SOCIAL AND ECONOMIC NETWORKS AND FINANCIAL LITERACY IN STATISTICS CLASSES: LESSONS AND EXPERIENCES

Peter Kovacs, Klara Kazar & Eva Kuruczleki
Faculty of Economics and Business Administration, University of Szeged, Hungary
kovacs.peter@eco.u-szeged.hu

In recent days, new social phenomena such as social and economic networks or financial literacy should also appear within/be discussed in the courses of economics and sociology education. Statistics courses could also embed these topics for several reasons. First, to develop specific skills related to data analysis and the usage of new statistical tools provided by ProCivicStat (PCS), second, to develop not statistics-related knowledge such as sound financial decision-making. In our study, we present preliminary results of implementing lesson plans in the above-mentioned topics developed in the framework of PCS and which enable students to discover real datasets in a practical way. Our study summarizes our experiences and provides comments and recommendations for future development opportunities.

INTRODUCTION

The implication of interesting and lifelike topics is highly important in statistics classes. Students should discover the connection between data and real life, and teachers should make the students part of the data set; in this way, their engagement and activity could be increased (Brown, 2016). This paper offers two examples from real life: first, as economic and social networks are deeply embedded in our everyday life, network analysis could be an interesting topic in statistics classes. Second, people must be able to make sound financial decisions every day, hence financial literacy could also be an important topic in statistics classes.

Besides the above mentioned current topics, innovative solutions should also be included in statistics education. University students are the members of Generation Y, who share common characteristics. They are considered the most technologically literate generation, they cannot imagine life without IT tools or Internet. Generation Y cannot be motivated/encouraged by the traditional way of teaching anymore, but they are eager to use technology during classes instead (Reilly, 2012). Using technology, IT and visualization tools in statistics classes provide an appropriate solution for teaching the members of this generation (Chance, et al. 2007, Ridgeway, 2016). More specifically, the usage of personal response systems (PRS or Electronic Voting Systems) is also recommended; they can motivate students to answer questions and they can also confirm whether students have understood the topic covered in the lesson (Lancaster & Titman, 2014).

The *ProCivicStat* project funded by the European Commission is a strategic partnership among six universities which create resources (theoretical framework, datasets, visualization tools and teaching materials) for statistics education (Engel 2017). One of the goals of this project is to offer citizens topics in statistics education which are relevant for their future life (e.g. economic networks or financial literacy); and another important part of the project is the application of modern solutions (e.g. visualization tools or evaluation, voting systems) in classes to grab the attention of our students. Based on these, the goal of this paper is to introduce two specific teaching methods developed in the framework of ProCivicStat in the topic of network analysis and financial literacy with the help of modern IT solutions.

ACTUALITY OF THE DEVELOPED MATERIALS

Financial literacy is a trending research topic these days. After the outburst of the 2008 financial crisis, many were blaming the inadequate level of adult financial literacy as one cause of the crisis. However, not only adults but also youngsters, such as high school students or Gen Y university students face the need to make financial decisions every day ; no wonder why OECD, who takes the leading role in assessing financial literacy, has just included financial literacy assessment modules in the PISA tests. As one part of the *ProCivicStat* project, we aimed at creating such lesson plans that highlight the importance of being able to make sound financial decisions and engage people in learning about the topic by including tasks that are relevant to their

life. While creating the lesson plans, we had financial literacy tests from past international surveys at our disposal (see e. g. OECD 2011, Klapper, et al. 2015) already containing both easy and slightly more difficult tasks that we could customize to fit into the framework of the *ProCivicStat* project. Furthermore, we thought that by including some degree of gamification and visual elements, students might become more interested in developing their financial skills and abilities: we will show some empirical results of teaching financial literacy in a diverting way in the next section.

As another part of the *ProCivicStat* project, we developed lesson plans that educate students about actual social and economic issues with the help of networks and graphs. Many structures in our everyday life can be examined as a complex system of nodes with edges symbolizing their connection. For decades, graphs played an essential part in many social and natural sciences, such as epidemiology, discrete mathematics or even marketing, providing a tool for academics and scientists to discover relationships of elements of complex systems. For ordinary people, network studies remained a distant, hard to understand field for long. Yet during the past few years, they have become a highly researched area and with the help of new tools and software solutions, visualizing networks has become a common way to educate people about many current issues and events (Barabási 2016).

DESCRIPTION AND REFLECTIONS ON THE DEVELOPED MATERIALS

As part of the PCS programme, we developed teaching materials in two fields: networks and on financial literacy. *Network studies* provide us with a very rich toolkit and data is available from all kinds of sources as well. In the developed teaching materials, we merged visuals and data together, and adjusted them to the prior knowledge of the recipients. As a first step, we created introductory level tasks that enable people to learn about the basics of graph theory, with real-life examples of how nodes and edges can be understood (such as stations and metro lines in the transportation network). An example for a task at introductory level: *"Examine the given graph. Is it a directed or an undirected graph? What are the nodes and the edges, what do the thickness of the edges depend on? If it is a directed graph, mention 3 source nodes with their targets!"* Introductory materials also include modules that teach people to create graphs themselves so that they could process information individually and apply this knowledge in their own fields of interest. The lesson plans were designed by keeping in mind that they should fit the needs of both older and younger generations, so that regardless of their initial digital capabilities they could learn the basics of graph theory step by step. To keep it simple and easy to access, we chose Gephi as the network visualization tool used in our modules, because it is simple enough to understand quickly and an open source program that is free to download and use. Beginner network studies materials thus contained easy to understand tasks that made the basics of networks and graphs easy to understand.

On top of the beginner lessons, we also created lesson plans for advanced level network studies. Advanced level lesson plans require students to be familiar with certain applied statistical methods such as calculating correlation or regression, or to have some background knowledge on given topics like migration, stocks or trade relations. For example, one of our advanced level materials includes lessons on migration. The dataset obtained from the UNHCR contained the number of refugees, their origin and destination between the years of 2013 and 2015, and after processing the raw data, we were able to create a graph that visualized the main migration patterns, with close to 200 nodes and 3600 edges. An example for a task at advanced level: *"Based on the given data, create a graph that shows international migration flows in the examined period. What patterns can you identify in international migration? What countries are the most favored destinations? What do you think could be the reason behind their popularity?"* By providing a visual way to reflect on recent events, students could be more engaged in learning about such a grave issue and its social consequences. At the same time, by applying sophisticated mathematical theory in a diverting way, their digital literacy can be improved even without them realizing it. Advanced level lesson plans therefore contained slightly more difficult tasks that required the recipients to have a higher level of statistical understanding, however we tried to make it as entertaining and easy to understand as we could.

The other lesson plan we created was aimed at improving the recipients' financial literacy. Assessing *financial literacy* of different target groups has been in the spotlight for many years and several institutions now provide lectures and training programs to enhance financial knowledge and abilities of people (Lusardi-Mitchell, 2011). As part of the *ProCivicStat* initiative we considered it important to include modules about financial literacy, as finances are so deeply embedded in the everyday life of people that financial literacy cannot be neglected when talking about civic issues. We put high emphasis on making financial literacy related materials much more interesting for all age groups by including gamified elements in the learning process, for example with an online voting system, VoxVote. We included this system in financial literacy education to create an engaging and interesting lecture for students. With the help of VoxVote, both open and closed (simple and multiple choice) questions can be used online. At the same time the respondents can answer only one question. Before the vote, the voting time can be set up; for instance, for 30 seconds, 1 minute, etc. If the time is over, the results can be seen online on a bar chart in the case of the closed questions and on a word cloud in the case of the open questions.

After testing the developed materials for the first few times, we were able to draw some conclusions on what were the good practices and what needed improvement. We faced some constraints regarding the prerequisites of advanced level materials. As advanced level materials require the recipients to have a higher understanding in the above areas, it is suggested to implement these/such materials in the course of mathematical statistics classes or in any statistics-related courses at university level; however, their complexity of the materials make them inconvenient to be applied at high school level and still need some further development. Another problem we experienced with preparing advanced level materials is that preparing raw data is rather time consuming. The obtained result was questionable in a sense that even though it was true that by completing this lecture the recipients learned intricate statistical methods, it was unclear whether it could be useful in their everyday life. Yet, as the aim of the *ProCivicStat* project is to create materials that are useful in the citizens' ordinary life, we still need to make further adjustments to advanced level lesson plans.

CASE STUDIES

One problem we generally face when teaching statistics is how to grab the attention of the audience. It is especially a problem if it is a large class, above 100, or in our case, about 450 students visiting Statistics I lectures on a weekly basis. VoxVote is a voting system that is available free of charge for educational institutions and does not require any special hardware, only a computer or smartphone, through which voters can access the polls by simply following a web address. As a pilot project, we first introduced VoxVote in the case of two target groups: first time, the respondents were 50 secondary school students in July 2017 in the framework of a summer camp. *Are you better than the national average* was the name of our game. Since 2011, the University of Szeged as a partner of Econventio Association has examined and developed the financial literacy of the Hungarian high school students. Each year more than 10 thousand students take part in the program. Six questions were selected from the national test and with the help of VoxVote we asked the students and compared their results with the national 'average' rate of the right answers in the case of each closed question. For instance, a simple choice question of our test was one of the typical questions of financial literacy tests: *You save money with 1% interest rate and 2% inflation rate. After one year can you buy more or less than in the previous year?* The respondents can select one of 4 options: less, more, the same amount, I don't know. We not only examine the financial knowledge of the students but ask their opinion about social phenomena. For instance, in the summer test, an open question was asked what the first 3 words were in your mind which you associated to a rich man. The main experience was that students enjoyed this playful format and we could involve them in the game.

The second target group was tested during a lecture on financial literacy at the European Researchers' Night in 2017. This lecture was open for everyone, so most of the participants were foreign or exchange students. As the Researchers' Night is a series of informal events, our lecture was more like a game show that contained a summary of the very basics of financial literacy and an in-house competition where the participants could challenge themselves and were provided with a comparative assessment of their level of financial literacy. Participants had to answer finance-

related questions that they could access from a survey that had been created prior to using VoxVote and the results were instantly available right after them answering each of the questions. If they had been just listening to a boring lecture on financial literacy, they probably would not have been this much interested in the topic. To make the lecture on financial literacy both interesting and educating, we borrowed the 2015 S&P Financial Literacy Survey questions and results (Klapper et al. 2015). The survey was containing only 5 single choice questions in the topics of risk diversification, inflation and interest rates, this way it was a perfect choice: it was short enough so that the participants did not get bored, but long enough so that we gained some relevant results to interpret. After providing the participants with their personal results they could compare their performance with their national average results. We noticed that after telling the participants that they could compare their results, they seemed instantly more engaged, as they were driven by their competitiveness and need for success so that they could tell that they progressed better than an average citizen in their country. This healthy competitiveness created an engaged audience.

After the initial testing we found that the materials could be used within the PCS framework, VoxVote proved to be a viable way to keep the attention of larger classes. We think VoxVote is a useful tool to include in not only statistics, but many other fields of education.

CONCLUSION

In the ProCivicStat project, we aim at creating statistics materials that teach students to use data in a practical way and to help them discover the connections between the data and real life. In this study, we introduced two from the developed materials:(1) the application of networks and graphs to explore real life connections with the help of Gephi and (2) an interactive lecture on financial literacy including a competition using the VoxVote online voting system. Financial literacy can be an engaging topic for students if we serve it in a gamified way, and visualizing network relations can help students to better understand the nature of social and economic phenomena as well. Gephi and VoxVote proved to be suitable tools to be included in the teaching materials.

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