Chapter 14
Implementing Civic Statistics in Business Education: Technology in Small and Large Classrooms

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Abstract Introducing Civic Statistics is of high importance in business education as its multidisciplinary nature helps students to develop complex and critical thinking and also to link different areas of their studies. In this chapter we share our hands-on experiences on the implementation of Civic Statistics both in large and small classrooms and highlight the differences between the techniques and topics employed in different circumstances. The study materials developed include topics such as the ageing society, poverty and income inequality, social and business networks and even financial literacy, the implementation of which will be discussed in detail in this chapter. The challenges of introducing Civic Statistics in a small or a large classroom in business education are different, and both are described here. In general, we received positive feedback from students: the social themes explored facilitated increased engagement and participation, and students welcomed the topics and tools—even though they are rather unusual compared to their 'ordinary' statistics classes.

Keywords Business education · Large class · Small class · Student experience · Voting systems · Critical questions

14.1   Introduction

Developing citizens' and students' ability to understand complex, real social and economic phenomena and to interpret relationships among social and business data correctly has a key position in university education in general, and is of particular importance in business education. Students nowadays, in the "post-truth" era face an immense supply of raw data, and are ill-prepared to handle them efficiently and confidently. This can lead to many problems and malpractices both in their studies

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and in their personal lives as consumers, from vulnerability to emotional appeals, through the lack of engagement and critical thinking, to the inadequacy in the skills required to interpret the data (Ridgway et al., 2017). Given the above, the ProCivicStat project has emphasized the importance of teaching Civic Statistics (CS). Part I of this book described the many features of Civic Statistics (Chap. 2), discussed and illustrated the 11 facets and tools (i.e., knowledge bases, skills, dispositions) needed to understand Civic Statistics (Chap. 3) and outlined general recommendations regarding teaching and assessment issues (Chap. 4).

This chapter focuses on introducing Civic Statistics into an academic curriculum, with a focus on programs oriented towards business or management. This is challenging not only because of various constraints and pressures in statistics classes, but also because students usually possess very limited prior knowledge on civic issues, and on Civic Statistics. Compared to regular statistics classes, Civic Statistics is a multidisciplinary area which requires a different way of thinking (Ridgway & Ridgway, 2019) and more preparation both from educators and students. Both parties need to learn how to link knowledge elements from different fields such as sociology and economics, and how to formulate questions that can be addressed using rich data sources.

This chapter deals with two general challenges that many teachers and universities face, namely introducing Civic Statistics into the curriculum of a regular statistics course at the university level and, as well, into a statistics course in a business school, where students' orientation and expectations have a unique focus, different to that in general introductory statistics courses. When teaching students in business or management-oriented programs, many students do not usually encounter civic issues in a statistics class or in a business context, even though there is a need for them to discuss social issues alongside business-related topics during classes. This is a common challenge most academic institutions face, since almost all universities in the world offer business education. This is a challenge not only at the level of tertiary education but also at the level of high schools offering business education; therefore this chapter can be of broad interest.

Current university students are members of Generation Y and Z, who share common characteristics: they are the most technologically literate generation, who cannot live their lives without IT tools or the Internet. They cannot be motivated in classes to learn statistics with tools they perceive to be obsolete, such as entirely paper-based analyses (even though learning some basics by hand is important to help students better understand the methodology behind some calculations); educators must embrace technological tools and interactive analyses in classes (Eckleberry-Hunt & Tucciarone, 2011; Reilly, 2012; Sox et al., 2014).

Using technology, IT and visualization tools in statistics classes provides an appropriate solution for teaching members of Gen Y and Z (Chance et al., 2007; Ridgway, 2016). Educators are facing new challenges on how to introduce new methodological tools in both economic and statistical education. In this chapter, we share our experiences implementing both new analytical methods as part of statistical courses in business and economics education, and of implementing Civic Statistics in both small and large classes.

In response to the challenges sketched above, our team (at the University of Szeged) developed new ideas and implemented lessons on diverse civic topics with a particular focus on business education. Examples include activities addressing poverty, income equality, ageing society, and social and business network analysis. A variety of technologies were employed, including an online voting game on financial literacy ('Are you better than your national average?'). A whole new course named *Data Collection and Analysis* was launched, oriented towards Civic Statistics. These and related initiatives were implemented in business education at both the undergraduate and postgraduate levels; materials were developed for use both in small seminar groups and in large classes for business students. In addition, we implemented some of these ideas with secondary school pupils, both in school and in summer camps.

We faced several challenges in developing new approaches for teaching about Civic Statistics. These included:

- Ensuring that students encountered a balanced and valuable mixture of statistical methods.
- Developing ways to use IT and learning technologies effectively.
- Providing sufficient social and economic content.
- Finding an appropriate place for Civic Statistics in the curriculum.
- Reflecting new educational goals in assessment systems.
- Preparing for the new topics—namely topics that had not been taught previously by the teachers.
- Assessing prior knowledge of students in the relevant societal topics.

The above challenges will be discussed in more detail in the later parts of this chapter. Our evaluation during and at the end of the revised or new courses shows that, initially, students faced difficulties using software and seeing the conceptual links between a given civic topic and their academic discipline. However, with the help of structured presentations and detailed discussions of the activities, students were able to discover and gain personal experiences and deeper knowledge about the given social topic and the societal context. These lessons help to facilitate more active student participation, and students enjoy this form of education.

This chapter builds on ideas and methods introduced in the previous parts of this book and summarizes the most important takeaway messages from the lessons learned at the University of Szeged concerning the implementation of Civic Statistics in business education programs. Below we illustrate some new activities used and their underlying principles, and discuss experiences regarding the implementation of selected topics in different teaching and learning environments. These include working with small and large classes, and the role of technology (software, Internet, datasets, online voting systems). The chapter concludes with an analysis of the differences between an ordinary statistics course and a Civic Statistics course, from both the educators' and the students' point of view.

14.2   The Importance and Challenge of Including Civic Statistics in Business Education

Traditional statistics classes at several universities are not dealing with real life processes; most of the data used during classes are generated artificially. However, using real world data must be an essential element of economic analysis if students are to better understand not only the methodology behind data collection and analyses but also real-world processes. Students need to learn how to explore the connections between data and real-life events. Teachers should also aim to immerse students in the data set, to increase their engagement with economic analysis (Brown, 2016). Even though students in business education encounter several semesters (at least two) of statistics, they barely see the world through statistical analyses. While regular statistics classes aim at teaching the theoretical background and methodology of analyses and how to conduct an analysis, Civic Statistics requires a deeper understanding into the sociological, demographic, or economic background of certain phenomena. This section offers examples from our experiences and provides insights into innovative approaches that can be included in statistics education, based on case studies of live courses designed to implement materials developed as part of the ProCivicStatistics project (PCS).

The goal of implementing Civic Statistics in business education is therefore two-fold: first, to create a bridge between economic issues and statistical analyses, and second to provide students with a deeper understanding of the societal and economic mechanisms, processes, or correlates behind the examined issues, which are essential for proper interpretation of the results of statistical findings. Through the introduction of Civic Statistics in business education, different areas of study become connected with the help of statistics; statistical analysis becomes no longer isolated from other subjects such as macro or microeconomics. Rather, students learn how to integrate their knowledge into a more complex web of economic analysis and can develop their critical thinking. And second, Civic Statistics can add much value through providing students with an expanded and deeper perception about their place in society, making them overall more responsible citizens.

The limitations of the curriculum is also a challenge in implementing Civic Statistics in business education: regular statistics courses have limited room for manoeuvre in modifying the syllabus of the courses and cannot give much space for Civic Statistics. However, through the introduction of a course which focuses entirely on the social and economic aspects of some critical social issues, students can acquire knowledge that complements their prior economic and statistical skills. That said, educators in business education must consider where to place such a course in the curriculum, taking into account students' prior knowledge: when designing a course on Civic Statistics. PCS study materials do not require notable prior mathematical and IT skills; yet students must possess some degree of preliminary knowledge in economics if they want to better understand Civic Statistics in business education.

14.3   An Implementation of CS: Building Modules into Existing Courses

For implementing Civic Statistics in business education, we followed two paths: first, we have developed four Civic Statistics teaching modules, which we have included in our already existing small and large statistics classes, and second, a separate course dedicated to teaching Civic Statistics has been developed. Therefore, Sect. 14.3 introduces and discusses the modules and our experiences of implementing CS in existing courses, while Sect. 14.4 describes the newly developed course *Data Collection and Analysis*, a course developed for teaching Civic Statistics in small classes.

14.3.1   *Exploring Social Problems*

We have developed four modules, which focused on four main social themes, which are: poverty and income inequality; ageing society; social and business networks; and last, but not least, financial literacy. These social and economic issues require various tools to explore them effectively. This provides an opportunity to balance the curriculum in terms of statistical concepts and techniques, exposure to different software packages and styles of working. Table 14.1 provides an illustration. A fuller (searchable) index of the content of every PCS teaching module (including the ones listed below) can be found here

Lessons on the topics of **poverty and income inequality** focus on the differences in the distribution of wealth among different nations and across time periods, trends and patterns of income distribution and poverty, the causes and reasons behind the

Table 14.1 Social themes and content of the teaching modules

Social theme	Content, tools and pedagogy
Poverty and income inequality	• Concepts (e.g. absolute and relative poverty, Gini index), measurement, analysis and interpretation of data, correlation analysis • Lectures and small group work • Visualization: Gapminder, Tableau
Ageing society	• Concepts (e.g. population pyramid, ageing), measurement, analysis and interpretation of data • Lectures, small group work and individual problem solving • Visualization: online population pyramids
Social and business networks	• Concepts (e.g. node, edge, complex systems), measurement, network analysis • Small group work and individual projects and presentations • Visualization: Gephi, ORA, Cytoscape
Financial literacy	• Concepts (e.g. inflation, diversification, interest), measurement • Lectures and small group work • Online voting systems

deepening gap between the rich and the poor, and the social and economic causes of such growing inequalities. The classes on poverty and inequality not only introduce the main notions and concepts to the students, but familiarize them with the variety of indicators and measurement methods relevant to inequalities, such as the ratio of people living below a given poverty threshold as a measure of poverty, or inflation-adjusted GDP per capita as a measure of wealth in countries. The processes associated with poverty and inequality can be best examined using time series and comparison of data, e.g. through correlation analysis to uncover whether certain countries show similar progress in reducing poverty or income inequality. Within the framework of PCS, lesson plans focusing on income inequality and poverty are utilizing such tools as *Gapminder* or *Tableau*, which are excellent for visualizing multivariate data.

Gapminder Online is a free online dynamic visualization tool which can be used to visualize five different variables on a single chart simultaneously while still keeping the visualisation simple enough so that students can easily understand social and economic progress. Chapter 8 provided an overview on the use of Gapminder for dynamic data visualization. Gapminder Offline is a publicly available desktop version of Gapminder Offline which does not require constant internet access and in which students can visualize their own data as well. Tableau Public is also a free visualization tool which—similarly to Gapminder Offline—allows us to utilize our own data—hence, when using Tableau and Gapminder Offline, students not only learn how to visualize and explore data but how to construct their own databases.

Figure 14.1 shows just one example of the use of Tableau for visualization on the topic of poverty and income inequality. It shows the Gini index for countries of the World on a heatmap. Darker green areas of the map refer to countries where the Gini index—and therefore income inequality as well—is lower, while the darker red areas are countries where the Gini index is higher, with one example highlighted. In 2016, the Gini index and with it, income inequality, was the highest in Brazil according to the World Bank estimates. Such a geographical layout is not only a visually pleasing way of showing data to students but is also an excellent method to make students link the data to their general knowledge of the World, e.g. linking income inequalities to the politics or economic issues of a country.

Ageing society is a serious issue facing modern societies. According to reports from the World Health Organisation (WHO), the percentage of the global population living above the age of 60 will increase to 22% by 2050 from 12% in 2015, and the number of people above the age of 80 years will more than triple from 125 to 434 million persons by 2050.[1] It is important for all citizens to engage with the topic of an ageing society; it is particularly important for students of economics because of the implications for (for example) pensions, tax policies, and retirement planning. Ageing puts a huge burden on the economy and economists of the future should be aware of the processes behind the changes. Ageing society can be best examined

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[1] WHO (2018). Ageing and health. Online: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health, downloaded: 8 January 2020
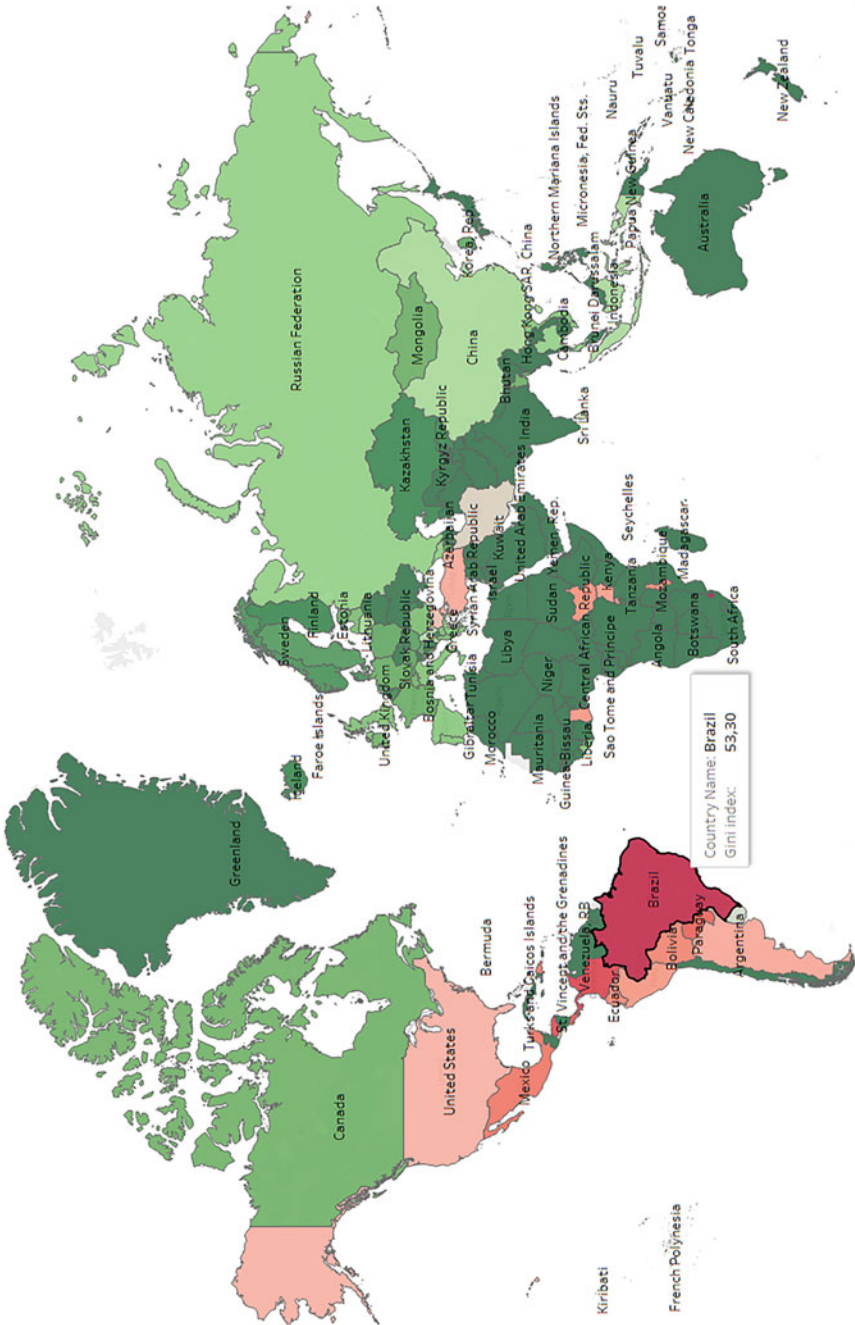
Fig. 14.1 Heatmap in Tableau visualizing the Gini index for 2016, data source: World Bank data

through population pyramids—examples can be accessed online or can be created with the help of such tools as Gapminder or Tableau. Examples of online population pyramids are provided on the World Life Expectancy website,[2] population pyramid net[3] Our World in Data[4] and elsewhere in this book. A population pyramid is shown in Chap. 8, along with descriptions of how to introduce students to modelling by changing the assumptions underpinning dynamic population pyramids and then examining the resulting predictions.

The topic of **social and business networks** focuses on the step-by-step introduction of students to network analysis and graph theory to help them better understand the links between agents of a network, or flows between countries or other entities forming a network. The advantage of introducing network analysis in business education is that students can better understand geographical and historical ties between countries; it is much easier to notice important links and flows when the network is visualized. Network analysis not only develops complex thinking in students, but can also sensitize them to be more open-minded when considering societal issues such as the state of refugees or international migration. Network analysis lessons within the PCS framework introduce students to basic notions around networks, such as the idea of a network, and its constituent elements; basic measures of networks help uncover important actors in the network. Students learn how to construct their own datasets in a form suitable for visualization, create visualizations, and analyze the networks themselves.

Network analysis is mainly carried out by using *Gephi*, open-source software for network visualization. The software is one of the most widely used software packages for graph and network visualization and exploration, and is available here.[5] Even though PCS lessons in the topic of networks and graphs have been created for Gephi, most of them can be further customized so that the given social and economic networks can be explored with the help of various other graph visualization and analysis software. As an example for graphs created in Gephi, Fig. 14.2 shows a graph on the topic of international migration and refugees made by one of the authors (EK) when a student. The graph visualises refugee flows (appearing as edges between the nodes of the graph) from their country of origin to the target countries (appearing as nodes on the graph) for the year 2015 based on United Nations data. To emphasize the possibilities for customizing networks in Gephi, the nodes of the network have different sizes to highlight the most popular target countries (the larger the size of the node, the greater the number of people who arrived in that country in 2015); and colours refer to clusters of nodes within which migration patterns can be detected. This means that countries that belong to the same cluster are such countries of origin and recipient countries which have stronger

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[2]https://www.worldlifeexpectancy.com/world-population-pyramid

[3]https://www.populationpyramid.net/

[4]https://ourworldindata.org/global-population-pyramid
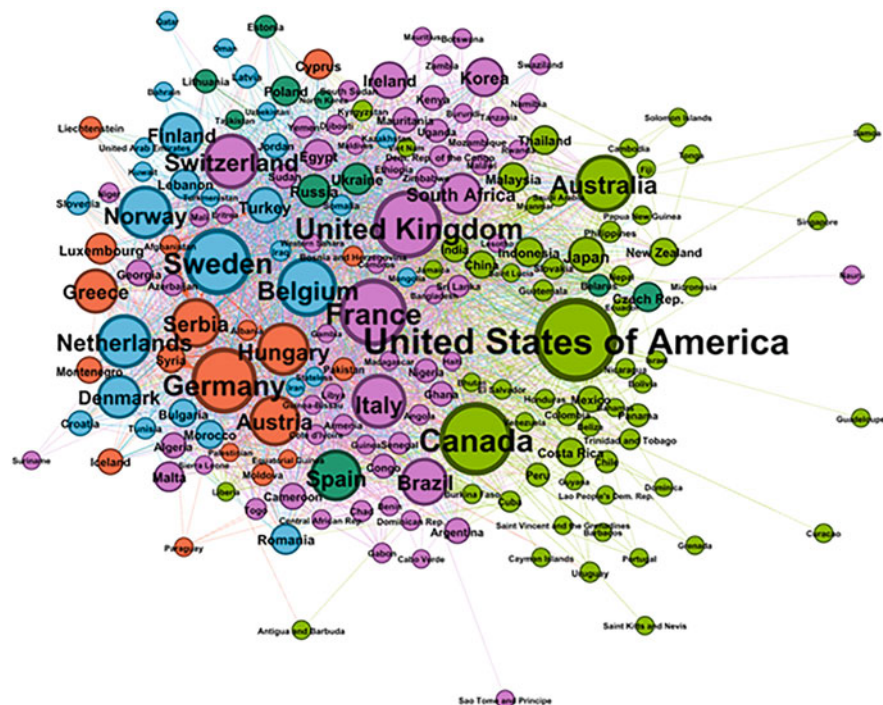
[5]https://gephi.org/

Fig. 14.2 Network of international refugee flows in 2015, data source: UN

migration flows between themselves than with the rest of the countries outside of their cluster.

Network analysis can not only be examined with the help of Gephi; *Tableau* can be useful as well, however to a different extent. Figure 14.3 illustrates refugee applications on a flow diagram or Sankey diagram, created as a dashboard in Tableau using the same UN refugee dataset as above, but in this case limiting the analysis to the top countries of origin (shown on the left side of the chart) and top asylum countries (right side). Such a diagram can also be helpful for the students in understanding flows in a much simpler context compared to a graph. However creating such a graph (or in this case, a Tableau dashboard in which the visualization was made) requires notable prior experience in Tableau, while creating a graph in Gephi is much easier even for a student who has no previous experience in the use of visualization tools. One common benefit of both, however, is that both Tableau and Gephi can handle geographical layouts, and these, combined with visualizing flows, can promote better understanding of social and economic phenomena—here international migration flows.

The fourth main module developed focuses on **financial literacy**. Financial literacy is *a combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual*
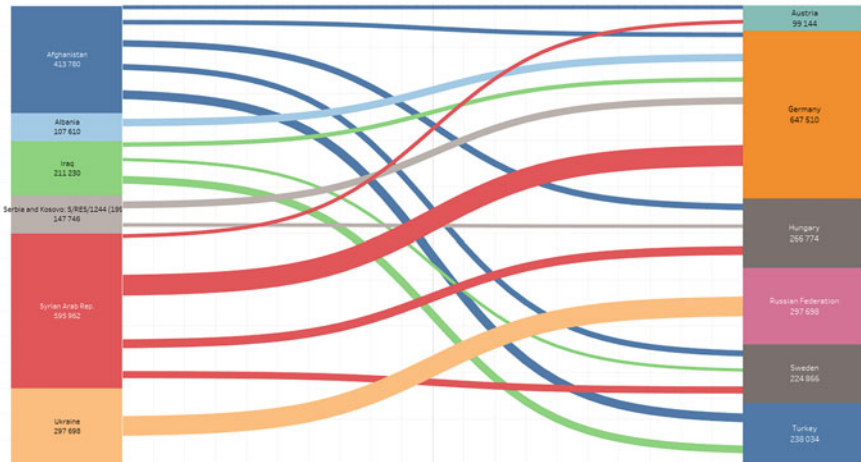
Fig. 14.3 Refugee applications in 2015–2017 by top countries of origin and top asylum countries, persons, data source: UN

financial wellbeing (OECD definition cited by Atkinson & Messy, 2012, p. 14). Following the 2008 financial crisis some blamed individuals for their poor financial decisions, which contributed to the crisis to the same extent as businesses' improper financial decisions (Klapper et al., 2012; Lusardi & Mitchell, 2014). Because of this, financial literacy research and financial education of individuals has been in the spotlight of many major international organizations, such as OECD, in the past decade. In business education it is equally as important for economics students to be aware of personal financial issues as well as general economics and finance, so that they can better understand financial processes from both the consumers' and companies' aspects.

The topic of financial literacy includes more discussions and far fewer visualizations; students are encouraged to think critically about their everyday finances and to test both their knowledge and attitudes. Online voting sites, such as VoxVote or Kahoot! served to support the ice-breaker for the topic: students filled out the same questionnaires as those used by OECD or Standard & Poor in their surveys, and can compare their results to either their national or the global average and discuss the differences in the results and the reason behind such differences.

The above four topics (poverty and income inequality, ageing society, social and business networks and financial literacy) serve as starting points in implementing Civic Statistics in business education. Depending on the previous knowledge and preparedness of the students and on the size of the classes, lesson plans can be tailored in different ways. Lessons on poverty and income inequality, ageing society and network analysis can function well in smaller classes, while quizzes and discussions on the topic of financial literacy can be both applied in smaller and larger classes, (most online voting sites do not have limitations on the number of participants in quizzes and polls) we have used quizzes with classes of 450 students.

14.3.2 Teaching Environments

Table 14.2 shows how teaching modules have been used with different student groups. Business education was the focus of our early development work; topics were first introduced to different sized groups of business students. Working in small classes has the advantage over large classes in that students can better collaborate with each other, and there is more room for conversations, use of interactive tools and group work. At the University of Szeged, Faculty of Economics and Business Administration, statistical education has been provided both in large and small classes: large classes of up to 450 students are aimed more at teaching the theoretical basics of statistics with less emphasis on the practical application of analytical tools in social and economic environments, while small classes of up to 30 students are aimed at teaching the practical application of statistical analyses, introducing some analytical methods and software, and developing students' critical thinking around data. Apart from economics students, through introductory statistics courses and high school programmes both law students and high school students have had the opportunity to learn about Civic Statistics. In the case of the law and high school students, courses were held in small groups, meaning that more discussions and debates were held on the topics of ageing society and financial literacy. These topics were chosen for these groups because of their implications in their everyday lives; high school students have just started managing their own finances and will soon leave their parents to continue their university studies, so they have to be aware of their finances way more than before. Law students upon becoming lawyers will have to be familiar with current demographic processes of our society and the world.

Civic Statistics has been implemented in both small and large classes in business education. In this environment, not all students own computers, however, more than 98% of students use smartphones with internet connections, and several of them use notebooks, or tablets to make notes during lectures. Most of the schools have Wi-Fi networks. These factors offer the opportunity to use online voting systems, online idea boxes, and data collection to encourage students' activities in classes. The

Table 14.2 Teaching modules introduced to different student groups

Program	Topics/Tools
Business program at bachelor level (small groups of 20–30 students in a special course after an introductory statistics course), IT	Ageing society Social and business networks CODAP, Tableau
Business program at bachelor level (large classes with 450 students in an introductory statistics course), IT	Ageing society Voting systems
Business programs at master level (small groups of 20–30 students in a special course), IT	Ageing society Poverty and income equality
Law programs (small groups of 20–30 students in an introductory statistics course), IT	Ageing society
Secondary school students (small groups of 20–30 students), IT	Financial literacy

implementation of Civic Statistics in large classes of up to 450 students served the purpose of introducing a topic and generating ideas; with the help of the voting sites used, students had the opportunity to engage and express themselves even in such large classes. For instance, at the beginning of the classes, we use warm-up questions. In the ageing society module can ask students for their perceptions about the age profiles of different countries. VoxVote can manage it either as a closed or an open question, and we can show the result immediately on a horizontal bar chart or on a word cloud. These systems provide immediate feedback, and engage students. They can also help develop critical thinking in students. For instance, we create activities on interpretations of different charts and tables in a quiz form. The open questions can help in formalizing critical questions.

Our experiences showed that sometimes students have a hard time expressing their ideas verbally in public even if they have valuable opinions to share, because of their fear of others' judgments. Through the introduction of the online voting sites, students feel more liberated and freer of the stress caused by speaking up in front of hundreds of their classmates.

After answering the questions about the teaching material we developed, students evaluated the online voting system through two questions. The opinions about using the online voting system were measured in a 5-point Likert scale (1—*I do not like the online voting system at all*, 5—*I like the online voting system very much*). 78% of the students (n = 189) gave 5 points as an evaluation, and only 9 students gave 3 or fewer points. The average evaluation score was 4.68 points (SD = 0.73 points), so students really liked getting questions through an online voting system. There was a closed question about the usage of the online voting system (*Shall we use this online voting system during the lectures?*) where 93% of the respondents (n = 183) voted yes; only 1 person voted no and 12 students responded *it does not matter* (7%).

In the following part of this chapter, we describe the introduction of a course called *Data Collection and Analysis* which has been developed primarily to test PCS materials, and has been further adapted to fit the needs of economics students. We also describe our experiences and takeaway lessons from implementing Civic Statistics in business education.

14.4 A New Course on Civic Statistics

The course *Data Collection and Analysis* has been developed on CS at the University of Szeged, Hungary, where students use both our and PCS partners' materials. The aim of the course is to bridge the gap between traditional statistics courses and social and economic issues, to show students how they can better analyze everyday phenomena using statistical analysis and visualisation tools and also to support the understanding of complex socio-economic phenomena through statistics. The course continues to run and evolve; it has been designed to run in the spring semesters of the academic year for a maximum of 30 students, making it a small class activity. Practical training, lab work and seminars are usually held in smaller groups of

students at universities; in Hungarian high schools, one class is usually composed of 20–30 persons. Smaller groups enable the educators and the students to engage better with topics and facilitate better communication and collaboration in the group.

The reason behind launching a course for such a small group of students has been twofold: one reason has been the limitation of computer rooms—most computer rooms at universities contain around 30 or even fewer computers. The other reason is that most of the PCS materials work better in small classes because they focus more on the practical application of analyses, and because of the important role of discussions around certain topics. Economics students take their first statistics class in the third semester; this is a prerequisite to register for the *Data Collection and Analysis* course, which is optional. So students already possess some preliminary knowledge about statistics which provides a good foundation in understanding Civic Statistics.

14.4.1   Lesson Structure

Classes are designed to be 90 min long and to cover one or two Civic Statistics themes during one class, depending on the complexity of the analysis to be performed. The structure of a typical lecture is given in Table 14.3.

Every lesson begins with a short (10 min) introduction to the topic. This introduction can include: a short presentation from the teacher; a short video on the topic (many educational and thought-provoking videos are freely available online and can be used to start a conversation and to attract students' interest in the topic); or even a short quiz or game (gamification in many cases can help to break the ice and encourage students to participate more actively in class activities). Following the introduction, students can share their impressions about the topic, what preliminary knowledge or assumptions they have about a given social or economic topic, or they might even formulate their own questions about the topic (10 min). Encouraging them to formulate questions which later can be answered through data analysis can not only strengthen students' engagement in class but can also develop their critical and logical thinking.

Table 14.3 Lesson structure in Data Collection and Analysis course

Lesson element	Length (minutes)
Introduction to the topic: basic notions, videos on the topic, quizzes, etc.	10
Warming up discussion: exploring students' preliminary knowledge and assumptions about the phenomenon	10
Exploring datasets in the topic	20–30
Data analysis and visualization in the topic	30–40
Closing remarks, discussing main takeaways, eliciting the experiences of the students	10

The core element of the class is the analytical module, which is separated into two parts, the first focusing on exploring real datasets which can be both from official statistics institutions or could be other real data (e.g. from university surveys); the second part focuses on the practical use of this data, aiming at answering students' questions on the topic. This analytical module requires around 60 min of class time. The length of each part can vary, depending on the scale of the datasets to be explored, the difficulty of the analysis methods, and the complexity of the software. In this module the main focus is on active participation and enhanced cooperation between the students. Teachers can set group tasks so that students have to collaborate in solving problems or can set competitions to find the most creative solution to a given social or economic problem, or can hold debates on the topic. This part of the class not only improves their analytical thinking and skills, but through the group activities or interactive exercises their communication skills can further develop as well.

In the last 10 min of the class, students discuss what they have learned during class, and can share their positive or negative experiences concerning the exercises or their interest in the phenomenon itself. It is important to close every class with a discussion, so that students have an opportunity to share with others the main messages (or moral) that the topic has given them, and also to collect valuable comments on how to develop the upcoming classes so that they will better fit future students' aims and needs.

14.4.2 Course Design

The *Data Collection and Analysis* course is generally planned for 12 weeks of classes (twelve 90 min classes). The materials selected for the classes are all taken from the PCS Teaching Resources, which are available from the CivicStatMap.[6]

In business education it is crucial to select topics that are directly connected to the studies of the students. Teachers need to keep in mind when designing the course that classes should be planned to allow a progression from the easiest to the most complex analysis methods and topics; at the beginning of the course, it is important not to overload students with analyses that are too complex, or to address social issues that are too controversial, because these can deter students from participating in classes. PCS Teaching Materials provide lesson plans to support (in addition to the topics outlined here) investigations about migration and refugees, climate and environment, gender equity, education, health, statistical literacy, and human development. Topics in many cases can be selected around an overarching theme—for example, gender equity, education, health and income inequality, and poverty are all related to personal well-being. A different approach is to take a single theme

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[6] https://rstudio.up.pt/shiny/users/pcs/civicstatmap/

Table 14.4 Sample curriculum for the *Data Collection and Analysis* course

Week	Topic	PCS teaching material	Software
1	Introduction, course requirements, assessment, warming up	5.202 Daily routine[a]	Online datasets
2	Interpretation practices	5.304 Interpretation practices[b]	–
3	Population and human development	5.102 World Population[c]	CODAP, iNZight
4	Human development, happiness	5.105 Human Development Index[d] 5.106 Happiness[e]	CODAP, iNZight
5	Ageing society	5.303 Ageing society[f]	Dynamic population pyramids
6	Introduction to Gapminder	5.301 Introduction to Gapminder[g]	Gapminder
7	Poverty and income inequality	5.302 Gapminder level 2[h] 5.201 Inequality[i]	Gapminder
8	Risk of poverty and social exclusion	5.302 Gapminder level 2 5.410 Risk of Poverty and Social Exclusion[j]	Gapminder, Tableau
9	Migration and refugees	5.405 Refugees[k]	Tableau
10	Migration and refugees	5.412 Refugees[l]	PowerBI
11	Introduction to networks and graphs	5.305 Networks level 1[m]	Gephi
12	Migration and refugees	5.306 Networks level 2[n]	Gephi

[a]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.202_SV_RoutineDay_EN.pdf
[b]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.304_TV_interpretation%20practices_EN.pdf
[c]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.102_TV_world's%20population_EN.pdf
[d]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.105_TV_HDI_EN.pdf
[e]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.106_TV_Happiness_EN.pdf
[f]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.303_TV_AgeingSociety_EN.pdf
[g]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.301_TV_gapminder_level1_EN.pdf
[h]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.302_TV_gapminder_level2_poverty_EN.pdf
[i]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.201_TV_Inequality_EN.pdf
[j]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.410_TV_Riskof%20Poverty%20or%20SocialExclusion_EN.pdf
[k]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.405_TV_RefugeesUNHCR_EN.pdf
[l]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.412_TV_RefugeesUNdata_EN.pdf
[m]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.305_TV_Networks_Level1_EN.pdf
[n]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.306_TV_Networks_Level2_EN.pdf

(e.g. gender equality), and to plan a sequence of explorations of increasing sophistication using multiple data sets.

Most of the PCS teaching materials address a given dataset that students can explore with the help of pre-specified software or analysis methods. However, teachers are encouraged to complement PCS materials with new datasets and to tailor the analysis methods to the students' needs or preliminary knowledge by e.g. choosing different software. Table 14.4 shows a sample syllabus for one semester of the Data Collection and Analysis course, illustrating the selected PCS

materials to be discussed during the course and the software needed to solve the exercises.

The above sample syllabus set out in Table 14.4 can be separated into four main modules, each module focusing on a given social or economic phenomenon:

- **Weeks 1–2:** introductory module. Students are introduced to the aims of the course and learn about the requirements in terms of activities and assessment. Warming up activities, basic practice with interpreting different visualisations.
- **Weeks 3–5**: module on population and population projections. Students learn about and discuss population processes, the current state of our society, how human development has progressed over the years and what projections we have about our future, concerning aging societies and population growth. Students are introduced to *Codap* and *iNZight* and as well online population pyramid tools.
- **Weeks 6–8:** module on inequalities, poverty and social exclusion. Students learn about income differences all around the world, different measures of poverty and social exclusion, and they discuss how to act against poverty and what projections show about future development in poor countries. The two main software packages used in this module are *Gapminder* and *Tableau*, using both *Gapminder Online* and *Gapminder Offline* is recommended in classes.
- **Weeks 9–12:** module on migration and the state of refugees. The prior weeks on income inequalities lead to the question of why people leave their countries and migrate to others. This module seeks to answer this question by exploring UN refugee and international migration datasets through various analysis methods (using *Tableau*, *PowerBI* and *Gephi*). The second part of this module contains an introduction to networks and graphs, which make it easier for students to discover the political and geographical patterns associated with migration.

14.4.3 Options for Adapting and Expanding the Course Design and Activities

This sample syllabus is built along four main social topics which have important economic implications (for pensions, healthcare, gender pay gap, aid to countries in need. etc.) which students all encounter during their studies. These modules support better understanding of how social problems and processes can play out in global and national economic systems. This syllabus is not set in stone; modules can be modified according to the particular needs of students. In a small course it is possible to include a more extended project that has many advantages. To give an example, the material on Gender Equity[7] contains a 4-week project about the gender pay gap, culminating in a student presentation. This project is divided into four 90 min long

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[7]https://rstudio.up.pt/shiny/users/pcs/civicstatmap/5.409_TV_Gender%20Equity_EN.pdf

sessions, during which students explore the topic of gender inequality and the gender pay gap, via rich data investigations. In summary:

- **Session 1:** introduction to topic, general discussion about the gender pay gap.
- **Session 2 and 3:** data analysis on the topic of the gender pay gap.
- **Session 4:** presentations and discussion of results.

Previous sections of this book introduced various tools, techniques and topics that can be further included in the course design. Chapters 5–12 each introduce different tools and datasets which can further enrich the syllabus. For example, the visualization tools introduced in Chap. 5 can complement the social themes introduced in the above syllabus (e.g. ageing society), and similarly, the data sources and visualizations on the topic of refugees in Chap. 6 can widen the range of datasets and tools that can be used during weeks 9–12 in the above-described syllabus. Moreover, educators are encouraged to relate such actual phenomena in the course structure such as climate change (see Chap. 11 about exploring climate change data) or even the "hottest" topic of the early 2020s, the COVID-19 pandemic (see Chap. 12 on civic statistics in the time of COVID-19).

This course can not only be implemented at the college and university level but can also be of interest to high school educators as well, because educating pupils about societal issues and data analysis techniques can be excellent preparation for their further studies in tertiary education. Pupils who learn about Civic Statistics during their high school years are not only going to be better equipped with the knowledge of statistical analysis and visualization tools but are also going to be more open and sensitive to important social and economic issues that are part of our everyday lives regardless of the profession one chooses. Therefore, we highly recommend adapting this course for use at high school level as well. The tools and topics introduced as part of the syllabus can be flexibly adapted to the needs of high school pupils and teachers, e.g. by including the visualization tools introduced in Chap. 9.

14.4.4   Evaluation

How can teachers evaluate the work and products of students who work on hands-on tasks or extended projects? This is a challenging topic that has been the subject of much scholarly work. Project based learning (PBL) is an educational approach which allows students to develop their skills through real life examples and at the same time promotes engagement in the classroom, and results in better educational outcomes compared to traditional learning environments (Krajcik & Blumenfeld, 2005). We can not only consider student engagement and learning activities but must think about how we can assess student performance. With PBL, assessment becomes not as straightforward as in the case of traditional teaching methods, because PBL teaching not only develops the theoretical knowledge of students, but endows them with complex analytical and critical skills, some of which we cannot measure with

traditional tests. Therefore, this teaching approach is creating an opportunity for innovation in assessment methods, illustrated by the examples in Bergeron et al. (2019). In our course, we aimed at developing an appropriate assessment model, which is virtually inseparable from the learning activities, therefore not burdening students further with additional course requirements. Rather, we set out to promote active participation and to gather evidence about the development of the skills students have developed, and to reward not only the tangible elements of students' work (e.g. written materials), but also their personal contribution to the course..

In order to pass the *Data Collection and Analysis* course, students have to work on a project in groups of 4 or 5 during the whole semester, exploring their chosen social or economic phenomenon. This phenomenon can be one discussed during the semester or even something else they are interested in and is approved by the teacher. From the first class of the course, students are encouraged to work in teams both during the course and in their project work, to develop their cooperation and conflict resolution skills. In their project work, students have to be able to formulate questions (i.e. they have to decide what they want to research in their project; they are not working on pre-defined questions, so that they learn how to ask better questions when it comes to research) and solve these questions using the tools they meet during the semester.

Students have to form groups at the beginning of the semester and during the whole semester they are expected to work together on their project. They have to report on their progress three times during the semester:

- **Week 3:** submitting group members' names; the submitted group composition is regarded as final by this week, and cannot be changed during the semester. Students get 3 weeks to form a group and are not forced to do this during the first class, because as classes are quite large, they might not know each other, making group formulation problematic at the beginning. Teachers allow time for students to get to know each other, and make their own choices about group composition, to ensure better cooperation between group members.
- **Week 6:** submitting their chosen topic and initial questions. During the semester students are developing their skills in formulating better questions, but they have to be able to briefly outline what they want to research by the middle of the semester. Teachers can give them some guidance on narrowing down the topic and students can start looking for data when they have the preliminary research questions.
- **Week 9:** reporting the final research question they are about to answer in their project. This research question should be well focussed. As an example, "What is the state of poverty in Africa?" cannot be considered an appropriate research question as it is too broad and too general, however "How has the proportion of people living in extreme poverty in Sub-Saharan Africa changed over time?" can be considered a suitably specific research question. The course is designed for undergraduate students who might never have carried out a research project, so teachers need to be generous in critiquing their research questions and offer guidance in specifying at least the target group and sub-topic they are to examine.

Table 14.5 Requirements of Data Collection and Analysis course

Assessment component	Weight (%)
Class participation and work	**10**
Group project	**60**
– Suitability of research questions	20
– Accuracy of chosen data analysis methods	20
– Accuracy of chosen visualisations	20
Group presentation	**30**
– Every member takes part in the presentation	5
– The presentation is easy to understand	5
– Reasoning is accurate and well-founded	10
– Students can answer questions related to their research	10
Total	**100**

- **Last week or exam period:** presenting results of the group project. Students have to make a 15–20 min presentation about how they answered their research question and their results; these are then discussed with the whole class for 5–10 min. Teachers encourage other students to formulate questions for the presenters, this way preparing each other for future presentations and exam situations where they must be able to accept critical comments and reply to the questions from the audience.

Given the size of the class (maximum of 30 students) teachers can monitor the progress of each group through the semester continuously and can base their evaluation not only on the reports of the students and the group project but can also monitor how they have developed individually during the semester. Groups are evaluated along the following criteria set out in Table 14.5.

14.4.5 Feedback from Students

The end-of-class discussions served the purpose of collecting student feedback about the course. Table 14.6 summarizes this student feedback. Students faced many challenges during the course, but could overcome many of them by the end of the semester.

Students faced the challenge of how to formalize questions properly, but the group project and the in-class discussions helped them develop their skills in this area. Students were also unfamiliar with multivariate issues as part of traditional statistics classes; they have not faced multivariate data or analyses, but only rather simple analyses.

The main positive feedback received from the students is that with the help of the teacher and through the guidance provided by the teachers during the introductory parts of the course students could successfully explore a social or economic topic they have been unfamiliar with prior the course.

Table 14.6 Student feedback from Data Collection and Analysis course

Challenges for the students	• Formalizing appropriate questions • Handling multivariate data to address questions • Learning to use the software • Linking knowledge elements from different fields
Positive results/experiences—feedback from students	• Learning to formulate and answer questions about complex situations • More personal experiences and deeper knowledge about the topic and ways in which they can use evidence to engage with reality • Active student participation • The students enjoy this form of learning • "Unconventional" and "more modern" analysis and visualisation methods are popular among students
Negative results/experiences—feedback from students	Some students had difficulty understanding • The importance of the topic for their study (and/or) for themselves • The relationship between the topic and the need for civic engagement

Students were not rushed; the ambition was not to learn something as fast as they can, but rather to get a deeper understanding of how and why to use certain software or analysis tools. The end-of-class discussions and self-reflection provided for the students a great platform to summarize their thoughts and feelings about the class and they were generally grateful for this opportunity, because they felt that the course was designed really for them and with them, because (as stated earlier) introductory discussions served the purpose of fine-tuning the upcoming classes to student interests. The informal style of the course and the introduction of new methods and topics proved to be interesting for the students; those participated in the course generally reported enjoying this interactive form of learning adopted for the course.

Some negative feedback arrived from the students as well. Some of them reported having difficulties in understanding why a certain topic needed to be covered. For example, students found some topics irrelevant for their studies. Some students wanted to focus more on visualization and not social issues, and were sometimes less interested in some phenomena than in ways of representing it. Civic Statistics was at first a notion hard to understand for the students. They could not understand the difference between social statistics and Civic Statistics; this issue, however, could be resolved when the teacher had a clear vision of these differences and could explain it in detail for the students.

Despite the difficulties reported by some students, the course *Data Collection and Analysis* proved to be a course suitable in business education as it provided the participants with valuable insight to the economic implications of many social themes and as well giving students a more colourful and diverse analysis toolkit to complement their statistical skills.

14.5   General Conclusions: Experiences and Recommendations

14.5.1   Experiences

In teaching large classes, the main challenges teachers had to face related to course design, finding the right balance between substantive exploration of the topic and teaching analytic methods in sufficient breadth and depth. Including too few tools and methods might not provide students with enough new skills for their future and could also result in boredom during classes; however, teachers also had to avoid overloading students with new tools, because it takes some time to get to know how to use these tools. Here, lesson plans were selected to cover around 7–8 social topics and 4–5 tools during the semester, so that students have enough time to learn how to use these tools effectively to their own benefit.

Another challenge for teachers is motivating students during the course. Student initial responses to the unconventional content and teaching approaches were not always positive; as students had no significant prior knowledge of the social topics covered, they sometimes were not engaged from the outset, and did not participate fully in class activities. Teachers needed to find a way to break the ice and engage students' attention. Breaking the ice is probably the greatest challenge of the course, but after tackling this issue students showed much more willingness to participate actively on subsequent courses; this process can be further supported with the tasks introduced in Chap. 7 which we have found beneficial for student motivation. As a result of the introduction of interactive class activities and quizzes, students enjoyed the courses much better, collaborated more, and were more communicative during classes.

In large classes, speaking up and participating in the discussion is a challenge both for the teachers and the students. Teachers often have problems with facilitating discussion and engaging all of the students, while for students, speaking up and expressing their opinion in front of others can be stressful, especially with a younger audience, who are not often used to speaking in front of dozens or even hundreds of people. Therefore, the introduction of online quizzes, where all of the students could share their opinions anonymously, served as a good foundation for further discussion. The use of digital tools, especially mobile phones is generally not recommended in education; however our experiences with university students and high school students showed that members of generations Y and Z are not only accustomed to have their phones in their hands all the time, even in school, but welcome every opportunity to use them—even if for educational purposes. The notion that smartphones simply distract students from learning is wrong; if used well, they can not only help engage students in a topic but can also promote sharing opinions, leading to increased class participation.

In the case of Civic Statistics topics, teachers need to know about the social context, the relation between statistics and the social content, and possible civic engagement; hence at the very beginning of the courses more preparation was

needed. The main challenges teachers and instructors faced during the courses were associated with finding an appropriate level of difficulty during the course, taking account of students' preliminary knowledge and interests, and constructing a course in which IT tools, statistical methods, social context and the importance of the topics covered are weighted appropriately. Teachers had to balance different course elements and stress the value of each element to the students to motivate them while learning to use new tools and discussing controversial topics.

14.5.2   Recommendations for Introducing Civic Statistics in Classes

In the previous sections of this chapter we have summarized our experiences from the implementation of Civic Statistics in different classes and the feedback received from students. Even though there was some negative feedback and difficulties experienced by both teachers and students, in general, the inclusion of civic statistics in either business education or as part of introductory statistics courses was found to be beneficial both at high school and university level.

Our recommendations for the implementation of Civic Statistics can be summarized in a few points:

- **Breaking the ice is key**: students, especially in large classes can be intimidated when it comes to speaking up in front of others.
- **Find the right balance, do not try to introduce too many societal topics and statistical tools at the same time**: the capacity of students to comprehend is limited. The aim of introducing Civic Statistics is to draw their attention to important topics and to develop their critical thinking. More generally, we aim to make students better informed and open to certain topics—so it is important not to overwhelm them with too many topics and tools during one course.
- **Find the right balance in the choice of software**: on one hand, we want to give students a feeling for what can be achieved using different packages, but on the other hand, changing from one tool to another too quickly can distract students and does not give them enough time to develop mastery over a given package.
- **Tailor the implementation to your students' needs and prior skills**: the modules, analysis tools and topics require different levels of prior knowledge on the usage of these tools and in the topics they discuss;therefore we highly recommend exploring your students' skills and also their needs in order to tailor the course to the students' knowledge and needs.
- **Do not forget the economic implications of the topics when introduced in business education**: even though the course we have described can be implemented in any field of education, as the topic of this chapter was the implementation of Civic Statistics in business education, when adopting any of the modules or even the entire course, teachers should not forget to link the topics

to students' original studies, this way ensuring that Civic Statistics becomes a valuable extension of their business-related studies.

- **Devote time in conversation with the students about the economic implications of social issues** to make explicit the relevance of each topic covered during the semester to their overall courses of study. For people new to teaching about Civic Statistics we do recommend that the first lesson is used to fine-tune the content for the semester. PCS Teaching Materials are extensive; teachers can ask students what they would be most interested in studying during the semester, to tailor the course to the group's personal needs and interests.
- **Start with relatively easier things and then proceed to more complex ones:** students learned how to discover connections between the variables and how to understand the complex background of many phenomena.

Statistics classes in business education are usually not focussed on real life problems and do not include real data. Implementing Civic Statistics in business education can sometimes be tough and challenging, and requires notable efforts from both students and teachers at the beginning, but can complement the statistical courses in such programmes nicely. A number of approaches can be taken to introducing Civic Statistics into teaching. We can expand existing statistics classes with just a handful of PCS modules and materials to engage students in certain topics, or to facilitate discussion in a large class, or we can implement the whole *Data Collection and Analysis* course, tailored to the needs and skills of students. In small classes, our experiences show that we can give students relevant complementary knowledge in societal issues which can not only help them in their further studies, but in the long run can open their eyes to real issues and problems, and make them more responsible citizens in their future life.

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