

MS-C1620 Statistical Inference

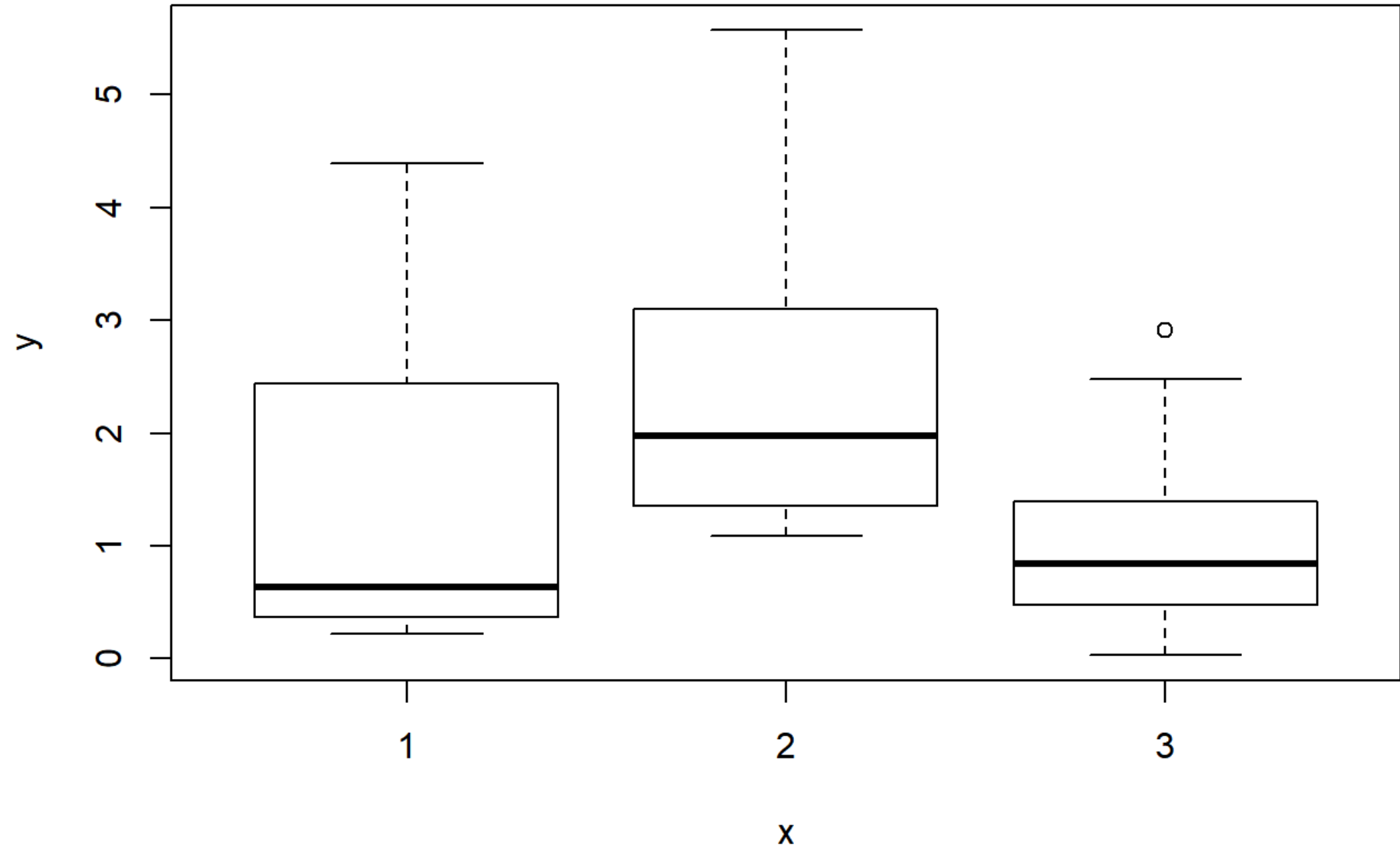
Exercise 12

Homework exercise

To be solved at home before the exercise session.

1. Consider a data set with measurements of the variable `y` for three groups (`x`). Each group has sample size 15. Below are shown boxplots of the groups, along with outputs given by ANOVA and the Kruskal-Wallis test for the data.
 - a. What are the conclusions of the two tests?
 - b. Which test (if either) would you trust and why?
 - c. How would you continue the analysis?

```
boxplot(y ~ x, data = my_data)
```



```
summary(aov(y ~ x, data = my_data))
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## x           1   1.13   1.129    0.586  0.448
## Residuals  43  82.89   1.928
```

```
kruskal.test(y ~ x, data = my_data)
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  y by x
## Kruskal-Wallis chi-squared = 10.185, df = 2, p-value = 0.006142
```

Class exercise

To be solved at the exercise session.

1. A botanist wants to test the hypothesis that the three iris species have equal expected value of `Sepal.Width`.
 - a. Visualize the data.
 - b. Conduct an analysis of variance.
 - c. Are the assumptions of ANOVA satisfied?
 - d. If the assumptions are fulfilled, conduct pairwise comparisons using the Bonferroni correction.
 - e. State your conclusions.

2. The data set `mtcars` has measurements for 32 cars. We investigate the relationship between `mpg` (miles/gallon, the response) and `hp` and `am` (horsepowers and transmission type, the explanatory variables) through an *analysis of covariance*.
 - a. Find a suitable visualization for the data.
 - b. Using the function `lm`, fit a regression model with the covariates `hp`, `am` and `hp:am` (the final one is an interaction effect, the product of the two covariates).
 - c. Interpret the fitted model (homework problem 10.1.a might prove helpful).

3. **(Optional)** Consider still the `mtcars` data set but replace the variable `am` with the variable `gear` (and make sure its type is `factor`). Fit the linear regression model `mpg ~ hp + gear` and find out how the function `anova` can be used to test whether all regression coefficients related to `gear` are equal to zero **simultaneously**. *Note that the situation is different from problem 2 as `gear` has three classes (i.e., two coefficients) and thus the p -values from the model only relate to the hypotheses whether the two coefficients can be set to zero individually.*