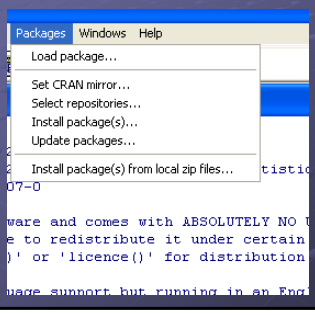
## Using R for Text Mining


## Part 2 : R Text Mining

Assumes knowledge of R but not how to text mine in R

## Install the tm package



## Load the tm package

- The "library" command loads the bundled functions of the desired library. Help describing those functions is a short command away.
- >library(tm) #loads library
- >help(package=tm)


## What we do with **tm**

- Apply functions similar to Perl parsing methods
- Statistically analyze the data to derive content from unstructured text data

## TM – data sources & readers

```
> #************************************************************
> # for an up-to-date list of available data sources and readers
> #************************************************************
> getSources()
[1] "DataframeSource" "DirSource"       "GmaneSource"     "ReutersSource"
"URISource"
[6] "VectorSource"

> getReaders()
[1] "readDOC"              "readGmane"            "readPDF"
[4] "readReut21578XML"     "readReut21578XMLasPlain" "readPlain"
[7] "readRCV1"             "readTabular"
>
```

# TM – source documents

```
#*********************************************************************
# read in source document collection
#*********************************************************************
>txt.csv <- read.csv(file="c:/text mining/Top2Iss.txt", header=FALSE)
>txt <- Corpus(DataframeSource(txt.csv))

>summary(txt)
A corpus with 330 text documents

# examine the first 10 rows
>inspect(txt[1:10])
[[1]]
A crisis that could affect our ability to regulate ourselves.

[[2]]
A need to deal more thoroughly with non-traditional risk management approaches

[[3]]
Ability of members to prove they are more than just number crunchers

[[4]]
ability to convince non-insurance companies of the value/skills offered by CAS members.
```

# TM – preprocess – lowercase

```
> #*********************************************************************
> # a little pre-processing to prep the data for TM
> # convert to lower case
> # tmTolower is one of several available text transformations.
> # To see all currently available use: getTransformations()
> #*********************************************************************
> txt <- tm_map(txt, tolower)

> inspect(txt[1:10])
[[1]]
a crisis that could affect our ability to regulate ourselves.

[[2]]
a need to deal more thoroughly with non-traditional risk management approaches

[[3]]
ability of members to prove they are more than just number crunchers

[[4]]
ability to convince non-insurance companies of the value/skills offered by cas
members.
```

# TM – search & replace

```
> #*********************************************************************
> # Replace the slashes in the text with a blank
> #*********************************************************************
> # txt <- gsub("/"," ",txt)
> for (j in 1:length(txt)) txt[[j]] <- gsub("/", " ",txt[[j]])

> inspect(txt[1:10])
[[1]]
a crisis that could affect our ability to regulate ourselves.

[[2]]
a need to deal more thoroughly with non-traditional risk management approaches

[[3]]
ability of members to prove they are more than just number crunchers

[[4]]
ability to convince non-insurance companies of the value skills offered by cas members.
```

## TM – search & replace con't

```
> #****************************************************************
> # Replace other characters
> #****************************************************************
>
> for (j in 1:length(txt)) txt[[j]] <- gsub("[&-/\\()\\.]", " ",txt[[j]])
> for (j in 1:length(txt)) txt[[j]] <- gsub("[|&|-|/|\\|()|\\.]", " ", txt[[j]]);
> inspect(txt[1:10])
[[1]]
a crisis that could affect our ability to regulate ourselves

[[2]]
a need to deal more thoroughly with non traditional risk management approaches

[[3]]
ability of members to prove they are more than just number crunchers

[[4]]
ability to convince non insurance companies of the value skills offered by cas members

[[5]]
ability to help sort out property pricing problems
```

## TM – search & replace con't

```
> #****************************************************************
> # Replace enterprise risk management
> #****************************************************************
> for (j in 1:length(txt)) txt[[j]] <- gsub("enterprise risk management", "erm",txt[[j]])
> for (j in 1:length(txt)) txt[[j]] <- gsub("off shoring", "offshoring", txt[[j]]);
> inspect(txt[1:10])
[[1]]
a crisis that could affect our ability to regulate ourselves

[[2]]
a need to deal more thoroughly with non traditional risk management approaches

[[3]]
ability of members to prove they are more than just number crunchers

[[4]]
ability to convince non insurance companies of the value skills offered by cas members

[[5]]
ability to help sort out property pricing problems
```

## TM – search & replace con't

```
> #****************************************************************
> # remove stopwords
> #****************************************************************
> txt <- tm_map(txt, removeWords, stopwords("english"))
> #dbInit(db='txtcsv')
>
> #****************************************************************
> # remove punctuation
> #****************************************************************
> txt <- tm_map(txt, removeNumbers)
> txt <- tm_map(txt, removePunctuation)
> inspect(txt[1:10])
[[1]]
 crisis  affect  ability  regulate

[[2]]
   deal  thoroughly  traditional risk management approaches

[[3]]
ability  prove     crunchers

[[4]]
ability  convince  insurance companies  value skills offered  cas

[[5]]
ability  help sort  property pricing
```

## TM – search & replace con't

```
> #*********************************************************************
> # remove stopwords & punctuation
> #*********************************************************************
> txt <- tm_map(txt, removeWords, stopwords("english"))
> txt <- tm_map(txt, removeNumbers)
> txt <- tm_map(txt, removePunctuation)
> inspect(txt[1:10])
[[1]]
 crisis  affect  ability  regulate

[[2]]
   deal  thoroughly  traditional risk management approaches

[[3]]
ability  prove  crunchers

[[4]]
ability  convince  insurance companies  value skills offered  cas

[[5]]
ability  help sort  property pricing
> length(txt);
[1] 330
```

## TM – search & replace con't

```
 (j in 1:length(txt)) txt[[j]] <- gsub("professional", "professions", txt[[j]]);
>
> getTransformations()
[1] "as.PlainTextDocument" "convert_UTF_8"        "removeNumbers"
    "removePunctuation"
[5] "removeWords"          "stemDocument"         "stripWhitespace"
> txt <- tm_map(txt, stemDocument)
> inspect(txt[40:50])
[[1]]
climat chang

[[2]]
compani complain  oner  expen educ system set  cas

[[3]]
compani will  pay  meet

[[4]]
compet  profess organ

[[5]]
competit  profess
```

## TM – Document by Term Matrix

```
> #*********************************************************************
> # create a document_by_term matrix
> #*********************************************************************
> dtm <- DocumentTermMatrix(txt)
> nrow(dtm); ncol(dtm)
[1] 330
[1] 469
> inspect(dtm[1:24,1:9])
A document-term matrix (24 documents, 9 terms)

Non-/sparse entries: 10/206
Sparsity           : 95%
Maximal term length: 8
Weighting          : term frequency (tf)

   abil aca accept account accredit accuraci activ actuari address
1     1   0      0       0        0        0     0       0       0
2     0   0      0       0        0        0     0       0       0
3     1   0      0       0        0        0     0       0       0
4     1   0      0       0        0        0     0       0       0
5     1   0      0       0        0        0     0       0       0
6     0   0      1       0        0        0     0       0       0
7     0   0      0       0        0        0     0       1       0
8     0   0      0       0        0        0     0       1       0
9     0   0      0       0        0        0     0       1       0
10    0   0      0       0        0        0     0       0       0
```

# TM – ID Frequent Occuring Words

```
> #*********************************************************************
> # ID frequently occuring words
> #*********************************************************************
> findFreqTerms(dtm, 1.2)# 2 occurances=lower frequency bound;
[1] "exam"    "cost"    "smart"   "actuari" "focus"   "expen"   "profess"
>
> #*********************************************************************
> # tighten up dtm matrix by removing sparse terms
> #*********************************************************************
> nrow(dtm); ncol(dtm)
[1] 330
[1] 469
> dtm2 <- removeSparseTerms(dtm, 0.995)
> nrow(dtm2); ncol(dtm2)
[1] 330
[1] 192
> inspect(dtm2[1:12,1:15])

   abil aca accept account activ actuari admiss aig analysi analyst analyt applic approach
1     1   0      0       0     0       0      0   0       0       0      0      0        0
2     0   0      0       0     0       0      0   0       0       0      0      0        1
3     1   0      0       0     0       0      0   0       0       0      0      0        0
4     1   0      0       0     0       0      0   0       0       0      0      0        0
5     1   0      0       0     0       0      0   0       0       0      0      0        0
6     0   0      1       0     0       0      0   0       0       0      0      0        0
7     0   0      0       0     0       1      0   0       0       0      0      0        0
8     0   0      0       0     0       1      0   0       0       0      0      0        0
9     0   0      0       0     0       1      0   0       0       0      0      0        0
10    0   0      0       0     0       0      1   0       0       0      0      0        0
```

# TM – Remove Sparse terms

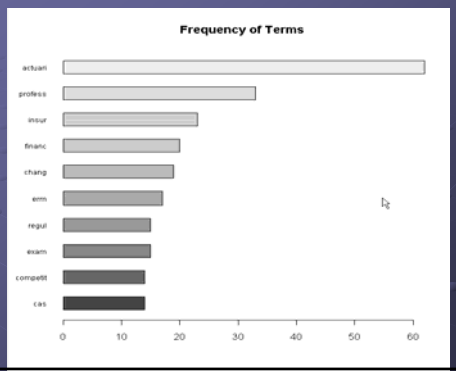
```
> #*********************************************************************
> # tighten up dtm matrix more for correlation plot by removing sparse terms
> #*********************************************************************
> dtm3 <- removeSparseTerms(dtm, 0.98)
> nrow(dtm3); ncol(dtm3)
[1] 330
[1] 36
> #inspect(dtm3[1:3,])
>
> findFreqTerms(dtm3, 2)
[1] "exam"    "actuari" "focus"   "profess"
>
> # find words correlated with the themes
> findAssocs(dtm2,  "educ", 0.05)
      educ    regard    system     train     topic  research   practic   qualiti
      1.00      0.37      0.37      0.37      0.25      0.23      0.20      0.20
   continu   environ    materi   pressur       set  syllabus   current    applic
      0.18      0.18      0.18      0.18      0.18      0.14      0.13      0.11
  opportun     reput    result   student    provid   actuari      exam     expen
      0.11      0.11      0.11      0.11      0.10      0.09      0.09      0.09
     chang  structur casualti membership     relev
      0.08      0.08      0.06      0.06      0.06
```

# TM – Find Frequent terms

```
**********************************************************************
> # export dtm
> #*********************************************************************
> top2.matrix <- as.matrix(dtm3)
> write.csv(top2.matrix, file="c:/text mining/top2tf.csv", row.names=FALSE)

**********************************************************************
> # find most frequently mentioned terms
> #*********************************************************************
> tags <- sort(findFreqTerms(dtm3, 1, 3)); tags[1:10]
 [1] "abil"    "account" "actuari" "cas"     "casualti" "chang"   "compani" "competit"
 [9] "continu" "credibl"
> #tags <- sort(paste('top2$',findFreqTerms(dtm2, 1, 3),sep="")); tags[1:10]
> sum(abil); # returns 5
[1] 7
> sum(actuari); # returns 60
[1] 62
> sum(account); # returns 6
[1] 8
> numwords <- 30
> v <- as.matrix(sort(sapply(top2, sum),decreasing=TRUE)[1:numwords], colnames=count);v[1:numwords]
 [1] 62 33 23 20 19 17 15 15 14 14 14 14 12 12 12 12 11 11 11 11 10 10 10 10  9  9  9  9  8  8
> w <- rownames(v); length(w); w
[1] 30
 [1] "actuari"  "profess"  "insur"    "financ"   "chang"    "erm"      "exam"     "regul"
 [9] "cas"      "competit" "educ"     "increa"   "compani"  "credibl"  "intern"   "model"
[17] "current"  "organ"    "reserv"   "standard" "focus:"   "industri" "manag"    "research"
[25] "global"   "issu"     "market"   "risk"     "account"  "casualti"
> require(grDevices); # for colors
> x <- sort(v[1:10,], decreasing=FALSE)
> barplot(x, horiz=TRUE, cex.names=0.75, space=1, las=1, col=grey.colors(10), main="Frequency of Terms")
>
```

**barplot**(x, horiz=TRUE, cex.names=0.75, space=1, las=1, col=grey.colors(10), main="Frequency of Terms")

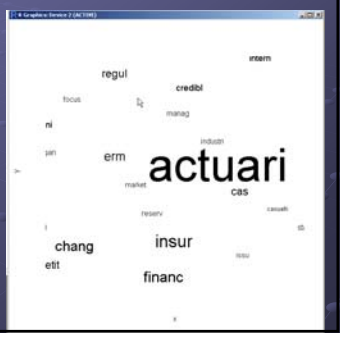



## Three Variations on Tag Clouds

```
#
# tag Cloud as a list
2/06/Tag-cloud-for-the-R-Graph-Gallery
#
# as a list
require(snippets)
v <- sapply(top2, sum);v
cloud(v, col=col.bbr(v, fit=TRUE))
```

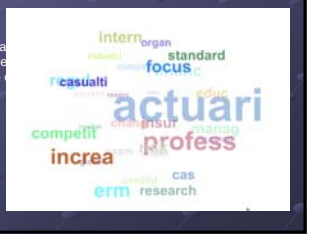

## Three Variations on Tag Clouds

```
#
# Tag Cloud with random placement
#
set.seed(221);
factor=0.8;
x=runif(length(w))*factor;
y=runif(length(w))*factor;
plot(x, y, type="n", axes=FALSE);
# font size=relative term frequency
pointLabel(x, y, w, 0.10*v);
```



# Three Variations on Tag Clouds

```
#*********************************************************************
# install.packages("fun", repos="http://r-forge.r-project.org").
# with style
#*********************************************************************
require(fun)
data(tagData)
v <- as.matrix(sort(sapply(top2,
doit),decreasing=TRUE)[1:numwords],
colnames=count);v[1:numwords];v
x <-data.frame(rownames(v), "http://www.casa
tagData$color[1:length(v)],tagData$hicolor[1:le
                                    colnames(x) <-
'count','color','hicolor');x
htmlFile=paste(tempfile(), ".html", sep="")
#htmlFile=paste("tagData", ".html", sep="")
if (file.create(htmlFile)) {
    tagCloud(x, htmlFile)
    browseURL(htmlFile)
}
```




## Get Individual Records associated with the term “actuar”

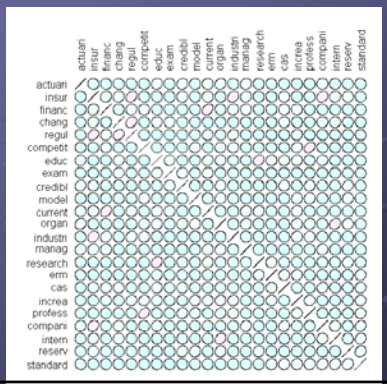
```
> #*********************************************************************
> # Get records for the word actuar
> #*********************************************************************
> subset(top2, actuari>=1)[1:10,1:10]
   abil account actuari cas casualti chang compani competit continu credibl
7    0       0       1   0        0     0       0        0      0       0
8    0       0       1   0        0     0       0        0      0       0
9    0       0       1   0        0     0       0        0      0       0
17   0       0       1   0        0     0       0        0      0       0
> rownames(subset(top2, actuari>=1)) #which rows have actauri=1
  [1] "7"  "8"  "9"  "17" "20" "45" "46" "57" "59" "71" "74" "77" "78" "81"
 [15] "82" "95" "105" "118" "136" "149" "153" "160" "163" "173" "180" "182" "183" "186"
 [29] "191" "193" "195" "196" "197" "204" "205" "206" "214" "220" "221" "223" "224" "225"
 [43] "227" "229" "250" "261" "263" "266" "277" "282" "298" "299" "309" "313" "318" "321"
 [57] "323" "328" "329"
> txt.actuari <- txt.csv[rownames(subset(top2, actuari>=1)),]
> txt.actuari[1:5]; #print out records with actuari
[1] Actuarial Malpractice (2)
[2] Actuarial Students of today are not good communicators/executive material.
[3] Actuaries regain status as masters of risk
[4] automation/modeling of actuarial skills
[5] Being a market leading brand of actuarial science - what do we stand for?
330 Levels:  approaches to address external changes  ERM ... Will we get to a point where we have too
many members??
```

## Correlation Plot

```
> #*********************************************************************
> # produce a Correlation plot with the most frequenctly occuring top 24 terms
> #*********************************************************************
> require(ellipse)
> nrow(dtm3); ncol(dtm3)
[1] 330
[1] 36
> dtm4 <- removeSparseTerms(dtm, 0.97)
> nrow(dtm4); ncol(dtm4)
[1] 330
[1] 23
> inspect(dtm4[1:3,])

   actuari cas chang compani competit credibl current educ erm exam financ increa industri
1        0   0     0       0        0       0       0    0   0    0      0      0       0
2        0   0     0       0        0       0       0    0   0    0      0      0       0
3        0   0     0       0        0       0       0    0   0    0      0      0       0
  insur intern manag model organ profess regul research reserv standard
1     0      0     0     0     0       0     1        0      0        0
2     0      0     1     0     0       0     0        0      0        0
3     0      0     0     0     0       0     0        0      0        0
> top4.matrix <- as.matrix(dtm4)
> txt.corr <- cor(top4.matrix)
> ord <- order(txt.corr[ncol(dtm4),])
> xc <- txt.corr[ord, ord]
> plotcorr(xc, col=cm.colors(12)[5*xc + 6])
>
```

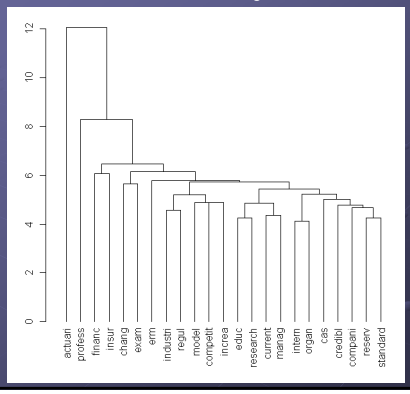
## Correlation Plot




## Correlation Plot

```
*****************************************************
> # hierarchical clustering (Ward's minimum variance method)
> #*****************************************************
> require(stats)
> #new for clustering variables
> dtm3 <- removeSparseTerms(dtm, 0.97)
> dtmtrans<-t(dtm3)
> hClust <- hclust(dist(dtmtrans), method='ward'); # average, single, complete, median, centroid, ward,
mcquitty;
> plot(hClust)
> # for interactive plot
> # (x <- identify(hClust))
>
> require(graphics);
> require(utils)
> (dend1 <- as.dendrogram(hClust)) # "print()" method
'dendrogram' with 2 branches and 23 members total, at height 12.07791
> dend2 <- str(dend1, max=4) # only the first two sub-levels
--[dendrogram w/ 2 branches and 23 members at h = 12.1]
  |--leaf "actuari"
  `--[dendrogram w/ 2 branches and 22 members at h = 8.3]
     |--leaf "profess"
     `--[dendrogram w/ 2 branches and 21 members at h = 6.48]
        |--[dendrogram w/ 2 branches and 2 members at h = 6.08]
        |  |--leaf "financ"
        |  `--leaf "insur"
        `--[dendrogram w/ 2 branches and 19 members at h = 6.15]
           |--[dendrogram w/ 2 branches and 2 members at h = 5.66] ..
           `--[dendrogram w/ 2 branches and 17 members at h = 5.78] ..
> plot(dend1)
```

## hierarchical clustering



## Principal Components

- An unsupervised technique
- Groups similar variables (rather than similar records) together
- Uses correlation matrix – variables (here terms) that are highly correlated are grouped together

## R Princomp function

```
>require(stats)
>prcomp(top2, scale=TRUE)
>summary(prcomp(top2, scale=TRUE))
```

- Then examine top components

```
>.for (i in 1:15) {
>  top4[[i]] <- sort(survey.prcomp$rotation[,i], decreasing=TRUE)[1:4]}
>top4.
```

## The Top Components

| Component | Concept |
|---|---|
| 1 | practical research |
| 2 | predictive modeling |
| 3 | maintain standards |
| 4 | demand for actuarial skills |
| 5 | risk management |
| 6 | exam structure |
| 7 | actuarial organization |
| 8 | reputation/financial issues |
| 9 | economic capital |
| 10 | competition - other professions |
| 11 | opportunities for actuaries |
| 12 | capital |
| 13 | predictive modeling |
| 14 | globalism/competition |
| 15 | reserving and credibility |