Introduction to R and Data Science Tools in the Microsoft Stack

Jamey Johnston

Agenda

- **Intro to R**
  - *R and RStudio*
  - *Basics*
  - *Objects in R*
  - *Packages*
  - *Control Flows*
  - *RStudio Overview*
- **MS and R**
  - *Databricks*
  - *Azure ML*
  - *MS Machine Learning Services*
  - *SQL 2016+*
  - *Power BI*
- **Resources**

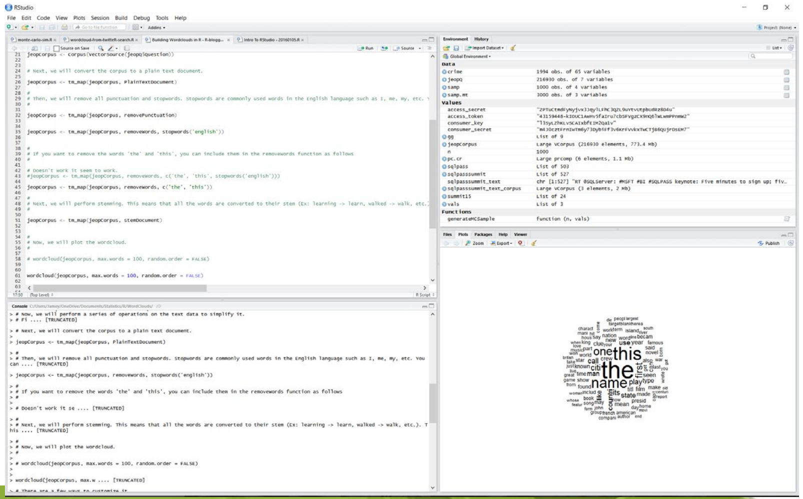
Source: https://www.r-project.org/logo/

Jamey Johnston

- Sr. Data Scientist/Engineer for O&G Company
- 25+ years Data Experience
- TAMU MS in Analytics
  - http://analytics.stat.tamu.edu
- Semi-Pro Photographer
  - http://jamey.photography
- @STATCowboy
- GitHub (code) - https://github.com/STATCowboy/CodeLIkePirate
- http://STATCowboy.com

R and RStudio

- R Project for Statistical Computing
  - https://www.r-project.org/
- RStudio
  - https://www.rstudio.com/



RStudio
File Edit Code View Plots Session Build Debug Tools Help
Go to file/function
Addins
monte-carlo-sim.R
wordcloud-from-twitteR-search.R
Building Wordclouds in R - R-blogg...
Intro To RStudio - 20160105.R
Source on Save
Run
Source
Project: (None)
Environment
History
Import Dataset
List
Global Environment
Files
Plots
Packages
Help
Viewer
Zoom
Export
Publish
17:50
(Top Level)
R Script
Console C:/Users/Jamey/OneDrive/Documents/Statistics/R/WordClouds/

```
jeopCorpus <- Corpus(VectorSource(jeopQ$Question))


# Next, we will convert the corpus to a plain text document.

jeopCorpus <- tm_map(jeopCorpus, PlainTextDocument)

#
# Then, we will remove all punctuation and stopwords. Stopwords are commonly used words in the English language such as I, me, my, etc. Y
#

jeopCorpus <- tm_map(jeopCorpus, removePunctuation)


jeopCorpus <- tm_map(jeopCorpus, removeWords, stopwords('english'))


#
# If you want to remove the words 'the' and 'this', you can include them in the removeWords function as follows
#

# Doesn't work it seem to work.
#jeopCorpus <- tm_map(jeopCorpus, removeWords, c('the', 'this', stopwords('english')))

jeopCorpus <- tm_map(jeopCorpus, removeWords, c('the', 'this'))

#
# Next, we will perform stemming. This means that all the words are converted to their stem (Ex: learning -> learn, walked -> walk, etc.)
#

jeopCorpus <- tm_map(jeopCorpus, stemDocument)


#
# Now, we will plot the wordcloud.
#

# wordcloud(jeopCorpus, max.words = 100, random.order = FALSE)


wordcloud(jeopCorpus, max.words = 100, random.order = FALSE)
```

```
> # Now, we will perform a series of operations on the text data to simplify it.
> # Fi .... [TRUNCATED]

> # Next, we will convert the corpus to a plain text document.
>
> jeopCorpus <- tm_map(jeopCorpus, PlainTextDocument)

> #
> # Then, we will remove all punctuation and stopwords. Stopwords are commonly used words in the English language such as I, me, my, etc. You
can .... [TRUNCATED]

> jeopCorpus <- tm_map(jeopCorpus, removeWords, stopwords('english'))

> #
> # If you want to remove the words 'the' and 'this', you can include them in the removeWords function as follows
> #
>
> # Doesn't work it se .... [TRUNCATED]

> #
> # Next, we will perform stemming. This means that all the words are converted to their stem (Ex: learning -> learn, walked -> walk, etc.). T
his .... [TRUNCATED]

> #
> # Now, we will plot the wordcloud.
> #
>
> # wordcloud(jeopCorpus, max.words = 100, random.order = FALSE)
>
>
> wordcloud(jeopCorpus, max.w .... [TRUNCATED]

> # There are a few ways to customize it
```

Data	
crime	1994 obs. of 65 variables
jeopQ	216930 obs. of 7 variables
samp	1000 obs. of 4 variables
samp.mt	3000 obs. of 3 variables
Values	
access_secret	"ZPTuCtmdFyNyjvx3JqylLFhC3QZL9uYtvUtpbudRz8D4u"
access_token	"43159448-kIOUC1AwHv5faIru7cbSFVgzCX9nQ6lWLwmPPnmW2"
consumer_key	"l3SyLZhKLvSCAIxbfEIM2Qa1v"
consumer_secret	"m4J0cztFrnIwTm6y73Dyb1Ff3v6KrFVvkxTWCTjB6QUjrDsEM7"
gg	List of 9
jeopCorpus	Large VCorpus (216930 elements, 773.4 Mb)
n	1000
pc.cr	Large prcomp (6 elements, 1.1 Mb)
sqlpass	List of 503
sqlpasssummit	List of 527
sqlpasssummit_text	chr [1:527] "RT @SQLServer: #MSFT #BI #SQLPASS keynote: Five minutes to sign up; fiv…
sqlpasssummit_text_corpus	Large VCorpus (3 elements, 2 Mb)
summit15	List of 24
vals	List of 3
Functions	
generateMCSample	function (n, vals)

Basics

- # - comment

```
> # Basics
```

- Variable Creation

```
> m <- 3 * 5
> m
[1] 15
```

- Help

```
> help(“lm”)  # lm is function for Fitting Linear Models
> ?lm
> lm(y ~ x)
```

Objects in R

- Variables, Values, Commands, Functions …
- Everything in R is an Object
- Typical Data in R is stored in:
  - Vectors (one row, same data type)
  - Matrices (multiple rows, same data type)
  - Data Frames (multiple rows, multiple data types)
    - It’s like a Table!
  - List (collection of objects)

Vector

- Building Blocks for data objects in R
- *c* (combine) function to create a Vector
  - `v <- c(2, 3, 1.5, 3.1, 49)`
- *seq* function generates numeric sequences
  - `s <- seq(from = 0, to = 100, by = .1)`
- *rep* function replicates values
  - `r <- rep(c(1,4), times = 4)`
- *:* creates a number seq incremented by 1 or -1
  - `colon <- 1:10`
- length(var) returns length of vector
  - `length(colon)`

Matrix

- *matrix* function used to build matrix
- rbind (row bind) and cbind (column bind)
  - Combine matrices by row or column
- http://www.ats.ucla.edu/stat/r/library/matrix_alg.htm
- Demos

Data Frame

- It is like a table!
- *rownames* – extract row labels
- *colnames* – extract column labels
- *read.table, read.csv, readxl, RODBC*
  - Different ways to create data frames
- Demos

List

- Combine multiple objects types into one object
    - vectors, matrices, data frames, list, functions
- Typically used by functions to output the model output
    - e.g. the output from the lm function
- Demo

Missing Data

- NA is used to represent Missing Data
- The *is.na* and *which* functions are used to manage NA

```
> x <- c(1.3,2.3,3.4,NA)
> print(x)
[1] 1.3 2.3 3.4  NA
>
> # Returns integer location of values (not the values)
> n <- which (is.na(x))
> v <- which (!is.na(x))
> print(n)
[1] 4
> print(v)
[1] 1 2 3
>
> # y will be set to the values not = NA
> y <- x[!is.na(x)]
> print(y)
[1] 1.3 2.3 3.4
```

Packages

- Add-ons for R
- *library()*
  - List packages already installed
- *install.package("dplyr2", "ggplot2")*
  - Install new packages
- *library(dplyr2)*
  - Load package to be used in R

Conditional Operators

- Comparisons return logical vector

```
> 1:10 == 2
 [1] FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
> 1:10 != 2
 [1]  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
> 1:10 > 2
 [1] FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
> 1:10 >= 2
 [1] FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
> 1:10 < 2
 [1]  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
> 1:10 <= 2
 [1]  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE

> x <- 2
> x > 1
[1] TRUE
```

Logical Operations

```
> x <- 1:4
> x
[1] 1 2 3 4
>
> (x > 2) | (x <= 3)
[1] TRUE TRUE TRUE TRUE
>
> (x > 2) & (x <= 3)
[1] FALSE FALSE  TRUE FALSE
>
> xor((x > 2), (x < 4))
[1]  TRUE  TRUE FALSE  TRUE
>
> 0:5 %in% x
[1] FALSE  TRUE  TRUE  TRUE  TRUE FALSE
```

Control Flows

- IF … ELSE

```
x <- 4
if (x < 3) print("true") else print("false")
ifelse ((x < 3), print("true"), print("false"))
```

- FOR Loops

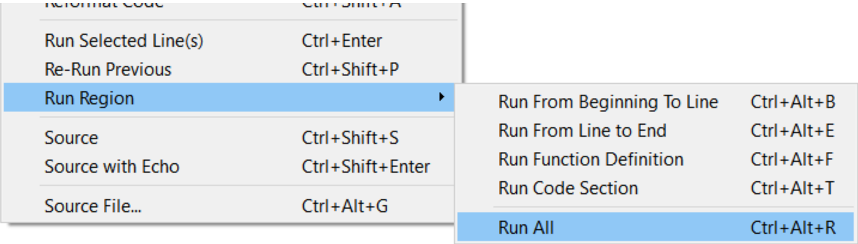
```
for(i in 1:10)
  print(1:i)

for (i in 1:nrow(df))
  print(df[i,])
```

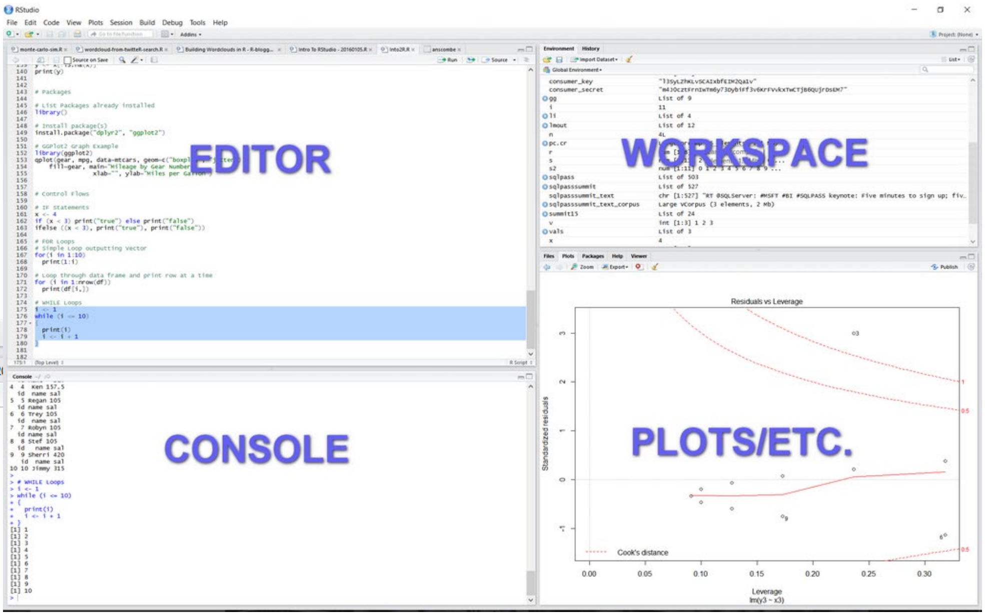
- WHILE Loops

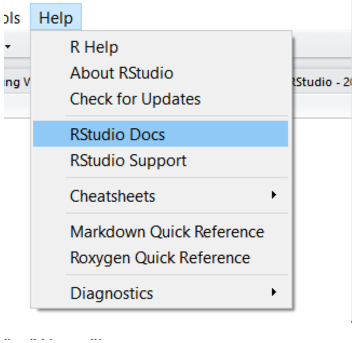
```
i <- 1
while (i <= 10)
{
  print(i)
  i <- i + 1
}
```

RStudio

- Run Options
  - CTL+Enter
  - Ctl+Alt+R
- Built-In Docs
- Version Control
- Projects

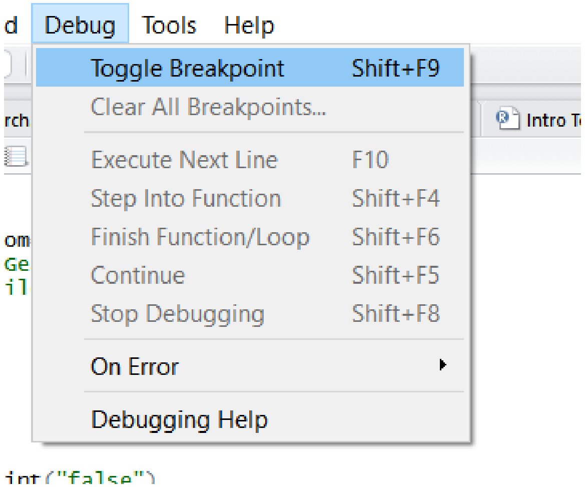

Run Selected Line(s) Ctrl+Enter
Re-Run Previous Ctrl+Shift+P
Run Region
Source Ctrl+Shift+S
Source with Echo Ctrl+Shift+Enter
Source File... Ctrl+Alt+G
Run From Beginning To Line Ctrl+Alt+B
Run From Line to End Ctrl+Alt+E
Run Function Definition Ctrl+Alt+F
Run Code Section Ctrl+Alt+T
Run All Ctrl+Alt+R





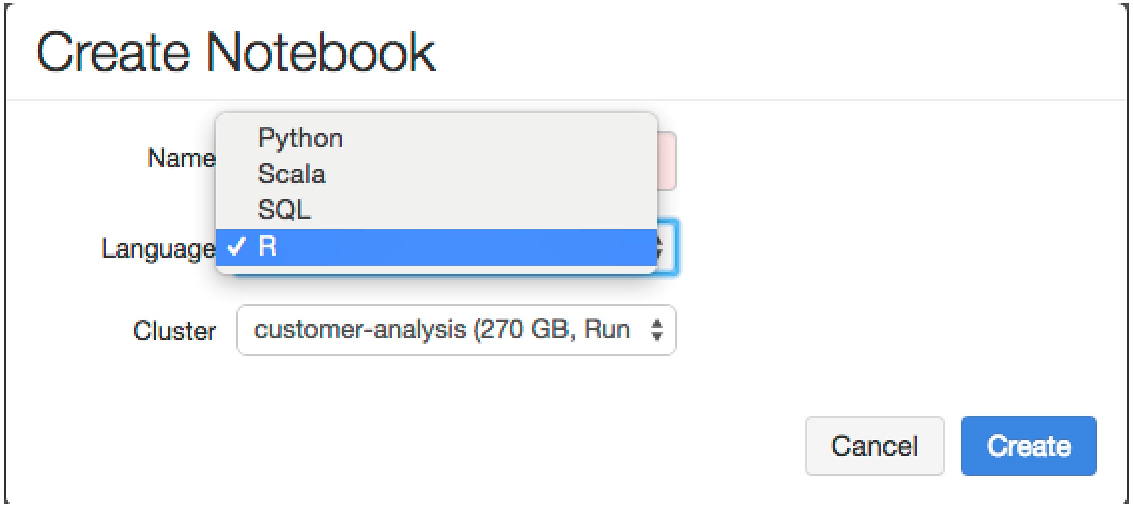
RStudio Debugging

- Breakpoints (Shift+F9)
- R Functions
  - browser()
  - debugonce()
- Environment Pane
  - Traceback(Callstack)
- Console
  - Step into function (Shift+F4)
  - Finish Function (Shift+F6)
  - Continue Running (Shift+F5)
  - Stop Debugging (Shift+F8)



Azure Databricks

- Azure Databricks
  - R Integration
  - Python
  - Scala
  - Spark SQL



Create Notebook

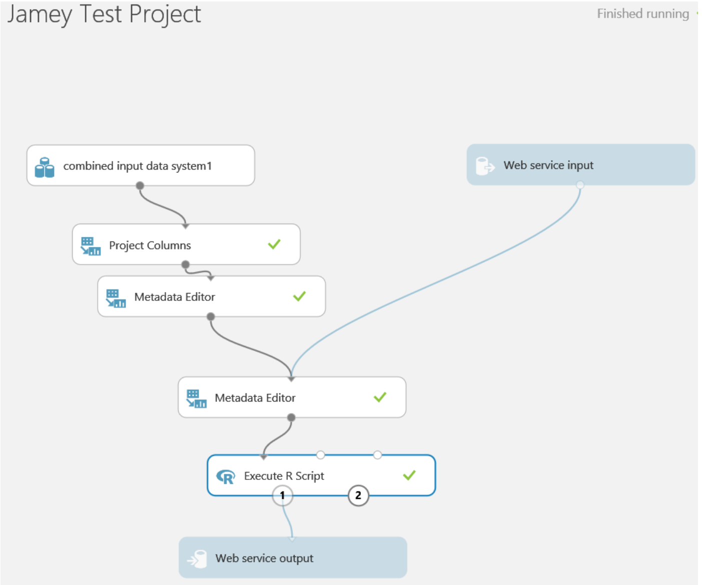
Name

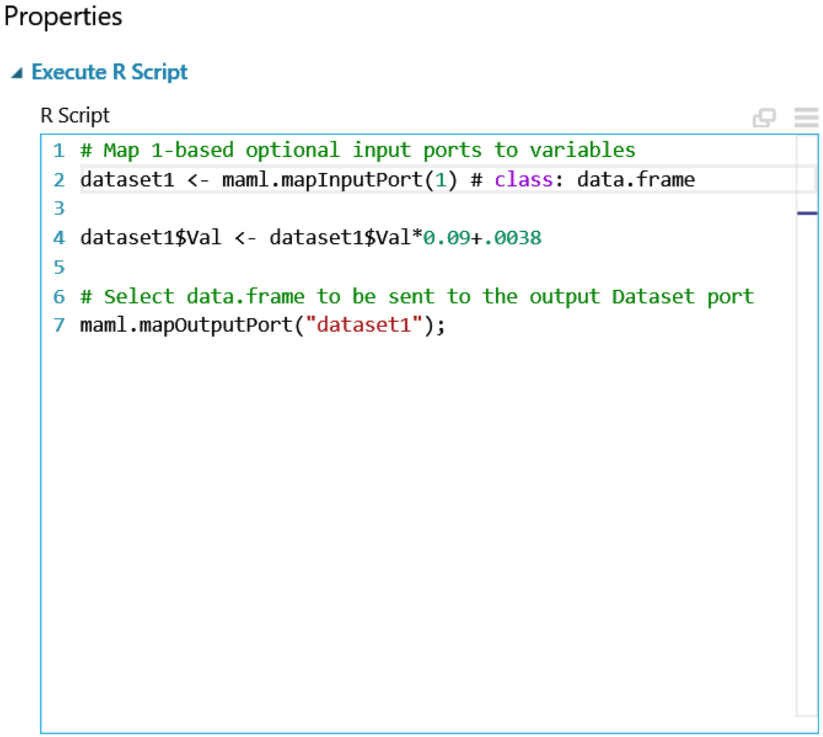
Language ✓ R

Cluster customer-analysis (270 GB, Run

Azure ML

- Azure Machine Learning
  - R Integration

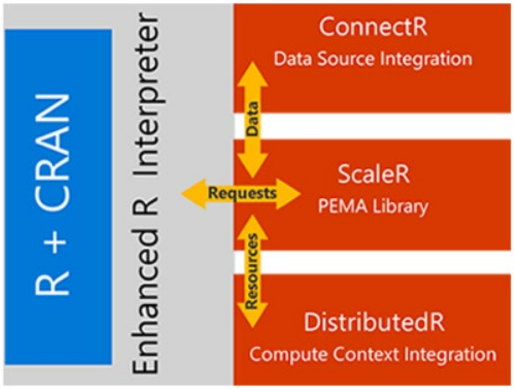




```r
# Map 1-based optional input ports to variables
dataset1 <- maml.mapInputPort(1) # class: data.frame

dataset1$Val <- dataset1$Val*0.09+.0038

# Select data.frame to be sent to the output Dataset port
maml.mapOutputPort("dataset1");
```

MS Machine Learning Services

- Enterprise Class R, Python and Java (2019)
- Built on Revolution Analytics acquistion
- SQL Server 2016 R Support via R Server
  - https://www.microsoft.com/en-us/server-cloud/products/r-server/



Source: Microsoft Website (URL above)

SQL 2016+ and R

- Leverages the MS R Server
- https://docs.microsoft.com/en-us/sql/advanced-analytics/what-is-sql-server-machine-learning?view=sql-server-2017

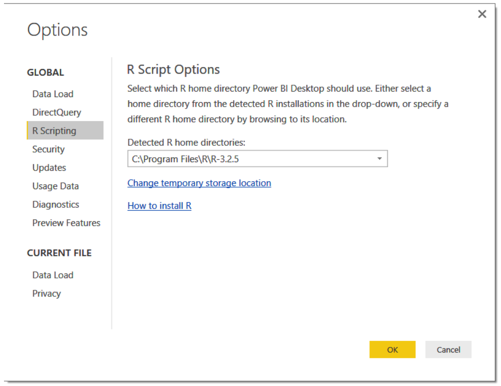
SQL 2016+ and R

- **SQL Server R Services Tutorials**
  - https://msdn.microsoft.com/en-US/library/mt591993.aspx
- DEMO - iris-sepal-example.sql
  - **sp_execute_external_script (Transact-SQL)**
  - https://msdn.microsoft.com/en-us/library/mt604368.aspx

```
sp_execute_external_script
    @language = N'language' ,
    @script = N'script',
    @input_data_1 = ] 'input_data_1'
    [ , @input_data_1_name = ] N'input_data_1_name' ]
    [ , @output_data_1_name = 'output_data_1_name' ]
    [ WITH <execute_option> [ ,...n ] ]
[;]
```

Power BI

- **Running R Scripts in Power BI Desktop**
  - https://powerbi.microsoft.com/en-us/documentation/powerbi-desktop-r-scripts/
  - https://powerbi.microsoft.com/en-us/blog/announcing-preview-of-r-visuals-in-power-bi-desktop/
- **Demo – mtcars.pbix**



Options

GLOBAL
- Data Load
- DirectQuery
- R Scripting
- Security
- Updates
- Usage Data
- Diagnostics
- Preview Features

CURRENT FILE
- Data Load
- Privacy

R Script Options

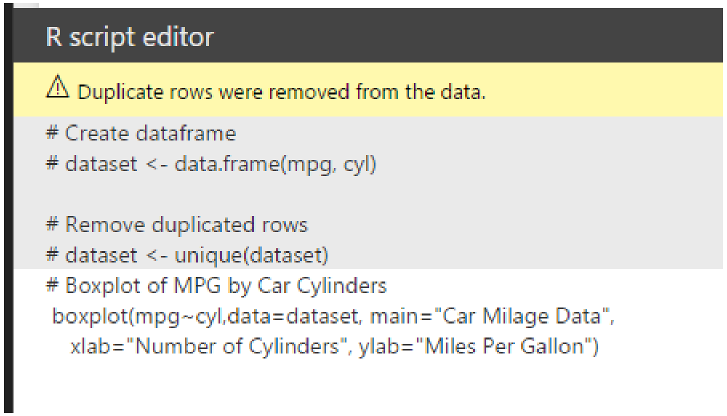
Select which R home directory Power BI Desktop should use. Either select a home directory from the detected R installations in the drop-down, or specify a different R home directory by browsing to its location.

Detected R home directories: C:\Program Files\R\R-3.2.5

Change temporary storage location

How to install R

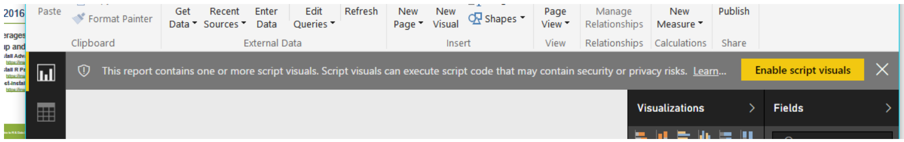
Options Needed



R script editor

⚠ Duplicate rows were removed from the data.

```
# Create dataframe
# dataset <- data.frame(mpg, cyl)

# Remove duplicated rows
# dataset <- unique(dataset)
# Boxplot of MPG by Car Cylinders
 boxplot(mpg~cyl,data=dataset, main="Car Milage Data",
   xlab="Number of Cylinders", ylab="Miles Per Gallon")
```



This report contains one or more script visuals. Script visuals can execute script code that may contain security or privacy risks. Learn...

Resources

- UCLA idre
  - http://statistics.ats.ucla.edu/stat/r/
- R-Bloggers (sign up for daily email)
  - http://www.r-bloggers.com/
- Quick-R
  - http://www.statmethods.net/
  - R in Action (book to go with website)
- Hadley Wickham
  - http://hadley.nz/

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Questions?

Thank you for attending!

- @STATCowboy
- http://STATCowboy.com
- https://github.com/STATCowboy/CodeLIkePirate
  - Download Demos and PPT