HSS 317 Data Project Reproducibility Materials

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2024-05-10

Gemini Function

The `gemini` function was created in order to utilize Google's Gemini API for text generation and sentiment analysis. It takes several parameters, including `prompts`, `temperature`, `max_output_tokens`, `api_key`, and `model`. Here's a breakdown of each parameter:

- `prompts`: A vector containing the text prompts for which sentiment analysis is to be performed.
- `temperature`: A parameter controlling the randomness of the text generation process. Higher values result in more random outputs.
- `max_output_tokens`: The maximum number of tokens in the generated text.
- `api_key`: The API key required for accessing the Gemini API. If not provided, the function prompts the user to input the API key.
- `model`: The name of the model to be used for text generation. Default is "gemini-pro".

The function sends requests to the Gemini API, processes the responses, and returns the generated text along with sentiment analysis results. More information of the source code can be found here (https://github.com/wilkflow/qssProj/blob/main/317_Gemini_LLM.R).

Gemini Output Cleaning and Output Analysis

Figure 1 *Stacked Crowdworker Sentiment Distribution (Crowdworkers vs Gemini Classification)*

```
data <- read.csv("text_emotion_with_gemini.csv") #Assuming you imported the data into a new csv name upon q
uerying. If not, text_emotion.csv should suffice.
data = na.omit(data)

text_emotion <- read.csv("text_emotion_with_gemini.csv")
head(text_emotion) #optional: check the beginning of the dataset
```

```
##     tweet_id sentiment        author
## 1 1956967341     empty    xoshayzers
## 2 1956969456   neutral    feinyheiny
## 3 1956971981     worry andreagauster
## 4 1956974706      hate   MavrickAces
## 5 1956977084 happiness      ktierson
## 6 1956979894   neutral  lookitsholly
##                                                                                content
## 1 @tiffanylue i know  i was listenin to bad habit earlier and i started freakin at his part =[
## 2                                                                          cant fall asleep
## 3       @raaaaaaek oh too bad! I hope it gets better. I've been having sleep issues lately too
## 4         It is so annoying when she starts typing on her computer in the middle of the night!
## 5                      mmm much better day... so far! it's still quite early. last day of #uds
## 6                          Chocolate milk is so much better through a straw. I lack said straw
##   gemini
## 1     12
## 2     11
## 3     10
## 4      1
## 5      6
## 6      2
```

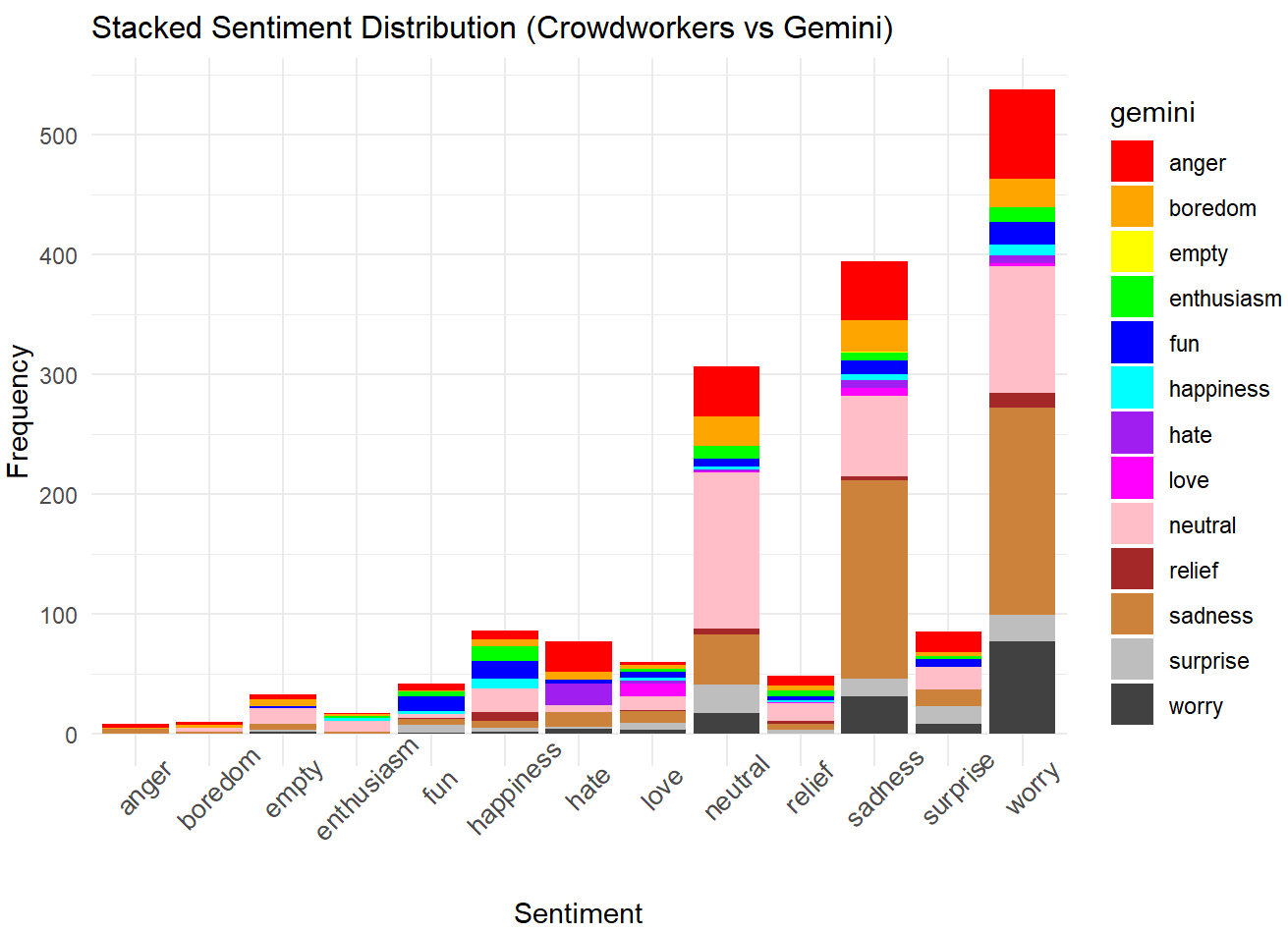
```
#remove all NA's to only analyze Gemini's performance
text_emotion_only_gemini <- na.omit(text_emotion)
head(text_emotion_only_gemini) #optional: verify that the dataset was cleaned
```

```
##     tweet_id sentiment        author
## 1 1956967341     empty    xoshayzers
## 2 1956969456   neutral    feinyheiny
## 3 1956971981     worry andreagauster
## 4 1956974706      hate   MavrickAces
## 5 1956977084 happiness      ktierson
## 6 1956979894   neutral  lookitsholly
##                                                                                content
## 1 @tiffanylue i know  i was listenin to bad habit earlier and i started freakin at his part =[
## 2                                                                          cant fall asleep
## 3       @raaaaaaek oh too bad! I hope it gets better. I've been having sleep issues lately too
## 4         It is so annoying when she starts typing on her computer in the middle of the night!
## 5                      mmm much better day... so far! it's still quite early. last day of #uds
## 6                          Chocolate milk is so much better through a straw. I lack said straw
##   gemini
## 1     12
## 2     11
## 3     10
## 4      1
## 5      6
## 6      2
```

```r
# Define a function to map numeric values to sentiment words
map_sentiment <- function(value) {
  sentiment_map <- c("anger", "boredom", "empty", "enthusiasm", "fun",
                     "happiness", "hate", "love", "neutral", "relief",
                     "sadness", "surprise", "worry")
  return(sentiment_map[value])
}
data$gemini <- sapply(data$gemini, map_sentiment)

# Convert the numeric values in the gemini column to sentiment words
text_emotion_only_gemini$gemini <- sapply(text_emotion_only_gemini$gemini, map_sentiment)

#print(text_emotion_only_gemini)
# Optional: View the updated dataset
# Load required library for plotting
# Convert the sentiment_distribution data into a long format
library(tidyr)
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.3
```

```r
# Convert the rownames of sentiment_distribution to a new column
sentiment_distribution <- table(text_emotion_only_gemini$sentiment, text_emotion_only_gemini$gemini)
sentiment_distribution <- as.data.frame.matrix(sentiment_distribution)
sentiment_distribution$sentiment <- rownames(sentiment_distribution)

# Define custom colors for the bar plot
# Define breaks and labels for y-axis
breaks <- seq(0, 600, by = 100)
labels <- seq(0, 600, by = 100)
custom_colors <- c("red", "orange", "yellow", "green", "blue", "cyan", "purple", "magenta", "pink", "brow
n", "tan3", "gray", "gray26")
sentiment_long <- tidyr::pivot_longer(sentiment_distribution, cols = -sentiment, names_to = "gemini", value
s_to = "count")

# Create a stacked bar chart of sentiment distribution with custom colors
ggplot(sentiment_long, aes(x = sentiment, y = count, fill = gemini)) +
  geom_bar(stat = "identity",) +
  labs(title = "Stacked Sentiment Distribution (Crowdworkers vs Gemini)",
       x = "Sentiment",
       y = "Frequency") +
  scale_fill_manual(values = custom_colors) +  # Apply custom colors
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 0.5, size = 10), plot.title = element_text(size = 1
2, hjust = 0)) +
  scale_y_continuous(breaks = breaks, labels = labels) # Text adjustment for the x and y axis respectively
```



Confusion Matrix and Heatmap: Crowdworkers vs Gemini

Figure 2 *Confusion Matrix: Accuracy Between Gemini and Crowdworker Classification*

```
# Load necessary library
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.3.3
```

```
## Loading required package: lattice
```

```
## Warning: package 'lattice' was built under R version 4.3.3
```

```
library(timechange)
```

```
## Warning: package 'timechange' was built under R version 4.3.3
```

```
 # Calculate confusion matrix
 c = confusionMatrix(as.factor(data$sentiment), as.factor(data$gemini), positive = NULL, dnn = c("Predictio
n", "Gemini"))
 # Convert confusion matrix to data frame
plt <- as.data.frame(c$table)
ggplot(plt, aes(Prediction, rev(Gemini), fill = Freq)) +
  geom_tile() +
  geom_text(aes(label = Freq)) +
  scale_fill_gradient(low = "white", high = "#009194") +
  labs(x = "Crowdworker Classification", y = "Gemini") +
  scale_x_discrete(labels = c("anger", "boredom", "empty", "enthusiasm", "fun",
                              "happiness", "hate", "love", "neutral", "relief",
                              "sadness", "surprise", "worry")) +
  scale_y_discrete(labels = rev(c("anger", "boredom", "empty", "enthusiasm", "fun",
                                  "happiness", "hate", "love", "neutral", "relief",
                                  "sadness", "surprise", "worry"))) +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```

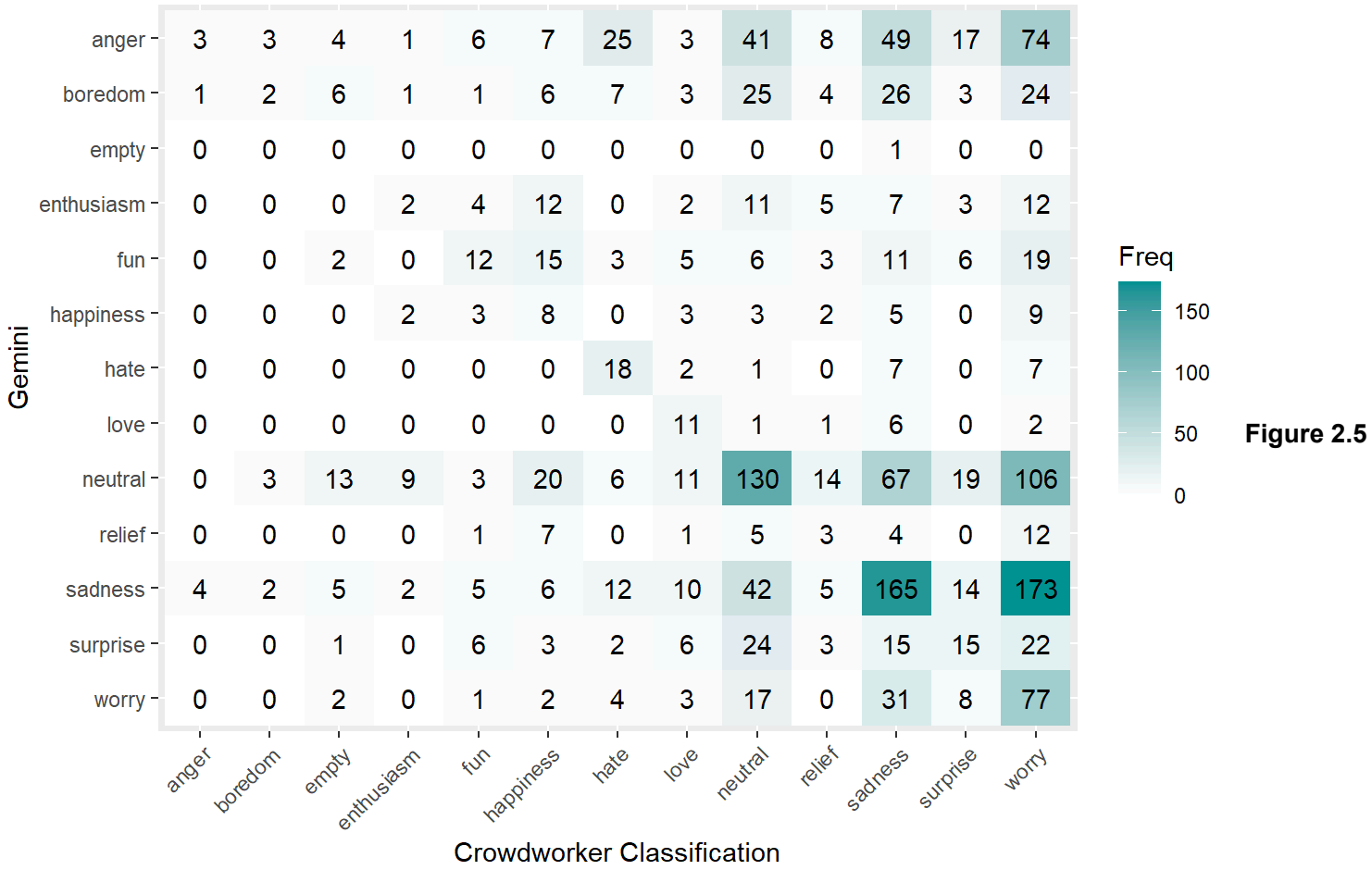


Figure 2.5

Confusion matrix output

```
print(c[3])
```

```
## $overall
##       Accuracy          Kappa  AccuracyLower  AccuracyUpper   AccuracyNull
##      0.2618908      0.1437429      0.2411405      0.2834647      0.2613036
## AccuracyPValue  McnemarPValue
##      0.4872510            NaN
```

Figure 3 *Crowdworker Sentiment Classification: Distribution of Sentiments*

```
# Define the mapping of sentiment labels to numeric values
sentiment_mapping <- c('anger' = 1, 'boredom' = 2, 'empty' = 3, 'enthusiasm' = 4,
                       'fun' = 5, 'happiness' = 6, 'hate' = 7, 'love' = 8,
                       'neutral' = 9, 'relief' = 10, 'sadness' = 11, 'surprise' = 12,
                       'worry' = 13)
# Convert sentiment labels to numeric values
data$sentiment <- as.integer(factor(data$sentiment, levels = names(sentiment_mapping), labels = sentiment_m
apping))
# Count the occurrences of each sentiment
sentiment_counts <- table(data$sentiment)
# Create a bar plot of sentiment distribution
ggplot(data, aes(x=factor(sentiment, levels = names(sentiment_counts)))) +
  geom_bar() +
  labs(x = "Sentiment", y = "Count", title = "Distribution of Sentiments") +
  theme_minimal()
```

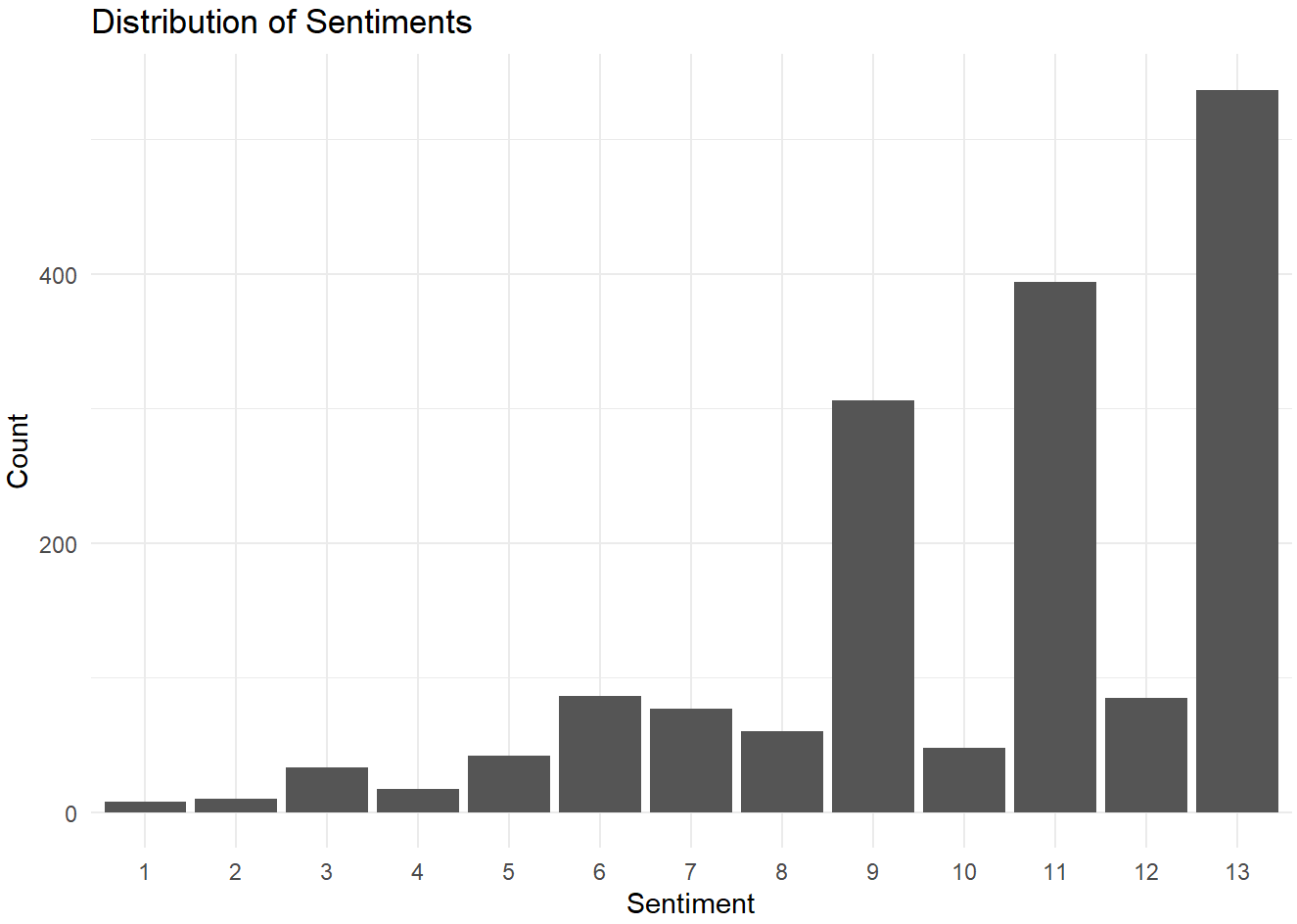


Figure 4 *Gemini Sentiment Classification: Distribution of Sentiments*

```
# Optional: Display the structure and first few rows of the data
head(data)
```

```
##     tweet_id sentiment        author
## 1 1956967341         3    xoshayzers
## 2 1956969456         9    feinyheiny
## 3 1956971981        13 andreagauster
## 4 1956974706         7   MavrickAces
## 5 1956977084         6      ktierson
## 6 1956979894         9  lookitsholly
##                                                                                 content
## 1 @tiffanylue i know  i was listenin to bad habit earlier and i started freakin at his part =[
## 2                                                                          cant fall asleep
## 3       @raaaaaaek oh too bad! I hope it gets better. I've been having sleep issues lately too
## 4         It is so annoying when she starts typing on her computer in the middle of the night!
## 5                       mmm much better day... so far! it's still quite early. last day of #uds
## 6                           Chocolate milk is so much better through a straw. I lack said straw
##      gemini
## 1  surprise
## 2   sadness
## 3    relief
## 4     anger
## 5 happiness
## 6   boredom
```

```
str(data)
```

```
## 'data.frame':    1703 obs. of  5 variables:
##  $ tweet_id : int  1956967341 1956969456 1956971981 1956974706 1956977084 1956979894 1956982449 19569839
31 1956985764 1956988145 ...
##  $ sentiment: int  3 9 13 7 6 9 13 9 11 9 ...
##  $ author   : chr  "xoshayzers" "feinyheiny" "andreagauster" "MavrickAces" ...
##  $ content  : chr  "@tiffanylue i know  i was listenin to bad habit earlier and i started freakin at his
part =[" "cant fall asleep" "@raaaaaaek oh too bad! I hope it gets better. I've been having sleep issues la
tely too" "It is so annoying when she starts typing on her computer in the middle of the night!" ...
##  $ gemini   : chr  "surprise" "sadness" "relief" "anger" ...
##  - attr(*, "na.action")= 'omit' Named int [1:54] 43 65 83 143 153 165 193 200 223 297 ...
##   ..- attr(*, "names")= chr [1:54] "43" "65" "83" "143" ...
```

```
# Count the occurrences of each Gemini sentiment
gemini_counts <- table(data$gemini)

ggplot(data, aes(x=factor(gemini, levels = names(gemini_counts)))) +
  geom_bar(fill = "steelblue") +
  labs(x = "Gemini Sentiment", y = "Count", title = "Distribution of Gemini API Sentiments") +
  theme_minimal()
```

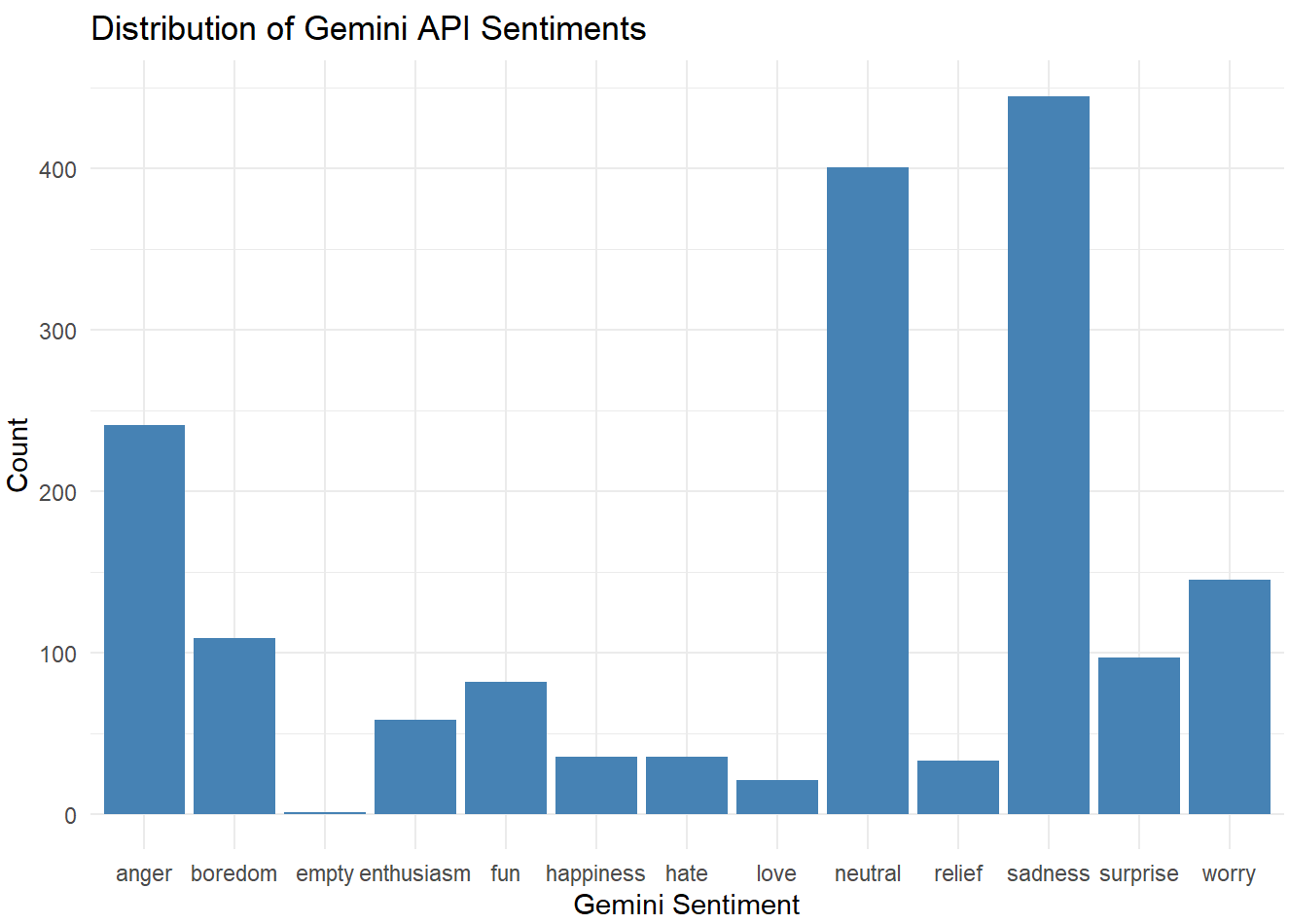


Figure 5 *Gemini vs Crowdworker Sentiment Classification: Distribution of Sentiments*

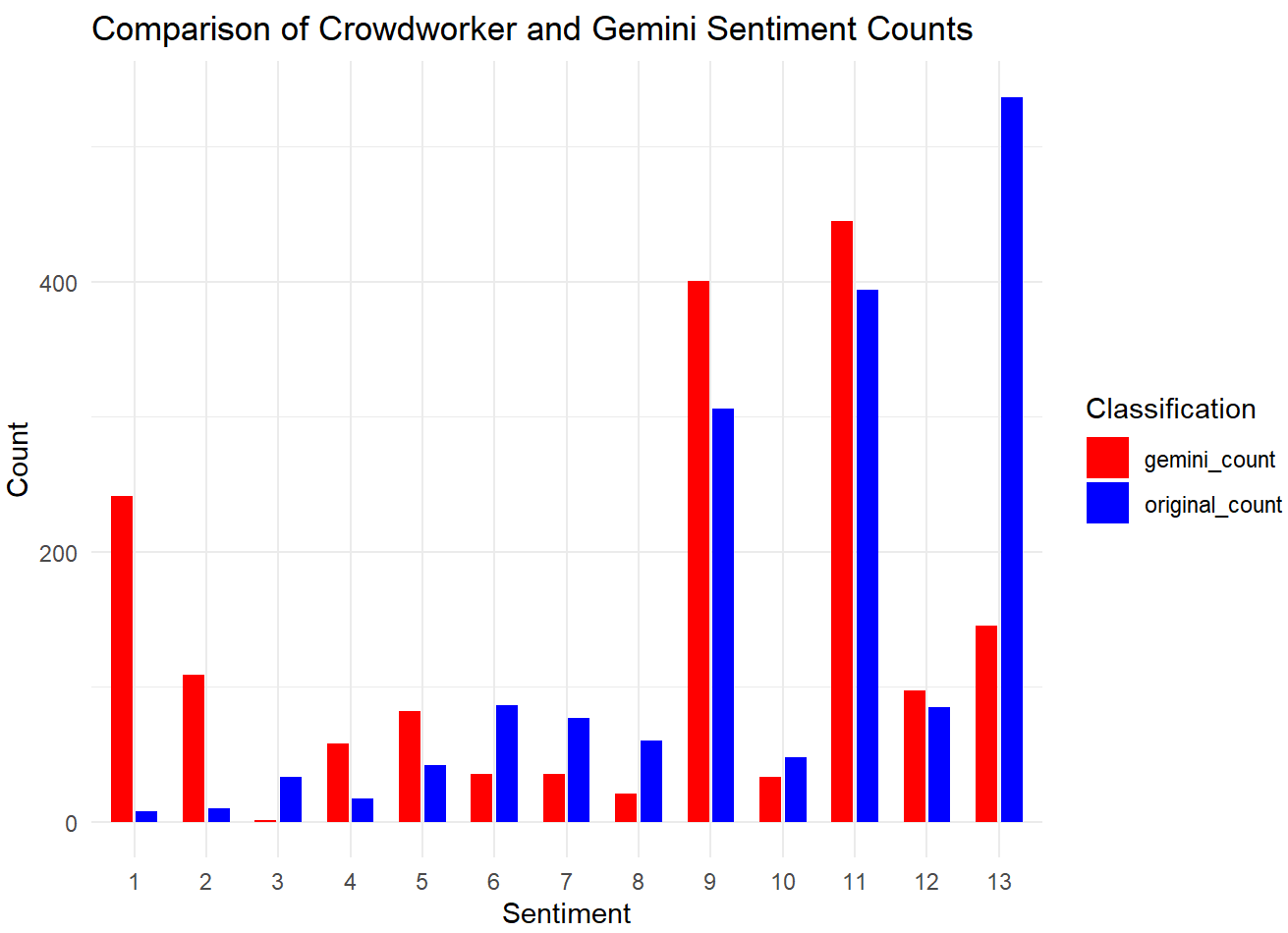
```
# Load necessary packages
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
library(ggplot2)

# Read the data and remove NAs (Tweets that were not queried)
data <- read.csv("text_emotion_with_gemini.csv")
data = na.omit(data)
sentiment_mapping <- c('anger' = 1, 'boredom' = 2, 'empty' = 3, 'enthusiasm' = 4,
                       'fun' = 5, 'happiness' = 6, 'hate' = 7, 'love' = 8,
                       'neutral' = 9, 'relief' = 10, 'sadness' = 11, 'surprise' = 12,
                       'worry' = 13)
# Convert sentiment labels to numeric values
data$sentiment <- as.integer(factor(data$sentiment, levels = names(sentiment_mapping), labels = sentiment_m
apping))
# Count the occurrences of each sentiment for both crowdworker and Gemini classifications
original_counts <- data %>%
  count(sentiment, name = "original_count")
gemini_counts <- data %>%
  count(gemini, name = "gemini_count")
# Define levels of sentiment for plotting
levels_sentiment <- sort(as.numeric(unique(c(as.character(original_counts$sentiment), as.character(gemini_c
ounts$gemini)))))
levels_sentiment <- as.character(levels_sentiment)
levels_sentiment[is.na(levels_sentiment)] <- "NA"
# Set sentiment factors with defined levels
original_counts$sentiment <- factor(original_counts$sentiment, levels = levels_sentiment)
gemini_counts$gemini <- factor(gemini_counts$gemini, levels = levels_sentiment)
# Merge counts of crowdworker and Gemini sentiments
combined_counts <- full_join(original_counts, gemini_counts, by = c("sentiment" = "gemini"))
# Pivot the data to long format for plotting
plot_data <- tidyr::pivot_longer(combined_counts, cols = c("original_count", "gemini_count"),
                                 names_to = "Classification", values_to = "count")
plot_data$count[is.na(plot_data$count)] <- 0
# Create a bar plot comparing crowdworker and Gemini sentiment counts

ggplot(plot_data, aes(x = sentiment, y = count, fill = Classification)) +
  geom_bar(stat = "identity", position = position_dodge(width = 0.7), width = 0.6) +
  scale_fill_manual(values = c("original_count" = "blue", "gemini_count" = "red")) +
  labs(x = "Sentiment", y = "Count", title = "Comparison of Crowdworker and Gemini Sentiment Counts") +
  theme_minimal()
```



Chi-Squared Test

```
# Convert gemini and sentiment variables to factors
data$gemini <- factor(data$gemini)
data$sentiment <- as.factor(data$sentiment)
# Create a contingency table to summarize the relationship between Gemini and sentiment
table_data <- table(data$gemini, data$sentiment)
# Perform Chi-Squared Test to evaluate the independence between Gemini and sentiment
chi_squared_result <- chisq.test(table_data)
```

```
## Warning in chisq.test(table_data): Chi-squared approximation may be incorrect
```

```
# Display the Chi-Squared Test results
chi_squared_result
```

```
##
##  Pearson's Chi-squared test
##
## data:  table_data
## X-squared = 870.63, df = 144, p-value < 2.2e-16
```