

# KEN4258: Computational Statistics

## Homework Assignment 2 (graded)

Christof Seiler

Posted on March 16 at 20:00 / Due on March 23 at 20:00

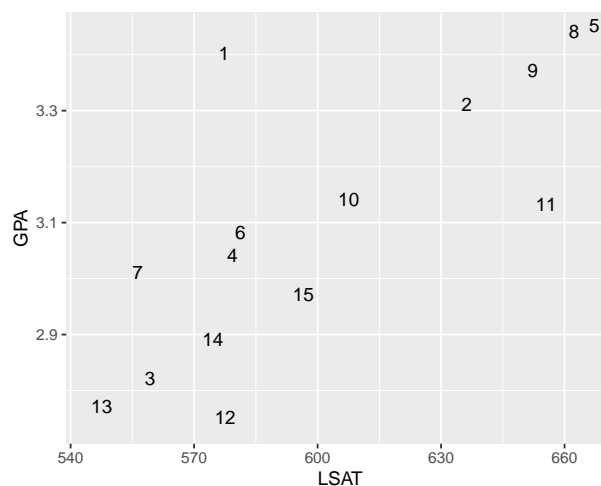
### Logistics

The final submission in the form of a report should be one single pdf that you can upload to Canvas. One submission per group. The group can have a maximum of 5 members. We recommend to keep the same groups from assignment 1. Keep the report short. The main text should not exceed three pages. You can add an appendix to mention details that you find important. Otherwise, the structure of the report is up to you. You might want to add a link to your GitHub repository with your code.

### The Bootstrap [100 points]

Consider the following law data on the relationship between LSAT and GPA.

```
library("ggplot2")
library("tibble")
library("bootstrap")
library("magrittr")
data(law)
law %<>% add_column(observation = 1:nrow(law), .before = 1)
ggplot(law, aes(x = LSAT, y = GPA)) +
  geom_text(aes(label = observation),
            hjust = 0, vjust = 0)
```



During the exercises, you will compute the nonparametric bootstrap distribution of the Pearson's correlation coefficient between LSAT and GPA using  $B = 40000$  bootstrap samples. In this assignment, work on these additional tasks:

1. [20 points] Recompute using the complete enumeration bootstrap.
2. [20 points] Use Gray codes for compositions to speedup computations.
3. [20 points] How much speedup can you get by using Gray codes? Show either experimentally or theoretically.

4. [20 points] Which observation(s) do you need to remove from the sample to make the Monte Carlo and complete enumeration bootstrap look more similar?
5. [20 points] Explain why you obtain difference results for Monte Carlo and complete enumeration bootstrap.

For details on the implementation take a look at Wilf (1989) and Klingsberg (1982).

## References

- Klingsberg, Paul. 1982. "A Gray Code for Compositions." *Journal of Algorithms* 3 (1): 41–44.
- Wilf, Herbert S. 1989. *Combinatorial Algorithms: An Update*. SIAM.