

Naive Bayes Agency Conditional Probabilities

Frank Neugebauer

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Introduction

The conditional probabilities are interesting but take up a lot of space in a document (and they're not super readable). Therefore, that part is segmented here and only summarized in the main RMD file.

```
# Read the original data set
agency_data_orig <- read.xlsx('./AgencyData_clean.xlsx', sheetIndex=1, stringsAsFactors=T)
# 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 ...
## $ assigned_agent : Factor w/ 6 levels "Boehm, Sebastian",...: 6 2 2 6 6 6 6 6 6 ...
## $ lob : Factor w/ 20 levels "Auto (Commercial)",...: 10 10 2 10 2 2 10 2 2 2 ...
## $ master_company : Factor w/ 20 levels "Aimonetti Insurance",...: 9 9 9 9 9 9 9 9 9 ...
## $ effective_date : Date, format: "2014-10-07" "2014-10-06" ...
## $ policy_term : Factor w/ 3 levels "12 Months","6 Months",...: 1 1 1 1 1 1 1 1 1 ...
## $ policy_type : Factor w/ 2 levels "Commercial","Personal": 2 2 2 2 2 2 2 2 2 ...
## $ annual_premium : num 291 868 1239 789 1648 ...
## $ written_premium : num 291 868 1239 789 1648 ...
## $ rating_state : Factor w/ 8 levels "FL","ND","NV",...: 1 1 1 1 1 1 1 1 1 ...
## $ status : Factor w/ 2 levels "Active","Inactive": 2 2 2 2 2 2 2 2 2 ...
## $ transaction_type: Factor w/ 13 levels "Cancel Conf",...: 13 13 13 13 13 13 13 13 13 ...

# 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,]
nb_model <- naiveBayes(transaction_type~., data=train_ad)
```

Conditional Probabilities

```
nb_model$tables$assigned_agent
```

##	assigned_agent		
## Y	Boehm, Sebastian	Doyle, Walter	Insurance, Nichersen
## Cancel Conf	0.124260355	0.442307692	0.059171598
## Cancel Req	0.000000000	0.714285714	0.000000000
## Cancel/DNR	0.000000000	0.000000000	1.000000000
## DB Synch	0.000000000	0.333333333	0.333333333
## New Business	0.089385475	0.374301676	0.011173184
## Non-Renewal			
## Policy Change	0.141361257	0.321989529	0.005235602
## Re-Issue	0.000000000	0.000000000	0.000000000
## Reinstate	0.046511628	0.279069767	0.023255814
## Renew Quote			
## Renewal	0.255072464	0.400000000	0.000000000

##	Renewal Re-Quote	0.500000000	0.000000000	0.000000000
##	Rewrite	0.142857143	0.333333333	0.000000000
##	assigned_agent			
## Y	Padberg, Tracy Rohan, Elwood Tremblay, Deena			
##	Cancel Conf	0.008875740	0.008875740	0.356508876
##	Cancel Req	0.000000000	0.142857143	0.142857143
##	Cancel/DNR	0.000000000	0.000000000	0.000000000
##	DB Synch	0.333333333	0.000000000	0.000000000
##	New Business	0.167597765	0.078212291	0.279329609
##	Non-Renewal			
##	Policy Change	0.109947644	0.073298429	0.348167539
##	Re-Issue	0.000000000	0.000000000	1.000000000
##	Reinstate	0.046511628	0.186046512	0.418604651
##	Renew Quote			
##	Renewal	0.005797101	0.008695652	0.330434783
##	Renewal Re-Quote	0.000000000	0.000000000	0.500000000
##	Rewrite	0.000000000	0.000000000	0.523809524

nb_model\$tables\$lob

##	lob			
## Y	Auto (Commercial) Auto (Personal) BOP Liability			
##	Cancel Conf	0.008875740	0.698224852	0.000000000
##	Cancel Req	0.000000000	0.857142857	0.000000000
##	Cancel/DNR	0.000000000	1.000000000	0.000000000
##	DB Synch	0.000000000	1.000000000	0.000000000
##	New Business	0.022346369	0.234636872	0.005586592
##	Non-Renewal			
##	Policy Change	0.013089005	0.693717277	0.000000000
##	Re-Issue	0.000000000	1.000000000	0.000000000
##	Reinstate	0.023255814	0.651162791	0.000000000
##	Renew Quote			
##	Renewal	0.026086957	0.527536232	0.000000000
##	Renewal Re-Quote	0.000000000	1.000000000	0.000000000
##	Rewrite	0.000000000	0.761904762	0.000000000
##	lob			
## Y	BOP Property Business Owners Policy Commercial Prpty			
##	Cancel Conf	0.001479290	0.004437870	0.001479290
##	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	0.027932961	0.005586592
##	Non-Renewal			
##	Policy Change	0.000000000	0.002617801	0.000000000
##	Re-Issue	0.000000000	0.000000000	0.000000000
##	Reinstate	0.000000000	0.000000000	0.000000000
##	Renew Quote			
##	Renewal	0.000000000	0.005797101	0.002898551
##	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	0.014792899	0.000000000	0.014792899
##	Cancel Req	0.142857143	0.000000000	0.000000000
##	Cancel/DNR	0.000000000	0.000000000	0.000000000

##	DB Synch	0.000000000	0.000000000	0.000000000	0.000000000
##	New Business	0.055865922	0.000000000	0.039106145	0.491620112
##	Non-Renewal				
##	Policy Change	0.026178010	0.002617801	0.000000000	0.240837696
##	Re-Issue	0.000000000	0.000000000	0.000000000	0.000000000
##	Reinstate	0.046511628	0.000000000	0.000000000	0.279069767
##	Renew Quote				
##	Renewal	0.011594203	0.000000000	0.031884058	0.371014493
##	Renewal Re-Quote	0.000000000	0.000000000	0.000000000	0.000000000
##	Rewrite	0.000000000	0.000000000	0.000000000	0.238095238
##		lob			
##	Y	Inland marine (comm)	Inland Marine (pers)		
##	Cancel Conf	0.000000000	0.001479290		
##	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				
##	Policy Change	0.000000000	0.000000000		
##	Re-Issue	0.000000000	0.000000000		
##	Reinstate	0.000000000	0.000000000		
##	Renew Quote				
##	Renewal	0.008695652	0.002898551		
##	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	0.005586592	0.005586592	0.011173184	
##	Non-Renewal				
##	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				
##	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	0.002958580	0.004437870	
##	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	0.005586592	0.072625698	
##	Non-Renewal				
##	Policy Change	0.002617801	0.000000000	0.015706806	
##	Re-Issue	0.000000000	0.000000000	0.000000000	
##	Reinstate	0.000000000	0.000000000	0.000000000	
##	Renew Quote				
##	Renewal	0.000000000	0.000000000	0.011594203	
##	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	0.001479290	
##	Cancel Req	0.000000000	0.000000000	
##	Cancel/DNR	0.000000000	0.000000000	
##	DB Synch	0.000000000	0.000000000	
##	New Business	0.011173184	0.005586592	
##	Non-Renewal			
##	Policy Change	0.002617801	0.000000000	
##	Re-Issue	0.000000000	0.000000000	
##	Reinstate	0.000000000	0.000000000	
##	Renew Quote			
##	Renewal	0.000000000	0.000000000	
##	Renewal Re-Quote	0.000000000	0.000000000	
##	Rewrite	0.000000000	0.000000000	

nb_model\$stables\$master_company

##		master_company		
##	Y	Aimonetti Insurance	Beulah General Agency	
##	Cancel Conf	0.326923077	0.000000000	
##	Cancel Req	0.857142857	0.000000000	
##	Cancel/DNR	0.250000000	0.000000000	
##	DB Synch	1.000000000	0.000000000	
##	New Business	0.156424581	0.000000000	
##	Non-Renewal			
##	Policy Change	0.332460733	0.000000000	
##	Re-Issue	1.000000000	0.000000000	
##	Reinstate	0.372093023	0.000000000	
##	Renew Quote			
##	Renewal	0.284057971	0.002898551	
##	Renewal Re-Quote	1.000000000	0.000000000	
##	Rewrite	0.000000000	0.000000000	
##		master_company		
##	Y	Beulah Insurance	Beyer Strategic Insurance	
##	Cancel Conf	0.082840237	0.053254438	
##	Cancel Req	0.000000000	0.000000000	
##	Cancel/DNR	0.000000000	0.000000000	
##	DB Synch	0.000000000	0.000000000	
##	New Business	0.022346369	0.061452514	
##	Non-Renewal			
##	Policy Change	0.062827225	0.034031414	
##	Re-Issue	0.000000000	0.000000000	
##	Reinstate	0.000000000	0.046511628	
##	Renew Quote			
##	Renewal	0.078260870	0.043478261	
##	Renewal Re-Quote	0.000000000	0.000000000	
##	Rewrite	0.095238095	0.000000000	
##		master_company		
##	Y	Borer Group, LLC	Brakus Fire & Casualty	
##	Cancel Conf	0.004437870	0.002958580	
##	Cancel Req	0.000000000	0.000000000	
##	Cancel/DNR	0.000000000	0.000000000	
##	DB Synch	0.000000000	0.000000000	

##	New Business	0.083798883	0.000000000
##	Non-Renewal		
##	Policy Change	0.036649215	0.000000000
##	Re-Issue	0.000000000	0.000000000
##	Reinstate	0.000000000	0.000000000
##	Renew Quote		
##	Renewal	0.000000000	0.000000000
##	Renewal Re-Quote	0.000000000	0.000000000
##	Rewrite	0.142857143	0.000000000
##	master_company		
## Y	Breitenberg Insurance DuBuque Insurance		
##	Cancel Conf	0.174556213	0.099112426
##	Cancel Req	0.000000000	0.000000000
##	Cancel/DNR	0.500000000	0.000000000
##	DB Synch	0.000000000	0.000000000
##	New Business	0.094972067	0.178770950
##	Non-Renewal		
##	Policy Change	0.086387435	0.154450262
##	Re-Issue	0.000000000	0.000000000
##	Reinstate	0.023255814	0.186046512
##	Renew Quote		
##	Renewal	0.191304348	0.034782609
##	Renewal Re-Quote	0.000000000	0.000000000
##	Rewrite	0.000000000	0.142857143
##	master_company		
## Y	Friesen Insurance Helen Herman Group Hui Insurance		
##	Cancel Conf	0.047337278	0.004437870 0.016272189
##	Cancel Req	0.000000000	0.000000000 0.142857143
##	Cancel/DNR	0.000000000	0.000000000 0.000000000
##	DB Synch	0.000000000	0.000000000 0.000000000
##	New Business	0.005586592	0.000000000 0.189944134
##	Non-Renewal		
##	Policy Change	0.049738220	0.000000000 0.078534031
##	Re-Issue	0.000000000	0.000000000 0.000000000
##	Reinstate	0.069767442	0.000000000 0.116279070
##	Renew Quote		
##	Renewal	0.066666667	0.002898551 0.034782609
##	Renewal Re-Quote	0.000000000	0.000000000 0.000000000
##	Rewrite	0.333333333	0.000000000 0.142857143
##	master_company		
## Y	Kilback Excess & Surplus Roderick Insurance		
##	Cancel Conf	0.000000000	0.008875740
##	Cancel Req	0.000000000	0.000000000
##	Cancel/DNR	0.000000000	0.000000000
##	DB Synch	0.000000000	0.000000000
##	New Business	0.022346369	0.055865922
##	Non-Renewal		
##	Policy Change	0.000000000	0.062827225
##	Re-Issue	0.000000000	0.000000000
##	Reinstate	0.000000000	0.023255814
##	Renew Quote		
##	Renewal	0.000000000	0.101449275
##	Renewal Re-Quote	0.000000000	0.000000000
##	Rewrite	0.000000000	0.000000000

```

##          master_company
## Y          Ryan Hyatt Insurance Schimel Mutual Insurance
##   Cancel Conf      0.005917160      0.020710059
##   Cancel Req       0.000000000      0.000000000
##   Cancel/DNR       0.000000000      0.000000000
##   DB Synch         0.000000000      0.000000000
##   New Business     0.005586592      0.039106145
##   Non-Renewal
##   Policy Change    0.002617801      0.000000000
##   Re-Issue         0.000000000      0.000000000
##   Reinstate        0.023255814      0.000000000
##   Renew Quote
##   Renewal          0.000000000      0.046376812
##   Renewal Re-Quote 0.000000000      0.000000000
##   Rewrite          0.000000000      0.000000000
##          master_company
## Y          Schuppe Group Simonis Insurance Spinka West Insurance
##   Cancel Conf      0.062130178      0.045857988      0.034023669
##   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     0.039106145      0.022346369      0.005586592
##   Non-Renewal
##   Policy Change    0.075916230      0.010471204      0.000000000
##   Re-Issue         0.000000000      0.000000000      0.000000000
##   Reinstate        0.023255814      0.023255814      0.023255814
##   Renew Quote
##   Renewal          0.060869565      0.017391304      0.011594203
##   Renewal Re-Quote 0.000000000      0.000000000      0.000000000
##   Rewrite          0.142857143      0.000000000      0.000000000
##          master_company
## Y          Streich Group Insurance Sultan Insurance
##   Cancel Conf      0.010355030      0.000000000
##   Cancel Req       0.000000000      0.000000000
##   Cancel/DNR       0.000000000      0.000000000
##   DB Synch         0.000000000      0.000000000
##   New Business     0.011173184      0.005586592
##   Non-Renewal
##   Policy Change    0.013089005      0.000000000
##   Re-Issue         0.000000000      0.000000000
##   Reinstate        0.069767442      0.000000000
##   Renew Quote
##   Renewal          0.023188406      0.000000000
##   Renewal Re-Quote 0.000000000      0.000000000
##   Rewrite          0.000000000      0.000000000

```

```

#nb_model$tables$effective_date # bin this
nb_model$tables$policy_term

```

```

##          policy_term
## Y          12 Months      6 Months      7 Months
##   Cancel Conf      0.547337278 0.452662722 0.000000000
##   Cancel Req       0.285714286 0.714285714 0.000000000
##   Cancel/DNR       0.250000000 0.750000000 0.000000000
##   DB Synch         0.666666667 0.333333333 0.000000000

```

```
## New Business      0.960893855 0.033519553 0.005586592
## Non-Renewal
## Policy Change     0.848167539 0.151832461 0.000000000
## Re-Issue          1.000000000 0.000000000 0.000000000
## Reinstate         0.767441860 0.232558140 0.000000000
## Renew Quote
## Renewal           0.759420290 0.240579710 0.000000000
## Renewal Re-Quote  0.500000000 0.500000000 0.000000000
## Rewrite           0.952380952 0.047619048 0.000000000
```

```
nb_model$stables$policy_type
```

```
## policy_type
## Y      Commercial  Personal
## Cancel Conf      0.03698225 0.96301775
## Cancel Req       0.14285714 0.85714286
## Cancel/DNR       0.00000000 1.00000000
## DB Synch         0.00000000 1.00000000
## New Business     0.11731844 0.88268156
## Non-Renewal
## Policy Change    0.02879581 0.97120419
## Re-Issue         0.00000000 1.00000000
## Reinstate        0.04651163 0.95348837
## Renew Quote
## Renewal          0.07536232 0.92463768
## Renewal Re-Quote 0.00000000 1.00000000
## Rewrite          0.00000000 1.00000000
```

```
# create one for binned premium
```

```
nb_model$stables$rating_state
```

```
## rating_state
## Y      FL      ND      NV      OK
## Cancel Conf      0.995562130 0.001479290 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     0.988826816 0.000000000 0.005586592 0.000000000
## Non-Renewal
## Policy Change    0.992146597 0.000000000 0.000000000 0.005235602
## Re-Issue         1.000000000 0.000000000 0.000000000 0.000000000
## Reinstate        1.000000000 0.000000000 0.000000000 0.000000000
## Renew Quote
## Renewal          0.997101449 0.000000000 0.000000000 0.002898551
## 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      0.001479290 0.001479290 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 0.005586592 0.000000000
## Non-Renewal
## Policy Change    0.000000000 0.000000000 0.000000000 0.002617801
```

##	Re-Issue	0.000000000	0.000000000	0.000000000	0.000000000
##	Reinstate	0.000000000	0.000000000	0.000000000	0.000000000
##	Renew Quote				
##	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

nb_model\$stables\$status

##		status	
##	Y	Active	Inactive
##	Cancel Conf	0.000000000	1.000000000
##	Cancel Req	0.000000000	1.000000000
##	Cancel/DNR	0.000000000	1.000000000
##	DB Synch	0.333333333	0.666666667
##	New Business	0.916201117	0.083798883
##	Non-Renewal		
##	Policy Change	0.947643979	0.052356021
##	Re-Issue	1.000000000	0.000000000
##	Reinstate	0.837209302	0.162790698
##	Renew Quote		
##	Renewal	0.994202899	0.005797101
##	Renewal Re-Quote	0.000000000	1.000000000
##	Rewrite	0.714285714	0.285714286