

Contents

1	Introduction	2
1.1	Structure of collection	2
2	RMarkdown	4
2.1	Formatting basics	4
3	Rstudio	4
3.1	Useful packages	5
3.2	Remove a package	6
3.3	Import using Janitor	6
3.4	Remove dataframe	6
3.5	New vars by concatination	7
3.6	Save dataframe (CSV or Rdata)	7
3.7	Save a diagram or plot	7
3.8	Recode a text variable	8
3.9	Alter variable names:	8
4	Data Wrangling and manipulation	9
4.1	Bin variable (e.g. Low/Medium/High)	10
4.2	Conditional function	10
4.3	Sum across rows	10
4.4	Standardise variable	10
4.5	Conditional Replacement	11
4.6	replace a specific value	11
4.7	Filter na's or retain complete cases	11
4.8	Delete specified columns	11
4.9	Change specific datapoint	12
4.10	Work with dates	12
4.11	Find duplicate rows	12
4.12	Impute missing values	12
4.13	Keep rows based on a unique value.	12
4.14	Delete rows on a variable value	13
4.15	Use if else to calculate on values	13
4.16	Merge data frames (variables)	13
4.17	Merge data frames (individuals)	14
4.18	Create a new factor from existing	14

4.19 change data types	15
4.20 calculate dates and photoperiod	15
4.21 Reduce variables using PCA	16
5 Statistical Analysis	16
5.1 Regression	16
5.2 Linear Regression	16
5.3 Logistic Regression	18
5.4 Principle Component Analysis	18
5.5 Survival Analysis and Visualisation	18
5.6 Receiver Operated Curves (ROC)	18
6 Data Visualisation	18
6.1 Packages needed	18
6.2 Summary Tables	19
6.3 Correlation matrix	23
6.4 Graphing	23
6.5 line defined by equation to scatterplot	43
7 BBC style	44
7.1 load packages	44
##— #title: “Useful R syntax” #author: “Dr Chris McNeil” #site: bookdown::bookdown_site #document-class: book #output: # bookdown::gitbook: default # bookdown::pdf_book: default #—	

1 Introduction

This document is a collection of useful code for Rmarkdown and R

I have used the mtcars dataset if possible

I have used the Tidyverse and the pipe (%>%) if possible

I recommend that the code is checked for warnings that is is not depreciated

1.1 Structure of collection

- 1. Rmarkdown
 - formatting basics
- 2. Rstudio
 - load/unload packages
 - print figures to files
 - Libraries/packages



Figure 1: Don't Panic

- essential/useful packaged
- 3. Data wrangling
 - load dataset
 - clean environment
 - check for duplicates
 - Merging datasheets
 - Merging datasets
 - Reshaping
 - recode factors
 - dealing with missing data
 - Data reduction with PCA
 - Data standardisation
- 4. Statistical analysis
- 5. Data Visualisation
 - Tables
 - Plots

2 RMarkdown

This chapter contains syntax for the non-code rmarkdown sections.

2.1 Formatting basics

```
*** on its own, for a horizontal line
**text** for bold
*text* for italics
1. Item 1
2. Item 2
3. Item 3
  + Item 3a
  + Item 3b for ordered lists

[linked phrase](http://example.com) for links
![alt text](figures/img.png) for images

### R chunk basics
message=FALSE, warning=FALSE, include=FALSE, ECHO=FALSE (show output),

To set document default knitr::opts_chunk$set(echo=FALSE)
```

3 Rstudio

This chapter contains syntax for manipulating data and packages within the R studio environment.

3.1 Useful packages

Load all libraries

```
library(tidyverse) # data handling and viz

## Warning: package 'tidyverse' was built under R version 4.0.5

## -- Attaching packages ----- tidyverse 1.3.1 --

## v ggplot2 3.3.3      v purrr   0.3.4
## v tibble   3.1.2      v dplyr    1.0.6
## v tidyr    1.1.3      v stringr  1.4.0
## v readr    1.4.0      vforcats  0.5.1

## Warning: package 'ggplot2' was built under R version 4.0.5

## Warning: package 'tibble' was built under R version 4.0.5

## Warning: package 'tidyr' was built under R version 4.0.5

## Warning: package 'dplyr' was built under R version 4.0.5

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()

library(janitor) #dataframe import cleaning

## Warning: package 'janitor' was built under R version 4.0.5

##
## Attaching package: 'janitor'

## The following objects are masked from 'package:stats':
## 
##     chisq.test, fisher.test

library(knitr) #nice html tables

## Warning: package 'knitr' was built under R version 4.0.5

library(kableExtra) # nicer knitr tables

## Warning: package 'kableExtra' was built under R version 4.0.5

##
## Attaching package: 'kableExtra'

## The following object is masked from 'package:dplyr':
## 
##     group_rows
```

```

library(broom)

## Warning: package 'broom' was built under R version 4.0.5

library(readr) # load csv stored data
library(geosphere) # for calc daylength

## Warning: package 'geosphere' was built under R version 4.0.5

```

3.2 Remove a package

```

#Unload a module:
library(clipr) #load

## Welcome to clipr. See ?write_clip for advisories on writing to the clipboard in R.

detach(package:clipr) #unload

```

3.3 Import using Janitor

```

# Create a data.frame with dirty names
test_df <- as.data.frame(matrix(ncol = 6))
names(test_df) <- c("firstName", "ábc@!*", "% successful (2009)",
                    "REPEAT VALUE", "REPEAT VALUE", "")
head(test_df)

##   firstName ábc@!* % successful (2009) REPEAT VALUE REPEAT VALUE
## 1          NA      NA                 NA          NA      NA NA

test_df <- test_df %>%
  clean_names()
head(test_df)

##   first_name abc_percent_successful_2009 repeat_value repeat_value_2  x
## 1          NA      NA                 NA          NA      NA NA

```

Reference

3.4 Remove dataframe

```

data("mtcars")
data("band_instruments")
data("band_instruments2") # Load example datasets

rm(list=ls()[! ls() %in% c("band_instruments", "band_instruments2")])
# Everything except Band instruments
rm(list=setdiff(ls(), "band_instruments")) # Everything except "bandinstruments"
rm(list=ls()) # Remove everything

```

Reference:Stackoverflow

3.5 New vars by concatenation

3.6 Save dataframe (CSV or Rdata)

make date string

```

datenow <- format(Sys.time(), "_%Y_%m_%d")
date

```

```

## function ()
## .Internal(date())
## <bytecode: 0x000000001a771db0>
## <environment: namespace:base>

```

```
data(mtcars)
```

Write file names

```
#create data directory
dir.create("data_out")
```

```
## Warning in dir.create("data_out"): 'data_out' already exists
```

```
filenamecsv <- paste("data_out/mtcsvdata", datenow, ".csv", sep="")
filenamerda <- paste("data_out/mtrdadada", datenow, ".rda", sep="")
```

Save the files

```
save(mtcars, file=filenamerda)
write.csv(mtcars, file=filenamecsv)
```

3.7 Save a diagram or plot

```

plot1 <- mtcars %>% ggplot(aes(hp, qsec)) + geom_point()
#plot1 #print plot if required
pdf("plot.pdf")
plot1
dev.off()

```

name	band
Mick	Stones
John	Beatles
Paul	Beatles

name	band
m	Stones
John	Beatles
Paul	Beatles

```
## pdf
## 2
```

```
pdf 'device' off.
```

3.8 Recode a text variable

```
data("band_members")
kable(head(band_members)) %>% kable_minimal(full_width = F)
```

```
band_members <- band_members %>% mutate(name=recode(name, "Mick"= "m"))
kable(head((band_members))) %>% kable_minimal(full_width = F)
```

```
rm(list=ls()) # Remove everything
```

Reference: Kable Extra

3.9 Alter variable names:

Remove underscores

```
data("mtcars")
mtcars <- mtcars %>% rename(hp_new=hp)
kable(head((mtcars))) %>% kable_minimal(full_width = F)
```

```
mtcars <- mtcars %>% rename_with(.fn = ~str_replace(., "_", ""))
kable(head((mtcars))) %>% kable_minimal(full_width = F)
```

	mpg	cyl	disp	hp_new	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

	mpg	cyl	disp	hpnew	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

3.9.1 list datasets available

```
#data() # list all available datasets
data("diamonds")
```

3.9.2 Render book

4 Data Wrangling and manipulation

```
library(Hmisc) #impute values

## Warning: package 'Hmisc' was built under R version 4.0.5

## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':
## 
##     src, summarize

## The following objects are masked from 'package:base':
## 
##     format.pval, units

library(naniar) # deal with NAs

## Warning: package 'naniar' was built under R version 4.0.5
```

```

library(geosphere)
library(tidyverse) # data handling and viz
library(janitor) #dataframe import cleaning
library(knitr) #nice html tables
library(kableExtra) # nicer knitr tables
library(broom)
library(readr) # load csv stored data
library(geosphere) # for calc daylength
library(lubridate)

##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##       date, intersect, setdiff, union

```

4.1 Bin variable (e.g. Low/Medium/High)

```

data(mtcars)
mtcars <- mtcars %>% mutate(hp_cat=cut(hp, breaks=c(-Inf, 100, Inf),
                                         labels=c("low hp","high hp")))

```

4.2 Conditional function

```

mtcars <- mtcars %>% mutate(loghp=ifelse(cyl>4,log10(hp),NA))
# Nonsensical example, but log transformed all horse powers of cars with more
# than four cylinders

```

4.3 Sum across rows

```

mtcars <- mtcars %>%  mutate(sum = select(., disp:drat) %>%
apply(1, sum, na.rm=TRUE))
#apply() takes Data frame or matrix as an input and gives output in vector
#(i.e.many columns to one list)
# the '1' sets the dataframe to use (already selected here)

```

Reference

4.4 Standardise variable

```

dat2 <- mtcars %>%
  as_tibble() %>%
  mutate(across(where(is.numeric), scale))

funcs <- list(mean = ~mean(.x,na.rm = TRUE),
  sd = ~sd(.x,na.rm = TRUE)
)
dat2 %>% summarise(across(where(is.numeric), funcs))

## # A tibble: 1 x 26
##   mpg_mean mpg_sd cyl_mean cyl_sd disp_mean disp_sd hp_mean hp_sd drat_mean
##   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 7.11e-17    1 -1.47e-17    1 -9.08e-17    1 1.04e-17    1 -2.92e-16
## # ... with 17 more variables: drat_sd <dbl>, wt_mean <dbl>, wt_sd <dbl>,
## #   qsec_mean <dbl>, qsec_sd <dbl>, vs_mean <dbl>, vs_sd <dbl>, am_mean <dbl>,
## #   am_sd <dbl>, gear_mean <dbl>, gear_sd <dbl>, carb_mean <dbl>,
## #   carb_sd <dbl>, loghp_mean <dbl>, loghp_sd <dbl>, sum_mean <dbl>,
## #   sum_sd <dbl>

```

4.5 Conditional Replacement

Replace all 'NA's in a specified variable with 0.

```

mtcars <- mtcars %>% mutate(loghp1 = coalesce(loghp, 0))
#or
mtcars <- mtcars %>% mutate(loghp = replace_na(loghp, "missing"))

```

4.6 replace a specific value

```
#ageandheight [row number, column number] = [new value]
```

4.7 Filter na's or retain complete cases

```

mtcars <- mtcars %>% filter(!is.na(hp)) # no missing values found
mtcars <- mtcars %>%filter(complete.cases(.)) # no missing values found

```

4.8 Delete specified columns

```

mtcars1 <- mtcars %>% select(-(drat)) # single column
mtcars2 <- mtcars %>% select(-c(drat,hp,vs:gear)) # multiple columns

rm(list=setdiff(ls(), "mtcars")) # clean environment

```

	Var1	Freq
1	10.4	2
6	15.2	2
14	19.2	2
16	21	2
17	21.4	2
19	22.8	2
23	30.4	2

4.9 Change specific datapoint

```
mtcarsmissingvalues <- mtcars %>% mutate(gear=ifelse(gear==5,"missing",gear))
```

4.10 Work with dates

Add a date column

```
mtcars <- mtcars %>% mutate(date=ymd("2001-05-24"))
```

4.11 Find duplicate rows

```
# specify which variable to check for duplication
n_occur1 <- data.frame(table(mtcars$mpg))
kable(n_occur1[n_occur1$Freq > 1,]) %>% kable_styling(full_width = F) %>%
  kable_minimal()
```

4.12 Impute missing values

4.12.1 To be completedImputing missing values using the mean:

```
#create missing values
#mtcarsmissingvalues <- mtcars %>% mutate(gear=ifelse(gear==5, "", gear))

mtcarsmissingvalues <- mtcars %>% replace_with_na(replace = list(gear = 5))
mtcarsmissingvalues$gear <- impute(mtcarsmissingvalues$gear, mean) # replace with mean
mtcarsmissingvalues$gear <- impute(mtcarsmissingvalues$gear, median) # median
mtcarsmissingvalues$gear <- impute(mtcarsmissingvalues$gear, 4) # replace specific number
```

Reference:

4.13 Keep rows based on a unique value.

e.g. prescription code

```
mtcarsdistinct <- mtcars %>%    distinct(cyl, .keep_all= TRUE)
```

Reference

4.14 Delete rows on a variable value

```
mtcars1<-mtcars %>% filter(!(cyl==6))
mtcars2<-mtcars %>% filter(!(cyl==6 | hp==180)) # | is the 'or' operator
mtcars3<-mtcars %>% filter(!(cyl==8 & hp==215)) # & is the 'and' operator
# remove the ! To select the individuals with the specified conditions
```

4.15 Use if else to calculate on values

```
# no NA's so all values unchanged.
mtcars <- mtcars %>% mutate(vs=ifelse(is.na(vs),(carb-am)/365.25,vs))
```

4.16 Merge data frames (variables)

*left_join(x, y): returns all rows from x, and all columns from x and y. Rows in x with no match in y will have NA values in the new columns. If there are multiple matches between x and y, all combinations of the matches are returned.

*inner_join(x, y): returns all rows from x where there are matching values in y, and all columns from x and y. If there are multiple matches between x and y, all combinations of the matches are returned.

*full_join(x, y): returns all rows and all columns from both x and y. Where there are not matching values, the function returns NA for the one missing

- inner: only rows with matching keys in both x and y
- left: all rows in x, adding matching columns from y
- right: all rows in y, adding matching columns from x
- full: all rows in x with matching columns in y, then the rows of y that don't match x.

```
# prepare new dataset
# make the rownames into a 'joinable' column
mtcars <- mtcars %>% mutate(carnames=rownames(mtcars))
mtcars_extradata <- mtcars %>% select(cyl)
# make the rownames into a 'joinable' column
mtcars_extradata <- mtcars_extradata %>%
mutate(carnames=rownames(mtcars_extradata))
mtcars_extradata <- mtcars_extradata %>% mutate(valves=cyl*4)
mtcars_extradata <- mtcars_extradata %>% select(-cyl)

kable(glimpse(mtcars_extradata%>% slice(1:6))) %>%
  kable_styling(full_width = F) %>%
  kable_minimal()
```

	carnames	valves
Mazda RX4	Mazda RX4	24
Mazda RX4 Wag	Mazda RX4 Wag	24
Datsun 710	Datsun 710	16
Hornet 4 Drive	Hornet 4 Drive	24
Hornet Sportabout	Hornet Sportabout	32
Valiant	Valiant	24

carb	hp_cat	loghp	sum	loghp1	date	carnames	valves
4	high hp	2.04139268515822	273.90	2.041393	2001-05-24	Mazda RX4	24
4	high hp	2.04139268515822	273.90	2.041393	2001-05-24	Mazda RX4 Wag	24
1	low hp	missing	204.85	0.000000	2001-05-24	Datsun 710	16
1	high hp	2.04139268515822	371.08	2.041393	2001-05-24	Hornet 4 Drive	24
2	high hp	2.24303804868629	538.15	2.243038	2001-05-24	Hornet Sportabout	32
1	high hp	2.02118929906994	332.76	2.021189	2001-05-24	Valiant	24

```
## Rows: 6
## Columns: 2
## $ carnames <chr> "Mazda RX4", "Mazda RX4 Wag", "Datsun 710", "Hornet 4 Drive",~
## $ valves    <dbl> 24, 24, 16, 24, 32, 24
```

```
mtcars <- left_join(mtcars, mtcars_extradata, by = 'carnames')

kable(glimpse(mtcars %>% select(carb:valves) %>% slice(1:6))) %>%
  kable_styling(full_width = F) %>%
  kable_minimal()
```

```
## Rows: 6
## Columns: 8
## $ carb      <dbl> 4, 4, 1, 1, 2, 1
## $ hp_cat    <fct> high hp, high hp, low hp, high hp, high hp, high hp
## $ loghp     <chr> "2.04139268515822", "2.04139268515822", "missing", "2.0413926~
## $ sum       <dbl> 273.90, 273.90, 204.85, 371.08, 538.15, 332.76
## $ loghp1    <dbl> 2.041393, 2.041393, 0.000000, 2.041393, 2.243038, 2.021189
## $ date      <date> 2001-05-24, 2001-05-24, 2001-05-24, 2001-05-24, 2001-05-24, 2~
## $ carnames   <chr> "Mazda RX4", "Mazda RX4 Wag", "Datsun 710", "Hornet 4 Drive",~
## $ valves    <dbl> 24, 24, 16, 24, 32, 24
```

4.17 Merge data frames (individuals)

```
mtcarsmerged <- bind_rows(mtcars2, mtcars3)
rm(list=setdiff(ls(), "mtcars")) # clean environment
```

Reference

4.18 Create a new factor from existing

```
mtcars <- mtcars %>% mutate(cyc_carb = paste(cyl,carb,sep="-"))
```

4.19 change data types

(merging fails if data types are different)

```
# adni_demog<-adni_demog %>% mutate(age_scan=as.numeric(age_scan))
# ukbb<-ukbb %>% mutate(scan_no=as.numeric(scan_no))
```

4.20 calculate dates and photoperiod

(using geosphere library)

```
#import sample dataset
dateslat <- read_csv("dateslat.csv")

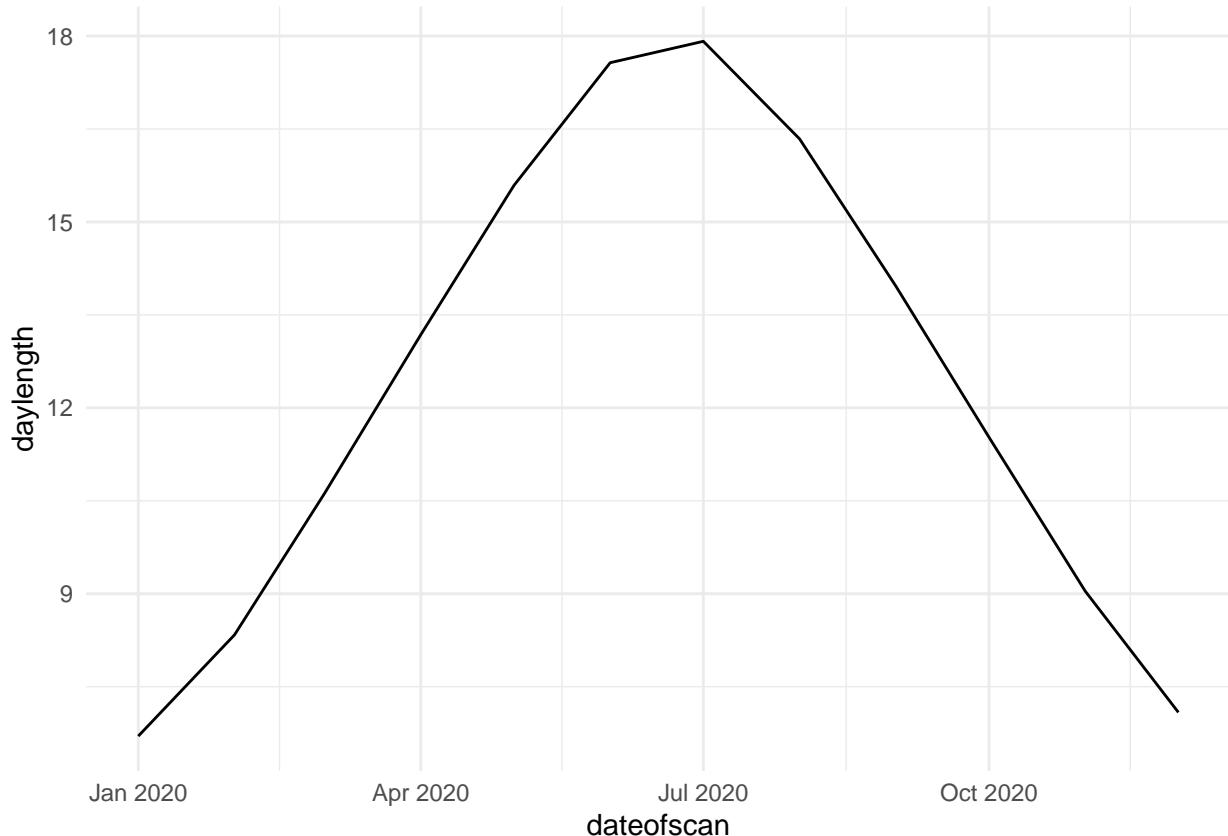
## 
## -- Column specification -----
## cols(
##   `ID's` = col_double(),
##   `date (dmy)` = col_character(),
##   latitude = col_double()
## )

dateslat <- dateslat %>%
  clean_names()

dateslat <- dateslat %>% mutate(dateofscan=(as.Date(date_dmy,format="%d/%m/%Y")))
dateslat <- dateslat %>% mutate(daylength=daylength(latitude,dateofscan))

dateslat %>% ggplot(aes(x=dateofscan,y=daylength)) +geom_line() +theme_minimal()
```

as.factor(gear)	mean	sd
3	17.692	1.349916
4	18.965	1.613880
5	15.640	1.130487



4.21 Reduce variables using PCA

4.21.1 To be completed

5 Statistical Analysis

5.1 Regression

5.1.1 Linear regression on groups

5.2 Linear Regression

```
kable(mtcars %>% group_by(as.factor(gear)) %>%
summarise(mean = mean(qsec), sd = sd(qsec))) %>%
kable_styling(full_width = F) %>%
kable_minimal()
```

gear	r.squared	adj.r.squared	sigma	statistic	p.value	df	logLik	AIC	BIC	deviance	df.residual	no
3	0.66	0.63	28.87	25.19	0.00	1	-70.65	147.31	149.43	10837.12	13	
4	0.10	0.01	25.72	1.15	0.31	1	-54.90	115.80	117.26	6616.46	10	
5	0.88	0.83	41.95	21.03	0.02	1	-24.50	55.00	53.83	5279.95	3	

```
#Run the same linear regression model by group levels?
#Instead of running #summary(lm(y~x)) for the number of levels
#you have, you can use the R package "broom" along with dplyr.
```

```
# Run the same regression model for gears ##
kable(mtcars %>% group_by(gear) %>%
  do(fitgear = glance(lm(hp~qsec, data = .))) %>%
  unnest(fitgear), digits=2) %>% kable_styling(full_width = F) %>%
  kable_minimal()
```

Reference

```
fit <- lm(qsec ~ wt + hp+disp+factor(cyl), data = mtcars)
summary(fit)

## 
## Call:
## lm(formula = qsec ~ wt + hp + disp + factor(cyl), data = mtcars)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -1.9745 -0.5007 -0.1771  0.4984  2.7516 
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept) 17.487436  0.856699  20.413 < 2e-16 ***
## wt          1.620772  0.424366   3.819 0.000748 ***
## hp         -0.019618  0.004912  -3.994 0.000475 ***
## disp        -0.004124  0.005194  -0.794 0.434313  
## factor(cyl)6 -1.407378  0.588219  -2.393 0.024245 *  
## factor(cyl)8 -1.636367  1.131421  -1.446 0.160043  
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.9978 on 26 degrees of freedom
## Multiple R-squared:  0.7385, Adjusted R-squared:  0.6882 
## F-statistic: 14.68 on 5 and 26 DF,  p-value: 7.13e-07
```

```
effectsize(fit)

## # Standardization method: refit
## 
## Parameter | Coefficient (std.) |         95% CI
## -----
## (Intercept) |                 0.57 | [-0.13,  1.28]
## wt          |                 0.89 | [ 0.41,  1.37]
```

```

## hp | -0.75 | [-1.14, -0.37]
## disp | -0.29 | [-1.03, 0.45]
## factor(cyl)6 | -0.79 | [-1.46, -0.11]
## factor(cyl)8 | -0.92 | [-2.22, 0.39]

anova_table <- anova(fit)
effectsize(anova_table)

## # Effect Size for ANOVA (Type I)
##
## Parameter | Eta2 (partial) | 90% CI
## -----
## wt | 0.10 | [0.00, 0.31]
## hp | 0.70 | [0.53, 0.80]
## disp | 0.10 | [0.00, 0.30]
## factor(cyl) | 0.18 | [0.00, 0.33]

```

5.3 Logistic Regression

5.3.1 Create the LogR model

5.4 Principle Component Analysis

5.4.1 Extracting 1st component

complete dataset needed for following

5.5 Survival Analysis and Visualisation

5.5.1 To be completed

5.6 Receiver Operated Curves (ROC)

5.6.1 To be completed

6 Data Visualisation

Tables and graphs, survival plots, missing values.

6.1 Packages needed

```

library(arsenal) # for summary tables
library(summarytools) # for summary tables
library(gridExtra) # print multiple plots as grid
library(ggpmisc) # add formulas and p values to scatterplots
library(corrplot) #plotting correlations
library(Hmisc) #impute values
library(naniar) # deal with NAs

```

cyl	Ave	StDev
4	82.63636	20.93453
6	122.28571	24.26049
8	209.21429	50.97689
mpg_mean	mpg_sd	cyl_mean
20.09	6.03	6.19
cyl_sd	hp_mean	hp_sd
1.79	146.69	68.56

```
library(geosphere)
library(tidyverse) # data handling and viz
library(janitor) #dataframe import cleaning
library(knitr) #nice html tables
library(kableExtra) # nicer knitr tables
library(broom)
library(readr) # load csv stored data
library(geosphere) # for calc daylength
#library(RColorBrewer)
library(viridis)
library(reshape2)
library(ggrepel) # label points on ggplot
source("https://gist.githubusercontent.com/benmarwick/2a1bb0133ff568cbe28d/raw/fb53bd97121f7f9ce947837e2

```

6.2 Summary Tables

6.2.1 Summarise by group

```
data(mtcars)
kable(mtcars %>% group_by(cyl) %>% summarise(Ave=mean(hp), StDev=sd(hp))) %>%
  kable_styling(full_width = FALSE) %>% kable_minimal()
```

6.2.2 Multiple functions, variables

```
# make sure brackets are correct

df.sum <- mtcars %>% select(mpg,cyl,hp) %>%
  summarise(across(everything(),list(mean=mean,sd=sd)))
kable(df.sum,digits=2) %>% kable_styling(full_width = FALSE) %>%
  kable_minimal() # perform the analysis
```

```
df.longer <- df.sum%>% pivot_longer(col=everything(),
  names_to = c("Attribute",".value"),
  names_sep = "_")
kable(df.longer,digits=2) %>%
  kable_styling(full_width = FALSE) %>%
  kable_minimal() # pivot longer the analysis to make it readable
```

Attribute	mean	sd
mpg	20.09	6.03
cyl	6.19	1.79
hp	146.69	68.56

6.2.3 ‘Arsenal’ summary table

```
tab1 <- tableby(cyl~gear+hp+wt,data=mtcars)
summary(tab1, text=TRUE, digits=2, digits.p=2, digits.pct=1)
```

	4 (N=11)	6 (N=7)	8 (N=14)	Total (N=32)	p value
gear					0.01
- Mean (SD)	4.09 (0.54)	3.86 (0.69)	3.29 (0.73)	3.69 (0.74)	
- Range	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	
hp					< 0.01
- Mean (SD)	82.64 (20.93)	122.29 (24.26)	209.21 (50.98)	146.69 (68.56)	
- Range	52.00 - 113.00	105.00 - 175.00	150.00 - 335.00	52.00 - 335.00	
wt					< 0.01
- Mean (SD)	2.29 (0.57)	3.12 (0.36)	4.00 (0.76)	3.22 (0.98)	
- Range	1.51 - 3.19	2.62 - 3.46	3.17 - 5.42	1.51 - 5.42	

6.2.4 Summarytools tables

```
descr(mtcars, stats = c("mean", "sd"), transpose = TRUE, headings = FALSE)
```

```
##
##          Mean   Std.Dev
## -----
##      am    0.41    0.50
##      carb   2.81    1.62
##      cyl    6.19    1.79
##      disp  230.72   123.94
##      drat   3.60    0.53
##      gear   3.69    0.74
##      hp    146.69   68.56
##      mpg   20.09    6.03
##      qsec   17.85    1.79
##      vs     0.44    0.50
##      wt     3.22    0.98
```

```
kable(descr(mtcars, stats = c("mean", "sd", "n.valid"), transpose = TRUE,
           headings = FALSE), digits = 3) %>%
  kable_styling(full_width = FALSE)%>% kable_minimal()
```

```
## Warning in if (grepl(re1, str, perl = TRUE)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in if (grepl(re2, str, perl = TRUE)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in if (grepl(re3, str, perl = TRUE)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Error in pryr::where(obj_name) : length(name) == 1 is not TRUE
```

	Mean	Std.Dev	N.Valid
am	0.406	0.499	32
carb	2.812	1.615	32
cyl	6.188	1.786	32
disp	230.722	123.939	32
drat	3.597	0.535	32
gear	3.688	0.738	32
hp	146.688	68.563	32
mpg	20.091	6.027	32
qsec	17.849	1.787	32
vs	0.438	0.504	32
wt	3.217	0.978	32

6.2.5 Visual summary of data

Options are for markdown

```
dfSummary(mtcars, plain.ascii = FALSE, style = "grid",
          graph.magnif = 0.5, valid.col = FALSE, tmp.img.dir = "/tmp")

## temporary images written to 'C:\tmp'
```

6.2.6 Data Frame Summary

6.2.6.1 mtcars Dimensions: 32 x 11

Duplicates: 0

No	Variable	Stats / Values	Freqs (% of Valid)	Graph	Missing
1	mpg	Mean (sd) : 20.1 (6) [numeric] min < med < max: 10.4 < 19.2 < 33.9 IQR (CV) : 7.4 (0.3)	25 distinct values		0 (0.0%)
2	cyl	Mean (sd) : 6.2 (1.8) [numeric] min < med < max: 4 < 6 < 8 IQR (CV) : 4 (0.3)	4 : 11 (34.4%) 6 : 7 (21.9%) 8 : 14 (43.8%)		0 (0.0%)
3	disp	Mean (sd) : 230.7 (123.9) [numeric] min < med < max: 71.1 < 196.3 < 472 IQR (CV) : 205.2 (0.5)	27 distinct values		0 (0.0%)

No	Variable	Stats / Values	Freqs (% of Valid)	Graph	Missing
4	hp	Mean (sd) : 146.7 (68.6) [numeric] min < med < max: $52 < 123 < 335$ IQR (CV) : 83.5 (0.5)	22 distinct values		0 (0.0%)
5	drat	Mean (sd) : 3.6 (0.5) [numeric] min < med < max: $2.8 < 3.7 < 4.9$ IQR (CV) : 0.8 (0.1)	22 distinct values		0 (0.0%)
6	wt	Mean (sd) : 3.2 (1) [numeric] min < med < max: $1.5 < 3.3 < 5.4$ IQR (CV) : 1 (0.3)	29 distinct values		0 (0.0%)
7	qsec	Mean (sd) : 17.8 (1.8) [numeric] min < med < max: $14.5 < 17.7 < 22.9$ IQR (CV) : 2 (0.1)	30 distinct values		0 (0.0%)
8	vs	Min : 0 [numeric] Mean : 0.4 Max : 1	0 : 18 (56.2%) 1 : 14 (43.8%)		0 (0.0%)
9	am	Min : 0 [numeric] Mean : 0.4 Max : 1	0 : 19 (59.4%) 1 : 13 (40.6%)		0 (0.0%)
10	gear	Mean (sd) : 3.7 (0.7) [numeric] min < med < max: $3 < 4 < 5$ IQR (CV) : 1 (0.2)	3 : 15 (46.9%) 4 : 12 (37.5%) 5 : 5 (15.6%)		0 (0.0%)

No	Variable	Stats / Values	Freqs (% of Valid)	Graph	Missing
11	carb [numeric]	Mean (sd) : 2.8 (1.6) min < med < max: 1 < 2 < 8 IQR (CV) : 2 (0.6)	1 : 7 (21.9%) 2 : 10 (31.2%) 3 : 3 (9.4%) 4 : 10 (31.2%) 6 : 1 (3.1%) 8 : 1 (3.1%)		0 (0.0%)

6.3 Correlation matrix

6.3.1 Ellipse style

```
corrdata <- mtcars %>% select(-c(cyl,disp,vs,am,gear,carb))
corr1 <- Hmisc::rcorr(as.matrix(corrdata))
M <- corr1$r
#M
colnames(M) <- c("mpg", "HP", "Axe Ratio", "Weight (kPounds)", "Quarter Mile (s)")
rownames(M) <- c("mpg", "HP", "Axe Ratio", "Weight (kPounds)", "Quarter Mile (s)")
p_mat <- corr1$p
corr <- corrplot(M, type = "upper", method="ellipse", order = "hclust",
                  p.mat = p_mat, sig.level = 0.05, insig = "blank")
```

- Red is -ve correlation
- Blue is + ve correlation
- Blank is no correlation

Reference

6.4 Graphing

6.4.1 Basic distribution Histogram

```
plot1 <- mtcars %>% ggplot(aes(qsec))+geom_histogram()
plot1

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

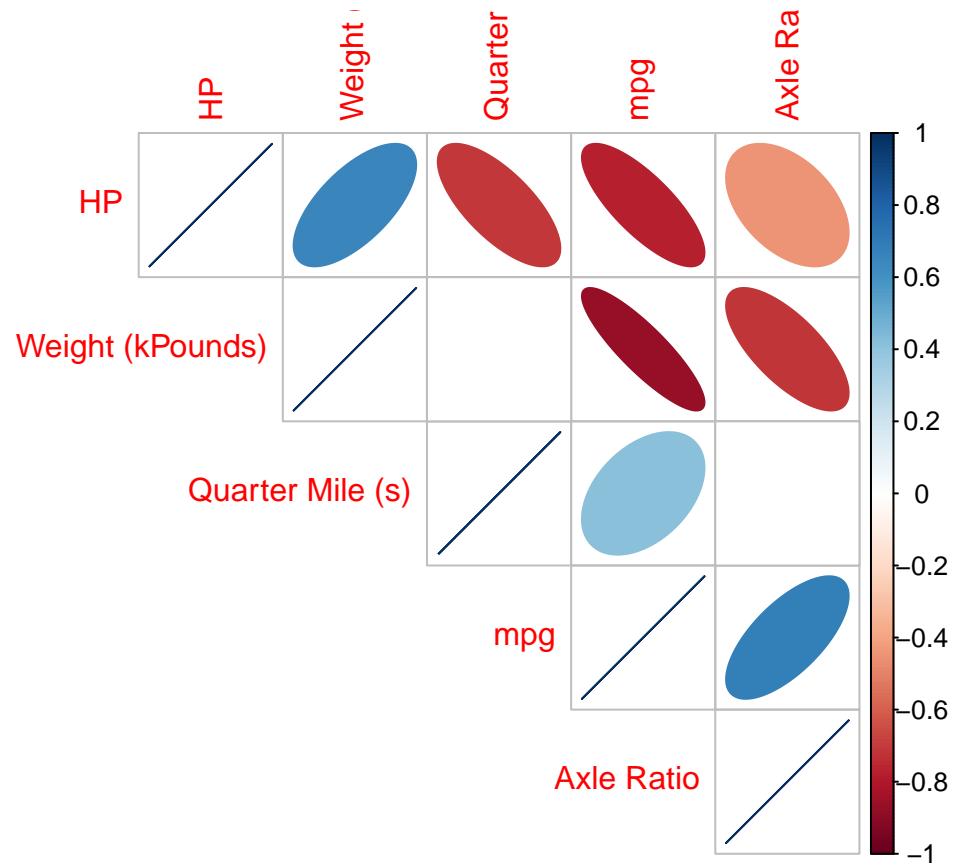
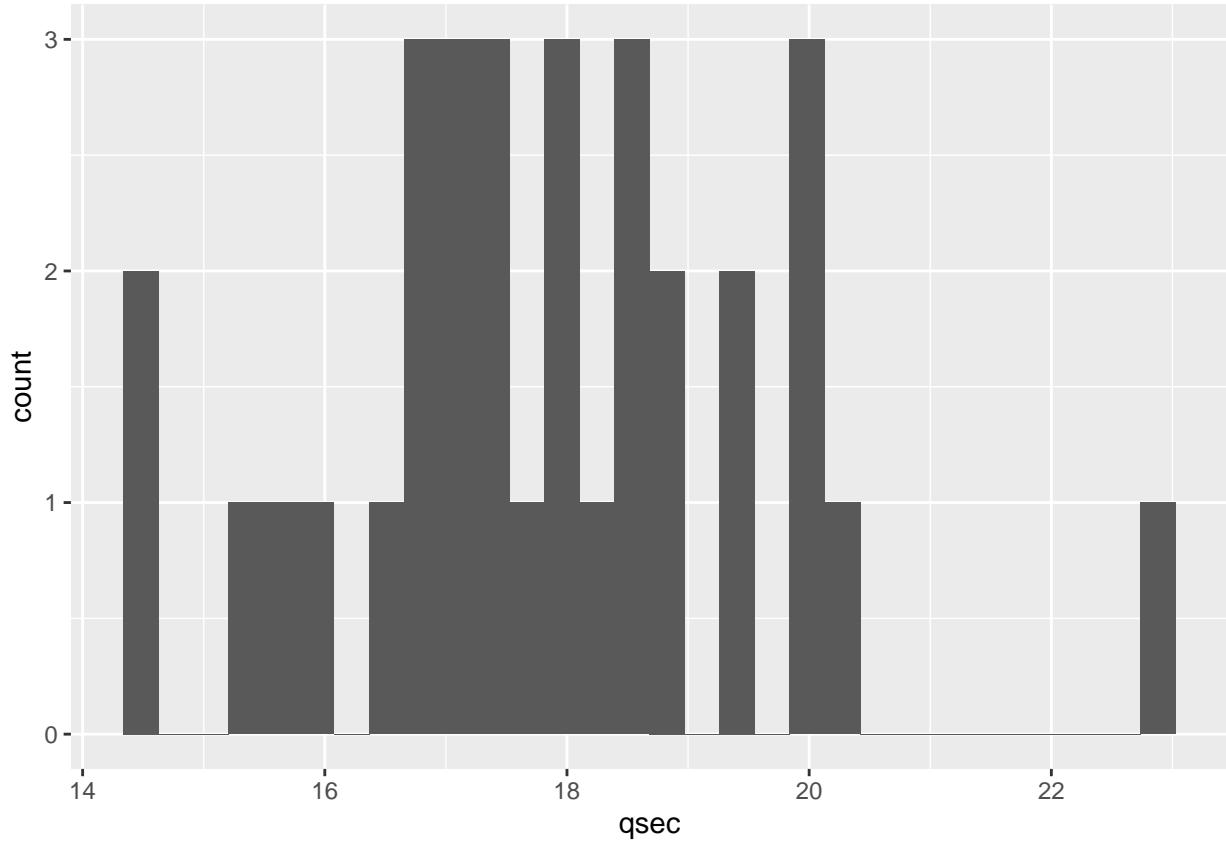
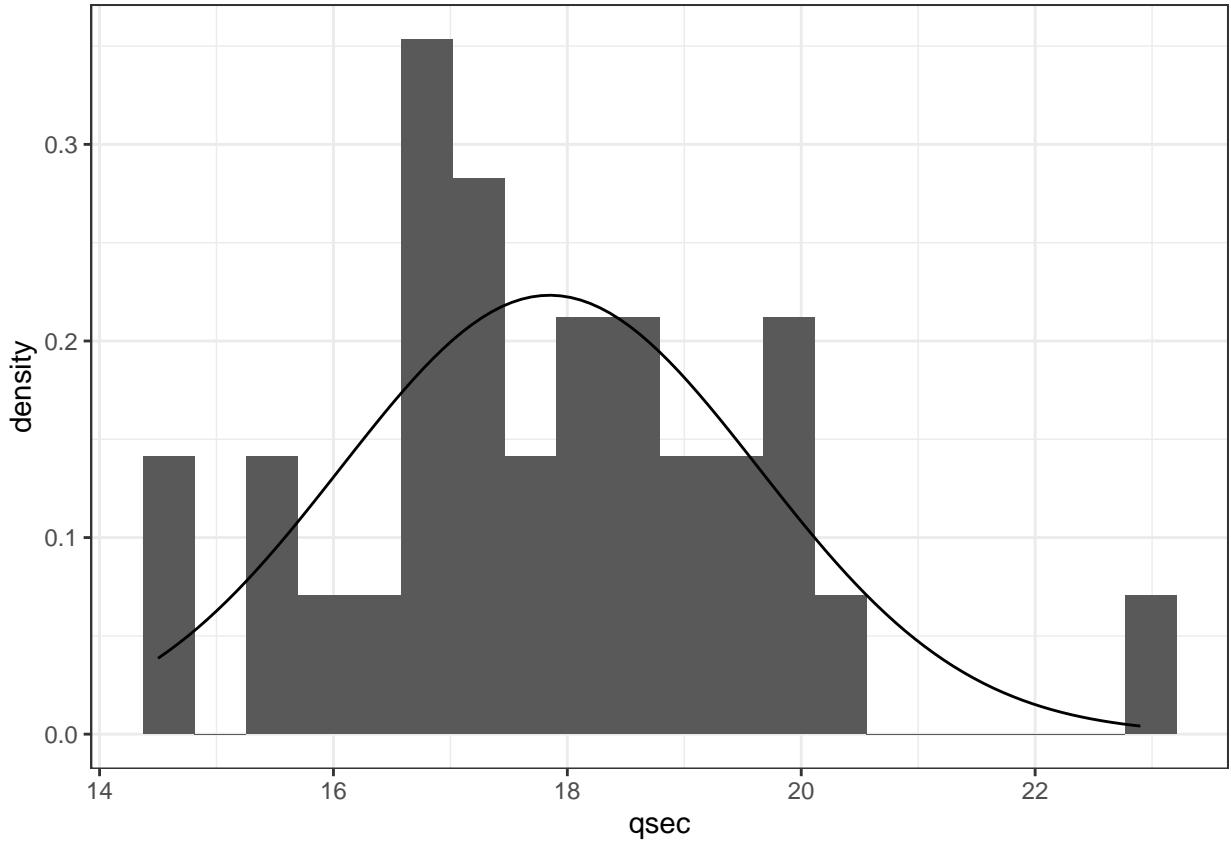


Figure 2: Correlation Plot



Distribution + Normal line

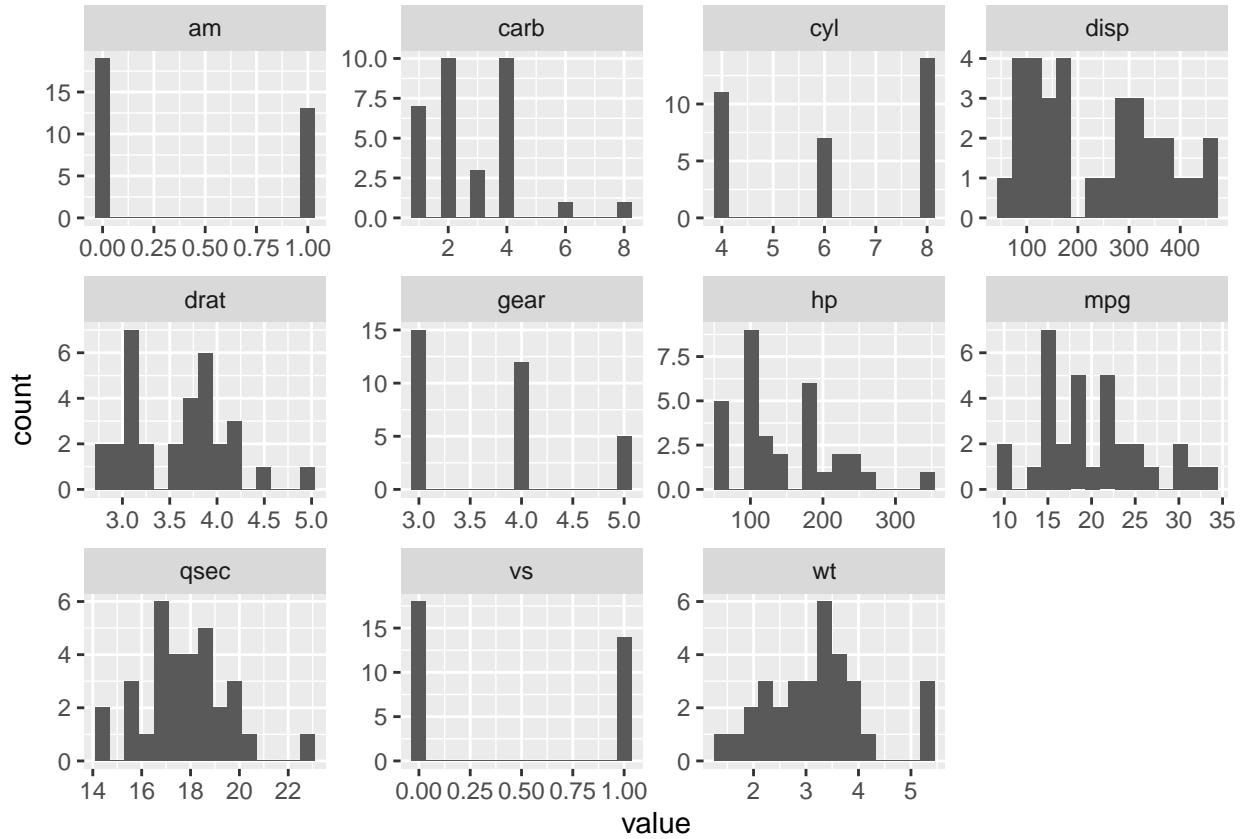
```
plot1 <- mtcars %>% ggplot(aes(qsec))
# plot1+geom_histogram()
# add normal plot
plot1 + geom_histogram(aes( y=..density..),bins = 20) +
  stat_function(fun = dnorm, args = list(mean =mean(mtcars$qsec), sd=sd(mtcars$qsec))) +
  theme_bw()
```



```
# ..density.. changes y axis to density, not count. stat function defines normal  
# line based on data provided.
```

6.4.2 multiple plot of all distributions

```
mtcars %>% keep(is.numeric) %>% gather() %>% ggplot(aes(value)) +  
  facet_wrap(~ key, scales = "free") + geom_histogram(bins = 15)
```



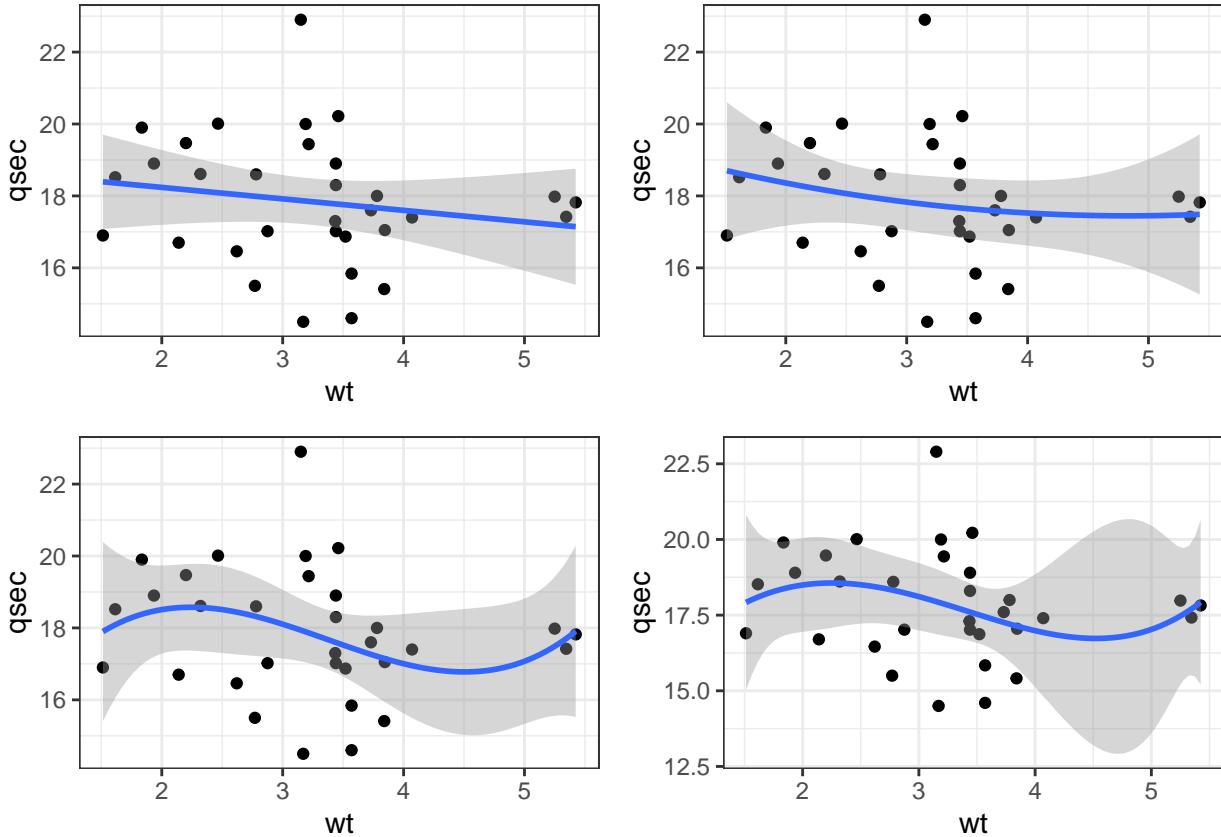
6.4.3 x*y scatterplot with linear or polynomial regression

```

plot2 <- mtcars %>% ggplot(aes(x=wt,y=qsec))
plot2a <- plot2 +geom_point() +stat_smooth(method='lm',formula=y~x) + theme_bw()
plot2b <- plot2 +geom_point() +stat_smooth(method='lm',formula = y ~ poly(x, 2)) + theme_bw()
plot2c <- plot2 +geom_point() +stat_smooth(method='lm',formula = y ~ poly(x, 3)) + theme_bw()
plot2d <- plot2 +geom_point() +stat_smooth(method='lm',formula = y ~ poly(x, 4)) + theme_bw()

grid.arrange(plot2a,plot2b,plot2c,plot2d,nrow=2,ncol=2)

```



6.4.4 Add formula to plot.

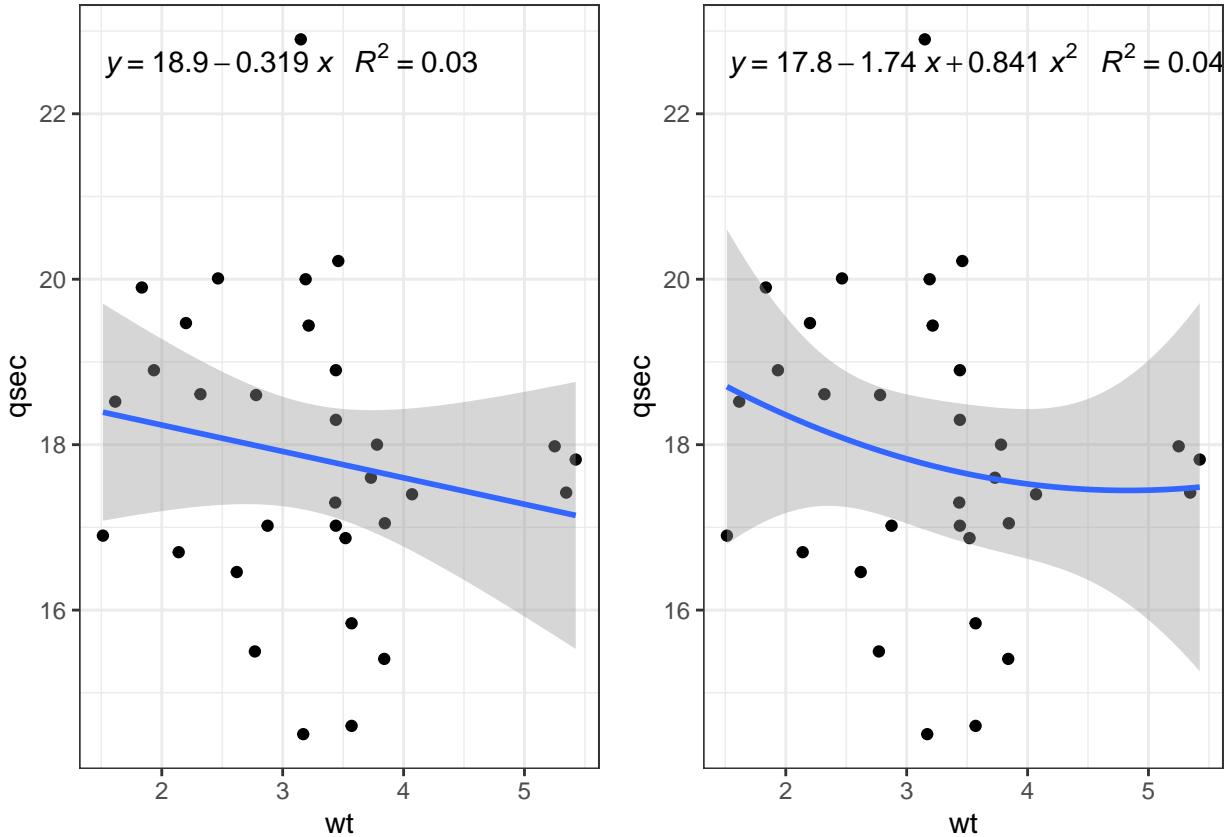
```

my.formula <- y ~ x
a <- plot2 +geom_point() +geom_smooth(method='lm', formula=my.formula) +
  stat_poly_eq(formula = my.formula, aes(label = paste(..eq.label.., ..rr.label..,
                                               sep = "~~~")), parse = TRUE) +
  theme_bw()

my.formula2 <- y ~ poly(x, 2)
b <- plot2 +geom_point() +geom_smooth(method='lm', formula=my.formula2) +
  stat_poly_eq(formula = my.formula2, aes(label = paste(..eq.label.., ..rr.label..,
                                               sep = "~~~")), parse = TRUE) +
  theme_bw()

grid.arrange(a,b,nrow=1)

```



6.4.5 Raincloud plots (ggplot)

```
library(plyr)

## Warning: package 'plyr' was built under R version 4.0.5

## -----
## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## -----
## 
## Attaching package: 'plyr'

## The following objects are masked from 'package:Hmisc':
## 
##     is.discrete, summarize
```

```

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize

## The following object is masked from 'package:purrr':
##
##     compact

library(dplyr)

```

```

theme_rain = theme(
text = element_text(size = 10),
axis.title.x = element_text(size = 16),
axis.title.y = element_text(size = 16),
axis.text = element_text(size = 14),
axis.text.x = element_text(angle = 0, vjust = 0.5),
legend.title=element_text(size=16),
legend.text=element_text(size=16),
legend.position = "right",
plot.title = element_text(lineheight=.8, face="bold", size = 16),
panel.border = element_blank(),
panel.grid.minor = element_blank(),
panel.grid.major = element_blank(),
axis.line.x = element_line(colour = 'black', size=0.5, linetype='solid'),
axis.line.y = element_line(colour = 'black', size=0.5, linetype='solid'))

```

6.4.5.1 custom theme creation

```

lb <- function(x) mean(x) - sd(x)
ub <- function(x) mean(x) + sd(x)

```

6.4.5.2 make summary functions

```

mtcars <- tibble::rownames_to_column(mtcars, "car_name")
mtcars <- mtcars %>% mutate(cyl=as_factor(cyl))

```

6.4.5.3 row names as real column

```

data("diamonds")
sumld<- ddply(diamonds, ~cut, summarise, mean = mean(carat), median = median(carat),
              lower = lb(carat), upper = ub(carat))
kable(head(sumld)) %>% kable_minimal()

```

cut	mean	median	lower	upper
Fair	1.0461366	1.00	0.5297323	1.562541
Good	0.8491847	0.82	0.3951303	1.303239
Very Good	0.8063814	0.71	0.3469460	1.265817
Premium	0.8919549	0.86	0.3766933	1.407217
Ideal	0.7028370	0.54	0.2699607	1.135713

6.4.5.4 calc summary data

6.4.6 raincloud plot (diamonds)

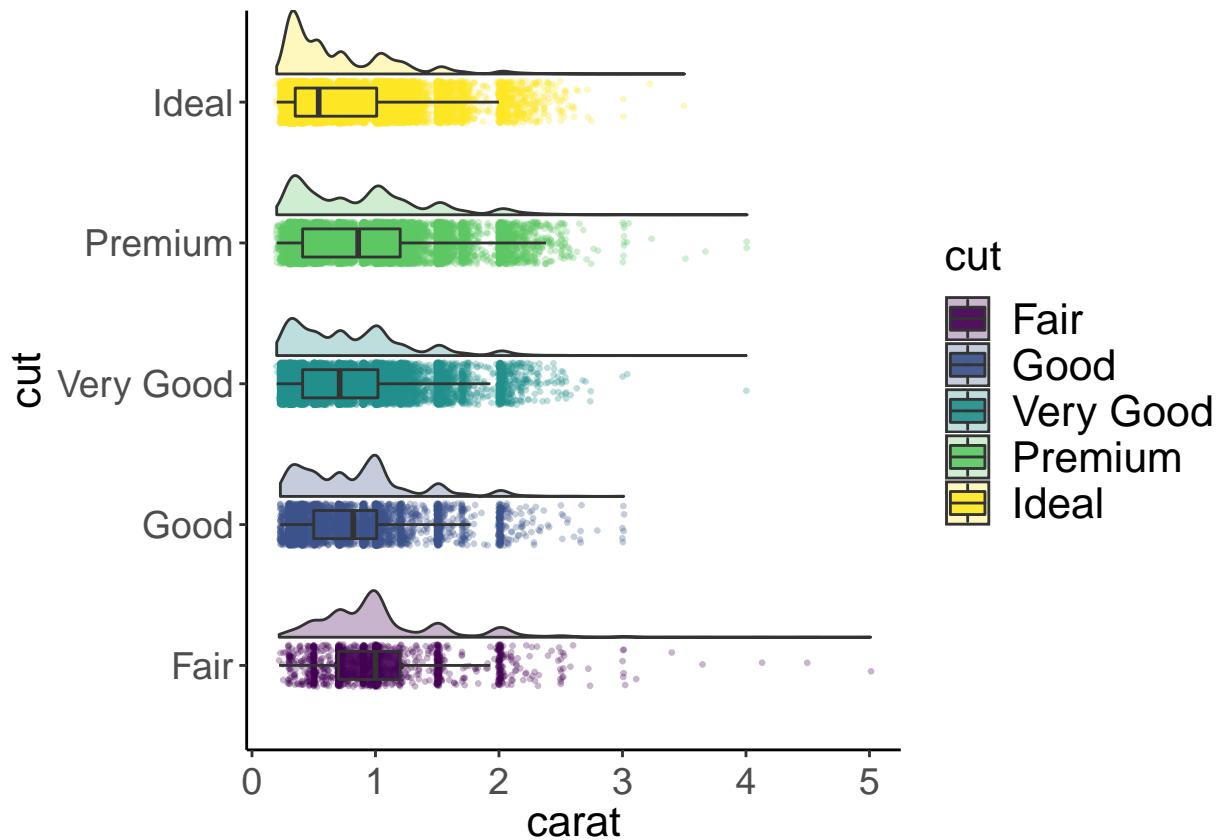
```

g <- ggplot(data = diamonds, aes(y = carat, x = cut, fill = cut)) +
  geom_flat_violin(position = position_nudge(x = .2, y = 0), alpha = .3) +
  geom_point(aes(y = carat, color = cut), position = position_jitter(width = .15), size = .5, alpha = 0.3) +
  geom_boxplot(width = .2, guides = FALSE, outlier.shape = NA, alpha = 0.9) +
  expand_limits(x = 5.25) +
  scale_color_viridis_d() +
  scale_fill_viridis_d() +
  coord_flip() +
  theme_bw() +
  theme_rain

```

Warning: Ignoring unknown parameters: guides

g



Alternative raincloud

```
#calculations needed
sumld<- ddply(diamonds, ~cut, summarise, mean = mean(carat), median = median(carat), lower = lb(carat), upper = ub(carat))

g <- ggplot(data = diamonds, aes(y = carat, x = cut, fill = cut)) +
  geom_flat_violin(position = position_nudge(x = .2, y = 0), alpha = .8) +
  geom_point(aes(y = carat, color = cut), position = position_jitter(width = .15), size = .5, alpha = 0.8) +
  geom_point(data = sumld, aes(x = cut, y = mean), position = position_nudge(x = 0.3), size = 2.5) +
  geom_errorbar(data = sumld, aes(ymin = lower, ymax = upper, y = mean), position = position_nudge(x = 0.3), width = 0.2) +
  expand_limits(x = 5.25) +
  guides(fill = FALSE) +
  guides(color = FALSE) +
  scale_color_viridis_d() +
  scale_fill_viridis_d() +
  theme_bw() +
  theme_rain

g
```

6.4.7 Scatterplot theme

```
theme_scatter = theme(
  text = element_text(size = 10),
```

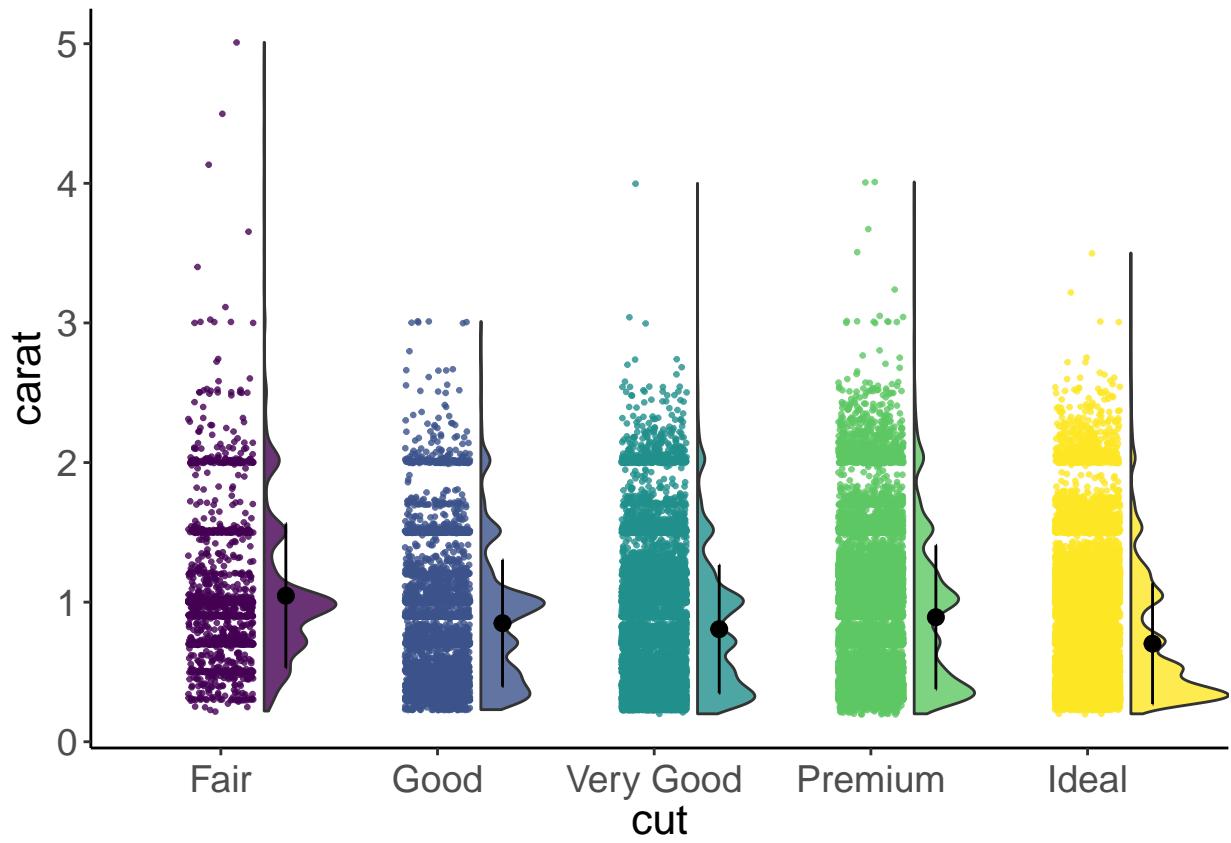


Figure 3: Raincoud plot of means

```

axis.title.x = element_text(size = 12),
axis.title.y = element_text(size = 12, angle = 0, vjust = .5),
axis.text = element_text(size = 10),
axis.text.x = element_text(angle = 0, vjust = 0.5),
legend.title=element_text(size=12,hjust = .5),
legend.text=element_text(size=10),
#legend.position = "right",
legend.background = element_rect(colour='light grey'),
plot.title = element_text(lineheight=.8, face="bold", size = 16),
panel.border = element_blank(),
panel.grid.minor = element_blank(),
panel.grid.major = element_blank(),
axis.line.x = element_line(colour = 'black', size=0.5, linetype='solid'),
axis.line.y = element_line(colour = 'black', size=0.5, linetype='solid'))

```

6.4.8 Scatterplots

```

sp <- diamonds %>% ggplot(aes(x=carat,y=price))
sp1 <- sp+geom_point()
sp2 <- sp+geom_point() +theme_bw()
sp3 <- sp+geom_point() +theme_bw() +theme_scatter
sp4 <- sp+geom_point(alpha=.01)+ylab('$(\text{£})$') +theme_bw() +theme_scatter

grid.arrange(sp1,sp2,sp3,sp4,nrow=2,ncol=2)

```

6.4.9 make axis logarithmic

```

sp5 <- sp+geom_point(alpha=.01)+ylab('$(\text{£})$') +theme_bw() +theme_scatter
sp5+ scale_x_continuous(trans='log10') +
  scale_y_continuous(trans='log10')

```

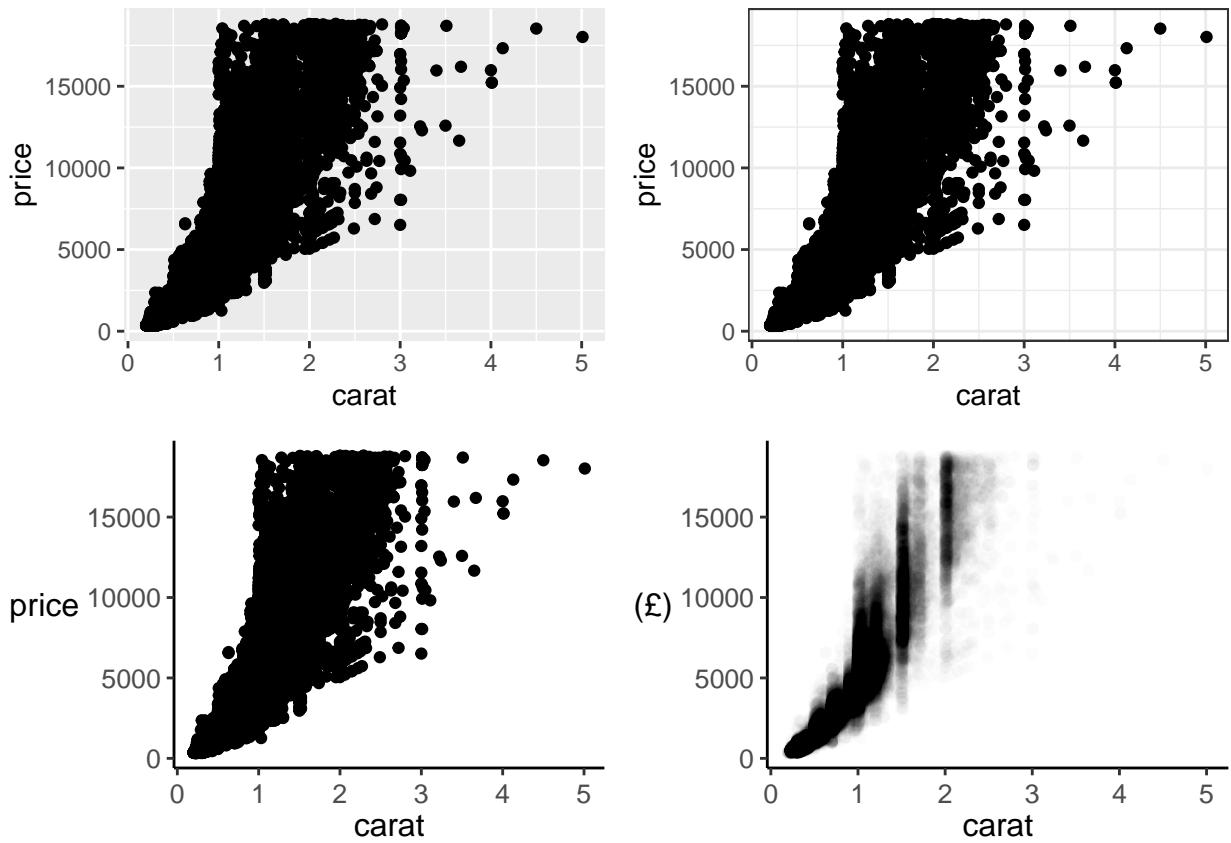
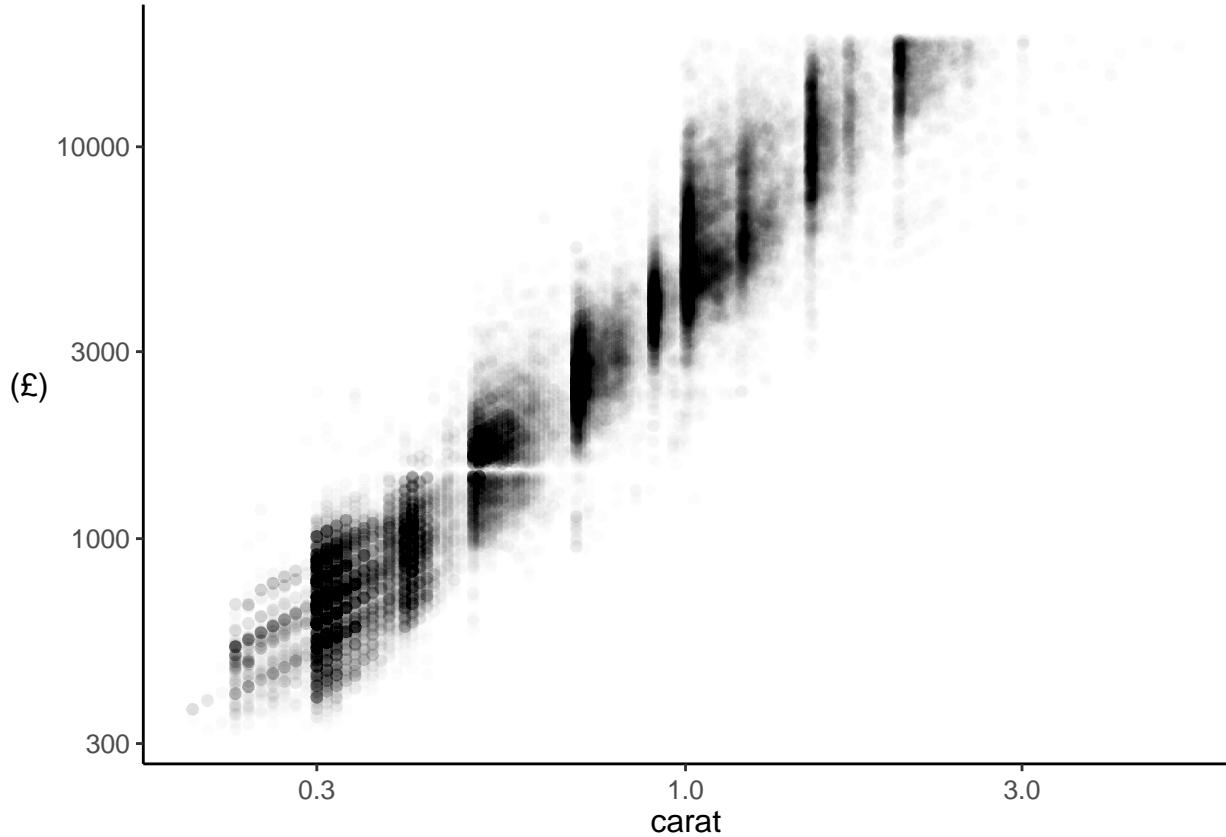


Figure 4: Scatterplots



6.4.10 add a trendline

```

my.formula <- y ~ x # calc formula for display

sp5+ylim(0,20000)+xlim(0,3)+geom_smooth(method='lm',formula =my.formula,
                                             colour='black', size=.4,alpha=.6)+

  stat_poly_eq(formula = my.formula,
               aes(label = paste(..eq.label.., ..rr.label..,
                                 sep = "~~~")), parse = TRUE)

## Warning: Removed 32 rows containing non-finite values (stat_smooth).

## Warning: Removed 32 rows containing non-finite values (stat_poly_eq).

## Warning: Removed 32 rows containing missing values (geom_point).

## Warning: Removed 8 rows containing missing values (geom_smooth).

```

6.4.11 add a trendline

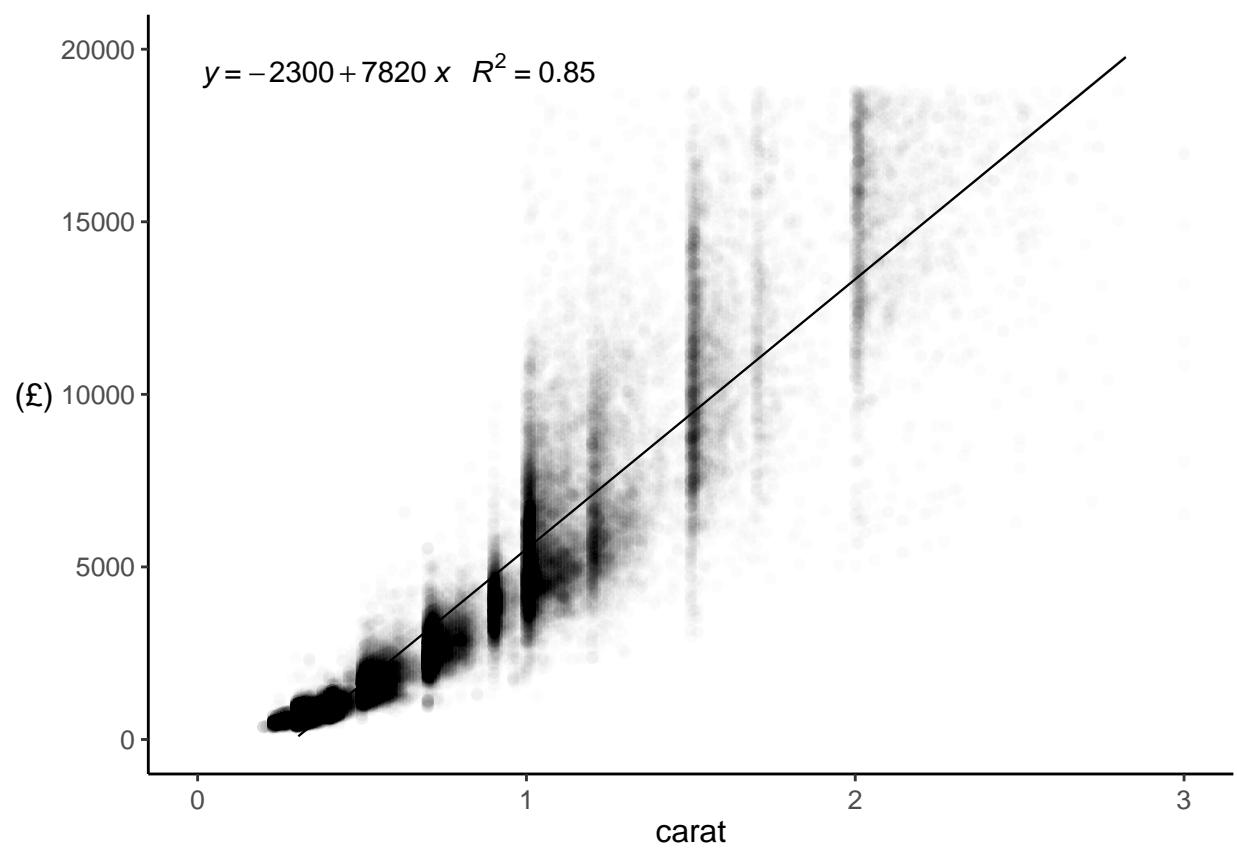


Figure 5: linear Trendline

```

formula <- y ~ poly(x, 2, raw=TRUE) # calc formula for display

sp5+ylim(0,20000)+xlim(0,3)+geom_smooth(method='lm',formula =formula,
                                         colour='black', size=.4,alpha=.6)+
  stat_poly_eq(formula = formula,
               aes(label = paste(..eq.label.., ..rr.label..,
                                 sep = "~~~")), parse = TRUE)

## Warning: Removed 32 rows containing non-finite values (stat_smooth).

## Warning: Removed 32 rows containing non-finite values (stat_poly_eq).

## Warning: Removed 32 rows containing missing values (geom_point).

## Warning: Removed 14 rows containing missing values (geom_smooth).

```

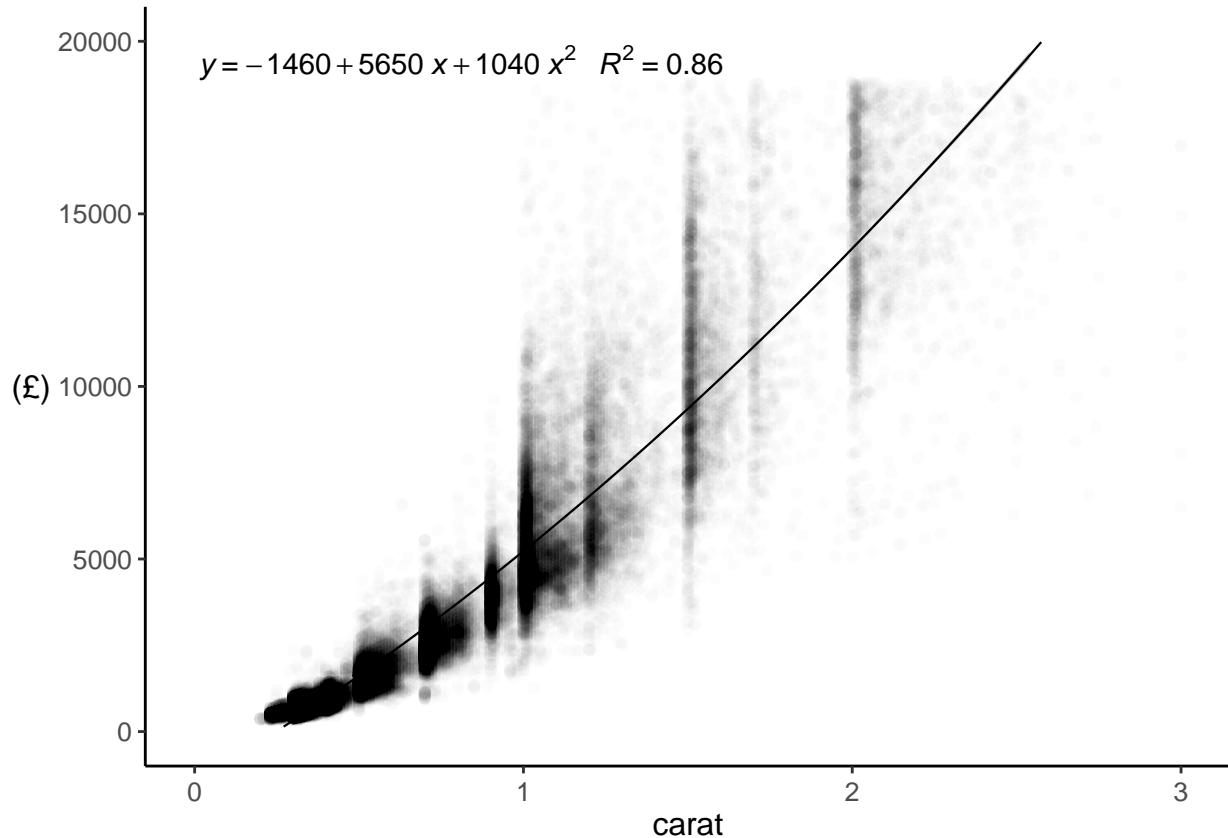


Figure 6: Polynomial trendline

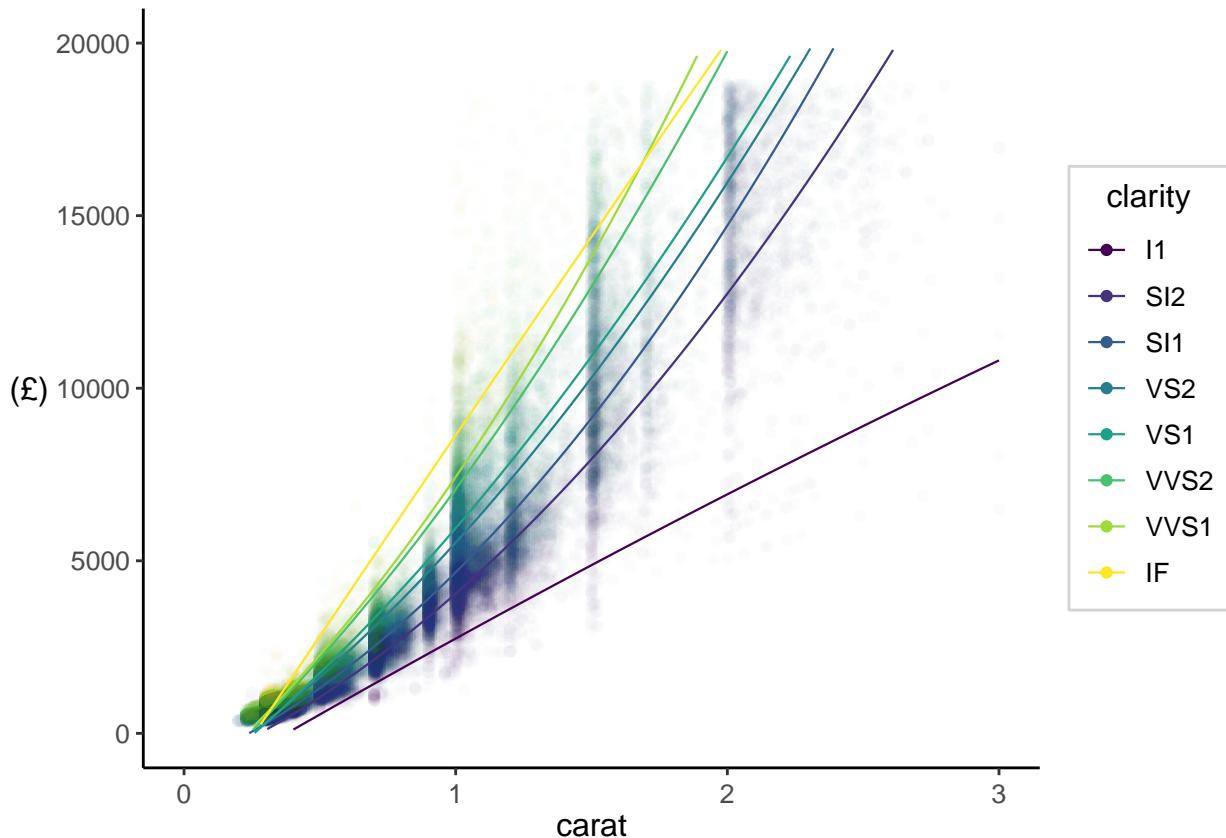
6.4.12 add multiple trendlines

```

sp <- diamonds %>% ggplot(aes(x=carat,y=price,colour=clarity))
sp5 <- sp+geom_point(alpha=.01)+ylab('(\u00a3)') +theme_bw() +theme_scatter
sp6 <- sp5+ylim(0,20000)+xlim(0,3)+guides(colour = guide_legend(override.aes = list(alpha = 1)))
my.formula4 <- y ~ poly(x, 2,raw = TRUE) # calc formula for display

sp7 <- sp6+geom_smooth(aes(colour=clarity),method='lm',formula = my.formula4,se=F, size=.4,alpha=.6)
sp7

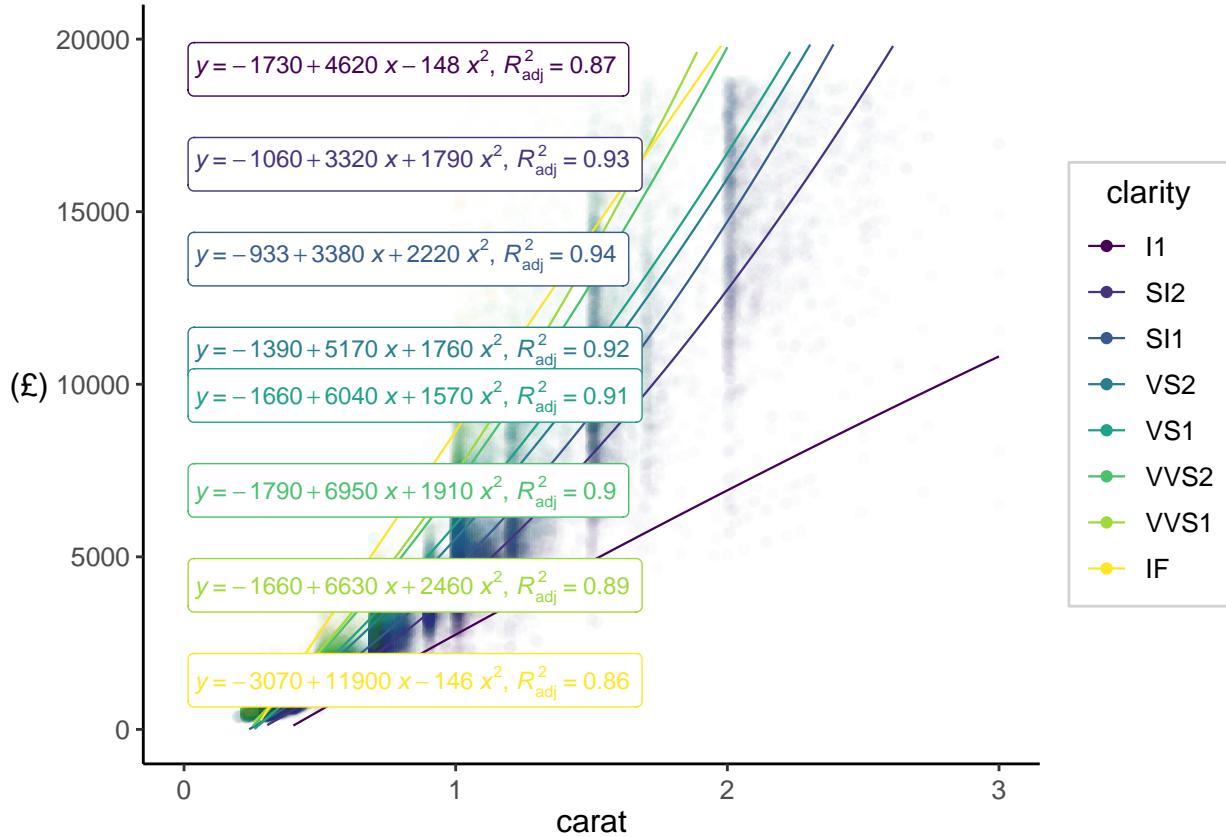
```



```

sp8 <- sp7+
  stat_poly_eq(aes(label =  paste(stat(eq.label),
                                stat(adj.rr.label), sep = "*\", \"*")),
                formula = my.formula4, parse = TRUE, size=3, geom = "label_npc")
sp8

```



```
#### add deviation from regression
```

```
data(mtcars)
mtcars <- tibble::rownames_to_column(mtcars, "car_name")

formula <- y ~ poly(x, 2, raw=TRUE) # calc formula for display

hpvmpg <- mtcars %>% ggplot(aes(x=hp, y=mpg, label=rownames(mtcars)))
# p1 <- hpvmpg+geom_point()+geom_smooth(method='lm', formula = formula, colour='black', size=.4, alpha=.6, se=1)
# stat_fit_deviations(formula = formula, colour = "red") + geom_label_repel(aes(label = rownames(mtcars)),
#   box.padding = 0.1,
#   point.padding = 0.3,
#   segment.color = 'grey50')

p2 <- hpvmpg+geom_point()+geom_smooth(method='lm', formula = formula, colour='black', size=.4, alpha=.6, se=1)
stat_fit_deviations(formula = formula, colour = "red") + geom_label_repel(aes(label = rownames(mtcars)),
  arrow = arrow(length = unit(0.02, "npc")),
  box.padding = .5, min.segment.length = 0, max.overlaps = Inf)
```

```
p2
```

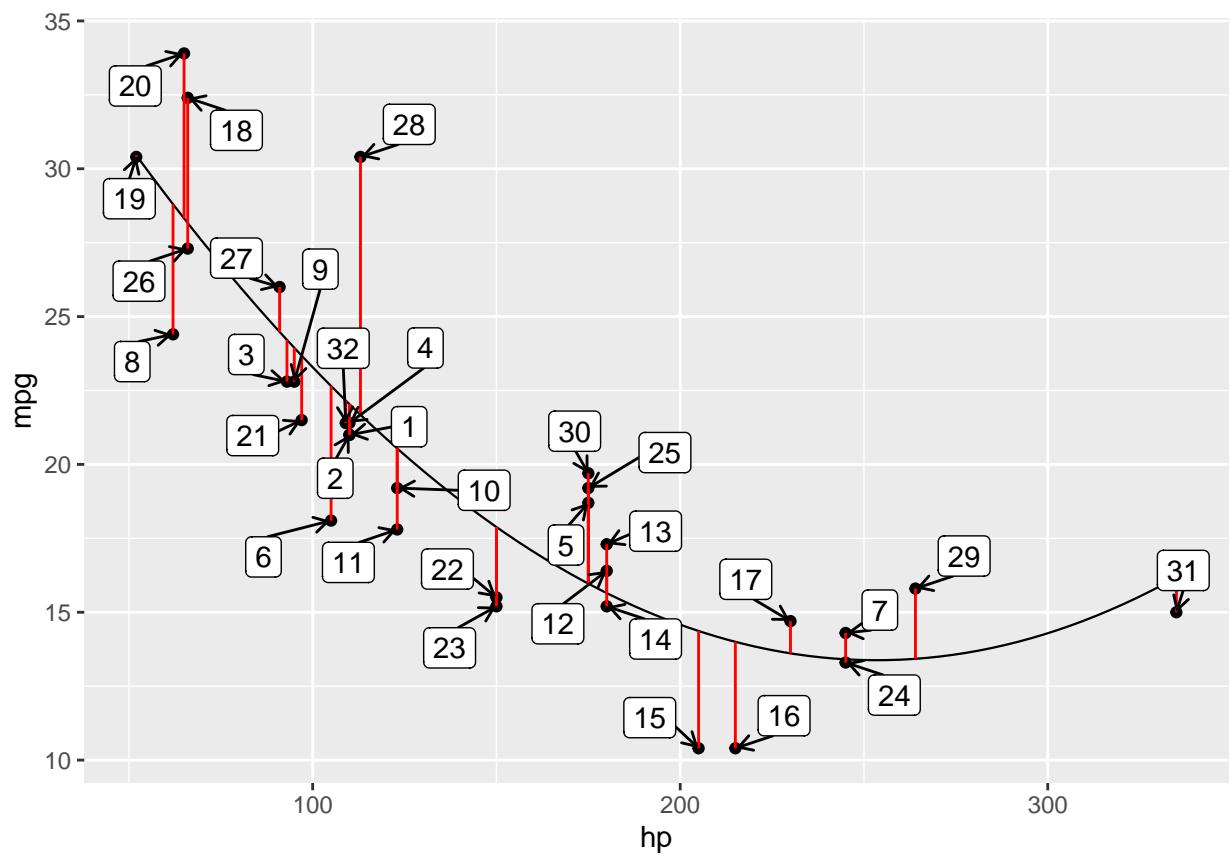


Figure 7: Deviation from predition

car_name	mpg	cyl	disp	hp	lmresids	sds
Mazda RX4	21.0	6	160	110	-11.763042	0
Mazda RX4 Wag	21.0	6	160	110	-11.763042	0
Datsun 710	22.8	4	108	93	5.792055	0
Hornet 4 Drive	21.4	6	258	110	-63.114644	1
Hornet Sportabout	18.7	8	360	175	-32.450810	0
Valiant	18.1	6	225	105	-52.832288	1

```
#grid.arrange(p1,p2)
```

6.4.13 residuals (ID those >1SD from \$bar{X})

```
lm <- lm(hp ~ poly(disp, 2, raw=TRUE), data=mtcars) # make lin model
resids <- resid(lm) # extract resids as vector
mtcars <- mtcars %>% mutate(lmresids=resids) # add to df

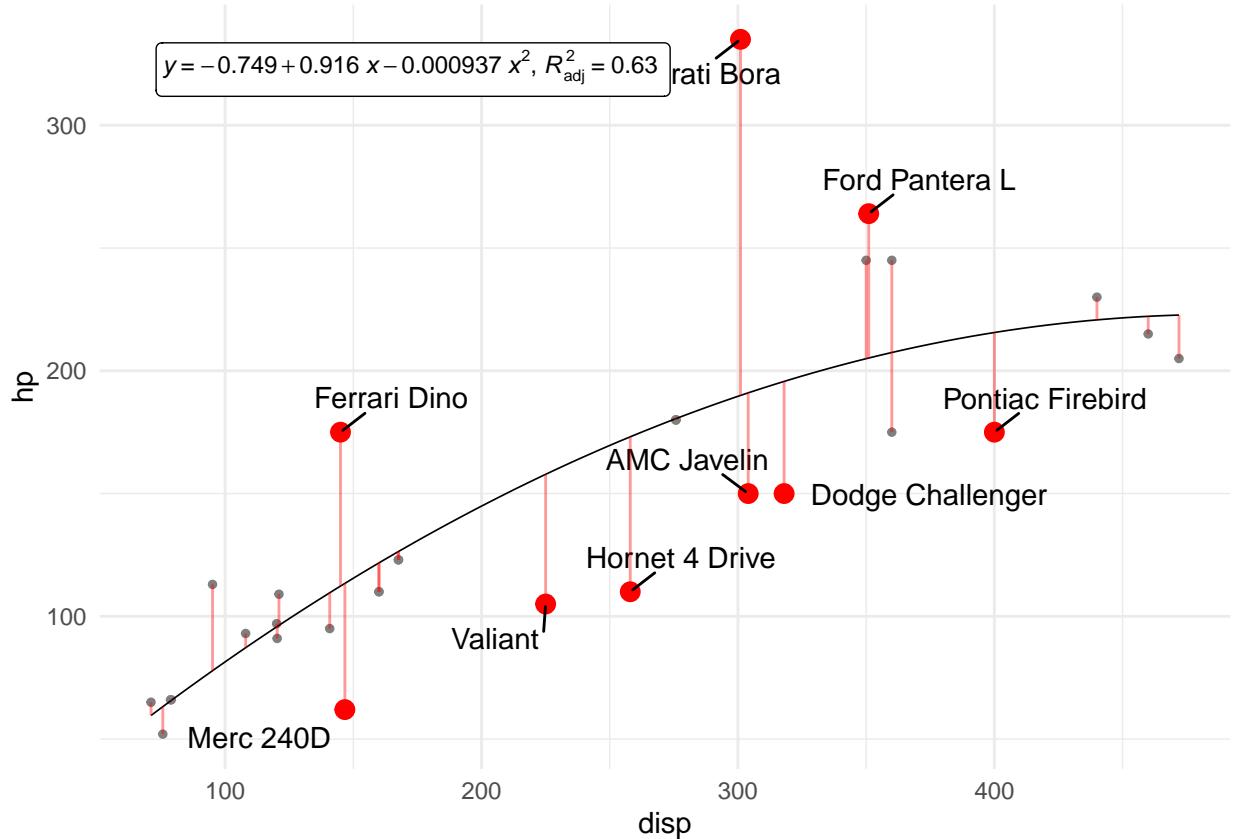
low <- mtcars %>% summarise(low=mean(lmresids)-sd(lmresids))#calc low limit
# assign as variable
high <- mtcars %>% summarise(high=mean(lmresids)+sd(lmresids))
low <- dplyr::pull(low)
high <- dplyr::pull(high)
mtcars <- mtcars %>% mutate(sds=ifelse(lmresids>low & lmresids<high, 0, 1)) #create new var
kable_styling(full_width = FALSE) %>% kable_minimal()

p2 <- hpvmpg+geom_point()+geom_smooth(method='lm', formula = formula, colour='black', size=.4, alpha=.6, se=F)
  stat_fit_deviations(formula = formula, colour = "red")+
  geom_label_repel(aes(label = car_name),
    arrow = arrow(length = unit(0.02, "npc")),
    box.padding = .5, min.segment.length = 0, max.overlaps = Inf)
```

6.4.14 only label extreme residuals

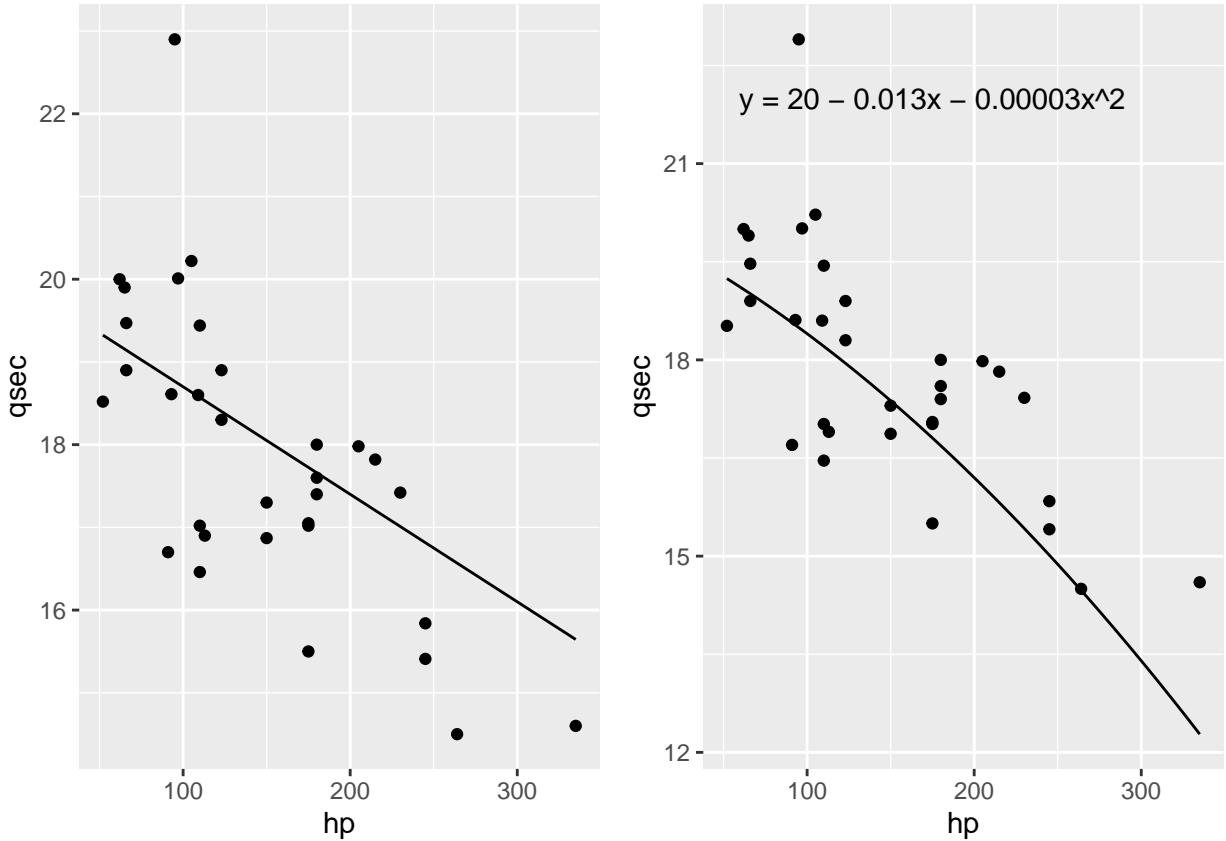
```
formula <- y ~ poly(x, 2, raw=TRUE) # calc formula for display
dat2 <- mtcars
dat2$car_name <- ""
ix_label <- which(mtcars$sds == 1)
dat2$car_name[ix_label] <- mtcars$car_name[ix_label]
hpvmpg <- dat2 %>% ggplot(aes(x=disp, y=hp, label=car_name))

hpvmpg+geom_point(color = ifelse(dat2$car_name == "", "grey50", "red"), size = ifelse(dat2$car_name == "",
  box.padding = .55)+geom_smooth(method='lm', formula = formula, colour='black', size=.3, alpha=.6, se=F)+
  stat_fit_deviations(formula = formula, colour = "red", size=.5, alpha=.4)+
  stat_poly_eq(aes(label = paste(stat(eq.label),
    stat(adj.rr.label), sep = "*\", \")",
  formula = formula, parse = TRUE, size=3, geom = "label_npc"))+theme_minimal()
```



6.5 line defined by equation to scatterplot

```
plot2<- mtcars %>% ggplot(aes(x=hp,y=qsec))
q1 <- plot2+geom_point()+
  stat_function(fun = function(x) 20-(.013*x)) # linear function
fun = 'y = 20 - 0.013x - 0.00003x^2'
q2 <- plot2+geom_point()+
  stat_function(fun = function(x) 20-(.013*x+.00003*x^2))# poly function
# poly function
q2 <- q2+ annotate("text", x = 175, y = 22, label = fun, size=4)
grid.arrange(q1,q2,nrow=1)
```



7 BBC style

7.1 load packages

```
library(tidyverse)
library(gapminder)

## Warning: package 'gapminder' was built under R version 4.0.5

library(ggalt)

## Warning: package 'ggalt' was built under R version 4.0.5

## Registered S3 methods overwritten by 'ggalt':
##   method           from
##   grid.draw.absoluteGrob  ggplot2
##   grobHeight.absoluteGrob ggplot2
##   grobWidth.absoluteGrob ggplot2
##   grobX.absoluteGrob     ggplot2
##   grobY.absoluteGrob     ggplot2
```

```
library(R.utils)

## Warning: package 'R.utils' was built under R version 4.0.5

## Loading required package: R.oo

## Loading required package: R.methodsS3

## R.methodsS3 v1.8.1 (2020-08-26 16:20:06 UTC) successfully loaded. See ?R.methodsS3 for help.

## R.oo v1.24.0 (2020-08-26 16:11:58 UTC) successfully loaded. See ?R.oo for help.

##
## Attaching package: 'R.oo'

## The following object is masked from 'package:R.methodsS3':
##
##     throw

## The following objects are masked from 'package:methods':
##
##     getClasses, getMethods

## The following objects are masked from 'package:base':
##
##     attach, detach, load, save

## R.utils v2.10.1 (2020-08-26 22:50:31 UTC) successfully loaded. See ?R.utils for help.

##
## Attaching package: 'R.utils'

## The following object is masked from 'package:Hmisc':
##
##     capitalize

## The following object is masked from 'package:tidyverse':
##
##     extract

## The following object is masked from 'package:utils':
##
##     timestamp

## The following objects are masked from 'package:base':
##
##     cat, commandArgs, getopt, inherits, isOpen, nullfile, parse,
##     warnings
```

```

library(png)
library(ggpubr)

## Warning: package 'ggpubr' was built under R version 4.0.5

##
## Attaching package: 'ggpubr'

## The following object is masked from 'package:plyr':
##     mutate

library(grid)
library(scales)

##
## Attaching package: 'scales'

## The following object is masked from 'package:viridis':
##     viridis_pal

## The following object is masked from 'package:arsenal':
##     ordinal

## The following object is masked from 'package:purrr':
##     discard

## The following object is masked from 'package:readr':
##     col_factor

library(bbplot)

#Prepare data
dumbbell_df <- gapminder %>%
  filter(year == 1967 | year == 2007) %>%
  select(country, year, lifeExp) %>%
  spread(year, lifeExp) %>%
  mutate(gap = `2007` - `1967`) %>%
  arrange(desc(gap)) %>%
  head(10)

#Make plot
ggplot(dumbbell_df, aes(x = `1967`, xend = `2007`, y = reorder(country, gap), group = country)) +
  geom_dumbbell(colour = "#dddddd",
                size = 3,
                colour_x = "#FAAB18",

```

```
colour_xend = "#1380A1") +  
bbc_style() +  
labs(title="We're living longer",  
subtitle="Biggest life expectancy rise, 1967-2007")
```

We're living longer

Biggest life expectancy rise, 1967–2007

