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Learning Tableau: A data visualization tool

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ABSTRACT

"Doing economics" is an important theme of undergraduate economics programs. Capstone courses increasingly include instruction in "data literacy" and the STEM-related skills of quantitative and empirical methods. Because the professional discipline has moved in this direction and because of greater employer demand for these skills, data visualization is a key component of data literacy. Tableau is a free data visualization software widely used in the data analytics industry. In this article, the authors introduce an exercise that teaches the fundamental Tableau concepts and commands needed to create charts, assemble them in a dashboard, and tell a story of patterns observed in the data. The exercise assumes no prior experience in Tableau and is appropriate for undergraduate upper-level economics courses or an empirical methods course.

Literature review

Hoyt and McGoldrick (2019) survey the five decades starting from the 1970s and single out the decline in the number of economics majors in the 1990s as a transition point in the economic education literature. Before the 1990s, economic educators were concerned with incorporating emerging technologies into instruction. Since the 1990s, the phrases "learning by doing," and "training to think like an economist" appear in seminal articles by Siegfried et al. (1991) and Hansen (2001); these phrases have become the mantra for writers on economic education as Hoyt and McGoldrick document.

"Doing economics" in undergraduate economics increasingly includes working with data. The pedagogy of undergraduate econometrics is moving, albeit slowly, from the "Stone Age" emphasis on statistical efficiency and functional form to the "Computer Age" of causal interpretation and empirical examples (Griffith and McFall 2013; Angrist and Pischke 2017). Similarly, undergraduate departments are turning toward increasing instruction in empirical and quantitative methods. By 2018, economics degrees classified as STEM-eligible (econometrics and quantitative) comprised 13.2 percent of all undergraduate economics degrees conferred, up from just 1.2 percent in 2012 (Marshall and Underwood 2020). A key factor in the orientation toward developing empirical quantitative methods is recognition of a greater demand by employers for these skills (Angrist and Pischke 2017; Kassens 2019; Marshall and Underwood 2020).

Data literacy is emerging as an important component of "doing economics" (Halliday 2019). Hoyt and McGoldrick (2017b) summarize what the literature emphasized that "doing economics"

was at that time, using analytical and presentation tools that students will be using after gradu-ation. They identify five goals of student research: (1) develop a worthwhile research question; (2) connect it to the literature; (3) formulate a testable hypothesis; (4) collect, clean, and use appro-priate tools to analyze data to test the hypothesis; and (5) present the findings. The penultimate goal defines what data literacy is, and is clearly foundational to the last goal of presenting the findings. A recent symposium section of the *Journal of Economic Education* highlights efforts in five top economics departments that have the goal of promoting economic literacy and a culture of undergraduate research (Hoyt and McGoldrick 2017a). Common to the department efforts is a focus on developing data literacy and investing in infrastructure support from data librarians as well as IT support specialists in software usage (e.g., Stata and GIS).[1]

Data visualization is a tool of data literacy: "Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data" (Tableau.com 2019, online). Data visualization helps the researcher identify relationships in data and enhances a presentation in the same way as a thousand words while taking up less space (Hennessey 2014). However, examples of modules published in the economic education literature with exercises aimed at developing data literacy skills for undergraduate economics courses are relatively few, although growing. In our search of the economic education literature, we uncov-ered four such exercises, as discussed herein, none of which uses Tableau.

The four visualization tools that have been explored in the economics of education literature are GIS, FRED, Infographics, and Excel. GIS (Geographic Information Systems) is a software that has the specific purpose of linking geographic information with descriptive information (ESRI 2012, 6). Peterson (2000) provides four assignments, using data prepackaged for GIS, to create thematic maps visualizing geo-spatial economic relationships for topics in economic development. FRED (Federal Reserve Bank of St. Louis [FRBSL] 2019) combines charting and mapping tools with an online database of economic time series. FRED specializes in the visualization of time ser-ies data. Méndez-Carbajo (2015) and Méndez-Carbajo, Taylor, and Bayles (2017) provide several assignments (using prepackaged data from the FRED online database) illustrating theoretical macroeconomic relationships with time series data. Infographics is a visualization that combines art and minimal text to make data easily understandable at a quick glance (Rouse 2012). VanderMolen and Spivey (2017) describe an assignment to develop an infographic for a health economics class. They discuss the steps of developing a research question and collecting relevant data. They include links to resources that describe "best practices" for infographics and tutorials on how to use several widely used infographics software. Excel is a workhorse software for many tasks, including data "cleaning" and visualization. Halliday (2019) includes an assignment for an economic development class that uses Excel to graph a Lorenz Curve. At first, students work with prepackaged data, and then they progress to collecting and "cleaning" data from a public site.

Learning a new data literacy tool has opportunity costs, so why Tableau? Because Tableau is a general-purpose data visualization tool more widely used in the data analytics industry than GIS, FRED, Infographics, or Excel.[2] Whereas GIS specializes in thematic geographic mapping (ESRI 2012), FRED (Federal Reserve Bank of St. Louis [FRBSL] 2019) in plotting time series data, Excel in data cleaning, and Infographics in directing focus to a specific statistic (Rouse 2012), all these features are also available in Tableau. Hennessey (2014) has an excellent overview of the options in Tableau that can be used to make thematic maps (like GIS), to manipulate data (like Excel), to make time series plots (like FRED), and to make infographics (like Infographics). Tableau's com-parative advantage, though, is in using multiple large data sets to create charts in interactive dash-boards from which the user can drill down to identify patterns in the data (Shaptunova 2017; Solanki 2017; KnowledgeHut 2019). Tableau also has a user-friendly drag-and-drop interface. For undergraduates looking toward the job market, data visualization is a skill in demand in the field of data analytics.
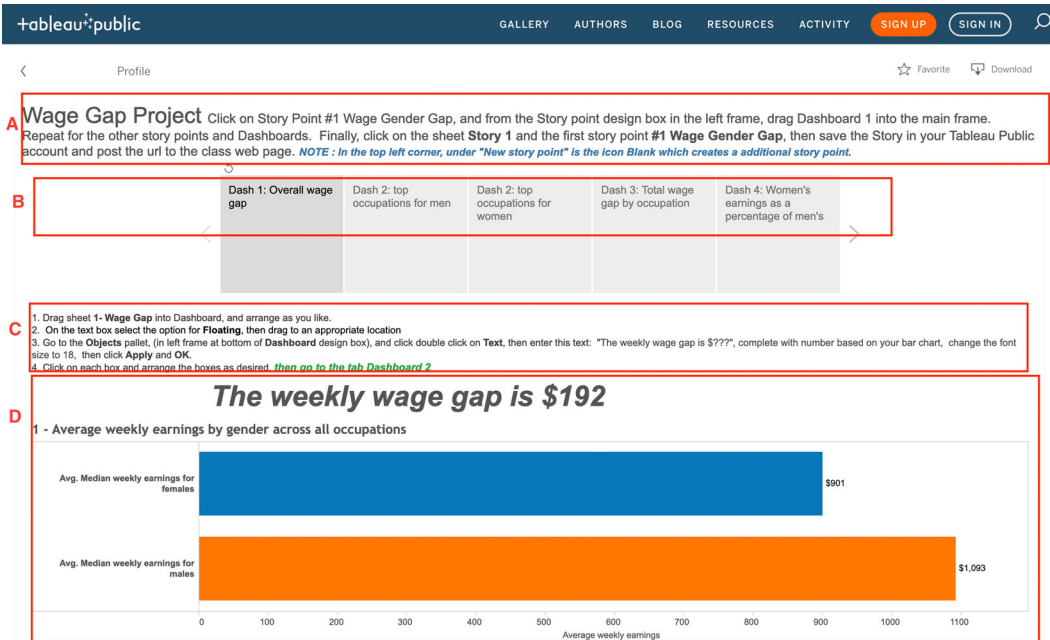
Figure 1. A story in Tableau.

To our knowledge, this is the first self-contained Tableau tutorial designed for an economics course. Our tutorial combines the comparative advantages of the data librarian with the economist. A data librarian performed the processing of data (downloading and cleaning) and the initial data visualization in Tableau, and economists framed the data into the puzzle of gender pay equity.

The tutorial: Components of Tableau visualization

Overview

In Tableau, the student begins by developing a single chart/graph in a worksheet. One or more worksheets are combined into dashboards, and the dashboards are linked by tabs in a story. The story is the final step of the data visualization and, as the name implies, tells the story of the patterns identified in the data. The story developed in this tutorial is shown in figure 1.[3]

The gender wage gap is a well-researched topic in labor economics that is often measured as the ratio of female to male earnings (Blau and Kahn 2017; Bolotnyy and Emanuel 2018). Occupation and industry are important explanatory variables of the gender wage gap because women are more likely to be in low-wage occupations that are less likely covered by union collective bargaining agreements (Blau and Kahn 1997). Further, Blau and Kahn (2017) estimate that, in 2010, 82.1 percent of the wage gap was explained by measurable human capital variables (age, work experience, education) and 91.6 percent by including measurable variables for industry and occupation. The residual was explained by discrimination and other unmeasurable variables. Therefore, in our tutorial, we focus on the effect of the control for occupation,[4] as combined with weekly average earnings by gender and by occupation.

Tableau annotation tools can be used to add commentary on patterns observed in the data; hence we recommend a few background reading assignments pitched at a level for undergraduates with at least a course in principles of microeconomics, so they can draw conclusions from the data in their presentation. As a primer on the gender wage gap, we recommend sections 1

and 2 of Gould, Schieder, and Geier (2016). For a review of factors explaining the gender wage gap among occupations, we suggest Hegewisch and Williams-Baron (2017). For a general discussion of how students can include Tableau visualizations in research projects, we use Hennessey (2014), which has an excellent review of the theory and principles of visualization using Tableau. Our work complements it in that we provide detailed instruction in Tableau commands and illustrate these commands with a cleaned data set.

We use national data from the Current Population Survey (CPS) for weekly average earnings by gender and by occupation. Our use of the CPS data is for reasons of relative ease of access and wide use in the economic studies of the wage gap. The U.S. Bureau of Labor Statistics' Web site includes a "Labor Force Statistics from the Current Population Survey" page of tables on employment and earnings data, with more than 20 years of data downloadable in Excel and text format.

Table 39, "Median weekly earnings of full-time wage and salary workers by detailed occupation and sex,"[5] was chosen as the basis for this tutorial because it contains wage data for a relatively high number of occupations for male and female workers. The original table was downloaded and modified slightly for use in Tableau: the column headings were reformatted into a single row, merged cells were deleted, and employment and wage estimates were converted to whole values (the estimates in the original table are expressed in thousands of dollars and thousands of workers). Only those rows with occupations that had estimated wage data for both men and women were retained—125 detailed occupations out of the original 535. Although cleaning and structuring data for use in Tableau is an important skill, we felt that preformatting the data in the packaged Tableau workbook avoided confusion, saved time, and allowed the students to focus primarily on understanding core Tableau functionality.

Tableau Public provides extensive support materials, including several how-to videos in the Resources section of the Tableau Public Web site.[6] Before the hands-on class sessions in which students were introduced to Tableau, students were required to watch the first how-to video, "Tableau Public Overview." The other brief videos are helpful for understanding how to connect to data, assemble and format dashboards, and other Tableau functionalities. In addition to extensive, well-maintained software documentation, Tableau supports a robust online community where users can post and search for questions and answers.

In figure 1, the title of the story "Wage Gap Project," is labeled with the red letter "A" and appears at the top of the main frame. Note that we include in the title directions from the tutorial on how to build a story; however, the usual use of the title caption is to explain the purpose of the data visualization. The pages of the story are the gray tabs opposite the red letter "B"; each tab displays the related dashboard (red letter "D"), although the storyboard title (red letter "A") is constant. Opposite red letter "C" is the dashboard title caption; as shown in figure 1, we display the instructions for constructing dashboard #1 of the tutorial. However, the student is instructed to replace this with an appropriate description of the dashboard. Figure 1 also displays the dashboard related to the first chart/graph (red letter "D"), which corresponds to the first worksheet of our exercise.

Worksheets

The ultimate result of the tutorial is to build a story that presents the findings from the CPS data; this starts with a worksheet. The first worksheet of the exercise is displayed in figure 2. The horizontal bar at the top (in the blue highlighted rectangle) has icons to activate commands that apply operations to the chart in the worksheet. Mouse-over reveals the operations of the icons. Extremely useful commands are those to: "undo and redo" (A), "sort data" (B), and the "Show Me" pallet (C).
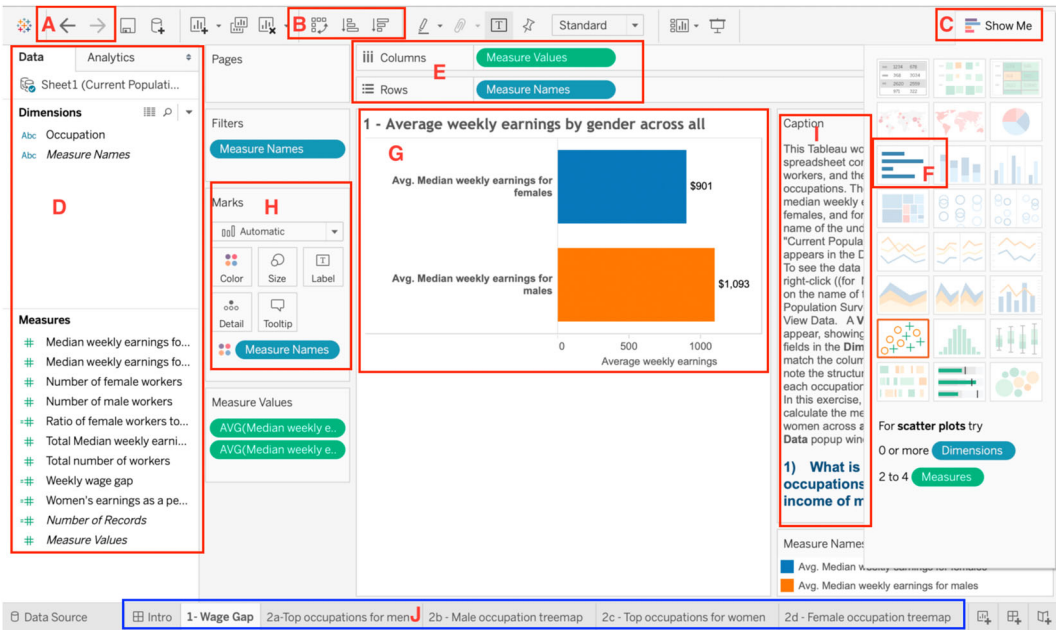
Figure 2. Guide to the Tableau workspace.

The Data pane, (D), has the labels of the categorical variables (Dimensions) and quantitative variables (Measures). Making a chart starts with dragging variable "pills" from Dimensions and Measures (D) to the **Columns** and **Rows** shelves (E).

Clicking the **Show Me** icon (C) reveals the chart types appropriate for the data, highlighted with a red border, and selecting one, a bar chart in our case (F), results in the chart appearing in the rectangle "G." The **Marks** card (H) has the commands to format the chart display (e.g., color of bars, labels, numerical units, etc.).

In the exercise, we use the **Caption** field (I) for the worksheet to embed step-by-step instructions for the user to build the worksheet. In a completed story, the worksheet caption is used to explain the visualization in the worksheet. In this first worksheet, we show the user a few basic formatting commands in the **Marks** card. The horizontal bar "J" at the bottom has tabs to navigate the worksheets, dashboards, and story.

The exercise has eight worksheets that gradually introduce the student to Tableau visualization commands. We introduce several chart types: horizontal bars, treemap, scatter plot, and trend line (with statistics). We introduce some of the options for formatting various attributes such as labels, currency symbols, and axes labels. And, we introduce the command of **Calculated Field** to make combinations and transformations of variables.

The worksheets build on the theme of exploring two dimensions of wage-gender difference—(1) the differential concentration by gender in occupations and (2) the wage differential by gender in occupations. The second set of worksheets (2a through 2d) builds charts that display occupations separately by concentration of males and females. This allows students to observe that some occupations are more heavily concentrated with one gender than other occupations. The third worksheet illustrates the 25 highest-paying occupations for men and the corresponding earnings for women in the same occupations. Students should find it evident that in some occupations the wage differential between males and females is larger than in other occupations. The fourth set of worksheets (4a and 4 b) instructs the students to display a scatter plot and trend line of wage differential mapped on the concentration of female workers in occupations. Students can discern a correlation between the wage gap and type of occupation.

Figure 3. Guide to the Tableau dashboard.

Dashboards

A dashboard collects one or more worksheets. Figure 3 displays Dashboard 4, which displays two worksheets. The instructions to the student for building a dashboard are in the *Caption* box for the dashboard (A). The dashboard is constructed by dragging worksheets from the *Dashboard pane* (B) to the center of the Dashboard box. The chart of women's earnings as a percent of men's is in the box labeled "C." The trend line regression of women's earnings as a percent of men on the percent of female workers to the total number of workers in an occupation is in the box labeled "D." This shows that the ratio of female wages to male wages increases as the occupation becomes more concentrated with female workers, albeit with only an R-squared of 0.109 but a statistically significant coefficient of 0.159 (*t*-value = 3.89). To give a background for understanding patterns in the data in "D," the article by Hegewisch and Williams-Baron (2017) is assigned, which is an introduction to the research that examines the causal relation between the wage gap and gender segregation of workers by occupation. The box labeled "E" gives the student the opportunity to make observations on the patterns in the data. Located in the horizontal bar at the bottom in the right corner are the icons to navigate among the dashboards (F) and to create a dashboard page (G).

Story

The Story is a Tableau feature that binds the dashboards into storyboard presentation with a shareable link that has tabs with captions that link to each of the data visualizations. It is a convenient and concise way to share the charts with annotations that the author can use to point out highlights to the reader. The story for this exercise was introduced earlier in figure 1; this is the sharable link.[7]

Suggestions for use

Tableau supports the use of Tableau Public and Tableau Desktop in an academic setting in a number of ways. The "Resources" page on the Tableau Public Web site includes a Sample Data

section with several dozen preformatted data sets in areas including sports, government and business. The Tableau Community Forums provide an Instructor Resource that includes guides for students and instructors, as well as information on free licenses for Tableau Desktop for students and instructors. A Tableau for Teaching User Group provides sample assignments and curriculum as well as assignment tutorial workbooks on Tableau Public that students can download and complete (similar to our wage gap assignment).

For instructors considering using Tableau for the first time in the classroom, our advice is that it can be a challenging and rewarding experience. Five pointers are offered: (1) if the type of chart desired is not highlighted in the Show Me card, try changing the default setting in the Marks card for the type of chart from Automatic to the type of chart desired; (2) to have several lines (bars) appear in the same line plot (bar chart), from Dimensions, drag the pill with the different categories onto Colors in the Marks card; (3) save your file to the Tableau Public server frequently so your work is not lost; (4) practice with the four below examples; and, (5) if all else fails, try Googling the question. There is a very large community of Tableau users who post helpful videos and comments.

Each of the next four examples uses cleaned data from Kaggle and has a few simple visualizations in Tableau accessible to a user with an introductory understanding of Tableau (see links).

The first exercise is the U.S. minimum wage by state from 1968 to 2017 in 2018 equivalent dollars (2750 observations scraped from the U.S. Department of Labor). Possible courses for use include public finance, contemporary economic problems, and labor.

For the Tableau exercise, use the "connect" tool in Tableau to import the workbook, "Minimum Wage Data.xlsx." From Dimensions, drag "Year" to the Columns shelf and from Measures, drag "High 2018" to the Rows shelf. In the Marks card, switch "Automatic" to "Line"; from Dimensions, drag "State" to the Filters card and select, for example, three states: CA, CT, KY. Then, from Dimensions, drag "State" to the Marks card. The line plot compares the trend in the real minimum wage for three states from 1965 to 2017. The visualization reveals some interesting differences.

Next, to make a table, mouse-over "Sheet 1," then depress the "Ctrl" key (right click on PC) and select "Duplicate as Crosstab." Select the "Show Me" card, select "text table" first row first column, then select the "swap rows and columns" icon in the top toolbar. The table lists the real value of the minimum wage for the three states for the time period.

Then, to make a treemap in a new sheet, from Dimensions, drag the Year pill on to the Filters card and select year 2017. From Dimensions, drag the State pill to the Columns shelf, drag the High 2018 pill to the Rows shelf, and change SUM to AVG. In the Show Me card, select treemap (third row, first column). From Measures, drag the High 2018 pill onto Label in the Marks card.

Lastly, create a Story and drag Sheet 2 on to the first story point, add a new story point and drag in Sheet 2, and do the same for the last sheet. Publish to Tableau Public and remember to save while open on the first story point.

Links: Kaggle:
https://www.kaggle.com/lislejoem/us-minimum-wage-by-state-from-1968-to-2017/data
Example Tableau visualization:
https://public.tableau.com/profile/econ2327#!/vizhome/MinimumWageExample/Story1?publish = yes

The second exercise is the Boomers and Millennials, which contains a data set (2,750 observations) of Millennial and Baby Boomer Employment identified by state, MSA, and industry for the years 2009–2013. There are separate worksheets for metropolitan areas, and for 2- and 5-digit occupation codes. Possible courses for use include urban economics or capstone research course.

For the exercise, use the "connect" tool in Tableau to import the workbook, "EMSI_MillenialsvsBabyBoomers.xlsx," and drag the worksheet "States" into the data pane. From Dimensions, drag the State pill to the Columns shelf and from Measures, drag the % Job Change pill to the Rows shelf, and change SUM to AVG. In the Show Me card, select maps (second row,

second column). From Dimensions, drag the State pill to the Filters card and deselect Alaska and Hawaii. From Dimensions, drag the Generations pill to the Filters card and select Millennial. From Dimensions, drag the % Job Change pill to Label in the Marks card and change Format to percentage.

Then, to show a side-by-side comparison in a new sheet, from Dimensions, drag the State pill to the Columns shelf and from Measures, drag the % Job Change pill to the Rows shelf and change SUM to AVG. From Measures, drag the % Job Change pill to Color on the Marks card. Click the Swap Rows and Columns icon. From Dimensions, drag the % Job Change pill to Label in the Marks card and change Format to percentage with 1 decimal place.

Next, to show a line plot comparison in a new sheet, from Dimensions, drag the State pill to the Columns shelf and from Measures drag the % Job Change pill to the Rows shelf and change SUM to AVG. In the Marks card, switch "Automatic" to "Line," and from Dimensions, drag the Generation pill to the Marks card. The line plot compares the change in job share of Boomers to Millennials from 2009 to 2013 across states. Generally, the peaks and valleys track each other, but there are some exceptions: Georgia and North Dakota are interesting exceptions.

Lastly, create a Story, and drag Sheet 1 on to the first story point, add a new story point and drag in Sheet 2, and the same for Sheet 3. Publish to Tableau Public and remember to save while open on the first story point.

Links:

https://public.tableau.com/s/sites/default/files/media/EMSI_MillenialsvsBabyBoomers.xls

Example Tableau visualization:

https://public.tableau.com/profile/econ2327#!/vizhome/BoomersMillennials/Story1?= yes

The third exercise is the U.S. educational finances with annual state-level data on revenues and expenditures for U.S. K–12 schools from the U.S. Census Bureau. There is a data file for school districts with 374,162 observations (districts.csv) and another file for states with 1,276 observations (states.csv). Possible course applications include urban economics, public finance, and contemporary economic problems.

In the Measures pane, click the Total Expenditure pill, in the dropdown carrot, select "create," then calculated field," and create the variable Spending Per Pupil as the ratio of Total Expenditure to Enroll. From Dimensions, drag "Year" to the Columns shelf and from Measures, drag the Spending Per Pupil pill to the Rows shelf. In the Marks card, switch Automatic to Line; from Dimensions, drag State to the Filters card and select, for example, three states and the District of Columbia: CA, CT, NC, and DC. Then, from Dimensions, drag the State pill to the Marks card. The line plot compares the trend in education spending for three states and DC from 1992 to 2016 in thousands of dollars. The visualization reveals some interesting differences.

To visualize a map, in a separate sheet, from Dimensions, drag the State pill to the Columns shelf, from Measures, drag Spending Per Pupil to the Rows shelf and change SUM to AVG. In the Show Me card, select maps (second row, middle column). From Dimensions, drag the Year, State pills on to the Filter card, and filter by Year (2016), and State (uncheck Alaska and Hawaii). From Measures, drag Spending Per Pupil onto Label in the Marks card, change from SUM to AVG, select Format Currency Custom, and select 3 decimal places.

Create a Story and drag Sheet 1 on to the first story point, add a new story point, and drag in Sheet 2. Publish to Tableau Public and remember to save while open on the first story point.

Links:

https://www.kaggle.com/noriuk/us-educational-finances

Example tableau visualization:

https://public.tableau.com/profile/econ2327#!/vizhome/StateEducationExpenditures/Story1

The fourth exercise is the U.S. unemployment rate by county, 1990–2016, data set scraped from the United States Bureau of Labor Statistics. It has county-level unemployment data with

885,548 observations. Course applications include urban economics, contemporary economic problems, labor, and public finance.

For the Tableau exercise, use the "connect" tool in Tableau to import the text file, "output.csv." From Dimensions, drag Year pill to the Columns shelf and from Measure, drag the Rate pill to the Rows shelf. Click the dropdown on the Rate pill and select Average. In the Marks card, switch Automatic to Line. From Dimensions, drag the State pill to the Filters card, click the dropdown, select Edit Filter and select, for example, CT. From Dimensions, drag the County pill to the Filters card, select the dropdown to Edit Filter and click Select from List and select all the counties in CT. Then, from Dimensions, drag the County pill to the Marks card, and drag it again to the Marks Card on Color. Now we have a line plot comparing the unemployment rate of CT counties since 1990. The visualization shows that 30 years later, unemployment is slightly higher than at the start, and the variance in the unemployment peaks are differentially larger for some counties.

To visualize a map, in a separate sheet, from Dimensions, drag the Year, State, and County pills on to the Filter card, and filter by Year (2016), State (CT), and County (All). From Measures, drag Rate to the Rows shelf and change SUM to AVG. From Dimensions, drag County onto Color in the Marks Card. In the Show Me card, select maps (second row, middle column). From Measures, drag Rate onto Label in the Marks card, change from SUM to AVG, select Format Custom Numbers, and select 1 decimal place.

Create a Story and drag Sheet 2 on to the first story point, add a new story point and drag in Sheet 1. Publish to Tableau Public and remember to save while open on the first story point.

Links:

https://www.kaggle.com/jayrav13/unemployment-by-county-us

Example tableau visualization:

https://public.tableau.com/profile/econ2327#!/vizhome/UnemploymentRateByCountyinCT1990-2017/Story1

Summary

An emerging and complementary tool of data analysis is data visualization in order to envision the relationships and then communicate those relationships convincingly to others. Tableau is a widely-used data visualization tool, yet in the economics of education literature, there are only a handful of exemplary research projects illustrating data visualization and none for Tableau. Our tutorial seeks to fill this gap by identifying and describing a research question—gender wage differences. As the student is creating visualizations, there are opportunities for the student to look for patterns and to speculate about possible causal relationships. The visualizations generally support the theory that the gender wage gap decreases as the occupation becomes more concentrated with female workers.

The contribution of this exercise is to make Tableau more accessible to undergraduate students in economics, as well as to those instructors thinking about incorporating data literacy in their course work. Our tutorial exercise is a self-contained module that provides a step-by-step tutorial on how to develop data visualizations in Tableau with a cleaned data set. Along the way, the student is encouraged to think about explanations for the gender wage gap and has the opportunity to annotate their visualization with their explanations of data patterns observed in the visualizations.

An extension for this exercise is to export the data to an Excel file to estimate a multivariate OLS regression, which can further explore patterns observed in the Tableau univariate trendline visualization. Another extension is to apply the framework of the exercise to another empirical exercise with easily accessible data sources in Kaggle.

Notes

1. These department efforts are described in: Archibong et al. (2017), Lima and Tsiang (2017), Feyrer (2017), Ferderer and Krueger (2017), Brunnermeier (2017), and Butcher and Weerapana (2017). Additionally, Marshall and Underwood (2019) describe data literacy in the context of a capstone course.
2. The *CV Compiler* (Ste 2019) survey of 300 data science vacancies reports that data visualization is among the top five key employer preferences and that employers prefer Tableau as the tool for data visualization. The (Enlyft 2020) survey of 300 thousand firms that use data visualization software for business intelligence reports that Tableau has the largest market share (15.5%) followed by Cognos (9.3%). The Hale (2019) survey of several thousand job listings for data scientists in Indeed, SimplyHired, and Monster reports that, among the top 15 technologies in demand, Tableau ranks #7, Excel #14, and Python, R and SQL are the top three. For takeaways on technologies to learn: "Learn Tableau for data visualization. It's probably the technology on the list that is the most fun to learn and the quickest to pick up" (Hale 2019).
3. Links to the student and instruction version of the tutorial, to a YouTube video of a how-to step-by-step tutorial for each Tableau worksheet, and to download the free public version of Tableau are located at https://stamford.econ.uconn.edu/learning-tableau-a-data-visualization-tool/.
4. McDonald and Thornton (2011, 2016) describe a student exercise for simulating the wage gender gap using the National Association of Colleges and Employers (NACE) database, which is based on the technique in McDonald and Thornton (2007). A similarity with the tutorial herein is that they use college major, whereas we use occupation as the explanatory variable to analyze the wage gender gap.
5. The data used herein are from https://www.bls.gov/cps/aa2018/cpsaat39.htm, the most recent data available. Data from prior years are at this link: https://www.bls.gov/cps/tables.htm.
6. https://public.tableau.com/s/
7. https://public.tableau.com/profile/econ2327#!/vizhome/Wagegapworkbook02-24-20As/Story1

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Disclosure statement

The authors certify that they are not involved with Tableau.com in any way that would constitute a conflict of interest.

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Appendix

Three other clean data sets that can be used.

#1—US Veteran Suicides
2005–2011 veteran deaths outside of combat by state
https://www.kaggle.com/residentmario/us-veteran-suicides
The data consist of six files, one for each year between 2005 and 2011. Each year's worth of data includes the general population of each U.S. state, a count of suicides, a count of state veterans, and a count of veteran suicides.

#2—Fatal Police Shootings, 2015–Present
Civilians shot and killed by on-duty police officers in United States
https://www.kaggle.com/washingtonpost/police-shootings
A database of every fatal shooting in the United States by a police officer in the line of duty since January 1, 2015.

#3—Home Price Index
Housing indexed prices from January 1991 to August 2016
https://www.kaggle.com/PythonforSASUsers/hpindex
For the Federal Housing Finance Agency House Price Index (HPI), monthly and quarterly time series from January 1991 to August 2016 for the U.S., state, and MSA categories. Analysis variables are the aggregate nonseasonally adjusted value and seasonally adjusted index values. The index value is 100 beginning in January 1991.