AUA CS 108, Statistics, Fall 2019

Lecture 01

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Welcome to the AUA Statistics Course

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And Happy New ~~Year~~ Semester ! ◡̈

Contents

- Syllabus highlights
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Supplementary Info

- Section A Instructor: **Ruben Gevorgyan**

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- Section A Instructor: **Ruben Gevorgyan**
- Section A TA: **Lusine Zilfimyan**

Course Materials

- Moodle Page: shared with the Section A

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- Question: Do we need some supplementary R Labs? YESSS/No

Syllabus Highlights, Cont'd

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- Advice: Run over the Probability Topics, especially, about RVs and Distributions

QA Session

Questions?

About Statistics

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And finally, to understand the everyday usage of Statistical language, graphs and estimates, say, about polls and salaries ⌣̈

Course Structure: Topics at a glance

The structure of our course will be the following:

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- Quick reminder on RVs, Convergence Types for RVs, and our good old LLN and CLT:

The rest will use these topics intensively.

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The structure of our course will be the following:

- Intro + Descriptive Statistics
- Quick reminder on RVs, Convergence Types for RVs, and our good old LLN and CLT:

The rest will use these topics intensively.

- Models, Statistical Inference and Learning:

Here we will talk about Parametric and Non-Parametric Statistics, and the main problems of the Parametric Statistics: Parameter Estimation, Confidence Intervals and Hypothesis Testing

Course Structure: Topics at a glance

Then we will run over these three problems:

- Parameter Point Estimates

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- Parameter Point Estimates
- Confidence Intervals
- Hypothesis Testing

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- Linear Regression

And at the end of the course we will return back to Testing and cover:

- Goodness of fit tests

Descriptive Statistics

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> *This dataset contains a subset of the fuel economy data that the EPA makes available on http://fueleconomy.gov. It contains only models which had a new release every year between 1999 and 2008.*

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Consider, for example, the dataset `mpg` from the `ggplot2` package. From the official description of the data,

> *This dataset contains a subset of the fuel economy data that the EPA makes available on http://fueleconomy.gov. It contains only models which had a new release every year between 1999 and 2008.*

Lets look at the first 3 rows of our dataset:

```
head(ggplot2::mpg, 3)
```

```
## # A tibble: 3 x 11
##   manufacturer model displ  year   cyl trans      drv      cty
##   <chr>        <chr> <dbl> <int> <int> <chr>      <chr> <int>
## 1 audi         a4      1.8  1999     4 auto(l5)   f        18
## 2 audi         a4      1.8  1999     4 manual(m5) f        21
## 3 audi         a4      2    2008     4 manual(m6) f        20
```

Descriptive Statistics

Descriptive Statistics

The variable `cty` is the *city miles per gallon*, and the variable `cyl` is the *number of cylinders*. Let's separate that Variables:

```
cty <- ggplot2::mpg$cty
cyl <- ggplot2::mpg$cyl
```

Descriptive Statistics

Let's see the results:

```
cyl
```

```
##   [1] 4 4 4 4 6 6 6 4 4 4 4 6 6 6 6 6 8 8 8 8 8 8 8 8 8 8
##  [38] 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 8 8 8 8 8 6 8 8 8 8 8 8 8
##  [75] 8 8 8 6 6 6 6 8 8 6 6 8 8 8 8 8 6 6 6 6 8 8 8 8 8 4 4 4
## [112] 4 6 6 6 4 4 4 4 6 6 6 6 6 6 8 8 8 8 8 8 8 8 8 8 8 6 6
## [149] 6 6 6 6 6 8 6 6 6 6 8 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 6
## [186] 6 4 4 4 4 6 6 6 4 4 4 4 4 8 8 4 4 4 6 6 6 6 4 4 4 4 6 4
## [223] 4 4 4 5 5 4 4 4 4 6 6 6
```

Descriptive Statistics

Let's see the results:

```
cyl
```

```
##   [1] 4 4 4 4 6 6 6 4 4 4 4 6 6 6 6 6 8 8 8 8 8 8 8 8 8 8
##  [38] 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 8 8 8 8 8 6 8 8 8 8 8 8 8
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## [149] 6 6 6 6 6 8 6 6 6 6 8 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 6
## [186] 6 4 4 4 4 6 6 6 4 4 4 4 4 8 8 4 4 4 6 6 6 6 4 4 4 4 6 4
## [223] 4 4 4 5 5 4 4 4 4 6 6 6
```

Can you describe this data? What can be said about the No. of Cylinders of these cars?

Descriptive Statistics

Let's see the results for `cty`:

```
cty
```

```
##   [1] 18 21 20 21 16 18 18 18 16 20 19 15 17 17 15 15 17 16 1
##  [26] 16 15 15 14 11 11 14 19 22 18 18 17 18 17 16 16 17 17 1
##  [51] 13 14 14 14  9 11 11 13 13  9 13 11 13 11 12  9 13 13 1
##  [76] 11 12 14 15 14 13 13 13 14 14 13 13 13 11 13 18 18 17 1
## [101] 24 25 23 24 26 25 24 21 18 18 21 21 18 18 19 19 19 20 2
## [126] 14  9 14 13 11 11 12 12 11 11 11 12 14 13 13 13 21 19 2
## [151] 14 15 14 12 18 16 17 18 16 18 18 20 19 20 18 21 19 19 1
## [176] 15 15 16 14 21 21 21 21 18 18 19 21 21 21 22 18 18 18 2
## [201] 15 16 17 15 15 15 16 21 19 21 22 17 33 21 19 22 21 21 2
## [226] 20 20 21 18 19 21 16 18 17
```

Descriptive Statistics

Let's see the results for `cty`:

```
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##   [1] 18 21 20 21 16 18 18 18 16 20 19 15 17 17 15 15 17 16 1
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## [201] 15 16 17 15 15 15 16 21 19 21 22 17 33 21 19 22 21 21 2
## [226] 20 20 21 18 19 21 16 18 17
```

Again, can you describe this data? What can be said about the City Miles per Gallon values of these cars?

Descriptive Statistics

Descriptive Statistics gives us tools to Describe the Data, get some basic, general information about the dataset.

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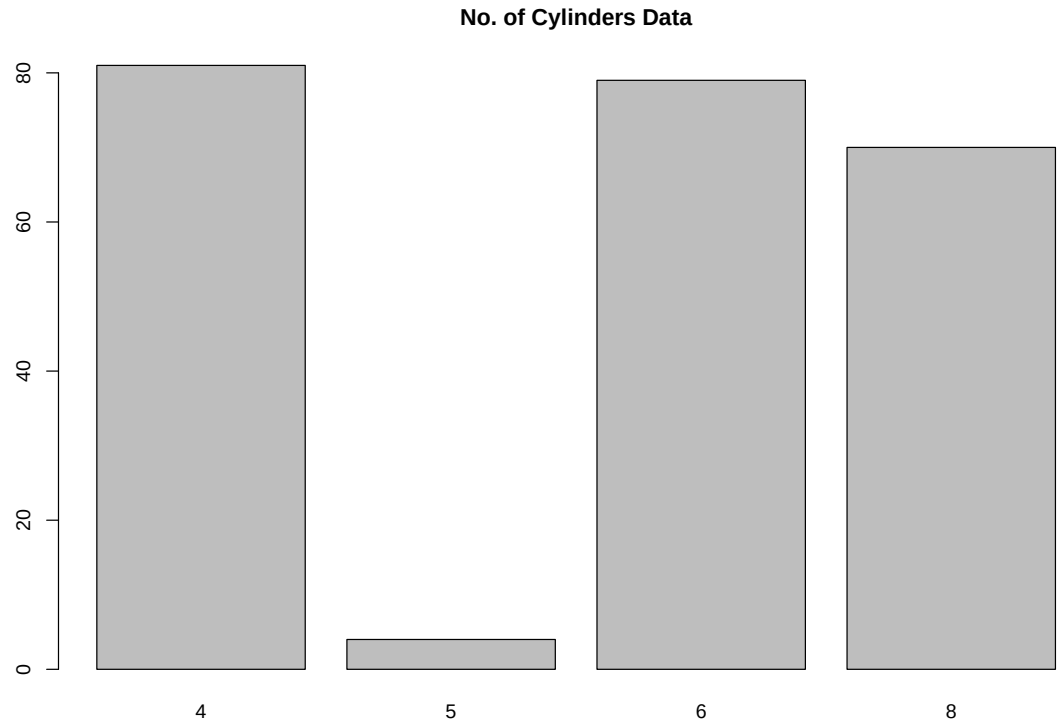
For example, let us draw the BarPlot for the frequencies of the `cyl` variable:

```
barplot(table(cyl), main = "No. of Cylinders Data")
```



Descriptive Statistics

Now, let us give some numerical summaries for `cty`: calculate the average Miles per Gallon for a City, and its max and min.

```
cat("mean = ", mean(cty))
```

```
## mean =  16.85897
```

```
cat("Max = ", max(cty))
```

```
## Max =  35
```

```
cat("Min = ", min(cty))
```

```
## Min =  9
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## Min =  9
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And we can use the `summary` command to get some numerical info:

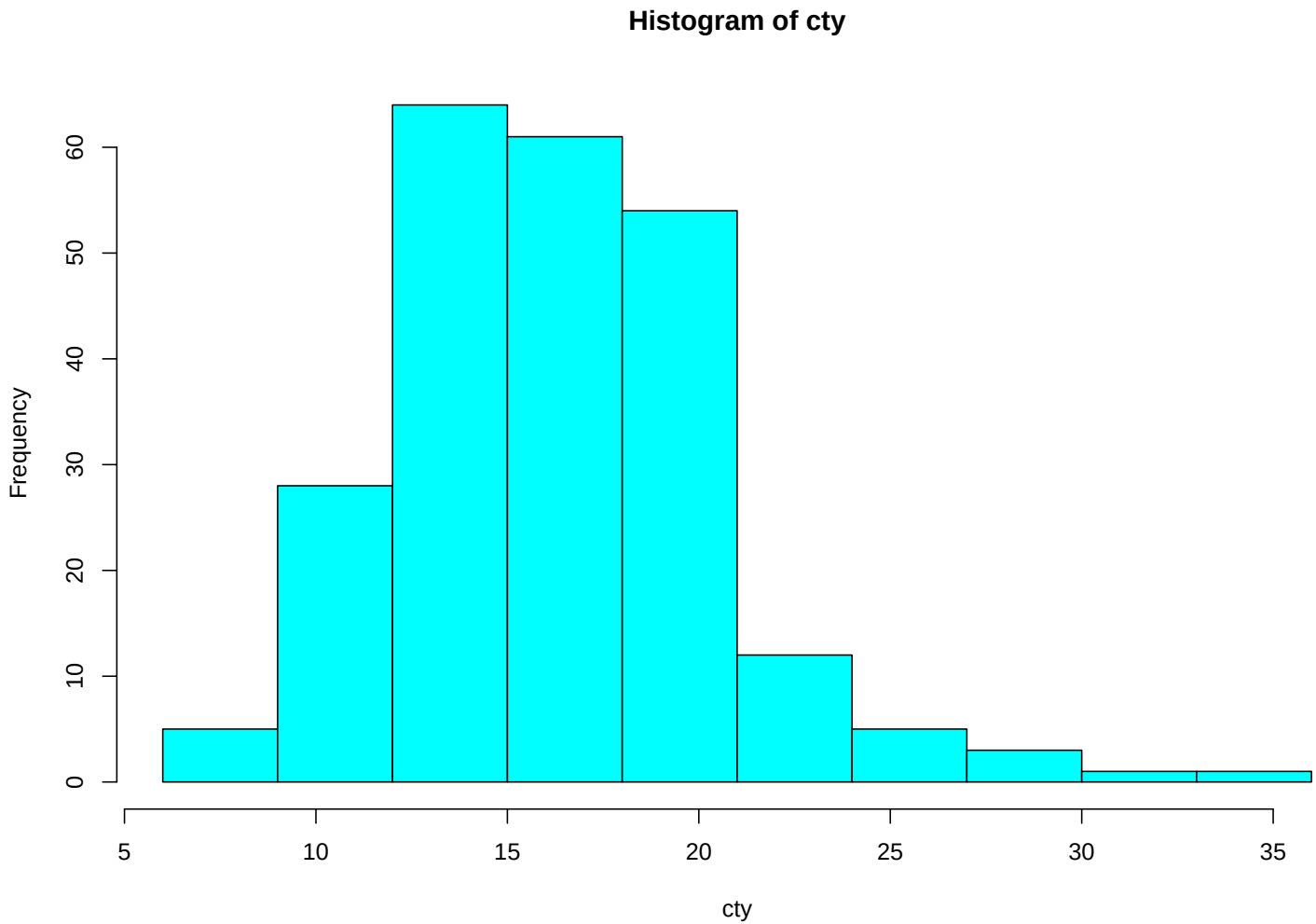
```
summary(cty)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    9.00   14.00   17.00   16.86   19.00   35.00
```

Descriptive Statistics

To get some visual information about the Variable `cty`, its distribution, we can draw the Histogram:

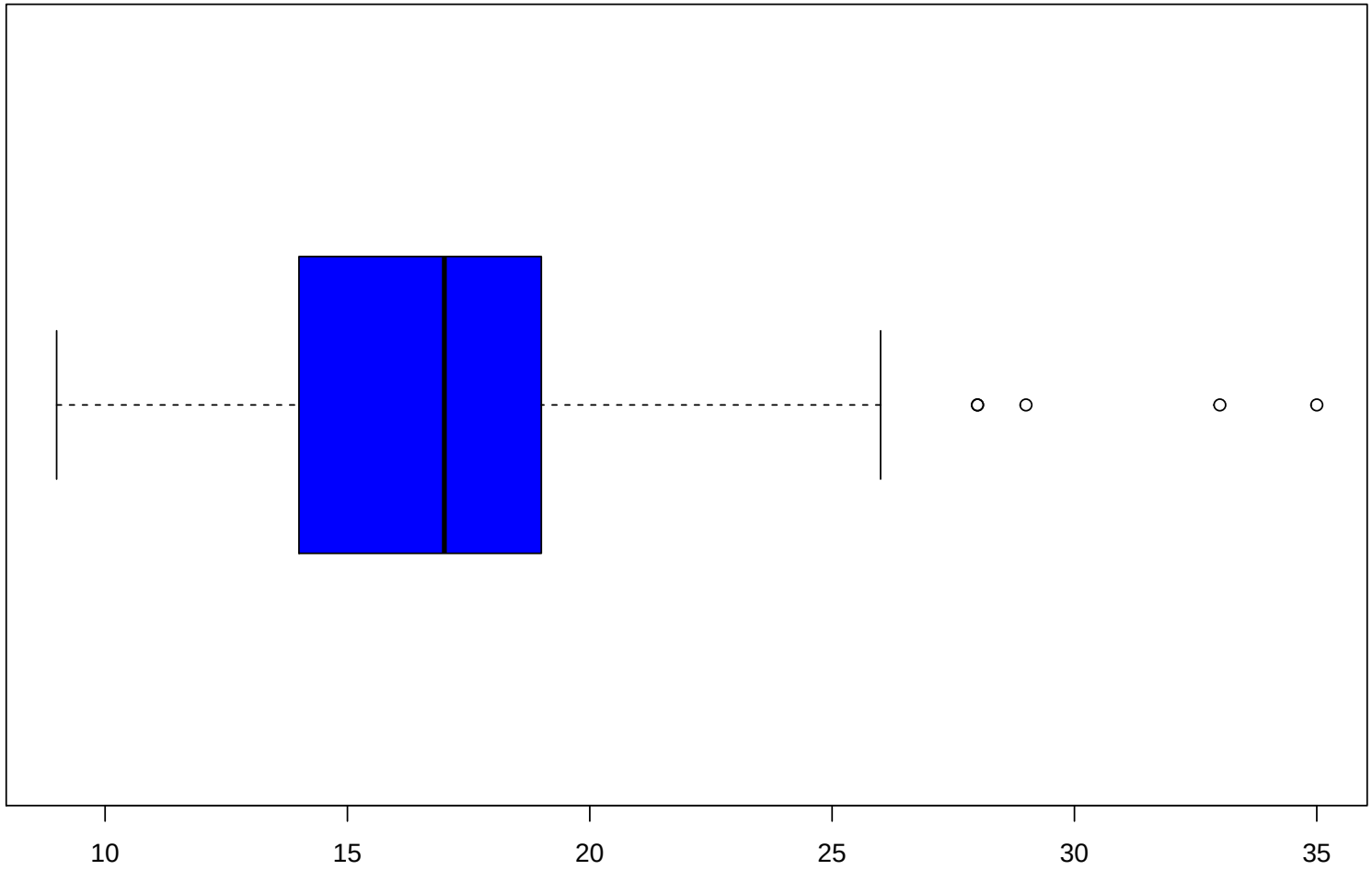
```
hist(cty, breaks=seq(6,36, 3),col="cyan")
```



Descriptive Statistics

Now, we can draw the BoxPlot of the `cty` data:

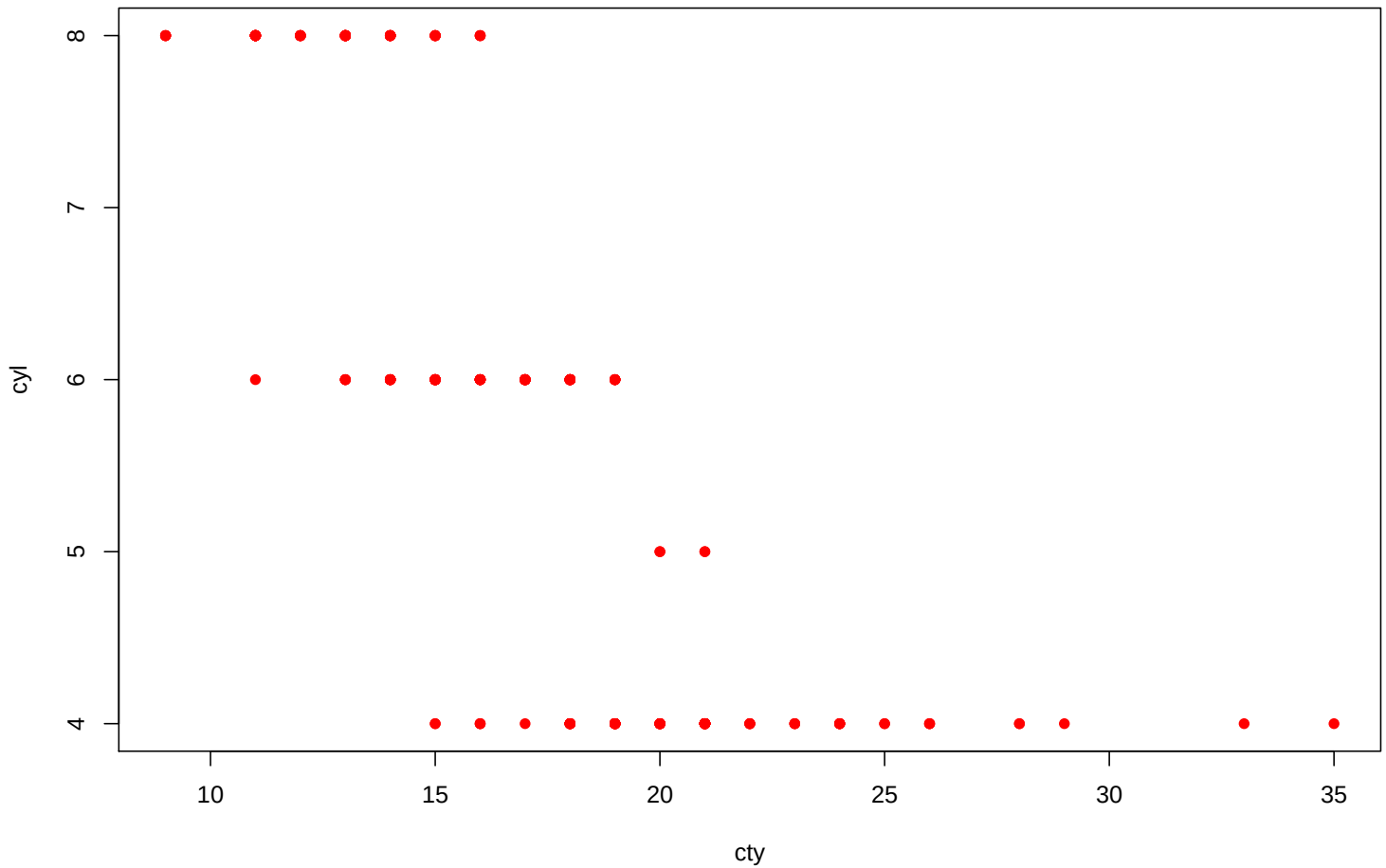
```
boxplot(cty, horizontal = T, col = "blue")
```



Descriptive Statistics

Now, instead of just getting information about `cyl` and `cty` separately, let us give visually the relationship between them:

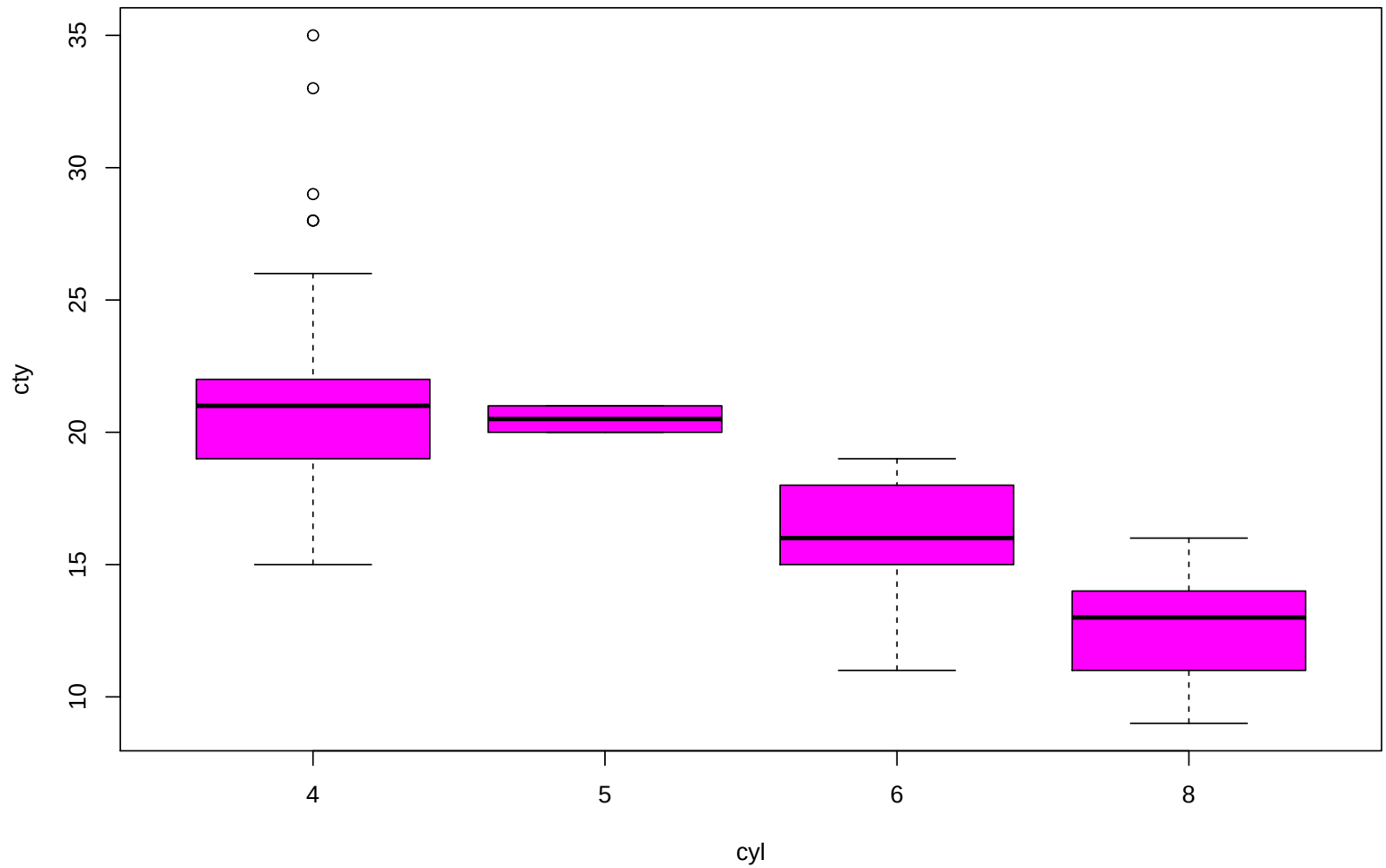
```
plot(cty, cyl, pch=16, col = "red")
```



Descriptive Statistics

. . . or draw a BoxPlot of `cty` for each type of the cylinder:

```
boxplot(cty~cyl, col="magenta")
```



Descriptive Statistics

Moral: our brain cannot get an insight from the list of numbers, but Descriptive Statistics can help ⌣̈