DEVELOPING A MOBILE LEARNING COURSE OF ELEMENTARY STATISTICS FOR K-MOOC BY USING MODULES OF DYNAMIC GRAPHICAL SOFTWARE FOR TEACHING STATISTICS, eStat

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Korean Government has led the K-MOOC project since 2015 by taking advantage of advanced IT and high-speed network infra-structure in Korea. At the same period, we have developed a software for teaching statistics called eStat which is a web-based, dynamic, graphical software to all levels of students. This eStat system enables to develop a mobile learning course of Elementary Statistics for the K-MOOC which is consisted of eBook, lecture movie, web-based data processing as a statistical package and simulation module for teaching statistics. The eStat, www.estat.me, includes the most of graphs in the textbook and simulation modules for Statistics Education such as distributions, central limit theorem, confidence interval and regression. All of these modules are utilized in the Elementary Statistics course of the K-MOOC.

INTRODUCTION

Recently, Massive Open Online Course (MOOC) become popular in the computer advanced countries and Korean Government has also led the K-MOOC project since 2015 by taking advantage of the advanced IT and high-speed network infra-structure in Korea. At the similar period, Jung Jin Lee and his colleagues have developed a software for teaching statistics called eStat on www.estat.me which is a web-based, dynamic, graphical software to all levels of students. The eStat project was started in 2012 with the support of Korean government and finished in 2017. The eStat system enables us to develop a mobile learning course of Elementary Statistics for the K-MOOC which is consisted of eBook, lecture movie, web-based data processing as statistical package and simulation module for teaching statistics. The eStat includes the most of statistical graphic modules such as bar graph, pie chart, line graph, histogram and also includes special simulation modules for statistics education. All of these modules are utilized in the Elementary Statistics course of the K-MOOC.

Since the eStat is a freeware and its modules are made by HTML5, JavaScript and D3.js, we invite any developer to add his/her interesting idea, experience and modules. We hope that the Elementary Statistics course of the K-MOOC with eStat can help students in math/statistics classroom of all levels in the world, especially developing countries, and they realise the usefulness of statistics in the era of information society.

K-MOOC

The K-MOOC project was initiated by the Korean government since 2015. The strategy, direction, number of courses developed by year and contents of development of the K-MOOC are summarized in Table 1. Thirty four universities have been involved in the K-MOOC project and more than three hundreds courses have been developed until 2017. The K-MOOC has a plan to develop additional 200 more courses in 2018 and has a strategy for global service to expand their courses to whole world. The Elementary Statistics course of the K-MOOC is also targeting for globalization and the eStat, which is the tool to develop the course, has been translated into seven languages (Korean, English, Japanese, Chinese, French, Spanish and German) until now. In order to help students in developing countries, we plan to translate eStat into Mongolian and Vietnamese.

Table 1. Summary K-MOOC Project

K-MOOC	2015	2016	2017	2018
Strategy	Construct Platform		K-MOOC Model	K-MOOC Expansion
Direction	Develop Brand	Standard Service	Active Service	Global Service
Courses Developed	27	100	300	500
Contents Development	Contents Diversification		Standardization	Globalization

In M. A. Sorto, A. White, & L. Guyot (Eds.), *Looking back, looking forward. Proceedings of the Tenth International Conference on Teaching Statistics (ICOTS10, July, 2018), Kyoto, Japan.* Voorburg, The Netherlands: International Statistical Institute. iase-web.org

SYSTEM DESIGN OF ELEMENTARY STATISTICS COURSE OF THE K-MOOC

The Elementary Statistics course of the K-MOOC is consisted of eBook, lecture movie and eStat dynamic graphical module connected to each example of a chapter as Figure 1. By using the attached eStat graphic module of this eBook, a student is able to practice other graphs such as pie chart, band graph and line graph as well as the provided bar graph of population pyramid which is the only one in a traditional textbook.

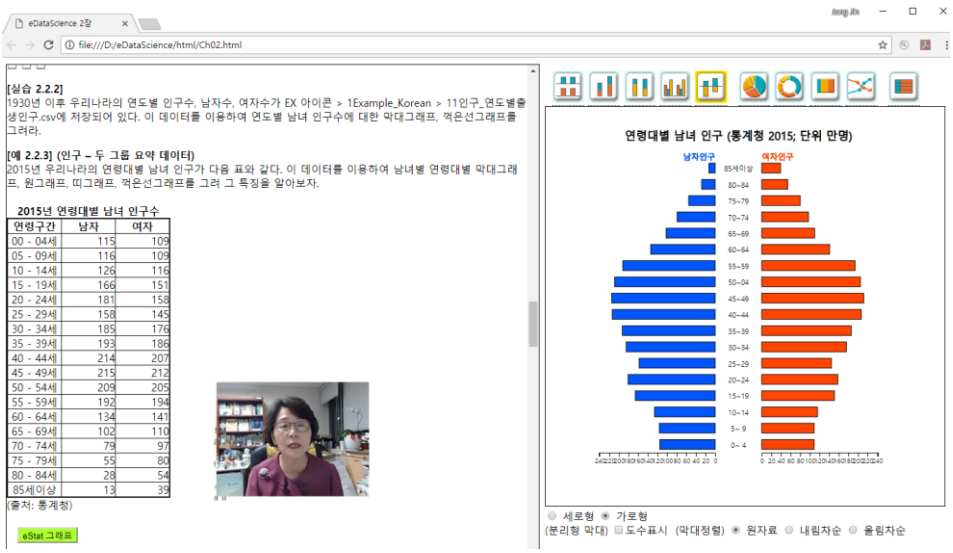

Figure 1. Statistics course of K-MOOC with eBook, lecture movie and eStat Graph

In addition to the above three components of the Elementary Statistics course, there is a data processing module of the eStat which can practice an exercise problem of the eBook as Figure 2. Figure 3 is the bar graph of the eStat by using the data of the exercise problem in Figure 2.

[실습 2.2.3] (건강 - 두 그룹 요약 데이터)
2015년 우리나라의 남녀별 사망원인이 다
프, 꺾은선그래프를 그려 그 특징을 알아보

2015년 남녀별 사망원인

사망원인	남자	여자
암	48428	29853
순환계	28199	31345
질병이환	19600	9184
호흡계	15507	12299
이상증상	10562	13834
소화계	7428	4280

(출처: 통계청)

Figure 2. Exercise problem for data processing using eStat

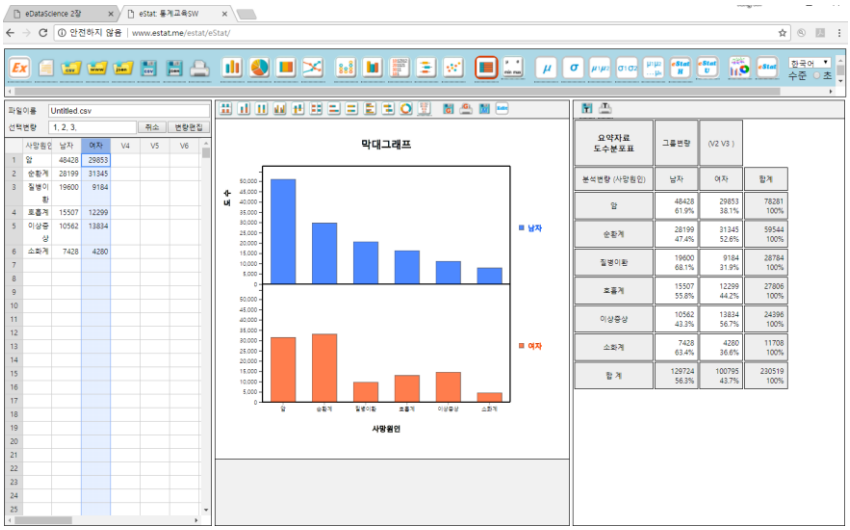

Figure 3. Main screen of eStat with the bar graph by using the data of Figure 2

SYSTEM DESIGN OF THE ESTAT

The eStat is a web-based statistical package with dynamic graphs. Since users of the eStat can be elementary students, one of key designs of the eStat is that there are only icons on the top of main screen as Figure 3, instead of top-down menu which is used in usual software, to select a specific graph and analysis. Icons only design can help users to find all functions of the eStat at a glance and it is to prepare for mobile learning system of the K-MOOC. In case of elementary or middle school students, the icons can be more simplified by selecting the level button of E or M at the right-top corner of the main screen.

The main screen of the eStat is divided into three regions, the sheet for data input located at the left side, the graph output is at the middle, and the log output is at the right side. Users enter data in the sheet, and then click an icon suitable for their analysis at the top of the screen. If you have data in the server, only mouse clicking is necessary to get a result. This system design is adopted to handle the eStat by finger pointing when they use the smartphone. The result of analysis will be appeared at the graph output area with dynamic graph. If users want to save their result, they can move the result to the log output area by selecting an icon.

Most of the graphs appeared in the textbook of elementary school in Korea are based on the categorical data which are the summary of raw data. However, the graphs in the middle school or higher level use usually the raw data which are common in statistical packages. Another key design features of the eStat is that the system can handle both raw and summary data by detecting data type automatically. Therefore, any level of students can use the eStat easily without considering summary or raw data. Since the most of the eStat graphs are dynamic, it can have more attention from the users and they can enjoy modern technology.

The eStat is a web-based software developed by using HTML5, CSS3, JavaScript and d3 library. The eStat is a freeware and available in the web site *www.estat.me*. Therefore, students can use the eStat in anywhere and in anytime to study statistics if internet is available.

The eStat is developed with a multilingual structure and a translation of the eStat system into other language requires only roughly 200 words / sentences translation.

CONTENTS OF THE ESTAT SYSTEM

The eStat has the following modules for students in elementary school.

- Bar Graph: vertical, horizontal: separate, stacked, ratio, side-by-side, both-side if two groups
- Pie Chart: pie or doughnut
- Band Graph
- Line Graph

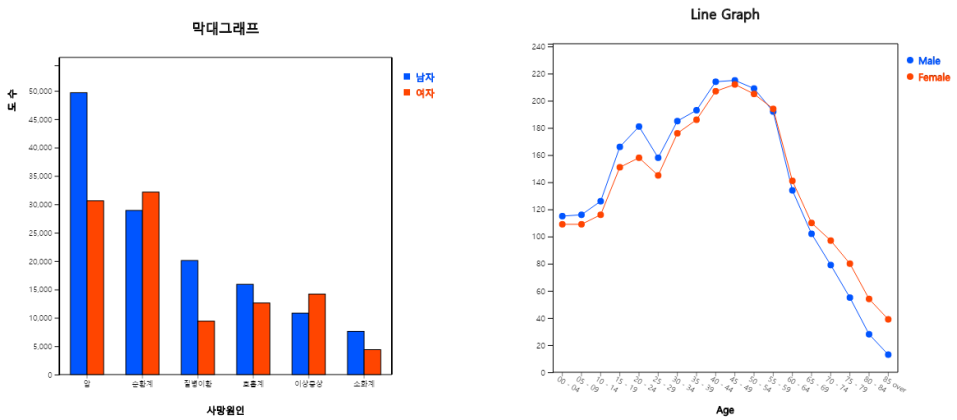

Figure 4. Example of Bar Graph and Line Graph of eStat

The eStat has the following modules for students in middle school.

- Dot Graph
- Histogram
- Stem and Leaf Plot: one-side, both-side if two groups
- Box-Whisker Plot
- Scatter Plot

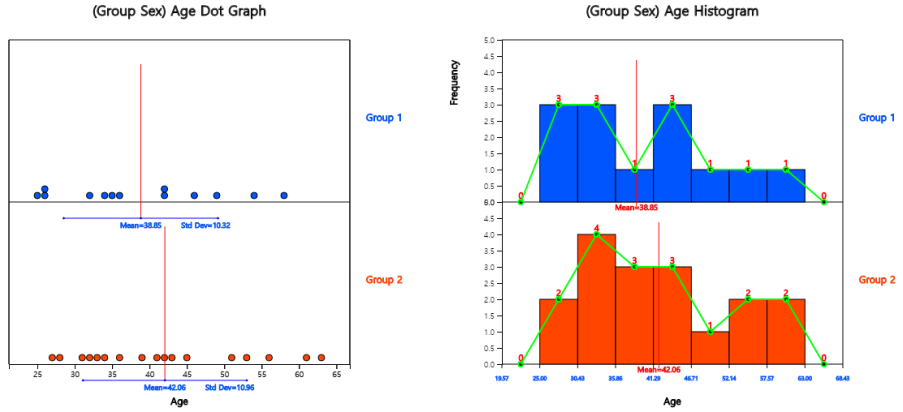

Figure 5. Example of Dot Graph with mean comparison and Histogram with polygon

The eStat has the following modules for students in high school.

- Binomial Distribution: simulation, probability distribution
- Normal Distribution: simulation, probability distribution
- Population and Sample Statistics: simulation
- Sampling Distribution of Sample Means: simulation
- Law of Large Number: simulation
- Confidence Interval: simulation

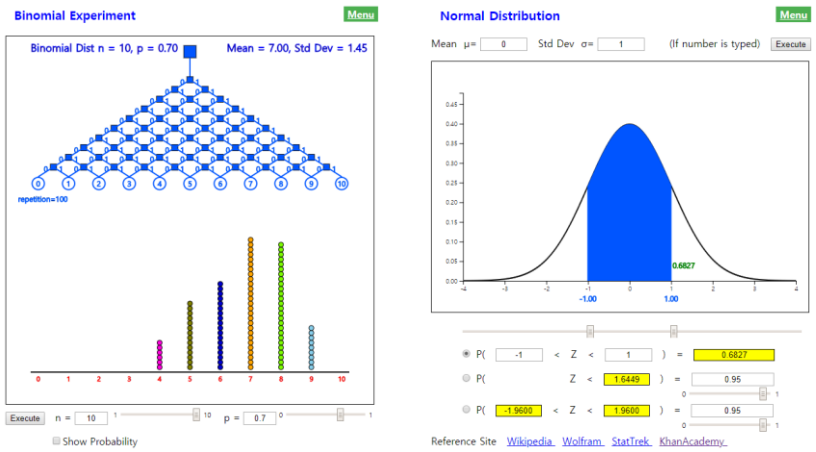

Figure 6. Binomial Simulation and Normal Distribution

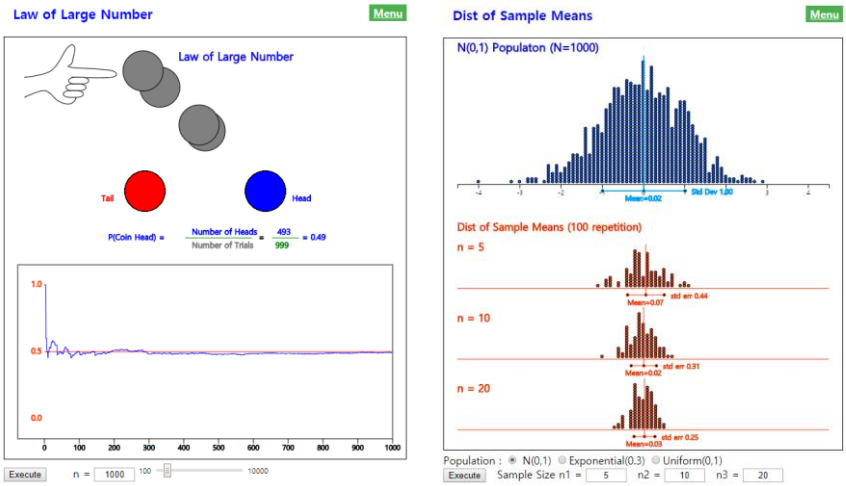

Figure 7. Law of Large Number and Sampling Distribution Simulation

The eStat has the following modules for students in university undergraduate level.

- All high school level modules
- Poisson, Hypergeometric, Geometric Distributions: probability distribution
- Student t, ChiSquare, F Distributions: probability distribution
- Estimation and Testing Hypothesis of Single Population: mean, variance, proportion
- Testing Hypothesis for Two Populations: means, variances, proportions
- Analysis of Variance
- Correlation: simulation
- Regression: simulation, analysis

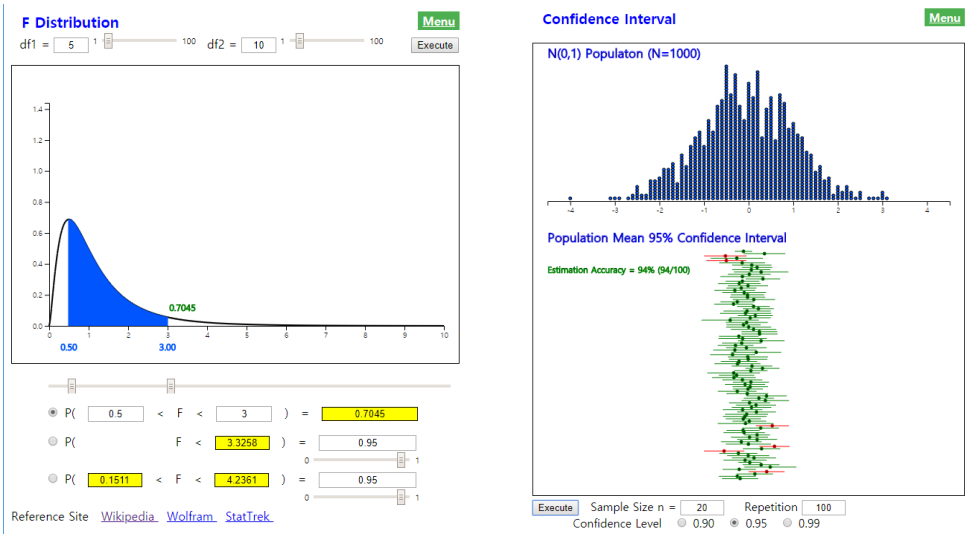

Figure 8. F Distribution and Confidence Interval

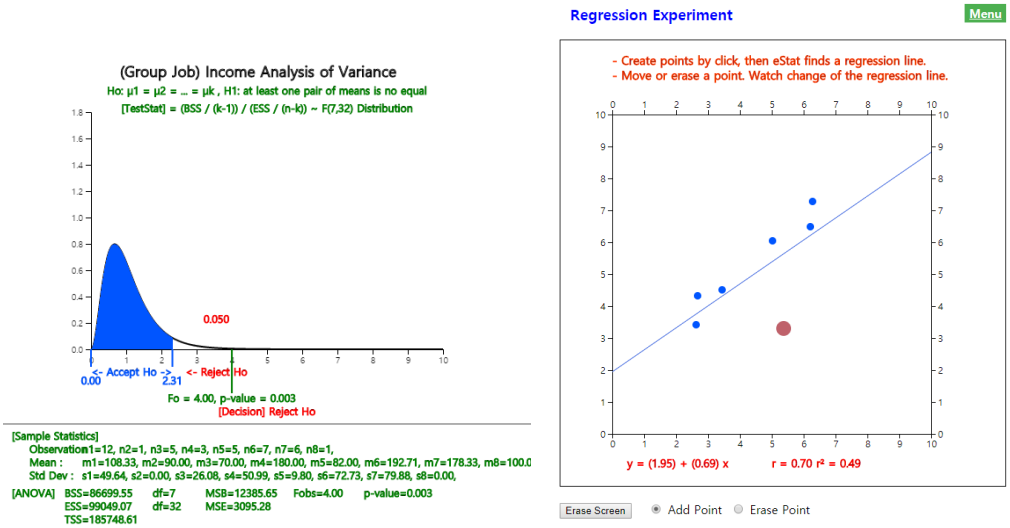

Figure 9. ANOVA and Regression Simulation to check outlier influence

CONCLUSION

Since the eStat modules are made by HTML5, JavaScript and D3.js, we invite any developer to share his/her interesting idea, experience and their own modules in teaching statistics. We expect an international collaboration for further development of the eStat. We hope that the Elementary Statistics course of K-MOOC with the eStat can help students in math/statistics classroom of all levels in the world, especially developing countries, and they realise the usefulness of statistics in the era of information society.

REFERENCES

Lee, J. J., Lee, T. R., Kang, G., Kim, S., Park, H. J., Lee, Y., & Sim, S. (2014). A Statistics Education Package Tong-Gramy for 5-8th Grader. *The Korean Journal of Applied Statistics*, *27*(3), 421-429.