Week 10

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1. Fit a Logistic Regression Model to Thoracic Surgery Binary Dataset

a. For this problem, you will be working with the thoracic surgery data set from the University of California Irvine machine learning repository. This dataset contains information on life expectancy in lung cancer patients after surgery. The underlying thoracic surgery data is in ARFF format. This is a text-based format with information on each of the attributes. You can load this data using a package such as foreign or by cutting and pasting the data section into a CSV file.

```
## Loading required package: dfidx
```

```
##
## Attaching package: 'dfidx'
```

```
## The following object is masked from 'package:stats':
##
##     filter
```

```
thoracic_df <- readARFF('data/ThoraricSurgery.arff' )
```

```
## Parse with reader=readr : data/ThoraricSurgery.arff
```

```
## Loading required package: readr
```

```
## header: 0.000000; preproc: 0.000000; data: 0.100000; postproc: 0.000000; total: 0.100000
```

```
head(thoracic_df)
```

```
##    DGN PRE4 PRE5 PRE6 PRE7 PRE8 PRE9 PRE10 PRE11 PRE14 PRE17 PRE19 PRE25 PRE30
## 1 DGN2 2.88 2.16 PRZ1    F    F    F     T     T  OC14     F     F     F     T
## 2 DGN3 3.40 1.88 PRZ0    F    F    F     F     F  OC12     F     F     F     T
## 3 DGN3 2.76 2.08 PRZ1    F    F    F     T     F  OC11     F     F     F     T
## 4 DGN3 3.68 3.04 PRZ0    F    F    F     F     F  OC11     F     F     F     F
## 5 DGN3 2.44 0.96 PRZ2    F    T    F     T     T  OC11     F     F     F     T
## 6 DGN3 2.48 1.88 PRZ1    F    F    F     T     F  OC11     F     F     F     F
##   PRE32 AGE Risk1Yr
## 1     F  60       F
## 2     F  51       F
## 3     F  59       F
## 4     F  54       F
## 5     F  73       T
## 6     F  51       F
```

Data Dictionary:

1. DGN: Diagnosis - specific combination of ICD-10 codes for primary and secondary as well multiple tumours if any (DGN3,DGN2,DGN4,DGN6,DGN5,DGN8,DGN1)
2. PRE4: Forced vital capacity - FVC (numeric)
3. PRE5: Volume that has been exhaled at the end of the first second of forced expiration - FEV1 (numeric)
4. PRE6: Performance status - Zubrod scale (PRZ2,PRZ1,PRZ0)
5. PRE7: Pain before surgery (T,F)
6. PRE8: Haemoptysis before surgery (T,F)
7. PRE9: Dyspnoea before surgery (T,F)
8. PRE10: Cough before surgery (T,F)
9. PRE11: Weakness before surgery (T,F)
10. PRE14: T in clinical TNM - size of the original tumour, from OC11 (smallest) to OC14 (largest) (OC11,OC14,OC12,OC13)
11. PRE17: Type 2 DM - diabetes mellitus (T,F)
12. PRE19: MI up to 6 months (T,F)
13. PRE25: PAD - peripheral arterial diseases (T,F)
14. PRE30: Smoking (T,F)
15. PRE32: Asthma (T,F)
16. AGE: Age at surgery (numeric)
17. Risk1Y: 1 year survival period - (T)rue value if died (T,F)

b. Assignment Instructions:

i. Fit a binary logistic regression model to the data set that predicts whether or not the patient survived for one year (the Risk1Y variable) after the surgery. Use the glm() function to perform the logistic regression. See Generalized Linear Models for an example. Include a summary using the summary() function in your results.

```r
thoracic.model <- glm(Risk1Yr ~ DGN + PRE4 + PRE5 + PRE6 + PRE7 + PRE8 +
                           PRE9 + PRE10 + PRE11 + PRE14 + PRE17 + PRE19 +
                           PRE25 + PRE30 + PRE32 + AGE, data = thoracic_df,
                      family = binomial())

summary(thoracic.model)
```

```
##
## Call:
## glm(formula = Risk1Yr ~ DGN + PRE4 + PRE5 + PRE6 + PRE7 + PRE8 +
##     PRE9 + PRE10 + PRE11 + PRE14 + PRE17 + PRE19 + PRE25 + PRE30 +
##     PRE32 + AGE, family = binomial(), data = thoracic_df)
##
```

```
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.4929   0.2762   0.4199   0.5439   1.6084
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)  2.604e+01  2.333e+03   0.011 0.991093
## DGNDGN2     -5.557e-01  4.128e-01  -1.346 0.178199
## DGNDGN4     -4.278e-01  4.733e-01  -0.904 0.366122
## DGNDGN6      1.377e+01  1.178e+03   0.012 0.990671
## DGNDGN5     -2.201e+00  6.113e-01  -3.600 0.000318 ***
## DGNDGN8     -3.852e+00  1.550e+00  -2.485 0.012959 *
## DGNDGN1      1.418e+01  2.400e+03   0.006 0.995285
## PRE4         2.272e-01  1.849e-01   1.229 0.219094
## PRE5         3.030e-02  1.786e-02   1.697 0.089715 .
## PRE6PRZ1     1.490e-01  5.783e-01   0.258 0.796647
## PRE6PRZ0    -2.937e-01  7.907e-01  -0.371 0.710303
## PRE7F        7.153e-01  5.556e-01   1.288 0.197884
## PRE8F        1.743e-01  3.892e-01   0.448 0.654188
## PRE9F        1.368e+00  4.868e-01   2.811 0.004942 **
## PRE10F       5.770e-01  4.826e-01   1.196 0.231855
## PRE11F       5.162e-01  3.965e-01   1.302 0.192948
## PRE14OC14   -1.653e+00  6.094e-01  -2.713 0.006675 **
## PRE14OC12   -4.394e-01  3.301e-01  -1.331 0.183177
## PRE14OC13   -1.179e+00  6.165e-01  -1.913 0.055799 .
## PRE17F       9.266e-01  4.445e-01   2.085 0.037092 *
## PRE19F      -1.466e+01  1.654e+03  -0.009 0.992928
## PRE25F      -9.789e-02  1.003e+00  -0.098 0.922273
## PRE30F       1.084e+00  4.990e-01   2.172 0.029840 *
## PRE32F      -1.398e+01  1.645e+03  -0.008 0.993219
## AGE          9.506e-03  1.810e-02   0.525 0.599442
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 395.61  on 469  degrees of freedom
## Residual deviance: 341.19  on 445  degrees of freedom
## AIC: 391.19
##
## Number of Fisher Scoring iterations: 15
```

ii. According to the summary, which variables had the greatest effect on the survival rate?

With a probability level of about 0 DGN5 has the greatest effect on living for at least 1 year. PRE14OC14 & PRE9F was next with a probability of 0.001 then DSG8, PRE17F, and PRE30F all having probability levels of about 0.01. Finally, PRE6PRZ1 and PRE14OC13 had levels under 0.05.

iii. To compute the accuracy of your model, use the dataset to predict the outcome variable. The percent of correct predictions is the accuracy of your model. What is the accuracy of your model?

Split the data into training and validation data sets

```r
split <- sample.split(thoracic_df, SplitRatio = 0.8)

split
```

```
##  [1] FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE
## [13]  TRUE  TRUE  TRUE FALSE  TRUE
```

```r
train <- subset(thoracic_df, split == "TRUE")
validate <- subset(thoracic_df, split == "FALSE")
```

Train model using training data set

```r
thoracic.train <- glm(Risk1Yr ~ DGN + PRE4 + PRE5 + PRE6 + PRE7 + PRE8 + PRE9 + PRE10 +
                PRE11 + PRE14 + PRE17 + PRE19 + PRE25 + PRE30 + PRE32 + AGE,
              data = train, family = binomial()  )

summary(thoracic.train)
```

```
##
## Call:
## glm(formula = Risk1Yr ~ DGN + PRE4 + PRE5 + PRE6 + PRE7 + PRE8 +
##     PRE9 + PRE10 + PRE11 + PRE14 + PRE17 + PRE19 + PRE25 + PRE30 +
##     PRE32 + AGE, family = binomial(), data = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.5067   0.2439   0.3501   0.4853   1.7086
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  25.36596 2332.63225   0.011 0.991324
## DGNDGN2      -0.87798    0.49341  -1.779 0.075171 .
## DGNDGN4      -0.66321    0.54182  -1.224 0.220935
## DGNDGN6      13.37866 1182.34873   0.011 0.990972
## DGNDGN5      -2.70026    0.79134  -3.412 0.000644 ***
## DGNDGN8      12.75818 2399.54485   0.005 0.995758
## DGNDGN1      13.72092 2399.54478   0.006 0.995438
## PRE4          0.22844    0.22759   1.004 0.315522
## PRE5          0.02845    0.01934   1.471 0.141244
## PRE6PRZ1      0.33870    0.65566   0.517 0.605455
## PRE6PRZ0     -0.33551    0.90584  -0.370 0.711099
## PRE7F         1.30565    0.62779   2.080 0.037547 *
## PRE8F         0.20624    0.46352   0.445 0.656359
## PRE9F         1.50625    0.58874   2.558 0.010514 *
## PRE10F        0.88236    0.58673   1.504 0.132614
## PRE11F        0.74347    0.47748   1.557 0.119453
## PRE14OC14    -1.88263    0.71417  -2.636 0.008386 **
## PRE14OC12    -0.54683    0.42432  -1.289 0.197501
## PRE14OC13    -1.62072    0.69610  -2.328 0.019897 *
## PRE17F        1.14142    0.51981   2.196 0.028104 *
## PRE19F      -14.41154 1634.25526  -0.009 0.992964
## PRE25F       -1.18273    1.39849  -0.846 0.397712
## PRE30F         0.78166    0.56440   1.385 0.166071
## PRE32F       -13.61531 1664.44463  -0.008 0.993473
## AGE            0.01352    0.02243   0.603 0.546693
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 286.15  on 358  degrees of freedom
## Residual deviance: 230.97  on 334  degrees of freedom
## AIC: 280.97
##
## Number of Fisher Scoring iterations: 15
```

Run validation data through the model built on training data

```r
res <- predict(thoracic.train, validate, type = "response")

res
```

```
##         1         8         9        16        18        25        26        33
## 0.3599318 0.9675401 0.8841162 0.9466826 0.8493649 1.0000000 0.4620470 0.2617560
##        35        42        43        50        52        59        60        67
## 0.9535622 0.8370773 0.9296677 0.9767442 0.9653233 0.9259154 0.9440856 0.9710009
##        69        76        77        84        86        93        94       101
## 0.9137019 0.7162570 0.8811579 0.9303608 0.9290055 0.9279200 0.9783513 0.9613864
##       103       110       111       118       120       127       128       135
## 0.9084046 0.7599662 0.8877261 0.7570216 0.8521844 0.9662361 0.6854598 0.9433641
##       137       144       145       152       154       161       162       169
## 0.6401044 0.8646033 0.7834953 0.9548280 0.8846204 0.9731128 0.9564036 0.8583627
##       171       178       179       186       188       195       196       203
## 0.9381797 0.9175244 0.8402482 0.4028329 0.9144187 0.9635243 0.8959655 0.5011501
##       205       212       213       220       222       229       230       237
## 0.9753271 0.9260897 0.6601496 0.9625995 0.8972379 0.9791201 0.7774126 0.8687793
##       239       246       247       254       256       263       264       271
## 0.6025216 0.9501113 0.9375159 0.9332906 0.9271188 0.8849556 0.9691483 0.8444933
##       273       280       281       288       290       297       298       305
## 0.9606075 0.9566688 0.9404031 0.9199416 0.9383533 0.9014583 0.4644108 0.9575815
##       307       314       315       322       324       331       332       339
## 0.3048720 0.9200988 0.8416680 0.9552885 0.5430022 0.9370540 0.9665652 0.9698999
##       341       348       349       356       358       365       366       373
## 0.9701495 0.5786769 0.9044770 0.9259680 0.9242215 0.8391273 0.9199518 0.9402039
##       375       382       383       390       392       399       400       407
## 0.9163372 0.9720270 0.7711951 0.5573176 0.7303689 0.9034140 0.9501445 0.9536421
##       409       416       417       424       426       433       434       441
## 0.7815321 0.9834409 0.8034590 0.9437775 0.9080976 0.9400113 0.8621625 0.8508243
##       443       450       451       458       460       467       468
## 0.7443953 0.9063512 0.9374371 0.9359015 0.9487489 0.9670235 0.8824155
```

```r
res2 <-predict(thoracic.train, train, type = "response")

res2
```

```
##         2         3         4         5         6         7        10        11
## 0.9294931 0.9471107 0.9827904 0.8430472 0.9703759 0.8315424 0.9381616 0.9015232
##        12        13        14        15        17        19        20        21
## 0.9739563 0.9110222 0.4092299 0.9491369 0.7842240 0.9197635 0.9642349 0.9464019
##        22        23        24        27        28        29        30        31
## 0.8882937 0.9230371 0.9661347 0.9542104 0.9196401 0.9011370 0.9999999 0.6077216
##        32        34        36        37        38        39        40        41
## 0.9692023 0.8657530 0.9514241 0.9144519 0.8015378 0.9680224 0.9627408 0.6134047
##        44        45        46        47        48        49        51        53
## 0.2384240 0.7766194 0.9544764 0.9427008 0.9232839 0.8415195 0.9655150 0.3135074
##        54        55        56        57        58        61        62        63
## 0.8940115 0.9328340 0.8679582 0.8914195 0.4822419 0.8240203 0.8266888 0.9733674
##        64        65        66        68        70        71        72        73
## 0.9488491 0.7961823 0.9566725 0.7690983 0.9126126 0.9883943 0.8271896 0.9659390
##        74        75        78        79        80        81        82        83
## 0.9806965 0.9639317 0.9231642 0.8932786 0.9690246 0.9280950 0.6917805 0.9234085
##        85        87        88        89        90        91        92        95
## 0.9437352 0.8012072 0.9484220 0.2888346 0.7993359 0.8748559 0.9541575 0.8046241
##        96        97        98        99       100       102       104       105
## 0.9634576 0.8585507 0.9999999 0.9583909 0.7394436 0.6002558 1.0000000 0.9733607
##       106       107       108       109       112       113       114       115
## 0.8370967 0.9020631 0.9225482 0.9828003 0.8147993 0.9893812 0.9700315 0.8897303
##       116       117       119       121       122       123       124       125
## 0.7093585 0.7600398 0.9628689 0.9547508 0.9395295 0.3045726 0.9355536 0.8789194
##       126       129       130       131       132       133       134       136
## 0.9250592 0.5624105 0.9268709 0.9564649 0.9159907 0.7426833 0.9505287 0.9517322
##       138       139       140       141       142       143       146       147
## 0.6673346 0.9036327 0.9811172 0.8709573 0.9360351 0.9933120 0.9340762 0.9838410
##       148       149       150       151       153       155       156       157
## 0.9241416 0.9405595 0.9628309 0.9628762 0.9486448 0.9292528 0.8986591 0.4979968
##       158       159       160       163       164       165       166       167
## 0.9999999 0.9357377 0.9389441 0.7390103 0.9125879 0.5436428 0.6598270 0.8102527
##       168       170       172       173       174       175       176       177
## 0.9157118 0.5672571 0.6453188 0.7457781 0.9428143 0.8642650 0.6314065 0.6655199
##       180       181       182       183       184       185       187       189
## 0.7912585 0.8636250 0.9490806 0.9548746 0.9124072 0.9782616 0.9561739 0.9491836
##       190       191       192       193       194       197       198       199
## 0.9196001 0.9999999 0.9567986 0.9392443 0.9398327 0.8645183 0.9608250 0.9842510
##       200       201       202       204       206       207       208       209
## 0.8275881 0.9020295 0.9521630 0.8667184 0.9231717 0.9665352 0.9497280 0.9550912
##       210       211       214       215       216       217       218       219
## 0.6046994 0.9707879 0.7884082 0.9542512 0.8088707 0.8308133 0.9531780 0.9664021
##       221       223       224       225       226       227       228       231
## 0.1898193 0.7804681 0.9898167 0.9381138 0.5382490 0.8496608 0.9149228 0.8535466
##       232       233       234       235       236       238       240       241
## 0.4103566 0.9490337 0.9077148 0.8977290 0.9395237 0.9221379 0.9267653 0.9754545
##       242       243       244       245       248       249       250       251
## 0.9559993 0.4958484 0.9824194 1.0000000 0.8747379 0.8977455 0.9222963 0.9381186
##       252       253       255       257       258       259       260       261
## 0.8897140 0.9344273 0.9369545 0.9452211 0.9556031 0.9469805 0.9381699 0.8927092
##       262       265       266       267       268       269       270       272
## 0.9069230 0.9484216 0.9323050 0.9412153 0.5958525 0.4719420 0.8931301 0.6515660
##       274       275       276       277       278       279       282       283
## 0.5816121 0.8478821 0.9085249 0.9247941 0.8153447 0.9836511 0.9750439 0.8865256
##       284       285       286       287       289       291       292       293 
## 0.7702743 0.9520434 0.9521721 0.8969181 0.5775264 0.8826129 0.7788885 0.9999999 
##       294       295       296       299       300       301       302       303 
## 0.9823070 0.7084602 0.9224042 0.9015588 0.9355160 0.8607641 0.9698401 0.5358560 
##       304       306       308       309       310       311       312       313 
## 0.8647486 0.9226637 0.9111145 0.9431239 0.9558376 0.9688105 0.8924616 0.7553761 
##       316       317       318       319       320       321       323       325 
## 0.7988565 0.9644574 0.7361632 0.9461982 0.9925319 0.8117076 0.9503402 0.9750826 
##       326       327       328       329       330       333       334       335 
## 0.9919267 0.8726067 0.8437122 0.8945960 0.9396944 0.9548807 0.9622444 0.8677700 
##       336       337       338       340       342       343       344       345 
## 0.9459661 0.8738040 0.8737775 0.9154288 0.9575795 0.8984681 0.9012498 0.9331788 
##       346       347       350       351       352       353       354       355 
## 0.3299440 0.9104145 0.9929952 0.9062943 0.9559741 0.9875128 0.9473136 0.9639772 
##       357       359       360       361       362       363       364       367 
## 0.6894286 0.9096261 0.9400259 0.9045565 0.9414439 0.6231262 0.8798033 0.9470242 
##       368       369       370       371       372       374       376       377 
## 0.4389565 0.9999999 0.9434727 0.9293165 0.9594776 0.2323115 0.9612291 0.9609867 
##       378       379       380       381       384       385       386       387 
## 0.9211347 0.9511911 0.9189368 0.9200781 0.9706266 0.9507788 0.7882551 0.7437867 
##       388       389       391       393       394       395       396       397 
## 0.9032651 0.7680915 0.9306610 0.7151378 0.9315591 0.8263752 0.7786193 0.9434594 
##       398       401       402       403       404       405       406       408 
## 0.9428330 0.9786361 0.9750741 0.9094049 0.9156093 0.6919848 1.0000000 0.8541546 
##       410       411       412       413       414       415       418       419 
## 0.9555514 0.8034012 0.6003505 0.9815656 0.8895435 0.9222224 0.9767281 0.7406479 
##       420       421       422       423       425       427       428       429 
## 0.6672166 0.6872363 0.5214608 0.9357898 0.7783955 0.7563832 0.9253775 0.8479795 
##       430       431       432       435       436       437       438       439 
## 0.5532628 0.9464066 0.9272458 0.9496441 0.9473107 0.7800291 0.9179620 0.6443053 
##       440       442       444       445       446       447       448       449 
## 0.9589820 0.9487744 0.9591845 0.9900407 0.9580813 0.9999999 0.7395463 0.9388859 
##       452       453       454       455       456       457       459       461 
## 0.8515870 0.5302669 0.8943833 0.9667874 0.8648129 0.9065996 0.9760892 0.9469934 
##       462       463       464       465       466       469       470 
## 0.8261986 0.8767668 0.4802262 0.7040639 0.6676483 0.8417246 0.9492255
```

Validate model using confusion matrix

```
confmatrix <- table(Actual_Value = train$Risk1Yr, Predicted_Value = res2 > 0.5)

confmatrix
```

```
##             Predicted_Value
## Actual_Value FALSE TRUE
##            T     8   41
##            F     7  303
```

Accuracy

```
(confmatrix[[1,1]] + confmatrix[[2,2]]) / sum(confmatrix)
```

```
## [1] 0.8662953
```

2. Fit a Logistic Regression Model

```
## Load the binary classifier data
binary_df <- read.csv("data/binary-classifier-data.csv",
    header = TRUE,
    stringsAsFactors = FALSE)

head(binary_df)
```

```
##   label        x        y
## 1     0 70.88469 83.17702
## 2     0 74.97176 87.92922
## 3     0 73.78333 92.20325
## 4     0 66.40747 81.10617
## 5     0 69.07399 84.53739
## 6     0 72.23616 86.38403
```

a. Fit a logistic regression model to the binary-classifier-data.csv dataset

```
binary.model <- glm(label ~ x + y,
                       data = binary_df, family = binomial())
summary(binary.model)
```

```
##
## Call:
## glm(formula = label ~ x + y, family = binomial(), data = binary_df)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.3728  -1.1697  -0.9575   1.1646   1.3989
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  0.424809   0.117224   3.624  0.00029 ***
## x           -0.002571   0.001823  -1.411  0.15836
## y           -0.007956   0.001869  -4.257 2.07e-05 ***
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 2075.8  on 1497  degrees of freedom
## Residual deviance: 2052.1  on 1495  degrees of freedom
## AIC: 2058.1
##
## Number of Fisher Scoring iterations: 4
```

b. The dataset (found in binary-classifier-data.csv) contains three variables; label, x, and y. The label variable is either 0 or 1 and is the output we want to predict using the x and y variables.

i. What is the accuracy of the logistic regression classifier?

Split the data into training and validation data sets

```
split <- sample.split(binary_df, SplitRatio = 0.8)

split
```

```
## [1] FALSE  TRUE  TRUE
```

```
train <- subset(binary_df, split == "TRUE")
validate <- subset(binary_df, split == "FALSE")
```

Train model using training data set

```
binary.train <- glm(label ~ x + y, data = train, family = binomial()  )

summary(binary.train)
```

```
##
## Call:
## glm(formula = label ~ x + y, family = binomial(), data = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.3658  -1.1672  -0.9614   1.1650   1.4004
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  0.415200   0.143553   2.892 0.003824 **
## x           -0.002376   0.002237  -1.062 0.288036
## y           -0.007953   0.002302  -3.456 0.000549 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1382.9  on 997  degrees of freedom
## Residual deviance: 1367.6  on 995  degrees of freedom
## AIC: 1373.6
##
## Number of Fisher Scoring iterations: 4
```

Run validation data through the model built on training data

```
res <- predict(binary.train, validate, type = "response")

res
```

```
##         1         4         7        10        13        16        19        22
## 0.3977673 0.4042790 0.3853257 0.3825992 0.3981837 0.3857950 0.3768663 0.3794590
##        25        28        31        34        37        40        43        46
## 0.3788121 0.3876935 0.4005309 0.3994941 0.3957225 0.3956623 0.3832636 0.3701284
##        49        52        55        58        61        64        67        70
## 0.3842516 0.3951534 0.3843245 0.4954530 0.4994679 0.4860272 0.4949504 0.4896907
##        73        76        79        82        85        88        91        94
## 0.4830109 0.4927486 0.5047070 0.4871315 0.5021351 0.5044042 0.5139531 0.5014514
##        97       100       103       106       109       112       115       118
## 0.4798234 0.4314930 0.4313161 0.4283464 0.4267198 0.4306351 0.4282186 0.4366567
##       121       124       127       130       133       136       139       142
## 0.4295201 0.4286252 0.4336776 0.4293152 0.4284116 0.4303541 0.4270534 0.4322570
##       145       148       151       154       157       160       163       166
## 0.4317959 0.4291048 0.4319417 0.4279352 0.4319919 0.4311006 0.4230409 0.4220366
##       169       172       175       178       181       184       187       190
## 0.4254915 0.4246210 0.4247007 0.4241695 0.4060710 0.4308843 0.4208624 0.4083780
##       193       196       199       202       205       208       211       214
## 0.4178333 0.4134836 0.4794247 0.4767779 0.4807273 0.4804414 0.4690502 0.4735529
##       217       220       223       226       229       232       235       238
## 0.4771430 0.4755777 0.3827384 0.3845051 0.3911307 0.3870332 0.3760181 0.3932622
##       241       244       247       250       253       256       259       262
## 0.3944128 0.3946762 0.3808742 0.3904907 0.4007251 0.3924161 0.3838895 0.5328529
##       265       268       271       274       277       280       283       286
## 0.5384941 0.5385540 0.5380433 0.5351827 0.5413458 0.5365877 0.5368384 0.5353943
##       289       292       295       298       301       304       307       310
## 0.5399065 0.5377078 0.5466507 0.5403124 0.5404028 0.5303579 0.5373611 0.5363369
##       313       316       319       322       325       328       331       334
## 0.5417280 0.4913804 0.4899161 0.4912349 0.4862078 0.4847235 0.4952330 0.4881346
##       337       340       343       346       349       352       355       358
## 0.4939212 0.4934924 0.4936127 0.4879397 0.4974921 0.4933311 0.4939454 0.5025995
##       361       364       367       370       373       376       379       382
## 0.4990867 0.4902849 0.4955709 0.5329797 0.5310851 0.5168753 0.5359665 0.5409683
##       385       388       391       394       397       400       403       406
## 0.5309293 0.5342076 0.5268316 0.5352597 0.5379883 0.5262060 0.5338689 0.5391159
##       409       412       415       418       421       424       427       430
## 0.5277617 0.5350061 0.5376833 0.5308223 0.5281087 0.5212671 0.5175785 0.5286295
##       433       436       439       442       445       448       451       454
## 0.5255544 0.5340328 0.5361724 0.5291256 0.5309436 0.5263626 0.5268140 0.5239280
##       457       460       463       466       469       472       475       478
## 0.5295672 0.5314519 0.5276100 0.5290064 0.5322092 0.5327931 0.5242716 0.5295104
##       481       484       487       490       493       496       499       502
## 0.5986335 0.5955333 0.6011943 0.6004924 0.6062439 0.5988243 0.6046938 0.5999525
##       505       508       511       514       517       520       523       526
## 0.6020176 0.6035150 0.6036680 0.6059221 0.5952913 0.6062122 0.6005091 0.6022645
##       529       532       535       538       541       544       547       550
## 0.6080079 0.4198562 0.4064610 0.3958583 0.4096641 0.4181626 0.4082451 0.3931338
##       553       556       559       562       565       568       571       574
## 0.4075589 0.3995033 0.4340935 0.4039533 0.4140193 0.3954005 0.4112012 0.4122719
##       577       580       583       586       589       592       595       598
## 0.5400533 0.5347425 0.5470211 0.5562836 0.5329767 0.5315190 0.5492481 0.5438291
##       601       604       607       610       613       616       619       622
## 0.5531801 0.5506387 0.5409519 0.5388725 0.5423908 0.5487297 0.5566146 0.5374575
##       625       628       631       634       637       640       643       646
## 0.5404452 0.5450808 0.5497523 0.5408552 0.5566192 0.5481136 0.5441862 0.5436392
##       649       652       655       658       661       664       667       670 
## 0.5352556 0.5288365 0.5405346 0.5474551 0.5467726 0.5460389 0.5614501 0.5399182 
##       673       676       679       682       685       688       691       694 
## 0.5382995 0.5574178 0.4869652 0.4711272 0.4732088 0.4844801 0.4902641 0.4828467 
##       697       700       703       706       709       712       715       718 
## 0.5052442 0.4528893 0.4735644 0.4843985 0.4907011 0.4979385 0.3681975 0.3748495 
##       721       724       727       730       733       736       739       742 
## 0.3695699 0.3719246 0.3671987 0.3667063 0.3649603 0.3699320 0.3734149 0.3743469 
##       745       748       751       754       757       760       763       766 
## 0.3750611 0.3745513 0.3768387 0.3703722 0.3692650 0.3701412 0.3755060 0.3716052 
##       769       772       775       778       781       784       787       790 
## 0.4528963 0.4384844 0.4527142 0.4450445 0.4457255 0.4561621 0.4580500 0.4596299 
##       793       796       799       802       805       808       811       814 
## 0.4676460 0.4603691 0.4549946 0.4252948 0.4510663 0.4502078 0.4531078 0.4629077 
##       817       820       823       826       829       832       835       838 
## 0.4485700 0.5218260 0.5067683 0.5209743 0.5129134 0.5145611 0.5085064 0.5132225 
##       841       844       847       850       853       856       859       862 
## 0.5157388 0.5148689 0.5107409 0.5112926 0.5091500 0.5083831 0.5201983 0.5156602 
##       865       868       871       874       877       880       883       886 
## 0.5080362 0.5000631 0.5143283 0.5132004 0.5030905 0.5080310 0.5036898 0.5099958 
##       889       892       895       898       901       904       907       910 
## 0.5137313 0.5104993 0.5096968 0.5052245 0.5160565 0.5140506 0.5003021 0.5099809 
##       913       916       919       922       925       928       931       934 
## 0.5082098 0.5162526 0.5118293 0.5026046 0.5131344 0.5117206 0.5160433 0.5089581 
##       937       940       943       946       949       952       955       958 
## 0.4398655 0.4364723 0.4358376 0.4429055 0.4372280 0.4395787 0.4364861 0.4349431 
##       961       964       967       970       973       976       979       982 
## 0.4356625 0.4421379 0.4369462 0.4377057 0.4431954 0.4380982 0.4325799 0.4401721 
##       985       988       991       994       997      1000      1003      1006 
## 0.4397648 0.4987584 0.4996649 0.5288143 0.5172671 0.5134264 0.5195993 0.5108706 
##      1009      1012      1015      1018      1021      1024      1027      1030 
## 0.5109078 0.5135390 0.5156480 0.5126880 0.5052417 0.5067616 0.5075808 0.5072742 
##      1033      1036      1039      1042      1045      1048      1051      1054 
## 0.5065748 0.5074816 0.5178841 0.4519815 0.4448699 0.4449682 0.4467714 0.4445812 
##      1057      1060      1063      1066      1069      1072      1075      1078 
## 0.4475845 0.4504478 0.4460623 0.4500222 0.4433942 0.4506594 0.4469482 0.4459974 
##      1081      1084      1087      1090      1093      1096      1099      1102 
## 0.4394259 0.4455736 0.4490835 0.4474475 0.4466379 0.5198132 0.5114216 0.5071993 
##      1105      1108      1111      1114      1117      1120      1123      1126 
## 0.5173181 0.5059043 0.5031605 0.5046978 0.5074425 0.5155996 0.5166734 0.5101506 
##      1129      1132      1135      1138      1141      1144      1147      1150 
## 0.5163310 0.5082289 0.5128231 0.5751664 0.5789738 0.5738068 0.5698438 0.5689646 
##      1153      1156      1159      1162      1165      1168      1171      1174 
## 0.5776979 0.5760935 0.5688316 0.5654334 0.5637664 0.5637039 0.5630099 0.5582285 
##      1177      1180      1183      1186      1189      1192      1195      1198 
## 0.5624965 0.5596184 0.5577365 0.5532673 0.5606760 0.5628892 0.5580176 0.5613590 
##      1201      1204      1207      1210      1213      1216      1219      1222 
## 0.5591404 0.5636096 0.5602289 0.5618293 0.5589194 0.5595403 0.5540893 0.5498934 
##      1225      1228      1231      1234      1237      1240      1243      1246 
## 0.5451637 0.5508124 0.5384307 0.5560359 0.5476617 0.5434079 0.5476035 0.5489505 
##      1249      1252      1255      1258      1261      1264      1267      1270 
## 0.5434505 0.5436458 0.5439854 0.5466514 0.5411182 0.5480155 0.5472390 0.5512712 
##      1273      1276      1279      1282      1285      1288      1291      1294 
## 0.4480030 0.4432700 0.4309961 0.4350703 0.4426451 0.4385229 0.4326147 0.4480609
##      1297      1300      1303      1306      1309      1312      1315      1318
## 0.4273578 0.4412025 0.4363084 0.4401033 0.4180282 0.4260257 0.4381928 0.4404265
##      1321      1324      1327      1330      1333      1336      1339      1342
## 0.4284502 0.4395400 0.4400655 0.4338192 0.4493043 0.4274498 0.4412940 0.4491514
##      1345      1348      1351      1354      1357      1360      1363      1366
## 0.5012308 0.5056960 0.5063298 0.5016566 0.5026718 0.5030999 0.5006095 0.5022375
##      1369      1372      1375      1378      1381      1384      1387      1390
## 0.5014341 0.4979230 0.5004730 0.4992273 0.4991980 0.4986311 0.4988779 0.5019543
##      1393      1396      1399      1402      1405      1408      1411      1414
## 0.5003145 0.5022248 0.5020134 0.5731293 0.5704806 0.5866268 0.5960095 0.5836988
##      1417      1420      1423      1426      1429      1432      1435      1438
## 0.5780298 0.5830832 0.5816426 0.5869082 0.5834342 0.5711107 0.5770981 0.5827871
##      1441      1444      1447      1450      1453      1456      1459      1462
## 0.5770477 0.5970178 0.5625302 0.5732783 0.5935695 0.4000513 0.3921612 0.3863003
##      1465      1468      1471      1474      1477      1480      1483      1486
## 0.3946752 0.3874710 0.3870317 0.3937776 0.3891184 0.4036467 0.3960348 0.3970495
##      1489      1492      1495      1498
## 0.3929626 0.3913505 0.3830839 0.3953764
```

```
res2 <-predict(binary.train, train, type = "response")

res2
```

```
##         2         3         5         6         8         9        11        12
## 0.3864440 0.3790805 0.3962074 0.3909086 0.3650274 0.3793350 0.3952054 0.3633326
##        14        15        17        18        20        21        23        24
## 0.3855104 0.3915347 0.4011531 0.3833641 0.3857139 0.3831118 0.3932558 0.3859975
##        26        27        29        30        32        33        35        36
## 0.3950780 0.3830077 0.4056189 0.3901061 0.4053711 0.3906178 0.4005312 0.3904780
##        38        39        41        42        44        45        47        48
## 0.3735497 0.3978000 0.3799961 0.4011939 0.3961075 0.3897124 0.3712479 0.3769536
##        50        51        53        54        56        57        59        60
## 0.3873387 0.3946059 0.3777650 0.3996143 0.4953275 0.4981150 0.4883627 0.4910701
##        62        63        65        66        68        69        71        72
## 0.4908639 0.4962543 0.4832333 0.4897509 0.5076387 0.4882538 0.5042544 0.4970130
##        74        75        77        78        80        81        83        84
## 0.4811962 0.4882685 0.4941820 0.4860312 0.5009828 0.5022218 0.4995720 0.4984751
##        86        87        89        90        92        93        95        96
## 0.4861349 0.4882487 0.4960894 0.4968431 0.5020489 0.4915224 0.4866503 0.4921453
##        98        99       101       102       104       105       107       108
## 0.4799457 0.4287961 0.4318430 0.4335833 0.4300549 0.4272305 0.4331822 0.4316359
##       110       111       113       114       116       117       119       120
## 0.4277115 0.4273523 0.4308882 0.4327932 0.4310089 0.4330372 0.4328817 0.4267070
##       122       123       125       126       128       129       131       132
## 0.4289718 0.4289666 0.4306703 0.4343088 0.4305625 0.4297637 0.4317642 0.4305205
##       134       135       137       138       140       141       143       144
## 0.4257388 0.4290116 0.4306525 0.4296719 0.4313753 0.4293983 0.4285130 0.4340103
##       146       147       149       150       152       153       155       156
## 0.4279281 0.4300484 0.4277035 0.4289198 0.4302613 0.4316812 0.4293282 0.4358152
##       158       159       161       162       164       165       167       168
## 0.4329722 0.4271808 0.4196840 0.4203943 0.4216714 0.4230803 0.4296428 0.4018964
##       170       171       173       174       176       177       179       180
## 0.4207310 0.4348316 0.4253104 0.4307706 0.4191934 0.4313923 0.4286247 0.4146817
##       182       183       185       186       188       189       191       192
## 0.4184904 0.4160362 0.4268356 0.4321625 0.4229293 0.4335117 0.4210473 0.4203639
##       194       195       197       198       200       201       203       204
## 0.4068543 0.4274646 0.4765629 0.4731169 0.4741614 0.4778074 0.4784087 0.4769667
##       206       207       209       210       212       213       215       216
## 0.4840309 0.4767695 0.4822346 0.4758579 0.4820264 0.4755524 0.4742388 0.4809481
##       218       219       221       222       224       225       227       228
## 0.4801900 0.4822905 0.4735703 0.4769467 0.3870318 0.3803140 0.3938333 0.3819524
##       230       231       233       234       236       237       239       240
## 0.3837401 0.3848051 0.3826378 0.3891826 0.3895615 0.3956451 0.3826995 0.3831621
##       242       243       245       246       248       249       251       252
## 0.3864946 0.3741244 0.3886868 0.3879953 0.3898403 0.3942631 0.3860413 0.3939074
##       254       255       257       258       260       261       263       264
## 0.3815178 0.3882943 0.3976057 0.3853628 0.5318863 0.5346666 0.5398048 0.5360797
##       266       267       269       270       272       273       275       276
## 0.5405989 0.5396356 0.5331405 0.5286047 0.5418437 0.5313213 0.5339135 0.5379494
##       278       279       281       282       284       285       287       288
## 0.5336202 0.5401368 0.5392890 0.5401228 0.5374613 0.5344393 0.5394674 0.5450538
##       290       291       293       294       296       297       299       300
## 0.5361017 0.5393993 0.5352840 0.5422486 0.5414093 0.5386711 0.5325805 0.5389080
##       302       303       305       306       308       309       311       312
## 0.5270084 0.5320725 0.5340657 0.5378862 0.5465878 0.5359389 0.5356062 0.5428479
##       314       315       317       318       320       321       323       324
## 0.4936187 0.4758225 0.4766762 0.4895432 0.5020251 0.4967901 0.4971420 0.4901442
##       326       327       329       330       332       333       335       336
## 0.4917201 0.4939553 0.4823721 0.4977047 0.4945084 0.5073092 0.4971724 0.4836170
##       338       339       341       342       344       345       347       348
## 0.4853108 0.4818169 0.4958517 0.4962393 0.4942995 0.4869540 0.4940181 0.4963817
##       350       351       353       354       356       357       359       360
## 0.4939811 0.4831651 0.4924426 0.4965069 0.4959727 0.4938758 0.4880026 0.5013093
##       362       363       365       366       368       369       371       372
## 0.4748403 0.4913622 0.4948684 0.4845686 0.4996543 0.4870976 0.5285454 0.5387612
##       374       375       377       378       380       381       383       384
## 0.5281185 0.5330591 0.5282376 0.5153953 0.5234929 0.5231425 0.5397075 0.5285046
##       386       387       389       390       392       393       395       396
## 0.5426309 0.5267001 0.5255263 0.5260150 0.5308077 0.5237709 0.5229829 0.5263288
##       398       399       401       402       404       405       407       408
## 0.5337090 0.5294960 0.5287162 0.5226216 0.5305788 0.5251105 0.5257177 0.5215596
##       410       411       413       414       416       417       419       420
## 0.5326459 0.5320361 0.5311621 0.5353534 0.5236270 0.5411608 0.5371405 0.5248722
##       422       423       425       426       428       429       431       432
## 0.5213621 0.5377637 0.5277620 0.5367315 0.5264784 0.5296276 0.5339106 0.5295457
##       434       435       437       438       440       441       443       444
## 0.5303183 0.5275306 0.5338717 0.5261200 0.5217643 0.5253671 0.5278772 0.5264770
##       446       447       449       450       452       453       455       456
## 0.5310190 0.5323403 0.5262805 0.5275207 0.5335806 0.5291744 0.5294480 0.5244869
##       458       459       461       462       464       465       467       468
## 0.5294489 0.5223571 0.5312808 0.5272805 0.5268973 0.5287566 0.5257970 0.5252888
##       470       471       473       474       476       477       479       480
## 0.5232415 0.5299962 0.5251511 0.5258348 0.5324524 0.5297589 0.6033771 0.6016761
##       482       483       485       486       488       489       491       492
## 0.5962543 0.5940271 0.6033174 0.5942462 0.6022132 0.6002287 0.5973792 0.5957843
##       494       495       497       498       500       501       503       504
## 0.5998403 0.6064980 0.5996378 0.6003804 0.6051124 0.5951959 0.5958588 0.6033700
##       506       507       509       510       512       513       515       516
## 0.5988861 0.6031140 0.6001135 0.6010320 0.5933708 0.6055712 0.5978760 0.5975595
##       518       519       521       522       524       525       527       528
## 0.5996742 0.5997357 0.6063392 0.6010867 0.6008453 0.5982852 0.6020268 0.5983447
##       530       531       533       534       536       537       539       540
## 0.5958120 0.5945870 0.4003134 0.4073677 0.4096669 0.4093814 0.4221728 0.4099919
##       542       543       545       546       548       549       551       552
## 0.4210657 0.4211453 0.4147109 0.4026305 0.4148891 0.4153221 0.4083690 0.4065352
##       554       555       557       558       560       561       563       564
## 0.4239016 0.4073387 0.4108924 0.4065185 0.3948554 0.4228346 0.4177065 0.4108656
##       566       567       569       570       572       573       575       576
## 0.4167810 0.4126657 0.4043187 0.4187565 0.3991354 0.4120018 0.4075662 0.5342654
##       578       579       581       582       584       585       587       588
## 0.5516483 0.5427565 0.5353670 0.5395888 0.5393917 0.5527845 0.5380195 0.5337239
##       590       591       593       594       596       597       599       600
## 0.5502140 0.5373869 0.5297394 0.5333425 0.5440094 0.5348962 0.5391650 0.5411422
##       602       603       605       606       608       609       611       612
## 0.5433960 0.5308945 0.5463946 0.5533023 0.5534316 0.5465922 0.5392676 0.5322809
##       614       615       617       618       620       621       623       624
## 0.5273907 0.5526272 0.5227324 0.5478694 0.5475251 0.5448078 0.5552260 0.5373380
##       626       627       629       630       632       633       635       636
## 0.5327297 0.5420560 0.5633605 0.5451148 0.5487590 0.5597251 0.5595232 0.5426985
##       638       639       641       642       644       645       647       648
## 0.5534392 0.5539732 0.5495939 0.5423723 0.5453271 0.5423695 0.5359294 0.5555527
##       650       651       653       654       656       657       659       660
## 0.5463058 0.5481220 0.5404541 0.5326012 0.5483321 0.5430335 0.5459581 0.5509401
##       662       663       665       666       668       669       671       672
## 0.5555125 0.5408778 0.5377726 0.5497271 0.5349080 0.5464778 0.5406291 0.5500358
##       674       675       677       678       680       681       683       684
## 0.5351430 0.5447049 0.5418802 0.4827956 0.4730888 0.4818535 0.4722245 0.4946676
##       686       687       689       690       692       693       695       696
## 0.4672201 0.4958203 0.4894152 0.5060491 0.4950809 0.4916608 0.4786943 0.4931006
##       698       699       701       702       704       705       707       708
## 0.4861212 0.4838784 0.4782501 0.5006808 0.4874795 0.4889404 0.4671468 0.4973386
##       710       711       713       714       716       717       719       720
## 0.4769909 0.4955251 0.4869427 0.3740734 0.3692686 0.3765598 0.3715221 0.3693992
##       722       723       725       726       728       729       731       732
## 0.3685209 0.3756684 0.3699956 0.3689088 0.3713792 0.3700862 0.3666544 0.3716854
##       734       735       737       738       740       741       743       744
## 0.3655407 0.3768325 0.3714475 0.3766287 0.3724371 0.3720302 0.3742344 0.3759474
##       746       747       749       750       752       753       755       756
## 0.3738445 0.3750296 0.3666478 0.3691726 0.3766292 0.3741631 0.3779649 0.3717056
##       758       759       761       762       764       765       767       768
## 0.3743808 0.3706101 0.3700794 0.3705589 0.3736569 0.3715516 0.3677986 0.4498798
##       770       771       773       774       776       777       779       780
## 0.4635510 0.4559030 0.4530602 0.4477238 0.4658178 0.4532878 0.4679907 0.4423053
##       782       783       785       786       788       789       791       792
## 0.4548843 0.4453781 0.4661475 0.4433995 0.4512429 0.4581659 0.4465434 0.4634007
##       794       795       797       798       800       801       803       804
## 0.4549336 0.4492421 0.4519165 0.4242657 0.4493163 0.4636130 0.4435009 0.4469974
##       806       807       809       810       812       813       815       816
## 0.4428707 0.4490092 0.4537417 0.4474205 0.4621058 0.4532929 0.4504713 0.4691254
##       818       819       821       822       824       825       827       828
## 0.4346098 0.5129625 0.5041655 0.5145983 0.5094085 0.5012281 0.5167394 0.5132338
##       830       831       833       834       836       837       839       840
## 0.5152423 0.5131192 0.5242294 0.5230291 0.5150588 0.5047231 0.5234098 0.5166514
##       842       843       845       846       848       849       851       852
## 0.5087070 0.5162499 0.5197185 0.5173732 0.5157765 0.5215026 0.5145544 0.5076600
##       854       855       857       858       860       861       863       864
## 0.5129813 0.5120817 0.5043733 0.5074234 0.5192794 0.5117692 0.5195451 0.5145485
##       866       867       869       870       872       873       875       876
## 0.4981962 0.5191630 0.5081164 0.5206988 0.5137132 0.5131964 0.5204550 0.5152126
##       878       879       881       882       884       885       887       888
## 0.5117623 0.5079594 0.5109842 0.5147270 0.5085265 0.5102999 0.5109371 0.5166201
##       890       891       893       894       896       897       899       900
## 0.5099266 0.5124980 0.5105126 0.5135105 0.5045639 0.5074277 0.5072595 0.5080124
##       902       903       905       906       908       909       911       912
## 0.5100779 0.5068722 0.5146337 0.5143848 0.5096221 0.5048044 0.5095129 0.5140431
##       914       915       917       918       920       921       923       924
## 0.5135065 0.5077271 0.5131279 0.5111548 0.5161028 0.5115764 0.5124756 0.5098475
##       926       927       929       930       932       933       935       936
## 0.5125384 0.5027327 0.5127044 0.5137117 0.5064448 0.5092688 0.4379993 0.4416928
##       938       939       941       942       944       945       947       948
## 0.4312836 0.4395500 0.4430731 0.4378109 0.4429087 0.4361586 0.4350112 0.4429412
##       950       951       953       954       956       957       959       960
## 0.4376098 0.4434929 0.4408530 0.4324507 0.4361049 0.4332146 0.4331985 0.4372260
##       962       963       965       966       968       969       971       972
## 0.4433048 0.4415758 0.4359253 0.4386520 0.4368021 0.4433634 0.4390770 0.4316452
##       974       975       977       978       980       981       983       984
## 0.4382371 0.4398763 0.4388802 0.4361811 0.4409417 0.4367541 0.4348510 0.4376832
##       986       987       989       990       992       993       995       996
## 0.4405096 0.5188269 0.4947951 0.5141178 0.5002618 0.5085944 0.5092533 0.5203062
##       998       999      1001      1002      1004      1005      1007      1008
## 0.5121182 0.5109580 0.5150530 0.5076517 0.5245870 0.5107758 0.5219362 0.4937855
##      1010      1011      1013      1014      1016      1017      1019      1020
## 0.5130545 0.5120470 0.5207545 0.5103535 0.5291046 0.5173165 0.5302658 0.5113211
##      1022      1023      1025      1026      1028      1029      1031      1032
## 0.5141624 0.5116004 0.5093395 0.5074473 0.5173151 0.5015704 0.5044679 0.5066631
##      1034      1035      1037      1038      1040      1041      1043      1044
## 0.5056496 0.5023178 0.5113630 0.5197224 0.4450000 0.4439649 0.4444900 0.4446797
##      1046      1047      1049      1050      1052      1053      1055      1056
## 0.4471705 0.4464691 0.4484977 0.4393093 0.4453602 0.4459835 0.4474415 0.4463804
##      1058      1059      1061      1062      1064      1065      1067      1068
## 0.4466937 0.4496313 0.4487553 0.4487339 0.4450492 0.4527761 0.4491982 0.4450803
##      1070      1071      1073      1074      1076      1077      1079      1080
## 0.4395164 0.4395516 0.4535614 0.4461640 0.4463124 0.4489837 0.4465470 0.4441644
##      1082      1083      1085      1086      1088      1089      1091      1092
## 0.4487404 0.4471342 0.4492607 0.4459614 0.4476545 0.4463899 0.4458657 0.4477569
##      1094      1095      1097      1098      1100      1101      1103      1104
## 0.4407661 0.4433364 0.5081973 0.5067357 0.5143176 0.4987057 0.5108799 0.5136424
##      1106      1107      1109      1110      1112      1113      1115      1116
## 0.5105071 0.5069391 0.5214757 0.5124065 0.5087476 0.5111857 0.5153853 0.5049649
##      1118      1119      1121      1122      1124      1125      1127      1128
## 0.5149851 0.5022015 0.5147303 0.5137281 0.5227940 0.5226694 0.5033434 0.5102087
##      1130      1131      1133      1134      1136      1137      1139      1140
## 0.5017507 0.5157639 0.5108048 0.5196115 0.4935814 0.5780043 0.5683017 0.5726842
##      1142      1143      1145      1146      1148      1149      1151      1152
## 0.5733323 0.5768736 0.5858017 0.5668187 0.5727829 0.5767691 0.5760130 0.5739748
##      1154      1155      1157      1158      1160      1161      1163      1164
## 0.5797798 0.5751888 0.5804216 0.5776263 0.5722605 0.5655185 0.5722166 0.5749712
##      1166      1167      1169      1170      1172      1173      1175      1176
## 0.5618764 0.5516417 0.5577474 0.5670066 0.5588398 0.5595479 0.5482490 0.5687826
##      1178      1179      1181      1182      1184      1185      1187      1188
## 0.5583237 0.5594037 0.5611863 0.5593805 0.5564321 0.5608529 0.5637187 0.5525276
##      1190      1191      1193      1194      1196      1197      1199      1200
## 0.5631669 0.5583761 0.5565774 0.5613659 0.5609141 0.5660573 0.5628781 0.5688722
##      1202      1203      1205      1206      1208      1209      1211      1212
## 0.5534775 0.5572931 0.5663533 0.5619037 0.5574963 0.5565679 0.5666840 0.5514221
##      1214      1215      1217      1218      1220      1221      1223      1224
## 0.5579740 0.5569225 0.5568945 0.5567160 0.5558747 0.5578570 0.5434965 0.5493107
##      1226      1227      1229      1230      1232      1233      1235      1236
## 0.5497334 0.5433517 0.5411371 0.5532866 0.5441884 0.5525330 0.5498858 0.5507218
##      1238      1239      1241      1242      1244      1245      1247      1248
## 0.5421553 0.5470723 0.5492014 0.5434592 0.5440411 0.5428242 0.5519844 0.5497519
##      1250      1251      1253      1254      1256      1257      1259      1260
## 0.5469963 0.5461289 0.5448900 0.5405234 0.5450121 0.5458232 0.5447688 0.5475498
##      1262      1263      1265      1266      1268      1269      1271      1272
## 0.5430295 0.5499628 0.5457714 0.5454904 0.5422902 0.5523110 0.4481029 0.4203197
##      1274      1275      1277      1278      1280      1281      1283      1284
## 0.4458330 0.4444479 0.4686818 0.4392748 0.4322076 0.4492708 0.4443028 0.4349508
##      1286      1287      1289      1290      1292      1293      1295      1296
## 0.4476998 0.4245360 0.4352801 0.4501315 0.4377613 0.4400979 0.4291438 0.4402564
##      1298      1299      1301      1302      1304      1305      1307      1308
## 0.4325353 0.4328895 0.4486225 0.4447265 0.4418536 0.4402509 0.4413554 0.4378312
##      1310      1311      1313      1314      1316      1317      1319      1320
## 0.4247062 0.4331553 0.4382826 0.4357394 0.4378237 0.4384414 0.4512488 0.4400030
##      1322      1323      1325      1326      1328      1329      1331      1332
## 0.4423826 0.4246518 0.4513200 0.4543303 0.4531315 0.4491300 0.4410961 0.4408380
##      1334      1335      1337      1338      1340      1341      1343      1344
## 0.4395715 0.4650507 0.4529066 0.4382397 0.4359778 0.4347589 0.4399865 0.4988282
##      1346      1347      1349      1350      1352      1353      1355      1356
## 0.5000362 0.4995042 0.5010688 0.5018656 0.5002367 0.5036163 0.4977762 0.4988738
##      1358      1359      1361      1362      1364      1365      1367      1368
## 0.4982638 0.5021552 0.5024434 0.5028223 0.5028037 0.5000109 0.5001506 0.5005988
##      1370      1371      1373      1374      1376      1377      1379      1380
## 0.5011458 0.5010325 0.5014890 0.5028802 0.5003653 0.4988058 0.4995212 0.4996335
##      1382      1383      1385      1386      1388      1389      1391      1392
## 0.5017102 0.4970873 0.5023378 0.4995754 0.4996911 0.5031686 0.5008723 0.4988996
##      1394      1395      1397      1398      1400      1401      1403      1404
## 0.5017024 0.5037299 0.5009749 0.5057386 0.5002465 0.5749424 0.5872935 0.5878459
##      1406      1407      1409      1410      1412      1413      1415      1416
## 0.5708345 0.5902520 0.5838060 0.5981133 0.5890015 0.5819373 0.5756862 0.5839995
##      1418      1419      1421      1422      1424      1425      1427      1428
## 0.5752046 0.5772801 0.5696379 0.5753853 0.5811793 0.5810831 0.5723843 0.5876272
##      1430      1431      1433      1434      1436      1437      1439      1440
## 0.5877565 0.5757320 0.5789263 0.5717885 0.5864299 0.5950618 0.5599572 0.5829373
##      1442      1443      1445      1446      1448      1449      1451      1452
## 0.5954978 0.5868901 0.5757122 0.5895607 0.5728889 0.5623862 0.5834595 0.5754769
##      1454      1455      1457      1458      1460      1461      1463      1464
## 0.5798598 0.3830383 0.3856705 0.3947470 0.3846475 0.3867331 0.3884741 0.3911125
##      1466      1467      1469      1470      1472      1473      1475      1476
## 0.3946060 0.3751245 0.3819350 0.3898251 0.3982435 0.4043783 0.3890936 0.3945966
##      1478      1479      1481      1482      1484      1485      1487      1488
## 0.3890715 0.4064780 0.3940380 0.4092299 0.3950810 0.4052099 0.3983261 0.3969363
##      1490      1491      1493      1494      1496      1497
## 0.3813926 0.4020394 0.3909374 0.3867452 0.4018312 0.3799412
```

Validate model using confusion matrix

```
confmatrix <- table(Actual_Value = train$label, Predicted_Value = res2 > 0.5)

confmatrix
```

```
##              Predicted_Value
## Actual_Value FALSE TRUE
##            0   289  222
##            1   202  285
```

Accuracy

```
(confmatrix[[1,1]] + confmatrix[[2,2]]) / sum(confmatrix)
```

```
## [1] 0.5751503
```

ii. Keep this assignment handy, as you will be comparing your results from this week to next week.