**FE2010\_linear\_regression.R**

SIMATIT MUNI

Thu Oct 25 15:36:21 2018

**setwd**("C:/Users/tsraj/Desktop/Acadgild students projects/projwct1 data/New folder")

**library**(readr)

FE2010 <- **read\_csv**("FE2010.csv")

## Parsed with column specification: ## cols(

## EngDispl = col\_double(), ## NumCyl = col\_integer(), ## FE = col\_double(),

## NumGears = col\_integer(), ## TransLockup = col\_integer(),

## TransCreeperGear = col\_integer(), ## IntakeValvePerCyl = col\_integer(),

## ExhaustValvesPerCyl = col\_integer(), ## VarValveTiming = col\_integer(),

## VarValveLift = col\_integer() ## )

**View**(FE2010) **str**(FE2010)

## Classes 'tbl\_df', 'tbl' and 'data.frame': 1107 obs. of 10 variables: ## $ EngDispl : num 4.7 4.7 4.2 4.2 5.2 5.2 2 6 3 3 ...

## $ NumCyl : int 8 8 8 8 10 10 4 12 6 6 ...

## $ FE : num 28 25.6 26.8 25 24.8 ...

## $ NumGears : int 6 6 6 6 6 6 6 6 6 6 ...

## $ TransLockup : int 1 1 1 1 0 0 0 0 1 0 ...

## $ TransCreeperGear : int 0 0 0 0 0 0 0 0 0 0 ...

## $ IntakeValvePerCyl : int 2 2 2 2 2 2 2 2 2 2 ...

## $ ExhaustValvesPerCyl: int 2 2 2 2 2 2 2 2 2 2 ...

## $ VarValveTiming : int 1 1 1 1 1 1 1 1 1 1 ...

## $ VarValveLift : int 0 0 0 0 0 0 0 0 1 1 ... ## - attr(\*, "spec")=List of 2

## ..$ cols :List of 10

## .. ..$ EngDispl : list()

## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector" ## .. ..$ NumCyl : list()

## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector" ## .. ..$ FE : list()

## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector" ## .. ..$ NumGears : list()

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ TransLockup : | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ TransCreeperGear : | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ IntakeValvePerCyl : | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ ExhaustValvesPerCyl: | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ VarValveTiming : | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | .. | ..$ VarValveLift : | | list() | | |  |
| ## | .. | .. ..- attr(\*, "class")= | | chr "collector\_integer" | | | "collector" |
| ## | ..$ default: list() | | |  | |  | |
| ## | .. ..- attr(\*, "class")= chr | | | "collector\_guess" | | "collector" | |
| ## ..- attr(\*, "class")= chr "col\_spec"  **summary**(FE2010) | | | | | | | |
| ## | EngDispl | | NumCyl | | FE NumGears | | |
| ## | Min. :1.000 | | Min. : 2.000 | | Min. :17.50 Min. :1.000 | | |
| ## | 1st Qu.:2.400 | | 1st Qu.: 4.000 | | 1st Qu.:29.09 1st Qu.:5.000 | | |
| ## | Median :3.500 | | Median : 6.000 | | Median :34.51 Median :6.000 | | |
| ## | Mean :3.507 | | Mean : 5.971 | | Mean :34.71 Mean :5.268 | | |
| ## | 3rd Qu.:4.300 | | 3rd Qu.: 8.000 | | 3rd Qu.:39.20 3rd Qu.:6.000 | | |
| ## | Max. :8.400 | | Max. :16.000 | | Max. :69.64 Max. :8.000 | | |
| ## | TransLockup | | TransCreeperGear | | IntakeValvePerCyl ExhaustValvesPerCyl | | |
| ## | Min. :0.0000 | | Min. :0.00000 | | Min. :0.000 Min. :0.000 | | |
| ## | 1st Qu.:0.0000 | | 1st Qu.:0.00000 | | 1st Qu.:2.000 1st Qu.:2.000 | | |
| ## | Median :1.0000 | | Median :0.00000 | | Median :2.000 Median :2.000 | | |
| ## | Mean :0.6802 | | Mean :0.04878 | | Mean :1.862 Mean :1.837 | | |
| ## | 3rd Qu.:1.0000 | | 3rd Qu.:0.00000 | | 3rd Qu.:2.000 3rd Qu.:2.000 | | |
| ## | Max. :1.0000 | | Max. :1.00000 | | Max. :3.000 Max. :2.000 | | |
| ## | VarValveTiming | | VarValveLift | |  | | |
| ## | Min. :0.0000 | | Min. :0.0000 | |  | | |
| ## | 1st Qu.:1.0000 | | 1st Qu.:0.0000 | |  | | |
| ## | Median :1.0000 | | Median :0.0000 | |  | | |
| ## | Mean :0.8229 | | Mean :0.1671 | |  | | |
| ## | 3rd Qu.:1.0000 | | 3rd Qu.:0.0000 | |  | | |
| ## | Max. :1.0000 | | Max. :1.0000 | |  | | |
| **library**(ggplot2) **library**(reshape2) **library**(corrplot)  ## corrplot 0.84 loaded  **library**(e1071) **library**(caret)  ## Loading required package: lattice | | | | | | | |

**library**(rpart) **library**(C50) **library**(party)

## Loading required package: grid

## Loading required package: mvtnorm

## Loading required package: modeltools

## Loading required package: stats4

## Loading required package: strucchange

## Loading required package: zoo

##

## Attaching package: 'zoo'

## The following objects are masked from 'package:base': ##

## as.Date, as.Date.numeric

## Loading required package: sandwich

*#library(partykit)*

**library**(randomForest)

## randomForest 4.6-14

## Type rfNews() to see new features/changes/bug fixes.

##

## Attaching package: 'randomForest'

## The following object is masked from 'package:ggplot2': ##

## margin

**library**(ROCR)

## Loading required package: gplots

##

## Attaching package: 'gplots'

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

## lowess

**library**(dplyr)

##

## Attaching package: 'dplyr'

## The following object is masked from 'package:randomForest': ##

## combine

## The following objects are masked from 'package:stats': ##

## filter, lag

## The following objects are masked from 'package:base': ##

## intersect, setdiff, setequal, union

**library**(car)

## Loading required package: carData

##

## Attaching package: 'car'

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

## recode

## The following object is masked from 'package:modeltools': ##

## Predict

mydata<-FE2010

**head**(mydata)

## # A tibble: 6 x 10

## EngDispl NumCyl FE NumGears TransLockup TransCreeperGear ## <dbl> <int> <dbl> <int> <int> <int> ## 1 4.7 8 28.0 6 1 0

## 2 4.7 8 25.6 6 1 0

## 3 4.2 8 26.8 6 1 0

## 4 4.2 8 25.0 6 1 0

## 5 5.2 10 24.8 6 0 0

## 6 5.2 10 23.9 6 0 0

## # ... with 4 more variables: IntakeValvePerCyl <int>,

## # ExhaustValvesPerCyl <int>, VarValveTiming <int>, VarValveLift <int>

**summary**(mydata)

## EngDispl NumCyl FE NumGears ## Min. :1.000 Min. : 2.000 Min. :17.50 Min. :1.000 ## 1st Qu.:2.400 1st Qu.: 4.000 1st Qu.:29.09 1st Qu.:5.000

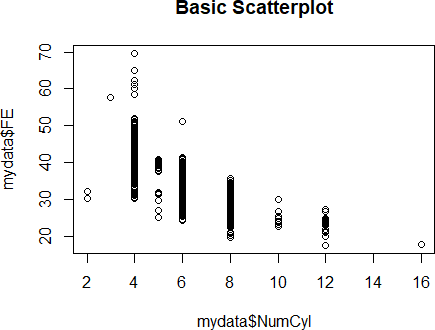
## Median :3.500 Median : 6.000 Median :34.51 Median :6.000

## Mean :3.507 Mean : 5.971 Mean :34.71 Mean :5.268 ## 3rd Qu.:4.300 3rd Qu.: 8.000 3rd Qu.:39.20 3rd Qu.:6.000 ## Max. :8.400 Max. :16.000 Max. :69.64 Max. :8.000

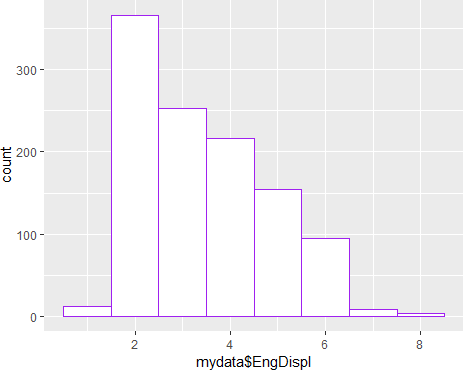
## TransLockup TransCreeperGear IntakeValvePerCyl ExhaustValvesPerCyl

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ## | Min. :0.0000 | Min. :0.00000 | | Min. :0.000 | | Min. :0.000 |
| ## | 1st Qu.:0.0000 | 1st Qu.:0.00000 | | 1st Qu.:2.000 | | 1st Qu.:2.000 |
| ## | Median :1.0000 | Median :0.00000 | | Median :2.000 | | Median :2.000 |
| ## | Mean :0.6802 | Mean :0.04878 | | Mean :1.862 | | Mean :1.837 |
| ## | 3rd Qu.:1.0000 | 3rd Qu.:0.00000 | | 3rd Qu.:2.000 | | 3rd Qu.:2.000 |
| ## | Max. :1.0000 | Max. :1.00000 | | Max. :3.000 | | Max. :2.000 |
| ## | VarValveTiming | VarValveLift | |  | |  |
| ## | Min. :0.0000 | Min. :0.0000 | |  | |  |
| ## | 1st Qu.:1.0000 | 1st Qu.:0.0000 | |  | |  |
| ## | Median :1.0000 | Median :0.0000 | |  | |  |
| ## | Mean :0.8229 | Mean :0.1671 | |  | |  |
| ## | 3rd Qu.:1.0000 | 3rd Qu.:0.0000 | |  | |  |
| ## | Max. :1.0000 | Max. :1.0000 | |  | |  |
| **View**(mydata) **sapply**(mydata, sd) | | | | | | |
| ## | EngDispl | | NumCyl | | FE | |
| ## | 1.3059051 | | 1.9005745 | | 7.4980326 | |
| ## | NumGears | | TransLockup | | TransCreeperGear | |
| ## | 1.3966238 | | 0.4666032 | | 0.2155062 | |
| ## | IntakeValvePerCyl | | ExhaustValvesPerCyl | | VarValveTiming | |
| ## | 0.3530462 | | 0.3740349 | | 0.3818879 | |
| ## | VarValveLift | |  | |  | |
| ## | 0.3732501 | |  | |  | |
| cormatrix <- **round**(**cor**(mydata), digits = 2 ) cormatrix | | | | | | |
| ## |  | | EngDispl NumCyl | FE NumGears TransLockup | | |
| ## | EngDispl | | 1.00 0.91 | -0.79 0.21 0.23 | | |
| ## | NumCyl | | 0.91 1.00 | -0.74 0.29 0.21 | | |
| ## | FE | | -0.79 -0.74 | 1.00 -0.21 -0.27 | | |
| ## | NumGears | | 0.21 0.29 | -0.21 1.00 0.00 | | |
| ## | TransLockup | | 0.23 0.21 | -0.27 0.00 1.00 | | |
| ## | TransCreeperGear | | 0.03 0.03 | -0.07 0.04 0.09 | | |
| ## | IntakeValvePerCyl | | -0.42 -0.25 | 0.28 0.18 -0.13 | | |
| ## | ExhaustValvesPerCyl | | -0.48 -0.34 | 0.34 0.15 -0.16 | | |
| ## | VarValveTiming | | -0.07 0.01 | 0.12 0.09 -0.09 | | |
| ## | VarValveLift | | -0.09 -0.06 | 0.10 0.13 -0.10 | | |
| ## |  | | TransCreeperGear | IntakeValvePerCyl ExhaustValvesPerCyl | | |
| ## | EngDispl | | 0.03 | -0.42 -0.48 | | |
| ## | NumCyl | | 0.03 | -0.25 -0.34 | | |
| ## | FE | | -0.07 | 0.28 0.34 | | |
| ## | NumGears | | 0.04 | 0.18 0.15 | | |
| ## | TransLockup | | 0.09 | -0.13 -0.16 | | |
| ## | TransCreeperGear | | 1.00 | -0.08 -0.17 | | |
| ## | IntakeValvePerCyl | | -0.08 | 1.00 0.91 | | |
| ## | ExhaustValvesPerCyl | | -0.17 | 0.91 1.00 | | |
| ## | VarValveTiming | | -0.24 | 0.24 0.28 | | |
| ## | VarValveLift | | -0.10 | 0.15 0.18 | | |

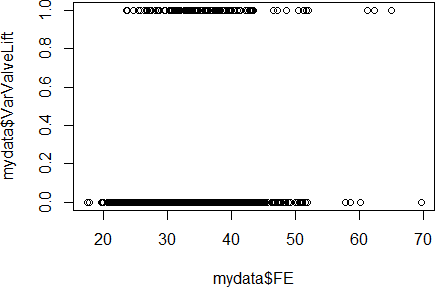
|  |  |  |  |
| --- | --- | --- | --- |
| ## |  | VarValveTiming | VarValveLift |
| ## | EngDispl | -0.07 | -0.09 |
| ## | NumCyl | 0.01 | -0.06 |
| ## | FE | 0.12 | 0.10 |
| ## | NumGears | 0.09 | 0.13 |
| ## | TransLockup | -0.09 | -0.10 |
| ## | TransCreeperGear | -0.24 | -0.10 |
| ## | IntakeValvePerCyl | 0.24 | 0.15 |
| ## | ExhaustValvesPerCyl | 0.28 | 0.18 |
| ## | VarValveTiming | 1.00 | 0.06 |
| ## | VarValveLift | 0.06 | 1.00 |
| **plot.new**()  **plot**(mydata**$**FE **~**mydata**$**NumCyl) **title**('Basic Scatterplot') | | | |



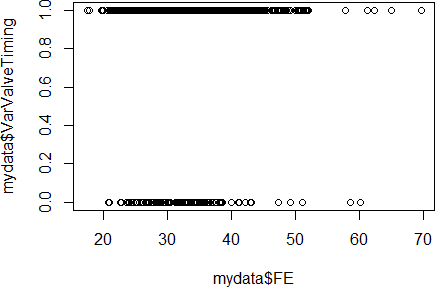
**ggplot**(mydata, **aes**(x=mydata**$**EngDispl)) **+ geom\_histogram**(binwidth = 1, fill = "white", color = "purple")



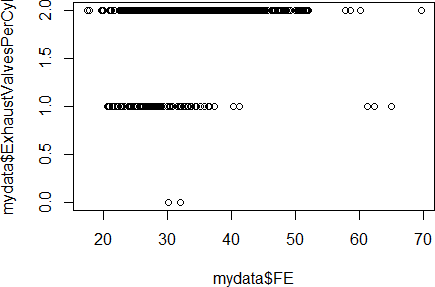
**plot**(mydata**$**FE,mydata**$**VarValveLift)



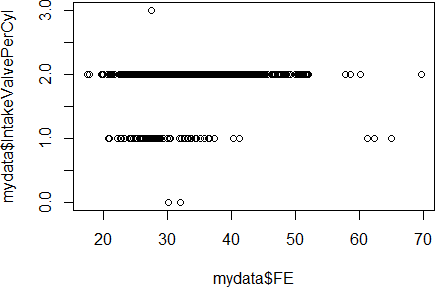
**plot**(mydata**$**FE,mydata**$**VarValveTiming)



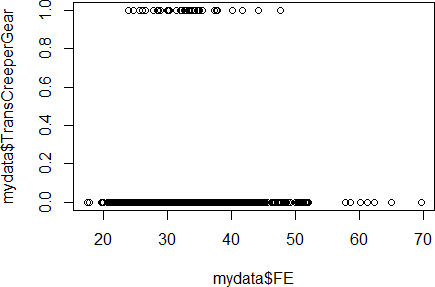
**plot**(mydata**$**FE,mydata**$**ExhaustValvesPerCyl)



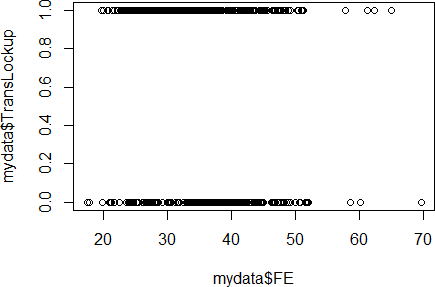
**plot**(mydata**$**FE,mydata**$**IntakeValvePerCyl)



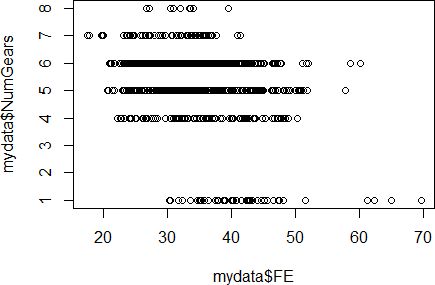
**plot**(mydata**$**FE,mydata**$**TransCreeperGear)



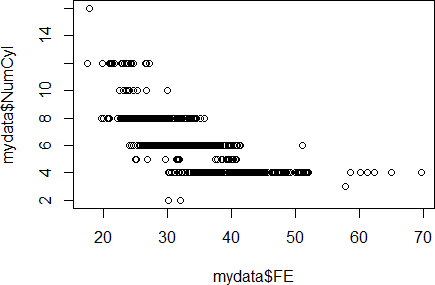
**plot**(mydata**$**FE,mydata**$**TransLockup)



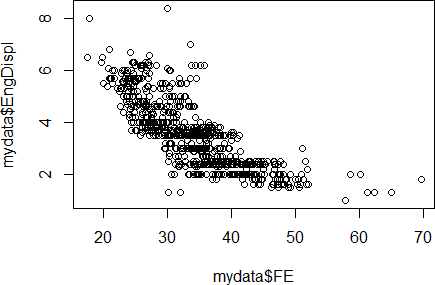
**plot**(mydata**$**FE,mydata**$**NumGears)



**plot**(mydata**$**FE,mydata**$**NumCyl)



**plot**(mydata**$**FE,mydata**$**EngDispl)



**cor**(mydata**$**FE,mydata**$**EngDispl)

## [1] -0.7873938

**cor**(mydata**$**FE,mydata**$**VarValveLift)

## [1] 0.09621127

**cor**(mydata**$**FE,mydata**$**VarValveTiming)

## [1] 0.1249528

**cor**(mydata**$**FE,mydata**$**ExhaustValvesPerCyl)

## [1] 0.3356529

**cor**(mydata**$**FE,mydata**$**IntakeValvePerCyl)

## [1] 0.280344

**cor**(mydata**$**FE,mydata**$**TransCreeperGear)

## [1] -0.06962168

**cor**(mydata**$**FE,mydata**$**TransLockup)

## [1] -0.2719389

**cor**(mydata**$**FE,mydata**$**NumGears)

## [1] -0.2112849

**cor**(mydata**$**FE,mydata**$**NumCyl)

## [1] -0.740218

mod=**lm**(mydata**$**FE**~**mydata**$**EngDispl) mod

##

## Call:

## lm(formula = mydata$FE ~ mydata$EngDispl) ##

## Coefficients:

## (Intercept) mydata$EngDispl ## 50.563 -4.521

**summary**(mod)

##

## Call:

## lm(formula = mydata$FE ~ mydata$EngDispl) ##

## Residuals:

## Min 1Q Median 3Q Max ## -14.486 -3.192 -0.365 2.671 27.215

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ##  ## Coefficients:  ## Estimate Std. Error t value Pr(>|t|)  ## (Intercept) 50.5632 0.3985 126.89 <2e-16 \*\*\*  ## mydata$EngDispl -4.5209 0.1065 -42.46 <2e-16 \*\*\* ## ---  ## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 ##  ## Residual standard error: 4.624 on 1105 degrees of freedom ## Multiple R-squared: 0.62, Adjusted R-squared: 0.6196 ## F-statistic: 1803 on 1 and 1105 DF, p-value: < 2.2e-16  **predict**(mod) | | | | | | | | |
| ## | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| ## | 29.31486 | 29.31486 | 31.57533 | 31.57533 | 27.05440 | 27.05440 | 41.52137 | 23.43765 |
| ## | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| ## | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 14.39580 | 22.53347 | 22.53347 | 22.53347 |
| ## | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| ## | 18.91672 | 12.58742 | 12.58742 | 30.21905 | 24.79393 | 24.79393 | 27.05440 | 27.05440 |
| ## | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| ## | 27.05440 | 27.05440 | 21.17719 | 21.17719 | 21.17719 | 21.17719 | 21.17719 | 42.42556 |
| ## | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| ## | 42.42556 | 41.52137 | 41.52137 | 41.52137 | 25.69812 | 37.00044 | 34.73998 | 34.73998 |
| ## | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| ## | 34.73998 | 25.69812 | 46.04230 | 46.04230 | 33.83579 | 33.83579 | 33.83579 | 33.83579 |
| ## | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| ## | 41.52137 | 41.52137 | 39.71300 | 39.71300 | 33.38370 | 33.38370 | 37.45254 | 37.45254 |
| ## | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 |
| ## | 35.19207 | 35.19207 | 37.45254 | 37.45254 | 35.19207 | 35.19207 | 41.52137 | 41.52137 |
| ## | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| ## | 39.71300 | 39.71300 | 31.57533 | 23.88975 | 23.88975 | 23.88975 | 23.88975 | 31.12323 |
| ## | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| ## | 27.95858 | 27.95858 | 27.95858 | 31.12323 | 34.73998 | 43.32974 | 43.32974 | 43.32974 |
| ## | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| ## | 43.32974 | 43.32974 | 43.32974 | 43.32974 | 43.32974 | 43.32974 | 43.32974 | 39.71300 |
| ## | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 |
| ## | 33.38370 | 34.28788 | 34.28788 | 34.28788 | 34.28788 | 34.28788 | 34.28788 | 34.28788 |
| ## | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 |
| ## | 34.28788 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 34.28788 |
| ## | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 |
| ## | 34.28788 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 33.38370 | 33.38370 |
| ## | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| ## | 33.38370 | 33.38370 | 33.38370 | 39.26091 | 23.88975 | 41.52137 | 41.52137 | 41.52137 |
| ## | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 |
| ## | 41.52137 | 36.09626 | 31.57533 | 31.57533 | 37.00044 | 41.52137 | 23.43765 | 37.00044 |
| ## | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 |
| ## | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 |
| ## | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 |
| ## | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ## | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 |
| ## | 37.00044 | 37.00044 | 37.00044 | 28.86277 | 28.86277 | 28.86277 | 28.86277 | 32.47951 |
| ## | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 |
| ## | 32.47951 | 32.47951 | 32.47951 | 27.95858 | 27.95858 | 27.95858 | 27.95858 | 43.32974 |
| ## | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 |
| ## | 43.32974 | 40.61719 | 40.61719 | 41.52137 | 40.61719 | 32.47951 | 32.47951 | 29.76696 |
| ## | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 |
| ## | 29.76696 | 26.15021 | 42.42556 | 42.42556 | 42.42556 | 41.52137 | 41.52137 | 41.52137 |
| ## | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 |
| ## | 33.38370 | 33.38370 | 33.83579 | 33.83579 | 33.83579 | 33.83579 | 33.83579 | 39.26091 |
| ## | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 |
| ## | 39.26091 | 39.26091 | 34.73998 | 27.95858 | 31.57533 | 29.31486 | 29.31486 | 44.68602 |
| ## | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 |
| ## | 44.68602 | 34.73998 | 25.69812 | 43.32974 | 43.32974 | 43.32974 | 43.32974 | 43.32974 |
| ## | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 |
| ## | 39.71300 | 39.71300 | 33.38370 | 33.38370 | 39.26091 | 39.26091 | 34.73998 | 34.73998 |
| ## | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 |
| ## | 33.38370 | 40.61719 | 40.61719 | 40.61719 | 40.61719 | 40.61719 | 29.76696 | 29.76696 |
| ## | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 |
| ## | 41.52137 | 41.52137 | 43.32974 | 43.32974 | 39.71300 | 39.71300 | 42.42556 | 42.42556 |
| ## | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 |
| ## | 43.78184 | 43.78184 | 41.52137 | 41.52137 | 39.26091 | 39.26091 | 39.26091 | 39.26091 |
| ## | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 |
| ## | 39.71300 | 39.71300 | 34.73998 | 41.52137 | 41.52137 | 41.52137 | 37.00044 | 37.00044 |
| ## | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 |
| ## | 19.82091 | 19.82091 | 23.43765 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 |
| ## | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 |
| ## | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 32.47951 | 32.47951 | 43.32974 | 43.32974 |
| ## | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 |
| ## | 34.28788 | 34.28788 | 22.53347 | 22.53347 | 40.61719 | 40.61719 | 40.61719 | 39.71300 |
| ## | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 |
| ## | 38.35672 | 34.73998 | 34.73998 | 24.79393 | 24.79393 | 22.98556 | 22.98556 | 41.52137 |
| ## | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 |
| ## | 41.52137 | 39.71300 | 39.71300 | 34.73998 | 34.73998 | 44.68602 | 44.68602 | 44.68602 |
| ## | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 |
| ## | 43.32974 | 43.32974 | 43.32974 | 41.52137 | 41.52137 | 41.52137 | 39.71300 | 39.71300 |
| ## | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 |
| ## | 43.32974 | 43.32974 | 34.73998 | 39.71300 | 41.52137 | 41.52137 | 39.26091 | 39.26091 |
| ## | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 |
| ## | 37.00044 | 37.00044 | 34.73998 | 37.00044 | 34.73998 | 34.73998 | 22.08138 | 25.69812 |
| ## | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 |
| ## | 25.69812 | 22.08138 | 23.43765 | 25.69812 | 22.08138 | 41.52137 | 41.52137 | 41.52137 |
| ## | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 |
| ## | 39.71300 | 39.71300 | 41.52137 | 41.52137 | 43.32974 | 43.32974 | 39.71300 | 39.71300 |
| ## | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 |
| ## | 39.71300 | 39.71300 | 34.73998 | 34.73998 | 34.28788 | 34.28788 | 20.27300 | 20.27300 |
| ## | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 |
| ## | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 39.26091 | 39.26091 | 39.26091 |
| ## | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 |
| ## | 39.26091 | 39.71300 | 39.71300 | 39.71300 | 39.71300 | 39.71300 | 39.71300 | 41.52137 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ## | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 |
| ## | 41.52137 | 41.52137 | 41.52137 | 42.42556 | 42.42556 | 39.71300 | 39.71300 | 41.52137 |
| ## | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 |
| ## | 41.52137 | 34.28788 | 34.28788 | 41.52137 | 41.52137 | 39.26091 | 39.26091 | 41.52137 |
| ## | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 |
| ## | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 39.26091 | 39.26091 | 39.71300 |
| ## | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 |
| ## | 39.71300 | 39.26091 | 39.26091 | 39.26091 | 39.26091 | 39.71300 | 39.71300 | 39.26091 |
| ## | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 |
| ## | 39.26091 | 33.83579 | 34.73998 | 33.83579 | 33.83579 | 36.09626 | 37.00044 | 31.57533 |
| ## | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 |
| ## | 31.57533 | 27.05440 | 23.43765 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 |
| ## | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 |
| ## | 37.00044 | 37.00044 | 37.00044 | 28.86277 | 28.86277 | 27.95858 | 27.95858 | 39.71300 |
| ## | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 |
| ## | 37.00044 | 34.28788 | 37.00044 | 37.00044 | 37.00044 | 34.28788 | 34.28788 | 22.53347 |
| ## | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 |
| ## | 22.53347 | 37.00044 | 34.28788 | 34.28788 | 29.76696 | 34.28788 | 29.76696 | 39.71300 |
| ## | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 |
| ## | 39.71300 | 39.71300 | 39.71300 | 34.73998 | 34.73998 | 34.28788 | 39.71300 | 39.71300 |
| ## | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 |
| ## | 38.35672 | 34.73998 | 39.71300 | 38.35672 | 34.73998 | 24.79393 | 24.79393 | 34.73998 |
| ## | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 |
| ## | 37.00044 | 39.26091 | 39.26091 | 37.00044 | 34.73998 | 39.26091 | 39.26091 | 39.26091 |
| ## | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 |
| ## | 41.52137 | 41.52137 | 41.52137 | 33.83579 | 33.83579 | 33.83579 | 31.57533 | 27.95858 |
| ## | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 |
| ## | 27.95858 | 39.71300 | 39.71300 | 38.35672 | 34.73998 | 34.73998 | 34.73998 | 29.76696 |
| ## | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 |
| ## | 29.76696 | 29.76696 | 29.76696 | 29.76696 | 27.95858 | 37.00044 | 39.26091 | 39.26091 |
| ## | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 |
| ## | 37.00044 | 39.26091 | 39.26091 | 39.26091 | 34.73998 | 34.73998 | 39.26091 | 39.26091 |
| ## | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 |
| ## | 33.83579 | 40.16509 | 34.73998 | 34.73998 | 25.69812 | 25.69812 | 22.08138 | 39.71300 |
| ## | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 |
| ## | 39.26091 | 34.73998 | 34.73998 | 39.26091 | 34.73998 | 41.52137 | 41.52137 | 39.26091 |
| ## | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 |
| ## | 39.26091 | 43.32974 | 43.32974 | 42.42556 | 42.42556 | 42.42556 | 20.27300 | 37.90463 |
| ## | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 |
| ## | 39.71300 | 39.71300 | 34.28788 | 39.26091 | 39.26091 | 39.26091 | 34.28788 | 39.26091 |
| ## | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 |
| ## | 39.26091 | 34.73998 | 39.71300 | 42.42556 | 41.52137 | 37.00044 | 30.67114 | 36.09626 |
| ## | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 |
| ## | 31.57533 | 37.00044 | 30.67114 | 30.67114 | 30.67114 | 30.67114 | 30.67114 | 30.67114 |
| ## | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 |
| ## | 23.43765 | 32.93161 | 32.93161 | 29.76696 | 29.76696 | 29.76696 | 29.76696 | 29.76696 |
| ## | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 |
| ## | 34.73998 | 34.73998 | 32.93161 | 34.73998 | 24.79393 | 38.35672 | 34.73998 | 24.79393 |
| ## | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 |
| ## | 22.98556 | 38.35672 | 34.73998 | 24.79393 | 22.98556 | 34.73998 | 24.79393 | 29.76696 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ## | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 |
| ## | 34.73998 | 34.73998 | 34.73998 | 34.73998 | 39.71300 | 39.71300 | 34.73998 | 35.64416 |
| ## | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 |
| ## | 33.38370 | 33.38370 | 29.76696 | 39.71300 | 39.71300 | 35.64416 | 34.73998 | 34.73998 |
| ## | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 |
| ## | 30.21905 | 30.21905 | 27.95858 | 27.95858 | 27.95858 | 29.76696 | 34.73998 | 34.73998 |
| ## | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 |
| ## | 34.73998 | 29.76696 | 31.57533 | 29.31486 | 25.69812 | 23.43765 | 23.43765 | 25.69812 |
| ## | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 |
| ## | 25.69812 | 25.69812 | 22.08138 | 23.43765 | 34.73998 | 28.86277 | 28.86277 | 28.86277 |
| ## | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 |
| ## | 20.72510 | 20.27300 | 34.73998 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 41.52137 |
| ## | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 |
| ## | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 34.28788 | 37.00044 | 34.28788 |
| ## | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 |
| ## | 41.52137 | 41.52137 | 39.71300 | 39.71300 | 43.78184 | 43.78184 | 43.78184 | 41.52137 |
| ## | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 |
| ## | 41.52137 | 34.73998 | 34.73998 | 43.32974 | 43.32974 | 41.52137 | 41.52137 | 41.52137 |
| ## | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 |
| ## | 39.71300 | 39.71300 | 42.42556 | 42.42556 | 42.42556 | 42.42556 | 39.71300 | 39.71300 |
| ## | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 |
| ## | 39.71300 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 39.26091 | 39.26091 |
| ## | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 |
| ## | 39.26091 | 39.26091 | 39.26091 | 41.52137 | 41.52137 | 41.52137 | 41.52137 | 42.42556 |
| ## | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 |
| ## | 42.42556 | 39.71300 | 39.71300 | 39.71300 | 39.71300 | 39.71300 | 41.52137 | 41.52137 |
| ## | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 |
| ## | 39.26091 | 39.26091 | 39.26091 | 39.26091 | 39.71300 | 39.26091 | 39.26091 | 37.00044 |
| ## | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 |
| ## | 37.00044 | 37.00044 | 39.71300 | 38.35672 | 41.52137 | 36.09626 | 37.45254 | 37.45254 |
| ## | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 |
| ## | 33.83579 | 26.60230 | 33.83579 | 37.45254 | 37.45254 | 33.83579 | 26.60230 | 40.16509 |
| ## | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 |
| ## | 40.16509 | 32.47951 | 32.47951 | 37.45254 | 37.45254 | 33.83579 | 26.60230 | 33.83579 |
| ## | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 |
| ## | 37.45254 | 37.45254 | 33.83579 | 26.60230 | 39.26091 | 39.26091 | 32.47951 | 32.47951 |
| ## | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 |
| ## | 39.26091 | 39.26091 | 32.47951 | 38.35672 | 38.35672 | 32.47951 | 32.47951 | 37.45254 |
| ## | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 |
| ## | 37.45254 | 33.83579 | 26.60230 | 33.83579 | 33.83579 | 26.60230 | 32.47951 | 32.47951 |
| ## | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 |
| ## | 37.45254 | 37.45254 | 33.83579 | 26.60230 | 33.83579 | 33.83579 | 26.60230 | 32.47951 |
| ## | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 |
| ## | 32.47951 | 32.47951 | 38.35672 | 32.47951 | 32.47951 | 31.12323 | 28.86277 | 26.60230 |
| ## | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 |
| ## | 22.53347 | 23.43765 | 26.60230 | 33.83579 | 29.31486 | 33.83579 | 29.31486 | 24.79393 |
| ## | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 |
| ## | 32.47951 | 29.76696 | 26.15021 | 29.76696 | 29.76696 | 31.12323 | 28.86277 | 26.60230 |
| ## | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 |
| ## | 22.53347 | 23.43765 | 26.60230 | 25.24603 | 25.24603 | 32.47951 | 29.76696 | 24.79393 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ## | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 |
| ## | 31.12323 | 28.86277 | 26.60230 | 22.53347 | 23.43765 | 33.83579 | 29.31486 | 29.31486 |
| ## | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 |
| ## | 24.79393 | 32.47951 | 29.76696 | 26.15021 | 29.76696 | 29.76696 | 31.12323 | 28.86277 |
| ## | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 |
| ## | 26.60230 | 22.53347 | 23.43765 | 22.53347 | 34.73998 | 33.83579 | 33.83579 | 26.60230 |
| ## | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 |
| ## | 25.24603 | 25.24603 | 29.76696 | 24.79393 | 24.79393 | 31.12323 | 26.60230 | 26.60230 |
| ## | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 |
| ## | 26.60230 | 26.60230 | 31.12323 | 26.60230 | 26.60230 | 26.60230 | 26.60230 | 26.60230 |
| ## | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 |
| ## | 26.60230 | 26.60230 | 26.60230 | 41.52137 | 35.64416 | 33.38370 | 32.47951 | 35.64416 |
| ## | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 |
| ## | 33.38370 | 32.47951 | 34.73998 | 34.73998 | 33.38370 | 33.38370 | 40.16509 | 40.16509 |
| ## | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 |
| ## | 34.73998 | 33.38370 | 32.47951 | 34.73998 | 40.16509 | 34.28788 | 22.53347 | 23.43765 |
| ## | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 |
| ## | 22.53347 | 37.00044 | 26.60230 | 22.53347 | 26.60230 | 22.53347 | 26.60230 | 23.43765 |
| ## | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 |
| ## | 39.71300 | 37.00044 | 41.52137 | 41.52137 | 40.61719 | 40.61719 | 39.71300 | 39.71300 |
| ## | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 |
| ## | 40.61719 | 40.61719 | 39.71300 | 39.71300 | 34.28788 | 39.71300 | 39.71300 | 34.73998 |
| ## | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 |
| ## | 33.83579 | 32.47951 | 34.73998 | 39.26091 | 39.26091 | 37.00044 | 39.26091 | 26.15021 |
| ## | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 |
| ## | 32.47951 | 29.76696 | 34.73998 | 34.28788 | 26.60230 | 22.53347 | 23.43765 | 26.60230 |
| ## | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 |
| ## | 22.53347 | 22.53347 | 39.71300 | 37.00044 | 34.73998 | 39.71300 | 39.71300 | 39.71300 |
| ## | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 |
| ## | 34.73998 | 39.71300 | 39.71300 | 34.73998 | 39.71300 | 39.71300 | 33.38370 | 34.73998 |
| ## | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 |
| ## | 25.24603 | 33.83579 | 24.79393 | 41.52137 | 41.52137 | 39.71300 | 39.71300 | 33.83579 |
| ## | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 |
| ## | 24.79393 | 33.83579 | 41.52137 | 41.52137 | 39.71300 | 39.71300 | 33.38370 | 33.38370 |
| ## | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 |
| ## | 29.76696 | 41.52137 | 41.52137 | 38.35672 | 34.73998 | 34.73998 | 34.73998 | 34.73998 |
| ## | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 |
| ## | 26.15021 | 40.16509 | 39.26091 | 33.83579 | 39.26091 | 39.26091 | 37.00044 | 39.26091 |
| ## | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 |
| ## | 34.73998 | 34.73998 | 39.26091 | 37.00044 | 39.26091 | 32.47951 | 29.76696 | 39.71300 |
| ## | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 |
| ## | 37.00044 | 33.38370 | 25.24603 | 25.24603 | 34.73998 | 32.47951 | 32.47951 | 39.26091 |
| ## | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 |
| ## | 32.47951 | 32.47951 | 34.28788 | 39.71300 | 34.28788 | 34.28788 | 39.71300 | 39.71300 |
| ## | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 |
| ## | 39.71300 | 36.09626 | 38.35672 | 32.47951 | 32.47951 | 38.35672 | 34.73998 | 39.26091 |
| ## | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 |
| ## | 34.73998 | 29.76696 | 24.79393 | 38.35672 | 34.73998 | 41.52137 | 41.52137 | 36.09626 |
| ## | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 |
| ## | 36.09626 | 34.73998 | 40.16509 | 33.83579 | 36.09626 | 37.00044 | 34.28788 | 31.57533 |

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| ## | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 |
| ## | 30.67114 | 37.00044 | 37.00044 | 37.00044 | 37.00044 | 28.86277 | 30.67114 | 37.00044 |
| ## | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 |
| ## | 30.67114 | 30.67114 | 34.28788 | 22.53347 | 37.90463 | 37.00044 | 39.71300 | 37.00044 |
| ## | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 |
| ## | 26.60230 | 23.43765 | 34.28788 | 34.73998 | 33.83579 | 32.47951 | 34.73998 | 39.26091 |
| ## | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 |
| ## | 37.00044 | 39.26091 | 26.15021 | 32.47951 | 29.76696 | 34.73998 | 34.73998 | 34.28788 |
| ## | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 |
| ## | 26.60230 | 23.43765 | 22.53347 | 39.71300 | 37.00044 | 34.73998 | 39.71300 | 39.71300 |
| ## | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 |
| ## | 39.71300 | 34.73998 | 33.83579 | 33.83579 | 26.60230 | 39.71300 | 34.73998 | 39.71300 |
| ## | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 |
| ## | 39.71300 | 33.38370 | 34.73998 | 27.95858 | 25.24603 | 33.83579 | 24.79393 | 39.71300 |
| ## | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 |
| ## | 39.71300 | 33.83579 | 24.79393 | 22.98556 | 33.83579 | 39.71300 | 39.71300 | 39.71300 |
| ## | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 |
| ## | 33.38370 | 33.38370 | 33.38370 | 29.76696 | 41.52137 | 38.35672 | 36.09626 | 27.95858 |
| ## | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 | 1023 | 1024 |
| ## | 27.95858 | 27.95858 | 27.95858 | 27.95858 | 29.76696 | 24.79393 | 34.73998 | 34.73998 |
| ## | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 |
| ## | 34.73998 | 34.73998 | 34.73998 | 40.16509 | 33.83579 | 39.26091 | 37.00044 | 39.26091 |
| ## | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 |
| ## | 26.15021 | 25.69812 | 37.00044 | 29.31486 | 25.69812 | 34.73998 | 34.73998 | 37.00044 |
| ## | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 |
| ## | 25.69812 | 22.08138 | 34.73998 | 34.73998 | 37.00044 | 39.26091 | 37.00044 | 39.26091 |
| ## | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 |
| ## | 32.47951 | 29.76696 | 39.71300 | 37.00044 | 33.38370 | 25.24603 | 25.24603 | 34.73998 |
| ## | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 |
| ## | 32.47951 | 25.24603 | 39.26091 | 32.47951 | 32.47951 | 34.28788 | 34.28788 | 28.86277 |
| ## | 1065 | 1066 | 1067 | 1068 | 1069 | 1070 | 1071 | 1072 |
| ## | 28.86277 | 28.86277 | 28.86277 | 28.86277 | 28.86277 | 28.86277 | 34.28788 | 34.73998 |
| ## | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 |
| ## | 34.28788 | 34.28788 | 39.26091 | 39.26091 | 39.26091 | 39.26091 | 39.26091 | 34.28788 |
| ## | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 |
| ## | 34.28788 | 39.71300 | 39.71300 | 36.09626 | 32.47951 | 32.47951 | 32.47951 | 32.47951 |
| ## | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 |
| ## | 34.73998 | 35.64416 | 24.79393 | 39.26091 | 34.73998 | 29.76696 | 24.79393 | 24.79393 |
| ## | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 |
| ## | 38.35672 | 34.73998 | 41.52137 | 37.00044 | 34.28788 | 37.00044 | 36.09626 | 37.00044 |
| ## | 1105 | 1106 | 1107 |  |  |  |  |  |
| ## | 36.09626 | 36.09626 | 30.67114 |  |  |  |  |  |
| pred=**predict**(mod) mydata**$**predicted=NA mydata**$**predicted=pred mydata**$**error=mod**$**residuals **library**(car)  **dwt**(mod) | | | | | | | | |

**plot**(mydata**$**FE,mydata**$**EngDispl,**abline**(**lm**(mydata**$**FE**~**mydata**$**EngDispl),col="oran

ge"))

Alternative hypothesis: rho != 0

0

0.891743

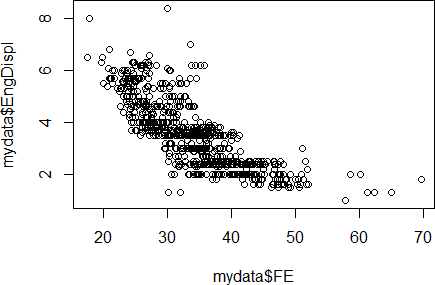
0.55367

1

lag Autocorrelation D-W Statistic p-value

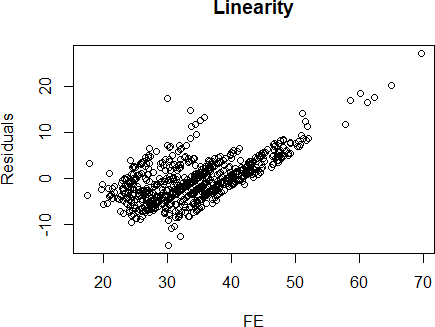
##

## ##

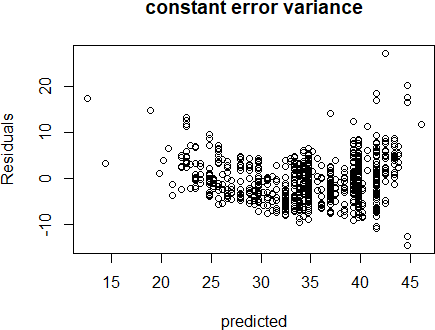


*#Assumption1 Linearity*

**plot**(mydata**$**FE,mydata**$**error,xlab="FE",ylab="Residuals",main="Linearity")

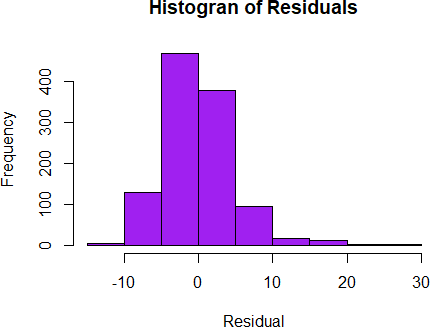


*#Assumption 2 constant error variance* **plot**(mydata**$**predicted,mydata**$**error, xlab="predicted", ylab="Residuals",main="constant error variance")



*#Assumption 3 constant error variance #plot(mydata$observation.no,mydata$error, xlab="observation.no",ylab="Residuals",main="independence of error") #Assumption 4: Normality*

**hist**(mydata**$**error, xlab="Residual", main="Histogran of Residuals",col="purple")



## # ... with 6 more variables: IntakeValvePerCyl <int>,

## # ExhaustValvesPerCyl <int>, VarValveTiming <int>, VarValveLift <int>, ## # predicted <dbl>, error <dbl>

FE2010new<-mydata

**head**(FE2010new)

<int>

0

0

0

0

0

0

<int>

1

1

1

1

0

0

<int>

6

6

6

6

6

6

28.0

25.6

26.8

25.0

24.8

23.9

8

8

8

8

10

10

<int> <dbl>

<dbl>

4.7

4.7

4.2

4.2

5.2

5.2

FE NumGears TransLockup TransCreeperGear

EngDispl NumCyl

##

## ## 1

## 2

## 3

## 4

## 5

## 6

*#Save all newly inserted variables like predicted, error along with original*

*variables in a new file*

**head**(mydata)

## # A tibble: 6 x 12

## # A tibble: 6 x 12

## EngDispl NumCyl FE NumGears TransLockup TransCreeperGear ## <dbl> <int> <dbl> <int> <int> <int> ## 1 4.7 8 28.0 6 1 0

## 2 4.7 8 25.6 6 1 0

## 3 4.2 8 26.8 6 1 0

## 4 4.2 8 25.0 6 1 0

## 5 5.2 10 24.8 6 0 0

## 6 5.2 10 23.9 6 0 0

## # ... with 6 more variables: IntakeValvePerCyl <int>,

## # ExhaustValvesPerCyl <int>, VarValveTiming <int>, VarValveLift <int>, ## # predicted <dbl>, error <dbl>

**write.csv**(FE2010new,"C:/Users/tsraj/Desktop/Acadgild students projects/projwct1 data/New folder/FE2010new.csv") **names**(FE2010)

## [1] "EngDispl" "NumCyl" "FE"

## [4] "NumGears" "TransLockup" "TransCreeperGear" ## [7] "IntakeValvePerCyl" "ExhaustValvesPerCyl" "VarValveTiming" ## [10] "VarValveLift"

fit<-

**lm**(FE**~**EngDispl**+**NumCyl**+**NumGears**+**TransLockup**+**TransCreeperGear**+**IntakeValvePerCyl

**+**ExhaustValvesPerCyl**+**VarValveTiming**+**VarValveLift,data=FE2010) fit

##

## Call:

## lm(formula = FE ~ EngDispl + NumCyl + NumGears + TransLockup + ## TransCreeperGear + IntakeValvePerCyl + ExhaustValvesPerCyl + ## VarValveTiming + VarValveLift, data = FE2010)

##

## Coefficients:

## (Intercept) EngDispl NumCyl

## 54.3472 -3.8610 -0.4888

## NumGears TransLockup TransCreeperGear ## -0.1725 -1.4450 -0.9138

## IntakeValvePerCyl ExhaustValvesPerCyl VarValveTiming ## -0.3737 -1.1105 1.6870

## VarValveLift

## 0.6235

**summary**(fit)

##

## Call:

## lm(formula = FE ~ EngDispl + NumCyl + NumGears + TransLockup + ## TransCreeperGear + IntakeValvePerCyl + ExhaustValvesPerCyl + ## VarValveTiming + VarValveLift, data = FE2010)

##

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ## Residuals:  ## Min 1Q Median 3Q Max ## -17.1153 -2.7142 -0.3535 2.4191 25.6521 ## | | | | | | |
| ## | Coefficients: |  |  |  |  |  |
| ## |  | Estimate | Std. Error | t value | Pr(>|t|) |  |
| ## | (Intercept) | 54.3472 | 1.0973 | 49.530 | < 2e-16 | \*\*\* |
| ## | EngDispl | -3.8610 | 0.2805 | -13.765 | < 2e-16 | \*\*\* |
| ## | NumCyl | -0.4888 | 0.1845 | -2.649 | 0.00819 | \*\* |
| ## | NumGears | -0.1725 | 0.1065 | -1.620 | 0.10555 |  |
| ## | TransLockup | -1.4450 | 0.3000 | -4.817 | 1.66e-06 | \*\*\* |
| ## | TransCreeperGear | -0.9138 | 0.6681 | -1.368 | 0.17167 |  |
| ## | IntakeValvePerCyl | -0.3737 | 0.9892 | -0.378 | 0.70566 |  |
| ## | ExhaustValvesPerCyl | -1.1105 | 0.9598 | -1.157 | 0.24752 |  |
| ## | VarValveTiming | 1.6870 | 0.3796 | 4.444 | 9.71e-06 | \*\*\* |
| ## | VarValveLift | 0.6235 | 0.3719 | 1.676 | 0.09393 | . |
| ## | --- |  |  |  |  |  |
| ## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 ##  ## Residual standard error: 4.489 on 1097 degrees of freedom ## Multiple R-squared: 0.6445, Adjusted R-squared: 0.6415 ## F-statistic: 220.9 on 9 and 1097 DF, p-value: < 2.2e-16  **vif**(fit) | | | | | | |
| ## | EngDispl | NumCyl | | NumGears | | |
| ## | 7.363137 | 6.750388 | | 1.214238 | | |
| ## | TransLockup | TransCreeperGear | | IntakeValvePerCyl | | |
| ## | 1.075253 | 1.137623 | | 6.693985 | | |
| ## | ExhaustValvesPerCyl | VarValveTiming | | VarValveLift | | |
| ## | 7.073284 | 1.153276 | | 1.057688 | | |
| **vif**(fit)**>**5 | | | | | | |
| ## | EngDispl | NumCyl | | NumGears | | |
| ## | TRUE | TRUE | | FALSE | | |
| ## | TransLockup | TransCreeperGear | | IntakeValvePerCyl | | |
| ## | FALSE | FALSE | | TRUE | | |
| ## | ExhaustValvesPerCyl | VarValveTiming | | VarValveLift | | |
| ## | TRUE | FALSE | | FALSE | | |