COMP320

RESEARCH PRACTICE

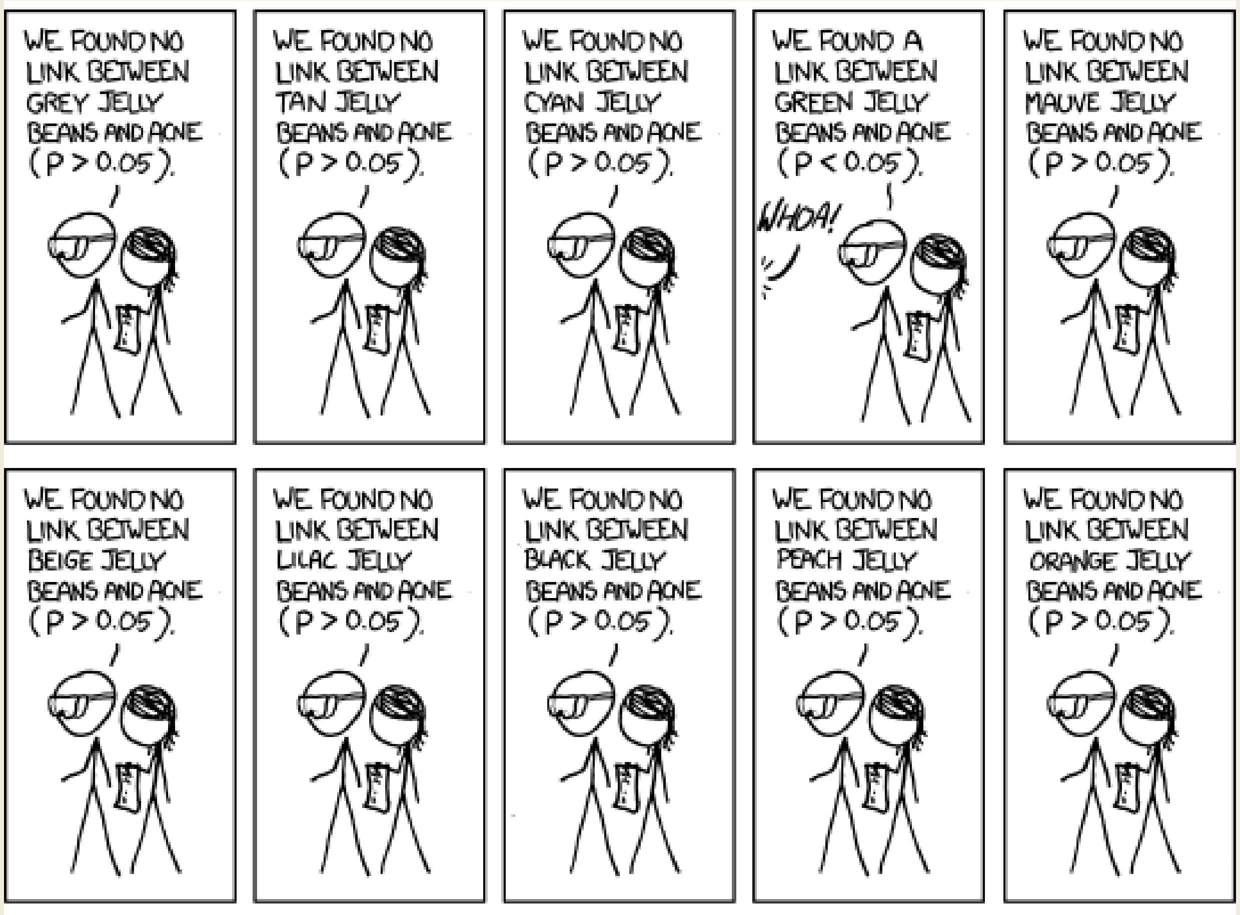
Statistical Data Analysis I

False Discovery & Replicability

When we make claims as researchers, we are often subject to error and so replication is important:

		Reality	
		True	False
Decision	Accept Claim	Good Decision	**Type-1 Error (“False Positive”)**
	Reject Claim	**Type-2 Error (“False Negative”)**	Good Decision

False Discovery & Replicability



False Discovery & Replicability

An alternative to replication is to use a larger dataset and to assess multiple hypotheses with reasonable adjustment. For example:

- **Benjamini Hochberg**
  Used in multiple hypothesis testing on the same dataset

- **Bonferroni**
  Used for multiple group comparisons using the same dataset

Common Statistical Tests

Use in your Dissertations

Research Questions

- Researchers often want to know if there is a significant **relationship** between two variables
  - *How strong is the relationship between **login queue waiting time** and **player satisfaction**?*
  - *Does an increase in **in-game prompts** correspond to an increased number of **in-game micro transactions**?*
  - *Is there a relationship between employees' **levels of stress** and **talent retention**?*
  - *Does **age** predict **play-style**?*

Research Questions

- Or if there is a **difference** between one or more scores/conditions/groups

  - *Is **game-0** selling more copies than **game-1** in the UK?*
  - *Does **working in pairs** improve programming performance?*
  - *Has allowing programmers to **work from home** decrease game development **productivity**?*
  - *Has the **new character** caused a significant disruption to **game balance** in terms of win/loss ratio?*
  - *Is there a difference in the way **male and female players** interact with costume-orientated micro transactions in an MMORPG?*

GAMES ACADEMY | FALMOUTH UNIVERSITY

Statistical tests: Why we need them?

- Does **marital status** affect **play**?

- *'In a scale from 1 to 8, how often do you play games?'*
- Great! I found a difference!!

life sat

marital status	Mean	N	Std. Deviation
single	5.58	26	2.318
married/defacto	5.19	86	2.384
divorced	5.38	8	2.200
widowed	7.67	3	3.215
Total	5.34	123	2.381

- How confident are you? Is it an accident (due to chance)?
- We need to have a statistical test to make the inference!

Choosing the right test

- If you browse any introductory statistics text book you'll find a bewildering array of different statistical tests
- Each has:
  - a specific purpose (i.e. exploring relationships, comparing groups)
  - Assumptions and data requirements (categorical, ordinal or continuous data, normal distribution)
- Most of the well known tests are very easy to run in R
- However, it is critically important to be able to
  - Select the most appropriate test given your research question
  - Understand conceptually what the test is computing
  - Effectively interpret the output

Step 1: What is your question?

- Remember, when conducting research it is important to be clear about the questions you are trying to answer…ideally before you begin data collection

- The questions...

    - *Does an increase in* ***in-game prompts*** *correspond to an increased number of* ***in-game micro transactions****?*
    - *Is there a relationship between employees’* ***levels of stress*** *and* ***talent retention****?*

- ...require quite different statistical tests to questions like:

    - *Is* ***game-0*** *selling more copies than* ***game-1*** *in the UK?*
    - *Has allowing programmers to* ***work from home*** *decrease game development* ***productivity****?*

Step 2: Select your data

- Which variables will you be using?
- Which is the **independent variable (IV)**?
  - The variable that is believed to affect the dependent variable
  - What you control/manipulate
- Which is the **dependent variable (DV)**?
  - The observation that is believed to be affected by the IV
  - What you measure (aka outcome variable)
- Identify the IV and DV in the following questions:
  - Does gender affect product ratings?
  - Does revision time affect test scores?
  - Does the website background colour influence reading speed?
  - Which type of interface results in higher user satisfaction?

Step 2: Select your data

- What is the level of measurement for each variable?
  - Categorical or continuous?
  - Examples of categorical variables?
  - Examples of continuous variables?

Step 3: Describe your data

- Descriptive statistics should be used to define the characteristics of your data (last lecture)
- For categorical variables you need to know if numbers in each group/category are balanced
  - (e.g. Reliable comparison of gender effect not possible if 25 males and only 3 females)
- For continuous variables you need to know if the distribution is normally distributed (e.g. Not skewed)

Relationships vs. Difference

- Analysing relationships:
  - **Correlation** – are continuous variables, X and Y, related?
    - Pearson’s rho for normally-distributed ratio data
    - Spearman’s rank correlation for non-normal or interval data
  - **Chi-square** – is there an association between two categorical variables.
    - Useful for inferring differences between groups on discrete measures
    - Also used for ‘goodness of fit’ tests when comparing matricies
  - **Regression** – does the ‘level’ of X predict the ‘level’ of Y?
    - OLS regression for continuous data with normally distributed residuals
    - Logistic regression used for discrete data, based on probability of belonging
    - Flexible, can re-code some nominal/ordinal data as binary values

Relationships vs. Difference

Analysing differences:

- **T-tests** - differences between two groups (e.g. experienced, inexperienced) according to some *continuous variable* (e.g. score)
- **Mann-Whitney U Test** – based on ranks, lower power but more robust and can compare two groups with non-normal data.
- **Analysis of Variance** (ANOVA) measure differences when there *are more than two groups.*
- **Kruskal-Wallis H Test** – like Mann-Whitney U, but for multiple groups.
- **Analysis of Co-variance** (ANCOVA) measure differences when there *are more than two groups and/or continuous predictors.*
  - Essentially, combines ANOVA with regression.
- **MANOVA/MANCOVA – multivariate versions** for more than one dependent variable.

Import Data Into R

Prepare for Analysis

Import Data into R

Download and examine

https://www.dropbox.com/s/6x44olpr3kwdkkh/obfuscated_data.csv?dl=1

Import Data into R

To import data from a pre-prepared CSV file, use the following command. Note: Requires the Rcpp module. Run Rstudio in admin mode to install if not available.

```
> library(readr)
> dat <- read_csv("E:/Stats/obfuscated_data.csv")
```

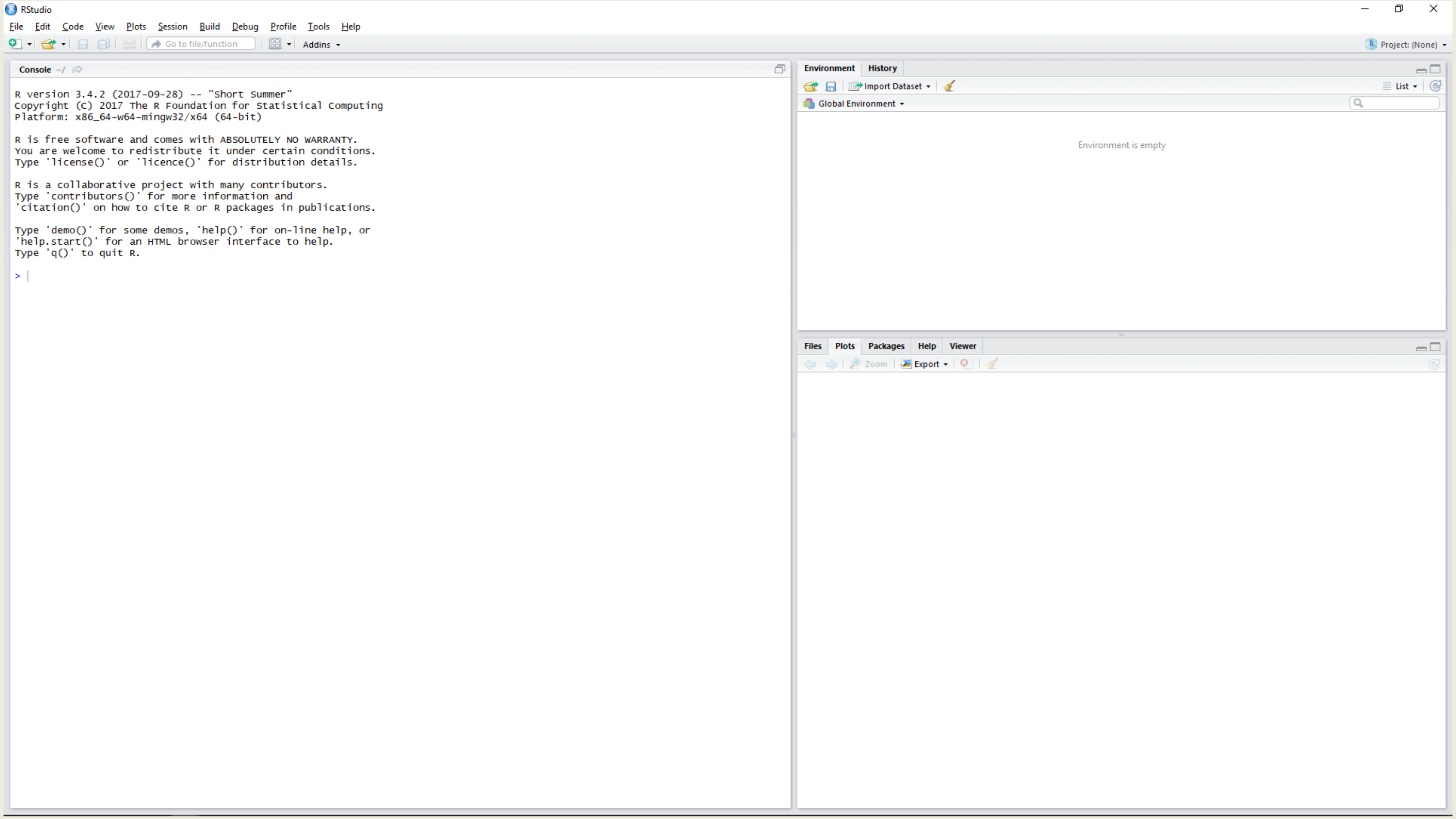
To view the data use:

```
> view(dat)
```

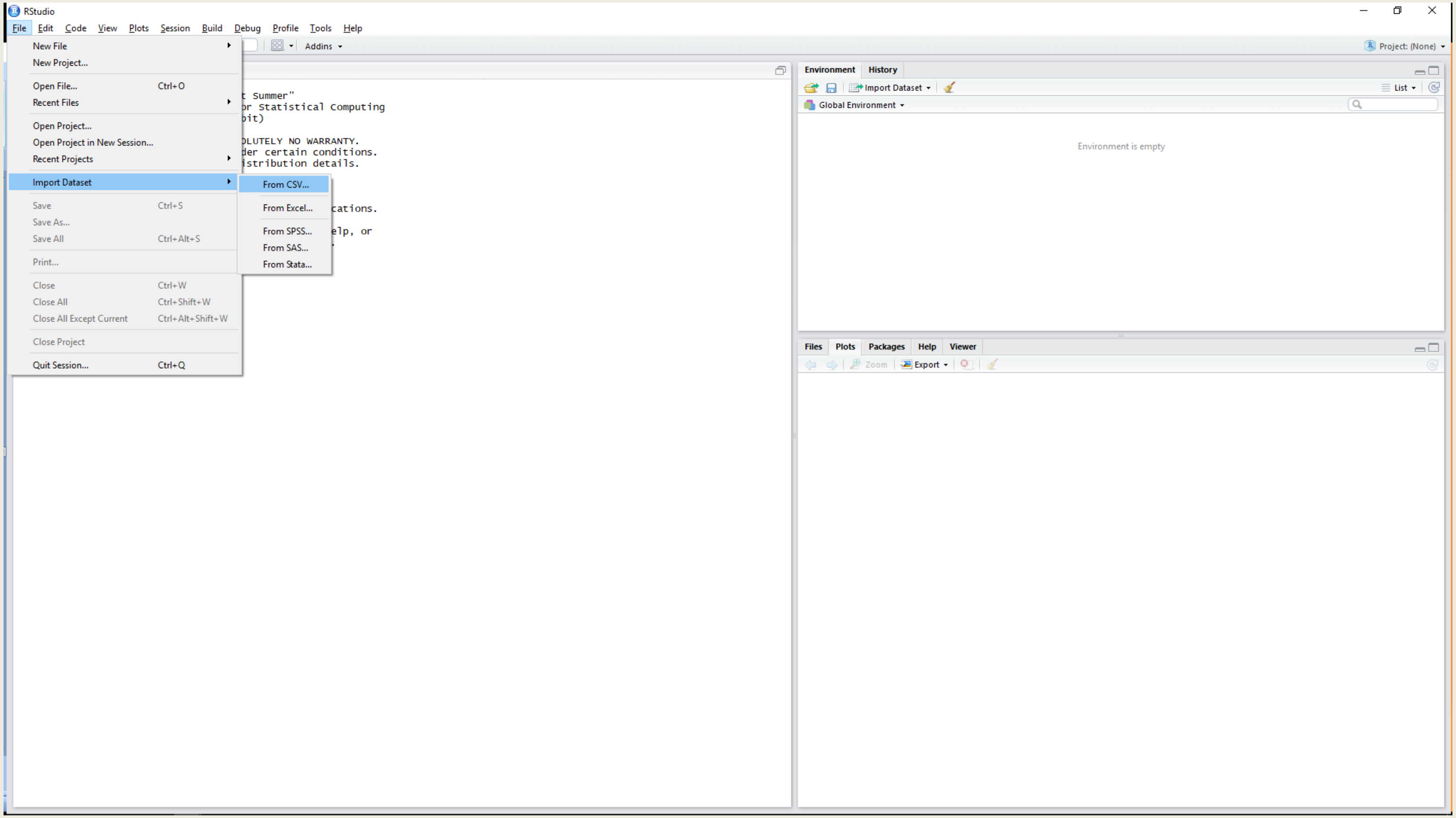
To see the descriptive statistics for all of the variables in the data use:

```
> summary(dat)
```

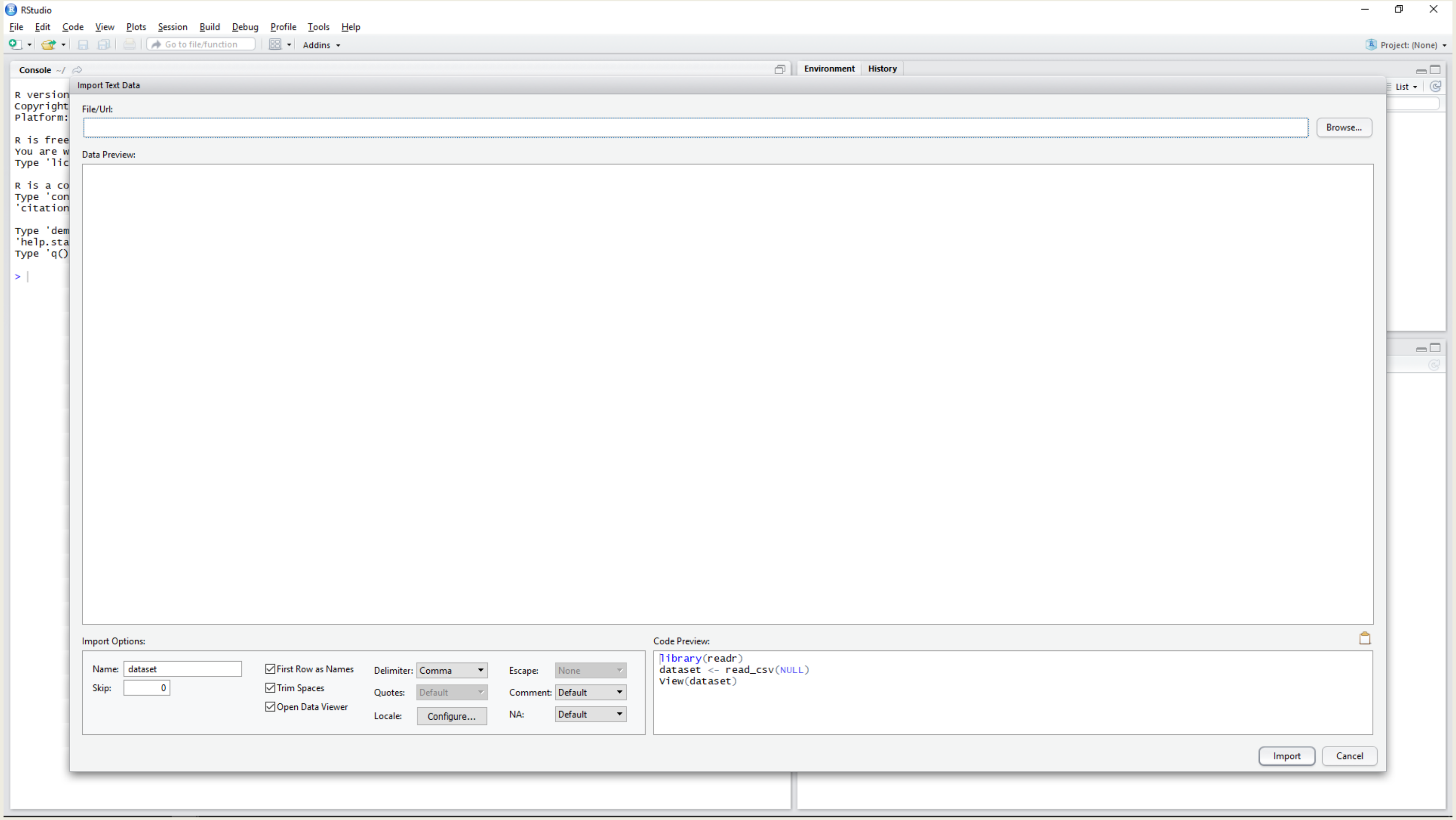
Import Data into R



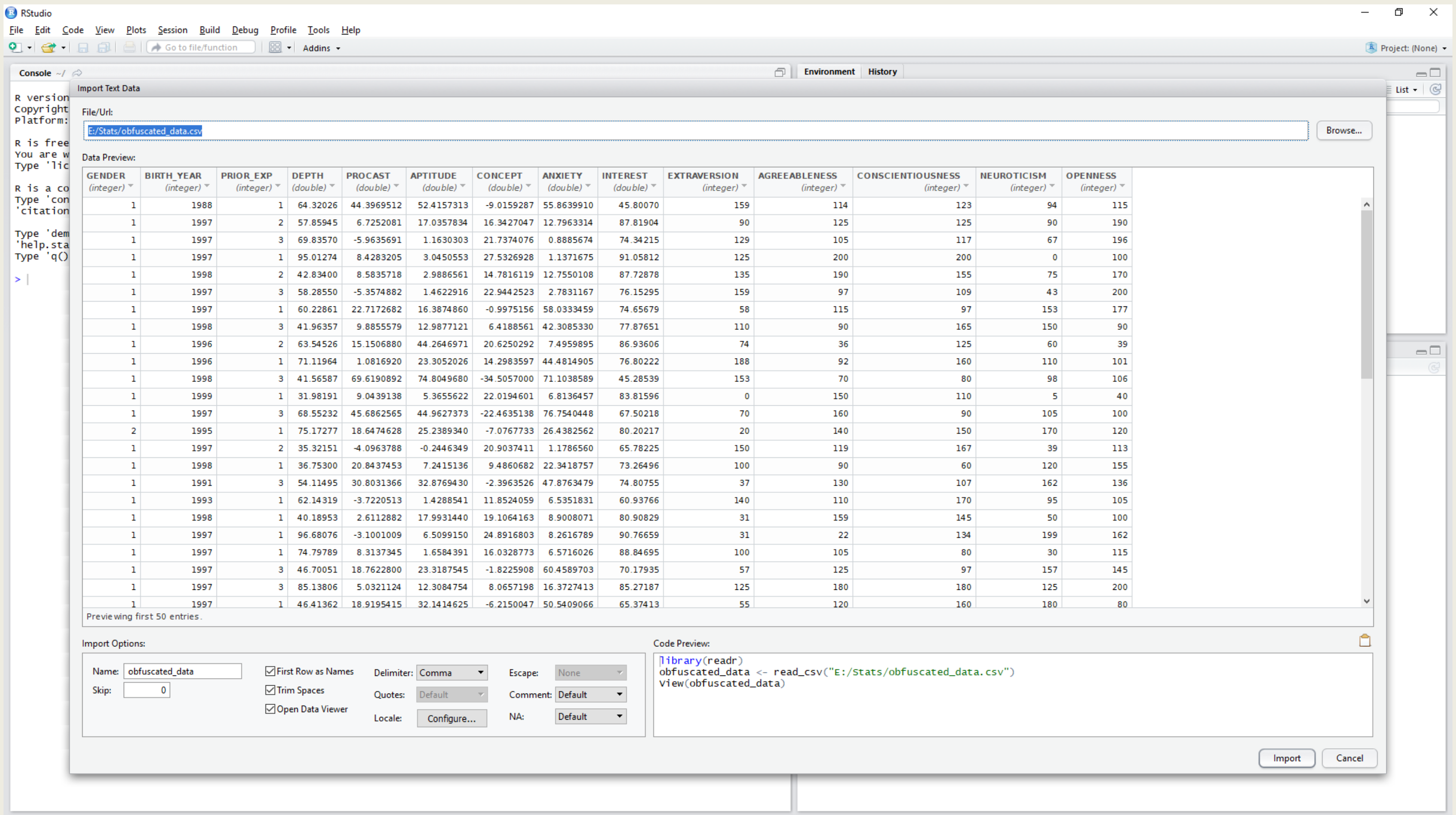
Import Data into R



Import Data into R



Import Data into R

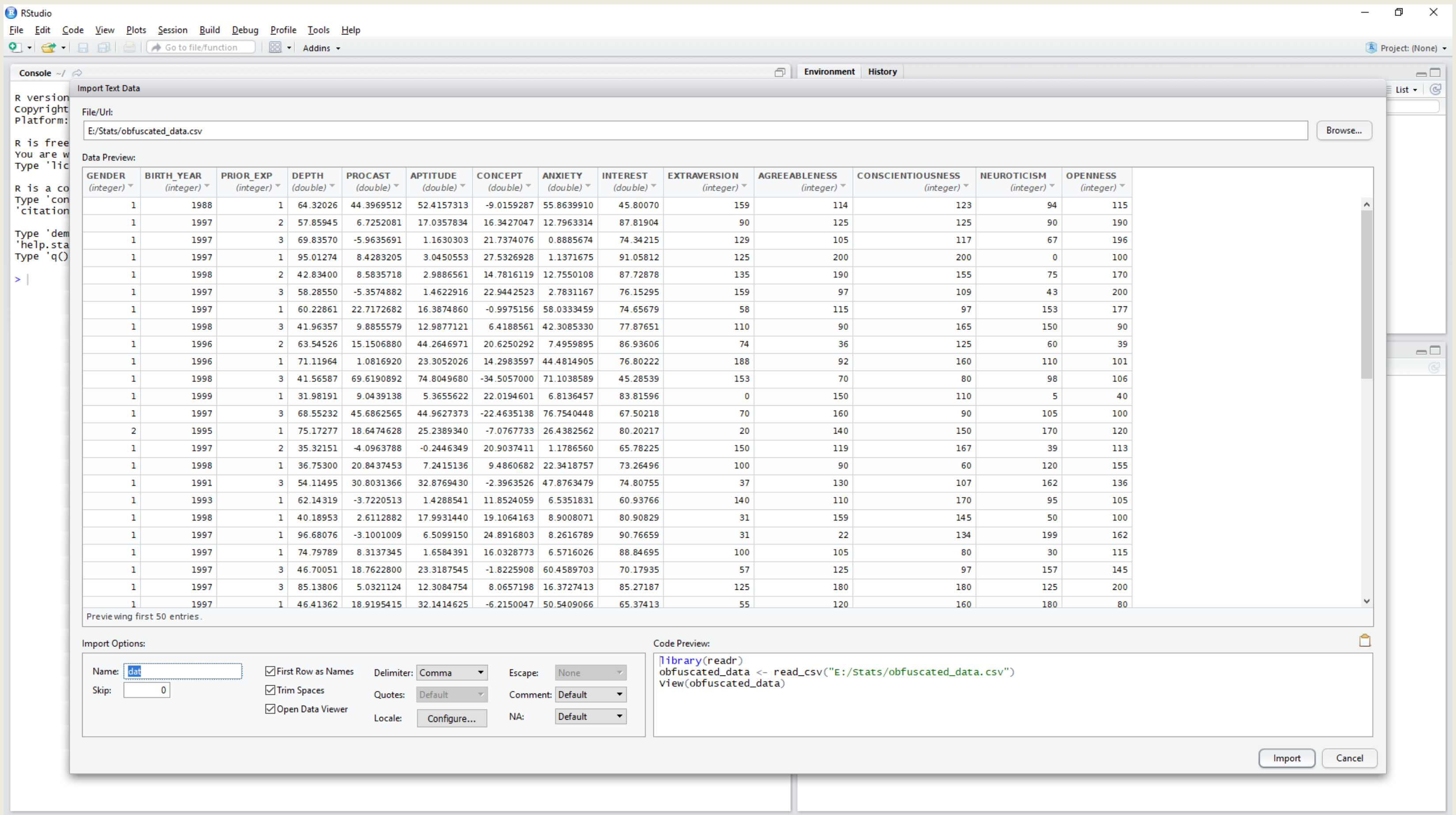


GENDER (integer)	BIRTH_YEAR (integer)	PRIOR_EXP (integer)	DEPTH (double)	PROCAST (double)	APTITUDE (double)	CONCEPT (double)	ANXIETY (double)	INTEREST (double)	EXTRAVERSION (integer)	AGREEABLENESS (integer)	CONSCIENTIOUSNESS (integer)	NEUROTICISM (integer)	OPENNESS (integer)
1	1988	1	64.32026	44.3969512	52.4157313	-9.0159287	55.8639910	45.80070	159	114	123	94	115
1	1997	2	57.85945	6.7252081	17.0357834	16.3427047	12.7963314	87.81904	90	125	125	90	190
1	1997	3	69.83570	-5.9635691	1.1630303	21.7374076	0.8885674	74.34215	129	105	117	67	196
1	1997	1	95.01274	8.4283205	3.0450553	27.5326928	1.1371675	91.05812	125	200	200	0	100
1	1998	2	42.83400	8.5835718	2.9886561	14.7816119	12.7550108	87.72878	135	190	155	75	170
1	1997	3	58.28550	-5.3574882	1.4622916	22.9442523	2.7831167	76.15295	159	97	109	43	200
1	1997	1	60.22861	22.7172682	16.3874860	-0.9975156	58.0333459	74.65679	58	115	97	153	177
1	1998	3	41.96357	9.8855579	12.9877121	6.4188561	42.3085330	77.87651	110	90	165	150	90
1	1996	2	63.54526	15.1506880	44.2646971	20.6250292	7.4959895	86.93606	74	36	125	60	39
1	1996	1	71.11964	1.0816920	23.3052026	14.2983597	44.4814905	76.80222	188	92	160	110	101
1	1998	3	41.56587	69.6190892	74.8049680	-34.5057000	71.1038589	45.28539	153	70	80	98	106
1	1999	1	31.98191	9.0439138	5.3655622	22.0194601	6.8136457	83.81596	0	150	110	5	40
1	1997	3	68.55232	45.6862565	44.9627373	-22.4635138	76.7540448	67.50218	70	160	90	105	100
2	1995	1	75.17277	18.6474628	25.2389340	-7.0767733	26.4382562	80.20217	20	140	150	170	120
1	1997	2	35.32151	-4.0963788	-0.2446349	20.9037411	1.1786560	65.78225	150	119	167	39	113
1	1998	1	36.75300	20.8437453	7.2415136	9.4860682	22.3418757	73.26496	100	90	60	120	155
1	1991	3	54.11495	30.8031366	32.8769430	-2.3963526	47.8763479	74.80755	37	130	107	162	136
1	1993	1	62.14319	-3.7220513	1.4288541	11.8524059	6.5351831	60.93766	140	110	170	95	105
1	1998	1	40.18953	2.6112882	17.9931440	19.1064163	8.9008071	80.90829	31	159	145	50	100
1	1997	1	96.68076	-3.1001009	6.5099150	24.8916803	8.2616789	90.76659	31	22	134	199	162
1	1997	1	74.79789	8.3137345	1.6584391	16.0328773	6.5716026	88.84695	100	105	80	30	115
1	1997	3	46.70051	18.7622800	23.3187545	-1.8225908	60.4589703	70.17935	57	125	97	157	145
1	1997	3	85.13806	5.0321124	12.3084754	8.0657198	16.3727413	85.27187	125	180	180	125	200
1	1997	1	46.41362	18.9195415	32.1414625	-6.2150047	50.5409066	65.37413	55	120	160	180	80

```r
library(readr)
obfuscated_data <- read_csv("E:/Stats/obfuscated_data.csv")
View(obfuscated_data)
```

GAMES ACADEMY | FALMOUTH UNIVERSITY

Import Data into R

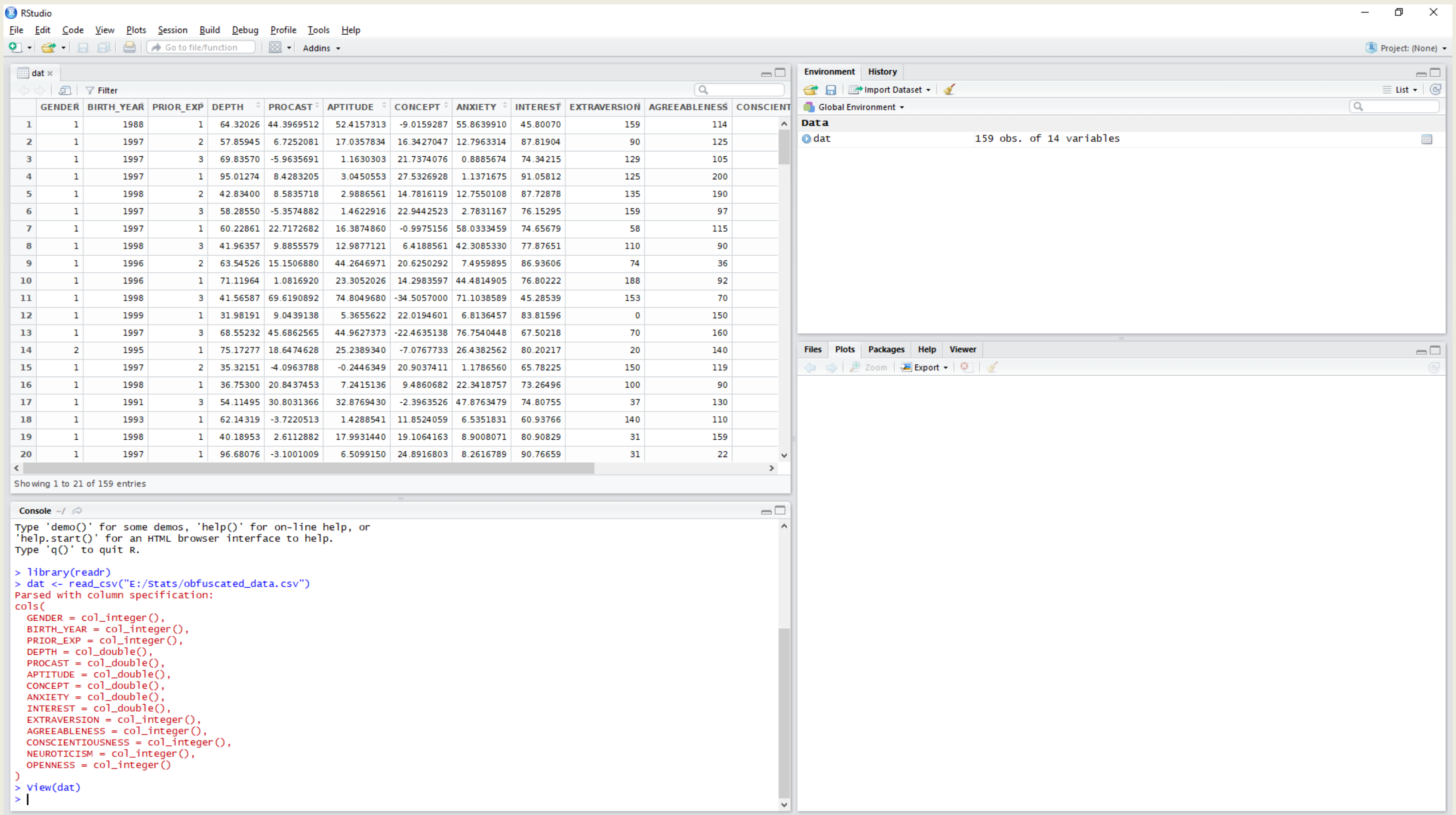


GENDER (integer)	BIRTH_YEAR (integer)	PRIOR_EXP (integer)	DEPTH (double)	PROCAST (double)	APTITUDE (double)	CONCEPT (double)	ANXIETY (double)	INTEREST (double)	EXTRAVERSION (integer)	AGREEABLENESS (integer)	CONSCIENTIOUSNESS (integer)	NEUROTICISM (integer)	OPENNESS (integer)
1	1988	1	64.32026	44.3969512	52.4157313	-9.0159287	55.8639910	45.80070	159	114	123	94	115
1	1997	2	57.85945	6.7252081	17.0357834	16.3427047	12.7963314	87.81904	90	125	125	90	190
1	1997	3	69.83570	-5.9635691	1.1630303	21.7374076	0.8885674	74.34215	129	105	117	67	196
1	1997	1	95.01274	8.4283205	3.0450553	27.5326928	1.1371675	91.05812	125	200	200	0	100
1	1998	2	42.83400	8.5835718	2.9886561	14.7816119	12.7550108	87.72878	135	190	155	75	170
1	1997	3	58.28550	-5.3574882	1.4622916	22.9442523	2.7831167	76.15295	159	97	109	43	200
1	1997	1	60.22861	22.7172682	16.3874860	-0.9975156	58.0333459	74.65679	58	115	97	153	177
1	1998	3	41.96357	9.8855579	12.9877121	6.4188561	42.3085330	77.87651	110	90	165	150	90
1	1996	2	63.54526	15.1506880	44.2646971	20.6250292	7.4959895	86.93606	74	36	125	60	39
1	1996	1	71.11964	1.0816920	23.3052026	14.2983597	44.4814905	76.80222	188	92	160	110	101
1	1998	3	41.56587	69.6190892	74.8049680	-34.5057000	71.1038589	45.28539	153	70	80	98	106
1	1999	1	31.98191	9.0439138	5.3655622	22.0194601	6.8136457	83.81596	0	150	110	5	40
1	1997	3	68.55232	45.6862565	44.9627373	-22.4635138	76.7540448	67.50218	70	160	90	105	100
2	1995	1	75.17277	18.6474628	25.2389340	-7.0767733	26.4382562	80.20217	20	140	150	170	120
1	1997	2	35.32151	-4.0963788	-0.2446349	20.9037411	1.1786560	65.78225	150	119	167	39	113
1	1998	1	36.75300	20.8437453	7.2415136	9.4860682	22.3418757	73.26496	100	90	60	120	155
1	1991	3	54.11495	30.8031366	32.8769430	-2.3963526	47.8763479	74.80755	37	130	107	162	136
1	1993	1	62.14319	-3.7220513	1.4288541	11.8524059	6.5351831	60.93766	140	110	170	95	105
1	1998	1	40.18953	2.6112882	17.9931440	19.1064163	8.9008071	80.90829	31	159	145	50	100
1	1997	1	96.68076	-3.1001009	6.5099150	24.8916803	8.2616789	90.76659	31	22	134	199	162
1	1997	1	74.79789	8.3137345	1.6584391	16.0328773	6.5716026	88.84695	100	105	80	30	115
1	1997	3	46.70051	18.7622800	23.3187545	-1.8225908	60.4589703	70.17935	57	125	97	157	145
1	1997	3	85.13806	5.0321124	12.3084754	8.0657198	16.3727413	85.27187	125	180	180	125	200
1	1997	1	46.41362	18.9195415	32.1414625	-6.2150047	50.5409066	65.37413	55	120	160	180	80

```
library(readr)
obfuscated_data <- read_csv("E:/Stats/obfuscated_data.csv")
View(obfuscated_data)
```

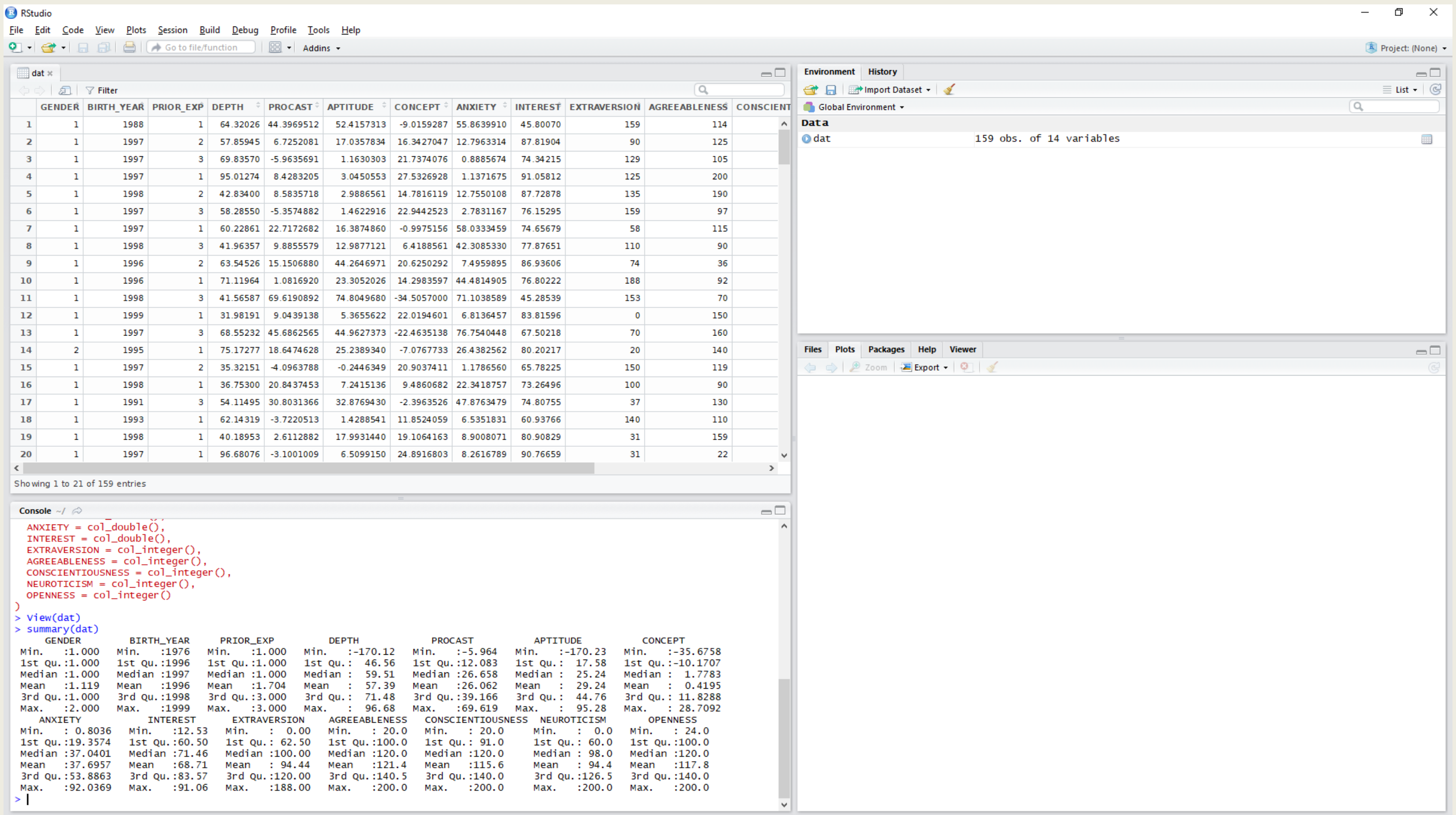
GAMES ACADEMY | FALMOUTH UNIVERSITY

Import Data into R



GAMES ACADEMY | FALMOUTH UNIVERSITY

Import Data into R



Data Analysis in R

Illustrating Your Findings

Data Analysis in R

To access a specific variable, use the $ character. It works a bit like the dot operator:

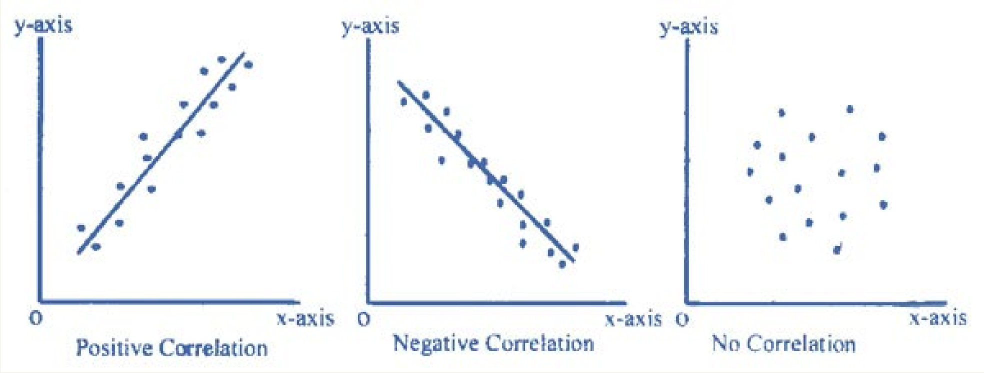
```
> describe(dat$PROCAST)
```

Note, some functions such as describe require external libraries to be installed and loaded:

```
> install.packages("psych")
> library(psych)
```

Correlation

- Extent to which two continuous variables co-vary (change together)
  - Ice-cream sales relate to temperature
  - Waiting time relates to customer satisfaction
- Correlations have
  - Direction
    - **Positive** (as the one increases the other variable increases as well)
    - **Negative** (as the one increases the other one decreases)
  - Magnitude – how closely related?



Pearson's correlation

- Provides a numerical measure of the magnitude/direction of the correlation known as **r**
  - any value between **-1 to +1**
  - -1 (negative), 1 (positive), Close to 0 (no/low)
- Pearson r, is a parametric test so assumes both variables
  - Are continuous
  - Have an approximately normal distribution

Correlation

To see a correlation:

```
> cor(x, y)
> cor.test(x, y, method)
```

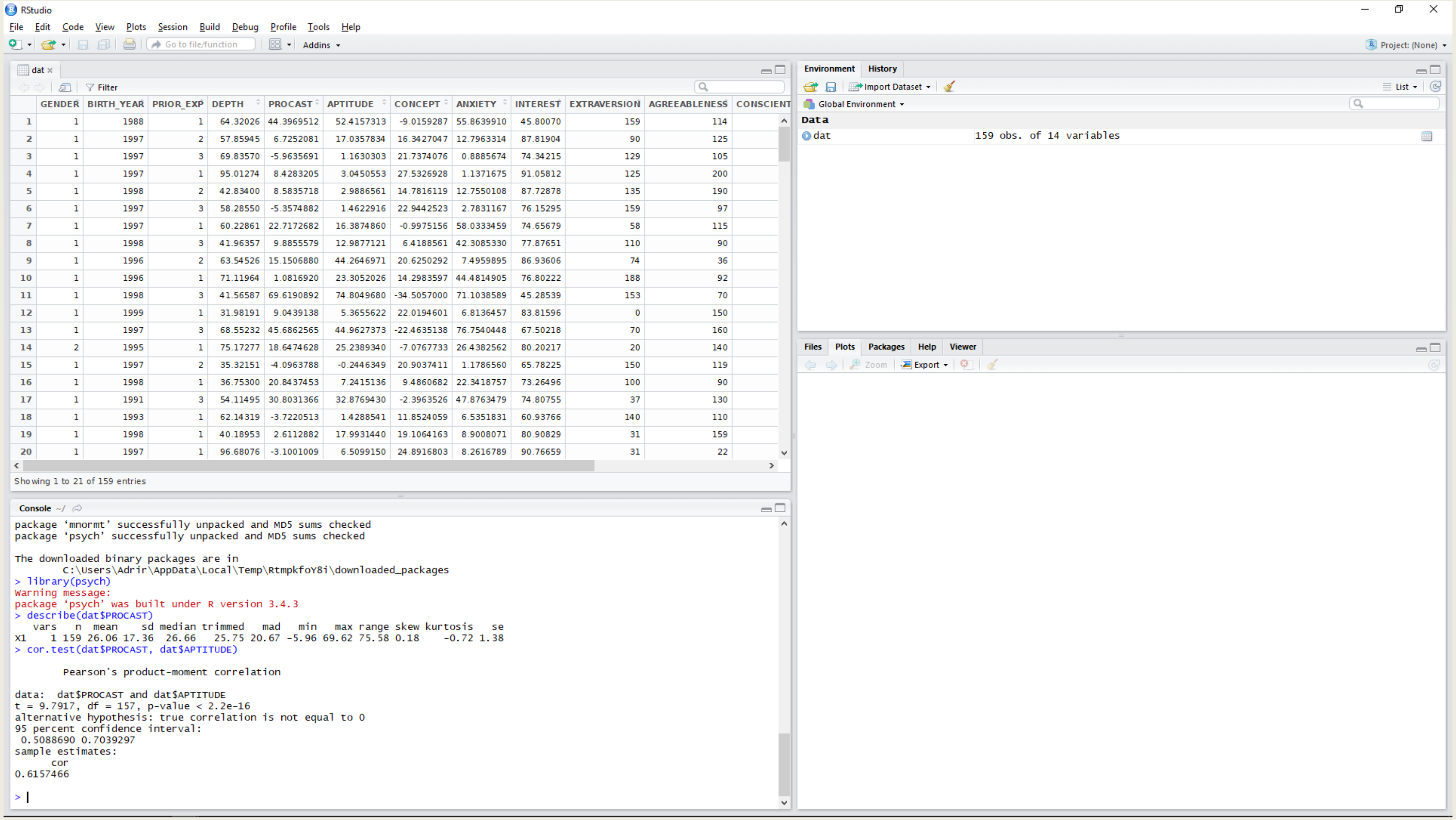
Try:

```
> cor.test(dat$PROCAST, dat$APTITUDE, method="pearson")
```

What does "2.2e-16" mean?

What can we conclude from this data?

Correlation



	GENDER	BIRTH_YEAR	PRIOR_EXP	DEPTH	PROCAST	APTITUDE	CONCEPT	ANXIETY	INTEREST	EXTRAVERSION	AGREEABLENESS	CONSCIENT
1	1	1988	1	64.32026	44.3969512	52.4157313	-9.0159287	55.8639910	45.80070	159	114	
2	1	1997	2	57.85945	6.7252081	17.0357834	16.3427047	12.7963314	87.81904	90	125	
3	1	1997	3	69.83570	-5.9635691	1.1630303	21.7374076	0.8885674	74.34215	129	105	
4	1	1997	1	95.01274	8.4283205	3.0450553	27.5326928	1.1371675	91.05812	125	200	
5	1	1998	2	42.83400	8.5835718	2.9886561	14.7816119	12.7550108	87.72878	135	190	
6	1	1997	3	58.28550	-5.3574882	1.4622916	22.9442523	2.7831167	76.15295	159	97	
7	1	1997	1	60.22861	22.7172682	16.3874860	-0.9975156	58.0333459	74.65679	58	115	
8	1	1998	3	41.96357	9.8855579	12.9877121	6.4188561	42.3085330	77.87651	110	90	
9	1	1996	2	63.54526	15.1506880	44.2646971	20.6250292	7.4959895	86.93606	74	36	
10	1	1996	1	71.11964	1.0816920	23.3052026	14.2983597	44.4814905	76.80222	188	92	
11	1	1998	3	41.56587	69.6190892	74.8049680	-34.5057000	71.1038589	45.28539	153	70	
12	1	1999	1	31.98191	9.0439138	5.3655622	22.0194601	6.8136457	83.81596	0	150	
13	1	1997	3	68.55232	45.6862565	44.9627373	-22.4635138	76.7540448	67.50218	70	160	
14	2	1995	1	75.17277	18.6474628	25.2389340	-7.0767733	26.4382562	80.20217	20	140	
15	1	1997	2	35.32151	-4.0963788	-0.2446349	20.9037411	1.1786560	65.78225	150	119	
16	1	1998	1	36.75300	20.8437453	7.2415136	9.4860682	22.3418757	73.26496	100	90	
17	1	1991	3	54.11495	30.8031366	32.8769430	-2.3963526	47.8763479	74.80755	37	130	
18	1	1993	1	62.14319	-3.7220513	1.4288541	11.8524059	6.5351831	60.93766	140	110	
19	1	1998	1	40.18953	2.6112882	17.9931440	19.1064163	8.9008071	80.90829	31	159	
20	1	1997	1	96.68076	-3.1001009	6.5099150	24.8916803	8.2616789	90.76659	31	22	

Showing 1 to 21 of 159 entries

```
package ‘mnormt’ successfully unpacked and MD5 sums checked
package ‘psych’ successfully unpacked and MD5 sums checked

The downloaded binary packages are in
        C:\Users\Adrir\AppData\Local\Temp\RtmpkfoY8i\downloaded_packages
> library(psych)
Warning message:
package ‘psych’ was built under R version 3.4.3
> describe(dat$PROCAST)
   vars   n  mean    sd median trimmed   mad   min   max range skew kurtosis   se
X1    1 159 26.06 17.36  26.66   25.75 20.67 -5.96 69.62 75.58 0.18    -0.72 1.38
> cor.test(dat$PROCAST, dat$APTITUDE)

        Pearson's product-moment correlation

data:  dat$PROCAST and dat$APTITUDE
t = 9.7917, df = 157, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.5088690 0.7039297
sample estimates:
      cor
0.6157466

> 
```

Statistical Tests

- Enable us to assign a confidence value to an observed relationship or difference between groups or treatment conditions

- This is what statisticians call **significance** level (or sometimes **alpha α**)

- Significance is the probability (**p**) that observations as extreme or more extreme were made under the assumption that the **null hypothesis** is true

- A lower significance value implies a lower probability that the result is within expected variance assuming the null hypothesis is true

Statistical tests

- Significance depends on various factors:
  - Size of difference / degree of relationship
  - Degree of variability or dispersion within the sample(s)
  - Size of the sample
- Conventionally **p = 0.05** is used as the threshold of significance
  - Means 1 in 20 chance that observed difference/relationship is not real
  - Lower values → better (e.g. $p = 0.01$, $p = 0.001$)
  - Threshold should be lowered if you are computing many tests on the same data because chance of false positive increases

T-Test

To see a correlation:

```
> t.test(x~y)
```

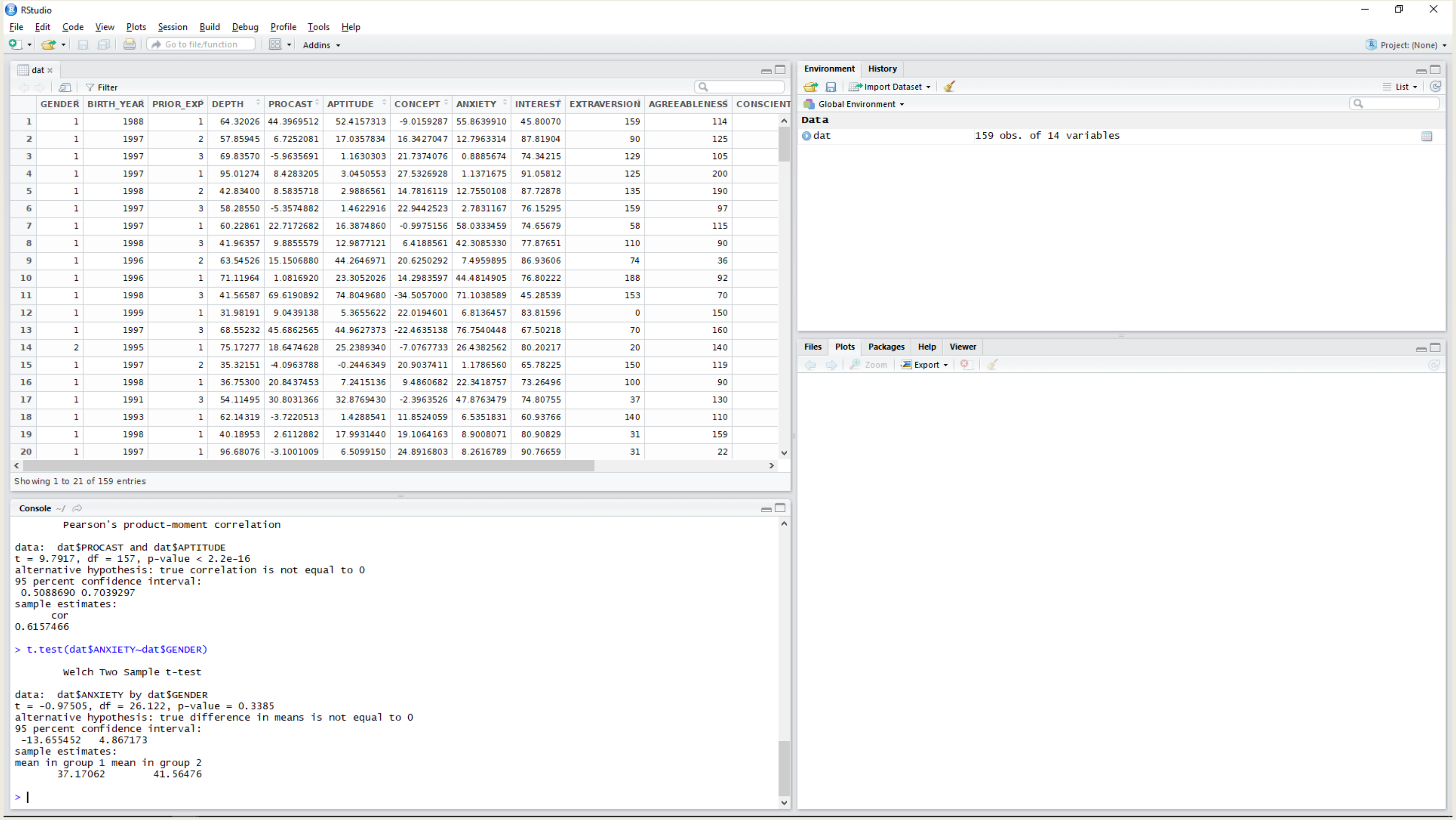
Note: Data must be in long-format. The tilde indicates the grouping variable.

Try:

```
> t.test(dat$ANXIETY~dat$GENDER)
```

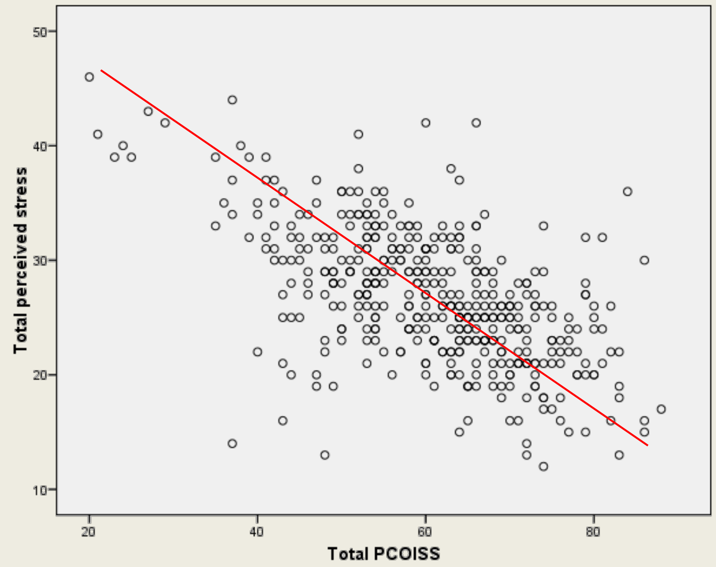
What can we conclude from this data?

T-Test


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Addins
Project: (None)
dat
Filter
GENDER BIRTH_YEAR PRIOR_EXP DEPTH PROCAST APTITUDE CONCEPT ANXIETY INTEREST EXTRAVERSION AGREEABLENESS CONSCIENT
Showing 1 to 21 of 159 entries
Environment History
Import Dataset
List
Global Environment
Data
dat 159 obs. of 14 variables
Files Plots Packages Help Viewer
Zoom Export
Console ~/
Pearson's product-moment correlation
data: dat$PROCAST and dat$APTITUDE
t = 9.7917, df = 157, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
0.5088690 0.7039297
sample estimates:
cor
0.6157466
> t.test(dat$ANXIETY~dat$GENDER)
Welch Two Sample t-test
data: dat$ANXIETY by dat$GENDER
t = -0.97505, df = 26.122, p-value = 0.3385
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-13.655452 4.867173
sample estimates:
mean in group 1 mean in group 2
37.17062 41.56476

Linear regression

- Finds a linear model for the relationship between one or more independent variables and a dependent variable
- Between an IV x and a DV y, line of best fit has form
$$y = mx + c$$
- Linear regression finds the coefficients m and c
- Can be used to quantify the relationships of variables, and also for prediction (if correlation is strong)
- Multiple variable linear regression:
$$y = m_1 x_1 + m_2 x_2 + \cdots + c$$



Linear Regression

To regress one independent variable (neuroticism) against one dependent variable (anxiety):

```
> rm <- lm(dat$ANXIETY ~ dat$NEUROTICISM)
```

<- is the assignment operator in R

A formula object

To view the analysis use:

```
> summary(rm)
```

What does these results suggest?

Multiple Regression

To regress two independent variables against one dependent variable:

```
> rm <- lm(dat$ANXIETY ~ dat$NEUROTICISM + dat$APTITUDE)
```

To view the analysis use:

```
> summary(rm)
```

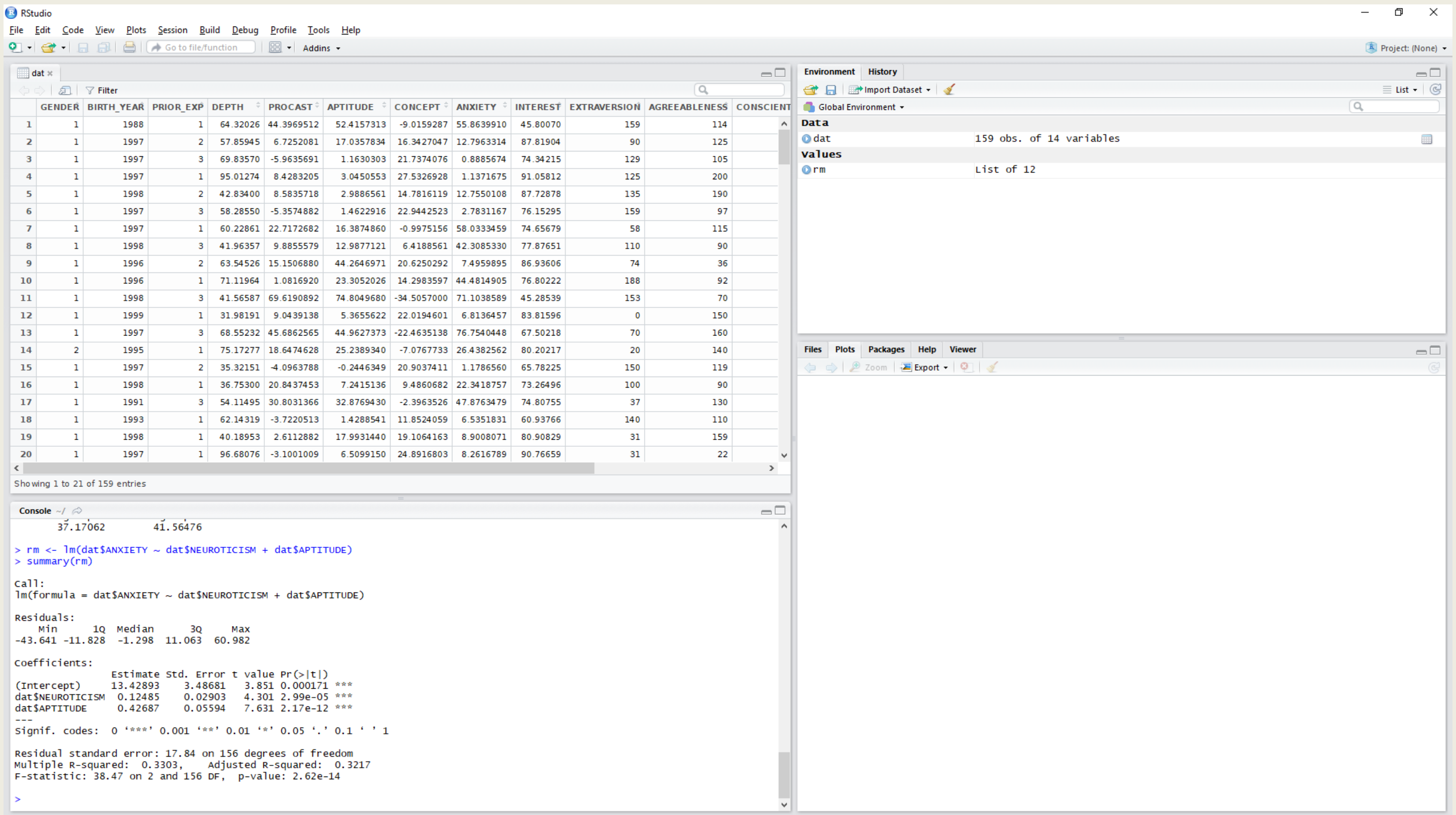
What does these results suggest?

To investigate relative importance of predictors, use:

```
> library(relaimpo)
> calc.relimp(rm,type=c("pratt"), rela=TRUE)
```

What happens if you wrap this with the plot() function?

Multiple Regression



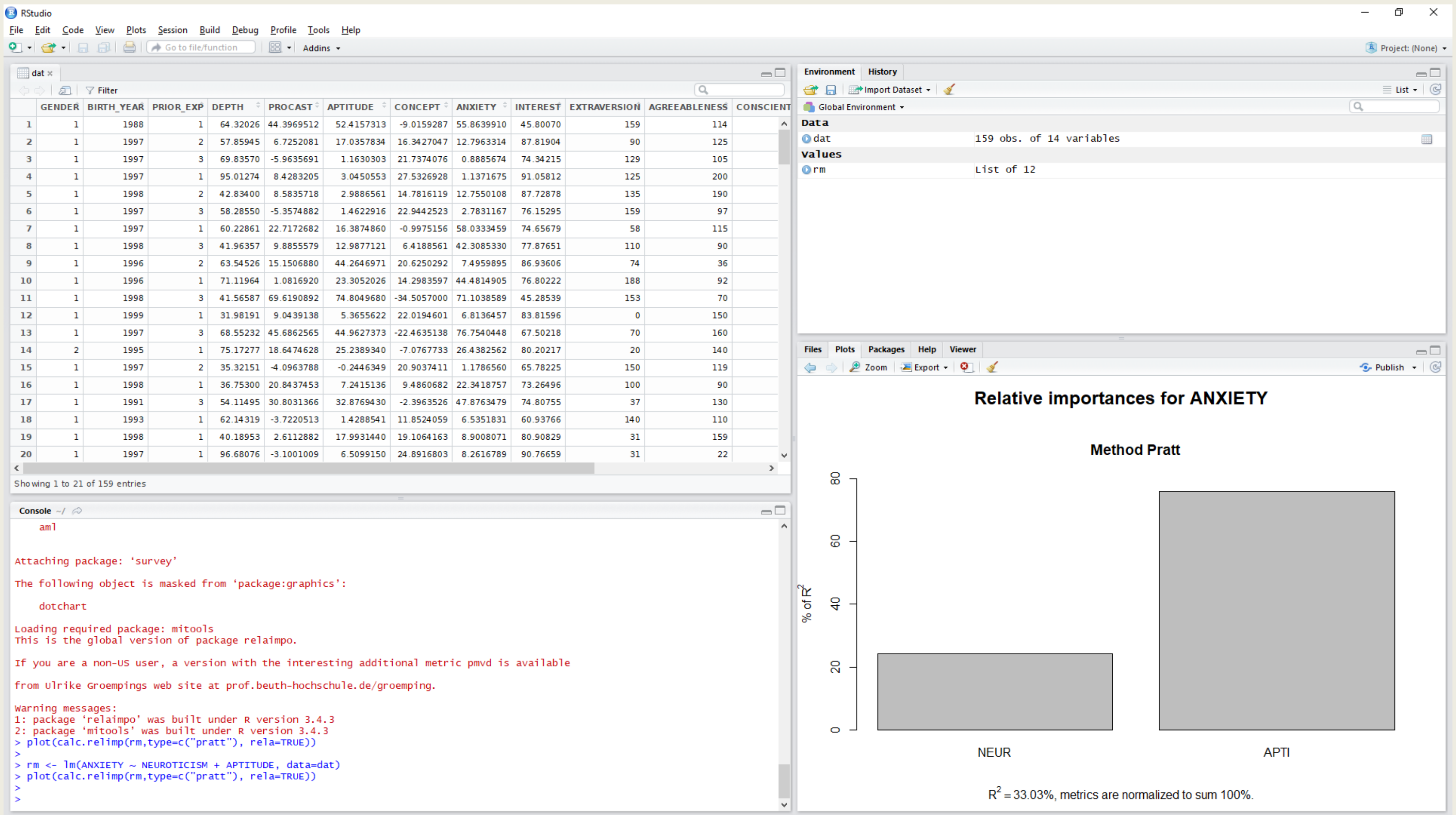
	GENDER	BIRTH_YEAR	PRIOR_EXP	DEPTH	PROCAST	APTITUDE	CONCEPT	ANXIETY	INTEREST	EXTRAVERSION	AGREEABLENESS	CONSCIENT
1	1	1988	1	64.32026	44.3969512	52.4157313	-9.0159287	55.8639910	45.80070	159	114	
2	1	1997	2	57.85945	6.7252081	17.0357834	16.3427047	12.7963314	87.81904	90	125	
3	1	1997	3	69.83570	-5.9635691	1.1630303	21.7374076	0.8885674	74.34215	129	105	
4	1	1997	1	95.01274	8.4283205	3.0450553	27.5326928	1.1371675	91.05812	125	200	
5	1	1998	2	42.83400	8.5835718	2.9886561	14.7816119	12.7550108	87.72878	135	190	
6	1	1997	3	58.28550	-5.3574882	1.4622916	22.9442523	2.7831167	76.15295	159	97	
7	1	1997	1	60.22861	22.7172682	16.3874860	-0.9975156	58.0333459	74.65679	58	115	
8	1	1998	3	41.96357	9.8855579	12.9877121	6.4188561	42.3085330	77.87651	110	90	
9	1	1996	2	63.54526	15.1506880	44.2646971	20.6250292	7.4959895	86.93606	74	36	
10	1	1996	1	71.11964	1.0816920	23.3052026	14.2983597	44.4814905	76.80222	188	92	
11	1	1998	3	41.56587	69.6190892	74.8049680	-34.5057000	71.1038589	45.28539	153	70	
12	1	1999	1	31.98191	9.0439138	5.3655622	22.0194601	6.8136457	83.81596	0	150	
13	1	1997	3	68.55232	45.6862565	44.9627373	-22.4635138	76.7540448	67.50218	70	160	
14	2	1995	1	75.17277	18.6474628	25.2389340	-7.0767733	26.4382562	80.20217	20	140	
15	1	1997	2	35.32151	-4.0963788	-0.2446349	20.9037411	1.1786560	65.78225	150	119	
16	1	1998	1	36.75300	20.8437453	7.2415136	9.4860682	22.3418757	73.26496	100	90	
17	1	1991	3	54.11495	30.8031366	32.8769430	-2.3963526	47.8763479	74.80755	37	130	
18	1	1993	1	62.14319	-3.7220513	1.4288541	11.8524059	6.5351831	60.93766	140	110	
19	1	1998	1	40.18953	2.6112882	17.9931440	19.1064163	8.9008071	80.90829	31	159	
20	1	1997	1	96.68076	-3.1001009	6.5099150	24.8916803	8.2616789	90.76659	31	22	

Showing 1 to 21 of 159 entries

```
      37.17062        41.56476

> rm <- lm(dat$ANXIETY ~ dat$NEUROTICISM + dat$APTITUDE)
> summary(rm)

Call:
lm(formula = dat$ANXIETY ~ dat$NEUROTICISM + dat$APTITUDE)

Residuals:
    Min      1Q  Median      3Q     Max 
-43.641 -11.828  -1.298  11.063  60.982 

Coefficients:
                Estimate Std. Error t value Pr(>|t|)    
(Intercept)     13.42893    3.48681   3.851 0.000171 ***
dat$NEUROTICISM  0.12485    0.02903   4.301 2.99e-05 ***
dat$APTITUDE     0.42687    0.05594   7.631 2.17e-12 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 17.84 on 156 degrees of freedom
Multiple R-squared:  0.3303,	Adjusted R-squared:  0.3217 
F-statistic: 38.47 on 2 and 156 DF,  p-value: 2.62e-14

>
```

GAMES ACADEMY | FALMOUTH UNIVERSITY

Multiple Regression



GAMES ACADEMY | FALMOUTH UNIVERSITY

Other Analyses

- There is a whole host of analyses that can be conducted in Rstudio!
- Investigate for yourself those which will have relevance to your particular project.
- For resources, see:
  - www.rdocumentation.org
  - www.statmethods.net
  - http://tutorials.iq.harvard.edu/R/
  - https://support.rstudio.com/hc/en-us