

***** **APPENDIX** *****

PART A - R Codes and Output

The codes and a screenshot of the output has been provided section wise.

```
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#### MSBA 1 HULT 2021-2022 #####
#### Business Insight Report of 10-K #####
#### Text Analytics & NLP #####
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#### Submission Date: December 5, 2021 ####
#####
```

Library packages required for the analysis

```
library(magrittr)
library(tidyverse)
library(tidytext)
library(textdata)
library(pdftools)
library(tm)
library(wordcloud)
library(scales)
library(ggplot2)
library(igraph)
library(ggraph)
library(topicmodels)
library(widyr)
```

```
##### xxxx #####
```

Importing all PDF files from the same folder which is in my C drive.

Using the below code as there are multiple files (3 in this case) inside a folder that needs to be put together

```
getwd()
setwd("C:/MBAN HULT/Text Analytics & NLP/Business Insight Report/PDF for project")
nm <- list.files(path="C:/MBAN HULT/Text Analytics & NLP/Business Insight Report/PDF for project")

my_pdf_text <- do.call(rbind, lapply(nm, function(x) pdf_text(x))) ## Binding the files together by rows
my_pdf_text <- as.data.frame(my_pdf_text) # Converting to a dataframe so that we don't have errors

## We have 116 columns, so we need to combine them together so that we have only 1 column
## Renaming as annual_reports
annual_reports <- unite(my_pdf_text, text, 1:116, sep=" ", remove = T, na.rm = F)
```

```
## Adding a column to name each row for the respective company & renaming the variable as company
annual_reports <- annual_reports %>%
  bind_cols(c("Columbia", "Starbucks", "UnderArmour"))
colnames(annual_reports)[2] <- "company"
```

The dataframe called annual_reports is now ready to start work with.

Tidying the data

Calling stop words data so that we can filter out the stop words to create a tidy format for each company's annual report.

```
data("stop_words")
```

Creating a tidy format for starbucks

```
tidy_star <- annual_reports %>%
  filter(company == "Starbucks") %>%
  unnest_tokens(word, text) %>%
  anti_join(stop_words)
```

Creating a tidy format for columbia

```
tidy_columbia <- annual_reports %>%
  filter(company == "Columbia") %>%
  unnest_tokens(word, text) %>%
  anti_join(stop_words)
```

Creating a tidy format for under armour

```
tidy_ua <- annual_reports %>%
  filter(company == "UnderArmour") %>%
  unnest_tokens(word, text) %>%
  anti_join(stop_words)
```

Creating a consolidated tidy format of the entire dataset

```
tidy_report <- annual_reports %>%
  unnest_tokens(word, text) %>%
  anti_join(stop_words)
```

The screenshot shows the RStudio environment. The left pane displays a data frame with columns 'company' and 'word'. The right pane shows the 'Environment' tab with a list of datasets: annual_reports, my_pdf_text, tidy_columbia, tidy_report, tidy_star, and tidy_ua. The console at the bottom contains R code for creating a tidy format for Under Armour data and a consolidated tidy format for the entire dataset.

```

R 4.1.1 - C:\MBAN\HULT\Text Analytics & NLP\Business Insight Report\PDF for project/
Joining, by = "word"
>
> ### Creating a tidy format for under armour
> tidy_ua <- annual_reports %>%
+   filter(company == "UnderArmour") %>%
+   unnest_tokens(word, text) %>%
+   anti_join(stop_words)
Joining, by = "word"
>
> ### Creating a consolidated tidy format of the entire dataset
> tidy_report <- annual_reports %>%
+   unnest_tokens(word, text) %>%
+   anti_join(stop_words)
Joining, by = "word"
> View(tidy_report)
> View(tidy_report)
>

```


 ### Framework 1 - Correlograms
 #####

##Combining all the datasets and counting frequencies - which will be used to plot the correlograms

```

frequency <- bind_rows(mutate(tidy_star, company="Starbucks"),
  mutate(tidy_columbia, company="Columbia"),
  mutate(tidy_ua, company="UnderArmour")
) %>% #closing bind_rows
mutate(word=str_extract(word, "[a-z']+")) %>%
count(company, word) %>%
group_by(company) %>%
mutate(proportion = n/sum(n)) %>%
select(-n) %>%
spread(company, proportion) %>%
gather(company, proportion, `Starbucks`, `Columbia`)

```

Plotting the frequencies as correlograms:

```

ggplot(frequency, aes(x=proportion, y=`UnderArmour`,
  color = abs(`UnderArmour` - proportion)))+
  geom_abline(color="grey40", lty=2)+

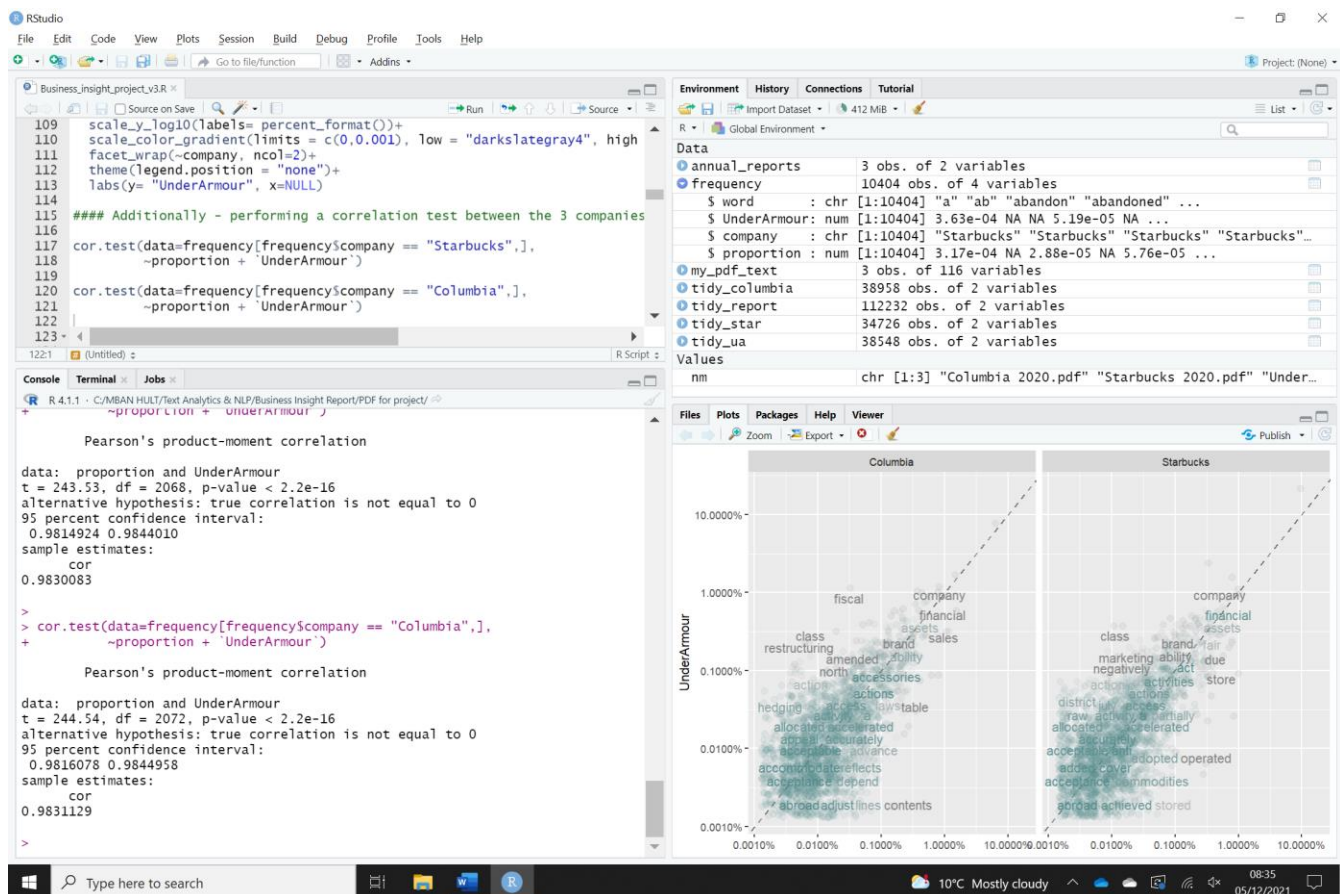
```

```
geom_jitter(alpha=.1, size=2.5, width=0.3, height=0.3)+
geom_text(aes(label=word), check_overlap = TRUE, vjust=1.5) +
scale_x_log10(labels = percent_format())+
scale_y_log10(labels= percent_format())+
scale_color_gradient(limits = c(0,0.001), low = "darkslategray4", high = "gray75")+
facet_wrap(~company, ncol=2)+
theme(legend.position = "none")+
labs(y= "UnderArmour", x=NULL)
```

Additionally - performing a correlation test between the 3 companies

```
cor.test(data=frequency[frequency$company == "Starbucks",],
~proportion + `UnderArmour`)
```

```
cor.test(data=frequency[frequency$company == "Columbia",],
~proportion + `UnderArmour`)
```



```
#####  
### Framework 2 - TF IDF  
#####
```

```
annual_token <- annual_reports %>% ## finding the number of each token company wise  
  unnest_tokens(word, text) %>%  
  count(company, word, sort=TRUE) %>%  
  ungroup()
```

```
total_words <- annual_token %>% ## finding the total sum of tokens per company  
  group_by(company) %>%  
  summarize(total=sum(n))
```

```
## combining the 2 sets giving us word count of each token company wise and total number of words company  
wise  
report_words <- left_join(annual_token, total_words)
```

```
## using the tf idf function to get the tf, if and tf-idf values  
company_words <- report_words %>%  
  bind_tf_idf(word, company, n) ## we want to see the word, company(document)
```

```
## arrange in descending order of tf-idf so that we can see the unique words in each company  
uniqueness <- company_words %>%  
  arrange(desc(tf_idf))
```

```
## plotting the unique words to get a visual representation of the top 15 words they use in their reports  
uniqueness %>%  
  mutate(word=factor(word, levels=rev(unique(word)))) %>%  
  group_by(company) %>%  
  top_n(15) %>%  
  ungroup %>%  
  ggplot(aes(word, tf_idf, fill=company))+  
  geom_col(show.legend=FALSE)+  
  labs(x=NULL, y="tf-idf")+  
  facet_wrap(~company, ncol=2, scales="free")+  
  coord_flip()
```

RStudio interface showing R code and Environment pane.

```

130 ungroup()
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133 total_words <- annual_token %>% ## finding the total sum of tokens per c
134 group_by(company) %>%
135 summarize(total=sum(n))
136
137
138 ## combining the 2 sets giving us word count of each token company wise a
139 report_words <- left_join(annual_token, total_words)
140
141 ## using the tf idf function to get the tf, if and tf-idf values
142 company_words <- report_words %>%
143 bind_tf_idf(word, company, n) ## we want to see the word, company(docu
144
145
146 ## arrange in descending order of tf-idf so that we can see the unique wc
147 uniqueness <- company_words %>%
148 arrange(desc(tf_idf))
149
150
151 ## plotting the unique words to get a visual representation of the top 15
152 uniqueness %>%
153 mutate(word=factor(word, levels=rev(unique(word)))) %>%
154 group_by(company) %>%
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```

Environment pane shows data objects:

- annual_reports: 3 obs. of 2 variables
- annual_token: 15289 obs. of 3 variables
- company_words: 15289 obs. of 7 variables
- frequency: 10404 obs. of 4 variables
- my_pdf_text: 3 obs. of 116 variables
- report_words: 15289 obs. of 4 variables
- tidy_columbia: 38958 obs. of 2 variables
- tidy_report: 11232 obs. of 2 variables
- tidy_star: 34726 obs. of 2 variables
- tidy_uu: 38548 obs. of 2 variables
- total_words: 3 obs. of 2 variables
- uniqueness: 15289 obs. of 7 variables

RStudio interface showing R code and Environment pane.

```

143 bind_tf_idf(word, company, n) ## we want to see the word, company(docu
144
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153 mutate(word=factor(word, levels=rev(unique(word)))) %>%
154 group_by(company) %>%
155 top_n(15) %>%
156 ungroup %>%
157 ggplot(aes(word, tf_idf, fill=company))+
158 geom_col(show.legend=FALSE)+
159 labs(x=NULL, y="tf-idf")+
160 facet_wrap(~company, ncol=2, scales="free")+
161 coord_flip()
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```

Environment pane shows data objects:

- tidy_star: 34726 obs. of 2 variables
- tidy_uu: 38548 obs. of 2 variables
- total_words: 3 obs. of 2 variables
- uniqueness: 15289 obs. of 7 variables

Files pane shows plots:

- Columbia: Bar chart showing tf-idf values for various words.
- Starbucks: Bar chart showing tf-idf values for various words.
- UnderArmour: Bar chart showing tf-idf values for various words.

```
#####  
### Framework 3 - N-grams  
#####
```

```
##### Creating a bigram for Columbia #####
```

```
columbia_bigrams <- annual_reports %>%   ## splitting into bigrams and removing stopwords  
  filter(company == "Columbia") %>%  
  unnest_tokens(bigram, text, token = "ngrams", n=2) %>%  
  separate(bigram, c("word1", "word2"), sep = " ") %>%  
  filter(!word1 %in% stop_words$word) %>%  
  filter(!word2 %in% stop_words$word)
```

```
columbia_bigrams_count <- columbia_bigrams %>% ## sorting the bigrams  
  count(word1, word2, sort = TRUE)
```

```
bigram_graph_columbia <- columbia_bigrams_count %>% ## filtering the bigrams with count greater than 20  
for plotting them  
  filter(n>20) %>%  
  graph_from_data_frame()
```

```
bigram_graph_columbia
```

```
## Using ggraph to plot the bigram network  
ggraph(bigram_graph_columbia, layout = "fr") +  
  geom_edge_link()+  
  geom_node_point()+  
  geom_node_text(aes(label=name), vjust=1, hjust=1)+  
  labs(title = "Bigrams - Columbia Sportswear")
```

```
##### Creating a bigram for Starbucks #####
```

```
starbucks_bigrams <- annual_reports %>%  
  filter(company == "Starbucks") %>%  
  unnest_tokens(bigram, text, token = "ngrams", n=2) %>%  
  separate(bigram, c("word1", "word2"), sep = " ") %>%  
  filter(!word1 %in% stop_words$word) %>%  
  filter(!word2 %in% stop_words$word)
```

```
starbucks_bigrams_count <- starbucks_bigrams %>%  
  count(word1, word2, sort = TRUE)
```

```
bigram_graph_starbucks <- starbucks_bigrams_count %>% ## filtering the bigrams with count greater than 15  
  filter(n>15) %>%  
  graph_from_data_frame()
```

```
bigram_graph_starbucks
```

```
ggraph(bigram_graph_starbucks, layout = "fr") +  
  geom_edge_link()+  
  geom_node_point()+
```

```
geom_node_text(aes(label=name), vjust =1, hjust=1) +  
labs(title = "Bigrams - Starbucks")
```

Creating a bigram for UnderArmour

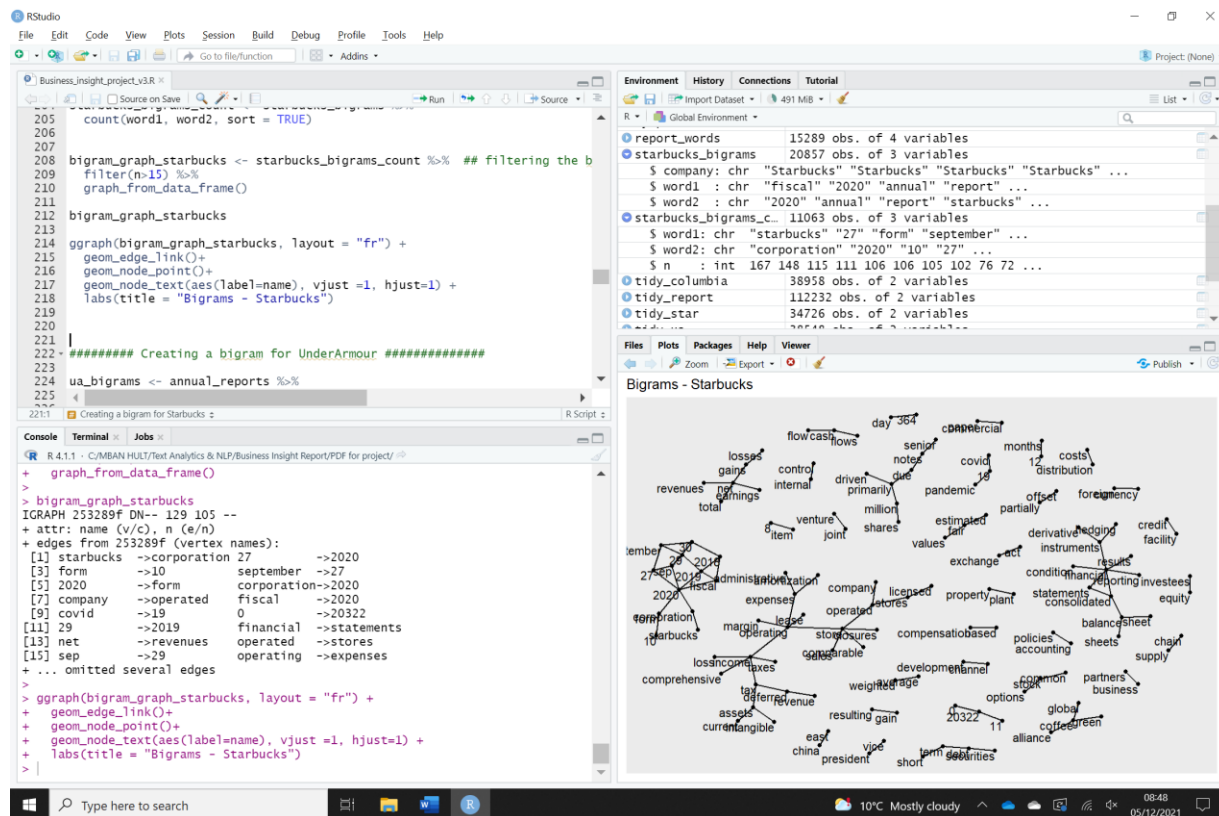
```
ua_bigrams <- annual_reports %>%  
  filter(company == "UnderArmour") %>%  
  unnest_tokens(bigram, text, token = "ngrams", n=2) %>%  
  separate(bigram,c("word1", "word2"), sep = " ") %>%  
  filter(!word1 %in% stop_words$word) %>%  
  filter(!word2 %in% stop_words$word)
```

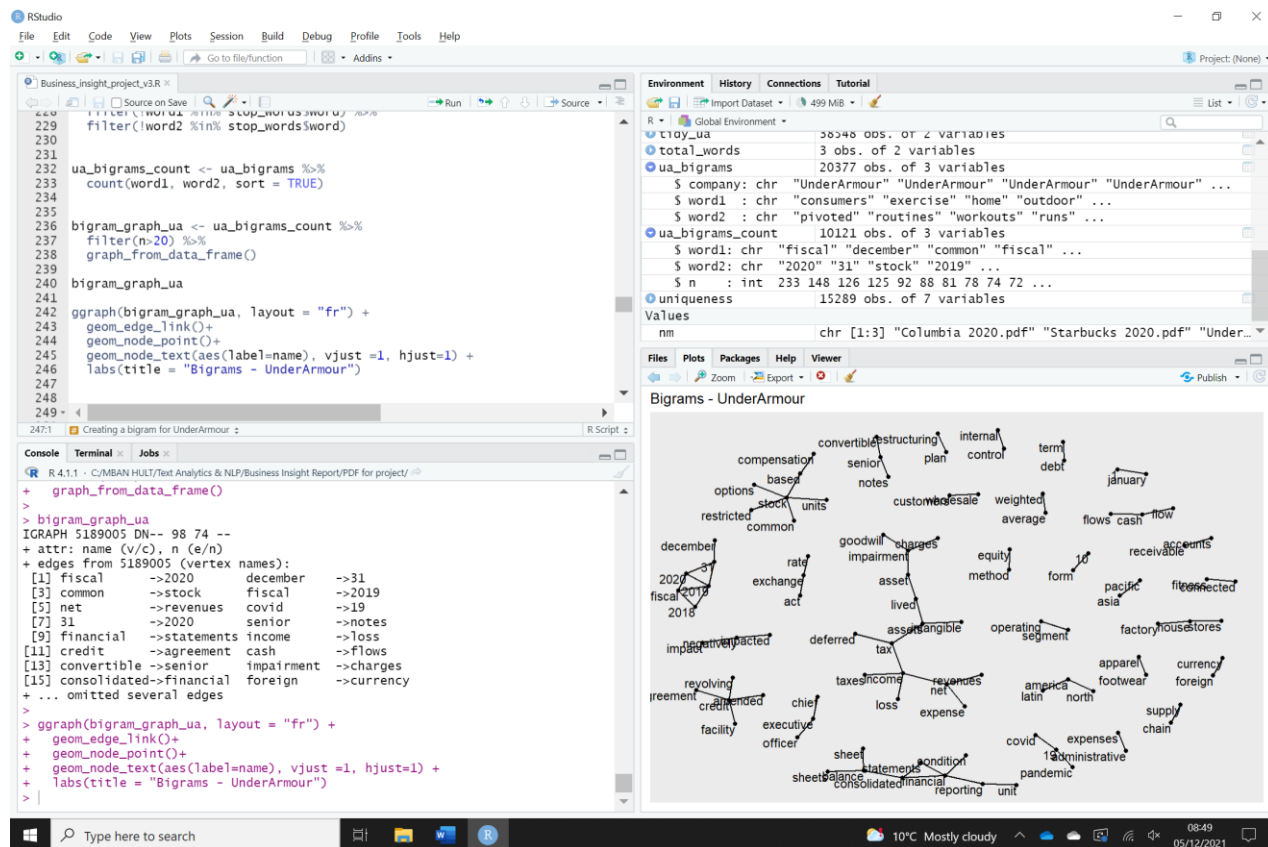
```
ua_bigrams_count <- ua_bigrams %>%  
  count(word1, word2, sort = TRUE)
```

```
bigram_graph_ua <- ua_bigrams_count %>%  
  filter(n>20) %>%  
  graph_from_data_frame()
```

```
bigram_graph_ua
```

```
ggraph(bigram_graph_ua, layout = "fr") +  
  geom_edge_link()+  
  geom_node_point()+  
  geom_node_text(aes(label=name), vjust =1, hjust=1) +  
  labs(title = "Bigrams - UnderArmour")
```



 ### Framework 4 - Sentiment Analysis
 #####

Sentiment Analysis - Columbia

```

bing_columbia <- tidy_columbia %>%
  inner_join(get_sentiments("bing")) %>%
  count(word, sentiment, sort=T) %>%
  ungroup()

```

```

bing_columbia %>%
  group_by(sentiment) %>%
  top_n(10) %>%
  ungroup() %>%
  mutate(word=reorder(word, n)) %>%
  ggplot(aes(word, n, fill=sentiment)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~sentiment, scales = "free_y")+
  labs(title = "Sentiment Analysis - Columbia Sportswear", y="Contribution to sentiment", x=NULL)+
  coord_flip()

```

```

afinn_score_columbia <- tidy_columbia %>%
  inner_join(get_sentiments("afinn")) %>%

```

```
summarise(sentiment=sum(value)) %>%  
mutate(method="AFINN")
```

```
##calculating the maximum negative value
```

```
afinn_neg_columbia <- tidy_columbia %>%  
  inner_join(get_sentiments("afinn")) %>%  
  filter(value<1) %>%  
  summarise(sentiment=sum(value)) %>%  
  mutate(method="AFINN")
```

```
#### Sentiment Analysis - Starbucks
```

```
bing_starbucks <- tidy_star %>%  
  inner_join(get_sentiments("bing")) %>%  
  count(word, sentiment, sort=T) %>%  
  ungroup()
```

```
bing_starbucks %>%  
  group_by(sentiment) %>%  
  top_n(10) %>%  
  ungroup() %>%  
  mutate(word=reorder(word, n)) %>%  
  ggplot(aes(word, n, fill=sentiment)) +  
  geom_col(show.legend = FALSE) +  
  facet_wrap(~sentiment, scales = "free_y")+  
  labs(title = "Sentiment Analysis - Starbucks Corporation", y="Contribution to sentiment", x=NULL)+  
  coord_flip()
```

```
afinn_score_starbucks <- tidy_star %>%  
  inner_join(get_sentiments("afinn")) %>%  
  summarise(sentiment=sum(value)) %>%  
  mutate(method="AFINN")
```

```
afinn_neg_star <- tidy_star %>%  
  inner_join(get_sentiments("afinn")) %>%  
  filter(value<1) %>%  
  summarise(sentiment=sum(value)) %>%  
  mutate(method="AFINN")
```

```
#### Sentiment Analysis - Under Armour
```

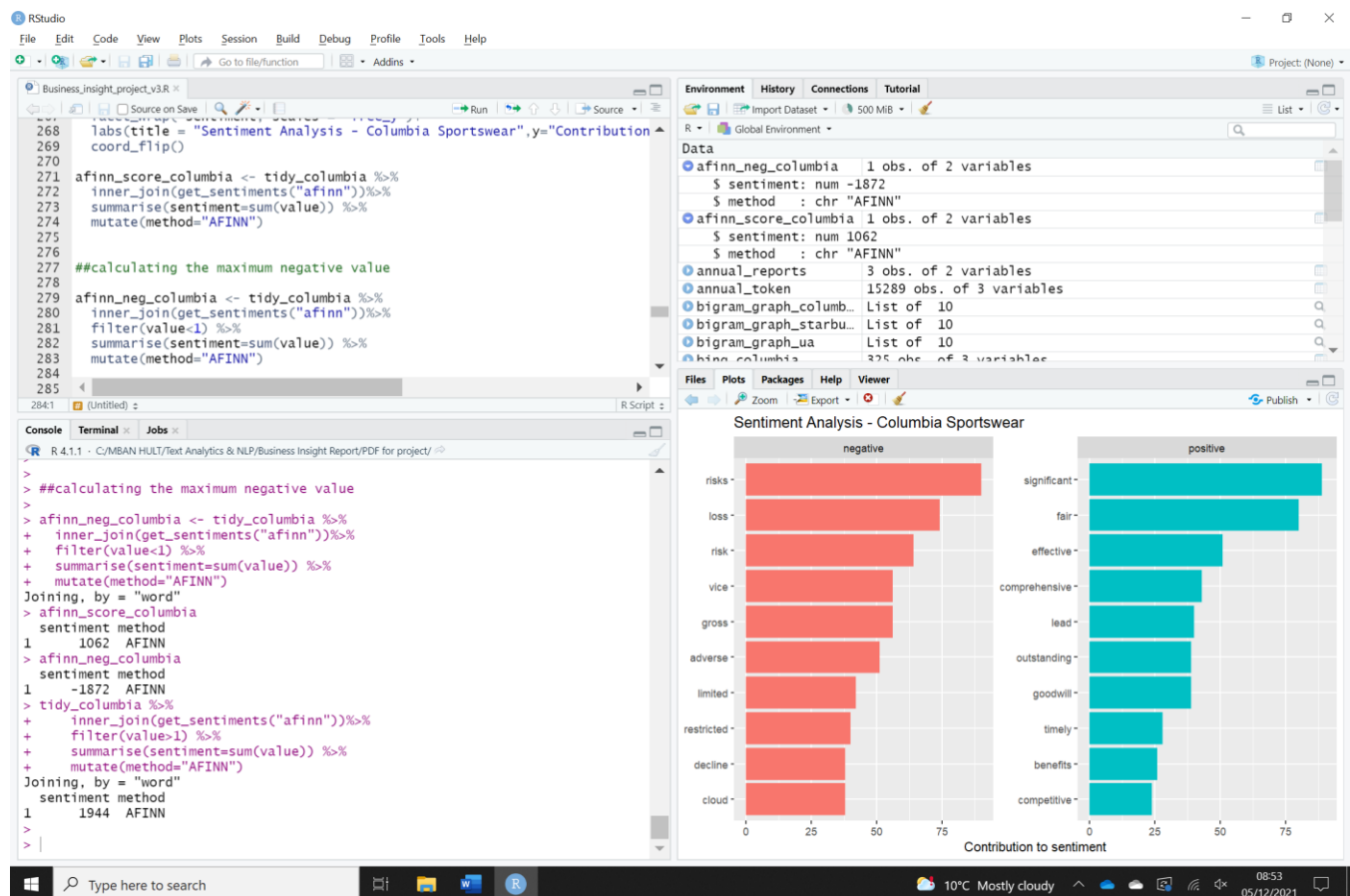
```
bing_ua <- tidy_ua %>%  
  inner_join(get_sentiments("bing")) %>%  
  count(word, sentiment, sort=T) %>%  
  ungroup()
```

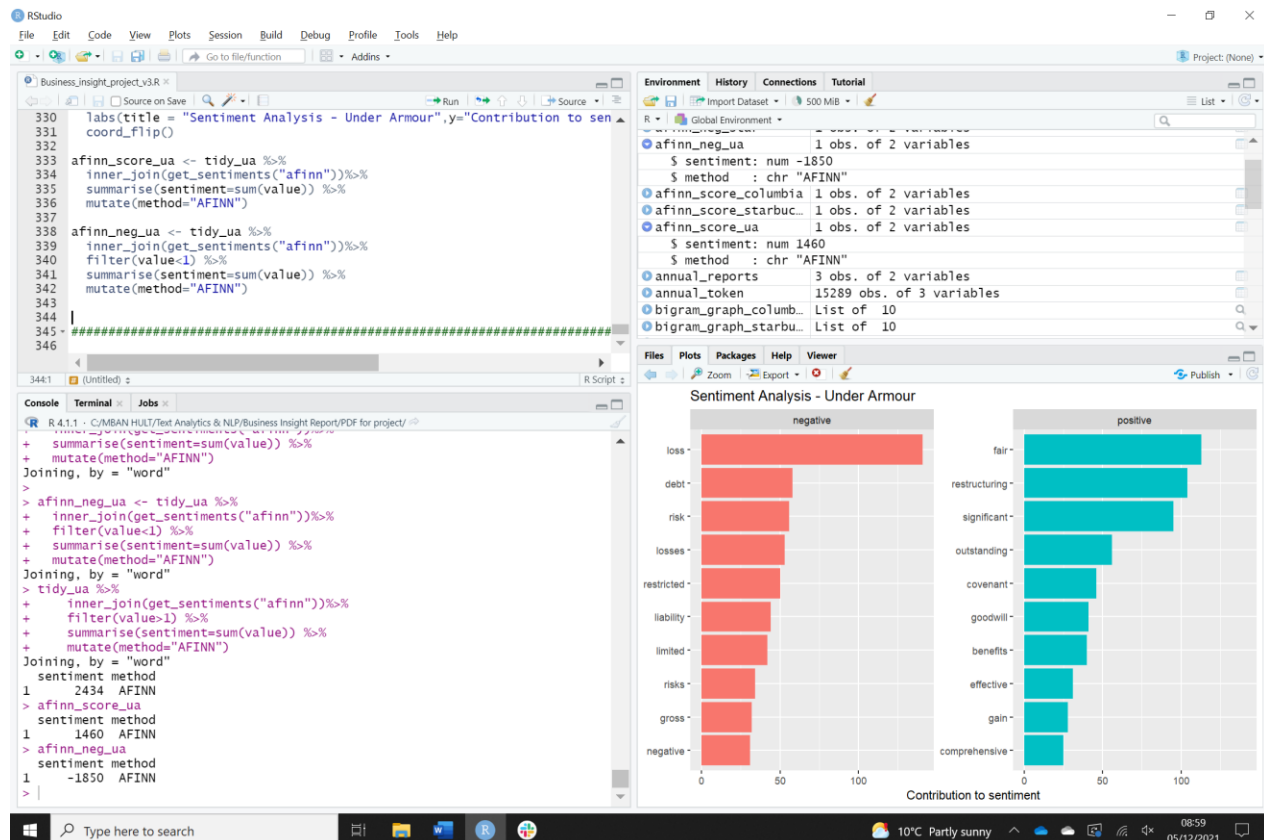
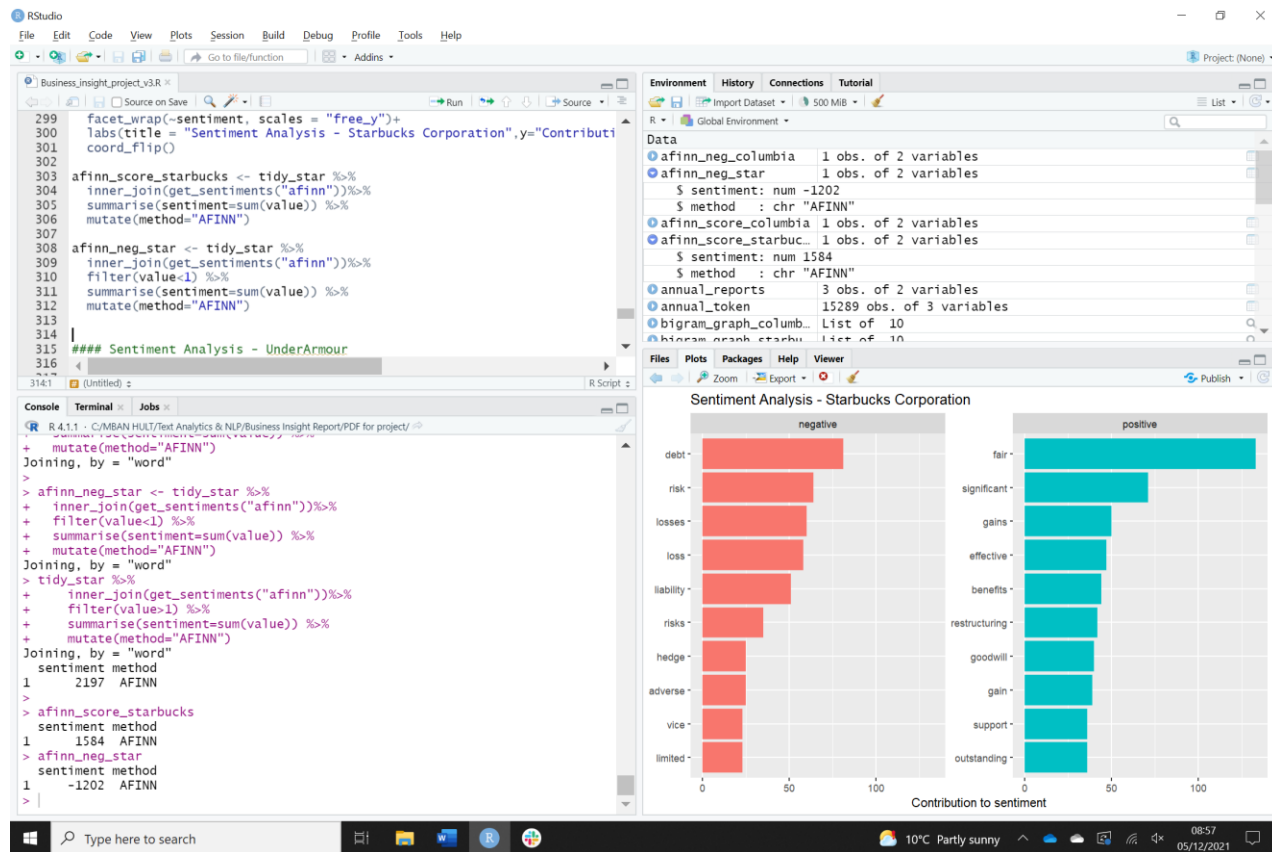
```
bing_ua %>%  
  group_by(sentiment) %>%  
  top_n(10) %>%  
  ungroup() %>%  
  mutate(word=reorder(word, n)) %>%
```

```
ggplot(aes(word, n, fill=sentiment)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~sentiment, scales = "free_y")+
  labs(title = "Sentiment Analysis - Under Armour",y="Contribution to sentiment", x=NULL)+
  coord_flip()
```

```
afinn_score_ua <- tidy_ua %>%
  inner_join(get_sentiments("afinn"))%>%
  summarise(sentiment=sum(value)) %>%
  mutate(method="AFINN")
```

```
afinn_neg_ua <- tidy_ua %>%
  inner_join(get_sentiments("afinn"))%>%
  filter(value<1) %>%
  summarise(sentiment=sum(value)) %>%
  mutate(method="AFINN")
```





PART B - REFERENCES

Documents used for the Analysis:

1. Most recent 10-K Annual Report from official website of Columbia Sportswear Company -
https://investor.columbia.com/sec-filings/annual-reports?form_type=&year=2021
Link to download file - [Columbia Sportswear Company 10-K](#)
2. Most recent 10-K Annual Report from official website of Starbucks -
<https://investor.starbucks.com/financial-data/annual-reports/default.aspx>
Link to download file - [Starbucks Corporation 10-K](#)
3. Most recent 10-K Annual Report from official website of Under Armour -
<https://about.underarmour.com/investor-relations/annualreport2020>
Link to download file - [Under Armour, INC 10-K](#)

Other references used for financial terms:

- Investopedia
- Wikipedia

Coding references:

- Class notes & codes provided by Prof. Thomas Kurnicki.