```
library(caret)
> library(ISLR)
> # install.packages("e1071") #install first
> library(e1071)
> library(pROC)
> library("gmodels")
> FlightDelays <- read_csv("C:/Users/Ghirghir/Desktop/Mashine Learning/Assign
ment/FlightDelays.csv")
Parsed with column specification:
cols(
  CRS_DEP_TIME = col_double(),
  CARRIER = col_character(),
  DEP_TIME = col_double(),
  DEST = col_character(),
  DISTANCE = col_double(),
  FL_DATE = col_character(),
  FL_NUM = col_double(),
  ORIGIN = col_character(),
  Weather = col_double(),
  DAY_WEEK = col_double(),
  DAY_OF_MONTH = col_double(),
  TAIL_NUM = col_character(),
  FlightStatus = col_character()
)
> summary(FlightDelays)
  CRS_DEP_TIME      CARRIER                DEP_TIME          DEST                DISTA
NCE
 Min.   : 600    Length:2201         Min.   :  10    Length:2201         Min.   :
169.0
 1st Qu.:1000    Class :character    1st Qu.:1004    Class :character    1st Qu.:
213.0
 Median :1455    Mode  :character    Median :1450    Mode  :character    Median :
214.0
 Mean   :1372                        Mean   :1369                        Mean   :
211.9
 3rd Qu.:1710                        3rd Qu.:1709                        3rd Qu.:
214.0
 Max.   :2130                        Max.   :2330                        Max.   :
229.0
    FL_DATE             FL_NUM           ORIGIN              Weather             DA
Y_WEEK
 Length:2201        Min.   : 746    Length:2201         Min.   :0.00000    Min.
:1.000
 Class :character   1st Qu.:2156    Class :character    1st Qu.:0.00000    1st Q
u.:2.000
 Mode  :character   Median :2385    Mode  :character    Median :0.00000    Media
n :4.000
                    Mean   :3815                        Mean   :0.01454    Mean
:3.905
                    3rd Qu.:6155                        3rd Qu.:0.00000    3rd Q
u.:5.000
                    Max.   :7924                        Max.   :1.00000    Max.
:7.000
  DAY_OF_MONTH       TAIL_NUM           FlightStatus
 Min.   : 1.00    Length:2201        Length:2201
 1st Qu.: 8.00    Class :character   Class :character
 Median :16.00    Mode  :character   Mode  :character
 Mean   :16.02
 3rd Qu.:23.00
 Max.   :31.00
> str(FlightDelays)
Classes 'spec_tbl_df', 'tbl_df', 'tbl' and 'data.frame':    2201 obs. of  13
variables:
 $ CRS_DEP_TIME: num  1455 1640 1245 1715 1039 ...
```

```
 $ CARRIER     : chr   "OH" "DH" "DH" "DH" ...
 $ DEP_TIME    : num   1455 1640 1245 1709 1035 ...
 $ DEST        : chr   "JFK" "JFK" "LGA" "LGA" ...
 $ DISTANCE    : num   184 213 229 229 229 228 228 228 228 228 ...
 $ FL_DATE     : chr   "01/01/2004" "01/01/2004" "01/01/2004" "01/01/2004" ...
 $ FL_NUM      : num   5935 6155 7208 7215 7792 ...
 $ ORIGIN      : chr   "BWI" "DCA" "IAD" "IAD" ...
 $ Weather     : num   0 0 0 0 0 0 0 0 0 0 ...
 $ DAY_WEEK    : num   4 4 4 4 4 4 4 4 4 4 ...
 $ DAY_OF_MONTH: num   1 1 1 1 1 1 1 1 1 1 ...
 $ TAIL_NUM    : chr   "N940CA" "N405FJ" "N695BR" "N662BR" ...
 $ FlightStatus: chr   "ontime" "ontime" "ontime" "ontime" ...
 - attr(*, "spec")=
  .. cols(
  ..   CRS_DEP_TIME = col_double(),
  ..   CARRIER = col_character(),
  ..   DEP_TIME = col_double(),
  ..   DEST = col_character(),
  ..   DISTANCE = col_double(),
  ..   FL_DATE = col_character(),
  ..   FL_NUM = col_double(),
  ..   ORIGIN = col_character(),
  ..   Weather = col_double(),
  ..   DAY_WEEK = col_double(),
  ..   DAY_OF_MONTH = col_double(),
  ..   TAIL_NUM = col_character(),
  ..   FlightStatus = col_character()
  .. )
> FlightDelays$CRS_DEP_TIME <- as.factor(FlightDelays$CRS_DEP_TIME)
> FlightDelays$DEP_TIME <- as.factor(FlightDelays$DEP_TIME)
> FlightDelays$DAY_WEEK <- as.factor(FlightDelays$DAY_WEEK)
> FlightDelays$FlightStatus <- as.factor(FlightDelays$FlightStatus)
> Elham <- FlightDelays[,c(10,3,8,4,2,13)]
> str(Elham)
Classes 'tbl_df', 'tbl' and 'data.frame':     2201 obs. of  6 variables:
 $ DAY_WEEK    : Factor w/ 7 levels "1","2","3","4",..: 4 4 4 4 4 4 4 4 4 4 .
..
 $ DEP_TIME    : Factor w/ 633 levels "10","109","548",..: 314 404 225 433 17
0 102 223 408 434 605 ...
 $ ORIGIN      : chr   "BWI" "DCA" "IAD" "IAD" ...
 $ DEST        : chr   "JFK" "JFK" "LGA" "LGA" ...
 $ CARRIER     : chr   "OH" "DH" "DH" "DH" ...
 $ FlightStatus: Factor w/ 2 levels "delayed","ontime": 2 2 2 2 2 2 2 2 2 2 .
..
> set.seed(123)
> Index_Train<-createDataPartition(Elham$FlightStatus, p=0.6, list=FALSE)
> Train <-Elham[Index_Train,]
> Validation<-Elham[-Index_Train,]
> nb_model <- naiveBayes (Train$FlightStatus~., data = Train)
> nb_model

Naive Bayes Classifier for Discrete Predictors

Call:
naiveBayes.default(x = X, y = Y, laplace = laplace)

A-priori probabilities:
Y
  delayed    ontime
0.1945496 0.8054504

Conditional probabilities:
        DAY_WEEK
```

```
Y                    1          2          3          4          5          6
7
  delayed 0.18677043 0.15953307 0.11284047 0.15175097 0.17509728 0.05447471 0
.15953307
  ontime  0.14473684 0.12687970 0.13439850 0.18139098 0.18421053 0.12312030 0
.10526316

        DEP_TIME
Y                   10          109          548          550          552
553
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                  554          555          556          557          558
559
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                  613          622          623          624          625
626
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                  627          628          629          630          631
632
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                  633          634          635          638          640
641
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                  642          643          644          645          646
648
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                  650          651          652          653          654
655
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                  656          657          658          659          700
702
  delayed 0.0000000000 0.0155642023 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
        DEP_TIME
Y                  703          704          706          707          708
711
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                  714          721          722          726          727
728
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                  729          730          731          732          733
734
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
```

```
Y                       739          741          744          745          746
747
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       749          750          753          754          755
756
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       757          758          759          800          801
810
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       815          817          822          824          826
827
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                       828          829          830          831          832
833
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       834          835          836          837          838
839
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                       840          841          842          843          844
845
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       846          847          848          849          850
851
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       852          853          854          855          856
857
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                       858          859          900          901          904
906
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                       911          912          913          915          917
918
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                       919          920          921          924          925
926
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                       927          928          929          930          931
932
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
```

```
        DEP_TIME
Y                     941            943            946            954            955
956
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                     957            958           1000           1001           1004
1005
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    1017           1019           1022           1025           1026
1027
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1028           1029           1030           1031           1032
1033
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    1034           1035           1036           1037           1038
1040
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                    1044           1047           1048           1050           1053
1054
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1055           1056           1057           1058           1059
1100
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    1102           1103           1106           1108           1111
1128
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1129           1130           1131           1132           1137
1141
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                    1151           1153           1155           1156           1157
1158
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    1159           1202           1217           1221           1227
1228
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    1229           1230           1231           1232           1235
1236
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                    1237           1238           1239           1240           1241
1242
```

delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y   1243   1244   1245   1246   1247
1248
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y   1249   1250   1251   1252   1253
1254
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y   1255   1256   1257   1258   1259
1300
  delayed 0.0000000000 0.0000000000 0.0077821012 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y   1301   1302   1303   1304   1305
1306
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y   1307   1309   1310   1312   1313
1314
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y   1315   1319   1320   1321   1324
1326
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0077821012 0.0038910506 0.
0038910506
        DEP_TIME
Y   1327   1328   1329   1330   1331
1332
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y   1338   1341   1342   1345   1348
1349
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.
0000000000
        DEP_TIME
Y   1350   1351   1352   1353   1354
1355
  delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y   1356   1357   1358   1359   1400
1401
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y   1402   1403   1405   1408   1409
1416
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y   1421   1423   1424   1425   1426
1427
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME

```
Y            1428          1429          1430          1431          1432          1433
delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506
        DEP_TIME
Y            1435          1439          1442          1444          1445          1446
delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0000000000
        DEP_TIME
Y            1448          1449          1450          1451          1452          1453
delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000
        DEP_TIME
Y            1454          1455          1456          1457          1458          1459
delayed 0.0000000000 0.0000000000 0.0116731518 0.0116731518 0.0038910506 0.0038910506
        DEP_TIME
Y            1500          1501          1502          1503          1504          1505
delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0077821012
        DEP_TIME
Y            1506          1508          1509          1510          1511          1512
delayed 0.0000000000 0.0000000000 0.0077821012 0.0000000000 0.0038910506 0.0077821012
        DEP_TIME
Y            1513          1514          1515          1516          1517          1519
delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000
        DEP_TIME
Y            1520          1521          1522          1523          1524          1525
delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000
        DEP_TIME
Y            1526          1527          1528          1529          1530          1531
delayed 0.0000000000 0.0077821012 0.0116731518 0.0000000000 0.0038910506 0.0000000000
        DEP_TIME
Y            1532          1533          1534          1535          1536          1537
delayed 0.0000000000 0.0038910506 0.0000000000 0.0116731518 0.0038910506 0.0000000000
        DEP_TIME
Y            1538          1539          1540          1545          1548          1549
delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.0077821012
        DEP_TIME
Y            1551          1552          1554          1555          1556          1557
delayed 0.0038910506 0.0000000000 0.0000000000 0.0116731518 0.0000000000 0.0038910506
        DEP_TIME
Y            1558          1559          1600          1601          1602          1603
delayed 0.0000000000 0.0000000000 0.0116731518 0.0038910506 0.0000000000 0.0000000000
```

```
        DEP_TIME
Y                 1604           1605           1606           1607           1608
1609
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                 1610           1612           1613           1615           1617
1618
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                 1619           1620           1622           1623           1624
1625
  delayed 0.0038910506 0.0038910506 0.0077821012 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                 1627           1628           1629           1630           1631
1632
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                 1633           1634           1635           1636           1637
1638
  delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0077821012
        DEP_TIME
Y                 1639           1640           1641           1642           1643
1644
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
        DEP_TIME
Y                 1645           1646           1647           1648           1649
1650
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                 1651           1652           1653           1654           1655
1656
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0077821012
        DEP_TIME
Y                 1657           1658           1659           1700           1701
1702
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
        DEP_TIME
Y                 1703           1704           1705           1706           1707
1708
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0077821012 0.0000000000 0.
0000000000
        DEP_TIME
Y                 1709           1710           1711           1712           1713
1714
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                 1715           1716           1717           1718           1719
1720
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                 1721           1722           1723           1725           1726
1727
```

```
        delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
                DEP_TIME
Y                       1728            1729            1730            1731            1732
1733
        delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0077821012 0.
0038910506
                DEP_TIME
Y                       1735            1736            1737            1738            1739
1740
        delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0077821012
                DEP_TIME
Y                       1741            1744            1745            1748            1750
1751
        delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
                DEP_TIME
Y                       1752            1753            1754            1755            1756
1757
        delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
                DEP_TIME
Y                       1758            1759            1800            1802            1803
1808
        delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
                DEP_TIME
Y                       1811            1812            1813            1816            1818
1819
        delayed 0.0038910506 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.
0000000000
                DEP_TIME
Y                       1820            1822            1823            1824            1825
1826
        delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
                DEP_TIME
Y                       1827            1828            1829            1830            1831
1832
        delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0038910506
                DEP_TIME
Y                       1833            1834            1837            1842            1843
1844
        delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
                DEP_TIME
Y                       1846            1847            1848            1849            1850
1851
        delayed 0.0038910506 0.0000000000 0.0038910506 0.0077821012 0.0000000000 0.
0077821012
                DEP_TIME
Y                       1852            1853            1854            1855            1856
1857
        delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
                DEP_TIME
Y                       1858            1859            1900            1901            1902
1903
        delayed 0.0077821012 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
                DEP_TIME
```

```
Y                  1904          1912          1915          1916          1917
1918
  delayed 0.0000000000 0.0000000000 0.0077821012 0.0077821012 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1920          1922          1924          1927          1928
1929
  delayed 0.0038910506 0.0077821012 0.0000000000 0.0077821012 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1930          1931          1936          1937          1939
1941
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
         DEP_TIME
Y                  1947          1948          1949          1951          1952
1953
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1955          1956          1957          1958          1959
2000
  delayed 0.0038910506 0.0077821012 0.0000000000 0.0000000000 0.0077821012 0.
0000000000
         DEP_TIME
Y                  2001          2002          2004          2006          2007
2010
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
         DEP_TIME
Y                  2011          2012          2014          2015          2019
2023
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.
0038910506
         DEP_TIME
Y                  2024          2026          2027          2028          2029
2030
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
         DEP_TIME
Y                  2031          2032          2033          2045          2050
2051
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0038910506
         DEP_TIME
Y                  2052          2054          2055          2056          2057
2058
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                  2059          2100          2104          2105          2106
2110
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
         DEP_TIME
Y                  2111          2112          2113          2114          2115
2116
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y                  2117          2118          2119          2120          2121
2122
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
```

```
        DEP_TIME
Y                   2124          2125          2126          2127          2129
2130
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                   2133          2134          2135          2136          2138
2139
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0038910506
        DEP_TIME
Y                   2140          2143          2145          2150          2151
2153
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
        DEP_TIME
Y                   2155          2200          2211          2213          2214
2220
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
        DEP_TIME
Y                   2221          2222          2230          2239          2244
2300
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0038910506 0.0077821012 0.
0038910506
        DEP_TIME
Y                   2305          2312          2330
  delayed 0.0000000000 0.0038910506 0.0038910506
 [ reached getOption("max.print") -- omitted 1 row ]

        ORIGIN
Y              BWI        DCA        IAD
  delayed 0.07392996 0.51361868 0.41245136
  ontime  0.06109023 0.64849624 0.29041353

        DEST
Y             EWR        JFK        LGA
  delayed 0.3891051 0.2217899 0.3891051
  ontime  0.2819549 0.1823308 0.5357143

        CARRIER
Y                CO          DH          DL          MQ          OH
RU          UA
  delayed 0.066147860 0.322957198 0.112840467 0.178988327 0.007782101 0.20622
5681 0.011673152
  ontime  0.037593985 0.240601504 0.186090226 0.124060150 0.013157895 0.17857
1429 0.015037594
        CARRIER
Y                US
  delayed 0.093385214
  ontime  0.204887218

> nb_model

Naive Bayes Classifier for Discrete Predictors

Call:
naiveBayes.default(x = X, y = Y, laplace = laplace)

A-priori probabilities:
Y
  delayed    ontime
0.1945496 0.8054504
```

```
Conditional probabilities:
        DAY_WEEK
Y                        1           2           3           4           5           6
7
  delayed 0.18677043 0.15953307 0.11284047 0.15175097 0.17509728 0.05447471 0
.15953307
  ontime  0.14473684 0.12687970 0.13439850 0.18139098 0.18421053 0.12312030 0
.10526316

        DEP_TIME
Y                       10         109         548         550         552
553
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      554         555         556         557         558
559
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      613         622         623         624         625
626
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      627         628         629         630         631
632
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      633         634         635         638         640
641
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                      642         643         644         645         646
648
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                      650         651         652         653         654
655
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                      656         657         658         659         700
702
  delayed 0.0000000000 0.0155642023 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
        DEP_TIME
Y                      703         704         706         707         708
711
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                      714         721         722         726         727
728
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      729         730         731         732         733
734
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
```

```
        DEP_TIME
Y                      739           741           744           745           746
747
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      749           750           753           754           755
756
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      757           758           759           800           801
810
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      815           817           822           824           826
827
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                      828           829           830           831           832
833
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      834           835           836           837           838
839
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                      840           841           842           843           844
845
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      846           847           848           849           850
851
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      852           853           854           855           856
857
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                      858           859           900           901           904
906
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                      911           912           913           915           917
918
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                      919           920           921           924           925
926
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                      927           928           929           930           931
932
```

```
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                941           943           946           954           955
956
    delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                957           958          1000          1001          1004
1005
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y               1017          1019          1022          1025          1026
1027
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y               1028          1029          1030          1031          1032
1033
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y               1034          1035          1036          1037          1038
1040
    delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
         DEP_TIME
Y               1044          1047          1048          1050          1053
1054
    delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y               1055          1056          1057          1058          1059
1100
    delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y               1102          1103          1106          1108          1111
1128
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y               1129          1130          1131          1132          1137
1141
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
         DEP_TIME
Y               1151          1153          1155          1156          1157
1158
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y               1159          1202          1217          1221          1227
1228
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y               1229          1230          1231          1232          1235
1236
    delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
         DEP_TIME
```

```
Y                1237          1238          1239          1240          1241
1242
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                1243          1244          1245          1246          1247
1248
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                1249          1250          1251          1252          1253
1254
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                1255          1256          1257          1258          1259
1300
  delayed 0.0000000000 0.0000000000 0.0077821012 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                1301          1302          1303          1304          1305
1306
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                1307          1309          1310          1312          1313
1314
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                1315          1319          1320          1321          1324
1326
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0077821012 0.0038910506 0.
0038910506
        DEP_TIME
Y                1327          1328          1329          1330          1331
1332
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                1338          1341          1342          1345          1348
1349
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.
0000000000
        DEP_TIME
Y                1350          1351          1352          1353          1354
1355
  delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                1356          1357          1358          1359          1400
1401
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                1402          1403          1405          1408          1409
1416
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                1421          1423          1424          1425          1426
1427
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
```

```
        DEP_TIME
Y                   1428          1429          1430          1431          1432
1433
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
        DEP_TIME
Y                   1435          1439          1442          1444          1445
1446
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
        DEP_TIME
Y                   1448          1449          1450          1451          1452
1453
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                   1454          1455          1456          1457          1458
1459
  delayed 0.0000000000 0.0000000000 0.0116731518 0.0116731518 0.0038910506 0.
0038910506
        DEP_TIME
Y                   1500          1501          1502          1503          1504
1505
  delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0077821012
        DEP_TIME
Y                   1506          1508          1509          1510          1511
1512
  delayed 0.0000000000 0.0000000000 0.0077821012 0.0000000000 0.0038910506 0.
0077821012
        DEP_TIME
Y                   1513          1514          1515          1516          1517
1519
  delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                   1520          1521          1522          1523          1524
1525
  delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                   1526          1527          1528          1529          1530
1531
  delayed 0.0000000000 0.0077821012 0.0116731518 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                   1532          1533          1534          1535          1536
1537
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0116731518 0.0038910506 0.
0000000000
        DEP_TIME
Y                   1538          1539          1540          1545          1548
1549
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.
0077821012
        DEP_TIME
Y                   1551          1552          1554          1555          1556
1557
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0116731518 0.0000000000 0.
0038910506
        DEP_TIME
Y                   1558          1559          1600          1601          1602
1603
```

```
  delayed 0.0000000000 0.0000000000 0.0116731518 0.0038910506 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1604          1605          1606          1607          1608
1609
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
          DEP_TIME
Y                 1610          1612          1613          1615          1617
1618
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
          DEP_TIME
Y                 1619          1620          1622          1623          1624
1625
  delayed 0.0038910506 0.0038910506 0.0077821012 0.0000000000 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1627          1628          1629          1630          1631
1632
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1633          1634          1635          1636          1637
1638
  delayed 0.0077821012 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0077821012
          DEP_TIME
Y                 1639          1640          1641          1642          1643
1644
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
          DEP_TIME
Y                 1645          1646          1647          1648          1649
1650
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1651          1652          1653          1654          1655
1656
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0077821012
          DEP_TIME
Y                 1657          1658          1659          1700          1701
1702
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
          DEP_TIME
Y                 1703          1704          1705          1706          1707
1708
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0077821012 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1709          1710          1711          1712          1713
1714
  delayed 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
          DEP_TIME
Y                 1715          1716          1717          1718          1719
1720
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0038910506
          DEP_TIME
```

```
Y                  1721          1722          1723          1725          1726
1727
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1728          1729          1730          1731          1732
1733
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0077821012 0.
0038910506
         DEP_TIME
Y                  1735          1736          1737          1738          1739
1740
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0077821012
         DEP_TIME
Y                  1741          1744          1745          1748          1750
1751
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y                  1752          1753          1754          1755          1756
1757
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
         DEP_TIME
Y                  1758          1759          1800          1802          1803
1808
  delayed 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.
0038910506
         DEP_TIME
Y                  1811          1812          1813          1816          1818
1819
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1820          1822          1823          1824          1825
1826
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
         DEP_TIME
Y                  1827          1828          1829          1830          1831
1832
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0038910506
         DEP_TIME
Y                  1833          1834          1837          1842          1843
1844
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1846          1847          1848          1849          1850
1851
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0077821012 0.0000000000 0.
0077821012
         DEP_TIME
Y                  1852          1853          1854          1855          1856
1857
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0000000000
         DEP_TIME
Y                  1858          1859          1900          1901          1902
1903
  delayed 0.0077821012 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.
0000000000
```

```
        DEP_TIME
Y                    1904          1912          1915          1916          1917
1918
  delayed 0.0000000000 0.0000000000 0.0077821012 0.0077821012 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1920          1922          1924          1927          1928
1929
  delayed 0.0038910506 0.0077821012 0.0000000000 0.0077821012 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1930          1931          1936          1937          1939
1941
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
        DEP_TIME
Y                    1947          1948          1949          1951          1952
1953
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                    1955          1956          1957          1958          1959
2000
  delayed 0.0038910506 0.0077821012 0.0000000000 0.0000000000 0.0077821012 0.
0000000000
        DEP_TIME
Y                    2001          2002          2004          2006          2007
2010
  delayed 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
        DEP_TIME
Y                    2011          2012          2014          2015          2019
2023
  delayed 0.0000000000 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.
0038910506
        DEP_TIME
Y                    2024          2026          2027          2028          2029
2030
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
        DEP_TIME
Y                    2031          2032          2033          2045          2050
2051
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0038910506
        DEP_TIME
Y                    2052          2054          2055          2056          2057
2058
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0000000000
        DEP_TIME
Y                    2059          2100          2104          2105          2106
2110
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0038910506 0.
0038910506
        DEP_TIME
Y                    2111          2112          2113          2114          2115
2116
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
        DEP_TIME
Y                    2117          2118          2119          2120          2121
2122
```

```
    delayed 0.0000000000 0.0038910506 0.0038910506 0.0000000000 0.0000000000 0.
0000000000
          DEP_TIME
Y                  2124         2125         2126         2127         2129
2130
  delayed 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.
0000000000
          DEP_TIME
Y                  2133         2134         2135         2136         2138
2139
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.0000000000 0.
0038910506
          DEP_TIME
Y                  2140         2143         2145         2150         2151
2153
  delayed 0.0038910506 0.0000000000 0.0000000000 0.0038910506 0.0038910506 0.
0038910506
          DEP_TIME
Y                  2155         2200         2211         2213         2214
2220
  delayed 0.0038910506 0.0038910506 0.0038910506 0.0038910506 0.0000000000 0.
0038910506
          DEP_TIME
Y                  2221         2222         2230         2239         2244
2300
  delayed 0.0038910506 0.0000000000 0.0038910506 0.0038910506 0.0077821012 0.
0038910506
          DEP_TIME
Y                  2305         2312         2330
  delayed 0.0000000000 0.0038910506 0.0038910506
 [ reached getOption("max.print") -- omitted 1 row ]

          ORIGIN
Y               BWI         DCA         IAD
  delayed 0.07392996 0.51361868 0.41245136
  ontime  0.06109023 0.64849624 0.29041353

          DEST
Y               EWR         JFK         LGA
  delayed 0.3891051 0.2217899 0.3891051
  ontime  0.2819549 0.1823308 0.5357143

          CARRIER
Y                  CO          DH          DL          MQ          OH
RU          UA
  delayed 0.066147860 0.322957198 0.112840467 0.178988327 0.007782101 0.20622
5681 0.011673152
  ontime  0.037593985 0.240601504 0.186090226 0.124060150 0.013157895 0.17857
1429 0.015037594
          CARRIER
Y                  US
  delayed 0.093385214
  ontime  0.204887218
```

```
> # Predict the FlightStatus of Train dataset
> Predicted_Train_labels <-predict(nb_model,Train)
> Predicted_Validation_labels <-predict(nb_model,Validation)
> # Tthe confusion matrix of the classifier
> CrossTable(x=Validation$FlightStatus,y=Predicted_Validation_labels, prop.ch
isq = FALSE)


   Cell Contents
|-------------------------|
```

```
|                         N |
|           N / Row Total |
|           N / Col Total |
|         N / Table Total |
|-------------------------|
```

Total Observations in Table: 880

```
                       | Predicted_Validation_labels
Validation$FlightStatus |   delayed |    ontime | Row Total |
-----------------------|-----------|-----------|-----------|
               delayed |        29 |       142 |       171 |
                       |     0.170 |     0.830 |     0.194 |
                       |     0.408 |     0.176 |           |
                       |     0.033 |     0.161 |           |
-----------------------|-----------|-----------|-----------|
                ontime |        42 |       667 |       709 |
                       |     0.059 |     0.941 |     0.806 |
                       |     0.592 |     0.824 |           |
                       |     0.048 |     0.758 |           |
-----------------------|-----------|-----------|-----------|
          Column Total |        71 |       809 |       880 |
                       |     0.081 |     0.919 |           |
-----------------------|-----------|-----------|-----------|
```

```
> # Tthe confusion matrix of the classifier
> CrossTable(x=Validation$FlightStatus,y=Predicted_Validation_labels, prop.ch
isq = FALSE)
```

```
   Cell Contents
|-------------------------|
|                         N |
|           N / Row Total |
|           N / Col Total |
|         N / Table Total |
|-------------------------|
```

Total Observations in Table: 880

```
                       | Predicted_Validation_labels
Validation$FlightStatus |   delayed |    ontime | Row Total |
-----------------------|-----------|-----------|-----------|
               delayed |        29 |       142 |       171 |
                       |     0.170 |     0.830 |     0.194 |
                       |     0.408 |     0.176 |           |
                       |     0.033 |     0.161 |           |
-----------------------|-----------|-----------|-----------|
                ontime |        42 |       667 |       709 |
                       |     0.059 |     0.941 |     0.806 |
                       |     0.592 |     0.824 |           |
                       |     0.048 |     0.758 |           |
-----------------------|-----------|-----------|-----------|
          Column Total |        71 |       809 |       880 |
                       |     0.081 |     0.919 |           |
-----------------------|-----------|-----------|-----------|
```

```
> Predicted_Validation_labels <-predict(nb_model,Validation, type = "raw")
```

```
> # The first few values
> head(Predicted_Validation_labels)
         delayed      ontime
[1,]  0.12956597 0.8704340
[2,]  0.52123452 0.4787655
[3,]  0.11083013 0.8891699
[4,]  0.06976684 0.9302332
[5,]  0.02439002 0.9756100
[6,]  0.08191462 0.9180854
> # The first few values
> head(Predicted_Validation_labels)
         delayed      ontime
[1,]  0.12956597 0.8704340
[2,]  0.52123452 0.4787655
[3,]  0.11083013 0.8891699
[4,]  0.06976684 0.9302332
[5,]  0.02439002 0.9756100
[6,]  0.08191462 0.9180854
> # Passing the second column of the predicted probabilities
> # That column contains the probability associate to 'yes'
> roc(Validation$FlightStatus, Predicted_Validation_labels[,2])


Call:
roc.default(response = Validation$FlightStatus, predictor = Predicted_Validat
ion_labels[,      2])

Data: Predicted_Validation_labels[, 2] in 171 controls (Validation$FlightStat
us delayed) < 709 cases (Validation$FlightStatus ontime).
Area under the curve: 0.7092
> # Passing the second column of the predicted probabilities
> # That column contains the probability associate to 'yes'
> roc(Validation$FlightStatus, Predicted_Validation_labels[,2])


Call:
roc.default(response = Validation$FlightStatus, predictor = Predicted_Validat
ion_labels[,      2])

Data: Predicted_Validation_labels[, 2] in 171 controls (Validation$FlightStat
us delayed) < 709 cases (Validation$FlightStatus ontime).
Area under the curve: 0.7092
> plot.roc(Validation$FlightStatus,Predicted_Validation_labels[,2])
```