CURRENT SITUATION AND ISSUES FOR EFFECTIVE USE OF STATISTICAL SOFTWARE IN JAPAN

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It is one of goals for teaching statistics to understand and perform statistical problem solving. We have to make the effective use of statistical software in order to achieve the goal. There are many software, for example TinkerPlots and Fathom are well-known. If we consider using software in almost all schools, it is preferable that the software is free of charge and operations are limited. Especially Japanese teachers/students have difficulty to use English software. Unfortunately there are not many software with using Japanese language and treating easily. We have made several software programs for school use and published them free of charge. We present the characteristics of them and some examples for use.

INTRODUCTION

The development of the technology has changed the method of analyzing data. We can calculate statistics and the distribution of it by pushing the button of the menu. Technology not only helps the calculation of routine computation but also makes the statistical methods more complicated. Recently it is difficult to analyze data without the aid of software for all but the smallest datasets. In statistics education the role of using technology is more important. It is more common to use computer in teaching introductory statistics in undergraduate course. Statistical software can reduce the computational burdens. The Guidelines for Assessment and Instruction in Statistics Education (GAISE) (Carver et al., 2016) said that:

"By adopting the best available tools (subject to institutional constraints), we allow students to *do* analysis more easily and therefore open uptime to focus on interpretation of results and testing of conditions, rather than on computational mechanics."

Chance et al. (2007) reviewed the role of technological tool in helping students develop statistical literacy and reasoning. There are many roles in their results for secondary students. Here we emphasize two of them.

One of them is the automation of calculation. By using statistical software, students can carry out many calculations and graphing tasks with high accuracy and few errors. Students can spend more time focusing on understanding the concepts by reducing the computational task. The other role of technology is the investigation of real life problems. The data sets of real problem may be large and complicated. To focus to explore and solve the real problem the use of technology is more important.

Several technological tools, for example interactive applets, statistical software, web-based resources and so on, are already available. Especially ThinkerPlots and Fathom are famous for statistical software. The effectiveness of TinkerPlots has been investigated. Watson and Donne(2009) considered as a research tool to explore student understanding and Fitzallen and Watson(2010) proposed to use TinkerPlots to develop statistical reasoning. Fathom also excellent software for dynamic visualization.

Unfortunately Japan is lagging behind regarding the use of technology in teaching statistics in secondary school. We describe the recent situations in Japan in the next section.

JAPANESE SITUATION

Japanese government recommends that teacher use technology effectively. The Minister of Education, Culture, Sports, Science and Technology, Japan (MEXT) prepared the checklist of the ability to utilize ICT in teaching in 2007 and have been promoting the increasing the proportion of teachers with the ability. In 2009, MEXT proposed the guidance of informatization of education and promoted teacher's training and preparation of ICT environment in school. MEXT also provide the vision for ICT in education. The vision deals with the informatization of education. The

informatization of education consists of three elements, 1) information education 2) utilization of ICT in course instruction 3) introduction of school administrative works. Nevertheless, the ICT utilization in education in Japan has not been successfully advancing compared with other industrialized countries. Based on MEXT (2018) the percentage of teacher with the ability to utilize ICT in studying teaching materials, preparing classes, and evaluating students: was 83.2% and that of teacher with the ability to utilize ICT in class guidance was 73.5%..

Toyofuku (2015) insisted the following three reasons why Japanese teachers hesitated the use of ICT.

1) Use of ICT is not a goal of statistics education but a tool for education. So Japanease teachers considered that teachers should control how to use the ICT tool.
2) We need some evidence that Use of ICT has good effects of education and teachers have to have a clear reason of use.
3) Teachers need to have good ICT tools corresponding to the teacher's intent of the class.

Iijima (2015) considered that we need the excellent software that teachers don't have stress because the environment of ICT are different depend on the school. We have to consider the problem of time in Japan. We cannot spend enough time for statistical contents. There are many contents we teach in math. So teachers are struggling to make time.

Another issue for the use of technology is luck of excellent software programs in math. Of course there are many good statistical software and software for education. But Most of them were written in English. We use Japanese in classes except for English language class. So if we use English software, students have stress for English and they need enough time for that student can use software correctly.

PROPOSED SOFTWARE

We develop some statistical software programs for education in secondary schools. These software programs don't require special knowledge for using. And we can use them quickly.

Software 1: Histogram

Students learn the histogram in grade 6 and 7 in Japan. In grade 6, students learn the definition of frequency tables and histogram and have the experience to count the number for each category and to create the histogram by hand. In grade 7, students learn properties of histogram and how to use the histogram for problem solving. For example they try to draw several histograms for different size of bin or different value of bound of bins and choose a good graphical expression. So we created the statistical software (SimpleHist) for secondary students (Figure 1) about 10 years ago.

Figure 1. Main frame for SimpleHist

This software has the following properties:

1) If we set the bound of lowest bins and size of bins, it can make the frequency table and draw the histogram by pushing one button.
2) It can add the mean and median of the data in the graph.
3) It can make new frame for each histogram and compare them (Figure 2)
4) It can draw easily and quickly. So we can spend the interpretation of histogram.

Many math teachers use this software program and try to make students consider the reasoning and problem solving.
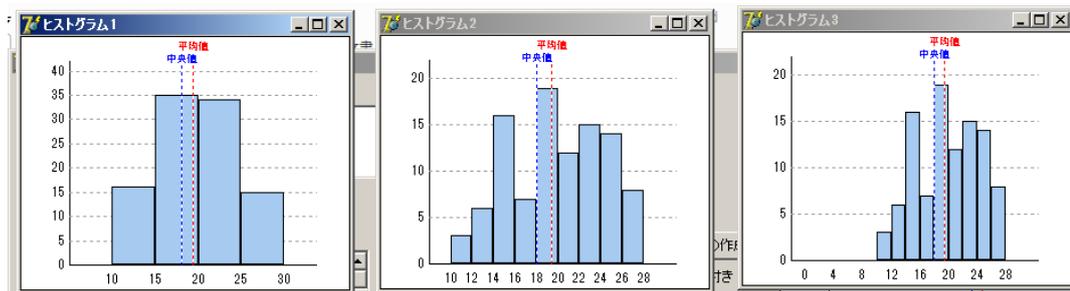

Figure 2. Several histograms can be shown simultaneously.

Software 2: Box-whisker plot.

In Japan we started to teach box-whisker plot in grade 10 about 10 years ago. At that time most of high school math teachers didn't know the box-plot. So most of teachers had no idea how they teach the definition of quartile and a box-whisker plot. Only a few teachers challenge to teach the statistical inquiry by using the box-whisker plots. One of the reason that high school math teacher feel difficulty is that they like to consider theoretically and don't like the statistical thinking because statistical problem don't have to have only one answer. Japanese government had decided to teach box-whisker plot in grade 8 since 2020. In this change of course of study in 2017, junior high school teachers teach histogram in grade 7 and box-whisker plot in grade 8. They have to teach the difference in properties between histogram and box-whisker plot. They are also required to challenge the statistical problem solving using histogram or box-whisker plot. So we have created new statistical software for box-whisker plot (Simplebox) for secondary students (Figure3).
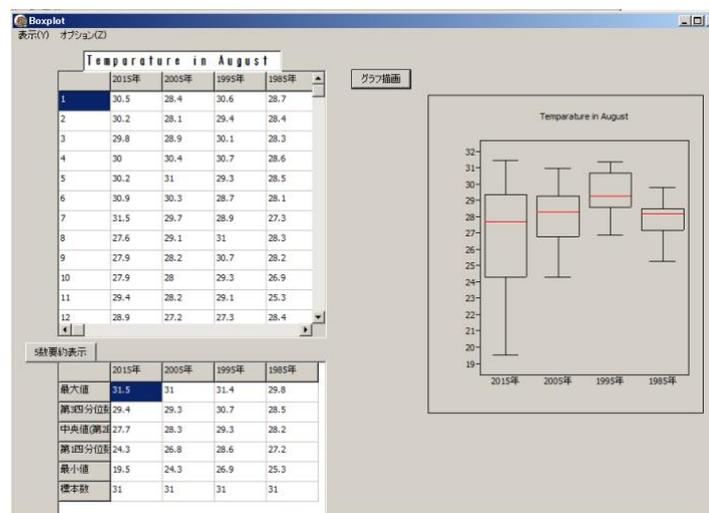

Figure 3. box-whisker plot in SimpleBox

We make Simlebox to draw the box-whisker plot easily like Simplehist. Simplebox has the following properties:
   1) data set can be imported from csv files.
   2) it can draw the several box-whisker plot simultaneously.
   3) it can divided to several groups by using a variable. The variable may be categorical data or contious data. If continuous data use, We choose the cutting point for grouping.
   Unfortunately, this software have just been completed recently, so it has no experience to use in a class. We have to consider how to use this software.

CONCLUSION

The software programs we created are special software programs which are used in school math, so we consider the special goal of each grade. They are not fitted to the statistical problem solving. On the other hand, TinkerPlots and Fathom can be used when we try to consider the statistical problem solving. So we need to combine these programs. If we can create the software, we can solve the statistical problem by using a software problem and consider the choice of statistical picture corresponding the data and goal of statistical problems.

We have to consider how to use the Simplebox in classes. It can draw quickly so we can spend times for understanding the concept of box-whisker plot and quarter points and for solving on the basic statistical problem.

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