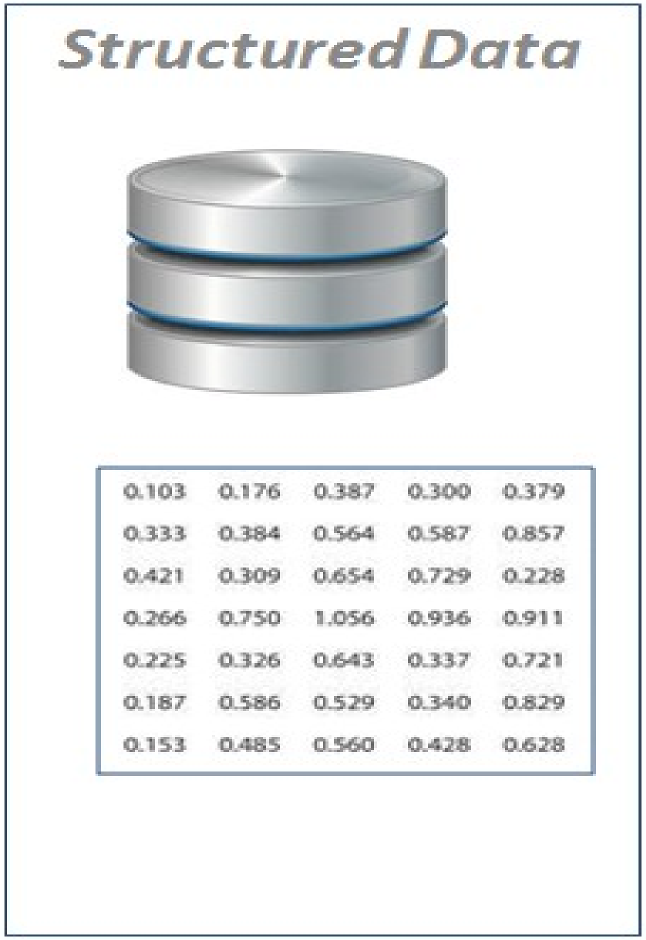
Text Mining
HR Appraisal Process Data

DATA SCIENCE
INSTITUTE

Structured Vs. Unstructured Data



0.103	0.176	0.387	0.300	0.379
0.333	0.384	0.564	0.587	0.857
0.421	0.309	0.654	0.729	0.228
0.266	0.750	1.056	0.936	0.911
0.225	0.326	0.643	0.337	0.721
0.187	0.586	0.529	0.340	0.829
0.153	0.485	0.560	0.428	0.628

Unstructured Data
PDF

What Is Text Analysis

- Text Mining is also known as **Text Data Mining (TDM)** and **Knowledge Discovery in Textual Database (KDT)**
- It is a process of identifying novel information from a collection of texts (Also known as a ‘Corpus’)
- **Corpus is a collection of ‘documents’ containing natural language text.** Here, documents, generally, are sentences. Each document is represented as a separate line.

Case Study – HR Appraisal Process Feedback

Background

- The company XYZ carried out Annual Performance Appraisal process which is a routine HR process.
- The employees were asked to give feedback about the overall process and questions used for assessing their performance level.

Objective

- To understand the employee sentiments and incorporate recommendations in the current performance appraisal process.

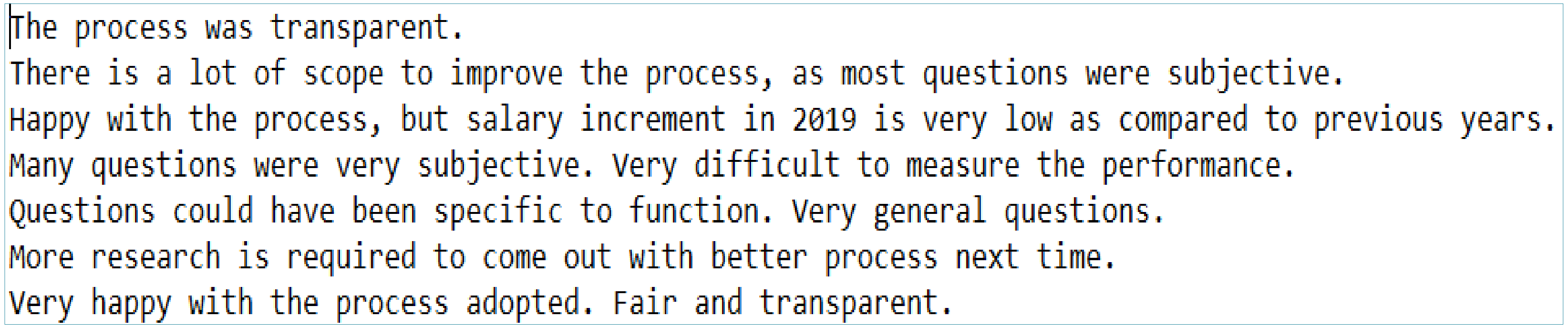
Available Information

- Feedback and comments from the employees were stored in a text document.

Data Snapshot

Example of data

Text Observations



```
The process was transparent.
There is a lot of scope to improve the process, as most questions were subjective.
Happy with the process, but salary increment in 2019 is very low as compared to previous years.
Many questions were very subjective. Very difficult to measure the performance.
Questions could have been specific to function. Very general questions.
More research is required to come out with better process next time.
Very happy with the process adopted. Fair and transparent.
```

*****

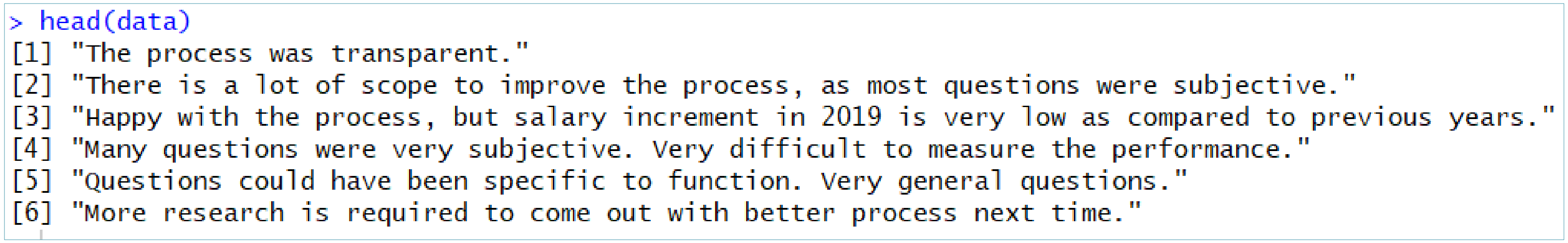
These are the comments received from employees.
Note that, data is not in structured format.

Text Mining In R

```
#Import the data.
#Import text file with one text record in one row
data<-readLines("HR Appraisal process.txt")
head(data)
```

- ❑ **readLines**() reads some or all text lines from a file or connection.

```
# Output:
```



```
> head(data)
[1] "The process was transparent."
[2] "There is a lot of scope to improve the process, as most questions were subjective."
[3] "Happy with the process, but salary increment in 2019 is very low as compared to previous years."
[4] "Many questions were very subjective. Very difficult to measure the performance."
[5] "Questions could have been specific to function. Very general questions."
[6] "More research is required to come out with better process next time."
```

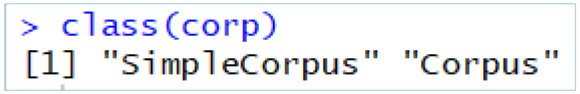
Interpretation:

- ➢ **head()** prints first 6 text lines from the data with each line as one document / observation.

Text Mining In R

```
#Convert this data into ‘Corpus’
install.packages("tm")
library(tm)

corp <- Corpus(VectorSource(data))
class(corp)
```



```
> class(corp)
[1] "SimpleCorpus" "Corpus"
```

- ❑ Install and load **T**ext **M**ining (**tm**) package.
- ❑ **Vector source()** interprets each element of the vector as a document.
- ❑ **Corpus()** converts and saves data as a corpus.

Interpretation:

- ➢ Class of the data should be Corpus.

* **In case NLP is not loaded , Before installing tm , please run the following command**
install.packages("NLP")
library(NLP)

Text Mining In R

```
# Inspect Corpus. Here [1:3] displays first 3 textlines.
```

```r
inspect(corp[1:3])
```

```
<<SimpleCorpus>>
Metadata: corpus specific: 1, document level (indexed): 0
Content: documents: 3

[1] The process was transparent.
[2] There is a lot of scope to improve the process, as most questions
were subjective.
[3] Happy with the process, but salary increment in 2019 is very low as
compared to previous years.
```

```
# Display a particular document from corpus.
```

```r
writeLines(as.character(corp[[3]]))
```

```
Happy with the process, but salary increment in 2019 is very low as
compared to previous years.
```

- **writelines()** prints text line of specified number in [[]]. Here it is printing 3rd line.

Text Mining In R

```
# Clean the Corpus for further analysis
corp <- tm_map(corp, tolower)
writeLines(as.character(corp[[3]]))
```

```
happy with the process, but salary increment in 2019 is very low as
compared to previous years.
```

```
corp <- tm_map(corp, removePunctuation)
writeLines(as.character(corp[[3]]))
```

```
happy with the process but salary increment in 2019 is very low as
compared to previous years
```

```
corp <- tm_map(corp, removeNumbers)
writeLines(as.character(corp[[3]]))
```

```
happy with the process but salary increment in is very low as compared
to previous years
```

- **tm_map**() applies transformation functions to a corpus.
- **tolower** converts text to lowercase.
- **removePunctuation** removes punctuation.
- **removeNumbers** removes numbers.

Text Mining In R

```
# Clean the Corpus for further analysis
```

```
corp <- tm_map(corp, removeWords, stopwords("english"))
writeLines(as.character(corp[[3]]))
```

```
happy process salary increment low compared previous years
```

```
corp <- tm_map(corp, removeWords, "process")
writeLines(as.character(corp[[3]]))
```

```
happy salary increment low compared previous years
```

- **removeWords, stopwords("english")** remove stop words like: i, me, our and, the, is, etc. There are more than 100 in-built English Stopwords in R. Use **stopwords("english")** to view the list of these stopwords.
- If you wish to remove specific words from the corpus, use **tm_map(corp, removeWords, "word")**. Here "**process**" word is removed.

Text Mining In R

```
# Convert to term-document matrix format
```

```
tdm <- TermDocumentMatrix(corp)
findFreqTerms(tdm)
```

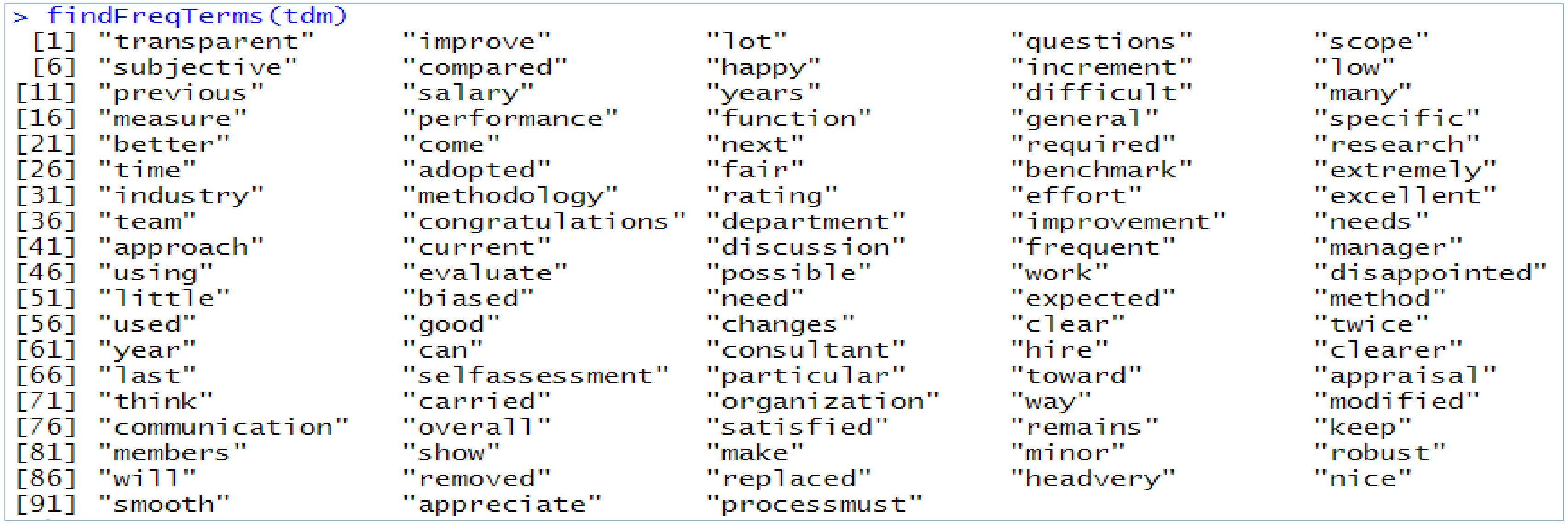
```
# Find terms with frequency of at least 5 and find words having high
association with ‘difficult’, ‘questions’
```

```
findFreqTerms(tdm,5)
findAssocs(tdm, 'difficult', 0.60 )
findAssocs(tdm, 'questions', 0.60 )
```

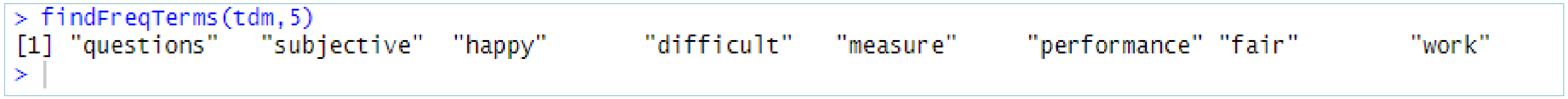
- **TermDocumentMatrix()** finds frequent terms in a document-term or term-document matrix. Default minimum frequency is 1 and maximum is infinite. **DocumentTermMatrix()** and **TermDocumentMatrix()** gives the same output.
- **findFreqTerms()** gives words with minimum specified frequency . **findFreqTerms**(tdm,5) gives words having minimum frequency 5.
- **findAssocs()** gives words with specified minimum correlations with the given word. **findAssocs**(tdm, 'difficult', 0.60) gives words with at least 0.6 correlation with word ‘difficult’.

Text Mining In R

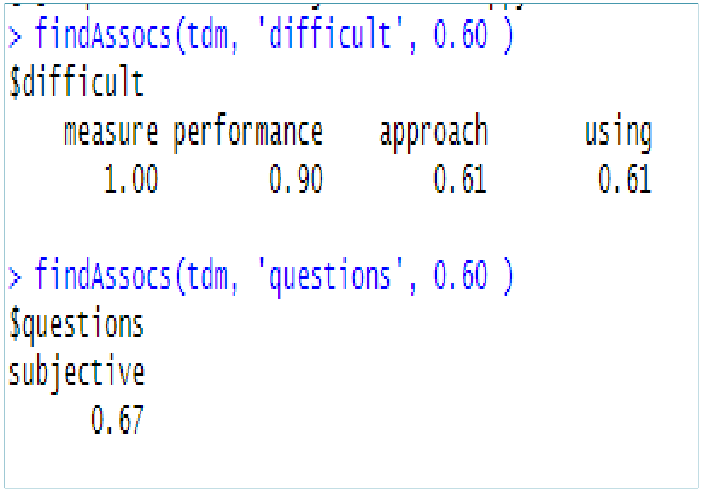
```
# Output:
```



```
> findFreqTerms(tdm)
 [1] "transparent"    "improve"         "lot"            "questions"      "scope"
 [6] "subjective"     "compared"        "happy"          "increment"      "low"
[11] "previous"       "salary"          "years"          "difficult"      "many"
[16] "measure"        "performance"     "function"       "general"        "specific"
[21] "better"         "come"            "next"           "required"       "research"
[26] "time"           "adopted"         "fair"           "benchmark"      "extremely"
[31] "industry"       "methodology"     "rating"         "effort"         "excellent"
[36] "team"           "congratulations" "department"     "improvement"    "needs"
[41] "approach"       "current"         "discussion"     "frequent"       "manager"
[46] "using"          "evaluate"        "possible"       "work"           "disappointed"
[51] "little"         "biased"          "need"           "expected"       "method"
[56] "used"           "good"            "changes"        "clear"          "twice"
[61] "year"           "can"             "consultant"     "hire"           "clearer"
[66] "last"           "selfassessment"  "particular"     "toward"         "appraisal"
[71] "think"          "carried"         "organization"   "way"            "modified"
[76] "communication"  "overall"         "satisfied"      "remains"        "keep"
[81] "members"        "show"            "make"           "minor"          "robust"
[86] "will"           "removed"         "replaced"       "headvery"       "nice"
[91] "smooth"         "appreciate"      "processmust"
```



```
> findFreqTerms(tdm,5)
[1] "questions"   "subjective"  "happy"       "difficult"   "measure"     "performance" "fair"        "work"
> 
```



```
> findAssocs(tdm, 'difficult', 0.60 )
$difficult
    measure performance    approach       using
       1.00        0.90        0.61        0.61

> findAssocs(tdm, 'questions', 0.60 )
$questions
subjective
      0.67
```

Interpretation:

- questions, subjective, happy, difficult, measure, performance, fair, work are appearing more than 5 times.
- Word 'difficult' is having high correlation with measure, performance

Word Cloud In R

Word cloud, as the name suggests, is an **image showing compilation of words**, in which, **size of words indicates its frequency or importance**.

```
# Install and load package “wordcloud”
```

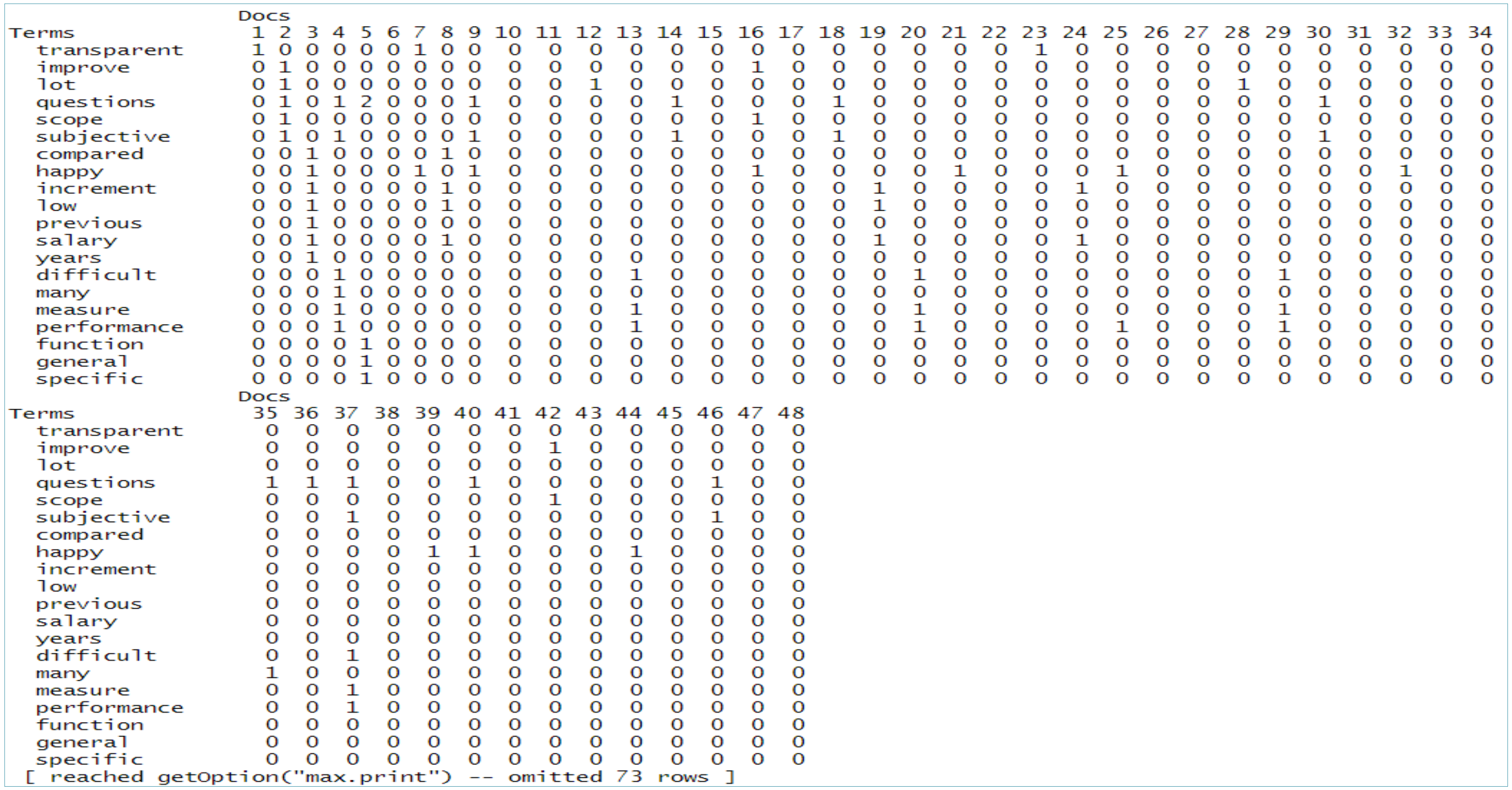
```
install.packages("wordcloud")
library(wordcloud)
```

```
# Convert tdm object to a matrix
```

```
m <- as.matrix(tdm)
m
```

Word Cloud In R

# Output :



```
                Docs
Terms            1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
  transparent    1 0 0 0 0 0 1 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0
  improve        0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  lot            0 1 0 0 0 0 0 0 0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0
  questions      0 1 0 1 2 0 0 0 1  0  0  0  0  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0
  scope          0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  subjective     0 1 0 1 0 0 0 0 1  0  0  0  0  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0
  compared       0 0 1 0 0 0 0 1 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  happy          0 0 1 0 0 0 1 0 1  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  1  0  0  0  0  0  0  1  0  0
  increment      0 0 1 0 0 0 0 1 0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
  low            0 0 1 0 0 0 0 1 0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  previous       0 0 1 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  salary         0 0 1 0 0 0 0 1 0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
  years          0 0 1 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  difficult      0 0 0 1 0 0 0 0 0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  many           0 0 0 1 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  measure        0 0 0 1 0 0 0 0 0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  performance    0 0 0 1 0 0 0 0 0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  1  0  0  0  0  0
  function       0 0 0 0 1 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  general        0 0 0 0 1 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  specific       0 0 0 0 1 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
                Docs
Terms            35 36 37 38 39 40 41 42 43 44 45 46 47 48
  transparent     0  0  0  0  0  0  0  0  0  0  0  0  0  0
  improve         0  0  0  0  0  0  0  1  0  0  0  0  0  0
  lot             0  0  0  0  0  0  0  0  0  0  0  0  0  0
  questions       1  1  1  0  0  1  0  0  0  0  0  1  0  0
  scope           0  0  0  0  0  0  0  1  0  0  0  0  0  0
  subjective      0  0  1  0  0  0  0  0  0  0  0  1  0  0
  compared        0  0  0  0  0  0  0  0  0  0  0  0  0  0
  happy           0  0  0  0  1  1  0  0  0  1  0  0  0  0
  increment       0  0  0  0  0  0  0  0  0  0  0  0  0  0
  low             0  0  0  0  0  0  0  0  0  0  0  0  0  0
  previous        0  0  0  0  0  0  0  0  0  0  0  0  0  0
  salary          0  0  0  0  0  0  0  0  0  0  0  0  0  0
  years           0  0  0  0  0  0  0  0  0  0  0  0  0  0
  difficult       0  0  1  0  0  0  0  0  0  0  0  0  0  0
  many            1  0  0  0  0  0  0  0  0  0  0  0  0  0
  measure         0  0  1  0  0  0  0  0  0  0  0  0  0  0
  performance     0  0  1  0  0  0  0  0  0  0  0  0  0  0
  function        0  0  0  0  0  0  0  0  0  0  0  0  0  0
  general         0  0  0  0  0  0  0  0  0  0  0  0  0  0
  specific        0  0  0  0  0  0  0  0  0  0  0  0  0  0
 [ reached getOption("max.print") -- omitted 73 rows ]
```

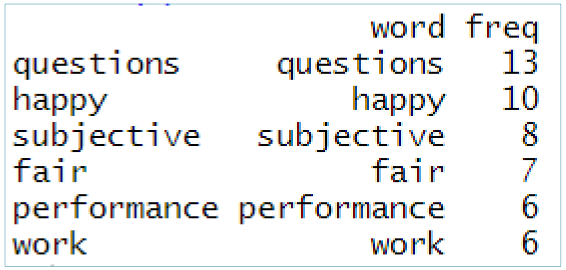
Interpretation:

- There are 48 docs (text lines).
- Example of how to read this output table: Term ‘transparent’ is appearing once in docs 1,7,23 and so on.,

Word Cloud In R

```
# Calculate total frequency of words & creating a data frame of it
```

```
v <- sort(rowSums(m), decreasing=TRUE)
myNames <- names(v)
d <- data.frame(word=myNames, freq=v)
head(d)
```



```
                   word freq
questions     questions   13
happy             happy   10
subjective   subjective    8
fair               fair    7
performance performance    6
work               work    6
```

```
# Create color palette
```

```
pal2 <- brewer.pal(8,"Dark2")
```

- **brewer.pal** () was developed by Cynthia Brewer. It makes the color palettes from Color Brewer available as R palettes.
- **Arguments:**
  Number of colors included in the palette: 8
  Palette Name: 'Dark 2'
- Check out different palettes at **http://colorbrewer2.org/**

Word Cloud In R

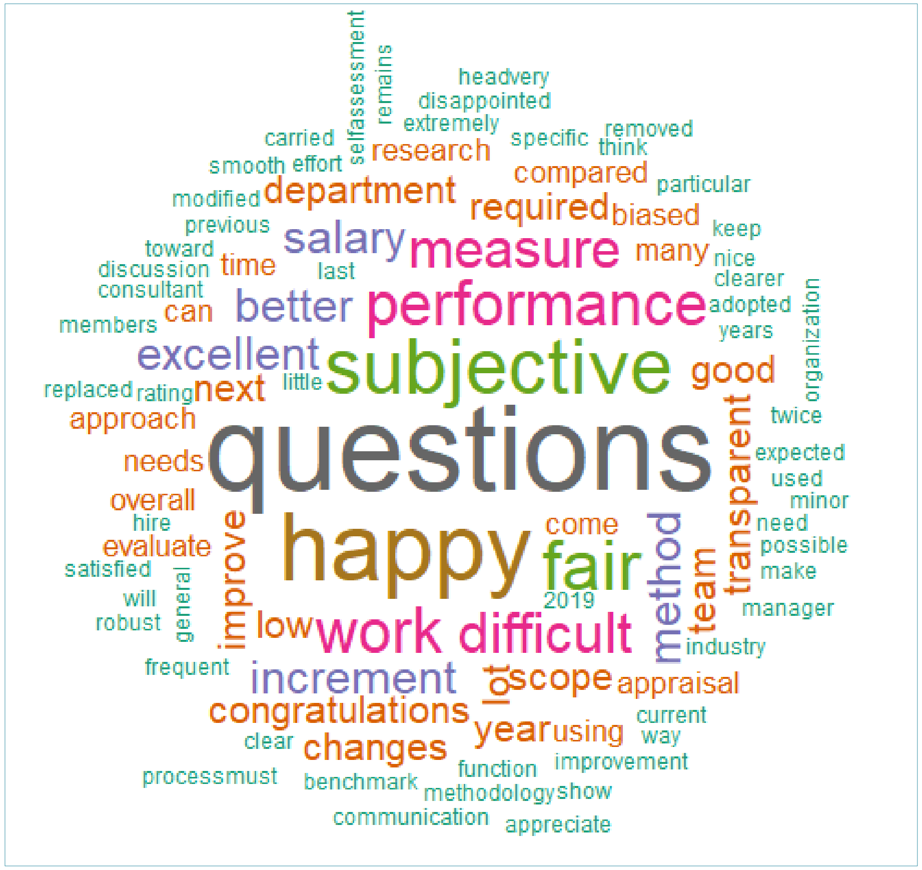
```
# Get Word Cloud
```

```r
wordcloud(d$word, d$freq, random.order = FALSE , min.freq =
1,colors=pal2)
```

- First and second argument in **wordcloud()** are the words **(d$word)** and the frequency **(d$freq)** respectively.
- **random.order=FALSE** plots words in decreasing frequency. By default, plot words in random order.
- **min.freq =** words with frequency below min.freq will not be plotted.
- **colors =** color words from least to most frequent with specified color palette.

Word Cloud In R

```
# Output :
```



Interpretation:
- Word questions has largest size, indicating most frequent word followed by happy and subjective and so on..

Text Mining Using ggplot2

Plotting frequent terms as a bar plot

```
term.freq <- rowSums(m)
term.freq <- subset(term.freq, term.freq >= 5)
```

```
# Transform as a dataframe
```

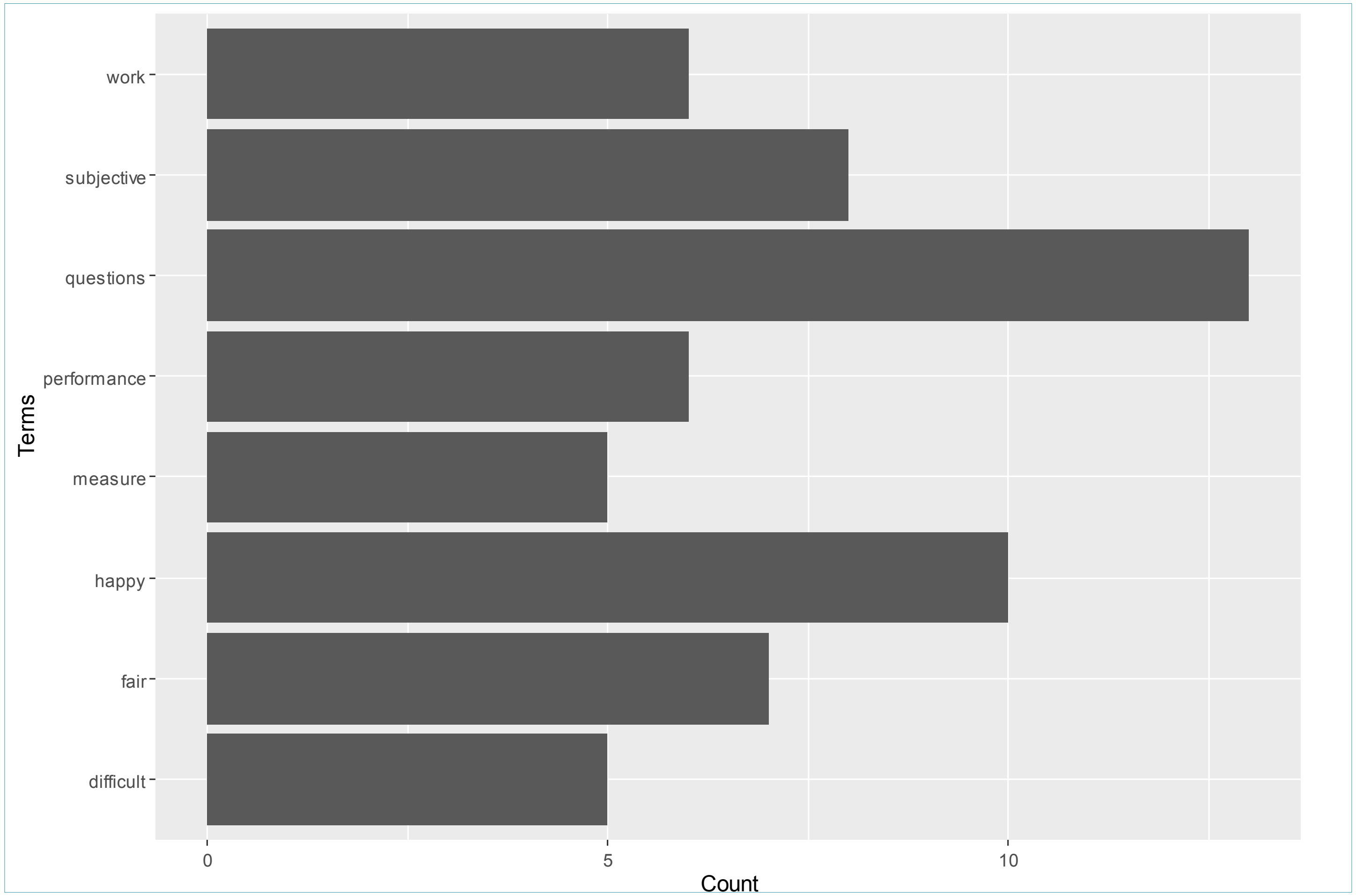
```
df <- data.frame(term = names(term.freq), freq = term.freq)
```

```
# Horizontal bar plot
```

```
install.packages("ggplot2")
library(ggplot2)
ggplot(df, aes(x = term, y = freq))+
  geom_bar(stat = "identity") +
  xlab("Terms") + ylab("Count") + coord_flip()
```

Text Mining Using ggplot2

```
# Output :
```



Interpretation:

➢ Graph shows the frequency of the words appearing at least 5 times on a horizontal bar graph. questions is the most frequent word with frequency more than 10

Sentiment Analysis Using "sentimentr"

```
# Install and Load package “sentimentr”
```

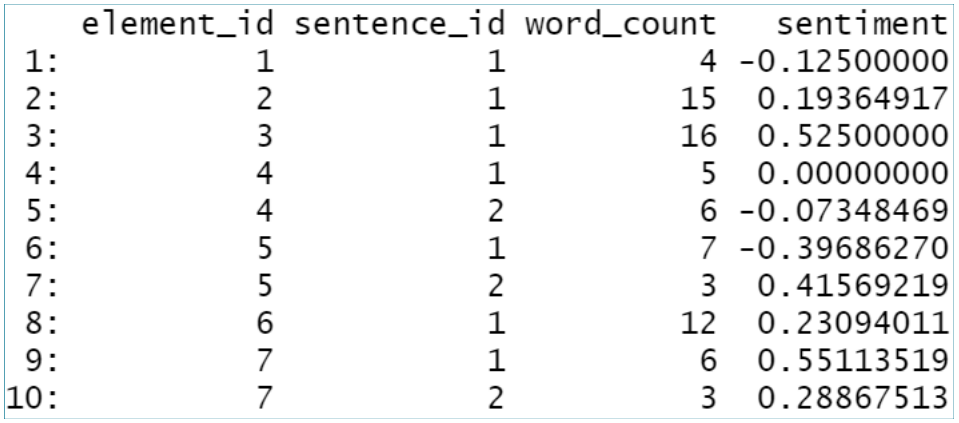
```r
install.packages("sentimentr")
library(sentimentr)
```

```
# Calculate Sentiment Score
```

```r
data<-readLines("HR Appraisal process.txt")
sentiment(data)
```

- **sentiment()** calculates the sentiment values of each sentence in the

```
# Output
```



```
    element_id sentence_id word_count   sentiment
 1:          1           1          4 -0.12500000
 2:          2           1         15  0.19364917
 3:          3           1         16  0.52500000
 4:          4           1          5  0.00000000
 5:          4           2          6 -0.07348469
 6:          5           1          7 -0.39686270
 7:          5           2          3  0.41569219
 8:          6           1         12  0.23094011
 9:          7           1          6  0.55113519
10:          7           2          3  0.28867513
```

- **element_id** is the id number of the original vector passed to sentiment
- **sentence_id** is the id number of the sentences within each element_id
- **word_count** is the count of words in each sentence
- **sentiment** is the sentiment/polarity score of each sentence

Sentiment Analysis Using "sentimentr"

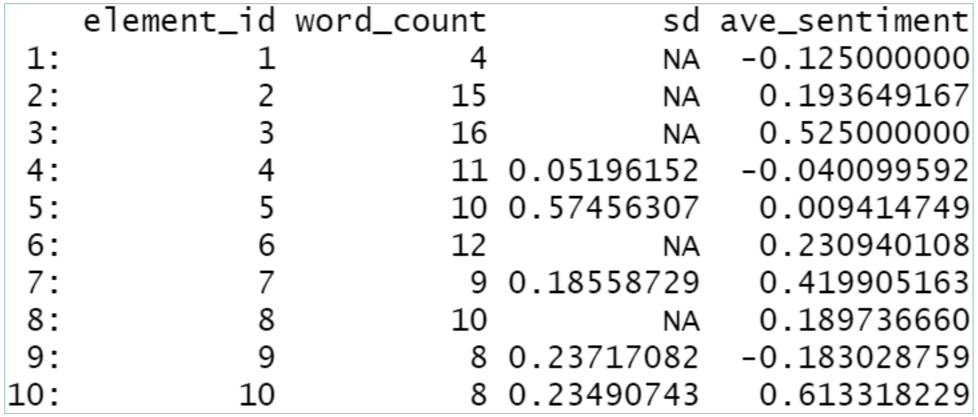
```
# Aggregate sentiment scores”
```

You can also calculate the sentiment scores by aggregating it with respect to different elements. The default value is by=”NULL”, which aggregates the sentiment scores with respect to each line

```
# Calculate Avg Sentiment Score
sentiment_by(data)
```

- **Sentiment_by()** calculates the aggregate sentiment values

```
# Output
```



```
    element_id word_count         sd ave_sentiment
 1:          1          4         NA  -0.125000000
 2:          2         15         NA   0.193649167
 3:          3         16         NA   0.525000000
 4:          4         11 0.05196152  -0.040099592
 5:          5         10 0.57456307   0.009414749
 6:          6         12         NA   0.230940108
 7:          7          9 0.18558729   0.419905163
 8:          8         10         NA   0.189736660
 9:          9          8 0.23717082  -0.183028759
10:         10          8 0.23490743   0.613318229
```

- **sd** gives the standard deviation of the sentiment score of the sentences in the review
- **ave_sentiment** gives the average sentiment score of the sentences in the review

* Note : Sentiment Categories can be derived using Sentiment Scores

Sentiment Analysis Using "syuzhet"

```
# Install and Load package “syuzhet”
```

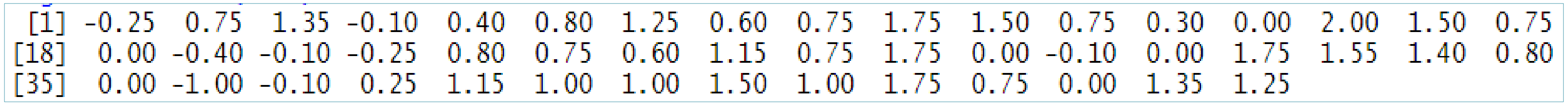
```r
install.packages("syuzhet")
library(syuzhet)
```

```
# Calculate Sentiment Values
```

```r
get_sentiment(data)
```

- **get_sentiment()** calculates sentiment of each word or sentence. First argument is a character vector (or sentences or words) and second argument is for method (Which lexicon to be used). The function uses **method="syuzhet"** by default.
- We have passed data object as it is to the function. This ensures feedback with more than one sentences is not split and considered entirely. However, it is a better practice to 'tokenise' data. Sentences separated by full stops are split.

```
# Output
```



```
 [1] -0.25  0.75  1.35 -0.10  0.40  0.80  1.25  0.60  0.75  1.75  1.50  0.75  0.30  0.00  2.00  1.50  0.75
[18]  0.00 -0.40 -0.10 -0.25  0.80  0.75  0.60  1.15  0.75  1.75  0.00 -0.10  0.00  1.75  1.55  1.40  0.80
[35]  0.00 -1.00 -0.10  0.25  1.15  1.00  1.00  1.50  1.00  1.75  0.75  0.00  1.35  1.25
```

Sentiment Analysis Using "syuzhet"

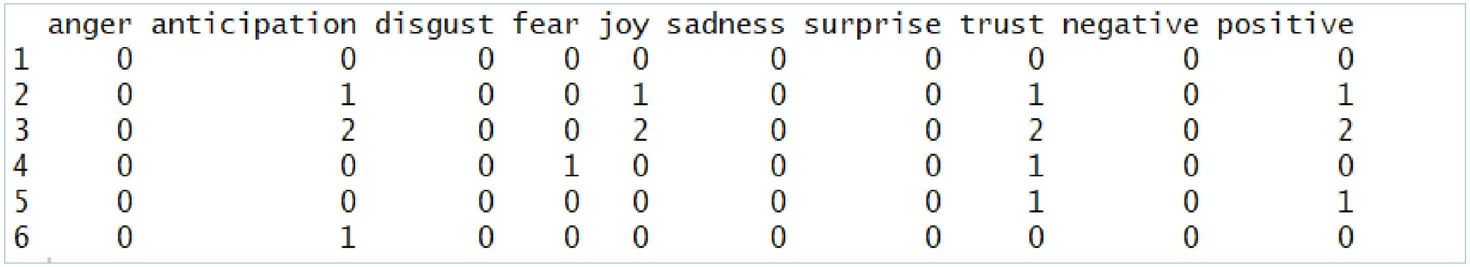
```
# Display emotions and valence from NRC dictionary
```

```
nrcsentiment <- get_nrc_sentiment(data)
head(nrcsentiment)
```

- **get_nrc_sentiment()** calls the NRC sentiment dictionary to calculate the presence of eight different emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust)and two sentiments (positive and negative).
- It returns a data frame in which each row represents a sentence from the original file. The columns include one for each emotion type as well as the positive or negative sentiment valence.

Sentiment Analysis Using "syuzhet"

```
# Output :
```



```
  anger anticipation disgust fear joy sadness surprise trust negative positive
1     0            0       0    0   0       0        0     0        0        0
2     0            1       0    0   1       0        0     1        0        1
3     0            2       0    0   2       0        0     2        0        2
4     0            0       0    1   0       0        0     1        0        0
5     0            0       0    0   0       0        0     1        0        1
6     0            1       0    0   0       0        0     0        0        0
```

Interpretation:

- Negative score indicates ,negative sentiments.
- Example of how to read output table : second sentence is having joyful sentiments. 4th sentence has fear sentiment.

THANK YOU!