Continuous Data (3 of 4)

Aug 2, 2023. V1.6 -=- This chapter is being heavily edited – very much Work in Progress

Continuous Data Across Categories: Group-wise Statistics and Data Manipulation

1. This chapter takes us a step further in our exploration of continuous data. Here, we delve into the intersection of continuous data and categorical variables, examining how the former can be split, summarized, and compared across different levels of one or more categorical variables.

2. We bring to light methods for generating statistics per group and sophisticated data manipulation techniques. This includes processes like grouping, filtering, and summarizing continuous data, contingent on categorical variables. When it comes to visualizations, our focus shifts towards creating juxtaposed box plots, segmented histograms, and density plots that reveal the distribution of continuous data across varied categories.

3. To achieve this, we exemplify the use of libraries such as `dplyr` and `ggplot2`. Incorporating categorical variables into our analysis elevates the depth of our comprehension of the data. It allows us to shift from a broad, holistic view to a more concentrated inspection of specific data segments. This approach empowers us to produce a more granular and nuanced interpretation of our data.

4. **Data**: Let us work with the same mtcars data from the previous chapter. Suppose we have run the following code:

```r
# Load the required libraries, suppressing annoying startup messages
library(tibble)
suppressPackageStartupMessages(library(dplyr))
# Read the mtcars dataset into a tibble called tb
data(mtcars)
tb <- as_tibble(mtcars)
attach(tb)
# Convert several numeric columns into factor variables
tb$cyl <- as.factor(tb$cyl)
```

```
tb$vs <- as.factor(tb$vs)
tb$am <- as.factor(tb$am)
tb$gear <- as.factor(tb$gear)

attach(tb)
```

```
The following objects are masked from tb (pos = 3):

    am, carb, cyl, disp, drat, gear, hp, mpg, qsec, vs, wt
```

Summarizing Continuous Data by one Factor

1. We investigate the bivariate Relationship between Miles Per Gallon (`mpg`) and Cylinders (`cyl`). The following code will display a summary table showing the descriptive statistics of mileage of the cars broken down by number of cylinders (`cyl` = 4, 6, 8) using `aggregate()`.

```
agg <- aggregate(tb$mpg,
          by = list("cyl" = tb$cyl),
          FUN = mean)
names(agg) <- c("Cylinders", "Avg MPG")
agg
```

```
  Cylinders  Avg MPG
1         4 26.66364
2         6 19.74286
3         8 15.10000
```

2. Here is how it works:

- The first argument in `aggregate()` is `tb$mpg`, which is the data vector we want to apply the function to.
- The second argument, `by`, denotes a list of variables to group by. Here, we've supplied `tb$cyl`, implying that we wish to partition our data based on the unique values of `cyl`.
- The third argument, FUN, is the function we want to apply to each subset of data. We're using mean here, meaning we're calculating the average mpg for each unique cyl value.
- The output of aggregate(), a data frame, is then stored in a new variable, agg.

Next, we utilize the names() function to rename the columns in the agg data frame. [1]

3. Using tapply()

```
tapply(tb$mpg, tb$cyl, mean)
```

```
       4        6        8 
26.66364 19.74286 15.10000 
```

4. Using psych::describeBy() Bivariate Relationship between Weight (wt) and Cylinders (cyl)

Display a summary table showing the mean weight of the cars broken down by cylinders (cyl=4,6,8)

```
psych::describeBy(mpg, cyl)
```

```
 Descriptive statistics by group 
group: 4
   vars  n  mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 11 26.66 4.51     26   26.44 6.52 21.4 33.9  12.5 0.26    -1.65 1.36
------------------------------------------------------------ 
group: 6
   vars n  mean   sd median trimmed  mad  min  max range  skew kurtosis   se
X1    1 7 19.74 1.45   19.7   19.74 1.93 17.8 21.4   3.6 -0.16    -1.91 0.55
------------------------------------------------------------ 
group: 8
   vars  n mean   sd median trimmed  mad  min  max range  skew kurtosis   se
X1    1 14 15.1 2.56   15.2   15.15 1.56 10.4 19.2   8.8 -0.36    -0.57 0.68
```

Summarizing Continuous Data by two Factors

Distribution of Weight (wt) by Cylinders (cyl = {4,6,8}) and Transmisson Type (am = {0,1})

```
aggregate(wt,
          by = list("am" =am, "cyl" = cyl),
          mean)
```

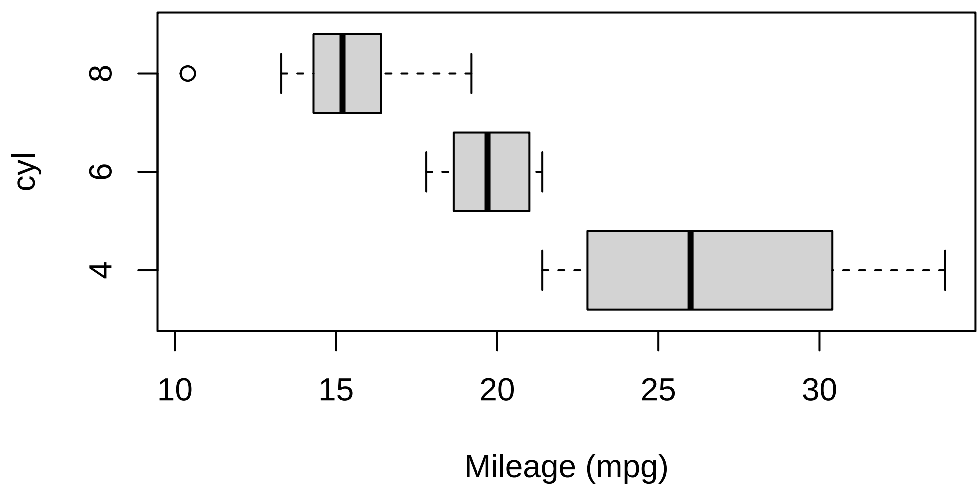
```
  am cyl        x
1  0   4 2.935000
2  1   4 2.042250
3  0   6 3.388750
4  1   6 2.755000
5  0   8 4.104083
6  1   8 3.370000
```

Visualizing Continuous Data by one Factor

Box Plot of Continuous Data by one Factor

Visualizing Median using Box Plot – median weight of the cars broken down by cylinders (cyl=4,6,8)

```
boxplot(mpg~cyl
        , ylab = "cyl"
        , xlab = "Mileage (mpg)"
        , horizontal = TRUE
        )
```



Means Plot of Continuous Data by one Factor

Visualizing Means – mean plot showing the average weight of the cars, broken down by transmission (am=1 & am=0)

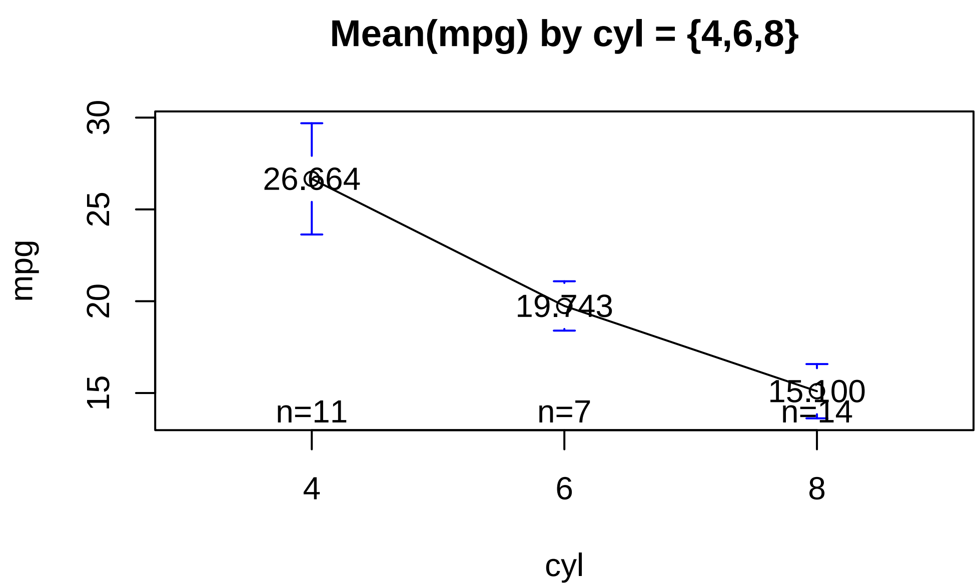
```r
library(gplots)
```

```
Attaching package: 'gplots'

The following object is masked from 'package:stats':

    lowess
```

```r
plotmeans(data = mtcars,
          mpg ~ cyl,
          mean.labels = TRUE,
          digits=3,
          main = "Mean(mpg) by cyl = {4,6,8}"
          )
```

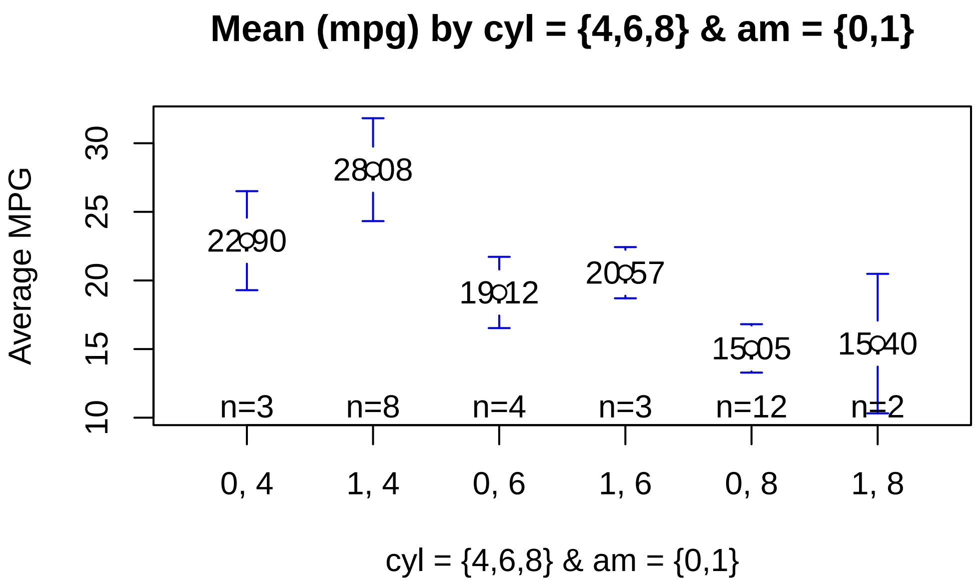


Means Plot of Continuous Data by two Factors

We show a mean plot showing the mean weight of the cars broken down by Transmission Type (am=1 & am=0) & cylinders (cyl=4,6,8).

```r
library(gplots)
plotmeans(mpg ~ interaction(am, cyl, sep = ", ")
```

```
          , data = mtcars
          , mean.labels = TRUE
          , digits=2
          , connect = FALSE
          , main = "Mean (mpg) by cyl = {4,6,8} & am = {0,1}"
          , xlab= "cyl = {4,6,8} & am = {0,1}"
          , ylab="Average MPG"
          )
```



Stem-and-Leaf Plot of Continuous Data by one Factor

1. The provided R code first selects the mpg and cyl columns from tb, then it segments the data into groups based on cyl values, and lastly, it generates a stem-and-leaf plot for the mpg values in each separate group.

```
# Use the 'select()' function from 'dplyr' to choose 'mpg' and 'cyl' columns from 'tb' tib
tb3 <- select(tb, mpg, cyl)

# Split the 'tb3' tibble into subsets based on 'cyl'. Each subset consists of rows with th
tb_split <- split(tb3, tb3$cyl)

# Apply a function to each subset of 'tb_split' using 'lapply()'.
# The function takes a subset 'x' and creates a stem-and-leaf plot of the 'mpg' values in
```

```r
lapply(tb_split,
       function(x)
         stem(x$mpg))
```

```

  The decimal point is 1 digit(s) to the right of the |

  2 | 12334
  2 | 67
  3 | 0024


  The decimal point is at the |

  17 | 8
  18 | 1
  19 | 27
  20 |
  21 | 004


  The decimal point is at the |

  10 | 44
  12 | 3
  14 | 3702258
  16 | 43
  18 | 72

$`4`
NULL

$`6`
NULL

$`8`
NULL
```

2. Here is how it works:

- `tb3 <- select(tb, mpg, cyl)`: In this line, we're using the `select()` function from the `dplyr` package to pick out the `mpg` and `cyl` columns from the tibble `tb`. We then store this newly created subset of the original tibble into a new tibble `tb3`.

- `tb_split <- split(tb3, tb3$cyl)`: With the `split()` function, we're segmenting the `tb3` tibble into subsets based on the `cyl` column. This action groups all rows with identical `cyl` values together into the same subset. We then store this list of new, smaller tibbles as `tb_split`.
- `lapply(tb_split, function(x) stem(x$mpg))`: Here we employ the `lapply()` function to apply a specified function to each element within a list. The function we've elected to apply is `function(x) stem(x$mpg)`, which plots a stem-and-leaf display for the mpg column of each tibble `x` in `tb_split`. As `tb_split` is a list of tibbles that have been grouped according to `cyl` values, this step will generate a separate stem-and-leaf plot for each group of `cyl` values.

References

[1] R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Fox, J. and Weisberg, S. (2011). An R Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage.

[10]

Chambers, J. M., Freeny, A. E., & Heiberger, R. M. (1992). Analysis of variance; designed experiments. In Statistical Models in S (pp. 145–193). Pacific Grove, CA: Wadsworth & Brooks/Cole.