Customer Response Prediction

...

By: Bailey Paulk, Madhuparna Deb, Martin Vincent, Bhavika Bhandari, Naymal Mehmood

*Source

The Grocery Industry

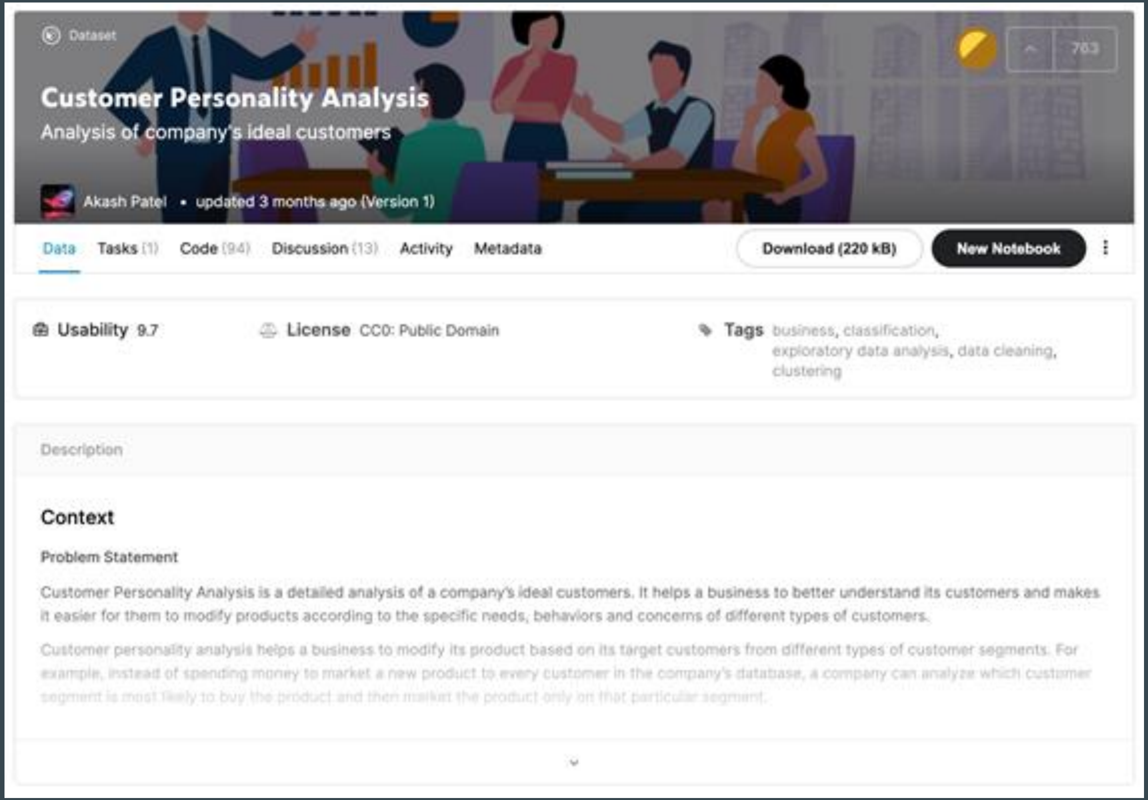
- Grocery stores rely heavily on ad campaigns and crafting a brand and reputation
- Ad campaigns can increase profits widely, but first we must answer one important question...

Appendix

What customers should be sent an advertising campaign?

Appendix

Where We Got Our Data



[*Source]

[Appendix]

Predicting Likelihood of Campaign Acceptance

- Creating a Model based on Logistic Regression
- Why Logistic Regression?
- We had to decide what variables were important

*Source

Appendix

Variables Being Used

Recency : Number of days since customer's last purchase

MntWines : Amount spent on wine in last 2 years

MntFruits : Amount spent on fruits in last 2 years

MntMeatProducts : Amount spent on meat in last 2 years

MntFishProducts : Amount spent on fish in last 2 years

MntSweetProducts : Amount spent on sweets in last 2 years

MntGoldProds : Amount spent on gold in last 2 years

NumDealsPurchases : Number of purchases made with a discount

Appendix

Variables Being Used

NumWebPurchases : Number of purchases made through the company's web site

NumStorePurchases : Number of purchases made directly in stores

NumWebVisitsMonth : Number of visits to company's web site in the last month

AcceptedCmp1 : 1 if customer accepted the offer in the 1st campaign, 0 otherwise

AcceptedCmp2 : 1 if customer accepted the offer in the 2nd campaign, 0 otherwise

AcceptedCmp3 : 1 if customer accepted the offer in the 3rd campaign, 0 otherwise

AcceptedCmp4 : 1 if customer accepted the offer in the 4th campaign, 0 otherwise

AcceptedCmp5 : 1 if customer accepted the offer in the 5th campaign, 0 otherwise

Response : 1 if customer accepted the offer in the last campaign, 0 otherwise

Which Variables were Important

- Interpretation of Logistic Regression

  - From the model output we can see which of our predictors are statistically significant at the 5% level
  - All the significant predictors have positive coefficients except for number of purchases made directly in stores.

*Source

Appendix

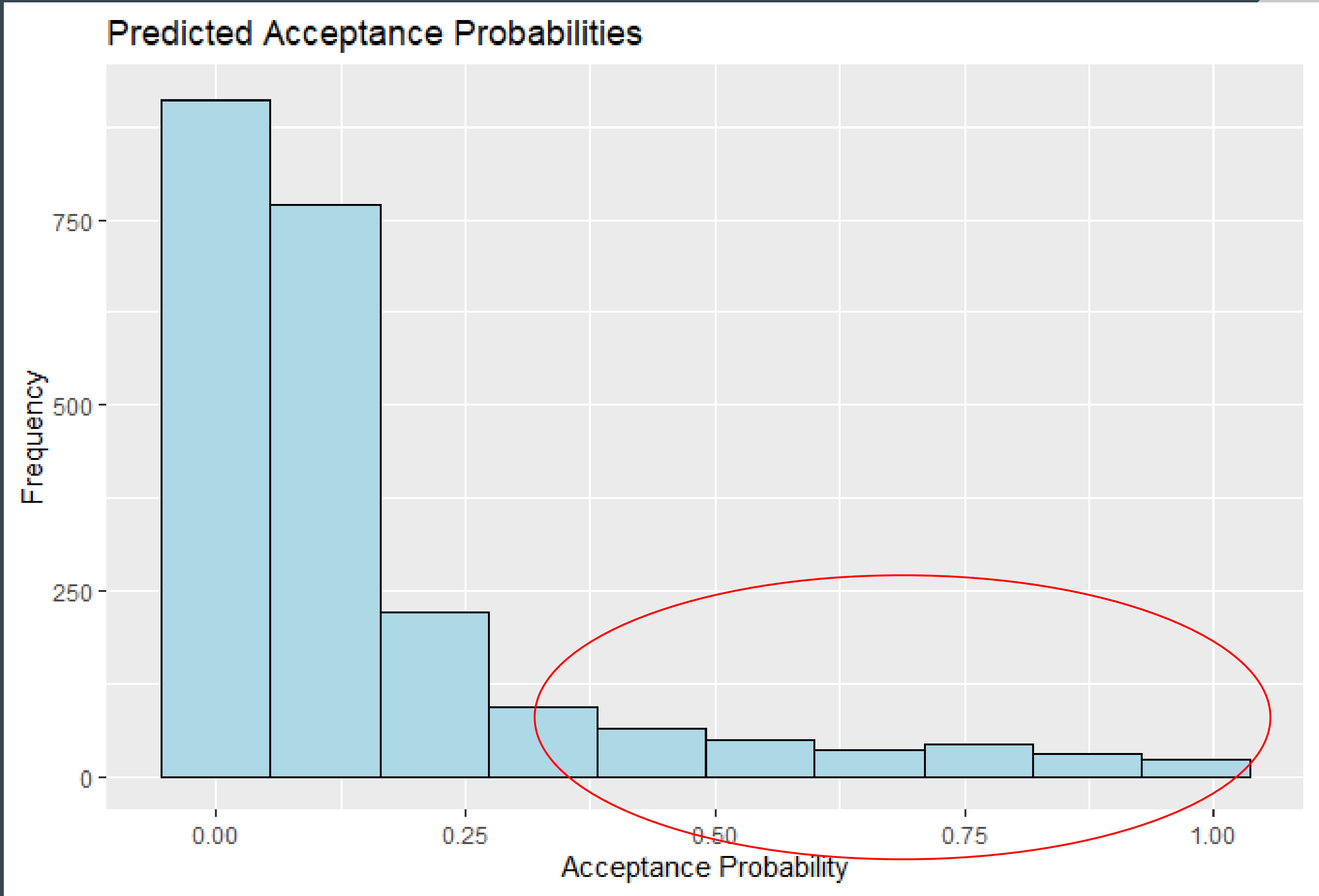
Determining Customer Profitability

- Average amount spend per customer is about **$33**
- Average profit margin for grocery store is **4%***
- Average profit per customer is $33 * .04 = **$1.33**
- Cost of sending each flyer is **$0.46***
- Breakeven response rate = $0.46/$1.33 = **0.35**

Appendix

Who should be sent a campaign?

- Cutoff rate was 35%
- We filtered campaign based on acceptance probability > cutoff rate
- We were left with 268 customers out of 2,240 original customers - 12% of our customers

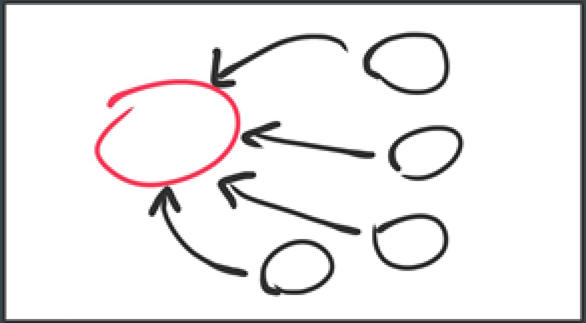


Predicted Acceptance Probabilities
750
500
250
0
Frequency
0.00
0.25
0.50
0.75
1.00
Acceptance Probability

Appendix

In Summary

- Objective: Determine who to direct our marketing towards
- Data on customers includes demographic and Recency-Frequency-Monetary information, from which we created our model
- Assuming a 4% profit margin, we created a predicted profit per customer and a cutoff rate of 35%
- We should send advertisements to 268 customers, 12% of the customers we analyzed



Appendix

Thank You!

...

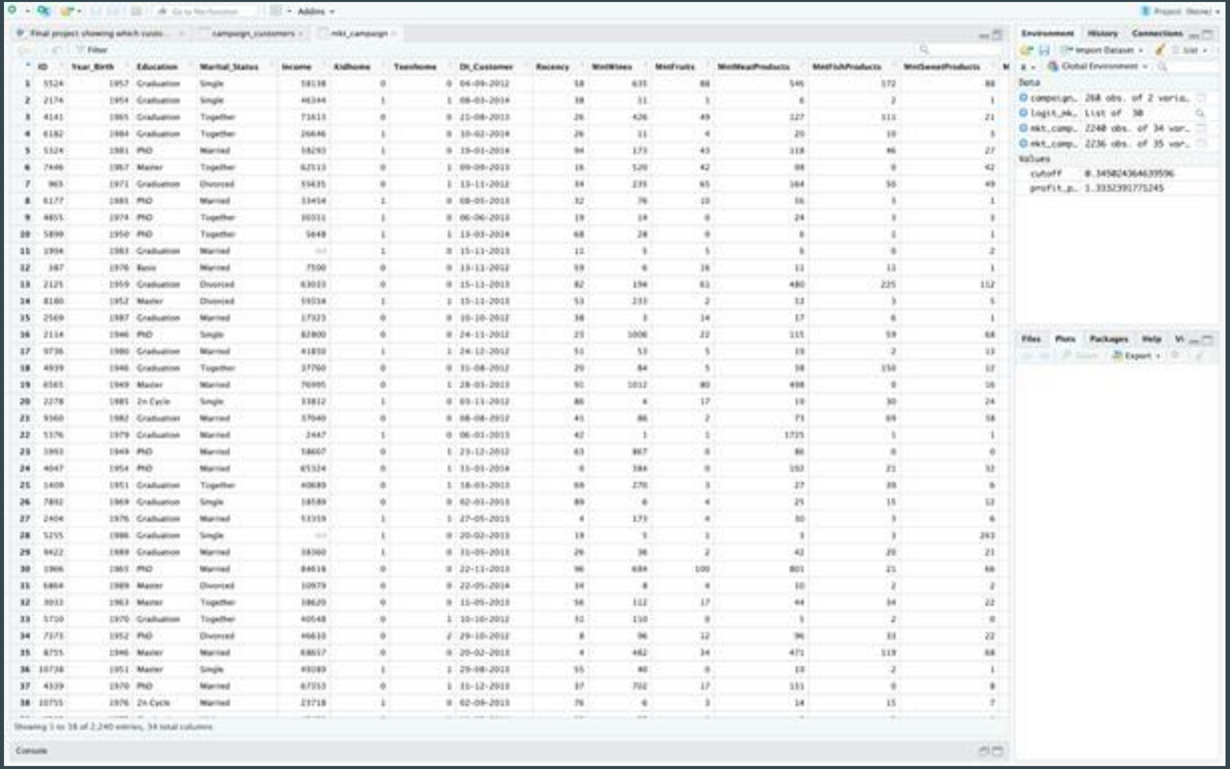
Appendix

Appendix

2 3 4 5 6 7 8 9 10 11 12

```r
#Import database
mkt_campaign <- read.csv("marketing_campaign.csv", sep ='\t')
```

mkt_camp… 2240 obs.



Appendix

```r
###profit analysis - Martin
#Find total spend divided by number of visits for all customers to get avg spent per visit
mkt_campaign$total_visits <- mkt_campaign$NumCatalogPurchases + mkt_campaign$NumDealsPurchases +
  mkt_campaign$NumStorePurchases + mkt_campaign$NumWebPurchases

mkt_campaign$total_spent <- mkt_campaign$MntWines + mkt_campaign$MntFruits + mkt_campaign$MntMeatProducts +
  mkt_campaign$MntFishProducts + mkt_campaign$MntSweetProducts + mkt_campaign$MntGoldProds
```

accept_prob	total_visits	total_spent
0.348184304	25	1617
0.050702702	6	27
0.059503637	21	776
0.071550767	8	53
0.017592396	19	422
0.092308593	22	716
0.117026295	21	590
0.119782956	10	169
0.188723453	6	46
0.800145254	2	49
0.136094944	4	19
0.051083502	6	61
0.020745933	16	1102
0.053029289	15	310
0.079821962	5	46
0.414000775	26	1315
0.073828840	9	96
0.102081309	13	317
0.224213943	26	1782
0.019326475	8	133
0.089041148	12	316
0.825108134	43	1730
0.082398626	17	972
0.095384950	20	544
0.075665697	20	444
0.020435160	8	75
0.217639677	14	257
0.396304930	27	637
0.043054834	9	131
0.162310884	26	1672

Appendix

```r
#Logistic Regression, selecting them for business purposes
logit_mktcmp <- glm(Response ~ Recency +
                      MntWines + MntFruits + MntMeatProducts + MntFishProducts + MntSweetProducts +
                      MntGoldProds + NumDealsPurchases + NumWebPurchases + NumStorePurchases +
                      NumWebVisitsMonth + AcceptedCmp3 + AcceptedCmp4 + AcceptedCmp5 +
                      AcceptedCmp1 + AcceptedCmp2, data = mkt_campaign, family = "binomial")
summary(logit_mktcmp)
```

```
Call:
glm(formula = Response ~ Recency + MntWines + MntFruits + MntMeatProducts +
    MntFishProducts + MntSweetProducts + MntGoldProds + NumDealsPurchases +
    NumWebPurchases + NumStorePurchases + NumWebVisitsMonth +
    AcceptedCmp3 + AcceptedCmp4 + AcceptedCmp5 + AcceptedCmp1 +
    AcceptedCmp2, family = "binomial", data = mkt_campaign)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.3384  -0.4712  -0.3098  -0.1884   2.9563

Coefficients:
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)       -2.8846568  0.3258079  -8.854  < 2e-16 ***
Recency           -0.0267394  0.0027120  -9.860  < 2e-16 ***
MntWines           0.0004356  0.0003064   1.422  0.15510
MntFruits          0.0025313  0.0022497   1.125  0.26052
MntMeatProducts    0.0026322  0.0003996   6.587 4.49e-11 ***
MntFishProducts    0.0002013  0.0016801   0.120  0.90461
MntSweetProducts   0.0005038  0.0020912   0.241  0.80964
MntGoldProds       0.0017214  0.0014459   1.191  0.23384
NumDealsPurchases  0.0537274  0.0363850   1.477  0.13977
NumWebPurchases    0.0739172  0.0286359   2.581  0.00984 **
NumStorePurchases -0.1403464  0.0317461  -4.421 9.83e-06 ***
NumWebVisitsMonth  0.2071958  0.0387848   5.342 9.18e-08 ***
AcceptedCmp3       1.7675006  0.2063526   8.565  < 2e-16 ***
AcceptedCmp4       0.8188212  0.2589397   3.162  0.00157 **
AcceptedCmp5       1.6053765  0.2594646   6.187 6.12e-10 ***
AcceptedCmp1       1.1180354  0.2531659   4.416 1.00e-05 ***
AcceptedCmp2       1.2938719  0.5151584   2.512  0.01202 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 1886.8  on 2239  degrees of freedom
Residual deviance: 1338.8  on 2223  degrees of freedom
AIC: 1372.8

Number of Fisher Scoring iterations: 6

>
```

Appendix

```r
#Prediction
mkt_campaign$accept_prob<- predict(logit_mktcmp, newdata = mkt_campaign, type = "response")
mkt_campaign$accept_prob
```

```
> mkt_campaign$accept_prob
  [1] 0.348184304 0.050702702 0.059503637 0.071550767 0.017592396 0.092308593 0.117026295 0.119782956 0.188723453 0.800145254
 [11] 0.136094944 0.051083502 0.020745933 0.053029289 0.079821962 0.414000775 0.073828840 0.102081309 0.224213943 0.019326475
 [21] 0.089041148 0.825108134 0.082398626 0.095384950 0.075665697 0.020435160 0.217639677 0.396304930 0.043054834 0.162310884
 [31] 0.057247463 0.026566562 0.109269233 0.159385694 0.289668501 0.045177720 0.024245574 0.037375071 0.009116585 0.380841722
 [41] 0.482350388 0.025364280 0.091374974 0.008328836 0.081936731 0.015750345 0.180073775 0.036755636 0.013618392 0.156364544
 [51] 0.022963316 0.255547496 0.049303774 0.639036441 0.021358503 0.122050745 0.082723591 0.029612576 0.037350523 0.053861104
 [61] 0.526921258 0.032786859 0.139069667 0.096505253 0.190950716 0.028208564 0.170746533 0.778790207 0.094278940 0.077489626
 [71] 0.255765993 0.145877424 0.148383037 0.063609227 0.013499825 0.026831434 0.550089089 0.664324487 0.051142030 0.629766814
 [81] 0.031433228 0.154948130 0.024502925 0.026566562 0.035794776 0.013642357 0.134400447 0.631464977 0.239110669 0.007496877
 [91] 0.436386353 0.059279947 0.009682525 0.028542916 0.016639203 0.068882331 0.084216844 0.073118707 0.113242502 0.061251638
[101] 0.208178662 0.051571864 0.056393957 0.053811159 0.136122002 0.009812439 0.151390520 0.053246237 0.140748217 0.116044067
[111] 0.041624162 0.554537796 0.178470771 0.061916660 0.179783842 0.083438080 0.848920095 0.120521427 0.014466826 0.059937650
[121] 0.021854597 0.100621009 0.034840326 0.019909887 0.237149463 0.007704165 0.311990188 0.037986720 0.084556761 0.015607482
[131] 0.163751900 0.158636444 0.130385943 0.016789094 0.080808578 0.180069685 0.094087229 0.063756296 0.248613491 0.028491833
[141] 0.131500486 0.238024429 0.051006275 0.064687038 0.211532047 0.134090670 0.046096918 0.065895965 0.035711529 0.014780467
[151] 0.017124637 0.044285110 0.156845076 0.123607682 0.027918563 0.793414751 0.207984991 0.023926068 0.046153859 0.016909858
[161] 0.172408628 0.225190742 0.026252126 0.071558653 0.373238704 0.018565770 0.300537369 0.035863614 0.047685081 0.016620732
[171] 0.040167276 0.031873838 0.150883693 0.082595750 0.092245695 0.161716291 0.247557681 0.018823389 0.004548496 0.113242502
[181] 0.016628512 0.023410099 0.037263868 0.090854127 0.019193646 0.090638121 0.020049116 0.068547454 0.137581776 0.133316149
[191] 0.212021562 0.013861085 0.011142698 0.024488761 0.065844215 0.127380659 0.007527216 0.276734284 0.256604083 0.276005071
[201] 0.096948961 0.044782857 0.098140362 0.532261110 0.027916578 0.452386318 0.139690318 0.067126010 0.011437866 0.849798704
[211] 0.083041926 0.055650197 0.056924858 0.161666026 0.025226600 0.081855448 0.195267537 0.369411803 0.110587535 0.070222778
[221] 0.006435147 0.038329739 0.065460014 0.090059854 0.095602143 0.082066005 0.065259030 0.109579077 0.065142848 0.042437084
[231] 0.124373727 0.787615511 0.043695956 0.028904144 0.029068233 0.041534290 0.050325854 0.024607038 0.058078616 0.057193069
[241] 0.093006242 0.028119531 0.044159013 0.441035950 0.199777701 0.063542512 0.871225063 0.063252966 0.125712484 0.123822442
[251] 0.053859966 0.038260476 0.946305439 0.015654176 0.052130413 0.058206291 0.223063178 0.006749493 0.010511779 0.118875779
[261] 0.210948627 0.067406445 0.014941103 0.122149277 0.262679939 0.109095287 0.260206934 0.243689522 0.096798835 0.135853834
[271] 0.362451001 0.088779344 0.135885657 0.037284184 0.072658305 0.007297173 0.063844390 0.082725260 0.166486136 0.043685592
[281] 0.061703524 0.065259030 0.102081309 0.010724371 0.078841827 0.034461843 0.053954971 0.026313156 0.315531340 0.076624810
```

Appendix

```r
mkt_campaign_filtered <- filter(mkt_campaign, total_visits!=0)

mkt_campaign_filtered$spent_per_visit<- mkt_campaign_filtered$total_spent/mkt_campaign_filtered$total_visits

mean(mkt_campaign_filtered$spent_per_visit)

#avg profit assuming a 4% profit margin -
profit_per_person <- mean(mkt_campaign_filtered$spent_per_visit) * .04

#assuming cost per letter sent to a person is $0.46, then breakeven response rate is:
cutoff <- .46/profit_per_person

```

```
> mean(mkt_campaign_filtered$spent_per_visit)
[1] 33.33098
> profit_per_person <- mean(mkt_campaign_filtered$spent_per_visit) * .04
> profit_per_person
[1] 1.333239
```

```
> cutoff <- .46/profit_per_person
> cutoff
[1] 0.3450244
```

Appendix

```r
#filter out customers who have accept probability greater than breakeven rate
campaign_customers <- filter(mkt_campaign, mkt_campaign$accept_prob > cutoff)
campaign_customers <- campaign_customers[,c("ID", "accept_prob")]
```

Final project showing which custo... | campaign_customers

	ID	accept_prob
1	5524	0.3481843
2	5899	0.8001453
3	2114	0.4140008
4	5376	0.8251081
5	5255	0.3963049
6	2968	0.3808417
7	8601	0.4823504
8	2225	0.6390364
9	6853	0.5269213
10	9369	0.7787902
11	1859	0.5500891
12	7503	0.6643245
13	1618	0.6297668
14	4452	0.6314650
15	8996	0.4363864
16	7431	0.5545378
17	1592	0.8489201
18	10240	0.7934148
19	8475	0.3732387
20	2798	0.5322611
21	624	0.4523863
22	380	0.8497987
23	6274	0.3694118
24	5341	0.7876155
25	9529	0.4410360
26	2176	0.8712251
27	10089	0.9463054
28	2379	0.3624510
29	9262	0.4521319
30	4543	0.5520798

Showing 1 to 30 of 268 entries, 2 total columns

Appendix