A Study of Collaborative Work: Answers to a Test on Formal Specification in B

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Objective It is commonly admitted that strength comes through unity. The point we address here, is to discuss to what extent this applies to a pair of students facing a test in formal specification (B notation). More precisely, we aim at deciding whether collaborative work is of benefit for one, other, or both of the collaborating students. We use data analysis to examine a sample of students and derive some qualitative and quantitative information. What follows is a seminal work: i.e., the sample is small. Here follow the main points of our contribution:

- Identification of a strategy to design a formal specification test and collect data
- Proposal of a statistical approach to exploratory data analysis
- Application of graphical analysis and statistical hypothesis testing procedures

Further analysis carried out in the same manner on larger samples may be of interest and would provide for more accurate conclusions.

Sampling 26 students involved in the first year of a course (IUT¹) in computer science were first presented with a test in formal specification. The test was made of incomplete source text for three B machines, and students were asked to fill in the missing parts. Time for answering was limited but amply sufficient. Individual results ranging between 0 and 20 were recorded.

Independently from these results, students were asked to discuss the previous examination and the answers they provided. Each student was allowed to revise his work and give an individual corrected final version. Once again, copies were corrected and given a mark between 0 and 20. Individual and collective results have been confronted and analysed.

¹ Institut Universitaire de Technologie: two years study that trains computer science technicians

Statistical Analysis In brief, our main conclusions are the following:

- Collaborative work never is prejudicial except for one student in the sample. The overall average mark is 8.5 without collaboration and around 13 after collaboration. All pairs gained on average. According to Student's means comparison test procedure, all effects are significant (5%). One could advance that better results might be assigned to more time for answering the test, independently of any collaboration effect. This seems not to be sound since time was not an actual constraint during the individual examination.
- We applied a linear regression model $M2 = a_0 + a_1M1 + \epsilon$ to capture the relation between the independent variable (individual result before collaboration: $M1$) and the dependent variable (individual result after collaboration: $M2$). Doing so, we could compute an estimate for the general effect of collaboration ($a_0 \approx 7$) and one for an extra bonus related to the initial level of the student ($a_1 \approx 0.7$). It is worth discussing the meaning of $a1$ which is significantly not null and less than unity.
- Graphical plots suggest that heterogeneity of results within pairs of students increased after collaboration. This intuition is not confirmed by a statistical analysis (T test). More precisely, we concluded that collaborative work has a consensus effect for groups over 8, while collaboration widens the gap for groups under 8.
- Lastly, a correlation analysis showed that no significant relation existed between the difference within groups and the score of groups.