
##  3rd Qu.: 0.596750   3rd Qu.: 0.596750   3rd Qu.: 0.59700  
##  Max.   : 5.733000   Max.   : 5.733000   Max.   : 5.73300  
##      Volume           Today           Direction 
##  Min.   :0.3561   Min.   :-4.922000   Down:602  
##  1st Qu.:1.2574   1st Qu.:-0.639500   Up  :648  
##  Median :1.4229   Median : 0.038500             
##  Mean   :1.4783   Mean   : 0.003138             
##  3rd Qu.:1.6417   3rd Qu.: 0.596750             
##  Max.   :3.1525   Max.   : 5.733000
```

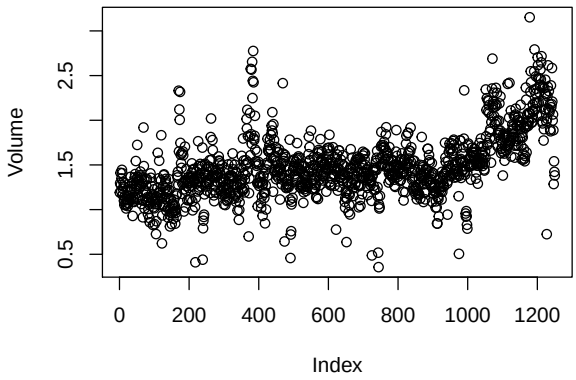
```
pairs(Smarket)
```




```
# cor(Smarket)
# Error in cor(Smarket ) : 'x' must be numeric
cor(Smarket[,-9])
```

```
##                Year         Lag1         Lag2         Lag3         Lag4
## Year    1.00000000  0.029699649  0.030596422  0.033194581  0.035688718
## Lag1    0.02969965  1.000000000 -0.026294328 -0.010803402 -0.002985911
## Lag2    0.03059642 -0.026294328  1.000000000 -0.025896670 -0.010853533
## Lag3    0.03319458 -0.010803402 -0.025896670  1.000000000 -0.024051036
## Lag4    0.03568872 -0.002985911 -0.010853533 -0.024051036  1.000000000
## Lag5    0.02978799 -0.005674606 -0.003557949 -0.018808338 -0.027083641
## Volume  0.53900647  0.040909908 -0.043383215 -0.041823686 -0.048414246
## Today   0.03009523 -0.026155045 -0.010250033 -0.002447647 -0.006899527
##                 Lag5       Volume         Today
## Year     0.029787995  0.53900647  0.030095229
## Lag1    -0.005674606  0.04090991 -0.026155045
## Lag2    -0.003557949 -0.04338321 -0.010250033
## Lag3    -0.018808338 -0.04182369 -0.002447647
## Lag4    -0.027083641 -0.04841425 -0.006899527
## Lag5     1.000000000 -0.02200231 -0.034860083
## Volume  -0.022002315  1.00000000  0.014591823
## Today   -0.034860083  0.01459182  1.000000000
```

```
attach(Smarket)
plot(Volume)
```



4.6.2 Logistic Regression

```
glm.fits = glm(Direction ~ Lag1+Lag2+Lag3+Lag4+Lag5+Volume, data=Smarket, family=binomial)
summary(glm.fits)
```

```
##
## Call:
## glm(formula = Direction ~ Lag1 + Lag2 + Lag3 + Lag4 + Lag5 +
##     Volume, family = binomial, data = Smarket)
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
## -1.446  -1.203   1.065   1.145   1.326
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.126000   0.240736  -0.523    0.601
## Lag1        -0.073074   0.050167  -1.457    0.145
## Lag2        -0.042301   0.050086  -0.845    0.398
## Lag3         0.011085   0.049939   0.222    0.824
## Lag4         0.009359   0.049974   0.187    0.851
## Lag5         0.010313   0.049511   0.208    0.835
## Volume       0.135441   0.158360   0.855    0.392
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1731.2  on 1249  degrees of freedom
## Residual deviance: 1727.6  on 1243  degrees of freedom
## AIC: 1741.6
##
## Number of Fisher Scoring iterations: 3
```

```r
coef(glm.fits)
```

```
##  (Intercept)         Lag1         Lag2         Lag3         Lag4
## -0.126000257 -0.073073746 -0.042301344  0.011085108  0.009358938
##         Lag5       Volume
##  0.010313068  0.135440659
```

```r
summary(glm.fits)$coef
```

```
##                 Estimate Std. Error    z value  Pr(>|z|)
## (Intercept) -0.126000257 0.24073574 -0.5233966 0.6006983
## Lag1        -0.073073746 0.05016739 -1.4565986 0.1452272
## Lag2        -0.042301344 0.05008605 -0.8445733 0.3983491
## Lag3         0.011085108 0.04993854  0.2219750 0.8243333
## Lag4         0.009358938 0.04997413  0.1872757 0.8514445
## Lag5         0.010313068 0.04951146  0.2082966 0.8349974
## Volume       0.135440659 0.15835970  0.8552723 0.3924004
```

```r
summary(glm.fits)$coef[,4] # P-values
```

```
## (Intercept)        Lag1        Lag2        Lag3        Lag4        Lag5
##   0.6006983   0.1452272   0.3983491   0.8243333   0.8514445   0.8349974
##      Volume
##   0.3924004
```

```r
glm.probs = predict(glm.fits, type="response")
glm.probs[1:10]
```

```
##         1         2         3         4         5         6         7
## 0.5070841 0.4814679 0.4811388 0.5152224 0.5107812 0.5069565 0.4926509
##         8         9        10
## 0.5092292 0.5176135 0.4888378
```

```r
contrasts(Direction)
```

```
##      Up
## Down  0
## Up    1
```

```r
glm.pred = rep("Down", 1250)
glm.pred[glm.probs > 0.5]="Up"
table(glm.pred, Direction)
```

```
##         Direction
## glm.pred Down  Up
##     Down  145 141
##     Up    457 507
```

```r
(507 + 145) / 1250
```

```
## [1] 0.5216
```

```
mean(glm.pred == Direction)
```

```
## [1] 0.5216
```

```
train = (Year < 2005)
Smarket.2005 = Smarket[!train, ]
dim(Smarket.2005)
```

```
## [1] 252   9
```

```
Direction.2005 = Direction[!train]
```

```
glm.fits = glm(Direction~Lag1+Lag2+Lag3+Lag4+Lag5+Volume, data=Smarket, family=binomial, subset
glm.probs = predict(glm.fits, Smarket.2005, type="response")
glm.pred = rep("Down", 252)
glm.pred[glm.probs > 0.5] = "Up"
table(glm.pred, Direction.2005)
```

```
##         Direction.2005
## glm.pred Down Up
##     Down   77 97
##     Up     34 44
```

```
mean(glm.pred == Direction.2005)
```

```
## [1] 0.4801587
```

```
mean(glm.pred != Direction.2005)
```

```
## [1] 0.5198413
```

```
glm.fits = glm(Direction~Lag1+Lag2, data=Smarket, family=binomial, subset=train)
glm.probs = predict(glm.fits, Smarket.2005, type="response")
glm.pred = rep("Down", 252)
glm.pred[glm.probs > 0.5] = "Up"
table(glm.pred, Direction.2005)
```

```
##         Direction.2005
## glm.pred Down  Up
##     Down   35  35
##     Up     76 106
```

```
mean(glm.pred == Direction.2005)
```

```
## [1] 0.5595238
```

```
106 / (106 + 76)
```

```
## [1] 0.5824176
```

```
predict(glm.fits, newdata=data.frame(Lag1=c(1.2, 1.5), Lag2=c(1.1, -0.8)), type="response")
```

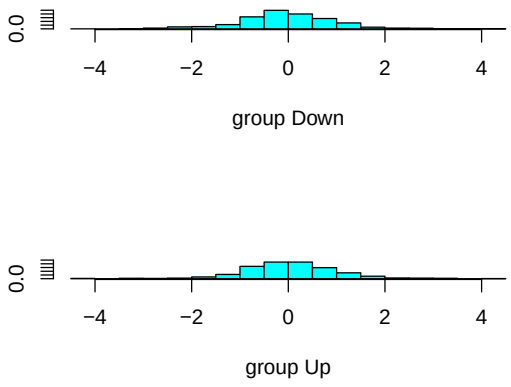
```
##         1         2
## 0.4791462 0.4960939
```

4.6.3 Linear Discriminant Analysis

```
library(MASS)
lda.fit = lda(Direction~Lag1+Lag2, data=Smarket, subset=train)
lda.fit
```

```
## Call:
## lda(Direction ~ Lag1 + Lag2, data = Smarket, subset = train)
##
## Prior probabilities of groups:
##     Down       Up
## 0.491984 0.508016
##
## Group means:
##             Lag1        Lag2
## Down  0.04279022  0.03389409
## Up   -0.03954635 -0.03132544
##
## Coefficients of linear discriminants:
##             LD1
## Lag1 -0.6420190
## Lag2 -0.5135293
```

```
plot(lda.fit)
```




```
lda.pred = predict(lda.fit, Smarket.2005)
names(lda.pred)
```

```
## [1] "class"     "posterior" "x"
```

```
lda.class = lda.pred$class
table(lda.class, Direction.2005)
```

```
##          Direction.2005
## lda.class Down  Up
```

```
##      Down   35  35
##      Up     76 106
```

```
mean(lda.class == Direction.2005)
```

```
## [1] 0.5595238
```

```
sum(lda.pred$posterior[, 1]>=0.5)
```

```
## [1] 70
```

```
sum(lda.pred$posterior[, 1]<0.5)
```

```
## [1] 182
```

```
lda.pred$posterior[1:20, 1]
```

```
##       999      1000      1001      1002      1003      1004      1005
## 0.4901792 0.4792185 0.4668185 0.4740011 0.4927877 0.4938562 0.4951016
##      1006      1007      1008      1009      1010      1011      1012
## 0.4872861 0.4907013 0.4844026 0.4906963 0.5119988 0.4895152 0.4706761
##      1013      1014      1015      1016      1017      1018
## 0.4744593 0.4799583 0.4935775 0.5030894 0.4978806 0.4886331
```

```
lda.class[1:20]
```

```
##  [1] Up   Up   Up   Up   Up   Up   Up   Up   Up   Up   Up   Down Up   Up
## [15] Up   Up   Up   Down Up   Up
## Levels: Down Up
```

```
sum(lda.pred$posterior[, 1]>0.9)
```

```
## [1] 0
```

4.6.4 Quadratic Discriminant Analysis

```
qda.fit = qda(Direction~Lag1+Lag2, data=Smarket, subset=train)
qda.fit
```

```
## Call:
## qda(Direction ~ Lag1 + Lag2, data = Smarket, subset = train)
##
## Prior probabilities of groups:
##     Down       Up
## 0.491984 0.508016
##
## Group means:
##              Lag1        Lag2
## Down  0.04279022  0.03389409
## Up   -0.03954635 -0.03132544
```

```
qda.class = predict(qda.fit, Smarket.2005)$class
table(qda.class, Direction.2005)
```

```
##          Direction.2005
## qda.class Down  Up
##      Down   30  20
##      Up     81 121
```

```
mean(qda.class == Direction.2005)
```

```
## [1] 0.5992063
```

4.6.5 K-Nearest Neighbors

```
library(class)
train.X = cbind(Lag1, Lag2)[train, ]
test.X = cbind(Lag1, Lag2)[!train, ]
train.Direction = Direction[train]
```

```
set.seed(1)
knn.pred = knn(train.X, test.X, train.Direction, k=1)
table(knn.pred, Direction.2005)
```

```
##         Direction.2005
## knn.pred Down Up
##     Down   43 58
##     Up     68 83
```

```
(83 + 43) / 252
```

```
## [1] 0.5
```

```
knn.pred = knn(train.X, test.X, train.Direction, k=3)
table(knn.pred, Direction.2005)
```

```
##         Direction.2005
## knn.pred Down Up
##     Down   48 54
##     Up     63 87
```

```
mean(knn.pred == Direction.2005)
```

```
## [1] 0.5357143
```

4.6.6 An Application to Caravan Insurance Data

```
dim(Caravan)
```

```
## [1] 5822   86
```

```
attach(Caravan)
summary(Purchase)
```

```
##   No  Yes
## 5474  348
```

```
348 / 5822
```

```
## [1] 0.05977327
```

```
standardized.X = scale(Caravan[, -86])
var(Caravan[, 1])
```

```
## [1] 165.0378
```

```
var(Caravan[, 2])
```

```
## [1] 0.1647078
```

```
var(standardized.X[, 1])
```

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

```
var(standardized.X[, 2])
```

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

```
test = 1:1000
train.X = standardized.X[-test, ]
test.X = standardized.X[test, ]
train.Y = Purchase[-test]
test.Y = Purchase[test]
set.seed(1)
knn.pred = knn(train.X, test.X, train.Y, k=1)
mean(test.Y != knn.pred)
```

```
## [1] 0.118
```

```
mean(test.Y != "No")
```

```
## [1] 0.059
```

```
table(knn.pred, test.Y)
```

```
##         test.Y
## knn.pred  No Yes
##      No  873  50
##      Yes  68   9
```

```
9 / (68+9)
```

```
## [1] 0.1168831
```

```
knn.pred = knn(train.X, test.X, train.Y, k=3)
table(knn.pred, test.Y)
```

```
##         test.Y
## knn.pred  No Yes
##      No  920  54
##      Yes  21   5
```

```
5 / 26
```

```
## [1] 0.1923077
```

```
knn.pred = knn(train.X, test.X, train.Y, k=5)
table(knn.pred, test.Y)
```

```
##         test.Y
## knn.pred  No Yes
##      No  930  55
##      Yes  11   4
```

```
4 / 15
```

```
## [1] 0.2666667
```

```
glm.fits = glm(Purchase~., data=Caravan, family=binomial, subset=-test)
# Warning message :
# glm.fits: fitted probabilities numerically 0 or 1 occurred
glm.probs = predict(glm.fits, Caravan[test, ], type="response")
glm.pred = rep("No", 1000)
glm.pred[glm.probs > 0.5]="Yes"
table(glm.pred, test.Y)
```

```
##         test.Y
## glm.pred  No Yes
##      No  934  59
##      Yes   7   0
```

```
glm.pred = rep("No", 1000)
glm.pred[glm.probs > 0.25]="Yes"
table(glm.pred, test.Y)
```

```
##         test.Y
## glm.pred  No Yes
##      No  919  48
##      Yes  22  11
```

```
11 / (22 + 11)
```

```
## [1] 0.3333333
```