Depression Draft 1

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```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(cowplot)
```

```
##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##     stamp
```

```
library(caret)
```

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

```
library(ROCR)
```

```
## Warning: package 'ROCR' was built under R version 4.4.2
```

```
depression = read.csv("final_depression_dataset_1.csv")
```

```r
# find the dimension of depression
dim(depression)
```

```
## [1] 2556   19
```

```r
# find if there exist duplicates
sum(duplicated(depression))
```

```
## [1] 0
```

```r
# find number of NAs for each column
sapply(depression, function(x) {sum(is.na(x))})
```

```
##                                   Name                                 Gender
##                                      0                                      0
##                                    Age                                   City
##                                      0                                      0
##       Working.Professional.or.Student                             Profession
##                                      0                                      0
##                     Academic.Pressure                          Work.Pressure
##                                   2054                                    502
##                                   CGPA                    Study.Satisfaction
##                                   2054                                   2054
##                       Job.Satisfaction                        Sleep.Duration
##                                    502                                      0
##                         Dietary.Habits                                 Degree
##                                      0                                      0
## Have.you.ever.had.suicidal.thoughts..                       Work.Study.Hours
##                                      0                                      0
##                       Financial.Stress      Family.History.of.Mental.Illness
##                                      0                                      0
##                             Depression
##                                      0
```

```r
# combine pressure columns into one
helper1 = ifelse(is.na(depression$Academic.Pressure), 0, depression$Academic.Pressure)

helper2 = ifelse(is.na(depression$Work.Pressure), 0, depression$Work.Pressure)

depression$Pressure = helper1+helper2
```

```r
# combine satisfaction into one column
helper3 = ifelse(is.na(depression$Study.Satisfaction), 0, depression$Study.Satisfaction)

helper4 = ifelse(is.na(depression$Job.Satisfaction), 0, depression$Job.Satisfaction)

depression$Satisfaction = helper3 + helper4
```

```r
# delete columns with NAs
depression = depression[, -c(7:11)]
sapply(depression, function(x) {sum(is.na(x))})
```

```
##                                   Name                                 Gender
##                                      0                                      0
##                                    Age                                   City
##                                      0                                      0
##       Working.Professional.or.Student                             Profession
##                                      0                                      0
##                          Sleep.Duration                         Dietary.Habits
##                                      0                                      0
##                                 Degree Have.you.ever.had.suicidal.thoughts..
##                                      0                                      0
##                        Work.Study.Hours                        Financial.Stress
##                                      0                                      0
##      Family.History.of.Mental.Illness                             Depression
##                                      0                                      0
##                                Pressure                           Satisfaction
##                                      0                                      0
```

```
# due to a large amount of varied answers for "City" and "Profession," we delete the variables
# we also delete name because we don't care about that variable
unique(depression$City)
```

```
##  [1] "Ghaziabad"     "Kalyan"        "Bhopal"        "Thane"
##  [5] "Indore"        "Pune"          "Bangalore"     "Hyderabad"
##  [9] "Srinagar"      "Nashik"        "Kolkata"       "Ahmedabad"
## [13] "Varanasi"      "Chennai"       "Jaipur"        "Surat"
## [17] "Vasai-Virar"   "Rajkot"        "Patna"         "Mumbai"
## [21] "Vadodara"      "Lucknow"       "Faridabad"     "Meerut"
## [25] "Kanpur"        "Visakhapatnam" "Ludhiana"      "Nagpur"
## [29] "Delhi"         "Agra"
```

```
unique(depression$Profession)
```

```
##  [1] "Teacher"                "Financial Analyst"      "UX/UI Designer"
##  [4] "Civil Engineer"         "Accountant"             "Lawyer"
##  [7] "Content Writer"         ""                       "Pilot"
## [10] "Customer Support"       "Judge"                  "Architect"
## [13] "HR Manager"             "Digital Marketer"       "Sales Executive"
## [16] "Business Analyst"       "Mechanical Engineer"    "Consultant"
## [19] "Data Scientist"         "Pharmacist"             "Software Engineer"
## [22] "Travel Consultant"      "Manager"                "Entrepreneur"
## [25] "Doctor"                 "Researcher"             "Plumber"
## [28] "Finanancial Analyst"    "Marketing Manager"      "Educational Consultant"
## [31] "Chemist"                "Research Analyst"       "Chef"
## [34] "Electrician"            "Graphic Designer"       "Investment Banker"
```

```
depression = subset(depression, select = -c(Name, City, Profession))
```

```
# degree has many varied answers as well; however, they can be recoded into three main categories: high
unique(depression$Degree)
```

```
##  [1] "MA"       "B.Com"    "M.Com"    "MD"       "BE"       "MCA"
```

```
##  [7] "BA"       "LLM"      "BCA"      "Class 12" "B.Ed"     "M.Tech"
## [13] "LLB"      "B.Arch"   "ME"       "MBA"      "M.Pharm"  "MBBS"
## [19] "PhD"      "BSc"      "MSc"      "MHM"      "BBA"      "BHM"
## [25] "B.Tech"   "M.Ed"     "B.Pharm"
```

```
depression$Degree = case_when(depression$Degree == "Class 12" ~ "High School Equivalent",
                              grepl("^[BL]", depression$Degree) ~ "Bachelors Degree",
                              grepl("^[MP]", depression$Degree) ~ "Post-Graduate Degree")

table(depression$Degree)
```

```
##
##       Bachelors Degree High School Equivalent   Post-Graduate Degree
##                   1193                    275                   1088
```

```
# find type of each variable so we can change each type
sapply(depression, function(x) {class(x)})
```

```
##                                Gender                                   Age
##                           "character"                             "integer"
##       Working.Professional.or.Student                        Sleep.Duration
##                           "character"                             "character"
##                         Dietary.Habits                                Degree
##                           "character"                             "character"
## Have.you.ever.had.suicidal.thoughts..                       Work.Study.Hours
##                           "character"                             "integer"
##                       Financial.Stress     Family.History.of.Mental.Illness
##                             "integer"                             "character"
##                            Depression                                Pressure
##                           "character"                             "numeric"
##                          Satisfaction
##                             "numeric"
```

```
# change each categorical into a factor, changing the base/ordering them if needed
depression$Gender = as.factor(depression$Gender)
depression$Working.Professional.or.Student = as.factor(depression$Working.Professional.or.Student)
depression$Sleep.Duration = factor(depression$Sleep.Duration, levels = c("Less than 5 hours", "5-6 hours
depression$Dietary.Habits = factor(depression$Dietary.Habits, levels = c("Unhealthy", "Moderate", "Healt
depression$Degree = factor(depression$Degree, levels = c("High School Equivalent", "Bachelors Degree",
depression$Have.you.ever.had.suicidal.thoughts.. = as.factor(depression$Have.you.ever.had.suicidal.thoug
depression$Financial.Stress = factor(depression$Financial.Stress, levels = c(1, 2, 3, 4, 5))
depression$Family.History.of.Mental.Illness = as.factor(depression$Family.History.of.Mental.Illness)
depression$Depression = as.factor(depression$Depression)
depression$Pressure = factor(depression$Pressure, levels = c(1, 2, 3, 4, 5))
depression$Satisfaction = factor(depression$Satisfaction, levels = c(1, 2, 3, 4, 5))
```

```
depressionFactored = select(depression, where(is.factor))
sapply(depressionFactored, table)
```

```
## $Gender
##
```

```
## Female   Male
##   1223   1333
##
## $Working.Professional.or.Student
##
##              Student Working Professional
##                  502                 2054
##
## $Sleep.Duration
##
## Less than 5 hours         5-6 hours         7-8 hours More than 8 hours
##               648               628               658               622
##              TRUE
##                 0
##
## $Dietary.Habits
##
## Unhealthy  Moderate   Healthy
##       882       832       842
##
## $Degree
##
## High School Equivalent       Bachelors Degree   Post-Graduate Degree
##                    275                   1193                   1088
##
## $Have.you.ever.had.suicidal.thoughts..
##
##   No  Yes
## 1307 1249
##
## $Financial.Stress
##
##   1   2   3   4   5
## 517 549 488 501 501
##
## $Family.History.of.Mental.Illness
##
##   No  Yes
## 1311 1245
##
## $Depression
##
##   No  Yes
## 2101  455
##
## $Pressure
##
##   1   2   3   4   5
## 500 501 529 504 522
##
## $Satisfaction
##
##   1   2   3   4   5
## 482 531 507 508 528
```

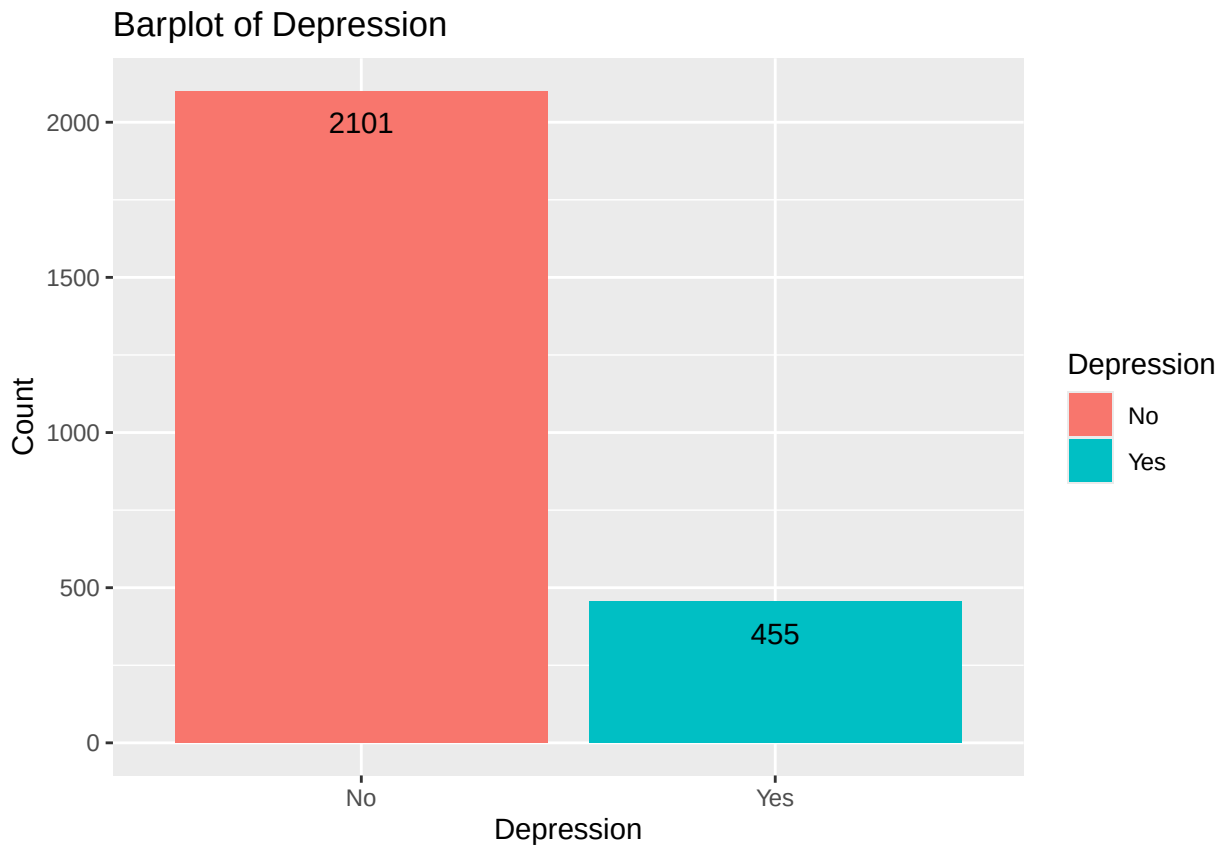
IF YOU WANT TO CHANGE THE COLOR, PLEASE USE THESE TWO LINKS:

https://sape.inf.usi.ch/quick-reference/ggplot2/colour

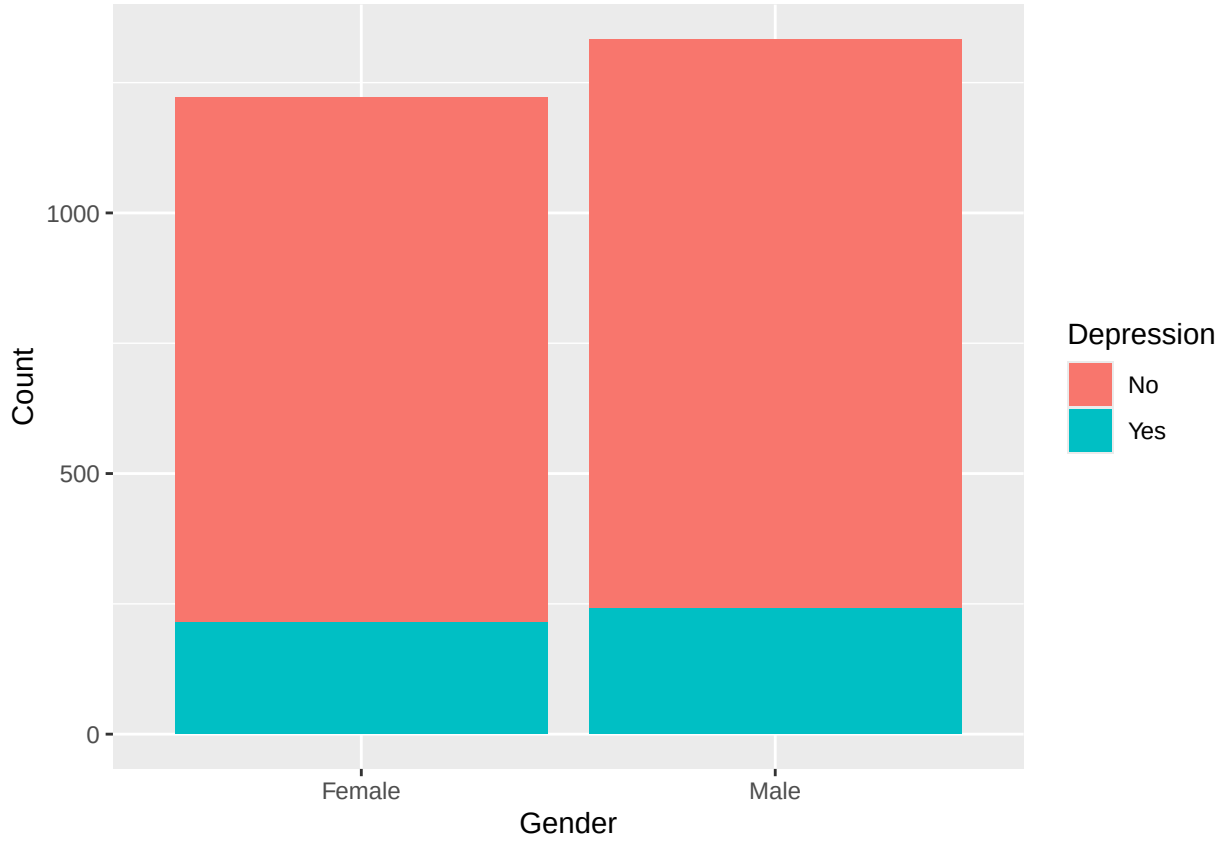
https://www.rapidtables.com/web/color/RGB_Color.html

```
# plot depression count
ggplot(depression, aes(x = Depression)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Depression") +
  ylab("Count") +
  ggtitle("Barplot of Depression") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```

```
## Warning: The dot-dot notation (‘..count..‘) was deprecated in ggplot2 3.4.0.
## i Please use ‘after_stat(count)‘ instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```



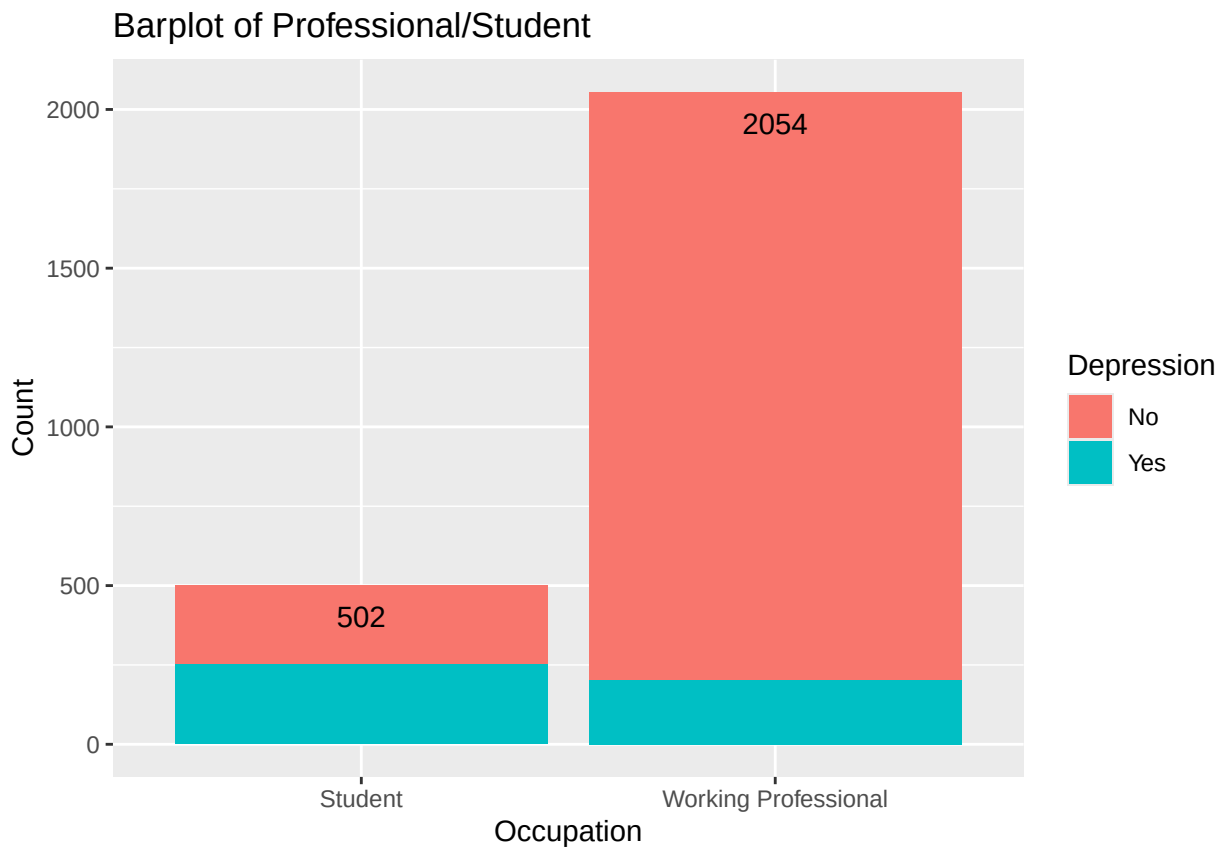

```
# plot gender
ggplot(depression, aes(x = Gender)) +
  geom_bar(aes(fill = Depression)) +
  ylab("Count")
```



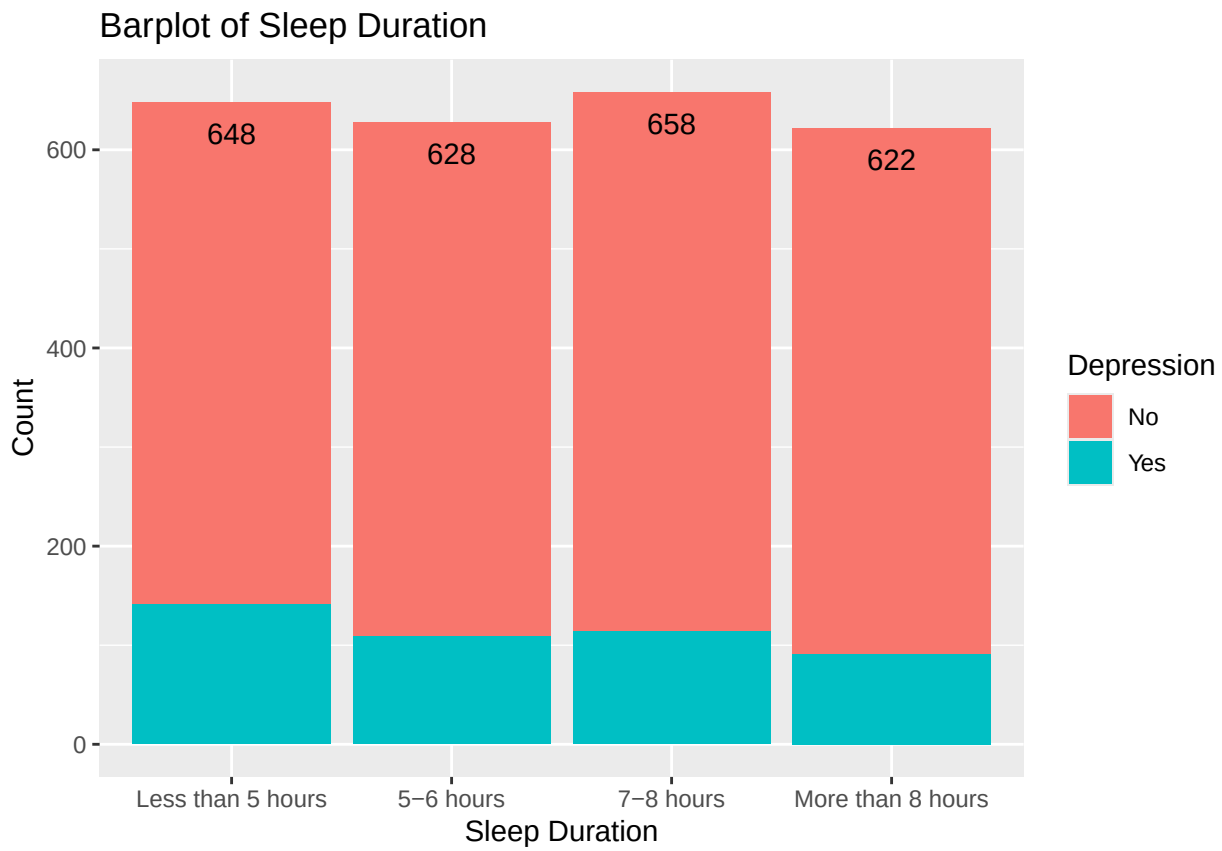

```
  ggtitle("Barplot of Gender") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```

```
## NULL
```

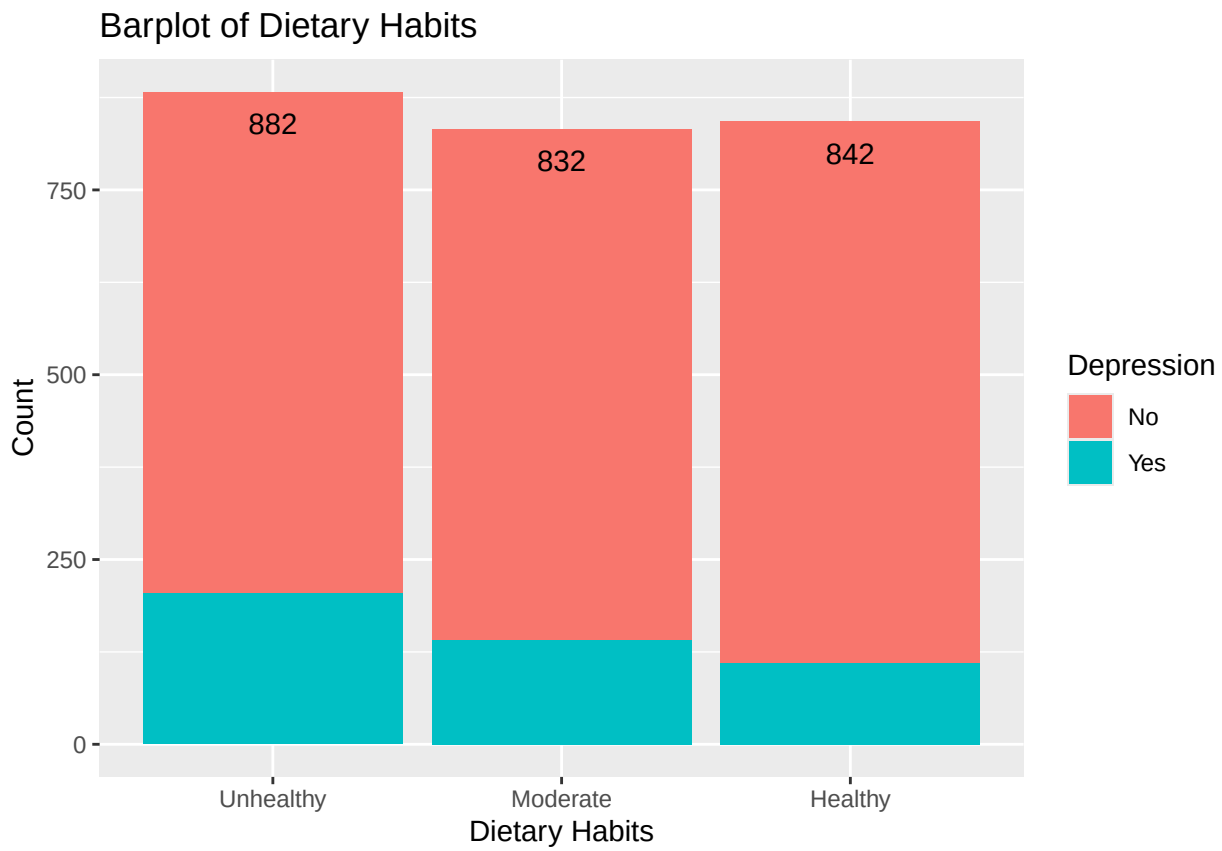
```
# plot whether or not person is a working professional or student
ggplot(depression, aes(x = Working.Professional.or.Student)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Occupation") +
  ylab("Count") +
  ggtitle("Barplot of Professional/Student") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```



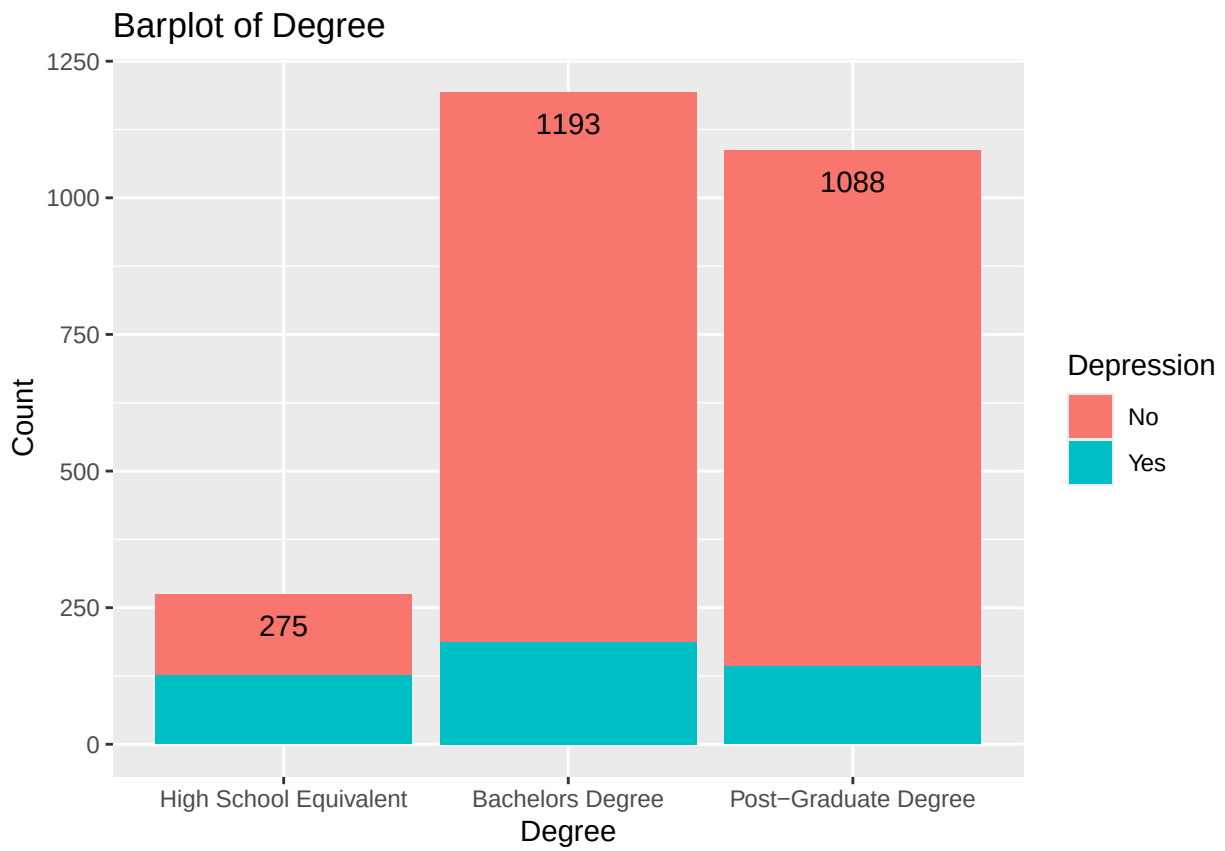

```r
# plot sleep duration habits
ggplot(depression, aes(x = Sleep.Duration)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Sleep Duration") +
  ylab("Count") +
  ggtitle("Barplot of Sleep Duration") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```



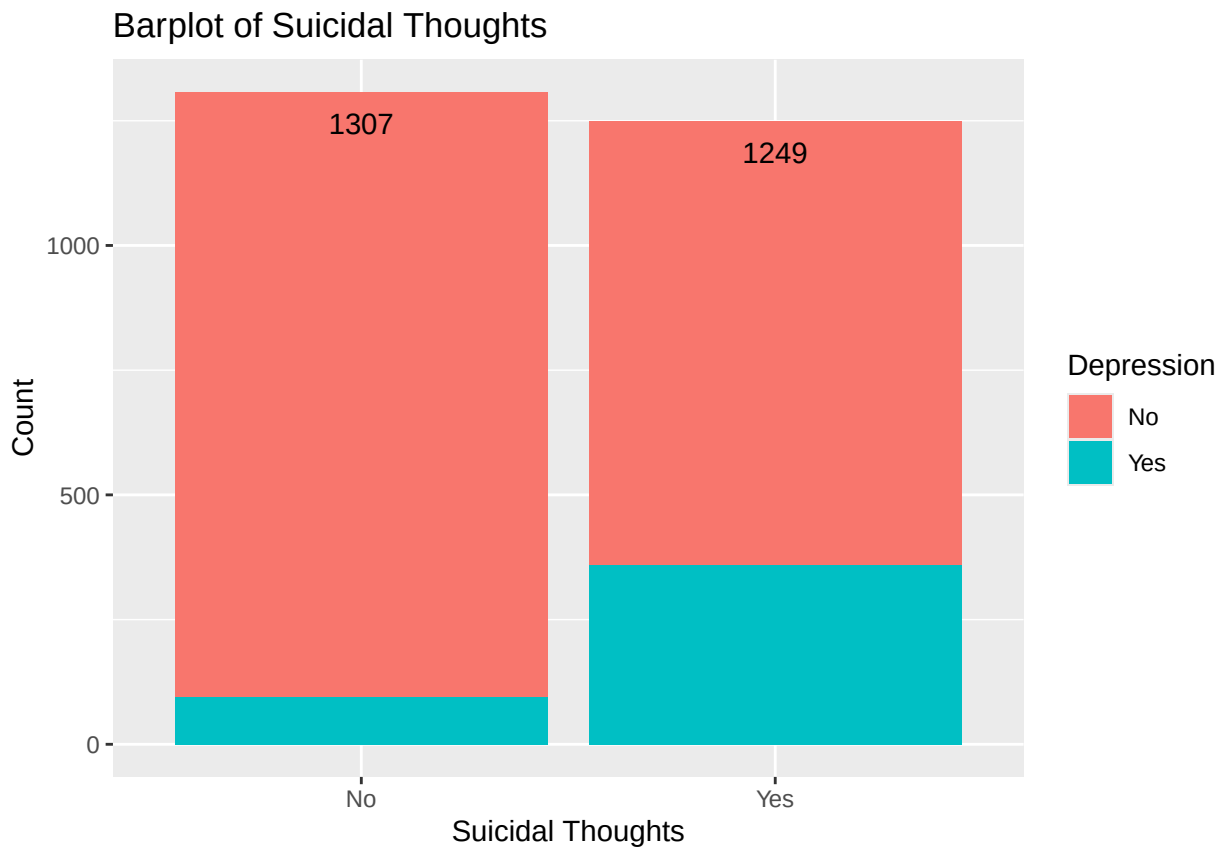

```r
# plot dietary habits
ggplot(depression, aes(x = Dietary.Habits)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Dietary Habits") +
  ylab("Count") +
  ggtitle("Barplot of Dietary Habits") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```




```r
# plot degree count
ggplot(depression, aes(x = Degree)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Degree") +
  ylab("Count") +
  ggtitle("Barplot of Degree") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```




```
# plot degree count
ggplot(depression, aes(x = Have.you.ever.had.suicidal.thoughts..)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Suicidal Thoughts") +
  ylab("Count") +
  ggtitle("Barplot of Suicidal Thoughts") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```

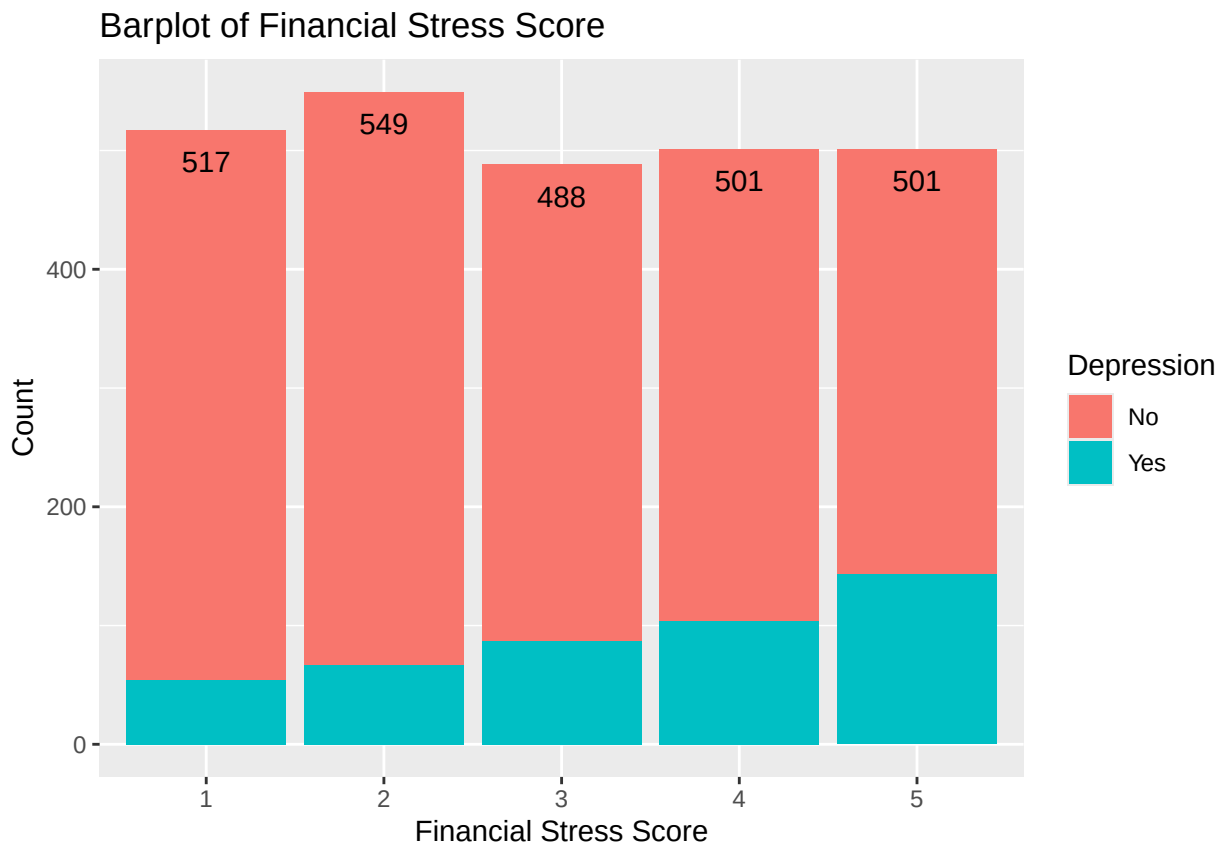



```
# variables look highly correlated, especially when we plot a table of depression and suicidal thoughts
table(depression$Have.you.ever.had.suicidal.thoughts.., depression$Depression)
```

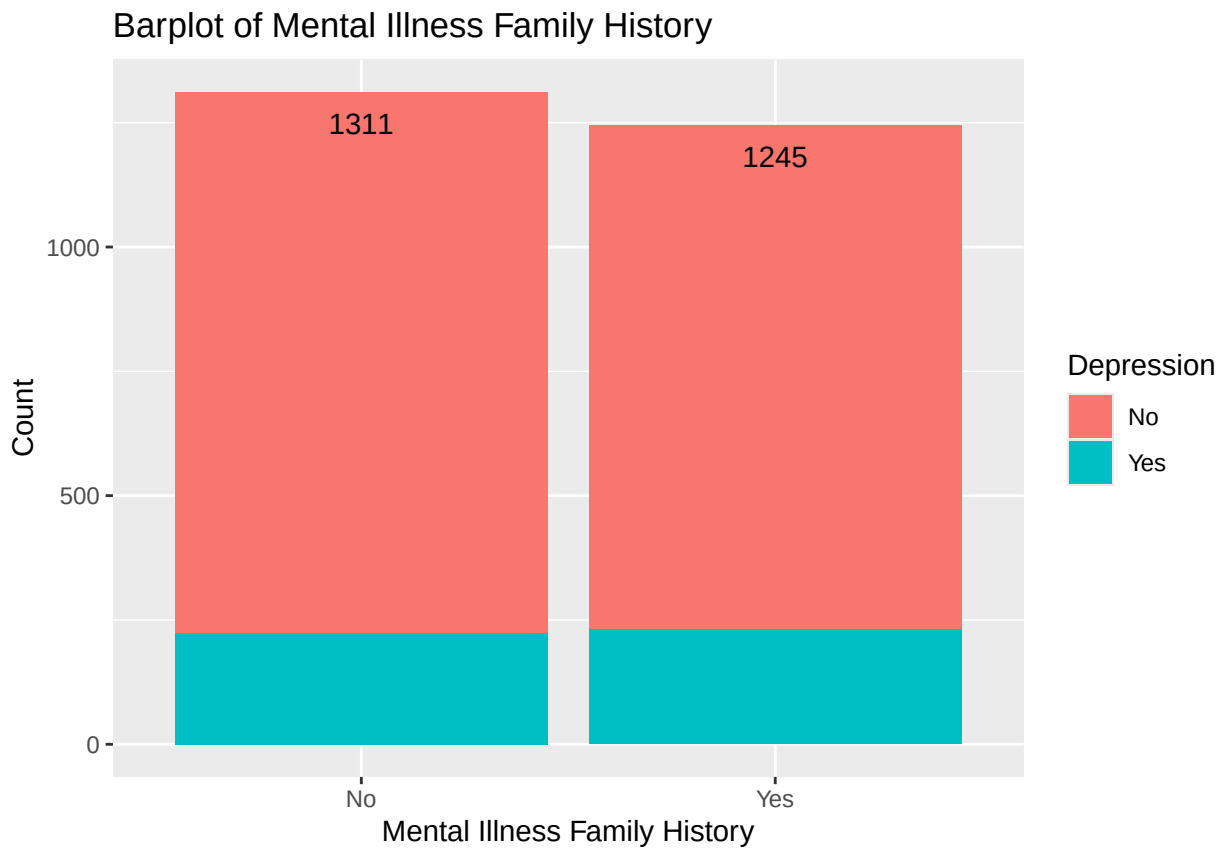
```
##
##          No  Yes
##   No   1212   95
##   Yes   889  360
```

```
# delete suicidal thoughts variable
depression = subset(depression, select = -c(Have.you.ever.had.suicidal.thoughts..))
```

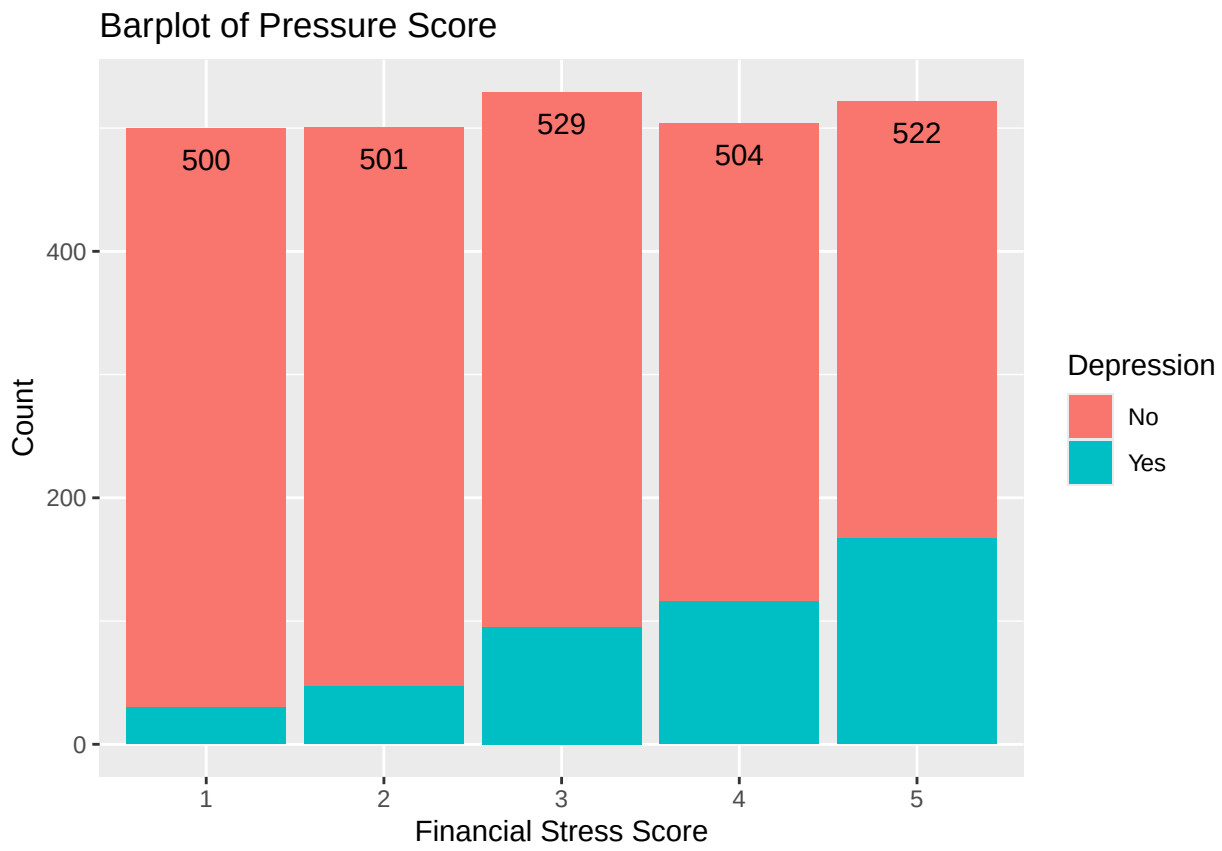
```
# plot financial stress count
ggplot(depression, aes(x = Financial.Stress)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Financial Stress Score") +
  ylab("Count") +
  ggtitle("Barplot of Financial Stress Score") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```



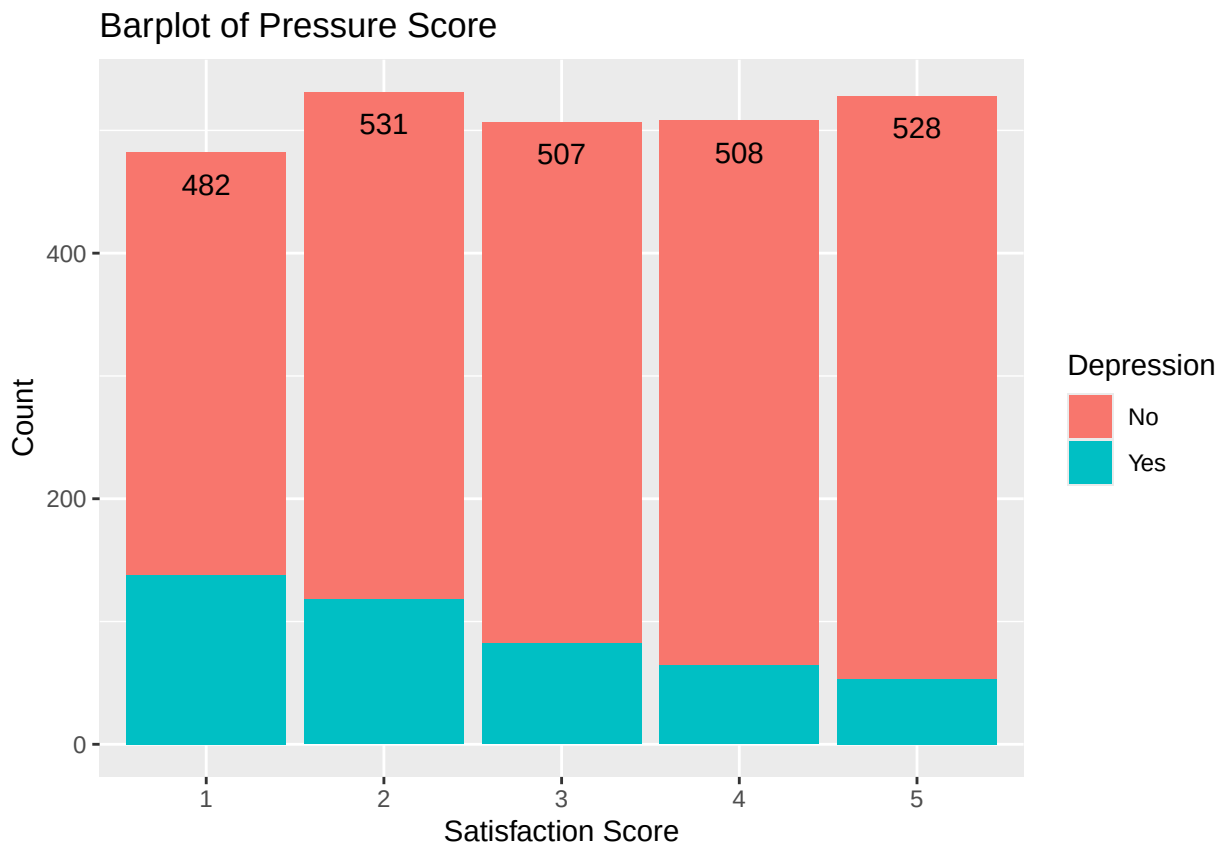

```
# plot family history of mental illness count
ggplot(depression, aes(x = Family.History.of.Mental.Illness)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Mental Illness Family History") +
  ylab("Count") +
  ggtitle("Barplot of Mental Illness Family History") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```




```
ggplot(depression, aes(x = Pressure)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Financial Stress Score") +
  ylab("Count") +
  ggtitle("Barplot of Pressure Score") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```




```
ggplot(depression, aes(x = Satisfaction)) +
  geom_bar(aes(fill = Depression)) +
  xlab("Satisfaction Score") +
  ylab("Count") +
  ggtitle("Barplot of Pressure Score") +
  geom_text(aes(label = ..count..), stat = "count", vjust = 2)
```

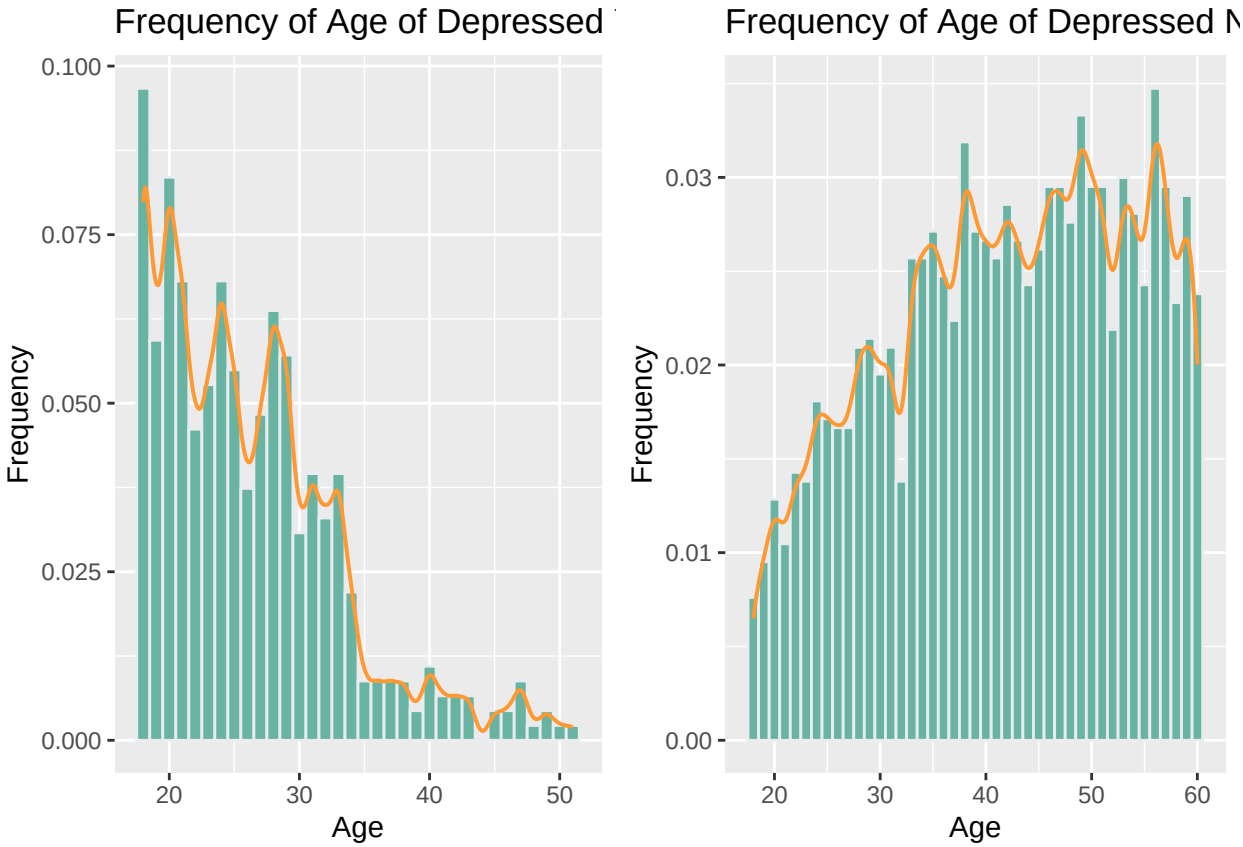



```
depressionYes = depression[depression$Depression == "Yes", ]
depressionNo = depression[depression$Depression == "No", ]
```

```
p1 = ggplot(depressionYes, aes(x = Age, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 0.3) +
  ggtitle("Frequency of Age of Depressed Yes") +
  ylab("Frequency")

p2 = ggplot(depressionNo, aes(x = Age, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 0.3) +
  ggtitle("Frequency of Age of Depressed No") +
  ylab("Frequency")
```

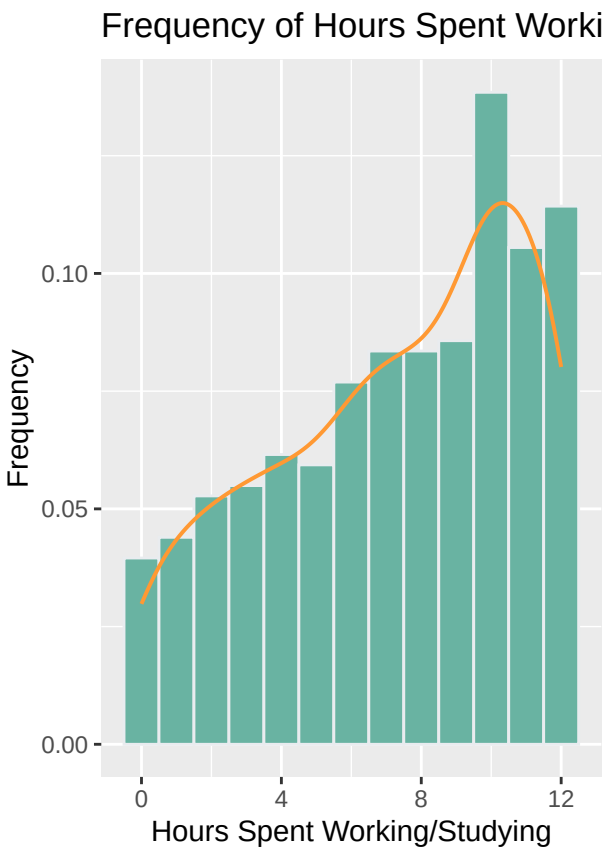
```
plot_grid(p1, p2)
```

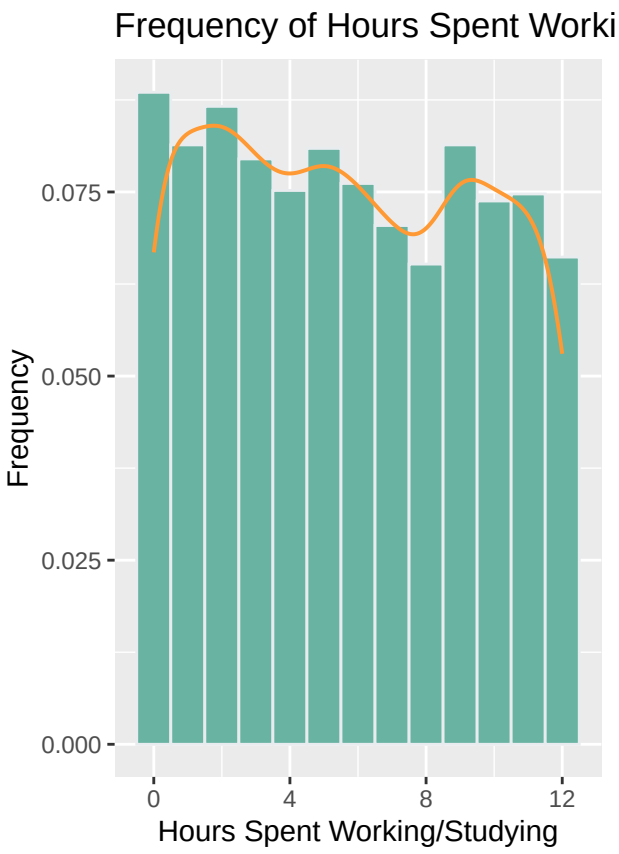



```
p3 = ggplot(depressionYes, aes(x = Work.Study.Hours, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 1) +
  ggtitle("Frequency of Hours Spent Working/Studying of Depressed Yes") +
  xlab("Hours Spent Working/Studying") +
  ylab("Frequency")

p4 = ggplot(depressionNo, aes(x = Work.Study.Hours, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 1) +
  ggtitle("Frequency of Hours Spent Working/Studying of Depressed No") +
  xlab("Hours Spent Working/Studying") +
  ylab("Frequency")
```

```
plot_grid(p3, p4)
```





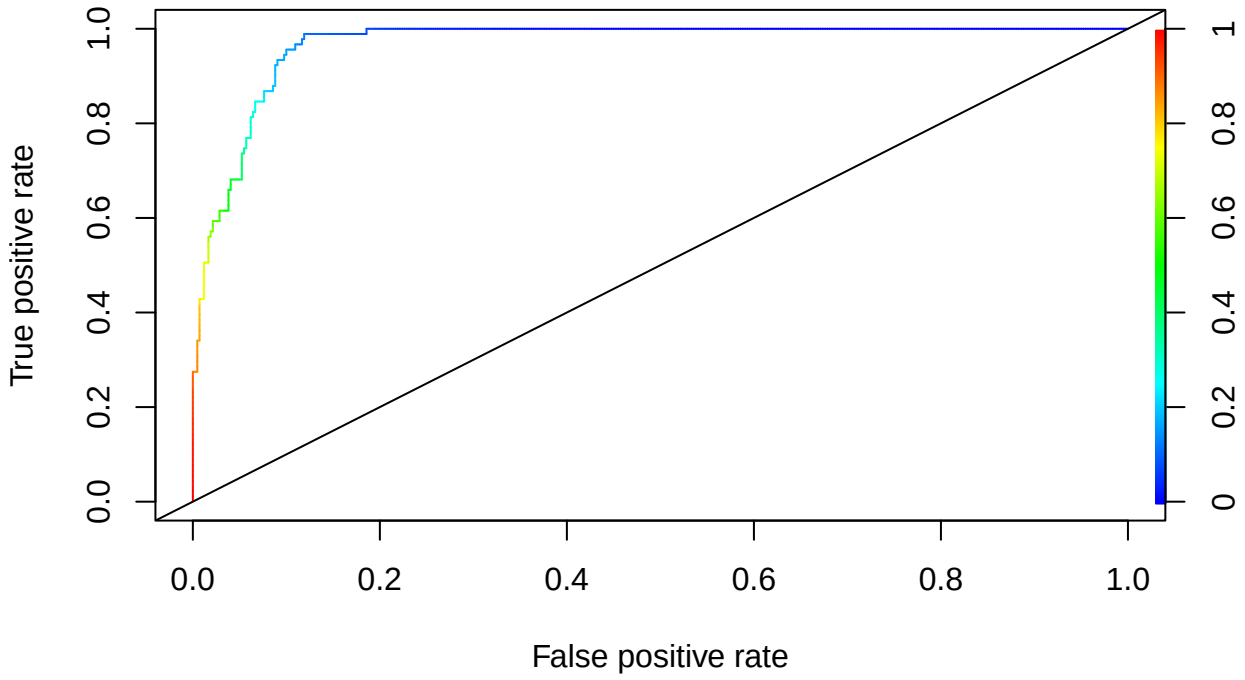

```r
# create train and test set
set.seed(213)
index = createDataPartition(depression$Depression, p = 0.80, list = FALSE, times = 1)
depression_train = depression[index,]
depression_test = depression[-index,]
```

```r
# create model with all predictors (no interaction effects)
depression_glm = glm(Depression ~ ., data = depression_train, family = "binomial")
summary(depression_glm)
```

```
##
## Call:
## glm(formula = Depression ~ ., family = "binomial", data = depression_train)
##
## Coefficients:
##                                                  Estimate Std. Error z value
## (Intercept)                                       3.78330    0.61857   6.116
## GenderMale                                       -0.13997    0.19537  -0.716
## Age                                              -0.22579    0.01685 -13.403
## Working.Professional.or.StudentWorking Professional -1.71232    0.22493  -7.613
## Sleep.Duration5-6 hours                          -0.42781    0.26647  -1.605
## Sleep.Duration7-8 hours                          -0.92515    0.26493  -3.492
## Sleep.DurationMore than 8 hours                  -1.32329    0.28303  -4.675
## Dietary.HabitsModerate                           -0.65864    0.23724  -2.776
## Dietary.HabitsHealthy                            -1.38810    0.24582  -5.647
```

```
## DegreeBachelors Degree                                    -0.35659    0.28808  -1.238
## DegreePost-Graduate Degree                                -0.39307    0.30470  -1.290
## Work.Study.Hours                                           0.24047    0.02836   8.479
## Financial.Stress2                                          0.49314    0.34183   1.443
## Financial.Stress3                                          1.35803    0.33647   4.036
## Financial.Stress4                                          2.02442    0.33801   5.989
## Financial.Stress5                                          2.69829    0.34286   7.870
## Family.History.of.Mental.IllnessYes                        0.71387    0.19667   3.630
## Pressure2                                                  1.40523    0.39798   3.531
## Pressure3                                                  2.68474    0.37228   7.212
## Pressure4                                                  3.65120    0.38559   9.469
## Pressure5                                                  4.70617    0.40602  11.591
## Satisfaction2                                             -0.93343    0.28160  -3.315
## Satisfaction3                                             -1.62497    0.30082  -5.402
## Satisfaction4                                             -2.94344    0.34103  -8.631
## Satisfaction5                                             -3.51745    0.36623  -9.604
##                                                           Pr(>|z|)
## (Intercept)                                               9.58e-10 ***
## GenderMale                                                0.473705
## Age                                                        < 2e-16 ***
## Working.Professional.or.StudentWorking Professional       2.68e-14 ***
## Sleep.Duration5-6 hours                                   0.108390
## Sleep.Duration7-8 hours                                   0.000479 ***
## Sleep.DurationMore than 8 hours                           2.93e-06 ***
## Dietary.HabitsModerate                                    0.005498 **
## Dietary.HabitsHealthy                                     1.64e-08 ***
## DegreeBachelors Degree                                    0.215785
## DegreePost-Graduate Degree                                0.197042
## Work.Study.Hours                                           < 2e-16 ***
## Financial.Stress2                                         0.149121
## Financial.Stress3                                         5.43e-05 ***
## Financial.Stress4                                         2.11e-09 ***
## Financial.Stress5                                         3.55e-15 ***
## Family.History.of.Mental.IllnessYes                       0.000284 ***
## Pressure2                                                 0.000414 ***
## Pressure3                                                 5.53e-13 ***
## Pressure4                                                  < 2e-16 ***
## Pressure5                                                  < 2e-16 ***
## Satisfaction2                                             0.000917 ***
## Satisfaction3                                             6.60e-08 ***
## Satisfaction4                                              < 2e-16 ***
## Satisfaction5                                              < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1915.51  on 2044  degrees of freedom
## Residual deviance:  717.15  on 2020  degrees of freedom
## AIC: 767.15
##
## Number of Fisher Scoring iterations: 8
```

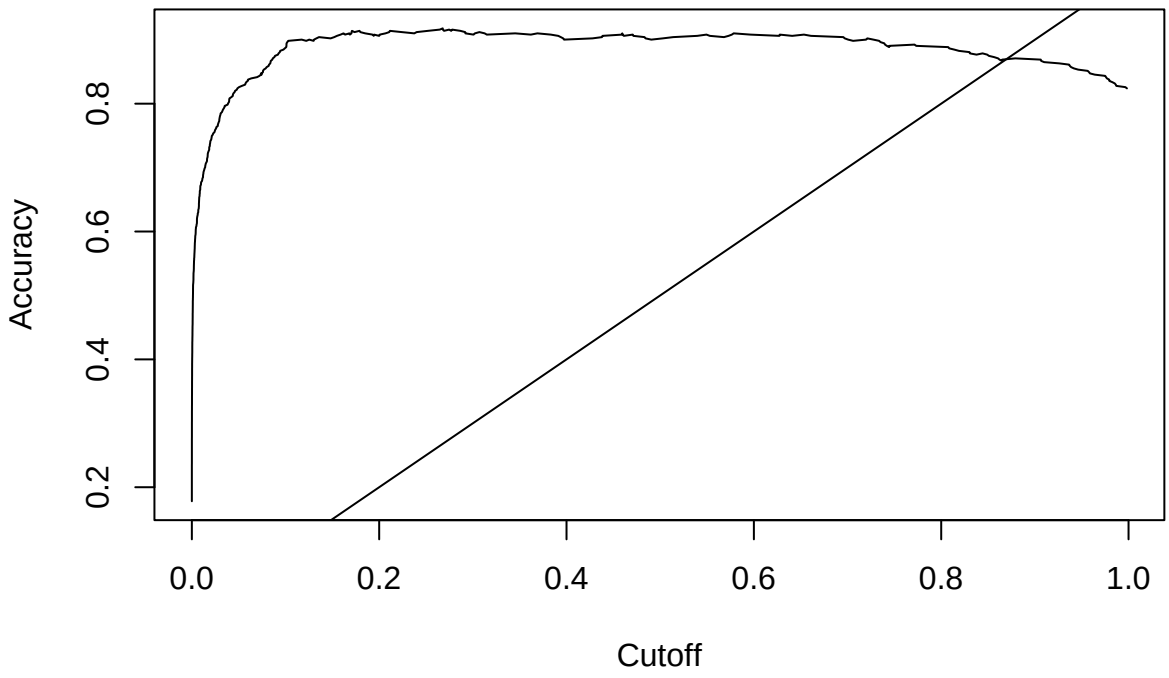
```r
# draw a roc curve for true positive rate and true negative rate to find the optimal cutoff
glm_predictions = predict(depression_glm, newdata = depression_test, type = "response")
prob_predictions = prediction(glm_predictions, depression_test$Depression)
roc_curve = performance(prob_predictions, "tpr", "fpr")
plot(roc_curve, colorize = TRUE)
abline(0, 1)
```




```r
# auc value
unlist(slot(performance(prob_predictions, "auc"), "y.values"))
```

```
## [1] 0.9682365
```

```r
acc = performance(prob_predictions, "acc")
plot(acc)
abline(0, 1)
```




```
glm_predictions2 = predict(depression_glm, newdata = depression_test)
glm_predictions2 = ifelse(glm_predictions2 > 0.30, "Yes", "No")
glm_predictions2 = as.factor(glm_predictions2)
confusionMatrix(glm_predictions2, depression_test$Depression)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  410  37
##        Yes  10  54
##
##                Accuracy : 0.908
##                  95% CI : (0.8796, 0.9316)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 2.887e-08
##
##                   Kappa : 0.6445
##
##  Mcnemar's Test P-Value : 0.0001491
##
##             Sensitivity : 0.9762
##             Specificity : 0.5934
##          Pos Pred Value : 0.9172
##          Neg Pred Value : 0.8437
```

```
##              Prevalence : 0.8219
##          Detection Rate : 0.8023
##    Detection Prevalence : 0.8748
##       Balanced Accuracy : 0.7848
##
##        'Positive' Class : No
##
```

```
train_control = trainControl(method = "repeatedcv", number = 10, repeats = 3, classProbs = TRUE)
depression_cvglm = train(Depression ~ .,
                         data = depression_train,
                         method = "glm",
                         family = binomial,
                         trControl = train_control)
```

```
depression_cvglm$results
```

```
##   parameter  Accuracy     Kappa AccuracySD    KappaSD
## 1      none 0.8968226 0.6369108 0.02223823 0.07530717
```

```
cvglm_predictions = predict(depression_cvglm, depression_test)
confusionMatrix(cvglm_predictions, depression_test$Depression)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  405  35
##        Yes  15  56
##
##                Accuracy : 0.9022
##                  95% CI : (0.873, 0.9265)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 2.632e-07
##
##                   Kappa : 0.6343
##
##  Mcnemar's Test P-Value : 0.00721
##
##             Sensitivity : 0.9643
##             Specificity : 0.6154
##          Pos Pred Value : 0.9205
##          Neg Pred Value : 0.7887
##              Prevalence : 0.8219
##          Detection Rate : 0.7926
##    Detection Prevalence : 0.8611
##       Balanced Accuracy : 0.7898
##
##        'Positive' Class : No
##
```

```r
varImp(depression_cvglm)
```

```
## glm variable importance
##
##   only 20 most important variables shown (out of 24)
##
##                                                    Overall
## Age                                                100.000
## Pressure5                                           85.715
## Satisfaction5                                       70.057
## Pressure4                                           68.991
## Satisfaction4                                       62.384
## Work.Study.Hours                                    61.189
## Financial.Stress5                                   56.386
## `Working.Professional.or.StudentWorking Professional`  54.358
## Pressure3                                           51.196
## Financial.Stress4                                   41.562
## Dietary.HabitsHealthy                               38.862
## Satisfaction3                                       36.931
## `Sleep.DurationMore than 8 hours`                   31.206
## Financial.Stress3                                   26.167
## Family.History.of.Mental.IllnessYes                 22.964
## Pressure2                                           22.184
## `Sleep.Duration7-8 hours`                           21.878
## Satisfaction2                                       20.480
## Dietary.HabitsModerate                              16.236
## `Sleep.Duration5-6 hours`                            7.007
```