Statistical teaching based on visual simulations with JAVA

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1. Introduction

This software, which we have made public at this time, aims to support statistics education, and is part of the "After School Math." It assists students so that they can study by themselves. The rationale behind this software is the fact that the mathematics should be understood visually. In particular, this statistics software further provides simulations related to daily life. For example, you can (1) find the value of π(pi) by dropping a number of needles(Buffon Needle problem), (2) simulate the central limit theorem visually, (3) simulate the phenomenon that the probabilities of elevators coming down from upstairs and coming up form downstairs are both 0.5, (4) calculate how many coins should be prepared for changes by the host for a party registration, (5) why an unbiased estimator id a value divided by n-1 and so on.

This software was developed with the assistance of IPA (Information-Technology Promotion Agency, Japan).

2. The history and the purpose of "After School Math"

We have been working on the production of the software entitled "After School Math" for 8 years. The prime motivation that made me start creating and continue its development is:
(1-a) to help every student to learn subjects based on his/her ability.
(1-b) to pursue the possibility of utilizing multimedia in mathematics education.

As for (1-a), we have been giving large classroom lectures for over 20 years. But we have not been able to give each student a lesson that meets his/her individual needs. We always feel a need to help students to learn subjects based on their own ability and at their own pace. In particular, we have a strong desire to give sufficient education to handicapped students who are even unable to open textbooks by themselves, or students who cannot come to school for one reason or another.

At the same time, as stated in (1-b), we have been investigating the possibility of comprehending mathematics visually for tutorial teaching through the use of a PC.

With the emergence of the Internet and various script languages, it is now possible to bring (1-a) and (1-b) together.

3. Examples

Any part of the software, now being made available to the public free of charge, can be used extensively at any time, according to the needs and desires of the users. Now we give you some examples as follows

(a) *Example 1*

Figure 5 is a simulation of the Buffon Needle Problem. Parallel lines are drawn on a plane and needles are dropped from above. The value of π(pi) is obtained from the ratio of the number of needles crossing the parallel lines to the number of needles dropped. This simulation can make us confirm that that value converges π(pi) visually.

(b) *Example 2* Figure 2 is a simulation of an Unbiased Estimator Simulation. In estimating a population variance, we are able to easily prove that we had better use a unbiased estimator. But we would like to find whether it is true visually. This simulation allow us to confirm that it is true.

Fig. 1. Simulation of Buffon Needle Problem

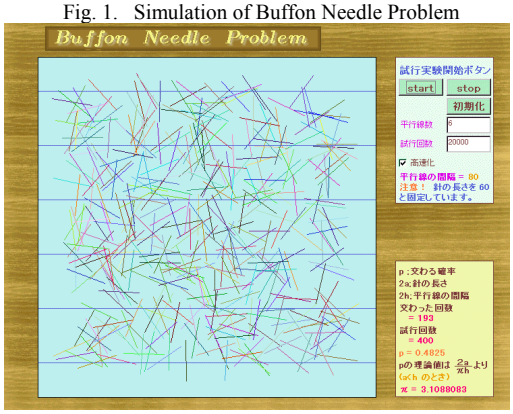
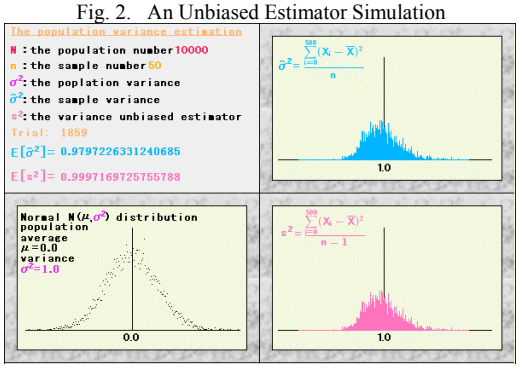


Fig. 2. An Unbiased Estimator Simulation



4. Results

As for the teaching method, it is still said that, “what is indispensable for learning mathematics is, after all, paper and pencils.” Surely they are indispensable in pure mathematics. However, it is also true that quite a few things are not confirmed without the use of a PC. This software can make us confirm visually what we could not visualize in mathematic so far.

Furthermore we would like to express other statistical problems visually and develop the software. Now, we are most interested in optimization problems (visual calculus variation and so on).

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REFERENCE

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RÉSUMÉ

Le logiciel intitulé " Les Maths post-scolaires" a été créé en vue (1) d'aider les étudiants dans l'étude du sujet fondé sur leur compétence (2) la possibilité de continuer d´utiliser le multimedia dans l'apprentissage des mathématiques. Plusieurs exemples sont affichés et des simulations sont réalisées.