Part3.R

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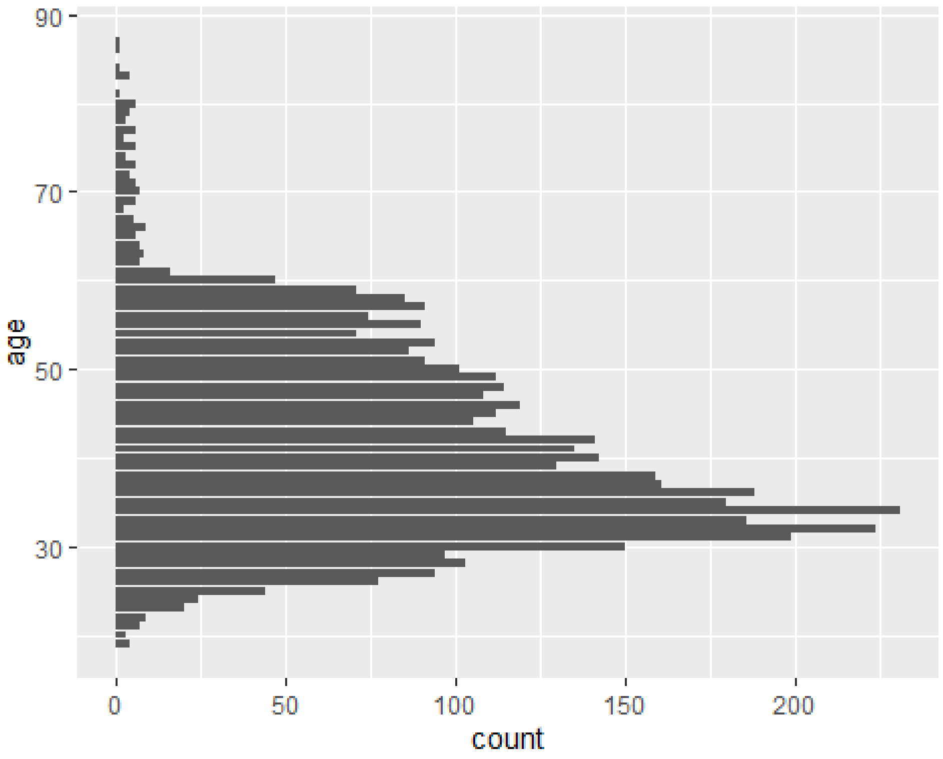
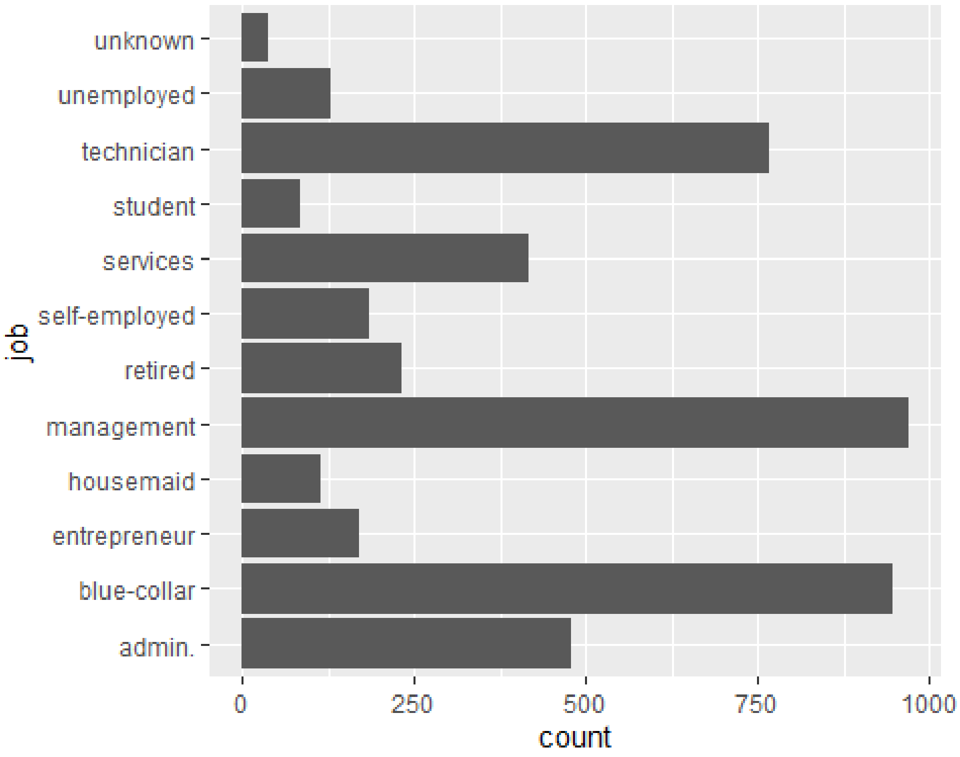
```
library(caTools)

## Warning: package 'caTools' was built under R version 4.0.4

library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.0.4

library(randomForest)

## Warning: package 'randomForest' was built under R version 4.0.4

## randomForest 4.6-14

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

##
## Attaching package: 'randomForest'

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

library(caret)

## Warning: package 'caret' was built under R version 4.0.4

## Loading required package: lattice

## Warning: package 'lattice' was built under R version 4.0.4

setwd("C:/Users/Cheng Jun/Desktop/SIM/Year 2/Machine Learning/Coursework")

data <- read.table("bank.csv",header=1,sep = ';')
sum(is.na(data))

## [1] 0

columns = names(data)
columns

##  [1] "age"       "job"       "marital"   "education" "default"   "balance"
##  [7] "housing"   "loan"      "contact"   "day"       "month"
"duration"
## [13] "campaign"  "pdays"     "previous"  "poutcome"  "y"
```

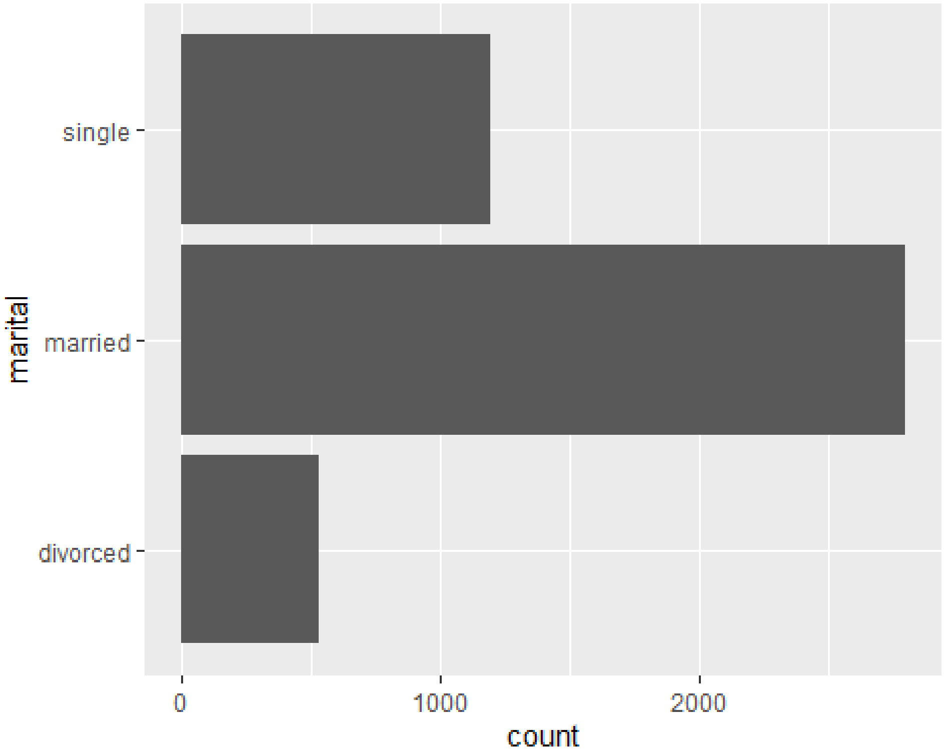
```
#Illustration of data
#plot age row
ggplot(data) + geom_bar(aes(y = age))
```



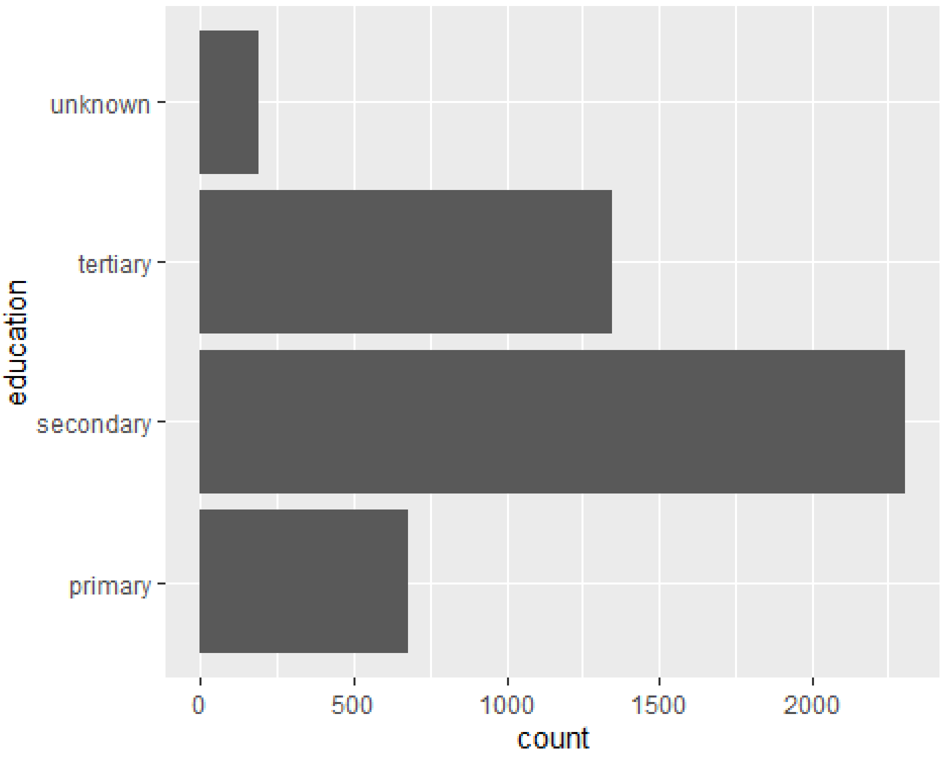
```
#plot job row
ggplot(data) + geom_bar(aes(y = job))
```



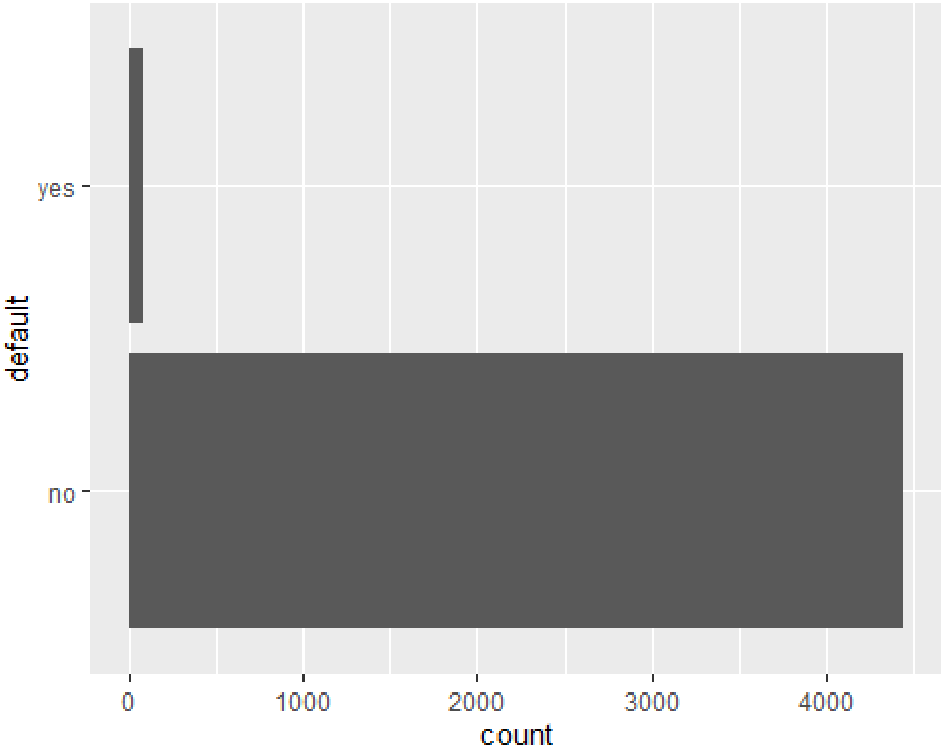
```r
#plot marital row
ggplot(data) + geom_bar(aes(y = marital))
```



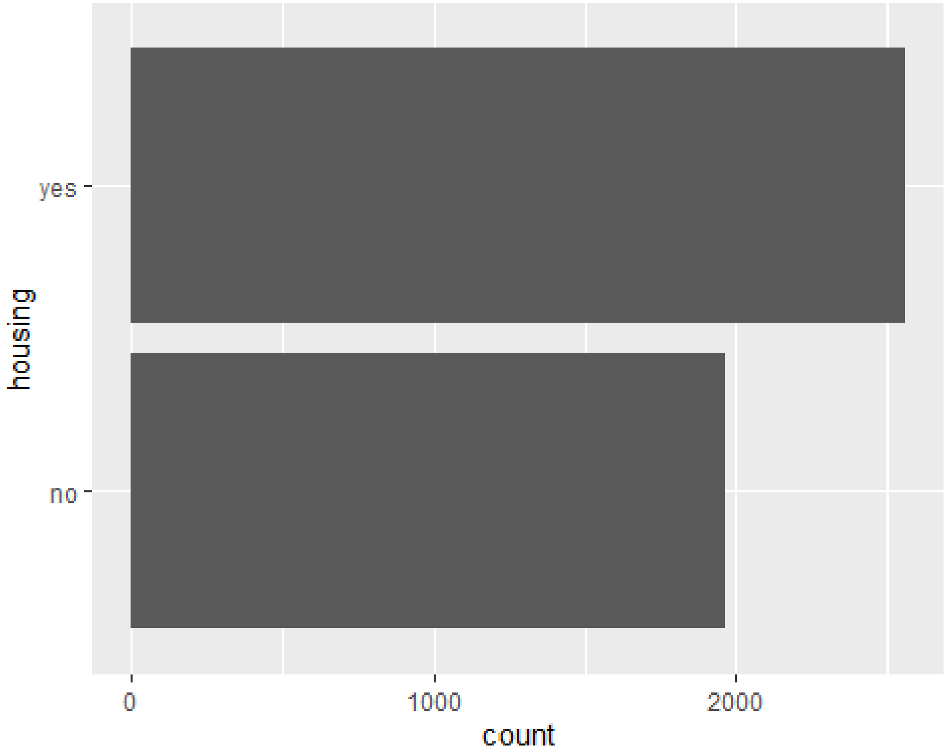
```r
#plot education row
ggplot(data) + geom_bar(aes(y = education))
```



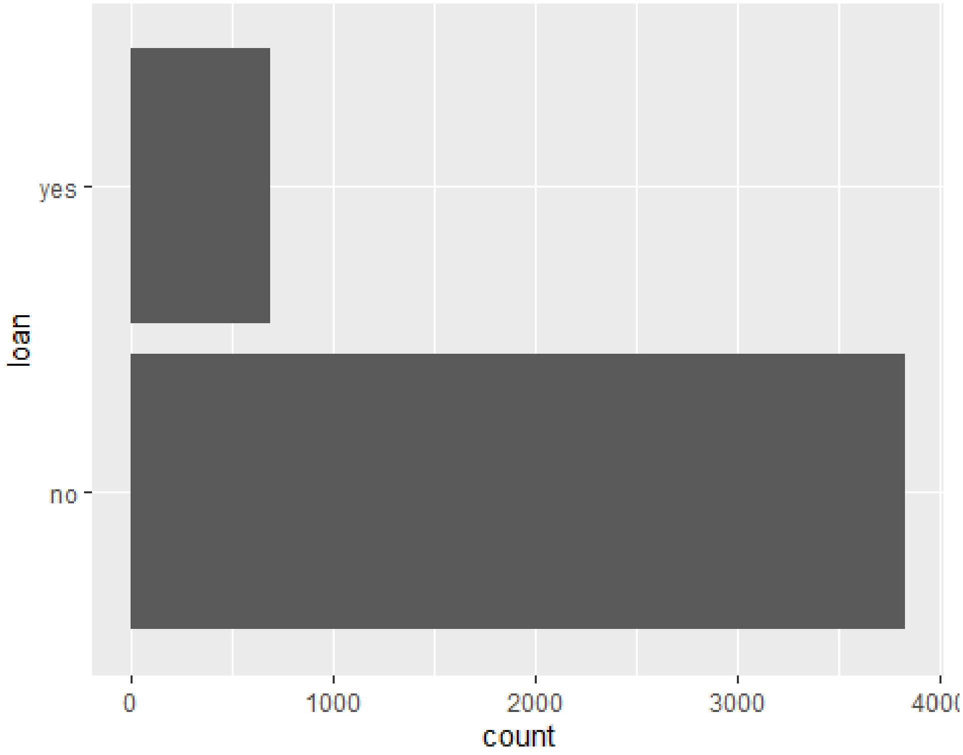
```r
#plot default row
ggplot(data) + geom_bar(aes(y = default))
```



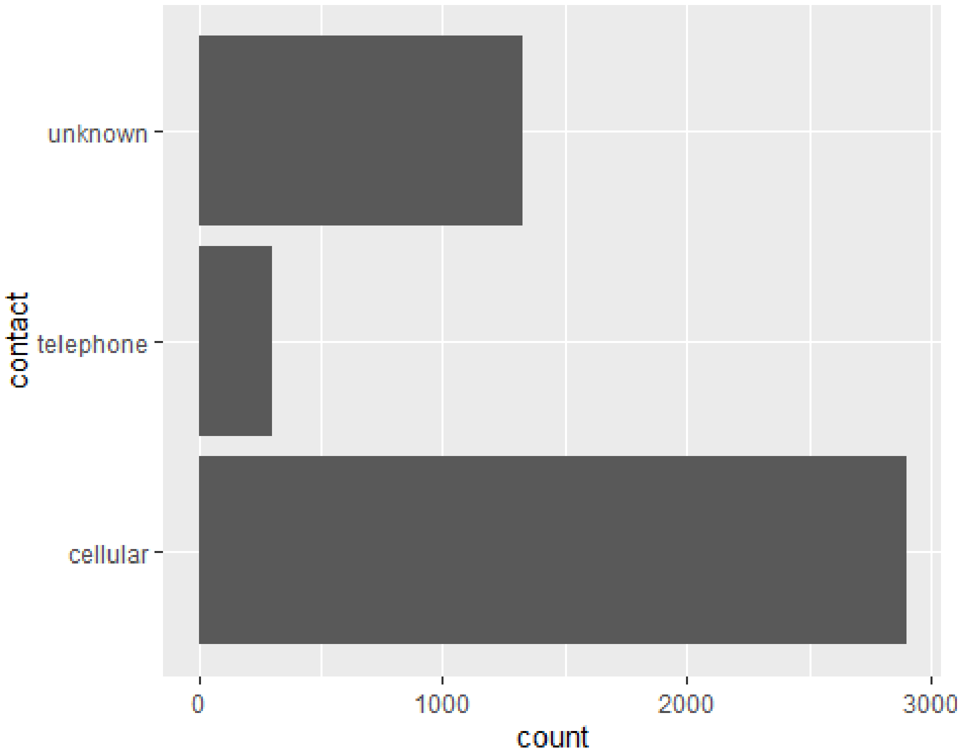
```
#As default has mostly 'no' value if we place it in the dataframe it might
result in overfitting due to it not being equally distributed.
data = data[,-c(5)]
#plot housing row
ggplot(data) + geom_bar(aes(y = housing))
```



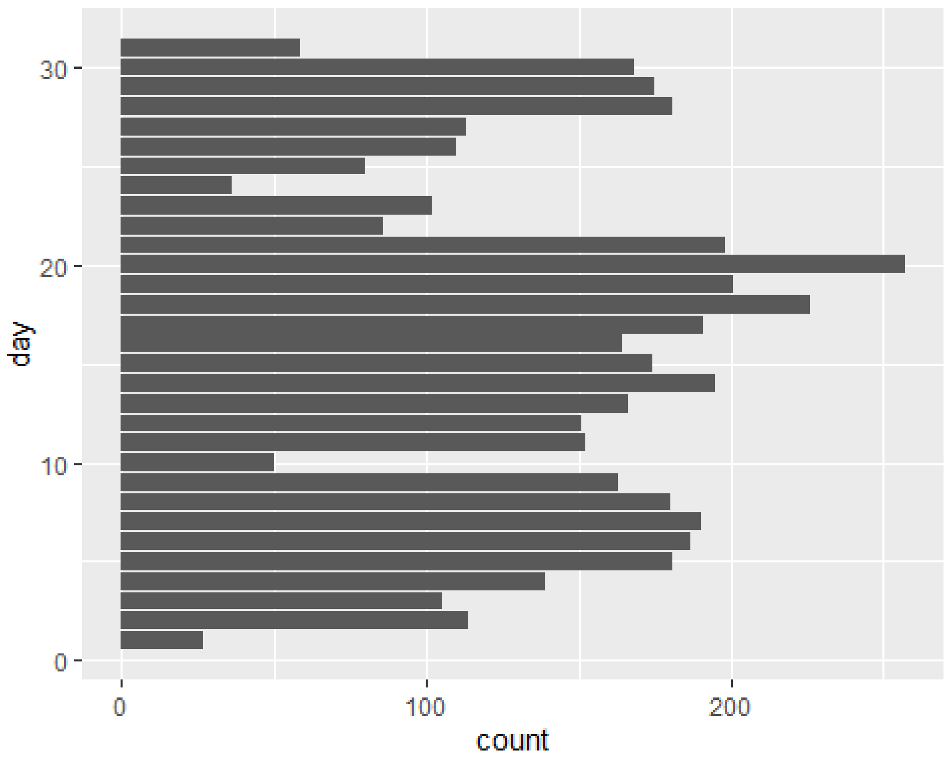
```
#plot loan row
ggplot(data) + geom_bar(aes(y = loan))
```



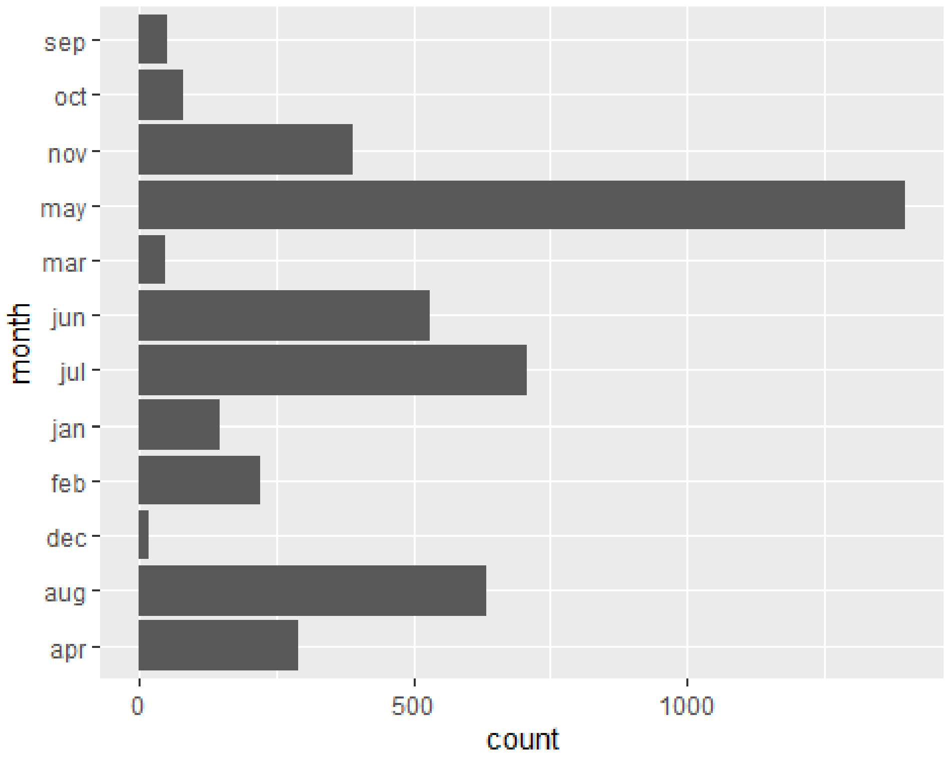
```
#plot contact row
ggplot(data) + geom_bar(aes(y = contact))
```



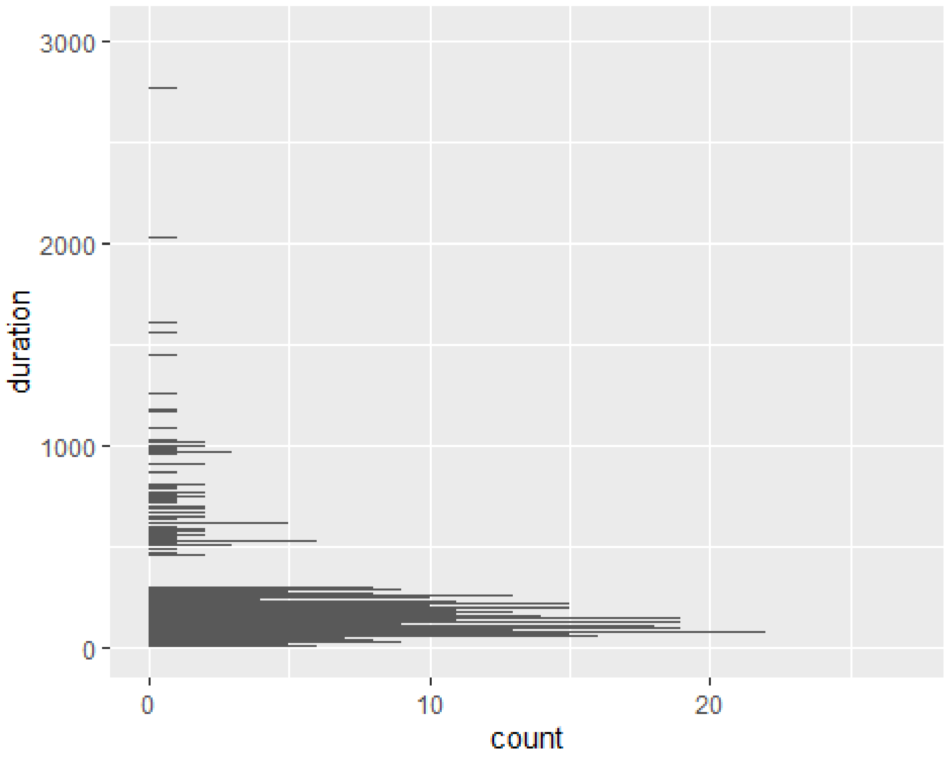
```
#plot day row
ggplot(data) + geom_bar(aes(y =day))
```



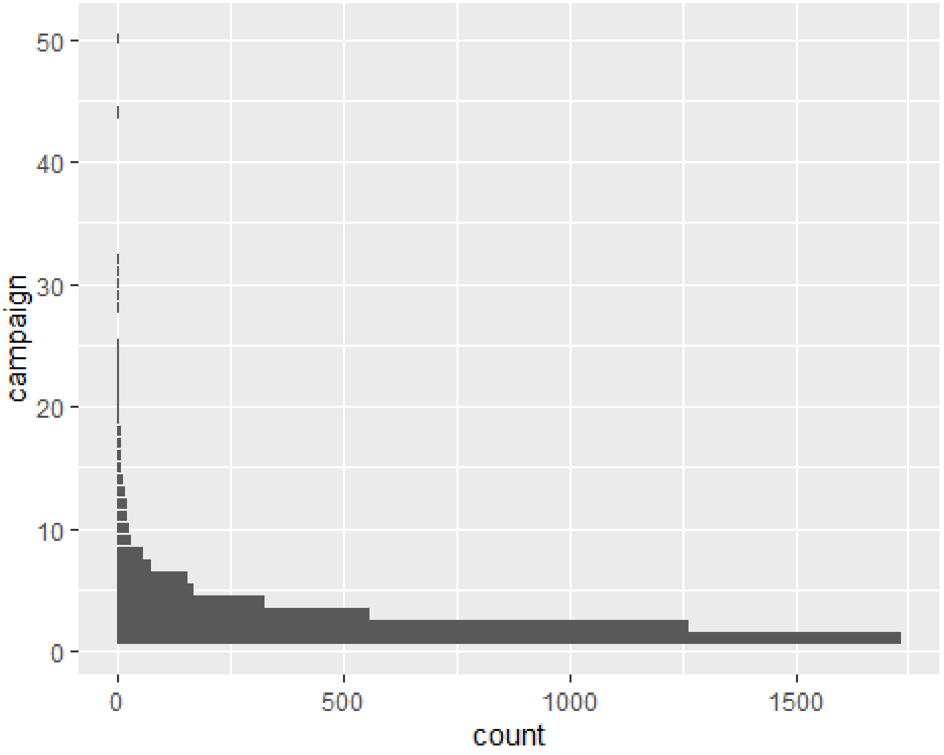
```r
#plot month row
ggplot(data) + geom_bar(aes(y = month))
```



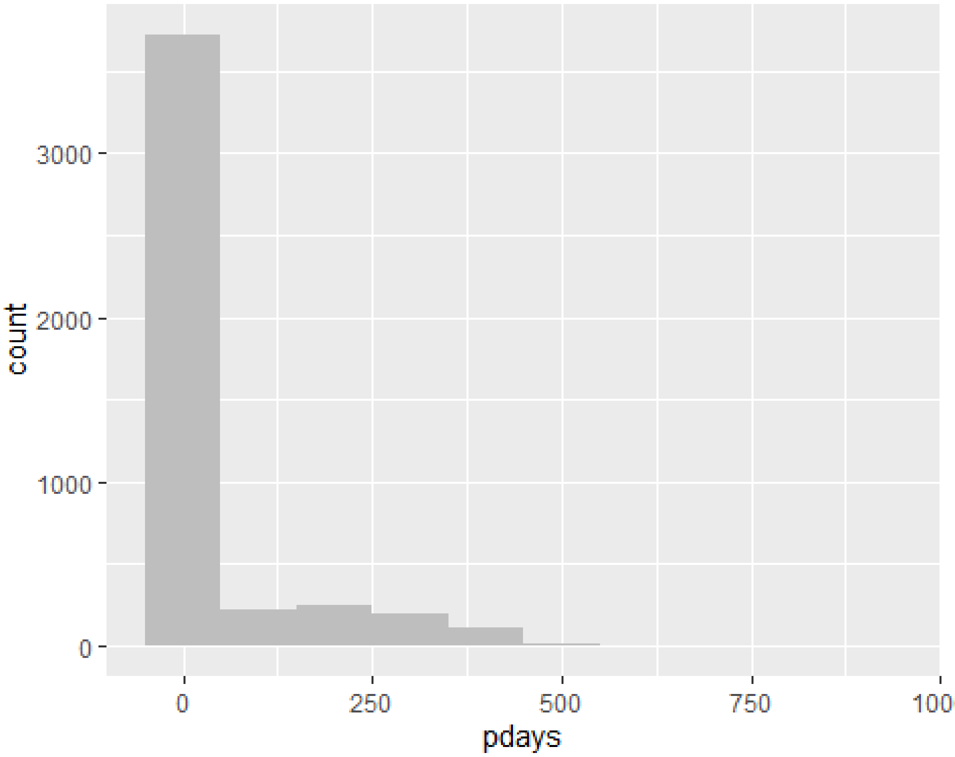
```
#plot duration row
ggplot(data) + geom_bar(aes(y =duration))
```



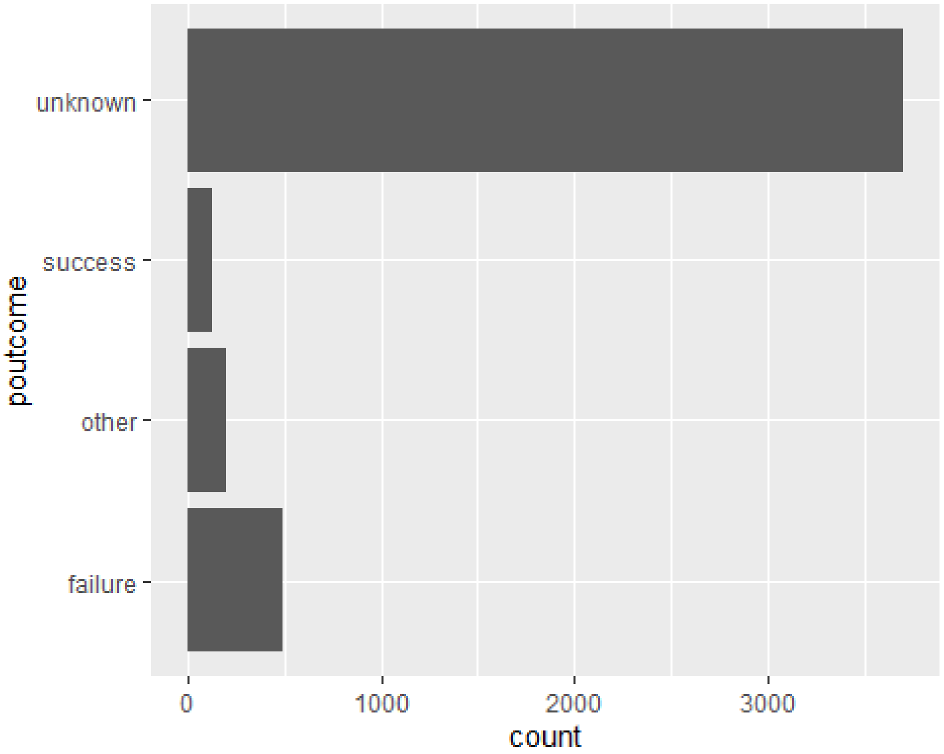
```
#plot campaign row
ggplot(data) + geom_bar(aes(y =campaign))
```



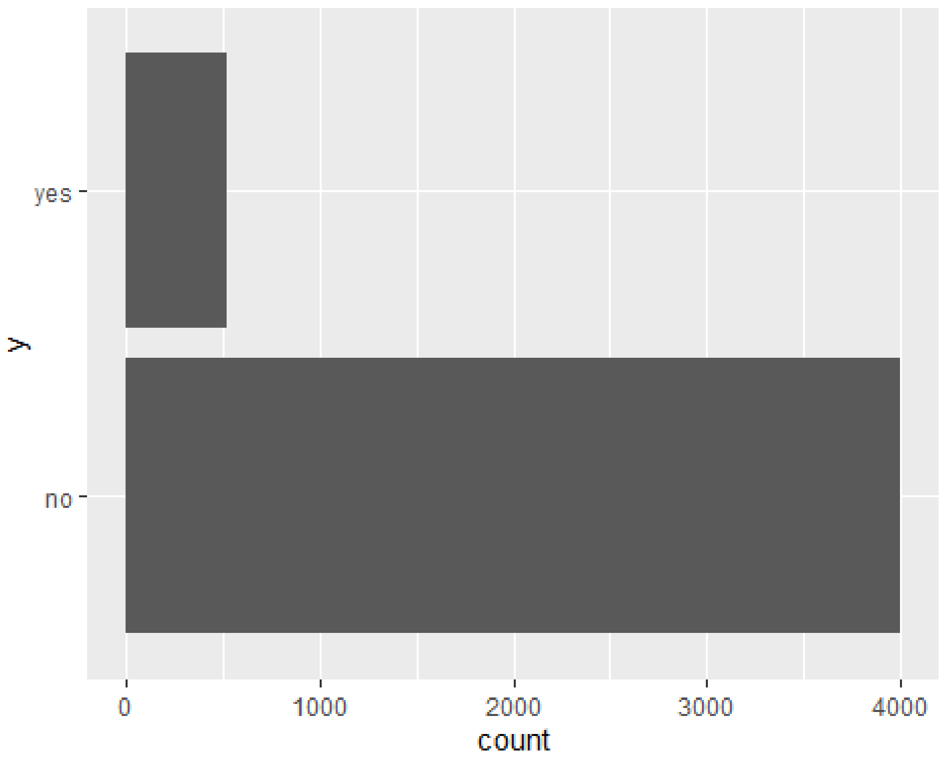
```
#for pdays row
ggplot(data, aes(x = pdays)) + geom_histogram(fill="grey",
position="dodge",binwidth=100)
```



```
data$pdays[data$pdays==-1] = mean(data$pdays)
#plot poutcome row
ggplot(data) + geom_bar(aes(y = poutcome))
```



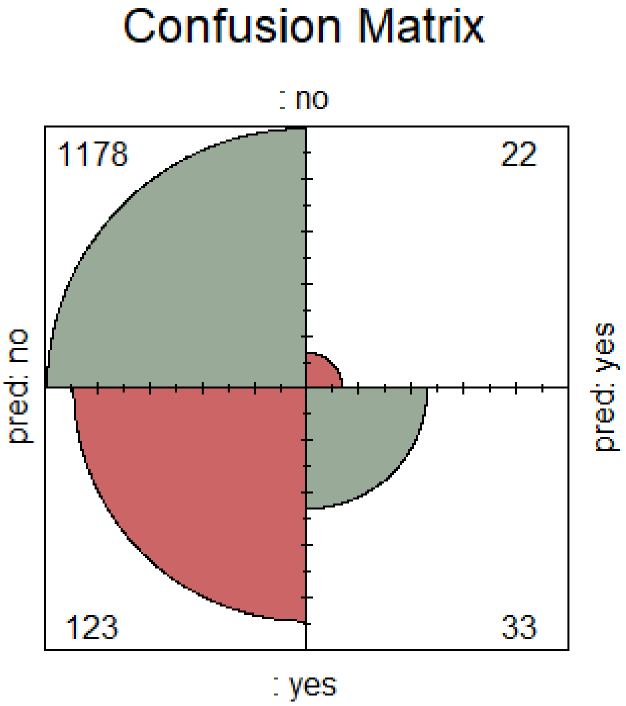
```
#As poutcome also mostly has unknown only, so we remove it to prevent
overfitting from occuring
data = data[,-c(15)]
#plot y row
ggplot(data) + geom_bar(aes(y =y))
```



```
#for balance row
data$balance[data$balance==0] = mean(data$balance)

data <- transform(
  data,
  age = age,
  job = as.integer(factor(job)),
  marital = as.integer(factor(marital)),
  education=as.integer(factor(education)),
  balance = balance,
  housing = as.integer(factor(housing)),
  loan = as.integer(factor(loan)),
  contact = as.integer(factor(contact)),
  day = day,
  month = as.integer(factor(month)),
  duration = duration,
  campaign = campaign,
  pdays = pdays
)
sapply(data, class)
```

```
##         age         job     marital   education     balance     housing
##   "integer"   "integer"   "integer"   "integer"   "numeric"   "integer"
##        loan     contact         day       month    duration    campaign
##   "integer"   "integer"   "integer"   "integer"   "integer"   "integer"
##       pdays    previous           y
##   "numeric"   "integer" "character"
```

```r
#train test split
split = sample.split(data$y,SplitRatio=0.7)
training = subset(data,split==TRUE)
test = subset(data,split==FALSE)

#scaling the data
training[,c(1:14)] = scale(training[,c(1:14)])

#random forest
rf <- randomForest(
  as.factor(y) ~ .,
  data=training,
)

test[,c(1:14)] = scale(test[,c(1:14)])

pred = predict(rf, newdata=test[,c(1:14)])
cm = table(test[,15], pred)
#confusion matrix
fourfoldplot(cm, color = c("#CC6666", "#99AA99"),conf.level = 0, margin =1,
main = "Confusion Matrix")
```



```r
res = confusionMatrix(cm)

print(res)
```

```
## Confusion Matrix and Statistics
## 
##       pred
##          no  yes
##   no   1178   22
##   yes   123   33
## 
##                Accuracy : 0.8931
##                  95% CI : (0.8754, 0.909)
##     No Information Rate : 0.9594
##     P-Value [Acc > NIR] : 1
## 
##                   Kappa : 0.269
## 
##  Mcnemar's Test P-Value : <2e-16
## 
##             Sensitivity : 0.9055
##             Specificity : 0.6000
##          Pos Pred Value : 0.9817
##          Neg Pred Value : 0.2115
##              Prevalence : 0.9594
##          Detection Rate : 0.8687
##    Detection Prevalence : 0.8850
##       Balanced Accuracy : 0.7527
## 
##        'Positive' Class : no
## 
```

```
Precisionvalue = res$byClass["Pos Pred Value"]
print(Precisionvalue)
```

```
## Pos Pred Value
##      0.9816667
```

```
Accuracy=res$overall["Accuracy"]
print(Accuracy)
```

```
##  Accuracy
## 0.8930678
```