

PRACTICE OF THE IMPROVEMENT IN STATISTICAL PROBLEM-SOLVING FACULTY THROUGH THE ANALYSIS OF REGIONAL DATA

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For elementary, junior and high school students, making use of regional data is very useful to feel familiar with statistics, have an interest in their surroundings or make a new discovery.

Also, regional studies are assumed to be helpful for teachers to improve students' statistical problem-solving faculty and easy to deal with. It was significant for the Civil Service, which has specific data, to cooperate with schools. Therefore, I introduce the lessons about statistics which I had at schools, and the efforts to make the textbook for high school students and college students.

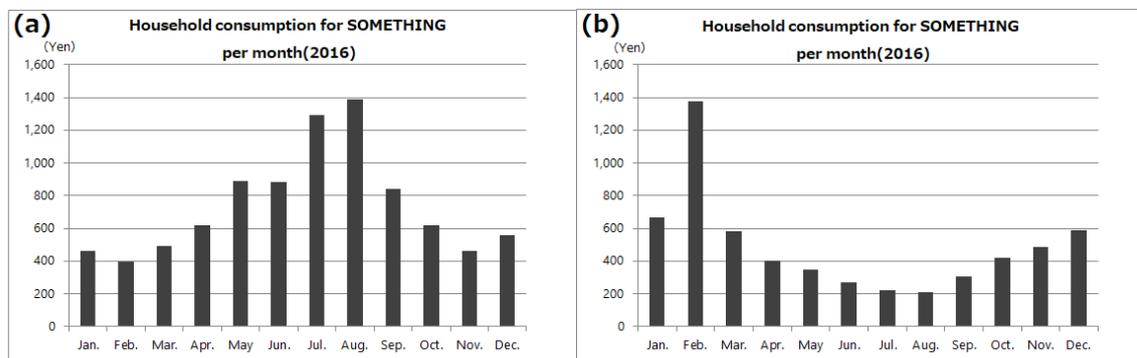
INTRODUCTION

Niigata Prefecture is about 12,584 km², and its population is about 2,300,000, lies in the center of the mainland along the Sea of Japan, and has a broad stretch of fertile land surrounded by mountains. The major industry in Niigata Prefecture is agriculture, and rice is the principal product. The coastline is 331 km long, so many people enjoy sea bathing in summer, while many people including foreign tourists enjoy skiing and snowboarding in winter because it snows a lot in this area.

Since 2014, the Statistics Department of Niigata Prefecture has made an effort to teach statistics in elementary schools or junior high schools with regional data so that children feel familiar with statistics. By schools' request, I had 25 lessons for 2018. In addition, I made the textbook on statistics for high school students and college students using the data about rice, which is one of the specialties of Niigata Prefecture. I focused on how to make children interested in statistics naturally, and how to have them understand easily in any studies. Furthermore, in the second year of this career, I found out that Niigata Prefecture is the birthplace of statistics in Japan.

DELIVERY CLASS FOR LEARNING STATISTICS

In order to have children feel familiar with statistics, the workers in statistics department go to school and have lessons about statistics using the data around its area. Figure 1, which comes from the statistics development, shows the total amount of money spent in a month per family. With this figure, have children guess what is bought for each month. For example, graph (a) is thought to be "ice cream, since the amount of spent money goes up in summer. And graph (b) shows chocolate since many people buy some in February for Valentine's Day. Graph (c) is supposed to be the one for cake, and in graph (d), you can tell on which date people buy it a lot. This quiz about statistics could be popular no matter which grade the students belong to. In addition, children can think about statistics as an important thing as well as it's interesting.



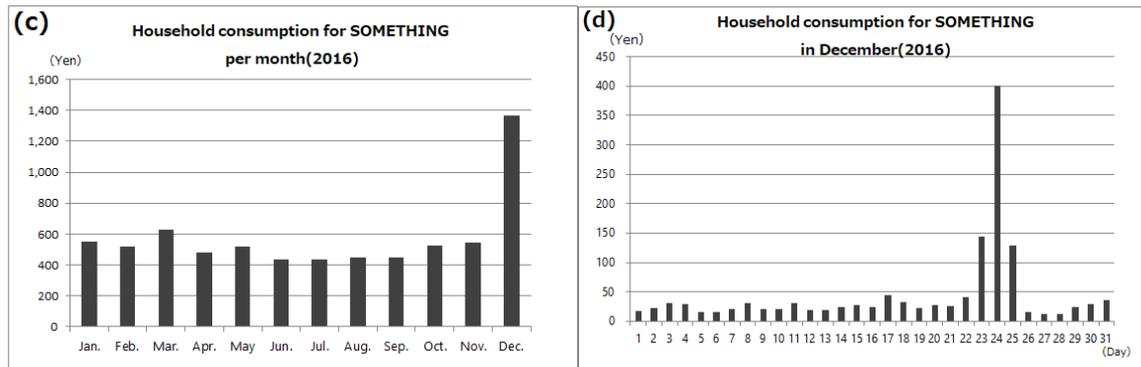


Figure 1. Quiz about Statistics

The educational programs are already organized into a specific pattern, so the data will be changed depending on the area the workers visit. This is the strong point of the prefectural development.

Lesson plan

- Learn why we need to study statistics now
- Tell the importance of the survey on statistics
- Search Statistics used around you
- Explore characteristics of the area around school
- Ask questions about statistics
- Make a figure according to children’s understanding, adapt to problem-solving learning

Figure2 is used in the delivery lesson for elementary school students in Yuzawa town. Yuzawa town is located in Uonuma area and is famous for its ski resorts. In the lesson, students thought about the problems of their hometown in accordance with the procedure below.

- It is said that the number of tourists for skiing is decreasing these days. Figure out whether it is true or not by using the graphic data.
- Think about the way of advertisement. Which is more efficient to increase the number of tourists for skiing? Advertise to people who live in Niigata prefecture, or to people who live in other prefectures.

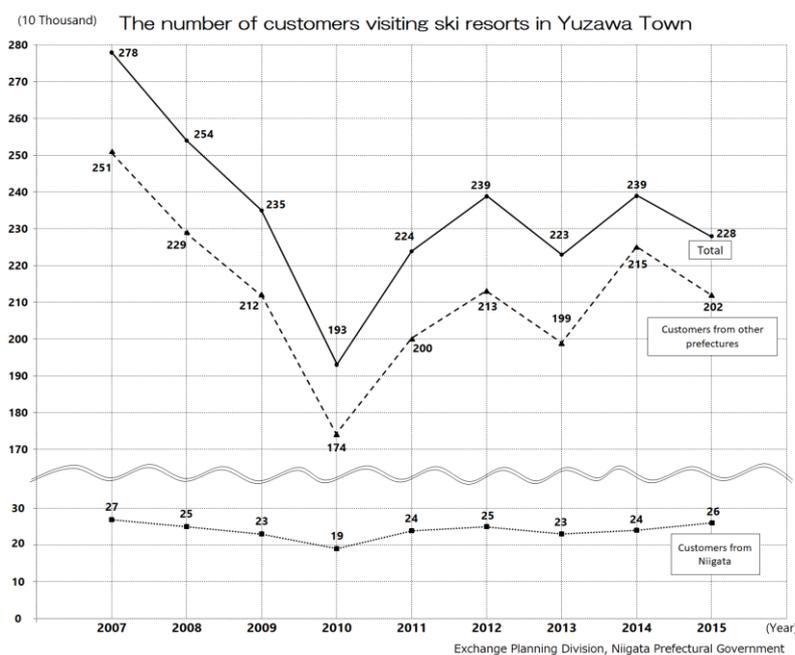


Figure 2. Line graph made by students

Fourth grade students are supposed to study line graphs in class, so it is actually appropriate for them to use its graph when they think about the transition of the number of tourists. According to the figure, the fluctuation of the number of tourists from Niigata is smaller than that of other prefectures. As a result, students concluded that more promotion should be done for people outside Niigata.

CREATING A WORKBOOK FOR STUDENTS IN HIGH SCHOOLS AND UNIVERSITIES

The part 6 of “Practical Use of Statistic and Data Science in High School- Advanced-” was written. It is about problem solving in the statistical way about rice which is Niigata’s special product. The content is about viewing reason and measures of why the rice quality in 2010 became the lowest in its history in Niigata, where rice is grown the most in Japan, based on data analysis by following a procedure of statistical research, PPDAC cycle.

Problem

Investigating measures to keep the rice high quality by analyzing a relation between the quality and weather

Plan

- A relation between the quality and weather
Is it affected by just the temperature or are other weather conditions involved?
- Temperature at which the quality deteriorates
From what temperature does the quality deteriorate?

Two problems were set and investigated by using “Weather Data” and “Ratio of the 1st grade rice”.

- (i) Creating a polygonal line graph to see the transition in time, and see if there is a time when the conditions were the same as 2010. The graph created here shows the ratio of the 1st grade rice in the left vertical axis, and weather data in the right vertical axis.
- (ii) Investigating a relation between the ratio of the 1st grade rice and the weather data such as average temperature, the highest temperature, the lowest temperature, precipitation, and sunshine duration. Creating a scatter diagram to see a correlation coefficient by CORREL function. There is a way to check a correlation coefficient by using a function, “Analysis Tool”, in Excel.
- (iii) Searching the temperature at which the ratio of the 1st grade rice becomes worse than average years by regression formula.

Data

Downloading the August Weather Data every year from 1979 to 2015 and Data which shows the ratio of the 1st grade rice and doing data cleaning.

Analysis

- (i) Analyzing the ratio of the 1st grade rice and weather data in time series data.
In case of showing the transition in time series data, it would be better to create a polygonal line data whose vertical line shows volume and whose horizontal axis shows time. (Figure. 3)
- (ii) Investigating a correlation between the ratio of the 1st grade rice and weather data. (Figure. 4)
- 4) Making a scatter diagram and searching a correlation coefficient about the ratio of the 1st grade rice and weather data of August.
- (iii) Searching a temperature at which has a possibility the quality goes bad by using regression analysis.
Searching regression formula by using an Excel function which adds an approximate curve in a scatter diagram.

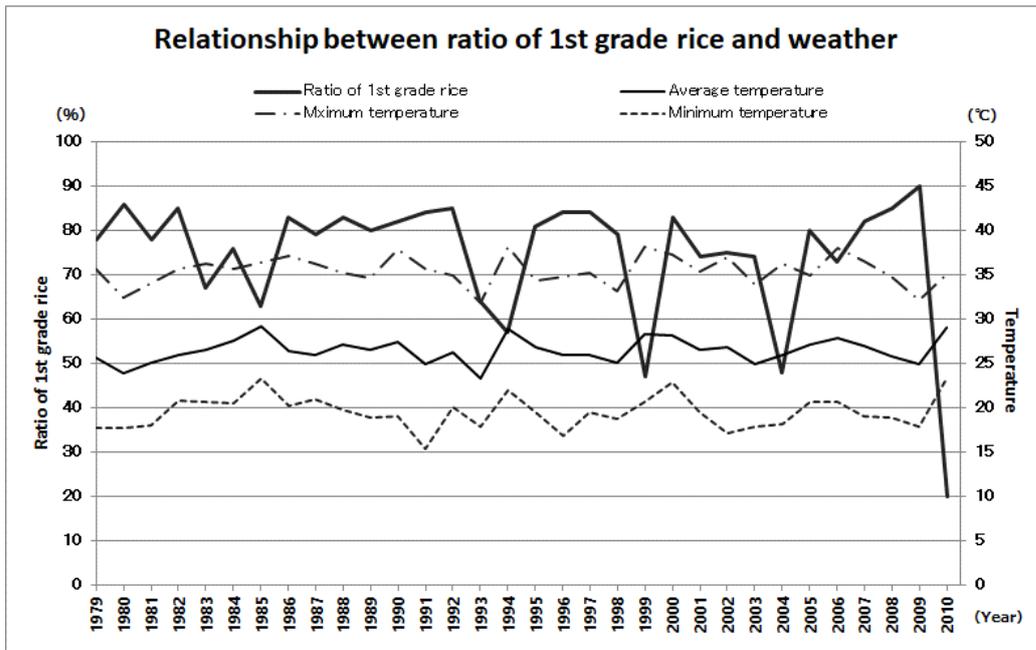


Figure 3. Transition of time series data

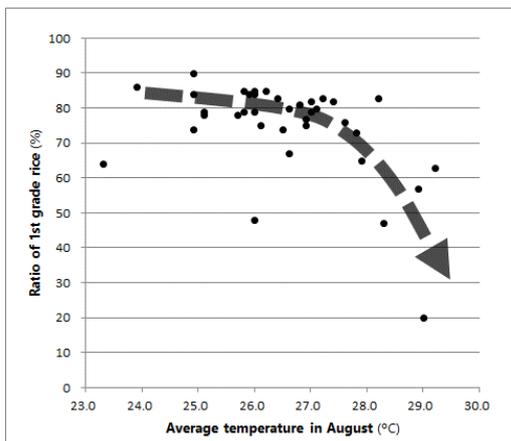


Figure 4. Correlation between the ratio of the 1st grade rice and average temperature

There were years when the ratio of the 1st grade rice drastically fell compared to average years, which were in 1985, 1994, 1999, and 2004. The figures show that the average temperature, the highest temperature and the lowest temperature were all higher than average years in these years. In the transition of precipitation and the ratio of the 1st grade rice there was not outstanding features. According to the scatter diagram and the correlation function, the average temperature and the lowest temperature have correlation with the ratio of the 1st grade rice, which is the same result as the analysis from the time series data. The result also shows the same as the fact that rice becomes unripe when the average temperature is about 27 and 28 degrees Celsius and the lowest temperature passed over 23 and 24 degrees Celsius.

The data of years when average temperature passed over 27.0 degrees Celsius shows that regression line is $y = 555.78 - 17.471 \times R$, $y = 0.541$ in a scatter diagram. Since the average ratio of the 1st grade rice in years when the average temperature passed over 27.0 degrees Celsius is 68.5%, it is presumed that the ratio of the 1st grade rice deteriorates when the average temperature passed over 27.9 degrees Celsius. Here the average temperature is searched through regression formula by considering “being deteriorate” as “being below average”. Moreover since the average temperature in 2010 will be 29.0 degrees Celsius, the predictive value in 2010 will be $y = 555.78 - 17.471 \times 29.0$, $y = 49.1\dots$ % by regression formula. Therefore, the ratio of the 1st grade rice is predicted 49.1% based on the average temperature.

Conclusion

It was presumed that the ratio of the 1st grade rice, the rice quality, has a special correlation with temperature and it deteriorates when the average temperature passed over 27.9 degrees Celsius by analysis of series, correlation, and regression. Although the predicted value of the ratio of the 1st grade rice based on regression formula in 2010 is 49.1%, in fact the actual measured value is 20.0%, which is quite far apart from the predicted one. It could be because the reason why the ratio deteriorated was not only the average temperature but also the other factors. It is profitable to develop the second PPDAC cycle through considering the other factors from a point of view of problem solving.

In the Chapter 2, taste, criterion evaluation for tasty rice, is considered by data as what kind of rice becomes tasty from the point of view of maintaining Niigata's rice brand.

NIIGATA IS WHERE STATISTICAL EDUCATION WAS BORN

The history of statistical education in Niigata began in 1947 when the Cooperative School for Statistics designated the first pilot school that would focus on statistical education. Right after the war, Stuart A. Rice, an ambassador of statistics in the United States, reported that it was in 1947 that the education of statistics should be undertaken for Japanese people to learn a statistical approach or a statistical way of thinking, and that the education for statistics should be carried out not only for the elementary schools but also for high schools, but Niigata prefecture had already started a pilot school for statistics education.

The goal of the school was to cultivate a statistical way of thinking in children, and to spread statistical ideas to the family through them. The schools were supposed to practice the statistical education originally without any special limitation under the goal of making children interested in statistics and for cultivation of the ability to judge any social matters through a statistical approach. After the agreement of Statistical development and the education department, which is now the board of education, 9 elementary schools were chosen as the pilot school for the first research. In 1950, 3 years after the system's foundation, the first research presentation of statistical education was held at one of the Cooperative schools, Tohoncho elementary school in Takada city, now in Joetsu city. Almost 200 teachers including those in these cooperative schools joined this first open presentation. Taking this opportunity, the importance of statistics was recognized widely in educational area. Afterward the research presentation was held once in a year until the fifth one in 1954, supported by the educational department. Since the second one, it had been held also for dissemination of the statistical education towards the whole country. That raised the number of participants in the fifth one up to about 800 people, and about 250 participants were from outside of the prefecture. The result tells us it was a great success and a full house as if it was a national presentation. The contents of presentation were an open research class, a lecture, research presentations from teachers and students, group discussions, and an exhibition of statistical charts, which were all substantial.

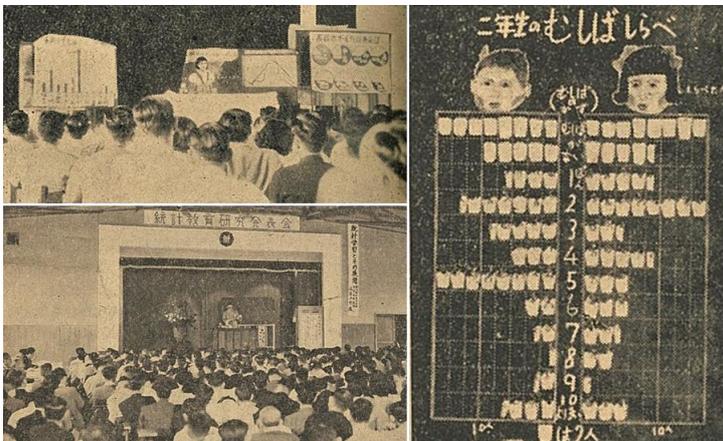


Figure 5. The Presentations given by children (above), The lecture about statistics(below), The work of the student(right)

In the first research presentation of statistical education in 1950, 171 statistical charts were submitted from each school and exhibited, and Jiro Kondo, an officer in Statistics Bureau of Prime Minister's Office and also a teacher in Tokyo University, examined and made comments. In his comments he mentioned that it was difficult to examine charts because they were all exhibited in groups of each school, not divided by kinds as students', teachers', students' and teachers' or even their grades. Based on his advice and reviews from this presentation, a system had been organized gradually while things were decided such as ways how to exhibit and examine, categories; school, teachers, students and awards; the Prize of the Minister for education, the Prize of Statistical Standards Manager in Administrative Management Agency, the Prize of Statistics Bureau of Prime Minister's Office, the Prize of Prefectural Governor, and the Prize of Prefectural Board of Education.

Niigata prefecture started statistical education for the first time among the whole nation as I wrote, but why Niigata? Haruki Genji, old Prefectural Chief for Statistic, mentioned as below in a special contribution sent to "60 nen no ayumi" which was published by Niigata Statistical Association in 1996. "The key person must be Ryuichi Aiba who had a teaching experience and also worked as a subsection chief editor in statistic department after repatriation from Taiwan. From his experience, I am sure that he knew new direction of education after the war and leaven at place of education without Dr. Lice's advice. Since then he had been promoting for this statistical education until his retirement for about 15 years and received Ouchi Prize which was also represented as Nobel Prize in statistic study for the first time in this prefecture." In this way Mr. Aiba having teaching experience created a relationship between statistical education and place of education, which contributed to the first foundation of statistical education in the whole nation and later developed greatly. Moreover, another big factor was receiving understanding, instruction and continuous cooperation from each area such as Central Government and universities. Especially Jiro Kondo, who used to be a professor emeritus in Tokyo University, had worked for it since beginning. To start with this foundation, Niigata asked Statistics Bureau of Prime Minister's Office to dispatch a staff, and Mr. Kondo was the staff, who was an officer in Statistics Bureau and a teacher at Tokyo University at the moment. Soon Mr. Kondo watched classes in elementary schools and thought it was necessary for teachers themselves to get interested in statistical education and gain mathematical knowledge, especially about variable numbers. He explained the importance to consider something by reading charts and graphs. He kept holding performances and gave a lot of indications to Niigata's education. Thus, statistical education started in Niigata and has been spreading throughout the whole nation.

CONCLUSION

Finally, by cooperating with the Civil Service, teachers can make an authentic teaching plan in that I can provide abundant data for teachers. I hope the spread of statistical perspective among students will create a sensation of data science, and that Niigata will attract attention again like postwar Niigata.

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