
# Utilizing  in IR

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# Agenda

- What is R?
- Where to get R?
- Getting Started
- Loading Data
- Describing Data
- Plotting Data
- T-Tests
- ANOVA
- Regression Modeling
- Test for Proportion Differ.
- Resources

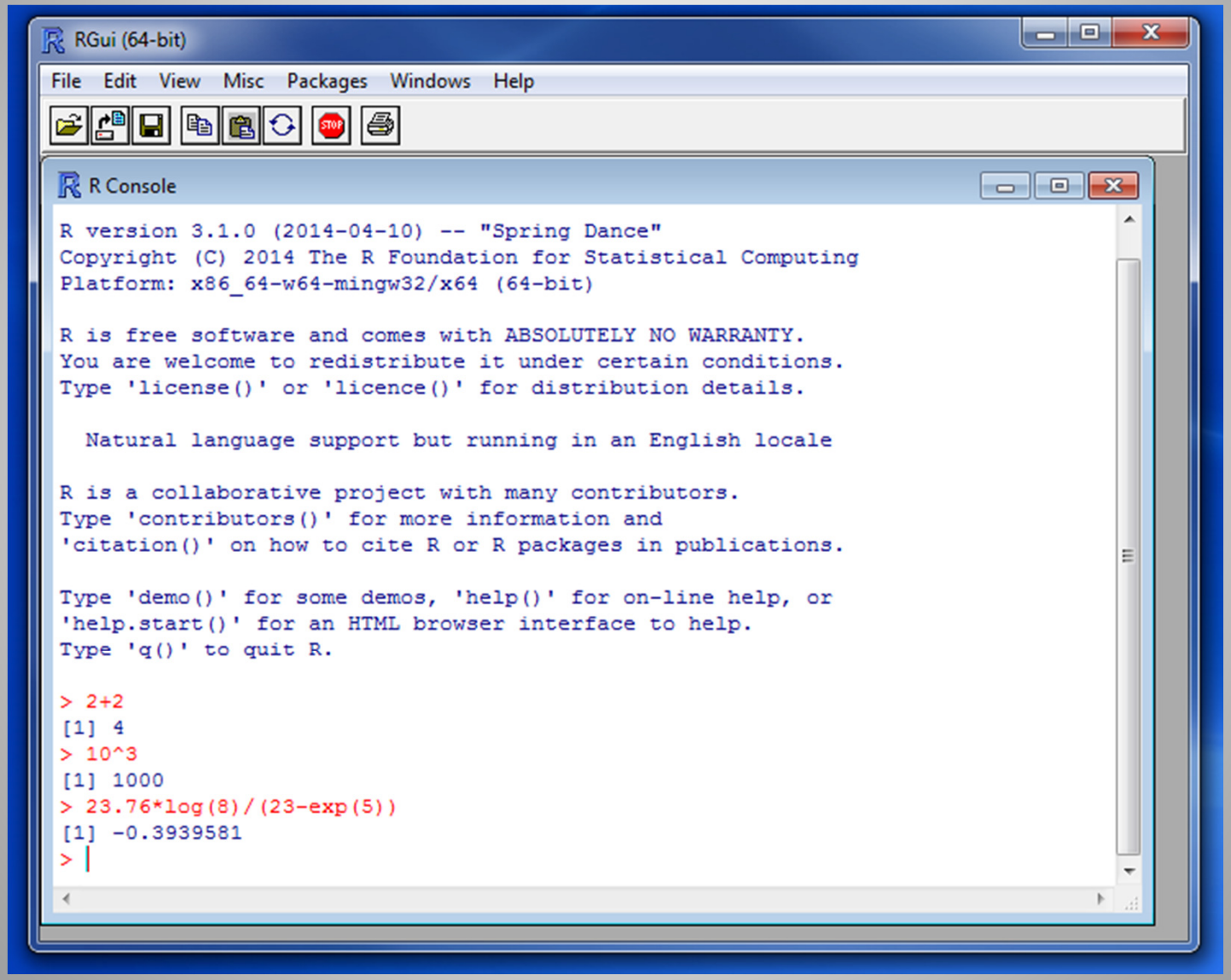
# What is R?

- R is a FREE language and environment for statistical computing and graphics
- Available for multiple platforms (i.e. Windows, Mac, Linux)
- More than 2,000 packages available to broaden your capabilities

# Where to get R?

- www.r-project.org
- Also consider downloading:
  - R Studio (http://www.rstudio.com)
  - Includes a console, syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management.
  - R Commander: (http://www.rcommander.com)
  - Enables access a selection of commonly-used R commands using a simple interface that should be familiar to most computer users.

# Getting Started: Calculator



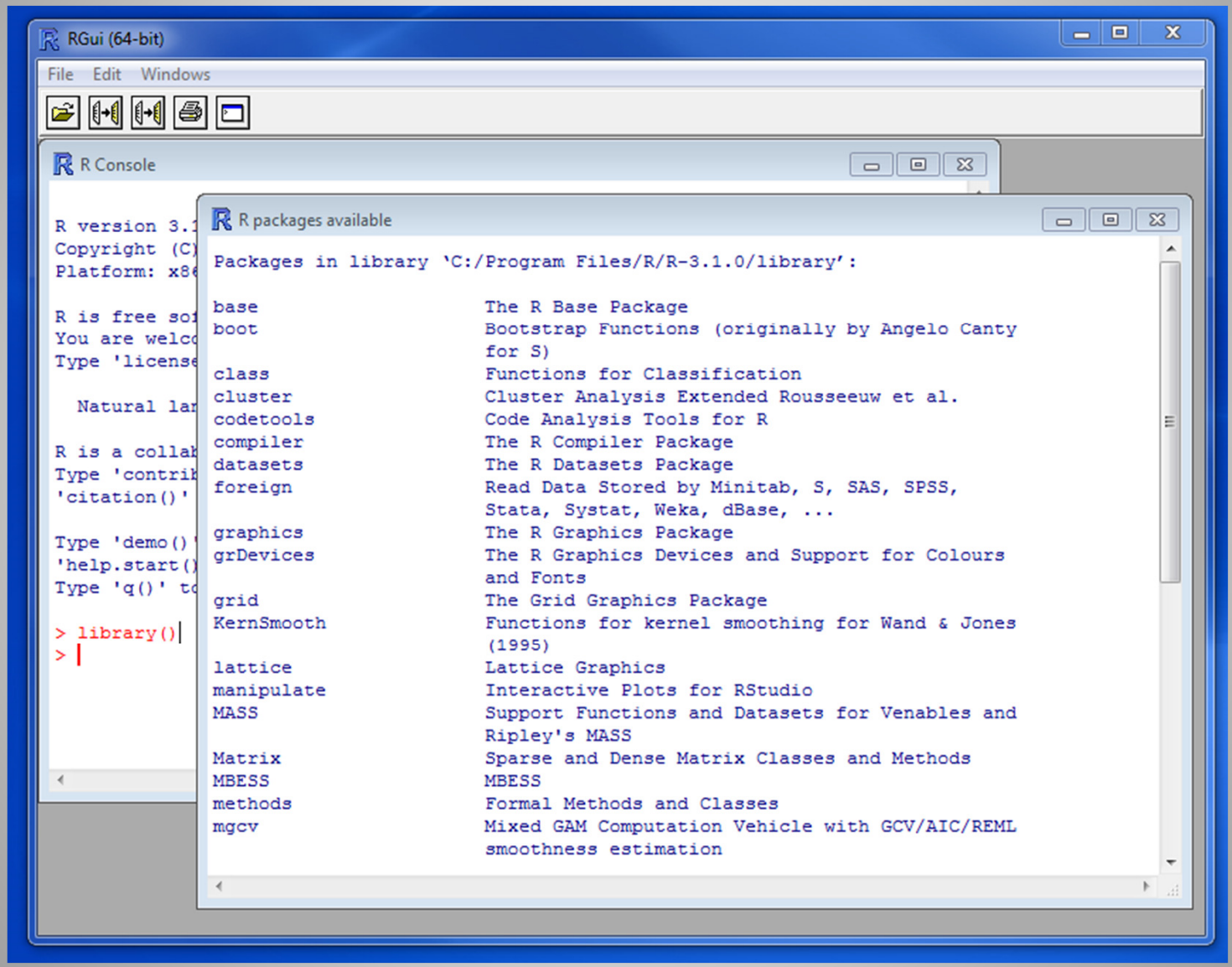
# Getting Started: Useful Packages for IR

| Package | Description |
|---|---|
| foreign | Contains functions to read SPSS files |
| gdata | Contains functions to read Excel spreadsheets |
| ggplot2 | Package for creating nice looking graphics http://had.co.nz/ggplot2 |
| psych | Package contains lots of useful functions for descriptive statistics |
| rcmdr | R Commander is a graphical interface for R |
| RMySQL | Package for interfacing with MySQL databases |
| RODBC | Package contains functions to read and write data from ODBC databases (e.g. Oracle, MS SQLServer) |
| RSQLite | Package for the creation and editing of SQLite databases embedded within R |
| stats | Package contains functions for statistical calculations and random number generation |

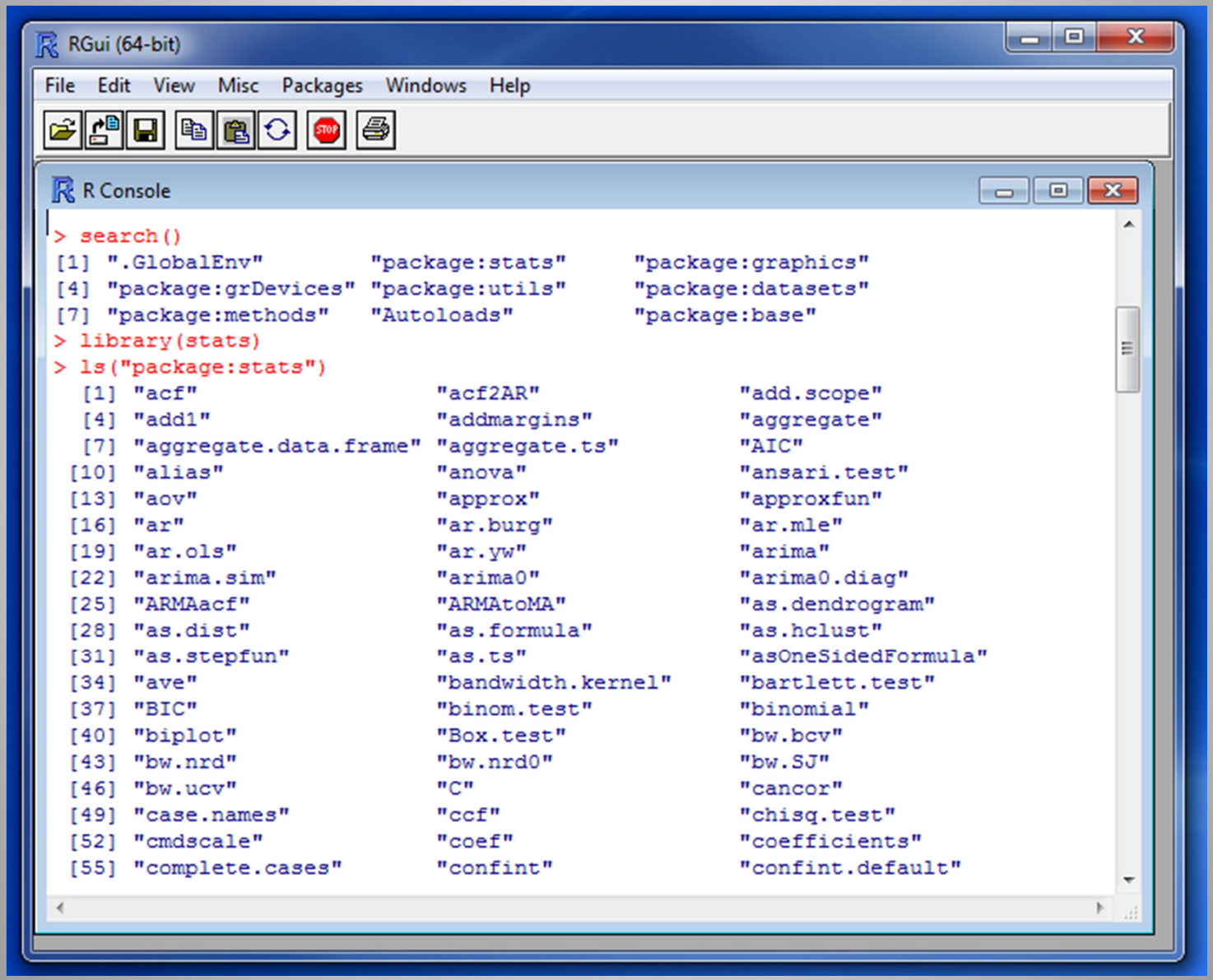
# Getting Started: Basic Commands

- search() : Returns all packages that are currently attached to the system
- library(package_name) : Loads the requested package
- ls(package_name) : Returns a list of functions in a particular package
- ?function_name : loads the help file associated with a function

# Getting Started: Loading Packages



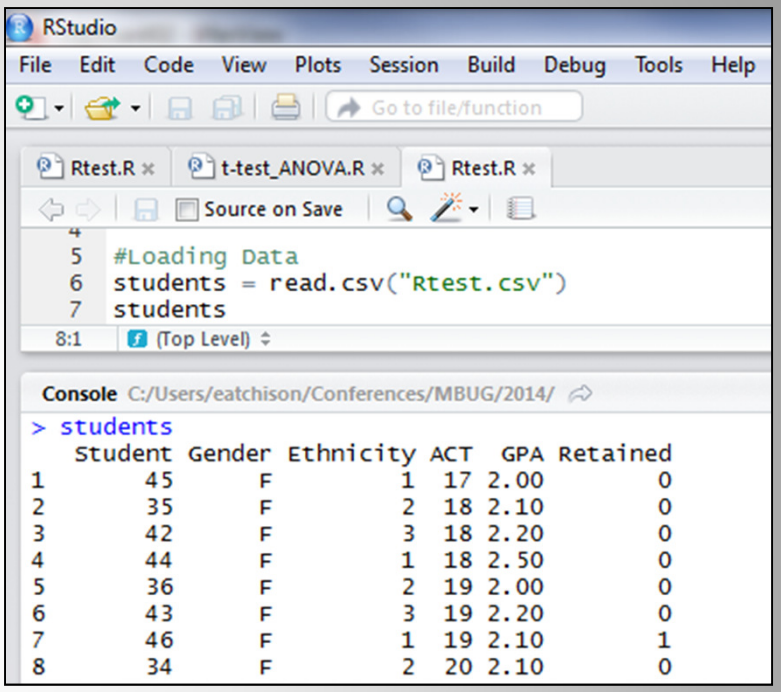
# Getting Started: Loading Packages



# Loading Data: CSV Files

> students = read.csv("Rtest.csv")

> students




> names(students)

> nrow(students)

```
> names(students)
[1] "Student"   "Gender"    "Ethnicity" "ACT"       "GPA"       "Retained"
> nrow(students)
[1] 50
```

> str(students)

```
> str(students)
'data.frame': 50 obs. of  4 variables:
 $ Student: int  1 2 3 4 5 6 7 8 9 10 ...
 $ Gender : Factor w/ 2 levels "F","M": 2 2
 $ ACT    : int  16 16 17 18 19 19 21 23 24
 $ GPA    : num  1.8 1.9 2 2.2 2.5 2.8 3.2
```

# Loading Data: Sampling

> sample.int(50,size=10)

> sample.int(30,size=10)

> sample.int(20,size=10)

```
> #Sampling from Data File
> sample.int(50,size=10)
 [1] 33 16 46 36 21 19 14 38 49 22
> sample.int(30,size=10)
 [1]  7 11 13 21 14  1 22 25 24 23
> sample.int(20,size=10)
 [1] 19  4  9 15  3 20 14  2 10  8
```

# Describing Data: Frequency Tables

One-Way Frequency Table:

> table(students$gender)

> table(students$ACT)

```
> table(students$Gender)

 F  M
25 25
> table(students$ACT)

16 17 18 19 20 21 22 23 24 25 26 27 28 30 31 32
 3  3  7  7  6  2  2  2  3  4  1  2  4  2  1  1
```

Two-way Frequency Table:

> table1 = table(students$gender,students$ACT)

```
> table(students$Gender,students$ACT)

   16 17 18 19 20 21 22 23 24 25 26 27 28 30 31 32
 F  0  1  3  3  4  0  1  1  1  3  1  1  3  1  1  1
 M  3  2  4  4  2  2  1  1  2  1  0  1  1  1  0  0
```

# Describing Data: Proportions

Cell percentages: prop.table(table1)

Row percentages: prop.table(table1, 1)

Column percentages: prop.table(table1, 2)

```
> prop.table(table1)

     16   17   18   19   20   21   22   23   24   25   26   27   28   30   31   32
F 0.00 0.02 0.06 0.06 0.08 0.00 0.02 0.02 0.02 0.06 0.02 0.02 0.06 0.02 0.02 0.02
M 0.06 0.04 0.08 0.08 0.04 0.04 0.02 0.02 0.04 0.02 0.00 0.02 0.02 0.02 0.00 0.00
> prop.table(table1,1)

     16   17   18   19   20   21   22   23   24   25   26   27   28   30   31   32
F 0.00 0.04 0.12 0.12 0.16 0.00 0.04 0.04 0.04 0.12 0.04 0.04 0.12 0.04 0.04 0.04
M 0.12 0.08 0.16 0.16 0.08 0.08 0.04 0.04 0.08 0.04 0.00 0.04 0.04 0.04 0.00 0.00
> prop.table(table1,2)

          16        17        18        19        20        21        22        23
F 0.0000000 0.3333333 0.4285714 0.4285714 0.6666667 0.0000000 0.5000000 0.5000000
M 1.0000000 0.6666667 0.5714286 0.5714286 0.3333333 1.0000000 0.5000000 0.5000000
```

# Describing Data: Mean & SD

> mean(students$ACT, na.rm=TRUE)

> sd(students$ACT, na.rm=TRUE)

```
> mean(students$ACT, na.rm=TRUE)
[1] 21.94
> sd(students$ACT, na.rm=TRUE)
[1] 4.409683
```

> summary(students$ACT)

```
> summary(students$ACT)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  16.00   18.25   20.00   21.94   25.00   32.00
```

# Describing Data: Descriptives

- Using the "psych" package provides the *describe* and *describeBy* functions

> describe(students$ACT)

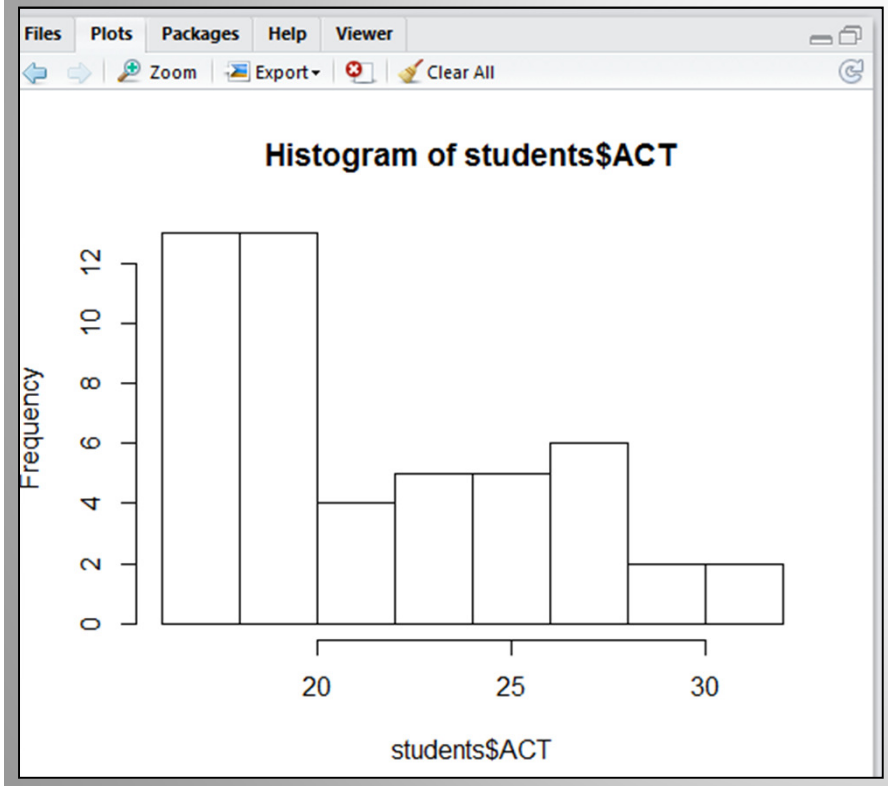
```
> describe(students$ACT)
  vars  n  mean   sd median trimmed  mad min max range skew kurtosis   se
1    1 50 21.94 4.41     20    21.6 4.45  16  32    16 0.59    -0.85 0.62
```

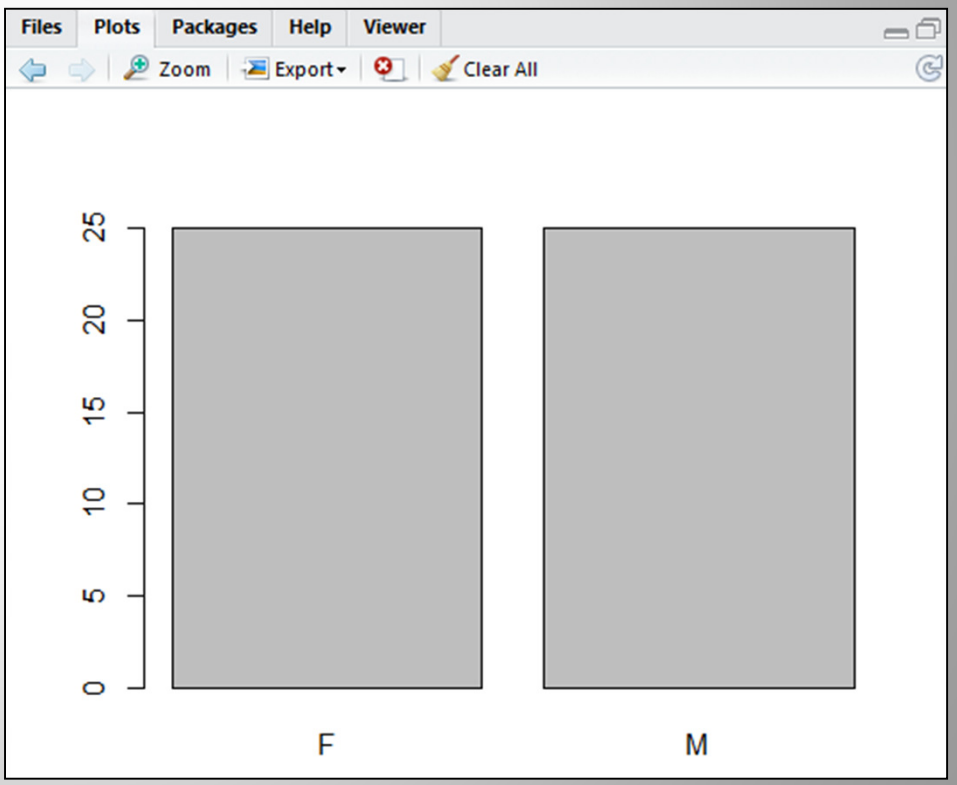
> describeBy(students$ACT, students$Gender)

```
> describeBy(students$ACT, students$Gender)
group: F
  vars  n  mean   sd median trimmed  mad min max range skew kurtosis   se
1    1 25 23.28 4.57     23   23.05 5.93  17  32    15 0.32     -1.3 0.91
------------------------------------------------------------------------
group: M
  vars  n mean   sd median trimmed  mad min max range skew kurtosis   se
1    1 25 20.6 3.88     19   20.24 2.97  16  30    14 0.82    -0.35 0.78
```

# Plotting Data: Bar Charts

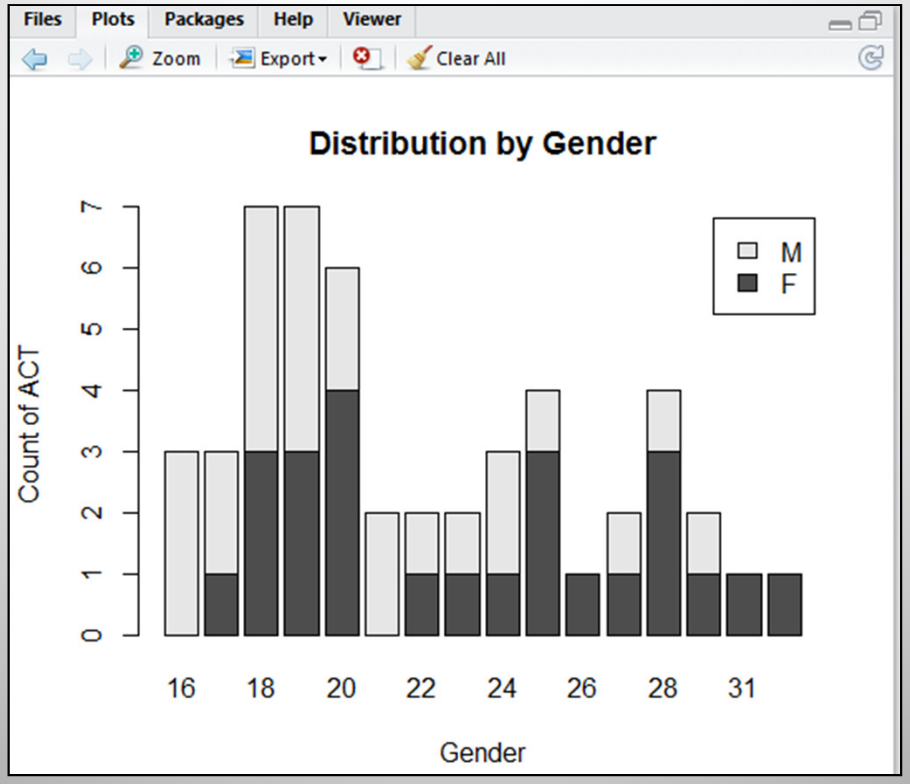
```
> hist(students$ACT)
> barplot(table(students$Gender))
```



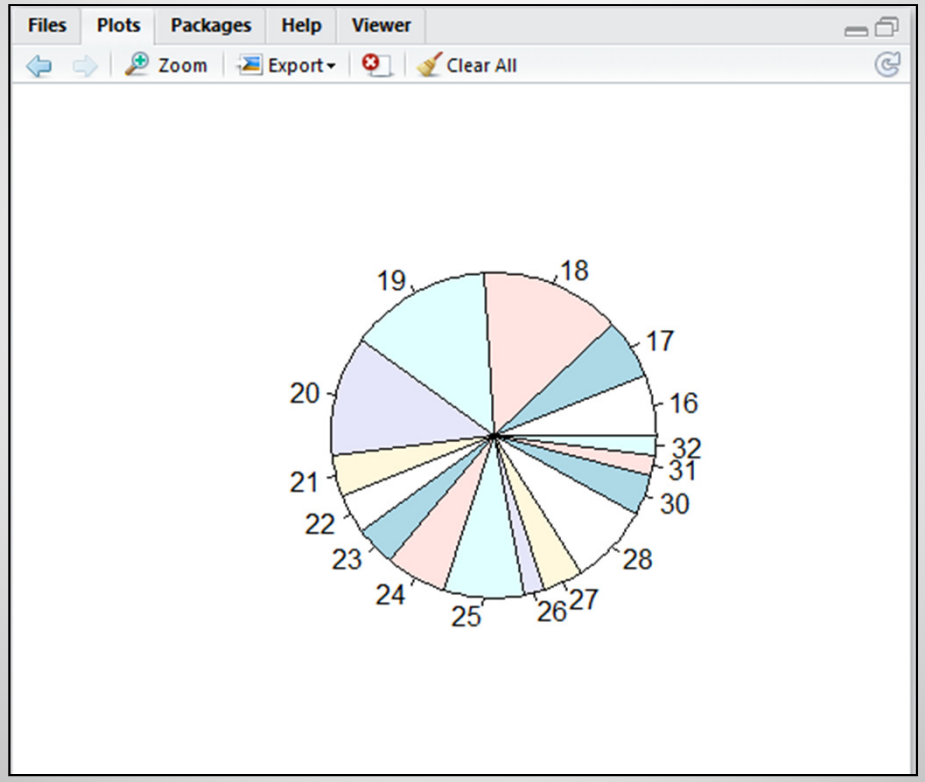
# Plotting Data: Stacked Bar Charts

```
> barplot(table1, main='Distribution by Gender',
        xlab='Gender', ylab='Count of ACT',
        legend=rownames(table1))
```



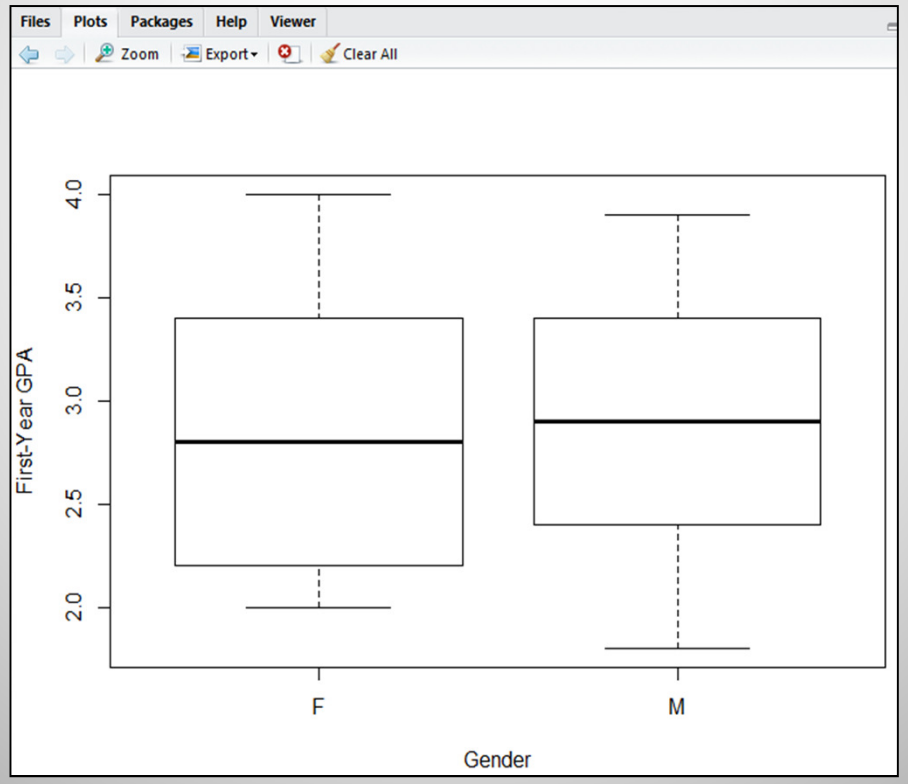
# Plotting Data: Pie Charts

```
> pie(table(students$ACT))
```



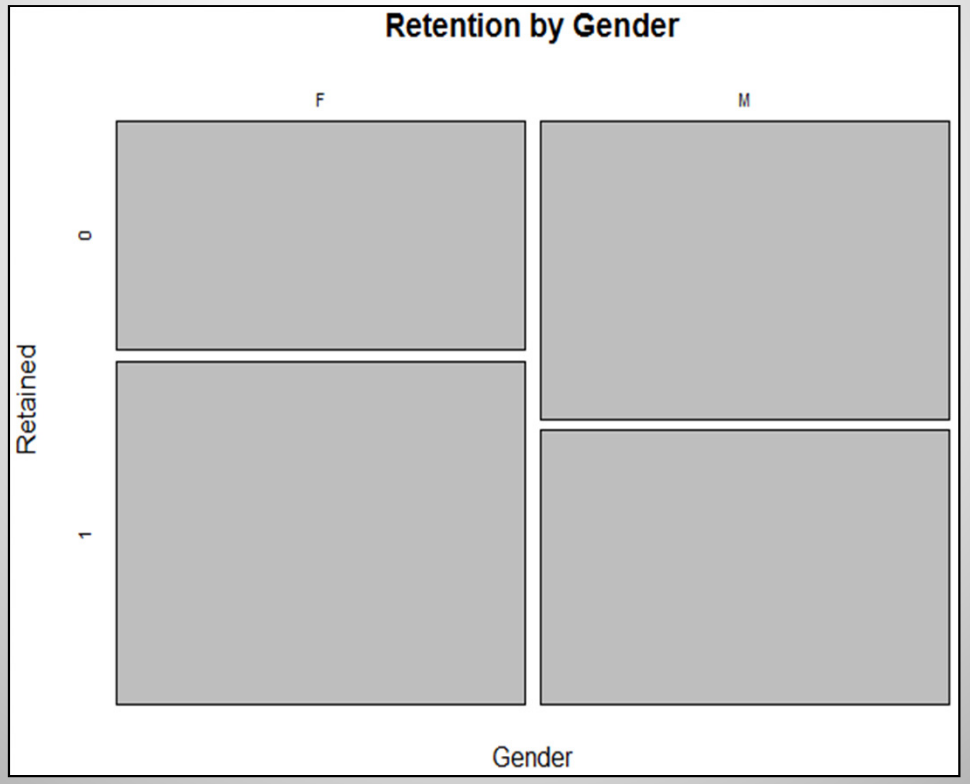
# Plotting Data: Box Plots

```
> boxplot(GPA~Gender,data=students, xlab="Gender",
        ylab="First-Year GPA")
```



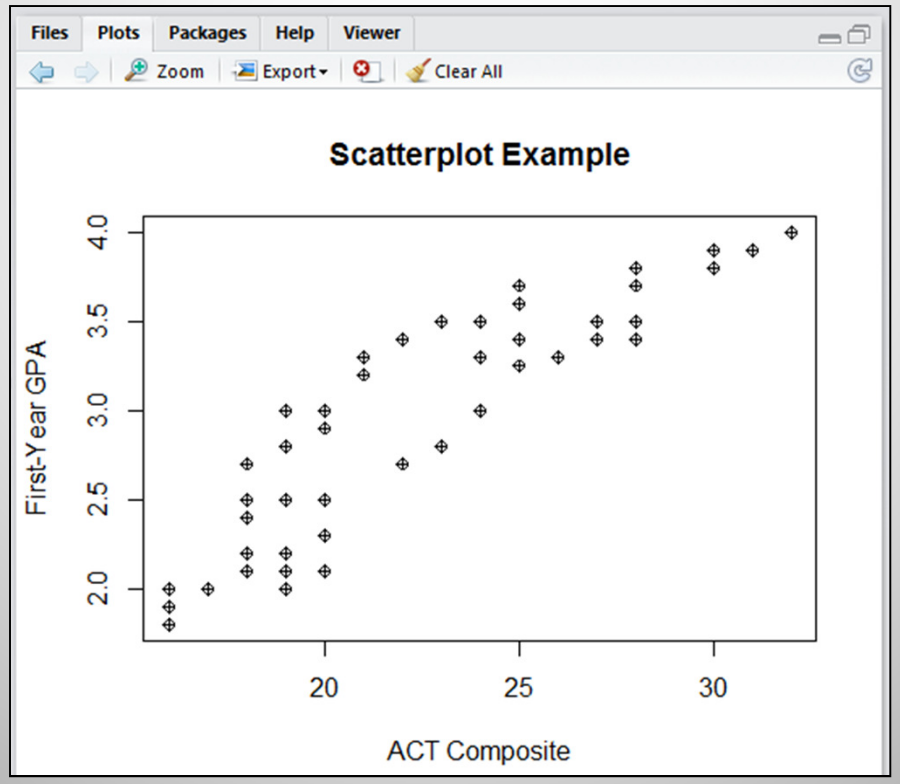
# Plotting Data: Mosaic Plots

```
> mosaicplot(~Gender + Retained, data=students,
        main="Retention by Gender")
```



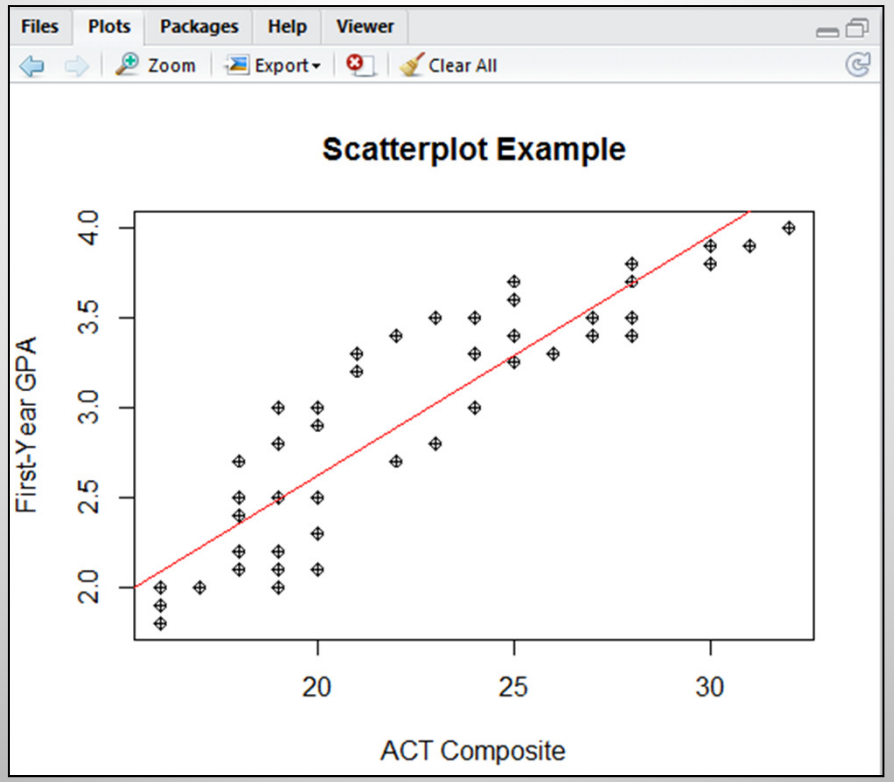
# Plotting Data: Scatter Plots

```
> plot(ACT, GPA, main="Scatterplot Example", xlab="ACT Composite", ylab="First-Year GPA", pch=10)
```



# Plotting Data: Adding Fit Lines

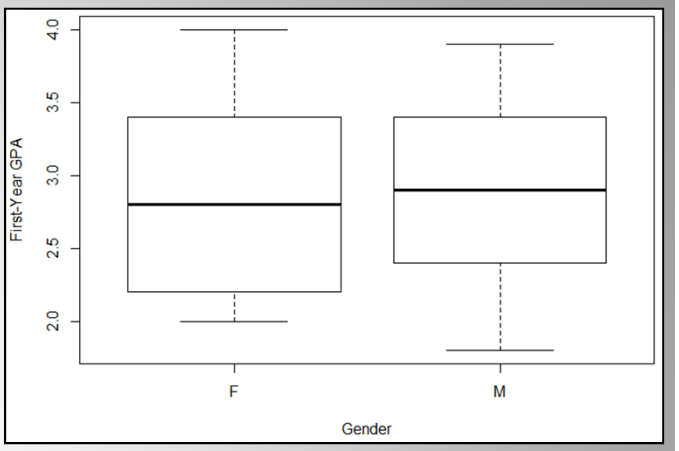
```
> plot(ACT, GPA, main="Scatterplot Example", xlab="ACT
      Composite", ylab="First-Year GPA", pch=10)
> abline(lm(ACT~GPA), col="red")
```



# T-Tests: Independent & Paired Samples

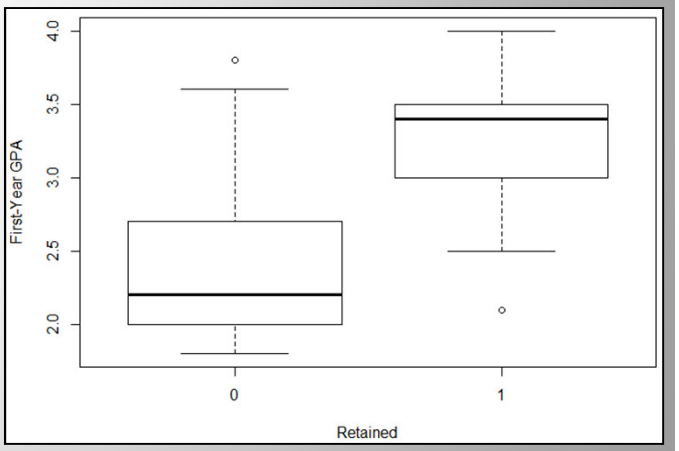
## > t.test(GPA~Gender)

```
> t.test(GPA~Gender)

 Welch Two Sample t-test

data:  GPA by Gender
t = 0.1393, df = 47.885, p-value = 0.8898
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3492603  0.4012603
sample estimates:
mean in group 1 mean in group 2
          2.890           2.864
```




## > t.test(GPA~Retained)

```
> t.test(GPA~Retained)

 Welch Two Sample t-test

data:  GPA by Retained
t = -6.0801, df = 45.191, p-value = 2.338e-07
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.1437569 -0.5746006
sample estimates:
mean in group 0 mean in group 1
       2.413043        3.272222
```



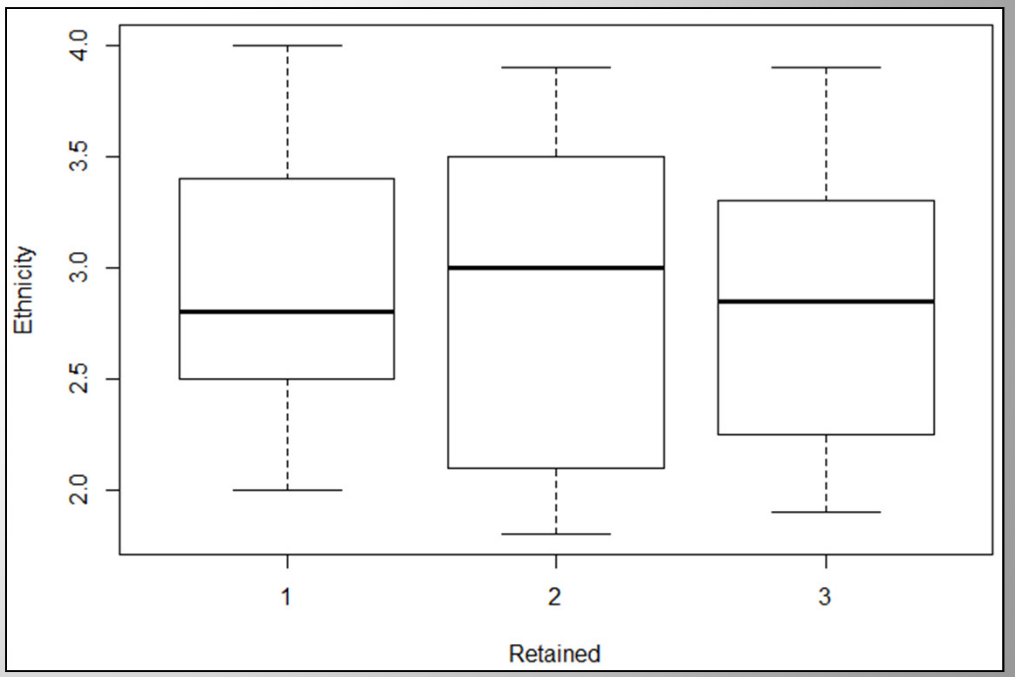

## Paired Samples T-Test:

## > t.test(pretest,posttest,paired=TRUE)

# ANOVA

```
> Ex_anova <- aov(GPA~Ethnicity, students)
> anova(Ex_anova)
> boxplot(GPA~Ethnicity,data=students, xlab="Retained",
        ylab="Ethnicity")
```

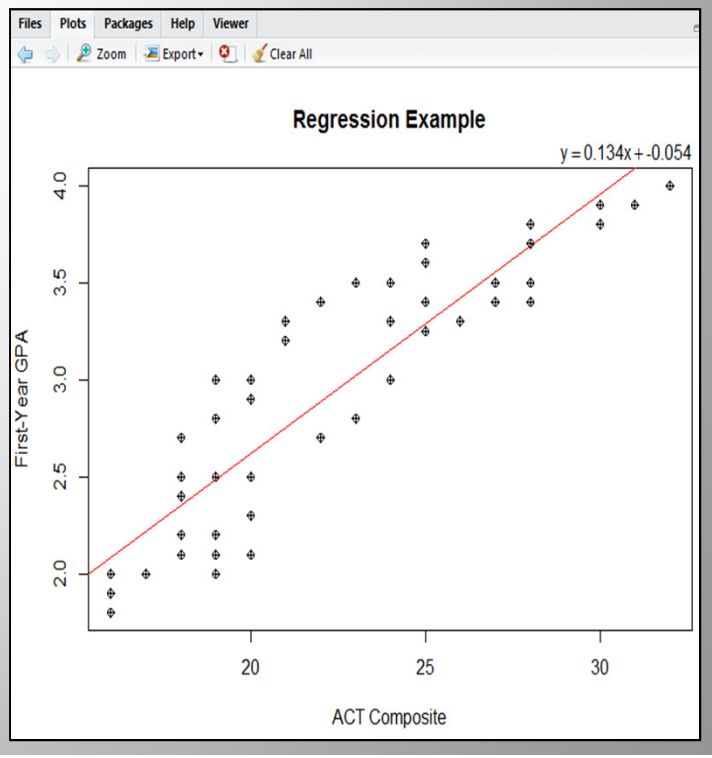
```
Analysis of Variance Table

Response: GPA
           Df  Sum Sq Mean Sq F value Pr(>F)
Ethnicity   1  0.0572 0.05716  0.1316 0.7184
Residuals  48 20.8489 0.43435
>
```



# Regression Modeling: Linear

```
> mlr <- lm(GPA~ACT, students)
> summary(mlr)
> lm_coef<-round(coef(mlr),3)
> mtext(bquote(y==.(lm_coef[2])*x + .(lm_coef[1])),
        adj=1,pad    j=0)
```

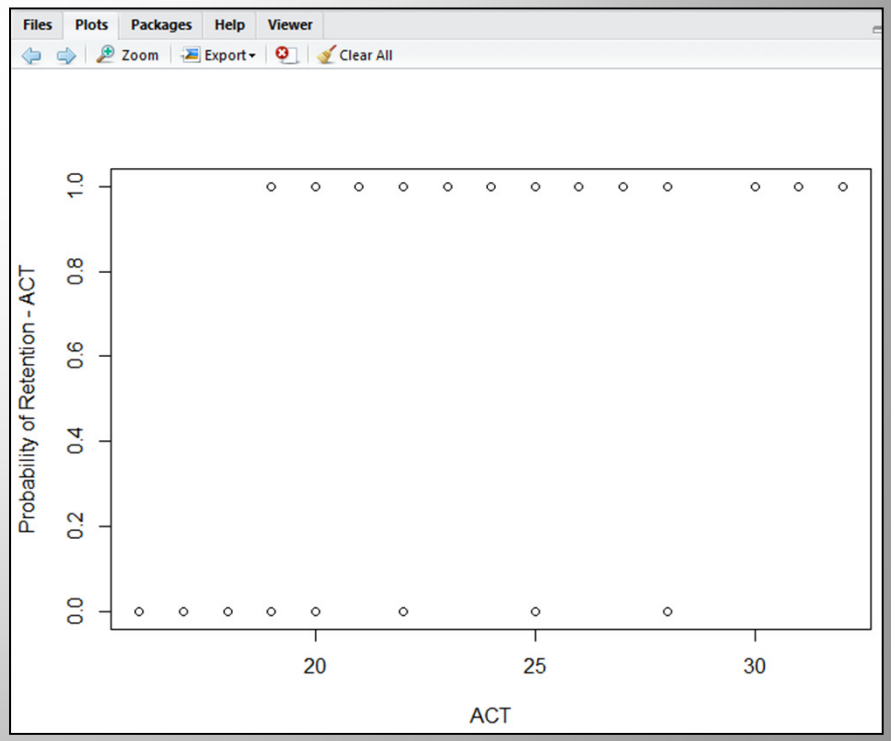
```
> mlr <- lm(GPA~ACT, students)
> summary(mlr)

Call:
lm(formula = GPA ~ ACT, data = students)

Residuals:
    Min      1Q  Median      3Q     Max
-0.5179 -0.2096 -0.1007  0.2489  0.5486

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.053821   0.206663   -0.26    0.796
ACT          0.133583   0.009238   14.46   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2852 on 48 degrees of freedom
Multiple R-squared:  0.8133, Adjusted R-squared:  0.8094
F-statistic: 209.1 on 1 and 48 DF,  p-value: < 2.2e-16
```



# Regression Modeling: Logistic

```
> logreg <- glm(cbind(Retained)~ +ACT, family=binomial)
> summary(logreg)
> plot(ACT,Retained,xlab="ACT",ylab="Probability of
      Retention - ACT")
```

```
> summary(logreg)

Call:
glm(formula = cbind(Retained) ~ +ACT, family = binomial)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.6486  -0.6719   0.1362   0.6241   1.5703

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -10.1044     2.8311  -3.569 0.000358 ***
ACT           0.4851     0.1374   3.530 0.000415 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 68.994  on 49  degrees of freedom
Residual deviance: 43.862  on 48  degrees of freedom
AIC: 47.862

Number of Fisher Scoring iterations: 5
```



# Test for Proportion Differences

| | 2005 | | 2006 | |
|---|---|---|---|---|
| ***Retention and Graduation Rates*** | *#* | *%* | *#* | *%* |
| ***All first-time entering freshmen*** | ***393*** | ***100%*** | ***463*** | ***100%*** |
| ***Average ACT Score*** | ***20.3*** | | ***20.3*** | |
| 2nd Year - Returned | 249 | 63% | 281 | 61% |
| 3rd Year - Returned | 187 | 48% | 220 | 48% |
| Degrees thru 3 years* | 4 | 1% | 7 | 2% |
| 4th Year - Returned | 156 | 40% | 193 | 42% |
| Degrees thru 4 years* | 67 | 17% | 84 | 18% |
| 5th Year - Returned | 84 | 21% | 111 | 24% |
| Degrees thru 5 years* | 108 | 27% | 153 | 33% |
| 6th Year - Returned | 40 | 10% | 37 | 8% |
| Degrees thru 6 years* | 127 | 32% | 169 | 37% |

```
> prop.test(x=c(127,169), n=c(393,463))
```

```
2-sample test for equality of prop. with continuity correction
data: c(127, 169) out of c(393, 463)
X-squared = 1.4663, df = 1, p-value = 0.2259
```

# Resources

- http://cran.r-project.org/doc/manuals/R-intro.html
- http://www.statmethods.net/interface/help.html
- http://www.r-tutor.com/
- http://www.r-bloggers.com/
- http://jason.bryer.org/
- http://stackoverflow.com/questions/tagged/r
- http://oit.utk.edu/scc/RforSAS&SPSSusers.pdf
- http://cran.r-project.org/doc/contrib/Short-refcard.pdf
- http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

# Contact Information

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