Project_Code

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```
df<-read.csv("online_shoppers_intention.csv")
library(ggplot2)
library(forcats)
library(corrplot)
```

```
## corrplot 0.92 loaded
```

```
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✓ dplyr     1.1.0     ✓ stringr   1.5.0
## ✓ lubridate 1.9.2     ✓ tibble    3.2.0
## ✓ purrr     1.0.1     ✓ tidyr     1.3.0
## ✓ readr     2.1.4
```

```
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the ]8;;http://conflicted.r-lib.org/conflicted package]8;; to force all conflicts
to become errors
```

data profiling

```
#summary of the dataframe
summary(df)
```

```
##  Administrative   Administrative_Duration Informational
##  Min.   : 0.000   Min.   :   0.00         Min.   : 0.0000
##  1st Qu.: 0.000   1st Qu.:   0.00         1st Qu.: 0.0000
##  Median : 1.000   Median :   7.50         Median : 0.0000
##  Mean   : 2.315   Mean   :  80.82         Mean   : 0.5036
##  3rd Qu.: 4.000   3rd Qu.:  93.26         3rd Qu.: 0.0000
##  Max.   :27.000   Max.   :3398.75         Max.   :24.0000
##  Informational_Duration ProductRelated   ProductRelated_Duration
##  Min.   :   0.00        Min.   :  0.00   Min.   :    0.0
##  1st Qu.:   0.00        1st Qu.:  7.00   1st Qu.:  184.1
##  Median :   0.00        Median : 18.00   Median :  598.9
##  Mean   :  34.47        Mean   : 31.73   Mean   : 1194.8
##  3rd Qu.:   0.00        3rd Qu.: 38.00   3rd Qu.: 1464.2
##  Max.   :2549.38        Max.   :705.00   Max.   :63973.5
##   BounceRates         ExitRates         PageValues        SpecialDay
##  Min.   :0.000000   Min.   :0.00000   Min.   :  0.000   Min.   :0.00000
##  1st Qu.:0.000000   1st Qu.:0.01429   1st Qu.:  0.000   1st Qu.:0.00000
##  Median :0.003112   Median :0.02516   Median :  0.000   Median :0.00000
##  Mean   :0.022191   Mean   :0.04307   Mean   :  5.889   Mean   :0.06143
##  3rd Qu.:0.016813   3rd Qu.:0.05000   3rd Qu.:  0.000   3rd Qu.:0.00000
##  Max.   :0.200000   Max.   :0.20000   Max.   :361.764   Max.   :1.00000
##     Month           OperatingSystems    Browser           Region
##  Length:12330       Min.   :1.000    Min.   : 1.000   Min.   :1.000
##  Class :character   1st Qu.:2.000    1st Qu.: 2.000   1st Qu.:1.000
##  Mode  :character   Median :2.000    Median : 2.000   Median :3.000
##                     Mean   :2.124    Mean   : 2.357   Mean   :3.147
##                     3rd Qu.:3.000    3rd Qu.: 2.000   3rd Qu.:4.000
##                     Max.   :8.000    Max.   :13.000   Max.   :9.000
##   TrafficType    VisitorType         Weekend         Revenue
##  Min.   : 1.00   Length:12330       Mode :logical   Mode :logical
##  1st Qu.: 2.00   Class :character   FALSE:9462      FALSE:10422
##  Median : 2.00   Mode  :character   TRUE :2868      TRUE :1908
##  Mean   : 4.07
##  3rd Qu.: 4.00
##  Max.   :20.00
```

```
#structure of columns to identify outliers
str(df)
```

```
## 'data.frame':    12330 obs. of  18 variables:
##  $ Administrative         : int  0 0 0 0 0 0 0 1 0 0 ...
##  $ Administrative_Duration: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ Informational          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Informational_Duration : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductRelated         : int  1 2 1 2 10 19 1 0 2 3 ...
##  $ ProductRelated_Duration: num  0 64 0 2.67 627.5 ...
##  $ BounceRates            : num  0.2 0 0.2 0.05 0.02 ...
##  $ ExitRates              : num  0.2 0.1 0.2 0.14 0.05 ...
##  $ PageValues             : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ SpecialDay             : num  0 0 0 0 0 0 0.4 0 0.8 0.4 ...
##  $ Month                  : chr  "Feb" "Feb" "Feb" "Feb" ...
##  $ OperatingSystems       : int  1 2 4 3 3 2 2 1 2 2 ...
##  $ Browser                : int  1 2 1 2 3 2 4 2 2 4 ...
##  $ Region                 : int  1 1 9 2 1 1 3 1 2 1 ...
##  $ TrafficType            : int  1 2 3 4 4 3 3 5 3 2 ...
##  $ VisitorType            : chr  "Returning_Visitor" "Returning_Visitor" "Returning_Visitor"
"Returning_Visitor" ...
##  $ Weekend                : logi  FALSE FALSE FALSE FALSE TRUE FALSE ...
##  $ Revenue                : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
```

```
#identifying nulls
colSums(is.na(df))
```

```
##          Administrative Administrative_Duration           Informational
##                       0                       0                       0
##  Informational_Duration          ProductRelated ProductRelated_Duration
##                       0                       0                       0
##             BounceRates               ExitRates              PageValues
##                       0                       0                       0
##              SpecialDay                   Month        OperatingSystems
##                       0                       0                       0
##                 Browser                  Region             TrafficType
##                       0                       0                       0
##             VisitorType                 Weekend                 Revenue
##                       0                       0                       0
```

```
# Identify numerical, categorical and boolean columns
num_cols <- names(df)[sapply(df, is.numeric)]
cat_cols <- names(df)[sapply(df, is.character)]
bool_cols <- names(df)[sapply(df, is.logical)]

# Print out the number and names of numerical, categorical and boolean columns
print(paste("There are", length(num_cols), "numerical columns,", length(cat_cols), "categorical
columns and", length(bool_cols), "boolean columns in the dataset\n"))
```

```
## [1] "There are 14 numerical columns, 2 categorical columns and 2 boolean columns in the data
set\n"
```

```
print(paste("Numerical columns:", paste(num_cols, collapse = ", ")))
```

```
## [1] "Numerical columns: Administrative, Administrative_Duration, Informational, Informational_Duration, ProductRelated, ProductRelated_Duration, BounceRates, ExitRates, PageValues, SpecialDay, OperatingSystems, Browser, Region, TrafficType"
```

```
print(paste("Categorical columns:", paste(cat_cols, collapse = ", ")))
```

```
## [1] "Categorical columns: Month, VisitorType"
```

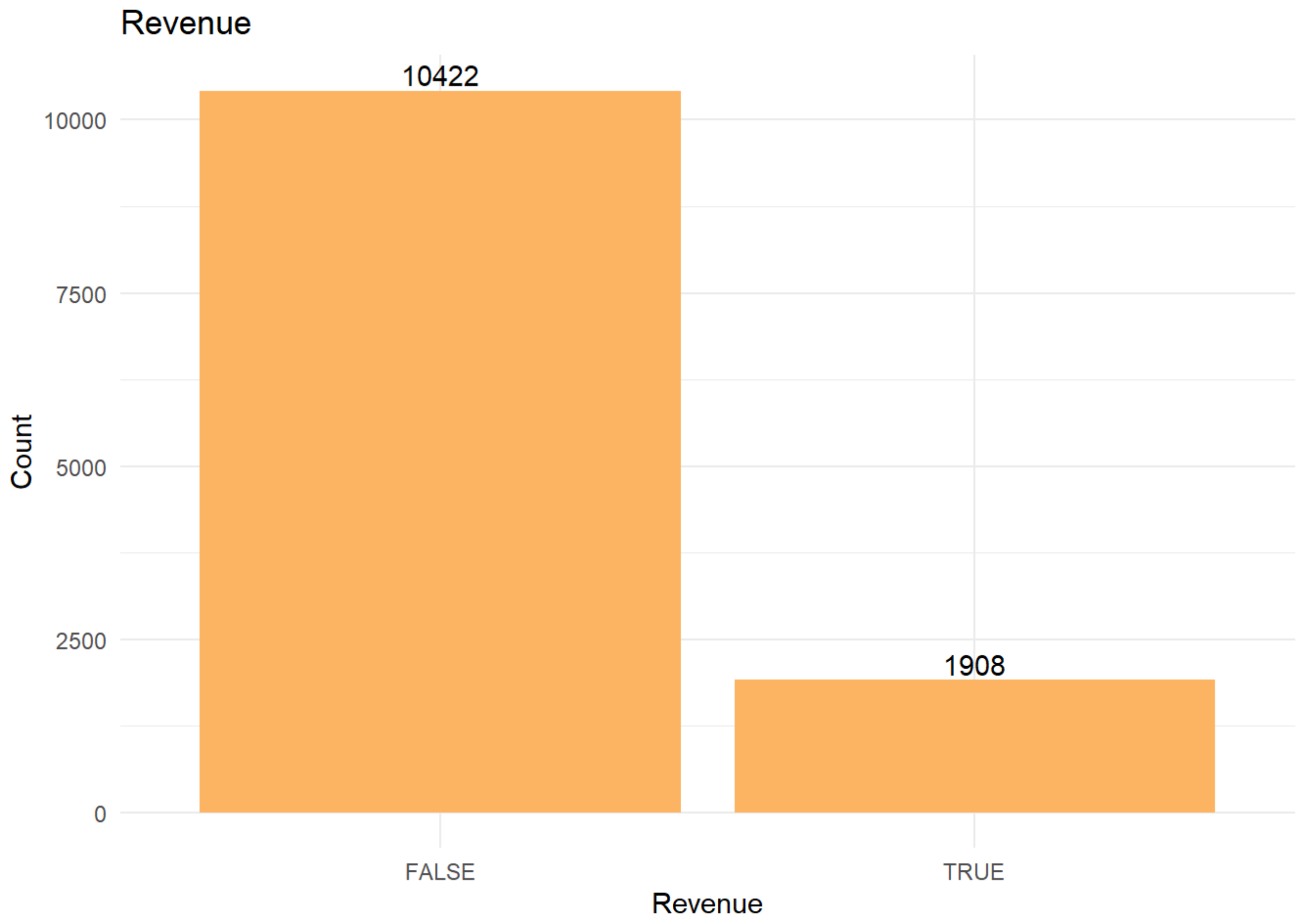
```
print(paste("Boolean columns:", paste(bool_cols, collapse = ", ")))
```

```
## [1] "Boolean columns: Weekend, Revenue"
```

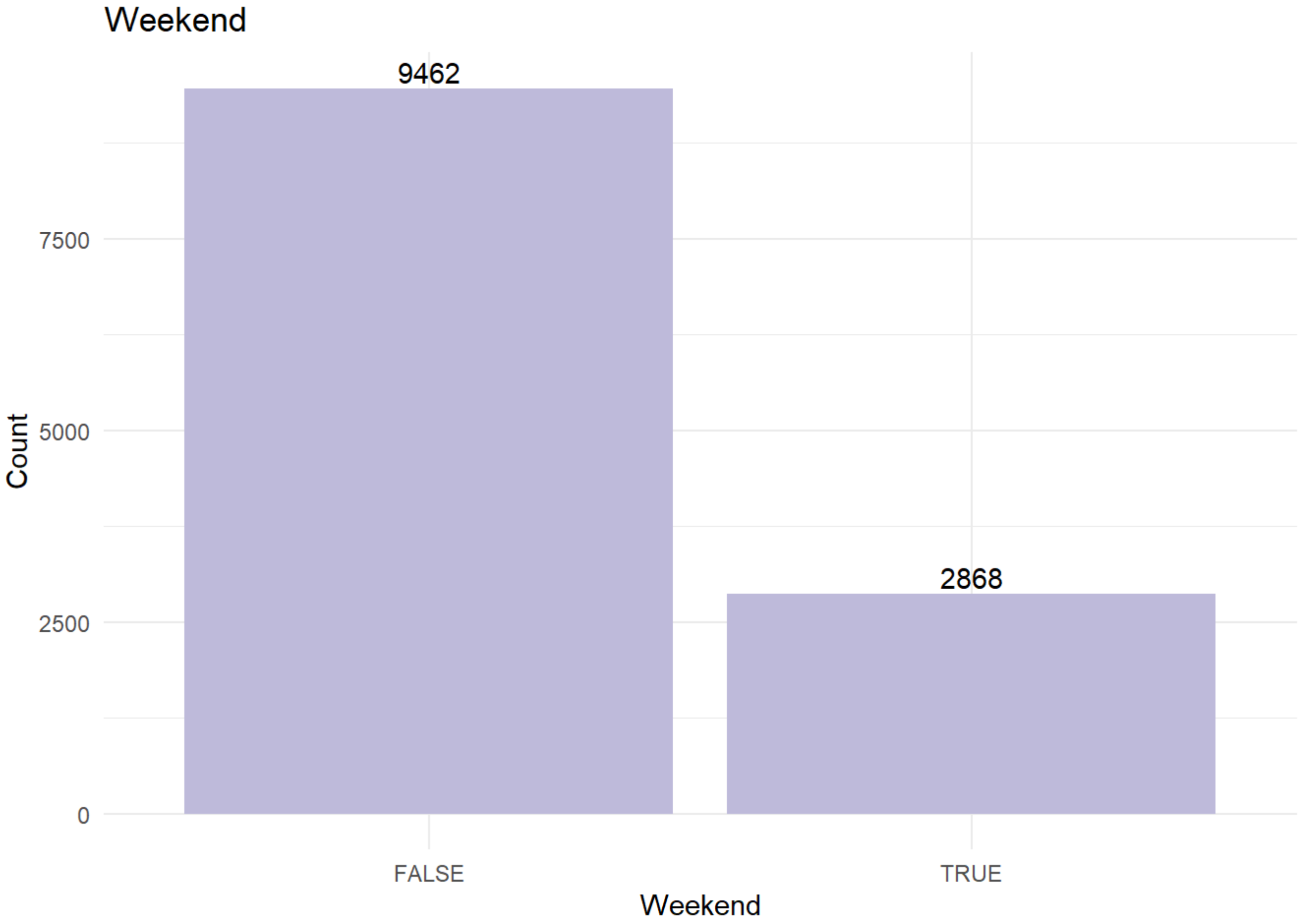
EDA

```
# Revenue
ggplot(df, aes(x = factor(Revenue))) +
  geom_bar(fill = "#FDB462") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Revenue", x="Revenue", y="Count") +
  theme_minimal()
```

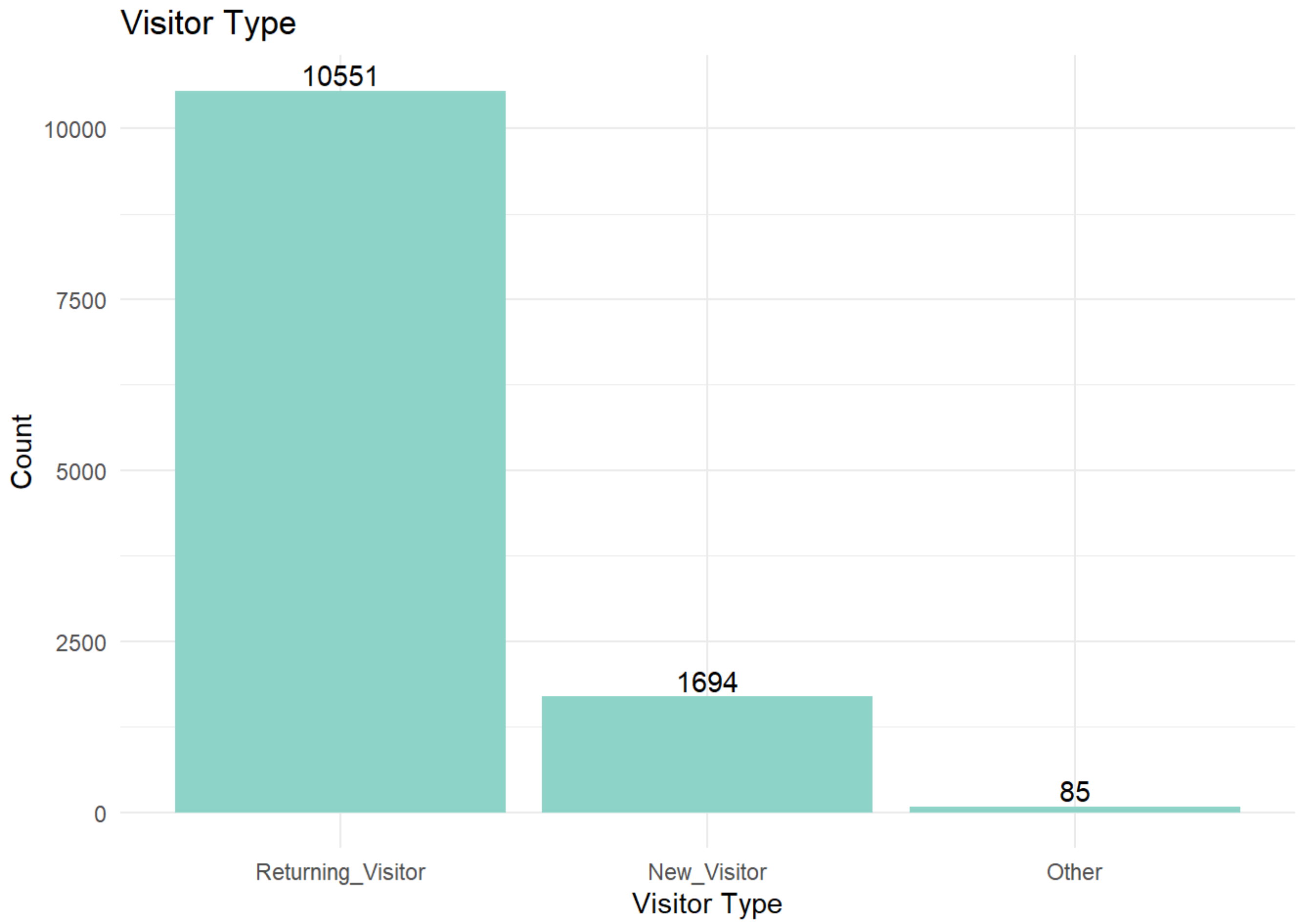
```
## Warning: The dot-dot notation (`..count..`) was deprecated in ggplot2 3.4.0.
## ℹ Please use `after_stat(count)` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```



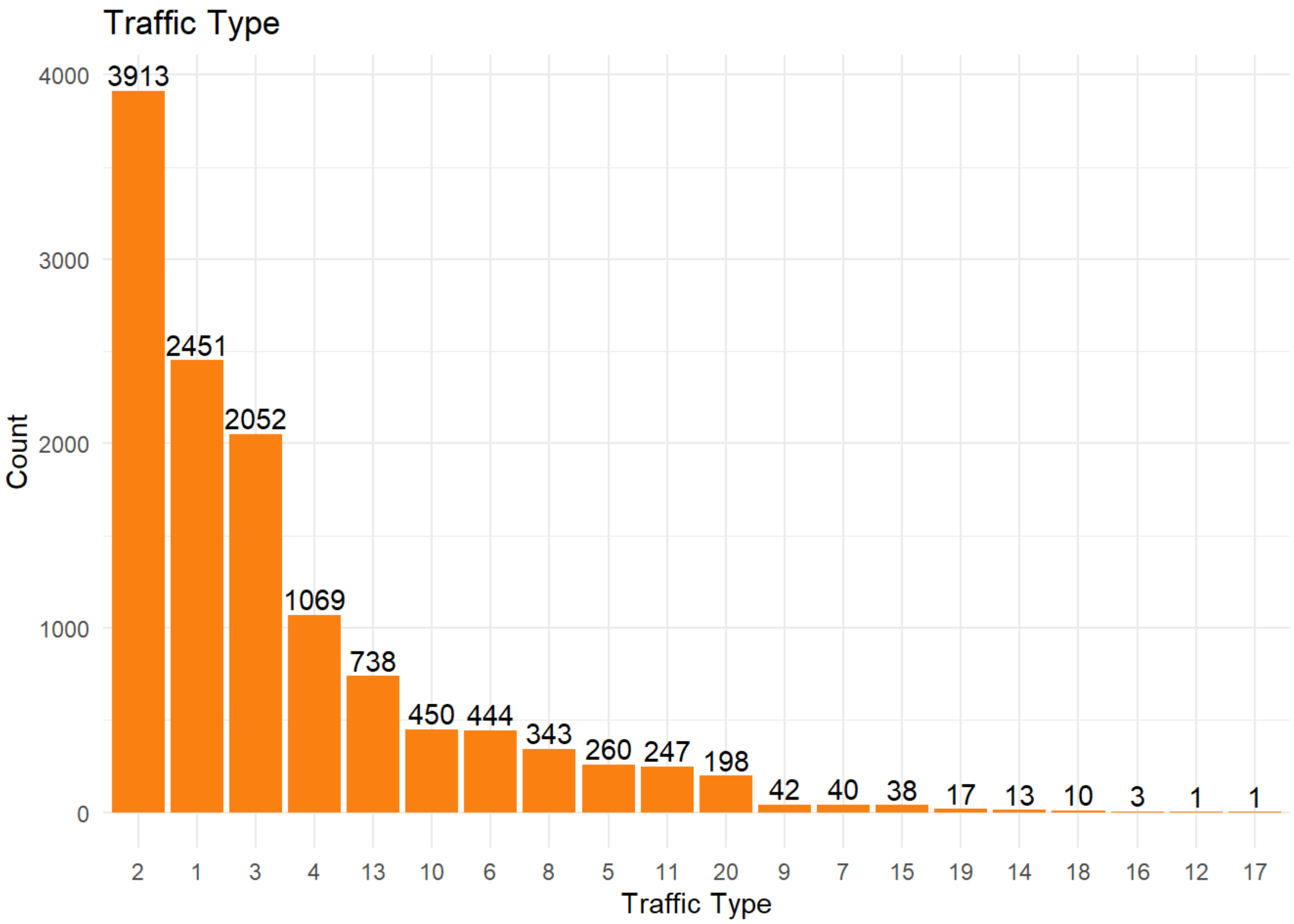
```r
# Weekend
ggplot(df, aes(x = factor(Weekend))) +
  geom_bar(fill = "#BEBADA") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Weekend", x="Weekend", y="Count") +
  theme_minimal()
```



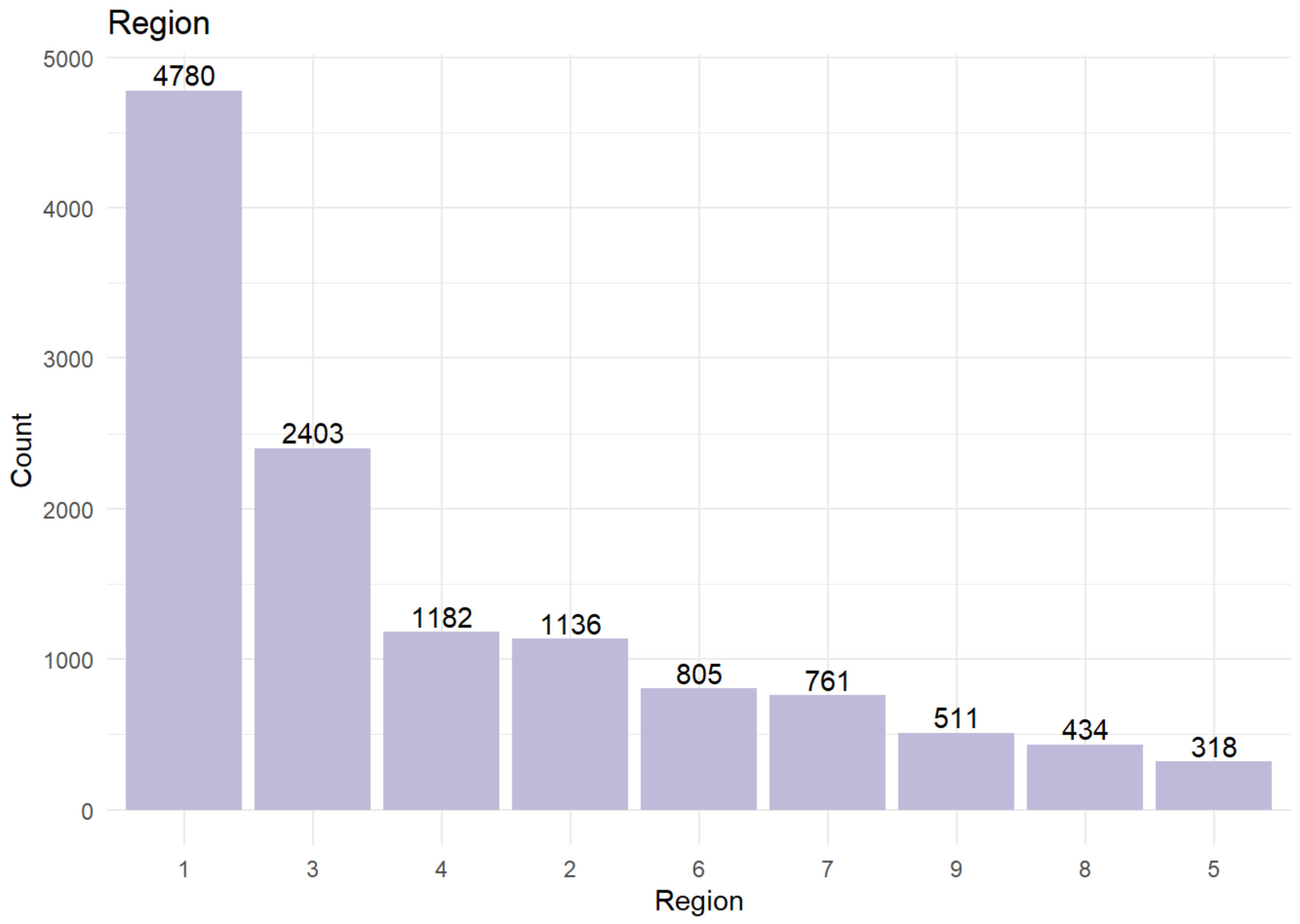
```
# Other non-logical variables should still use `forcats::fct_infreq` as they were.

# VisitorType
ggplot(df, aes(x = forcats::fct_infreq(VisitorType))) +
  geom_bar(fill = "#8DD3C7") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Visitor Type", x="Visitor Type", y="Count") +
  theme_minimal()
```



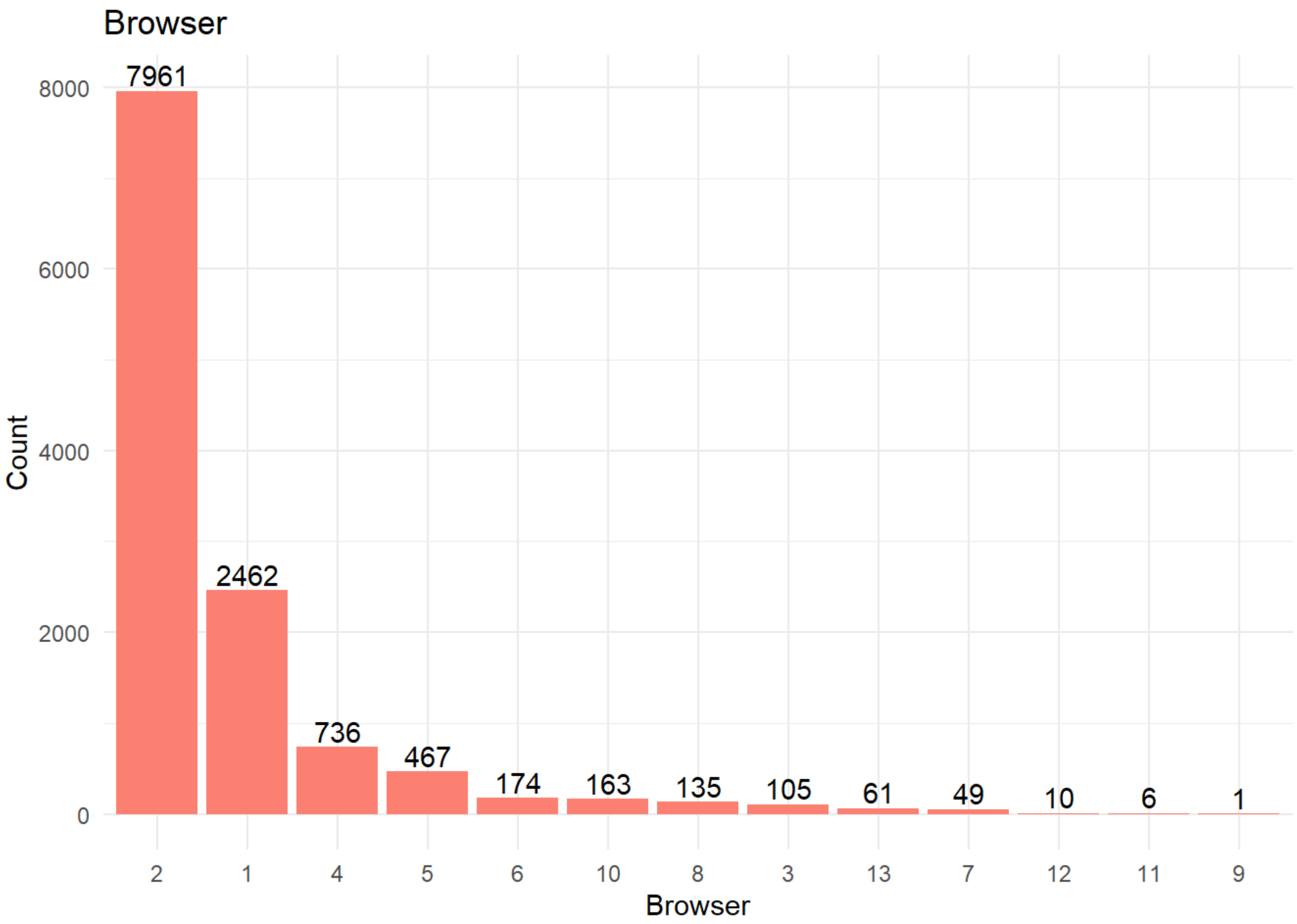
```
# TrafficType
ggplot(df, aes(x = forcats::fct_infreq(factor(TrafficType)))) +
  geom_bar(fill = "#FB8012") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Traffic Type", x="Traffic Type", y="Count") +
  theme_minimal()
```



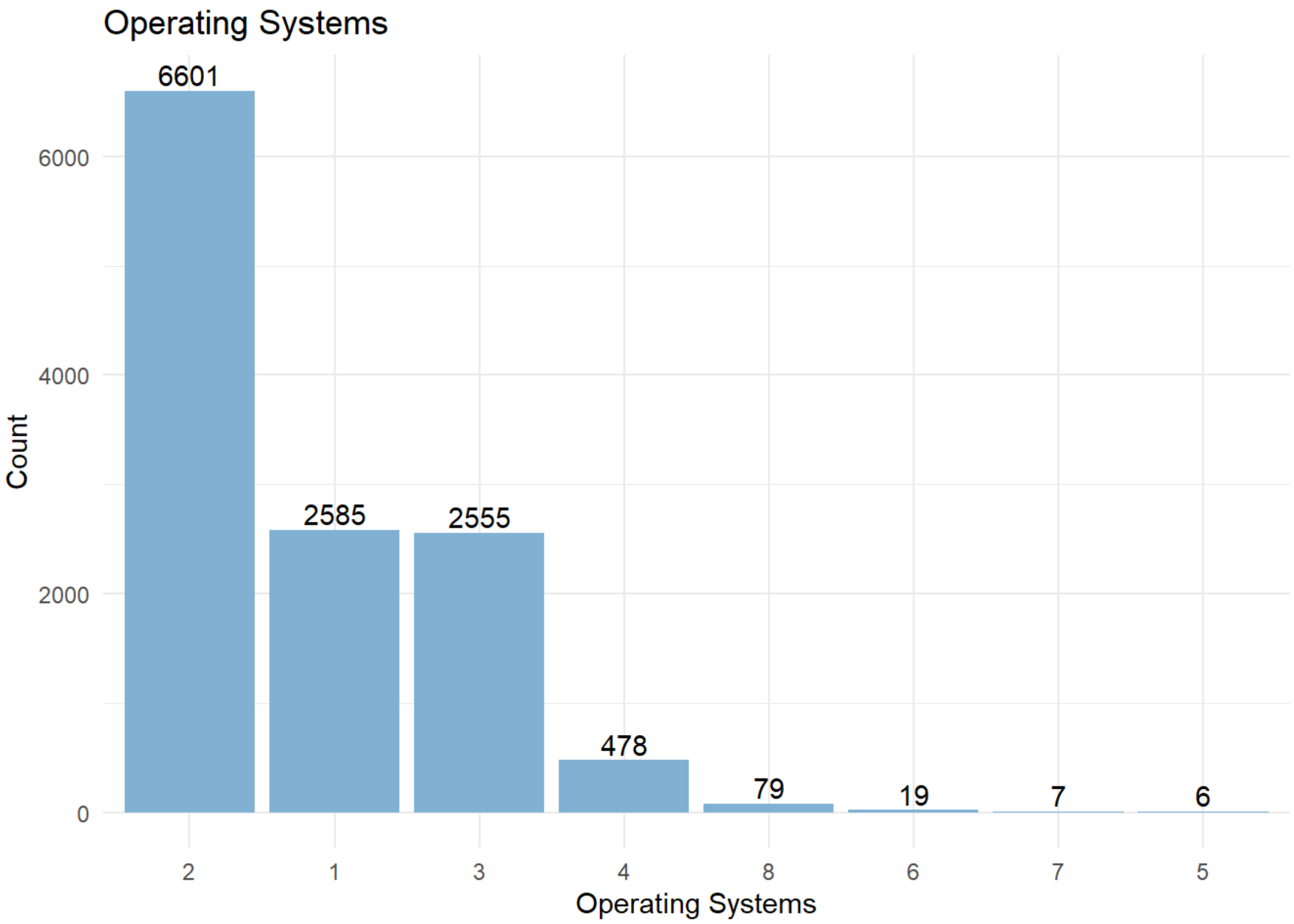
```
# Region
ggplot(df, aes(x = forcats::fct_infreq(factor(Region)))) +
  geom_bar(fill = "#BEBADA") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Region", x="Region", y="Count") +
  theme_minimal()
```



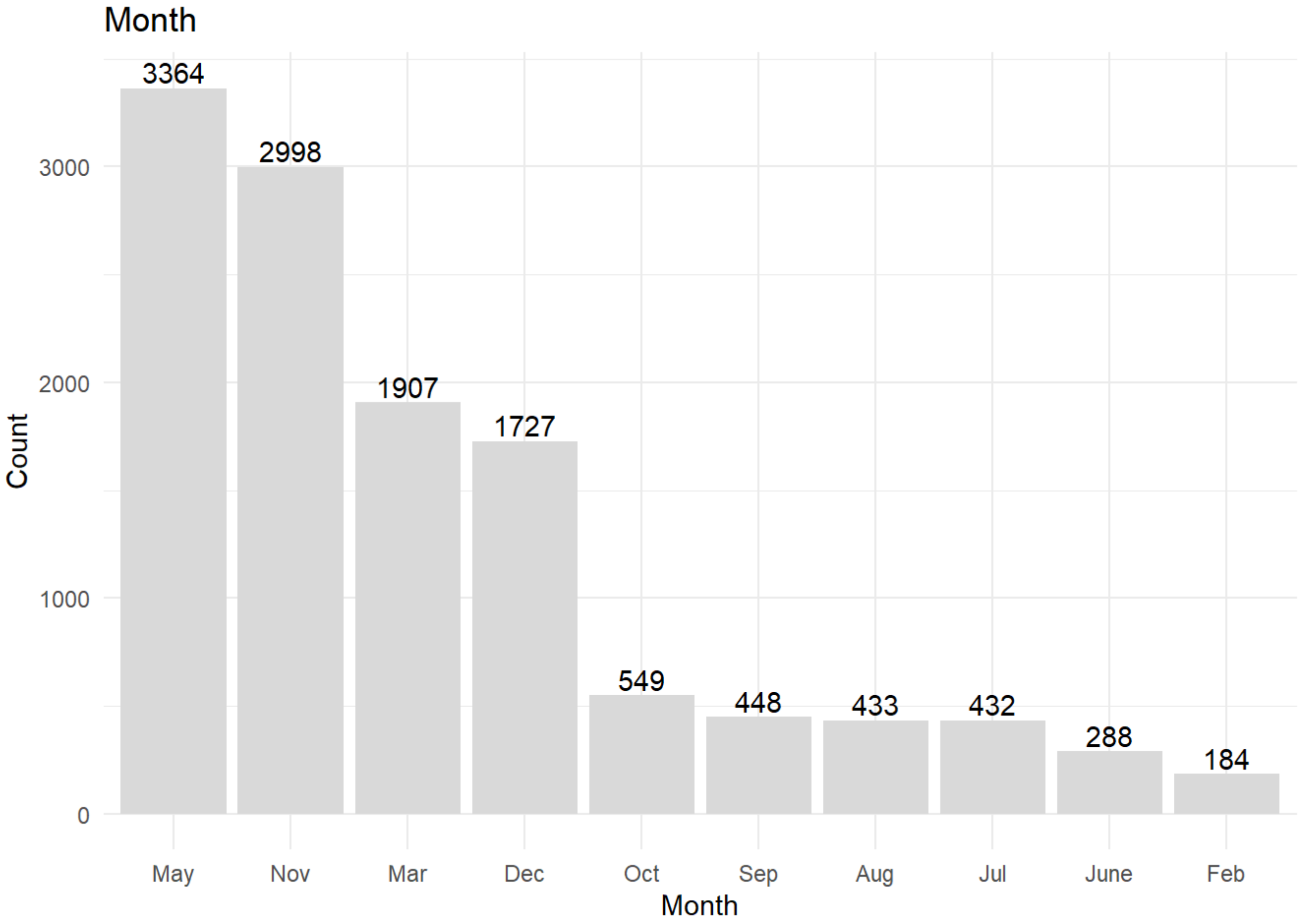
```
# Browser
ggplot(df, aes(x = forcats::fct_infreq(factor(Browser)))) +
  geom_bar(fill = "#FB8072") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Browser", x="Browser", y="Count") +
  theme_minimal()
```



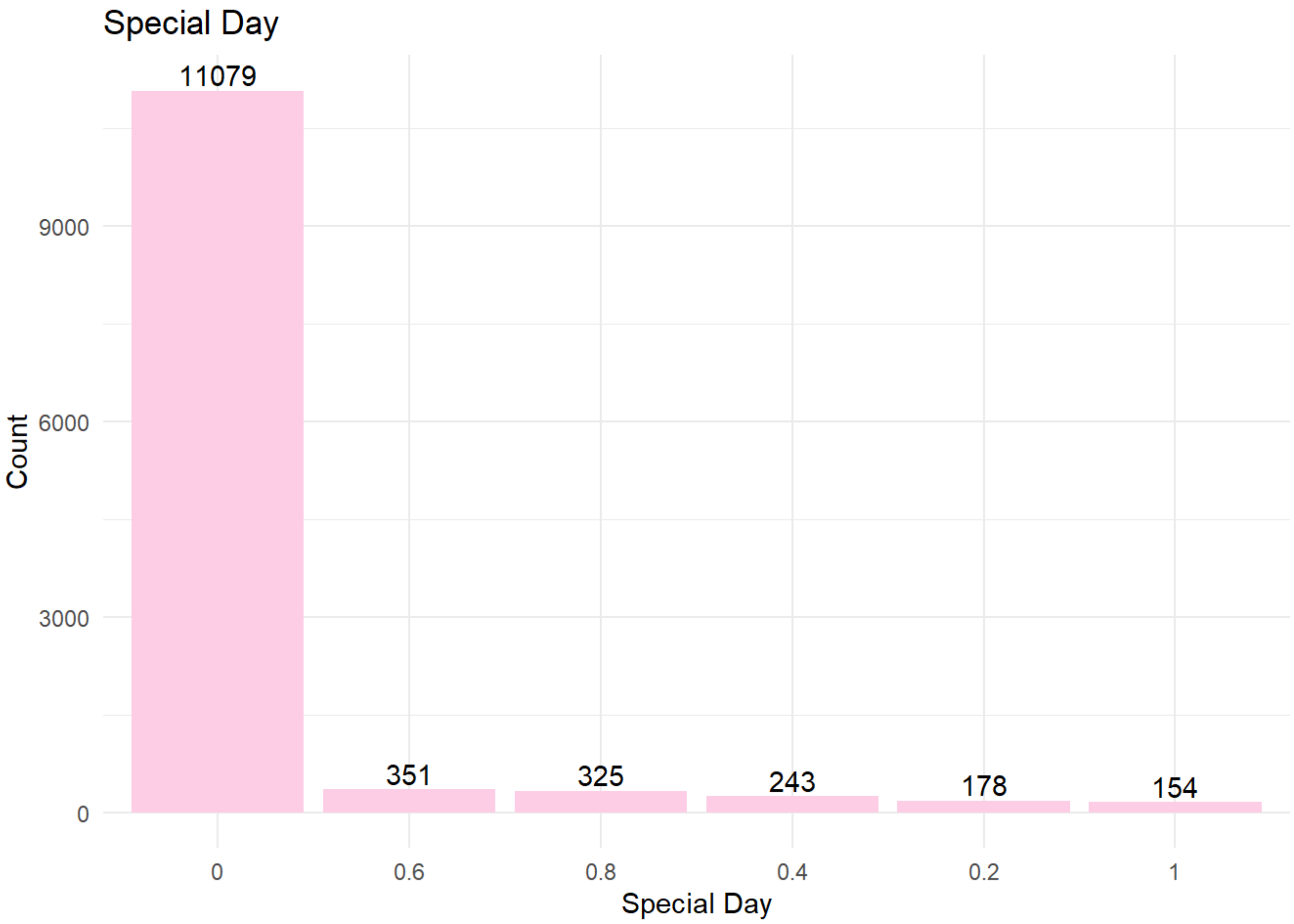
```
# OperatingSystems
ggplot(df, aes(x = forcats::fct_infreq(factor(OperatingSystems)))) +
  geom_bar(fill = "#80B1D3") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Operating Systems", x="Operating Systems", y="Count") +
  theme_minimal()
```



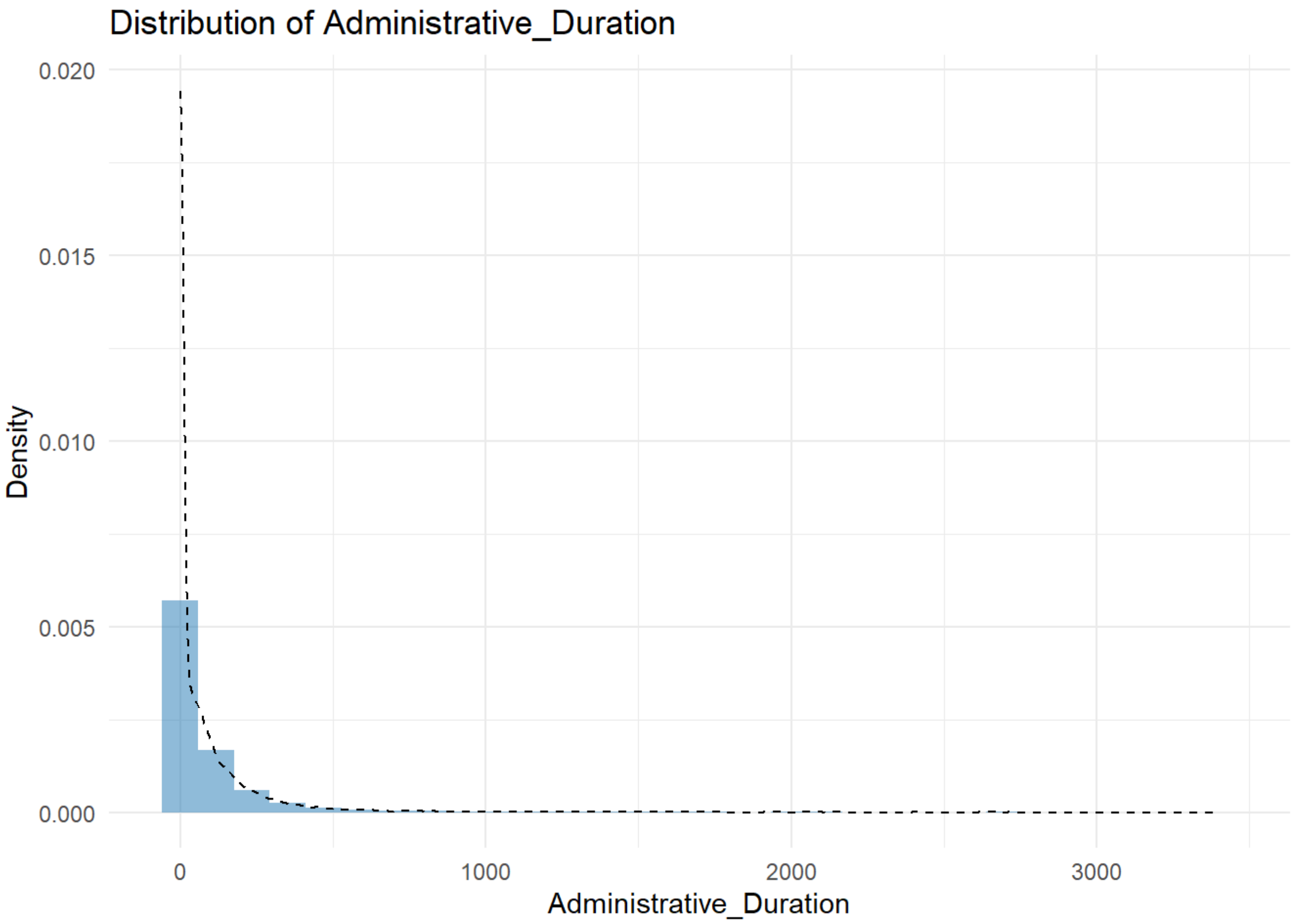
```
# Month
ggplot(df, aes(x = forcats::fct_infreq(Month))) +
  geom_bar(fill = "#D9D9D9") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Month", x="Month", y="Count") +
  theme_minimal()
```



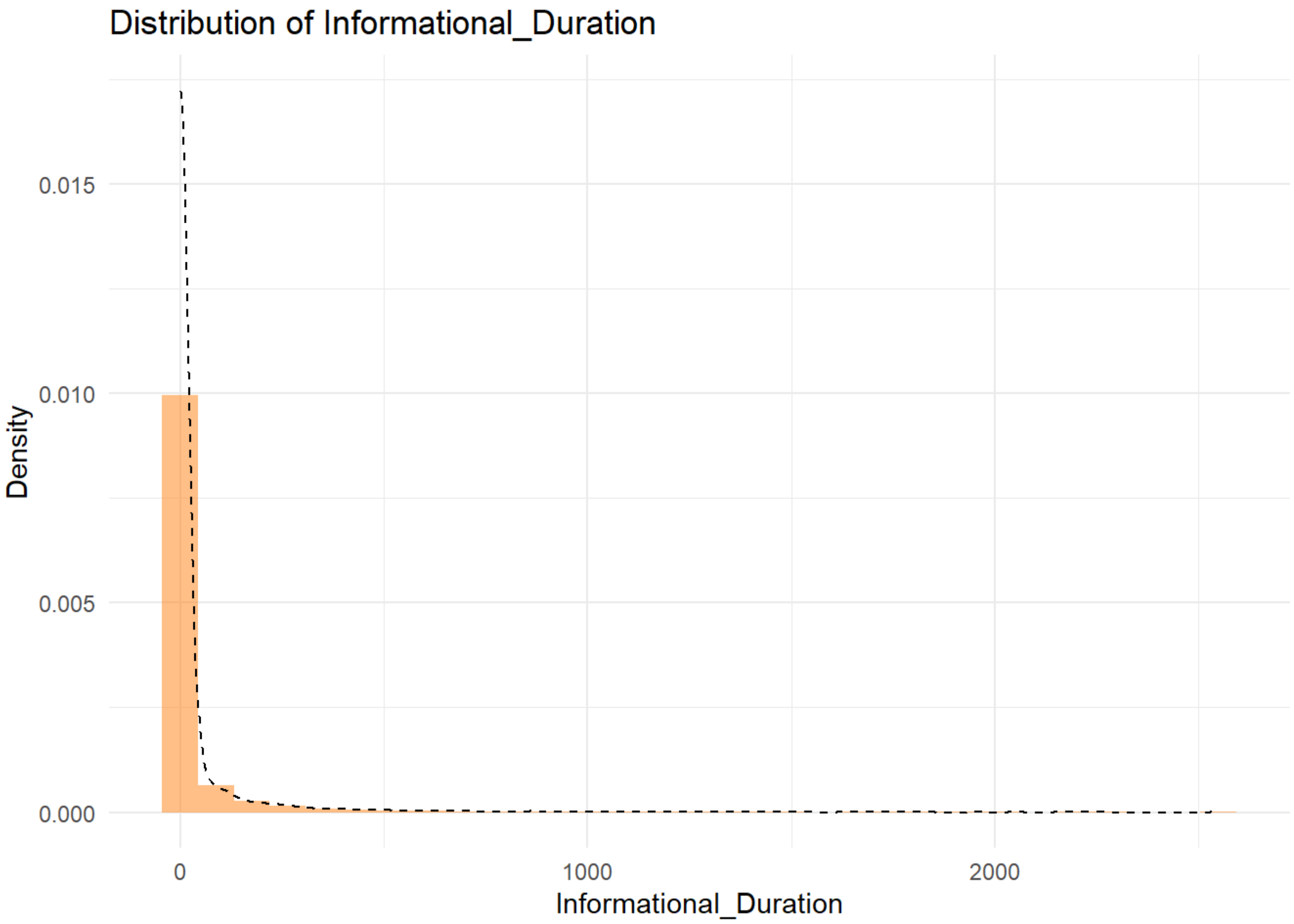
```
# SpecialDay
ggplot(df, aes(x = forcats::fct_infreq(factor(SpecialDay)))) +
  geom_bar(fill = "#FCCDE5") +
  geom_text(stat='count', aes(label=..count..), vjust=-0.25) +
  labs(title="Special Day", x="Special Day", y="Count") +
  theme_minimal()
```



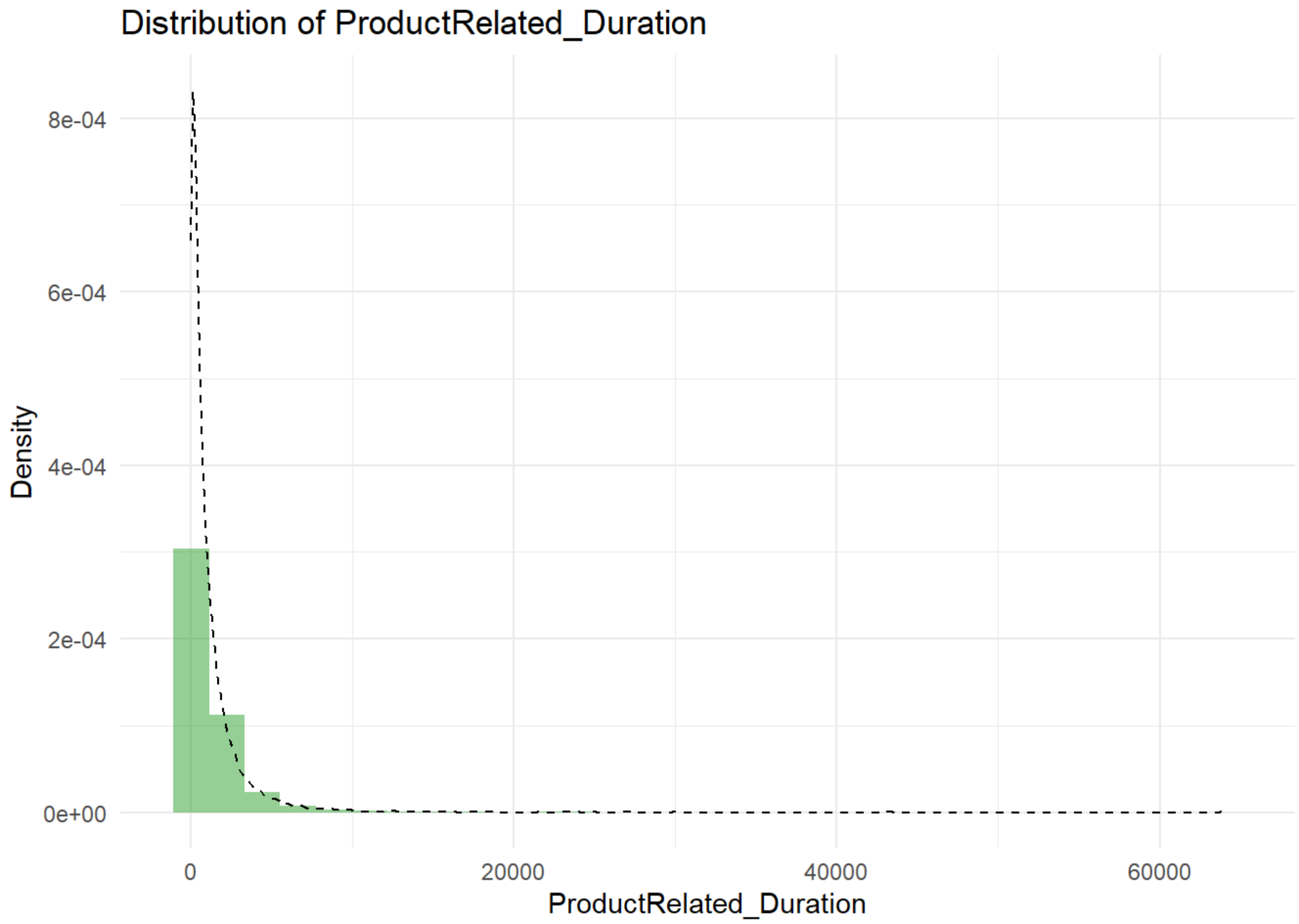
```
# Administrative_Duration
ggplot(df, aes(x = Administrative_Duration)) +
  geom_histogram(aes(y = ..density..), fill = "#1f77b4", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of Administrative_Duration", x = "Administrative_Duration", y = "D
ensity")
```



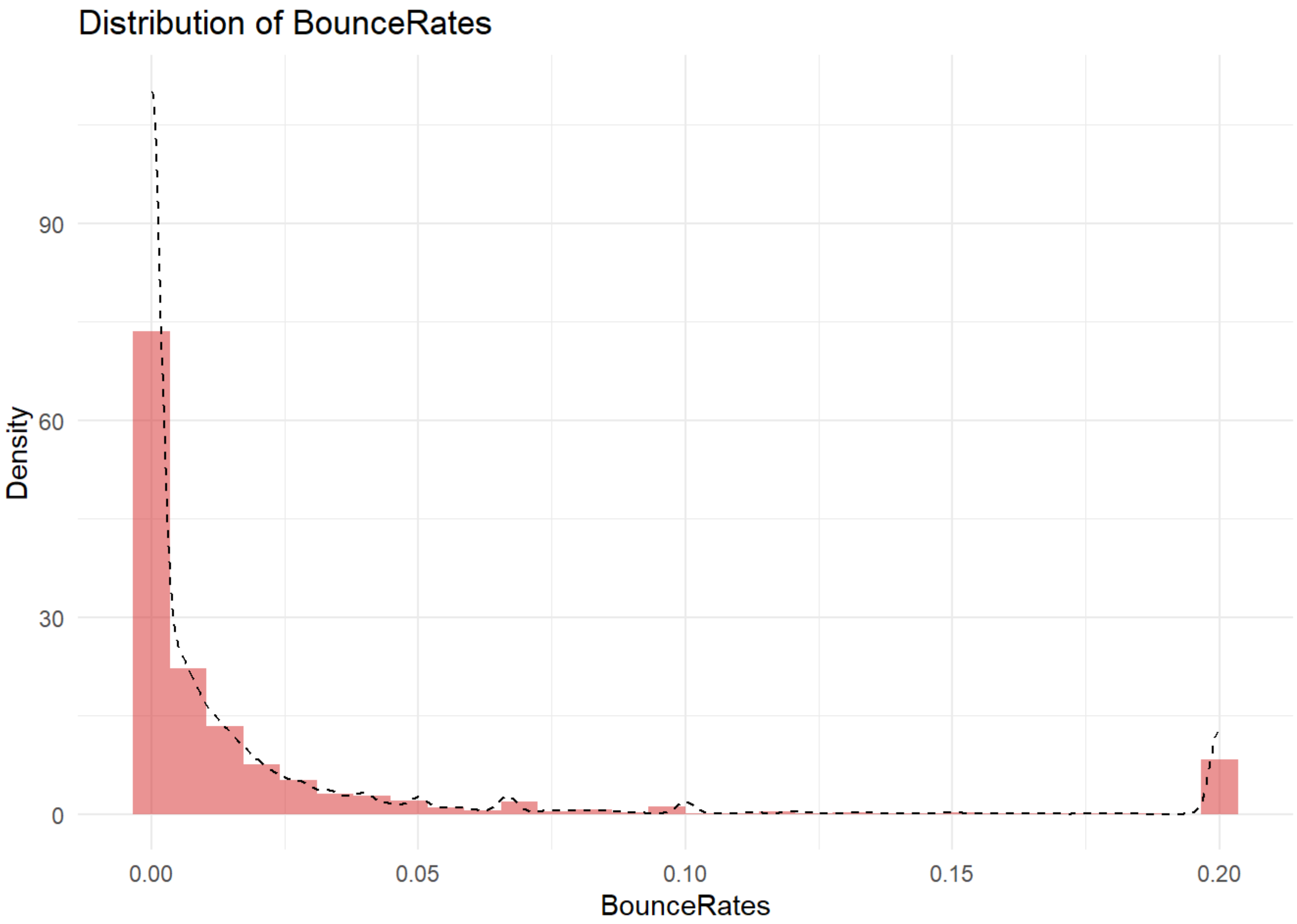
```
# Informational_Duration
ggplot(df, aes(x = Informational_Duration)) +
  geom_histogram(aes(y = ..density..), fill = "#ff7f0e", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of Informational_Duration", x = "Informational_Duration", y = "Den
sity")
```



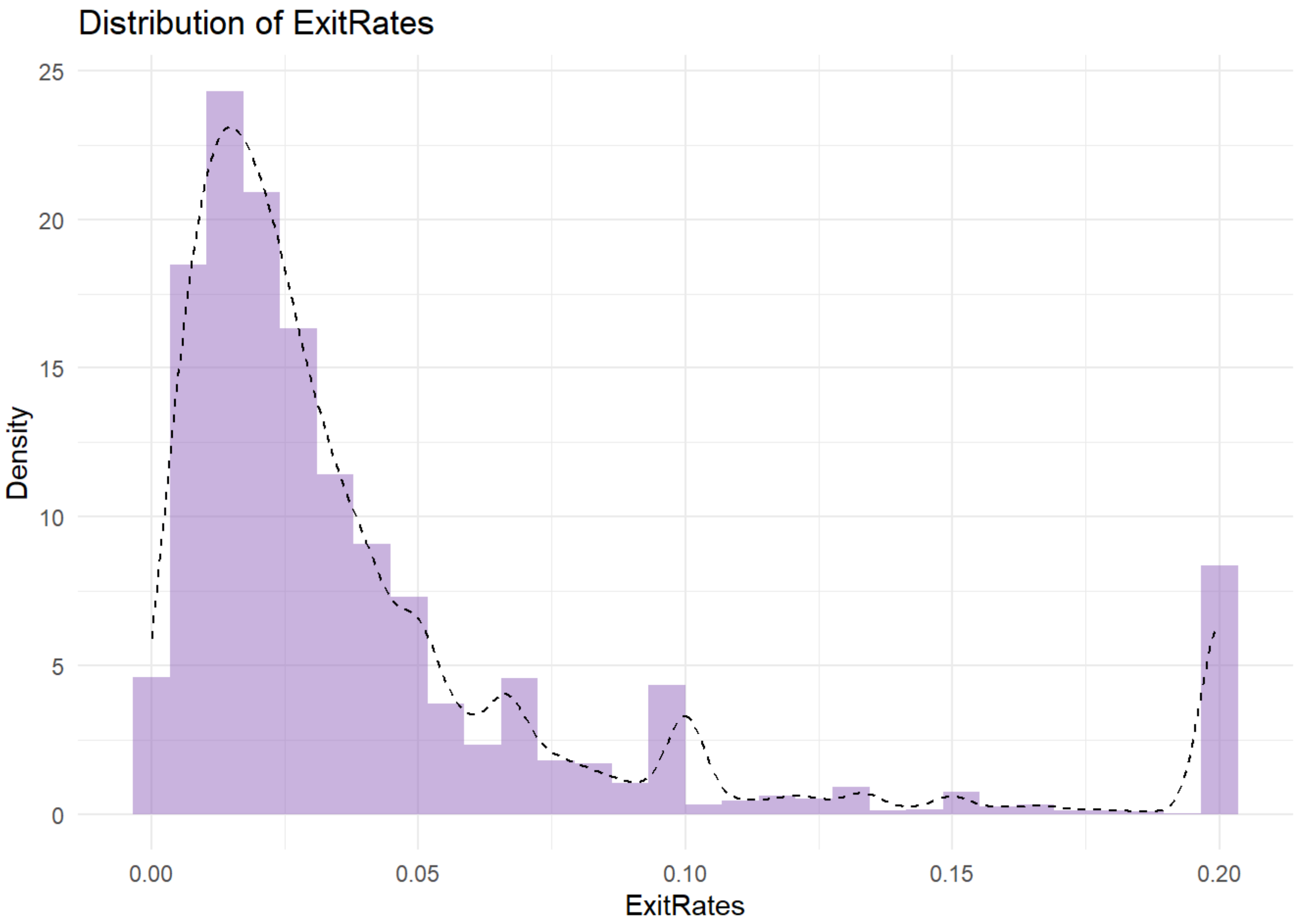
```r
# ProductRelated_Duration
ggplot(df, aes(x = ProductRelated_Duration)) +
  geom_histogram(aes(y = ..density..), fill = "#2ca02c", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of ProductRelated_Duration", x = "ProductRelated_Duration", y = "Density")
```



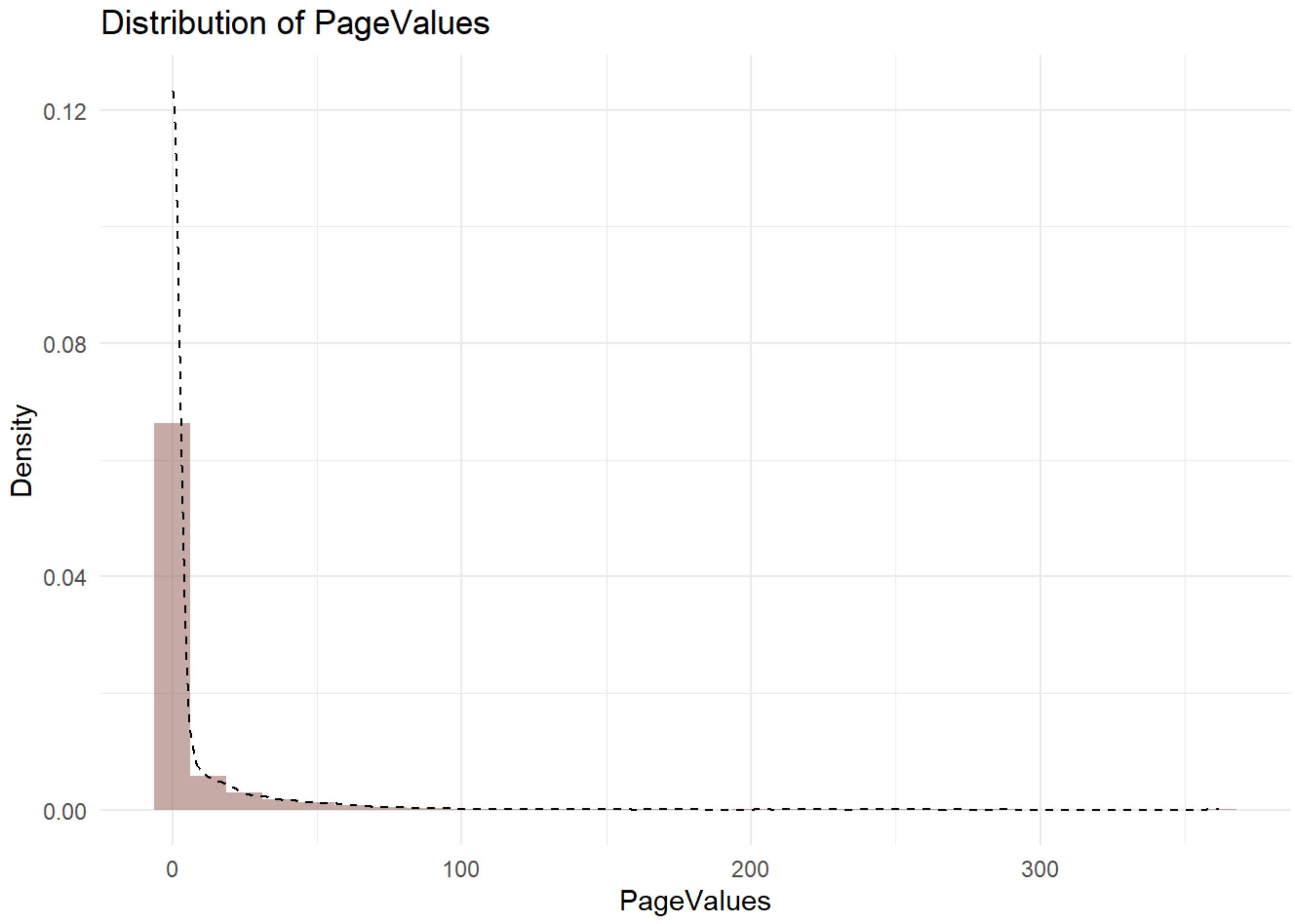
```
# BounceRates
ggplot(df, aes(x = BounceRates)) +
  geom_histogram(aes(y = ..density..), fill = "#d62728", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of BounceRates", x = "BounceRates", y = "Density")
```



```r
# ExitRates
ggplot(df, aes(x = ExitRates)) +
  geom_histogram(aes(y = ..density..), fill = "#9467bd", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of ExitRates", x = "ExitRates", y = "Density")
```



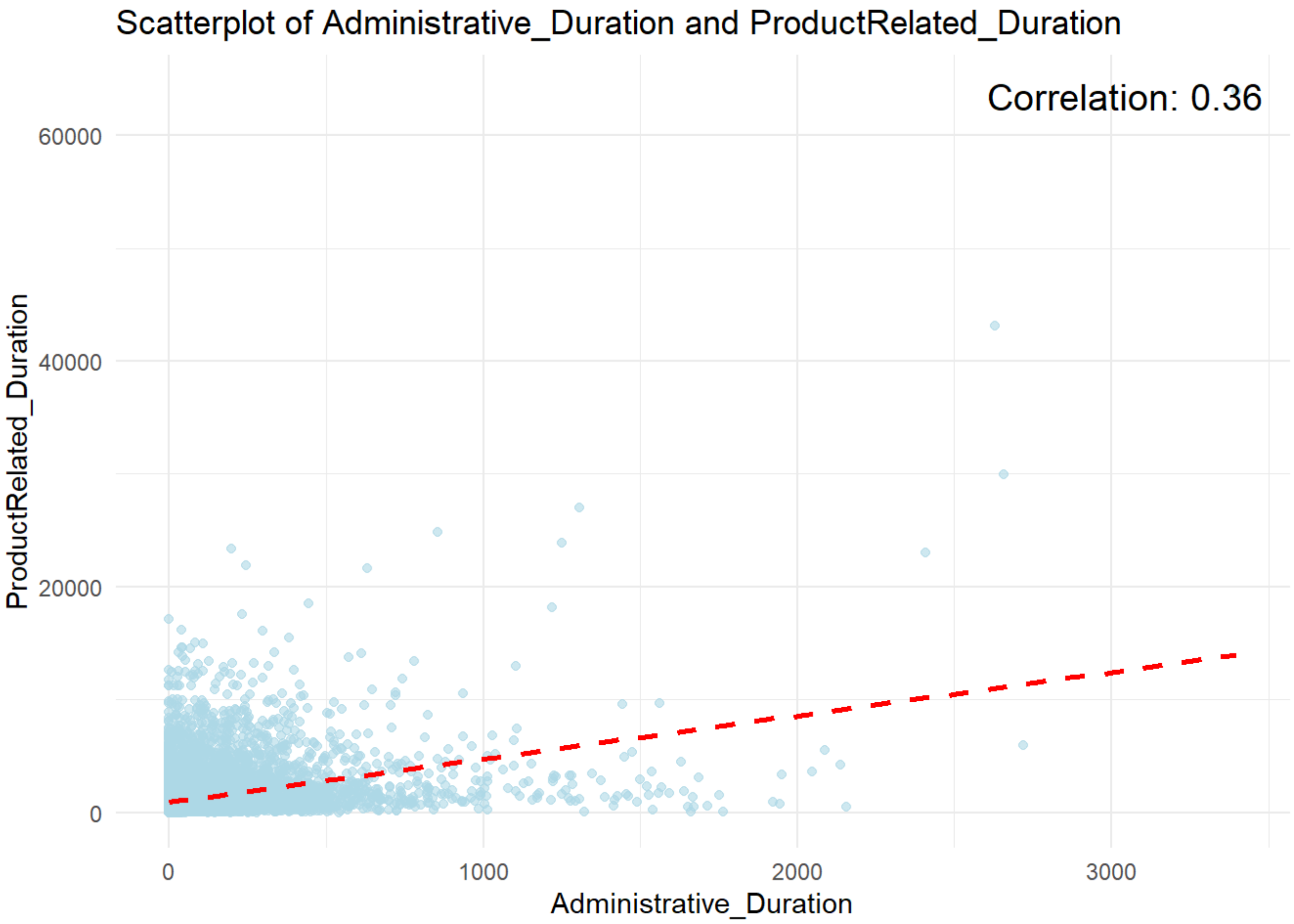
```
# PageValues
ggplot(df, aes(x = PageValues)) +
  geom_histogram(aes(y = ..density..), fill = "#8c564b", alpha = 0.5, bins = 30) +
  geom_density(color = "black", linetype = "dashed") +
  theme_minimal() +
  labs(title = "Distribution of PageValues", x = "PageValues", y = "Density")
```



```r
cor_ad <- cor(df$Administrative_Duration, df$ProductRelated_Duration)
cor_id <- cor(df$Informational_Duration, df$ProductRelated_Duration)
cor_br <- cor(df$BounceRates, df$ProductRelated_Duration)
cor_er <- cor(df$ExitRates, df$ProductRelated_Duration)


# Scatterplot for Administrative_Duration
ggplot(df, aes(x = Administrative_Duration, y = ProductRelated_Duration)) +
  geom_point(color = 'lightblue', alpha = 0.6) +
  geom_smooth(method = 'lm', col = 'red', linetype = 'dashed', size = 1, se = FALSE) +
  annotate("text", x = Inf, y = Inf, label = sprintf("Correlation: %.2f", cor_ad), hjust = 1.1,
vjust = 2, size = 5) +
  labs(title = 'Scatterplot of Administrative_Duration and ProductRelated_Duration') +
  theme_minimal()
```

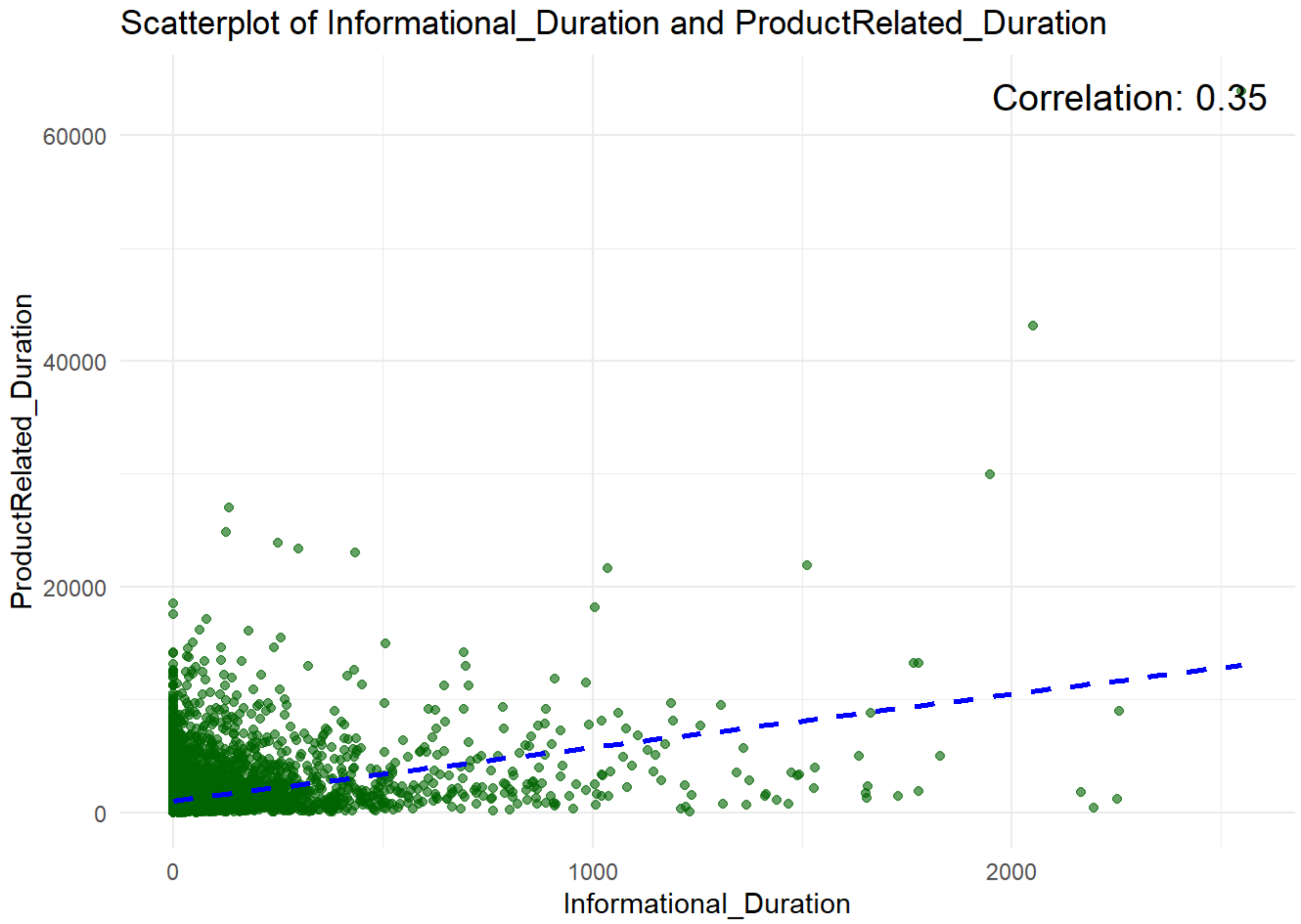
```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## ℹ Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



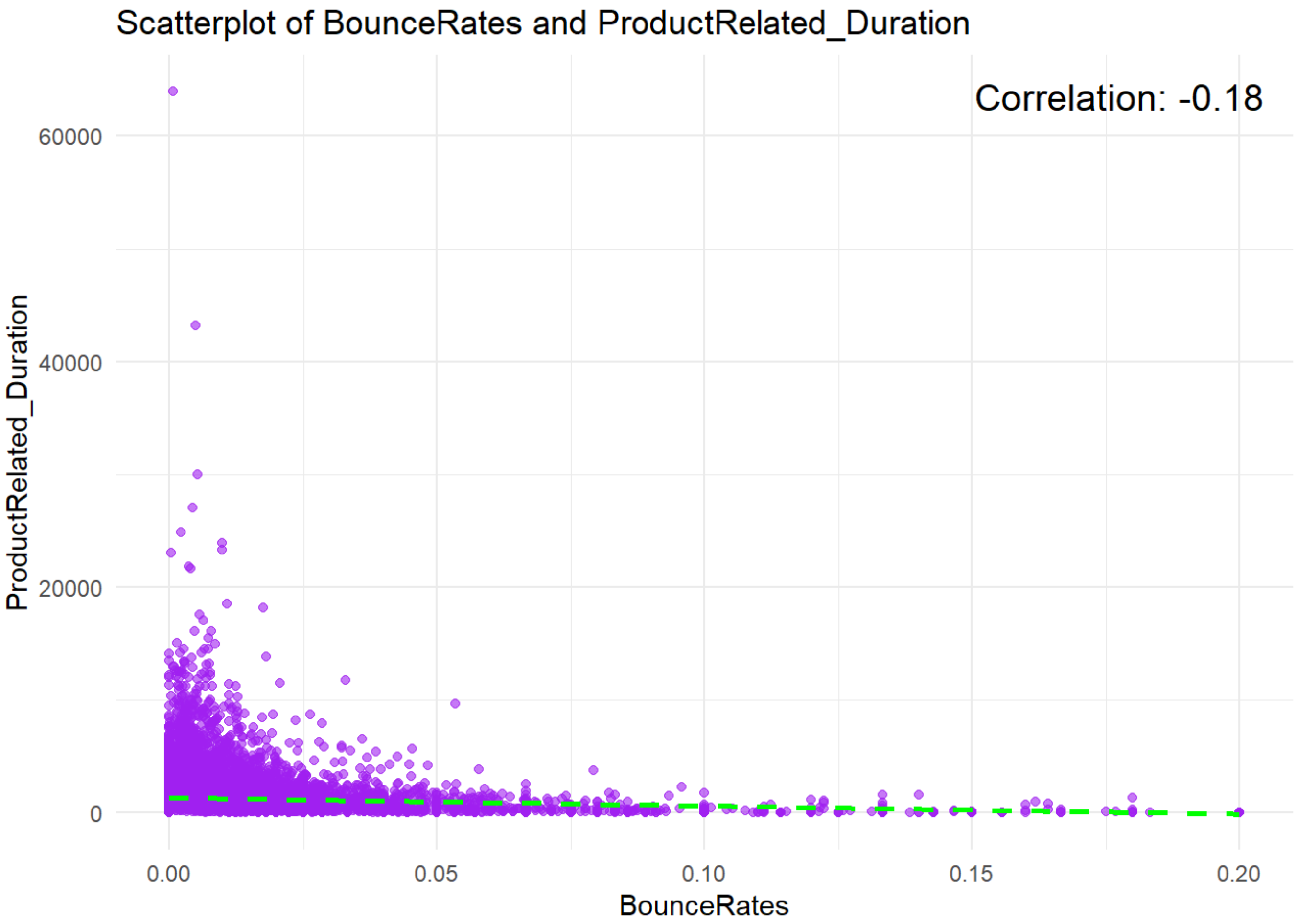
```
# Scatterplot for Informational_Duration
ggplot(df, aes(x = Informational_Duration, y = ProductRelated_Duration)) +
  geom_point(color = 'darkgreen', alpha = 0.6) +
  geom_smooth(method = 'lm', col = 'blue', linetype = 'dashed', size = 1, se = FALSE) +
  annotate("text", x = Inf, y = Inf, label = sprintf("Correlation: %.2f", cor_id), hjust = 1.1,
vjust = 2, size = 5) +
  labs(title = 'Scatterplot of Informational_Duration and ProductRelated_Duration') +
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



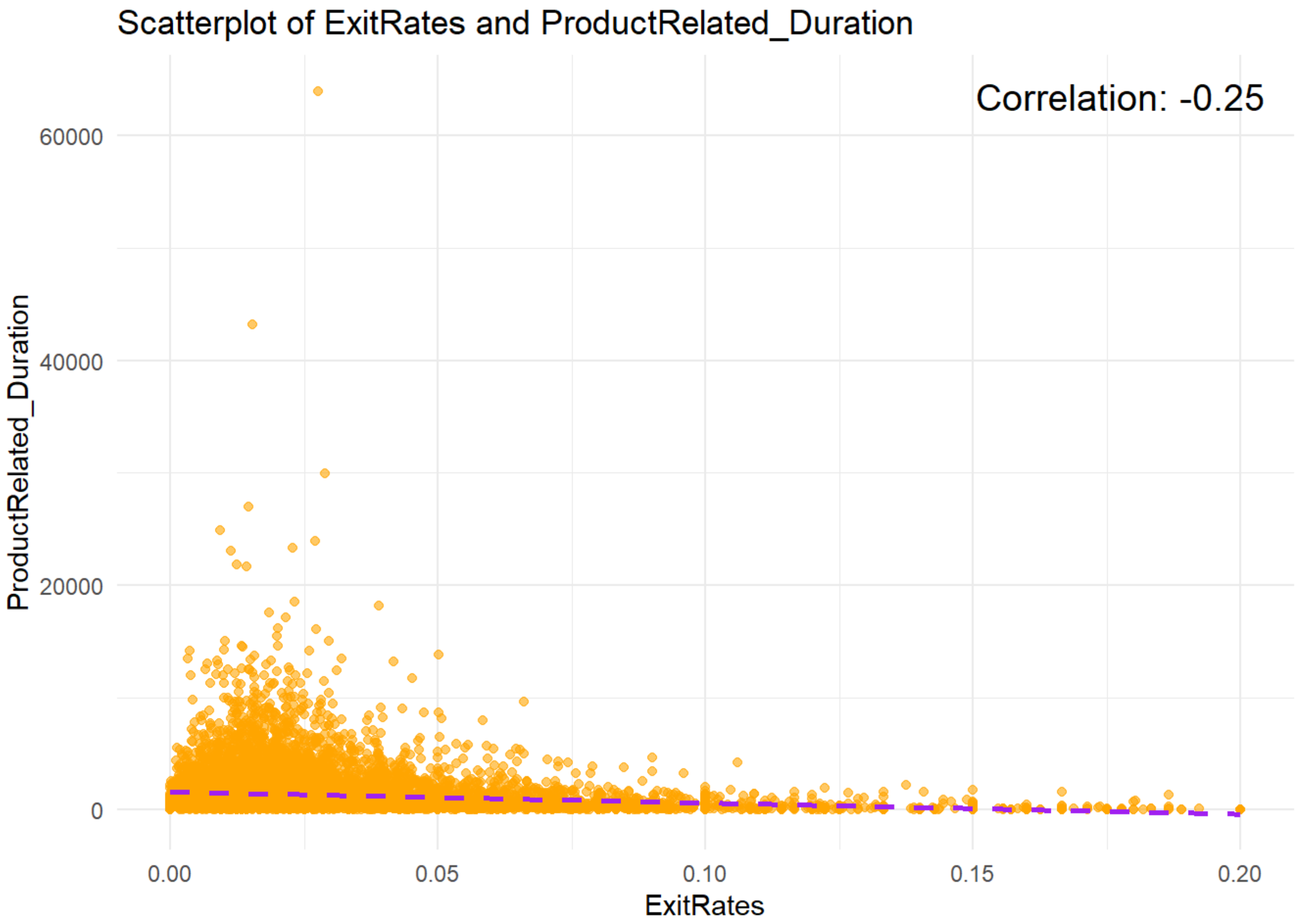
```
# Scatterplot for BounceRates
ggplot(df, aes(x = BounceRates, y = ProductRelated_Duration)) +
  geom_point(color = 'purple', alpha = 0.6) +
  geom_smooth(method = 'lm', col = 'green', linetype = 'dashed', size = 1, se = FALSE) +
  annotate("text", x = Inf, y = Inf, label = sprintf("Correlation: %.2f", cor_br), hjust = 1.1,
vjust = 2, size = 5) +
  labs(title = 'Scatterplot of BounceRates and ProductRelated_Duration') +
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

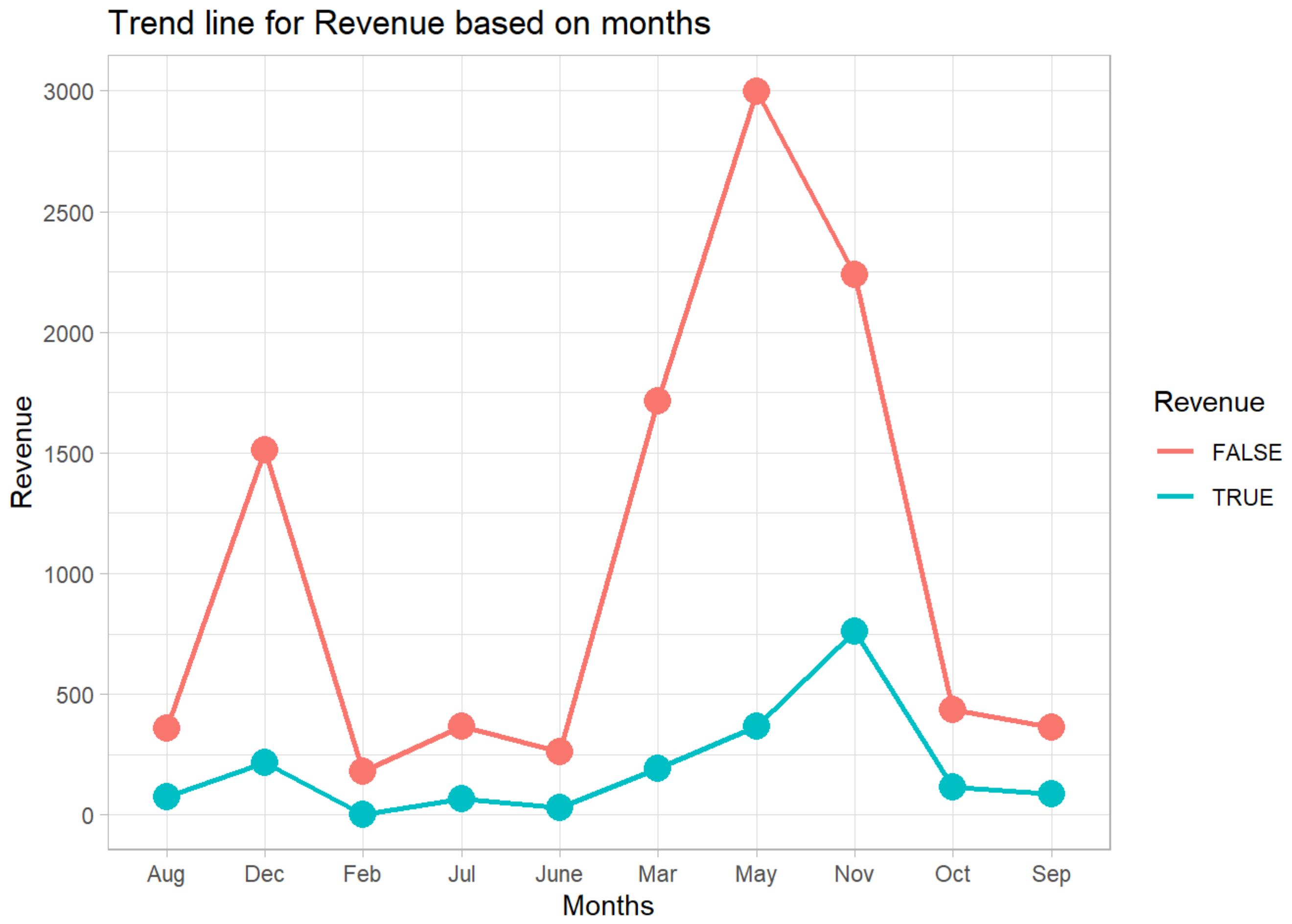


```
# Scatterplot for ExitRates
ggplot(df, aes(x = ExitRates, y = ProductRelated_Duration)) +
  geom_point(color = 'orange', alpha = 0.6) +
  geom_smooth(method = 'lm', col = 'purple', linetype = 'dashed', size = 1, se = FALSE) +
  annotate("text", x = Inf, y = Inf, label = sprintf("Correlation: %.2f", cor_er), hjust = 1.1,
vjust = 2, size = 5) +
  labs(title = 'Scatterplot of ExitRates and ProductRelated_Duration') +
  theme_minimal()
```

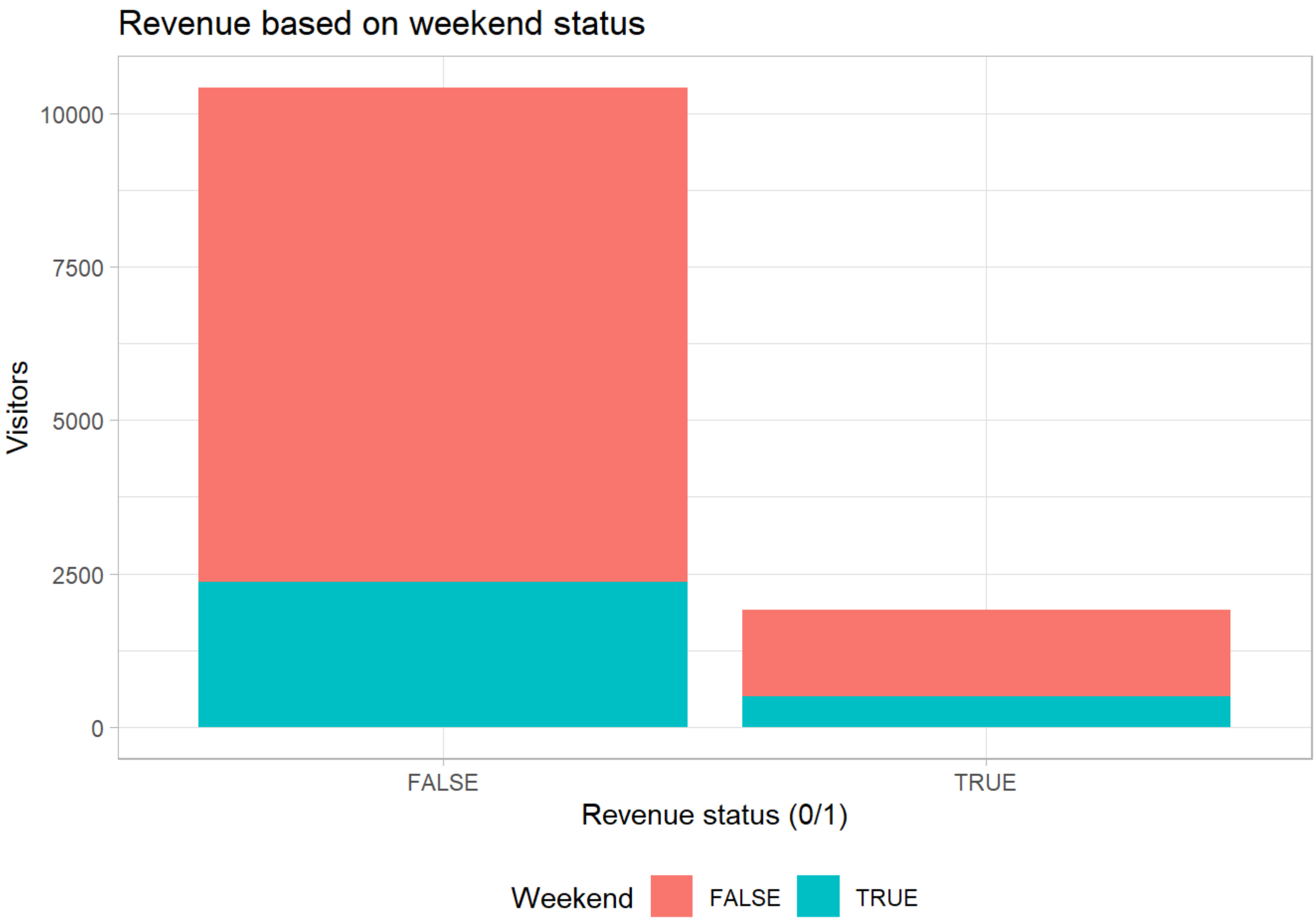
```
## `geom_smooth()` using formula = 'y ~ x'
```



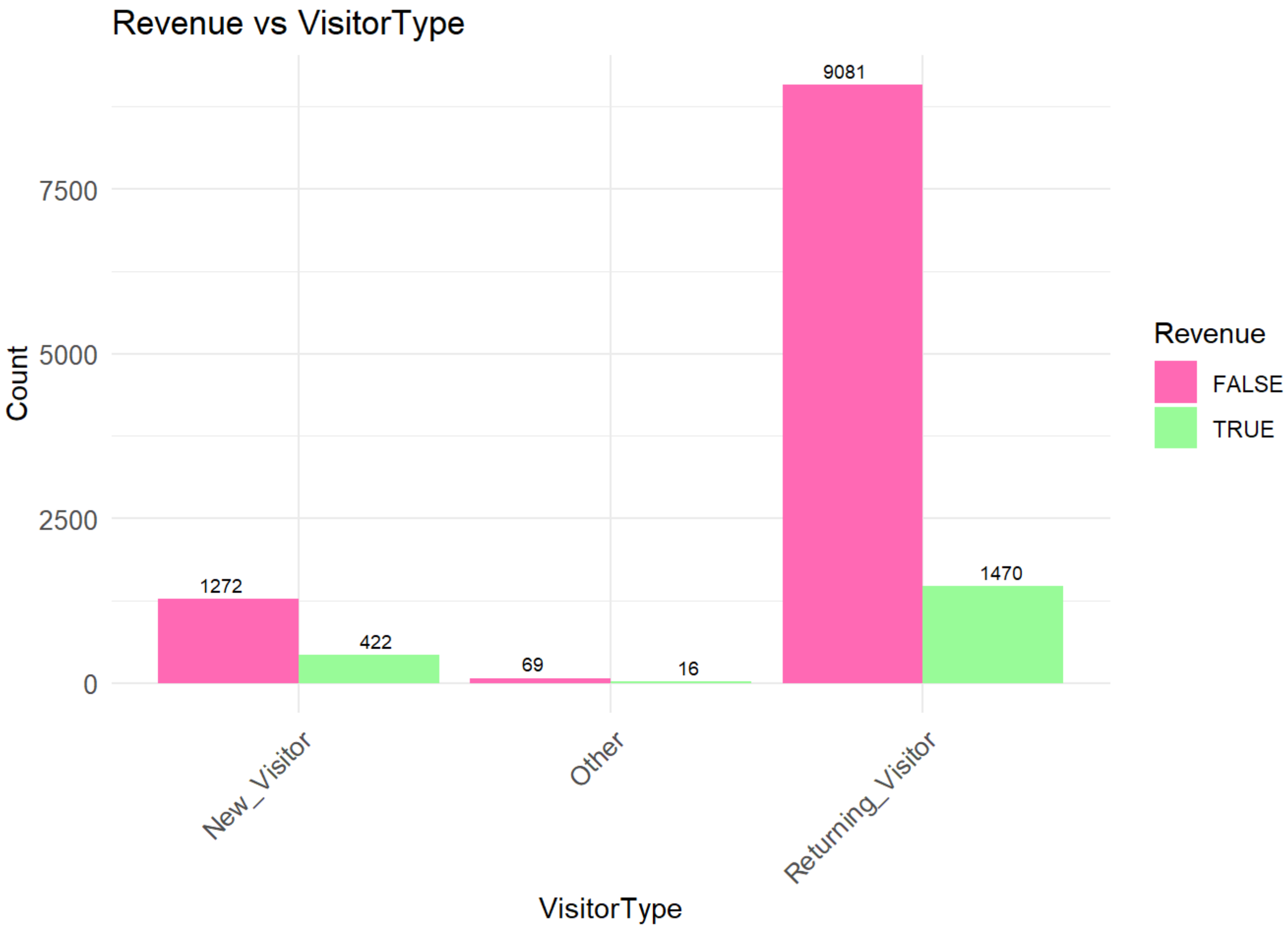
```
# Copy the relevant rows into df_categorical
df_categorical <- df[df$Revenue %in% c(TRUE, FALSE), ]

# Convert columns to categorical variables
df_categorical$Weekend <- as.factor(df_categorical$Weekend)
df_categorical$VisitorType <- as.factor(df_categorical$VisitorType)
df_categorical$TrafficType <- as.factor(df_categorical$TrafficType)
df_categorical$Region <- as.factor(df_categorical$Region)
df_categorical$Browser <- as.factor(df_categorical$Browser)
df_categorical$OperatingSystems <- as.factor(df_categorical$OperatingSystems)
df_categorical$Month <- as.factor(df_categorical$Month)

# Set the label size
label_size <- 10

# trendline for Revenue
trend <- data.frame(table(df$Revenue, df$Month))
names(trend) <- c("Revenue", "Month", "Frequency")
ggplot(data = trend, mapping = aes(x = Month, y = Frequency)) + geom_line(mapping = aes(color =
Revenue, group = Revenue), lwd = 1) +
  geom_point(mapping = aes(color = Revenue, group = Revenue, size = 0.1), show.legend = FALSE)
+ theme_light() +
  scale_y_continuous(breaks = seq(from = 0, to = 4000, by = 500)) +
  ggtitle("Trend line for Revenue based on months") + xlab("Months") + ylab("Revenue")
```



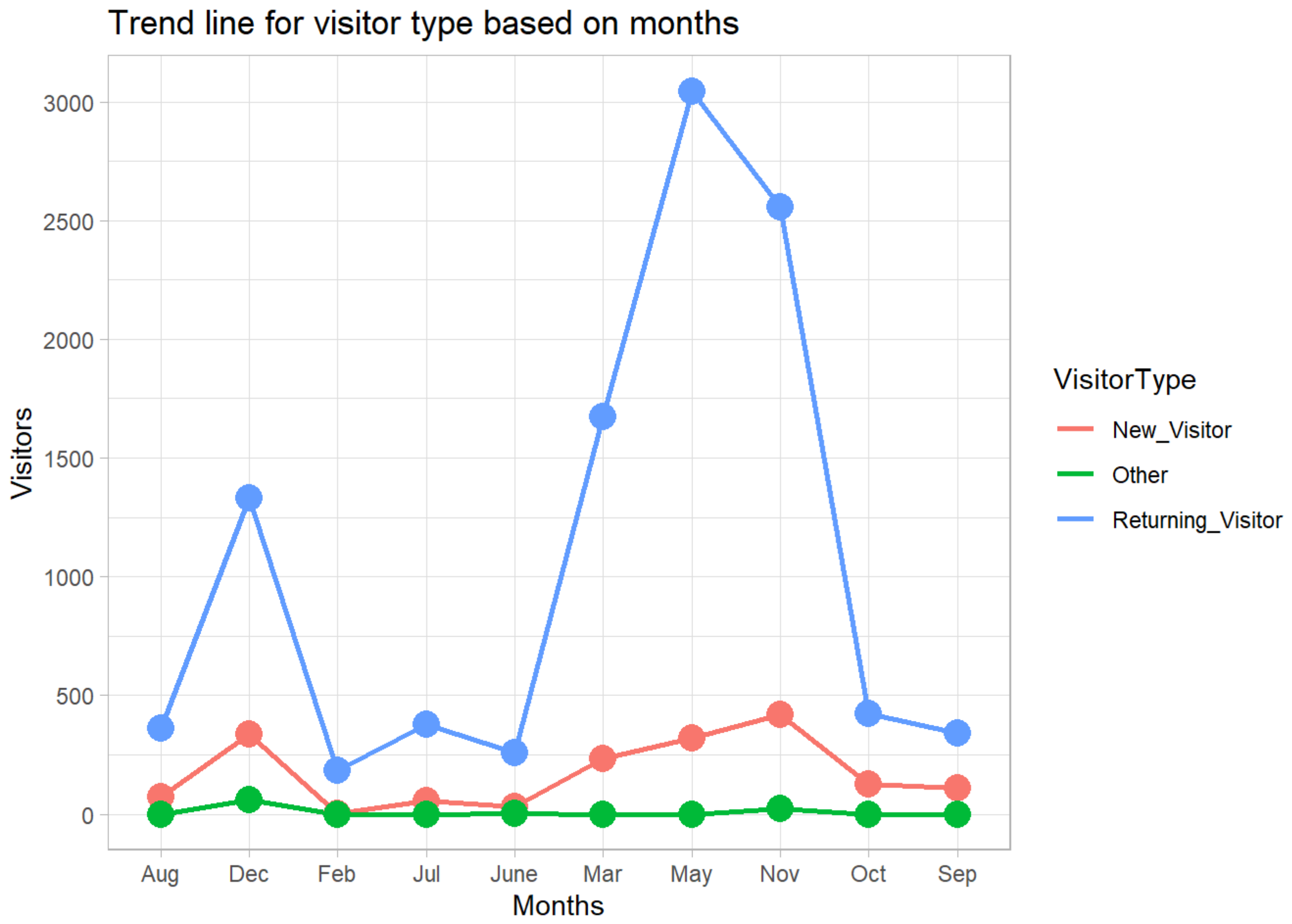
```
# StackedPlot for weekend
ggplot(data = df, mapping = aes(x = Revenue)) +
  geom_bar(mapping = aes(fill = Weekend)) + theme_light() +
  ggtitle("Revenue based on weekend status") + xlab("Revenue status (0/1)") + ylab("Visitors")
+
  theme(legend.position = "bottom")
```



```
# Bar plot for VisitorType
ggplot(df_categorical, aes(x = VisitorType, fill = Revenue)) +
  geom_bar(position = "dodge") +
  labs(title = "Revenue vs VisitorType", x = "VisitorType", y = "Count") +
  theme_minimal() +
  scale_fill_manual(values = c("#FF69B4", "#98FB98")) +
  geom_text(stat = "count", aes(label = after_stat(count)), position = position_dodge(width =
1), vjust = -0.5, size = 2.5) +
  guides(fill = guide_legend(title = "Revenue")) +
  theme(axis.text = element_text(size = label_size),
        axis.text.x = element_text(size = label_size, angle = 45, hjust = 1))
```

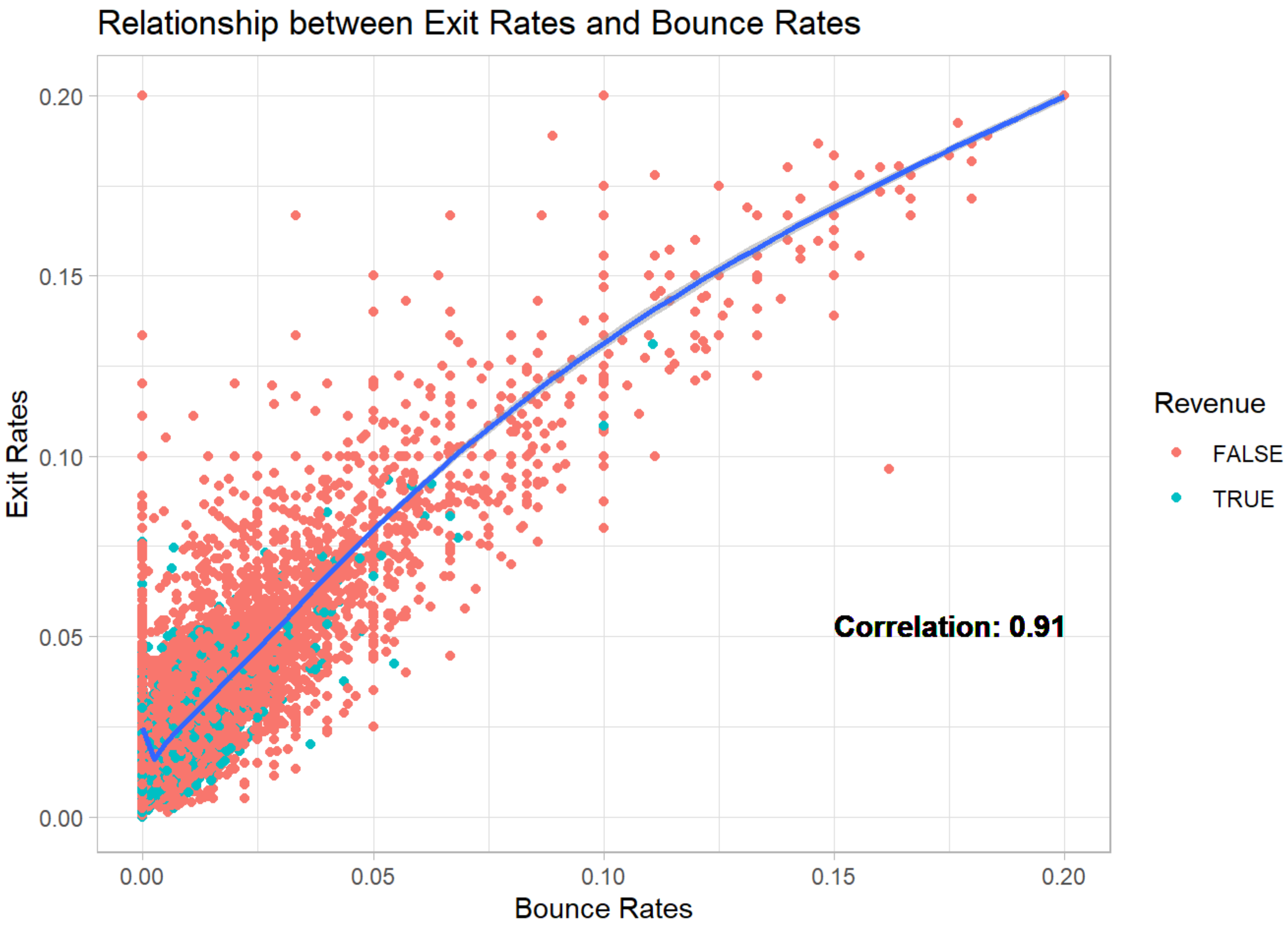


```r
# trendline for Visitor Type
trend <- data.frame(table(df$VisitorType, df$Month))
names(trend) <- c("VisitorType", "Month", "Frequency")
ggplot(data = trend, mapping = aes(x = Month, y = Frequency)) + geom_line(mapping = aes(color =
VisitorType, group = VisitorType), lwd = 1) +
  geom_point(mapping = aes(color = VisitorType, group = VisitorType, size = 0.1), show.legend =
FALSE) + theme_light() +
  scale_y_continuous(breaks = seq(from = 0, to = 4000, by = 500)) +
  ggtitle("Trend line for visitor type based on months") + xlab("Months") + ylab("Visitors")
```

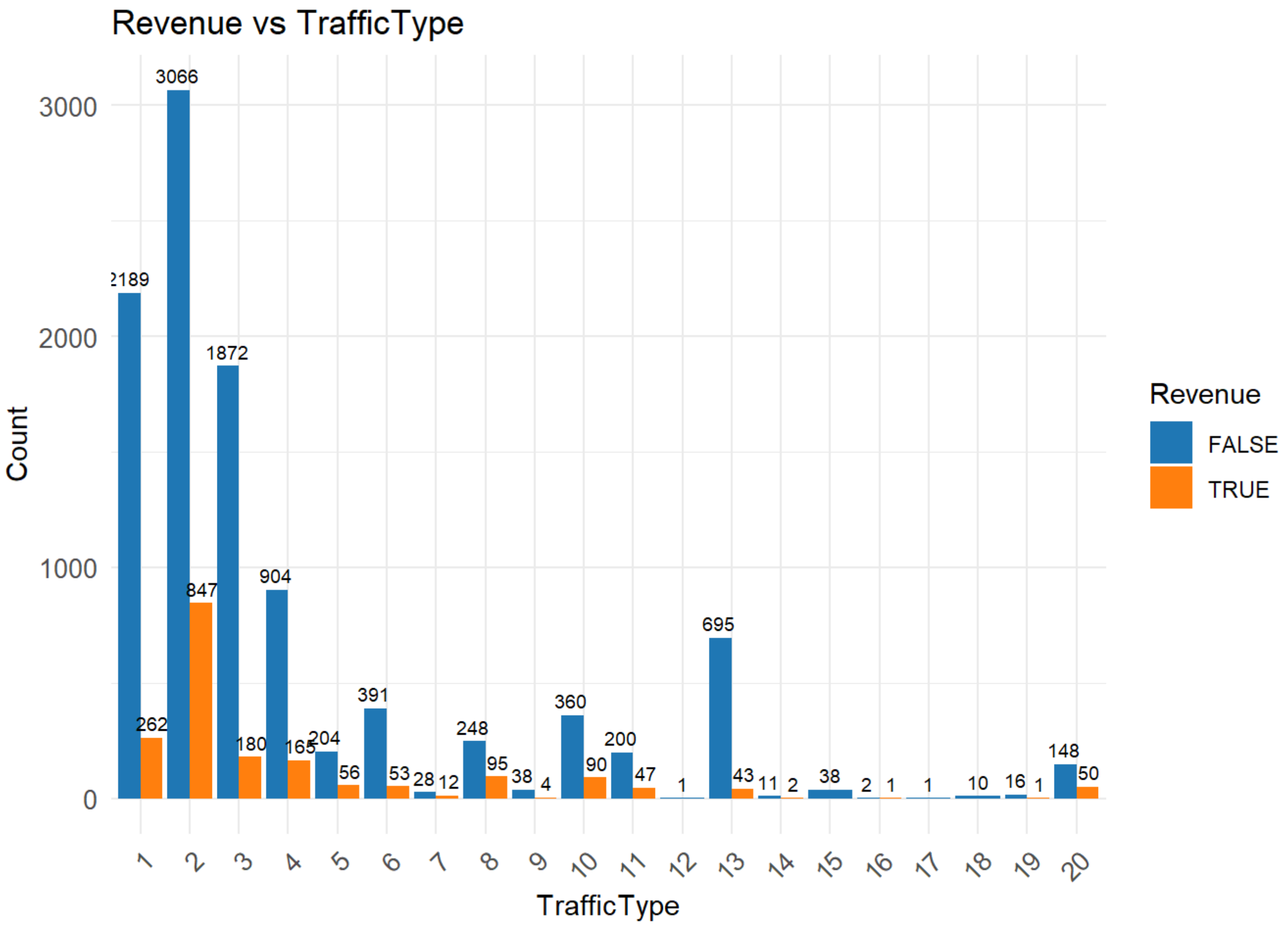


```
# Scatterplot for bounce and exit rates
ggplot(data = df, mapping = aes(x = BounceRates, y = ExitRates)) +
  geom_point(mapping = aes(color = Revenue)) +
  geom_smooth(se = TRUE, alpha = 0.5) +
  geom_text(label = paste("Correlation:", round(cor(df$BounceRates, df$ExitRates), 2)),
            x = 0.15, y = 0.05, hjust = 0, vjust = 0,
            size = 4, color = "black", fontface = "bold") +
  theme_light() +
  ggtitle("Relationship between Exit Rates and Bounce Rates") +
  xlab("Bounce Rates") +
  ylab("Exit Rates")
```

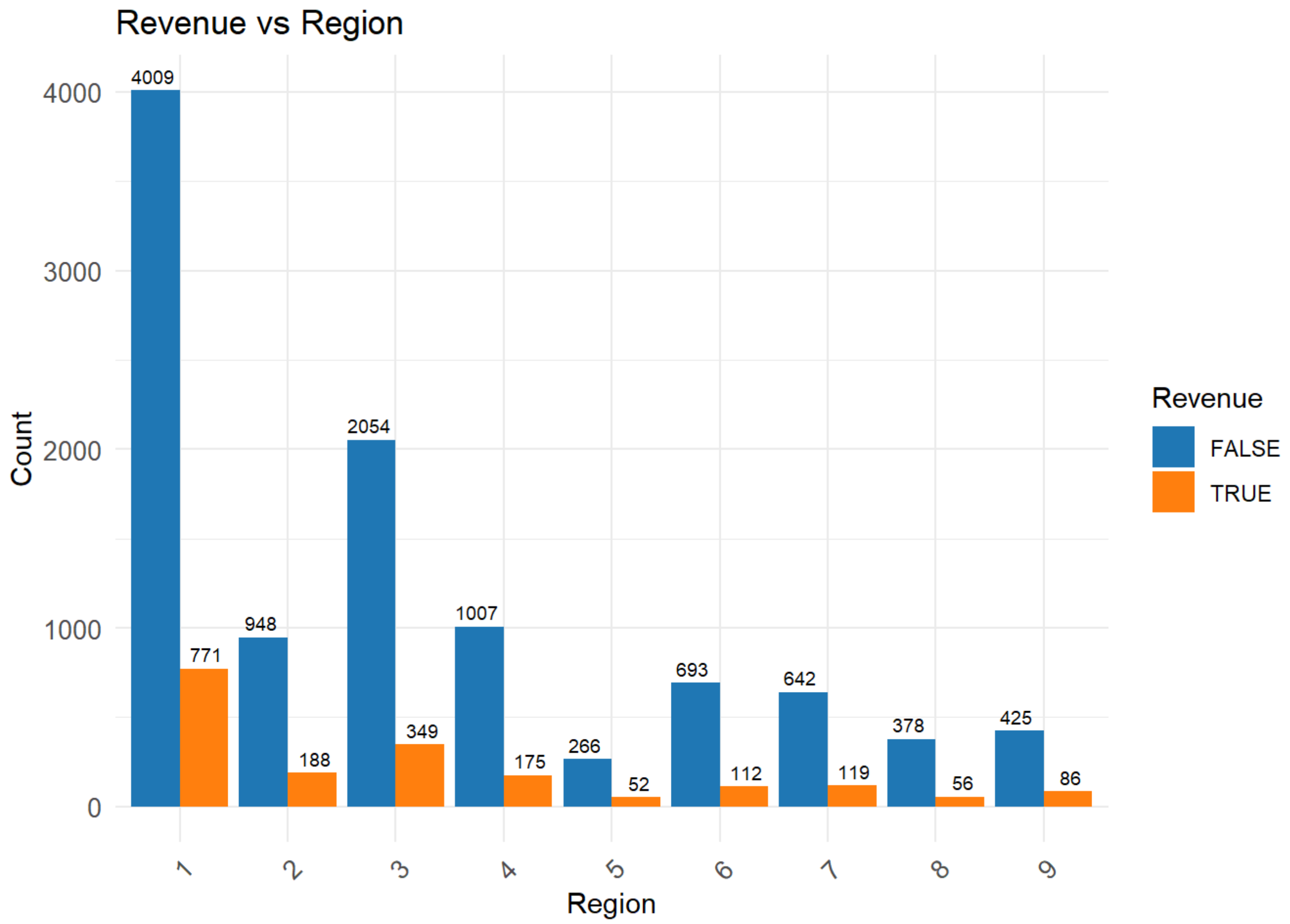
```
## `geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```



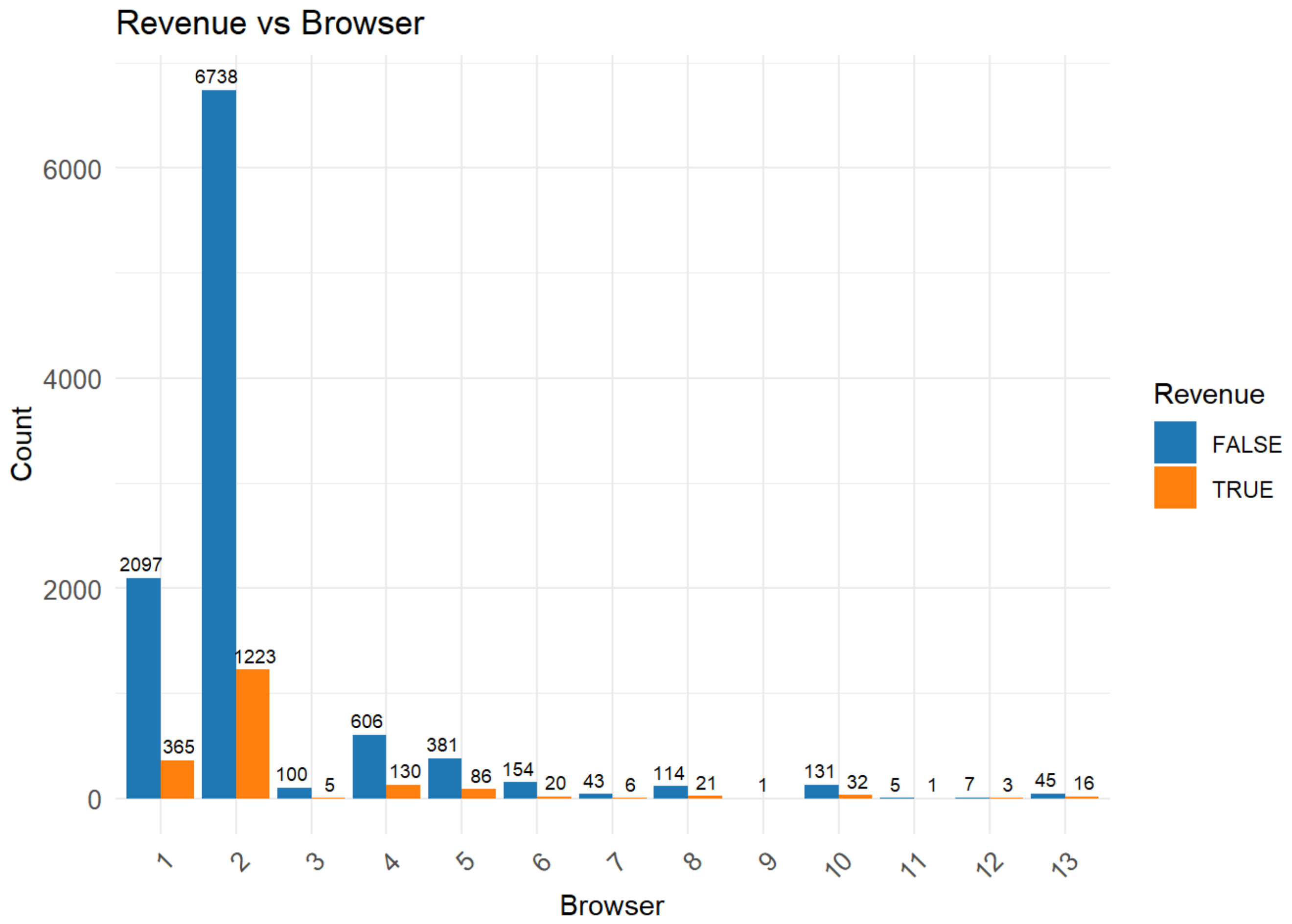
```
# Bar plot for TrafficType
ggplot(df_categorical, aes(x = TrafficType, fill = Revenue)) +
  geom_bar(position = "dodge") +
  labs(title = "Revenue vs TrafficType", x = "TrafficType", y = "Count") +
  theme_minimal() +
  scale_fill_manual(values = c("#1f77b4", "#ff7f0e")) +
  geom_text(stat = "count", aes(label = after_stat(count)), position = position_dodge(width =
1), vjust = -0.5, size = 2.5) +
  guides(fill = guide_legend(title = "Revenue")) +
  theme(axis.text = element_text(size = label_size),
        axis.text.x = element_text(size = label_size, angle = 45, hjust = 1))
```



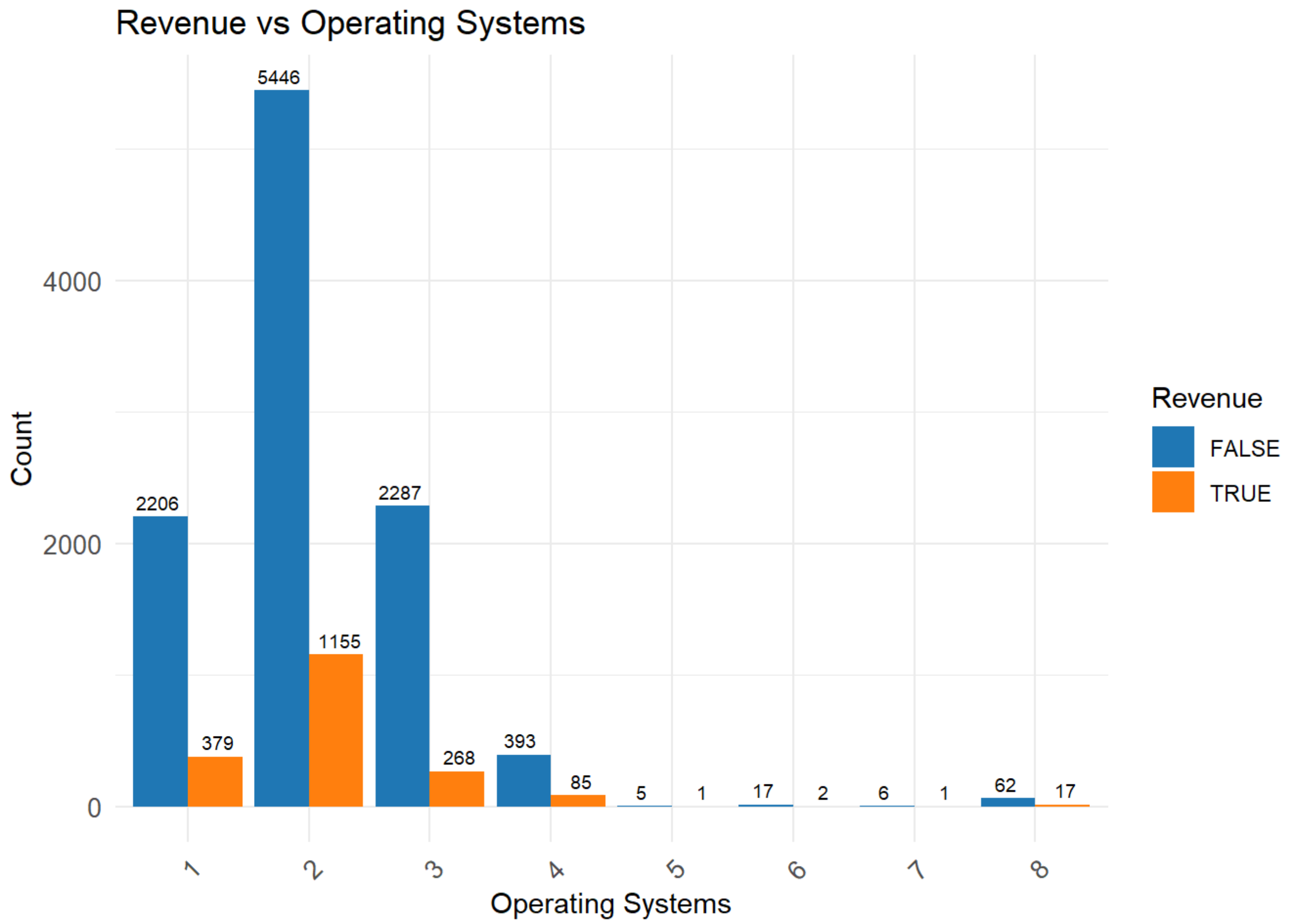
```
# Bar plot for Region
ggplot(df_categorical, aes(x = Region, fill = Revenue)) +
  geom_bar(position = "dodge") +
  labs(title = "Revenue vs Region", x = "Region", y = "Count") +
  theme_minimal() +
  scale_fill_manual(values = c("#1f77b4", "#ff7f0e")) +
  geom_text(stat = "count", aes(label = after_stat(count)), position = position_dodge(width =
1), vjust = -0.5, size = 2.5) +
  guides(fill = guide_legend(title = "Revenue")) +
  theme(axis.text = element_text(size = label_size),
        axis.text.x = element_text(size = label_size, angle = 45, hjust = 1))
```



```
# Bar plot for Browser
ggplot(df_categorical, aes(x = Browser, fill = Revenue)) +
  geom_bar(position = "dodge") +
  labs(title = "Revenue vs Browser", x = "Browser", y = "Count") +
  theme_minimal() +
  scale_fill_manual(values = c("#1f77b4", "#ff7f0e")) +
  geom_text(stat = "count", aes(label = after_stat(count)), position = position_dodge(width =
1), vjust = -0.5, size = 2.5) +
  guides(fill = guide_legend(title = "Revenue")) +
  theme(axis.text = element_text(size = label_size),
        axis.text.x = element_text(size = label_size, angle = 45, hjust = 1))
```



```
# Bar plot for OperatingSystems
ggplot(df_categorical, aes(x = OperatingSystems, fill = Revenue)) +
  geom_bar(position = "dodge") +
  labs(title = "Revenue vs Operating Systems", x = "Operating Systems", y = "Count") +
  theme_minimal() +
  scale_fill_manual(values = c("#1f77b4", "#ff7f0e")) +
  geom_text(stat = "count", aes(label = after_stat(count)), position = position_dodge(width =
1), vjust = -0.5, size = 2.5) +
  guides(fill = guide_legend(title = "Revenue")) +
  theme(axis.text = element_text(size = label_size),
        axis.text.x = element_text(size = label_size, angle = 45, hjust = 1))
```



Hypothesis testing

```
# set the confidence level

confidence_level <- 0.95

# Hypothesis Test with ProductRelated_Duration as the Target Variable (Pearson Correlation)
correlation <- cor(df$ProductRelated_Duration, df[["Informational_Duration"]])
p_value <- cor.test(df$ProductRelated_Duration, df[["Informational_Duration"]])$p.value
conf_interval <- cor.test(df$ProductRelated_Duration, df[["Informational_Duration"]])$conf.int

# Print the results
cat("Hypothesis Test with ProductRelated_Duration as the Target Variable (Pearson Correlation)\n")
```

```
## Hypothesis Test with ProductRelated_Duration as the Target Variable (Pearson Correlation)
```

```
cat("Variable of Interest:Informational_Duration", "\n")
```

```
## Variable of Interest:Informational_Duration
```

```
cat("Null Hypothesis: There is no correlation between ProductRelated_Duration and Informational_Duration", "\n")
```

```
## Null Hypothesis: There is no correlation between ProductRelated_Duration and Informational_D
uration
```

```
cat("Alternate Hypothesis: There is a correlation between ProductRelated_Duration and Informati
onal_Duration", "\n")
```

```
## Alternate Hypothesis: There is a correlation between ProductRelated_Duration and Information
al_Duration
```

```
cat("Correlation:", correlation, "\n")
```

```
## Correlation: 0.3473636
```

```
cat("p-value:", p_value, "\n")
```

```
## p-value: 0
```

```
cat("Confidence Interval:", conf_interval[1], "-", conf_interval[2], "\n")
```

```
## Confidence Interval: 0.3317464 - 0.3627904
```

```
cat("\n")
```

```
# Hypothesis Test with ProductRelated_Duration as the Target Variable (t-test)
t_result <- t.test(df$ProductRelated_Duration ~ df$Revenue)

# Print the results
cat("Hypothesis Test with ProductRelated_Duration as the Target Variable (t-test)\n")
```

```
## Hypothesis Test with ProductRelated_Duration as the Target Variable (t-test)
```

```
cat("Variable of Interest:Revenue", "\n")
```

```
## Variable of Interest:Revenue
```

```
cat("Null Hypothesis: The mean ProductRelated_Duration is the same for Reveue levels", "\n")
```

```
## Null Hypothesis: The mean ProductRelated_Duration is the same for Reveue levels
```

```
cat("Alternate Hypothesis: The mean ProductRelated_Duration is different for Revenue Levels",
"\n")
```

```
## Alternate Hypothesis: The mean ProductRelated_Duration is different for Revenue Levels
```

```
cat("t-value:", t_result$statistic, "\n")
```

```
## t-value: -14.44699
```

```
cat("p-value:", t_result$p.value, "\n")
```

```
## p-value: 2.173791e-45
```

```
cat("Confidence Interval:", t_result$conf.int[1], "-", t_result$conf.int[2], "\n")
```

```
## Confidence Interval: -915.655 - -696.7886
```

```
cat("\n")
```

```
# Hypothesis Test with Revenue as the Target Variable (Chi-square Test)
cross_table <- table(df$Revenue, df$Region)
chi_square <- chisq.test(cross_table)$statistic
p_value <- chisq.test(cross_table)$p.value

# Print the results
cat("Hypothesis Test with Revenue as the Target Variable (Chi-square Test)\n")
```

```
## Hypothesis Test with Revenue as the Target Variable (Chi-square Test)
```

```
cat("Variable of Interest:Region", "\n")
```

```
## Variable of Interest:Region
```

```
cat("Null Hypothesis: There is no association between Revenue and Region", "\n")
```

```
## Null Hypothesis: There is no association between Revenue and Region
```

```
cat("Alternate Hypothesis: There is an association between Revenue and Region", "\n")
```

```
## Alternate Hypothesis: There is an association between Revenue and Region
```

```
cat("Chi-square:", chi_square, "\n")
```

```
## Chi-square: 9.252751
```

```
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.321425
```

```
cat("\n")
```

```
# Hypothesis Test with Revenue as the Target Variable (z-test)
z_result <- prop.test(table(df$Revenue, df$Weekend))

# Print the results
cat("Hypothesis Test with Revenue as the Target Variable (z-test)\n")
```

```
## Hypothesis Test with Revenue as the Target Variable (z-test)
```

```
cat("Variable of Interest: Weekend", "\n")
```

```
## Variable of Interest: Weekend
```

```
cat("Null Hypothesis: The proportion of Revenue is the same for Weekend/Weekday", "\n")
```

```
## Null Hypothesis: The proportion of Revenue is the same for Weekend/Weekday
```

```
cat("Alternate Hypothesis: The proportion of Revenue is different for Weekend/Weekday", "\n")
```

```
## Alternate Hypothesis: The proportion of Revenue is different for Weekend/Weekday
```

```
cat("z-value:", z_result$statistic, "\n")
```

```
## z-value: 10.39098
```

```
cat("p-value:", z_result$p.value, "\n")
```

```
## p-value: 0.001266325
```

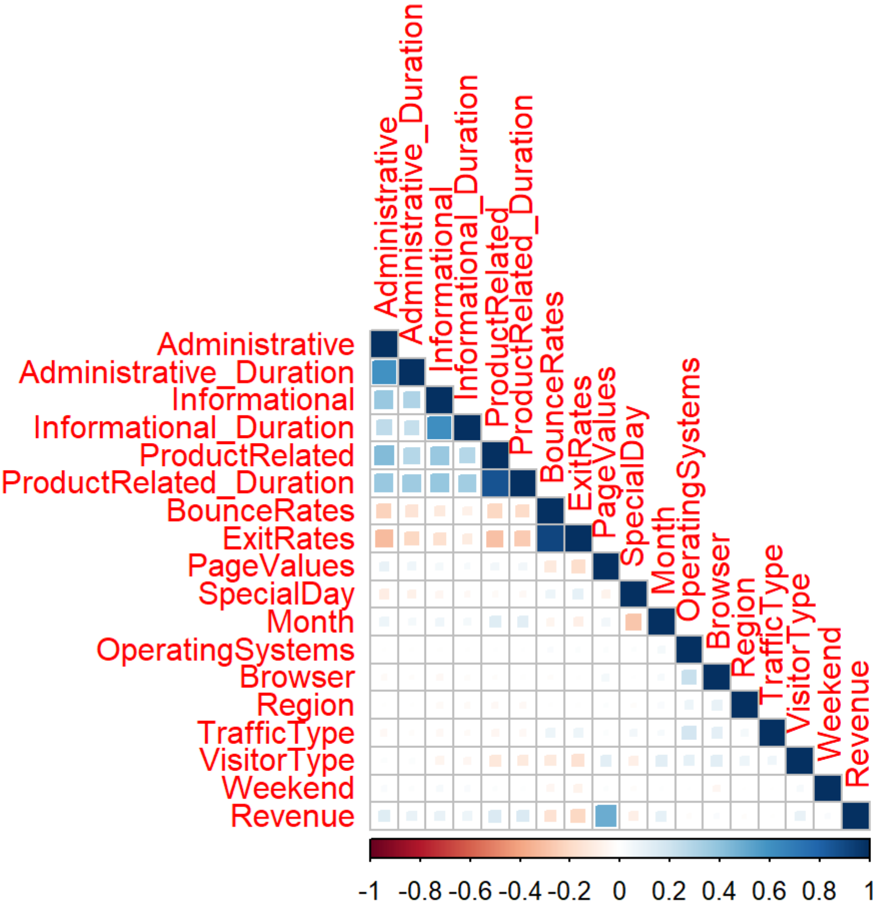
```
cat("Confidence Interval:", z_result$conf.int[1], "-", z_result$conf.int[2], "\n")
```

```
## Confidence Interval: 0.01261532 - 0.05583024
```

```
cat("\n")
```

Correlation plot

```
#dataprep for correlation plot
df_corr <- df

# Convert 'Month' to numerical representation
df_corr$Month <- as.numeric(factor(df_corr$Month, levels = unique(df_corr$Month)))

# Convert 'VisitorType' to numerical representation
df_corr$VisitorType <- as.numeric(factor(df_corr$VisitorType, levels = unique(df_corr$VisitorTy
pe)))


# Convert logical variables to numeric
df_corr$Weekend <- as.integer(df_corr$Weekend)
df_corr$Revenue <- as.integer(df_corr$Revenue)

# Compute the correlation matrix
cor_matrix <- cor(df_corr)


# Plot the correlation matrix with improved legibility and column names
corrplot(cor_matrix, method = "square", type = "lower", diag = TRUE)
```



```
# Compute correlation coefficients with ProductRelated_Duration
correlation <- cor(df_corr$ProductRelated_Duration, df_corr)

# Create a data frame with the correlation value for ProductRelated_Duration
correlation_df <- data.frame(Variable = colnames(df_corr), Correlation = correlation)

# Convert to long format and filter for ProductRelated_Duration
correlation_long <- correlation_df %>%
  pivot_longer(cols = -Variable, names_to = "Variable2", values_to = "Correlation") %>%
  filter(Variable == "ProductRelated_Duration")

# Print the correlation table for ProductRelated_Duration in long format
print(correlation_long)
```

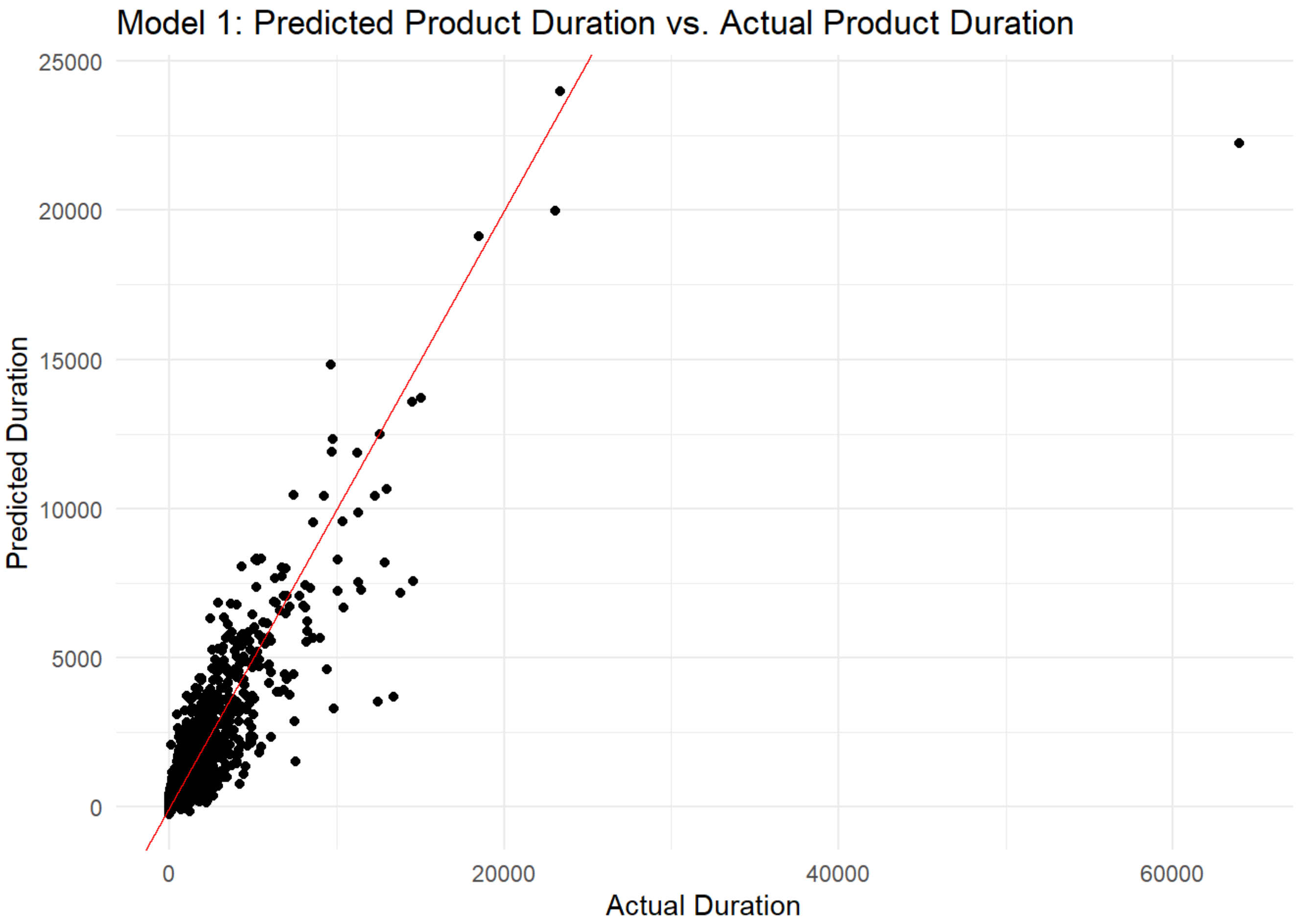
```
## # A tibble: 18 × 3
##    Variable                Variable2                            Correlation
##    <chr>                   <chr>                                      <dbl>
##  1 ProductRelated_Duration Correlation.Administrative               0.374
##  2 ProductRelated_Duration Correlation.Administrative_Duration      0.355
##  3 ProductRelated_Duration Correlation.Informational                0.388
##  4 ProductRelated_Duration Correlation.Informational_Duration       0.347
##  5 ProductRelated_Duration Correlation.ProductRelated               0.861
##  6 ProductRelated_Duration Correlation.ProductRelated_Duration      1
##  7 ProductRelated_Duration Correlation.BounceRates                 -0.185
##  8 ProductRelated_Duration Correlation.ExitRates                   -0.252
##  9 ProductRelated_Duration Correlation.PageValues                   0.0528
## 10 ProductRelated_Duration Correlation.SpecialDay                  -0.0364
## 11 ProductRelated_Duration Correlation.Month                        0.124
## 12 ProductRelated_Duration Correlation.OperatingSystems             0.00298
## 13 ProductRelated_Duration Correlation.Browser                     -0.00738
## 14 ProductRelated_Duration Correlation.Region                      -0.0331
## 15 ProductRelated_Duration Correlation.TrafficType                 -0.0364
## 16 ProductRelated_Duration Correlation.VisitorType                 -0.118
## 17 ProductRelated_Duration Correlation.Weekend                      0.00731
## 18 ProductRelated_Duration Correlation.Revenue                      0.152
```

Linear Regression

```
data<-df

# Splitting the data into training and testing sets
set.seed(123)
train_indices <- sample(1:nrow(data), 0.8 * nrow(data))
train_data <- data[train_indices, ]
test_data <- data[-train_indices, ]

model1 <- lm(ProductRelated_Duration ~ Administrative + Administrative_Duration + Informational
+ Informational_Duration +  ProductRelated + BounceRates
             + ExitRates + Month + VisitorType + Revenue, data = train_data)
summary(model1)
```

```
##
## Call:
## lm(formula = ProductRelated_Duration ~ Administrative + Administrative_Duration +
##     Informational + Informational_Duration + ProductRelated +
##     BounceRates + ExitRates + Month + VisitorType + Revenue,
##     data = train_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6036.3  -289.4   -88.9   152.3 12986.4
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  -2.704e+02  5.221e+01  -5.180 2.27e-07 ***
## Administrative               -3.771e+01  3.557e+00 -10.602  < 2e-16 ***
## Administrative_Duration       1.211e+00  6.365e-02  19.024  < 2e-16 ***
## Informational                 4.782e+01  8.954e+00   5.341 9.47e-08 ***
## Informational_Duration        8.608e-01  7.732e-02  11.133  < 2e-16 ***
## ProductRelated                3.512e+01  2.361e-01 148.752  < 2e-16 ***
## BounceRates                  -1.994e+03  4.433e+02  -4.498 6.92e-06 ***
## ExitRates                     1.898e+03  4.670e+02   4.063 4.88e-05 ***
## MonthDec                      2.048e+02  5.111e+01   4.007 6.19e-05 ***
## MonthFeb                      2.398e+02  8.519e+01   2.814  0.00490 **
## MonthJul                      2.361e+01  6.428e+01   0.367  0.71341
## MonthJune                     5.189e+01  7.197e+01   0.721  0.47089
## MonthMar                      2.270e+02  5.059e+01   4.487 7.30e-06 ***
## MonthMay                      1.529e+02  4.852e+01   3.151  0.00163 **
## MonthNov                      2.315e+02  4.887e+01   4.737 2.20e-06 ***
## MonthOct                      3.665e+01  6.110e+01   0.600  0.54867
## MonthSep                      1.526e+02  6.352e+01   2.403  0.01628 *
## VisitorTypeOther              1.109e+02  1.067e+02   1.040  0.29860
## VisitorTypeReturning_Visitor  6.981e+01  2.620e+01   2.665  0.00772 **
## RevenueTRUE                   1.020e+02  2.447e+01   4.169 3.08e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 841.5 on 9844 degrees of freedom
## Multiple R-squared:  0.7879, Adjusted R-squared:  0.7875
## F-statistic:  1925 on 19 and 9844 DF,  p-value: < 2.2e-16
```

```
#make predictions with model
predictions_model1 <- predict(model1, newdata = test_data)


# Create a scatter plot of predicted charges vs. actual charges
ggplot(test_data, aes(x = ProductRelated_Duration, y = predictions_model1)) +
  geom_point() +
  geom_abline(intercept = 0, slope = 1, color = "red") +
  labs(x = "Actual Duration", y = "Predicted Duration",
       title = "Model 1: Predicted Product Duration vs. Actual Product Duration") +
  theme_minimal()
```



```
model2 <- lm(ProductRelated_Duration ~ Administrative_Duration + Informational_Duration + BounceRates + ExitRates + ProductRelated + Month + Revenue + VisitorType, data = train_data)
model3 <- lm(ProductRelated_Duration ~ Administrative_Duration + Informational_Duration + ExitRates + ProductRelated + Month + Revenue + VisitorType, data = train_data)
model4 <- lm(ProductRelated_Duration ~ Informational_Duration + ExitRates + ProductRelated + Month + Revenue + VisitorType, data = train_data)


# Compare the models using an ANOVA table
anova(model1, model2, model3, model4)
```

```
## Analysis of Variance Table
##
## Model 1: ProductRelated_Duration ~ Administrative + Administrative_Duration +
##     Informational + Informational_Duration + ProductRelated +
##     BounceRates + ExitRates + Month + VisitorType + Revenue
## Model 2: ProductRelated_Duration ~ Administrative_Duration + Informational_Duration +
##     BounceRates + ExitRates + ProductRelated + Month + Revenue +
##     VisitorType
## Model 3: ProductRelated_Duration ~ Administrative_Duration + Informational_Duration +
##     ExitRates + ProductRelated + Month + Revenue + VisitorType
## Model 4: ProductRelated_Duration ~ Informational_Duration + ExitRates +
##     ProductRelated + Month + Revenue + VisitorType
##   Res.Df        RSS Df  Sum of Sq       F    Pr(>F)
## 1   9844 6971577568
## 2   9846 7062498800 -2  -90921231  64.191 < 2.2e-16 ***
## 3   9847 7082734838 -1  -20236039  28.574 9.222e-08 ***
## 4   9848 7272873798 -1 -190138959 268.480 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#model4 has highest anova
```