feature extraction maysam

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```
library(data.table)
library(keras)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:data.table':
##
##     between, first, last
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(quantmod)
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:data.table':
##
##     yearmon, yearqtr
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
##
## ######################### Warning from 'xts' package ##########################
## #                                                                             #
## # The dplyr lag() function breaks how base R's lag() function is supposed to  #
## # work, which breaks lag(my_xts). Calls to lag(my_xts) that you type or       #
## # source() into this session won't work correctly.                            #
## #                                                                             #
## # Use stats::lag() to make sure you're not using dplyr::lag(), or you can add #
## # conflictRules('dplyr', exclude = 'lag') to your .Rprofile to stop           #
## # dplyr from breaking base R's lag() function.                                #
## #                                                                             #
## # Code in packages is not affected. It's protected by R's namespace mechanism #
## # Set `options(xts.warn_dplyr_breaks_lag = FALSE)` to suppress this warning.  #
## #                                                                             #
## ###############################################################################
```

```
##
## Attaching package: 'xts'
```

```
## The following objects are masked from 'package:dplyr':
##
##     first, last
```

```
## The following objects are masked from 'package:data.table':
##
##     first, last
```

```
## Loading required package: TTR
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
library(zoo)
library(TTR)
# Attempt to load the CSV file with a suspected delimiter
data <- read.csv("titlonmoyin.csv", header = TRUE, sep = "c")  # If "c" is suspected as part of the delimiter

# try to see if there's a complex delimiter like "c\" or similar
#data <- read.csv("titlonmoyin.csv", header = TRUE, sep = 'c')  # If 'c"' is the delimiter

# Check the structure of the data to see if columns are properly separated
str(data)
```

```
## 'data.frame':    1872367 obs. of  48 variables:
##  $ Date                       : chr  "2019-07-15" "2019-07-16" "2019-07-17" "2019-07-18" ...
##  $ Internal.code              : int  2014128 2014128 2014128 2014128 2014128 2014128 2014128 2014128 2014128 20
14128 ...
##  $ SecurityId                 : int  1304857 1304857 1304857 1304857 1304857 1304857 1304857 1304857 1304857 13
04857 ...
##  $ CompanyId                  : int  12720 12720 12720 12720 12720 12720 12720 12720 12720 12720 ...
##  $ Symbol                     : chr  "2020" "2020" "2020" "2020" ...
##  $ ISIN                       : chr  "BMG9156K1018" "BMG9156K1018" "BMG9156K1018" "BMG9156K1018" ...
##  $ Name                       : chr  "2020 Bulkers" "2020 Bulkers" "2020 Bulkers" "2020 Bulkers" ...
##  $ BestBidPrice               : num  80 80.5 80.4 77.4 78 ...
##  $ BestAskPrice               : num  81 81 81 80 79 78.5 79 78 77.4 77 ...
##  $ Open                       : num  83 81 81 80 78 ...
##  $ High                       : num  84 81 81 80 79 ...
##  $ Low                        : num  81 80 80.5 77 78 ...
##  $ Close                      : num  81 81 81 80 79 ...
##  $ NumberOfTrades             : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Volume                     : int  8810 21400 12966 4789 5030 8989 500 2151 12126 2195 ...
##  $ Turnover                   : num  720755 1733377 1049996 382497 397340 ...
##  $ VolumeWeightedAveragePrice: num  81.8 81 81 79.9 79 ...
##  $ Price                      : num  81 81 81 80 79 ...
##  $ AdjustedPrice              : num  49.9 49.9 49.9 49.3 48.7 ...
##  $ Dividends                  : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ LDividends                 : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ CorpAdj                    : num  1 1 1 1 1 1 1 1 1 1 ...
##  $ DividendAdj                : num  0.617 0.617 0.617 0.617 0.617 ...
##  $ Currency                   : chr  "NOK" "NOK" "NOK" "NOK" ...
##  $ NumberOfShares             : num  22170906 22170906 22170906 22170906 22170906 ...
##  $ Exchange                   : chr  "OAX" "OAX" "OAX" "OAX" ...
##  $ NOKPerForex                : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ mktcap                     : num  1.80e+09 1.80e+09 1.80e+09 1.77e+09 1.75e+09 ...
##  $ OSEBXmktshare_prevmnth     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ OSEBXAlpha_prevmnth        : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ OSEBXBeta_prevmnth         : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ SMB                        : num  -0.000806 -0.007297 0.001962 0.009697 -0.004902 ...
##  $ HML                        : num  -0.00519 0.00342 -0.00321 -0.01069 -0.00554 ...
##  $ LIQ                        : num  0.01343 -0.01184 0.00741 0.00646 -0.00242 ...
##  $ MOM                        : num  -0.01566 0.00819 -0.00329 0.00108 -0.00118 ...
##  $ lnDeltaP                   : num  -0.0244 0 0 -0.0124 -0.0126 ...
##  $ lnDeltaOSEBX               : num  -0.00144 -0.00728 -0.00721 -0.00687 0.00154 ...
##  $ lnDeltaOBX                 : num  -0.00106 -0.00916 -0.008 -0.00584 0.00289 ...
##  $ NOWA_DayLnrate             : num  5.52e-05 5.52e-05 5.48e-05 5.57e-05 5.52e-05 ...
##  $ bills_3month_Lnrate        : num  5.61e-05 5.64e-05 5.65e-05 5.66e-05 5.67e-05 ...
##  $ Sector                     : chr  "Industrials" "Industrials" "Industrials" "Industrials" ...
##  $ IN_OSEBX                   : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Equity                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Debt                       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Earnings                   : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ debt_ratio                 : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PE                         : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ ID                         : int  1570527 1437408 1437518 1570897 1571022 1571146 1437961 1571374 1571492 14
38389 ...
```

```r
# Replace commas with dots and convert to numeric where needed
data <- data %>%
  mutate(across(c(SMB, HML, LIQ, MOM, Close), ~as.numeric(gsub(",", ".", .x))),
         Date = as.Date(Date, format = "%Y-%m-%d"))  # Convert Date to Date type


#write.csv(data, "titlonmoyinready.csv", row.names = FALSE)
data <- read.csv("titlonmoyinready.csv")

str(data,50)
```

```
## 'data.frame':    1872358 obs. of  63 variables:
##  $ Date                     : chr  "2019-07-29" "2019-07-30" "2019-07-31" "2019-08-01" ...
##  $ Internal.code            : int  2014128 2014128 2014128 2014128 2014128 2014128 2014128 2014128 2014128 20
14128 ...
##  $ SecurityId               : int  1304857 1304857 1304857 1304857 1304857 1304857 1304857 1304857 1304857 13
04857 ...
##  $ CompanyId                : int  12720 12720 12720 12720 12720 12720 12720 12720 12720 12720 ...
##  $ Symbol                   : chr  "2020" "2020" "2020" "2020" ...
##  $ ISIN                     : chr  "BMG9156K1018" "BMG9156K1018" "BMG9156K1018" "BMG9156K1018" ...
##  $ Name                     : chr  "2020 Bulkers" "2020 Bulkers" "2020 Bulkers" "2020 Bulkers" ...
##  $ BestBidPrice             : num  76 76 77 70 70.1 ...
##  $ BestAskPrice             : num  77 77 78 76 76 69 71 70 75 75.5 ...
##  $ Open                     : num  76 76 77 78 76 ...
##  $ High                     : num  78 77 77 78 76 ...
##  $ Low                      : num  76 76 76 75 75 ...
##  $ Close                    : num  77 77 77 75 75 ...
##  $ NumberOfTrades           : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Volume                   : num  2195 100 4324 1522 537 ...
##  $ Turnover                 : num  169518 7651 332116 115770 40285 ...
##  $ VolumeWeightedAveragePrice: num  77.2 76.5 76.8 76.1 75 ...
##  $ Price                    : num  77 77 77 75 75 ...
##  $ AdjustedPrice            : num  47.5 47.5 47.5 46.2 46.2 ...
##  $ Dividends                : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ LDividends               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ CorpAdj                  : num  1 1 1 1 1 1 1 1 1 1 ...
##  $ DividendAdj              : num  0.617 0.617 0.617 0.617 0.617 ...
##  $ Currency                 : chr  "NOK" "NOK" "NOK" "NOK" ...
##  $ NumberOfShares           : num  22170906 22170906 22170906 22170906 22170906 ...
##  $ Exchange                 : chr  "OAX" "OAX" "OAX" "OAX" ...
##  $ NOKPerForex              : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ mktcap                   : num  1.71e+09 1.71e+09 1.71e+09 1.66e+09 1.66e+09 ...
##  $ OSEBXmktshare_prevmnth   : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ OSEBXAlpha_prevmnth      : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ OSEBXBeta_prevmnth       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ SMB                      : num  -0.005101 0.004157 0.000479 -0.001486 0.008561 ...
##  $ HML                      : num  0.00818 -0.00442 -0.01274 -0.00161 -0.00127 ...
##  $ LIQ                      : num  0.001633 0.010677 -0.00865 0.000509 0.011394 ...
##  $ MOM                      : num  -0.00508 -0.00767 0.00282 -0.00175 0.00339 ...
##  $ lnDeltaP                 : num  -0.00531 0.00013 0 -0.02632 0 ...
##  $ lnDeltaOSEBX             : num  0.00148 -0.01476 0.00787 0.00479 -0.01129 ...
##  $ lnDeltaOBX               : num  0.000756 -0.015365 0.008592 0.004494 -0.012291 ...
##  $ NOWA_DayLnrate           : num  5.57e-05 5.52e-05 5.52e-05 5.48e-05 5.48e-05 ...
##  $ bills_3month_Lnrate      : num  5.70e-05 5.70e-05 5.70e-05 5.70e-05 5.71e-05 ...
##  $ Sector                   : chr  "Industrials" "Industrials" "Industrials" "Industrials" ...
##  $ IN_OSEBX                 : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Equity                   : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Debt                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Earnings                 : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ debt_ratio               : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PE                       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ ID                       : int  1438389 1571848 1438611 1572088 1438840 1572536 1572657 1572890 1573019 14
39748 ...
##  $ MA5                      : num  370 457 367 341 320 ...
##  $ MA10                     : num  250 315 310 300 302 ...
##  $ MA20                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ BIAS5                    : num  -79.2 -83.2 -79 -78 -76.6 ...
##  $ BIAS10                   : num  -69.2 -75.5 -75.2 -75 -75.1 ...
##  $ RSI6                     : num  NA NA NA NA NA ...
##  $ RSI12                    : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Stoch_K                  : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Stoch_D                  : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ MACD                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Signal                   : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ WPR                      : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ VOL1                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ VOL2                     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ Delta_MA5                : num  NA 87 -90 -26 -20.5 -115 -107 0.5 0.5 -0.5 ...
```

```
summary(data,50)
```

```
##      Date           Internal.code       SecurityId        CompanyId
##  Length:1872358     Min.   :2004834   Min.   :   6000   Min.   : 1007
##  Class :character   1st Qu.:2015528   1st Qu.:   6212   1st Qu.: 2237
##  Mode  :character   Median :2015566   Median :  24518   Median : 5203
##                     Mean   :2037838   Mean   : 170204   Mean   : 5307
##                     3rd Qu.:2015611   3rd Qu.:  60388   3rd Qu.: 7953
##                     Max.   :9067757   Max.   :1305713   Max.   :12811
```

```
##                   NA's   :812035    NA's   :112444    NA's   :112547
##     Symbol             ISIN              Name            BestBidPrice
##  Length:1872358     Length:1872358     Length:1872358     Min.   :-999999999
##  Class :character   Class :character   Class :character   1st Qu.:         9
##  Mode  :character   Mode  :character   Mode  :character   Median :        40
##                                                           Mean   :   -372601
##                                                           3rd Qu.:       110
##                                                           Max.   :     24000
##                                                           NA's   :12898
##   BestAskPrice             Open              High               Low
##  Min.   :-999999999   Min.   :    0.0   Min.   :    0.00   Min.   :    0.00
##  1st Qu.:         9   1st Qu.:    8.0   1st Qu.:    9.00   1st Qu.:    8.70
##  Median :        40   Median :   34.9   Median :   40.00   Median :   39.00
##  Mean   :   -649848   Mean   :   76.8   Mean   :   89.05   Mean   :   87.36
##  3rd Qu.:       110   3rd Qu.:   98.0   3rd Qu.:  111.50   3rd Qu.:  109.50
##  Max.   :     25000   Max.   :17500.0   Max.   :25000.00   Max.   :25000.00
##  NA's   :18329        NA's   :116694    NA's   :11         NA's   :11
##      Close          NumberOfTrades         Volume             Turnover
##  Min.   :    0.00   Min.   :     0.0   Min.   :-1.819e+09   Min.   :0.000e+00
##  1st Qu.:    8.90   1st Qu.:    12.0   1st Qu.: 3.144e+03   1st Qu.:1.128e+05
##  Median :   39.50   Median :    67.0   Median : 2.600e+04   Median :7.358e+05
##  Mean   :   88.19   Mean   :   451.8   Mean   : 7.110e+05   Mean   :2.007e+07
##  3rd Qu.:  110.00   3rd Qu.:   371.0   3rd Qu.: 1.852e+05   3rd Qu.:5.240e+06
##  Max.   :25000.00   Max.   :103757.0   Max.   : 1.977e+09   Max.   :1.632e+10
##                     NA's   :1586306    NA's   :77           NA's   :121445
##  VolumeWeightedAveragePrice     Price          AdjustedPrice
##  Min.   :   -0.55           Min.   :    0.00   Min.   :       0
##  1st Qu.:    8.41           1st Qu.:    9.30   1st Qu.:       8
##  Median :   35.49           Median :   40.00   Median :      27
##  Mean   :   77.56           Mean   :   88.92   Mean   :   20263
##  3rd Qu.:   99.48           3rd Qu.:  111.50   3rd Qu.:      77
##  Max.   :17500.00           Max.   :25000.00   Max.   :58612732
##  NA's   :116811
##    Dividends          LDividends          CorpAdj         DividendAdj
##  Min.   :  0.0000   Min.   :  0.0000   Min.   :      0   Min.   :0.004756
##  1st Qu.:  0.0000   1st Qu.:  0.0000   1st Qu.:      1   1st Qu.:0.690736
##  Median :  0.0000   Median :  0.0000   Median :      1   Median :0.920635
##  Mean   :  0.0121   Mean   :  0.0121   Mean   :   1636   Mean   :0.812673
##  3rd Qu.:  0.0000   3rd Qu.:  0.0000   3rd Qu.:      1   3rd Qu.:1.000000
##  Max.   :869.3840   Max.   :869.3840   Max.   :1695150   Max.   :1.000000
##                     NA's   :931
##    Currency         NumberOfShares        Exchange          NOKPerForex
##  Length:1872358     Min.   :0.000e+00   Length:1872358     Min.   :1
##  Class :character   1st Qu.:1.395e+07   Class :character   1st Qu.:1
##  Mode  :character   Median :4.386e+07   Mode  :character   Median :1
##                     Mean   :1.487e+08                      Mean   :1
##                     3rd Qu.:1.257e+08                      3rd Qu.:1
##                     Max.   :2.563e+10                      Max.   :1
##                     NA's   :13973
##     mktcap          OSEBXmktshare_prevmnth OSEBXAlpha_prevmnth
##  Min.   :0.000e+00   Min.   :0.0            Min.   :-0.3
##  1st Qu.:3.383e+08   1st Qu.:0.0            1st Qu.: 0.0
##  Median :1.103e+09   Median :0.0            Median : 0.0
##  Mean   :7.323e+09   Mean   :0.0            Mean   : 0.0
##  3rd Qu.:3.695e+09   3rd Qu.:0.0            3rd Qu.: 0.0
##  Max.   :1.290e+12   Max.   :0.3            Max.   : 0.8
##  NA's   :13973       NA's   :1389220        NA's   :1389295
##  OSEBXBeta_prevmnth      SMB              HML              LIQ
##  Min.   :-24.7      Min.   :-0.1     Min.   :-0.2     Min.   :-0.2
##  1st Qu.:  0.4      1st Qu.: 0.0     1st Qu.: 0.0     1st Qu.: 0.0
##  Median :  0.8      Median : 0.0     Median : 0.0     Median : 0.0
##  Mean   :  0.9      Mean   : 0.0     Mean   : 0.0     Mean   : 0.0
##  3rd Qu.:  1.3      3rd Qu.: 0.0     3rd Qu.: 0.0     3rd Qu.: 0.0
##  Max.   : 30.8      Max.   : 0.4     Max.   : 0.8     Max.   : 0.5
##  NA's   :1389295    NA's   :334560   NA's   :396392   NA's   :334560
##       MOM            lnDeltaP        lnDeltaOSEBX      lnDeltaOBX
##  Min.   :-0.5     Min.   :-5.8430   Min.   :-0.685   Min.   :-0.7
##  1st Qu.: 0.0     1st Qu.:-0.0132   1st Qu.:-0.005   1st Qu.: 0.0
##  Median : 0.0     Median : 0.0000   Median : 0.000   Median : 0.0
##  Mean   : 0.0     Mean   :-0.0004   Mean   : 0.000   Mean   : 0.0
##  3rd Qu.: 0.0     3rd Qu.: 0.0121   3rd Qu.: 0.006   3rd Qu.: 0.0
##  Max.   : 0.5     Max.   : 6.8365   Max.   : 1.776   Max.   : 1.9
##  NA's   :334560   NA's   :931       NA's   :30218    NA's   :332031
##  NOWA_DayLnrate       bills_3month_Lnrate    Sector             IN_OSEBX
##  Min.   :-4.445e-07   Min.   :0           Length:1872358     Min.   :0.000
##  1st Qu.: 6.530e-05   1st Qu.:0           Class :character   1st Qu.:0.000
##  Median : 1.232e-04   Median :0           Mode  :character   Median :0.000
##  Mean   : 1.861e-04   Mean   :0                              Mean   :0.263
##  3rd Qu.: 2.678e-04   3rd Qu.:0                              3rd Qu.:1.000
```

```
##  Max.   : 2.586e-03   Max.   :0                           Max.   :1.000
##                       NA's   :93089
##      Equity               Debt              Earnings            debt_ratio
##  Min.   :-1.270e+11   Min.   :0.000e+00   Min.   :-6.352e+11   Min.   :  0.0
##  1st Qu.: 1.840e+08   1st Qu.:1.606e+08   1st Qu.:-2.806e+07   1st Qu.:  0.4
##  Median : 7.990e+08   Median :1.217e+09   Median : 3.722e+07   Median :  0.6
##  Mean   : 4.791e+11   Mean   :5.748e+11   Mean   : 2.146e+10   Mean   :  0.6
##  3rd Qu.: 3.462e+09   3rd Qu.:7.982e+09   3rd Qu.: 3.418e+08   3rd Qu.:  0.7
##  Max.   : 1.015e+15   Max.   :9.036e+14   Max.   : 8.456e+13   Max.   :159.1
##  NA's   :553474       NA's   :695665      NA's   :696329       NA's   :696822
##        PE                   ID               MA5               MA10
##  Min.   :-1883157.9   Min.   :      1   Min.   :   0.00   Min.   :   0.00
##  1st Qu.:      -2.2   1st Qu.: 468090   1st Qu.:  31.01   1st Qu.:  39.73
##  Median :       5.9   Median : 936180   Median :  60.60   Median :  64.91
##  Mean   :      -7.3   Mean   : 936181   Mean   :  88.19   Mean   :  88.19
##  3rd Qu.:      17.3   3rd Qu.:1404269   3rd Qu.: 105.85   3rd Qu.: 103.63
##  Max.   :  374153.9   Max.   :1872368   Max.   :5237.80   Max.   :3184.00
##  NA's   :713263
##       MA20             BIAS5                BIAS10
##  Min.   :   0.00   Min.   :-3.800e+15   Min.   :-5.142e+16
##  1st Qu.:  45.68   1st Qu.:-8.600e+01   1st Qu.:-8.700e+01
##  Median :  67.75   Median :-3.700e+01   Median :-4.300e+01
##  Mean   :  88.19   Mean   :-1.794e+12   Mean   : 3.608e+13
##  3rd Qu.: 100.08   3rd Qu.: 1.100e+02   3rd Qu.: 8.000e+01
##  Max.   :1885.15   Max.   : 2.682e+05   Max.   : 2.364e+17
##  NA's   :10
##       RSI6                RSI12            Stoch_K            Stoch_D
##  Min.   :-164100.00   Min.   :-36.67   Min.   : -6.667   Min.   :  0.00
##  1st Qu.:     30.00   1st Qu.: 36.84   1st Qu.: 22.222   1st Qu.: 25.69
##  Median :     50.00   Median : 50.00   Median : 50.000   Median : 50.37
##  Mean   :     53.57   Mean   : 49.81   Mean   : 50.379   Mean   : 50.38
##  3rd Qu.:     69.23   3rd Qu.: 62.92   3rd Qu.: 79.487   3rd Qu.: 75.33
##  Max.   : 187528.57   Max.   :100.00   Max.   :114.286   Max.   :100.00
##  NA's   :6            NA's   :12       NA's   :1595      NA's   :2159
##       MACD                Signal                WPR               VOL1
##  Min.   :-100.00000   Min.   :-100.00000   Min.   :-106.67   Min.   :  0.00
##  1st Qu.:  -2.02671   1st Qu.:  -1.96772   1st Qu.: -78.05   1st Qu.:  1.46
##  Median :  -0.04564   Median :  -0.05985   Median : -50.00   Median :  2.30
##  Mean   :  -0.64041   Mean   :  -0.64044   Mean   : -49.68   Mean   :  3.62
##  3rd Qu.:   1.73382   3rd Qu.:   1.64356   3rd Qu.: -20.51   3rd Qu.:  3.69
##  Max.   : 107.69231   Max.   :  67.88527   Max.   :  14.29   Max.   :311.86
##  NA's   :25           NA's   :33           NA's   :1962      NA's   :80076
##       VOL2           Delta_MA5
##  Min.   :  0.00   Min.   :-4984.500
##  1st Qu.: 68.84   1st Qu.:   -9.740
##  Median :109.65   Median :   -0.004
##  Mean   :125.58   Mean   :    0.000
##  3rd Qu.:166.07   3rd Qu.:    9.900
##  Max.   :838.13   Max.   : 4980.500
##  NA's   :80846    NA's   :1
```

```r
# Load necessary libraries
library(quantmod)
stock_data_xts <- xts(data[, -1], order.by = as.Date(data$Date))


# Calculate Moving Averages
data$MA5 <- SMA(stock_data_xts$Close, n=5)
data$MA10 <- SMA(stock_data_xts$Close, n=10)
data$MA20 <- SMA(stock_data_xts$Close, n=20)


# Save data frame to a CSV file
#write.csv(data, "700mb.csv", row.names = FALSE)
# Load data frame from the CSV file
#data <- read.csv("700mb.csv")



 #Remove rows with NAs in MA5 and MA10
data <- data[!is.na(data$MA5) & !is.na(data$MA10), ]


data$Close <- as.numeric(as.character(data$Close))
data$MA5 <- as.numeric(as.character(data$MA5))
# Check for unique values in 'Close' and 'MA5' columns
print(head(unique(data$Close), 10))
```

```
##  [1] 75.30 75.00 74.99 79.79 78.00 77.98 79.00 76.99 77.00 78.80
```

```
print(head(unique(data$MA5), 10))
```

```
##  [1] 370.0 457.0 367.0 341.0 320.5 205.5  98.5  99.0  99.5 229.0
```

```
# Now calculate BIAS
data$BIAS5 <- (data$Close - data$MA5) / data$MA5 * 100
data$BIAS10 <- (data$Close - data$MA10) / data$MA10 * 100

# Save data frame to a CSV file
#write.csv(data, "700mb.csv", row.names = FALSE)


library(zoo)
library(data.table)

calculate_RSI <- function(prices, n) {
  # Calculate daily changes in price
  deltas <- diff(prices)

  # Separate gains and losses
  gains <- pmax(deltas, 0)
  losses <- pmax(-deltas, 0)

  # Calculate the average gains and losses using a rolling mean
  avg_gains <- rollapply(gains, n, mean, fill = NA, align = 'right')
  avg_losses <- rollapply(losses, n, mean, fill = NA, align = 'right')

  # Calculate the RS (Relative Strength)
  rs <- avg_gains / avg_losses

  # Calculate the RSI (Relative Strength Index)
  rsi <- 100 - (100 / (1 + rs))

  return(rsi)
}

#
# Convert 'Close' column to numeric if it's not
#data[, Close := as.numeric(as.character(Close))]

# Calculate RSI for 6 periods


rsi6_values <- calculate_RSI(data$Close, 6)
# Prepend NA to the rsi6_values to match the length of the data
rsi6_values <- c(NA, rsi6_values)

# Now the lengths match and you can assign it to the data table
data$RSI6 <- rsi6_values

# Do the same for RSI12 if needed
rsi12_values <- c(NA, calculate_RSI(data$Close, 12))
data$RSI12 <- rsi12_values


# Save data frame to a CSV file
#write.csv(data, "700mb.csv", row.names = FALSE)




calculate_stoch <- function(high, low, close, n, smoothK, smoothD) {
  # Calculate %K
  lowest_low <- rollapply(low, n, min, fill = NA, align = 'right')
  highest_high <- rollapply(high, n, max, fill = NA, align = 'right')
  fastK <- (close - lowest_low) / (highest_high - lowest_low) * 100

  # Smooth %K to get the slow %K
  slowK <- rollapply(fastK, smoothK, mean, fill = NA, align = 'right')

  # Calculate %D as a moving average of %K
  fastD <- rollapply(slowK, smoothD, mean, fill = NA, align = 'right')

  return(list(fastK = fastK, fastD = fastD))
```

```
}

#
high_prices <- data$High
low_prices <- data$Low
close_prices <- data$Close

# Set the parameters
n <- 14       # The look-back period for %K
smoothK <- 3  # The smoothing period for %K
smoothD <- 3  # The smoothing period for %D

# Calculate stochastic oscillator
stoch_values <- calculate_stoch(high_prices, low_prices, close_prices, n, smoothK, smoothD)

# Add the stochastic values to  data frame
data$Stoch_K <- stoch_values$fastK
data$Stoch_D <- stoch_values$fastD

# Save data frame to a CSV file
#write.csv(data, "700mb.csv", row.names = FALSE)


#load the TTR package
library(TTR)

# Convert the 'Close' column of  data to numeric (if it's not already)
data$Close <- as.numeric(as.character(data$Close))

# Calculate MACD
macd_results <- MACD(x = data$Close)
print(head(macd_results,30) ) # This will show the output structure
```

```
##           macd signal
##  [1,]       NA     NA
##  [2,]       NA     NA
##  [3,]       NA     NA
##  [4,]       NA     NA
##  [5,]       NA     NA
##  [6,]       NA     NA
##  [7,]       NA     NA
##  [8,]       NA     NA
##  [9,]       NA     NA
## [10,]       NA     NA
## [11,]       NA     NA
## [12,]       NA     NA
## [13,]       NA     NA
## [14,]       NA     NA
## [15,]       NA     NA
## [16,]       NA     NA
## [17,]       NA     NA
## [18,]       NA     NA
## [19,]       NA     NA
## [20,]       NA     NA
## [21,]       NA     NA
## [22,]       NA     NA
## [23,]       NA     NA
## [24,]       NA     NA
## [25,]       NA     NA
## [26,] 2.444412     NA
## [27,] 2.467804     NA
## [28,] 2.308527     NA
## [29,] 2.108842     NA
## [30,] 1.976866     NA
```

```
print(class(macd_results)) # Check the class/type of macd_results
```

```
## [1] "matrix" "array"
```

```
data$MACD <- macd_results[, 1]
data$Signal <- macd_results[, 2]




# Calculate Williams
calculate_WPR <- function(high, low, close, n) {
  highest_high <- rollapply(high, n, max, fill = NA, align = 'right')
  lowest_low <- rollapply(low, n, min, fill = NA, align = 'right')
  wpr <- ((highest_high - close) / (highest_high - lowest_low)) * -100
  return(wpr)
}

#
library(zoo)  # for rollapply

data$WPR <- calculate_WPR(data$High, data$Low, data$Close, 12)


# Calculate Volatility

calculate_volatility <- function(series, n) {
  # Calculate the percentage change
  pct_change <- diff(log(series)) * 100

  # Calculate the rolling standard deviation (volatility)
  vol <- rollapply(pct_change, width = n, FUN = sd, fill = NA, align = 'right')

  return(vol)
}

#data <- data[, !names(data) %in% c("Volume", "VOL1" ,"VOL2")]

colnames(data)
```

```
##  [1] "Date"                       "Internal.code"
##  [3] "SecurityId"                 "CompanyId"
##  [5] "Symbol"                     "ISIN"
##  [7] "Name"                       "BestBidPrice"
##  [9] "BestAskPrice"               "Open"
## [11] "High"                       "Low"
## [13] "Close"                      "NumberOfTrades"
## [15] "Volume"                     "Turnover"
## [17] "VolumeWeightedAveragePrice" "Price"
## [19] "AdjustedPrice"              "Dividends"
## [21] "LDividends"                 "CorpAdj"
## [23] "DividendAdj"                "Currency"
## [25] "NumberOfShares"             "Exchange"
## [27] "NOKPerForex"                "mktcap"
## [29] "OSEBXmktshare_prevmnth"     "OSEBXAlpha_prevmnth"
## [31] "OSEBXBeta_prevmnth"         "SMB"
## [33] "HML"                        "LIQ"
## [35] "MOM"                        "lnDeltaP"
## [37] "lnDeltaOSEBX"               "lnDeltaOBX"
## [39] "NOWA_DayLnrate"             "bills_3month_Lnrate"
## [41] "Sector"                     "IN_OSEBX"
## [43] "Equity"                     "Debt"
## [45] "Earnings"                   "debt_ratio"
## [47] "PE"                         "ID"
## [49] "MA5"                        "MA10"
## [51] "MA20"                       "BIAS5"
## [53] "BIAS10"                     "RSI6"
## [55] "RSI12"                      "Stoch_K"
## [57] "Stoch_D"                    "MACD"
## [59] "Signal"                     "WPR"
## [61] "VOL1"                       "VOL2"
## [63] "Delta_MA5"
```

```
library(zoo)  # for rollapply

# Specify numeric columns
numeric_columns <- c("Open", "High", "Low", "Close","OfficialVolume")


# Convert 'Close' and 'Volume' to numeric
data$Close <- as.numeric(as.character(data$Close))
data$Volume <- as.numeric(as.character(data$Volume))


# Prepend NA to the volatility vectors
vol1_values <- c(NA, calculate_volatility(data$Close, 10))
vol2_values <- c(NA, calculate_volatility(data$Volume, 10))
```

```
## Warning in log(series): NaNs produced
```

```
# Now assign the values to the data table
data$VOL1 <- vol1_values
data$VOL2 <- vol2_values

# Calculate Differential Technical Indicators (ΔMA5: the change in MA5 from one period to the next)
# Add NA to the beginning to align lengths
data$Delta_MA5 <- c(NA, diff(data$MA5, lag = 1))


colnames(data)
```

```
##  [1] "Date"                       "Internal.code"
##  [3] "SecurityId"                 "CompanyId"
##  [5] "Symbol"                     "ISIN"
##  [7] "Name"                       "BestBidPrice"
##  [9] "BestAskPrice"               "Open"
## [11] "High"                       "Low"
## [13] "Close"                      "NumberOfTrades"
## [15] "Volume"                     "Turnover"
## [17] "VolumeWeightedAveragePrice" "Price"
## [19] "AdjustedPrice"              "Dividends"
## [21] "LDividends"                 "CorpAdj"
## [23] "DividendAdj"                "Currency"
## [25] "NumberOfShares"             "Exchange"
## [27] "NOKPerForex"                "mktcap"
## [29] "OSEBXmktshare_prevmnth"     "OSEBXAlpha_prevmnth"
## [31] "OSEBXBeta_prevmnth"         "SMB"
## [33] "HML"                        "LIQ"
## [35] "MOM"                        "lnDeltaP"
## [37] "lnDeltaOSEBX"               "lnDeltaOBX"
## [39] "NOWA_DayLnrate"             "bills_3month_Lnrate"
## [41] "Sector"                     "IN_OSEBX"
## [43] "Equity"                     "Debt"
## [45] "Earnings"                   "debt_ratio"
## [47] "PE"                         "ID"
## [49] "MA5"                        "MA10"
## [51] "MA20"                       "BIAS5"
## [53] "BIAS10"                     "RSI6"
## [55] "RSI12"                      "Stoch_K"
## [57] "Stoch_D"                    "MACD"
## [59] "Signal"                     "WPR"
## [61] "VOL1"                       "VOL2"
## [63] "Delta_MA5"
```

```
# Corrected list of columns to check for NAs
columns_to_check <- c("MA5", "MA10", "MA20", "BIAS5", "BIAS10", "RSI6", "RSI12", "Stoch_K", "Stoch_D", "MACD", "S
ignal", "WPR", "VOL1", "VOL2", "Delta_MA5")

# Subset the dataframe to keep only rows that are complete cases in the specified columns
data <- data[complete.cases(data[, columns_to_check]), ]

# Check the structure of the cleaned data
#str(data,10)

#unique(data$CompanyId)
#summary(data)
#typeof(data$Date)



# Defining the columns to keep
# Updated list of columns to keep
columns_to_keep <- c("Date", "CompanyId", "Close","SMB", "HML", "LIQ", "MOM", "MA5", "MA10", "MA20", "BIAS5", "BI
AS10", "RSI6", "RSI12",
                     "Stoch_K", "Stoch_D", "MACD", "Signal", "WPR", "VOL1", "VOL2", "Delta_MA5" )

library(dplyr)

# Subset the dataframe to include only specified columns
data <- select(data, all_of(columns_to_keep))

# Optionally, check the structure of the new subset
print(head(unique(data$CompanyId), 10))
```

```
##  [1] 12720  8380 12440  2017  8548  8408 12348  2407  7811  2202
```

```
summary(data)
```

```
##      Date             CompanyId         Close                SMB
##  Length:1790443     Min.   : 1007   Min.   :    0.002   Min.   :-0.1
##  Class :character   1st Qu.: 2231   1st Qu.:    9.350   1st Qu.: 0.0
##  Mode  :character   Median : 5203   Median :   40.810   Median : 0.0
##                     Mean   : 5261   Mean   :   89.360   Mean   : 0.0
##                     3rd Qu.: 7942   3rd Qu.:  111.500   3rd Qu.: 0.0
##                     Max.   :12811   Max.   :25000.000   Max.   : 0.4
##                     NA's   :70971                       NA's   :321416
##       HML              LIQ              MOM              MA5
##  Min.   :-0.2     Min.   :-0.2     Min.   :-0.5     Min.   :   0.00
##  1st Qu.: 0.0     1st Qu.: 0.0     1st Qu.: 0.0     1st Qu.:  31.00
##  Median : 0.0     Median : 0.0     Median : 0.0     Median :  60.59
##  Mean   : 0.0     Mean   : 0.0     Mean   : 0.0     Mean   :  88.33
##  3rd Qu.: 0.0     3rd Qu.: 0.0     3rd Qu.: 0.0     3rd Qu.: 105.90
##  Max.   : 0.8     Max.   : 0.5     Max.   : 0.5     Max.   :5237.80
##  NA's   :383123   NA's   :321416   NA's   :321416
##       MA10.Index           MA10.X[[i]]
##  Min.   :1980-01-04    Min.   :   0.000
##  1st Qu.:1999-07-06    1st Qu.:  39.712
##  Median :2009-05-13    Median :  64.897
##  Mean   :2008-01-01    Mean   :  88.318
##  3rd Qu.:2017-10-26    3rd Qu.: 103.650
##  Max.   :2024-04-04    Max.   :3184.000
##
##       MA20.Index           MA20.X[[i]]          BIAS5
##  Min.   :1980-01-04    Min.   :   0.0000    Min.   :-3.800e+15
##  1st Qu.:1999-07-06    1st Qu.:  45.6730    1st Qu.:-8.500e+01
##  Median :2009-05-13    Median :  67.7370    Median :-3.500e+01
##  Mean   :2008-01-01    Mean   :  88.3183    Mean   :-1.454e+12
##  3rd Qu.:2017-10-26    3rd Qu.: 100.0586    3rd Qu.: 1.140e+02
##  Max.   :2024-04-04    Max.   :1885.1500    Max.   : 2.905e+05
##
##          BIAS10.Index                BIAS10.X[[i]]
##  Min.   :1980-01-04            Min.   :-51423313052900000
##  1st Qu.:1999-07-06            1st Qu.:               -87
##  Median :2009-05-13            Median :               -41
##  Mean   :2008-01-01            Mean   :    13760395599800
##  3rd Qu.:2017-10-26            3rd Qu.:                83
##  Max.   :2024-04-04            Max.   :236438980437000000
##
##       RSI6               RSI12           Stoch_K           Stoch_D
##  Min.   :-164100.00   Min.   :-36.67   Min.   : -6.667   Min.   :  0.00
##  1st Qu.:     29.41   1st Qu.: 36.36   1st Qu.: 22.059   1st Qu.: 25.00
##  Median :     50.00   Median : 50.00   Median : 50.000   Median : 49.21
##  Mean   :     52.66   Mean   : 49.89   Mean   : 49.443   Mean   : 49.59
##  3rd Qu.:     69.57   3rd Qu.: 63.46   3rd Qu.: 76.923   3rd Qu.: 74.32
##  Max.   : 187528.57   Max.   :100.00   Max.   :114.286   Max.   :100.00
##
##       MACD               Signal              WPR               VOL1
##  Min.   :-93.05972   Min.   :-92.71547   Min.   :-106.67   Min.   :  0.000
##  1st Qu.: -1.88572   1st Qu.: -1.80856   1st Qu.: -78.26   1st Qu.:  1.463
##  Median : -0.01107   Median : -0.00711   Median : -50.00   Median :  2.300
##  Mean   : -0.48776   Mean   : -0.48076   Mean   : -50.64   Mean   :  3.623
##  3rd Qu.:  1.72478   3rd Qu.:  1.66327   3rd Qu.: -23.08   3rd Qu.:  3.692
##  Max.   :107.38287   Max.   : 67.88527   Max.   :  14.29   Max.   :283.504
##
##       VOL2          Delta_MA5
##  Min.   :  0.00   Min.   :-4984.500
##  1st Qu.: 68.83   1st Qu.:   -9.732
##  Median :109.62   Median :   -0.006
##  Mean   :125.56   Mean   :    0.000
##  3rd Qu.:166.05   3rd Qu.:    9.900
##  Max.   :838.13   Max.   : 4980.500
##
```

```
print(typeof(data$Date))
```

```
## [1] "character"
```

```
str(head(data, 10))
```

```
## 'data.frame':    10 obs. of  22 variables:
##  $ Date     : chr  "2019-09-30" "2019-10-01" "2019-10-02" "2019-10-03" ...
##  $ CompanyId: int  12720 12720 12720 12720 12720 12720 12720 12720 12720 12720
##  $ Close    : num  83 83 81 80.8 80.8 81.8 82.4 83.4 81.6 82
##  $ SMB      : num  -0.01322 0.00532 0.00465 0.01004 -0.01364 ...
##  $ HML      : num  -0.00281 -0.00886 0.0235 -0.01351 -0.0041 ...
##  $ LIQ      : num  -0.0037 -0.00532 0.00761 -0.00195 0.01229 ...
##  $ MOM      : num  -1.01e-04 3.09e-05 1.06e-02 -7.09e-03 -1.02e-03 ...
##  $ MA5      : num  92 102 121 128 144 ...
##  $ MA10     :An xts object on 1980-01-04 / 1980-01-04 containing:
##   Data:    double [10, 1]
##   Index:   Date [10] (TZ: "UTC")
##  $ MA20     :An xts object on 1980-01-04 / 1980-01-04 containing:
##   Data:    double [10, 1]
##   Index:   Date [10] (TZ: "UTC")
##  $ BIAS5    : num  -9.78 -18.47 -32.95 -36.88 -43.81 ...
##  $ BIAS10   :An xts object on 1980-01-04 / 1980-01-04 containing:
##   Data:    double [10, 1]
##   Index:   Date [10] (TZ: "UTC")
##  $ RSI6     : num  59.3 62.1 50 65.6 0 ...
##  $ RSI12    : num  60.5 58.5 45.9 45.5 40.2 ...
##  $ Stoch_K  : num  75.9 70.2 40 40 40.1 ...
##  $ Stoch_D  : num  67.9 74.4 73.3 62.8 50.7 ...
##  $ MACD     : num  1.95 1.94 1.72 1.5 1.32 ...
##  $ Signal   : num  2.06 2.04 1.97 1.88 1.77 ...
##  $ WPR      : num  -33.3 -28.6 -57.1 -59.9 -52.5 ...
##  $ VOL1     : num  2.95 2.95 2.98 2.94 2.89 ...
##  $ VOL2     : num  130 119 112 120 160 ...
##  $ Delta_MA5: num  25 9.8 19 7.2 15.8 ...
```

```
data <- read.csv("titlonmoyinreadyfinalsubset 17.5.2024.csv")

# Load necessary libraries
library(quantmod)
library(keras)
library(data.table)
library(keras)
library(tensorflow)

# Remove rows with any NA values from cnn_output dataframe
data <- na.omit(data)


# Select the columns to be used as features
features <- data[, c("Close","SMB", "HML", "LIQ", "MOM", "MA5", "MA10", "MA20", "BIAS5", "BIAS10", "RSI6", "RSI12
",
                     "Stoch_K", "Stoch_D", "MACD", "Signal", "WPR", "VOL1", "VOL2", "Delta_MA5")]

# Normalize the features
# We will perform min-max scaling here. You can also use other methods like Z-score standardization
min_vals <- sapply(features, min, na.rm = TRUE)
max_vals <- sapply(features, max, na.rm = TRUE)
scaled_features <- as.data.table(scale(features, center = min_vals, scale = max_vals - min_vals))

# Prepare the data for the CNN
#  use a sequence length of 'n' days for each prediction
sequence_length <- 10 #   using the past 10 days to predict the next day
n_features <- ncol(features)
n_samples <- nrow(features) - sequence_length + 1

# Initialize an array to hold the reshaped data
cnn_input <- array(NA, dim = c(n_samples, sequence_length, n_features))
dates <- data$Date[(11:(nrow(data) + 1))]


# Reshape the data into a 3D array
for(i in 1:n_samples) {
  cnn_input[i,,] <- as.matrix(scaled_features[i:(i + sequence_length - 1),])
}

# Now, cnn_input is ready to be used as an input for the CNN
# It has the shape: (number of samples, sequence length, number of features)
print(dim(cnn_input))
```

```
## [1] 1336811      10      20
```

```
# Prepare the output data (target variable)
# Shift the closing price by one time step to create the target output
cnn_output <- data$Close[(sequence_length + 1):nrow(data)]

# Make sure the length of cnn_output matches the number of samples in cnn_input
# The last value of 'Close' will not have a corresponding future value to predict, so we remove it
cnn_output <- cnn_output[1:n_samples]

# If the CNN model's output layer has one neuron, ensure the target is a matrix with one column
cnn_output <- matrix(cnn_output, ncol = 1)
print(length(cnn_output))  # Should match n_samples
```

```
## [1] 1336811
```

```
# Convert the list element 'Output' into a dataframe
cnn_output <- data.frame(cnn_output)

# Now add the 'dates' vector as a new column to the dataframe
cnn_output$Date <- dates



### check data
# Apply is.na() and is.infinite() to each element in the data frame
na_or_inf <- sapply(data, function(x) is.na(x) | is.infinite(x))

# Count the number of rows that have any NA or Inf
count_rows_with_na_or_inf <- sum(rowSums(na_or_inf) > 0)

# Print the result
print(paste("Number of rows with NA or Inf:", count_rows_with_na_or_inf))
```

```
## [1] "Number of rows with NA or Inf: 0"
```

```
# Check for NA, NaN, or Inf in each column
columns_with_issues <- sapply(data, function(x) any(is.na(x) | is.infinite(x)))

# Get names of columns with any NA, NaN, or Inf
columns_names_with_issues <- names(data)[columns_with_issues]

# Print the result
print(columns_names_with_issues)
```

```
## character(0)
```

```
# Identified columns with issues
columns_with_issues <- c("CompanyId", "SMB", "HML", "MOM")

# Count NA, NaN, or Inf in each identified column
count_issues_per_column <- sapply(data[columns_with_issues], function(x) sum(is.na(x) | is.infinite(x)))

# Print the counts
print(count_issues_per_column)
```

```
## CompanyId       SMB       HML       MOM
##         0         0         0         0
```

```
# Function to remove rows with any NaN values
remove_NaN_rows <- function(input, output) {
  nan_rows_input <- apply(is.na(input), c(1), any)
  nan_rows_output <- is.na(output)
  nan_rows <- nan_rows_input | nan_rows_output

  input_clean <- input[!nan_rows, , ]
  output_clean <- output[!nan_rows]

  return(list("input_clean" = input_clean, "output_clean" = output_clean))
}

# Remove NaN values from cnn_input and cnn_output
#clean_data <- remove_NaN_rows(cnn_input, cnn_output)
#cnn_input <- clean_data$input_clean
#cnn_output <- clean_data$output_clean


# Function to check for NaN, Inf, or -Inf values in an array
check_for_bad_values <- function(arr) {
  nan_count <- sum(is.na(arr))
  inf_count <- sum(arr == Inf)
  neg_inf_count <- sum(arr == -Inf)

  return(list("NaN Count" = nan_count, "Inf Count" = inf_count, "-Inf Count" = neg_inf_count))
}


cnn_output <- na.omit(cnn_output)


# Check for bad values in cnn_input
input_check <- check_for_bad_values(cnn_input)
print(input_check)
```

```
## $`NaN Count`
## [1] 0
##
## $`Inf Count`
## [1] 0
##
## $`-Inf Count`
## [1] 0
```

```
# Check for bad values in cnn_output
output_check <- check_for_bad_values(cnn_output)
print(output_check)
```

```
## $`NaN Count`
## [1] 0
##
## $`Inf Count`
## [1] 0
##
## $`-Inf Count`
## [1] 0
```

```
cnn_input<- cnn_input[1:1336810, , ]

# Now cnn_output is ready to be used as the target for training the CNN

# Save cnn_input

save(cnn_input, file = "cnn_input17.5.2024.RData")
save(cnn_output, file = "cnn_output17.5.2024.RData")

# Load cnn_input
load("cnn_input17.5.2024.RData")
load("cnn_output17.5.2024.RData")

# Now cnn_output is ready to be used as the target for training the CNN
```

```
###model running testing



# Load cnn_input
load("cnn_input17.5.2024.RData")
load("cnn_output17.5.2024.RData")
summary(cnn_input)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.00000 0.06211 0.32636 0.36304 0.58998 1.00000
```

```
data <- read.csv("titlonmoyinreadyfinalsubset 17.5.2024.csv")

features <- data[, c("Close","SMB", "HML", "LIQ", "MOM", "MA5", "MA10", "MA20", "BIAS5", "BIAS10", "RSI6", "RSI12
",
                     "Stoch_K", "Stoch_D", "MACD", "Signal", "WPR", "VOL1", "VOL2", "Delta_MA5")]
# Prepare the data for the CNN
#  use a sequence length of 'n' days for each prediction
sequence_length <- 10 #   using the past 10 days to predict the next day
n_features <- ncol(features)
n_samples <- nrow(features) - sequence_length + 1

library(keras)
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✔ forcats   1.0.0     ✔ readr     2.1.5
## ✔ ggplot2   3.5.1     ✔ stringr   1.5.1
## ✔ lubridate 1.9.3     ✔ tibble    3.2.1
## ✔ purrr     1.0.2     ✔ tidyr     1.3.1
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::between()     masks data.table::between()
## ✖ dplyr::filter()      masks stats::filter()
## ✖ xts::first()         masks dplyr::first(), data.table::first()
## ✖ lubridate::hour()    masks data.table::hour()
## ✖ lubridate::isoweek() masks data.table::isoweek()
## ✖ dplyr::lag()         masks stats::lag()
## ✖ xts::last()          masks dplyr::last(), data.table::last()
## ✖ lubridate::mday()    masks data.table::mday()
## ✖ lubridate::minute()  masks data.table::minute()
## ✖ lubridate::month()   masks data.table::month()
## ✖ lubridate::quarter() masks data.table::quarter()
## ✖ lubridate::second()  masks data.table::second()
## ✖ purrr::transpose()   masks data.table::transpose()
## ✖ lubridate::wday()    masks data.table::wday()
## ✖ lubridate::week()    masks data.table::week()
## ✖ lubridate::yday()    masks data.table::yday()
## ✖ lubridate::year()    masks data.table::year()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
# Specify TensorFlow version
#install_keras(tensorflow = "2.16.1")


# Load necessary libraries
library(quantmod)
library(keras)
library(data.table)
library(tensorflow)
#install.packages("tensorflo
library(keras)

# Adding 1D Convolutional layers with different kernel sizes as per the paper
# Note that 'input_shape' is set according to  input data's dimensions (sequence_length, n_features)


# Define the model
model <- keras_model_sequential()

 model2 <- keras_model_sequential() %>%
  layer_conv_1d(
    filters = 32,
    kernel_size = 3,
    activation = 'relu',
    input_shape = c(sequence_length, n_features),
    padding = "same",
    kernel_regularizer = regularizer_l2(0.01),  # Adding L2 regularization
    kernel_initializer = initializer_glorot_uniform()  # Changing the initializer
  ) %>%
  layer_max_pooling_1d(pool_size = 2, strides = 2) %>%
  layer_conv_1d(
    filters = 64,
    kernel_size = 3,
    activation = 'relu',
    padding = "same",
    kernel_regularizer = regularizer_l2(0.01),  # Adding L2 regularization to another layer
    kernel_initializer = initializer_glorot_uniform()  # Applying initializer here as well
  ) %>%
  layer_max_pooling_1d(pool_size = 2, strides = 2) %>%
  layer_flatten()



model2 %>% compile(
  loss = 'mse',  # Mean Squared Error for regression tasks
  optimizer = optimizer_adam(learning_rate = 0.00005, clipnorm = 1),## learnin rate nesf kardam 0.0001 bood
  metrics = c('mean_absolute_error', 'accuracy')  # Combining metrics into one vector
)

# Print the model summary
summary(model2)
```

```
## Model: "sequential_1"
## _________________________________________________________________________
##  Layer (type)                       Output Shape                     Param #
## =========================================================================
##  conv1d_1 (Conv1D)                  (None, 10, 32)                   1952
##  max_pooling1d_1 (MaxPooling1D)     (None, 5, 32)                    0
##  conv1d (Conv1D)                    (None, 5, 64)                    6208
##  max_pooling1d (MaxPooling1D)       (None, 2, 64)                    0
##  flatten (Flatten)                  (None, 128)                      0
## =========================================================================
## Total params: 8160 (31.88 KB)
## Trainable params: 8160 (31.88 KB)
## Non-trainable params: 0 (0.00 Byte)
## _________________________________________________________________________
```

```r
# Train the model
history <- model2 %>% fit(
  x = cnn_input,
  y = cnn_output$cnn_output,
  epochs = 10,
  batch_size = 32,
  validation_split = 0.2
)
```

```
## Epoch 1/10
## 33421/33421 - 98s - loss: 34143.5742 - mean_absolute_error: 67.7059 - accuracy: 0.0014 - val_loss: 17255.3828
- val_mean_absolute_error: 63.2252 - val_accuracy: 0.0018 - 98s/epoch - 3ms/step
## Epoch 2/10
## 33421/33421 - 136s - loss: 31293.7422 - mean_absolute_error: 65.2233 - accuracy: 0.0013 - val_loss: 15351.7783
- val_mean_absolute_error: 59.3631 - val_accuracy: 0.0017 - 136s/epoch - 4ms/step
## Epoch 3/10
## 33421/33421 - 144s - loss: 24956.6895 - mean_absolute_error: 57.5307 - accuracy: 0.0013 - val_loss: 10672.9082
- val_mean_absolute_error: 49.0417 - val_accuracy: 0.0016 - 144s/epoch - 4ms/step
## Epoch 4/10
## 33421/33421 - 81s - loss: 13519.9033 - mean_absolute_error: 40.8776 - accuracy: 0.0013 - val_loss: 4075.7043 -
val_mean_absolute_error: 28.5433 - val_accuracy: 0.0018 - 81s/epoch - 2ms/step
## Epoch 5/10
## 33421/33421 - 100s - loss: 3231.6775 - mean_absolute_error: 18.0687 - accuracy: 0.0013 - val_loss: 1003.8926 -
val_mean_absolute_error: 9.5267 - val_accuracy: 0.0020 - 100s/epoch - 3ms/step
## Epoch 6/10
## 33421/33421 - 133s - loss: 874.7887 - mean_absolute_error: 6.8794 - accuracy: 0.0015 - val_loss: 775.6360 - va
l_mean_absolute_error: 5.7688 - val_accuracy: 0.0021 - 133s/epoch - 4ms/step
## Epoch 7/10
## 33421/33421 - 141s - loss: 719.8345 - mean_absolute_error: 4.6062 - accuracy: 0.0015 - val_loss: 682.2665 - va
l_mean_absolute_error: 4.5168 - val_accuracy: 0.0017 - 141s/epoch - 4ms/step
## Epoch 8/10
## 33421/33421 - 146s - loss: 649.9177 - mean_absolute_error: 3.7987 - accuracy: 0.0014 - val_loss: 638.8582 - va
l_mean_absolute_error: 4.1336 - val_accuracy: 0.0017 - 146s/epoch - 4ms/step
## Epoch 9/10
## 33421/33421 - 98s - loss: 611.9424 - mean_absolute_error: 3.6009 - accuracy: 0.0014 - val_loss: 613.8934 - val
_mean_absolute_error: 3.9820 - val_accuracy: 0.0017 - 98s/epoch - 3ms/step
## Epoch 10/10
## 33421/33421 - 88s - loss: 589.1505 - mean_absolute_error: 3.5075 - accuracy: 0.0013 - val_loss: 596.9057 - val
_mean_absolute_error: 3.9482 - val_accuracy: 0.0017 - 88s/epoch - 3ms/step
```

```
# Create a feature extraction model that outputs from the second convolutional layer

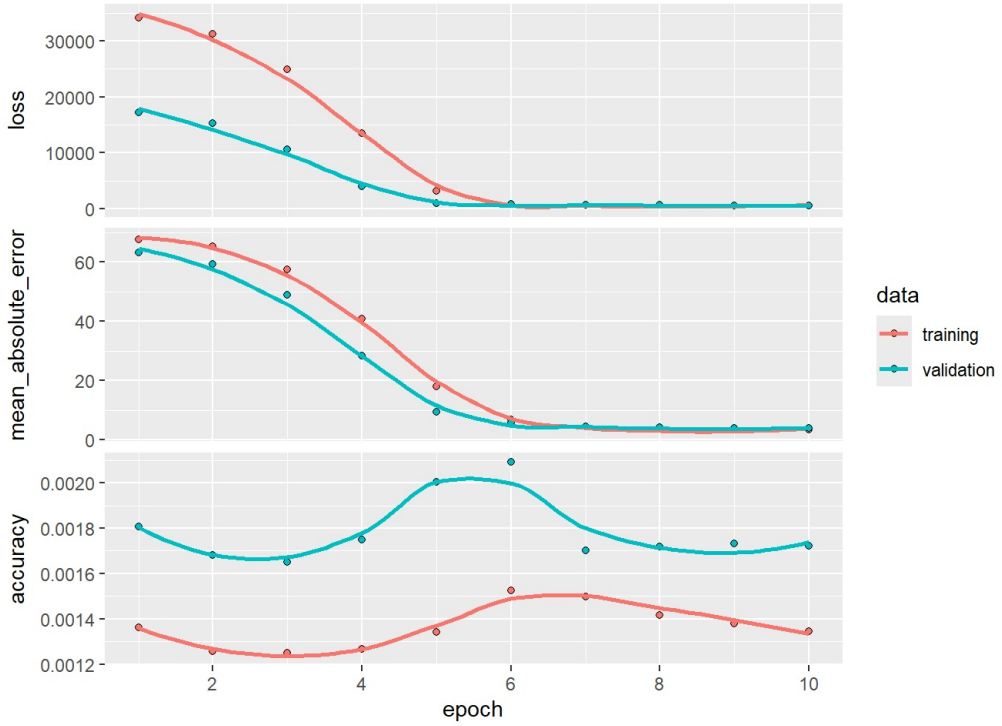
feature_extractor <- keras_model(inputs = model2$input, outputs = get_layer(model2, index = 2)$output)

# Now, use this model to predict features
extracted_features <- predict(feature_extractor, cnn_input)
```

```
## 41776/41776 - 56s - 56s/epoch - 1ms/step
```

```
# Saving the extracted features for later use
saveRDS(extracted_features, file = "extracted_features_medel2.19.5.2024fama frenchfinalgetbetter pca.rds")

# Plot training and validation loss
plot(history)
```



```
# Load the RDS file
extracted_features <- readRDS("extracted_features_medel2.19.5.2024fama frenchfinalgetbetter pca.rds")



# View the dimensions of the loaded features
dim(extracted_features)
```

```
## [1] 1336810       5      32
```

```
# Check the summary statistics for the features
summary(extracted_features)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   1.972   2.422   3.145   2.943  31.698
```

```
# If you want to see the first few rows to understand what the features look like
head(extracted_features)
```

```
## , , 1
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.954318 2.902958 2.793275 2.851139 2.940864
## [2,] 2.902958 2.842877 2.786640 2.940864 2.905286
## [3,] 2.842877 2.793275 2.851139 2.940864 2.843683
## [4,] 2.793275 2.786640 2.940864 2.905286 2.774110
## [5,] 2.734892 2.851139 2.940864 2.843683 2.761003
## [6,] 2.786640 2.940864 2.905286 2.774110 2.787590
##
## , , 2
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.319855 2.291306 2.190804 2.231504 2.316408
## [2,] 2.291306 2.230147 2.184289 2.316408 2.312615
## [3,] 2.230147 2.190804 2.231504 2.316408 2.278483
## [4,] 2.190804 2.184289 2.316408 2.312615 2.237279
## [5,] 2.116596 2.231504 2.316408 2.278483 2.191635
## [6,] 2.184289 2.316408 2.312615 2.237279 2.210824
##
## , , 3
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.781562 2.721928 2.652502 2.691606 2.728589
## [2,] 2.721928 2.682832 2.633554 2.728589 2.723169
## [3,] 2.682832 2.652502 2.691606 2.728589 2.633924
## [4,] 2.652502 2.633554 2.728589 2.723169 2.633364
## [5,] 2.587069 2.691606 2.728589 2.633924 2.598199
## [6,] 2.633554 2.728589 2.723169 2.633364 2.626759
##
## , , 4
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.767569 3.715847 3.565057 3.604253 3.722660
## [2,] 3.715847 3.624586 3.544922 3.722660 3.709620
## [3,] 3.624586 3.565057 3.604253 3.722660 3.590407
## [4,] 3.565057 3.544922 3.722660 3.709620 3.516551
## [5,] 3.429116 3.604253 3.722660 3.590407 3.412183
## [6,] 3.544922 3.722660 3.709620 3.516551 3.456850
##
## , , 5
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.848643 2.810842 2.705670 2.720306 2.800961
## [2,] 2.810842 2.754901 2.669765 2.800961 2.784938
## [3,] 2.754901 2.705670 2.720306 2.800961 2.735616
## [4,] 2.705670 2.669765 2.800961 2.784938 2.683870
## [5,] 2.604631 2.720306 2.800961 2.735616 2.633394
## [6,] 2.669765 2.800961 2.784938 2.683870 2.616972
##
## , , 6
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    0    0    0    0    0
## [2,]    0    0    0    0    0
```

```
## [3,]    0    0    0    0    0
## [4,]    0    0    0    0    0
## [5,]    0    0    0    0    0
## [6,]    0    0    0    0    0
##
## , , 7
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.622634 2.567065 2.455908 2.480480 2.557527
## [2,] 2.567065 2.499005 2.424078 2.557527 2.561853
## [3,] 2.499005 2.455908 2.480480 2.561853 2.502497
## [4,] 2.455908 2.424078 2.557527 2.561853 2.450645
## [5,] 2.389630 2.480480 2.561853 2.502497 2.395728
## [6,] 2.424078 2.557527 2.561853 2.450645 2.441107
##
## , , 8
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.050714 2.996390 2.893982 2.919470 2.971909
## [2,] 2.996390 2.934685 2.870043 2.971909 2.985106
## [3,] 2.934685 2.893982 2.919470 2.985106 2.924108
## [4,] 2.893982 2.870043 2.971909 2.985106 2.913815
## [5,] 2.812239 2.919470 2.985106 2.924108 2.867736
## [6,] 2.870043 2.971909 2.985106 2.913815 2.896150
##
## , , 9
##
##           [,1]      [,2]      [,3]      [,4]      [,5]
## [1,] 0.6281550 0.6120690 0.5777699 0.5939625 0.6120415
## [2,] 0.6120690 0.5933056 0.5932828 0.6120415 0.5913891
## [3,] 0.5933056 0.5777699 0.5939625 0.6120415 0.5878857
## [4,] 0.5777699 0.5932828 0.6120415 0.5913891 0.5689480
## [5,] 0.5409214 0.5939625 0.6120415 0.5878857 0.5353054
## [6,] 0.5932828 0.6120415 0.5913891 0.5689480 0.5662389
##
## , , 10
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.129924 3.078132 2.966232 3.002552 3.111548
## [2,] 3.078132 3.003875 2.966014 3.111548 3.087477
## [3,] 3.003875 2.966232 3.002552 3.111548 2.995544
## [4,] 2.966232 2.966014 3.111548 3.087477 2.954662
## [5,] 2.831478 3.002552 3.111548 2.995544 2.894800
## [6,] 2.966014 3.111548 3.087477 2.954662 2.913656
##
## , , 11
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.208476 2.156288 2.093285 2.190548 2.211378
## [2,] 2.156288 2.107503 2.144052 2.211378 2.172805
## [3,] 2.107503 2.093285 2.190548 2.211378 2.090384
## [4,] 2.093285 2.144052 2.211378 2.172805 2.065701
## [5,] 2.010753 2.190548 2.211378 2.090384 2.064604
## [6,] 2.144052 2.211378 2.172805 2.065701 2.084885
##
## , , 12
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.087142 3.062483 2.960894 2.979788 3.060022
## [2,] 3.062483 3.002443 2.915417 3.060022 3.074085
## [3,] 3.002443 2.960894 2.979788 3.074085 3.010867
## [4,] 2.960894 2.915417 3.060022 3.074085 2.962034
## [5,] 2.876361 2.979788 3.074085 3.010867 2.900420
## [6,] 2.915417 3.060022 3.074085 2.962034 2.883407
##
## , , 13
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.740625 2.671417 2.627221 2.713439 2.699677
## [2,] 2.671417 2.636334 2.659643 2.713439 2.694354
## [3,] 2.636334 2.627221 2.713439 2.699677 2.594595
## [4,] 2.627221 2.659643 2.713439 2.694354 2.566846
## [5,] 2.526364 2.713439 2.699677 2.594595 2.559771
## [6,] 2.659643 2.713439 2.694354 2.566846 2.595991
##
## , , 14
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.641452 2.617517 2.521078 2.516832 2.615083
```

```
## [2,] 2.617517 2.565220 2.465686 2.615083 2.623219
## [3,] 2.565220 2.521078 2.516832 2.623219 2.589463
## [4,] 2.521078 2.465686 2.615083 2.623219 2.528605
## [5,] 2.427723 2.516832 2.623219 2.589463 2.490943
## [6,] 2.465686 2.615083 2.623219 2.528605 2.498967
##
## , , 15
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.967037 2.923476 2.792659 2.813413 2.898127
## [2,] 2.923476 2.842431 2.754575 2.898127 2.871614
## [3,] 2.842431 2.792659 2.813413 2.898127 2.831438
## [4,] 2.792659 2.754575 2.898127 2.871614 2.771378
## [5,] 2.700878 2.813413 2.898127 2.831438 2.705415
## [6,] 2.754575 2.898127 2.871614 2.771378 2.688599
##
## , , 16
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.345538 3.304990 3.204113 3.254920 3.354094
## [2,] 3.304990 3.251389 3.179498 3.354094 3.321936
## [3,] 3.251389 3.204113 3.254920 3.354094 3.241472
## [4,] 3.204113 3.179498 3.354094 3.321936 3.211694
## [5,] 3.123771 3.254920 3.354094 3.241472 3.179174
## [6,] 3.179498 3.354094 3.321936 3.211694 3.219393
##
## , , 17
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.056042 3.017359 2.893963 2.954183 3.041197
## [2,] 3.017359 2.936780 2.892976 3.041197 3.017299
## [3,] 2.936780 2.893963 2.954183 3.041197 2.967087
## [4,] 2.893963 2.892976 3.041197 3.017299 2.915750
## [5,] 2.828662 2.954183 3.041197 2.967087 2.870609
## [6,] 2.892976 3.041197 3.017299 2.915750 2.902232
##
## , , 18
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.251759 3.197350 3.118888 3.119411 3.178431
## [2,] 3.197350 3.147736 3.061527 3.178431 3.168839
## [3,] 3.147736 3.118888 3.119411 3.178431 3.119441
## [4,] 3.118888 3.061527 3.178431 3.168839 3.077954
## [5,] 3.044368 3.119411 3.178431 3.119441 3.077577
## [6,] 3.061527 3.178431 3.168839 3.077954 3.065518
##
## , , 19
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.873053 2.843155 2.719352 2.771043 2.870885
## [2,] 2.843155 2.763168 2.734197 2.870885 2.819052
## [3,] 2.763168 2.719352 2.771043 2.870885 2.773652
## [4,] 2.719352 2.734197 2.870885 2.819052 2.722332
## [5,] 2.640645 2.771043 2.870885 2.773652 2.643290
## [6,] 2.734197 2.870885 2.819052 2.722332 2.688293
##
## , , 20
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 1.527283 1.493188 1.419245 1.431216 1.490720
## [2,] 1.493188 1.450546 1.396144 1.490720 1.479255
## [3,] 1.450546 1.419245 1.431216 1.490720 1.444307
## [4,] 1.419245 1.396144 1.490720 1.479255 1.403357
## [5,] 1.335613 1.431216 1.490720 1.444307 1.332538
## [6,] 1.396144 1.490720 1.479255 1.403357 1.317446
##
## , , 21
##
##           [,1]      [,2]      [,3]      [,4]      [,5]
## [1,] 0.6173271 0.5984175 0.5602492 0.5740771 0.5869714
## [2,] 0.5984175 0.5719535 0.5740771 0.5869714 0.5929846
## [3,] 0.5719535 0.5602492 0.5740771 0.5929846 0.5765064
## [4,] 0.5602492 0.5740771 0.5869714 0.5929846 0.5503516
## [5,] 0.5377978 0.5740771 0.5929846 0.5765064 0.5348529
## [6,] 0.5740771 0.5869714 0.5929846 0.5503516 0.5501267
##
## , , 22
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
```

```
## [1,] 3.141166 3.113188 3.000761 3.011733 3.101300
## [2,] 3.113188 3.055427 2.973862 3.101300 3.096423
## [3,] 3.055427 3.000761 3.011733 3.101300 3.066905
## [4,] 3.000761 2.973862 3.101300 3.096423 2.975310
## [5,] 2.902640 3.011733 3.101300 3.066905 2.900775
## [6,] 2.973862 3.101300 3.096423 2.975310 2.898582
##
## , , 23
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.973756 2.938513 2.828700 2.846973 2.920516
## [2,] 2.938513 2.881334 2.801356 2.920516 2.929999
## [3,] 2.881334 2.828700 2.846973 2.929999 2.884977
## [4,] 2.828700 2.801356 2.920516 2.929999 2.833885
## [5,] 2.735139 2.846973 2.929999 2.884977 2.768606
## [6,] 2.801356 2.920516 2.929999 2.833885 2.806856
##
## , , 24
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 16.91631 16.76044 15.97400 16.04786 16.66906
## [2,] 16.76044 16.33565 15.75999 16.66906 16.59522
## [3,] 16.33565 15.97400 16.04786 16.66906 16.36987
## [4,] 15.97400 15.75999 16.66906 16.59522 16.04740
## [5,] 15.57182 16.04786 16.66906 16.36987 15.63823
## [6,] 15.75999 16.66906 16.59522 16.04740 15.65354
##
## , , 25
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.207378 3.185500 3.056593 3.116370 3.208179
## [2,] 3.185500 3.107914 3.038446 3.208179 3.208334
## [3,] 3.107914 3.056593 3.116370 3.208334 3.147545
## [4,] 3.056593 3.038446 3.208179 3.208334 3.082471
## [5,] 2.943789 3.116370 3.208334 3.147545 3.003130
## [6,] 3.038446 3.208179 3.208334 3.082471 3.024259
##
## , , 26
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 1.986640 1.966478 1.906163 1.918697 1.970094
## [2,] 1.966478 1.929324 1.892851 1.970094 1.959148
## [3,] 1.929324 1.906163 1.918697 1.970094 1.932972
## [4,] 1.906163 1.892851 1.970094 1.959148 1.899286
## [5,] 1.867426 1.918697 1.970094 1.932972 1.864228
## [6,] 1.892851 1.970094 1.959148 1.899286 1.874582
##
## , , 27
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.622403 2.588847 2.483687 2.510450 2.580549
## [2,] 2.588847 2.521481 2.472068 2.580549 2.573039
## [3,] 2.521481 2.483687 2.510450 2.580549 2.523389
## [4,] 2.483687 2.472068 2.580549 2.573039 2.471047
## [5,] 2.425348 2.510450 2.580549 2.523389 2.432238
## [6,] 2.472068 2.580549 2.573039 2.471047 2.427258
##
## , , 28
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 3.557818 3.509318 3.392532 3.453823 3.524165
## [2,] 3.509318 3.451707 3.402643 3.524165 3.515938
## [3,] 3.451707 3.392532 3.453823 3.524165 3.444752
## [4,] 3.392532 3.402643 3.524165 3.515938 3.386801
## [5,] 3.290368 3.453823 3.524165 3.444752 3.316172
## [6,] 3.402643 3.524165 3.515938 3.386801 3.320003
##
## , , 29
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.812152 2.782400 2.695077 2.693002 2.757360
## [2,] 2.782400 2.735908 2.665402 2.757360 2.745985
## [3,] 2.735908 2.695077 2.693002 2.757360 2.702783
## [4,] 2.695077 2.665402 2.757360 2.745985 2.659160
## [5,] 2.624502 2.693002 2.757360 2.702783 2.614398
## [6,] 2.665402 2.757360 2.745985 2.659160 2.628008
##
## , , 30
##
```

```
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 16.58248 16.42806 15.62566 15.67463 16.31684
## [2,] 16.42806 15.99365 15.37027 16.31684 16.24078
## [3,] 15.99365 15.62566 15.67463 16.31684 16.01666
## [4,] 15.62566 15.37027 16.31684 16.24078 15.67296
## [5,] 15.20001 15.67463 16.31684 16.01666 15.22410
## [6,] 15.37027 16.31684 16.24078 15.67296 15.21288
##
## , , 31
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.918725 2.873864 2.743254 2.755913 2.849358
## [2,] 2.873864 2.805976 2.721694 2.849358 2.854462
## [3,] 2.805976 2.743254 2.755913 2.854462 2.795372
## [4,] 2.743254 2.721694 2.849358 2.854462 2.712779
## [5,] 2.670018 2.755913 2.854462 2.795372 2.631255
## [6,] 2.721694 2.849358 2.854462 2.712779 2.669034
##
## , , 32
##
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 2.883401 2.850788 2.747334 2.824714 2.895210
## [2,] 2.850788 2.791325 2.769894 2.895210 2.865869
## [3,] 2.791325 2.747334 2.824714 2.895210 2.797762
## [4,] 2.747334 2.769894 2.895210 2.865869 2.758550
## [5,] 2.690532 2.824714 2.895210 2.797762 2.714154
## [6,] 2.769894 2.895210 2.865869 2.758550 2.730249
```

```
######PCA TEST ###########




# Flatten the array into a 2D matrix
flattened_data <- array(extracted_features, dim = c(dim(extracted_features)[1], dim(extracted_features)[2] * dim(
extracted_features)[3]))

summary(flattened_data)## dataha too ranega an scaleled ok
```

```
##        V1               V2               V3               V4
##  Min.   : 1.545   Min.   : 1.550   Min.   : 1.550   Min.   : 1.550
##  1st Qu.: 2.265   1st Qu.: 2.290   1st Qu.: 2.290   1st Qu.: 2.290
##  Median : 2.483   Median : 2.506   Median : 2.506   Median : 2.506
##  Mean   : 2.676   Mean   : 2.700   Mean   : 2.700   Mean   : 2.700
##  3rd Qu.: 2.806   3rd Qu.: 2.830   3rd Qu.: 2.830   3rd Qu.: 2.830
##  Max.   :30.945   Max.   :30.945   Max.   :30.945   Max.   :30.945
##        V5               V6               V7               V8
##  Min.   : 1.545   Min.   : 1.032   Min.   : 1.070   Min.   : 1.070
##  1st Qu.: 2.265   1st Qu.: 1.608   1st Qu.: 1.635   1st Qu.: 1.635
##  Median : 2.483   Median : 1.862   Median : 1.887   Median : 1.887
##  Mean   : 2.676   Mean   : 2.039   Mean   : 2.064   Mean   : 2.064
##  3rd Qu.: 2.806   3rd Qu.: 2.188   3rd Qu.: 2.211   3rd Qu.: 2.211
##  Max.   :30.945   Max.   :30.287   Max.   :30.287   Max.   :30.287
##        V9              V10              V11              V12
##  Min.   : 1.070   Min.   : 1.032   Min.   : 1.572   Min.   : 1.575
##  1st Qu.: 1.635   1st Qu.: 1.608   1st Qu.: 2.089   1st Qu.: 2.110
##  Median : 1.887   Median : 1.862   Median : 2.289   Median : 2.309
##  Mean   : 2.064   Mean   : 2.039   Mean   : 2.496   Mean   : 2.516
##  3rd Qu.: 2.211   3rd Qu.: 2.188   3rd Qu.: 2.615   3rd Qu.: 2.636
##  Max.   :30.287   Max.   :30.287   Max.   :31.147   Max.   :31.147
##       V13              V14              V15              V16
##  Min.   : 1.575   Min.   : 1.575   Min.   : 1.572   Min.   : 2.182
##  1st Qu.: 2.110   1st Qu.: 2.110   1st Qu.: 2.089   1st Qu.: 2.904
##  Median : 2.309   Median : 2.309   Median : 2.289   Median : 3.219
##  Mean   : 2.516   Mean   : 2.516   Mean   : 2.496   Mean   : 3.375
##  3rd Qu.: 2.636   3rd Qu.: 2.636   3rd Qu.: 2.615   3rd Qu.: 3.573
##  Max.   :31.147   Max.   :31.147   Max.   :31.147   Max.   :31.698
##       V17              V18              V19              V20
##  Min.   : 2.186   Min.   : 2.186   Min.   : 2.186   Min.   : 2.182
##  1st Qu.: 2.942   1st Qu.: 2.942   1st Qu.: 2.942   1st Qu.: 2.904
##  Median : 3.257   Median : 3.257   Median : 3.257   Median : 3.219
##  Mean   : 3.410   Mean   : 3.410   Mean   : 3.410   Mean   : 3.375
##  3rd Qu.: 3.605   3rd Qu.: 3.605   3rd Qu.: 3.605   3rd Qu.: 3.573
##  Max.   :31.698   Max.   :31.698   Max.   :31.698   Max.   :31.698
##       V21              V22              V23              V24
##  Min.   : 1.310   Min.   : 1.314   Min.   : 1.314   Min.   : 1.314
##  1st Qu.: 2.044   1st Qu.: 2.074   1st Qu.: 2.074   1st Qu.: 2.074
```

```
##  Median : 2.351   Median : 2.381   Median : 2.381   Median : 2.381
##  Mean   : 2.514   Mean   : 2.543   Mean   : 2.543   Mean   : 2.543
##  3rd Qu.: 2.707   3rd Qu.: 2.733   3rd Qu.: 2.733   3rd Qu.: 2.733
##  Max.   :30.948   Max.   :30.948   Max.   :30.948   Max.   :30.948
##       V25              V26          V27          V28          V29          V30
##  Min.   : 1.310   Min.   :0   Min.   :0   Min.   :0   Min.   :0   Min.   :0
##  1st Qu.: 2.044   1st Qu.:0   1st Qu.:0   1st Qu.:0   1st Qu.:0   1st Qu.:0
##  Median : 2.351   Median :0   Median :0   Median :0   Median :0   Median :0
##  Mean   : 2.514   Mean   :0   Mean   :0   Mean   :0   Mean   :0   Mean   :0
##  3rd Qu.: 2.707   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0
##  Max.   :30.948   Max.   :0   Max.   :0   Max.   :0   Max.   :0   Max.   :0
##       V31              V32              V33              V34
##  Min.   : 1.250   Min.   : 1.274   Min.   : 1.274   Min.   : 1.274
##  1st Qu.: 1.847   1st Qu.: 1.874   1st Qu.: 1.874   1st Qu.: 1.874
##  Median : 2.109   Median : 2.135   Median : 2.135   Median : 2.135
##  Mean   : 2.286   Mean   : 2.312   Mean   : 2.312   Mean   : 2.312
##  3rd Qu.: 2.442   3rd Qu.: 2.467   3rd Qu.: 2.467   3rd Qu.: 2.467
##  Max.   :30.819   Max.   :30.819   Max.   :30.819   Max.   :30.819
##       V35              V36              V37              V38
##  Min.   : 1.250   Min.   : 1.258   Min.   : 1.273   Min.   : 1.273
##  1st Qu.: 1.847   1st Qu.: 2.188   1st Qu.: 2.221   1st Qu.: 2.221
##  Median : 2.109   Median : 2.509   Median : 2.541   Median : 2.541
##  Mean   : 2.286   Mean   : 2.665   Mean   : 2.695   Mean   : 2.695
##  3rd Qu.: 2.442   3rd Qu.: 2.871   3rd Qu.: 2.899   3rd Qu.: 2.899
##  Max.   :30.819   Max.   :31.167   Max.   :31.167   Max.   :31.167
##       V39              V40              V41              V42
##  Min.   : 1.273   Min.   : 1.258   Min.   : 0.0000   Min.   : 0.0000
##  1st Qu.: 2.221   1st Qu.: 2.188   1st Qu.: 0.1014   1st Qu.: 0.1105
##  Median : 2.541   Median : 2.509   Median : 0.2445   Median : 0.2543
##  Mean   : 2.695   Mean   : 2.665   Mean   : 0.4946   Mean   : 0.5045
##  3rd Qu.: 2.899   3rd Qu.: 2.871   3rd Qu.: 0.5923   3rd Qu.: 0.6034
##  Max.   :31.167   Max.   :31.167   Max.   :29.0143   Max.   :29.0143
##       V43              V44              V45              V46
##  Min.   : 0.0000   Min.   : 0.0000   Min.   : 0.0000   Min.   : 1.517
##  1st Qu.: 0.1105   1st Qu.: 0.1105   1st Qu.: 0.1010   1st Qu.: 2.287
##  Median : 0.2543   Median : 0.2543   Median : 0.2444   Median : 2.603
##  Mean   : 0.5045   Mean   : 0.5045   Mean   : 0.4943   Mean   : 2.764
##  3rd Qu.: 0.6034   3rd Qu.: 0.6034   3rd Qu.: 0.5922   3rd Qu.: 2.961
##  Max.   :29.0143   Max.   :29.0143   Max.   :29.0143   Max.   :31.517
##       V47              V48              V49              V50
##  Min.   : 1.530   Min.   : 1.530   Min.   : 1.530   Min.   : 1.517
##  1st Qu.: 2.324   1st Qu.: 2.324   1st Qu.: 2.324   1st Qu.: 2.287
##  Median : 2.639   Median : 2.639   Median : 2.639   Median : 2.603
##  Mean   : 2.798   Mean   : 2.798   Mean   : 2.798   Mean   : 2.764
##  3rd Qu.: 2.992   3rd Qu.: 2.992   3rd Qu.: 2.992   3rd Qu.: 2.961
##  Max.   :31.517   Max.   :31.517   Max.   :31.517   Max.   :31.517
##       V51              V52              V53              V54
##  Min.   : 0.6825   Min.   : 0.6872   Min.   : 0.6872   Min.   : 0.6872
##  1st Qu.: 1.5748   1st Qu.: 1.5986   1st Qu.: 1.5986   1st Qu.: 1.5986
##  Median : 1.7743   Median : 1.7946   Median : 1.7946   Median : 1.7946
##  Mean   : 1.9826   Mean   : 2.0048   Mean   : 2.0048   Mean   : 2.0048
##  3rd Qu.: 2.1049   3rd Qu.: 2.1269   3rd Qu.: 2.1269   3rd Qu.: 2.1269
##  Max.   :30.5721   Max.   :30.5721   Max.   :30.5721   Max.   :30.5721
##       V55              V56              V57              V58
##  Min.   : 0.6825   Min.   : 1.614   Min.   : 1.616   Min.   : 1.616
##  1st Qu.: 1.5748   1st Qu.: 2.324   1st Qu.: 2.353   1st Qu.: 2.353
##  Median : 1.7743   Median : 2.613   Median : 2.641   Median : 2.641
##  Mean   : 1.9826   Mean   : 2.776   Mean   : 2.803   Mean   : 2.803
##  3rd Qu.: 2.1049   3rd Qu.: 2.951   3rd Qu.: 2.976   3rd Qu.: 2.976
##  Max.   :30.5721   Max.   :30.770   Max.   :30.770   Max.   :30.770
##       V59              V60              V61              V62
##  Min.   : 1.616   Min.   : 1.614   Min.   : 1.294   Min.   : 1.302
##  1st Qu.: 2.353   1st Qu.: 2.324   1st Qu.: 2.078   1st Qu.: 2.105
##  Median : 2.641   Median : 2.613   Median : 2.293   Median : 2.317
##  Mean   : 2.803   Mean   : 2.776   Mean   : 2.490   Mean   : 2.515
##  3rd Qu.: 2.976   3rd Qu.: 2.951   3rd Qu.: 2.619   3rd Qu.: 2.644
##  Max.   :30.770   Max.   :30.770   Max.   :30.842   Max.   :30.842
##       V63              V64              V65              V66
##  Min.   : 1.302   Min.   : 1.302   Min.   : 1.294   Min.   : 1.197
##  1st Qu.: 2.105   1st Qu.: 2.105   1st Qu.: 2.078   1st Qu.: 1.858
##  Median : 2.317   Median : 2.317   Median : 2.293   Median : 2.159
##  Mean   : 2.515   Mean   : 2.515   Mean   : 2.490   Mean   : 2.322
##  3rd Qu.: 2.644   3rd Qu.: 2.644   3rd Qu.: 2.619   3rd Qu.: 2.508
##  Max.   :30.842   Max.   :30.842   Max.   :30.842   Max.   :30.849
##       V67              V68              V69              V70
##  Min.   : 1.232   Min.   : 1.232   Min.   : 1.232   Min.   : 1.197
##  1st Qu.: 1.888   1st Qu.: 1.888   1st Qu.: 1.888   1st Qu.: 1.858
##  Median : 2.189   Median : 2.189   Median : 2.189   Median : 2.159
##  Mean   : 2.350   Mean   : 2.350   Mean   : 2.350   Mean   : 2.322
```

```
##  3rd Qu.: 2.533   3rd Qu.: 2.533   3rd Qu.: 2.533   3rd Qu.: 2.508
##  Max.   :30.849   Max.   :30.849   Max.   :30.849   Max.   :30.849
##       V71              V72              V73              V74
##  Min.   : 1.427   Min.   : 1.432   Min.   : 1.432   Min.   : 1.432
##  1st Qu.: 2.121   1st Qu.: 2.153   1st Qu.: 2.153   1st Qu.: 2.153
##  Median : 2.430   Median : 2.461   Median : 2.461   Median : 2.461
##  Mean   : 2.592   Mean   : 2.622   Mean   : 2.622   Mean   : 2.622
##  3rd Qu.: 2.787   3rd Qu.: 2.814   3rd Qu.: 2.814   3rd Qu.: 2.814
##  Max.   :31.179   Max.   :31.179   Max.   :31.179   Max.   :31.179
##       V75              V76              V77              V78
##  Min.   : 1.427   Min.   : 2.012   Min.   : 2.018   Min.   : 2.018
##  1st Qu.: 2.121   1st Qu.: 2.647   1st Qu.: 2.674   1st Qu.: 2.674
##  Median : 2.430   Median : 2.883   Median : 2.909   Median : 2.909
##  Mean   : 2.592   Mean   : 3.064   Mean   : 3.090   Mean   : 3.090
##  3rd Qu.: 2.787   3rd Qu.: 3.202   3rd Qu.: 3.227   3rd Qu.: 3.227
##  Max.   :31.179   Max.   :31.124   Max.   :31.124   Max.   :31.124
##       V79              V80              V81              V82
##  Min.   : 2.018   Min.   : 2.012   Min.   : 1.714   Min.   : 1.722
##  1st Qu.: 2.674   1st Qu.: 2.647   1st Qu.: 2.341   1st Qu.: 2.368
##  Median : 2.909   Median : 2.883   Median : 2.579   Median : 2.604
##  Mean   : 3.090   Mean   : 3.064   Mean   : 2.763   Mean   : 2.788
##  3rd Qu.: 3.227   3rd Qu.: 3.202   3rd Qu.: 2.902   3rd Qu.: 2.926
##  Max.   :31.124   Max.   :31.124   Max.   :30.970   Max.   :30.970
##       V83              V84              V85              V86
##  Min.   : 1.722   Min.   : 1.722   Min.   : 1.714   Min.   : 1.712
##  1st Qu.: 2.368   1st Qu.: 2.368   1st Qu.: 2.341   1st Qu.: 2.472
##  Median : 2.604   Median : 2.604   Median : 2.579   Median : 2.731
##  Mean   : 2.788   Mean   : 2.788   Mean   : 2.763   Mean   : 2.909
##  3rd Qu.: 2.926   3rd Qu.: 2.926   3rd Qu.: 2.902   3rd Qu.: 3.068
##  Max.   :30.970   Max.   :30.970   Max.   :30.970   Max.   :31.394
##       V87              V88              V89              V90
##  Min.   : 1.760   Min.   : 1.760   Min.   : 1.760   Min.   : 1.712
##  1st Qu.: 2.497   1st Qu.: 2.497   1st Qu.: 2.497   1st Qu.: 2.472
##  Median : 2.756   Median : 2.756   Median : 2.756   Median : 2.731
##  Mean   : 2.933   Mean   : 2.933   Mean   : 2.933   Mean   : 2.909
##  3rd Qu.: 3.091   3rd Qu.: 3.091   3rd Qu.: 3.091   3rd Qu.: 3.068
##  Max.   :31.394   Max.   :31.394   Max.   :31.394   Max.   :31.394
##       V91              V92              V93              V94
##  Min.   : 1.451   Min.   : 1.453   Min.   : 1.453   Min.   : 1.453
##  1st Qu.: 2.139   1st Qu.: 2.167   1st Qu.: 2.167   1st Qu.: 2.167
##  Median : 2.399   Median : 2.426   Median : 2.426   Median : 2.426
##  Mean   : 2.574   Mean   : 2.600   Mean   : 2.600   Mean   : 2.600
##  3rd Qu.: 2.728   3rd Qu.: 2.752   3rd Qu.: 2.752   3rd Qu.: 2.752
##  Max.   :30.862   Max.   :30.862   Max.   :30.862   Max.   :30.862
##       V95              V96               V97               V98
##  Min.   : 1.451   Min.   : 0.1324   Min.   : 0.1730   Min.   : 0.1730
##  1st Qu.: 2.139   1st Qu.: 0.8280   1st Qu.: 0.8512   1st Qu.: 0.8512
##  Median : 2.399   Median : 1.0691   Median : 1.0912   Median : 1.0912
##  Mean   : 2.574   Mean   : 1.2589   Mean   : 1.2811   Mean   : 1.2811
##  3rd Qu.: 2.728   3rd Qu.: 1.4022   3rd Qu.: 1.4241   3rd Qu.: 1.4241
##  Max.   :30.862   Max.   :29.8339   Max.   :29.8339   Max.   :29.8339
##       V99              V100              V101               V102
##  Min.   : 0.1730   Min.   : 0.173   Min.   : 0.00000   Min.   : 0.0000
##  1st Qu.: 0.8512   1st Qu.: 0.828   1st Qu.: 0.09587   1st Qu.: 0.1038
##  Median : 1.0912   Median : 1.069   Median : 0.23625   Median : 0.2447
##  Mean   : 1.2811   Mean   : 1.259   Mean   : 0.48458   Mean   : 0.4935
##  3rd Qu.: 1.4241   3rd Qu.: 1.402   3rd Qu.: 0.58040   3rd Qu.: 0.5900
##  Max.   :29.8339   Max.   :29.834   Max.   :28.75524   Max.   :28.7552
##       V103              V104              V105               V106
##  Min.   : 0.0000   Min.   : 0.0000   Min.   : 0.00000   Min.   : 1.480
##  1st Qu.: 0.1038   1st Qu.: 0.1038   1st Qu.: 0.09589   1st Qu.: 2.332
##  Median : 0.2447   Median : 0.2447   Median : 0.23625   Median : 2.643
##  Mean   : 0.4935   Mean   : 0.4935   Mean   : 0.48465   Mean   : 2.803
##  3rd Qu.: 0.5900   3rd Qu.: 0.5900   3rd Qu.: 0.58035   3rd Qu.: 2.997
##  Max.   :28.7552   Max.   :28.7552   Max.   :28.75524   Max.   :31.328
##       V107              V108              V109               V110
##  Min.   : 1.496   Min.   : 1.496   Min.   : 1.496   Min.   : 1.480
##  1st Qu.: 2.363   1st Qu.: 2.363   1st Qu.: 2.363   1st Qu.: 2.332
##  Median : 2.673   Median : 2.673   Median : 2.673   Median : 2.643
##  Mean   : 2.832   Mean   : 2.832   Mean   : 2.832   Mean   : 2.803
##  3rd Qu.: 3.024   3rd Qu.: 3.024   3rd Qu.: 3.024   3rd Qu.: 2.997
##  Max.   :31.328   Max.   :31.328   Max.   :31.328   Max.   :31.328
##       V111              V112              V113              V114
##  Min.   : 1.591   Min.   : 1.596   Min.   : 1.596   Min.   : 1.596
##  1st Qu.: 2.228   1st Qu.: 2.255   1st Qu.: 2.255   1st Qu.: 2.255
##  Median : 2.492   Median : 2.519   Median : 2.519   Median : 2.519
##  Mean   : 2.667   Mean   : 2.693   Mean   : 2.693   Mean   : 2.693
##  3rd Qu.: 2.825   3rd Qu.: 2.849   3rd Qu.: 2.849   3rd Qu.: 2.849
##  Max.   :31.080   Max.   :31.080   Max.   :31.080   Max.   :31.080
```

```
##       V115             V116            V117            V118
##  Min.   : 1.591   Min.   : 0.00   Min.   : 0.00   Min.   : 0.00
##  1st Qu.: 2.228   1st Qu.:13.99   1st Qu.:14.16   1st Qu.:14.16
##  Median : 2.492   Median :15.26   Median :15.46   Median :15.46
##  Mean   : 2.667   Mean   :15.22   Mean   :15.38   Mean   :15.38
##  3rd Qu.: 2.825   3rd Qu.:16.55   3rd Qu.:16.71   3rd Qu.:16.71
##  Max.   :31.080   Max.   :21.18   Max.   :21.18   Max.   :21.18
##       V119            V120            V121            V122
##  Min.   : 0.00   Min.   : 0.00   Min.   : 1.766   Min.   : 1.784
##  1st Qu.:14.16   1st Qu.:13.99   1st Qu.: 2.408   1st Qu.: 2.443
##  Median :15.46   Median :15.26   Median : 2.727   Median : 2.762
##  Mean   :15.38   Mean   :15.22   Mean   : 2.883   Mean   : 2.916
##  3rd Qu.:16.71   3rd Qu.:16.55   3rd Qu.: 3.079   3rd Qu.: 3.109
##  Max.   :21.18   Max.   :21.18   Max.   :31.381   Max.   :31.381
##       V123             V124            V125            V126
##  Min.   : 1.784   Min.   : 1.784   Min.   : 1.766   Min.   : 0.9736
##  1st Qu.: 2.443   1st Qu.: 2.443   1st Qu.: 2.408   1st Qu.: 1.4141
##  Median : 2.762   Median : 2.762   Median : 2.727   Median : 1.5857
##  Mean   : 2.916   Mean   : 2.916   Mean   : 2.883   Mean   : 1.7983
##  3rd Qu.: 3.109   3rd Qu.: 3.109   3rd Qu.: 3.079   3rd Qu.: 1.9024
##  Max.   :31.381   Max.   :31.381   Max.   :31.381   Max.   :29.5175
##       V127             V128            V129            V130
##  Min.   : 0.975   Min.   : 0.975   Min.   : 0.975   Min.   : 0.9736
##  1st Qu.: 1.428   1st Qu.: 1.428   1st Qu.: 1.428   1st Qu.: 1.4141
##  Median : 1.598   Median : 1.598   Median : 1.598   Median : 1.5857
##  Mean   : 1.812   Mean   : 1.812   Mean   : 1.812   Mean   : 1.7983
##  3rd Qu.: 1.917   3rd Qu.: 1.917   3rd Qu.: 1.917   3rd Qu.: 1.9023
##  Max.   :29.518   Max.   :29.518   Max.   :29.518   Max.   :29.5175
##       V131             V132            V133            V134
##  Min.   : 1.175   Min.   : 1.190   Min.   : 1.190   Min.   : 1.190
##  1st Qu.: 1.916   1st Qu.: 1.939   1st Qu.: 1.939   1st Qu.: 1.939
##  Median : 2.148   Median : 2.168   Median : 2.168   Median : 2.168
##  Mean   : 2.342   Mean   : 2.363   Mean   : 2.363   Mean   : 2.363
##  3rd Qu.: 2.479   3rd Qu.: 2.500   3rd Qu.: 2.500   3rd Qu.: 2.500
##  Max.   :31.248   Max.   :31.248   Max.   :31.248   Max.   :31.248
##       V135             V136            V137            V138
##  Min.   : 1.175   Min.   : 2.083   Min.   : 2.093   Min.   : 2.093
##  1st Qu.: 1.916   1st Qu.: 2.748   1st Qu.: 2.781   1st Qu.: 2.781
##  Median : 2.148   Median : 3.054   Median : 3.087   Median : 3.087
##  Mean   : 2.342   Mean   : 3.214   Mean   : 3.245   Mean   : 3.245
##  3rd Qu.: 2.479   3rd Qu.: 3.403   3rd Qu.: 3.432   3rd Qu.: 3.432
##  Max.   :31.248   Max.   :31.436   Max.   :31.436   Max.   :31.436
##       V139             V140            V141            V142
##  Min.   : 2.093   Min.   : 2.083   Min.   : 1.452   Min.   : 1.462
##  1st Qu.: 2.781   1st Qu.: 2.748   1st Qu.: 2.107   1st Qu.: 2.131
##  Median : 3.087   Median : 3.054   Median : 2.340   Median : 2.362
##  Mean   : 3.245   Mean   : 3.214   Mean   : 2.524   Mean   : 2.547
##  3rd Qu.: 3.432   3rd Qu.: 3.403   3rd Qu.: 2.663   3rd Qu.: 2.685
##  Max.   :31.436   Max.   :31.436   Max.   :30.691   Max.   :30.691
##       V143             V144            V145            V146
##  Min.   : 1.462   Min.   : 1.462   Min.   : 1.452   Min.   : 0.00
##  1st Qu.: 2.131   1st Qu.: 2.131   1st Qu.: 2.107   1st Qu.:13.52
##  Median : 2.362   Median : 2.362   Median : 2.340   Median :14.86
##  Mean   : 2.547   Mean   : 2.547   Mean   : 2.524   Mean   :14.82
##  3rd Qu.: 2.685   3rd Qu.: 2.685   3rd Qu.: 2.663   3rd Qu.:16.22
##  Max.   :30.691   Max.   :30.691   Max.   :30.691   Max.   :20.73
##       V147            V148            V149            V150
##  Min.   : 0.00   Min.   : 0.00   Min.   : 0.00   Min.   : 0.00
##  1st Qu.:13.70   1st Qu.:13.70   1st Qu.:13.70   1st Qu.:13.52
##  Median :15.06   Median :15.06   Median :15.06   Median :14.86
##  Mean   :14.99   Mean   :14.99   Mean   :14.99   Mean   :14.82
##  3rd Qu.:16.39   3rd Qu.:16.39   3rd Qu.:16.39   3rd Qu.:16.22
##  Max.   :20.73   Max.   :20.73   Max.   :20.73   Max.   :20.73
##       V151             V152            V153            V154
##  Min.   : 1.517   Min.   : 1.524   Min.   : 1.524   Min.   : 1.524
##  1st Qu.: 2.131   1st Qu.: 2.160   1st Qu.: 2.160   1st Qu.: 2.160
##  Median : 2.404   Median : 2.432   Median : 2.432   Median : 2.432
##  Mean   : 2.576   Mean   : 2.604   Mean   : 2.604   Mean   : 2.604
##  3rd Qu.: 2.740   3rd Qu.: 2.766   3rd Qu.: 2.766   3rd Qu.: 2.766
##  Max.   :31.077   Max.   :31.077   Max.   :31.077   Max.   :31.077
##       V155             V156            V157            V158
##  Min.   : 1.517   Min.   : 1.306   Min.   : 1.314   Min.   : 1.314
##  1st Qu.: 2.131   1st Qu.: 2.237   1st Qu.: 2.259   1st Qu.: 2.259
##  Median : 2.404   Median : 2.441   Median : 2.461   Median : 2.461
##  Mean   : 2.576   Mean   : 2.641   Mean   : 2.662   Mean   : 2.662
##  3rd Qu.: 2.740   3rd Qu.: 2.764   3rd Qu.: 2.785   3rd Qu.: 2.785
##  Max.   :31.077   Max.   :30.892   Max.   :30.892   Max.   :30.892
##       V159            V160
##  Min.   : 1.314   Min.   : 1.306
```

```
##  1st Qu.: 2.259   1st Qu.: 2.237
##  Median : 2.461   Median : 2.441
##  Mean   : 2.662   Mean   : 2.641
##  3rd Qu.: 2.785   3rd Qu.: 2.764
##  Max.   :30.892   Max.   :30.892
```

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summary(flattened_data)## dataha too ranega an scaleled ok
```

```
##        V1               V2               V3               V4
##  Min.   : 1.545   Min.   : 1.550   Min.   : 1.550   Min.   : 1.550
##  1st Qu.: 2.265   1st Qu.: 2.290   1st Qu.: 2.290   1st Qu.: 2.290
##  Median : 2.483   Median : 2.506   Median : 2.506   Median : 2.506
##  Mean   : 2.676   Mean   : 2.700   Mean   : 2.700   Mean   : 2.700
##  3rd Qu.: 2.806   3rd Qu.: 2.830   3rd Qu.: 2.830   3rd Qu.: 2.830
##  Max.   :30.945   Max.   :30.945   Max.   :30.945   Max.   :30.945
##        V5               V6               V7               V8
##  Min.   : 1.545   Min.   : 1.032   Min.   : 1.070   Min.   : 1.070
##  1st Qu.: 2.265   1st Qu.: 1.608   1st Qu.: 1.635   1st Qu.: 1.635
##  Median : 2.483   Median : 1.862   Median : 1.887   Median : 1.887
##  Mean   : 2.676   Mean   : 2.039   Mean   : 2.064   Mean   : 2.064
##  3rd Qu.: 2.806   3rd Qu.: 2.188   3rd Qu.: 2.211   3rd Qu.: 2.211
##  Max.   :30.945   Max.   :30.287   Max.   :30.287   Max.   :30.287
##        V9              V10              V11              V12
##  Min.   : 1.070   Min.   : 1.032   Min.   : 1.572   Min.   : 1.575
##  1st Qu.: 1.635   1st Qu.: 1.608   1st Qu.: 2.089   1st Qu.: 2.110
##  Median : 1.887   Median : 1.862   Median : 2.289   Median : 2.309
##  Mean   : 2.064   Mean   : 2.039   Mean   : 2.496   Mean   : 2.516
##  3rd Qu.: 2.211   3rd Qu.: 2.188   3rd Qu.: 2.615   3rd Qu.: 2.636
##  Max.   :30.287   Max.   :30.287   Max.   :31.147   Max.   :31.147
##       V13              V14              V15              V16
##  Min.   : 1.575   Min.   : 1.575   Min.   : 1.572   Min.   : 2.182
##  1st Qu.: 2.110   1st Qu.: 2.110   1st Qu.: 2.089   1st Qu.: 2.904
##  Median : 2.309   Median : 2.309   Median : 2.289   Median : 3.219
##  Mean   : 2.516   Mean   : 2.516   Mean   : 2.496   Mean   : 3.375
##  3rd Qu.: 2.636   3rd Qu.: 2.636   3rd Qu.: 2.615   3rd Qu.: 3.573
##  Max.   :31.147   Max.   :31.147   Max.   :31.147   Max.   :31.698
##       V17              V18              V19              V20
##  Min.   : 2.186   Min.   : 2.186   Min.   : 2.186   Min.   : 2.182
##  1st Qu.: 2.942   1st Qu.: 2.942   1st Qu.: 2.942   1st Qu.: 2.904
##  Median : 3.257   Median : 3.257   Median : 3.257   Median : 3.219
##  Mean   : 3.410   Mean   : 3.410   Mean   : 3.410   Mean   : 3.375
##  3rd Qu.: 3.605   3rd Qu.: 3.605   3rd Qu.: 3.605   3rd Qu.: 3.573
##  Max.   :31.698   Max.   :31.698   Max.   :31.698   Max.   :31.698
##       V21              V22              V23              V24
##  Min.   : 1.310   Min.   : 1.314   Min.   : 1.314   Min.   : 1.314
##  1st Qu.: 2.044   1st Qu.: 2.074   1st Qu.: 2.074   1st Qu.: 2.074
##  Median : 2.351   Median : 2.381   Median : 2.381   Median : 2.381
##  Mean   : 2.514   Mean   : 2.543   Mean   : 2.543   Mean   : 2.543
##  3rd Qu.: 2.707   3rd Qu.: 2.733   3rd Qu.: 2.733   3rd Qu.: 2.733
##  Max.   :30.948   Max.   :30.948   Max.   :30.948   Max.   :30.948
##       V25              V26         V27         V28         V29         V30
##  Min.   : 1.310   Min.   :0   Min.   :0   Min.   :0   Min.   :0   Min.   :0
##  1st Qu.: 2.044   1st Qu.:0   1st Qu.:0   1st Qu.:0   1st Qu.:0   1st Qu.:0
##  Median : 2.351   Median :0   Median :0   Median :0   Median :0   Median :0
##  Mean   : 2.514   Mean   :0   Mean   :0   Mean   :0   Mean   :0   Mean   :0
##  3rd Qu.: 2.707   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0   3rd Qu.:0
##  Max.   :30.948   Max.   :0   Max.   :0   Max.   :0   Max.   :0   Max.   :0
##       V31              V32              V33              V34
##  Min.   : 1.250   Min.   : 1.274   Min.   : 1.274   Min.   : 1.274
##  1st Qu.: 1.847   1st Qu.: 1.874   1st Qu.: 1.874   1st Qu.: 1.874
##  Median : 2.109   Median : 2.135   Median : 2.135   Median : 2.135
##  Mean   : 2.286   Mean   : 2.312   Mean   : 2.312   Mean   : 2.312
##  3rd Qu.: 2.442   3rd Qu.: 2.467   3rd Qu.: 2.467   3rd Qu.: 2.467
##  Max.   :30.819   Max.   :30.819   Max.   :30.819   Max.   :30.819
##       V35              V36              V37              V38
##  Min.   : 1.250   Min.   : 1.258   Min.   : 1.273   Min.   : 1.273
##  1st Qu.: 1.847   1st Qu.: 2.188   1st Qu.: 2.221   1st Qu.: 2.221
##  Median : 2.109   Median : 2.509   Median : 2.541   Median : 2.541
##  Mean   : 2.286   Mean   : 2.665   Mean   : 2.695   Mean   : 2.695
##  3rd Qu.: 2.442   3rd Qu.: 2.871   3rd Qu.: 2.899   3rd Qu.: 2.899
##  Max.   :30.819   Max.   :31.167   Max.   :31.167   Max.   :31.167
##       V39              V40              V41              V42
##  Min.   : 1.273   Min.   : 1.258   Min.   : 0.0000   Min.   : 0.0000
##  1st Qu.: 2.221   1st Qu.: 2.188   1st Qu.: 0.1014   1st Qu.: 0.1105
##  Median : 2.541   Median : 2.509   Median : 0.2445   Median : 0.2543
##  Mean   : 2.695   Mean   : 2.665   Mean   : 0.4946   Mean   : 0.5045
##  3rd Qu.: 2.899   3rd Qu.: 2.871   3rd Qu.: 0.5923   3rd Qu.: 0.6034
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##  Max.   :31.167   Max.   :31.167   Max.   :29.0143   Max.   :29.0143
##       V43               V44               V45               V46
##  Min.   : 0.0000   Min.   : 0.0000   Min.   : 0.0000   Min.   : 1.517
##  1st Qu.: 0.1105   1st Qu.: 0.1105   1st Qu.: 0.1010   1st Qu.: 2.287
##  Median : 0.2543   Median : 0.2543   Median : 0.2444   Median : 2.603
##  Mean   : 0.5045   Mean   : 0.5045   Mean   : 0.4943   Mean   : 2.764
##  3rd Qu.: 0.6034   3rd Qu.: 0.6034   3rd Qu.: 0.5922   3rd Qu.: 2.961
##  Max.   :29.0143   Max.   :29.0143   Max.   :29.0143   Max.   :31.517
##       V47              V48               V49               V50
##  Min.   : 1.530   Min.   : 1.530   Min.   : 1.530   Min.   : 1.517
##  1st Qu.: 2.324   1st Qu.: 2.324   1st Qu.: 2.324   1st Qu.: 2.287
##  Median : 2.639   Median : 2.639   Median : 2.639   Median : 2.603
##  Mean   : 2.798   Mean   : 2.798   Mean   : 2.798   Mean   : 2.764
##  3rd Qu.: 2.992   3rd Qu.: 2.992   3rd Qu.: 2.992   3rd Qu.: 2.961
##  Max.   :31.517   Max.   :31.517   Max.   :31.517   Max.   :31.517
##       V51               V52               V53               V54
##  Min.   : 0.6825   Min.   : 0.6872   Min.   : 0.6872   Min.   : 0.6872
##  1st Qu.: 1.5748   1st Qu.: 1.5986   1st Qu.: 1.5986   1st Qu.: 1.5986
##  Median : 1.7743   Median : 1.7946   Median : 1.7946   Median : 1.7946
##  Mean   : 1.9826   Mean   : 2.0048   Mean   : 2.0048   Mean   : 2.0048
##  3rd Qu.: 2.1049   3rd Qu.: 2.1269   3rd Qu.: 2.1269   3rd Qu.: 2.1269
##  Max.   :30.5721   Max.   :30.5721   Max.   :30.5721   Max.   :30.5721
##       V55               V56               V57               V58
##  Min.   : 0.6825   Min.   : 1.614   Min.   : 1.616   Min.   : 1.616
##  1st Qu.: 1.5748   1st Qu.: 2.324   1st Qu.: 2.353   1st Qu.: 2.353
##  Median : 1.7743   Median : 2.613   Median : 2.641   Median : 2.641
##  Mean   : 1.9826   Mean   : 2.776   Mean   : 2.803   Mean   : 2.803
##  3rd Qu.: 2.1049   3rd Qu.: 2.951   3rd Qu.: 2.976   3rd Qu.: 2.976
##  Max.   :30.5721   Max.   :30.770   Max.   :30.770   Max.   :30.770
##       V59              V60               V61               V62
##  Min.   : 1.616   Min.   : 1.614   Min.   : 1.294   Min.   : 1.302
##  1st Qu.: 2.353   1st Qu.: 2.324   1st Qu.: 2.078   1st Qu.: 2.105
##  Median : 2.641   Median : 2.613   Median : 2.293   Median : 2.317
##  Mean   : 2.803   Mean   : 2.776   Mean   : 2.490   Mean   : 2.515
##  3rd Qu.: 2.976   3rd Qu.: 2.951   3rd Qu.: 2.619   3rd Qu.: 2.644
##  Max.   :30.770   Max.   :30.770   Max.   :30.842   Max.   :30.842
##       V63              V64               V65               V66
##  Min.   : 1.302   Min.   : 1.302   Min.   : 1.294   Min.   : 1.197
##  1st Qu.: 2.105   1st Qu.: 2.105   1st Qu.: 2.078   1st Qu.: 1.858
##  Median : 2.317   Median : 2.317   Median : 2.293   Median : 2.159
##  Mean   : 2.515   Mean   : 2.515   Mean   : 2.490   Mean   : 2.322
##  3rd Qu.: 2.644   3rd Qu.: 2.644   3rd Qu.: 2.619   3rd Qu.: 2.508
##  Max.   :30.842   Max.   :30.842   Max.   :30.842   Max.   :30.849
##       V67              V68               V69               V70
##  Min.   : 1.232   Min.   : 1.232   Min.   : 1.232   Min.   : 1.197
##  1st Qu.: 1.888   1st Qu.: 1.888   1st Qu.: 1.888   1st Qu.: 1.858
##  Median : 2.189   Median : 2.189   Median : 2.189   Median : 2.159
##  Mean   : 2.350   Mean   : 2.350   Mean   : 2.350   Mean   : 2.322
##  3rd Qu.: 2.533   3rd Qu.: 2.533   3rd Qu.: 2.533   3rd Qu.: 2.508
##  Max.   :30.849   Max.   :30.849   Max.   :30.849   Max.   :30.849
##       V71              V72               V73               V74
##  Min.   : 1.427   Min.   : 1.432   Min.   : 1.432   Min.   : 1.432
##  1st Qu.: 2.121   1st Qu.: 2.153   1st Qu.: 2.153   1st Qu.: 2.153
##  Median : 2.430   Median : 2.461   Median : 2.461   Median : 2.461
##  Mean   : 2.592   Mean   : 2.622   Mean   : 2.622   Mean   : 2.622
##  3rd Qu.: 2.787   3rd Qu.: 2.814   3rd Qu.: 2.814   3rd Qu.: 2.814
##  Max.   :31.179   Max.   :31.179   Max.   :31.179   Max.   :31.179
##       V75              V76               V77               V78
##  Min.   : 1.427   Min.   : 2.012   Min.   : 2.018   Min.   : 2.018
##  1st Qu.: 2.121   1st Qu.: 2.647   1st Qu.: 2.674   1st Qu.: 2.674
##  Median : 2.430   Median : 2.883   Median : 2.909   Median : 2.909
##  Mean   : 2.592   Mean   : 3.064   Mean   : 3.090   Mean   : 3.090
##  3rd Qu.: 2.787   3rd Qu.: 3.202   3rd Qu.: 3.227   3rd Qu.: 3.227
##  Max.   :31.179   Max.   :31.124   Max.   :31.124   Max.   :31.124
##       V79              V80               V81               V82
##  Min.   : 2.018   Min.   : 2.012   Min.   : 1.714   Min.   : 1.722
##  1st Qu.: 2.674   1st Qu.: 2.647   1st Qu.: 2.341   1st Qu.: 2.368
##  Median : 2.909   Median : 2.883   Median : 2.579   Median : 2.604
##  Mean   : 3.090   Mean   : 3.064   Mean   : 2.763   Mean   : 2.788
##  3rd Qu.: 3.227   3rd Qu.: 3.202   3rd Qu.: 2.902   3rd Qu.: 2.926
##  Max.   :31.124   Max.   :31.124   Max.   :30.970   Max.   :30.970
##       V83              V84               V85               V86
##  Min.   : 1.722   Min.   : 1.722   Min.   : 1.714   Min.   : 1.712
##  1st Qu.: 2.368   1st Qu.: 2.368   1st Qu.: 2.341   1st Qu.: 2.472
##  Median : 2.604   Median : 2.604   Median : 2.579   Median : 2.731
##  Mean   : 2.788   Mean   : 2.788   Mean   : 2.763   Mean   : 2.909
##  3rd Qu.: 2.926   3rd Qu.: 2.926   3rd Qu.: 2.902   3rd Qu.: 3.068
##  Max.   :30.970   Max.   :30.970   Max.   :30.970   Max.   :31.394
##       V87              V88               V89               V90
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##  Min.   : 1.760   Min.   : 1.760   Min.   : 1.760   Min.   : 1.712
##  1st Qu.: 2.497   1st Qu.: 2.497   1st Qu.: 2.497   1st Qu.: 2.472
##  Median : 2.756   Median : 2.756   Median : 2.756   Median : 2.731
##  Mean   : 2.933   Mean   : 2.933   Mean   : 2.933   Mean   : 2.909
##  3rd Qu.: 3.091   3rd Qu.: 3.091   3rd Qu.: 3.091   3rd Qu.: 3.068
##  Max.   :31.394   Max.   :31.394   Max.   :31.394   Max.   :31.394
##       V91              V92              V93              V94
##  Min.   : 1.451   Min.   : 1.453   Min.   : 1.453   Min.   : 1.453
##  1st Qu.: 2.139   1st Qu.: 2.167   1st Qu.: 2.167   1st Qu.: 2.167
##  Median : 2.399   Median : 2.426   Median : 2.426   Median : 2.426
##  Mean   : 2.574   Mean   : 2.600   Mean   : 2.600   Mean   : 2.600
##  3rd Qu.: 2.728   3rd Qu.: 2.752   3rd Qu.: 2.752   3rd Qu.: 2.752
##  Max.   :30.862   Max.   :30.862   Max.   :30.862   Max.   :30.862
##       V95              V96               V97               V98
##  Min.   : 1.451   Min.   : 0.1324   Min.   : 0.1730   Min.   : 0.1730
##  1st Qu.: 2.139   1st Qu.: 0.8280   1st Qu.: 0.8512   1st Qu.: 0.8512
##  Median : 2.399   Median : 1.0691   Median : 1.0912   Median : 1.0912
##  Mean   : 2.574   Mean   : 1.2589   Mean   : 1.2811   Mean   : 1.2811
##  3rd Qu.: 2.728   3rd Qu.: 1.4022   3rd Qu.: 1.4241   3rd Qu.: 1.4241
##  Max.   :30.862   Max.   :29.8339   Max.   :29.8339   Max.   :29.8339
##       V99              V100              V101              V102
##  Min.   : 0.1730   Min.   : 0.173   Min.   : 0.00000   Min.   : 0.0000
##  1st Qu.: 0.8512   1st Qu.: 0.828   1st Qu.: 0.09587   1st Qu.: 0.1038
##  Median : 1.0912   Median : 1.069   Median : 0.23625   Median : 0.2447
##  Mean   : 1.2811   Mean   : 1.259   Mean   : 0.48458   Mean   : 0.4935
##  3rd Qu.: 1.4241   3rd Qu.: 1.402   3rd Qu.: 0.58040   3rd Qu.: 0.5900
##  Max.   :29.8339   Max.   :29.834   Max.   :28.75524   Max.   :28.7552
##       V103              V104              V105              V106
##  Min.   : 0.0000   Min.   : 0.0000   Min.   : 0.00000   Min.   : 1.480
##  1st Qu.: 0.1038   1st Qu.: 0.1038   1st Qu.: 0.09589   1st Qu.: 2.332
##  Median : 0.2447   Median : 0.2447   Median : 0.23625   Median : 2.643
##  Mean   : 0.4935   Mean   : 0.4935   Mean   : 0.48465   Mean   : 2.803
##  3rd Qu.: 0.5900   3rd Qu.: 0.5900   3rd Qu.: 0.58035   3rd Qu.: 2.997
##  Max.   :28.7552   Max.   :28.7552   Max.   :28.75524   Max.   :31.328
##       V107              V108              V109              V110
##  Min.   : 1.496   Min.   : 1.496   Min.   : 1.496   Min.   : 1.480
##  1st Qu.: 2.363   1st Qu.: 2.363   1st Qu.: 2.363   1st Qu.: 2.332
##  Median : 2.673   Median : 2.673   Median : 2.673   Median : 2.643
##  Mean   : 2.832   Mean   : 2.832   Mean   : 2.832   Mean   : 2.803
##  3rd Qu.: 3.024   3rd Qu.: 3.024   3rd Qu.: 3.024   3rd Qu.: 2.997
##  Max.   :31.328   Max.   :31.328   Max.   :31.328   Max.   :31.328
##       V111              V112              V113              V114
##  Min.   : 1.591   Min.   : 1.596   Min.   : 1.596   Min.   : 1.596
##  1st Qu.: 2.228   1st Qu.: 2.255   1st Qu.: 2.255   1st Qu.: 2.255
##  Median : 2.492   Median : 2.519   Median : 2.519   Median : 2.519
##  Mean   : 2.667   Mean   : 2.693   Mean   : 2.693   Mean   : 2.693
##  3rd Qu.: 2.825   3rd Qu.: 2.849   3rd Qu.: 2.849   3rd Qu.: 2.849
##  Max.   :31.080   Max.   :31.080   Max.   :31.080   Max.   :31.080
##       V115              V116             V117             V118
##  Min.   : 1.591   Min.   : 0.00   Min.   : 0.00   Min.   : 0.00
##  1st Qu.: 2.228   1st Qu.:13.99   1st Qu.:14.16   1st Qu.:14.16
##  Median : 2.492   Median :15.26   Median :15.46   Median :15.46
##  Mean   : 2.667   Mean   :15.22   Mean   :15.38   Mean   :15.38
##  3rd Qu.: 2.825   3rd Qu.:16.55   3rd Qu.:16.71   3rd Qu.:16.71
##  Max.   :31.080   Max.   :21.18   Max.   :21.18   Max.   :21.18
##       V119             V120             V121             V122
##  Min.   : 0.00   Min.   : 0.00   Min.   : 1.766   Min.   : 1.784
##  1st Qu.:14.16   1st Qu.:13.99   1st Qu.: 2.408   1st Qu.: 2.443
##  Median :15.46   Median :15.26   Median : 2.727   Median : 2.762
##  Mean   :15.38   Mean   :15.22   Mean   : 2.883   Mean   : 2.916
##  3rd Qu.:16.71   3rd Qu.:16.55   3rd Qu.: 3.079   3rd Qu.: 3.109
##  Max.   :21.18   Max.   :21.18   Max.   :31.381   Max.   :31.381
##       V123             V124             V125             V126
##  Min.   : 1.784   Min.   : 1.784   Min.   : 1.766   Min.   : 0.9736
##  1st Qu.: 2.443   1st Qu.: 2.443   1st Qu.: 2.408   1st Qu.: 1.4141
##  Median : 2.762   Median : 2.762   Median : 2.727   Median : 1.5857
##  Mean   : 2.916   Mean   : 2.916   Mean   : 2.883   Mean   : 1.7983
##  3rd Qu.: 3.109   3rd Qu.: 3.109   3rd Qu.: 3.079   3rd Qu.: 1.9024
##  Max.   :31.381   Max.   :31.381   Max.   :31.381   Max.   :29.5175
##       V127             V128             V129             V130
##  Min.   : 0.975   Min.   : 0.975   Min.   : 0.975   Min.   : 0.9736
##  1st Qu.: 1.428   1st Qu.: 1.428   1st Qu.: 1.428   1st Qu.: 1.4141
##  Median : 1.598   Median : 1.598   Median : 1.598   Median : 1.5857
##  Mean   : 1.812   Mean   : 1.812   Mean   : 1.812   Mean   : 1.7983
##  3rd Qu.: 1.917   3rd Qu.: 1.917   3rd Qu.: 1.917   3rd Qu.: 1.9023
##  Max.   :29.518   Max.   :29.518   Max.   :29.518   Max.   :29.5175
##       V131             V132             V133             V134
##  Min.   : 1.175   Min.   : 1.190   Min.   : 1.190   Min.   : 1.190
##  1st Qu.: 1.916   1st Qu.: 1.939   1st Qu.: 1.939   1st Qu.: 1.939
```

```
##  Median : 2.148   Median : 2.168   Median : 2.168   Median : 2.168
##  Mean   : 2.342   Mean   : 2.363   Mean   : 2.363   Mean   : 2.363
##  3rd Qu.: 2.479   3rd Qu.: 2.500   3rd Qu.: 2.500   3rd Qu.: 2.500
##  Max.   :31.248   Max.   :31.248   Max.   :31.248   Max.   :31.248
##       V135             V136             V137             V138
##  Min.   : 1.175   Min.   : 2.083   Min.   : 2.093   Min.   : 2.093
##  1st Qu.: 1.916   1st Qu.: 2.748   1st Qu.: 2.781   1st Qu.: 2.781
##  Median : 2.148   Median : 3.054   Median : 3.087   Median : 3.087
##  Mean   : 2.342   Mean   : 3.214   Mean   : 3.245   Mean   : 3.245
##  3rd Qu.: 2.479   3rd Qu.: 3.403   3rd Qu.: 3.432   3rd Qu.: 3.432
##  Max.   :31.248   Max.   :31.436   Max.   :31.436   Max.   :31.436
##       V139             V140             V141             V142
##  Min.   : 2.093   Min.   : 2.083   Min.   : 1.452   Min.   : 1.462
##  1st Qu.: 2.781   1st Qu.: 2.748   1st Qu.: 2.107   1st Qu.: 2.131
##  Median : 3.087   Median : 3.054   Median : 2.340   Median : 2.362
##  Mean   : 3.245   Mean   : 3.214   Mean   : 2.524   Mean   : 2.547
##  3rd Qu.: 3.432   3rd Qu.: 3.403   3rd Qu.: 2.663   3rd Qu.: 2.685
##  Max.   :31.436   Max.   :31.436   Max.   :30.691   Max.   :30.691
##       V143             V144             V145             V146
##  Min.   : 1.462   Min.   : 1.462   Min.   : 1.452   Min.   : 0.00
##  1st Qu.: 2.131   1st Qu.: 2.131   1st Qu.: 2.107   1st Qu.:13.52
##  Median : 2.362   Median : 2.362   Median : 2.340   Median :14.86
##  Mean   : 2.547   Mean   : 2.547   Mean   : 2.524   Mean   :14.82
##  3rd Qu.: 2.685   3rd Qu.: 2.685   3rd Qu.: 2.663   3rd Qu.:16.22
##  Max.   :30.691   Max.   :30.691   Max.   :30.691   Max.   :20.73
##       V147            V148            V149            V150
##  Min.   : 0.00   Min.   : 0.00   Min.   : 0.00   Min.   : 0.00
##  1st Qu.:13.70   1st Qu.:13.70   1st Qu.:13.70   1st Qu.:13.52
##  Median :15.06   Median :15.06   Median :15.06   Median :14.86
##  Mean   :14.99   Mean   :14.99   Mean   :14.99   Mean   :14.82
##  3rd Qu.:16.39   3rd Qu.:16.39   3rd Qu.:16.39   3rd Qu.:16.22
##  Max.   :20.73   Max.   :20.73   Max.   :20.73   Max.   :20.73
##       V151             V152             V153             V154
##  Min.   : 1.517   Min.   : 1.524   Min.   : 1.524   Min.   : 1.524
##  1st Qu.: 2.131   1st Qu.: 2.160   1st Qu.: 2.160   1st Qu.: 2.160
##  Median : 2.404   Median : 2.432   Median : 2.432   Median : 2.432
##  Mean   : 2.576   Mean   : 2.604   Mean   : 2.604   Mean   : 2.604
##  3rd Qu.: 2.740   3rd Qu.: 2.766   3rd Qu.: 2.766   3rd Qu.: 2.766
##  Max.   :31.077   Max.   :31.077   Max.   :31.077   Max.   :31.077
##       V155             V156             V157             V158
##  Min.   : 1.517   Min.   : 1.306   Min.   : 1.314   Min.   : 1.314
##  1st Qu.: 2.131   1st Qu.: 2.237   1st Qu.: 2.259   1st Qu.: 2.259
##  Median : 2.404   Median : 2.441   Median : 2.461   Median : 2.461
##  Mean   : 2.576   Mean   : 2.641   Mean   : 2.662   Mean   : 2.662
##  3rd Qu.: 2.740   3rd Qu.: 2.764   3rd Qu.: 2.785   3rd Qu.: 2.785
##  Max.   :31.077   Max.   :30.892   Max.   :30.892   Max.   :30.892
##       V159             V160
##  Min.   : 1.314   Min.   : 1.306
##  1st Qu.: 2.259   1st Qu.: 2.237
##  Median : 2.461   Median : 2.441
##  Mean   : 2.662   Mean   : 2.641
##  3rd Qu.: 2.785   3rd Qu.: 2.764
##  Max.   :30.892   Max.   :30.892
```

```
# Identify columns where all rows are zero
columns_all_zeros <- apply(flattened_data, 2, function(x) all(x == 0))

# Get the names of these columns (if the matrix has column names)
columns_with_all_zeros <- names(columns_all_zeros)[columns_all_zeros]

# Print the names of columns with all zeros
print(columns_with_all_zeros)
```

```
## NULL
```

```
# Remove these columns from extracted_features
flattened_data <- flattened_data[, !columns_all_zeros]

# Display the dimensions of the cleaned extracted_features
print(dim(flattened_data))
```

```
## [1] 1336810     155
```

```r
# Step 1: Identify columns that contain at least one zero
#columns_with_zeros <- apply(flattened_data, 2, function(x) any(x == 0))

# Step 2: Filter out these columns from the matrix
#flattened_data <- flattened_data[, !columns_with_zeros]

# Show dimensions or summary of the filtered data
#print(dim(filtered_data))
#summary(filtered_data)



library(stats)

#
pca <- prcomp(flattened_data, scale. = TRUE, center = TRUE)

# Extracting the importance of components
explained_variance <- summary(pca)$importance[2,]
cumulative_variance <- cumsum(explained_variance)
num_components <- which(cumulative_variance >= 0.999)[1]

# Using the number of components to reduce dimensions
reduced_data <- pca$x[, 1:num_components]

summary(reduced_data)
```

```
##       PC1                PC2                 PC3                PC4          
##  Min.   :-321.156   Min.   :-10.43790   Min.   :-22.3097   Min.   :-22.60498  
##  1st Qu.:  -1.464   1st Qu.: -2.20609   1st Qu.: -1.0018   1st Qu.: -0.42571  
##  Median :   2.298   Median : -0.04554   Median :  0.0193   Median : -0.01867  
##  Mean   :   0.000   Mean   :  0.00000   Mean   :  0.0000   Mean   :  0.00000  
##  3rd Qu.:   4.691   3rd Qu.:  2.13991   3rd Qu.:  1.0148   3rd Qu.:  0.40148  
##  Max.   :  11.300   Max.   : 14.30648   Max.   : 87.2442   Max.   : 45.61329  
##       PC5                 PC6                 PC7          
##  Min.   :-22.32528   Min.   :-41.33976   Min.   :-9.51994  
##  1st Qu.: -0.09744   1st Qu.: -0.19908   1st Qu.:-0.11711  
##  Median : -0.00279   Median :  0.00184   Median : 0.02676  
##  Mean   :  0.00000   Mean   :  0.00000   Mean   : 0.00000  
##  3rd Qu.:  0.09110   3rd Qu.:  0.20026   3rd Qu.: 0.14409  
##  Max.   : 97.42868   Max.   : 18.73958   Max.   :11.17001  
##       PC8          
##  Min.   :-14.486692  
##  1st Qu.: -0.128074  
##  Median : -0.008422  
##  Mean   :  0.000000  
##  3rd Qu.:  0.119418  
##  Max.   : 15.148364
```

```r
# Combine df1 and df2 side by side
combined_df <- cbind(cnn_output, reduced_data)
data <- rename(combined_df, c("close"= "cnn_output"  ))
combined_df <- rename(combined_df, c("close"= "cnn_output"  ))

# Display the combined data frame
print(head(combined_df,100))
```

```
##     close       Date         PC1         PC2         PC3          PC4
## 1    83.0 2019-10-01 -2.26918747 -2.24243821  0.43747432 -1.104238831
## 2    81.0 2019-10-02 -2.16304539 -2.15324518 -0.08013630 -1.050565237
## 3    80.8 2019-10-03 -1.95001609 -1.92132539 -0.29606686 -0.463170987
## 4    80.8 2019-10-04 -1.86825572 -1.83262084 -0.33459373  0.282201038
## 5    81.8 2019-10-07 -1.58824028 -1.56645507 -0.12940610  0.772491511
## 6    82.4 2019-10-08 -1.78946263 -1.70874145  0.42550469  0.547143425
## 7    83.4 2019-10-09 -1.82946503 -1.66088641  0.53428766 -0.090016863
## 8    81.6 2019-10-10 -2.11481635 -2.04738572  0.33184996 -0.939907068
## 9    82.0 2019-10-11 -2.07436920 -2.04127037 -0.13550107 -1.124886587
## 10   81.0 2019-10-14 -1.97948701 -2.02827851 -0.50641104 -0.741481434
## 11   81.6 2019-10-15 -1.80047321 -1.81618493 -0.46024136  0.185197214
## 12   87.6 2019-10-16 -1.76901564 -1.77161515 -0.41581906  0.609646282
## 13   86.0 2019-10-17 -1.87868331 -1.76201342  0.07385843  0.515288868
## 14   86.6 2019-10-18 -2.10050495 -1.92921059  0.21190047  0.150690565
## 15   85.8 2019-10-21 -2.20685552 -2.07602461  0.29518447 -0.776919697
## 16   86.8 2019-10-22 -2.27141868 -2.09924641  0.28924172 -0.699691975
## 17   87.0 2019-10-23 -2.18334795 -2.01829409 -0.10177895 -0.746829583
## 18   88.6 2019-10-24 -2.15653411 -1.89323013 -0.53335582 -0.181463880
```

```
## 19   88.8 2019-10-25 -2.30962010 -2.02295434 -0.79206654 -0.237598123
## 20   89.8 2019-10-28 -2.66426537 -2.33916804 -0.84058779 -0.317825640
## 21   91.4 2019-10-29 -2.92668286 -2.68046668 -1.07369855 -0.650816495
## 22   91.0 2019-10-30 -3.29315936 -3.17567513 -1.16222373 -0.606267353
## 23   91.0 2019-10-31 -3.37337779 -3.29751806 -1.37422738 -0.380515571
## 24   92.0 2019-11-01 -3.63663800 -3.63010951 -0.98148336  0.042730214
## 25   91.0 2019-11-04 -3.73465371 -3.75081117 -0.83116012  0.183157775
## 26   91.2 2019-11-05 -3.91955986 -3.93417642 -0.23427501  0.135159727
## 27   89.0 2019-11-06 -3.98161425 -4.00562427  0.01379722  0.059753506
## 28   89.0 2019-11-07 -3.87294512 -3.85707105  0.73846120 -0.061387691
## 29   89.2 2019-11-08 -3.72909426 -3.66463604  1.16968084  0.078936839
## 30   86.0 2019-11-11 -3.33243600 -3.10848591  1.72403860  0.192704833
## 31   87.0 2019-11-12 -2.87638596 -2.52515861  2.17714491  0.587525197
## 32   85.4 2019-11-13 -2.39332372 -1.81263032  2.61381184  0.368351782
## 33   86.0 2019-11-14 -1.77956855 -1.02668148  3.23907562  0.359880257
## 34   87.4 2019-11-15 -1.26497139 -0.26610007  3.26517231 -0.055107899
## 35   85.8 2019-11-18 -0.52280041  0.71823961  3.02501991 -0.336243617
## 36   85.2 2019-11-19 -0.09023679  1.40460439  2.48001842 -0.483996844
## 37   84.4 2019-11-20  0.45635335  2.12760951  1.74166844 -0.799698865
## 38   83.6 2019-11-21  0.87482352  2.62209541  1.20154216 -0.478076466
## 39   87.0 2019-11-22  1.20327072  3.09246417  0.67047704 -0.285909803
## 40   86.4 2019-11-25  1.35318697  3.30749223 -0.01152339 -0.092111429
## 41   86.0 2019-11-26  1.14720923  3.11910735 -0.57666816 -0.194393359
## 42   86.4 2019-11-27  0.94388597  2.78888918 -1.10479067 -0.507064954
## 43   85.2 2019-11-28  0.62189102  2.32931943 -1.43435315 -0.365269347
## 44   85.6 2019-11-29  0.47738895  2.01454628 -1.58243290 -0.138680874
## 45   84.2 2019-12-02  0.23293777  1.63606990 -1.68120761  0.330478804
## 46   82.8 2019-12-03  0.15391679  1.43555132 -1.33933134  0.810697552
## 47   84.2 2019-12-04  0.01876250  1.20325274 -0.56237682  0.971086736
## 48   84.0 2019-12-05 -0.02107456  1.18774465  0.20783168  0.969179411
## 49   85.0 2019-12-06  0.01450782  1.17293836  0.84275167  0.679366112
## 50   84.4 2019-12-09  0.01762329  1.28972747  1.03043637  0.112660807
## 51   83.2 2019-12-10  0.11542934  1.37624439  0.98425327 -0.272169573
## 52   83.4 2019-12-11  0.26615968  1.61627506  0.88782469 -0.622480677
## 53   83.4 2019-12-12  0.51356272  1.88672586  0.50406445 -0.327883133
## 54   82.8 2019-12-13  0.75900077  2.19233444  0.11681619 -0.029833737
## 55   82.6 2019-12-16  0.83400864  2.36889111  0.07329674  0.258093102
## 56   85.8 2019-12-17  0.92906705  2.46946898  0.14609029  0.373480242
## 57   85.2 2019-12-18  0.78245465  2.38274336  0.14741609 -0.041326022
## 58   85.4 2019-12-19  0.53306824  2.10467578 -0.34754527 -0.482614749
## 59   85.0 2019-12-20  0.23287265  1.63441119 -1.15958310 -0.895492059
## 60   84.0 2019-12-23 -0.09779604  1.14122410 -1.85565896 -0.850526558
## 61   87.0 2019-12-27 -0.28346359  0.72917229 -2.06735890 -0.226290421
## 62   87.6 2019-12-30 -0.66891284  0.28269481 -2.25734285  0.209396382
## 63   87.6 2020-01-02 -1.11323531 -0.31347470 -2.31085956  0.555689525
## 64   84.0 2020-01-03 -1.72371125 -1.08398979 -2.33611884  0.114666835
## 65   83.8 2020-01-06 -2.11238379 -1.79270314 -1.75966699  0.272889441
## 66   84.4 2020-01-07 -2.22009538 -1.94850152 -0.89139994  0.408579784
## 67   84.4 2020-01-08 -2.24236975 -2.11336836  0.11329525  1.035544290
## 68   84.4 2020-01-09 -2.04604772 -1.84212607  0.59485296  1.173235725
## 69   84.2 2020-01-10 -1.95655812 -1.66850839  1.58798871  0.829599053
## 70   83.0 2020-01-13 -1.72624064 -1.24175594  2.07499213  0.370984052
## 71   81.0 2020-01-14 -1.31559180 -0.73348698  2.80414401 -0.318379287
## 72   81.0 2020-01-15 -0.66054831  0.04305778  2.71230048 -0.120367278
## 73   81.0 2020-01-16  0.06563980  1.08417256  2.53196712  0.159249101
## 74   81.0 2020-01-17  0.60346976  1.90411462  2.36195092  0.387907350
## 75   78.0 2020-01-20  1.09075665  2.61072184  2.42356341  0.136101809
## 76   80.0 2020-01-21  1.56672970  3.24070682  2.38529710 -0.008106613
## 77   78.4 2020-01-22  1.92520227  3.80375131  1.84951267 -0.391420629
## 78   76.0 2020-01-23  2.31934503  4.26581536  1.21299249 -0.372528585
## 79   78.0 2020-01-24  2.56938630  4.54775068  0.47073261 -0.436803313
## 80   74.4 2020-01-27  2.62747031  4.62253889 -0.21173473 -0.305143424
## 81   76.6 2020-01-28  2.70834951  4.60612541 -0.59001329 -0.085686334
## 82   79.0 2020-01-29  2.62762207  4.42004029 -0.90444363  0.104059824
## 83   78.2 2020-01-30  2.47608353  4.20224665 -1.24639174  0.319798799
## 84   78.0 2020-01-31  2.10343449  3.69577548 -1.38231535  0.015302841
## 85   74.0 2020-02-03  1.80554927  3.16784492 -1.56436564  0.086048304
## 86   77.8 2020-02-04  1.74657402  2.95518311 -1.18594897  0.347736430
## 87   77.6 2020-02-05  1.26429845  2.31615660 -1.40774483  0.172177092
## 88   75.2 2020-02-06  0.88152992  1.72414631 -1.85344725  0.001693554
## 89   73.0 2020-02-07  0.32767077  0.88627101 -2.19550138 -0.363349166
## 90   71.4 2020-02-10  0.06980170  0.39623438 -2.00618404  0.084444200
## 91   72.8 2020-02-11 -0.12779380  0.06737101 -1.42574091  0.511518919
## 92   73.6 2020-02-12 -0.16407265 -0.18082997 -0.69886679  1.105975068
## 93   73.0 2020-02-13 -0.09677602 -0.12498061 -0.43274396  1.395513722
## 94   74.0 2020-02-14 -0.28590765 -0.31754288  0.50731135  0.749812637
## 95   73.2 2020-02-17 -0.44930305 -0.47699315  0.69068682 -0.161874456
## 96   75.0 2020-02-18 -0.46837405 -0.57997864  0.78599037 -0.817567536
## 97   75.0 2020-02-19 -0.33857288 -0.31401934  0.18442645 -0.847124431
```

```
## 98   75.0 2020-02-20 -0.32389911 -0.30869688 -0.41466695 -0.465512601
## 99   75.0 2020-02-21 -0.30662499 -0.26444237 -0.92489160 -0.307376431
## 100  68.8 2020-02-24 -0.56643942 -0.63766213 -1.03317867 -0.126647457
##               PC5          PC6          PC7           PC8
## 1    8.517397e-03 -0.284581165  0.007407972  3.353055e-02
## 2    1.677207e-01  0.265566009 -0.128344815 -1.647790e-01
## 3    2.053564e-01  0.440556055 -0.030381288 -2.725254e-02
## 4    1.646317e-01  0.491063123  0.148170749  2.400937e-01
## 5   -1.502566e-02  0.108259543  0.023184723  8.987586e-02
## 6   -8.638432e-02 -0.365059557 -0.058743162  9.835542e-03
## 7   -1.253019e-01 -0.611404957 -0.004865333  1.526114e-01
## 8    9.887654e-03 -0.375972021 -0.072734596  1.467222e-01
## 9    2.079814e-01  0.119801335 -0.306438724 -1.424219e-01
## 10   1.506840e-01  0.287459420 -0.147113714  9.410234e-02
## 11   1.832769e-01  0.628713174 -0.008370578  3.412481e-01
## 12   7.081935e-02  0.296412269 -0.159156002  1.318477e-01
## 13  -1.917867e-01 -0.475953430 -0.125695162  2.217364e-01
## 14  -2.319938e-01 -0.491413720 -0.106255208  2.595702e-01
## 15  -5.431455e-02 -0.309531677 -0.261308339  5.272896e-02
## 16  -6.582975e-03  0.068847437 -0.357656349 -1.348573e-01
## 17   1.890932e-02  0.382858672 -0.040207129  2.779280e-01
## 18  -4.990710e-02  0.134569491  0.075953174  3.273594e-01
## 19  -1.003020e-01 -0.200273902  0.023851145  2.477119e-01
## 20   2.389758e-02 -0.272231447 -0.093346835 -3.465474e-02
## 21   4.669441e-02 -0.255405004 -0.030026279  4.609111e-02
## 22   1.328698e-01  0.107678006  0.037540276  7.095434e-02
## 23   1.037875e-01  0.065225953  0.053421690  5.140690e-02
## 24   4.393296e-02  0.106554185  0.105053873  5.505759e-02
## 25   7.607837e-03  0.028745028  0.094649359  3.158046e-02
## 26  -6.049942e-02 -0.209970124  0.081181460  1.169791e-02
## 27  -6.947103e-02 -0.232489647  0.056029536  1.584096e-02
## 28   5.132763e-02  0.096968482 -0.052002975 -1.284680e-01
## 29   6.207960e-02  0.344149457 -0.132150644 -1.903670e-01
## 30   4.076205e-02  0.444937330  0.014417772  4.730249e-02
## 31   4.168247e-05  0.373427742  0.015094523  8.092872e-02
## 32  -7.018407e-02  0.212956544 -0.054341012  1.784656e-02
## 33  -8.348701e-02  0.098026645 -0.148018840 -4.487345e-02
## 34  -7.207112e-02  0.252805476 -0.103421742  5.406426e-02
## 35  -1.947466e-01 -0.055405594 -0.052351910  1.683910e-01
## 36  -1.273214e-01 -0.059309854 -0.015347044  2.017028e-01
## 37  -2.419564e-02  0.015511986 -0.120021610  5.928372e-02
## 38   1.591198e-02  0.149799470 -0.183569591 -6.671301e-02
## 39   8.503666e-02  0.407005828 -0.051750250  1.188840e-01
## 40  -9.673922e-02 -0.060286661  0.094376797  2.920221e-01
## 41  -6.955279e-02 -0.158403253  0.023791907  1.908882e-01
## 42   7.376006e-02 -0.243925505 -0.147536105 -8.866026e-02
## 43   1.461536e-01  0.020740501 -0.141505949 -1.101538e-01
## 44   1.721157e-01  0.311075848  0.034796206  1.351050e-01
## 45   7.425095e-02  0.022987242  0.113044271  2.102178e-01
## 46   1.959392e-02 -0.035718290 -0.070866710 -5.004652e-02
## 47   6.575522e-02 -0.014394352 -0.218851591 -2.980175e-01
## 48  -3.996943e-02 -0.019342938 -0.108359134 -1.247968e-01
## 49  -1.161588e-01 -0.055800055  0.066855965  1.477166e-01
## 50  -1.842379e-01 -0.355326056  0.059277804  1.578028e-01
## 51  -1.268252e-01 -0.279151263 -0.134911661 -9.620873e-02
## 52   2.915828e-02  0.049692799 -0.143072609 -9.269454e-02
## 53  -7.703258e-03  0.266844227 -0.028176354  7.802570e-02
## 54  -1.049974e-02  0.291267427  0.048043598  1.796428e-01
## 55  -2.120695e-02  0.022664761 -0.019483121  7.205170e-02
## 56  -4.249978e-02 -0.055642685 -0.069129198  9.525828e-03
## 57  -7.703507e-02 -0.189109524  0.025638981  1.214819e-01
## 58  -1.115470e-01 -0.311219437  0.036787991  1.521099e-01
## 59   3.718694e-02 -0.181553271 -0.058693495 -9.568511e-03
## 60   2.208069e-01  0.070212064 -0.103510369 -1.564288e-01
## 61   3.076344e-01  0.435459080 -0.012370880 -1.873864e-02
## 62   1.201825e-01  0.142210323  0.248053253  3.153517e-01
## 63  -5.407765e-02 -0.299408719  0.141412724  1.796844e-01
## 64  -4.806465e-02 -0.772963606 -0.022268253 -9.454094e-02
## 65   1.968327e-01 -0.167525136 -0.297241606 -4.766055e-01
## 66   2.372226e-01  0.443978164 -0.197245013 -3.320669e-01
## 67   8.386687e-02  0.586545307  0.092426654  7.991099e-02
## 68  -1.237245e-01  0.127533583  0.145294493  2.142717e-01
## 69  -2.494414e-01 -0.534763365  0.018138244 -9.590652e-03
## 70  -1.587178e-01 -0.442243593 -0.153283842 -2.316268e-01
## 71  -1.511841e-02  0.223875818 -0.178572450 -2.907394e-01
## 72  -9.494606e-02  0.512494402 -0.117489375 -1.215420e-01
## 73  -1.090639e-01  0.532415665  0.081902169  1.133144e-01
## 74  -1.358326e-01  0.168084219  0.061410118  7.518041e-02
## 75  -1.482617e-01  0.003071744  0.034472396 -5.428643e-05
```

```
## 76  -1.007418e-01  0.026855282 -0.033496326 -8.803027e-02
## 77  -1.014240e-01  0.004046392  0.044726220  1.770356e-02
## 78  -6.294254e-02  0.031345538  0.033423309  3.195920e-03
## 79   3.746224e-02  0.018624673  0.072581359  2.492040e-02
## 80   7.907437e-02  0.033583321  0.050377526 -1.926971e-02
## 81   1.573986e-01  0.166293035  0.018331931 -5.577653e-02
## 82   1.325887e-01  0.004140257  0.108116146  6.267537e-02
## 83   1.566766e-02 -0.126622876  0.087564914  6.308358e-02
## 84   1.923811e-02 -0.282987968  0.044745717  8.156926e-03
## 85   7.366669e-02 -0.181118088 -0.096913754 -1.418189e-01
## 86   1.413849e-01  0.221458151 -0.134193749 -2.026747e-01
## 87   4.555657e-02 -0.112695835  0.079798874  2.020417e-01
## 88   2.325527e-02 -0.311094007  0.042739334  2.696694e-01
## 89   1.733329e-01 -0.431375663 -0.218436131 -6.770686e-02
## 90   3.577631e-01  0.081944631 -0.438120584 -2.997086e-01
## 91   3.636392e-01  0.506839208 -0.238546073  6.656466e-02
## 92   1.443857e-01  0.364112131 -0.089753920  4.244045e-01
## 93  -1.570128e-01 -0.399100916 -0.249346976  2.590960e-01
## 94  -2.496885e-01 -0.701296673 -0.448498144  4.375985e-02
## 95  -1.363792e-01 -0.688052785 -0.430170716  1.067822e-01
## 96   9.365824e-02  0.031906446 -0.412011590  1.313277e-01
## 97   5.022116e-02  0.050704413 -0.339130562  2.479776e-01
## 98   4.099108e-02  0.181005502 -0.176246652  3.676044e-01
## 99   6.941029e-02  0.015793282 -0.200227650  3.146651e-01
## 100  5.373250e-02 -0.134789751 -0.224100815  1.505442e-01
```

```
write.csv(combined_df, file = "final.feature.feed_to_other_models19.05.2024better pca +++.csv", row.names = FALSE
, na = "NA")


save(reduced_data, file = "datatabnetwithpcafinal+19.5.2024.RData")
```

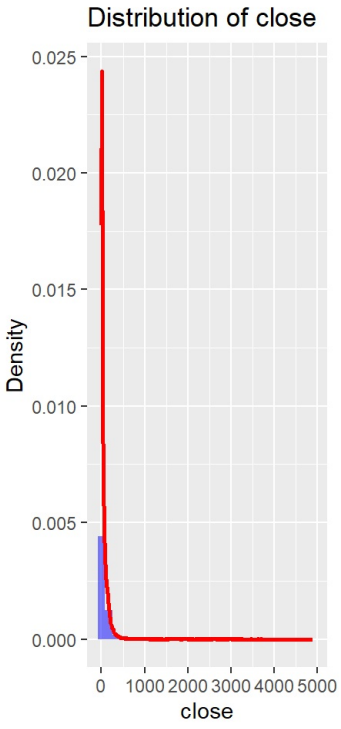
```
################################  pca histogrms




# Load necessary libraries
library(ggplot2)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

```r
#install.packages("gridExtra")
# Load  data
# Load necessary libraries
library(ggplot2)
library(gridExtra)
library(dplyr)

# Load  data
#data <- read.csv("final.feature.feed_to_other_models17.05.2024+++.csv")

# List of PCA components
pca_columns <- c( "close", "PC1", "PC2", "PC3", "PC4", "PC5", "PC6", "PC7")
pca_columns <- c( "close")

# Create a list to hold the plots
plots <- list()

# Generate histograms using tidy evaluation
for (pca in pca_columns) {
  p <- ggplot(data, aes(x = .data[[pca]])) +
    geom_histogram(aes(y = ..density..), bins = 30, fill = "blue", alpha = 0.5) +
    geom_density(color = "red", linewidth = 1) +
    labs(title = paste("Distribution of", pca), x = pca, y = "Density")
  plots[[pca]] <- p
}

# Arrange the plots in a grid
do.call(grid.arrange, c(plots, ncol = 3))
```

```
## Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.
## ℹ Please use `after_stat(density)` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```




```r
summary(data)
```

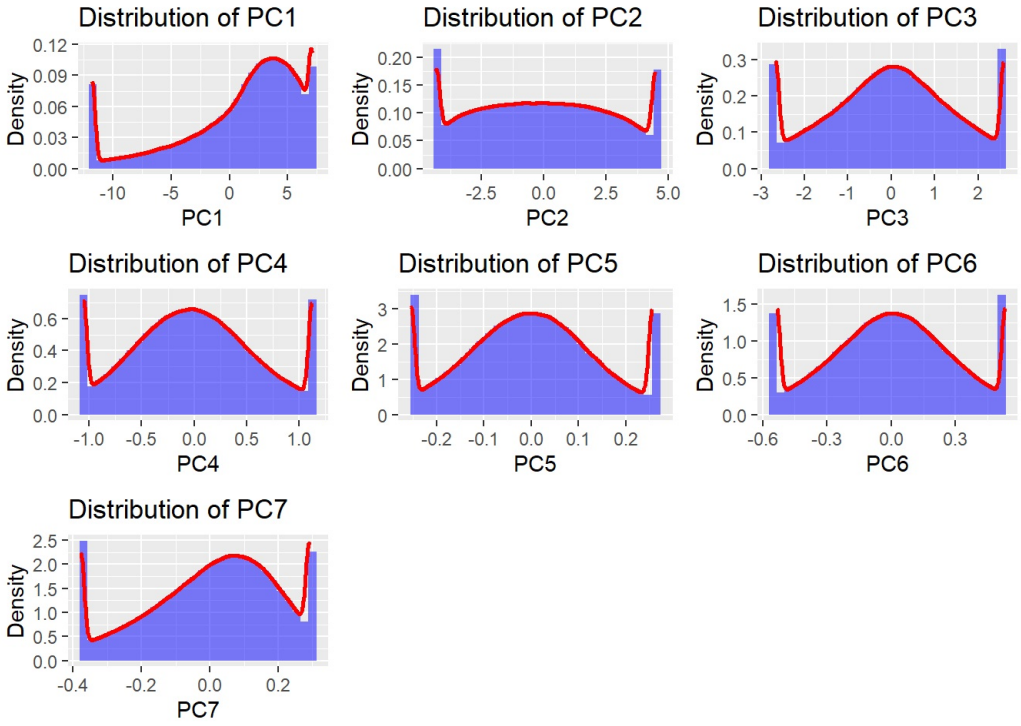
```
##      close              Date               PC1                PC2          
##  Min.   :   0.013   Length:1336810     Min.   :-321.156   Min.   :-10.43790  
##  1st Qu.:   6.950   Class :character   1st Qu.:  -1.464   1st Qu.: -2.20609  
##  Median :  29.800   Mode  :character   Median :   2.298   Median : -0.04554  
##  Mean   :  72.798                      Mean   :   0.000   Mean   :  0.00000  
##  3rd Qu.:  86.000                      3rd Qu.:   4.691   3rd Qu.:  2.13991  
##  Max.   :4900.000                      Max.   :  11.300   Max.   : 14.30648  
##       PC3                PC4                PC5                 PC6          
##  Min.   :-22.3097   Min.   :-22.60498   Min.   :-22.32528   Min.   :-41.33976  
##  1st Qu.: -1.0018   1st Qu.: -0.42571   1st Qu.: -0.09744   1st Qu.: -0.19908  
##  Median :  0.0193   Median : -0.01867   Median : -0.00279   Median :  0.00184  
##  Mean   :  0.0000   Mean   :  0.00000   Mean   :  0.00000   Mean   :  0.00000  
##  3rd Qu.:  1.0148   3rd Qu.:  0.40148   3rd Qu.:  0.09110   3rd Qu.:  0.20026  
##  Max.   : 87.2442   Max.   : 45.61329   Max.   : 97.42868   Max.   : 18.73958  
##       PC7                PC8          
##  Min.   :-9.51994   Min.   :-14.486692  
##  1st Qu.:-0.11711   1st Qu.: -0.128074  
##  Median : 0.02676   Median : -0.008422  
##  Mean   : 0.00000   Mean   :  0.000000  
##  3rd Qu.: 0.14409   3rd Qu.:  0.119418  
##  Max.   :11.17001   Max.   : 15.148364
```

```
#install.packages("DescTools")
# Load necessary libraries
library(DescTools)
```

```
##
## Attaching package: 'DescTools'
```

```
## The following object is masked from 'package:data.table':
##
##     %like%
```

```
library(ggplot2)
library(gridExtra)

# Load  data
#data <- read.csv("final.feature.feed_to_other_models17.05.2024+++.csv")

# List of PCA components
pca_columns <- c("PC1", "PC2", "PC3", "PC4", "PC5", "PC6", "PC7")

# Apply winsorization to each PCA component
for (pca in pca_columns) {
  data[[pca]] <- Winsorize(data[[pca]], probs = c(0.05, 0.95))
}

# Create a list to hold the plots
plots <- list()

# Generate histograms using tidy evaluation
for (pca in pca_columns) {
  p <- ggplot(data, aes(x = .data[[pca]])) +
    geom_histogram(aes(y = ..density..), bins = 30, fill = "blue", alpha = 0.5) +
    geom_density(color = "red", linewidth = 1) +
    labs(title = paste("Distribution of", pca), x = pca, y = "Density")
  plots[[pca]] <- p
}

# Arrange the plots in a grid
do.call(grid.arrange, c(plots, ncol = 3))
```




```
# Load necessary libraries
library(DescTools)
library(dplyr)

# Load  data
#data <- read.csv("final.feature.feed_to_other_models17.05.2024+++.csv")

# Ensure the date column is in datetime format
data$Date <- as.Date(data$Date)

# List of PCA components and other features to winsorize
pca_columns <- c("PC1", "PC2", "PC3", "PC4", "PC5", "PC6", "PC7")

# Store the number of rows before winsorization
num_rows_before <- nrow(data)

# Apply winsorization to each PCA component
for (pca in pca_columns) {
  data[[pca]] <- Winsorize(data[[pca]], probs = c(0.05, 0.95))
}

# Store the number of rows after winsorization
num_rows_after <- nrow(data)

# Print the number of rows before and after winsorization to verify they are the same
cat("Number of rows before winsorization:", num_rows_before, "\n")
```

```
## Number of rows before winsorization: 1336810
```

```
cat("Number of rows after winsorization:", num_rows_after, "\n")
```

```
## Number of rows after winsorization: 1336810
```

```r
# Function to check for NA, NaN, and infinite values in each column
check_missing_values <- function(df) {
  sapply(df, function(x) {
    list(
      `NA` = sum(is.na(x)),
      `NaN` = sum(is.nan(x)),
      `PosInf` = sum(is.infinite(x) & x > 0),
      `NegInf` = sum(is.infinite(x) & x < 0)
    )
  })
}

# Check for missing values in the dataset
missing_values_summary <- check_missing_values(data)
print(missing_values_summary)
```

```
##        close Date PC1 PC2 PC3 PC4 PC5 PC6 PC7 PC8
## NA     0     0    0   0   0   0   0   0   0   0
## NaN    0     0    0   0   0   0   0   0   0   0
## PosInf 0     0    0   0   0   0   0   0   0   0
## NegInf 0     0    0   0   0   0   0   0   0   0
```

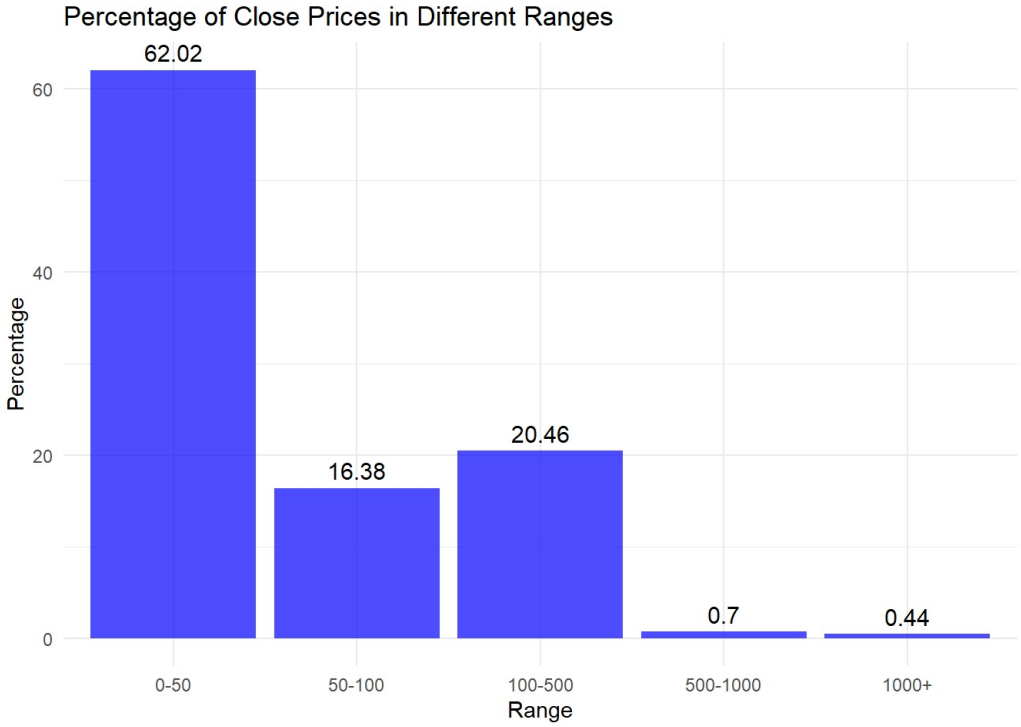
```r
# Save the updated data frame if needed
write.csv(data, "winsorized_datapca final 18.5.2024.csv", row.names = FALSE)

# Check the structure of the updated data
str(data)
```

```
## 'data.frame':    1336810 obs. of  10 variables:
##  $ close: num  83 81 80.8 80.8 81.8 82.4 83.4 81.6 82 81 ...
##  $ Date : Date, format: "2019-10-01" "2019-10-02" ...
##  $ PC1  : num  -2.27 -2.16 -1.95 -1.87 -1.59 ...
##  $ PC2  : num  -2.24 -2.15 -1.92 -1.83 -1.57 ...
##  $ PC3  : num  0.4375 -0.0801 -0.2961 -0.3346 -0.1294 ...
##  $ PC4  : num  -1.058 -1.051 -0.463 0.282 0.772 ...
##  $ PC5  : num  0.00852 0.16772 0.20536 0.16463 -0.01503 ...
##  $ PC6  : num  -0.285 0.266 0.441 0.491 0.108 ...
##  $ PC7  : num  0.00741 -0.12834 -0.03038 0.14817 0.02318 ...
##  $ PC8  : num  0.0335 -0.1648 -0.0273 0.2401 0.0899 ...
```

```r
########### close prices assessing

# Load necessary libraries
library(dplyr)


# Define the ranges
ranges <- list(
  "0-50" = c(0, 50),
  "50-100" = c(50, 100),
  "100-500" = c(100, 500),
  "500-1000" = c(500, 1000),
  "1000+" = c(1000, Inf)
)

# Function to calculate percentage of values in each range
calculate_percentage <- function(data, column, ranges) {
  total_count <- nrow(data)
  percentages <- sapply(ranges, function(range) {
    count <- sum(data[[column]] >= range[1] & data[[column]] < range[2])
    percentage <- (count / total_count) * 100
    return(percentage)
  })
  return(percentages)
}

# Calculate percentages for 'close' prices
percentages <- calculate_percentage(data, "close", ranges)

# Print the results
percentages
```

```
##       0-50     50-100    100-500   500-1000      1000+
## 62.0204816 16.3770469 20.4624442  0.6977057  0.4423216
```

```r
# Load necessary libraries
library(ggplot2)

# Define the ranges and percentages
ranges <- c("0-50", "50-100", "100-500", "500-1000", "1000+")
percentages <- c(62.02, 16.38, 20.46, 0.70, 0.44)

# Create a data frame for plotting
percentage_data <- data.frame(
  Range = factor(ranges, levels = ranges),
  Percentage = percentages
)

# Plot the histogram
ggplot(percentage_data, aes(x = Range, y = Percentage)) +
  geom_bar(stat = "identity", fill = "blue", alpha = 0.7) +
  geom_text(aes(label = round(Percentage, 2)), vjust = -0.5, size = 4) +
  labs(title = "Percentage of Close Prices in Different Ranges",
       x = "Range",
       y = "Percentage") +
  theme_minimal()
```




```r
library(dplyr)
library(DescTools)

# Winsorize the 'close' column
data$close <- Winsorize(data$close, probs = c(0.05, 0.95))

# Check the summary of the winsorized 'close' column
summary(data$close)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.098   6.950  29.800  58.159  86.000 238.000
```

```r
# Plot distribution of winsorized 'close' prices
ggplot(data, aes(x = close)) +
  geom_histogram(aes(y = ..density..), bins = 30, fill = "blue", alpha = 0.5) +
  geom_density(color = "red", size = 1) +
  labs(title = "Distribution of Winsorized Close Prices", x = "Winsorized Close", y = "Density")
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## ℹ Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```


```
# Save the updated data frame if needed
write.csv(data, "winsorized_datapca and clsoe prices final 18.5.2024.csv", row.names = FALSE)
```