Walmart Customer Trip Type Classification

1. 분석목적 (Purpose of Analysis)

Walmart Recruiting: Trip Type Classification 이용, Walmart 소비자 패턴을 분석하여 범주화된 Trip Type에 해당되는 VisitNumber 예측 및 분류.

2. 사용한 라이브러리

```
## Loading required package: grid
## Loading required package: mvtnorm
## Loading required package: modeltools
## Loading required package: stats4
## Loading required package: strucchange
## Loading required package: zoo
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
      as.Date, as.Date.numeric
## Loading required package: sandwich
## Attaching package: 'dplyr'
## The following objects are masked from 'package:stats':
       filter, lag
## The following objects are masked from 'package:base':
##
##
       intersect, setdiff, setequal, union
```

```
## Loading required package: lattice
## Loading required package: ggplot2
##
## Attaching package: 'MASS'
\#\# The following object is masked from 'package:dplyr':
##
##
      select
## Loading required package: Hmisc
## Loading required package: survival
## Attaching package: 'survival'
## The following object is masked from 'package:caret':
##
##
      cluster
## Loading required package: Formula
##
## Attaching package: 'Hmisc'
## The following object is masked from 'package:e1071':
##
##
      impute
## The following objects are masked from 'package:dplyr':
##
##
      combine, src, summarize
## The following objects are masked from 'package:base':
##
##
       format.pval, round.POSIXt, trunc.POSIXt, units
## funModeling v.1.6.5 :)
## Examples and tutorials at livebook.datascienceheroes.com
## Attaching package: 'kknn'
## The following object is masked from 'package:caret':
##
##
      contr.dummy
## Type 'citation("pROC")' for a citation.
## Attaching package: 'pROC'
## The following objects are masked from 'package:stats':
##
```

##

cov, smooth, var

```
## randomForest 4.6-12
 ## Type rfNews() to see new features/changes/bug fixes.
 ##
 ## Attaching package: 'randomForest'
 ## The following object is masked from 'package:Hmisc':
 ##
 ##
      combine
 ## The following object is masked from 'package:ggplot2':
 ##
 ##
      margin
 ## The following object is masked from 'package:dplyr':
 ##
 ##
       combine
수정 전 데이터
 wal dataset <- read.csv("C:/Users/rudghksldl/Desktop/train 3.csv")</pre>
 head(wal dataset, 20)
 ##
    TripType VisitNumber Weekday
                                       Upc ScanCount
 ## 1 999
               5 Friday 68113152929 -1
 ## 2
          30
                      7 Friday 60538815980
           30
 ## 3
                      7 Friday 7410811099
                                                 1
                      8 Friday 2238403510
 ## 4
           26
 ## 5
           26
                      8 Friday 2006613744
                      8 Friday 2006618783
 ## 6
           26
                                                  2
 ## 7
                     8 Friday 2006613743
          26
                                                  1
                     8 Friday 7004802737
          26
 ## 8
                                                 1
                     8 Friday 2238495318
 ## 9
          26
                                                 1
 ## 10
          26
                     8 Friday 2238400200
                                                 -1
 ## 11
          26
                     8 Friday 5200010239
 ## 12
          26
                     8 Friday 88679300501
 ## 13
          26
                     8 Friday 22006000000
                                                 1
 ## 14
          26
                     8 Friday 2236760452
                                                 1
 ## 15
          26
                     8 Friday 88679300501
                                                 -1
 ## 16
          26
                     8 Friday 2238400200
                     8 Friday 3019294203
 ## 17
           26
                                                 1
 ## 18
           26
                      8 Friday 72450408840
                      8 Friday 25541500000
 ## 19
           26
                                                  2
          26
                      8 Friday 2310010776
 ## 20
                                                 1
 ## DepartmentDescription FinelineNumber
 ## 1
       FINANCIAL SERVICES
                                 1000
 ## 2
                   SHOES
                                  8931
 ## 2 SHOES
## 3 PERSONAL CARE
                                  4504
 ## 4 PAINT AND ACCESSORIES
                                  3565
 ## 5 PAINT AND ACCESSORIES
                                  1017
 ## 6 PAINT AND ACCESSORIES
                                  1017
 ## 7 PAINT AND ACCESSORIES
                                  1017
                                  2802
 ## 8 PAINT AND ACCESSORIES
 ## 9 PAINT AND ACCESSORIES
                                  4501
 ## 10 PAINT AND ACCESSORIES
 ## 11
       DSD GROCERY
                                  4606
                                  3504
 ## 12 PAINT AND ACCESSORIES
 ## 13 MEAT - FRESH & FROZEN
                                  6009
 ## 14 PAINT AND ACCESSORIES
                                    7
 ## 15 PAINT AND ACCESSORIES
                                 3504
 ## 16 PAINT AND ACCESSORIES
                                  3565
```

17 PAINT AND ACCESSORIES

18 PAINT AND ACCESSORIES

19 DAIRY

PETS AND SUPPLIES

20

2801

1028

1305

3300

변수 설명

TripType - a categorical id representing the type of shopping trip the customer made. This is the ground truth that you are predicting.

TripType 999 is an "other" category. VisitNumber - an id corresponding to a single trip by a single customer

Weekday - the weekday of the trip

Upc - the UPC number of the product purchased

ScanCount - the number of the given item that was purchased. A negative value indicates a product return.

DepartmentDescription - a high-level description of the item's department

FinelineNumber - a more refined category for each of the products, created by Walmart

변수 변화

```
dt <- na.omit(read.csv("C:/Users/rudghksldl/Desktop/newdata (1).csv"))
dt <- dt[ ,c(-1,-2,-5,-6)]
dt$triptype <- as.factor(dt$triptype)
glimpse(dt)</pre>
```

```
## Observations: 94,247
## Variables: 74
                             <int> -1, 2, 28, 3, 3, 4, 7, 9, 4, 9, 3,...
## $ num prod
                              <fctr> Friday, Friday, Friday, Friday, F...
## $ weekday
                          <int> 1, 2, 22, 3, 3, 4, 7, 8, 4, 9, 2, ...
<dbl> 1.000, 0.500, 0.727, 0.667, 0.667,...
## $ TotalDescCount
## $ max prodrate
## $ X1.HR.PHOTO
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                           <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ ACCESSORIES
## $ AUTOMOTIVE
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ BAKERY
## $ BATH.AND.SHOWER
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ BEAUTY
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ BEDDING
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ BOOKS.AND.MAGAZINES
                              <int> 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0...
## $ BOYS.WEAR
## $ CANDY..TOBACCO..COOKIES <int> 0, 0, 0, 0, 1, 0, 0, 0, 2, 0, 0...
## $ CELEBRATION <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                         <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
<int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
<int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ COMM.BREAD
## $ CONCEPT.STORES
## $ COOK.AND.DINE
                              <int> 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ DAIRY
## $ DSD.GROCERY
                               <int> 0, 0, 1, 0, 2, 1, 0, 0, 2, 0, 0, 0...
## $ ELECTRONICS
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
<int> 0, 0, 0, 0, 0, 0, 0, 8, 0, 1, 0, 0...
<int> 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ FABRICS.AND.CRAFTS
## $ FINANCIAL.SERVICES
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0...
## $ FROZEN.FOODS
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ FURNITURE
## $ GIRLS.WEAR..4.6X..AND.7.14 <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ GROCERY.DRY.GOODS <int> 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0...
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ HARDWARE
## $ HEALTH.AND.BEAUTY.AIDS <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ HOME.DECOR
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1...
## $ HOME.MANAGEMENT
## $ HORTICULTURE.AND.ACCESS
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ INFANT.CONSUMABLE.HARDLINES <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ JEWELRY.AND.SUNGLASSES <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0...
## $ LADIES.SOCKS
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ LADIESWEAR
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ LARGE.HOUSEHOLD.GOODS <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ LAWN.AND.GARDEN
## $ LIQUOR.WINE.BEER
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ MEAT...FRESH...FROZEN <int> 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0...
## $ MEDIA.AND.GAMING
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ MENS.WEAR
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 0, 0...
## $ MENSWEAR
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ NULL.
                               <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ OFFICE.SUPPLIES
## 9 OPTICAL FRAMES
```

```
MM A OLITOVH. **EIVUHPO
                              ## $ OPTICAL...LENSES
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ OTHER.DEPARTMENTS
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                             <int> 0, 0, 16, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ PAINT.AND.ACCESSORIES
## $ PERSONAL.CARE
                             <int> 0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0...
## $ PETS.AND.SUPPLIES
                             <int> 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ PHARMACY.OTC
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ PHARMACY.RX
## $ PLAYERS.AND.ELECTRONICS <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ PLUS.AND.MATERNITY
## $ PRE.PACKED.DELI
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ PRODUCE
                              <int> 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 1...
## $ SEAFOOD
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ SEASONAL
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ SERVICE.DELI
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0...
## $ SHEER.HOSIERY
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
                              <int> 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0...
## $ SHOES
## $ SLEEPWEAR.FOUNDATIONS
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ SPORTING.GOODS
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ SWIMWEAR.OUTERWEAR
                             <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ TOYS
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ WIRELESS
                              <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ triptype
                              <fctr> 999, 30, 26, 8, 8, 35, 41, 21, 6,...
```

새로 만든 변수 설명

```
id - 고객 고유값
num_prod - 구매 + 환불(-)
weekday - 방문요일
RefundCount - 고객의 총 환불량
TotalDescCount - 고객의 총 구매량
MaxDescCount - 최대값을 갖는 DepartmentDescription의 양
max_prodrate - 최대값을 갖는 DepartmentDescription의 해당비율
DepartmentDescription의 dummy 변수(one hot 인코딩) - 68열
```

TripType - 예측해야할 타겟 변수

4. Model Accuracy 판단

```
# train / validation data
trn_idx <- sample(1:dim(dt)[1], round(0.7*dim(dt)[1]))
w_trn <- dt[trn_idx, ]
w_val <- dt[-trn_idx, ]</pre>
```

4.1 KNN

찾은 K 값으로 모델 적합

모델 적합 후 정확도 확인

```
pima_knn_fit <- fitted(w_knn)
pima_knn_cf <- confusionMatrix(w_val$triptype, as.factor(pima_knn_fit))
pima_knn_cf</pre>
```

```
## Confusion Matrix and Statistics
##
##
       Reference
                         8
## Prediction 3 4
               5 6 7
                            9
                               12
                                   14
                                      1.5
                                         18
                                            19
    3 1020 0 0 1 0 29
                            7
##
                                0
                                   0
                                             Ω
         1 2 78 0 1
                          7
##
##
     5
         6 5 731 6 22 71
                            40
                                             1
                                   0
     6
                                0
                                      0
                                         0
\# \#
         1 0 1 274 6 58
                             3
                                              1
##
     7
         3 0 10 8 1208 220
                                      .3
                             2.4
                                1 0
                                              0
```

## 12														
##	##	£ 8	7	Ω	111	70	194	2917	133	Ω	Λ	Λ	Ω	0
Heat														31
He														
Heat														0
## 18 0 0 0 0 0 0 0 0 9 49 49 0 0 1 66 ## 119 0 0 0 0 0 0 0 0 9 49 0 0 0 1 66 ## 120 1 0 2 1 1 1 1 69 0 0 0 1 2 2 ## 21 0 0 2 1 1 1 3 46 0 0 0 5 2 2 ## 23 2 0 0 0 0 0 0 0 0 22 0 0 0 0 0 1 2 ## 24 5 0 3 4 7 9 151 0 0 3 3 1 ## 25 8 0 3 6 5 7 175 2 0 0 1 2 0 1 ## 26 2 0 1 0 1 2 2 2 2 5 5 3 0 0 1 2 2 ## 28 1 0 2 0 2 0 0 63 0 0 0 1 2 2 ## 28 1 0 2 0 2 0 2 0 63 0 0 0 0 0 1 2 2 ## 30 2 0 2 1 1 0 1 1 1 5 7 0 0 0 1 0 0 1 2 ## 31 4 0 0 1 0 2 5 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			0	0	0	0	0			0	0			0
## 19 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 2 ### 20 1 0 0 2 1 1 1 1 1 69 0 0 1 1 0 ### 21 0 0 2 1 1 1 1 3 69 0 0 0 1 1 0 ### 22 2 2 0 2 0 0 0 0 0 91 0 0 0 0 1 2 ### 24 5 0 3 4 7 9 151 0 0 3 3 1 ### 25 8 0 3 4 7 9 151 0 0 3 3 1 ### 26 2 0 1 1 0 1 1 1 57 0 0 0 1 1 0 ### 28 1 0 2 0 2 0 6 6 3 0 0 0 0 0 0 1 2 ### 28 1 0 2 0 2 0 6 6 3 0 0 0 0 0 1 2 ### 29 3 0 4 0 0 0 2 51 0 0 0 0 1 3 ### 30 2 0 0 2 1 2 2 2 123 0 0 0 0 0 0 ### 33 3 0 0 1 1 0 1 1 0 4 36 0 0 0 0 0 0 ### 33 3 0 0 0 1 6 6 62 11 0 0 0 3 6 ### 35 11 0 12 7 34 140 28 0 0 2 2 4 ### 36 10 0 44 4 7 115 35 0 0 3 3 2 ### 37 6 0 8 1 1126 71 130 0 0 5 1 1 ### 38 2 0 5 7 80 115 72 292 191 130 8 0 2 2 13 ### 40 0 1 1 14 3 22 2 2 4 3 3 0 0 4 4 4 ### 41 1 0 1 1 0 3 0 3 6 6 ### 42 2 0 1 1 5 72 292 191 130 8 0 0 2 2 13 ### 44 0 0 1 1 1 6 6 6 1 1 2 0 1 1 0 2 2 1 1 1 0 1 1 1 0 ### 41 1 0 1 1 0 0 0 3 6 0 0 1 1 0 2 1 1 1 0 1 1 0 ### 42 2 0 0 5 7 80 107 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	##	15	2	0	3	1	8	47	49	1	0	97	1	0
## 20 1 0 0 2 1 1 1 1 69 0 0 0 1 1 0 ## 21 0 0 0 2 1 1 1 1 3 69 0 0 0 1 1 0 ## 22 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 2 ## 23 2 0 0 0 0 0 0 0 0 22 0 0 0 0 0 1 1 2 ## 25 8 0 0 3 4 7 9 150 0 0 3 3 1 ## 26 2 0 1 0 1 1 7 57 0 0 1 1 0 ## 27 3 0 0 1 2 2 2 55 3 0 0 1 0 0 0 0 0 ## 28 1 0 2 0 2 0 2 0 63 0 0 0 0 0 0 0 0 ## 29 3 0 0 4 0 0 0 2 5 51 0 0 0 0 0 0 0 ## 30 2 0 2 1 2 2 123 0 0 0 0 0 0 0 0 0 ## 31 4 0 0 1 0 0 4 3 1 1 0 0 4 3 6 0 0 0 0 0 0 0 0 ## 33 3 0 0 0 1 6 6 3 9 4 4 31 1 0 0 3 6 0 0 0 0 0 0 0 0 ## 35 11 0 12 7 34 144 28 0 0 0 2 2 4 ## 36 10 0 44 4 7 115 35 0 0 0 3 2 2 4 ## 37 8 2 0 5 7 80 107 20 0 0 0 2 2 4 ## 38 2 0 5 7 80 107 20 0 0 0 2 2 1 ## 39 21 0 115 72 292 191 130 8 0 2 2 1 ## 44 0 0 1 1 4 0 0 3 6 0 0 0 0 0 2 2 ## 44 1 1 0 1 1 0 0 3 6 0 0 0 1 0 2 2 ## 44 0 0 1 1 4 0 0 0 1 0 0 3 6 0 0 0 0 0 0 2 2 ## 44 0 0 1 1 4 0 0 0 1 0 0 0 3 6 0 0 0 0 0 0 2 2 ## 44 1 1 0 1 1 0 0 0 0 0 3 6 0 0 0 1 2 2 ## 44 4 0 0 0 1 1 0 0 0 3 6 0 0 0 0 0 0 2 2 ## 44 4 0 0 0 1 1 4 0 0 0 3 0 0 0 0 0 0 0 2 2 ## 44 4 0 0 0 1 1 4 0 0 0 3 6 0 0 0 1 2 2 ## 44 0 0 0 1 1 0 0 0 3 6 0 0 0 1 2 2 ## 44 0 0 0 1 1 0 0 0 3 6 0 0 0 1 2 2 ## 8 10 0 0 5 1 1 0 0 0 0 3 6 0 0 0 1 2 2 ## 8 20 0 5 7 80 107 20 0 0 0 0 1 2 2 ## 8 20 0 5 7 80 107 20 0 0 0 0 1 2 2 ## 8 20 0 5 7 80 107 20 0 0 0 0 1 2 2 ## 8 20 0 5 7 80 107 20 0 0 0 0 0 0 2 2 ## 8 20 0 1 1 0 0 0 0 3 6 0 0 0 1 1 0 6 ## 44 0 0 0 1 1 0 0 0 0 0 3 6 0 0 0 1 1 0 6 ## 20 123 0 1 1 0 0 0 0 0 0 0 0 0 0 1 2 0 ## 99 221 2 3 39 7 54 263 374 0 0 0 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	##	18	0	0	0	0	0	9	49	0	0	1	66	0
## 21 0 0 0 2 1 1 1 1 3 4 6 0 0 0 5 2 2 1 1 1 1 3 4 6 0 0 0 5 5 2 2 1 1 1 1 3 4 6 0 0 0 5 5 2 1 1 1 2 1 3 4 6 1 0 0 0 0 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1	##	19	0	0	0	0	0	0	43	0	0	0	1	28
## 21 0 0 0 2 1 1 1 1 3 4 6 0 0 0 5 2 2 1 1 1 1 3 4 6 0 0 0 5 5 2 2 1 1 1 1 3 4 6 0 0 0 5 5 2 1 1 1 2 1 3 4 6 1 0 0 0 0 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1	##	20	1	0	2	1	1	1	69	0	0	1	0	0
### 22														1
## 23														
## 24														
##														0
## 26 2 0 1 0 1 0 0 1 1 57 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0														1
## 27 3 0 1 2 2 2 2 55 3 3 0 1 2 2 ## 28 1 0 0 2 0 0 13 ## 28 1 0 0 2 0 0 2 0 63 0 0 0 0 0 0 1 3 ## 30 2 0 2 1 2 2 2 123 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	##	25	8	0	3	6	5	7	175	2	0	0	2	0
## 28	##	26	2	0	1	0	1	1	57	0	0	1	0	0
## 30	##	ŧ 27	3	0	1	2	2	2	55	3	0	1	2	0
## 30	##	28	1	0	2	0	2	0	63	0	0	0	0	0
### 31	##	29	3	0	4	0	0	2	51	0	0	Ο	13	1
### 31														0
## 32 5 0 6 6 3 9 44 31 1 0 3 6 ## 33 3 0 0 1 1 6 62 11 0 0 0 0 0 0 ## 35 11 0 12 7 34 140 28 0 0 2 4 4 ## 36 10 0 44 4 7 115 35 0 0 3 2 ## 37 6 0 8 1 126 71 13 0 0 0 5 1 ## 38 2 0 5 7 80 107 20 0 0 0 0 2 ## 39 21 0 118 72 292 191 130 8 0 22 13 ## 40 0 1 14 3 22 2 4 3 3 0 4 4 ## 41 1 0 1 0 0 0 36 0 0 1 3 ## 44 0 0 8 4 3 2 12 0 0 10 6 ## 44 0 0 8 4 3 2 12 0 0 10 6 ## 7 11 62 3 0 8 6 ## 7 8eference ## Prediction 20 21 22 23 24 25 26 27 28 29 30 3 ## 4 0 0 0 0 0 0 0 0 0 0 1 1 0 1 2 ## 5 1 3 1 0 0 10 6 1 2 2 1 1 4 ## 7 1 1 1 0 0 0 0 0 0 0 0 0 1 1 0 ## 5 1 3 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ## 7 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														0
## 33 3 3 0 0 0 1 6 6 62 11 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														
## 35 11 0 12 7 34 140 28 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														0
## 35 11 0 12 7 34 140 28 0 0 2 4 ## 36 10 0 44 4 7 115 35 0 0 3 2 4 ## 36 10 0 44 4 7 115 35 0 0 0 3 2 4 ## 37 6 0 8 1 126 71 13 0 0 5 1 1 ## 38 2 0 5 7 80 107 20 0 0 0 0 2 2 ## 38 2 0 15 7 80 107 20 0 0 0 0 2 2 ## 39 21 0 115 72 292 191 130 8 0 22 13 ## 40 0 1 14 3 22 2 4 3 0 4 4 ## 41 1 0 0 1 0 0 0 0 36 0 0 1 1 3 ## 42 2 0 1 3 2 7 85 1 0 26 18 ## 44 0 0 8 4 3 2 12 0 0 0 10 6 ## 44 0 0 8 4 3 2 12 0 0 0 10 6 ## 44 0 0 10 6 ## 499 221 2 39 7 54 263 374 0 0 12 6 ## 80 22 1 3 8 ## 3 1 0 5 1 6 0 0 0 1 1 1 0 1 0 1 0 6 6 1 2 1 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1														0
## 36 10 0 44 4 7 115 35 0 0 3 2 ## 37 6 0 8 1 126 71 13 0 0 0 5 1 ## 38 2 0 5 7 80 107 20 0 0 0 2 ## 39 21 0 115 72 292 191 130 8 0 22 13 ## 40 0 1 14 3 22 2 4 3 0 4 4 ## 41 1 0 1 0 0 0 36 0 0 1 3 3 ## 42 2 0 1 3 3 2 7 85 1 0 26 18 ## 43 7 0 5 1 2 11 62 3 0 8 6 ## 44 0 0 8 4 3 2 12 0 0 10 6 ## 999 221 2 39 7 54 263 374 0 0 12 6 ## 8 Ference ## Prediction 20 21 22 23 24 25 26 27 28 29 30 3 3 ## 4 0 0 0 0 0 0 0 0 0 0 0 1 0 6 ## 5 1 3 1 0 10 6 1 2 1 1 0 1 0 0 0 0 0 ## 8 8 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			1	0	2	4	4	37		0	0	0	0	0
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## 30 1 2 1 0 1 27 0 1 1 0 126 ## 31 0 0 1 1 0 0 0 0 1 0 0 0 1 0 0 0 13 1 0 0 0 0 1 1 1 0 0 13 1 0 0 0 1 1 1 1 0 0 1 1 1 1 9 9 1 3 1 0 0 0 1 0 1 0 1 0 1 0 <t< th=""><th>## ## ## ## ## ##</th><th># 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26</th><th>0 0 4 0 123 0 0 0 2 3 2</th><th>1 7 4 0 0 111 1 0 6 2 2</th><th>0 1 4 0 44 1 0 99 2 2 3 0</th><th>0 0 0 1 0 0 7 17 0 1</th><th>2 0 4 4 0 0 2 4 0 463 12 5</th><th>0 5 2 0 1 0 4 0 10 775 0</th><th>0 1 0 0 0 1 1 0 5 4 45 2</th><th>0 1 0 0 0 1 0 0 3 3 0</th><th>0 2 0 1 0 0 0 0 2 1 1</th><th>2 0 0 25 0 0 1 0 0 0</th><th>0 0 1 1 0 0 0 1 0 2 21 0</th><th>0 0 1 0 0 0 0 0 8 0 0</th></t<>	## ## ## ## ## ##	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26	0 0 4 0 123 0 0 0 2 3 2	1 7 4 0 0 111 1 0 6 2 2	0 1 4 0 44 1 0 99 2 2 3 0	0 0 0 1 0 0 7 17 0 1	2 0 4 4 0 0 2 4 0 463 12 5	0 5 2 0 1 0 4 0 10 775 0	0 1 0 0 0 1 1 0 5 4 45 2	0 1 0 0 0 1 0 0 3 3 0	0 2 0 1 0 0 0 0 2 1 1	2 0 0 25 0 0 1 0 0 0	0 0 1 1 0 0 0 1 0 2 21 0	0 0 1 0 0 0 0 0 8 0 0
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## 32 0 5 0 0 3 10 0 1 1 1 9 ## 33 3 3 1 0 7 3 2 2 0 2 0 ## 34 1 0 1 0 1 1 0 0 0 ## 35 2 3 0 0 5 3 1 1 2 1 1 ## 36 3 7 5 0 14 22 2 11 1 0 5 ## 37 4 0 5 0 10 7 2 1 3 0 4 ## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1	## ## ## ## ## ## ##	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28	0 0 4 0 123 0 0 0 2 3 2 0 0	1 7 4 0 0 1111 1 0 6 2 2 1 1	0 1 4 0 44 1 0 99 2 2 3 0 0 0	0 0 0 1 0 0 7 17 0 1 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6	0 5 2 0 1 0 4 0 10 775 0 0 2 4	0 1 0 0 0 1 1 0 5 4 45 2 0	0 1 0 0 0 1 0 0 3 3 0 144 1	0 2 0 1 0 0 0 0 2 1 1 0 65	2 0 0 25 0 0 1 0 0 0 0 1 0	0 0 1 1 0 0 0 1 0 2 21 0 0	0 0 1 0 0 0 0 0 8 0 0 0 1 0 0
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## 34 1 0 1 0 1 1 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	### ## ## ## ## ## ## ##	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31	0 0 4 0 123 0 0 0 2 3 2 0 0 0	1 7 4 0 0 111 1 0 6 2 2 1 1 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0	0 0 0 1 0 0 7 17 0 1 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27	0 1 0 0 0 1 1 0 5 4 45 2 0 0	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1	2 0 0 25 0 0 1 0 0 0 1 0 1 6 8 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1	0 0 1 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0
## 35 2 3 0 0 5 3 1 1 2 1 1 ## 36 3 7 5 0 14 22 2 11 1 0 5 ## 37 4 0 5 0 10 7 2 1 3 0 4 ## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10	# # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32	0 0 4 0 123 0 0 0 2 3 2 0 0 0 1 1 1	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0	0 0 0 1 0 7 17 0 1 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 1 2	0 0 1 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0
## 36 3 7 5 0 14 22 2 11 1 0 5 ## 37 4 0 5 0 10 7 2 1 3 0 4 ## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 1 0 0	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1	0 0 0 1 0 7 17 0 1 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1 0	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 1 26 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1 0 0 0 1 1 0 0 1 1 0 0 1 1 0 0 0 1 1 0 0 0 0 1 0 0 1 0 0 0 0 1 0
## 37 4 0 5 0 10 7 2 1 3 0 4 ## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0	0 0 0 1 0 7 17 0 1 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1 0	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1 1	2 0 0 25 0 0 1 0 0 0 1 0 1 6 8 0 0 1 2 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0	0 0 0 1 0 7 17 0 1 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1 0	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1 1	2 0 0 25 0 0 1 0 0 0 1 0 1 6 8 0 0 1 2 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1 0 0 0 1 1 0 0 0 1 1 0 0 0 0 1 1 0 0 0 0 0 1 0
## 38 2 1 1 0 3 5 1 3 0 1 6 ## 39 27 9 30 2 68 72 20 19 10 9 34 ## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 0 0 3 1 2 0 0 0 1 1 0 0 0 1 1 0 0 0 0 0 0 0 0	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0	0 0 0 1 0 7 17 0 1 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 0 3	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0	0 1 0 0 0 1 0 0 3 3 0 0 144 1 0 1 0 1 2 1	0 2 0 1 0 0 0 0 2 1 1 0 65 16 1 1	2 0 0 25 0 0 1 0 0 0 0 1 6 8 0 0 1 2 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 1 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35	0 0 4 0 123 0 0 0 2 3 2 0 0 0 1 1 1 0 0 3 1 2 3 3 2 3 3 1 1 1 1 1 1 1 1 1 1 1 1	1 7 4 0 0 1111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 1	0 0 0 1 0 7 17 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 2 2	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1 0 0 0 0 1 0 0 3 3 0 0 144 1 0 1 0 1 2 1 1	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0 1 2 0 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9 0	0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 1 0 0 0 0
## 40 2 5 2 1 21 46 7 7 4 0 2 ## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 1 0 0 3 1 2 3 4 4 0 0 3 1 2 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	1 7 4 0 0 1111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 1 0 5 5 5 5	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5 1 1	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 2 7	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0 0 2 1 1 1 2 2 2 2 2 2 2 2 2 2	0 1 0 0 0 0 1 0 0 3 3 3 0 0 144 1 0 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0 2 3	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0 1 2 0 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9 0	0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0
## 41 2 0 9 0 16 37 7 1 1 2 28 ## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37 # 38	0 0 4 0 123 0 0 0 2 3 2 0 0 0 1 1 1 0 0 3 1 2 3 4 4 2 3 3 4 4 1 2 3 4 1 2 3 4 4 1 2 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	1 7 4 0 0 1111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 1 0 5 5 1	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5 14 10 3	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 2 2 7 5	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0 0 2 1 1 2 1 2 1 2 1 2 1 2 1 1 2 1 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 2 1 1 2 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 2 1 2 2 1 2 1 2 2 2 1 2 1 2 1 2 1 2 2 1 2	0 1 0 0 0 1 0 0 3 3 3 0 144 1 0 1 0 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0 2 1 3	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0 1 2 0 0 1 0 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9 0 0	0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0
## 42 15 29 29 3 49 96 17 27 9 4 24 ## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37 # 38 # 39	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 3 4 2 2 3 4 4 2 3 4 4 4 2 3 4 4 4 4 4	1 7 4 0 0 1111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 5 5 1 1 0 5 5	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5 14 10 3 6 8	0 5 2 0 1 0 4 0 10 775 0 2 4 27 0 10 3 0 3 22 7 5	0 1 0 0 0 1 1 0 5 4 45 2 0 0 0 0 0 2 1 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 2 2 1 2	0 1 0 0 0 1 0 0 3 3 3 0 144 1 0 1 0 1 2 1 1 1 1 1 1	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0 2 1 1 0 0 1 1 0 0 1 1 0 0 0 1 1 1 0 0 0 1 1 0 0 0 0 1 0	2 0 0 25 0 0 1 0 0 0 1 6 8 0 0 1 2 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0	0 0 1 1 0 0 0 1 0 2 21 0 0 1 1 1 126 0 9 0 0 1 5 4 6 6 6 7 8 9 0 1 9 1 9 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8	0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0 0
## 43 10 21 1 0 21 22 9 8 3 1 10 ## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37 # 38 # 39 # 40	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 4 2 2 3 2 3	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0 1 1 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 5 5 1 1 0 5 5 1 1 0 5 5 1 1 1 1	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 5 14 10 3 6 8 11 10 10 10 10 10 10 10 10 10 10 10 10	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 22 7 5 7 22 4	0 1 0 0 0 1 1 0 5 4 4 45 2 0 0 0 0 0 2 1 1 2 2 1 2 2 7 7	0 1 0 0 0 0 1 0 3 3 0 144 1 0 1 1 2 1 1 1 1 1 3 1 7	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 1 0 0 2 1 1 0 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2 0 0 25 0 0 0 0 0 0 1 0 0 1 6 8 0 0 1 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1 1 0 0 0 2 21 0 0 1 1 126 0 9 0 0 1 5 4 6 3 4 6	0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0
## 44 2 13 9 1 33 71 10 17 3 2 14	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37 # 38 # 39 # 40 # 41	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 3 2 2 2 2 3 4 2 2 3 4 2 2 2 3 4 2 2 2 2	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0 1 9 9 0 1 9 0 1 0 1 0 0 1 0 0 1 0 0 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 5 5 1 3 0 2 9 9 1 1 0 0 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 0 463 12 5 4 6 1 1 0 3 7 1 1 5 14 10 3 6 8 11 10 10 10 10 10 10 10 10 10 10 10 10	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 22 7 5 7 2 4 6 3 7 2 4 6 3 7 4 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	0 1 0 0 0 1 1 0 5 4 4 45 2 0 0 0 0 0 2 1 1 2 2 1 2 2 7 7 7 7 7	0 1 0 0 0 0 3 3 3 0 144 1 0 1 2 1 1 1 1 1 3 1 1 1	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 1 0 0 2 1 1 0 4 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1	2 0 0 25 0 0 0 0 0 0 1 0 16 8 0 0 1 2 0 0 1 0 0 1 0 0 0 0 1 0 0 0 0 0	0 0 0 1 1 0 0 2 21 0 0 1 1 126 0 9 0 0 1 5 4 6 3 4 2 2 8	0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0
	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 36 # 37 # 38 # 39 # 40 # 41 # 42	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 3 3 2 2 0 2 3 3 1 2 2 3 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0 1 9 9 1 9 9 9 9 0 1 9 0 1 9 0 1 9 0 1 9 0 0 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 5 5 1 1 3 0 2 9 2 9 2 9 2 9 2 9 2 9 2 9 2 9 2 9 2	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 6 1 1 0 3 7 1 5 14 10 3 6 8 21 16 49	0 5 2 0 1 0 4 0 775 0 0 2 4 27 0 10 3 0 3 22 7 5 7 2 4 6 3 7 9 9	0 1 0 0 0 1 1 0 5 4 4 45 2 0 0 0 0 0 2 1 1 2 2 1 2 2 7 7 7 7 7	0 1 0 0 0 0 3 3 3 0 144 1 0 1 2 1 1 1 1 3 1 9 7	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0 2 1 1 0 4 1 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	2 0 0 25 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 0 1 0	0 0 0 1 1 0 0 2 21 0 0 1 1 126 0 9 0 0 1 5 4 6 3 4 2 2 8	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 139 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0
##	# # # # # # # # # # # # # # # # # # # #	# 15 # 18 # 19 # 20 # 21 # 22 # 23 # 24 # 25 # 26 # 27 # 28 # 29 # 30 # 31 # 32 # 33 # 34 # 35 # 34 # 35 # 36 # 37 # 38 # 39 # 40 # 41 # 42 # 43	0 0 4 0 123 0 0 0 2 3 2 0 0 1 1 0 0 3 1 2 3 4 2 2 7 2 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	1 7 4 0 0 111 1 0 6 2 2 1 1 0 2 0 5 3 0 3 7 0 0 1 9 1 9 9 9 9 0 1 9 0 1 9 0 0 1 9 0 0 0 0	0 1 4 0 44 1 0 99 2 2 3 0 0 0 0 1 1 0 5 5 1 1 3 0 2 9 2 9 1	0 0 0 1 0 7 17 0 0 0 0 0 0 0 0 0 0 0 0 0	2 0 4 4 0 0 2 4 6 1 1 0 3 7 1 5 14 10 3 68 21 16 49 21	0 5 2 0 1 0 4 0 10 775 0 0 2 4 27 0 10 3 0 3 22 7 5 7 2 4 6 3 7 2 4 6 3 7 2 7 2 4 6 6 7 2 7 2 7 2 7 2 7 2 7 2 7 2 7 2 7 2	0 1 0 0 0 1 1 0 5 4 4 45 2 0 0 0 0 0 2 1 1 2 2 2 7 7 7 7 7 7 7	0 1 0 0 0 1 0 0 3 3 0 144 1 0 1 2 1 1 1 1 3 1 9 7 7 1 8	0 2 0 1 0 0 0 2 1 1 0 65 16 1 1 0 0 2 1 3 0 0 4 1 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	2 0 0 25 0 0 0 0 0 0 1 0 0 1 6 8 0 0 1 2 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0	0 0 0 1 1 0 0 2 21 0 0 1 1 126 0 9 0 0 1 5 4 6 3 4 2 2 8 8 2 8 8 8 1 9 1 9 1 9 1 9 1 8 1 8 1 8 1 8 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 139 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 1 0
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##	フフフ	J	۷	۷.	*1	JJ	υυ	4	т т	ΤO	J	ТТ	ΤO
##		Refere											
##	Prediction	32	33	34	35	36	37	38	39	40	41	42	43
##	3	0	0	0	0	0	0	0	1	0	0	0	0
##	4	0	1	0	0	2	0	0	2	0	0	0	0
##	5 6	0	1	2	5 4	22 1	2	4	28 13	0 1	0	1	1
##	7	2	2	1	3	1	47	36	86	1	0	0	0
##	8	43	15	11	24	38	14	24	16	0	0	0	0
##	9	25	1	0	3	4	0	1	10	0	0	3	1
##	12	0	10	1	2	2	4	1	10	5	0	0	0
##	14 15	0	0 10	0	0 7	0	0	0	0 29	0	0	0 1	0
##	18	3	0	0	3	3	1	0	29	0	0	2	0
##	19	0	0	1	0	0	0	0	0	0	1	0	0
##	20	0	0	1	0	1	0	0	0	0	1	2	1
##	21	0	1	0	2	3	0	0	0	0	0	6	3
##	22	0	2	2	0	0	0	0	5	3	1	0	0
##	23 24	0	0 9	0	0	0 5	0	0	2 25	0	0	0	0
##	25	5	2	1	5	7	3	1	17	2	1	8	2
##	26	0	0	0	1	0	0	2	5	1	1	0	0
##	27	0	0	4	0	1	1	0	3	0	0	0	0
##	28	1	1	0	0	1	0	0	1	0	0	0	1
##	29	2	0	1 1	0	0	2	0	8 7	0	0	4	0
##	30 31	0	0	0	1	4	0	0	1	0	0	3	0
##	32	382	7	2	5	5	2	8	22	5	0	3	0
##	33	2	207	0	6	11	4	1	54	0	0	0	1
##	34	0	0	126	1	2	0	1	19	6	1	0	0
##	35	4	5	1	282	8	13	17	49	3	0	1	0
##	36	5 1	4	1 5	7 7	459 2	3 398	4 12	78 54	7 47	0	2	1
##	37 38	8	7	3	37	6	398	336	146	47	0	1	1
##	39	51	82	46	110	142	56		1110	26	1	6	5
##	40	11	27	21	16	34	98	88	456	914	0	2	5
##	41	6	1	0	2	1	0	0	3	0	2	6	2
##	42	24	1	2	6	3	0	1	11	3	4	38	2
##	43 44	4 13	0	1 5	1	9 10	0	1	16 39	0 11	1	3 17	4
##	999	20	3	4	3	17	6	15	9	0	1	3	0
##	R	Refere	nce										
	Prediction	44	999										
##	3	0	23										
##	4 5	0	0 5										
##	6	1	1										
##	7	0	4										
##	8	0	20										
##	9	0	92										
##	12 14	0	2										
##	15	0	2										
##	18	0	1										
##	19	0	8										
##	20	0	1										
##	21 22	0	0 18										
##	23	0	2										
##	24	0	37										
##	25	4	28										
##	26	0	7										
##	27 28	0	2										
##	28 29	0	1										
##	30	0	6										
##	31	0	1										
##	32	0	1										
##	33 34	0	2										
##	34 35	1	1										
##	36	0	7										

##

1 1 0 7 0 1

```
38
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        41
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##
        44
               7
                   2
##
        999
             0 1240
##
## Overall Statistics
##
##
                Accuracy: 0.5683
                 95% CI: (0.5625, 0.5741)
##
    No Information Rate : 0.1621
##
##
    P-Value [Acc > NIR] : < 2.2e-16
                  Kappa : 0.5371
## Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##
                     Class: 3 Class: 4 Class: 5 Class: 6 Class: 7
## Sensitivity
                      0.73753 2.000e-01 0.59383 0.552419 0.56927
## Specificity
                      0.99710 9.966e-01 0.99053 0.996580 0.98180
                     0.92896 2.041e-02 0.74063 0.742547 0.71734
## Pos Pred Value
                     0.98664 9.997e-01 0.98168 0.992044 0.96563
## Neg Pred Value
                    0.04891 3.537e-04 0.04354 0.017543 0.07505
## Prevalence
## Detection Rate
                    0.03608 7.074e-05 0.02585 0.009691 0.04272
## Detection Prevalence 0.03883 3.466e-03 0.03491 0.013051 0.05956
## Balanced Accuracy 0.86731 5.983e-01 0.79218 0.774500 0.77554
##
                    Class: 8 Class: 9 Class: 12 Class: 14 Class: 15
## Sensitivity
                    0.6363 0.49412 0.1034483 NA 0.442922
                     0.9685 0.96940 0.9970260 9.999e-01 0.992907
## Specificity
                     0.7963 0.74092 0.0344828 NA 0.327703
## Pos Pred Value
                     0.9323 0.91540 0.9990776
## Neg Pred Value
                                                    NA 0.995639
                 0.1621 0.15046 0.0010257 0.000e+00 0.007746 0.1032 0.07434 0.0001061 0.000e+00 0.003431
## Prevalence
## Detection Rate
## Detection Prevalence 0.1296 0.10034 0.0030770 7.074e-05 0.010469
                      0.8024 0.73176 0.5502371 NA 0.717915
## Balanced Accuracy
##
                    Class: 18 Class: 19 Class: 20 Class: 21 Class: 22
                    0.362637 0.2568807 0.518987 0.447581 0.306502
## Sensitivity
                   0.995942 0.9964495 0.996968 0.997110 0.993739
## Specificity
                    0.366667 0.2187500 0.591346 0.578125 0.361314
## Pos Pred Value
## Neg Pred Value
                    0.995871 0.9971221 0.995938 0.995121 0.992000
## Prevalence
                    0.006437 0.0038551 0.008382 0.008771 0.011424
## Detection Rate 0.002334 0.0009903 0.004350 0.003926 0.003501
## Detection Prevalence 0.006366 0.0045271 0.007357 0.006791 0.009691
                  Class: 23 Class: 24 Class: 25 Class: 26 Class: 27 0.3090909 0.50436 0.56735 0.0055
## Balanced Accuracy 0.679290 0.6266651 0.757978 0.722345 0.650120
##
## Sensitivity
                     0.9989369 0.98816
                                        0.98718 0.996764 0.996818
## Specificity
                     0.3617021 0.58831 0.69196 0.330882 0.618026
## Pos Pred Value
                    ## Neg Pred Value
                    0.0019453 0.03247 0.04831 0.005553 0.010646
## Prevalence
## Detection Rate 0.0006013 0.01638 0.02741 0.001592 0.005093
## Balanced Accuracy 0.6540139 0.74626 0.77726 0.641694 0.737612
##
                    Class: 28 Class: 29 Class: 30 Class: 31 Class: 32
## Sensitivity
                    0.396341 0.0879121 0.361032 0.599138 0.62114
## Specificity
                    0.996371 0.9959195 0.993160 0.998217
                                                           0.99284
## Pos Pred Value
                    0.389222 0.0650407 0.397476 0.735450
                                                           0.65862
## Neg Pred Value
                     0.996478 0.9970516 0.992023 0.996689
                                                           0.99159
## Prevalence
                      0.005800 0.0032185 0.012343 0.008205
                 0.002299 0.0002829 0.004456 0.004916
                                                           0.01351
## Detection Rate
## Detection Prevalence 0.005906 0.0043503 0.011212 0.006685
                                                           0.02051
## Balanced Accuracy 0.696356 0.5419158 0.677096 0.798677 0.80699
##
                     Class: 33 Class: 34 Class: 35 Class: 36 Class: 37
## Sensitivity
                    0.512376 0.514286 0.515539 0.56877 0.57598
                   0.993254 0.996575 0.986980 0.98507 0.98539
## Specificity
                    0.524051 0.567568 0.438569 0.52819 0.49688
## Pos Pred Value
## Neg Pred Value
                    0.992934 0.995758 0.990409 0.98730 0.98933
                    0.014289 0.008665 0.019346 0.02854 0.02444
## Prevalence
## Detection Rate
                    0.007321 0.004456 0.009974 0.01623 0.01408
```

4.2 RandomForest

최적의 파라미터를 찾기 위한 그리드 서치

```
## 하이퍼 파라미터 정의
ntree = c(10, 20)
mtry = c(3, 5, 10)
# 결과값 넣을 메트릭스
tree result <- matrix(0, length(ntree)*length(mtry),6)</pre>
iter_cnt = 1
i = 1
j = 1
# 위 파라미터들 다 넣는 포문
for(i in 1:length(ntree)) {
  for(j in 1:length(mtry)){
    cat("ntree : ", ntree[i],
       ", mtry : ", mtry[j],
       "\n")
   ## 위 파라미터로 RF 모형 적합
   tmp_rf <- randomForest(triptype ~ .,</pre>
                          data = w_trn,
                          ntree = ntree[i],
                          mtry = mtry[j]
    ## 위 적합으로 검증데이터 예측 수행
    tmp_tree_val_pred <- predict(tmp_rf, newdata = w_val, type = "class")</pre>
   ## 혼동행렬 작성
    tmp tree val cf <- confusionMatrix(as.factor(tmp tree val pred), w val$triptype)</pre>
    ## AUROC
    ### 조건들 저장
    tree_result[iter_cnt, 1] = ntree[i]
    tree_result[iter_cnt, 2] = mtry[j]
    tree_result[iter_cnt, 3] = tmp_tree_val_cf$byClass['Recall']
    tree_result[iter_cnt, 4] = tmp_tree_val_cf$byClass['Precision']
    tree_result[iter_cnt, 5] = tmp_tree_val_cf$overall['Accuracy']
    tree_result[iter_cnt, 6] = tmp_tree_val_cf$byClass['F1']
   iter_cnt = iter_cnt +1
 }
}
## ntree : 10 , mtry : 3
## ntree : 10 , mtry : 5
\mbox{\#\#} ntree : 10 , mtry : 10
## ntree : 20 , mtry :
## ntree : 20 , mtry :
## ntree : 20 , mtry : 10
colnames(tree_result) <- c("ntree", "mtry", "Recall", "Precision", "Accuracy",</pre>
                            "F1")
# 어큐러시 와 F1 지표를 기준으로 정렬
tree_result.df <- data.frame(tree_result)</pre>
tree_result.df <- tree_result.df[order(tree_result.df[,5], tree_result.df[,6], decreasing = T),]</pre>
```

head(tree result.df)

```
## ntree mtry Recall Precision Accuracy F1
## 6 20 10 NA
                       NA 0.6687770 NA
## 5
      20
          5
                NA
                         NA 0.6626229 NA
## 3
      10
          10
                        NA 0.6569286 NA
                NA
## 2
          5
                        NA 0.6523661 NA
      1.0
                NA
## 4
      20 3 NA
                        NA 0.6287402 NA
## 1
      10 3 NA
                        NA 0.6092523 NA
```

최적조건으로 최종적합

```
## Confusion Matrix and Statistics
##
##
         Reference
                    5
                        6
                           7
                              8
                                  9
                                       12
                                               15
                                                   18
                                                       19
## Prediction 3 4
##
   3 1038
                0
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                                   20
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##
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                                   2
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##
       8
            42 3 48
                      34 191 3092 233
                                               27
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##
       9
           1 0 17
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                              85 2261
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##
       12
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\# \#
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       Reference
## Prediction 20
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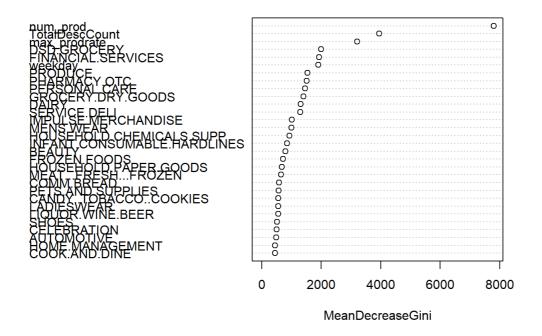
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# # # # # # # # # # # # # # # # # # #	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 1 0 0 3 0 0 4 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13 5 0 0 1 0 0 2 2 0 0 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 5 34 0 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 2 1 1 1 3 3 5 3 5 3 5 3 5 5 3 5 5 3 5 5 3 5 5 5 5 3 5	1 20 28 2 0 0 2 2 0 0 1 0 0 6 8 0 0 0 0 1 0 0 0 3 3 7 0 0 3 3 1 0 0 3 3 1 0 1 0 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 1 3 1 0 4 13 2 3 1 0 2 0 4 4 0 2 0 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 0 1 3 0 42 47 25 82 99 63	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 1 2 0 7 2 1 1 1 1 2 1 1 2 1 1 1 1 2 1 1 1 1 1	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 7 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 0 0 4 7 0 0 3 1 6 1 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* * * * * * * * * * * * * * * * * * * *	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 1 0 0 3 0 0 4 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13 5 0 0 1 0 0 2 2 0 0 4 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	3 5 34 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 2 1 1 1 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3	1 20 28 2 0 0 2 2 0 0 1 0 0 6 8 0 0 0 0 1 0 0 0 3 3 7 0 0 3 3 1 0 1 0 1 1 1 1 1 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 4 13 2 3 1 0 4 13 2 0 4 4 0 2 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 0 1 3 0 42 47 25 82 99 63 113 2181	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 1 2 0 7 2 1 1 1 1 2 1 1 2 1 1 2 1 1 2 1 1 1 1	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 1 4 1 8 1 1 8 1 8 1 8 1 8 1 8 1	1 7 0 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 5 0 4 7 7 0 3 1 1 6 4 3 3 1 1 5
# # # # # # # # # # # # # # # # # # #	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 1 0 0 3 0 0 4 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1	0 0 13 5 0 0 1 0 0 2 2 0 0 0 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 5 34 0 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 0 2 0	1 20 28 2 0 0 2 2 0 0 1 0 0 6 8 0 0 0 0 1 0 0 0 3 3 7 0 0 3 3 1 0 0 3 3 1 0 1 0 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 4 13 2 3 1 0 4 13 2 0 4 4 0 2 5 5 6 6 6 6 6 6 6 6 6 7 1 7 1 7 1 7 1 7 1 7	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 3 0 42 47 25 82 99 63 113 2181 46	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 12 0 7 2 1 1 1 1 2 1 1 1 2 1 1 2 1 1 1 2 1 1 1 1 2 1 1 1 1 1 1 2 1	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 1 9 1 9 1 9 1 8 1 9 1 8 1 9 1 8 1 8	1 7 0 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 5 0 4 7 7 0 3 1 1 6 4 3 3 1 1 5 2
* * * * * * * * * * * * * * * * * * * *	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 1 0 0 3 0 0 4 1 6 3 0 0 4 1 6 1 6 1 6 6 6 6 6 6 6 6 6 7 6 6 6 6 6	0 0 0 13 5 0 0 0 2 2 0 0 0 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 5 34 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 2 0 0 0 0 2 0	1 20 28 2 0 0 2 2 0 0 0 1 0 0 6 8 0 0 0 0 1 0 0 0 3 3 7 0 0 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 4 13 2 3 1 0 2 0 4 4 0 2 5 5 6 6 6 6 6 1 6 7 1 7 1 7 1 7 1 7 1 7 1 7	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 0 1 3 0 42 47 25 82 99 63 113 2181 46 0	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 1 2 0 7 2 1 1 1 2 1 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 3 1 2 1 3 1 3	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 4 4 8 8 1 9 1 9 1 8 1 8 1 8 1 8 1 8 1 8 1 8	1 7 0 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 0 4 7 7 0 3 1 16 4 4 3 115 2 0
* * * * * * * * * * * * * * * * * * * *	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 1 0 0 3 0 0 4 1 6 6 6 6 6 7 6 6 6 6 7 6 6 6 6 6 6 7 6 6 6 6 6 7 6 6 6 6 6 7 6 6 6 7 6 7 6 6 6 7 6 7 6 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7	0 0 0 13 5 0 0 0 2 2 0 0 0 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 5 34 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 0 2 0	1 20 28 2 0 0 2 2 0 0 0 1 0 0 6 8 0 0 0 0 1 0 0 0 3 3 7 0 0 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 4 13 2 3 1 0 2 0 4 4 0 2 5 5 6 6 6 6 1 6 7 1 7 1 8 1 6 6 6 6 6 6 7 1 7 1 8 1 1 7 1 8 1 1 1 1 1 1 1 1 1 1	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 0 1 3 0 42 47 25 82 99 63 113 2181 46 0 3	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 12 0 7 2 1 1 1 2 1 1 2 1 1 2 1 2 1 1 2 1 1 2 1 1 2 1 2 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 3 1 2 1 2	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 4 8 1 9 1 9 1 9 1 8 1 8 1 8 1 8 1 8 1 8 1	1 7 0 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 0 4 4 7 7 0 3 16 4 4 3 3 115 2 0 12
* * * * * * * * * * * * * * * * * * * *	6 7 8 9 12 14 15 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43	0 3 10 5 0 0 0 3 0 0 1 0 0 7 8 0 0 3 0 0 4 1 6 3 1 3 7 2 6 6 8 1 7 2 6 6 8 1 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 13 5 0 0 0 2 2 0 0 0 4 1 0 0 0 0 0 0 1 2 2 0 0 0 0 1 1 0 0 0 0	3 5 34 0 0 0 0 0 0 0 2 0 0 0 2 0 0 0 0 2 0	1 20 28 2 0 0 2 2 0 0 1 0 0 6 8 0 0 0 0 1 0 0 3 7 0 0 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 3 35 4 1 0 1 1 0 4 13 2 3 1 0 2 0 4 4 1 0 2 5 5 6 6 6 7 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1	0 80 41 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 46 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	12 125 13 3 0 0 5 1 1 0 0 24 25 0 1 3 0 42 47 25 82 99 63 113 2181 46 0 3 3	0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 3 0 0 2 4 1 1 1 0 0 15 35 2 2 1 3 12 0 7 2 1 1 1 2 1 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 2 1 3 1 3	0 1 5 10 1 0 18 10 0 7 12 4 0 46 98 6 14 7 3 10 0 26 6 1 8 8 1 4 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8	1 7 0 0 0 0 0 1 1 0 3 8 1 0 10 25 4 1 2 0 5 0 4 7 7 0 3 3 16 4 4 3 3 115 2 0 12 9

```
Reference
## Prediction 44 999
##
               0 212
         .3
##
         4
               0
##
         5
                3
                   24
##
               0
         6
##
         7
                1
                    36
               0 119
##
         8
##
         9
              0 124
##
        12
              0
                   0
##
        14
              0
##
        15
##
        18
               0
                    0
##
        19
               Ω
                    1
##
         20
               0
                    2
##
         21
               1
                    1
##
         22
                    13
               0
##
         23
               0
                    1
##
         24
               8
                    23
##
         25
               20
                    8
         26
\# \#
               0
                    2
         27
##
                1
                    1
##
        28
               Ω
                    1
        29
##
               Ω
         30
##
              0
                    3
##
         31
              1
##
         32
               7
                    5
         33
##
              1
                    1
              2
##
         3.4
                    0
##
         35
               0
                    3
##
         36
               8
                    13
##
         37
               2
                    6
##
         38
               2
                    14
##
         39
              147
                    16
##
         40
             104
                    Ω
              2
##
         41
                    0
##
         42
               9
                    2
##
         43
##
         44
             12 0
##
         999
              0 1882
##
## Overall Statistics
##
##
                Accuracy: 0.6674
                  95% CI : (0.6619, 0.6729)
##
##
     No Information Rate : 0.1296
      P-Value [Acc > NIR] : < 2.2e-16
##
##
##
                    Kappa : 0.642
## Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##
                     Class: 3 Class: 4 Class: 5 Class: 6 Class: 7
                      0.94536 0.000e+00 0.73658 0.639566 0.66330
## Sensitivity
## Specificity
                      0.99036 1.000e+00 0.98355 0.995951 0.97815
## Pos Pred Value
                       0.79846 0.000e+00 0.61820 0.676218 0.65783
## Neg Pred Value
                       0.99778 9.965e-01 0.99041 0.995237 0.97866
                       0.03883 3.466e-03 0.03491 0.013051 0.05956
## Prevalence
## Detection Rate
                       0.03671 0.000e+00 0.02571 0.008347 0.03951
## Detection Prevalence 0.04598 3.537e-05 0.04159 0.012343 0.06006
                       0.96786 5.000e-01 0.86006 0.817758 0.82073
## Balanced Accuracy
##
                      Class: 8 Class: 9 Class: 12 Class: 14 Class: 15
## Sensitivity
                       0.8441 0.79697 0.0000000 0.000e+00 0.371622
## Specificity
                       0.9616 0.96155 0.9998581 1.000e+00 0.997534
## Pos Pred Value
                       0.7661 0.69805 0.0000000 NaN 0.614525
## Neg Pred Value
                       0.9764 0.97699 0.9969225 9.999e-01 0.993380
                       0.1296 0.10034 0.0030770 7.074e-05 0.010469
## Prevalence
                        0.1094 0.07997 0.0000000 0.000e+00 0.003891
## Detection Rate
## Detection Prevalence 0.1427 0.11456 0.0001415 0.000e+00 0.006331
## Balanced Accuracy
                       0.9029 0.87926 0.4999290 5.000e-01 0.684578
                      Class: 18 Class: 19 Class: 20 Class: 21 Class: 22
## Songitivity
                       n 283333 n 1171875 n 500615 n 588542 n 220027
```

```
## SETISTUTATEA
                     U.ZOJJJJ U.IIIIOIJ U.JUJUIJ U.JOOJ4Z U.ZZJJZI
                     0.998042 0.9991473 0.998504 0.997436 0.997679
## Specificity
## Pos Pred Value
                     0.481132 0.3846154 0.716216 0.610811 0.492187
                    0.995420 0.9959979 0.996373 0.997188 0.992503
## Neg Pred Value
                     0.006366 0.0045271 0.007357 0.006791 0.009691
## Prevalence
                0.001804 0.0005305 0.003749 0.003997 0.002228
## Detection Rate
## Detection Prevalence 0.003749 0.0013794 0.005234 0.006543 0.004527
## Balanced Accuracy 0.640688 0.5581674 0.754059 0.792989 0.613803
                   Class: 23 Class: 24 Class: 25 Class: 26 Class: 27
##
## Sensitivity
                   0.2127660 0.46760 0.70000 0.352941 0.583691
                   0.9994686 0.99054 0.98501 0.999112 0.998253
## Specificity
## Pos Pred Value
                  0.4000000 0.58599 0.65827 0.657534 0.735135
## Neg Pred Value
                    0.9986902 0.98484 0.98759 0.996880 0.996547
## Prevalence
                    0.0016623 0.02783 0.03961 0.004810 0.008241
## Detection Rate
                    0.0003537
                               0.01302
                                       0.02773 0.001698 0.004810
## Detection Prevalence 0.0008842
                              0.02221
                                       0.04212 0.002582 0.006543
## Balanced Accuracy 0.6061173 0.72907 0.84251 0.676026 0.790972
##
                   Class: 28 Class: 29 Class: 30 Class: 31 Class: 32
                    0.335329 1.626e-02 0.302839 0.798942 0.71724
## Sensitivity
## Specificity
                    0.998826 9.992e-01 0.996817 0.997223 0.99101
## Pos Pred Value
                    0.629213 8.000e-02 0.518919 0.659389 0.62556
## Neg Pred Value
                    0.996062 9.957e-01 0.992132 0.998645 0.99406
## Prevalence
                    0.005906 4.350e-03 0.011212 0.006685 0.02051
## Detection Prevalence 0.003148 8.842e-04 0.006543 0.008099 0.02352
## Balanced Accuracy 0.667078 5.077e-01 0.649828 0.898082 0.85413
                   Class: 33 Class: 34 Class: 35 Class: 36 Class: 37
##
                   0.569620 0.509009 0.59409 0.63291 0.52809
## Sensitivity
                     0.994835 0.997647
                                       0.99066
                                                0.98745
## Specificity
                                                         0.98883
                    0.609756 0.631285 0.59688 0.61521 0.57945
## Pos Pred Value
                    0.993908 0.996120 0.99056 0.98835 0.98628
## Neg Pred Value
## Prevalence
                    0.013970 0.007852 0.02274 0.03073 0.02833
## Detection Rate 0.007958 0.003997 0.01351 0.01945 0.01496
## Detection Prevalence 0.013051 0.006331 0.02264 0.03162 0.02582
## Balanced Accuracy 0.782228 0.753328 0.79238 0.81018 0.75846
##
                   Class: 38 Class: 39 Class: 40 Class: 41 Class: 42
## Sensitivity
                    0.38155 0.73360 0.90256 0.0169492 0.180851
                    0.98828 0.91186 0.97870 0.9994305 0.994009
## Specificity
## Pos Pred Value
                    0.51067 0.49445 0.74651 0.1578947 0.380597
## Neg Pred Value
                     0.98034 0.96681 0.99313 0.9938418 0.983504
                              0.10515
## Prevalence
                     0.03105
                                       0.06497 0.0062602 0.019948
## Detection Rate
                      0.01185
                               0.07714
                                       0.05864 0.0001061 0.003608
                              0.15601
## Detection Prevalence 0.02320
                                       0.07855 0.0006720 0.009479
                      0.68492 0.82273
                                       0.94063 0.5081898 0.587430
## Balanced Accuracy
##
                   Class: 43 Class: 44 Class: 999
                  0.0355731 0.0353982 0.74653
## Sensitivity
                   0.9988580 0.9983175
                                       0.99915
## Specificity
## Pos Pred Value
                   0.2195122 0.2033898 0.98845
                   0.9913576 0.9884104 0.97577
## Neg Pred Value
## Prevalence
                   0.0089482 0.0119898
                                       0.08916
## Detection Prevalence 0.0014501 0.0020867
                                        0.06734
## Balanced Accuracy 0.5172156 0.5168579
                                        0.87284
```

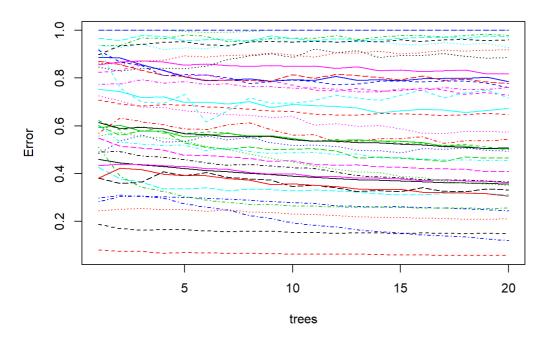
```
# 시각화
varImpPlot(tree)
```

tree



plot(tree)





5. 설정 모델로 예측 및 평가