Homework\_2\_DSC\_441

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install.packages(“dplyr”) install.packages(“tidyr”)

#Problem 1

library(tidyr)  
library(ggplot2)  
library(dplyr)

##   
## Attaching package: 'dplyr'

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

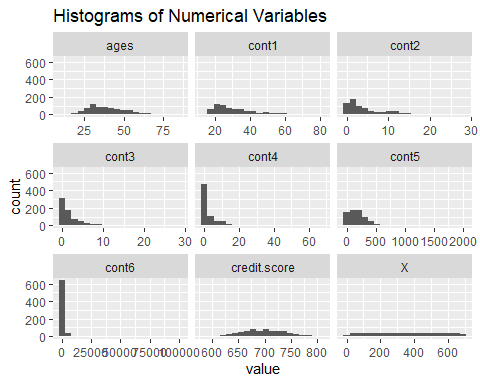
## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

bank\_data <- read.csv("BankData.csv")  
head(bank\_data)

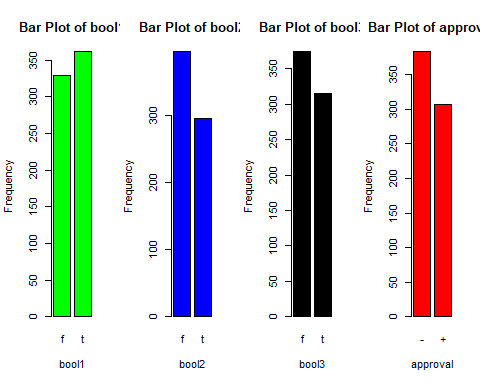
## X cont1 cont2 cont3 bool1 bool2 cont4 bool3 cont5 cont6 approval credit.score  
## 1 1 30.83 0.000 1.25 t t 1 f 202 0 + 664.60  
## 2 2 58.67 4.460 3.04 t t 6 f 43 560 + 693.88  
## 3 3 24.50 0.500 1.50 t f 0 f 280 824 + 621.82  
## 4 4 27.83 1.540 3.75 t t 5 t 100 3 + 653.97  
## 5 5 20.17 5.625 1.71 t f 0 f 120 0 + 670.26  
## 6 6 32.08 4.000 2.50 t f 0 t 360 0 + 672.16  
## ages  
## 1 42  
## 2 54  
## 3 29  
## 4 58  
## 5 65  
## 6 61

#problem (A)  
  
bank\_data %>%  
 select\_if(is.numeric) %>%  
 gather() %>%  
 ggplot(aes(x = value)) +  
 geom\_histogram(bins = 20) +  
 facet\_wrap(~key, scales = "free\_x") +  
 labs(title = "Histograms of Numerical Variables")

## Warning: Removed 25 rows containing non-finite values (`stat\_bin()`).



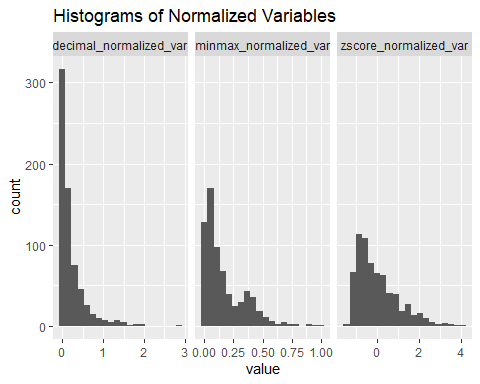
par(mfrow = c(1, 4))   
  
barplot(table(bank\_data$bool1), main="Bar Plot of bool1", xlab="bool1", ylab="Frequency", col="green")  
  
barplot(table(bank\_data$bool2), main="Bar Plot of bool2", xlab="bool2", ylab="Frequency", col="blue")  
  
barplot(table(bank\_data$bool3), main="Bar Plot of bool3", xlab="bool3", ylab="Frequency", col="black")  
  
barplot(table(bank\_data$approval), main="Bar Plot of approval", xlab="approval", ylab="Frequency", col="red")



bank\_data$zscore\_normalized\_var <- scale(bank\_data$cont1)  
  
#problem 1(B)  
  
# Apply min-max normalization to another numerical variable  
bank\_data$minmax\_normalized\_var <- (bank\_data$cont2 - min(bank\_data$cont2)) / (max(bank\_data$cont2) - min(bank\_data$cont2))  
  
# Apply decimal scaling normalization to a third numerical variable  
bank\_data$decimal\_normalized\_var <- bank\_data$cont3 / 10  
  
  
#problem 1(C)  
bank\_data %>%  
 select(zscore\_normalized\_var, minmax\_normalized\_var, decimal\_normalized\_var) %>%  
 gather() %>%  
 ggplot(aes(x = value)) +  
 geom\_histogram(bins = 20) +  
 facet\_wrap(~key, scales = "free\_x") +  
 labs(title = "Histograms of Normalized Variables")

## Warning: attributes are not identical across measure variables; they will be  
## dropped

## Warning: Removed 12 rows containing non-finite values (`stat\_bin()`).



#problem 1(D)  
  
breaks <- quantile(bank\_data$cont1, probs = c(0, 0.33, 0.66, 1), na.rm = TRUE)  
labels <- c("Low", "Medium", "High")  
bank\_data$v\_bins <- cut(bank\_data$cont1, breaks = breaks, labels = labels, include.lowest = TRUE)  
head(bank\_data)

## X cont1 cont2 cont3 bool1 bool2 cont4 bool3 cont5 cont6 approval credit.score  
## 1 1 30.83 0.000 1.25 t t 1 f 202 0 + 664.60  
## 2 2 58.67 4.460 3.04 t t 6 f 43 560 + 693.88  
## 3 3 24.50 0.500 1.50 t f 0 f 280 824 + 621.82  
## 4 4 27.83 1.540 3.75 t t 5 t 100 3 + 653.97  
## 5 5 20.17 5.625 1.71 t f 0 f 120 0 + 670.26  
## 6 6 32.08 4.000 2.50 t f 0 t 360 0 + 672.16  
## ages zscore\_normalized\_var minmax\_normalized\_var decimal\_normalized\_var  
## 1 42 -0.06173102 0.00000000 0.125  
## 2 54 2.26644427 0.15928571 0.304  
## 3 29 -0.59108985 0.01785714 0.150  
## 4 58 -0.31261198 0.05500000 0.375  
## 5 65 -0.95319469 0.20089286 0.171  
## 6 61 0.04280271 0.14285714 0.250  
## v\_bins  
## 1 Medium  
## 2 High  
## 3 Medium  
## 4 Medium  
## 5 Low  
## 6 Medium

#problem 1(E)  
bank\_data$v\_bins\_smoothed <- ave(as.numeric(bank\_data$v\_bins), bank\_data$v\_bins, FUN = function(x) mean(x, na.rm = TRUE))  
head(bank\_data)

## X cont1 cont2 cont3 bool1 bool2 cont4 bool3 cont5 cont6 approval credit.score  
## 1 1 30.83 0.000 1.25 t t 1 f 202 0 + 664.60  
## 2 2 58.67 4.460 3.04 t t 6 f 43 560 + 693.88  
## 3 3 24.50 0.500 1.50 t f 0 f 280 824 + 621.82  
## 4 4 27.83 1.540 3.75 t t 5 t 100 3 + 653.97  
## 5 5 20.17 5.625 1.71 t f 0 f 120 0 + 670.26  
## 6 6 32.08 4.000 2.50 t f 0 t 360 0 + 672.16  
## ages zscore\_normalized\_var minmax\_normalized\_var decimal\_normalized\_var  
## 1 42 -0.06173102 0.00000000 0.125  
## 2 54 2.26644427 0.15928571 0.304  
## 3 29 -0.59108985 0.01785714 0.150  
## 4 58 -0.31261198 0.05500000 0.375  
## 5 65 -0.95319469 0.20089286 0.171  
## 6 61 0.04280271 0.14285714 0.250  
## v\_bins v\_bins\_smoothed  
## 1 Medium 2  
## 2 High 3  
## 3 Medium 2  
## 4 Medium 2  
## 5 Low 1  
## 6 Medium 2

#problem 2

install.packages(“e1071”) install.packages(“caret”) library(e1071) library(caret)

data <- read.csv("BankData.csv")  
data <- na.omit(data)  
  
  
X <- data[, -which(names(data) == "approval")]  
Y <- data$approval  
  
# Ensure the 'approval' column is a factor variable  
data$approval <- as.factor(data$approval)  
  
# Load the e1071 package  
library(e1071)  
  
# Create a function to perform 10-fold cross-validation and calculate accuracy  
svm\_cross\_validation <- function(C) {  
 svm\_model <- svm(approval ~ ., data = data, kernel = "linear", cost = C)  
 predictions <- predict(svm\_model, X)  
 accuracy <- sum(predictions == Y) / length(Y)  
 return(accuracy)  
}  
  
# Perform 10-fold cross-validation for different values of C  
C\_values <- c(0.01, 0.1, 1, 10, 100)  
accuracies <- sapply(C\_values, svm\_cross\_validation)  
  
# Find the C value that maximizes accuracy  
best\_C <- C\_values[which.max(accuracies)]  
best\_accuracy <- max(accuracies)  
  
# Report the best C value and its corresponding accuracy  
cat("Best C value:", best\_C, "\n")

## Best C value: 0.01

cat("Accuracy with the best C value:", best\_accuracy, "\n")

## Accuracy with the best C value: 0.8648649

#another method  
  
# Perform grid search  
grid\_search\_result <- tune(svm, approval ~ ., data = data, kernel = "linear", ranges = list(C = C\_values))  
  
# Get the best parameter and accuracy  
best\_c <- grid\_search\_result$best.parameters$C  
best\_accuracy <- grid\_search\_result$best.performance  
  
# Display the best C parameter and accuracy  
best\_c

## [1] 0.01

best\_accuracy

## [1] 0.1367933

#problem 3(A)

# Load necessary libraries (if not already loaded)  
library(dplyr)  
  
# Load the Star Wars dataset  
data(starwars)  
  
# Remove unnecessary variables (films, vehicles, starships, and name)  
starwars\_cleaned <- starwars %>%  
 select(-films, -vehicles, -starships, -name)  
  
# Remove rows with missing values  
starwars\_cleaned <- na.omit(starwars\_cleaned)  
  
# View the cleaned dataset  
head(starwars\_cleaned)

## # A tibble: 6 × 10  
## height mass hair\_color skin\_color eye\_color birth\_year sex gender homeworld  
## <int> <dbl> <chr> <chr> <chr> <dbl> <chr> <chr> <chr>   
## 1 172 77 blond fair blue 19 male mascu… Tatooine   
## 2 202 136 none white yellow 41.9 male mascu… Tatooine   
## 3 150 49 brown light brown 19 fema… femin… Alderaan   
## 4 178 120 brown, gr… light blue 52 male mascu… Tatooine   
## 5 165 75 brown light blue 47 fema… femin… Tatooine   
## 6 183 84 black light brown 24 male mascu… Tatooine   
## # ℹ 1 more variable: species <chr>

# Load necessary libraries (if not already loaded)  
library(caret)

## Loading required package: lattice

# Convert categorical variables to dummy variables, excluding "gender"  
dummy\_data <- dummyVars(~ ., data = starwars\_cleaned[, -which(names(starwars\_cleaned) == "gender")])  
  
# Transform the original dataset into a dataset with dummy variables  
starwars\_dummies <- as.data.frame(predict(dummy\_data, starwars\_cleaned))  
  
# Add the "gender" column back to the dataset  
starwars\_dummies$gender <- starwars\_cleaned$gender  
  
# View the head of the dataset with dummy variables  
head(starwars\_dummies)

## height mass hair\_colorauburn, white hair\_colorblack hair\_colorblond  
## 1 172 77 0 0 1  
## 2 202 136 0 0 0  
## 3 150 49 0 0 0  
## 4 178 120 0 0 0  
## 5 165 75 0 0 0  
## 6 183 84 0 1 0  
## hair\_colorbrown hair\_colorbrown, grey hair\_colorgrey hair\_colornone  
## 1 0 0 0 0  
## 2 0 0 0 1  
## 3 1 0 0 0  
## 4 0 1 0 0  
## 5 1 0 0 0  
## 6 0 0 0 0  
## hair\_colorwhite skin\_colorblue skin\_colorbrown skin\_colorbrown mottle  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## skin\_colordark skin\_colorfair skin\_colorgreen skin\_colorlight  
## 1 0 1 0 0  
## 2 0 0 0 0  
## 3 0 0 0 1  
## 4 0 0 0 1  
## 5 0 0 0 1  
## 6 0 0 0 1  
## skin\_colororange skin\_colorpale skin\_colorred skin\_colortan skin\_colorunknown  
## 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  
## skin\_colorwhite skin\_coloryellow eye\_colorblack eye\_colorblue  
## 1 0 0 0 1  
## 2 1 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 1  
## 5 0 0 0 1  
## 6 0 0 0 0  
## eye\_colorblue-gray eye\_colorbrown eye\_colorhazel eye\_colororange eye\_colorred  
## 1 0 0 0 0 0  
## 2 0 0 0 0 0  
## 3 0 1 0 0 0  
## 4 0 0 0 0 0  
## 5 0 0 0 0 0  
## 6 0 1 0 0 0  
## eye\_coloryellow birth\_year sexfemale sexmale homeworldAlderaan  
## 1 0 19.0 0 1 0  
## 2 1 41.9 0 1 0  
## 3 0 19.0 1 0 1  
## 4 0 52.0 0 1 0  
## 5 0 47.0 1 0 0  
## 6 0 24.0 0 1 0  
## homeworldBespin homeworldCerea homeworldConcord Dawn homeworldCorellia  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## homeworldDathomir homeworldDorin homeworldEndor homeworldHaruun Kal  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## homeworldKamino homeworldKashyyyk homeworldMirial homeworldMon Cala  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## homeworldNaboo homeworldRyloth homeworldSerenno homeworldSocorro  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## homeworldStewjon homeworldTatooine homeworldTrandosha speciesCerean  
## 1 0 1 0 0  
## 2 0 1 0 0  
## 3 0 0 0 0  
## 4 0 1 0 0  
## 5 0 1 0 0  
## 6 0 1 0 0  
## speciesEwok speciesGungan speciesHuman speciesKel Dor speciesMirialan  
## 1 0 0 1 0 0  
## 2 0 0 1 0 0  
## 3 0 0 1 0 0  
## 4 0 0 1 0 0  
## 5 0 0 1 0 0  
## 6 0 0 1 0 0  
## speciesMon Calamari speciesTrandoshan speciesTwi'lek speciesWookiee  
## 1 0 0 0 0  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## speciesZabrak gender  
## 1 0 masculine  
## 2 0 masculine  
## 3 0 feminine  
## 4 0 masculine  
## 5 0 feminine  
## 6 0 masculine

#problem 3(B)

# Load necessary libraries (if not already loaded)  
library(e1071)  
data(starwars)  
  
# Load the dataset (assuming you have already prepared the dataset with dummy variables)  
# Replace 'starwars\_dummies' with the actual dataset name  
data <- starwars\_dummies  
  
# Split the data into a training set and a test set (e.g., 70% training, 30% testing)  
set.seed(123) # For reproducibility  
#train\_indices <- sample(1:nrow(starwars\_dummies), 0.7 \* nrow(starwars\_dummies))  
splitIndex <- createDataPartition(data$gender, p = 0.7, list = FALSE, times = 1)  
train\_data <- data[splitIndex, ]  
test\_data <- data[-splitIndex, ]  
  
# Define the training control for grid search (train/test split)  
train\_control <- trainControl(method = "cv", number = 5)  
  
# Grid search for C parameter on training data  
svm\_grid <- expand.grid(C = c(0.01, 0.1, 1, 10))  
svm\_model <- train(gender ~ .,   
 data = train\_data,   
 method = "svmLinear",  
 trControl = train\_control,   
 preProcess = c("center", "scale"),  
 tuneGrid = svm\_grid)

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: hair\_colorgrey, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colororange, skin\_colorwhite,  
## eye\_colorblack, eye\_colorred, homeworldAlderaan, homeworldDorin,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldNaboo, homeworldSocorro,  
## homeworldTrandosha, speciesEwok, speciesGungan, `speciesKel Dor`,  
## speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: hair\_colorgrey, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colororange, skin\_colorwhite,  
## eye\_colorblack, eye\_colorred, homeworldAlderaan, homeworldDorin,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldNaboo, homeworldSocorro,  
## homeworldTrandosha, speciesEwok, speciesGungan, `speciesKel Dor`,  
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## skin\_colordark, skin\_colorgreen, skin\_colororange, skin\_colorwhite,  
## eye\_colorblack, eye\_colorred, homeworldAlderaan, homeworldDorin,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldNaboo, homeworldSocorro,  
## homeworldTrandosha, speciesEwok, speciesGungan, `speciesKel Dor`,  
## speciesTrandoshan

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## 10, : These variables have zero variances: hair\_colorgrey, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colororange, skin\_colorwhite,  
## eye\_colorblack, eye\_colorred, homeworldAlderaan, homeworldDorin,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldNaboo, homeworldSocorro,  
## homeworldTrandosha, speciesEwok, speciesGungan, `speciesKel Dor`,  
## speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorauburn, white`,  
## hair\_colorblond, skin\_colorbrown, skin\_colordark, skin\_colorgreen,  
## skin\_colorwhite, `eye\_colorblue-gray`, eye\_colorred, homeworldAlderaan,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldKamino, homeworldSocorro,  
## homeworldStewjon, homeworldTrandosha, speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorauburn, white`,  
## hair\_colorblond, skin\_colorbrown, skin\_colordark, skin\_colorgreen,  
## skin\_colorwhite, `eye\_colorblue-gray`, eye\_colorred, homeworldAlderaan,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldKamino, homeworldSocorro,  
## homeworldStewjon, homeworldTrandosha, speciesEwok, speciesTrandoshan

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## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorauburn, white`,  
## hair\_colorblond, skin\_colorbrown, skin\_colordark, skin\_colorgreen,  
## skin\_colorwhite, `eye\_colorblue-gray`, eye\_colorred, homeworldAlderaan,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldKamino, homeworldSocorro,  
## homeworldStewjon, homeworldTrandosha, speciesEwok, speciesTrandoshan

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## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorauburn, white`,  
## hair\_colorblond, skin\_colorbrown, skin\_colordark, skin\_colorgreen,  
## skin\_colorwhite, `eye\_colorblue-gray`, eye\_colorred, homeworldAlderaan,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldKamino, homeworldSocorro,  
## homeworldStewjon, homeworldTrandosha, speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorbrown, `skin\_colorbrown  
## mottle`, skin\_colordark, skin\_colorgreen, skin\_colorwhite, eye\_colorred,  
## homeworldAlderaan, homeworldBespin, homeworldEndor, `homeworldHaruun Kal`,  
## `homeworldMon Cala`, homeworldSerenno, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, `speciesMon Calamari`, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorbrown, `skin\_colorbrown  
## mottle`, skin\_colordark, skin\_colorgreen, skin\_colorwhite, eye\_colorred,  
## homeworldAlderaan, homeworldBespin, homeworldEndor, `homeworldHaruun Kal`,  
## `homeworldMon Cala`, homeworldSerenno, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, `speciesMon Calamari`, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorbrown, `skin\_colorbrown  
## mottle`, skin\_colordark, skin\_colorgreen, skin\_colorwhite, eye\_colorred,  
## homeworldAlderaan, homeworldBespin, homeworldEndor, `homeworldHaruun Kal`,  
## `homeworldMon Cala`, homeworldSerenno, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, `speciesMon Calamari`, speciesTrandoshan

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## 10, : These variables have zero variances: skin\_colorbrown, `skin\_colorbrown  
## mottle`, skin\_colordark, skin\_colorgreen, skin\_colorwhite, eye\_colorred,  
## homeworldAlderaan, homeworldBespin, homeworldEndor, `homeworldHaruun Kal`,  
## `homeworldMon Cala`, homeworldSerenno, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, `speciesMon Calamari`, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorblue, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colorred, skin\_colorunknown,  
## skin\_colorwhite, eye\_colorhazel, eye\_colorred, homeworldAlderaan,  
## homeworldCerea, homeworldDathomir, homeworldEndor, `homeworldHaruun Kal`,  
## homeworldKashyyyk, homeworldRyloth, homeworldSocorro, homeworldTrandosha,  
## speciesCerean, speciesEwok, speciesTrandoshan, `speciesTwi'lek`,  
## speciesWookiee, speciesZabrak

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorblue, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colorred, skin\_colorunknown,  
## skin\_colorwhite, eye\_colorhazel, eye\_colorred, homeworldAlderaan,  
## homeworldCerea, homeworldDathomir, homeworldEndor, `homeworldHaruun Kal`,  
## homeworldKashyyyk, homeworldRyloth, homeworldSocorro, homeworldTrandosha,  
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## skin\_colordark, skin\_colorgreen, skin\_colorred, skin\_colorunknown,  
## skin\_colorwhite, eye\_colorhazel, eye\_colorred, homeworldAlderaan,  
## homeworldCerea, homeworldDathomir, homeworldEndor, `homeworldHaruun Kal`,  
## homeworldKashyyyk, homeworldRyloth, homeworldSocorro, homeworldTrandosha,  
## speciesCerean, speciesEwok, speciesTrandoshan, `speciesTwi'lek`,  
## speciesWookiee, speciesZabrak

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## 10, : These variables have zero variances: skin\_colorblue, skin\_colorbrown,  
## skin\_colordark, skin\_colorgreen, skin\_colorred, skin\_colorunknown,  
## skin\_colorwhite, eye\_colorhazel, eye\_colorred, homeworldAlderaan,  
## homeworldCerea, homeworldDathomir, homeworldEndor, `homeworldHaruun Kal`,  
## homeworldKashyyyk, homeworldRyloth, homeworldSocorro, homeworldTrandosha,  
## speciesCerean, speciesEwok, speciesTrandoshan, `speciesTwi'lek`,  
## speciesWookiee, speciesZabrak

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorbrown, grey`,  
## skin\_colorbrown, skin\_colordark, skin\_colorgreen, skin\_colortan,  
## skin\_colorwhite, eye\_colorred, homeworldAlderaan, `homeworldConcord Dawn`,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorbrown, grey`,  
## skin\_colorbrown, skin\_colordark, skin\_colorgreen, skin\_colortan,  
## skin\_colorwhite, eye\_colorred, homeworldAlderaan, `homeworldConcord Dawn`,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorbrown, grey`,  
## skin\_colorbrown, skin\_colordark, skin\_colorgreen, skin\_colortan,  
## skin\_colorwhite, eye\_colorred, homeworldAlderaan, `homeworldConcord Dawn`,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: `hair\_colorbrown, grey`,  
## skin\_colorbrown, skin\_colordark, skin\_colorgreen, skin\_colortan,  
## skin\_colorwhite, eye\_colorred, homeworldAlderaan, `homeworldConcord Dawn`,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19, uniqueCut =  
## 10, : These variables have zero variances: skin\_colorbrown, skin\_colordark,  
## skin\_colorgreen, skin\_colorwhite, eye\_colorred, homeworldAlderaan,  
## homeworldEndor, `homeworldHaruun Kal`, homeworldSocorro, homeworldTrandosha,  
## speciesEwok, speciesTrandoshan

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

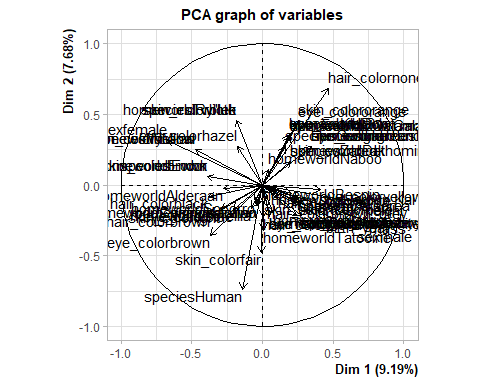
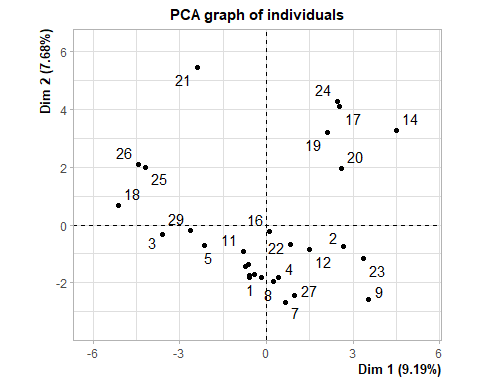
# Make predictions on the test set  
predictions <- predict(svm\_model, newdata = test\_data)  
  
  
  
# Calculate accuracy  
accuracy <- sum(predictions == test\_data$gender) / nrow(test\_data)  
  
# Print the accuracy  
cat("Accuracy:", accuracy, "\n")

## Accuracy: 0.8571429

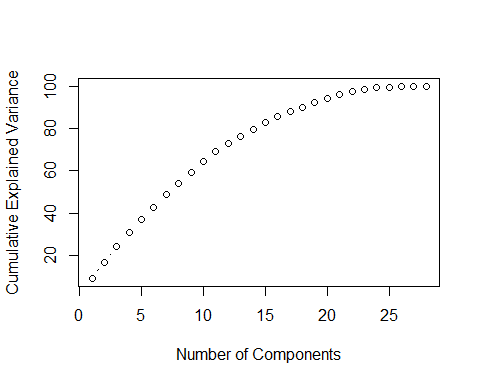
#Problem 3(C)

# Load necessary libraries (if not already loaded)  
library(caret)  
library(FactoMineR)  
data(starwars)  
  
# Load the dataset (assuming you have prepared the dataset with dummy variables)  
# Replace 'starwars\_dummies' with the actual dataset name  
data <- starwars\_dummies  
  
# Remove the 'gender' column temporarily for PCA  
data\_without\_gender <- data[, -which(names(data) == "gender")]  
  
# Perform PCA  
pca\_result <- PCA(data\_without\_gender, scale.unit = TRUE)

## Warning: ggrepel: 5 unlabeled data points (too many overlaps). Consider  
## increasing max.overlaps



# Determine the number of components based on explained variance  
# You can plot the cumulative explained variance to make a decision  
cumulative\_variance <- cumsum(pca\_result$eig[,"percentage of variance"])  
plot(cumulative\_variance, type = "b", xlab = "Number of Components", ylab = "Cumulative Explained Variance")



# Determine the appropriate number of components  
# You can choose a threshold (e.g., 90% explained variance) to decide the number of components  
threshold\_variance <- 0.90  
num\_pcs <- which(cumulative\_variance >= threshold\_variance)[1]  
  
# Reduce the data to the selected number of principal components  
reduced\_data <- as.data.frame(predict(pca\_result, newdata = data\_without\_gender, ncp = num\_pcs))  
  
  
  
# Add the 'gender' column back to the reduced data  
reduced\_data$gender <- data$gender  
  
# View the result  
head(reduced\_data)

## coord.Dim.1 coord.Dim.2 coord.Dim.3 coord.Dim.4 coord.Dim.5 cos2.Dim.1  
## 1 -0.1874903 -1.8205321 -0.13112814 -1.1024314 -1.1124239 0.001197212  
## 2 2.6753253 -0.7375425 0.04353232 -0.1254142 -0.2417166 0.133455085  
## 3 -3.6039826 -0.3103183 -0.54115210 -0.2835643 0.3526456 0.243648370  
## 4 0.4245881 -1.8245725 0.75192434 -1.2882557 -1.0678790 0.003818487  
## 5 -2.1561826 -0.6942455 1.14728679 -0.6286736 -0.3547291 0.177963393  
## 6 -0.7200900 -1.4463587 -0.48357220 -0.9231734 -0.6666090 0.027003326  
## cos2.Dim.2 cos2.Dim.3 cos2.Dim.4 cos2.Dim.5 dist gender  
## 1 0.112878263 5.856058e-04 0.041392034 0.042145797 5.418676 masculine  
## 2 0.010142758 3.533504e-05 0.000293275 0.001089419 7.323337 masculine  
## 3 0.001806395 5.493344e-03 0.001508347 0.002332787 7.301312 feminine  
## 4 0.070514431 1.197579e-02 0.035152799 0.024154601 6.871035 masculine  
## 5 0.018449547 5.038527e-02 0.015128995 0.004816741 5.111169 feminine  
## 6 0.108942084 1.217773e-02 0.044382341 0.023141208 4.382058 masculine

#problem 3(D)

# Load necessary libraries (if not already loaded)  
library(e1071)  
library(caret)  
library(FactoMineR)  
  
data(starwars)  
  
# Load the dataset (assuming you have prepared the dataset with PCA components)  
# Replace 'reduced\_data' with the actual dataset name  
data <- reduced\_data  
  
# Split the data into a training set and a test set (e.g., 70% training, 30% testing)  
set.seed(123) # For reproducibility  
splitIndex <- createDataPartition(data$gender, p = 0.7, list = FALSE, times = 1)  
train\_data <- data[splitIndex, ]  
test\_data <- data[-splitIndex, ]  
  
# Ensure that 'gender' is a factor with consistent levels in both train and test data  
train\_data$gender <- as.factor(train\_data$gender)  
test\_data$gender <- as.factor(test\_data$gender)  
  
# Define the training control for grid search  
train\_control <- trainControl(method = "cv", number = 5)  
  
# Grid search for C parameter on training data  
svm\_grid <- expand.grid(C = c(0.01, 0.1, 1, 10))  
svm\_model\_train\_test <- train(gender ~ .,   
 data = train\_data,   
 method = "svmLinear",  
 trControl = train\_control,   
 preProcess = c("center", "scale"),  
 tuneGrid = svm\_grid)  
  
# Print the best SVM model for train/test split  
svm\_model\_train\_test

## Support Vector Machines with Linear Kernel   
##   
## 22 samples  
## 11 predictors  
## 2 classes: 'feminine', 'masculine'   
##   
## Pre-processing: centered (11), scaled (11)   
## Resampling: Cross-Validated (5 fold)   
## Summary of sample sizes: 18, 18, 17, 17, 18   
## Resampling results across tuning parameters:  
##   
## C Accuracy Kappa  
## 0.01 0.77 0.00   
## 0.10 0.87 0.40   
## 1.00 0.92 0.75   
## 10.00 0.92 0.75   
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final value used for the model was C = 1.

# Make predictions on the test set  
predictions\_train\_test <- predict(svm\_model\_train\_test, newdata = test\_data)  
  
# Create a confusion matrix for train/test split  
confusion\_train\_test <- confusionMatrix(predictions\_train\_test, test\_data$gender)  
  
# Print the confusion matrix for train/test split  
print(confusion\_train\_test)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction feminine masculine  
## feminine 1 1  
## masculine 0 5  
##   
## Accuracy : 0.8571   
## 95% CI : (0.4213, 0.9964)  
## No Information Rate : 0.8571   
## P-Value [Acc > NIR] : 0.7365   
##   
## Kappa : 0.5882   
##   
## Mcnemar's Test P-Value : 1.0000   
##   
## Sensitivity : 1.0000   
## Specificity : 0.8333   
## Pos Pred Value : 0.5000   
## Neg Pred Value : 1.0000   
## Prevalence : 0.1429   
## Detection Rate : 0.1429   
## Detection Prevalence : 0.2857   
## Balanced Accuracy : 0.9167   
##   
## 'Positive' Class : feminine   
##

# K-fold cross-validation (e.g., 5-fold)  
train\_control\_cv <- trainControl(method = "cv", number = 5)  
  
# Grid search for C parameter using k-fold cross-validation  
svm\_grid\_cv <- expand.grid(C = c(0.01, 0.1, 1, 10))  
svm\_model\_cv <- train(gender ~ .,   
 data = data,   
 method = "svmLinear",  
 trControl = train\_control\_cv,   
 preProcess = c("center", "scale"),  
 tuneGrid = svm\_grid\_cv)  
  
# Print the best SVM model for k-fold cross-validation  
svm\_model\_cv

## Support Vector Machines with Linear Kernel   
##   
## 29 samples  
## 11 predictors  
## 2 classes: 'feminine', 'masculine'   
##   
## Pre-processing: centered (11), scaled (11)   
## Resampling: Cross-Validated (5 fold)   
## Summary of sample sizes: 23, 24, 23, 23, 23   
## Resampling results across tuning parameters:  
##   
## C Accuracy Kappa   
## 0.01 0.7933333 0.0000000  
## 0.10 0.8600000 0.5142857  
## 1.00 0.9266667 0.7142857  
## 10.00 0.9266667 0.7142857  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final value used for the model was C = 1.

# Ensure that 'gender' is a factor with consistent levels in the entire dataset  
data$gender <- as.factor(data$gender)  
  
# K-fold cross-validation (e.g., 5-fold)  
train\_control\_cv <- trainControl(method = "cv", number = 5)  
  
# Grid search for C parameter using k-fold cross-validation  
svm\_grid\_cv <- expand.grid(C = c(0.01, 0.1, 1, 10))  
svm\_model\_cv <- train(gender ~ .,   
 data = data,   
 method = "svmLinear",  
 trControl = train\_control\_cv,   
 preProcess = c("center", "scale"),  
 tuneGrid = svm\_grid\_cv)  
  
# Evaluate the model with k-fold cross-validation  
confusion\_cv <- confusionMatrix(predict(svm\_model\_cv, data), data$gender)  
  
# Print the confusion matrix for k-fold cross-validation  
print(confusion\_cv)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction feminine masculine  
## feminine 6 0  
## masculine 0 23  
##   
## Accuracy : 1   
## 95% CI : (0.8806, 1)  
## No Information Rate : 0.7931   
## P-Value [Acc > NIR] : 0.001204   
##   
## Kappa : 1   
##   
## Mcnemar's Test P-Value : NA   
##   
## Sensitivity : 1.0000   
## Specificity : 1.0000   
## Pos Pred Value : 1.0000   
## Neg Pred Value : 1.0000   
## Prevalence : 0.2069   
## Detection Rate : 0.2069   
## Detection Prevalence : 0.2069   
## Balanced Accuracy : 1.0000   
##   
## 'Positive' Class : feminine   
##

#Problem 3(E)

Dimensionality Reduction: PCA has reduced the dimensionality of the dataset by transforming the original features into a smaller set of principal components. These principal components are linear combinations of the original features and capture the most significant sources of variation in the data. As a result, the complexity of the model in terms of the number of input features has been reduced.

Simplified Model: With fewer input features to consider, the model becomes simpler and more interpretable. This reduction in complexity can lead to faster model training and improved computational efficiency.

Addressing Multicollinearity: PCA helps address multicollinearity, which occurs when predictor variables are highly correlated. Multicollinearity can make it challenging to interpret the individual effects of each predictor and can lead to unstable model coefficients. By creating uncorrelated principal components, PCA simplifies the relationships between variables, making the model more stable.

Reduced Noise: PCA often filters out noise and less important information in the data. It retains the principal components that explain the most variance while discarding components that contain less meaningful information. This can lead to a more robust model that generalizes better to new data.

Improved Interpretability: While the principal components themselves may not have a direct interpretation, they can be seen as representing patterns or combinations of the original variables. This can enhance the interpretability of the model by focusing on the most important patterns in the data.

Potential Performance Improvement: Although the primary goal of PCA is dimensionality reduction, it may also lead to improved model performance. In some cases, reducing dimensionality can lead to a model that is less prone to overfitting and generalizes better to new, unseen data.

#Probelem 4

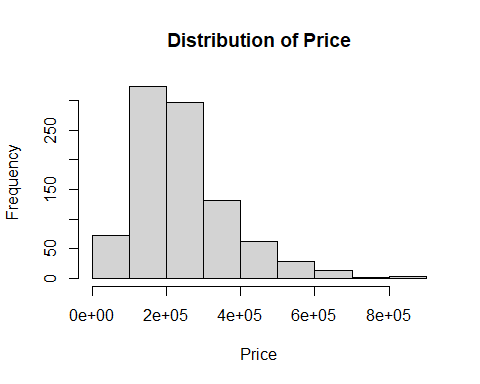
# Load necessary libraries (if not already loaded)  
library(caret)  
# Load the Sacramento housing price dataset  
data(Sacramento)  
  
# View the structure of the dataset  
  
str(Sacramento)

## 'data.frame': 932 obs. of 9 variables:  
## $ city : Factor w/ 37 levels "ANTELOPE","AUBURN",..: 34 34 34 34 34 34 34 34 29 31 ...  
## $ zip : Factor w/ 68 levels "z95603","z95608",..: 64 52 44 44 53 65 66 49 24 25 ...  
## $ beds : int 2 3 2 2 2 3 3 3 2 3 ...  
## $ baths : num 1 1 1 1 1 1 2 1 2 2 ...  
## $ sqft : int 836 1167 796 852 797 1122 1104 1177 941 1146 ...  
## $ type : Factor w/ 3 levels "Condo","Multi\_Family",..: 3 3 3 3 3 1 3 3 1 3 ...  
## $ price : int 59222 68212 68880 69307 81900 89921 90895 91002 94905 98937 ...  
## $ latitude : num 38.6 38.5 38.6 38.6 38.5 ...  
## $ longitude: num -121 -121 -121 -121 -121 ...

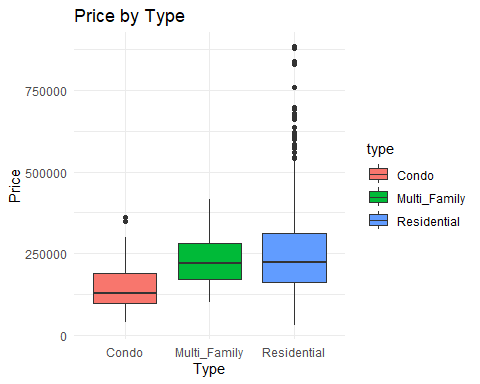
# Summary statistics for numeric variables  
summary(Sacramento)

## city zip beds baths   
## SACRAMENTO :438 z95823 : 61 Min. :1.000 Min. :1.000   
## ELK\_GROVE :114 z95828 : 45 1st Qu.:3.000 1st Qu.:2.000   
## ROSEVILLE : 48 z95758 : 44 Median :3.000 Median :2.000   
## CITRUS\_HEIGHTS: 35 z95835 : 37 Mean :3.276 Mean :2.053   
## ANTELOPE : 33 z95838 : 37 3rd Qu.:4.000 3rd Qu.:2.000   
## RANCHO\_CORDOVA: 28 z95757 : 36 Max. :8.000 Max. :5.000   
## (Other) :236 (Other):672   
## sqft type price latitude   
## Min. : 484 Condo : 53 Min. : 30000 Min. :38.24   
## 1st Qu.:1167 Multi\_Family: 13 1st Qu.:156000 1st Qu.:38.48   
## Median :1470 Residential :866 Median :220000 Median :38.62   
## Mean :1680 Mean :246662 Mean :38.59   
## 3rd Qu.:1954 3rd Qu.:305000 3rd Qu.:38.69   
## Max. :4878 Max. :884790 Max. :39.02   
##   
## longitude   
## Min. :-121.6   
## 1st Qu.:-121.4   
## Median :-121.4   
## Mean :-121.4   
## 3rd Qu.:-121.3   
## Max. :-120.6   
##

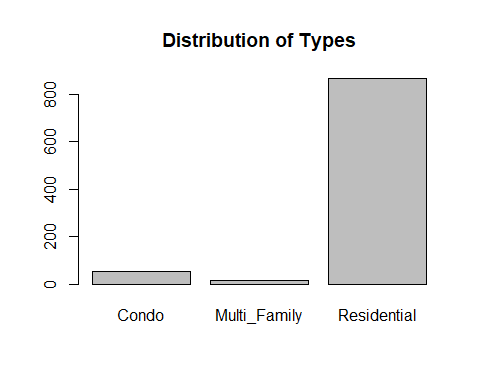
# Explore the distribution of numeric variables with histograms  
hist(Sacramento$price, main = "Distribution of Price", xlab = "Price")



# Box plot for price by type  
ggplot(Sacramento, aes(x = type, y = price, fill = type)) +  
 geom\_boxplot() +  
 labs(title = "Price by Type", x = "Type", y = "Price") +  
 theme\_minimal()



# Explore the distribution of categorical variables with bar plots  
barplot(table(Sacramento$type), main = "Distribution of Types")



# Check for class imbalance in the "type" variable  
table(Sacramento$type)

##   
## Condo Multi\_Family Residential   
## 53 13 866

# Calculate the class distribution  
prop.table(table(Sacramento$type))

##   
## Condo Multi\_Family Residential   
## 0.05686695 0.01394850 0.92918455

#problem 4(B)

library(caret)  
data(Sacramento)  
  
  
# Assuming you've already loaded and preprocessed the data as mentioned earlier  
# Dealing with extreme variations in numeric variables using normalization  
  
# Identify the numeric variables  
numeric\_cols <- sapply(Sacramento, is.numeric)  
  
  
  
# Min-max normalization  
Sacramento[, numeric\_cols] <- lapply(Sacramento[, numeric\_cols], function(x) (x - min(x)) / (max(x) - min(x)))  
Sacramento

## city zip beds baths sqft type price  
## 1 SACRAMENTO z95838 0.1428571 0.000 0.08010924 Residential 0.03418617  
## 2 SACRAMENTO z95823 0.2857143 0.000 0.15543924 Residential 0.04470338  
## 3 SACRAMENTO z95815 0.1428571 0.000 0.07100592 Residential 0.04548486  
## 4 SACRAMENTO z95815 0.1428571 0.000 0.08375057 Residential 0.04598439  
## 5 SACRAMENTO z95824 0.1428571 0.000 0.07123350 Residential 0.06071667  
## 6 SACRAMENTO z95841 0.2857143 0.000 0.14519800 Condo 0.07010026  
## 7 SACRAMENTO z95842 0.2857143 0.250 0.14110150 Residential 0.07123972  
## 8 SACRAMENTO z95820 0.2857143 0.000 0.15771507 Residential 0.07136490  
## 9 RANCHO\_CORDOVA z95670 0.1428571 0.250 0.10400546 Condo 0.07593093  
## 10 RIO\_LINDA z95673 0.2857143 0.250 0.15065999 Residential 0.08064788  
## 11 SACRAMENTO z95838 0.2857143 0.250 0.09672280 Residential 0.08225295  
## 12 SACRAMENTO z95823 0.2857143 0.250 0.18320437 Residential 0.08920320  
## 13 SACRAMENTO z95815 0.0000000 0.000 0.08807465 Residential 0.08990746  
## 14 SACRAMENTO z95822 0.2857143 0.000 0.12198452 Residential 0.09066788  
## 15 SACRAMENTO z95842 0.1428571 0.250 0.12243969 Residential 0.09212789  
## 16 SACRAMENTO z95842 0.1428571 0.250 0.14792899 Condo 0.09440915  
## 17 RIO\_LINDA z95673 0.1428571 0.000 0.08192990 Residential 0.09740755  
## 18 CITRUS\_HEIGHTS z95621 0.1428571 0.000 0.07077833 Condo 0.10090198  
## 19 SACRAMENTO z95833 0.1428571 0.000 0.02366864 Residential 0.10528902  
## 20 RIO\_LINDA z95673 0.2857143 0.250 0.19845244 Residential 0.10719592  
## 21 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.14428766 Residential 0.10762877  
## 22 SACRAMENTO z95823 0.4285714 0.250 0.19230769 Residential 0.10842663  
## 23 NORTH\_HIGHLANDS z95660 0.4285714 0.250 0.17205280 Residential 0.10879865  
## 24 SACRAMENTO z95834 0.2857143 0.250 0.25421029 Residential 0.11008552  
## 25 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.09490214 Residential 0.11113841  
## 26 ANTELOPE z95843 0.2857143 0.250 0.13746017 Residential 0.11305701  
## 27 SACRAMENTO z95820 0.2857143 0.000 0.10901229 Residential 0.11380690  
## 28 SACRAMENTO z95832 0.2857143 0.250 0.14451525 Residential 0.11581792  
## 29 SACRAMENTO z95827 0.4285714 0.250 0.20391443 Residential 0.11839165  
## 30 SACRAMENTO z95828 0.2857143 0.250 0.17387346 Residential 0.11932755  
## 31 ELK\_GROVE z95758 0.1428571 0.250 0.12630860 Condo 0.12049743  
## 32 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.15202549 Residential 0.12231659  
## 33 SACRAMENTO z95827 0.2857143 0.250 0.20391443 Residential 0.12459201  
## 34 ELVERTA z95626 0.2857143 0.250 0.14383250 Residential 0.12722423  
## 35 ELK\_GROVE z95758 0.1428571 0.250 0.12630860 Condo 0.12985646  
## 36 SACRAMENTO z95823 0.2857143 0.250 0.21256259 Residential 0.13599832  
## 37 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.13609467 Residential 0.13723605  
## 38 SACRAMENTO z95823 0.4285714 0.250 0.22485207 Residential 0.13892301  
## 39 SACRAMENTO z95828 0.4285714 0.250 0.15065999 Residential 0.13990922  
## 40 SACRAMENTO z95825 0.0000000 0.000 0.06281293 Condo 0.14038536  
## 41 SACRAMENTO z95835 0.1428571 0.250 0.18661812 Condo 0.14272511  
## 42 SACRAMENTO z95822 0.2857143 0.250 0.16454256 Residential 0.14506487  
## 43 ELK\_GROVE z95624 0.2857143 0.250 0.13017751 Residential 0.14845284  
## 44 ANTELOPE z95843 0.1428571 0.250 0.12721893 Residential 0.15354649  
## 45 NORTH\_HIGHLANDS z95660 0.4285714 0.250 0.25102412 Residential 0.15383895  
## 46 SACRAMENTO z95833 0.4285714 0.000 0.14474283 Residential 0.15676365  
## 47 SACRAMENTO z95823 0.4285714 0.250 0.24943104 Residential 0.15793353  
## 48 SACRAMENTO z95823 0.4285714 0.000 0.33477469 Residential 0.15952105  
## 49 SACRAMENTO z95838 0.4285714 0.250 0.26672736 Residential 0.15952105  
## 50 SACRAMENTO z95823 0.2857143 0.250 0.22598999 Residential 0.16144316  
## 51 ELK\_GROVE z95624 0.2857143 0.250 0.16021848 Residential 0.16378292  
## 52 SACRAMENTO z95828 0.4285714 0.250 0.25170687 Residential 0.16729255  
## 53 SACRAMENTO z95823 0.2857143 0.250 0.22280382 Residential 0.16875490  
## 54 SACRAMENTO z95828 0.4285714 0.250 0.27992717 Residential 0.16882860  
## 55 SACRAMENTO z95823 0.2857143 0.250 0.15953573 Residential 0.17370348  
## 56 GALT z95632 0.2857143 0.250 0.20983159 Residential 0.17403105  
## 57 SACRAMENTO z95842 0.4285714 0.250 0.33204370 Multi\_Family 0.17499035  
## 58 SACRAMENTO z95826 0.2857143 0.250 0.15657715 Residential 0.17665158  
## 59 CARMICHAEL z95608 0.2857143 0.000 0.15202549 Residential 0.17767171  
## 60 SACRAMENTO z95823 0.4285714 0.500 0.31110605 Residential 0.17850817  
## 61 ANTELOPE z95843 0.2857143 0.250 0.16636322 Residential 0.17865909  
## 62 GALT z95632 0.2857143 0.250 0.14701866 Residential 0.17869886  
## 63 ORANGEVALE z95662 0.4285714 0.250 0.25466545 Residential 0.17922531  
## 64 GALT z95632 0.2857143 0.000 0.22644515 Residential 0.18570760  
## 65 SACRAMENTO z95823 0.2857143 0.250 0.21301775 Residential 0.18601060  
## 66 SACRAMENTO z95826 0.2857143 0.250 0.18115612 Residential 0.18959861  
## 67 ELK\_GROVE z95758 0.2857143 0.250 0.25079654 Residential 0.19185999  
## 68 ANTELOPE z95843 0.2857143 0.250 0.19981793 Residential 0.19281695  
## 69 SACRAMENTO z95828 0.4285714 0.750 0.38188439 Multi\_Family 0.19302987  
## 70 SACRAMENTO z95823 0.2857143 0.250 0.17796996 Residential 0.19653950  
## 71 ELK\_GROVE z95624 0.4285714 0.250 0.28015476 Residential 0.19829432  
## 72 FOLSOM z95630 0.2857143 0.250 0.30405098 Residential 0.19887926  
## 73 CARMICHAEL z95608 0.2857143 0.000 0.10286755 Residential 0.19887926  
## 74 SACRAMENTO z95834 0.1428571 0.500 0.26877560 Residential 0.20589852  
## 75 SACRAMENTO z95834 0.2857143 0.250 0.23372781 Residential 0.20823828  
## 76 SACRAMENTO z95823 0.4285714 0.250 0.25170687 Residential 0.21392857  
## 77 ELK\_GROVE z95758 0.4285714 0.250 0.25307237 Residential 0.22344669  
## 78 SACRAMENTO z95835 0.1428571 0.250 0.19503869 Residential 0.22344669  
## 79 ELK\_GROVE z95624 0.5714286 0.500 0.37596723 Residential 0.22585430  
## 80 ELK\_GROVE z95624 0.4285714 0.250 0.25762403 Residential 0.23150364  
## 81 SACRAMENTO z95823 0.2857143 0.250 0.22621757 Residential 0.23570351  
## 82 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.18274920 Residential 0.23947051  
## 83 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.18047337 Residential 0.23982499  
## 84 SACRAMENTO z95833 0.4285714 0.250 0.21939008 Residential 0.24099486  
## 85 SACRAMENTO z95829 0.4285714 0.500 0.39849795 Residential 0.24179623  
## 86 MATHER z95655 0.2857143 0.250 0.36618116 Residential 0.24310064  
## 87 RIO\_LINDA z95673 0.2857143 0.250 0.16135640 Residential 0.24581710  
## 88 ELK\_GROVE z95757 0.2857143 0.250 0.38211197 Residential 0.24876051  
## 89 SACRAMENTO z95828 0.2857143 0.250 0.17865271 Residential 0.25035389  
## 90 SACRAMENTO z95833 0.2857143 0.500 0.22507965 Residential 0.25093883  
## 91 SACRAMENTO z95828 0.2857143 0.000 0.10787437 Residential 0.25147697  
## 92 ELK\_GROVE z95624 0.5714286 0.500 0.46062813 Residential 0.25259771  
## 93 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.18684570 Residential 0.25737316  
## 94 ELK\_GROVE z95758 0.4285714 0.250 0.25193446 Residential 0.25737316  
## 95 CARMICHAEL z95608 0.1428571 0.250 0.19162494 Condo 0.25752992  
## 96 ELK\_GROVE z95757 0.2857143 0.250 0.30928539 Residential 0.26228664  
## 97 SACRAMENTO z95841 0.4285714 0.250 0.32703687 Residential 0.26228664  
## 98 ELK\_GROVE z95758 0.5714286 0.500 0.52480655 Residential 0.26673218  
## 99 SACRAMENTO z95835 0.2857143 0.250 0.24055530 Residential 0.26907194  
## 100 SACRAMENTO z95820 0.2857143 0.000 0.12152936 Residential 0.26908831  
## 101 RANCHO\_CORDOVA z95742 0.4285714 0.250 0.27969959 Residential 0.27316651  
## 102 SACRAMENTO z95834 0.2857143 0.250 0.27036868 Condo 0.27492133  
## 103 POLLOCK\_PINES z95726 0.2857143 0.250 0.20391443 Residential 0.27492133  
## 104 SACRAMENTO z95822 0.2857143 0.000 0.11174329 Residential 0.28280864  
## 105 SACRAMENTO z95829 0.4285714 0.500 0.42967683 Residential 0.28515776  
## 106 SACRAMENTO z95822 0.2857143 0.250 0.21893491 Residential 0.28672072  
## 107 POLLOCK\_PINES z95726 0.1428571 0.250 0.18206645 Residential 0.29353174  
## 108 SACRAMENTO z95832 0.4285714 0.500 0.57464725 Residential 0.29362416  
## 109 SACRAMENTO z95826 1.0000000 0.750 0.71187984 Multi\_Family 0.29527720  
## 110 ELK\_GROVE z95758 0.4285714 0.250 0.35776058 Residential 0.29831889  
## 111 ELK\_GROVE z95624 0.4285714 0.250 0.34342285 Residential 0.30114648  
## 112 ELK\_GROVE z95757 0.2857143 0.250 0.31247155 Residential 0.30533815  
## 113 SACRAMENTO z95818 0.1428571 0.000 0.14610833 Residential 0.30653611  
## 114 SACRAMENTO z95827 0.4285714 0.750 0.39349112 Multi\_Family 0.31235742  
## 115 ELK\_GROVE z95758 0.5714286 0.500 0.45744197 Residential 0.31235742  
## 116 ELK\_GROVE z95757 0.2857143 0.250 0.30928539 Residential 0.31352730  
## 117 GOLD\_RIVER z95670 0.1428571 0.250 0.23577606 Residential 0.31469718  
## 118 SACRAMENTO z95835 0.5714286 0.500 0.52708239 Residential 0.32058985  
## 119 ELK\_GROVE z95624 0.4285714 0.250 0.41533910 Residential 0.32873571  
## 120 SACRAMENTO z95827 0.5714286 0.500 0.42853892 Residential 0.33404345  
## 121 RANCHO\_CORDOVA z95742 0.5714286 0.750 0.69003186 Residential 0.33926461  
## 122 RANCHO\_CORDOVA z95742 0.4285714 0.500 0.46700046 Residential 0.33926461  
## 123 SACRAMENTO z95826 0.4285714 0.500 0.32544379 Residential 0.34904479  
## 124 ORANGEVALE z95662 0.1428571 0.000 0.27446518 Residential 0.35581839  
## 125 ELK\_GROVE z95757 0.2857143 0.500 0.51001365 Residential 0.35769019  
## 126 ELK\_GROVE z95757 0.4285714 0.500 0.42558034 Residential 0.35769019  
## 127 SACRAMENTO z95833 0.2857143 0.500 0.30905781 Residential 0.36207724  
## 128 FOLSOM z95630 0.2857143 0.250 0.38711880 Residential 0.36763416  
## 129 ELK\_GROVE z95758 0.4285714 0.250 0.29972690 Residential 0.36992712  
## 130 SACRAMENTO z95823 0.2857143 0.500 0.33614019 Residential 0.37088525  
## 131 ELK\_GROVE z95757 0.4285714 0.250 0.60309513 Residential 0.37161174  
## 132 SACRAMENTO z95823 0.4285714 0.500 0.32567137 Residential 0.37588180  
## 133 EL\_DORADO\_HILLS z95762 0.2857143 0.500 0.31611288 Residential 0.37670071  
## 134 SACRAMENTO z95831 0.2857143 0.500 0.26263086 Residential 0.39775851  
## 135 RANCHO\_MURIETA z95683 0.4285714 0.500 0.51206190 Residential 0.39834345  
## 136 WILTON z95693 0.2857143 0.250 0.37005007 Residential 0.40009827  
## 137 ELK\_GROVE z95757 0.5714286 0.500 0.60992262 Residential 0.40360790  
## 138 SACRAMENTO z95835 0.5714286 0.500 0.70892126 Residential 0.41097813  
## 139 SACRAMENTO z95831 0.4285714 0.250 0.35730542 Residential 0.41172920  
## 140 ANTELOPE z95843 0.4285714 0.250 0.30632681 Residential 0.41850162  
## 141 SACRAMENTO z95814 0.2857143 0.500 0.26012745 Residential 0.42232595  
## 142 ELK\_GROVE z95757 0.4285714 0.500 0.67273555 Residential 0.42638543  
## 143 GREENWOOD z95635 0.2857143 0.250 0.53755121 Residential 0.42700546  
## 144 ELK\_GROVE z95624 0.4285714 0.500 0.42671825 Residential 0.43307245  
## 145 SACRAMENTO z95831 0.2857143 0.500 0.35685025 Residential 0.45040302  
## 146 ELK\_GROVE z95757 0.5714286 0.500 0.67114247 Residential 0.46210180  
## 147 RANCHO\_CORDOVA z95742 0.5714286 0.500 0.71256259 Residential 0.46795119  
## 148 ELK\_GROVE z95624 0.7142857 0.750 0.73509331 Residential 0.48549936  
## 149 FOLSOM z95630 0.5714286 0.500 0.50136550 Residential 0.50304753  
## 150 ELK\_GROVE z95757 0.4285714 0.500 0.50978607 Residential 0.50421741  
## 151 ELK\_GROVE z95757 0.4285714 0.500 0.67273555 Residential 0.53736239  
## 152 ELK\_GROVE z95757 0.5714286 0.750 0.68821120 Residential 0.56154143  
## 153 FOLSOM z95630 0.4285714 0.250 0.45015931 Residential 0.59546789  
## 154 FOLSOM z95630 0.5714286 0.500 0.54984069 Residential 0.64928228  
## 155 EL\_DORADO\_HILLS z95762 0.4285714 0.750 0.73304506 Residential 0.66683045  
## 156 EL\_DORADO\_HILLS z95762 0.4285714 0.500 0.69253528 Residential 0.67412815  
## 157 SACRAMENTO z95864 0.2857143 0.500 0.41898043 Residential 0.73702313  
## 158 EL\_DORADO\_HILLS z95762 0.7142857 1.000 1.00000000 Residential 0.93590239  
## 159 CITRUS\_HEIGHTS z95621 0.1428571 0.000 0.07077833 Condo 0.04562524  
## 160 SACRAMENTO z95817 0.4285714 0.250 0.13996359 Residential 0.04679512  
## 161 ELK\_GROVE z95624 0.1428571 0.000 0.08101957 Condo 0.04796500  
## 162 SACRAMENTO z95815 0.1428571 0.000 0.07191625 Residential 0.05615414  
## 163 SACRAMENTO z95824 0.1428571 0.000 0.05962676 Residential 0.05662209  
## 164 SACRAMENTO z95822 0.2857143 0.000 0.13268093 Residential 0.05849390  
## 165 SACRAMENTO z95815 0.4285714 0.250 0.18934911 Residential 0.06902280  
## 166 SACRAMENTO z95815 0.2857143 0.000 0.19412836 Residential 0.07019268  
## 167 SACRAMENTO z95824 0.1428571 0.000 0.08739190 Residential 0.07019268  
## 168 SACRAMENTO z95824 0.2857143 0.000 0.10013655 Residential 0.07253243  
## 169 SACRAMENTO z95820 0.1428571 0.000 0.02867547 Residential 0.07449198  
## 170 RANCHO\_MURIETA z95683 0.2857143 0.250 0.23486573 Residential 0.07925923  
## 171 SACRAMENTO z95815 0.1428571 0.000 0.16750114 Residential 0.07955170  
## 172 ELK\_GROVE z95758 0.0000000 0.000 0.05416477 Condo 0.07955170  
## 173 SACRAMENTO z95864 0.2857143 0.000 0.26376878 Residential 0.08072158  
## 174 ELK\_GROVE z95758 0.0000000 0.000 0.05416477 Condo 0.08189146  
## 175 GALT z95632 0.2857143 0.000 0.13563951 Residential 0.08974836  
## 176 SACRAMENTO z95820 0.2857143 0.000 0.12630860 Residential 0.09476012  
## 177 NORTH\_HIGHLANDS z95660 0.2857143 0.000 0.12903960 Residential 0.09476012  
## 178 SACRAMENTO z95842 0.1428571 0.250 0.10992262 Residential 0.09920565  
## 179 RANCHO\_CORDOVA z95670 0.2857143 0.000 0.13973600 Residential 0.10541537  
## 180 SACRAMENTO z95824 0.2857143 0.000 0.12881202 Residential 0.10906187  
## 181 SACRAMENTO z95838 0.2857143 0.250 0.14246700 Residential 0.10967606  
## 182 NORTH\_HIGHLANDS z95660 0.2857143 0.000 0.09194356 Residential 0.11113841  
## 183 SACRAMENTO z95822 0.2857143 0.250 0.14474283 Residential 0.11113841  
## 184 ELVERTA z95626 0.2857143 0.250 0.13563951 Residential 0.11230829  
## 185 NORTH\_HIGHLANDS z95660 0.2857143 0.000 0.10764679 Residential 0.11581792  
## 186 SACRAMENTO z95838 0.1428571 0.000 0.10650888 Residential 0.12166731  
## 187 SACRAMENTO z95838 0.2857143 0.250 0.16545289 Residential 0.12283719  
## 188 SACRAMENTO z95815 0.2857143 0.250 0.17751479 Residential 0.12342213  
## 189 SACRAMENTO z95833 0.2857143 0.000 0.13563951 Residential 0.12868658  
## 190 GALT z95632 0.2857143 0.250 0.17796996 Residential 0.12868658  
## 191 FAIR\_OAKS z95628 0.1428571 0.250 0.11606736 Condo 0.13161127  
## 192 SACRAMENTO z95834 0.2857143 0.250 0.16340464 Residential 0.13278115  
## 193 ELK\_GROVE z95758 0.1428571 0.250 0.12630860 Condo 0.13453597  
## 194 SACRAMENTO z95820 0.1428571 0.000 0.05416477 Residential 0.13453597  
## 195 SACRAMENTO z95828 0.4285714 0.250 0.21939008 Residential 0.13453597  
## 196 SACRAMENTO z95828 0.2857143 0.250 0.16021848 Residential 0.13453597  
## 197 NORTH\_HIGHLANDS z95660 0.4285714 0.250 0.15908056 Residential 0.13570585  
## 198 SACRAMENTO z95822 0.2857143 0.000 0.19025944 Residential 0.13863054  
## 199 SACRAMENTO z95828 0.2857143 0.250 0.14406008 Residential 0.13921548  
## 200 SACRAMENTO z95828 0.2857143 0.250 0.20027310 Residential 0.14038536  
## 201 SACRAMENTO z95823 0.4285714 0.250 0.18798361 Residential 0.14038536  
## 202 ELK\_GROVE z95758 0.1428571 0.250 0.11879836 Residential 0.14272511  
## 203 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.14110150 Residential 0.14740463  
## 204 SACRAMENTO z95825 0.1428571 0.000 0.07419208 Residential 0.14740463  
## 205 ELK\_GROVE z95624 0.1428571 0.250 0.14542558 Residential 0.14740463  
## 206 SACRAMENTO z95842 0.1428571 0.000 0.09558489 Residential 0.14949637  
## 207 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.15293582 Residential 0.15401795  
## 208 SACRAMENTO z95820 0.1428571 0.000 0.19048703 Residential 0.15422384  
## 209 ANTELOPE z95843 0.2857143 0.250 0.20664543 Residential 0.15793353  
## 210 SACRAMENTO z95823 0.2857143 0.250 0.21734183 Residential 0.16144316  
## 211 SACRAMENTO z95842 0.2857143 0.250 0.15361857 Residential 0.16261304  
## 212 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.27014110 Residential 0.16963231  
## 213 SACRAMENTO z95823 0.2857143 0.250 0.28584433 Residential 0.17109465  
## 214 SACRAMENTO z95823 0.2857143 0.250 0.17774238 Residential 0.17431182  
## 215 ANTELOPE z95843 0.1428571 0.250 0.11902594 Residential 0.17548170  
## 216 ELK\_GROVE z95758 0.2857143 0.250 0.28038234 Residential 0.17594965  
## 217 ELK\_GROVE z95758 0.4285714 0.250 0.27332726 Residential 0.17782145  
## 218 RANCHO\_CORDOVA z95670 0.4285714 0.250 0.30609923 Residential 0.18074615  
## 219 ELK\_GROVE z95758 0.2857143 0.250 0.24374147 Residential 0.18133109  
## 220 CARMICHAEL z95608 0.4285714 0.250 0.14474283 Residential 0.18601060  
## 221 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.14861174 Residential 0.19185999  
## 222 SACRAMENTO z95826 0.2857143 0.000 0.15703232 Residential 0.19302987  
## 223 ANTELOPE z95843 0.2857143 0.250 0.20687301 Residential 0.19887926  
## 224 CAMERON\_PARK z95682 0.2857143 0.125 0.21187984 Residential 0.20004913  
## 225 LINCOLN z95648 0.4285714 0.250 0.37369140 Residential 0.20180395  
## 226 SACRAMENTO z95828 0.2857143 0.250 0.18320437 Residential 0.20472865  
## 227 SACRAMENTO z95838 0.4285714 0.250 0.29927173 Residential 0.20472865  
## 228 PLACERVILLE z95667 0.2857143 0.250 0.18752845 Residential 0.20472865  
## 229 SACRAMENTO z95823 0.4285714 0.500 0.33431953 Residential 0.20472865  
## 230 SACRAMENTO z95820 0.1428571 0.000 0.05439235 Residential 0.20706840  
## 231 CAMERON\_PARK z95682 0.1428571 0.125 0.20300410 Residential 0.21057804  
## 232 PLACERVILLE z95667 0.1428571 0.000 0.10559854 Residential 0.21233285  
## 233 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.24897588 Residential 0.21642743  
## 234 CITRUS\_HEIGHTS z95610 0.2857143 0.250 0.18957670 Residential 0.21642743  
## 235 SACRAMENTO z95833 0.2857143 0.500 0.19936277 Residential 0.21701237  
## 236 SACRAMENTO z95824 0.2857143 0.000 0.19936277 Residential 0.22506230  
## 237 SACRAMENTO z95833 0.2857143 0.250 0.23623122 Residential 0.22812621  
## 238 SACRAMENTO z95825 0.4285714 0.250 0.28834775 Residential 0.22812621  
## 239 ELK\_GROVE z95624 0.2857143 0.250 0.22325899 Residential 0.22812621  
## 240 SACRAMENTO z95826 0.4285714 0.250 0.25512062 Residential 0.23163584  
## 241 RIO\_LINDA z95673 0.4285714 0.250 0.22553482 Residential 0.23358369  
## 242 MEADOW\_VISTA z95722 0.2857143 0.000 0.16659081 Residential 0.23397560  
## 243 FAIR\_OAKS z95628 0.1428571 0.250 0.18912153 Residential 0.23397560  
## 244 ELK\_GROVE z95757 0.2857143 0.250 0.24647246 Residential 0.23397560  
## 245 SACRAMENTO z95835 0.2857143 0.250 0.29403732 Residential 0.23865511  
## 246 SACRAMENTO z95835 0.2857143 0.250 0.38757396 Residential 0.23982499  
## 247 SACRAMENTO z95822 0.2857143 0.000 0.18365954 Residential 0.24128733  
## 248 FOLSOM z95630 0.1428571 0.250 0.14679108 Condo 0.24567438  
## 249 ELK\_GROVE z95624 0.2857143 0.375 0.22052799 Residential 0.24801413  
## 250 SACRAMENTO z95842 0.2857143 0.250 0.23190715 Residential 0.25152377  
## 251 SACRAMENTO z95828 0.4285714 0.500 0.45675922 Residential 0.25152377  
## 252 SACRAMENTO z95816 0.1428571 0.000 0.17865271 Residential 0.25152377  
## 253 SACRAMENTO z95835 0.2857143 0.375 0.28083751 Residential 0.25737316  
## 254 ORANGEVALE z95662 0.2857143 0.250 0.15748748 Residential 0.25737316  
## 255 ORANGEVALE z95662 0.4285714 0.250 0.22121074 Residential 0.25737316  
## 256 ROSEVILLE z95678 0.2857143 0.250 0.23076923 Residential 0.25737316  
## 257 ANTELOPE z95843 0.2857143 0.250 0.24806554 Residential 0.26322255  
## 258 CITRUS\_HEIGHTS z95610 0.5714286 0.750 0.36436049 Multi\_Family 0.26445560  
## 259 SACRAMENTO z95829 0.2857143 0.250 0.38370505 Residential 0.26641514  
## 260 ELK\_GROVE z95758 0.4285714 0.250 0.25284479 Residential 0.26907194  
## 261 ANTELOPE z95843 0.2857143 0.250 0.24647246 Residential 0.27024181  
## 262 LINCOLN z95648 0.4285714 0.500 0.55962676 Residential 0.27117772  
## 263 SACRAMENTO z95822 0.4285714 0.250 0.17501138 Residential 0.27430012  
## 264 ANTELOPE z95843 0.4285714 0.500 0.29221666 Residential 0.27492133  
## 265 SACRAMENTO z95835 0.4285714 0.375 0.34046427 Residential 0.28077072  
## 266 SACRAMENTO z95835 0.4285714 0.500 0.35184342 Residential 0.28077072  
## 267 SACRAMENTO z95835 0.2857143 0.250 0.23827947 Residential 0.28077072  
## 268 SACRAMENTO z95834 0.4285714 0.500 0.28812016 Residential 0.28077072  
## 269 ELK\_GROVE z95624 0.4285714 0.500 0.26604461 Residential 0.28662011  
## 270 ELK\_GROVE z95758 0.4285714 0.250 0.35776058 Residential 0.28662011  
## 271 ELK\_GROVE z95624 0.4285714 0.500 0.45744197 Residential 0.29246950  
## 272 FAIR\_OAKS z95628 0.2857143 0.250 0.21984524 Residential 0.29950397  
## 273 SACRAMENTO z95834 0.4285714 0.250 0.38347747 Residential 0.30650803  
## 274 ROSEVILLE z95747 0.2857143 0.250 0.21756941 Residential 0.30650803  
## 275 FAIR\_OAKS z95628 0.2857143 0.250 0.23736914 Residential 0.30883960  
## 276 ROSEVILLE z95678 0.2857143 0.250 0.20869367 Residential 0.30884779  
## 277 SACRAMENTO z95838 0.2857143 0.250 0.21096950 Residential 0.31208718  
## 278 LINCOLN z95648 0.4285714 0.750 0.57032317 Residential 0.31294236  
## 279 GOLD\_RIVER z95670 0.1428571 0.375 0.23873464 Condo 0.31586706  
## 280 RIO\_LINDA z95673 0.2857143 0.000 0.18206645 Residential 0.31586706  
## 281 GALT z95632 0.4285714 0.500 0.41488393 Residential 0.31586706  
## 282 PLACERVILLE z95667 0.2857143 0.250 0.19230769 Residential 0.31586706  
## 283 SACRAMENTO z95835 0.4285714 0.250 0.32453345 Residential 0.31645199  
## 284 GOLD\_RIVER z95670 0.2857143 0.250 0.34069185 Residential 0.32171644  
## 285 ROSEVILLE z95747 0.2857143 0.375 0.30609923 Residential 0.32347126  
## 286 SACRAMENTO z95835 0.2857143 0.250 0.26877560 Residential 0.33049053  
## 287 LINCOLN z95648 0.5714286 0.500 0.58898498 Residential 0.33341522  
## 288 SACRAMENTO z95823 0.4285714 0.250 0.39167046 Residential 0.33901777  
## 289 LINCOLN z95648 0.1428571 0.250 0.21961766 Residential 0.35096339  
## 290 FOLSOM z95630 0.2857143 0.250 0.17614929 Residential 0.35096339  
## 291 ELK\_GROVE z95757 0.2857143 0.250 0.47587619 Residential 0.35213327  
## 292 SACRAMENTO z95820 0.1428571 0.000 0.01251707 Residential 0.35564291  
## 293 RANCHO\_CORDOVA z95670 0.4285714 0.500 0.39235321 Residential 0.35798266  
## 294 SACRAMENTO z95819 0.2857143 0.000 0.14201183 Residential 0.36149230  
## 295 FOLSOM z95630 0.4285714 0.250 0.25284479 Residential 0.36149230  
## 296 GALT z95632 0.4285714 0.250 0.38120164 Residential 0.36851156  
## 297 PLACERVILLE z95667 0.4285714 0.500 0.41215294 Residential 0.37436095  
## 298 ROSEVILLE z95678 0.2857143 0.250 0.30814747 Residential 0.38138022  
## 299 SACRAMENTO z95823 0.4285714 0.250 0.32225762 Residential 0.38810117  
## 300 SACRAMENTO z95811 0.4285714 0.250 0.28083751 Residential 0.38833866  
## 301 ELK\_GROVE z95757 0.5714286 0.500 0.66112881 Residential 0.39775851  
## 302 ROCKLIN z95677 0.4285714 0.250 0.38825671 Residential 0.40945729  
## 303 ELK\_GROVE z95757 0.5714286 0.750 0.63177060 Residential 0.41530668  
## 304 CAMERON\_PARK z95682 0.2857143 0.250 0.34865726 Residential 0.43168498  
## 305 ROCKLIN z95765 0.4285714 0.250 0.48315885 Residential 0.43519461  
## 306 ELK\_GROVE z95757 0.4285714 0.500 0.50978607 Residential 0.43990454  
## 307 GALT z95632 0.5714286 0.750 0.74237597 Residential 0.45625241  
## 308 RANCHO\_CORDOVA z95742 0.5714286 0.750 0.79312699 Residential 0.46210180  
## 309 RANCHO\_MURIETA z95683 0.4285714 0.250 0.61629495 Residential 0.46210180  
## 310 SACRAMENTO z95834 0.2857143 0.500 0.53368229 Residential 0.47204577  
## 311 LINCOLN z95648 0.5714286 0.750 0.78379609 Residential 0.47584319  
## 312 EL\_DORADO\_HILLS z95762 0.5714286 0.500 0.70391443 Residential 0.47812913  
## 313 SACRAMENTO z95811 0.1428571 0.000 0.17364588 Residential 0.48549936  
## 314 FOLSOM z95630 0.4285714 0.250 0.47724169 Residential 0.49134875  
## 315 SACRAMENTO z95841 0.2857143 0.000 0.36049158 Residential 0.50304753  
## 316 EL\_DORADO\_HILLS z95762 0.2857143 0.250 0.37437415 Residential 0.50304753  
## 317 ELK\_GROVE z95624 0.4285714 0.500 0.79836140 Residential 0.50304753  
## 318 SACRAMENTO z95835 0.4285714 0.750 0.66294948 Residential 0.50889692  
## 319 SACRAMENTO z95835 0.5714286 0.500 0.77309968 Residential 0.51679360  
## 320 ROCKLIN z95765 0.5714286 0.750 0.61060537 Residential 0.52644509  
## 321 CARMICHAEL z95608 0.1428571 0.250 0.25352754 Residential 0.53112460  
## 322 PLACERVILLE z95667 0.4285714 0.500 0.32885753 Residential 0.53229448  
## 323 ELK\_GROVE z95757 0.4285714 0.500 0.58852981 Residential 0.54399326  
## 324 ROSEVILLE z95678 0.4285714 0.375 0.40691853 Residential 0.55042759  
## 325 AUBURN z95603 0.2857143 0.500 0.52503414 Residential 0.55452216  
## 326 EL\_DORADO\_HILLS z95762 0.5714286 0.500 0.59922622 Residential 0.59780765  
## 327 WILTON z95693 0.2857143 0.250 0.46882112 Residential 0.62003533  
## 328 SACRAMENTO z95829 0.5714286 0.500 0.79654074 Residential 0.63465881  
## 329 CARMICHAEL z95608 0.4285714 0.250 0.39553937 Residential 0.64577265  
## 330 ROSEVILLE z95661 0.4285714 0.500 0.76331361 Residential 0.68250798  
## 331 ROSEVILLE z95747 0.4285714 0.625 0.58602640 Residential 0.68320874  
## 332 FAIR\_OAKS z95628 0.5714286 1.000 0.53755121 Residential 0.76042069  
## 333 SACRAMENTO z95819 0.5714286 0.250 0.45516614 Residential 0.78264837  
## 334 LOOMIS z95650 0.4285714 0.750 0.25944470 Residential 0.94643129  
## 335 SACRAMENTO z95842 0.1428571 0.000 0.08101957 Condo 0.01169878  
## 336 SACRAMENTO z95825 0.0000000 0.000 0.00000000 Condo 0.02105780  
## 337 SACRAMENTO z95815 0.2857143 0.000 0.11060537 Residential 0.03685116  
## 338 SACRAMENTO z95817 0.1428571 0.000 0.03163405 Residential 0.03749459  
## 339 SACRAMENTO z95820 0.1428571 0.000 0.10195721 Residential 0.04094573  
## 340 SACRAMENTO z95838 0.1428571 0.000 0.07100592 Residential 0.04094573  
## 341 SACRAMENTO z95820 0.1428571 0.000 0.07965407 Residential 0.04445536  
## 342 SACRAMENTO z95820 0.1428571 0.000 0.07965407 Residential 0.04445536  
## 343 SACRAMENTO z95841 0.1428571 0.000 0.10013655 Condo 0.05498427  
## 344 SACRAMENTO z95842 0.1428571 0.000 0.07077833 Condo 0.06169001  
## 345 SACRAMENTO z95838 0.2857143 0.000 0.17432863 Residential 0.06317341  
## 346 SACRAMENTO z95820 0.1428571 0.000 0.11379153 Residential 0.06396308  
## 347 SACRAMENTO z95828 0.2857143 0.000 0.12039144 Residential 0.06434329  
## 348 SACRAMENTO z95822 0.2857143 0.000 0.12016386 Residential 0.07019268  
## 349 SACRAMENTO z95826 0.1428571 0.000 0.07077833 Condo 0.07019268  
## 350 SACRAMENTO z95838 0.1428571 0.250 0.09877105 Residential 0.07136256  
## 351 SACRAMENTO z95838 0.2857143 0.000 0.13609467 Residential 0.07604207  
## 352 SACRAMENTO z95842 0.1428571 0.000 0.10923987 Residential 0.07896676  
## 353 SACRAMENTO z95815 0.4285714 0.250 0.20937642 Multi\_Family 0.08189146  
## 354 SACRAMENTO z95826 0.0000000 0.000 0.03208921 Condo 0.08189146  
## 355 CITRUS\_HEIGHTS z95621 0.1428571 0.000 0.09194356 Residential 0.08306134  
## 356 SACRAMENTO z95815 0.4285714 0.250 0.14474283 Residential 0.08510862  
## 357 NORTH\_HIGHLANDS z95660 0.2857143 0.000 0.19276286 Residential 0.09651493  
## 358 SACRAMENTO z95821 0.2857143 0.000 0.12061903 Residential 0.09709987  
## 359 SACRAMENTO z95820 0.4285714 0.250 0.21939008 Residential 0.09826975  
## 360 SACRAMENTO z95838 0.2857143 0.000 0.10969504 Residential 0.09826975  
## 361 SACRAMENTO z95823 0.1428571 0.000 0.06713701 Residential 0.09914716  
## 362 ANTELOPE z95843 0.1428571 0.250 0.08010924 Condo 0.09943963  
## 363 ROSEVILLE z95678 0.1428571 0.250 0.14019117 Condo 0.09943963  
## 364 SACRAMENTO z95832 0.2857143 0.000 0.15703232 Residential 0.10072649  
## 365 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.16454256 Residential 0.10441161  
## 366 SACRAMENTO z95828 0.4285714 0.750 0.34387802 Multi\_Family 0.10528902  
## 367 SACRAMENTO z95820 0.1428571 0.000 0.07282658 Residential 0.10528902  
## 368 SACRAMENTO z95834 0.1428571 0.250 0.10787437 Condo 0.10528902  
## 369 SACRAMENTO z95823 0.2857143 0.250 0.20072827 Residential 0.10541537  
## 370 SACRAMENTO z95823 0.1428571 0.250 0.09490214 Residential 0.10704384  
## 371 SACRAMENTO z95815 0.2857143 0.000 0.04824761 Residential 0.10730706  
## 372 GALT z95632 0.2857143 0.250 0.13563951 Residential 0.10762877  
## 373 SACRAMENTO z95822 0.2857143 0.250 0.14110150 Residential 0.10879865  
## 374 SACRAMENTO z95825 0.1428571 0.000 0.11106054 Residential 0.11113841  
## 375 SACRAMENTO z95833 0.4285714 0.250 0.20619026 Residential 0.11180875  
## 376 ELVERTA z95626 0.4285714 0.250 0.19799727 Residential 0.11314358  
## 377 SACRAMENTO z95826 0.1428571 0.000 0.07077833 Condo 0.11343137  
## 378 ROSEVILLE z95678 0.1428571 0.000 0.06736459 Condo 0.11347816  
## 379 SACRAMENTO z95828 0.4285714 0.250 0.25102412 Residential 0.11406310  
## 380 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.16499772 Residential 0.11698780  
## 381 SACRAMENTO z95824 0.1428571 0.000 0.14906691 Residential 0.12062027  
## 382 RIO\_LINDA z95673 0.1428571 0.250 0.27446518 Residential 0.12459201  
## 383 CARMICHAEL z95608 0.2857143 0.250 0.17319071 Condo 0.12810164  
## 384 ELVERTA z95626 0.2857143 0.250 0.21210742 Residential 0.12868658  
## 385 SACRAMENTO z95832 0.2857143 0.250 0.18570778 Residential 0.12962248  
## 386 SACRAMENTO z95822 0.2857143 0.250 0.14474283 Residential 0.13453597  
## 387 SACRAMENTO z95828 0.4285714 0.250 0.25170687 Residential 0.13687572  
## 388 SACRAMENTO z95828 0.2857143 0.250 0.21005917 Residential 0.13991741  
## 389 SACRAMENTO z95820 0.5714286 0.250 0.23486573 Residential 0.14038536  
## 390 ROSEVILLE z95747 0.1428571 0.250 0.13040510 Condo 0.14038536  
## 391 SACRAMENTO z95822 0.2857143 0.250 0.26445152 Residential 0.14038536  
## 392 SACRAMENTO z95823 0.2857143 0.250 0.27127902 Residential 0.14623475  
## 393 SACRAMENTO z95838 0.2857143 0.250 0.20163860 Residential 0.14674364  
## 394 SACRAMENTO z95838 0.2857143 0.250 0.20163860 Residential 0.14681969  
## 395 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.19731452 Residential 0.14974438  
## 396 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.15202549 Residential 0.14974438  
## 397 SACRAMENTO z95823 0.2857143 0.250 0.22030041 Residential 0.15208414  
## 398 ROSEVILLE z95678 0.1428571 0.000 0.11515703 Residential 0.15208414  
## 399 CITRUS\_HEIGHTS z95621 0.1428571 0.250 0.15430132 Residential 0.15676365  
## 400 RIO\_LINDA z95673 0.2857143 0.250 0.15885298 Residential 0.15676365  
## 401 ELK\_GROVE z95758 0.1428571 0.250 0.14292217 Residential 0.15793353  
## 402 GALT z95632 0.2857143 0.250 0.14019117 Residential 0.16027328  
## 403 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.18115612 Residential 0.16061606  
## 404 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.18115612 Residential 0.16061606  
## 405 SACRAMENTO z95820 0.2857143 0.000 0.12630860 Residential 0.16144316  
## 406 SACRAMENTO z95842 0.2857143 0.250 0.15361857 Residential 0.16378292  
## 407 SACRAMENTO z95833 0.4285714 0.250 0.32612654 Residential 0.16378292  
## 408 SACRAMENTO z95827 0.2857143 0.250 0.23577606 Residential 0.16378292  
## 409 GALT z95632 0.2857143 0.250 0.16385981 Residential 0.16846243  
## 410 SACRAMENTO z95841 0.2857143 0.250 0.14474283 Residential 0.17314194  
## 411 SACRAMENTO z95823 0.2857143 0.250 0.21665908 Residential 0.17548170  
## 412 SACRAMENTO z95826 0.2857143 0.250 0.22007283 Residential 0.17548170  
## 413 SACRAMENTO z95828 0.4285714 0.250 0.26263086 Residential 0.17548170  
## 414 CARMICHAEL z95608 0.1428571 0.250 0.11743286 Condo 0.17782145  
## 415 ROSEVILLE z95661 0.2857143 0.000 0.15202549 Residential 0.18522093  
## 416 ROSEVILLE z95747 0.2857143 0.250 0.15248066 Residential 0.18893529  
## 417 SACRAMENTO z95838 0.2857143 0.250 0.19776969 Residential 0.18952023  
## 418 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.19230769 Residential 0.19033915  
## 419 SACRAMENTO z95826 0.2857143 0.000 0.19845244 Residential 0.19302987  
## 420 SACRAMENTO z95838 0.2857143 0.250 0.23236231 Residential 0.19613472  
## 421 SACRAMENTO z95842 0.2857143 0.000 0.11948111 Residential 0.19653950  
## 422 SACRAMENTO z95823 0.2857143 0.250 0.15020482 Residential 0.19928286  
## 423 SACRAMENTO z95864 0.1428571 0.000 0.10150205 Residential 0.20238889  
## 424 SACRAMENTO z95841 0.4285714 0.250 0.29176149 Residential 0.20706840  
## 425 SACRAMENTO z95828 0.4285714 0.500 0.33136095 Residential 0.20823828  
## 426 ELK\_GROVE z95758 0.4285714 0.250 0.29403732 Residential 0.21057804  
## 427 CITRUS\_HEIGHTS z95621 0.2857143 0.000 0.17614929 Residential 0.21291779  
## 428 SACRAMENTO z95828 0.4285714 0.250 0.31588530 Residential 0.21487734  
## 429 ELK\_GROVE z95758 0.1428571 0.250 0.14292217 Residential 0.21490308  
## 430 SACRAMENTO z95833 0.4285714 0.250 0.31224397 Residential 0.21642743  
## 431 SACRAMENTO z95816 0.4285714 0.500 0.33113336 Residential 0.21642743  
## 432 ROSEVILLE z95678 0.2857143 0.000 0.11697770 Residential 0.21654441  
## 433 ROSEVILLE z95678 0.2857143 0.250 0.28994083 Residential 0.21935212  
## 434 SACRAMENTO z95838 0.2857143 0.250 0.37733273 Residential 0.21993706  
## 435 SACRAMENTO z95831 0.1428571 0.000 0.10605371 Residential 0.22227682  
## 436 ELK\_GROVE z95758 0.4285714 0.500 0.28561675 Residential 0.22344669  
## 437 ELK\_GROVE z95624 0.2857143 0.250 0.23486573 Residential 0.22566946  
## 438 ANTELOPE z95843 0.2857143 0.000 0.11470187 Residential 0.22594906  
## 439 GALT z95632 0.4285714 0.250 0.24374147 Residential 0.22871115  
## 440 SACRAMENTO z95820 0.2857143 0.250 0.16568047 Residential 0.23201839  
## 441 SACRAMENTO z95833 0.4285714 0.250 0.31565772 Residential 0.23397560  
## 442 SACRAMENTO z95828 0.2857143 0.250 0.18616295 Residential 0.23397560  
## 443 SACRAMENTO z95841 0.1428571 0.000 0.06190259 Condo 0.23458627  
## 444 ANTELOPE z95843 0.4285714 0.500 0.35093309 Residential 0.23537945  
## 445 SACRAMENTO z95831 0.2857143 0.250 0.20277651 Residential 0.23631535  
## 446 SACRAMENTO z95834 0.1428571 0.250 0.17432863 Condo 0.23690029  
## 447 SACRAMENTO z95822 0.2857143 0.000 0.13063268 Residential 0.23823512  
## 448 ANTELOPE z95843 0.2857143 0.250 0.15999090 Residential 0.23865511  
## 449 SACRAMENTO z95831 0.1428571 0.250 0.19116978 Residential 0.23924005  
## 450 SACRAMENTO z95828 0.4285714 0.500 0.33045061 Residential 0.23982499  
## 451 RANCHO\_CORDOVA z95670 0.5714286 0.750 0.43195266 Multi\_Family 0.24099486  
## 452 FOLSOM z95630 0.2857143 0.250 0.21461083 Residential 0.24108027  
## 453 SACRAMENTO z95835 0.2857143 0.250 0.27173418 Condo 0.24333462  
## 454 GALT z95632 0.4285714 0.250 0.29904415 Residential 0.24434189  
## 455 ANTELOPE z95843 0.4285714 0.500 0.49340009 Residential 0.24532341  
## 456 SACRAMENTO z95829 0.4285714 0.250 0.30314065 Residential 0.24567438  
## 457 SACRAMENTO z95834 0.5714286 0.500 0.58989531 Residential 0.24567438  
## 458 ELK\_GROVE z95758 0.4285714 0.250 0.30951297 Residential 0.24684425  
## 459 SACRAMENTO z95823 0.2857143 0.250 0.18707328 Residential 0.25152377  
## 460 SACRAMENTO z95833 0.4285714 0.500 0.44674556 Residential 0.25269364  
## 461 SACRAMENTO z95828 0.4285714 0.250 0.15748748 Residential 0.25413727  
## 462 RIO\_LINDA z95673 0.4285714 0.250 0.15885298 Residential 0.25442506  
## 463 RIO\_LINDA z95673 0.2857143 0.000 0.15384615 Residential 0.25721171  
## 464 SACRAMENTO z95835 0.2857143 0.250 0.21392808 Residential 0.25854303  
## 465 ORANGEVALE z95662 0.4285714 0.250 0.24806554 Residential 0.25989424  
## 466 ANTELOPE z95843 0.2857143 0.250 0.30632681 Residential 0.26225389  
## 467 ELK\_GROVE z95624 0.4285714 0.250 0.28220300 Residential 0.26673218  
## 468 AUBURN z95603 0.1428571 0.250 0.17546655 Condo 0.26907194  
## 469 ELK\_GROVE z95758 0.2857143 0.500 0.28083751 Residential 0.27024181  
## 470 SACRAMENTO z95835 0.4285714 0.500 0.38484297 Residential 0.27024181  
## 471 SACRAMENTO z95835 0.4285714 0.250 0.32316796 Residential 0.27024181  
## 472 EL\_DORADO\_HILLS z95762 0.4285714 0.250 0.30131998 Residential 0.27199663  
## 473 RANCHO\_CORDOVA z95742 0.4285714 0.250 0.50682749 Residential 0.27609120  
## 474 CARMICHAEL z95608 0.2857143 0.000 0.27969959 Residential 0.27609120  
## 475 ELK\_GROVE z95757 0.2857143 0.250 0.22143832 Residential 0.28077072  
## 476 ELK\_GROVE z95757 0.4285714 0.500 0.50978607 Residential 0.28594743  
## 477 ROCKLIN z95765 0.2857143 0.250 0.31019572 Residential 0.28603517  
## 478 SACRAMENTO z95828 0.2857143 0.250 0.22394174 Residential 0.28701318  
## 479 SACRAMENTO z95835 0.4285714 0.500 0.47018662 Residential 0.29010634  
## 480 GALT z95632 0.4285714 0.250 0.32862995 Residential 0.29246950  
## 481 SACRAMENTO z95814 0.2857143 0.500 0.32726445 Residential 0.29795154  
## 482 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.19549386 Residential 0.29819371  
## 483 ROCKLIN z95677 0.2857143 0.250 0.23350023 Residential 0.29831889  
## 484 AUBURN z95603 0.1428571 0.250 0.10832954 Multi\_Family 0.29831889  
## 485 CARMICHAEL z95608 0.4285714 0.250 0.24465180 Residential 0.29831889  
## 486 EL\_DORADO z95623 0.2857143 0.250 0.25944470 Residential 0.30299840  
## 487 SACRAMENTO z95832 0.5714286 0.500 0.57077833 Residential 0.31001767  
## 488 ELK\_GROVE z95758 0.4285714 0.250 0.36982249 Residential 0.31118754  
## 489 RANCHO\_CORDOVA z95670 0.4285714 0.250 0.23668639 Residential 0.31125306  
## 490 SACRAMENTO z95828 0.2857143 0.250 0.17387346 Residential 0.31277741  
## 491 SACRAMENTO z95823 0.4285714 0.250 0.31679563 Residential 0.31579686  
## 492 LINCOLN z95648 0.5714286 0.500 0.45630405 Residential 0.32054657  
## 493 RANCHO\_CORDOVA z95670 0.4285714 0.500 0.31110605 Residential 0.32171644  
## 494 ROSEVILLE z95747 0.2857143 0.375 0.30609923 Residential 0.32405620  
## 495 SACRAMENTO z95835 0.4285714 0.250 0.39462904 Residential 0.32911943  
## 496 SACRAMENTO z95828 0.2857143 0.250 0.20710059 Residential 0.33123691  
## 497 SACRAMENTO z95828 0.2857143 0.250 0.21074192 Residential 0.33532213  
## 498 ELK\_GROVE z95758 0.5714286 0.500 0.67910787 Residential 0.33926461  
## 499 ANTELOPE z95843 0.5714286 0.500 0.42375967 Residential 0.33926461  
## 500 ANTELOPE z95843 0.5714286 0.500 0.42398726 Residential 0.34511400  
## 501 SACRAMENTO z95834 0.4285714 0.250 0.26741010 Residential 0.34929983  
## 502 ELK\_GROVE z95757 0.2857143 0.500 0.44560765 Residential 0.35213327  
## 503 RANCHO\_CORDOVA z95742 0.4285714 0.500 0.47928994 Residential 0.35271821  
## 504 SACRAMENTO z95833 0.4285714 0.250 0.38029131 Residential 0.36266217  
## 505 SACRAMENTO z95838 0.2857143 0.250 0.27059627 Residential 0.36822494  
## 506 SACRAMENTO z95828 0.2857143 0.250 0.30177515 Residential 0.36938429  
## 507 ELK\_GROVE z95757 0.4285714 0.250 0.52457897 Residential 0.37553083  
## 508 GALT z95632 0.4285714 0.250 0.25534820 Residential 0.37876788  
## 509 GALT z95632 0.5714286 0.625 0.68616295 Residential 0.38021034  
## 510 SACRAMENTO z95835 0.4285714 0.250 0.38279472 Residential 0.38142117  
## 511 SACRAMENTO z95816 0.1428571 0.250 0.14451525 Condo 0.38605973  
## 512 SACRAMENTO z95835 0.4285714 0.250 0.31565772 Residential 0.38670551  
## 513 SACRAMENTO z95835 0.2857143 0.250 0.29949932 Residential 0.38875630  
## 514 SACRAMENTO z95817 0.2857143 0.000 0.27287210 Residential 0.39190912  
## 515 ROSEVILLE z95678 0.2857143 0.250 0.25967228 Residential 0.39489699  
## 516 ROSEVILLE z95747 0.4285714 0.500 0.51615840 Residential 0.39600370  
## 517 ROCKLIN z95765 0.1428571 0.250 0.25307237 Residential 0.39775851  
## 518 PLACERVILLE z95667 0.4285714 0.375 0.50796541 Residential 0.39902900  
## 519 ELK\_GROVE z95757 0.2857143 0.250 0.15817023 Residential 0.40711754  
## 520 ELK\_GROVE z95757 0.5714286 0.625 0.50978607 Residential 0.41296693  
## 521 SACRAMENTO z95818 0.2857143 0.000 0.26285844 Residential 0.41881632  
## 522 RANCHO\_CORDOVA z95742 0.5714286 0.500 0.63654984 Residential 0.42712245  
## 523 SACRAMENTO z95819 0.2857143 0.250 0.27605826 Residential 0.43285485  
## 524 EL\_DORADO\_HILLS z95762 0.2857143 0.375 0.34342285 Residential 0.43285485  
## 525 ANTELOPE z95843 0.4285714 0.500 0.36436049 Residential 0.44271809  
## 526 ROCKLIN z95765 0.2857143 0.250 0.46973145 Residential 0.44806327  
## 527 SACRAMENTO z95815 0.4285714 0.250 0.28675467 Multi\_Family 0.45247020  
## 528 EL\_DORADO\_HILLS z95762 0.4285714 0.500 0.51115157 Residential 0.45625241  
## 529 FOLSOM z95630 0.4285714 0.500 0.33113336 Residential 0.45976205  
## 530 CAMERON\_PARK z95682 0.4285714 0.250 0.43058716 Residential 0.45976205  
## 531 SACRAMENTO z95814 0.1428571 0.500 0.29676832 Residential 0.46502650  
## 532 ROCKLIN z95765 0.2857143 0.250 0.27469276 Residential 0.46902982  
## 533 ELK\_GROVE z95758 0.4285714 0.250 0.34547110 Residential 0.48549936  
## 534 ELK\_GROVE z95757 0.4285714 0.750 0.86913974 Residential 0.49134875  
## 535 SACRAMENTO z95834 0.5714286 0.500 0.85616750 Residential 0.49368851  
## 536 ROSEVILLE z95661 0.2857143 0.250 0.40737369 Residential 0.51474631  
## 537 EL\_DORADO\_HILLS z95762 0.4285714 0.625 0.56395084 Residential 0.51591619  
## 538 ORANGEVALE z95662 0.4285714 0.750 0.58534365 Residential 0.52059570  
## 539 ELK\_GROVE z95758 0.2857143 0.500 0.45949021 Residential 0.53170954  
## 540 EL\_DORADO\_HILLS z95762 0.2857143 0.500 0.61766045 Residential 0.53521918  
## 541 ROCKLIN z95677 0.4285714 0.625 0.64815658 Residential 0.53668152  
## 542 FOLSOM z95630 0.2857143 0.250 0.32339554 Residential 0.54984265  
## 543 PENRYN z95663 0.2857143 0.250 0.19025944 Residential 0.55766680  
## 544 LINCOLN z95648 0.1428571 0.250 0.31611288 Residential 0.56388119  
## 545 ROSEVILLE z95747 0.5714286 0.750 0.60832954 Residential 0.57324021  
## 546 GOLD\_RIVER z95670 0.4285714 0.250 0.58101957 Residential 0.58259923  
## 547 WILTON z95693 0.5714286 0.250 0.74123805 Residential 0.64237181  
## 548 FOLSOM z95630 0.4285714 0.500 0.49522076 Residential 0.70894606  
## 549 CARMICHAEL z95608 0.4285714 0.500 0.65384615 Residential 0.74680916  
## 550 GRANITE\_BAY z95746 0.5714286 0.500 0.54893036 Residential 0.75597515  
## 551 PLACERVILLE z95667 0.2857143 0.250 0.35070551 Residential 0.75696721  
## 552 WILTON z95693 0.5714286 0.500 0.75193446 Residential 0.77406030  
## 553 GRANITE\_BAY z95746 0.5714286 0.500 0.72507965 Residential 0.85401093  
## 602 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.15521165 Residential 0.00000000  
## 603 RIO\_LINDA z95673 0.0000000 0.250 0.11743286 Residential 0.00000000  
## 604 SACRAMENTO z95823 0.1428571 0.000 0.08056441 Residential 0.02974064  
## 605 NORTH\_HIGHLANDS z95660 0.1428571 0.000 0.09558489 Residential 0.03860597  
## 606 SACRAMENTO z95815 0.1428571 0.000 0.12471552 Residential 0.04094573  
## 607 SACRAMENTO z95838 0.1428571 0.000 0.09558489 Residential 0.04094573  
## 608 SACRAMENTO z95817 0.1428571 0.000 0.13563951 Residential 0.04094573  
## 609 SACRAMENTO z95822 0.1428571 0.250 0.11515703 Residential 0.04270055  
## 610 SACRAMENTO z95838 0.1428571 0.000 0.09467456 Residential 0.04796500  
## 611 SACRAMENTO z95824 0.1428571 0.000 0.08579882 Residential 0.05264451  
## 612 SACRAMENTO z95823 0.1428571 0.000 0.09604005 Condo 0.05498427  
## 613 SACRAMENTO z95815 0.1428571 0.000 0.11993628 Residential 0.06434329  
## 614 SACRAMENTO z95823 0.2857143 0.250 0.13768776 Residential 0.07677324  
## 615 SACRAMENTO z95815 0.1428571 0.000 0.07919891 Residential 0.07737573  
## 616 SACRAMENTO z95822 0.1428571 0.000 0.07191625 Condo 0.08686344  
## 617 SACRAMENTO z95842 0.4285714 0.250 0.18388712 Residential 0.08774085  
## 618 SACRAMENTO z95822 0.1428571 0.000 0.07419208 Residential 0.09125048  
## 619 SACRAMENTO z95838 0.4285714 0.250 0.13199818 Residential 0.09242036  
## 620 RANCHO\_CORDOVA z95670 0.1428571 0.000 0.09717797 Residential 0.09943963  
## 621 SACRAMENTO z95835 0.0000000 0.000 0.08238507 Condo 0.09943963  
## 622 SACRAMENTO z95827 0.2857143 0.250 0.19025944 Residential 0.10002457  
## 623 SACRAMENTO z95838 0.2857143 0.250 0.21074192 Residential 0.10016495  
## 624 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.14360492 Residential 0.10060951  
## 625 SACRAMENTO z95822 0.2857143 0.250 0.15589440 Residential 0.10762877  
## 626 SACRAMENTO z95822 0.2857143 0.250 0.15475649 Residential 0.10821371  
## 627 SACRAMENTO z95823 0.4285714 0.250 0.19503869 Residential 0.10879865  
## 628 SACRAMENTO z95838 0.2857143 0.250 0.16727355 Residential 0.10996853  
## 629 SACRAMENTO z95842 0.4285714 0.250 0.14633591 Residential 0.10996853  
## 630 NORTH\_HIGHLANDS z95660 0.2857143 0.250 0.17933546 Residential 0.11045169  
## 631 SACRAMENTO z95822 0.4285714 0.250 0.17501138 Residential 0.11113841  
## 632 SACRAMENTO z95828 0.2857143 0.250 0.14474283 Residential 0.11698780  
## 633 NORTH\_HIGHLANDS z95660 0.1428571 0.250 0.14428766 Residential 0.11903508  
## 634 SACRAMENTO z95838 0.4285714 0.500 0.31998179 Residential 0.12602043  
## 635 SACRAMENTO z95833 0.2857143 0.250 0.17660446 Residential 0.12606605  
## 636 SACRAMENTO z95823 0.2857143 0.250 0.20846609 Residential 0.12634682  
## 637 SACRAMENTO z95821 0.2857143 0.000 0.17751479 Residential 0.12868658  
## 638 SACRAMENTO z95824 0.2857143 0.000 0.13108785 Residential 0.13453597  
## 639 SACRAMENTO z95828 0.1428571 0.250 0.14747383 Residential 0.13453597  
## 640 SACRAMENTO z95823 0.2857143 0.250 0.22348657 Residential 0.14038536  
## 641 SACRAMENTO z95827 0.2857143 0.250 0.13837051 Residential 0.14038536  
## 642 SACRAMENTO z95828 0.4285714 0.250 0.26035503 Residential 0.14155524  
## 643 SACRAMENTO z95842 0.2857143 0.250 0.10832954 Residential 0.14623475  
## 644 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.13450159 Residential 0.14717065  
## 645 SACRAMENTO z95826 0.2857143 0.250 0.21483842 Residential 0.14757075  
## 646 SACRAMENTO z95828 0.4285714 0.250 0.19890760 Residential 0.14974438  
## 647 SACRAMENTO z95828 0.7142857 0.750 0.45311789 Multi\_Family 0.15196715  
## 648 CITRUS\_HEIGHTS z95610 0.2857143 0.250 0.21074192 Residential 0.15208414  
## 649 ANTELOPE z95843 0.2857143 0.250 0.27924442 Residential 0.15383895  
## 650 SACRAMENTO z95826 0.4285714 0.250 0.22735548 Residential 0.15395594  
## 651 GALT z95632 0.2857143 0.250 0.14929449 Residential 0.15442389  
## 652 SACRAMENTO z95828 0.4285714 0.250 0.24237597 Residential 0.15793353  
## 653 SACRAMENTO z95828 0.2857143 0.250 0.21074192 Residential 0.15793353  
## 654 ELK\_GROVE z95758 0.2857143 0.250 0.17205280 Residential 0.16061606  
## 655 SACRAMENTO z95842 0.5714286 0.250 0.27947201 Residential 0.16144316  
## 656 SACRAMENTO z95823 0.4285714 0.250 0.24943104 Residential 0.16144316  
## 657 ANTELOPE z95843 0.2857143 0.250 0.26968594 Residential 0.16232057  
## 658 SACRAMENTO z95826 0.2857143 0.000 0.12403277 Residential 0.16232057  
## 659 CITRUS\_HEIGHTS z95621 0.2857143 0.000 0.14087392 Residential 0.16378292  
## 660 SACRAMENTO z95828 0.2857143 0.250 0.38165680 Residential 0.16407539  
## 661 SACRAMENTO z95823 0.2857143 0.250 0.26536186 Residential 0.16729255  
## 662 POLLOCK\_PINES z95726 0.2857143 0.000 0.19025944 Residential 0.16963231  
## 663 SACRAMENTO z95826 0.2857143 0.250 0.16294948 Residential 0.17091332  
## 664 SACRAMENTO z95835 0.2857143 0.250 0.15612198 Residential 0.17109465  
## 665 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.16272189 Residential 0.17314194  
## 666 SACRAMENTO z95823 0.4285714 0.250 0.27560310 Residential 0.17431182  
## 667 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.15316340 Residential 0.17548170  
## 668 SACRAMENTO z95838 0.2857143 0.250 0.21074192 Residential 0.17548170  
## 669 ROSEVILLE z95678 0.2857143 0.250 0.15703232 Residential 0.17548170  
## 670 SACRAMENTO z95823 0.2857143 0.250 0.25238962 Residential 0.17665158  
## 671 RIO\_LINDA z95673 0.2857143 0.250 0.13859809 Residential 0.17782145  
## 672 ROSEVILLE z95678 0.2857143 0.250 0.29267183 Residential 0.17850817  
## 673 SACRAMENTO z95822 0.4285714 0.250 0.21665908 Residential 0.18141766  
## 674 SACRAMENTO z95829 0.2857143 0.250 0.14565316 Residential 0.18230560  
## 675 SACRAMENTO z95826 0.4285714 0.250 0.14906691 Residential 0.18341932  
## 676 SACRAMENTO z95832 0.2857143 0.250 0.26263086 Residential 0.18367084  
## 677 SACRAMENTO z95833 0.2857143 0.250 0.19208011 Residential 0.18523263  
## 678 ELK\_GROVE z95758 0.2857143 0.250 0.17956304 Residential 0.18718048  
## 679 SACRAMENTO z95838 0.2857143 0.000 0.13609467 Residential 0.18718048  
## 680 SACRAMENTO z95827 0.4285714 0.250 0.24897588 Residential 0.18718048  
## 681 ROSEVILLE z95661 0.1428571 0.000 0.07100592 Residential 0.18718048  
## 682 SACRAMENTO z95823 0.2857143 0.250 0.20527993 Residential 0.18864282  
## 683 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.22030041 Residential 0.19069011  
## 684 SACRAMENTO z95823 0.2857143 0.250 0.23418298 Residential 0.19127505  
## 685 FORESTHILL z95631 0.2857143 0.250 0.17023213 Residential 0.19281695  
## 686 SACRAMENTO z95842 0.4285714 0.250 0.24897588 Residential 0.19302987  
## 687 CITRUS\_HEIGHTS z95610 0.4285714 0.500 0.28493400 Residential 0.19302987  
## 688 CAMERON\_PARK z95682 0.1428571 0.375 0.23076923 Residential 0.19302987  
## 689 SACRAMENTO z95821 0.2857143 0.000 0.22507965 Residential 0.19302987  
## 690 SACRAMENTO z95820 0.2857143 0.000 0.15157032 Residential 0.19653950  
## 691 SACRAMENTO z95833 0.2857143 0.250 0.14633591 Residential 0.19876227  
## 692 FAIR\_OAKS z95628 0.2857143 0.000 0.15020482 Residential 0.19887926  
## 693 CARMICHAEL z95608 0.2857143 0.000 0.11106054 Residential 0.20004913  
## 694 ELK\_GROVE z95758 0.4285714 0.250 0.41465635 Residential 0.20463272  
## 695 ANTELOPE z95843 0.2857143 0.250 0.22644515 Residential 0.20472865  
## 696 EL\_DORADO z95623 0.1428571 0.000 0.12653619 Residential 0.20472865  
## 697 SACRAMENTO z95838 0.2857143 0.250 0.21529358 Residential 0.20575580  
## 698 SACRAMENTO z95832 0.4285714 0.250 0.29949932 Residential 0.20706840  
## 699 ANTELOPE z95843 0.4285714 0.250 0.33431953 Residential 0.20793879  
## 700 SACRAMENTO z95835 0.2857143 0.250 0.14474283 Residential 0.20940816  
## 701 SACRAMENTO z95834 0.2857143 0.250 0.17023213 Residential 0.21057804  
## 702 SACRAMENTO z95835 0.0000000 0.000 0.11379153 Condo 0.21168240  
## 703 ROSEVILLE z95678 0.2857143 0.375 0.22257624 Condo 0.21350273  
## 704 ELK\_GROVE z95758 0.4285714 0.250 0.41989076 Residential 0.21496508  
## 705 ELK\_GROVE z95758 0.2857143 0.250 0.19731452 Residential 0.21642743  
## 706 CAMERON\_PARK z95682 0.2857143 0.250 0.18206645 Residential 0.21642743  
## 707 ROSEVILLE z95661 0.4285714 0.000 0.20300410 Residential 0.21642743  
## 708 DIAMOND\_SPRINGS z95619 0.2857143 0.250 0.18570778 Residential 0.21763591  
## 709 SACRAMENTO z95825 0.4285714 0.250 0.24624488 Residential 0.22227682  
## 710 SACRAMENTO z95817 0.1428571 0.000 0.14360492 Residential 0.22227682  
## 711 SACRAMENTO z95818 0.1428571 0.000 0.12471552 Residential 0.22227682  
## 712 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.21279017 Residential 0.22227682  
## 713 ELK\_GROVE z95757 0.2857143 0.250 0.17683204 Residential 0.22227682  
## 714 CARMICHAEL z95608 0.1428571 0.250 0.26240328 Residential 0.22309807  
## 715 SACRAMENTO z95825 0.4285714 0.250 0.29403732 Multi\_Family 0.22373916  
## 716 ELK\_GROVE z95758 0.2857143 0.250 0.19435594 Residential 0.22461657  
## 717 ELK\_GROVE z95757 0.1428571 0.250 0.17592171 Residential 0.22520151  
## 718 ELK\_GROVE z95624 0.5714286 0.250 0.40282203 Residential 0.22549398  
## 719 SACRAMENTO z95834 0.2857143 0.250 0.21779700 Residential 0.22812621  
## 720 SACRAMENTO z95838 0.4285714 0.250 0.34296768 Residential 0.22812621  
## 721 SACRAMENTO z95829 0.4285714 0.500 0.37369140 Residential 0.23251325  
## 722 ELK\_GROVE z95624 0.2857143 0.250 0.13882567 Residential 0.23280572  
## 723 ROCKLIN z95677 0.2857143 0.250 0.22257624 Residential 0.23408673  
## 724 SACRAMENTO z95834 0.5714286 0.500 0.40373236 Residential 0.23690029  
## 725 RANCHO\_CORDOVA z95670 0.2857143 0.250 0.13427401 Residential 0.23748523  
## 726 ELK\_GROVE z95624 0.4285714 0.250 0.37027765 Residential 0.23807017  
## 727 SACRAMENTO z95835 0.2857143 0.250 0.27355485 Residential 0.24450450  
## 728 ANTELOPE z95843 0.4285714 0.500 0.32567137 Residential 0.24567438  
## 729 ELK\_GROVE z95624 0.4285714 0.250 0.42853892 Residential 0.24567438  
## 730 SACRAMENTO z95823 0.2857143 0.250 0.33636777 Residential 0.24681033  
## 731 RANCHO\_CORDOVA z95670 0.1428571 0.250 0.20983159 Residential 0.24801413  
## 732 SACRAMENTO z95829 0.2857143 0.250 0.29699590 Residential 0.24971046  
## 733 SACRAMENTO z95835 0.4285714 0.250 0.31679563 Residential 0.24976895  
## 734 ANTELOPE z95843 0.2857143 0.250 0.17091488 Residential 0.25333006  
## 735 ANTELOPE z95843 0.4285714 0.250 0.45971780 Residential 0.25357105  
## 736 SACRAMENTO z95834 0.2857143 0.375 0.35161584 Residential 0.25386352  
## 737 CARMICHAEL z95608 0.2857143 0.250 0.27127902 Residential 0.25386352  
## 738 CITRUS\_HEIGHTS z95621 0.2857143 0.250 0.20095585 Residential 0.25620328  
## 739 ELK\_GROVE z95758 0.4285714 0.500 0.32203004 Residential 0.25620328  
## 740 ELK\_GROVE z95758 0.2857143 0.250 0.26217569 Residential 0.25737316  
## 741 SACRAMENTO z95821 0.2857143 0.250 0.30587164 Residential 0.25737316  
## 742 ROCKLIN z95765 0.2857143 0.250 0.29289941 Residential 0.25737316  
## 743 SACRAMENTO z95826 0.4285714 0.250 0.21711425 Residential 0.25971291  
## 744 ELK\_GROVE z95624 0.2857143 0.250 0.22007283 Residential 0.26322255  
## 745 SACRAMENTO z95825 0.2857143 0.000 0.23577606 Residential 0.26322255  
## 746 ROSEVILLE z95747 0.2857143 0.250 0.23258990 Residential 0.26322255  
## 747 SACRAMENTO z95835 0.4285714 0.250 0.48270369 Residential 0.26579628  
## 748 ORANGEVALE z95662 0.2857143 0.250 0.16203914 Residential 0.26907194  
## 749 LINCOLN z95648 0.2857143 0.250 0.25876195 Residential 0.26907194  
## 750 SACRAMENTO z95835 0.2857143 0.250 0.30200273 Residential 0.27316651  
## 751 ELK\_GROVE z95757 0.2857143 0.250 0.24032772 Residential 0.27668784  
## 752 LINCOLN z95648 0.4285714 0.375 0.49226218 Residential 0.27813849  
## 753 PLACERVILLE z95667 0.1428571 0.250 0.51570323 Residential 0.28077072  
## 754 ROSEVILLE z95747 0.2857143 0.375 0.32453345 Residential 0.28194059  
## 755 EL\_DORADO\_HILLS z95762 0.4285714 0.375 0.30996814 Residential 0.28392939  
## 756 ELK\_GROVE z95757 0.2857143 0.250 0.24101047 Residential 0.28662011  
## 757 SACRAMENTO z95835 0.5714286 0.500 0.45744197 Residential 0.28778998  
## 758 LINCOLN z95648 0.2857143 0.250 0.26536186 Residential 0.28837492  
## 759 GALT z95632 0.4285714 0.500 0.39371871 Residential 0.29012974  
## 760 SACRAMENTO z95835 0.5714286 0.500 0.40873919 Residential 0.29129962  
## 761 CARMICHAEL z95608 0.2857143 0.250 0.21825216 Residential 0.29246950  
## 762 CITRUS\_HEIGHTS z95621 0.4285714 0.250 0.24988621 Residential 0.29246950  
## 763 ELK\_GROVE z95757 0.2857143 0.250 0.31247155 Residential 0.29831889  
## 764 ELK\_GROVE z95758 0.2857143 0.250 0.28470642 Residential 0.30182852  
## 765 ELK\_GROVE z95624 0.4285714 0.500 0.36686391 Residential 0.30299840  
## 766 SACRAMENTO z95825 0.2857143 0.250 0.28129267 Residential 0.30416828  
## 767 ANTELOPE z95843 0.4285714 0.250 0.38142922 Residential 0.30416828  
## 768 SACRAMENTO z95838 0.4285714 0.250 0.20436959 Residential 0.30884311  
## 769 PLACERVILLE z95667 0.2857143 0.250 0.18161129 Residential 0.30884779  
## 770 ELK\_GROVE z95624 0.4285714 0.250 0.28152025 Residential 0.30905018  
## 771 LOOMIS z95650 0.4285714 0.250 0.19208011 Residential 0.31001767  
## 772 ELK\_GROVE z95624 0.2857143 0.250 0.32658170 Residential 0.31352730  
## 773 ELK\_GROVE z95624 0.4285714 0.250 0.34091944 Residential 0.31352730  
## 774 SACRAMENTO z95818 0.1428571 0.000 0.15020482 Residential 0.31469718  
## 775 SACRAMENTO z95825 0.1428571 0.250 0.25921711 Residential 0.31586706  
## 776 COOL z95614 0.2857143 0.250 0.22143832 Residential 0.31586706  
## 777 ELK\_GROVE z95624 0.7142857 0.500 0.47132453 Residential 0.31586706  
## 778 ROCKLIN z95765 0.2857143 0.250 0.24874829 Residential 0.31653038  
## 779 ELK\_GROVE z95757 0.5714286 0.500 0.47974511 Residential 0.31937669  
## 780 CITRUS\_HEIGHTS z95610 0.2857143 0.250 0.20869367 Residential 0.32171644  
## 781 LINCOLN z95648 0.4285714 0.250 0.35593992 Residential 0.32288632  
## 782 CARMICHAEL z95608 0.2857143 0.250 0.23167956 Residential 0.32756583  
## 783 FOLSOM z95630 0.2857143 0.250 0.19185253 Residential 0.32756583  
## 784 ROSEVILLE z95678 0.4285714 0.500 0.29949932 Residential 0.32756583  
## 785 SACRAMENTO z95831 0.4285714 0.250 0.38347747 Residential 0.32934171  
## 786 LINCOLN z95648 0.5714286 0.500 0.44902139 Residential 0.32990559  
## 787 RANCHO\_CORDOVA z95742 0.2857143 0.375 0.40509786 Residential 0.33107547  
## 788 ORANGEVALE z95662 0.4285714 0.250 0.34592626 Residential 0.33341522  
## 789 ROSEVILLE z95678 0.4285714 0.500 0.39326354 Residential 0.33341522  
## 790 ANTELOPE z95843 0.5714286 0.500 0.60309513 Residential 0.33341522  
## 791 SACRAMENTO z95864 0.2857143 0.250 0.19936277 Residential 0.33341522  
## 792 ROCKLIN z95765 0.4285714 0.375 0.33386436 Residential 0.33341522  
## 793 SACRAMENTO z95822 0.2857143 0.250 0.18024579 Residential 0.33926461  
## 794 SACRAMENTO z95834 0.4285714 0.500 0.56395084 Residential 0.34160437  
## 795 ROCKLIN z95765 0.4285714 0.250 0.31952663 Residential 0.34511400  
## 796 ROSEVILLE z95747 0.2857143 0.500 0.38029131 Residential 0.34569894  
## 797 ROSEVILLE z95678 0.2857143 0.250 0.28675467 Residential 0.34739644  
## 798 GALT z95632 0.2857143 0.250 0.24214838 Residential 0.34905649  
## 799 LINCOLN z95648 0.1428571 0.250 0.19071461 Residential 0.35096339  
## 800 RANCHO\_CORDOVA z95670 0.4285714 0.500 0.36982249 Residential 0.35096339  
## 801 SACRAMENTO z95827 0.4285714 0.250 0.45516614 Residential 0.35236725  
## 802 SACRAMENTO z95834 0.4285714 0.500 0.40373236 Residential 0.35330315  
## 803 SACRAMENTO z95835 0.2857143 0.500 0.39326354 Residential 0.35564291  
## 804 ORANGEVALE z95662 0.2857143 0.250 0.25762403 Residential 0.35681278  
## 805 SACRAMENTO z95835 0.4285714 0.250 0.42967683 Residential 0.36383205  
## 806 ROCKLIN z95765 0.5714286 0.500 0.48293127 Residential 0.37012015  
## 807 ROSEVILLE z95678 0.5714286 0.500 0.60969504 Residential 0.37111454  
## 808 ELK\_GROVE z95757 0.5714286 0.500 0.54460628 Residential 0.37319108  
## 809 ANTELOPE z95843 0.2857143 0.250 0.56349568 Residential 0.37436095  
## 810 LINCOLN z95648 0.1428571 0.250 0.27765134 Residential 0.37436095  
## 811 ROSEVILLE z95678 0.2857143 0.250 0.38416022 Residential 0.37436095  
## 812 ROSEVILLE z95678 0.2857143 0.250 0.36777424 Condo 0.37436095  
## 813 SACRAMENTO z95831 0.2857143 0.250 0.29836140 Residential 0.37553083  
## 814 EL\_DORADO\_HILLS z95762 0.2857143 0.375 0.32771962 Residential 0.38161420  
## 815 ROSEVILLE z95661 0.4285714 0.250 0.41215294 Residential 0.38605973  
## 816 ROSEVILLE z95747 0.4285714 0.500 0.47633136 Residential 0.39479053  
## 817 ROSEVILLE z95747 0.5714286 0.500 0.48520710 Residential 0.40360790  
## 818 WALNUT\_GROVE z95690 0.2857143 0.000 0.28288575 Residential 0.40945729  
## 819 ELK\_GROVE z95758 0.2857143 0.250 0.22781065 Residential 0.41013348  
## 820 CARMICHAEL z95608 0.2857143 0.250 0.26649977 Residential 0.41673627  
## 821 LINCOLN z95648 0.5714286 0.875 0.61333637 Residential 0.41998620  
## 822 RANCHO\_CORDOVA z95742 0.5714286 0.500 0.68161129 Residential 0.42115607  
## 823 ROSEVILLE z95661 0.2857143 0.250 0.35616750 Residential 0.42759040  
## 824 RANCHO\_CORDOVA z95742 0.4285714 0.500 0.58215749 Residential 0.42817534  
## 825 ELK\_GROVE z95757 0.5714286 0.500 0.54415112 Residential 0.42934522  
## 826 LINCOLN z95648 0.5714286 0.750 0.70141102 Residential 0.43285485  
## 827 EL\_DORADO\_HILLS z95762 0.4285714 0.250 0.39030496 Residential 0.43285485  
## 828 ROSEVILLE z95747 0.4285714 0.500 0.40009103 Residential 0.44747833  
## 829 SACRAMENTO z95818 0.1428571 0.000 0.18661812 Residential 0.44864821  
## 830 CARMICHAEL z95608 0.2857143 0.250 0.42102868 Residential 0.45040302  
## 831 AUBURN z95603 0.4285714 0.500 0.40828402 Residential 0.45678354  
## 832 SACRAMENTO z95819 0.2857143 0.000 0.22963132 Residential 0.46210180  
## 833 CAMERON\_PARK z95682 0.2857143 0.250 0.33227128 Residential 0.46210180  
## 834 LINCOLN z95648 0.5714286 0.750 0.78038234 Residential 0.47204577  
## 835 ROSEVILLE z95747 0.5714286 0.500 0.60696404 Residential 0.47731022  
## 836 FOLSOM z95630 0.5714286 0.500 0.52412381 Residential 0.48081985  
## 837 SACRAMENTO z95831 0.5714286 0.500 0.53254438 Residential 0.48549936  
## 838 FOLSOM z95630 0.4285714 0.500 0.63199818 Residential 0.48666924  
## 839 SACRAMENTO z95821 0.4285714 0.250 0.35707783 Residential 0.49134875  
## 840 ROSEVILLE z95661 0.4285714 0.500 0.43126991 Residential 0.49719814  
## 841 EL\_DORADO\_HILLS z95762 0.2857143 0.375 0.45425580 Residential 0.50304753  
## 842 PLACERVILLE z95667 0.2857143 0.250 0.27765134 Residential 0.52059570  
## 843 GARDEN\_VALLEY z95633 0.2857143 0.250 0.44014565 Residential 0.53814387  
## 844 EL\_DORADO\_HILLS z95762 0.4285714 0.375 0.63677742 Residential 0.54165351  
## 845 EL\_DORADO\_HILLS z95762 0.5714286 0.750 0.82089213 Residential 0.55920168  
## 846 ROSEVILLE z95747 0.4285714 0.500 0.52844788 Residential 0.56271131  
## 847 FAIR\_OAKS z95628 0.2857143 0.250 0.61197087 Residential 0.57908960  
## 848 EL\_DORADO\_HILLS z95762 0.4285714 0.500 0.65908056 Residential 0.58844862  
## 849 SACRAMENTO z95864 0.2857143 0.000 0.19663177 Residential 0.60248716  
## 850 AUBURN z95603 0.4285714 0.625 0.82066454 Residential 0.62003533  
## 851 SACRAMENTO z95816 0.1428571 0.000 0.17478380 Residential 0.63758350  
## 852 FOLSOM z95630 0.4285714 0.500 0.62471552 Residential 0.63758350  
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## 854 ROSEVILLE z95747 0.5714286 1.000 0.77765134 Residential 0.66683045  
## 855 ROCKLIN z95677 0.4285714 0.500 0.42375967 Residential 0.66683045  
## 856 GRANITE\_BAY z95746 0.4285714 0.500 0.42603550 Residential 0.66683045  
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## 871 SACRAMENTO z95815 0.4285714 0.250 0.15339099 Residential 0.05849390  
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## 899 LINCOLN z95648 0.0000000 0.125 0.13222576 Condo 0.12634682  
## 900 ANTELOPE z95843 0.2857143 0.250 0.16431497 Residential 0.13102633  
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## 914 SACRAMENTO z95818 0.1428571 0.000 0.09035048 Residential 0.15793353  
## 915 WEST\_SACRAMENTO z95691 0.4285714 0.250 0.32612654 Residential 0.15793353  
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## 936 CITRUS\_HEIGHTS z95621 0.4285714 0.500 0.32043696 Residential 0.18698862  
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## 947 ELK\_GROVE z95624 0.4285714 0.250 0.25603095 Residential 0.20443618  
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## 949 SACRAMENTO z95818 0.1428571 0.250 0.13768776 Residential 0.20472865  
## 950 CARMICHAEL z95608 0.2857143 0.250 0.18479745 Residential 0.20578154  
## 951 ELK\_GROVE z95758 0.1428571 0.250 0.16044606 Residential 0.20706840  
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## 953 ROSEVILLE z95747 0.2857143 0.250 0.20186618 Residential 0.20853075  
## 954 NORTH\_HIGHLANDS z95660 0.2857143 0.000 0.18798361 Residential 0.20861030  
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## 962 ELK\_GROVE z95757 0.2857143 0.250 0.18616295 Residential 0.22203582  
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## 689 0.4741997244 0.190482180  
## 690 0.3736856693 0.086600531  
## 691 0.4831360180 0.043484732  
## 692 0.5424473947 0.259959858  
## 693 0.4890580448 0.231481860  
## 694 0.2308191774 0.147116932  
## 695 0.6192386955 0.202602439  
## 696 0.5610770775 0.741622777  
## 697 0.5135584260 0.145687320  
## 698 0.3024737775 0.061980600  
## 699 0.6034000005 0.219083853  
## 700 0.5651756590 0.048941154  
## 701 0.5123778702 0.019056603  
## 702 0.5478279058 0.050553136  
## 703 0.7083578213 0.274622814  
## 704 0.2670840530 0.143590066  
## 705 0.2169232664 0.154466228  
## 706 0.5770620587 0.583536403  
## 707 0.6350337613 0.299027885  
## 708 0.5732637490 0.777135640  
## 709 0.4517986793 0.155189418  
## 710 0.4053912901 0.085277826  
## 711 0.4046021142 0.063970947  
## 712 0.5858430836 0.269164295  
## 713 0.2096436005 0.112886946  
## 714 0.5007301481 0.226828284  
## 715 0.4411390310 0.151849115  
## 716 0.2340567231 0.118004832  
## 717 0.0817226875 0.155542629  
## 718 0.2312336551 0.216446827  
## 719 0.5099076857 0.020774443  
## 720 0.5251099072 0.089320358  
## 721 0.2797532125 0.211301691  
## 722 0.2587855161 0.196326400  
## 723 0.7141258626 0.331556799  
## 724 0.5112024473 0.014779296  
## 725 0.4558433659 0.250483961  
## 726 0.1873439292 0.190155172  
## 727 0.5518353792 0.032268985  
## 728 0.5963025508 0.190959066  
## 729 0.2298529182 0.184367549  
## 730 0.2589407849 0.122007536  
## 731 0.4932900805 0.293664743  
## 732 0.2749142172 0.212168472  
## 733 0.5552615573 0.027467627  
## 734 0.6149835620 0.183445218  
## 735 0.5996786835 0.201387688  
## 736 0.4999717693 0.052221716  
## 737 0.5334995522 0.252961676  
## 738 0.5998403683 0.237954942  
## 739 0.2319111914 0.098188355  
## 740 0.2403945109 0.142621619  
## 741 0.4955562342 0.190760975  
## 742 0.7230634395 0.270510059  
## 743 0.4030815071 0.210682262  
## 744 0.2583505070 0.187015056  
## 745 0.4593067571 0.158681696  
## 746 0.6866920572 0.222318298  
## 747 0.5570169923 0.037549326  
## 748 0.5619124490 0.348595804  
## 749 0.8439253991 0.240214651  
## 750 0.5616327086 0.014759382  
## 751 0.1875980054 0.120722562  
## 752 0.8213151904 0.262404033  
## 753 0.7340387582 0.778163829  
## 754 0.6792314582 0.193592948  
## 755 0.5829468724 0.495215935  
## 756 0.2001054801 0.087320578  
## 757 0.5417903898 0.027115464  
## 758 0.7732665721 0.290217534  
## 759 0.0224074611 0.241522684  
## 760 0.5464150885 0.024554949  
## 761 0.5404199185 0.246142720  
## 762 0.5772904706 0.258345780  
## 763 0.2007060237 0.106366700  
## 764 0.2254309670 0.081549725  
## 765 0.1919314148 0.214308698  
## 766 0.4187777655 0.147787717  
## 767 0.5941788337 0.206424869  
## 768 0.5176647068 0.126992312  
## 769 0.6268224829 0.785286735  
## 770 0.2682350948 0.197779070  
## 771 0.7488598655 0.370265327  
## 772 0.2627660421 0.158145068  
## 773 0.2318855272 0.184366501  
## 774 0.4046354778 0.063866136  
## 775 0.4186879406 0.147783525  
## 776 0.8525832356 0.604267874  
## 777 0.2091521300 0.214615792  
## 778 0.7173480099 0.304709649  
## 779 0.1894099018 0.122958165  
## 780 0.6082158980 0.302664801  
## 781 0.8000870018 0.239684311  
## 782 0.4835851424 0.236364970  
## 783 0.5262494001 0.440234565  
## 784 0.6698062605 0.289090823  
## 785 0.3193839552 0.004234335  
## 786 0.7733025020 0.290879935  
## 787 0.3691379633 0.342676121  
## 788 0.5476431231 0.376675523  
## 789 0.6856950009 0.265002280  
## 790 0.6036399613 0.218105974  
## 791 0.4684432320 0.192096258  
## 792 0.7365371734 0.302687859  
## 793 0.3639204203 0.034603110  
## 794 0.5238793061 0.018052520  
## 795 0.7458237841 0.301291787  
## 796 0.6817799187 0.195872572  
## 797 0.6806198944 0.259159107  
## 798 0.0623705559 0.278460966  
## 799 0.7960410320 0.297898030  
## 800 0.4350489032 0.285805021  
## 801 0.4189894956 0.253366244  
## 802 0.5054395389 0.017517988  
## 803 0.5560802470 0.058593132  
## 804 0.5468911605 0.358711043  
## 805 0.5477983919 0.059809979  
## 806 0.7266859491 0.295246330  
## 807 0.7066216345 0.278537478  
## 808 0.1857129658 0.108525791  
## 809 0.6005422857 0.201599405  
## 810 0.7857817460 0.293428920  
## 811 0.7069822172 0.289269001  
## 812 0.6680906051 0.281156686  
## 813 0.3101499562 0.012067854  
## 814 0.5704560795 0.501298075  
## 815 0.6319450682 0.330087359  
## 816 0.7070232800 0.230378208  
## 817 0.6891455600 0.198820884  
## 818 0.0078853424 0.038334355  
## 819 0.2407627930 0.134429649  
## 820 0.4984190819 0.239615137  
## 821 0.8027920143 0.243808595  
## 822 0.3775032273 0.342524146  
## 823 0.6369329162 0.317238669  
## 824 0.3668320300 0.333477972  
## 825 0.2105200348 0.111641800  
## 826 0.8512255965 0.242063505  
## 827 0.5322574022 0.494621661  
## 828 0.7276676068 0.234621976  
## 829 0.3979204254 0.049540669  
## 830 0.5037854776 0.207868107  
## 831 0.8906330602 0.495423460  
## 832 0.4334846669 0.114436042  
## 833 0.5495884737 0.579283203  
## 834 0.7936581059 0.252339103  
## 835 0.7227811327 0.220635045  
## 836 0.5376610111 0.406679558  
## 837 0.3398678804 0.039039728  
## 838 0.5548201321 0.468110952  
## 839 0.4876875736 0.189520021  
## 840 0.6532361342 0.334277674  
## 841 0.5627888833 0.540021276  
## 842 0.5766155007 0.899338123  
## 843 0.7712570609 0.708836030  
## 844 0.5649523800 0.540680533  
## 845 0.5577060776 0.537438752  
## 846 0.6910575470 0.181307089  
## 847 0.5251176064 0.307173739  
## 848 0.5422241157 0.518778332  
## 849 0.4458163415 0.186664990  
## 850 0.8003808575 0.478809984  
## 851 0.4195130464 0.098364436  
## 852 0.5934191717 0.382142427  
## 853 0.2717151678 0.236843953  
## 854 0.7146648120 0.217638520  
## 855 0.6815887200 0.347416689  
## 856 0.6295210793 0.348559121  
## 857 0.6924472664 0.344724113  
## 858 0.7020405649 0.222416820  
## 859 0.5213513770 0.545856064  
## 860 0.5664704207 0.543389878  
## 861 0.5969223425 0.516541680  
## 862 0.2230018453 0.374011246  
## 865 0.3170998365 0.171831193  
## 866 0.3861251338 0.201026093  
## 867 0.2946577287 0.125194816  
## 868 0.5504379605 0.201136143  
## 869 0.3820111537 0.091996164  
## 870 0.5164469379 0.107055303  
## 871 0.4840304173 0.089483862  
## 872 0.5173990817 0.104261061  
## 873 0.4948491840 0.053353667  
## 874 0.3579586138 0.097576263  
## 875 0.3165993835 0.082949990  
## 876 0.4970242296 0.110655536  
## 877 0.3116410495 0.092806347  
## 878 0.5617456313 0.183511249  
## 879 0.4326492954 0.148571698  
## 880 0.3469537812 0.098550998  
## 881 0.5208355255 0.124504116  
## 882 0.5493087333 0.180090242  
## 883 0.3061899617 0.066905634  
## 884 0.3055060093 0.070604388  
## 885 0.2874871358 0.131111356  
## 886 0.5644583431 0.581687550  
## 887 0.3682371480 0.146627468  
## 888 0.3022941278 0.147923971  
## 889 0.3732160135 0.146770010  
## 890 0.5009803745 0.129890316  
## 891 0.3908370910 0.098478679  
## 892 0.3411100304 0.141951882  
## 893 0.2885611849 0.097308996  
## 894 0.3579855613 0.147070815  
## 895 0.3398819958 0.071407235  
## 896 0.5826748313 0.112745453  
## 897 0.2834129353 0.131167953  
## 898 0.4510941955 0.260625403  
## 899 0.8246387114 0.294964391  
## 900 0.5962589215 0.180198196  
## 901 0.4646243908 0.141172093  
## 902 0.3029010874 0.175370635  
## 903 0.4126427253 0.016900656  
## 904 0.3845224010 0.098076208  
## 905 0.2887562332 0.139057022  
## 906 0.5531327073 0.204327616  
## 907 0.2882686124 0.108395826  
## 908 0.6215356464 0.202434743  
## 909 0.2980402775 0.060713443  
## 910 0.3343025867 0.100279319  
## 911 0.5695501313 0.183172712  
## 912 0.6110967106 0.255089325  
## 913 0.2839839650 0.124272486  
## 914 0.4037808581 0.079077250  
## 915 0.4401573732 0.017917315  
## 916 0.2893619096 0.200957966  
## 917 0.5646649403 0.250255475  
## 918 0.5040177391 0.069801542  
## 919 0.8362107241 0.258153977  
## 920 0.7109191140 0.233606364  
## 921 0.3196380313 0.148339019  
## 922 0.3007067936 0.078256586  
## 923 0.3199152053 0.157279335  
## 924 0.3071305566 0.012534260  
## 925 0.4892633589 0.055057881  
## 926 0.3345848935 0.105082774  
## 927 0.2468965500 0.135579417  
## 928 0.4915423447 0.067907620  
## 929 0.2620654079 0.187824191  
## 930 0.2684686396 0.130149197  
## 931 0.5463149979 0.325955739  
## 932 0.8246643757 0.295022036  
## 933 0.5040729173 0.068761824  
## 934 0.3703736972 0.119707999  
## 935 0.5465665076 0.330470965  
## 936 0.5879680839 0.251616960  
## 937 0.5232223012 0.090551878  
## 938 0.5716610163 0.311690013  
## 939 0.3029075035 0.061974311  
## 940 0.2897828034 0.138203866  
## 941 0.5892551463 0.249871869  
## 942 0.5259529780 0.106156031  
## 943 0.2347073120 0.116703088  
## 944 0.2701945607 0.194153683  
## 945 0.4214442816 0.025327401  
## 946 0.5651987568 0.054164898  
## 947 0.2531830092 0.185801353  
## 948 0.5704599291 0.219404573  
## 949 0.4032714226 0.069565719  
## 950 0.4900050559 0.213853821  
## 951 0.2347085952 0.112973939  
## 952 0.4763029101 0.099606437  
## 953 0.6369457483 0.255277983  
## 954 0.5809938226 0.186886139  
## 955 0.0233467728 0.251636874  
## 956 0.2598326177 0.189403682  
## 957 0.6177963644 0.214430278  
## 958 0.2904192769 0.148136735  
## 959 0.2693258257 0.193993324  
## 960 0.3422366912 0.147255281  
## 961 0.6081260731 0.319630439  
## 962 0.1916850380 0.119361077  
## 963 0.2348061194 0.131127077  
## 964 0.7078689173 0.274266459  
## 965 0.5435560905 0.247145754  
## 966 0.0616327086 0.279945079  
## 967 0.5841518092 0.210862536  
## 968 0.4998267663 0.052221716  
## 969 0.4978275208 0.183689426  
## 970 0.5928904881 0.185095980  
## 971 0.5852168758 0.582708402  
## 972 0.5922565810 0.331706678  
## 973 0.1902260251 0.110530812  
## 974 0.8421725305 0.237932932  
## 975 0.2905475982 0.111336803  
## 976 0.2615546892 0.115500914  
## 977 0.2256760606 0.070620110  
## 978 0.2773856850 0.201323754  
## 979 0.3315552282 0.097278601  
## 980 0.5996581521 0.309086526  
## 981 0.2251858734 0.161701280  
## 982 0.5309048960 0.498675722

#pca apply  
  
data\_for\_pca <- Sacramento[, numeric\_cols]  
  
# Perform PCA  
pca\_result <- prcomp(data\_for\_pca, scale. = TRUE)  
  
# Determine the proportion of variance explained by each principal component  
pca\_result

## Standard deviations (1, .., p=6):  
## [1] 1.7566024 1.1719243 0.7840448 0.6811030 0.5660147 0.3767513  
##   
## Rotation (n x k) = (6 x 6):  
## PC1 PC2 PC3 PC4 PC5 PC6  
## beds 0.44774084 0.2761008 0.22819716 -0.54418157 -0.55057302 -0.26825049  
## baths 0.48664466 0.1416295 0.17687902 -0.15207456 0.79924608 -0.22340749  
## sqft 0.53205587 0.1086493 -0.00835624 0.16731075 -0.08063444 0.81886950  
## price 0.47391969 -0.1137701 -0.23702804 0.67381465 -0.21465539 -0.45406066  
## latitude 0.08550546 -0.6977679 0.70474681 0.06566378 -0.06506872 0.02439253  
## longitude 0.21842759 -0.6261638 -0.60309177 -0.44091831 0.03552831 0.02859084

# Choose the number of principal components that explain a satisfactory portion of variance  
# For example, retaining components that explain 95% of variance  
n\_components <- sum(cumsum(pca\_result$sdev^2) / sum(pca\_result$sdev^2) <= 0.95)  
  
# Keep only the selected number of principal components  
data\_pca <- predict(pca\_result, newdata = data\_for\_pca, ncomp = n\_components)

## Warning: In predict.prcomp(pca\_result, newdata = data\_for\_pca, ncomp = n\_components) :  
## extra argument 'ncomp' will be disregarded

z\_scores <- scale(data\_pca[, 1:(n\_components - 1)])   
  
z\_scores

## PC1 PC2 PC3  
## 1 -1.559763905 -0.3720837480 0.3677673297  
## 2 -1.168285047 0.5932163464 -0.3763558497  
## 3 -1.569460004 -0.2897952441 0.3040811900  
## 4 -1.541597045 -0.2943267466 0.2666738813  
## 5 -1.570954941 0.1085638064 -0.4324306785  
## 6 -0.984179021 -0.6372532903 0.2386145073  
## 7 -0.620568301 -0.4665657145 0.8076686428  
## 8 -1.141490647 0.5201190310 0.2236533607  
## 9 -0.917291419 -0.7965922359 -0.3773970792  
## 10 -0.660487037 -0.2046898880 1.4183377175  
## 11 -0.787028740 0.0772841384 1.0417739138  
## 12 -0.683450875 0.8903774343 -0.0552423017  
## 13 -1.739848591 -0.6059050767 -0.1536237993  
## 14 -1.202170997 0.7653594788 -0.1047018649  
## 15 -0.915014454 -0.6876512498 0.4232508653  
## 16 -0.847295210 -0.8259622082 0.5546895105  
## 17 -1.439710410 -0.6008798650 0.7247587352  
## 18 -1.335013682 -1.0923604600 -0.1052457480  
## 19 -1.575682341 -0.2303853106 0.2862842624  
## 20 -0.548129240 -0.0691136708 1.4009097810  
## 21 -0.513730774 -0.7222006596 0.7411390200  
## 22 -0.333684343 1.1034576455 0.1353378191  
## 23 -0.230146638 -0.1851785935 1.3683971901  
## 24 -0.485203493 0.3275080216 1.1169650584  
## 25 -0.649606205 -0.5123381979 0.9994677837  
## 26 -0.563080243 -0.5355936129 1.0347129628  
## 27 -1.152504848 0.4435068789 0.1427124845  
## 28 -0.743423704 0.9895313167 0.1679860431  
## 29 -0.159135548 0.2605127305 0.0824158650  
## 30 -0.598530937 0.6514055395 -0.4050504660  
## 31 -1.024147380 0.7291357220 -0.8383986773  
## 32 -0.525203872 -0.4578807084 0.8808954065  
## 33 -0.436445816 -0.0273926752 -0.1765879595  
## 34 -0.558464354 -0.4134893327 1.2349831230  
## 35 -1.007687389 0.7232129221 -0.8568427652  
## 36 -0.544442796 0.8167276156 -0.0182098853  
## 37 -0.543248732 -0.3166524427 0.6514656975  
## 38 -0.233354758 1.1252658366 0.2549943167  
## 39 -0.323074278 0.8370468264 0.1526284516  
## 40 -1.681067907 -0.6254284263 -0.6524378537  
## 41 -0.875872925 0.0764553516 1.2291280214  
## 42 -0.638252555 0.8587320062 0.1600643690  
## 43 -0.625777503 0.7616245020 -0.9667877570  
## 44 -0.756408628 -1.0399125136 0.4667210191  
## 45 0.002075269 -0.1948214348 1.1915768759  
## 46 -0.705984842 0.4028833846 0.9512651980  
## 47 -0.138101797 1.1384519194 -0.1473161343  
## 48 -0.366189645 0.9228721654 -0.0965325217  
## 49 -0.026846806 0.2812019411 1.0390538768  
## 50 -0.463450953 0.7220753285 -0.0290870945  
## 51 -0.536037331 0.7384797377 -1.0557941383  
## 52 -0.080164727 0.9065058040 -0.1885393375  
## 53 -0.433505508 0.6816485231 -0.3854670423  
## 54 -0.030983639 0.9408638101 -0.1517119428  
## 55 -0.558945676 0.7568585406 -0.3891662708  
## 56 -0.406190528 1.0377241861 -2.3509760694  
## 57 0.186968116 -0.0629015180 0.8495927021  
## 58 -0.468545071 0.1282934767 -0.2235718826  
## 59 -0.770354460 -0.7521843503 -0.0532012750  
## 60 0.390940272 1.3518794734 0.1133418046  
## 61 -0.370012192 -0.6811622167 0.7941585791  
## 62 -0.525802080 1.1329034792 -2.5220623951  
## 63 0.177194684 -0.6398423491 0.0618592159  
## 64 -0.758554816 1.0617390266 -2.8856532653  
## 65 -0.432403074 0.7671443163 -0.5144421293  
## 66 -0.405725292 0.1157326352 -0.0967525448  
## 67 -0.364825064 0.9402434007 -0.7786027582  
## 68 -0.325430552 -0.4829137694 0.9918036475  
## 69 0.959314067 1.3274382189 0.5016717769  
## 70 -0.481783525 0.8113061337 -0.6801678802  
## 71 0.027100669 0.9953830076 -0.5508946004  
## 72 0.064990800 -1.1715626857 -0.4049967874  
## 73 -0.833711286 -0.7545530250 -0.0052893380  
## 74 -0.204844196 0.2168651559 1.0063743492  
## 75 -0.382868540 0.3232248330 1.3493665082  
## 76 -0.040014448 1.1129427192 -0.1955430883  
## 77 -0.016903656 1.1674449528 -0.4756245473  
## 78 -0.681392076 -0.1702944344 0.9676420934  
## 79 0.911890407 1.5211984235 0.0408894469  
## 80 0.033917303 1.1213965479 -0.9096902269  
## 81 -0.325845549 0.6715448878 -0.2926996852  
## 82 -0.244084662 -0.3148692747 -0.3398489192  
## 83 0.077069514 -0.5271506551 0.7307188679  
## 84 -0.054361979 0.6169433005 1.2379300279  
## 85 0.735885984 0.9988369431 -0.3280346505  
## 86 0.108830578 -0.1273235363 -0.8319266009  
## 87 -0.351350751 -0.2787063191 1.0346150823  
## 88 -0.054337658 1.1706237070 -0.9075663536  
## 89 -0.364856551 0.5774082158 -0.5750611225  
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## 91 -0.874120345 0.2917648610 -0.6788448595  
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## 783 0.107523082 -1.3056575131 -1.1094193922  
## 784 0.887887153 -0.7595568076 1.0644629575  
## 785 0.321341390 1.3670574448 0.4050718083  
## 786 1.483820628 -0.7763105962 1.9089835595  
## 787 0.569174549 -0.2064795988 -1.2835337120  
## 788 0.639448183 -0.8004743346 -0.3586554743  
## 789 1.054104330 -0.6780151806 1.2559639988  
## 790 1.662771526 0.1593297465 1.3872912013  
## 791 -0.094783307 -0.2028235406 -0.1241221229  
## 792 0.799829979 -1.1078458125 1.1718485818  
## 793 -0.282376097 0.7169996268 0.1444000615  
## 794 1.126534863 0.8702643583 1.6768467292  
## 795 0.603879887 -1.2339557364 1.0494129073  
## 796 0.705282247 -0.6934337694 1.2463189708  
## 797 0.206704467 -1.1403603464 0.5994076077  
## 798 -0.030591324 0.9016160264 -2.7300724902  
## 799 -0.184634304 -2.0018683663 0.6706339810  
## 800 0.988747004 0.0889486492 -0.1947041211  
## 801 0.732223961 0.1421951340 -0.4291942697  
## 802 0.847840610 0.8387117046 1.5706427687  
## 803 0.594814836 0.2415276649 1.2883042309  
## 804 0.216326943 -1.0621904564 -0.6367058250  
## 805 0.578282207 0.3790525400 1.2357624480  
## 806 1.607202248 -0.6373936496 1.5612884415  
## 807 1.821433102 -0.4367622359 1.5338734677  
## 808 1.414632828 1.9452765820 -0.2957155394  
## 809 0.689902654 -0.5159208289 0.4116726740  
## 810 0.009145428 -1.9161770088 0.5887497830  
## 811 0.465562485 -1.3034642137 0.5199906585  
## 812 0.417672460 -1.1486451084 0.3604567569  
## 813 -0.036421116 1.0282215409 -0.0974522572  
## 814 0.707433907 -1.5549883128 -1.1574774712  
## 815 0.837803555 -0.9187789181 0.2173995906  
## 816 1.290996525 -0.6181110775 1.4222882443  
## 817 1.578044447 -0.1768067165 1.8039747746  
## 818 -0.451737917 1.7806968362 -2.1912332397  
## 819 -0.020908118 0.7617395091 -1.1640083576  
## 820 0.223478812 -0.4943784896 -0.3849284084  
## 821 2.486942771 -0.4210900098 2.5895836784  
## 822 2.002327343 0.4774789749 -0.6227915914  
## 823 0.511747286 -1.2122995578 -0.0952848014  
## 824 1.534709029 0.2217458744 -0.9663282777  
## 825 1.522210101 1.8123562690 -0.2931408668  
## 826 2.491495952 -0.6246185767 2.6644619320  
## 827 0.991133693 -1.2142311943 -1.2553255828  
## 828 1.253377336 -0.7810504887 1.4089418041  
## 829 -0.726496073 0.0468799317 -0.6122241406  
## 830 0.540514525 -0.3321141339 -0.2670096756  
## 831 1.551564224 -2.2944165716 0.8755304250  
## 832 -0.271993392 -0.0312000314 -0.4678206145  
## 833 0.725738063 -1.8984295077 -1.9897382913  
## 834 2.697557986 -0.4433940703 2.2277633530  
## 835 1.958761341 -0.3508153922 1.7122878913  
## 836 1.918243866 -0.4358396110 -0.2298809018  
## 837 1.574826805 1.5869842183 0.6524079755  
## 838 1.896018050 -0.9270966394 -0.8081576285  
## 839 0.762294511 -0.0061842591 -0.0038076049  
## 840 1.461254980 -0.9000177595 0.3985745234  
## 841 1.183487425 -1.6751678433 -1.6477165094  
## 842 1.007041434 -3.2234932257 -3.6360260596  
## 843 1.229480802 -3.1238362499 -1.6674412423  
## 844 1.874067528 -1.3417902812 -1.3999621057  
## 845 3.099655243 -0.6965922460 -0.6712125484  
## 846 1.635782489 -0.4614723138 1.2615526469  
## 847 1.206823095 -0.7413719376 -0.9414629178  
## 848 2.163970190 -1.1170132456 -1.3415195265  
## 849 -0.020947985 -0.4438744733 -1.0561223637  
## 850 2.746489642 -1.7102399593 0.2990678673  
## 851 -0.368469281 -0.3315596622 -1.1266777881  
## 852 2.086244224 -0.8475436128 -0.4534754241  
## 853 2.855900550 1.2894337058 -0.7964276633  
## 854 3.366813137 -0.0015514210 1.9255075030  
## 855 1.764966573 -1.1574219911 0.1440060665  
## 856 1.755381861 -0.9802219732 -0.1339796819  
## 857 1.938564249 -1.1572390987 0.0458704581  
## 858 2.486792055 -0.3582676611 1.1918391318  
## 859 2.687203073 -0.9335239760 -1.4720817581  
## 860 2.609374354 -1.5164290753 -1.8617574911  
## 861 3.248786890 -1.4192767511 -1.6917210317  
## 862 3.100384860 0.3832596076 -3.0763518989  
## 865 -0.335233901 0.8700633818 0.1122425377  
## 866 -1.905001903 -0.5552898763 -0.9695058719  
## 867 -1.595429329 0.3352267224 -0.7284978829  
## 868 -1.433005292 -0.8190379954 0.2062596940  
## 869 -1.588265420 0.1467105491 -0.1158601615  
## 870 -1.473251688 -0.3553031326 0.5017562118  
## 871 -0.457939256 0.5299430181 1.3670102892  
## 872 -0.739245706 0.0829878307 1.1243974220  
## 873 -1.502481583 -0.1086196708 0.6202301112  
## 874 -1.040757111 0.3934213674 -0.0202069411  
## 875 -1.192082157 0.6763435650 -0.1460595060  
## 876 -0.736076948 0.1144932522 0.9570576589  
## 877 -0.659787651 0.8560163927 0.0635592183  
## 878 -1.020001488 -0.5455106794 0.5844672965  
## 879 -1.808558716 -0.5516622864 -0.5629031333  
## 880 -1.098534443 0.5174091877 -0.1030396344  
## 881 -1.090823332 -0.1991330988 0.6689599505  
## 882 -0.941891040 -0.4710355506 0.5233022487  
## 883 -0.709551492 0.9493651052 0.1526450739  
## 884 -0.738582567 0.9253431418 0.1256978617  
## 885 -1.136363172 0.5802076277 -0.5979219860  
## 886 -0.576266002 -2.1172319449 -1.5331819109  
## 887 -0.230146948 0.7306883055 0.3631100704  
## 888 -0.614195936 0.6637214843 -0.3140637075  
## 889 -0.912493244 0.1457403688 -0.2681557301  
## 890 -0.150722120 0.3422805014 1.1298935174  
## 891 -0.694000332 0.5110959190 0.3980308238  
## 892 -1.105941338 0.3398069507 -0.4032450780  
## 893 -0.720554610 0.8667574163 -0.1354216868  
## 894 -0.641932341 0.4501634114 -0.0351787703  
## 895 -0.344546242 1.0751877380 0.5874905411  
## 896 -1.339244024 -0.6561837995 0.6754173093  
## 897 -0.661157269 0.7651182191 -0.3507525727  
## 898 -0.947624643 -0.4712374903 -0.4631135851  
## 899 -1.159987021 -2.3297001795 0.7978752577  
## 900 -0.488886366 -0.4931881741 1.0066403029  
## 901 -0.907496941 -0.0539104156 0.2079695428  
## 902 -0.427460091 0.5791302876 -0.5135898778  
## 903 -1.473442571 0.2583522834 0.2561136079  
## 904 -1.065749247 0.3416475306 0.0060407868  
## 905 -0.229582154 1.0030719622 -0.0769238050  
## 906 -1.251301688 -0.9066000323 -0.0001789422  
## 907 -0.613456403 0.8278077687 -0.2466418718  
## 908 -0.237936907 -0.6135692134 0.9801224567  
## 909 -0.602405486 0.9735199756 0.0379870712  
## 910 -0.475950758 0.7261096623 0.0116807826  
## 911 -0.387238501 -0.4036402653 0.8076642371  
## 912 -0.021677254 -0.5434609817 0.9728309096  
## 913 -0.554643805 0.7814553815 -0.3826108280  
## 914 -1.387541269 0.0491761718 -0.1571373442  
## 915 -0.039486540 0.9759029466 1.3055187688  
## 916 -0.054532688 0.7917762213 -0.4373256366  
## 917 -0.714984077 -0.8060932027 0.1053341402  
## 918 -0.554517459 0.2068084217 1.0408187382  
## 919 -0.339991313 -1.6403218031 1.7882916356  
## 920 -0.702833749 -1.3890348661 0.9355616614  
## 921 0.022917680 0.9073173622 -0.0172417561  
## 922 -0.590278635 0.8823089369 -0.0677292427  
## 923 -0.730543025 0.4125398705 -0.7009946304  
## 924 -0.950462592 0.8254748470 -0.0210881402  
## 925 -0.406516161 0.3577420856 1.0284800497  
## 926 -0.975538935 0.3581379054 -0.3612852683  
## 927 -0.503706917 0.8707746369 -0.6596064374  
## 928 -0.548011824 0.2532111449 0.9734640269  
## 929 -0.105161809 0.9090051399 -0.5347541326  
## 930 -0.138371161 1.0971955680 -0.2057667391  
## 931 -0.777158212 -1.0810117622 -0.4249739667  
## 932 -1.003256615 -2.3505488272 0.6805388460  
## 933 -0.420595857 0.2246634085 0.9978151979  
## 934 -0.960286395 0.2846676282 -0.2741766766  
## 935 -0.527734349 -1.0286288051 -0.4648723013  
## 936 0.624162710 -0.2395282909 1.1090498682  
## 937 0.084400279 0.4021328187 1.3017448395  
## 938 -0.246521120 -0.9115368911 0.0749449139  
## 939 -0.389518412 0.9696910886 -0.0269228299  
## 940 -0.304577660 0.7400080221 -0.5039411262  
## 941 -0.755536378 -0.9480296150 0.1659344808  
## 942 -0.441669749 -0.0205138596 0.8931174551  
## 943 -0.538447632 0.9412668217 -0.6819442421  
## 944 -0.362354334 0.5676345169 -0.9056862533  
## 945 -1.619921252 -0.1007195830 -0.1929962238  
## 946 -0.418466542 0.0479084365 1.3648424572  
## 947 0.003069451 0.9432761400 -0.6368015537  
## 948 0.654845025 -0.0633546806 1.1502075708  
## 949 -0.843298760 0.2497126682 0.1069313714  
## 950 -0.321436512 -0.2839187976 0.1270160218  
## 951 -0.808401319 0.6861174130 -1.0065184972  
## 952 -1.297110184 -0.3190955994 0.0162245669  
## 953 -0.208715897 -0.9349314066 0.6708341142  
## 954 -0.691110178 -0.6677840649 0.4252959483  
## 955 -0.428493768 1.1857417917 -2.5147816472  
## 956 0.076520087 0.9189028873 -0.6384269476  
## 957 -0.180096952 -0.7042916287 0.7739206656  
## 958 -0.354655069 0.6597507658 -0.5896367682  
## 959 -0.329815706 0.5593766499 -0.9462707417  
## 960 -0.952306310 0.2425195562 -0.6253920352  
## 961 0.072830572 -1.0120142562 0.1511589458  
## 962 -0.454671127 1.0819523976 -0.9679888807  
## 963 -0.383718891 0.9046824547 -0.8066214104  
## 964 0.081230804 -1.1627365585 1.0694036604  
## 965 0.047523601 -0.3323907695 0.5272346004  
## 966 0.127109081 1.2726527490 -2.1673437395  
## 967 0.162917535 -0.3037464423 0.9177192509  
## 968 -0.264324679 0.3036193127 0.9773783369  
## 969 -0.797668683 -0.4146009953 -0.0243919089  
## 970 -0.802444716 -0.7588942853 0.4651839040  
## 971 0.781426894 -1.6465320649 -0.7240218243  
## 972 -0.470144321 -1.2271150194 -0.3147100475  
## 973 -0.383949962 1.1319285974 -0.9504667555  
## 974 -0.128041077 -1.5986803674 1.7854722254  
## 975 -0.115239621 1.0307858772 -0.1048049372  
## 976 0.042096883 1.1648194885 -0.2848024319  
## 977 -0.481995250 1.1289858689 -0.5582730181  
## 978 0.743222114 1.0355327106 -0.3531492012  
## 979 -0.331599856 0.6903340670 -0.1573999616  
## 980 -0.183322701 -1.0412453919 0.1350338580  
## 981 0.069310604 1.1148327275 -0.7283563222  
## 982 0.020103848 -1.4748424389 -1.2203825990  
## attr(,"scaled:center")  
## PC1 PC2 PC3   
## 3.153027e-18 5.513145e-17 -9.764334e-18   
## attr(,"scaled:scale")  
## PC1 PC2 PC3   
## 1.7566024 1.1719243 0.7840448

# Define a Z-score threshold for outlier detection (e.g., 2 standard deviations)  
outlier\_threshold <- 2  
  
# Identify and remove outliers  
data\_no\_outliers <- data\_pca[apply(z\_scores, 1, function(row) all(abs(row) <= outlier\_threshold)), ]  
  
  
data\_pca$type <- Sacramento$type

## Warning in data\_pca$type <- Sacramento$type: Coercing LHS to a list

#problem 4(c)

# Load necessary libraries (if not already loaded)  
library(caret)  
  
  
# Load the Sacramento housing price dataset  
data(Sacramento)  
library(e1071)  
# Remove the "zip" and "city" variables (if not already removed)  
sacramento\_data <- Sacramento[, !names(Sacramento) %in% c("zip", "city")]  
  
# Define the training control for cross-validation  
train\_control <- trainControl(method = "cv", number = 5)  
  
svm\_grid <- expand.grid(C = c(0.1, 1, 10))  
  
  
  
svm\_model <- train(type ~ .,   
 data = sacramento\_data,   
 method = "svmLinear",  
 trControl = train\_control,   
 preProcess = c("center", "scale"),  
 tuneGrid = svm\_grid)  
  
# Print the best SVM model  
svm\_model

## Support Vector Machines with Linear Kernel   
##   
## 932 samples  
## 6 predictor  
## 3 classes: 'Condo', 'Multi\_Family', 'Residential'   
##   
## Pre-processing: centered (6), scaled (6)   
## Resampling: Cross-Validated (5 fold)   
## Summary of sample sizes: 745, 747, 746, 746, 744   
## Resampling results across tuning parameters:  
##   
## C Accuracy Kappa   
## 0.1 0.9292032 0.0000000  
## 1.0 0.9313481 0.1169045  
## 10.0 0.9291859 0.1339143  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final value used for the model was C = 1.

# Make predictions using the best model  
predictions <- predict(svm\_model, sacramento\_data)  
  
# Calculate the confusion matrix  
confusion <- confusionMatrix(predictions, sacramento\_data$type)  
  
# Extract kappa value  
kappa\_value <- confusion$kappa  
  
# Print the confusion matrix and kappa value  
print(confusion)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction Condo Multi\_Family Residential  
## Condo 11 0 3  
## Multi\_Family 0 0 0  
## Residential 42 13 863  
##   
## Overall Statistics  
##   
## Accuracy : 0.9378   
## 95% CI : (0.9203, 0.9524)  
## No Information Rate : 0.9292   
## P-Value [Acc > NIR] : 0.1694   
##   
## Kappa : 0.2584   
##   
## Mcnemar's Test P-Value : NA   
##   
## Statistics by Class:  
##   
## Class: Condo Class: Multi\_Family Class: Residential  
## Sensitivity 0.20755 0.00000 0.9965  
## Specificity 0.99659 1.00000 0.1667  
## Pos Pred Value 0.78571 NaN 0.9401  
## Neg Pred Value 0.95425 0.98605 0.7857  
## Prevalence 0.05687 0.01395 0.9292  
## Detection Rate 0.01180 0.00000 0.9260  
## Detection Prevalence 0.01502 0.00000 0.9850  
## Balanced Accuracy 0.60207 0.50000 0.5816

kappa\_value

## NULL

cat("Kappa Value:", kappa\_value)

## Kappa Value:

#problem 4(E)

library(caret)  
data(Sacramento)  
  
data\_pca$type <- Sacramento$type  
# Identify the minority and majority classes  
table(data\_pca$type)

##   
## Condo Multi\_Family Residential   
## 53 13 866

# Define the minority and majority class labels  
minority\_class <- "Multi\_Family"  
majority\_class <- "Residential"  
data\_pca$type <- Sacramento$type  
  
balanced\_data <- Sacramento[Sacramento$type == minority\_class, ]  
  
# Randomly sample from the majority class to balance the dataset  
set.seed(123)   
# For reproducibility  
majority\_samples <- Sacramento[Sacramento$type == majority\_class, ]  
sampled\_majority <- majority\_samples[sample(1:nrow(majority\_samples), nrow(balanced\_data)), ]  
  
  
# Combine the minority and sampled majority data  
balanced\_data <- rbind(balanced\_data, sampled\_majority)  
  
# Shuffle the rows for randomness  
balanced\_data <- balanced\_data[sample(nrow(balanced\_data)), ]  
  
  
  
  
# Check the distributions of variables in the new balanced dataset  
  
# Load necessary libraries for plotting  
library(ggplot2)  
library(gridExtra)

##   
## Attaching package: 'gridExtra'

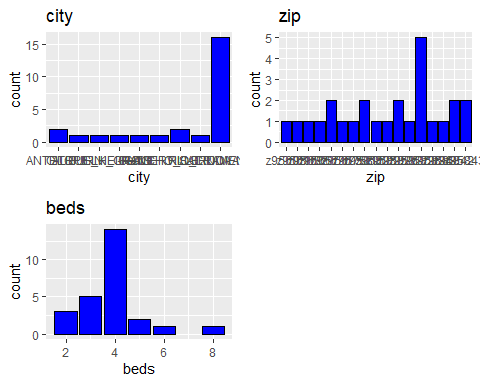
## The following object is masked from 'package:dplyr':  
##   
## combine

# Assuming 'balanced\_data' contains your balanced dataset  
  
# Create histograms for each numeric variable  
plots <- lapply(names(balanced\_data)[1:(n\_components - 1)], function(var\_name) {  
 p <- ggplot(data = balanced\_data, aes\_string(x = var\_name)) +  
 geom\_histogram(binwidth = 0.05, fill = "blue", color = "black", stat = "count") +  
 labs(title = var\_name)  
 return(p)  
})

## Warning: `aes\_string()` was deprecated in ggplot2 3.0.0.  
## ℹ Please use tidy evaluation idioms with `aes()`.  
## ℹ See also `vignette("ggplot2-in-packages")` for more information.  
## This warning is displayed once every 8 hours.  
## Call `lifecycle::last\_lifecycle\_warnings()` to see where this warning was  
## generated.

## Warning in geom\_histogram(binwidth = 0.05, fill = "blue", color = "black", : Ignoring unknown parameters: `binwidth`, `bins`, and `pad`  
## Ignoring unknown parameters: `binwidth`, `bins`, and `pad`  
## Ignoring unknown parameters: `binwidth`, `bins`, and `pad`

# Arrange the plots in a grid  
grid.arrange(grobs = plots, ncol = 2)



# Summary statistics for each numeric variable  
summary\_stats <- sapply(balanced\_data[, 1:(n\_components - 1)], summary)  
print(summary\_stats)

## $city  
## ANTELOPE AUBURN CAMERON\_PARK CARMICHAEL CITRUS\_HEIGHTS   
## 2 1 0 0 1   
## COOL DIAMOND\_SPRINGS EL\_DORADO EL\_DORADO\_HILLS ELK\_GROVE   
## 0 0 0 0 1   
## ELVERTA FAIR\_OAKS FOLSOM FORESTHILL GALT   
## 0 0 0 0 1   
## GARDEN\_VALLEY GOLD\_RIVER GRANITE\_BAY GREENWOOD LINCOLN   
## 0 0 0 0 0   
## LOOMIS MATHER MEADOW\_VISTA NORTH\_HIGHLANDS ORANGEVALE   
## 0 0 0 0 0   
## PENRYN PLACERVILLE POLLOCK\_PINES RANCHO\_CORDOVA RANCHO\_MURIETA   
## 0 1 0 2 0   
## RIO\_LINDA ROCKLIN ROSEVILLE SACRAMENTO WALNUT\_GROVE   
## 1 0 0 16 0   
## WEST\_SACRAMENTO WILTON   
## 0 0   
##   
## $zip  
## z95603 z95608 z95610 z95614 z95619 z95621 z95623 z95624 z95626 z95628 z95630   
## 1 0 1 0 0 0 0 0 0 0 0   
## z95631 z95632 z95633 z95635 z95648 z95650 z95655 z95660 z95661 z95662 z95663   
## 0 1 0 0 0 0 0 0 0 0 0   
## z95667 z95670 z95673 z95677 z95678 z95682 z95683 z95690 z95691 z95693 z95722   
## 1 2 1 0 0 0 0 0 0 0 0   
## z95726 z95742 z95746 z95747 z95757 z95758 z95762 z95765 z95811 z95814 z95815   
## 0 0 0 0 0 1 0 0 0 0 2   
## z95816 z95817 z95818 z95819 z95820 z95821 z95822 z95823 z95824 z95825 z95826   
## 0 0 0 0 0 0 0 1 0 1 2   
## z95827 z95828 z95829 z95831 z95832 z95833 z95834 z95835 z95838 z95841 z95842   
## 1 5 0 0 0 0 1 1 0 0 2   
## z95843 z95864   
## 2 0   
##   
## $beds  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.000 3.000 4.000 3.885 4.000 8.000

# Load the required libraries for SVM and grid search  
library(e1071)  
library(caret)  
  
# Set up a cross-validation control  
ctrl <- trainControl(method = "cv", number = 5)  
  
# Create a grid of hyperparameters for grid search  
  
  
  
svm\_grid <- expand.grid(C = c(0.1, 1, 10))  
  
  
  
svm\_grid

## C  
## 1 0.1  
## 2 1.0  
## 3 10.0

#Problem 5

# Load necessary libraries (if not already loaded)  
library(caret)  
  
# Make a copy of the mtcars dataset  
mycars <- mtcars  
  
# Initialize a new variable to hold fold indices  
mycars$folds <- 0  
  
# Create 5 folds and get a list of lists of indices  
flds <- createFolds(1:nrow(mycars), k = 5, list = TRUE)  
  
# This loop sets all the rows in a given fold to have that fold's index in the 'folds' variable  
for (i in 1:5) {  
 mycars$folds[flds[[i]]] <- i  
}  
  
# Create a visualization of the distribution of the 'gear' variable across folds  
library(ggplot2)  
  
# Convert 'folds' variable to a factor for visualization  
mycars$folds <- as.factor(mycars$folds)  
  
# Create a bar plot to visualize the distribution of 'gear' across folds  
ggplot(data = mycars, aes(x = factor(gear), fill = folds)) +  
 geom\_bar(position = "dodge") +  
 labs(title = "Distribution of 'gear' Variable Across Folds",  
 x = "Number of Gears",  
 y = "Count") +  
 scale\_fill\_manual(values = c("red", "blue", "green", "purple", "orange")) +  
 theme\_minimal()

