Alexis Casas: Titanic: Machine Learning from Disaster Competition

The competition is simple: use machine learning to create a model that predicts which passengers survived the Titanic shipwreck.

In this challenge, we ask you to build a predictive model that answers the question: “what sorts of people were more likely to survive?” using passenger data (ie name, age, gender, socio-economic class, etc).

In [177]:
```
#1. read the data
training_set <- read.csv('train.csv')
test_set <- read.csv('test.csv')
```

In [178]:
```
#View data
head(training_set)
```

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

In [179]:
```
test_set[test_set==""]  <- NA
training_set[training_set==""]  <- NA
```

In [180]:
```
#Checking Columns for Missing values: Training Set
library(questionr)
missingvaluestable <- freq.na(training_set)
missingvaluestable
```

	missing	%

Cabin	687	77
Age	177	20
Embarked	2	0
PassengerId	0	0
Survived	0	0
Pclass	0	0
Name	0	0
Sex	0	0
SibSp	0	0
Parch	0	0
Ticket	0	0
Fare	0	0

In [181]:
```
#Checking Columns for Missing values: Test Set
missingvaluestable <- freq.na(test_set)
missingvaluestable
```

	missing	**%**
Cabin	327	78
Age	86	21
Fare	1	0
PassengerId	0	0
Pclass	0	0
Name	0	0
Sex	0	0
SibSp	0	0
Parch	0	0
Ticket	0	0
Embarked	0	0

Cabin has about 78% of the data missing. I will delete this column for both sets. Both datasets are missing about 20% of their data in Age. Because Age seems important in predicting who would survive, I would rather not delete this. Will investigate more about this colum before making any decisions

In [182]:
```
head(training_set)#cabin is column 11
head(test_set) #cabin is column 10
```

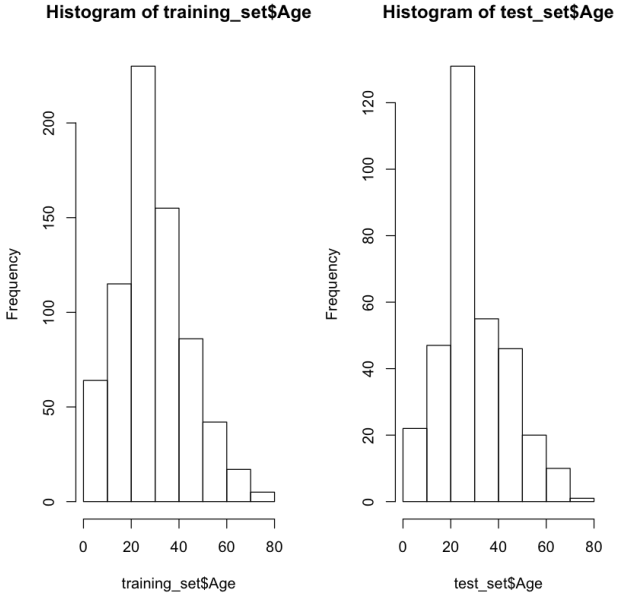
	PassengerId	**Survived**	**Pclass**	**Name**	**Sex**	**Age**	**SibSp**	**Parch**	**Ticket**	**Fare**	**Cabin**	**Embarked**
	<int>	**<int>**	**<int>**	**<fct>**	**<fct>**	**<dbl>**	**<int>**	**<int>**	**<fct>**	**<dbl>**	**<fct>**	**<fct>**
1	1	0	3	Braund, Mr. Owen Harris	male	22	1	0	A/5 21171	7.2500	NA	S
2	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Thayer)	female	38	1	0	PC 17599	71.2833	C85	C
3	3	1	3	Heikkinen, Miss. Laina	female	26	0	0	STON/O2. 3101282	7.9250	NA	S
4	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35	1	0	113803	53.1000	C123	S

5	5	0	3	Allen, Mr. William Henry	male	35	0	0	373450	8.0500	NA	S
6	6	0	3	Moran, Mr. James	male	NA	0	0	330877	8.4583	NA	Q

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
	<int>	<int>	<fct>	<fct>	<dbl>	<int>	<int>	<fct>	<dbl>	<fct>	<fct>
1	892	3	Kelly, Mr. James	male	34.5	0	0	330911	7.8292	NA	Q
2	893	3	Wilkes, Mrs. James (Ellen Needs)	female	47.0	1	0	363272	7.0000	NA	S
3	894	2	Myles, Mr. Thomas Francis	male	62.0	0	0	240276	9.6875	NA	Q
4	895	3	Wirz, Mr. Albert	male	27.0	0	0	315154	8.6625	NA	S
5	896	3	Hirvonen, Mrs. Alexander (Helga E Lindqvist)	female	22.0	1	1	3101298	12.2875	NA	S
6	897	3	Svensson, Mr. Johan Cervin	male	14.0	0	0	7538	9.2250	NA	S

In [183]:
```
training_set <- training_set[,-11]
test_set <- test_set[,-10]
```

In [184]:
```
par(mfrow=c(1,2))
hist(training_set$Age)
hist(test_set$Age)
```



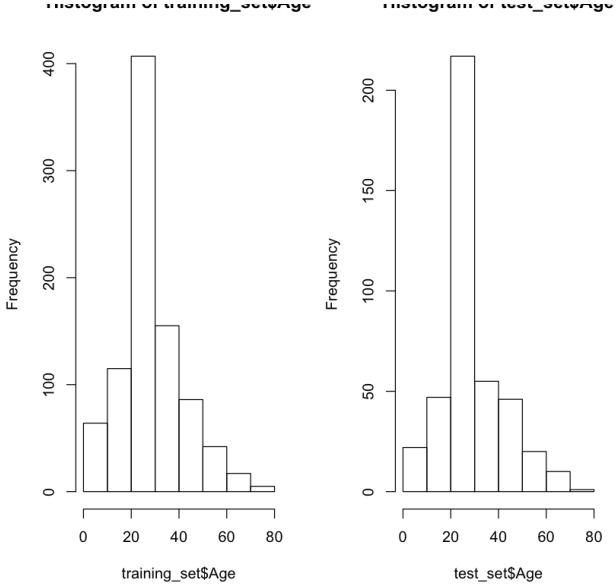
In [185]:
```
#what is the meadian and mean age?
median(training_set$Age,na.rm = T) #about 28 years old
mean(training_set$Age,na.rm = T)
#Because the data is skewed i will impute based on the median.
```

28

29.6991176470588

In [186]:
```
training_set$Age[is.na(training_set$Age)] <- median(training_set$Age,na.rm = T)
test_set$Age[is.na(test_set$Age)] <- median(test_set$Age,na.rm = T)
```

In [187]:
```
par(mfrow=c(1,2))
hist(training_set$Age)
hist(test_set$Age)
```



In [188]:
```
#checking if missing values are gone
missingvaluestable <- freq.na(training_set)
missingvaluestable #two values in embarked column
```

	missing	%
Embarked	2	0
PassengerId	0	0
Survived	0	0
Pclass	0	0
Name	0	0
Sex	0	0
Age	0	0
SibSp	0	0
Parch	0	0
Ticket	0	0
Fare	0	0

In [189]:
```
missingvaluestable <- freq.na(test_set)
missingvaluestable #one missing value for fare
```

	missing	%
Fare	1	0
PassengerId	0	0
Pclass	0	0
Name	0	0
Sex	0	0
Age	0	0
SibSp	0	0
Parch	0	0
Ticket	0	0
Embarked	0	0

In [190]:
```
training_set <- training_set[-which(is.na(training_set$Embarked)),]
test_set <- test_set[-which(is.na(test_set$Fare)),]
```

In [191]:
```
missingvaluestable <- freq.na(test_set)
missingvaluestable #All Clean!
```

	missing	%
PassengerId	0	0
Pclass	0	0
Name	0	0
Sex	0	0
Age	0	0
SibSp	0	0
Parch	0	0
Ticket	0	0
Fare	0	0
Embarked	0	0

Next, I believe that it may be nice to know someone's age group rather than their specific age for future predictions.

In [192]:
```
training_set$AgeGroup <- training_set$Age
training_set$AgeGroup[training_set$Age>=0 & training_set$Age<10] <- 1
training_set$AgeGroup[training_set$Age>=10 & training_set$Age<20] <- 2
training_set$AgeGroup[training_set$Age>=20 & training_set$Age<30] <- 3
training_set$AgeGroup[training_set$Age>=30 & training_set$Age<40] <- 4
training_set$AgeGroup[training_set$Age>=40 & training_set$Age<50] <- 5
training_set$AgeGroup[training_set$Age>=50 & training_set$Age<60] <- 6
training_set$AgeGroup[training_set$Age>=60 & training_set$Age<70] <- 7
training_set$AgeGroup[training_set$Age>=70 & training_set$Age<80] <- 8
```

In [193]:
```
test_set$AgeGroup <- test_set$Age
test_set$AgeGroup[test_set$Age>=0 & test_set$Age<10] <- 1
test_set$AgeGroup[test_set$Age>=10 & test_set$Age<20] <- 2
test_set$AgeGroup[test_set$Age>=20 & test_set$Age<30] <- 3
test_set$AgeGroup[test_set$Age>=30 & test_set$Age<40] <- 4
test_set$AgeGroup[test_set$Age>=40 & test_set$Age<50] <- 5
test_set$AgeGroup[test_set$Age>=50 & test_set$Age<60] <- 6
test_set$AgeGroup[test_set$Age>=60 & test_set$Age<70] <- 7
test_set$AgeGroup[test_set$Age>=70 & test_set$Age<80] <- 8
```

In [194]:
```
#Next I will examine the structure and encode variables.
str(training_set)
str(test_set)
```

```
'data.frame':   889 obs. of  12 variables:
 $ PassengerId: int  1 2 3 4 5 6 7 8 9 10 ...
 $ Survived   : int  0 1 1 1 0 0 0 0 1 1 ...
 $ Pclass     : int  3 1 3 1 3 3 1 3 3 2 ...
 $ Name       : Factor w/ 891 levels "Abbing, Mr. Anthony",..: 109 191 358 277 16 559 520 629 417
581 ...
 $ Sex        : Factor w/ 2 levels "female","male": 2 1 1 1 2 2 2 2 1 1 ...
 $ Age        : num  22 38 26 35 35 28 54 2 27 14 ...
 $ SibSp      : int  1 1 0 1 0 0 0 3 0 1 ...
 $ Parch      : int  0 0 0 0 0 0 0 1 2 0 ...
 $ Ticket     : Factor w/ 681 levels "110152","110413",..: 524 597 670 50 473 276 86 396 345 133 .
..
 $ Fare       : num  7.25 71.28 7.92 53.1 8.05 ...
 $ Embarked   : Factor w/ 4 levels "","C","Q","S": 4 2 4 4 4 3 4 4 4 2 ...
 $ AgeGroup   : num  3 4 3 4 4 3 6 1 3 2 ...
'data.frame':   417 obs. of  11 variables:
```

```
 $ PassengerId: int  892 893 894 895 896 897 898 899 900 901 ...
 $ Pclass     : int  3 3 2 3 3 3 3 2 3 3 ...
 $ Name       : Factor w/ 418 levels "Abbott, Master. Eugene Joseph",..: 210 409 273 414 182 370 8
5 58 5 104 ...
 $ Sex        : Factor w/ 2 levels "female","male": 2 1 2 2 1 2 1 2 1 2 ...
 $ Age        : num  34.5 47 62 27 22 14 30 26 18 21 ...
 $ SibSp      : int  0 1 0 0 1 0 0 1 0 2 ...
 $ Parch      : int  0 0 0 0 1 0 0 1 0 0 ...
 $ Ticket     : Factor w/ 363 levels "110469","110489",..: 153 222 74 148 139 262 159 85 101 270 .
..
 $ Fare       : num  7.83 7 9.69 8.66 12.29 ...
 $ Embarked   : Factor w/ 3 levels "C","Q","S": 2 3 2 3 3 3 2 3 1 3 ...
 $ AgeGroup   : num  4 5 7 3 3 2 4 3 2 3 ...
```

In [195]:
```
#First off we want to delete, name and ticket
training_set <- training_set[,-c(4,9)]
test_set <- test_set[,-c(3,8)]
```

In [196]:
```
str(training_set)
str(test_set)
```

```
'data.frame':   889 obs. of  10 variables:
 $ PassengerId: int  1 2 3 4 5 6 7 8 9 10 ...
 $ Survived   : int  0 1 1 1 0 0 0 0 1 1 ...
 $ Pclass     : int  3 1 3 1 3 3 1 3 3 2 ...
 $ Sex        : Factor w/ 2 levels "female","male": 2 1 1 1 2 2 2 2 1 1 ...
 $ Age        : num  22 38 26 35 35 28 54 2 27 14 ...
 $ SibSp      : int  1 1 0 1 0 0 0 3 0 1 ...
 $ Parch      : int  0 0 0 0 0 0 0 1 2 0 ...
 $ Fare       : num  7.25 71.28 7.92 53.1 8.05 ...
 $ Embarked   : Factor w/ 4 levels "","C","Q","S": 4 2 4 4 4 3 4 4 4 2 ...
 $ AgeGroup   : num  3 4 3 4 4 3 6 1 3 2 ...
'data.frame':   417 obs. of  9 variables:
 $ PassengerId: int  892 893 894 895 896 897 898 899 900 901 ...
 $ Pclass     : int  3 3 2 3 3 3 3 2 3 3 ...
 $ Sex        : Factor w/ 2 levels "female","male": 2 1 2 2 1 2 1 2 1 2 ...
 $ Age        : num  34.5 47 62 27 22 14 30 26 18 21 ...
 $ SibSp      : int  0 1 0 0 1 0 0 1 0 2 ...
 $ Parch      : int  0 0 0 0 1 0 0 1 0 0 ...
 $ Fare       : num  7.83 7 9.69 8.66 12.29 ...
 $ Embarked   : Factor w/ 3 levels "C","Q","S": 2 3 2 3 3 3 2 3 1 3 ...
 $ AgeGroup   : num  4 5 7 3 3 2 4 3 2 3 ...
```

In [197]:
```
#Next, encoding of categorical variables
training_set$Sex <- factor(training_set$Sex, levels=c('male','female'),1:2) #for Sex
training_set$Embarked <- factor(training_set$Embarked, levels=c('S','C','Q'),1:3) #for Embarked

test_set$Sex <- factor(test_set$Sex, levels=c('male','female'),1:2) #for Sex
test_set$Embarked <- factor(test_set$Embarked, levels=c('S','C','Q'),1:3) #for Embarked
```

In [198]:
```
str(training_set)
str(test_set)
head(test_set)
```

```
'data.frame':   889 obs. of  10 variables:
 $ PassengerId: int  1 2 3 4 5 6 7 8 9 10 ...
 $ Survived   : int  0 1 1 1 0 0 0 0 1 1 ...
 $ Pclass     : int  3 1 3 1 3 3 1 3 3 2 ...
 $ Sex        : Factor w/ 2 levels "1","2": 1 2 2 2 1 1 1 1 2 2 ...
 $ Age        : num  22 38 26 35 35 28 54 2 27 14 ...
 $ SibSp      : int  1 1 0 1 0 0 0 3 0 1 ...
 $ Parch      : int  0 0 0 0 0 0 0 1 2 0 ...
 $ Fare       : num  7.25 71.28 7.92 53.1 8.05 ...
 $ Embarked   : Factor w/ 3 levels "1","2","3": 1 2 1 1 1 3 1 1 1 2 ...
 $ AgeGroup   : num  3 4 3 4 4 3 6 1 3 2 ...
'data.frame':   417 obs. of  9 variables:
 $ PassengerId: int  892 893 894 895 896 897 898 899 900 901 ...
 $ Pclass     : int  3 3 2 3 3 3 3 2 3 3 ...
 $ Sex        : Factor w/ 2 levels "1","2": 1 2 1 1 2 1 2 1 2 1 ...
 $ Age        : num  34.5 47 62 27 22 14 30 26 18 21 ...
```

```
$ SibSp      : int  0 1 0 0 1 0 0 1 0 2 ...
$ Parch      : int  0 0 0 0 1 0 0 1 0 0 ...
$ Fare       : num  7.83 7 9.69 8.66 12.29 ...
$ Embarked   : Factor w/ 3 levels "1","2","3": 3 1 3 1 1 1 3 1 2 1 ...
$ AgeGroup   : num  4 5 7 3 3 2 4 3 2 3 ...
```

	PassengerId	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	AgeGroup
	<int>	<int>	<fct>	<dbl>	<int>	<int>	<dbl>	<fct>	<dbl>
1	892	3	1	34.5	0	0	7.8292	3	4
2	893	3	2	47.0	1	0	7.0000	1	5
3	894	2	1	62.0	0	0	9.6875	3	7
4	895	3	1	27.0	0	0	8.6625	1	3
5	896	3	2	22.0	1	1	12.2875	1	3
6	897	3	1	14.0	0	0	9.2250	1	2

In [199]:
```
#deleting age since we have age group
training_age <- training_set$Age
test_age <- test_set$Age
training_set <- training_set[,-5]
test_set <- test_set[,-4]
```

In [200]:
```
#The response variable is Survived since it is the dependent variable we are trying to predict in
our model
#Fitting Logistic onto the training set (glm- generalied linear models)
classifier <- glm(formula = Survived ~ .,
                  family = binomial,
                  data = training_set[,-1])
```

In [201]:
```
#Finding out the probability of prediction
prob_predictions = predict(classifier, type='response', test_set[,-1]) #test without passenger id
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #scorecard of the predictions
```

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In [202]:
```
summary(classifier)
```

```
Call:
glm(formula = Survived ~ ., family = binomial, data = training_set[,
    -1])

Deviance Residuals:
    Min       1Q   Median       3Q      Max
```

```
-2.3499  -0.6709  -0.4569   0.6726   2.5427

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  0.414036   0.378946   1.093   0.2746
Pclass      -0.854969   0.133033  -6.427  1.3e-10 ***
Sex2         2.722762   0.198198  13.738  < 2e-16 ***
SibSp       -0.237855   0.101562  -2.342   0.0192 *
Parch       -0.073129   0.114325  -0.640   0.5224
Fare         0.002393   0.002366   1.011   0.3120
Embarked2    0.458376   0.230079   1.992   0.0463 *
Embarked3    0.263279   0.322801   0.816   0.4147
AgeGroup    -0.018856   0.034097  -0.553   0.5803
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 1182.82  on 888  degrees of freedom
Residual deviance:  811.66  on 880  degrees of freedom
AIC: 829.66

Number of Fisher Scoring iterations: 5
```

It seems like ther eis a strong correlation between Pclass, Sex factor 2, Sibsp, and Embarked factor 2.

Now lets try and make some real predictions:

In [208]:
```
str(y_predict)
```

```
 Named num [1:417] 0 1 0 0 1 0 1 0 1 0 ...
 - attr(*, "names")= chr [1:417] "1" "2" "3" "4" ...
```

In [209]:
```
test_set$Survived <- y_predict
```

In [244]:
```
submission_file <- test_set[,c(1,9)]
submission_file
write.csv(submission_file,"gender_submission.csv", row.names = FALSE)
```

	PassengerId	Survived
	<int>	<dbl>
1	892	0
2	893	1
3	894	0
4	895	0
5	896	1
6	897	0
7	898	1
8	899	0
9	900	1
10	901	0
11	902	0
12	903	0
13	904	1
14	905	0
15	906	1
16	907	1

17	908	0
18	909	0
19	910	1
20	911	1
21	912	0
22	913	0
23	914	1
24	915	1
25	916	1
26	917	0
27	918	1
28	919	0
29	920	0
30	921	0
⋮	⋮	⋮
389	1280	0
390	1281	0
391	1282	0
392	1283	1
393	1284	0
394	1285	0
395	1286	0
396	1287	1
397	1288	0
398	1289	1
399	1290	0
400	1291	0
401	1292	1
402	1293	0
403	1294	1
404	1295	0
405	1296	0
406	1297	0
407	1298	0
408	1299	1
409	1300	1
410	1301	1
411	1302	1
412	1303	1
413	1304	1
414	1305	0
415	1306	1

416	1307	0
417	1308	0
418	1309	0

In [204]:
```
library(dplyr)
survived_training <- filter(training_set, Survived == 1)
```

In [205]:
```
#Lets take a look at a scorecard of individuals who did survive. What criteria was in place.
#Common Themes:
#Sex=2 (Female)
#Age Group <=4 (people under the age of 40)
#PClass:
#It looks like if they are in class 3 and dtraveling with no SibSp they can survive,
#if they are any other class and travelining with SibSp they also will
head(survived_training)
```

	PassengerId	Survived	Pclass	Sex	SibSp	Parch	Fare	Embarked	AgeGroup
	<int>	<int>	<int>	<fct>	<int>	<int>	<dbl>	<fct>	<dbl>
1	2	1	1	2	1	0	71.2833	2	4
2	3	1	3	2	0	0	7.9250	1	3
3	4	1	1	2	1	0	53.1000	1	4
4	9	1	3	2	0	2	11.1333	1	3
5	10	1	2	2	1	0	30.0708	2	2
6	11	1	3	2	1	1	16.7000	1	1

In [216]:
```
#Lets try and predict who will surve for females with an AgeGroup<5
test2 <- filter(test_set, AgeGroup <= 4)
test2 <- filter(test2, Sex==2)
```

In [218]:
```
#My guess is that the model will predict survived for females who are in an AgeGroup<=4.
prob_predictions = predict(classifier, type='response', test2[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #Looks like the model does predict this survived for most of these cases.
```

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In [233]:
```
#What about women of any age in first class?
test2 <- filter(test_set, Pclass==1)
test2 <- filter(test2, Sex==2)
prob_predictions = predict(classifier, type='response', test2[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #Women of any age survived
```

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In [219]:
```
#What about for men in that age group?
test3 <- filter(test_set, AgeGroup <= 4)
test3 <- filter(test3, Sex==1)
```

In [220]:
```
prob_predictions = predict(classifier, type='response', test3[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #yes, they are most likely not to survive!
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In [221]:
```
#What about old men?
test4 <- filter(test_set, AgeGroup > 4)
test4 <- filter(test3, Sex==1)
prob_predictions = predict(classifier, type='response', test4[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #Sorry men
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In [226]:
```
#What about first class men?
test5 <- filter(test_set, Pclass==1)
test5 <- filter(test5, Sex==1)
```

```
prob_predictions = predict(classifier, type='response', test5[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict
```

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```

In [229]:
```
#What about first class men and traveling with more than one Parchild?
test5 <- filter(test_set, Pclass==1)
```

```
test5 <- filter(test5, Sex==1)
test5 <- filter(test5, Parch>1)
prob_predictions = predict(classifier, type='response', test5[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #the model predicts about half of these will survive
```

1
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In [231]:
```
#What about first class men and traveling with more than one SibSp?
test5 <- filter(test_set, Pclass==1)
test5 <- filter(test5, Sex==1)
test5 <- filter(test5, SibSp>1)
prob_predictions = predict(classifier, type='response', test5[,-1])
y_predict <- ifelse(prob_predictions>=0.5,1,0)
y_predict #the model predicts SibSp is not more important for men than Parchild
```

1: 0

Logistic Regression Conclusions:

The most important factors in determining who survived were:

Sex (Females were most likely)

Parchild, or SibSp: Whether or not the individual was traveling with others

Class: First class passengers were most likely to survive

Here are some senarios and the likeliness of survival:

Women of any age & in first class were very likely to survive.

Women under 40 years old had 100% survival rate.

Older men were very likely not to survive

Men traveling in first class with a parent or child had a 50% chance of survival

In [ ]: