- 1. Open R (i.e. R x64 3.3.2) in your computer
- 2. Load R Commander by typing: library(Rcmdr) on your R console

```
    R Console (64-bit) - □ ×

    File Edit Misc Packages Windows Help

    R is a collaborative project with many contributors.
    Type 'contributors()' for more information and
    'citation()' on how to cite R or R packages in publications.

    Type 'demo()' for some demos, 'help()' for on-line help, or
    'help.start()' for an HTML browser interface to help.
    Type 'q()' to quit R.

[Previously saved workspace restored]
```

- > library (Rcmdr)
- 3. By now you should be active in R Commander window



4. Load your dataset into R, for example: **satisfaction.xlsx** by clicking on menu Data > Import data > From Excel file...

R Commander	
File Edit Data Statistics Graphs	Models Distributions Tools Help
New data set Load data set Merge data sets	it data set Model: X <no active="" model=""></no>
Import data 🔹 🕨	from text file, clipboard, or URL
Data in packages	from SPSS data set
Active data set	from SAS xport file
Manage variables in active data set 🕨	from Minitab data set
})	from STATA data set
	from Excel file
<	

5. After loading your data, you can check your dataset by clicking View data set

Start here...

Do you have more than one question assessing the same construct (e.g., Satisfaction with Life Scale has 5 questions, all intended to assess life satisfaction) \rightarrow Go to 1. Data Processing

Are you trying to describe the characteristics of your sample? \rightarrow Go to 2. Descriptives

Are you trying to test hypotheses? \rightarrow Go to 3. Hypothesis Testing

1. Data Processing

Are any of your items supposed to be reverse coded? If NO \rightarrow Go to 1.1. If YES \rightarrow Go to 1.2 Are you trying to calculate internal reliability for your survey measure? \rightarrow Go to 1.3 Do you need to create grouping variables out of a continuous variable? \rightarrow Go to 1.4

1.1. Create a new variable by making the average of all the items in your scale.

Example: swls = (swls1 + swls2 + swls3 + swls4 + swls5)/5

Data \rightarrow Manage variables in active data set \rightarrow Compute new variable...



In "New variable name" box, type your new variable name.

* R is case sensitive, be careful in typing the variable name or any command

In "Expression to compute" box, type (or double click) variables you want to average \rightarrow in between each variable name type + \rightarrow at the start and end of your variables in the box, type () \rightarrow type / \rightarrow type the total number of variables you have in this scale \rightarrow press OK

R Compute New Variable		×
Current variables (double-click t	o expression)	
Gender [factor]	^	
swls1		
swls2		
swls3	-	
swls4		
swls5	¥	
New variable name	Expression to compute	
swls	(swls1 + swls2 + swls3 + swls4	
	< >	
🔞 Help 🦘 Rese	t 🖌 OK 🎇 Cancel 🏞 App	ly

You should see the new variable swls:

	R Dataset										- 0	/ ×	$\langle \rangle$
5	Gender	swls1	swls2	swls3	swls4	swls5	trait1	trait2	trait3	trait4	trait5	swls	
, 1	Male	2	5	3	6	3	5	5	5	4	2	3.8	^
2	Male	4	5	4	5	2	5	5	5	3	4	4.0	
3	Male	3	7	4	6	5	5	4	4	5	1	5.0	
4	Male	1	4	1	4	3	5	4	4	4	1	2.6	
5	Male	2	5	3	5	3	5	4	3	4	3	3.6	
6	Male	1	6	4	6	6	6	7	6	7	1	4.6	

<u>IMPORTANT</u>: This new variable you created will be the one you use in your hypothesis testing, not the individual items.

1.2. Reverse code the items you need to have reverse coded *Example: for a 1-7 scale in variables trait1 and trait3, recode: 1=7, 2=6, 3=5, 4=4, 5=3, 6=2, 7=1*

Data \rightarrow Manage variables in active data set \rightarrow Recode variables...



In "Variables to recode" box, you can choose multiple variables e.g. click variable trait1 and Ctrl + click trait3 \rightarrow In "New variable name" box, you can type: reverse_ \rightarrow

Because we want these variables to be numeric, uncheck the box "Make (each) new variable a factor" \rightarrow In "Enter recode directives" type:

1=7 click ENTER 2=6 click ENTER 3=5 click ENTER 4=4 click ENTER 5=3 click ENTER 6=2 click ENTER 7=1 → Click OK

Recode Variables		×
Variables to recode	(pick one or more)	
ewle5	•	
trait1		
trait2		
trait3		
trait4		
trait5	v	
New variable name	e or prefix for multiple recodes: reverse	
Make (each) n	eu variable a factor	
	ew variable a factor	
Enter recode direct	ives	
1=7	^	
2=6		
3=5		
4=4		
	~	
5=3		
< 5=3	>	
5=3	>	
5=3	-> Reset 🖌 OK 🗶 Cancel	Apply

You should see the new variables reverse trait1 and reverse trait3:

٩	R Datas	et							/		- (J X
	wls4	swls5	trait1	trait2	trait3	trait4	trait5	swls	reverse	trait1	reverse	trait3
	6	3	5	5	5	4	2	3.8		3		3 ^
	5	2	5	5	5	3	4	4.0		3		3
	6	5	5	4	4	5	1	5.0		3		4
	4	3	5	4	4	4	1	2.6		3		4
	5	3	5	4	3	4	3	3.6	\	3		5
	6	6	6	7	6	7	1	4.6	\mathbf{X}	2		2
	4	2	3	2	3	3	5	2.8		5		<u> </u>
8	5	4	4	4	4	5	1	3.4		4		4

Now, go to \rightarrow 1.1. to create your new variables.

1.3. To calculate internal reliability/Cronbach's Alpha Statistics → Dimensional analysis → Scale reliability

🗬 R	Comm	ander								
File	Edit	Data	Statisti	cs	Graphs Models Distributions To	ools H	Help			
< F	Sumn Contin Mean	naries ngency s	tables) } }	Z Edit data set 🔯 View data s	set	Model	Σ <Ν	lo active	model>
	Propo Variar Nonp	ortions nces arameti	ric tests)))	ataset, { 3e_trait3, '1=5 2=4 3=3 4=	=2 5=	1; ;'	, as.	factor	.resul
	Dime	nsional	analysis	۲	Scale reliability					
<	Fit mo	odels		•	Principal-components analysis Factor analysis Confirmatory factor analysis Cluster analysis	; 4	=2 ;	5=1;	; ;',	as.fac
				L		-				

Pick variables you want to test:

Example: Click swls1 \rightarrow Ctrl + click swls2 \rightarrow Ctrl + click swls3 \rightarrow Ctrl + click swls4 \rightarrow Ctrl + click swls5 \rightarrow OK

R Scale Reliability	,			×
Variables (pick th	ree or more)			
i swls	^			
swls1				
swls2				
swls3				
swls4				
swls5	¥			
😧 Help	🥎 Reset	🚽 ОК	X Cancel	Apply

Important values to note: Cronbach's Alpha

1.4. Creating a 2-level grouping variable (dummy coding)

Example: Group scale 1-7 into: Low (1-4), High (5-7) would be (1="low", 2="low", 3="low", 4 =" low"); (5="high", 6="high", 7="high").

Data \rightarrow Manage variables in active data set \rightarrow Recode variables...

R Commander		
File Edit Data Statistics Graphs	Models Distributions Tools Help	
New data set Load data set Merge data sets	it data set 🔯 View data set Model: 🗵	<no active="" model=""></no>
Import data Data in packages Active data set	<pre>ata, -agerecitime_stelltime_s; /Guest123/Downloads/satisfact: JE, na="", sheet="jobperceptic</pre>	ion.xlsx", ons",
Manage variables in active data set 🕨	Recode variables	1s4 + sw1s5)/5)
Dataset\$swls <- with(Datas	Compute new variable	1s4 + sw1s5)/5)
	Add observation numbers to data set	
<	Standardize variables	
	Convert numeric variables to factors	
Output	Bin numeric variable	
Catpar	Reorder factor levels	
> mudata (maadVI (UC) (Uca	Drop unused factor levels	Data vlav"
+ rownames=FALSE, header	Define contrasts for a factor	Data".
+ stringsAsFactors=TRUE)	Rename variables	, Dava ,
	Delete variables from data set	

In "Variables to recode" box, click variable trait1 \rightarrow

In "New variable name" box, type: recoded \rightarrow

Because we want these variables to be factor, check the box "Make (each) new variable a factor" \rightarrow In "Enter recode directives" box, there are 2 ways to type, first:

1 , 2, 3, 4 = "low" click ENTER

5, 6, 7 = "high"

OR you can type:

1 : 4 = "low" click ENTER 5 : 7 = "high"

Click OK

Gender recoded swis1 swis2 swis2 wis3 New variable name or prefix for multiple recodes: Make (each) new variable a factor Enter recode directives 1:4="1ow" 5:17="nigh"	/ariables to recode (age	vick one or more)
wis2 wis3 New variable name or prefix for multiple recodes: recoded Make (each) new variable a factor inter recode directives 1:4="low" st]7="high"	Gender ecoded wist	
New variable name or prefix for multiple recodes: recoded Make (each) new variable a factor inter recode directives 1 4 = "10 w" 5 t] = "high"	wls2 wls3	v
Make (each) new variable a factor inter recode directives 1: 4 = "low" >: 1 ⁻ "high"		
inter recode directives 1:4="low" \$\7="high" \$\	New variable name	r prefix for multiple recodes: recoded
1:4="low" ∧	New variable name 🖉 Make (each) ne	r prefix for multiple recodes: recoded variable a factor
v	New variable name of Make (each) ne	r prefix for multiple recodes: variable a factor
	New variable name of Make (each) net Make (each) net Enter recode directive 1:4="low" 5:17="high"	r prefix for multiple recodes: recoded variable a factor Is
	Vew variable name of Make (each) ner Make (each) ner Inter recode directiv L: 4="low" S: 7="high"	r prefix for multiple recodes: recoded

2. Descriptives

Is your variable continuous? If YES \rightarrow Go to 2.1 Means and Standard Deviations. If NO \rightarrow Go to 2.2 Frequencies

2.1. Means and Standard Deviations: This is for continuous variables ONLY (e.g., age) Statistics \rightarrow Summaries \rightarrow Numerical summaries...

R Commander

File	Edit	Data	Statistic	:s	Graphs	Models	Distributions	Te	
	Summ	aries		Þ	Active	data set			
	Contin	igency	tables	Þ	Nume	rical sumr	naries	v u	
F	Means	;		•	Freque	ency distri	butions		
F	Propo	rtions		►	Count missing observations				
	Varian	ces		⊧ -	Table	of statistic	s	iec	
	Nonpa	arametr	ic tests	⊧ -	Correlation matrix				
	Dimen	sional	analysis	۲	Correla	ation test.		Ι.	
	Fit mo	dels		×۱.	Test of	f normality	y	38)	
		,	-,	_	-,				

→ Pick the variable you want to choose, e.g. age

R Numerical Summaries	Х
Data Statistics	
Variables (pick one or more)	
age	
swist swis2	
swis3 swis4	
swls5	
Summarize by groups	
🔞 Help 🔸 Reset 🖌 OK 🎇 Cancel	Apply

→ Select what statistics you want to compute in "Statistics" tab \rightarrow click OK

R Numerical Summaries	\times
Data Statistics	
Mean	
Standard Deviation	
Standard Error of Mean	
🗹 Interquartile Range	
Coefficient of Variation	
Skewness 🔿 Type 1	
🗌 Kurtosis 💿 Type 2	
○ Туре 3	
✓ Quantiles: 0, .25, .5, .75, 1	
🔞 Help 🧄 Reset 🖌 OK 💥 Cancel 🦽 Apply	,

Important values to note: Mean, Standard Deviation {ADD DISTRIBUTION PLOT}

To add distribution plot: Graphs... \rightarrow Histogram

2.2. Frequencies: These are for categorical variables ONLY (e.g., gender, class standing) How to run frequencies (counts/percentages):

Statistics \rightarrow Summaries \rightarrow Frequency distributions...



→ Pick the variable you want to choose, e.g. gender \rightarrow click OK

R Frequency Dist	ibutions	×
Variables (pick or	e or more)	
Gender	<u>^</u>	
	~	
Chi-square g	oodness-of-fit test (for one variable only)	
🔞 Help	♦ Reset	l 🥐 Apply
		,

Important Values to note: Frequency, Percent

3. Hypothesis Testing

Do you have more than one predictor variable that you want to account for in one single analysis? If Yes \rightarrow Go to 4. Multiple Regression. If No, keep reading below.

Is your independent variable (or predictor) categorical? (e.g., condition, gender, class year). If YES \rightarrow Go to 3.2 Categorical Predictors. If NO, it's continuous \rightarrow go to 3.1 Continuous Predictors

- 3.1. So your predictor/independent variable is continuous. Is your dependent (or outcome) variable also continuous? If YES \rightarrow Go to 3.1.1 Correlation. If No \rightarrow Go to 3.1.2 Logistic Regression
 - 3.1.1. Correlation (both predictor and outcome = continuous) Statistics \rightarrow Summaries \rightarrow Correlation test..

R	R Comma	nder									
File	e Edit	Data	Statistic	s	Graphs	Models	Distributions	5 Tools	Help		
F	Summ Contin Means Propor Variano Nonpa Dimen Fit mod	aries gency tions ces rametr sional dels	tables ic tests analysis	$\begin{array}{c} \bullet \\ \bullet $	Active Nume Freque Count Table Correl Correl Test o	data set rical sumr ency distri missing c of statistic ation mate ation test. f normalit	maries butions observations .s rix y	ata set	Model: Σ	<no active="" model=""></no>	e
			,				,	e=~1.	requency.,	, preaks-"Sturg	۲

Important values to note: Pearson Correlation (r) and Sig (p value).

3.1.2. Logistic Regression (predictor continuous, outcome = categorical, with two levels/choices) Does your outcome variable have more than 2 levels? If YES → go to 1.4 Creating a two-level grouping variable. If NO, keep reading below.

Statistics \rightarrow Fit models \rightarrow Generalized linear model..

🗬 R	Comm	ander					
File	Edit	Data	Statistics	Graphs Models	Distributions	Tools	Help
F	Summ Contin Means	naries ngency s	tables +	Z Edit data s	et 🗋 View da	ata set	Model: 2 <no active="" model=""></no>
	Propo	rtions	•				
	Varian	ces	+	ge, groups=Ge	ender, scal	e="fr	requency", breaks="Sturges",
•	Nonp	arametr	ric tests 🕨	ge, groups=Ge	ender, scal	e="fr	requency", breaks="Sturges",
	Dimer	nsional	analysis 🕨	taset, {			
	Fit mo	dels	Þ	Linear regressior	ı ¹	="hig	gh"', as.factor.result=TRUE)
				Linear model			
1				Generalized line	ar model		
_				Multinomial log	it model		
				Ordinal regression	on model		
Our	tput		L				

Enter your categorical dependent variable in the dependent box \rightarrow Enter your continuous predictor in the predictor box \rightarrow Select Family "binomial" \rightarrow Link function "logit"

Example: dependent variable: Gender , predictor: swls

	R Generalized Linear Model	×
Decondent	R Generalized Linear Model Enter name for model: GLM.2 Variables (double-click to formula) age Gender [factor] recoded [factor] swls swls1 swls2 Model Formula Operators (click to formula): + * : / %in% - ^ () Splines/Polynomials: (select variable and click) B-spline natural orthogonal polynomial deg. for polynomials: 2 ÷	×
Dependent	Swis Model formu	la
	Subset expression Weights	
	Esmily (double-click to select) Link function	
(gaussian logit	
	prove	
	inverse.gaussian	
	quasiproisson	
	🔞 Help 🔸 Reset 🖌 OK 🎇 Cancel 🥐 Apply	

Important values to note: Beta, Std Error, df, Sig (p value).

- 3.2. Categorical Predictors. So your predictor/independent variable is categorical. Is your dependent (or outcome) variable continuous? If YES \rightarrow Go to 3.2.1 T-Test/ANOVA. If NO \rightarrow Go to 3.2.2 Chi-Square
 - 3.2.1. T-Test/ANOVA (Predictor is categorical, outcome is continuous)
 Does your predictor variable have more than two conditions or groups (e.g., freshmen, sophomores, juniors, seniors)? If NO → Go to 3.2.1.1 T-Test. If Yes → Go to 3.2.1.2 ANOVA
 - 3.2.1.1. T-Test (Two conditions/groups/sets of variables). Are you trying to compare two different groups of people? If YES → Go to 3.2.1.1.1 Independent Samples T-Test. If NO, I'm trying to compare one person's responses on two different sets of questions → Go to 3.2.1.1.2 Paired Samples T-Test
 - 3.2.1.1.1. Independent Samples T-Test (are the means between two groups different between groups design)
 Statistics → Means → Independent Samples T-test →



Define Groups (categorical) \rightarrow Response Variable (continuous)

Data Options			
Groups (pick one)		Response Variable (pic	k one)
Gender	Ŷ	age intelligence speed_after speed_before swls1	
🔞 Help	🥎 R	swls2	Cancel Apply

On "Options" tab, set the equal variance assumption (or not) \rightarrow OK

R Independent Samples t-Test	×
Difference: Sexy - Neutral Alternative Hypothesis Confidence Level Assume equal variances? Two-sided .95 Difference < 0 Difference > 0	
🔁 Help 🦘 Reset 🖌 OK 🎇 Cancel 🥐 App	ply

Important values to note: t, df, sig (p value), mean, std. deviation

3.2.1.1.2. Paired Samples T-Test (within-groups design)

Statistics \rightarrow Means \rightarrow Paired t-test

	(in commander			,	
F	ile Edit Data Statistics	Graphs Models Distributions	Tools Help		
<	Summaries Contingency tables	Edit data set 🔯 View da	ta set Model: Z <no active="" model=""></no>		
F	Means 🕨 🕨	Single-sample t-test			
	Proportions	Independent samples t-test		_	
	Variances 🕨	Paired t-test	nfluency)		
	Nonparametric tests 🕨	One-way ANOVA			
	Dimensional analysis 🕨	Multi-way ANOVA	atistics=c("mean", "sd", "IQR", "quantiles"), quantiles=c(0,.25,.5,.75,1))		
	Fit models	<pre>'spanfluency"], statisti</pre>	cs=c("mean", "sd"))		

Pick first variable (before) and second variable (after) \rightarrow click OK

R Paired t-Test			>	<
Data Options				
First variable (pick one)	Second variable (pick o	one)	
age intelligence speed after	Â	age intelligence speed after	^	
speed_before swls1		speed_before swls1		
swis2	Υ.	swis2	Ŷ	
🔞 Help	5 R	eset 🚽 OK	🗙 Cancel 🥟 Apply	

Important values to note: t, df, sig (p value), mean, std. deviation

3.2.1.2. ANOVA. So your predictor variable has more than one level/group. Check the categorical variable (e.g. race) has been set as factor, by typing:

R	Data set: 🔲 Dataset 🛛 Z Edit data set 🔯 View data set
R Script	R Markdown
class	(Dataset\$race)
Click "Sı	ubmit" 🤹 Submit button

If the variable hasn't been set as factor, change it by clicking Data \rightarrow Manage variables in active data set \rightarrow Convert numeric variables to factors:



Next, set the default contrast in R to helmert, by typing in the command box ightarrow



R Commander	
File Edit Data Statistics Graphs	Models Distributions Tools Help
New data set	dit data set 🔊 View data set Model: 🔉 < No active models
Load data set	in did set
Merge data sets	
Import data	
Data in packages	<pre>htelligence, groups=year, statistics=c("mean", "sd"))</pre>
Active data set	/ Rootty bolmont#
Manage variables in active data set 🕨	Recode variables
<pre>} {contrasts(Dataset1\$year)</pre>	Compute new variable
}	Add observation numbers to data set
<	Standardize variables
	Convert numeric variables to factors
Output	Bin numeric variable
	Reorder factor levels
<pre>> summary(AnovaModel.2)</pre>	Drop unused factor levels
Df Sum Sq Mean	Define contrasts for a factor
Residuals 62 505.5 8.	Rename variables
	Delete variables from data set
Set Contrasts for Factor	X
Set contrasts for factor	
Factor (pick one)	
Gender	
race	
year 🗸	
Contrasts	
 Treatment (dummy) contrast 	s
O Sum (deviation) contrasts	
Helmert contrasts	
O Other (specify)	
😲 Help 🛛 🚽 OK	🐺 Cancel

Data \rightarrow Manage variables in active data set \rightarrow Define contrasts for a factor...

Next, conduct ANOVA: Statistics \rightarrow Means \rightarrow One-way ANOVA...

R Commander

File	e Edit Data	Statistics	Graphs	Models	Distributions	Tools	Help	
	Summaries Contingency	+ tables →		Edit data :	set 🔯 View d	ata set	Model: Σ	AnovaModel.8
F	Means		Single	-sample t	·test	1		
r	Proportions	•	Indep	endent sar	nples t-test			
	Variances	•	Paired	l t-test				
	Nonparamet	ric tests 🕨	One-v	vay ANOV	A			
	Dimensional	analysis 🕨	Multi-	way ANO	VA			
	Fit models					_		
-								

Don't forget to tick the "Pairwise comparisons of means" box for Tukey Comparison

R One-Way Analysis of Variance								
Enter name for model: AnovaModel.13								
Groups (pick one)		one)						
Gender	~	age	A					
race		intelligence						
year	\sim	speed_after						
		speed_before						
		swls1						
	_	swls2	¥					
Pairwise comparis	ons	of means						
Welch F-test not a	Welch F-test not assuming equal variances							
🔞 Help 🦘 Reset 🖌 OK 🎇 Cancel 🎓 Apply								

Important values to note: F, df, Sig (p value). If p < .05, check Tukey multiple comparisons for which groups are significantly different.

<u>OR</u>

3.2.2. Chi-Square (Both predictor and outcome are categorical) Statistics → Contingency tables → Two-way table...



Put your predictor in the row box \rightarrow Put your outcome in the column box \rightarrow

😨 Two-Way Table	×
Data Statistics	
Row variable (pick one) Column variable (pick one)	
Gender A Gender	
race race	
year v year v	
Subset expression	
<all cases="" valid=""></all>	
< >	
🔯 Help \land Reset 🖌 OK 💥 Cancel 🥐	Apply

You can set the output from Chi Square Hypothesis Tests on Statistics tab

ඹ Two-Way Table	×				
Data Statistics					
Compute Percentages Row percentages Column percentages					
Percentages of total No percentages					
Hypothesis Lests Chi-square test of independence Components of chi-square statistic					
Print expected frequencies Fished matter					
🔁 Help 🦘 Reset 🖌 OK 🗱 Cancel 🎢 Apply					

Important values to note: Pearson Chi-Square Value, df, Asymp Sig (p value).

4. **Multiple Regression:** (IMPORTANT: Outcome variable is continuous in this analysis. If your outcome is categorical, you will need to go to 3.1.2 Logistic Regression).

Are all of your predictors continuous? IF YES \rightarrow go to 4.1 Analyzing Multiple Regression. If NO \rightarrow go to 1.4 Creating a 2-level grouping variable. When done with this 1.4, you can come back to 4.1.

4.1. Analyzing Multiple Regression

Statistics \rightarrow Fit models \rightarrow Linear regression \rightarrow

R R	Comm	ander									
File	Edit	Data	Statistic	s	Graphs	Models	Distributio	ns	Tools	Help	
Summaries Contingency tables Means Proportions Variances Nonparametric tests Dimensional analysis		* * * * * * *	Junts: (ted) compon \$residu	Edit data	set	w d	ata set	Model:	Σ <no active="" model=""></no>		
	Fit mo	dels		۲	Linear	regressio	n				
<					Linear Genera Multin Ordina	model alized line omial log Il regressi	ar model git model on model				

[enter dependent variable into response box] \rightarrow [enter predictor variables into explanatory variable(s) box] \rightarrow click OK

R Linear Regression X							
Enter name for model: RegModel.1							
Response variable (pick	one)	Explanatory variables (pick one or more)					
age	^	age	~				
intelligence		intelligence					
speed_after		speed_after					
speed_before		speed_before					
swls		swls					
swls1	¥	swls1	Y				
Subset expression							
<all cases="" valid=""></all>							
< >							
🚯 Help 🔍	Rese	et 🎣 OK 😫 (Cancel 🥏 Apply				
			1				

Important values to note in Model Summary: R, R Square, Adjusted R Square; in ANOVA box: F, df, Sig (p value). in Coefficients box: Beta, Std. Error, Sig for each of your variables (ignore constant).