

Introduction to R Workshop Presenters: Jon Wayland and Jeremy Yagle Spring 2013

R is a free software downloadable at http://www.r-project.org/

Notes:	Code and Output:			
01 R Console Setup:				
> prompts you for formula or function.				
The result appears on the next line(s).				
02 Current Working Directory	> getwd()			
Use the getwd() function to see your current working	[1] "C:/Windows/system32"			
directory.				
You can manually change your working directory:				
"file" pull-down menu $ ightarrow$ "change dir" option .				
03 Warning R is case sensitive!				
04 Comments begin with #				
Anything on the line after the # will not be executed by	> # This is a comment!			
R				
05 Note:				
Rather than typing the R commands , you can copy the				
entire contents of the box and use the Edit \rightarrow "Paste				
commands only" option in R				
You can also use the T key to see and edit earlier				
commands				
06 Basic Operations:	> 1+2 #Simple Addition			
Addition Multiplication Exponents Square	[1] 3			
/Subtraction /Division root	> 2*3 #Multiplication			
+ and – * and / ^ Sqrt()				
	> 8/4 #Division			
	> 2 ⁿ 3 #Exponent			
	$\begin{bmatrix} I \end{bmatrix} \delta$			
	> (4*12)/(2*6) #ivitxed Operations			
07 Evenue of Decis Formula:				
U/ Example of Basic Formula:				
Weight*703				
$BMI = \frac{Height^2}{Height^2}$				
where weight is measured in pounds and height is				
measured in inches.	> (119*702)/(CA EA2)			
Calculate the BMI for a 118 lb person who is 64.5 inches				
tall.				
08 Vector				
A data structure in R consisting of a collection of all				
numeric (or all character) values where the position in				
the vector is important .				
So 165 170 175 is different than 165 175 170				

09 Example	Generating	Vectors:				
We have the	ree people w	ith the corres	oonding weights			
and heights						
Person	1	2	3			
Weight	165	170	175			
Height	56	58	60			
We can crea	ate two vecto	ors		> w=c(165,170,175)		
* w= the we	hights of the	three subjects		>w		
* h= the hei	ghts of the t	hree subjects		[1] 165 170 175		
This can be done in two different ways:				> h=scan() #The values below are part of the command		
using the c() function and using the scan() function.			an() function.	56 58		
				60		
For the scar	() function u	used creating h	, values are	> h		
separated b	y spaces or a	going to the ne	ext line.	[1] 56 58 60		
10 Vectors of	of character	values		>g=c("m", "f", "m")		
				>g		
				[1] "m" "f" "m"		
				>state=scan(what="", sep="\n")		
For the scar	n() command	d, what="" ind	icates that the	Pennsylvania		
values are c	haracter.			New York		
				West Virginia		
It values car	h be more th	ian one word,	put one value) state		
per line and	i use the sep		ate that values	> state [[1] "Dependuluania" "New York" "West Virginia"		
enu at the e	ind of the fir	10.		ILT FEITISYIVATIA NEW TOR VVEST VIEBITIA		
11 Example	Showing Us	e of Vectors:		> bmi=(w*703)/(h^2)		
From this w	e can calcula	ite each persoi	n's BMI in a single	> bmi		
step. This cr	eates a new	object that sto	ores these values	[1] 36.98820 35.52616 34.17361		
12 Sub-setti	ing Vectors					
We can find	the height.	weight or BMI	of a specific			
person.	<i>c ,</i>	-				
Find the hei	ght of Perso	n 2		> h[2]		
				[1] 58		
Find the we	ight of Perso	on 3.		> w[3]		
				[1] 175		
We can find	these value	s for more tha	n one person at a			
time.		Level Dev. C		> bmi[c(1,3)]		
Find the BM	II OF Person 1	L and Person 3		[1] 30.98820 34.17361		
13 Data Fra	mes					
A two-dime	nsional R dat	ta structure us	ed for individuals			
with more t	han one vari	able. Each rov	v in the data			
frame conta	ins the infor	mation for one	e individual and			
each columi	n is a variabl	e.				
Data frames	s allow us to	display multin	le records and			
multiple var	iables in a ta	abular format.				
14 Example	Showing Us	e of Data Fran	nes:	> DFbmi=data.frame(h,w,bmi)		
Let's store t	he heights, v	veights and BN	/II's together in a	> DFbmi		
data frame.		-	-	h w bmi		
				1 56 165 36.98820		
				2 58 170 35.52616		
				3 60 175 34.17361		

15 Sub-setting data frames	
	> DFbmi[2,]
Find <u>all</u> information for the second person:	h w bmi 2 58 170 35.52616
Find the heights and weights for the second and third person:	<pre>> DFbmi[c(2,3),c(1,2)] # or DFbmi[c(2,3),c("h","w")]</pre>
16 Importing Data Files Instead of creating vectors and combining them into a data frame, we can input existing data in tabular format.	
17 Example of Reading in Data: The comma-delimited excel file "body.csv" contains the Gender, height, and weight of 40 individuals (20 males and 20 females) . We input the file into R in two ways. The first way allows you to search for the file you want to work with.	> file=file.choose() > body=read.csv(file)
The second way works only if the file is in your working directory.	> body=read.csv("body.csv")
18 Basic Data Frame Information The names() function gives the names of the variables.	<pre>> names(body) [1] "Gender" "Weight" "Height"</pre>
The head() function shows the names, as well as the first six values of each variable.	> head(body) Gender Weight Height 1 Female 118 64.5 2 Male NA 72.5 3 Male 143 73.3 4 Male 172 68.8 5 Female 147 65.0 6 Female 146 69.0
19 Using Variables in Data Frames	> body\$Gender
You can call any variable in a data frame using the name of the data frame followed by \$ followed by the variable name.	 [1] Female Male Male Male Female Female Female [8] Female Male Male Female Male Male Female [15] Female Female Female Male Female Male [21] Male Male Female Male Female Male Female [28] Male Female Female Female Female Male Male [35] Female Female Male Female Male Male Levels: Female Male
20 Attaching and Detaching Using the attach function tells R that we will be working with this data set until we detach it.	> attach(body)
Note: By using the attach(body) function, you can call the variables by their variable names without including the name of the data frame i.e. Weight rather than body\$Weight	
21 Example Let's calculate the BMI of everyone in this data set. Let's also round these values to a single decimal place.	<pre>> BMI=(Weight*703)/(Height^2) > BMI=round(BMI,digits=1) > head(BMI)</pre>
	[1] 19 9 NA 18 7 25 5 24 5 21 6

22 Adding The BMI Vector To The Current Data Frame:					> newbody=data.frame(body,BMI)						
Now add this vector of newly calculated BMI's to our					> head(newbody)						
data frame. Since we are altering the data frame, let's					Gender Weight Height BMI						
name this altered data set newbody .				1 Female	118	64.5 19	9.9				
Missing Values					2 IVIdle	1/A	72.5	νΑ 2 7			
Notice that some of the values in our data set are " NA "					3 Male 143 /3.3 18.7 4 Male 172 69.8 25.5						
This means that they are missing values of there are					5 Female	147	65.0 24	4.5			
missing	values fo	or the We	eight or H	leight.	our BMI	will be	6 Female	146	69.0 2	1.6	
missing as well since our BMI depends on the Weight											
and Height.											
23 Descriptive Statistics:					> summary(n	ewbody	')				
							Condon	We	ight	Voight	DMT
lo find t	the avera	age heigh	it, weigh Lin D	t or BM	I, we car	n use	Female:20	Min.	:106.0	Min. :62.00	Min. :18.70
the sum	mary()	command	i in K.				Male :20	1st Qu	.:135.2	1st Qu.:66.00	1st Qu.:20.70
	provide	es the hui	mber or i	missing r data c	data vai	ues for		Median Mean	:146.5	Median :68.00 Mean :68.53	Median :22.30 Mean :22.63
each var	of male	s as it do	e triat ou	rualas	et nas ar	requar		3rd Qu	.:172.0	3rd Qu.:70.50	3rd Qu.:23.68
the aver	of male	s as it uoi		es. me	weart st	lows		Max.	:192.0	Max. :77.00	Max. :29.90
the aver	age for i		able.					NA'S	: 2.0	NA'S : 1.00	NA'S : 2.00
To find t	he meai	n BMI sco	ore for th	is data	set, we r	need to	> mean(BMI)	1			
account	for the	missing v	alues. Th	ie <mark>na.rn</mark>	n functio	on	[1]NA				
removes	s those r	nissing va	alues.				(5.5.4)	_			
							> mean(BMI,	na.rm=T)		
							[1]22.02032				
Find the	standar	d deviati	on of the	BMI's			> sd(BMI.na.	rm=T)			
	00000	a acriati	0.1.01.01.0				[1] 2.5721				
24 Finding Descriptive Statistics of Subsets of				> moon/Hoig	ht[Cond	or"Ma	lo"l no rm-T)				
24 Fillul	•		atistics c	JI SUDSE			> mean(neig	ntleeua	er Ivia	ie j,na.m=1)	
Individu	als					_	[1] 71.43158	nt[Gena	er Ividi	ie j,iia.iiii–i)	
Individu We can	also find	I the mea	n BMI, h	eight o	r weight	for	[1] 71.43158	nılgena	er ivia	ie j,iia.iiii–1)	
Individu We can males or	also find also find r female	l the mea s. Let's fii	n BMI, h nd the m	eight o ean hei	r weight ght for r	for nales.	[1] 71.43158	Condo			
Individu We can males or	also find also find r female	I the mea s. Let's fin	n BMI, h nd the m	eight o ean hei	r weight ght for r	for nales.	> mean(Heig [1] 71.43158 > tapply(BMI	, Gende	r, mean, i	na.rm=T)	
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Let's see the complete records for individuals with a	> newbody[BMI>25,]					
BMI exceeding 25.		Gender	Weight	Height	BMI	
	NA	<na></na>	NA	NA	NA	
	4	Male	172	68.8	25.54506	
Note the comma inside the subsetting brackets	8	Female	175	66.0	28.24265	
	10	Male	172	68.8	25.54506	
Before the comma: records	20	Male	180	70.0	25.82449	
After the comma: variables	NA.1	<na></na>	NA	NA	NA	
	30	Female	159	66.5	25.27605	
	32	Male	191	67.0	29.91156	
	34	Male	181	69.0	26.72611	

25 Graphical Interpretation:

Now let's look at the BMI's graphically using a histogram.





Let's make a **boxplot** of the BMI's for males and females and compare. Here we can verify that BMI tends to be a little higher for males than for females.

Or even better: (Come to the R Workshop in Graphs!)





> boxplot(BMI~Gender)



>boxplot(BMI~Gender, main="Distribution of BMI by Gender", xlab="Gender", ylab="BMI", col="yellow2")

>abline(h=median(BMI, na.rm=T), col="red", lwd=2)

>grid(NA, NULL, col="grey")

26 Packages There are thousands of functions and datasets that are accessible through packages. For example, the MASS package comes with R but can only be accessed if the library command is used. Other packages can be installed and then activated through the library () command.	> Animals Error: object 'Animals' not found > library(MASS) > Animals
See documentation on MASS at <u>http://cran.r-</u> project.org/web/packages/MASS/MASS.pdf	
27 Getting Help: Use the help() function to see documentation on an R function, including a list of function arguments.	> help(summary)
28 Saving Your Workspace Objects Select "File" and then "Save to file" which allows you to save this as a text file.	
R will also prompt you to save your workspace when you quit R	
29 Saving Your Workspace Commands and Results You may also save your workspace (on your h drive!) and save it as a Word Document or Note Pad (recommended).	
This will show commands and results. It will not save your data objects. You can later copy it and use the "Paste commands only" option in R, but if you used the scan() function to input data, it will not execute properly.	
30 Saving and loading an individual object To save objects as a .RData file, use the save() command.	<pre>> Save(Animals, file="Animals.RData")</pre>
You can move this .RData file to the working directory on another computer and load the objects there.	> load("Animals.RData")
31 The history() function Opens up a "R History window with the most recent commands that you submitted. This will not show the results and it does not include the R prompts.	> history(max.lines=60)
32 Quit R When you are finished with R, you can either exit out manually through the "File" pull down menu or you can use the exit function q() .	>q()

Gender	Weight	Height
Female	118	64.5
Male		72.5
Male	143	73.3
Male	172	68.8
Female	147	65
Female	146	69
Female	138	64.5
Female	175	66
Male	134	66.3
Male	172	68.8
Female	118	64.5
Male	151	70
Male	155	69
Female	155	70.5
Female	146	66
Female	135	68
Female	127	68.5
Male	178	73.5
Female	136	66.3
Male	180	70
Male		
Male	186	76.5
Female	122	62
Male	132	68
Female	114	63
Male	171	72
Female	140	68
Male	187	77
Female	106	63
Female	159	66.5
Female	127	62.5
Male	191	67
Male	192	75.5
Male	181	69
Female	143	66.5
Female	153	66.5
Male	144	70.5
Female	139	64.5
Male	148	74
Male	179	75.5

Appendix the body data set