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# Critical Analysis of the Use of a Statistical Test in a Research Document (Linear Regression Test)

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**Abstract**

This article takes a critical look at a text written with a quantitative methodological approach (with the use of a statistical test). This is the text of Michaelowa (2000), on "Educational expenditure, quality of education and poverty: the example of five French-speaking African countries". Indeed, most scientific articles and other research reports are written with a qualitative or quantitative approach (with the use of a statistical test). It would therefore be interesting to take a critical look at these texts, because as soon as research includes a presentation of results, it is possible to pass judgment on the methodology used. In the context of this work, the critical eye focuses on the use of the Linear Regression test.

**Keywords:** statistical test, methodological approach, scientific articles, research reports and critical eye

## 1. Introduction

The statistical test is useful only when the study of the entire population is impossible and the researcher must instead analyze a sample of this population. In this case, since sampling inevitably leads to some error, the hypothesis test aims to indicate the probability of obtaining the observed statistics on the basis of a hypothesis as to the value of a parameter of the population. While the first known hypothesis test, the chi-square test, can be attributed to Karl Pearson (1857-1936), it was Ronald Fisher (1890-1962) who first outlined the methodological logic of the tests (Bourque, Blais & Larose, 2009).

This is how most scientific articles and other technical reports written with the quantitative method use a statistical test. This is the case of this working paper from the OECD Development Center in Michaelowa (2000) on education expenditure, quality of education and poverty in five French-speaking African countries. The objective of this article is to make a critical analysis of the use of the Linear Regression test used by Michaelowa (2000). This type of test makes it possible to determine the predictive power of one or more independent variables to predict the value of a dependent variable (Howell, 2003). We will therefore try to take a critical look at the sampling, the research questions and objective, the variables and the test used.

## 2. Sampling Used by Author

In this document, the author did not mention

the sampling method used to choose not only the schools, pupils and teachers, but also the countries concerned by the study, namely Burkina Faso, Cameroon, Côte d'Ivoire, Madagascar and Senegal. It only exploited the database of the Conference of Ministers of Education of countries having French in common (CONFMEN). However, reading the document, we realize that the sample is made up of between 2,000 and 2,500 students at CM1 level (fifth class or year of primary or elementary school) from around a hundred schools in five French-speaking countries. Sub-Saharan Africa, namely Burkina Faso, Cameroon, Côte d'Ivoire, Madagascar and Senegal as well as their teachers and the directors of these schools.

*2.1 Sample Features*

They are all pupils of level CM1 (fifth class or year of primary or elementary school) from five French-speaking countries of sub-Saharan Africa: Burkina Faso, Cameroon, Côte d'Ivoire, Madagascar and Senegal. In the schools that make up the sample, only one CM1 class is chosen. These students are on average between 10 years and older. The other part of the sample is made up of the teachers of these classes and the directors of the various schools concerned by the study.

*2.2 Representativeness of the Sample*

Regarding the number of countries, the sample is fairly representative. Indeed, as mentioned by the author, the five countries of the sample are distributed in the three main regions of sub-Saharan Africa: Sahel (Burkina Faso), coast (Côte d'Ivoire and Senegal) and center/east (Cameroon and Madagascar). In addition, the average GDP/inhabitant of these countries is equal to 1480 dollars, which is slightly higher than the average of all fifteen French-speaking countries in sub-Saharan Africa (1207 dollars). Also, it should be noted that the education systems of all these countries are based on the same structures, adopted during the period of colonization. All in all, it appears that through their diversity as well as through their commonalities, the five countries that make up the sample can quite well serve as an example for French-speaking sub-Saharan Africa.

However, this sample is not as representative of the total population targeted in this study. Indeed, the primary or elementary schools of the French-speaking countries for which it is intended include six levels (from CI to CEM2). Consequently, the study of a single level does not make it possible to grasp the reality of the relationship between education expenditure, the quality of education and poverty. The study should have covered at least three levels. The author herself notes that her sample is not sufficiently representative, stating that "even if the sample is not strictly representative since certain strata with few observations have been slightly overrepresented..."

**3. Variables Used by Author**

In this document, the author has used different variables. For each variable, the type (quantitative or qualitative), the measurement scale (Interval/ratio, nominal and ordinal), the role (independent and dependent) and the values/modalities were specified.

**4. Test Used**

The test used is Linear Regression. This type of Test determines the predictive power of one or more independent variables to predict the value of a dependent variable. To apply it in a study, the dependent variable must first be of the interval-ratio type, normally distributed. Then, the independent variables must also be of the interval-ratio type, but can include "dummy" variables. There must also be at least 50 subjects and ten times as many subjects as independent variables.

**5. Relevance of Using the Test in this Study**

The Test finds its interest in this study, because it is even a predication of several independent variables (here the school level) on a dependent variable (school performance in math and French). In addition, a large part of the application conditions of the test are respected, because the dependent variable (school performance in math and French) is of the Interval/ratio type and the independent variables (school level) are not only of the Interval/ratio type, but also include "dummy" variables. There are also over 50 topics. Also, there are many more subjects than independent variables.

However, there are some variables that deviate from this rule. These are the "availability of the teacher's guide" variable and the "applied teaching methods" variable. These variables are of qualitative type and of ordinal scale. This can have an influence on the results of the study, because these two variables have a role to play

on school performance.

**6. Value of the Results Obtained**

In this study, the use of the linear regression test made it possible to see the degree of influence of the different variables of the school level on school achievements. Thus, we see that some variables influence more than others on student results. Among these variables, we have the master's knowledge of the local language, the organization of classes in double flow, the availability of books, the regular exchange between teachers, the visit of an inspector, the participation of the school in a particular program… are more relevant and therefore have a greater influence on academic achievement. This allowed the author to formulate a number of recommendations for good student learning. Among these recommendations we have: *The facilitation of students' access to books, the abandonment of double-shift classes, the granting of free snacks to the most deprived children, the encouragement of women to enter teaching, the revision of teacher training and repetition policy, etc.*

However, even if many variables are significant in the acquisition of student knowledge, the results of the regressions are not very clear on several other fundamental elements that can also influence school performance. This is the existence of basic equipment such as table benches for the students, the blackboard, white chalk, pencils, notebooks, slates or even the teacher's desk. The regressions also did not report on the influence that the instructional methods used by the teachers would have on the results of the students. In addition, the fact that teachers have activities outside of school does not seem to influence student results.

This could be for several reasons. First, at the level of the choice of subjects, we find that the sample is large even if it is not representative enough of the population studied. In such a situation, a small difference can be significant. Then, there are certain conditions of the application of the test which have not been respected as we have said above. The author also uses several regressions for a single variable (1 to 5 regressions) without giving the reasons. Finally, the author did not insist much on the effect of these different independent variables on school achievements.

The combination of all these factors makes it difficult to interpret the results and raises questions about the effectiveness of the author's recommendations. In addition, the test took place at the end of the year, which could influence the results, because during this period it is difficult to meet some students, especially those in rural areas with the start of the rainy season, and therefore the start of field work and the state of certain roads.

**7. Conclusion**

This text aimed to take a critical look at the use of a statistical test of Linear Regression on a research report. As a reminder, statistical tests are only in the quantitative research approach. Indeed, as we pointed out in the summary, any research, whether quantitative or even qualitative, as soon as it includes a methodology (sampling, data collection, etc.), it is likely to be the subject of criticism. scientists. It is to this exercise that we turn with the text of Michaelowa (2000), Audet (2008). During all this work we have shown the strengths of Michaelowa's document (2000) while listing the points to be improved. Indeed, Jr Hoppin (2003: 672) said that "insightful and reasoned criticism can substantially improve the scientific quality and clarity of a submitted work and can improve the authors' knowledge and their ability to conduct and present a scientific work".

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