Depression Draft 1

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```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.4.1
## Warning: package 'ggplot2' was built under R version 4.4.1
## Warning: package 'tidyr' was built under R version 4.4.1
## Warning: package 'readr' was built under R version 4.4.1
## Warning: package 'purrr' was built under R version 4.4.1
## Warning: package 'stringr' was built under R version 4.4.1
## Warning: package 'forcats' was built under R version 4.4.1
## Warning: package 'lubridate' was built under R version 4.4.1
## -- 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)
```

```
## Warning: package 'cowplot' was built under R version 4.4.2
##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##     stamp
```

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.4.1
## 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
```

```
library(sjPlot)
```

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

```
##
## Attaching package: 'sjPlot'
##
## The following objects are masked from 'package:cowplot':
##
##     plot_grid, save_plot
```

```
library(visdat)
```

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

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

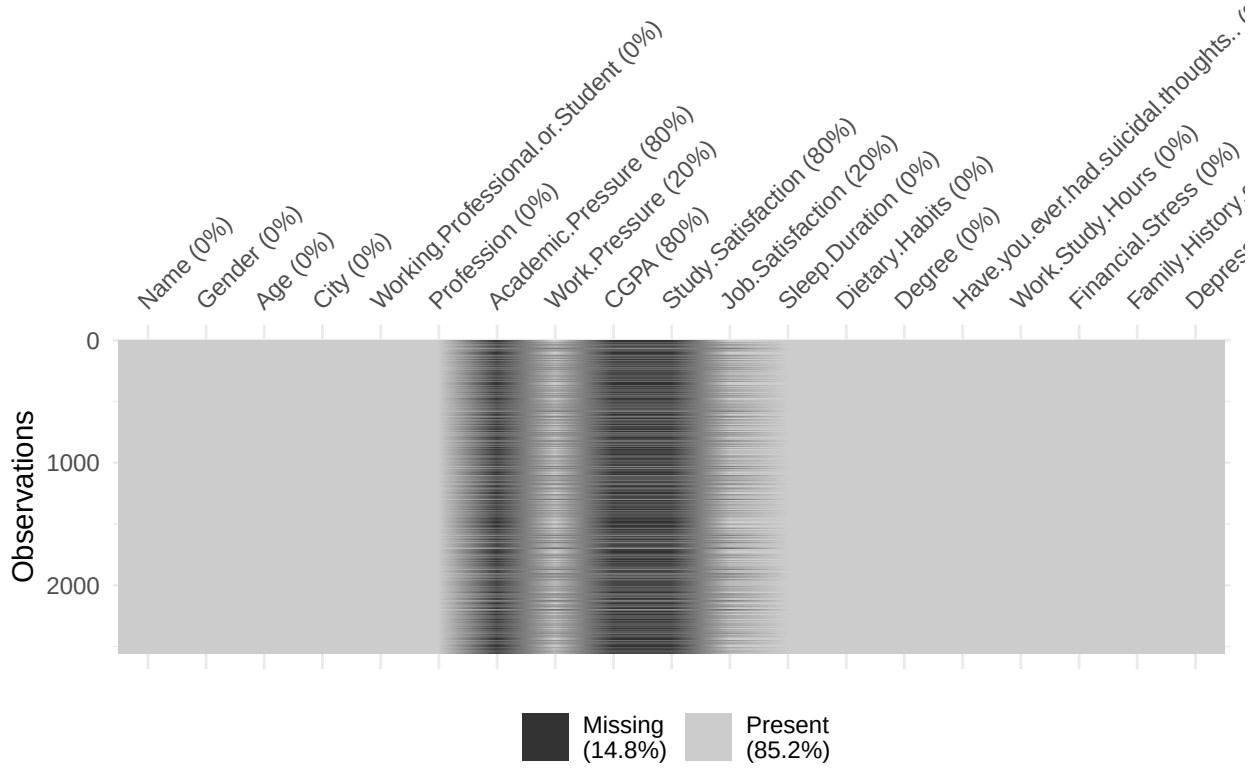
```
# find the dimension of depression
dim(depression)
```

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

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

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

```
vis_miss(depression)
```




```
# 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
```

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

```r
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
```

```r
# 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"
```

```r
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"
```

```
# recode degree into three categories
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"
```

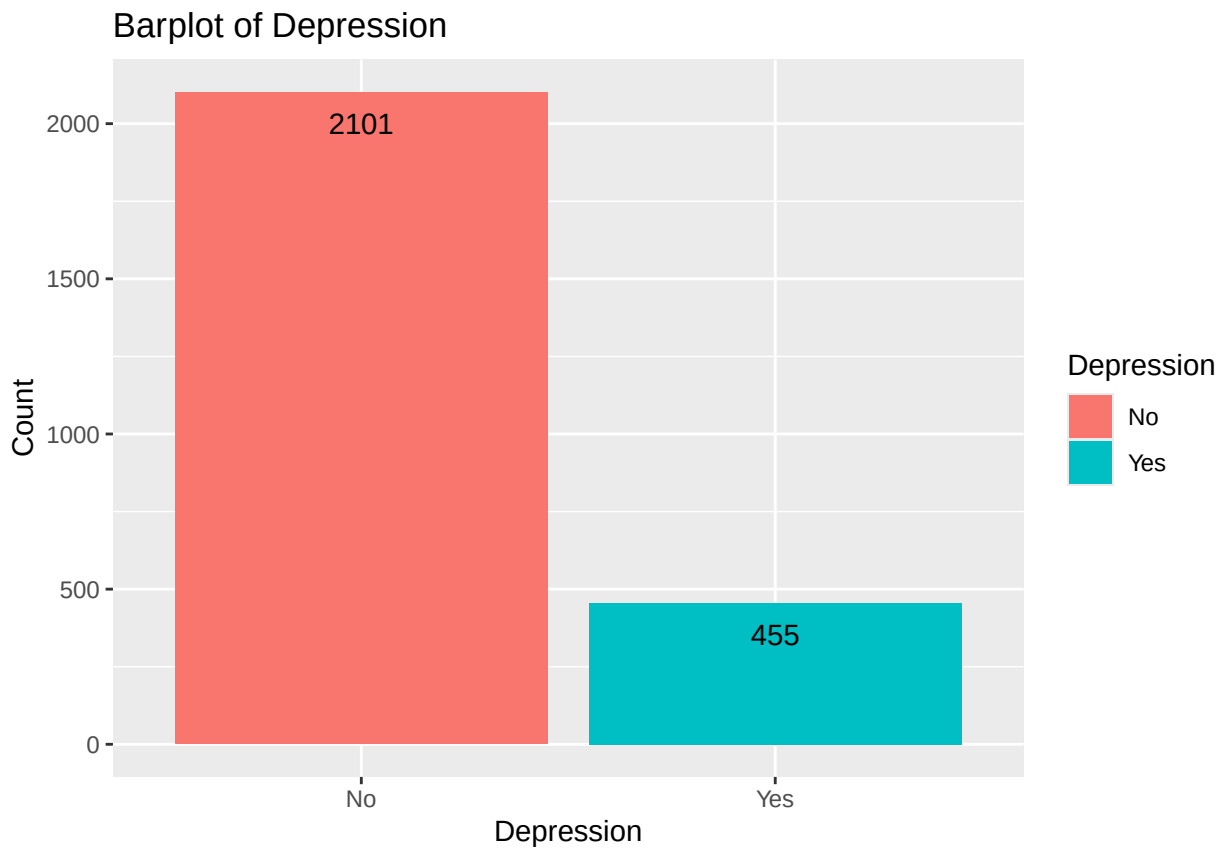
```
# change each categorical into a factor, changing the base/ordering them if needed
depression$Gender = as.factor(depression$Gender)
depression$Working.Professional.or.Student = as.factor(depression$Working.Professional.or.Student)
depression$Sleep.Duration = factor(depression$Sleep.Duration, levels = 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$Family.History.of.Mental.Illness = as.factor(depression$Family.History.of.Mental.Illness)
depression$Depression = as.factor(depression$Depression)
```

```
# find if any variables are unbalanced
depressionFactored = select(depression, where(is.factor))
sapply(depressionFactored, table)
```

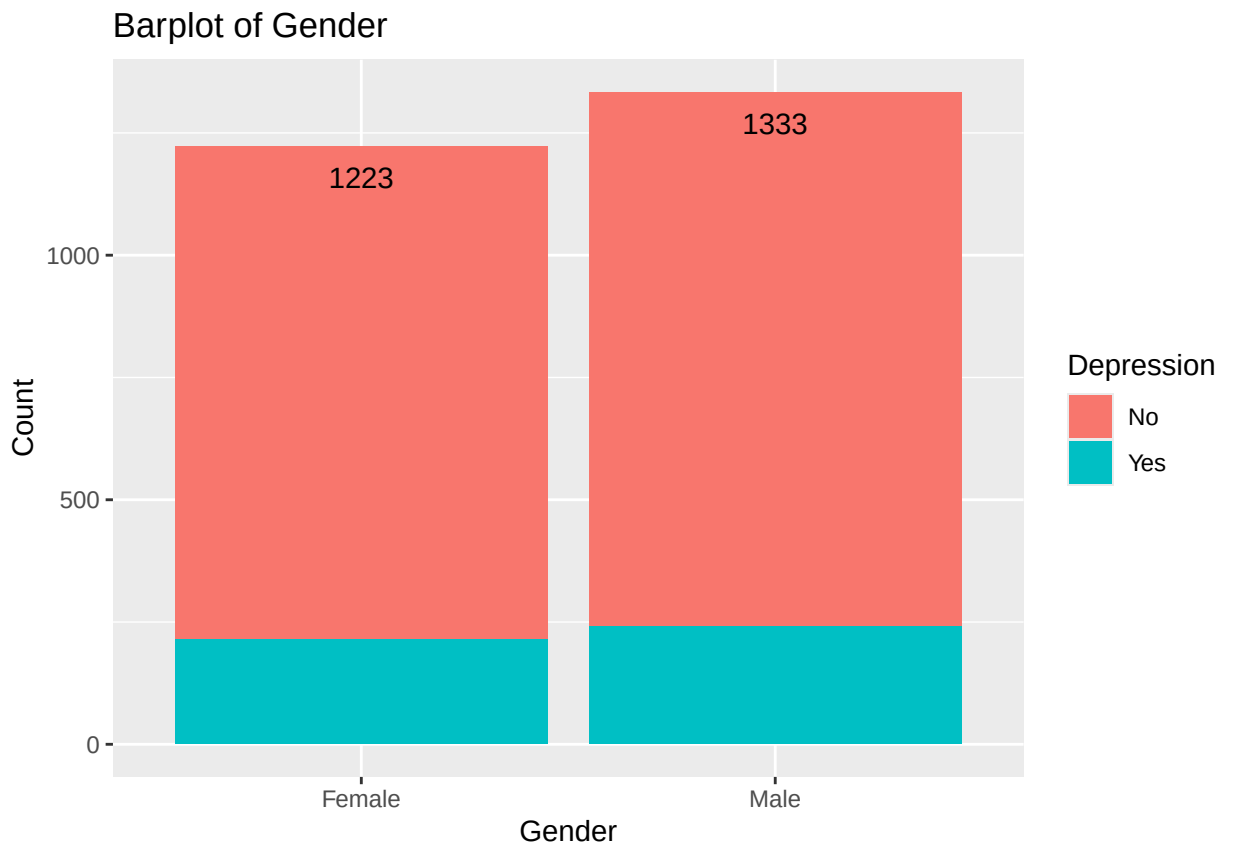
```
## $Gender
##
## Female   Male
##   1223   1333
##
## $Working.Professional.or.Student
##
##              Student Working Professional
##                  502                 2054
##
## $Sleep.Duration
##
## Less than 5 hours         5-6 hours         7-8 hours More than 8 hours
##               648               628               658               622
##
## $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
##
## $Family.History.of.Mental.Illness
##
##   No  Yes
## 1311 1245
##
## $Depression
##
##   No  Yes
## 2101  455
```

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



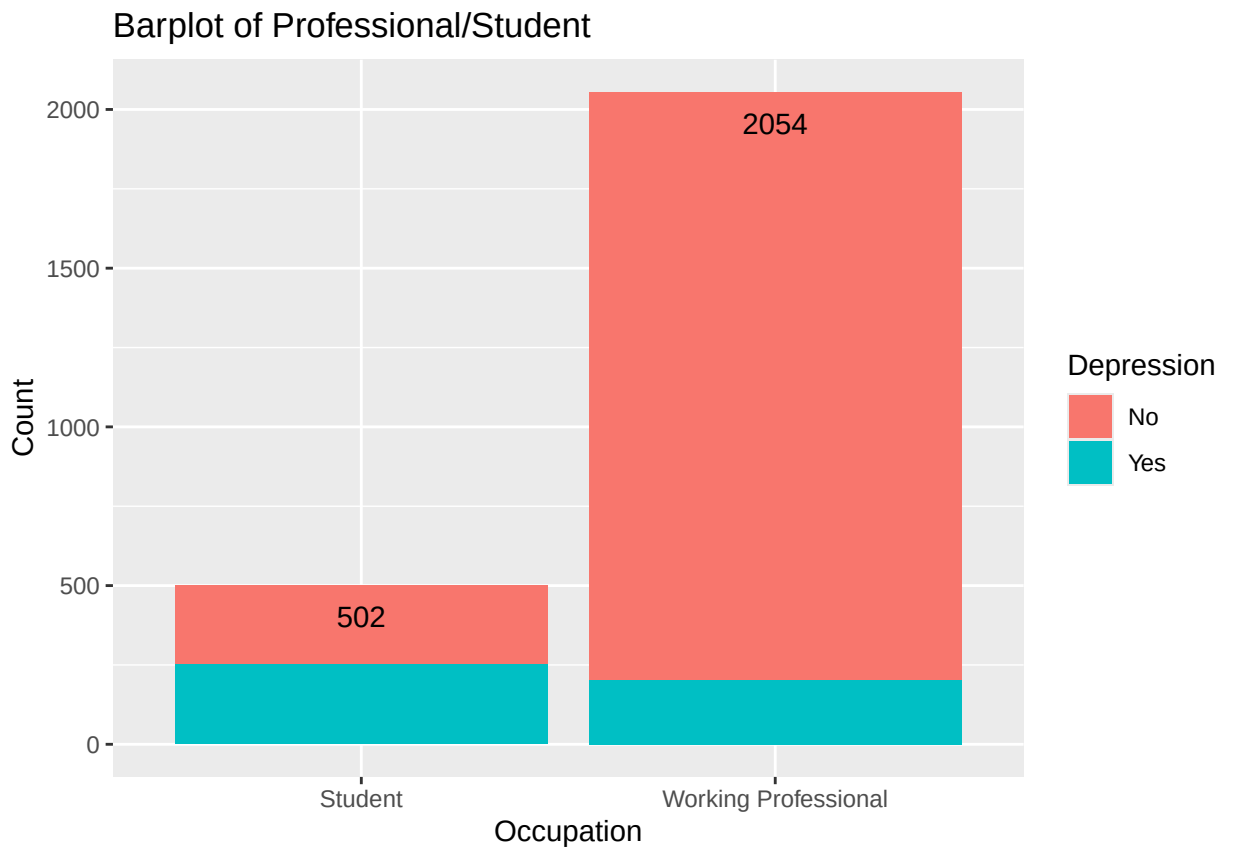

```
table(depression$Depression, depression$Gender)
```

```
##
##       Female Male
##   No    1009 1092
##   Yes    214  241
```

```
prop.table(table(depression$Depression, depression$Gender), margin = 1)
```

```
##
##          Female      Male
##   No  0.4802475 0.5197525
##   Yes 0.4703297 0.5296703
```

```
# 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)
```



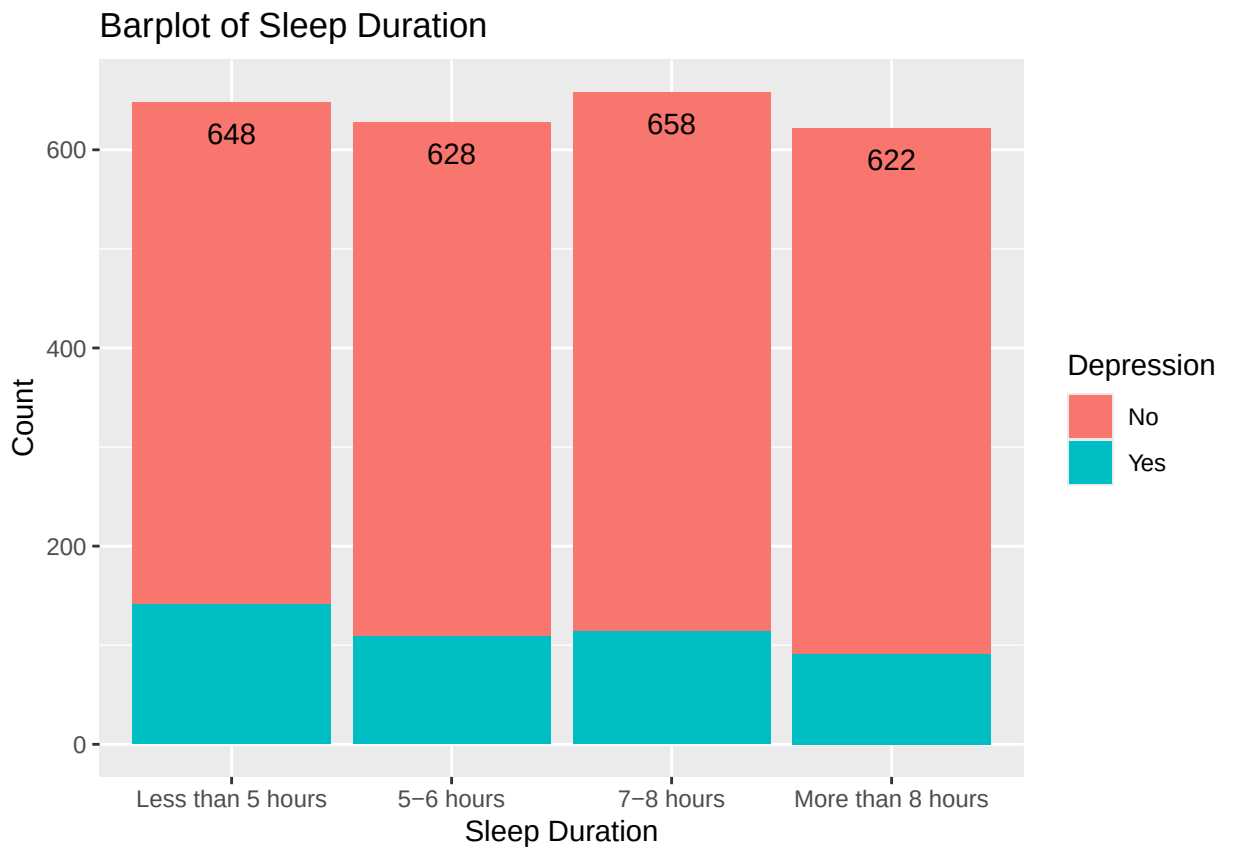

```
table(depression$Depression, depression$Working.Professional.or.Student)
```

```
##
##       Student Working Professional
##   No      250                  1851
##   Yes     252                   203
```

```
prop.table(table(depression$Depression, depression$Working.Professional.or.Student), margin = 1)
```

```
##
##         Student Working Professional
##   No  0.1189910            0.8810090
##   Yes 0.5538462            0.4461538
```

```
# 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)
```



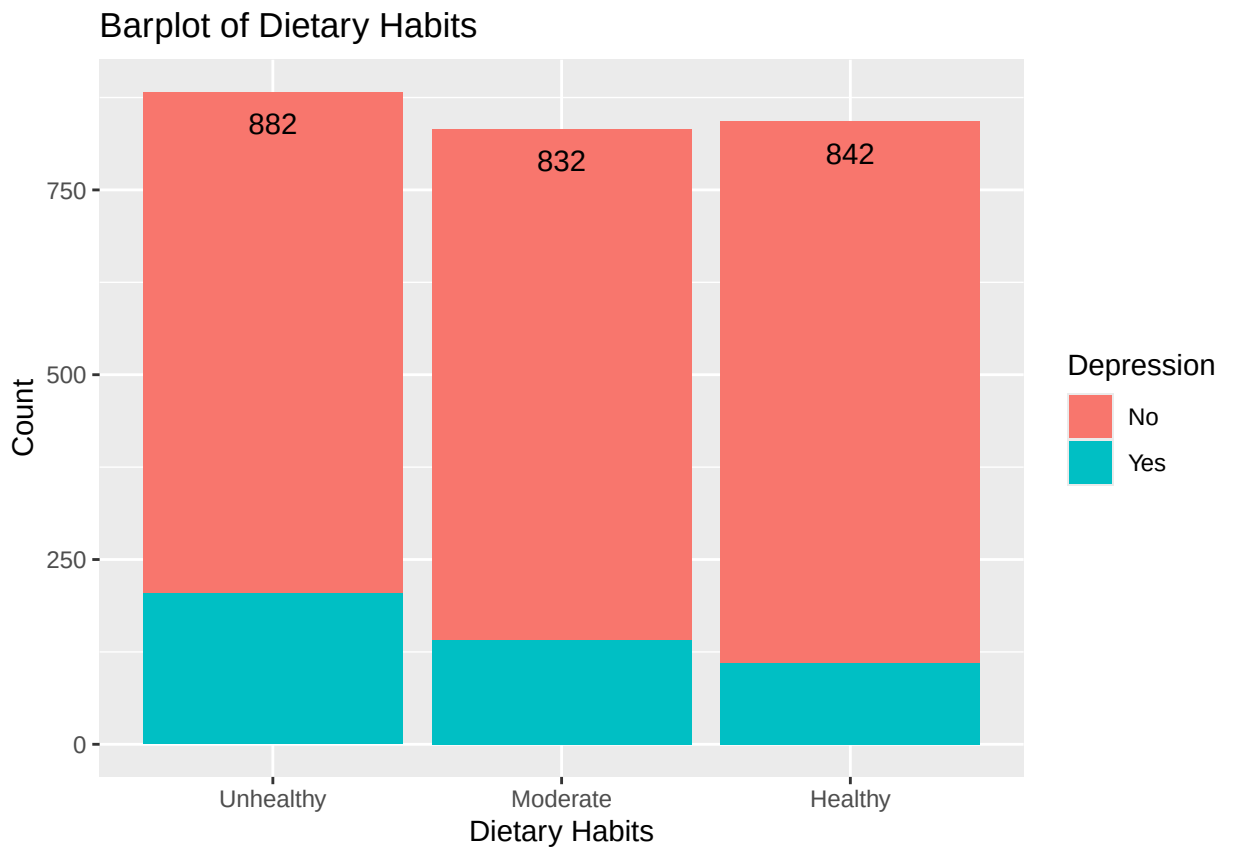

```
table(depression$Depression, depression$Sleep.Duration)
```

```
##
##       Less than 5 hours 5-6 hours 7-8 hours More than 8 hours
##   No                507       519       544               531
##   Yes               141       109       114                91
```

```
prop.table(table(depression$Depression, depression$Sleep.Duration), margin = 1)
```

```
##
##       Less than 5 hours 5-6 hours 7-8 hours More than 8 hours
##   No          0.2413137 0.2470252 0.2589243         0.2527368
##   Yes         0.3098901 0.2395604 0.2505495         0.2000000
```

```
# 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)
```



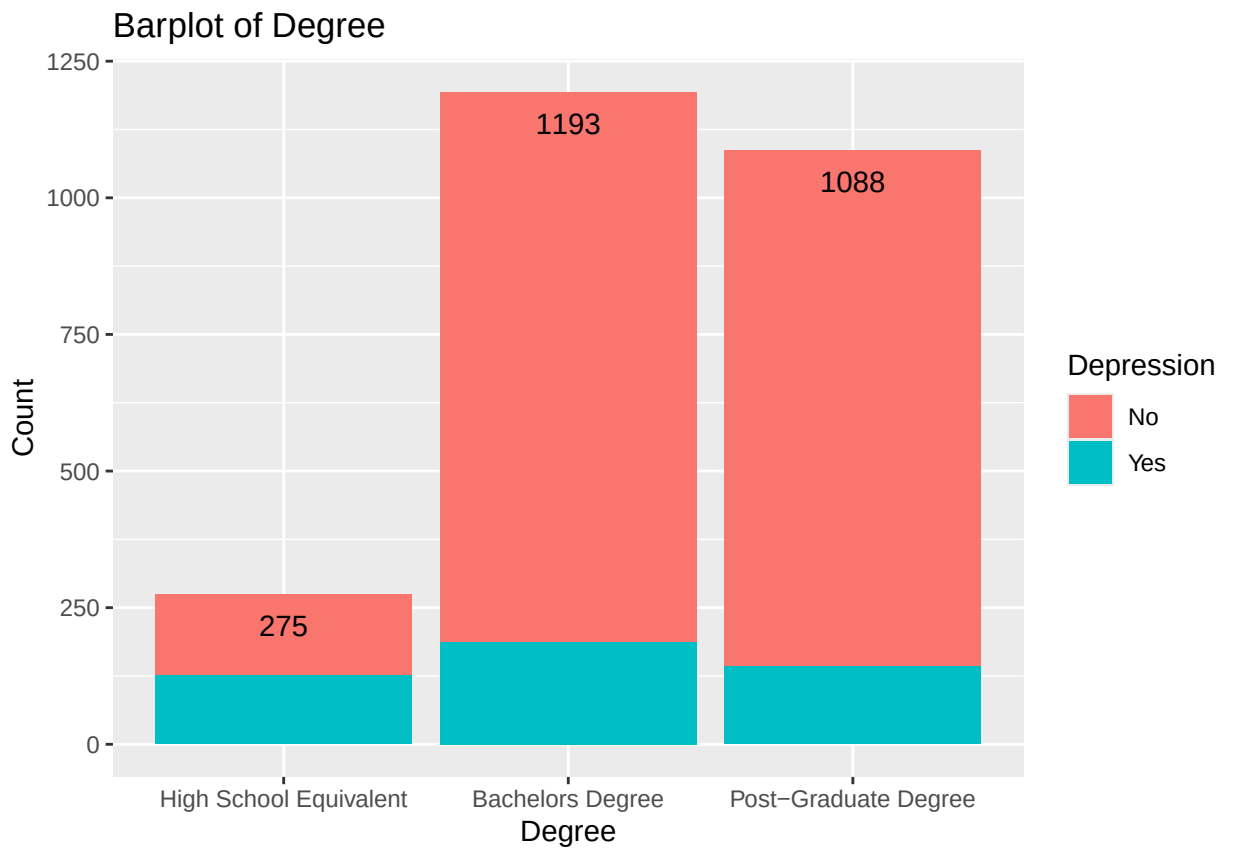

```
table(depression$Depression, depression$Dietary.Habits)
```

```
##
##       Unhealthy Moderate Healthy
##   No        678      691     732
##   Yes       204      141     110
```

```
prop.table(table(depression$Depression, depression$Dietary.Habits), margin = 1)
```

```
##
##       Unhealthy  Moderate   Healthy
##   No  0.3227035 0.3288910 0.3484055
##   Yes 0.4483516 0.3098901 0.2417582
```

```
# 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)
```



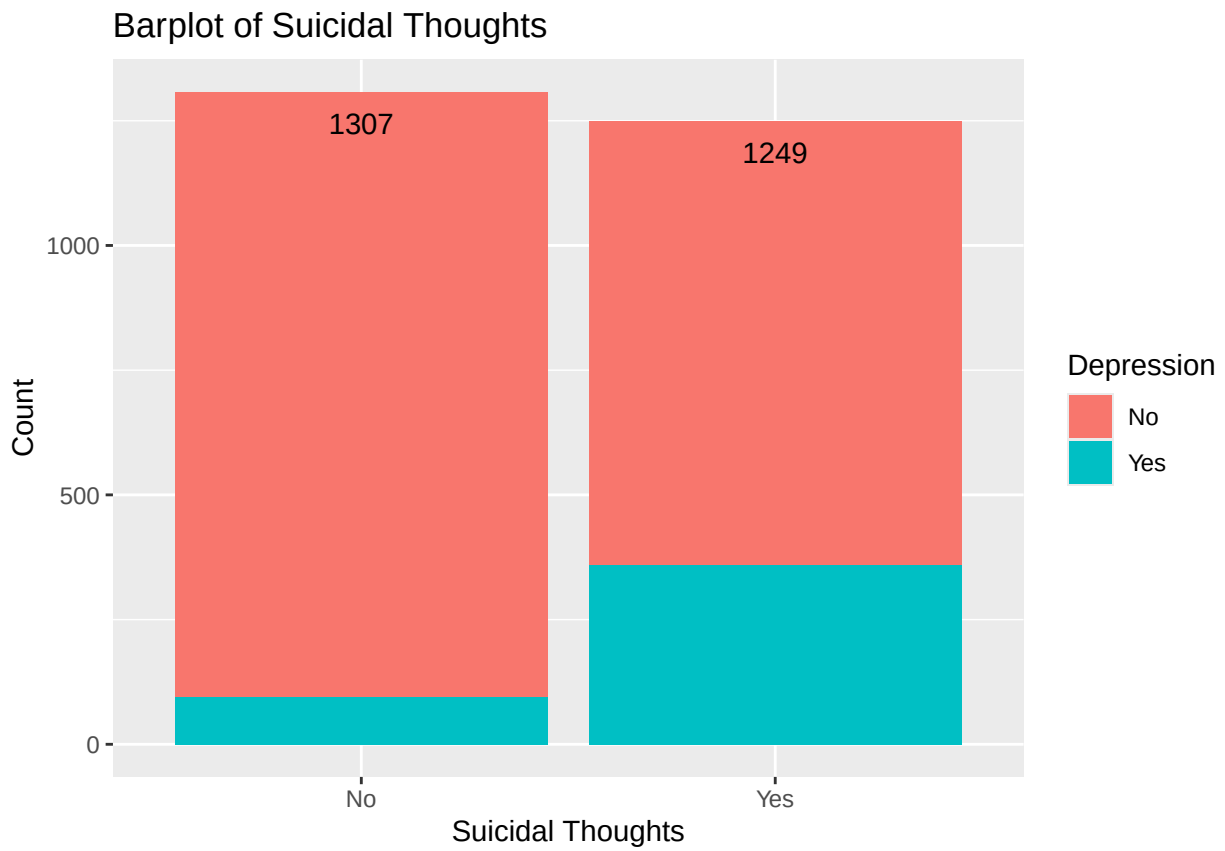

```
table(depression$Depression, depression$Degree)
```

```
##
##       High School Equivalent Bachelors Degree Post-Graduate Degree
##   No                     149             1006                  946
##   Yes                    126              187                  142
```

```
prop.table(table(depression$Depression, depression$Degree), margin = 1)
```

```
##
##       High School Equivalent Bachelors Degree Post-Graduate Degree
##   No              0.07091861       0.47881961           0.45026178
##   Yes             0.27692308       0.41098901           0.31208791
```

```
# 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)
```




```
table(depression$Depression, depression$Have.you.ever.had.suicidal.thoughts..)
```

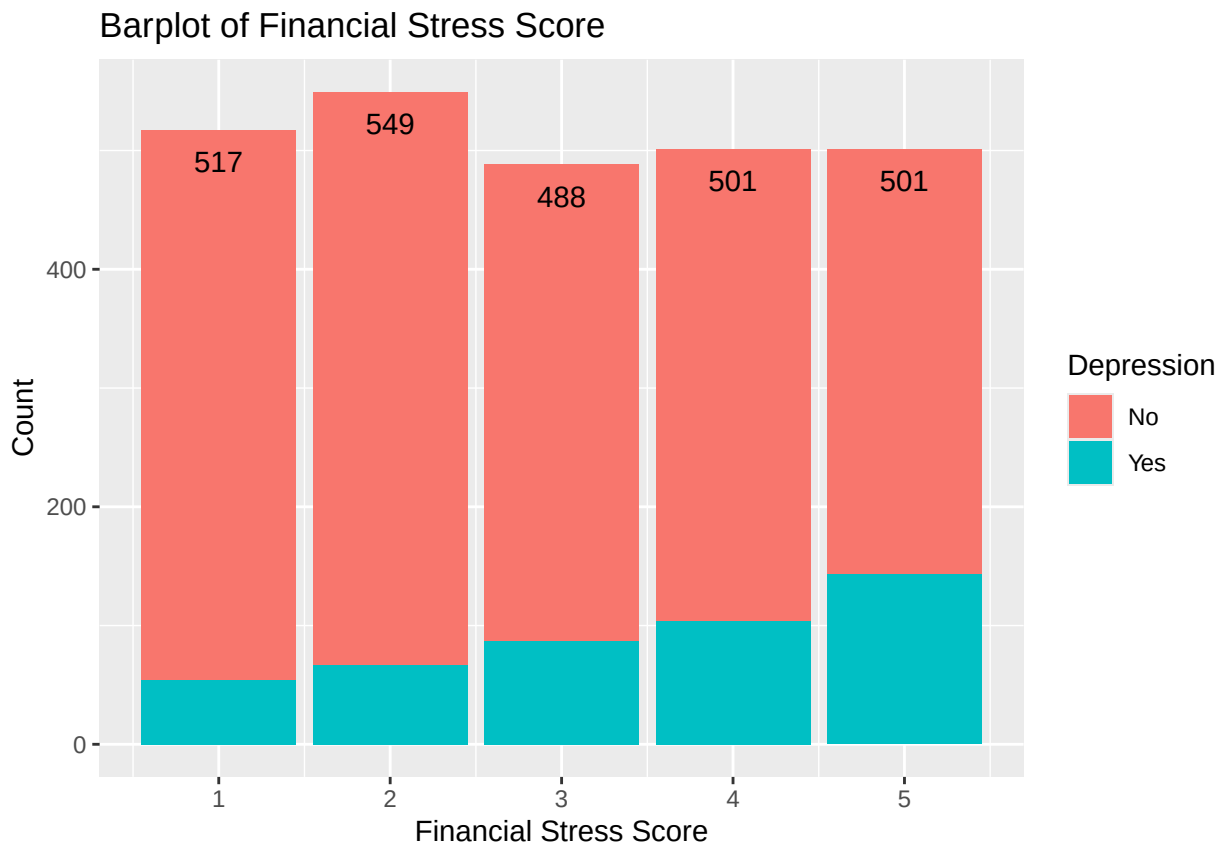
```
##
##         No  Yes
##   No  1212  889
##   Yes   95  360
```

```
prop.table(table(depression$Depression, depression$Have.you.ever.had.suicidal.thoughts..), margin = 1)
```

```
##
##              No       Yes
##   No  0.5768682 0.4231318
##   Yes 0.2087912 0.7912088
```

```
# 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)
```



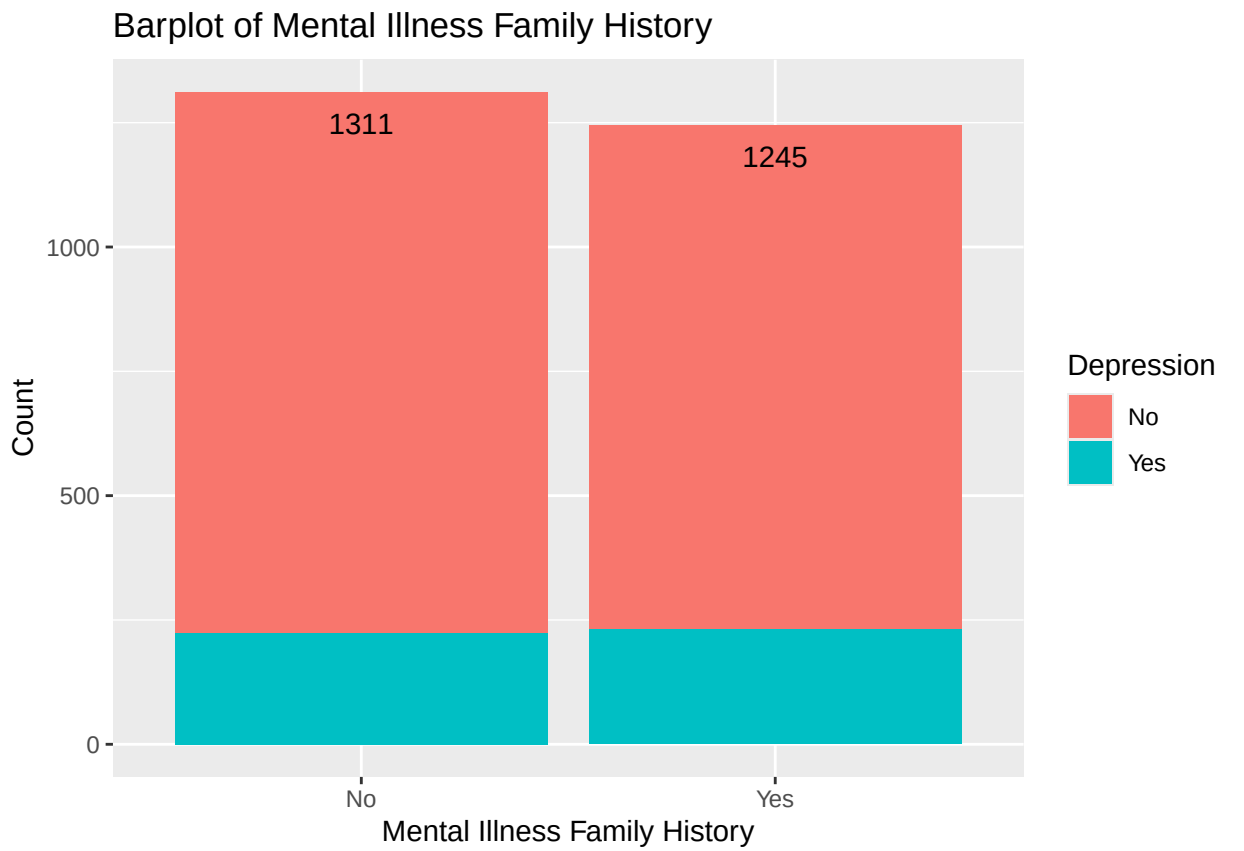

```
table(depression$Depression, depression$Financial.Stress)
```

```
##
##         1   2   3   4   5
##   No  463 482 401 397 358
##   Yes  54  67  87 104 143
```

```
prop.table(table(depression$Depression, depression$Financial.Stress), margin = 1)
```

```
##
##               1         2         3         4         5
##   No  0.2203713 0.2294146 0.1908615 0.1889576 0.1703950
##   Yes 0.1186813 0.1472527 0.1912088 0.2285714 0.3142857
```

```
# 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)
```



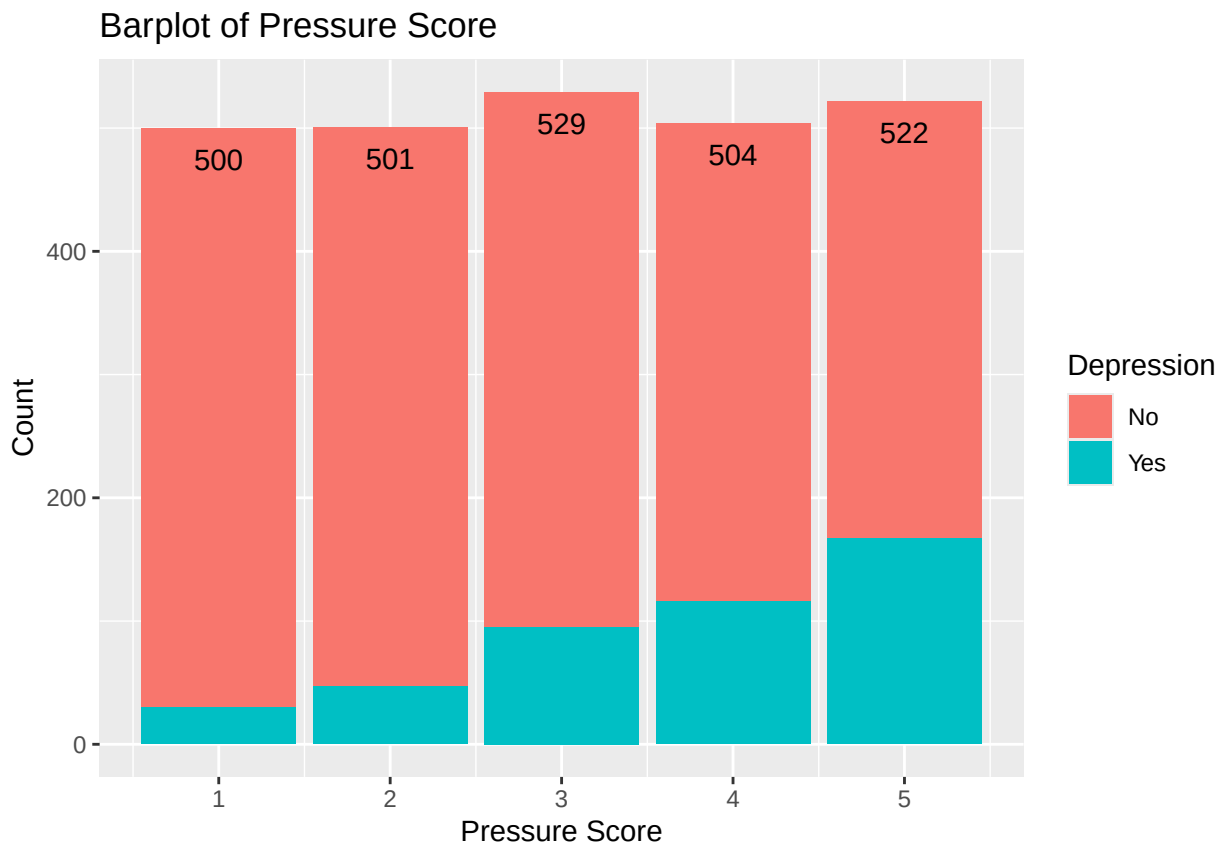

```
table(depression$Depression, depression$Family.History.of.Mental.Illness)
```

```
##
##         No  Yes
##   No  1087 1014
##   Yes  224  231
```

```
prop.table(table(depression$Depression, depression$Family.History.of.Mental.Illness), margin = 1)
```

```
##
##              No       Yes
##   No  0.5173727 0.4826273
##   Yes 0.4923077 0.5076923
```

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



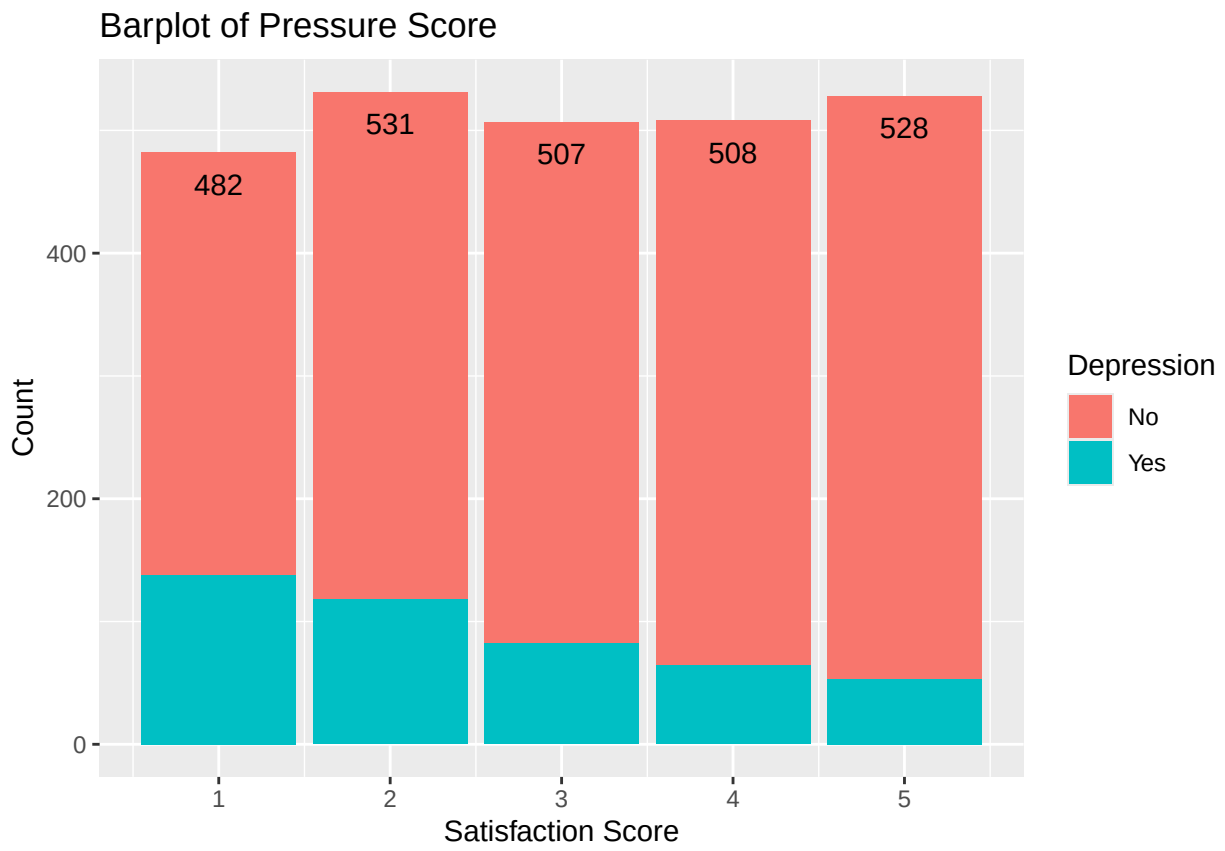

```
table(depression$Depression, depression$Pressure)
```

```
##
##         1   2   3   4   5
##   No  470 454 434 388 355
##   Yes  30  47  95 116 167
```

```
prop.table(table(depression$Depression, depression$Pressure), margin = 1)
```

```
##
##                1          2          3          4          5
##   No  0.22370300 0.21608758 0.20656830 0.18467396 0.16896716
##   Yes 0.06593407 0.10329670 0.20879121 0.25494505 0.36703297
```

```
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)
```




```
table(depression$Depression, depression$Satisfaction)
```

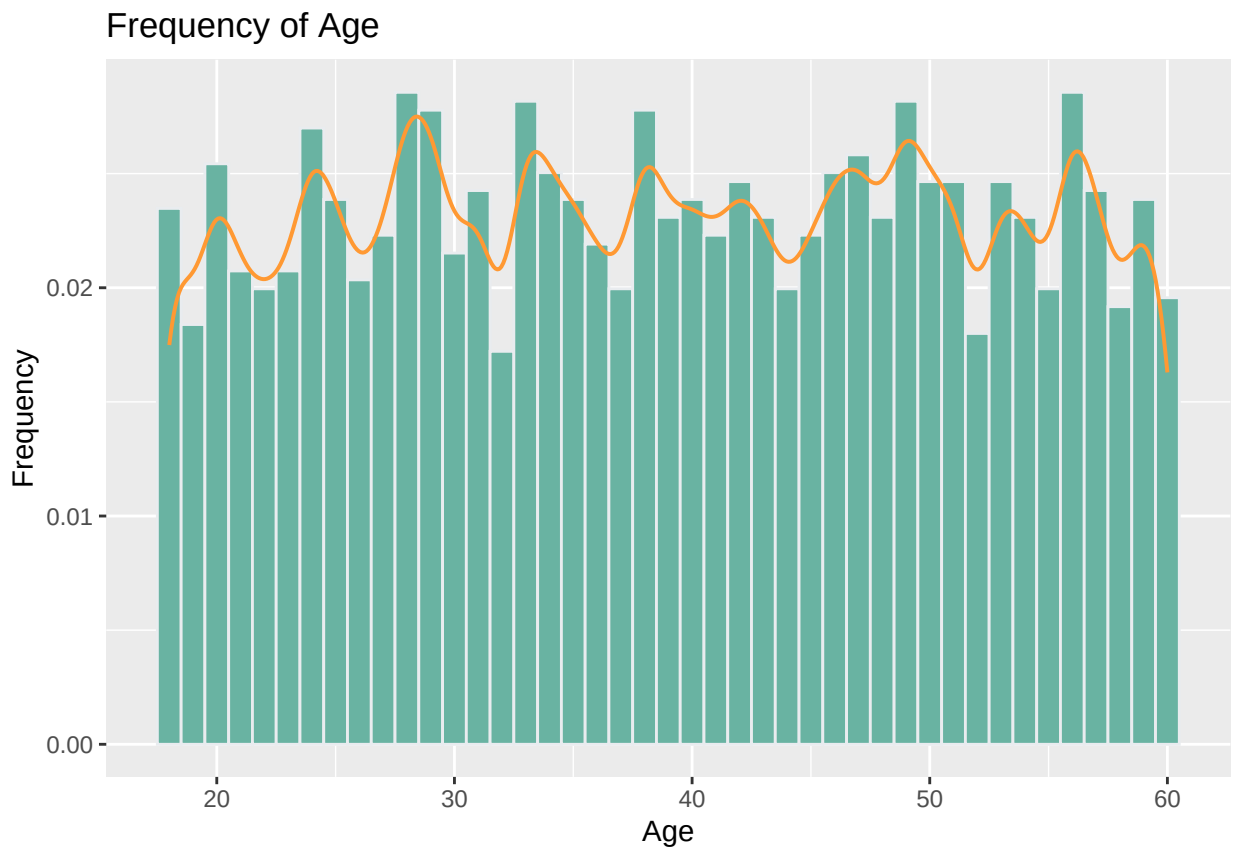
```
##
##         1   2   3   4   5
##   No  344 413 425 444 475
##   Yes 138 118  82  64  53
```

```
prop.table(table(depression$Depression, depression$Satisfaction), margin = 1)
```

```
##
##               1         2         3         4         5
##   No  0.1637316 0.1965731 0.2022846 0.2113279 0.2260828
##   Yes 0.3032967 0.2593407 0.1802198 0.1406593 0.1164835
```

```
# create specific data frames to separate those with and without risk of depression
depressionYes = depression[depression$Depression == "Yes", ]
depressionNo = depression[depression$Depression == "No", ]
```

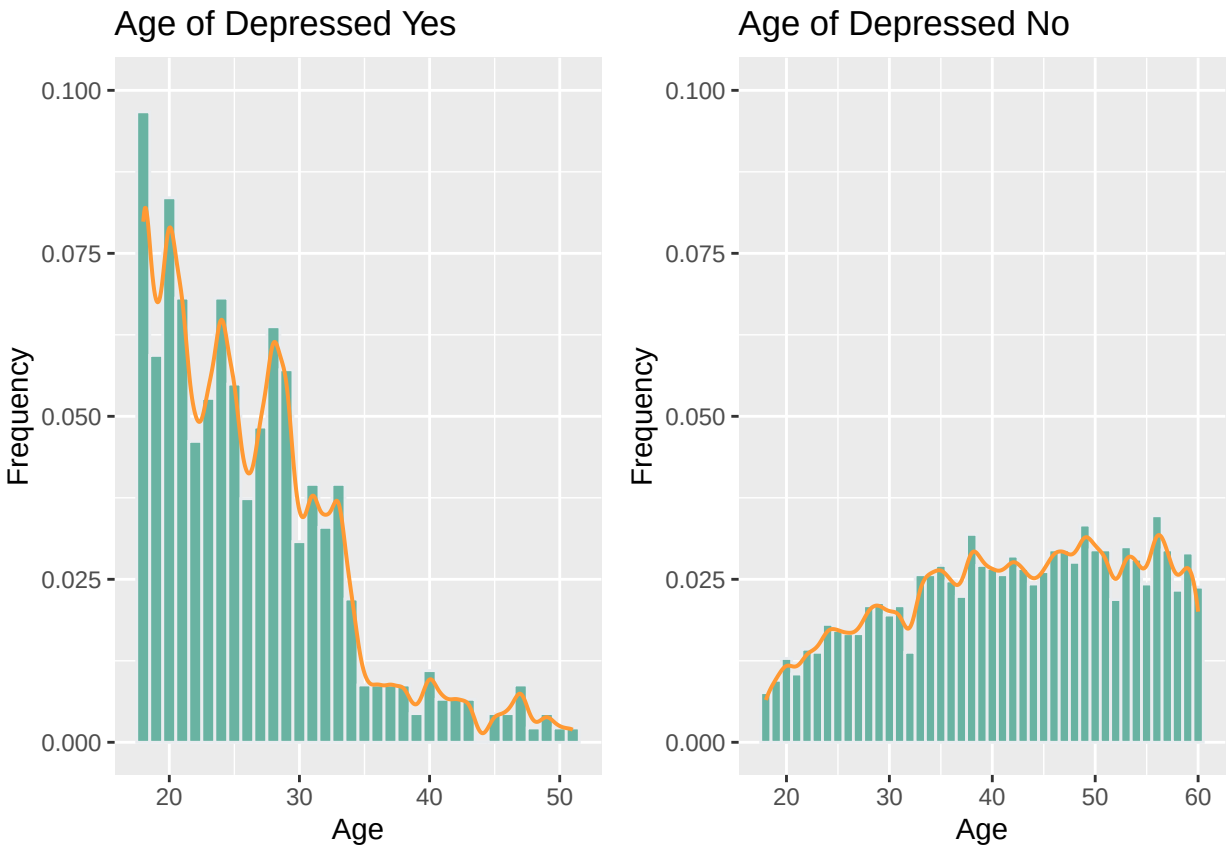
```
ggplot(depression, aes(x = Age, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 0.3) +
  ggtitle("Frequency of Age") +
  ylab("Frequency")
```



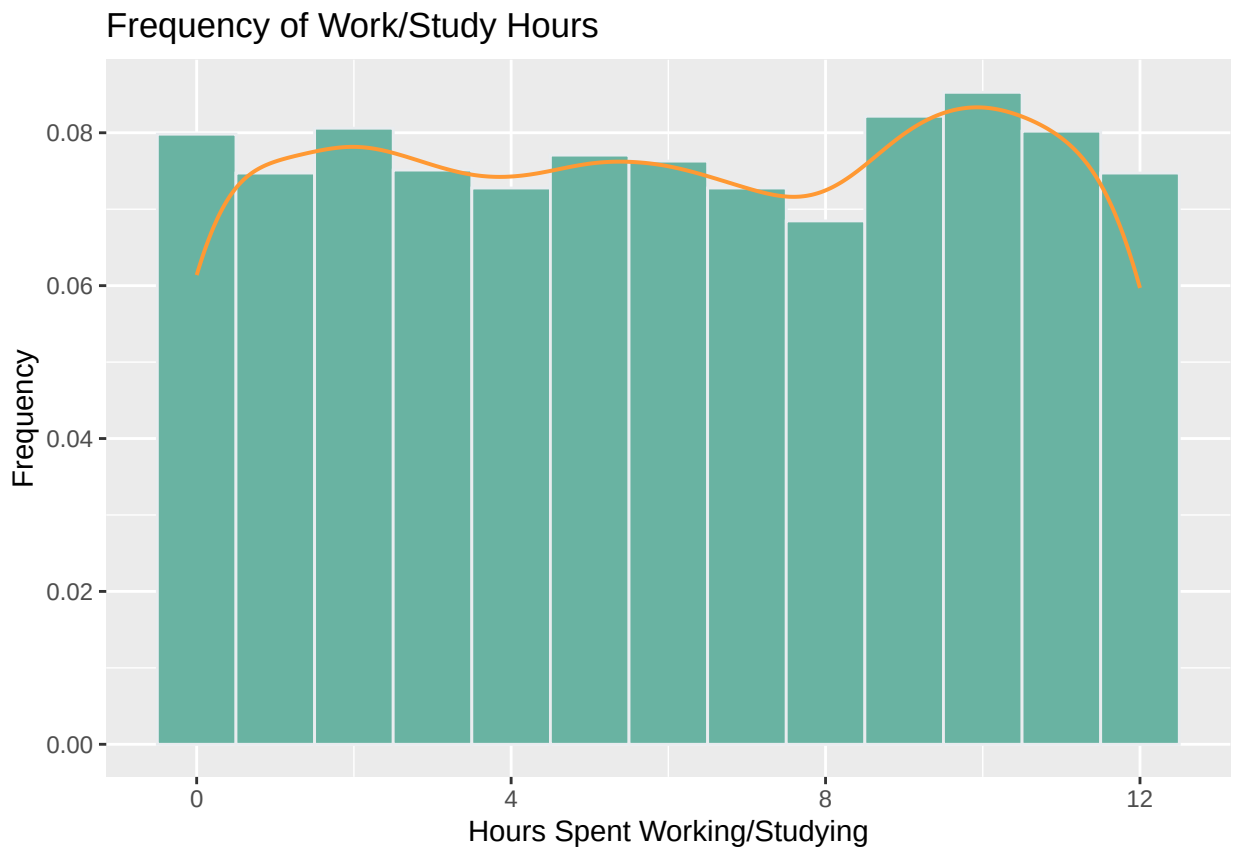

```
p1 = ggplot(depressionYes, aes(x = Age, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 0.3) +
  ggtitle("Age of Depressed Yes") +
  ylab("Frequency") +
  ylim(0, 0.10)

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("Age of Depressed No") +
  ylab("Frequency") +
  ylim(0, 0.10)
```

```
cowplot::plot_grid(p1, p2)
```



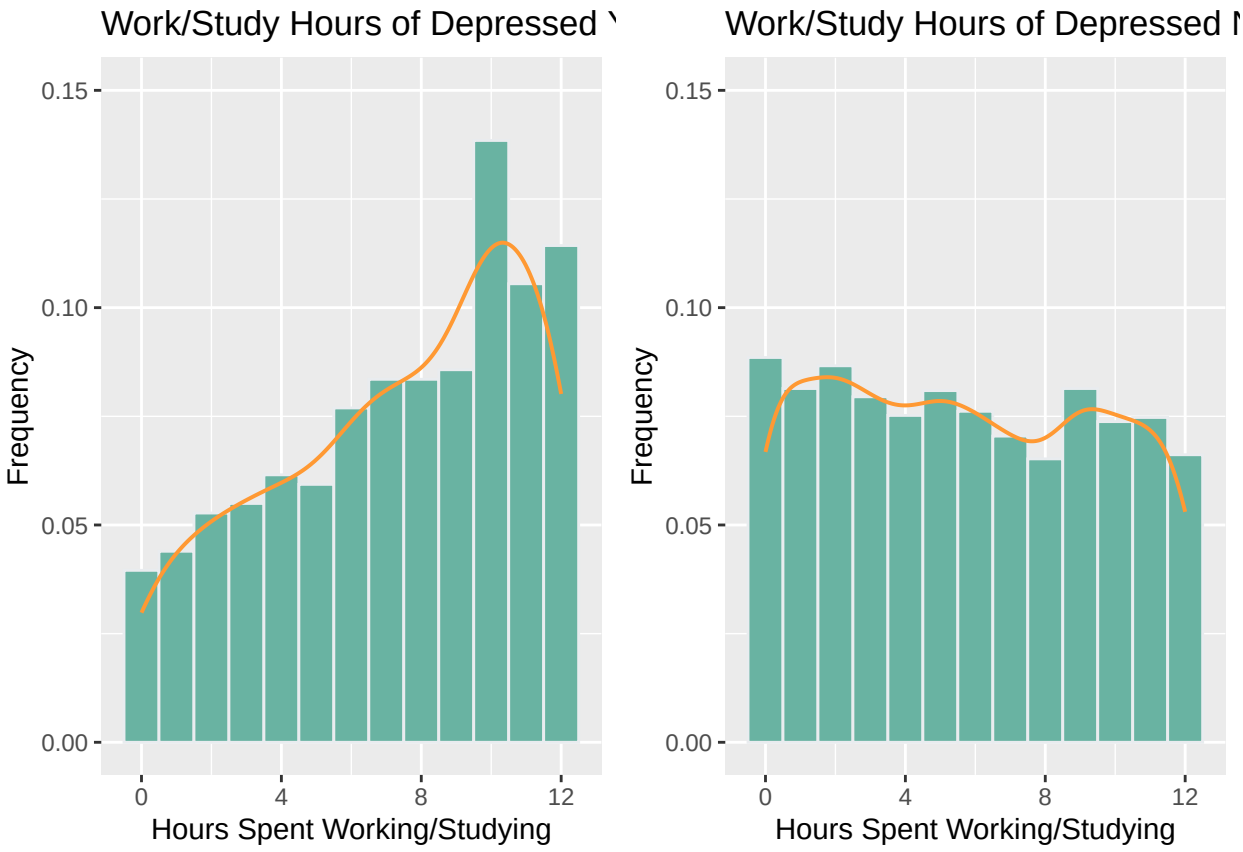

```
ggplot(depression, aes(x = Work.Study.Hours, y = after_stat(density))) +
  geom_histogram(binwidth = 1, fill="#69B3A2", color = "#E9ECEF") +
  geom_density(color = "#FF9933", linewidth = 0.7, adjust = 1) +
  ggtitle("Frequency of Work/Study Hours") +
  xlab("Hours Spent Working/Studying") +
  ylab("Frequency")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




```
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("Work/Study Hours of Depressed Yes") +
  xlab("Hours Spent Working/Studying") +
  ylab("Frequency") +
  ylim(0, 0.15)

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("Work/Study Hours of Depressed No") +
  xlab("Hours Spent Working/Studying") +
  ylab("Frequency") +
  ylim(0, 0.15)
```

```
cowplot::plot_grid(p3, p4, ncol = 2)
```



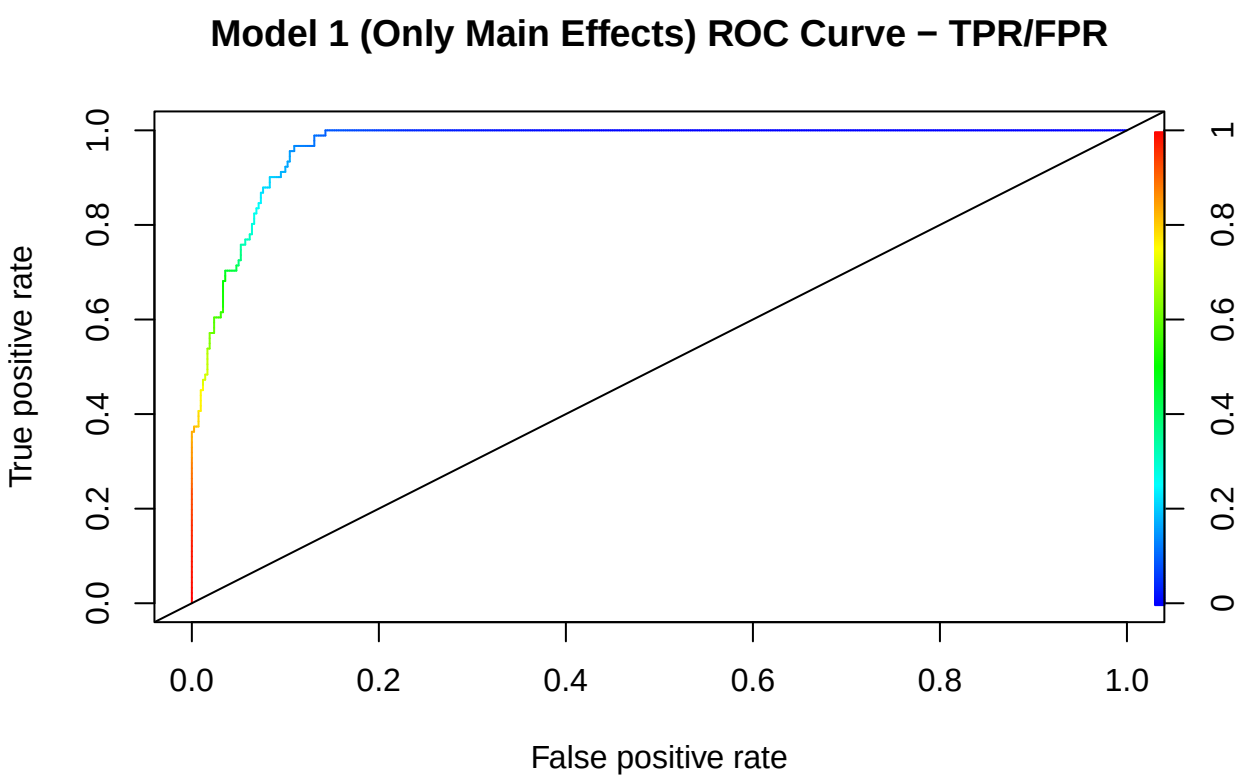

```
# create train and test set
set.seed(213)
index = createDataPartition(depression$Depression, p = 0.80, list = FALSE, times = 1)
depression_train = depression[index,]
depression_test = depression[-index,]
```

```
# 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)                                       2.96631    0.59651   4.973
## GenderMale                                       -0.12770    0.19393  -0.658
## Age                                              -0.22468    0.01667 -13.478
## Working.Professional.or.StudentWorking Professional -1.70515    0.22278  -7.654
## Sleep.Duration5-6 hours                          -0.44304    0.26513  -1.671
## Sleep.Duration7-8 hours                          -0.92674    0.26201  -3.537
## Sleep.DurationMore than 8 hours                  -1.31202    0.28084  -4.672
## Dietary.HabitsModerate                           -0.64680    0.23387  -2.766
## Dietary.HabitsHealthy                            -1.37469    0.24309  -5.655
## DegreeBachelors Degree                           -0.31858    0.28583  -1.115
## DegreePost-Graduate Degree                       -0.36122    0.30184  -1.197
```

```
## Work.Study.Hours                                      0.23994    0.02808   8.545
## Financial.Stress                                      0.68694    0.07639   8.993
## Family.History.of.Mental.IllnessYes                   0.71444    0.19588   3.647
## Pressure                                              1.12794    0.08818  12.791
## Satisfaction                                         -0.89314    0.08269 -10.801
##                                                     Pr(>|z|)
## (Intercept)                                         6.60e-07 ***
## GenderMale                                          0.510240
## Age                                                  < 2e-16 ***
## Working.Professional.or.StudentWorking Professional 1.95e-14 ***
## Sleep.Duration5-6 hours                             0.094711 .
## Sleep.Duration7-8 hours                             0.000405 ***
## Sleep.DurationMore than 8 hours                     2.99e-06 ***
## Dietary.HabitsModerate                              0.005680 **
## Dietary.HabitsHealthy                               1.56e-08 ***
## DegreeBachelors Degree                              0.265042
## DegreePost-Graduate Degree                          0.231408
## Work.Study.Hours                                     < 2e-16 ***
## Financial.Stress                                     < 2e-16 ***
## Family.History.of.Mental.IllnessYes                 0.000265 ***
## Pressure                                             < 2e-16 ***
## Satisfaction                                         < 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:  721.32  on 2029  degrees of freedom
## AIC: 753.32
##
## Number of Fisher Scoring iterations: 7
```

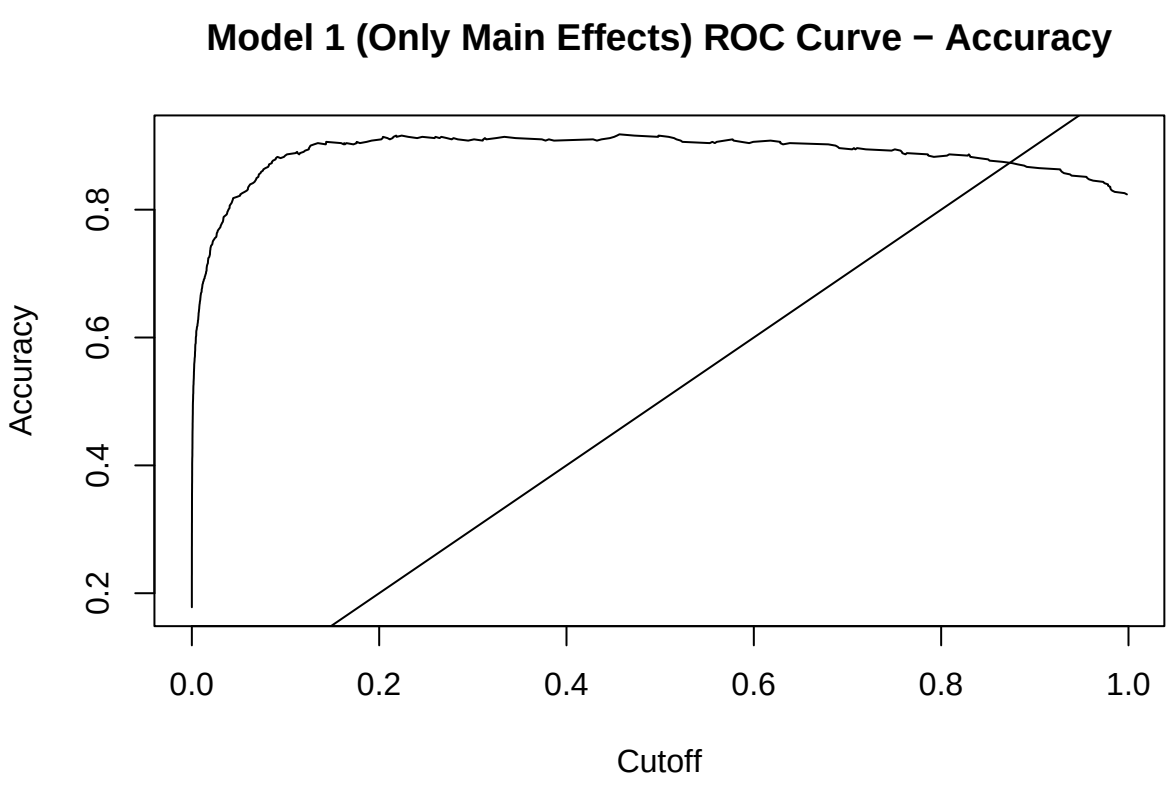
```r
# draw a roc curve for true positive rate and true negative rate to find the optimal cutoff
glm_predictions = predict(depression_glm, newdata = depression_test, type = "response")
prob_predictions = prediction(glm_predictions, depression_test$Depression)
roc_curve = performance(prob_predictions,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




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

```
## [1] 0.9692046
```

```
acc = performance(prob_predictions, "acc")
plot(acc, main = "Model 1 (Only Main Effects) ROC Curve - Accuracy")
abline(0, 1)
```




```
glm_predictions2 = predict(depression_glm, newdata = depression_test)
glm_predictions2 = ifelse(glm_predictions2 > 0.35, "Yes", "No")
glm_predictions2 = as.factor(glm_predictions2)
confusionMatrix(glm_predictions2, depression_test$Depression)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  410  39
##        Yes  10  52
##
##                Accuracy : 0.9041
##                  95% CI : (0.8752, 0.9282)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 1.288e-07
##
##                   Kappa : 0.6257
##
##  Mcnemar's Test P-Value : 6.334e-05
##
##             Sensitivity : 0.9762
##             Specificity : 0.5714
##          Pos Pred Value : 0.9131
##          Neg Pred Value : 0.8387
##              Prevalence : 0.8219
```

```
##          Detection Rate : 0.8023
##    Detection Prevalence : 0.8787
##       Balanced Accuracy : 0.7738
##
##        'Positive' Class : No
##
```

```
# create models for interaction effects of each categorical variable and see if there are any significa
# summary(glm(Depression ~ Gender*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Working.Professional.or.Student*., data = depression_train, family = "binomi
```

```
# summary(glm(Depression ~ Sleep.Duration*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Dietary.Habits*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Degree*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Work.Study.Hours*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Financial.Stress*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Family.History.of.Mental.Illness*., data = depression_train, family = "binom
```

```
# summary(glm(Depression ~ Pressure*., data = depression_train, family = "binomial"))
```

```
# summary(glm(Depression ~ Satisfaction*., data = depression_train, family = "binomial"))
```

None of the interaction effects were meaningfully significant; we will not be adding interaction effects to our model.

```
# create a table to easily see top important predictors and their odds for the first model
vI = cbind(varImp(depression_glm), Odds = exp(summary(depression_glm)$coefficients[-1, 1]), PValue = su
vI = vI[order(-vI$Overall), , drop = FALSE]
vI
```

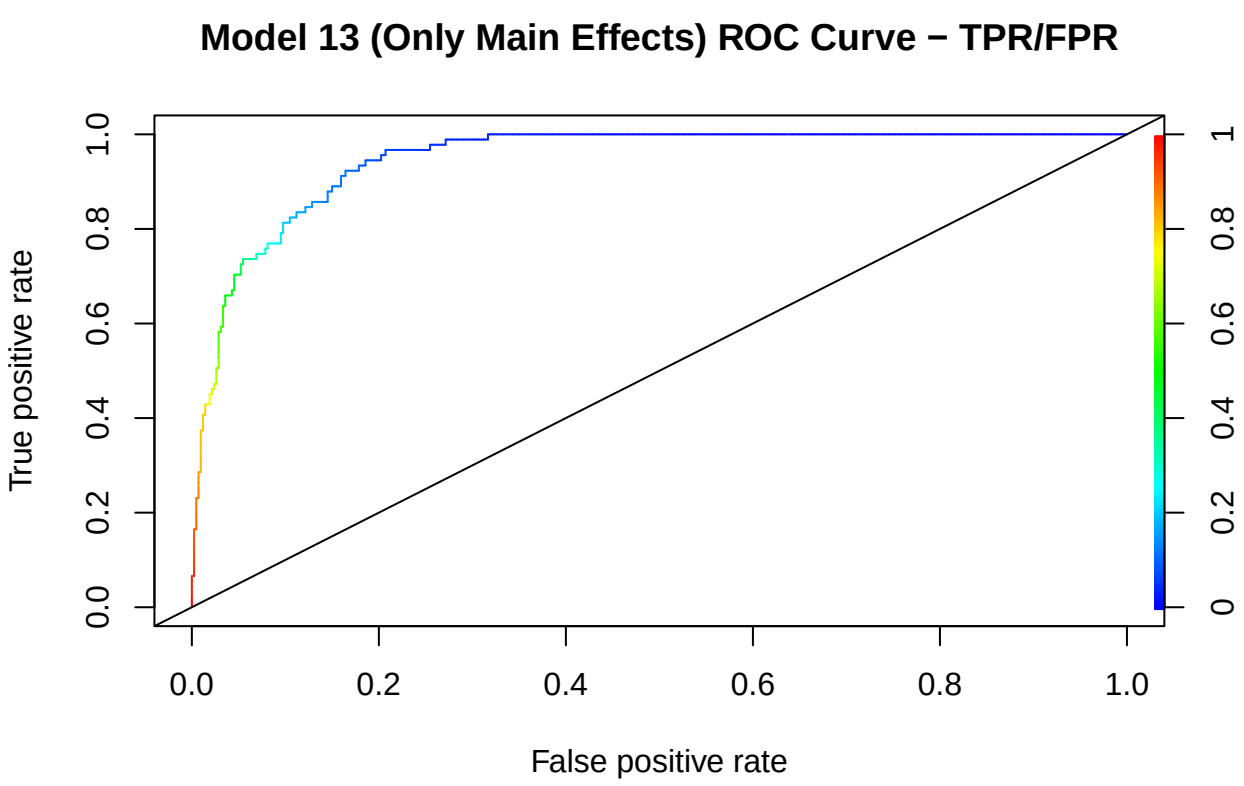
```
##                                                    Overall      Odds
## Age                                             13.4776802 0.7987731
## Pressure                                        12.7907714 3.0892894
## Satisfaction                                    10.8006607 0.4093688
## Financial.Stress                                 8.9929453 1.9876318
## Work.Study.Hours                                 8.5447237 1.2711695
## Working.Professional.or.StudentWorking Professional  7.6538603 0.1817443
## Dietary.HabitsHealthy                            5.6551330 0.2529184
## Sleep.DurationMore than 8 hours                  4.6717971 0.2692760
## Family.History.of.Mental.IllnessYes              3.6473649 2.0430348
## Sleep.Duration7-8 hours                          3.5369801 0.3958427
## Dietary.HabitsModerate                           2.7657051 0.5237177
## Sleep.Duration5-6 hours                          1.6710548 0.6420819
## DegreePost-Graduate Degree                       1.1967390 0.6968255
## DegreeBachelors Degree                           1.1145532 0.7271838
## GenderMale                                       0.6584642 0.8801194
##                                                        PValue
## Age                                             2.116574e-41
## Pressure                                        1.846321e-37
## Satisfaction                                    3.417355e-27
## Financial.Stress                                2.406920e-19
## Work.Study.Hours                                1.288442e-17
```

```
## Working.Professional.or.StudentWorking Professional 1.950341e-14
## Dietary.HabitsHealthy                                1.557257e-08
## Sleep.DurationMore than 8 hours                      2.985759e-06
## Family.History.of.Mental.IllnessYes                  2.649435e-04
## Sleep.Duration7-8 hours                              4.047301e-04
## Dietary.HabitsModerate                               5.679988e-03
## Sleep.Duration5-6 hours                              9.471084e-02
## DegreePost-Graduate Degree                           2.314083e-01
## DegreeBachelors Degree                               2.650419e-01
## GenderMale                                           5.102399e-01
```

```
depression_glm2 = glm(Depression ~ Age + Pressure + Satisfaction + Work.Study.Hours + Financial.Stress,
summary(depression_glm2)
```

```
##
## Call:
## glm(formula = Depression ~ Age + Pressure + Satisfaction + Work.Study.Hours +
##     Financial.Stress, family = "binomial", data = depression_train)
##
## Coefficients:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)       1.53847    0.48141   3.196  0.00139 **
## Age              -0.23489    0.01378 -17.052  < 2e-16 ***
## Pressure          0.97663    0.07620  12.817  < 2e-16 ***
## Satisfaction     -0.73730    0.07058 -10.446  < 2e-16 ***
## Work.Study.Hours  0.21818    0.02540   8.590  < 2e-16 ***
## Financial.Stress  0.59007    0.06725   8.774  < 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: 1915.5  on 2044  degrees of freedom
## Residual deviance:  850.5  on 2039  degrees of freedom
## AIC: 862.5
##
## Number of Fisher Scoring iterations: 7
```

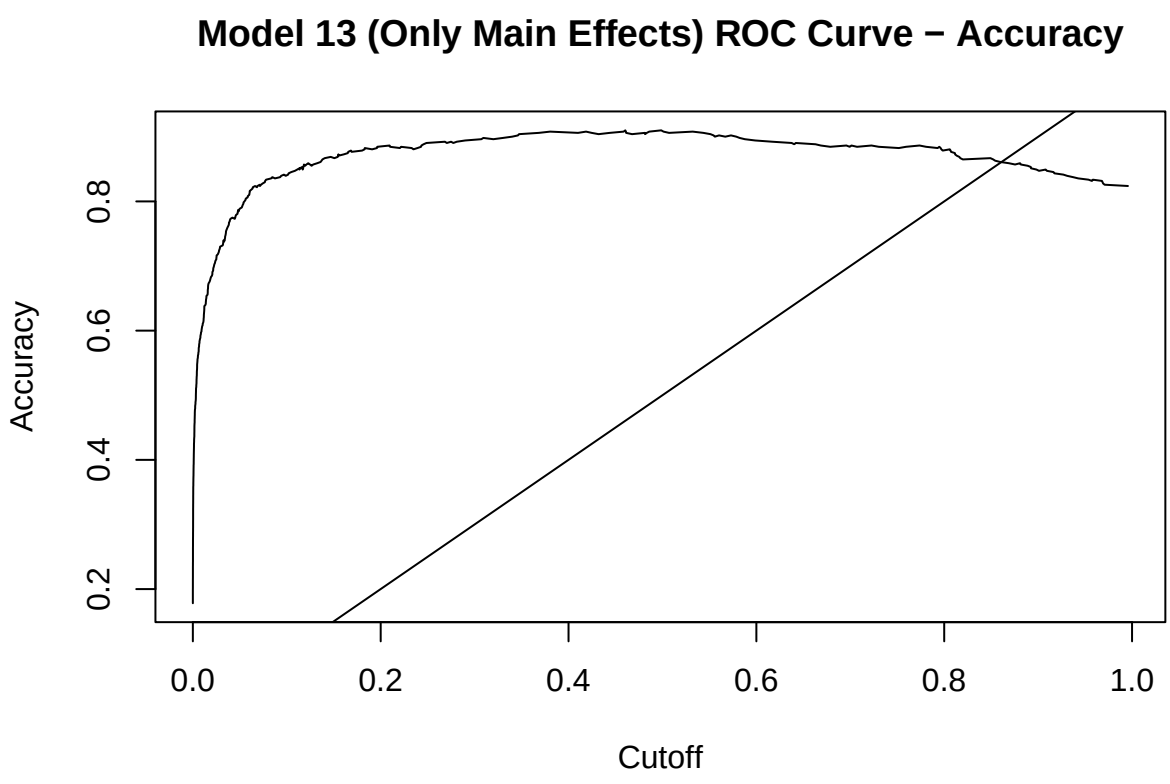
```
# draw a roc curve for true positive rate and true negative rate to find the optimal cutoff
glm_predictions3 = predict(depression_glm2, newdata = depression_test, type = "response")
prob_predictions2 = prediction(glm_predictions3, depression_test$Depression)
roc_curve2 = performance(prob_predictions2, "tpr", "fpr")
plot(roc_curve2, colorize = TRUE, main = "Model 13 (Only Main Effects) ROC Curve - TPR/FPR")
abline(0, 1)
```




```
# auc value
unlist(slot(performance(prob_predictions2, "auc"), "y.values"))
```

```
## [1] 0.9474359
```

```
acc2 = performance(prob_predictions2, "acc")
plot(acc2, main = "Model 13 (Only Main Effects) ROC Curve - Accuracy")
abline(0, 1)
```




```
glm_predictions4 = predict(depression_glm2, newdata = depression_test)
glm_predictions4 = ifelse(glm_predictions4 > 0.35, "Yes", "No")
glm_predictions4 = as.factor(glm_predictions4)
confusionMatrix(glm_predictions4, depression_test$Depression)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  408  41
##        Yes  12  50
##
##                Accuracy : 0.8963
##                  95% CI : (0.8665, 0.9213)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 1.978e-06
##
##                   Kappa : 0.5952
##
##  Mcnemar's Test P-Value : 0.00012
##
##             Sensitivity : 0.9714
##             Specificity : 0.5495
##          Pos Pred Value : 0.9087
##          Neg Pred Value : 0.8065
##              Prevalence : 0.8219
```

```
##          Detection Rate : 0.7984
##    Detection Prevalence : 0.8787
##       Balanced Accuracy : 0.7604
##
##        'Positive' Class : No
##
```

```
# create a table to easily see top important predictors and their odds for the second model
vI2 = cbind(varImp(depression_glm2), Odds = exp(summary(depression_glm2)$coefficients[-1, 1]), PValue =
vI2 = vI2[order(-vI2$Overall), , drop = FALSE]
vI2
```

```
##                    Overall      Odds       PValue
## Age              17.051838 0.7906572 3.387123e-65
## Pressure         12.816884 2.6555037 1.318950e-37
## Satisfaction     10.446477 0.4784051 1.520692e-25
## Financial.Stress  8.773779 1.8041063 1.727681e-18
## Work.Study.Hours  8.590176 1.2438171 8.683634e-18
```

```
paste("First Model Residual Deviance: ", depression_glm$deviance)
```

```
## [1] "First Model Residual Deviance:  721.315547208141"
```

```
paste("Second Model Residual Deviance: ", depression_glm2$deviance)
```

```
## [1] "Second Model Residual Deviance:  850.504771136837"
```

```
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 0.8964966 0.6350167 0.02113243 0.07054203
```

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

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  406  30
##        Yes  14  61
##
##                Accuracy : 0.9139
##                  95% CI : (0.8861, 0.9367)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 2.579e-09
##
##                   Kappa : 0.6841
##
##  Mcnemar's Test P-Value : 0.02374
##
```

```
##             Sensitivity : 0.9667
##             Specificity : 0.6703
##          Pos Pred Value : 0.9312
##          Neg Pred Value : 0.8133
##              Prevalence : 0.8219
##          Detection Rate : 0.7945
##    Detection Prevalence : 0.8532
##       Balanced Accuracy : 0.8185
##
##        'Positive' Class : No
##
```

```
varImp(depression_cvglm)
```

```
## glm variable importance
##
##                                                    Overall
## Age                                                100.000
## Pressure                                            94.642
## Satisfaction                                        79.117
## Financial.Stress                                    65.016
## Work.Study.Hours                                    61.519
## `Working.Professional.or.StudentWorking Professional`  54.570
## Dietary.HabitsHealthy                               38.978
## `Sleep.DurationMore than 8 hours`                   31.307
## Family.History.of.Mental.IllnessYes                 23.316
## `Sleep.Duration7-8 hours`                           22.455
## Dietary.HabitsModerate                              16.438
## `Sleep.Duration5-6 hours`                            7.899
## `DegreePost-Graduate Degree`                         4.199
## `DegreeBachelors Degree`                             3.558
## GenderMale                                           0.000
```

```
train_control2 = trainControl(method = "repeatedcv", number = 10, repeats = 3, classProbs = TRUE)
depression_cvglm2 = train(Depression ~ Age + Pressure + Satisfaction + Work.Study.Hours + Financial.Stre
                          data = depression_train,
                          method = "glm",
                          family = binomial,
                          trControl = train_control2)
```

```
depression_cvglm2$results
```

```
##   parameter  Accuracy     Kappa AccuracySD    KappaSD
## 1      none 0.8960062 0.6242043 0.02380412 0.08394406
```

```
cvglm_predictions2 = predict(depression_cvglm2, depression_test)
confusionMatrix(cvglm_predictions2, depression_test$Depression)
```

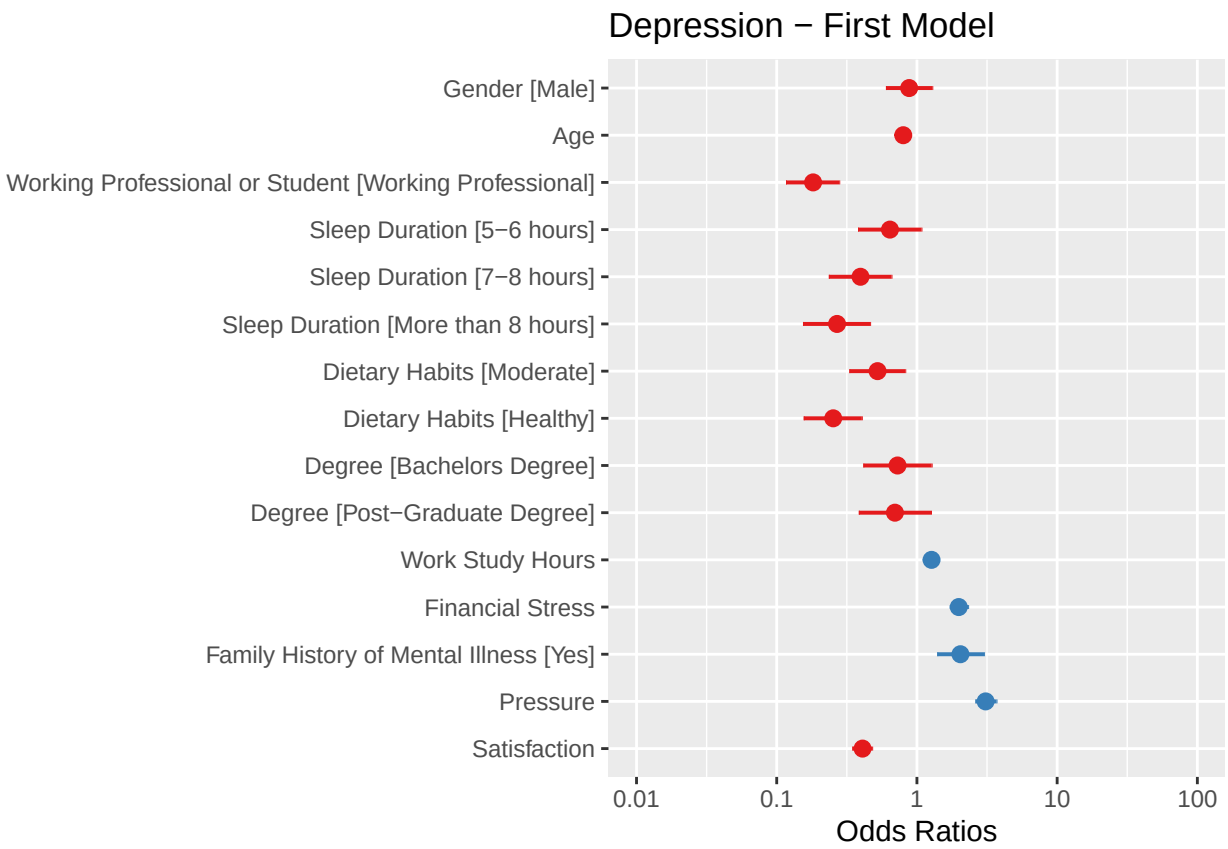
```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  405  32
##        Yes  15  59
##
##                Accuracy : 0.908
```

```
##                  95% CI : (0.8796, 0.9316)
##     No Information Rate : 0.8219
##     P-Value [Acc > NIR] : 2.887e-08
##
##                   Kappa : 0.661
##
##  Mcnemar's Test P-Value : 0.0196
##
##             Sensitivity : 0.9643
##             Specificity : 0.6484
##          Pos Pred Value : 0.9268
##          Neg Pred Value : 0.7973
##              Prevalence : 0.8219
##          Detection Rate : 0.7926
##    Detection Prevalence : 0.8552
##       Balanced Accuracy : 0.8063
##
##        'Positive' Class : No
##
```

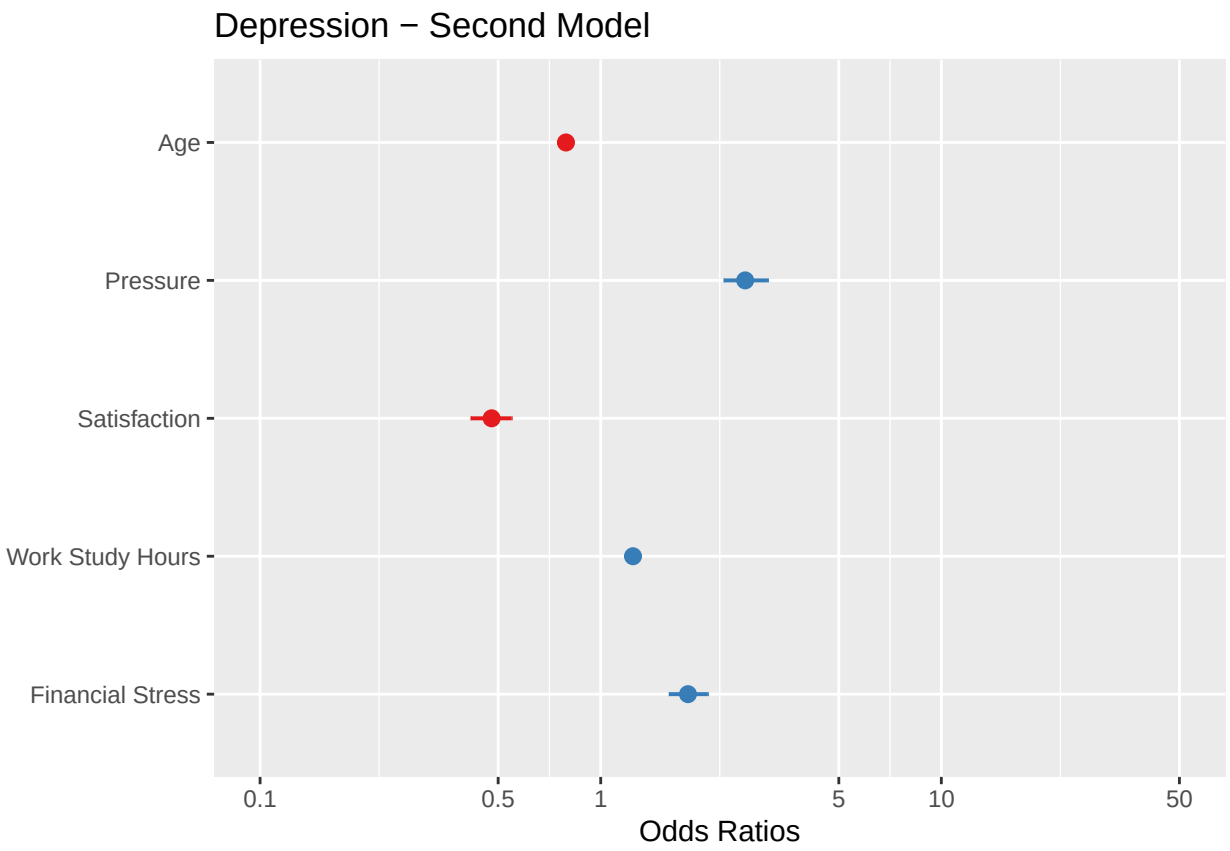
```r
varImp(depression_cvglm2)
```

```
## glm variable importance
##
##                  Overall
## Age               100.00
## Pressure           49.95
## Satisfaction       21.94
## Financial.Stress    2.17
## Work.Study.Hours    0.00
```

```r
plot_model(depression_glm, title = "Depression - First Model")
```




```
plot_model(depression_glm2, title = "Depression - Second Model")
```



$$\text{logit}(p) = 1.538 - 0.235 * Age + 0.977 * Pressure - 0.737 * Satisfaction + 0.218 * Work.Study.Hours + 0.590 * Financial.Stress$$

$$\text{where logit}(p) = ln(\frac{p}{1-p}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n +$$