THE EFFECT OF USING “STANAVI”
- Web Based Learning System
About Official Statistics

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Introduction

• In statistical education in Japanese universities, it is necessary for students to acquire comprehensive knowledge and skills in survey methods, data processing, and statistical analysis.

• To deal with this need, Center for Statistics and Information (CSI) was established at Rikkyo University in Japan, and started from March 1st 2010 for supporting statistical education.

• The CSI consists of three research sections; Social Research and Statistical Education, and Official Statistics.

• The Official Statistics section is responsible for providing support for students to utilize the official statistics.
What is “STANAVI”

• Our center provided a web based learning system for our students to study about official statistics.

• This learning system is named “Official Statistics Navigator. We call it ‘STANAVI’.
  (The name of this mascot character is "すたなび" in Japanese)

• The STANAVI is a guide for all kinds of the official statistics produced by Statistics Bureau (in the Ministry of Internal Affairs and Communication in Japan).
Contents of STANAVI

- the basic knowledge about statistics, statistics guide, basic excercise, and so on.

- It has been fixed to be able to be accessed from the outside of our University.
Basic knowledge about statistics

Cluster sampling

Basic exercise

What kind of statistics is family income and expenditure survey?

[1] Which of the following is the right answer?
A) Aggregate statistics (all residents)
B) Basic statistics (sample survey)
C) One-time statistics (sample survey)
D) Detailed statistics
E) Monthly statistics

What is the right answer?

A) 2
B) 8

http://www.stat.go.jp/data/kёkel1/inte55

[2] When the survey period and table presentation are correct, what is the correct answer?
A) Survey is conducted every month, and the table is published every quarter.
B) Survey is conducted every year, and the table is published every quarter.
C) Survey is conducted every month, and the table is published every year.
D) Survey is conducted every 5 years, and the table is published every year.

What is the correct answer?

[3] What is the correct answer?
A) Survey is conducted every month, and the table is published every quarter.
B) Survey is conducted every year, and the table is published every quarter.
C) Survey is conducted every month, and the table is published every year.
D) Survey is conducted every 5 years, and the table is published every year.

By repeating reading textbook parts and doing exercises parts, students learns Statistics and Official Statistics.
Points of this Work

• Purpose:
  Inspection of the *use effect* of “STANAVI”

• We think using STANAVI have at least 2 effects.
  – 1) Effect on *Understanding about statistics*
    • a) Effect as the textbook
    • b) Effect as the exercise book

  – 2) c) Effect on *students’ Impression for statistics*
    *For example, after using STANAVI, some students think that Statistics is not so difficult, or feel more familiar than before.*
    (I’m sorry but this point is at another opportunity.)
Adopted Test Method

- For this kind of study, the **pretest - post-test method** is the standard method to measure a learning effect.

- This method needs just one sample and the **same test** before and after the addition of the new learning method.

- But in this study, I adopted **2-sample t-test** *(parametric test)*.
  - This is the method to compare two independent means from the data of the different individuals.
Group A

Group B

Exam 1

Continue to distribute a lecture document

Group A

Group B

Exam 2

Start to the lecture using STANAVI

Group A

Group B

distribute a lecture document

Data

<table>
<thead>
<tr>
<th>Data</th>
<th>STANAVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>Male 31 not Used</td>
</tr>
<tr>
<td>Group B</td>
<td>Male 25 Used</td>
</tr>
</tbody>
</table>

F-Test

T-Test
Procedure of lectures and the exam.

- I distribute a lecture document to all students.
- After 3 times lecture, they take a test about the contents of a lecture till then.
  - This exam is done in order to check the equal ability for understanding about statistics between 2 groups.

- After that exam, For Group A, it is continued to distribute a summary at the lectures.
- For Group B, the use of STANAVI is started.

- After several lecture, we do the second exam for both groups.
  - This exam is done in order to measure the effect on using STANAVI.
Making of the sample groups

• We choose two classes where a student size is about 100. (the same university, the same department, the same course)

• The same test is carried out for all students equally, but we pull out only first graders’ results and use those for this analysis.

• The student who was absent from the lecture or the exam also at once is removed from a sample.
Exam 1, Exam 2

- Exam 1
  - Question A-1 ~ A-5
  - Question B-1 ~ B-5

- Exam 2
  - Question A-1 ~ A-10
  - Question B-1 ~ B-10

Questionnaire (1~5)※

※Questionnaire

<table>
<thead>
<tr>
<th>Question a)</th>
<th>Question from Basic Knowledge</th>
<th>write the answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question b)</td>
<td>Question from Exercise</td>
<td>choose the answer among five</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Answer by Four choices</td>
<td>(Strongly Agree, Agree, Not Agree, Strongly not Agree)</td>
</tr>
</tbody>
</table>

1. The interest for statistics increased
2. The impression that the statistics had difficult softened
3. I think that I took time for the review of the class well
4. I concentrated on it and was able to learn it efficiently
5. I think that I was able to make the knowledge about statistics clear.
Exam 1 and F-Test

• Student's t-test needs the equal variance in two samples.

• So, we carried out the first examination to check the equal variance in two samples, and the F-test was carried out.

\[ H_0: \] suppose that the variance between two groups does not have a difference

\[ H_1: \] suppose that the variance between two groups have a difference
Results of F-Test

(For example of Male)

• \( F = \frac{1.283}{1.213} = 1.117 < F_{0.05} = 1.938 \)
  
  \( \rightarrow P > 0.05, \) the null hypothesis is not rejected
  
  \( \rightarrow \) the variance between two groups does not have a difference

• By this result, the following T-test became meaningful.
Exam2 and T-test

• We want to measure the effect on using STANAVI by Student’s T-Test.

\[
\text{H}_0: \text{Between two classes, an understanding degree about statistics does not have the difference}
\]
\[
\text{H}_1: \text{There are a certain difference}
\]

\[
S = \sqrt{sd_A^2 (n_A - 1) + sd_B^2 (n_B - 1)} \over n_A + n_B - 2
\]

\[
t = \frac{\text{Mean}_A - \text{Mean}_B}{S \cdot \sqrt{\frac{1}{n_A} + \frac{1}{n_B}}}
\]

• If \(|t| > t_{0.05}\), \(P < \alpha\), then the null hypothesis is rejected.
<table>
<thead>
<tr>
<th>Question a) Male</th>
<th>Question b) Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group B</td>
</tr>
<tr>
<td>n</td>
<td>25</td>
</tr>
<tr>
<td>Mean</td>
<td>5.111</td>
</tr>
<tr>
<td>sd</td>
<td>1.242</td>
</tr>
<tr>
<td>Variance</td>
<td>1.543</td>
</tr>
</tbody>
</table>

S= 1.245

\[ t = \frac{1.242 - 1.247}{\sqrt{\frac{1.543^2}{25} + \frac{1.247^2}{31}}} = -2.324 \]

Example for Question a) Male

\[ S = \sqrt{\frac{1.556 \times 30 + 1.543 \times 24}{31 + 25 - 2}} \]

\[ t = \frac{4.333 - 5.111}{1.2450 \cdot \sqrt{\frac{1}{31} + \frac{1}{25}}} = -2.026 \]

<table>
<thead>
<tr>
<th>Question a) Female</th>
<th>Question b) Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group B</td>
</tr>
<tr>
<td>n</td>
<td>22</td>
</tr>
<tr>
<td>Mean</td>
<td>5.500</td>
</tr>
<tr>
<td>sd</td>
<td>1.258</td>
</tr>
<tr>
<td>Variance</td>
<td>1.583</td>
</tr>
</tbody>
</table>

S= 1.155

\[ t = \frac{5.500 - 4.833}{\sqrt{\frac{1.258^2}{25} + \frac{1.067^2}{31}}} = -2.026 \]

Example for Question a) Female

\[ S = \frac{\sqrt{1.556 \times 30 + 1.543 \times 24}}{\sqrt{31 + 25 - 2}} \]

\[ t = \frac{4.333 - 5.111}{1.2450 \cdot \sqrt{\frac{1}{31} + \frac{1}{25}}} = -5.274 \]
T-Test and Results
(example for question a, male)

• $|t\text{-value}| = 2.324 > t_{0.05} = 2.005$
  → $P < 0.05$ the null hypothesis is rejected.
  (It is similar in other cases)

Therefore,

• Between two classes, an understanding degree about statistics have the difference

→ We may think that it is effective in statistics learning to utilize STANAVI.
About Cohen’s $d$ (effect size)

- Cohen’s $d$ (Effect Size) shows a size of the degree of the gap between null hypothesis and the alternative hypothesis.

$$d = \frac{Mean_A - Mean_B}{\sqrt{sd_A^2 + sd_B^2}}$$

- In the case the means of two groups are greatly different, they say that “the Effect Size is large”, and Cohen’s $d$ should be scored as above 0.75.
Measurement of Cohen’s $d$

(Example for Question b), Male)

\[ |d| = \frac{5.722 - 8.278}{\sqrt{2.090 + 2.423}} = 0.5020 \]

→ Therefore, it is recognizable that there is a Medium Effect for using STANAVI.

<table>
<thead>
<tr>
<th>Question a)</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.3240</td>
</tr>
<tr>
<td>Female</td>
<td>0.3599</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question b)</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.5020</td>
</tr>
<tr>
<td>Female</td>
<td>0.5150</td>
</tr>
</tbody>
</table>

Relative Size of Cohen's $d$

- small effect: $0.15 = <d < 0.4$
- medium effect: $0.4 = <d < 0.75$
- large effect: $0.75 = <d < 1.10$
- very large effect: $1.10 = <d < 1.45$
- huge effect: $1.45 = <d$
Conclusions

• From the result of this experiment, it may be said that the use of STANAVI is effective for statistics learning.

• For students, using STANAVI is effective more as the exercise book than as the textbook for study statistics.
  – Because of the difference between results of the Effect size for question A and question B.