Naive Bayes Predictive Model

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# Agency Data Simple Naive Bayes Predictive Model

This uses a largely unalered simple Naive Bayes model to set a baseline for subsequent predictive models, which are create using other algorithms.

# Read the original data set  
agency\_data\_orig <- read.xlsx('./data/AgencyData\_clean.xlsx', sheetIndex=1, stringsAsFactors=T)

## Data Setup

There are a couple of irrelevant attributes from the original set. Get rid of those and then setup the train and test data sets.

# Trim the phat - i.e., data that's irrelevant  
agency\_data\_used <- agency\_data\_orig[c(-1, -4)]  
str(agency\_data\_used)

## 'data.frame': 2376 obs. of 12 variables:  
## $ account\_type : Factor w/ 2 levels "Commercial","Personal": 2 2 2 2 2 2 2 2 2 2 ...  
## $ assigned\_agent : Factor w/ 6 levels "Boehm, Sebastian",..: 3 1 3 3 3 3 3 1 3 2 ...  
## $ lob : Factor w/ 20 levels "Auto (Commercial)",..: 2 2 2 2 2 2 2 2 2 2 ...  
## $ master\_company : Factor w/ 20 levels "Aimonetti Insurance",..: 1 1 1 1 1 1 1 1 1 1 ...  
## $ effective\_date : Date, format: "2011-03-04" "2014-03-12" ...  
## $ policy\_term : Factor w/ 3 levels "12 Months","6 Months",..: 2 2 2 2 2 2 2 2 2 2 ...  
## $ policy\_type : Factor w/ 2 levels "Commercial","Personal": 2 2 2 2 2 2 2 2 2 2 ...  
## $ annual\_premium : num 2222 3400 2208 4660 5092 ...  
## $ written\_premium : num 1141 1735 1135 2370 2547 ...  
## $ rating\_state : Factor w/ 8 levels "FL","ND","NV",..: 1 1 1 1 1 1 1 1 1 1 ...  
## $ status : Factor w/ 2 levels "Active","Inactive": 2 1 2 2 2 2 2 2 2 2 ...  
## $ transaction\_type: Factor w/ 13 levels "Cancel Conf",..: 1 11 1 1 1 1 7 1 3 1 ...

# Setup train and test data, 70% / 30%  
train\_ad <- sample\_frac(agency\_data\_used, 0.7)  
sid <- as.numeric(rownames(train\_ad)) # because rownames() returns character  
test\_ad <- agency\_data\_used[-sid,]

## Build the Model

This step is set aside because with a big data set, it would be slow or put into a distributed system.

nb\_model <- naiveBayes(transaction\_type~., data=train\_ad)

## Conditional Probabilities

The model creates the conditional probabilities based on the training data. This output shows those, which is interesting unto itself.

## account\_type  
## Y Commercial Personal  
## Cancel Conf 0.03153153 0.96846847  
## Cancel Req 0.16666667 0.83333333  
## Cancel/DNR 0.00000000 1.00000000  
## DB Synch 0.00000000 1.00000000  
## New Business 0.10588235 0.89411765  
## Non-Renewal 0.00000000 1.00000000  
## Policy Change 0.02010050 0.97989950  
## Re-Issue 0.00000000 1.00000000  
## Reinstate 0.07317073 0.92682927  
## Renew Quote 0.00000000 1.00000000  
## Renewal 0.05142857 0.94857143  
## Renewal Re-Quote 0.00000000 1.00000000  
## Rewrite 0.00000000 1.00000000

## assigned\_agent  
## Y Boehm, Sebastian Doyle, Walter Insurance, Nichersen  
## Cancel Conf 0.121621622 0.453453453 0.046546547  
## Cancel Req 0.000000000 0.833333333 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 1.000000000  
## DB Synch 0.000000000 0.250000000 0.500000000  
## New Business 0.070588235 0.382352941 0.005882353  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.125628141 0.351758794 0.007537688  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.073170732 0.268292683 0.024390244  
## Renew Quote 0.000000000 1.000000000 0.000000000  
## Renewal 0.257142857 0.382857143 0.000000000  
## Renewal Re-Quote 0.500000000 0.000000000 0.000000000  
## Rewrite 0.157894737 0.263157895 0.000000000  
## assigned\_agent  
## Y Padberg, Tracy Rohan, Elwood Tremblay, Deena  
## Cancel Conf 0.012012012 0.007507508 0.358858859  
## Cancel Req 0.000000000 0.000000000 0.166666667  
## Cancel/DNR 0.000000000 0.000000000 0.000000000  
## DB Synch 0.250000000 0.000000000 0.000000000  
## New Business 0.188235294 0.088235294 0.264705882  
## Non-Renewal 0.000000000 0.000000000 1.000000000  
## Policy Change 0.118090452 0.062814070 0.334170854  
## Re-Issue 0.000000000 0.000000000 1.000000000  
## Reinstate 0.048780488 0.219512195 0.365853659  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.008571429 0.011428571 0.340000000  
## Renewal Re-Quote 0.000000000 0.000000000 0.500000000  
## Rewrite 0.000000000 0.000000000 0.578947368

## lob  
## Y Auto (Commercial) Auto (Personal) BOP Liability  
## Cancel Conf 0.010510511 0.699699700 0.001501502  
## Cancel Req 0.166666667 0.833333333 0.000000000  
## Cancel/DNR 0.000000000 1.000000000 0.000000000  
## DB Synch 0.000000000 1.000000000 0.000000000  
## New Business 0.005882353 0.188235294 0.005882353  
## Non-Renewal 0.000000000 1.000000000 0.000000000  
## Policy Change 0.010050251 0.733668342 0.000000000  
## Re-Issue 0.000000000 1.000000000 0.000000000  
## Reinstate 0.024390244 0.585365854 0.000000000  
## Renew Quote 0.000000000 1.000000000 0.000000000  
## Renewal 0.020000000 0.560000000 0.000000000  
## Renewal Re-Quote 0.000000000 1.000000000 0.000000000  
## Rewrite 0.000000000 0.736842105 0.000000000  
## lob  
## Y BOP Property Business Owners Policy Commercial Prpty  
## Cancel Conf 0.000000000 0.003003003 0.001501502  
## Cancel Req 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000  
## New Business 0.000000000 0.017647059 0.005882353  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000 0.000000000  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000 0.000000000  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.000000000 0.005714286 0.002857143  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000 0.000000000  
## lob  
## Y Dwelling fire Flood Genl Liability Homeowners  
## Cancel Conf 0.013513514 0.000000000 0.013513514 0.249249249  
## Cancel Req 0.000000000 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000 0.000000000  
## New Business 0.047058824 0.000000000 0.052941176 0.529411765  
## Non-Renewal 0.000000000 0.000000000 0.000000000 0.000000000  
## Policy Change 0.027638191 0.005025126 0.000000000 0.213567839  
## Re-Issue 0.000000000 0.000000000 0.000000000 0.000000000  
## Reinstate 0.048780488 0.000000000 0.024390244 0.292682927  
## Renew Quote 0.000000000 0.000000000 0.000000000 0.000000000  
## Renewal 0.008571429 0.000000000 0.028571429 0.340000000  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000 0.000000000 0.263157895  
## lob  
## Y Inland marine (comm) Inland Marine (pers)  
## Cancel Conf 0.000000000 0.000000000  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.000000000 0.000000000  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.011428571 0.005714286  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000  
## lob  
## Y Personal Liability Professional Liab Renters  
## Cancel Conf 0.000000000 0.000000000 0.000000000  
## Cancel Req 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000  
## New Business 0.005882353 0.011764706 0.011764706  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000 0.000000000  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000 0.000000000  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.000000000 0.000000000 0.000000000  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000 0.000000000  
## lob  
## Y Signs Umbrella - Comm Umbrella - Personal  
## Cancel Conf 0.000000000 0.003003003 0.003003003  
## Cancel Req 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000  
## New Business 0.000000000 0.005882353 0.088235294  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000 0.007537688  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000 0.024390244  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.000000000 0.000000000 0.014285714  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000 0.000000000  
## lob  
## Y Watercraft (small boat) Workers comp  
## Cancel Conf 0.000000000 0.001501502  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.017647059 0.005882353  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.002512563 0.000000000  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.002857143 0.000000000  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000

## master\_company  
## Y Aimonetti Insurance Beaulah General Agency  
## Cancel Conf 0.330330330 0.000000000  
## Cancel Req 1.000000000 0.000000000  
## Cancel/DNR 0.250000000 0.000000000  
## DB Synch 0.750000000 0.000000000  
## New Business 0.123529412 0.005882353  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.359296482 0.000000000  
## Re-Issue 1.000000000 0.000000000  
## Reinstate 0.390243902 0.000000000  
## Renew Quote 1.000000000 0.000000000  
## Renewal 0.288571429 0.000000000  
## Renewal Re-Quote 1.000000000 0.000000000  
## Rewrite 0.052631579 0.000000000  
## master\_company  
## Y Beaulah Insurance Beyer Strategic Insurance  
## Cancel Conf 0.090090090 0.060060060  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.023529412 0.076470588  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.052763819 0.045226131  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.000000000 0.024390244  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.080000000 0.034285714  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.105263158 0.000000000  
## master\_company  
## Y Borer Group, LLC Brakus Fire & Casualty  
## Cancel Conf 0.004504505 0.003003003  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.076470588 0.000000000  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.042713568 0.000000000  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.024390244 0.000000000  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.000000000 0.000000000  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.157894737 0.000000000  
## master\_company  
## Y Breitenberg Insurance DuBuque Insurance  
## Cancel Conf 0.165165165 0.099099099  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.500000000 0.000000000  
## DB Synch 0.250000000 0.000000000  
## New Business 0.076470588 0.164705882  
## Non-Renewal 1.000000000 0.000000000  
## Policy Change 0.077889447 0.163316583  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.048780488 0.146341463  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.188571429 0.022857143  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.052631579  
## master\_company  
## Y Friesen Insurance Helen Herman Group Hui Insurance  
## Cancel Conf 0.043543544 0.004504505 0.018018018  
## Cancel Req 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000  
## New Business 0.011764706 0.000000000 0.205882353  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.047738693 0.002512563 0.067839196  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.073170732 0.000000000 0.073170732  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.068571429 0.005714286 0.025714286  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000  
## Rewrite 0.421052632 0.000000000 0.105263158  
## master\_company  
## Y Kilback Excess & Surplus Roderick Insurance  
## Cancel Conf 0.000000000 0.004504505  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.029411765 0.082352941  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.000000000 0.047738693  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.000000000 0.048780488  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.000000000 0.097142857  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000  
## master\_company  
## Y Ryan Hyatt Insurance Schimel Mutual Insurance  
## Cancel Conf 0.006006006 0.019519520  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.000000000 0.047058824  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.000000000 0.024390244  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.000000000 0.051428571  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000  
## master\_company  
## Y Schuppe Group Simonis Insurance Spinka West Insurance  
## Cancel Conf 0.060060060 0.043543544 0.039039039  
## Cancel Req 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.250000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000  
## New Business 0.047058824 0.017647059 0.005882353  
## Non-Renewal 0.000000000 0.000000000 0.000000000  
## Policy Change 0.070351759 0.010050251 0.005025126  
## Re-Issue 0.000000000 0.000000000 0.000000000  
## Reinstate 0.000000000 0.024390244 0.024390244  
## Renew Quote 0.000000000 0.000000000 0.000000000  
## Renewal 0.077142857 0.014285714 0.017142857  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000  
## Rewrite 0.105263158 0.000000000 0.000000000  
## master\_company  
## Y Streich Group Insurance Sultan Insurance  
## Cancel Conf 0.009009009 0.000000000  
## Cancel Req 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000  
## New Business 0.005882353 0.000000000  
## Non-Renewal 0.000000000 0.000000000  
## Policy Change 0.007537688 0.000000000  
## Re-Issue 0.000000000 0.000000000  
## Reinstate 0.097560976 0.000000000  
## Renew Quote 0.000000000 0.000000000  
## Renewal 0.028571429 0.000000000  
## Renewal Re-Quote 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000

## policy\_term  
## Y 12 Months 6 Months 7 Months  
## Cancel Conf 0.54804805 0.45195195 0.00000000  
## Cancel Req 0.33333333 0.66666667 0.00000000  
## Cancel/DNR 0.25000000 0.75000000 0.00000000  
## DB Synch 0.50000000 0.50000000 0.00000000  
## New Business 0.97058824 0.02941176 0.00000000  
## Non-Renewal 1.00000000 0.00000000 0.00000000  
## Policy Change 0.83165829 0.16834171 0.00000000  
## Re-Issue 1.00000000 0.00000000 0.00000000  
## Reinstate 0.73170732 0.26829268 0.00000000  
## Renew Quote 0.00000000 1.00000000 0.00000000  
## Renewal 0.74857143 0.25142857 0.00000000  
## Renewal Re-Quote 0.50000000 0.50000000 0.00000000  
## Rewrite 1.00000000 0.00000000 0.00000000

## policy\_type  
## Y Commercial Personal  
## Cancel Conf 0.03603604 0.96396396  
## Cancel Req 0.16666667 0.83333333  
## Cancel/DNR 0.00000000 1.00000000  
## DB Synch 0.00000000 1.00000000  
## New Business 0.11176471 0.88823529  
## Non-Renewal 0.00000000 1.00000000  
## Policy Change 0.02261307 0.97738693  
## Re-Issue 0.00000000 1.00000000  
## Reinstate 0.07317073 0.92682927  
## Renew Quote 0.00000000 1.00000000  
## Renewal 0.06857143 0.93142857  
## Renewal Re-Quote 0.00000000 1.00000000  
## Rewrite 0.00000000 1.00000000

## rating\_state  
## Y FL ND NV OK  
## Cancel Conf 0.996996997 0.001501502 0.000000000 0.000000000  
## Cancel Req 1.000000000 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 1.000000000 0.000000000 0.000000000 0.000000000  
## DB Synch 1.000000000 0.000000000 0.000000000 0.000000000  
## New Business 1.000000000 0.000000000 0.000000000 0.000000000  
## Non-Renewal 1.000000000 0.000000000 0.000000000 0.000000000  
## Policy Change 0.989949749 0.000000000 0.000000000 0.007537688  
## Re-Issue 1.000000000 0.000000000 0.000000000 0.000000000  
## Reinstate 1.000000000 0.000000000 0.000000000 0.000000000  
## Renew Quote 1.000000000 0.000000000 0.000000000 0.000000000  
## Renewal 0.997142857 0.000000000 0.000000000 0.002857143  
## Renewal Re-Quote 1.000000000 0.000000000 0.000000000 0.000000000  
## Rewrite 1.000000000 0.000000000 0.000000000 0.000000000  
## rating\_state  
## Y OR UT WA WY  
## Cancel Conf 0.000000000 0.001501502 0.000000000 0.000000000  
## Cancel Req 0.000000000 0.000000000 0.000000000 0.000000000  
## Cancel/DNR 0.000000000 0.000000000 0.000000000 0.000000000  
## DB Synch 0.000000000 0.000000000 0.000000000 0.000000000  
## New Business 0.000000000 0.000000000 0.000000000 0.000000000  
## Non-Renewal 0.000000000 0.000000000 0.000000000 0.000000000  
## Policy Change 0.000000000 0.000000000 0.000000000 0.002512563  
## Re-Issue 0.000000000 0.000000000 0.000000000 0.000000000  
## Reinstate 0.000000000 0.000000000 0.000000000 0.000000000  
## Renew Quote 0.000000000 0.000000000 0.000000000 0.000000000  
## Renewal 0.000000000 0.000000000 0.000000000 0.000000000  
## Renewal Re-Quote 0.000000000 0.000000000 0.000000000 0.000000000  
## Rewrite 0.000000000 0.000000000 0.000000000 0.000000000

## status  
## Y Active Inactive  
## Cancel Conf 0.000000000 1.000000000  
## Cancel Req 0.000000000 1.000000000  
## Cancel/DNR 0.000000000 1.000000000  
## DB Synch 0.250000000 0.750000000  
## New Business 0.911764706 0.088235294  
## Non-Renewal 1.000000000 0.000000000  
## Policy Change 0.944723618 0.055276382  
## Re-Issue 1.000000000 0.000000000  
## Reinstate 0.902439024 0.097560976  
## Renew Quote 0.000000000 1.000000000  
## Renewal 0.997142857 0.002857143  
## Renewal Re-Quote 0.000000000 1.000000000  
## Rewrite 0.631578947 0.368421053

## Make Predictions

As with the model, this step can take some real time with a large data set, so it’s segregated from processing / output.

nb\_predict <- predict(nb\_model, test\_ad)

## Show the Predictions

This is similar to the conditional probability, but applies it to show the actual predicted values.

table(nb\_predict, test\_ad$account\_type)

##   
## nb\_predict Commercial Personal  
## Cancel Conf 6 202  
## Cancel Req 2 0  
## Cancel/DNR 0 0  
## DB Synch 0 1  
## New Business 58 167  
## Non-Renewal 0 0  
## Policy Change 0 90  
## Re-Issue 0 0  
## Reinstate 2 9  
## Renew Quote 0 0  
## Renewal 10 148  
## Renewal Re-Quote 0 0  
## Rewrite 0 18

table(nb\_predict, test\_ad$assigned\_agent)

##   
## nb\_predict Boehm, Sebastian Doyle, Walter Insurance, Nichersen  
## Cancel Conf 29 96 0  
## Cancel Req 0 2 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 1  
## New Business 14 75 0  
## Non-Renewal 0 0 0  
## Policy Change 10 28 0  
## Re-Issue 0 0 0  
## Reinstate 0 6 0  
## Renew Quote 0 0 0  
## Renewal 23 60 0  
## Renewal Re-Quote 0 0 0  
## Rewrite 3 4 0  
##   
## nb\_predict Padberg, Tracy Rohan, Elwood Tremblay, Deena  
## Cancel Conf 0 0 83  
## Cancel Req 0 0 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 0  
## New Business 47 35 54  
## Non-Renewal 0 0 0  
## Policy Change 20 3 29  
## Re-Issue 0 0 0  
## Reinstate 1 2 2  
## Renew Quote 0 0 0  
## Renewal 1 1 73  
## Renewal Re-Quote 0 0 0  
## Rewrite 0 0 11

table(nb\_predict, test\_ad$lob)

##   
## nb\_predict Auto (Commercial) Auto (Personal) BOP Liability  
## Cancel Conf 2 107 0  
## Cancel Req 0 0 1  
## Cancel/DNR 0 0 0  
## DB Synch 0 1 0  
## New Business 0 3 1  
## Non-Renewal 0 0 0  
## Policy Change 0 55 0  
## Re-Issue 0 0 0  
## Reinstate 1 7 0  
## Renew Quote 0 0 0  
## Renewal 0 67 0  
## Renewal Re-Quote 0 0 0  
## Rewrite 0 11 0  
##   
## nb\_predict BOP Property Business Owners Policy Commercial Prpty  
## Cancel Conf 1 1 0  
## Cancel Req 0 0 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 0  
## New Business 0 6 3  
## Non-Renewal 0 0 0  
## Policy Change 0 0 0  
## Re-Issue 0 0 0  
## Reinstate 0 0 0  
## Renew Quote 0 0 0  
## Renewal 0 0 1  
## Renewal Re-Quote 0 0 0  
## Rewrite 0 0 0  
##   
## nb\_predict Dwelling fire Flood Genl Liability Homeowners  
## Cancel Conf 3 0 0 91  
## Cancel Req 0 0 0 0  
## Cancel/DNR 0 0 0 0  
## DB Synch 0 0 0 0  
## New Business 26 0 35 150  
## Non-Renewal 0 0 0 0  
## Policy Change 11 2 0 21  
## Re-Issue 0 0 0 0  
## Reinstate 0 0 0 2  
## Renew Quote 0 0 0 0  
## Renewal 1 0 8 75  
## Renewal Re-Quote 0 0 0 0  
## Rewrite 0 0 0 7  
##   
## nb\_predict Inland marine (comm) Inland Marine (pers)  
## Cancel Conf 0 0  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 0  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 5 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Personal Liability Professional Liab Renters Signs  
## Cancel Conf 0 0 0 0  
## Cancel Req 0 1 0 0  
## Cancel/DNR 0 0 0 0  
## DB Synch 0 0 0 0  
## New Business 0 1 0 0  
## Non-Renewal 0 0 0 0  
## Policy Change 0 0 0 0  
## Re-Issue 0 0 0 0  
## Reinstate 0 0 0 0  
## Renew Quote 0 0 0 0  
## Renewal 0 0 0 0  
## Renewal Re-Quote 0 0 0 0  
## Rewrite 0 0 0 0  
##   
## nb\_predict Umbrella - Comm Umbrella - Personal  
## Cancel Conf 2 1  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 0  
## Non-Renewal 0 0  
## Policy Change 0 1  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 0 1  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Watercraft (small boat) Workers comp  
## Cancel Conf 0 0  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 0  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 1  
## Renew Quote 0 0  
## Renewal 0 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0

table(nb\_predict, test\_ad$master\_company)

##   
## nb\_predict Aimonetti Insurance Beaulah General Agency  
## Cancel Conf 0 0  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 3  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 0 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Beaulah Insurance Beyer Strategic Insurance  
## Cancel Conf 56 45  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 3 41  
## Non-Renewal 0 0  
## Policy Change 24 9  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 41 18  
## Renewal Re-Quote 0 0  
## Rewrite 2 0  
##   
## nb\_predict Borer Group, LLC Brakus Fire & Casualty  
## Cancel Conf 0 2  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 29 0  
## Non-Renewal 0 0  
## Policy Change 17 0  
## Re-Issue 0 0  
## Reinstate 1 0  
## Renew Quote 0 0  
## Renewal 0 0  
## Renewal Re-Quote 0 0  
## Rewrite 5 0  
##   
## nb\_predict Breitenberg Insurance DuBuque Insurance  
## Cancel Conf 0 0  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 0  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 0 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Friesen Insurance Helen Herman Group Hui Insurance  
## Cancel Conf 42 3 4  
## Cancel Req 0 1 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 0  
## New Business 1 0 102  
## Non-Renewal 0 0 0  
## Policy Change 23 1 13  
## Re-Issue 0 0 0  
## Reinstate 2 0 0  
## Renew Quote 0 0 0  
## Renewal 44 2 9  
## Renewal Re-Quote 0 0 0  
## Rewrite 10 0 1  
##   
## nb\_predict Kilback Excess & Surplus Roderick Insurance  
## Cancel Conf 0 0  
## Cancel Req 1 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 5 0  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 0  
## Renew Quote 0 0  
## Renewal 0 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Ryan Hyatt Insurance Schimel Mutual Insurance  
## Cancel Conf 12 3  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 0  
## New Business 0 37  
## Non-Renewal 0 0  
## Policy Change 0 0  
## Re-Issue 0 0  
## Reinstate 0 2  
## Renew Quote 0 0  
## Renewal 0 14  
## Renewal Re-Quote 0 0  
## Rewrite 0 0  
##   
## nb\_predict Schuppe Group Simonis Insurance Spinka West Insurance  
## Cancel Conf 0 0 33  
## Cancel Req 0 0 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 0  
## New Business 0 0 0  
## Non-Renewal 0 0 0  
## Policy Change 0 0 2  
## Re-Issue 0 0 0  
## Reinstate 0 0 4  
## Renew Quote 0 0 0  
## Renewal 0 0 10  
## Renewal Re-Quote 0 0 0  
## Rewrite 0 0 0  
##   
## nb\_predict Streich Group Insurance Sultan Insurance  
## Cancel Conf 8 0  
## Cancel Req 0 0  
## Cancel/DNR 0 0  
## DB Synch 0 1  
## New Business 4 0  
## Non-Renewal 0 0  
## Policy Change 1 0  
## Re-Issue 0 0  
## Reinstate 2 0  
## Renew Quote 0 0  
## Renewal 20 0  
## Renewal Re-Quote 0 0  
## Rewrite 0 0

#table(nb\_predict, test\_ad$effective\_date) # bin this  
table(nb\_predict, test\_ad$policy\_term)

##   
## nb\_predict 12 Months 6 Months 7 Months  
## Cancel Conf 139 69 0  
## Cancel Req 2 0 0  
## Cancel/DNR 0 0 0  
## DB Synch 0 0 1  
## New Business 225 0 0  
## Non-Renewal 0 0 0  
## Policy Change 84 6 0  
## Re-Issue 0 0 0  
## Reinstate 7 4 0  
## Renew Quote 0 0 0  
## Renewal 128 30 0  
## Renewal Re-Quote 0 0 0  
## Rewrite 18 0 0

table(nb\_predict, test\_ad$policy\_type)

##   
## nb\_predict Commercial Personal  
## Cancel Conf 6 202  
## Cancel Req 2 0  
## Cancel/DNR 0 0  
## DB Synch 0 1  
## New Business 59 166  
## Non-Renewal 0 0  
## Policy Change 0 90  
## Re-Issue 0 0  
## Reinstate 2 9  
## Renew Quote 0 0  
## Renewal 14 144  
## Renewal Re-Quote 0 0  
## Rewrite 0 18

table(nb\_predict, test\_ad$rating\_state)

##   
## nb\_predict FL ND NV OK OR UT WA WY  
## Cancel Conf 208 0 0 0 0 0 0 0  
## Cancel Req 2 0 0 0 0 0 0 0  
## Cancel/DNR 0 0 0 0 0 0 0 0  
## DB Synch 1 0 0 0 0 0 0 0  
## New Business 225 0 0 0 0 0 0 0  
## Non-Renewal 0 0 0 0 0 0 0 0  
## Policy Change 88 0 1 0 0 0 1 0  
## Re-Issue 0 0 0 0 0 0 0 0  
## Reinstate 11 0 0 0 0 0 0 0  
## Renew Quote 0 0 0 0 0 0 0 0  
## Renewal 158 0 0 0 0 0 0 0  
## Renewal Re-Quote 0 0 0 0 0 0 0 0  
## Rewrite 18 0 0 0 0 0 0 0

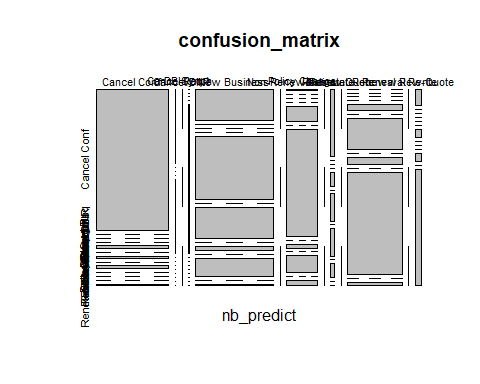
table(nb\_predict, test\_ad$status)

##   
## nb\_predict Active Inactive  
## Cancel Conf 0 208  
## Cancel Req 0 2  
## Cancel/DNR 0 0  
## DB Synch 0 1  
## New Business 158 67  
## Non-Renewal 0 0  
## Policy Change 89 1  
## Re-Issue 0 0  
## Reinstate 6 5  
## Renew Quote 0 0  
## Renewal 158 0  
## Renewal Re-Quote 0 0  
## Rewrite 7 11

## Confusion Matrix

Build a simple confusion matrix and then plot it.

confusion\_matrix <- table(nb\_predict, test\_ad$transaction\_type)  
plot(confusion\_matrix)



## Finally, Show Stats on the Confusion Matrix

confusionMatrix(confusion\_matrix)

## Confusion Matrix and Statistics  
##   
##   
## nb\_predict Cancel Conf Cancel Req Cancel/DNR DB Synch New Business  
## Cancel Conf 197 0 0 0 4  
## Cancel Req 1 0 0 0 1  
## Cancel/DNR 0 0 0 0 0  
## DB Synch 0 0 0 0 1  
## New Business 47 1 0 0 95  
## Non-Renewal 0 0 0 0 0  
## Policy Change 1 0 0 0 9  
## Re-Issue 0 0 0 0 0  
## Reinstate 5 0 0 0 1  
## Renew Quote 0 0 0 0 0  
## Renewal 0 0 0 0 6  
## Renewal Re-Quote 0 0 0 0 0  
## Rewrite 2 0 0 0 0  
##   
## nb\_predict Non-Renewal Policy Change Re-Issue Reinstate  
## Cancel Conf 0 2 0 4  
## Cancel Req 0 0 0 0  
## Cancel/DNR 0 0 0 0  
## DB Synch 0 0 0 0  
## New Business 0 47 0 6  
## Non-Renewal 0 0 0 0  
## Policy Change 0 65 0 2  
## Re-Issue 0 0 0 0  
## Reinstate 0 2 0 2  
## Renew Quote 0 0 0 0  
## Renewal 0 33 0 8  
## Renewal Re-Quote 0 0 0 0  
## Rewrite 0 1 0 0  
##   
## nb\_predict Renew Quote Renewal Renewal Re-Quote Rewrite  
## Cancel Conf 0 0 0 1  
## Cancel Req 0 0 0 0  
## Cancel/DNR 0 0 0 0  
## DB Synch 0 0 0 0  
## New Business 0 28 0 1  
## Non-Renewal 0 0 0 0  
## Policy Change 0 10 0 3  
## Re-Issue 0 0 0 0  
## Reinstate 0 1 0 0  
## Renew Quote 0 0 0 0  
## Renewal 0 108 0 3  
## Renewal Re-Quote 0 0 0 0  
## Rewrite 0 1 0 14  
##   
## Overall Statistics  
##   
## Accuracy : 0.6746   
## 95% CI : (0.6389, 0.7089)  
## No Information Rate : 0.3548   
## P-Value [Acc > NIR] : < 2.2e-16   
##   
## Kappa : 0.5779   
##   
## Mcnemar's Test P-Value : NA   
##   
## Statistics by Class:  
##   
## Class: Cancel Conf Class: Cancel Req  
## Sensitivity 0.7787 0.000000  
## Specificity 0.9761 0.997191  
## Pos Pred Value 0.9471 0.000000  
## Neg Pred Value 0.8891 0.998594  
## Prevalence 0.3548 0.001403  
## Detection Rate 0.2763 0.000000  
## Detection Prevalence 0.2917 0.002805  
## Balanced Accuracy 0.8774 0.498596  
## Class: Cancel/DNR Class: DB Synch Class: New Business  
## Sensitivity NA NA 0.8120  
## Specificity 1 0.998597 0.7819  
## Pos Pred Value NA NA 0.4222  
## Neg Pred Value NA NA 0.9549  
## Prevalence 0 0.000000 0.1641  
## Detection Rate 0 0.000000 0.1332  
## Detection Prevalence 0 0.001403 0.3156  
## Balanced Accuracy NA NA 0.7969  
## Class: Non-Renewal Class: Policy Change  
## Sensitivity NA 0.43333  
## Specificity 1 0.95560  
## Pos Pred Value NA 0.72222  
## Neg Pred Value NA 0.86356  
## Prevalence 0 0.21038  
## Detection Rate 0 0.09116  
## Detection Prevalence 0 0.12623  
## Balanced Accuracy NA 0.69446  
## Class: Re-Issue Class: Reinstate Class: Renew Quote  
## Sensitivity NA 0.090909 NA  
## Specificity 1 0.986975 1  
## Pos Pred Value NA 0.181818 NA  
## Neg Pred Value NA 0.971510 NA  
## Prevalence 0 0.030856 0  
## Detection Rate 0 0.002805 0  
## Detection Prevalence 0 0.015428 0  
## Balanced Accuracy NA 0.538942 NA  
## Class: Renewal Class: Renewal Re-Quote Class: Rewrite  
## Sensitivity 0.7297 NA 0.63636  
## Specificity 0.9115 1 0.99421  
## Pos Pred Value 0.6835 NA 0.77778  
## Neg Pred Value 0.9279 NA 0.98849  
## Prevalence 0.2076 0 0.03086  
## Detection Rate 0.1515 0 0.01964  
## Detection Prevalence 0.2216 0 0.02525  
## Balanced Accuracy 0.8206 NA 0.81529