Homework 5

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# Install packages

library(MASS)  
library(tidyverse)

## Warning: package 'tidyr' was built under R version 4.2.3

## Warning: package 'readr' was built under R version 4.2.3

## Warning: package 'dplyr' was built under R version 4.2.3

## Warning: package 'stringr' was built under R version 4.2.3

## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──  
## ✔ dplyr 1.1.4 ✔ readr 2.1.5  
## ✔ forcats 1.0.0 ✔ stringr 1.5.1  
## ✔ ggplot2 3.4.4 ✔ tibble 3.2.1  
## ✔ lubridate 1.9.3 ✔ tidyr 1.3.1  
## ✔ purrr 1.0.2   
## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::lag() masks stats::lag()  
## ✖ dplyr::select() masks MASS::select()  
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(caret)

## Loading required package: lattice  
##   
## Attaching package: 'caret'  
##   
## The following object is masked from 'package:purrr':  
##   
## lift

library(glmnet)

## Loading required package: Matrix  
##   
## Attaching package: 'Matrix'  
##   
## The following objects are masked from 'package:tidyr':  
##   
## expand, pack, unpack  
##   
## Loaded glmnet 4.1-8

# Question 1

# Reading data

data <- read.csv('Ames\_Housing\_Data.csv', sep =',')  
head(data)

## Id LotArea OverallQual OverallCond YearBuilt YearRemodAdd CentralAir  
## 1 1 8450 7 5 2003 2003 Y  
## 2 2 9600 6 8 1976 1976 Y  
## 3 3 11250 7 5 2001 2002 Y  
## 4 4 9550 7 5 1915 1970 Y  
## 5 5 14260 8 5 2000 2000 Y  
## 6 6 14115 5 5 1993 1995 Y  
## X1stFlrSF X2ndFlrSF GrLivArea FullBath HalfBath BedroomAbvGr KitchenAbvGr  
## 1 856 854 1710 2 1 3 1  
## 2 1262 0 1262 2 0 3 1  
## 3 920 866 1786 2 1 3 1  
## 4 961 756 1717 1 0 3 1  
## 5 1145 1053 2198 2 1 4 1  
## 6 796 566 1362 1 1 1 1  
## TotRmsAbvGrd Fireplaces GarageCars GarageArea YrSold SalePrice  
## 1 8 0 2 548 2008 208500  
## 2 6 1 2 460 2007 181500  
## 3 6 1 2 608 2008 223500  
## 4 7 1 3 642 2006 140000  
## 5 9 1 3 836 2008 250000  
## 6 5 0 2 480 2009 143000

## Question 1-1

set.seed(123)  
training.samples <- data$SalePrice %>% createDataPartition(p = 0.75, list = FALSE)  
train.data <- data[training.samples, ]  
test.data <- data[-training.samples, ]

## Question 1-2

fit <- lm(SalePrice~., data = train.data)  
fit\_step <- stepAIC(fit, k = log(nrow(train.data)), trace = 1)

## Start: AIC=22935.79  
## SalePrice ~ Id + LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + GrLivArea +   
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd +   
## Fireplaces + GarageCars + GarageArea + YrSold  
##   
## Df Sum of Sq RSS AIC  
## - GarageCars 1 1.8284e+08 1.1614e+12 22929  
## - YrSold 1 6.1308e+08 1.1618e+12 22929  
## - Id 1 1.0211e+09 1.1622e+12 22930  
## - GrLivArea 1 1.6624e+09 1.1628e+12 22930  
## - HalfBath 1 1.9541e+09 1.1631e+12 22931  
## - YearRemodAdd 1 2.6438e+09 1.1638e+12 22931  
## - Fireplaces 1 3.0769e+09 1.1642e+12 22932  
## - X2ndFlrSF 1 4.0107e+09 1.1652e+12 22933  
## <none> 1.1612e+12 22936  
## - FullBath 1 9.7790e+09 1.1709e+12 22938  
## - CentralAir 1 9.9825e+09 1.1712e+12 22938  
## - TotRmsAbvGrd 1 1.0026e+10 1.1712e+12 22938  
## - X1stFlrSF 1 1.2605e+10 1.1738e+12 22941  
## - GarageArea 1 1.6134e+10 1.1773e+12 22944  
## - OverallCond 1 3.5115e+10 1.1963e+12 22962  
## - LotArea 1 3.6303e+10 1.1975e+12 22963  
## - KitchenAbvGr 1 3.8261e+10 1.1994e+12 22964  
## - BedroomAbvGr 1 5.9457e+10 1.2206e+12 22984  
## - YearBuilt 1 9.1354e+10 1.2525e+12 23012  
## - OverallQual 1 1.9499e+11 1.3562e+12 23099  
##   
## Step: AIC=22928.96  
## SalePrice ~ Id + LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + GrLivArea +   
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd +   
## Fireplaces + GarageArea + YrSold  
##   
## Df Sum of Sq RSS AIC  
## - YrSold 1 5.8517e+08 1.1619e+12 22922  
## - Id 1 1.0481e+09 1.1624e+12 22923  
## - GrLivArea 1 1.6988e+09 1.1631e+12 22924  
## - HalfBath 1 2.0400e+09 1.1634e+12 22924  
## - YearRemodAdd 1 2.5750e+09 1.1639e+12 22924  
## - Fireplaces 1 2.9728e+09 1.1643e+12 22925  
## - X2ndFlrSF 1 3.9683e+09 1.1653e+12 22926  
## <none> 1.1614e+12 22929  
## - TotRmsAbvGrd 1 9.9368e+09 1.1713e+12 22931  
## - CentralAir 1 9.9685e+09 1.1713e+12 22931  
## - FullBath 1 1.0080e+10 1.1714e+12 22931  
## - X1stFlrSF 1 1.2540e+10 1.1739e+12 22934  
## - OverallCond 1 3.5389e+10 1.1967e+12 22955  
## - LotArea 1 3.6209e+10 1.1976e+12 22956  
## - GarageArea 1 3.7151e+10 1.1985e+12 22956  
## - KitchenAbvGr 1 3.8804e+10 1.2002e+12 22958  
## - BedroomAbvGr 1 5.9289e+10 1.2206e+12 22977  
## - YearBuilt 1 9.1242e+10 1.2526e+12 23005  
## - OverallQual 1 1.9572e+11 1.3571e+12 23093  
##   
## Step: AIC=22922.52  
## SalePrice ~ Id + LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + GrLivArea +   
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd +   
## Fireplaces + GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - Id 1 1.0639e+09 1.1630e+12 22916  
## - GrLivArea 1 1.6802e+09 1.1636e+12 22917  
## - HalfBath 1 2.0698e+09 1.1640e+12 22918  
## - YearRemodAdd 1 2.4109e+09 1.1643e+12 22918  
## - Fireplaces 1 2.9192e+09 1.1649e+12 22918  
## - X2ndFlrSF 1 4.0189e+09 1.1660e+12 22919  
## <none> 1.1619e+12 22922  
## - TotRmsAbvGrd 1 9.9514e+09 1.1719e+12 22925  
## - CentralAir 1 9.9614e+09 1.1719e+12 22925  
## - FullBath 1 1.0153e+10 1.1721e+12 22925  
## - X1stFlrSF 1 1.2605e+10 1.1745e+12 22927  
## - OverallCond 1 3.5180e+10 1.1971e+12 22948  
## - LotArea 1 3.6509e+10 1.1984e+12 22950  
## - GarageArea 1 3.7306e+10 1.1992e+12 22950  
## - KitchenAbvGr 1 3.9162e+10 1.2011e+12 22952  
## - BedroomAbvGr 1 5.9275e+10 1.2212e+12 22970  
## - YearBuilt 1 9.1804e+10 1.2537e+12 22999  
## - OverallQual 1 1.9612e+11 1.3581e+12 23087  
##   
## Step: AIC=22916.52  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + GrLivArea +   
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd +   
## Fireplaces + GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - GrLivArea 1 1.8774e+09 1.1649e+12 22911  
## - HalfBath 1 2.1432e+09 1.1651e+12 22912  
## - YearRemodAdd 1 2.4782e+09 1.1655e+12 22912  
## - Fireplaces 1 2.9670e+09 1.1660e+12 22912  
## - X2ndFlrSF 1 3.7890e+09 1.1668e+12 22913  
## <none> 1.1630e+12 22916  
## - TotRmsAbvGrd 1 9.7895e+09 1.1728e+12 22919  
## - CentralAir 1 9.9174e+09 1.1729e+12 22919  
## - FullBath 1 1.0227e+10 1.1732e+12 22919  
## - X1stFlrSF 1 1.2189e+10 1.1752e+12 22921  
## - OverallCond 1 3.4959e+10 1.1980e+12 22942  
## - GarageArea 1 3.6900e+10 1.1999e+12 22944  
## - LotArea 1 3.7099e+10 1.2001e+12 22944  
## - KitchenAbvGr 1 3.8798e+10 1.2018e+12 22946  
## - BedroomAbvGr 1 5.9664e+10 1.2227e+12 22964  
## - YearBuilt 1 9.2247e+10 1.2552e+12 22993  
## - OverallQual 1 1.9645e+11 1.3594e+12 23081  
##   
## Step: AIC=22911.29  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + FullBath +   
## HalfBath + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd + Fireplaces +   
## GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - HalfBath 1 2.0115e+09 1.1669e+12 22906  
## - YearRemodAdd 1 2.6644e+09 1.1675e+12 22907  
## - Fireplaces 1 2.8099e+09 1.1677e+12 22907  
## <none> 1.1649e+12 22911  
## - CentralAir 1 9.8930e+09 1.1748e+12 22914  
## - FullBath 1 9.9591e+09 1.1748e+12 22914  
## - TotRmsAbvGrd 1 1.1301e+10 1.1762e+12 22915  
## - OverallCond 1 3.3998e+10 1.1989e+12 22936  
## - LotArea 1 3.7034e+10 1.2019e+12 22939  
## - GarageArea 1 3.7453e+10 1.2023e+12 22939  
## - KitchenAbvGr 1 4.0916e+10 1.2058e+12 22942  
## - BedroomAbvGr 1 6.0331e+10 1.2252e+12 22960  
## - YearBuilt 1 9.0557e+10 1.2554e+12 22986  
## - X2ndFlrSF 1 1.8769e+11 1.3526e+12 23068  
## - OverallQual 1 1.9854e+11 1.3634e+12 23077  
## - X1stFlrSF 1 4.2093e+11 1.5858e+12 23243  
##   
## Step: AIC=22906.18  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + FullBath +   
## BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd + Fireplaces +   
## GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - Fireplaces 1 2.5070e+09 1.1694e+12 22902  
## - YearRemodAdd 1 2.6377e+09 1.1695e+12 22902  
## <none> 1.1669e+12 22906  
## - FullBath 1 8.0173e+09 1.1749e+12 22907  
## - CentralAir 1 9.9056e+09 1.1768e+12 22908  
## - TotRmsAbvGrd 1 1.1118e+10 1.1780e+12 22910  
## - OverallCond 1 3.3894e+10 1.2008e+12 22931  
## - LotArea 1 3.7537e+10 1.2044e+12 22934  
## - GarageArea 1 3.7997e+10 1.2049e+12 22934  
## - KitchenAbvGr 1 4.1028e+10 1.2079e+12 22937  
## - BedroomAbvGr 1 5.9865e+10 1.2268e+12 22954  
## - YearBuilt 1 9.1300e+10 1.2582e+12 22982  
## - OverallQual 1 1.9928e+11 1.3662e+12 23072  
## - X2ndFlrSF 1 2.2400e+11 1.3909e+12 23092  
## - X1stFlrSF 1 4.1892e+11 1.5858e+12 23236  
##   
## Step: AIC=22901.54  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## YearRemodAdd + CentralAir + X1stFlrSF + X2ndFlrSF + FullBath +   
## BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd + GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - YearRemodAdd 1 1.9916e+09 1.1714e+12 22896  
## <none> 1.1694e+12 22902  
## - FullBath 1 8.2979e+09 1.1777e+12 22902  
## - CentralAir 1 8.9376e+09 1.1783e+12 22903  
## - TotRmsAbvGrd 1 1.1181e+10 1.1806e+12 22905  
## - OverallCond 1 3.4291e+10 1.2037e+12 22926  
## - GarageArea 1 3.7167e+10 1.2066e+12 22929  
## - LotArea 1 4.1366e+10 1.2108e+12 22933  
## - KitchenAbvGr 1 4.3838e+10 1.2132e+12 22935  
## - BedroomAbvGr 1 6.3470e+10 1.2329e+12 22952  
## - YearBuilt 1 9.1019e+10 1.2604e+12 22977  
## - OverallQual 1 2.0888e+11 1.3783e+12 23075  
## - X2ndFlrSF 1 2.4529e+11 1.4147e+12 23103  
## - X1stFlrSF 1 4.7434e+11 1.6437e+12 23268  
##   
## Step: AIC=22896.4  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## CentralAir + X1stFlrSF + X2ndFlrSF + FullBath + BedroomAbvGr +   
## KitchenAbvGr + TotRmsAbvGrd + GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - FullBath 1 7.4074e+09 1.1788e+12 22896  
## <none> 1.1714e+12 22896  
## - CentralAir 1 9.0714e+09 1.1805e+12 22898  
## - TotRmsAbvGrd 1 1.1966e+10 1.1834e+12 22901  
## - GarageArea 1 3.6781e+10 1.2082e+12 22923  
## - LotArea 1 4.1197e+10 1.2126e+12 22927  
## - KitchenAbvGr 1 4.5133e+10 1.2165e+12 22931  
## - OverallCond 1 4.7140e+10 1.2185e+12 22933  
## - BedroomAbvGr 1 6.9403e+10 1.2408e+12 22952  
## - YearBuilt 1 1.2725e+11 1.2986e+12 23002  
## - OverallQual 1 2.1765e+11 1.3890e+12 23076  
## - X2ndFlrSF 1 2.4686e+11 1.4183e+12 23099  
## - X1stFlrSF 1 4.7547e+11 1.6469e+12 23263  
##   
## Step: AIC=22896.32  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## CentralAir + X1stFlrSF + X2ndFlrSF + BedroomAbvGr + KitchenAbvGr +   
## TotRmsAbvGrd + GarageArea  
##   
## Df Sum of Sq RSS AIC  
## - CentralAir 1 7.3715e+09 1.1862e+12 22896  
## <none> 1.1788e+12 22896  
## - TotRmsAbvGrd 1 1.2228e+10 1.1910e+12 22901  
## - GarageArea 1 3.6460e+10 1.2153e+12 22923  
## - LotArea 1 4.1286e+10 1.2201e+12 22927  
## - OverallCond 1 4.6195e+10 1.2250e+12 22932  
## - KitchenAbvGr 1 5.4264e+10 1.2331e+12 22939  
## - BedroomAbvGr 1 7.7274e+10 1.2561e+12 22959  
## - YearBuilt 1 1.2185e+11 1.3006e+12 22997  
## - OverallQual 1 2.1115e+11 1.3900e+12 23070  
## - X2ndFlrSF 1 2.4375e+11 1.4225e+12 23096  
## - X1stFlrSF 1 4.7505e+11 1.6538e+12 23261  
##   
## Step: AIC=22896.15  
## SalePrice ~ LotArea + OverallQual + OverallCond + YearBuilt +   
## X1stFlrSF + X2ndFlrSF + BedroomAbvGr + KitchenAbvGr + TotRmsAbvGrd +   
## GarageArea  
##   
## Df Sum of Sq RSS AIC  
## <none> 1.1862e+12 22896  
## - TotRmsAbvGrd 1 1.2247e+10 1.1984e+12 22900  
## - GarageArea 1 3.5374e+10 1.2215e+12 22921  
## - OverallCond 1 3.9455e+10 1.2256e+12 22925  
## - LotArea 1 4.0357e+10 1.2265e+12 22926  
## - KitchenAbvGr 1 4.9364e+10 1.2355e+12 22934  
## - BedroomAbvGr 1 8.0195e+10 1.2664e+12 22961  
## - YearBuilt 1 1.1617e+11 1.3023e+12 22992  
## - OverallQual 1 2.1235e+11 1.3985e+12 23070  
## - X2ndFlrSF 1 2.4684e+11 1.4330e+12 23096  
## - X1stFlrSF 1 4.7263e+11 1.6588e+12 23257

pred <- fit\_step %>% predict(test.data)  
data.frame(  
RMSE = RMSE(pred, test.data$SalePrice),  
Rsquare = R2(pred, test.data$SalePrice)  
)

## RMSE Rsquare  
## 1 48727.68 0.6601152

## Question 1-3

library(leaps)  
fit\_bs <- regsubsets(SalePrice~., data = train.data, nvmax = 30)  
result <- summary(fit\_bs)  
which.min(result$bic)

## [1] 10

result$which[3,]

## (Intercept) Id LotArea OverallQual OverallCond YearBuilt   
## TRUE FALSE FALSE TRUE FALSE FALSE   
## YearRemodAdd CentralAirY X1stFlrSF X2ndFlrSF GrLivArea FullBath   
## FALSE FALSE TRUE TRUE FALSE FALSE   
## HalfBath BedroomAbvGr KitchenAbvGr TotRmsAbvGrd Fireplaces GarageCars   
## FALSE FALSE FALSE FALSE FALSE FALSE   
## GarageArea YrSold   
## FALSE FALSE

fit\_bs <- lm(SalePrice~OverallQual+X1stFlrSF+X2ndFlrSF, data = train.data)  
pred <- fit\_bs %>% predict(test.data)  
data.frame(  
RMSE = RMSE(pred, test.data$SalePrice),  
Rsquare = R2(pred, test.data$SalePrice)  
)

## RMSE Rsquare  
## 1 48387.67 0.6343376

mod1 <- lm(SalePrice~TotRmsAbvGrd+GarageArea+OverallCond+LotArea+KitchenAbvGr+BedroomAbvGr+YearBuilt+OverallQual+X2ndFlrSF+X1stFlrSF, data = train.data)  
mod2 <- lm(SalePrice~OverallQual+X1stFlrSF+X2ndFlrSF, data=train.data)  
BIC(mod1)

## [1] 26016.31

BIC(mod2)

## [1] 26295.37

pred1 <- mod1 %>% predict(test.data)  
pred2 <- mod2 %>% predict(test.data)  
data.frame(  
 RMSE1 = RMSE(pred1, test.data$SalePrice),  
 RMSE2 = RMSE(pred2, test.data$SalePrice),  
 Rsquare1 = R2(pred1, test.data$SalePrice),  
 Rsquare2 = R2(pred2, test.data$SalePrice)  
)

## RMSE1 RMSE2 Rsquare1 Rsquare2  
## 1 48727.68 48387.67 0.6601152 0.6343376

Based on BIC and R^2, I concluded stepwise model is better selection. However, RMSE is slightly smaller in the subset model, which indicates less error.

# Question 2

## Question 2-1

data <- read.csv('Titanic2.csv', sep=',')  
head(data)

## PassengerId Survived Pclass  
## 1 1 0 3  
## 2 2 1 1  
## 3 3 1 3  
## 4 4 1 1  
## 5 5 0 3  
## 6 6 0 3  
## Name Sex Age SibSp Parch  
## 1 Braund, Mr. Owen Harris male 22 1 0  
## 2 Cumings, Mrs. John Bradley (Florence Briggs Thayer) female 38 1 0  
## 3 Heikkinen, Miss. Laina female 26 0 0  
## 4 Futrelle, Mrs. Jacques Heath (Lily May Peel) female 35 1 0  
## 5 Allen, Mr. William Henry male 35 0 0  
## 6 Moran, Mr. James male NA 0 0  
## Ticket Fare Cabin Embarked  
## 1 A/5 21171 7.2500 S  
## 2 PC 17599 71.2833 C85 C  
## 3 STON/O2. 3101282 7.9250 S  
## 4 113803 53.1000 C123 S  
## 5 373450 8.0500 S  
## 6 330877 8.4583 Q

nrow(data)

## [1] 891

data2 <- subset(data, select = - c(PassengerId, Name, Ticket, Cabin))  
data2 <- na.omit(data2)  
data2

## Survived Pclass Sex Age SibSp Parch Fare Embarked  
## 1 0 3 male 22.00 1 0 7.2500 S  
## 2 1 1 female 38.00 1 0 71.2833 C  
## 3 1 3 female 26.00 0 0 7.9250 S  
## 4 1 1 female 35.00 1 0 53.1000 S  
## 5 0 3 male 35.00 0 0 8.0500 S  
## 7 0 1 male 54.00 0 0 51.8625 S  
## 8 0 3 male 2.00 3 1 21.0750 S  
## 9 1 3 female 27.00 0 2 11.1333 S  
## 10 1 2 female 14.00 1 0 30.0708 C  
## 11 1 3 female 4.00 1 1 16.7000 S  
## 12 1 1 female 58.00 0 0 26.5500 S  
## 13 0 3 male 20.00 0 0 8.0500 S  
## 14 0 3 male 39.00 1 5 31.2750 S  
## 15 0 3 female 14.00 0 0 7.8542 S  
## 16 1 2 female 55.00 0 0 16.0000 S  
## 17 0 3 male 2.00 4 1 29.1250 Q  
## 19 0 3 female 31.00 1 0 18.0000 S  
## 21 0 2 male 35.00 0 0 26.0000 S  
## 22 1 2 male 34.00 0 0 13.0000 S  
## 23 1 3 female 15.00 0 0 8.0292 Q  
## 24 1 1 male 28.00 0 0 35.5000 S  
## 25 0 3 female 8.00 3 1 21.0750 S  
## 26 1 3 female 38.00 1 5 31.3875 S  
## 28 0 1 male 19.00 3 2 263.0000 S  
## 31 0 1 male 40.00 0 0 27.7208 C  
## 34 0 2 male 66.00 0 0 10.5000 S  
## 35 0 1 male 28.00 1 0 82.1708 C  
## 36 0 1 male 42.00 1 0 52.0000 S  
## 38 0 3 male 21.00 0 0 8.0500 S  
## 39 0 3 female 18.00 2 0 18.0000 S  
## 40 1 3 female 14.00 1 0 11.2417 C  
## 41 0 3 female 40.00 1 0 9.4750 S  
## 42 0 2 female 27.00 1 0 21.0000 S  
## 44 1 2 female 3.00 1 2 41.5792 C  
## 45 1 3 female 19.00 0 0 7.8792 Q  
## 50 0 3 female 18.00 1 0 17.8000 S  
## 51 0 3 male 7.00 4 1 39.6875 S  
## 52 0 3 male 21.00 0 0 7.8000 S  
## 53 1 1 female 49.00 1 0 76.7292 C  
## 54 1 2 female 29.00 1 0 26.0000 S  
## 55 0 1 male 65.00 0 1 61.9792 C  
## 57 1 2 female 21.00 0 0 10.5000 S  
## 58 0 3 male 28.50 0 0 7.2292 C  
## 59 1 2 female 5.00 1 2 27.7500 S  
## 60 0 3 male 11.00 5 2 46.9000 S  
## 61 0 3 male 22.00 0 0 7.2292 C  
## 62 1 1 female 38.00 0 0 80.0000 Q  
## 63 0 1 male 45.00 1 0 83.4750 S  
## 64 0 3 male 4.00 3 2 27.9000 S  
## 67 1 2 female 29.00 0 0 10.5000 S  
## 68 0 3 male 19.00 0 0 8.1583 S  
## 69 1 3 female 17.00 4 2 7.9250 S  
## 70 0 3 male 26.00 2 0 8.6625 S  
## 71 0 2 male 32.00 0 0 10.5000 S  
## 72 0 3 female 16.00 5 2 46.9000 S  
## 73 0 2 male 21.00 0 0 73.5000 S  
## 74 0 3 male 26.00 1 0 14.4542 C  
## 75 1 3 male 32.00 0 0 56.4958 S  
## 76 0 3 male 25.00 0 0 7.6500 S  
## 79 1 2 male 0.83 0 2 29.0000 S  
## 80 1 3 female 30.00 0 0 12.4750 S  
## 81 0 3 male 22.00 0 0 9.0000 S  
## 82 1 3 male 29.00 0 0 9.5000 S  
## 84 0 1 male 28.00 0 0 47.1000 S  
## 85 1 2 female 17.00 0 0 10.5000 S  
## 86 1 3 female 33.00 3 0 15.8500 S  
## 87 0 3 male 16.00 1 3 34.3750 S  
## 89 1 1 female 23.00 3 2 263.0000 S  
## 90 0 3 male 24.00 0 0 8.0500 S  
## 91 0 3 male 29.00 0 0 8.0500 S  
## 92 0 3 male 20.00 0 0 7.8542 S  
## 93 0 1 male 46.00 1 0 61.1750 S  
## 94 0 3 male 26.00 1 2 20.5750 S  
## 95 0 3 male 59.00 0 0 7.2500 S  
## 97 0 1 male 71.00 0 0 34.6542 C  
## 98 1 1 male 23.00 0 1 63.3583 C  
## 99 1 2 female 34.00 0 1 23.0000 S  
## 100 0 2 male 34.00 1 0 26.0000 S  
## 101 0 3 female 28.00 0 0 7.8958 S  
## 103 0 1 male 21.00 0 1 77.2875 S  
## 104 0 3 male 33.00 0 0 8.6542 S  
## 105 0 3 male 37.00 2 0 7.9250 S  
## 106 0 3 male 28.00 0 0 7.8958 S  
## 107 1 3 female 21.00 0 0 7.6500 S  
## 109 0 3 male 38.00 0 0 7.8958 S  
## 111 0 1 male 47.00 0 0 52.0000 S  
## 112 0 3 female 14.50 1 0 14.4542 C  
## 113 0 3 male 22.00 0 0 8.0500 S  
## 114 0 3 female 20.00 1 0 9.8250 S  
## 115 0 3 female 17.00 0 0 14.4583 C  
## 116 0 3 male 21.00 0 0 7.9250 S  
## 117 0 3 male 70.50 0 0 7.7500 Q  
## 118 0 2 male 29.00 1 0 21.0000 S  
## 119 0 1 male 24.00 0 1 247.5208 C  
## 120 0 3 female 2.00 4 2 31.2750 S  
## 121 0 2 male 21.00 2 0 73.5000 S  
## 123 0 2 male 32.50 1 0 30.0708 C  
## 124 1 2 female 32.50 0 0 13.0000 S  
## 125 0 1 male 54.00 0 1 77.2875 S  
## 126 1 3 male 12.00 1 0 11.2417 C  
## 128 1 3 male 24.00 0 0 7.1417 S  
## 130 0 3 male 45.00 0 0 6.9750 S  
## 131 0 3 male 33.00 0 0 7.8958 C  
## 132 0 3 male 20.00 0 0 7.0500 S  
## 133 0 3 female 47.00 1 0 14.5000 S  
## 134 1 2 female 29.00 1 0 26.0000 S  
## 135 0 2 male 25.00 0 0 13.0000 S  
## 136 0 2 male 23.00 0 0 15.0458 C  
## 137 1 1 female 19.00 0 2 26.2833 S  
## 138 0 1 male 37.00 1 0 53.1000 S  
## 139 0 3 male 16.00 0 0 9.2167 S  
## 140 0 1 male 24.00 0 0 79.2000 C  
## 142 1 3 female 22.00 0 0 7.7500 S  
## 143 1 3 female 24.00 1 0 15.8500 S  
## 144 0 3 male 19.00 0 0 6.7500 Q  
## 145 0 2 male 18.00 0 0 11.5000 S  
## 146 0 2 male 19.00 1 1 36.7500 S  
## 147 1 3 male 27.00 0 0 7.7958 S  
## 148 0 3 female 9.00 2 2 34.3750 S  
## 149 0 2 male 36.50 0 2 26.0000 S  
## 150 0 2 male 42.00 0 0 13.0000 S  
## 151 0 2 male 51.00 0 0 12.5250 S  
## 152 1 1 female 22.00 1 0 66.6000 S  
## 153 0 3 male 55.50 0 0 8.0500 S  
## 154 0 3 male 40.50 0 2 14.5000 S  
## 156 0 1 male 51.00 0 1 61.3792 C  
## 157 1 3 female 16.00 0 0 7.7333 Q  
## 158 0 3 male 30.00 0 0 8.0500 S  
## 161 0 3 male 44.00 0 1 16.1000 S  
## 162 1 2 female 40.00 0 0 15.7500 S  
## 163 0 3 male 26.00 0 0 7.7750 S  
## 164 0 3 male 17.00 0 0 8.6625 S  
## 165 0 3 male 1.00 4 1 39.6875 S  
## 166 1 3 male 9.00 0 2 20.5250 S  
## 168 0 3 female 45.00 1 4 27.9000 S  
## 170 0 3 male 28.00 0 0 56.4958 S  
## 171 0 1 male 61.00 0 0 33.5000 S  
## 172 0 3 male 4.00 4 1 29.1250 Q  
## 173 1 3 female 1.00 1 1 11.1333 S  
## 174 0 3 male 21.00 0 0 7.9250 S  
## 175 0 1 male 56.00 0 0 30.6958 C  
## 176 0 3 male 18.00 1 1 7.8542 S  
## 178 0 1 female 50.00 0 0 28.7125 C  
## 179 0 2 male 30.00 0 0 13.0000 S  
## 180 0 3 male 36.00 0 0 0.0000 S  
## 183 0 3 male 9.00 4 2 31.3875 S  
## 184 1 2 male 1.00 2 1 39.0000 S  
## 185 1 3 female 4.00 0 2 22.0250 S  
## 188 1 1 male 45.00 0 0 26.5500 S  
## 189 0 3 male 40.00 1 1 15.5000 Q  
## 190 0 3 male 36.00 0 0 7.8958 S  
## 191 1 2 female 32.00 0 0 13.0000 S  
## 192 0 2 male 19.00 0 0 13.0000 S  
## 193 1 3 female 19.00 1 0 7.8542 S  
## 194 1 2 male 3.00 1 1 26.0000 S  
## 195 1 1 female 44.00 0 0 27.7208 C  
## 196 1 1 female 58.00 0 0 146.5208 C  
## 198 0 3 male 42.00 0 1 8.4042 S  
## 200 0 2 female 24.00 0 0 13.0000 S  
## 201 0 3 male 28.00 0 0 9.5000 S  
## 203 0 3 male 34.00 0 0 6.4958 S  
## 204 0 3 male 45.50 0 0 7.2250 C  
## 205 1 3 male 18.00 0 0 8.0500 S  
## 206 0 3 female 2.00 0 1 10.4625 S  
## 207 0 3 male 32.00 1 0 15.8500 S  
## 208 1 3 male 26.00 0 0 18.7875 C  
## 209 1 3 female 16.00 0 0 7.7500 Q  
## 210 1 1 male 40.00 0 0 31.0000 C  
## 211 0 3 male 24.00 0 0 7.0500 S  
## 212 1 2 female 35.00 0 0 21.0000 S  
## 213 0 3 male 22.00 0 0 7.2500 S  
## 214 0 2 male 30.00 0 0 13.0000 S  
## 216 1 1 female 31.00 1 0 113.2750 C  
## 217 1 3 female 27.00 0 0 7.9250 S  
## 218 0 2 male 42.00 1 0 27.0000 S  
## 219 1 1 female 32.00 0 0 76.2917 C  
## 220 0 2 male 30.00 0 0 10.5000 S  
## 221 1 3 male 16.00 0 0 8.0500 S  
## 222 0 2 male 27.00 0 0 13.0000 S  
## 223 0 3 male 51.00 0 0 8.0500 S  
## 225 1 1 male 38.00 1 0 90.0000 S  
## 226 0 3 male 22.00 0 0 9.3500 S  
## 227 1 2 male 19.00 0 0 10.5000 S  
## 228 0 3 male 20.50 0 0 7.2500 Q  
## 229 0 2 male 18.00 0 0 13.0000 S  
## 231 1 1 female 35.00 1 0 83.4750 S  
## 232 0 3 male 29.00 0 0 7.7750 S  
## 233 0 2 male 59.00 0 0 13.5000 S  
## 234 1 3 female 5.00 4 2 31.3875 S  
## 235 0 2 male 24.00 0 0 10.5000 S  
## 237 0 2 male 44.00 1 0 26.0000 S  
## 238 1 2 female 8.00 0 2 26.2500 S  
## 239 0 2 male 19.00 0 0 10.5000 S  
## 240 0 2 male 33.00 0 0 12.2750 S  
## 243 0 2 male 29.00 0 0 10.5000 S  
## 244 0 3 male 22.00 0 0 7.1250 S  
## 245 0 3 male 30.00 0 0 7.2250 C  
## 246 0 1 male 44.00 2 0 90.0000 Q  
## 247 0 3 female 25.00 0 0 7.7750 S  
## 248 1 2 female 24.00 0 2 14.5000 S  
## 249 1 1 male 37.00 1 1 52.5542 S  
## 250 0 2 male 54.00 1 0 26.0000 S  
## 252 0 3 female 29.00 1 1 10.4625 S  
## 253 0 1 male 62.00 0 0 26.5500 S  
## 254 0 3 male 30.00 1 0 16.1000 S  
## 255 0 3 female 41.00 0 2 20.2125 S  
## 256 1 3 female 29.00 0 2 15.2458 C  
## 258 1 1 female 30.00 0 0 86.5000 S  
## 259 1 1 female 35.00 0 0 512.3292 C  
## 260 1 2 female 50.00 0 1 26.0000 S  
## 262 1 3 male 3.00 4 2 31.3875 S  
## 263 0 1 male 52.00 1 1 79.6500 S  
## 264 0 1 male 40.00 0 0 0.0000 S  
## 266 0 2 male 36.00 0 0 10.5000 S  
## 267 0 3 male 16.00 4 1 39.6875 S  
## 268 1 3 male 25.00 1 0 7.7750 S  
## 269 1 1 female 58.00 0 1 153.4625 S  
## 270 1 1 female 35.00 0 0 135.6333 S  
## 272 1 3 male 25.00 0 0 0.0000 S  
## 273 1 2 female 41.00 0 1 19.5000 S  
## 274 0 1 male 37.00 0 1 29.7000 C  
## 276 1 1 female 63.00 1 0 77.9583 S  
## 277 0 3 female 45.00 0 0 7.7500 S  
## 279 0 3 male 7.00 4 1 29.1250 Q  
## 280 1 3 female 35.00 1 1 20.2500 S  
## 281 0 3 male 65.00 0 0 7.7500 Q  
## 282 0 3 male 28.00 0 0 7.8542 S  
## 283 0 3 male 16.00 0 0 9.5000 S  
## 284 1 3 male 19.00 0 0 8.0500 S  
## 286 0 3 male 33.00 0 0 8.6625 C  
## 287 1 3 male 30.00 0 0 9.5000 S  
## 288 0 3 male 22.00 0 0 7.8958 S  
## 289 1 2 male 42.00 0 0 13.0000 S  
## 290 1 3 female 22.00 0 0 7.7500 Q  
## 291 1 1 female 26.00 0 0 78.8500 S  
## 292 1 1 female 19.00 1 0 91.0792 C  
## 293 0 2 male 36.00 0 0 12.8750 C  
## 294 0 3 female 24.00 0 0 8.8500 S  
## 295 0 3 male 24.00 0 0 7.8958 S  
## 297 0 3 male 23.50 0 0 7.2292 C  
## 298 0 1 female 2.00 1 2 151.5500 S  
## 300 1 1 female 50.00 0 1 247.5208 C  
## 303 0 3 male 19.00 0 0 0.0000 S  
## 306 1 1 male 0.92 1 2 151.5500 S  
## 308 1 1 female 17.00 1 0 108.9000 C  
## 309 0 2 male 30.00 1 0 24.0000 C  
## 310 1 1 female 30.00 0 0 56.9292 C  
## 311 1 1 female 24.00 0 0 83.1583 C  
## 312 1 1 female 18.00 2 2 262.3750 C  
## 313 0 2 female 26.00 1 1 26.0000 S  
## 314 0 3 male 28.00 0 0 7.8958 S  
## 315 0 2 male 43.00 1 1 26.2500 S  
## 316 1 3 female 26.00 0 0 7.8542 S  
## 317 1 2 female 24.00 1 0 26.0000 S  
## 318 0 2 male 54.00 0 0 14.0000 S  
## 319 1 1 female 31.00 0 2 164.8667 S  
## 320 1 1 female 40.00 1 1 134.5000 C  
## 321 0 3 male 22.00 0 0 7.2500 S  
## 322 0 3 male 27.00 0 0 7.8958 S  
## 323 1 2 female 30.00 0 0 12.3500 Q  
## 324 1 2 female 22.00 1 1 29.0000 S  
## 326 1 1 female 36.00 0 0 135.6333 C  
## 327 0 3 male 61.00 0 0 6.2375 S  
## 328 1 2 female 36.00 0 0 13.0000 S  
## 329 1 3 female 31.00 1 1 20.5250 S  
## 330 1 1 female 16.00 0 1 57.9792 C  
## 332 0 1 male 45.50 0 0 28.5000 S  
## 333 0 1 male 38.00 0 1 153.4625 S  
## 334 0 3 male 16.00 2 0 18.0000 S  
## 337 0 1 male 29.00 1 0 66.6000 S  
## 338 1 1 female 41.00 0 0 134.5000 C  
## 339 1 3 male 45.00 0 0 8.0500 S  
## 340 0 1 male 45.00 0 0 35.5000 S  
## 341 1 2 male 2.00 1 1 26.0000 S  
## 342 1 1 female 24.00 3 2 263.0000 S  
## 343 0 2 male 28.00 0 0 13.0000 S  
## 344 0 2 male 25.00 0 0 13.0000 S  
## 345 0 2 male 36.00 0 0 13.0000 S  
## 346 1 2 female 24.00 0 0 13.0000 S  
## 347 1 2 female 40.00 0 0 13.0000 S  
## 349 1 3 male 3.00 1 1 15.9000 S  
## 350 0 3 male 42.00 0 0 8.6625 S  
## 351 0 3 male 23.00 0 0 9.2250 S  
## 353 0 3 male 15.00 1 1 7.2292 C  
## 354 0 3 male 25.00 1 0 17.8000 S  
## 356 0 3 male 28.00 0 0 9.5000 S  
## 357 1 1 female 22.00 0 1 55.0000 S  
## 358 0 2 female 38.00 0 0 13.0000 S  
## 361 0 3 male 40.00 1 4 27.9000 S  
## 362 0 2 male 29.00 1 0 27.7208 C  
## 363 0 3 female 45.00 0 1 14.4542 C  
## 364 0 3 male 35.00 0 0 7.0500 S  
## 366 0 3 male 30.00 0 0 7.2500 S  
## 367 1 1 female 60.00 1 0 75.2500 C  
## 370 1 1 female 24.00 0 0 69.3000 C  
## 371 1 1 male 25.00 1 0 55.4417 C  
## 372 0 3 male 18.00 1 0 6.4958 S  
## 373 0 3 male 19.00 0 0 8.0500 S  
## 374 0 1 male 22.00 0 0 135.6333 C  
## 375 0 3 female 3.00 3 1 21.0750 S  
## 377 1 3 female 22.00 0 0 7.2500 S  
## 378 0 1 male 27.00 0 2 211.5000 C  
## 379 0 3 male 20.00 0 0 4.0125 C  
## 380 0 3 male 19.00 0 0 7.7750 S  
## 381 1 1 female 42.00 0 0 227.5250 C  
## 382 1 3 female 1.00 0 2 15.7417 C  
## 383 0 3 male 32.00 0 0 7.9250 S  
## 384 1 1 female 35.00 1 0 52.0000 S  
## 386 0 2 male 18.00 0 0 73.5000 S  
## 387 0 3 male 1.00 5 2 46.9000 S  
## 388 1 2 female 36.00 0 0 13.0000 S  
## 390 1 2 female 17.00 0 0 12.0000 C  
## 391 1 1 male 36.00 1 2 120.0000 S  
## 392 1 3 male 21.00 0 0 7.7958 S  
## 393 0 3 male 28.00 2 0 7.9250 S  
## 394 1 1 female 23.00 1 0 113.2750 C  
## 395 1 3 female 24.00 0 2 16.7000 S  
## 396 0 3 male 22.00 0 0 7.7958 S  
## 397 0 3 female 31.00 0 0 7.8542 S  
## 398 0 2 male 46.00 0 0 26.0000 S  
## 399 0 2 male 23.00 0 0 10.5000 S  
## 400 1 2 female 28.00 0 0 12.6500 S  
## 401 1 3 male 39.00 0 0 7.9250 S  
## 402 0 3 male 26.00 0 0 8.0500 S  
## 403 0 3 female 21.00 1 0 9.8250 S  
## 404 0 3 male 28.00 1 0 15.8500 S  
## 405 0 3 female 20.00 0 0 8.6625 S  
## 406 0 2 male 34.00 1 0 21.0000 S  
## 407 0 3 male 51.00 0 0 7.7500 S  
## 408 1 2 male 3.00 1 1 18.7500 S  
## 409 0 3 male 21.00 0 0 7.7750 S  
## 413 1 1 female 33.00 1 0 90.0000 Q  
## 415 1 3 male 44.00 0 0 7.9250 S  
## 417 1 2 female 34.00 1 1 32.5000 S  
## 418 1 2 female 18.00 0 2 13.0000 S  
## 419 0 2 male 30.00 0 0 13.0000 S  
## 420 0 3 female 10.00 0 2 24.1500 S  
## 422 0 3 male 21.00 0 0 7.7333 Q  
## 423 0 3 male 29.00 0 0 7.8750 S  
## 424 0 3 female 28.00 1 1 14.4000 S  
## 425 0 3 male 18.00 1 1 20.2125 S  
## 427 1 2 female 28.00 1 0 26.0000 S  
## 428 1 2 female 19.00 0 0 26.0000 S  
## 430 1 3 male 32.00 0 0 8.0500 S  
## 431 1 1 male 28.00 0 0 26.5500 S  
## 433 1 2 female 42.00 1 0 26.0000 S  
## 434 0 3 male 17.00 0 0 7.1250 S  
## 435 0 1 male 50.00 1 0 55.9000 S  
## 436 1 1 female 14.00 1 2 120.0000 S  
## 437 0 3 female 21.00 2 2 34.3750 S  
## 438 1 2 female 24.00 2 3 18.7500 S  
## 439 0 1 male 64.00 1 4 263.0000 S  
## 440 0 2 male 31.00 0 0 10.5000 S  
## 441 1 2 female 45.00 1 1 26.2500 S  
## 442 0 3 male 20.00 0 0 9.5000 S  
## 443 0 3 male 25.00 1 0 7.7750 S  
## 444 1 2 female 28.00 0 0 13.0000 S  
## 446 1 1 male 4.00 0 2 81.8583 S  
## 447 1 2 female 13.00 0 1 19.5000 S  
## 448 1 1 male 34.00 0 0 26.5500 S  
## 449 1 3 female 5.00 2 1 19.2583 C  
## 450 1 1 male 52.00 0 0 30.5000 S  
## 451 0 2 male 36.00 1 2 27.7500 S  
## 453 0 1 male 30.00 0 0 27.7500 C  
## 454 1 1 male 49.00 1 0 89.1042 C  
## 456 1 3 male 29.00 0 0 7.8958 C  
## 457 0 1 male 65.00 0 0 26.5500 S  
## 459 1 2 female 50.00 0 0 10.5000 S  
## 461 1 1 male 48.00 0 0 26.5500 S  
## 462 0 3 male 34.00 0 0 8.0500 S  
## 463 0 1 male 47.00 0 0 38.5000 S  
## 464 0 2 male 48.00 0 0 13.0000 S  
## 466 0 3 male 38.00 0 0 7.0500 S  
## 468 0 1 male 56.00 0 0 26.5500 S  
## 470 1 3 female 0.75 2 1 19.2583 C  
## 472 0 3 male 38.00 0 0 8.6625 S  
## 473 1 2 female 33.00 1 2 27.7500 S  
## 474 1 2 female 23.00 0 0 13.7917 C  
## 475 0 3 female 22.00 0 0 9.8375 S  
## 477 0 2 male 34.00 1 0 21.0000 S  
## 478 0 3 male 29.00 1 0 7.0458 S  
## 479 0 3 male 22.00 0 0 7.5208 S  
## 480 1 3 female 2.00 0 1 12.2875 S  
## 481 0 3 male 9.00 5 2 46.9000 S  
## 483 0 3 male 50.00 0 0 8.0500 S  
## 484 1 3 female 63.00 0 0 9.5875 S  
## 485 1 1 male 25.00 1 0 91.0792 C  
## 487 1 1 female 35.00 1 0 90.0000 S  
## 488 0 1 male 58.00 0 0 29.7000 C  
## 489 0 3 male 30.00 0 0 8.0500 S  
## 490 1 3 male 9.00 1 1 15.9000 S  
## 492 0 3 male 21.00 0 0 7.2500 S  
## 493 0 1 male 55.00 0 0 30.5000 S  
## 494 0 1 male 71.00 0 0 49.5042 C  
## 495 0 3 male 21.00 0 0 8.0500 S  
## 497 1 1 female 54.00 1 0 78.2667 C  
## 499 0 1 female 25.00 1 2 151.5500 S  
## 500 0 3 male 24.00 0 0 7.7958 S  
## 501 0 3 male 17.00 0 0 8.6625 S  
## 502 0 3 female 21.00 0 0 7.7500 Q  
## 504 0 3 female 37.00 0 0 9.5875 S  
## 505 1 1 female 16.00 0 0 86.5000 S  
## 506 0 1 male 18.00 1 0 108.9000 C  
## 507 1 2 female 33.00 0 2 26.0000 S  
## 509 0 3 male 28.00 0 0 22.5250 S  
## 510 1 3 male 26.00 0 0 56.4958 S  
## 511 1 3 male 29.00 0 0 7.7500 Q  
## 513 1 1 male 36.00 0 0 26.2875 S  
## 514 1 1 female 54.00 1 0 59.4000 C  
## 515 0 3 male 24.00 0 0 7.4958 S  
## 516 0 1 male 47.00 0 0 34.0208 S  
## 517 1 2 female 34.00 0 0 10.5000 S  
## 519 1 2 female 36.00 1 0 26.0000 S  
## 520 0 3 male 32.00 0 0 7.8958 S  
## 521 1 1 female 30.00 0 0 93.5000 S  
## 522 0 3 male 22.00 0 0 7.8958 S  
## 524 1 1 female 44.00 0 1 57.9792 C  
## 526 0 3 male 40.50 0 0 7.7500 Q  
## 527 1 2 female 50.00 0 0 10.5000 S  
## 529 0 3 male 39.00 0 0 7.9250 S  
## 530 0 2 male 23.00 2 1 11.5000 S  
## 531 1 2 female 2.00 1 1 26.0000 S  
## 533 0 3 male 17.00 1 1 7.2292 C  
## 535 0 3 female 30.00 0 0 8.6625 S  
## 536 1 2 female 7.00 0 2 26.2500 S  
## 537 0 1 male 45.00 0 0 26.5500 S  
## 538 1 1 female 30.00 0 0 106.4250 C  
## 540 1 1 female 22.00 0 2 49.5000 C  
## 541 1 1 female 36.00 0 2 71.0000 S  
## 542 0 3 female 9.00 4 2 31.2750 S  
## 543 0 3 female 11.00 4 2 31.2750 S  
## 544 1 2 male 32.00 1 0 26.0000 S  
## 545 0 1 male 50.00 1 0 106.4250 C  
## 546 0 1 male 64.00 0 0 26.0000 S  
## 547 1 2 female 19.00 1 0 26.0000 S  
## 549 0 3 male 33.00 1 1 20.5250 S  
## 550 1 2 male 8.00 1 1 36.7500 S  
## 551 1 1 male 17.00 0 2 110.8833 C  
## 552 0 2 male 27.00 0 0 26.0000 S  
## 554 1 3 male 22.00 0 0 7.2250 C  
## 555 1 3 female 22.00 0 0 7.7750 S  
## 556 0 1 male 62.00 0 0 26.5500 S  
## 557 1 1 female 48.00 1 0 39.6000 C  
## 559 1 1 female 39.00 1 1 79.6500 S  
## 560 1 3 female 36.00 1 0 17.4000 S  
## 562 0 3 male 40.00 0 0 7.8958 S  
## 563 0 2 male 28.00 0 0 13.5000 S  
## 566 0 3 male 24.00 2 0 24.1500 S  
## 567 0 3 male 19.00 0 0 7.8958 S  
## 568 0 3 female 29.00 0 4 21.0750 S  
## 570 1 3 male 32.00 0 0 7.8542 S  
## 571 1 2 male 62.00 0 0 10.5000 S  
## 572 1 1 female 53.00 2 0 51.4792 S  
## 573 1 1 male 36.00 0 0 26.3875 S  
## 575 0 3 male 16.00 0 0 8.0500 S  
## 576 0 3 male 19.00 0 0 14.5000 S  
## 577 1 2 female 34.00 0 0 13.0000 S  
## 578 1 1 female 39.00 1 0 55.9000 S  
## 580 1 3 male 32.00 0 0 7.9250 S  
## 581 1 2 female 25.00 1 1 30.0000 S  
## 582 1 1 female 39.00 1 1 110.8833 C  
## 583 0 2 male 54.00 0 0 26.0000 S  
## 584 0 1 male 36.00 0 0 40.1250 C  
## 586 1 1 female 18.00 0 2 79.6500 S  
## 587 0 2 male 47.00 0 0 15.0000 S  
## 588 1 1 male 60.00 1 1 79.2000 C  
## 589 0 3 male 22.00 0 0 8.0500 S  
## 591 0 3 male 35.00 0 0 7.1250 S  
## 592 1 1 female 52.00 1 0 78.2667 C  
## 593 0 3 male 47.00 0 0 7.2500 S  
## 595 0 2 male 37.00 1 0 26.0000 S  
## 596 0 3 male 36.00 1 1 24.1500 S  
## 598 0 3 male 49.00 0 0 0.0000 S  
## 600 1 1 male 49.00 1 0 56.9292 C  
## 601 1 2 female 24.00 2 1 27.0000 S  
## 604 0 3 male 44.00 0 0 8.0500 S  
## 605 1 1 male 35.00 0 0 26.5500 C  
## 606 0 3 male 36.00 1 0 15.5500 S  
## 607 0 3 male 30.00 0 0 7.8958 S  
## 608 1 1 male 27.00 0 0 30.5000 S  
## 609 1 2 female 22.00 1 2 41.5792 C  
## 610 1 1 female 40.00 0 0 153.4625 S  
## 611 0 3 female 39.00 1 5 31.2750 S  
## 615 0 3 male 35.00 0 0 8.0500 S  
## 616 1 2 female 24.00 1 2 65.0000 S  
## 617 0 3 male 34.00 1 1 14.4000 S  
## 618 0 3 female 26.00 1 0 16.1000 S  
## 619 1 2 female 4.00 2 1 39.0000 S  
## 620 0 2 male 26.00 0 0 10.5000 S  
## 621 0 3 male 27.00 1 0 14.4542 C  
## 622 1 1 male 42.00 1 0 52.5542 S  
## 623 1 3 male 20.00 1 1 15.7417 C  
## 624 0 3 male 21.00 0 0 7.8542 S  
## 625 0 3 male 21.00 0 0 16.1000 S  
## 626 0 1 male 61.00 0 0 32.3208 S  
## 627 0 2 male 57.00 0 0 12.3500 Q  
## 628 1 1 female 21.00 0 0 77.9583 S  
## 629 0 3 male 26.00 0 0 7.8958 S  
## 631 1 1 male 80.00 0 0 30.0000 S  
## 632 0 3 male 51.00 0 0 7.0542 S  
## 633 1 1 male 32.00 0 0 30.5000 C  
## 635 0 3 female 9.00 3 2 27.9000 S  
## 636 1 2 female 28.00 0 0 13.0000 S  
## 637 0 3 male 32.00 0 0 7.9250 S  
## 638 0 2 male 31.00 1 1 26.2500 S  
## 639 0 3 female 41.00 0 5 39.6875 S  
## 641 0 3 male 20.00 0 0 7.8542 S  
## 642 1 1 female 24.00 0 0 69.3000 C  
## 643 0 3 female 2.00 3 2 27.9000 S  
## 645 1 3 female 0.75 2 1 19.2583 C  
## 646 1 1 male 48.00 1 0 76.7292 C  
## 647 0 3 male 19.00 0 0 7.8958 S  
## 648 1 1 male 56.00 0 0 35.5000 C  
## 650 1 3 female 23.00 0 0 7.5500 S  
## 652 1 2 female 18.00 0 1 23.0000 S  
## 653 0 3 male 21.00 0 0 8.4333 S  
## 655 0 3 female 18.00 0 0 6.7500 Q  
## 656 0 2 male 24.00 2 0 73.5000 S  
## 658 0 3 female 32.00 1 1 15.5000 Q  
## 659 0 2 male 23.00 0 0 13.0000 S  
## 660 0 1 male 58.00 0 2 113.2750 C  
## 661 1 1 male 50.00 2 0 133.6500 S  
## 662 0 3 male 40.00 0 0 7.2250 C  
## 663 0 1 male 47.00 0 0 25.5875 S  
## 664 0 3 male 36.00 0 0 7.4958 S  
## 665 1 3 male 20.00 1 0 7.9250 S  
## 666 0 2 male 32.00 2 0 73.5000 S  
## 667 0 2 male 25.00 0 0 13.0000 S  
## 669 0 3 male 43.00 0 0 8.0500 S  
## 671 1 2 female 40.00 1 1 39.0000 S  
## 672 0 1 male 31.00 1 0 52.0000 S  
## 673 0 2 male 70.00 0 0 10.5000 S  
## 674 1 2 male 31.00 0 0 13.0000 S  
## 676 0 3 male 18.00 0 0 7.7750 S  
## 677 0 3 male 24.50 0 0 8.0500 S  
## 678 1 3 female 18.00 0 0 9.8417 S  
## 679 0 3 female 43.00 1 6 46.9000 S  
## 680 1 1 male 36.00 0 1 512.3292 C  
## 682 1 1 male 27.00 0 0 76.7292 C  
## 683 0 3 male 20.00 0 0 9.2250 S  
## 684 0 3 male 14.00 5 2 46.9000 S  
## 685 0 2 male 60.00 1 1 39.0000 S  
## 686 0 2 male 25.00 1 2 41.5792 C  
## 687 0 3 male 14.00 4 1 39.6875 S  
## 688 0 3 male 19.00 0 0 10.1708 S  
## 689 0 3 male 18.00 0 0 7.7958 S  
## 690 1 1 female 15.00 0 1 211.3375 S  
## 691 1 1 male 31.00 1 0 57.0000 S  
## 692 1 3 female 4.00 0 1 13.4167 C  
## 694 0 3 male 25.00 0 0 7.2250 C  
## 695 0 1 male 60.00 0 0 26.5500 S  
## 696 0 2 male 52.00 0 0 13.5000 S  
## 697 0 3 male 44.00 0 0 8.0500 S  
## 699 0 1 male 49.00 1 1 110.8833 C  
## 700 0 3 male 42.00 0 0 7.6500 S  
## 701 1 1 female 18.00 1 0 227.5250 C  
## 702 1 1 male 35.00 0 0 26.2875 S  
## 703 0 3 female 18.00 0 1 14.4542 C  
## 704 0 3 male 25.00 0 0 7.7417 Q  
## 705 0 3 male 26.00 1 0 7.8542 S  
## 706 0 2 male 39.00 0 0 26.0000 S  
## 707 1 2 female 45.00 0 0 13.5000 S  
## 708 1 1 male 42.00 0 0 26.2875 S  
## 709 1 1 female 22.00 0 0 151.5500 S  
## 711 1 1 female 24.00 0 0 49.5042 C  
## 713 1 1 male 48.00 1 0 52.0000 S  
## 714 0 3 male 29.00 0 0 9.4833 S  
## 715 0 2 male 52.00 0 0 13.0000 S  
## 716 0 3 male 19.00 0 0 7.6500 S  
## 717 1 1 female 38.00 0 0 227.5250 C  
## 718 1 2 female 27.00 0 0 10.5000 S  
## 720 0 3 male 33.00 0 0 7.7750 S  
## 721 1 2 female 6.00 0 1 33.0000 S  
## 722 0 3 male 17.00 1 0 7.0542 S  
## 723 0 2 male 34.00 0 0 13.0000 S  
## 724 0 2 male 50.00 0 0 13.0000 S  
## 725 1 1 male 27.00 1 0 53.1000 S  
## 726 0 3 male 20.00 0 0 8.6625 S  
## 727 1 2 female 30.00 3 0 21.0000 S  
## 729 0 2 male 25.00 1 0 26.0000 S  
## 730 0 3 female 25.00 1 0 7.9250 S  
## 731 1 1 female 29.00 0 0 211.3375 S  
## 732 0 3 male 11.00 0 0 18.7875 C  
## 734 0 2 male 23.00 0 0 13.0000 S  
## 735 0 2 male 23.00 0 0 13.0000 S  
## 736 0 3 male 28.50 0 0 16.1000 S  
## 737 0 3 female 48.00 1 3 34.3750 S  
## 738 1 1 male 35.00 0 0 512.3292 C  
## 742 0 1 male 36.00 1 0 78.8500 S  
## 743 1 1 female 21.00 2 2 262.3750 C  
## 744 0 3 male 24.00 1 0 16.1000 S  
## 745 1 3 male 31.00 0 0 7.9250 S  
## 746 0 1 male 70.00 1 1 71.0000 S  
## 747 0 3 male 16.00 1 1 20.2500 S  
## 748 1 2 female 30.00 0 0 13.0000 S  
## 749 0 1 male 19.00 1 0 53.1000 S  
## 750 0 3 male 31.00 0 0 7.7500 Q  
## 751 1 2 female 4.00 1 1 23.0000 S  
## 752 1 3 male 6.00 0 1 12.4750 S  
## 753 0 3 male 33.00 0 0 9.5000 S  
## 754 0 3 male 23.00 0 0 7.8958 S  
## 755 1 2 female 48.00 1 2 65.0000 S  
## 756 1 2 male 0.67 1 1 14.5000 S  
## 757 0 3 male 28.00 0 0 7.7958 S  
## 758 0 2 male 18.00 0 0 11.5000 S  
## 759 0 3 male 34.00 0 0 8.0500 S  
## 760 1 1 female 33.00 0 0 86.5000 S  
## 762 0 3 male 41.00 0 0 7.1250 S  
## 763 1 3 male 20.00 0 0 7.2292 C  
## 764 1 1 female 36.00 1 2 120.0000 S  
## 765 0 3 male 16.00 0 0 7.7750 S  
## 766 1 1 female 51.00 1 0 77.9583 S  
## 768 0 3 female 30.50 0 0 7.7500 Q  
## 770 0 3 male 32.00 0 0 8.3625 S  
## 771 0 3 male 24.00 0 0 9.5000 S  
## 772 0 3 male 48.00 0 0 7.8542 S  
## 773 0 2 female 57.00 0 0 10.5000 S  
## 775 1 2 female 54.00 1 3 23.0000 S  
## 776 0 3 male 18.00 0 0 7.7500 S  
## 778 1 3 female 5.00 0 0 12.4750 S  
## 780 1 1 female 43.00 0 1 211.3375 S  
## 781 1 3 female 13.00 0 0 7.2292 C  
## 782 1 1 female 17.00 1 0 57.0000 S  
## 783 0 1 male 29.00 0 0 30.0000 S  
## 785 0 3 male 25.00 0 0 7.0500 S  
## 786 0 3 male 25.00 0 0 7.2500 S  
## 787 1 3 female 18.00 0 0 7.4958 S  
## 788 0 3 male 8.00 4 1 29.1250 Q  
## 789 1 3 male 1.00 1 2 20.5750 S  
## 790 0 1 male 46.00 0 0 79.2000 C  
## 792 0 2 male 16.00 0 0 26.0000 S  
## 795 0 3 male 25.00 0 0 7.8958 S  
## 796 0 2 male 39.00 0 0 13.0000 S  
## 797 1 1 female 49.00 0 0 25.9292 S  
## 798 1 3 female 31.00 0 0 8.6833 S  
## 799 0 3 male 30.00 0 0 7.2292 C  
## 800 0 3 female 30.00 1 1 24.1500 S  
## 801 0 2 male 34.00 0 0 13.0000 S  
## 802 1 2 female 31.00 1 1 26.2500 S  
## 803 1 1 male 11.00 1 2 120.0000 S  
## 804 1 3 male 0.42 0 1 8.5167 C  
## 805 1 3 male 27.00 0 0 6.9750 S  
## 806 0 3 male 31.00 0 0 7.7750 S  
## 807 0 1 male 39.00 0 0 0.0000 S  
## 808 0 3 female 18.00 0 0 7.7750 S  
## 809 0 2 male 39.00 0 0 13.0000 S  
## 810 1 1 female 33.00 1 0 53.1000 S  
## 811 0 3 male 26.00 0 0 7.8875 S  
## 812 0 3 male 39.00 0 0 24.1500 S  
## 813 0 2 male 35.00 0 0 10.5000 S  
## 814 0 3 female 6.00 4 2 31.2750 S  
## 815 0 3 male 30.50 0 0 8.0500 S  
## 817 0 3 female 23.00 0 0 7.9250 S  
## 818 0 2 male 31.00 1 1 37.0042 C  
## 819 0 3 male 43.00 0 0 6.4500 S  
## 820 0 3 male 10.00 3 2 27.9000 S  
## 821 1 1 female 52.00 1 1 93.5000 S  
## 822 1 3 male 27.00 0 0 8.6625 S  
## 823 0 1 male 38.00 0 0 0.0000 S  
## 824 1 3 female 27.00 0 1 12.4750 S  
## 825 0 3 male 2.00 4 1 39.6875 S  
## 828 1 2 male 1.00 0 2 37.0042 C  
## 830 1 1 female 62.00 0 0 80.0000 Q  
## 831 1 3 female 15.00 1 0 14.4542 C  
## 832 1 2 male 0.83 1 1 18.7500 S  
## 834 0 3 male 23.00 0 0 7.8542 S  
## 835 0 3 male 18.00 0 0 8.3000 S  
## 836 1 1 female 39.00 1 1 83.1583 C  
## 837 0 3 male 21.00 0 0 8.6625 S  
## 839 1 3 male 32.00 0 0 56.4958 S  
## 841 0 3 male 20.00 0 0 7.9250 S  
## 842 0 2 male 16.00 0 0 10.5000 S  
## 843 1 1 female 30.00 0 0 31.0000 C  
## 844 0 3 male 34.50 0 0 6.4375 C  
## 845 0 3 male 17.00 0 0 8.6625 S  
## 846 0 3 male 42.00 0 0 7.5500 S  
## 848 0 3 male 35.00 0 0 7.8958 C  
## 849 0 2 male 28.00 0 1 33.0000 S  
## 851 0 3 male 4.00 4 2 31.2750 S  
## 852 0 3 male 74.00 0 0 7.7750 S  
## 853 0 3 female 9.00 1 1 15.2458 C  
## 854 1 1 female 16.00 0 1 39.4000 S  
## 855 0 2 female 44.00 1 0 26.0000 S  
## 856 1 3 female 18.00 0 1 9.3500 S  
## 857 1 1 female 45.00 1 1 164.8667 S  
## 858 1 1 male 51.00 0 0 26.5500 S  
## 859 1 3 female 24.00 0 3 19.2583 C  
## 861 0 3 male 41.00 2 0 14.1083 S  
## 862 0 2 male 21.00 1 0 11.5000 S  
## 863 1 1 female 48.00 0 0 25.9292 S  
## 865 0 2 male 24.00 0 0 13.0000 S  
## 866 1 2 female 42.00 0 0 13.0000 S  
## 867 1 2 female 27.00 1 0 13.8583 C  
## 868 0 1 male 31.00 0 0 50.4958 S  
## 870 1 3 male 4.00 1 1 11.1333 S  
## 871 0 3 male 26.00 0 0 7.8958 S  
## 872 1 1 female 47.00 1 1 52.5542 S  
## 873 0 1 male 33.00 0 0 5.0000 S  
## 874 0 3 male 47.00 0 0 9.0000 S  
## 875 1 2 female 28.00 1 0 24.0000 C  
## 876 1 3 female 15.00 0 0 7.2250 C  
## 877 0 3 male 20.00 0 0 9.8458 S  
## 878 0 3 male 19.00 0 0 7.8958 S  
## 880 1 1 female 56.00 0 1 83.1583 C  
## 881 1 2 female 25.00 0 1 26.0000 S  
## 882 0 3 male 33.00 0 0 7.8958 S  
## 883 0 3 female 22.00 0 0 10.5167 S  
## 884 0 2 male 28.00 0 0 10.5000 S  
## 885 0 3 male 25.00 0 0 7.0500 S  
## 886 0 3 female 39.00 0 5 29.1250 Q  
## 887 0 2 male 27.00 0 0 13.0000 S  
## 888 1 1 female 19.00 0 0 30.0000 S  
## 890 1 1 male 26.00 0 0 30.0000 C  
## 891 0 3 male 32.00 0 0 7.7500 Q

nrow(data2)

## [1] 714

Among 891 passengers, 714 passengers are left after deleting missing values in the variable age.

## Question 2-2

str(data2)

## 'data.frame': 714 obs. of 8 variables:  
## $ Survived: int 0 1 1 1 0 0 0 1 1 1 ...  
## $ Pclass : int 3 1 3 1 3 1 3 3 2 3 ...  
## $ Sex : chr "male" "female" "female" "female" ...  
## $ Age : num 22 38 26 35 35 54 2 27 14 4 ...  
## $ SibSp : int 1 1 0 1 0 0 3 0 1 1 ...  
## $ Parch : int 0 0 0 0 0 0 1 2 0 1 ...  
## $ Fare : num 7.25 71.28 7.92 53.1 8.05 ...  
## $ Embarked: chr "S" "C" "S" "S" ...  
## - attr(\*, "na.action")= 'omit' Named int [1:177] 6 18 20 27 29 30 32 33 37 43 ...  
## ..- attr(\*, "names")= chr [1:177] "6" "18" "20" "27" ...

data2$Pclass <- as.factor(data2$Pclass)  
data2$Survived <- as.factor(data2$Survived)  
str(data2)

## 'data.frame': 714 obs. of 8 variables:  
## $ Survived: Factor w/ 2 levels "0","1": 1 2 2 2 1 1 1 2 2 2 ...  
## $ Pclass : Factor w/ 3 levels "1","2","3": 3 1 3 1 3 1 3 3 2 3 ...  
## $ Sex : chr "male" "female" "female" "female" ...  
## $ Age : num 22 38 26 35 35 54 2 27 14 4 ...  
## $ SibSp : int 1 1 0 1 0 0 3 0 1 1 ...  
## $ Parch : int 0 0 0 0 0 0 1 2 0 1 ...  
## $ Fare : num 7.25 71.28 7.92 53.1 8.05 ...  
## $ Embarked: chr "S" "C" "S" "S" ...  
## - attr(\*, "na.action")= 'omit' Named int [1:177] 6 18 20 27 29 30 32 33 37 43 ...  
## ..- attr(\*, "names")= chr [1:177] "6" "18" "20" "27" ...

## Question 2-3

set.seed(123)  
training.samples <- data2$Survived %>%  
 createDataPartition(p = 0.80, list = FALSE)  
train.data <- data2[training.samples, ]  
test.data <- data2[-training.samples, ]

## Question 2-4

model <- glm(Survived~.,train.data, family=binomial)  
summary(model)

##   
## Call:  
## glm(formula = Survived ~ ., family = binomial, data = train.data)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.5369 -0.6665 -0.4107 0.6445 2.4178   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 4.128749 0.604277 6.833 8.34e-12 \*\*\*  
## Pclass2 -1.012074 0.370945 -2.728 0.006365 \*\*   
## Pclass3 -2.076496 0.384989 -5.394 6.90e-08 \*\*\*  
## Sexmale -2.556944 0.242699 -10.535 < 2e-16 \*\*\*  
## Age -0.031944 0.009200 -3.472 0.000516 \*\*\*  
## SibSp -0.350734 0.144212 -2.432 0.015012 \*   
## Parch -0.115459 0.139457 -0.828 0.407717   
## Fare 0.002723 0.003202 0.851 0.395005   
## EmbarkedQ -1.080480 0.641079 -1.685 0.091910 .   
## EmbarkedS -0.718802 0.320819 -2.241 0.025057 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 772.45 on 571 degrees of freedom  
## Residual deviance: 518.19 on 562 degrees of freedom  
## AIC: 538.19  
##   
## Number of Fisher Scoring iterations: 5

## Question 2-5

probabilities <- model %>% predict(test.data, type = "response")  
predicted.survival <- ifelse(probabilities>0.5, "1", "0")

## Confusion Matrix

table(predicted.survival, test.data$Survived)

##   
## predicted.survival 0 1  
## 0 71 15  
## 1 13 43

## Accuracy

(71+43)/(15+13+71+43)

## [1] 0.8028169

Overall Accuracy is 0.8028169.

## Sensitivity

43/(15+43)

## [1] 0.7413793

Sensitivity is 0.7413793.

## Specificity

71/(13+71)

## [1] 0.8452381

Specificity is 0.8452381.

## Question 2-6

predict(model, newdata = data.frame(Pclass="3", Sex="male",Age=23,SibSp=0,Parch=0,Fare=8.25,Embarked="Q"), type = "response")

## 1   
## 0.09133634

Probability of survival is 0.0913. As response variable is predicted to be less than 0.5, he is not likely to survive.