R Workshop: Correlation

Brier Gallihugh, M.S.

2024-02-23

Table of contents

Introduction

Correlations might be the most common statistical test run (especially early on in a project). For this part of the workshop we will be using the `mtcars` data set due to its many numerical values that we can assess for correlation. Below we will see the first 10 rows of the data set displayed

```
library(tidyverse)
library(car)
library(psych)

data <- mtcars

print(head(data,10))                                                  ①
```

① Display the first 10 rows of the `mtcars` data. You can also return the last 10 rows with the following function `tail(data,10)`

```
                   mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
Duster 360        14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 240D         24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
Merc 230          22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
Merc 280          19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
```

Statistical Assumptions

The primary assumption of a **Pearson's correlation coefficient** is that the data is on some kind of interval scale. However, if we wish to generalize, we must have a random large sample (unlikely) and the individual variables should be roughly normally distributed. This is the assumption we will focus on for this part of the workshop.

Normality of Variables

For this part of the workshop, we are going to focus on the `mpg` and `wt` variables. We will be looking at normality both statistically[1] as well as graphically.

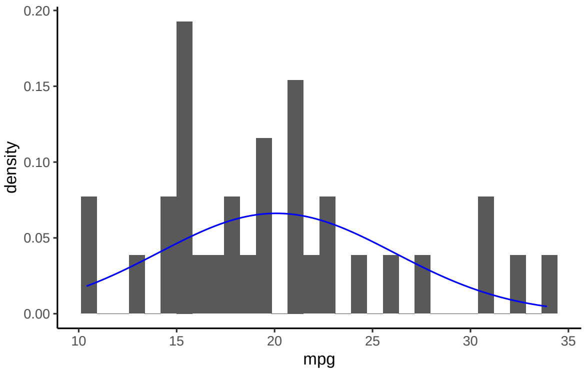
❗ A Note About Statistical Assumption Testing

1. Odds are your statistical test is going to fail pretty much every single time. Particularly if you use something like a Shapiro Wilk test, but we'll look at it anyway

Graphical Depiction of Normality Assumption (mpg)

```
mpg_plot <- ggplot(data,aes(x = mpg)) +                                    ①
  geom_histogram(aes(y=after_stat(density))) +
  stat_function(fun = dnorm,
                args = list(mean = mean(data$mpg),
                            sd = sd(data$mpg)),
                col = "blue") +
  theme_classic()

print(mpg_plot)
```

① This should look very familiar to the histogram part of the workshop



Statistical Depiction of Normality Assumption (mpg)

```
print(psych::describe(data$mpg))                                             ①

print(shapiro.test(data$mpg))                                                ②
```

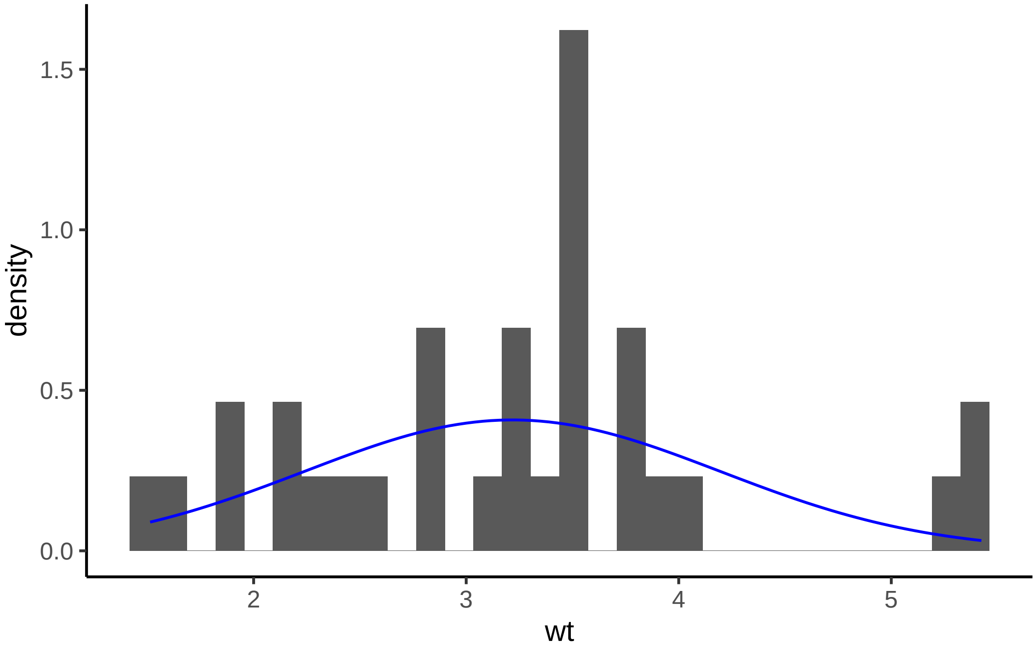
① The `psych` package has a bunch of nifty functions for social science research. One is the `describe()` function which gives you a bunch of variable level summary statistics (e.g., mean, median, se, etc.)

② The `shapiro.test()` performs a Shapiro Wilk test of normality. Keep in mind this particular test is very sensitive to sample sizes

```
   vars  n  mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 32 20.09 6.03   19.2    19.7 5.41 10.4 33.9  23.5 0.61    -0.37 1.07

	Shapiro-Wilk normality test

data:  data$mpg
W = 0.94756, p-value = 0.1229
```

Graphical Depiction of Normality Assumption (wt)

```
wt_plot <- ggplot(data,aes(x = wt)) +
  geom_histogram(aes(y=after_stat(density))) +
  stat_function(fun = dnorm,
                args = list(mean = mean(data$wt),
                            sd = sd(data$wt)),
                col = "blue") +
  theme_classic()

print(wt_plot)
```



Statistical Depiction of Normality Assumption (wt)

```r
print(psych::describe(data$wt))
print(shapiro.test(data$wt))
```

```
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 32 3.22 0.98   3.33    3.15 0.77 1.51 5.42  3.91 0.42    -0.02 0.17
    Shapiro-Wilk normality test


data:  data$wt
W = 0.94326, p-value = 0.09265
```

Running An Actual Correlation

There are multiple packages and methods for calculating a correlation in R depending on what you want to assess. The best to use for psychology is probably the `corr.test()` function in the `psych` package because it allows you to change the type of correlation you wish to compute (e.g., spearman vs pearson) as well as generate confidence intervals and do p value adjustments

```r
corr_results <- corr.test(x = data$mpg,                                  ①
          y = data$wt,                                                   ②
          use = "pairwise",                                              ③
          method = "pearson",                                            ④
          adjust = "holm")                                               ⑤

?corr.test()
```

① Choose one of your variables to be your `x` variable
② Choose the other to be your `y` variable
③ You can choose "pairwise" or "complete". For information on what each does, use the following function to access the documentation: `?psych::corr.test()`
④ You can adjust method to be other ones like "spearman"
⑤ You can also use "bonferroni" among a few others

Below we will see the output of the correlation results as you might be used to seeing in a program like SPSS.

```
print(corr_results)
```

```
Call:corr.test(x = data$mpg, y = data$wt, use = "pairwise", method = "pearson",
    adjust = "holm")
Correlation matrix
[1] -0.87
Sample Size
[1] 32
These are the unadjusted probability values.
  The probability values  adjusted for multiple tests are in the p.adj object.
[1] 0

 To see confidence intervals of the correlations, print with the short=FALSE option
```

While the above is great, notice we didn't get a confidence interval output despite asking for it with `ci = TRUE`. Sometimes R will store complex computations within the output object (e.g., `corr_results`). To get this output we can put a $ after the output. If there is extra information stored, but not shown, we'll get a drop down box. We want the `ci` option. Below we will see the output that results from this. We should see the following:

r = -.87 , p < .001 with a CI = [-.93,-.74]

```
print(corr_results$ci)
```

```
           lower          r      upper            p
NA-NA -0.9338264 -0.8676594 -0.7440872 1.293959e-10
```