

Community-Engaged “Data Fest” Events: Applying Econometric Skills to Build Confidence

Running Header: Community-Engaged “Data Fest” Events

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Abstract

This research discusses a “Data Fest” approach that combines big data and social issues with a collaborative and community-engaged event. In this paper we describe Data Fest, and present quantitative and qualitative analyses from three years of pre- and post-surveys of Data Fest events. Changes from pre- to post-survey suggest Data Fest was associated with increased economic analysis skills, an increased sense that econometrics was relevant to real-world issues, a greater growth (rather than fixed) mindset towards learning economics, and enhanced confidence. Student narratives illustrate the importance of a fun and supportive environment as well as the accountability to a community stakeholder.

Keywords: Economics education, Teaching economics, Econometrics, Community-engaged learning, Undergraduate research

JEL codes: A2, C01

“Economics is so much more than math and theory, but about ethics, social justice, and real human lives. I think these Data Fests have really made me appreciate economics in a different way than I thought was possible.” – Data Fest participant

Economics courses using big data to tackle economic and social issues can inspire students to pursue economics, and support recruiting and retaining underrepresented students (Bayer, Bruich, et al. 2020). These classes introduce econometric approaches that help undergraduates investigate policy-relevant topics. In contrast to the typical “chalk and talk” approach to economics pedagogy (Asarta et al. 2021), courses using big data to tackle social issues have incorporated elements such as personal connections, real world problems, scientific inquiry, along with career and social value (Bayer, Bruich, et al. 2020).

Such approaches to economics and econometrics may be particularly important for underrepresented students if they increase such students’ perceptions of the relevance of economics to real-world issues they care about, provide a sense of belonging in the economics field, and promote a growth (not fixed) mindset towards learning economics. Drawing on educational psychology literature, past research suggests these dimensions of relevance, belonging, and growth mindset (RBG) tend to be lower among female and underrepresented minority students and also associated with persistence in economics (Bayer, Bhanot, et al. 2020; Krafft et al. 2023; Allgood and McGoldrick 2023).¹

For example, “hackathons” are a related pedagogical approach, pervasive in the field of computer science, and more recently in data science, that also engage students with real-world problems, working over an intensive period (Nandi and Mandernach 2016; Warner and Guo

2017). Hackathons originated in 1999 with an open-source software programming event, evolved into a common model of developing technologies for the common good, and even spread into for-profit businesses and, in 2010, the college setting (Warner and Guo 2017; Richterich 2019). Increasingly, economics programs are creating similar experiences, e.g., the Econometrics Game, hosted by the University of Chicago, and The Econ Games developed and hosted by Northern Kentucky University and the University of Kentucky (Patel et al. 2024).

This paper discusses “Data Fest,” an event series bringing together the ideas of using big data to tackle economic and social issues with a hackathon model and community-engaged class-based undergraduate research experiences (CURE).² In this paper we describe Data Fest and present quantitative evidence from three years of pre-post surveys and qualitative reflections. Our central research question is how participants’ RBG and confidence are associated with participating in Data Fest. We find that Data Fest is associated with significant increases in some measures of relevance, belonging, growth mindset, and especially confidence. Economics departments can potentially use a “Data Fest” model to both recruit and retain students to economics by showing its real-world, fun, and collaborative aspects.

This paper builds on the literature on not only RBG and pedagogy in economics (Bayer, Bhanot, et al. 2020; Allgood and McGoldrick 2023; Bayer, Bruich, et al. 2020), but also higher education practices from other fields. Hackathon events are designed to be fun and feature peer-led learning, building a collaborative culture at the same time as skills (Lara et al. 2015; Nandi and Mandernach 2016). While many hackathons are extracurricular rather than integrated into college coursework, students who participate in hackathons improve their self-perception of interpersonal skills such as teamwork, time management, facilitating discussion, communication and critical thinking (Surendran et al. 2023). Students report increased confidence as a result of

hackathon participation in areas such as their coding abilities, entrepreneurial potential, and overall knowledge and readiness to talk with others about the particular hackathon topic e.g., homelessness or invasive species (Warner and Guo 2017; Szymanska et al. 2020; Surendran et al. 2023; Wilson et al. 2019; Gal 2024). Hackathons can also be designed to increase inclusion of under-represented students, such as women in computer science and engineering (Richard et al. 2015).

Data Fest differs from other hackathons and other intensive team-based events in economics because it is not a competition. Students work in groups and on a real-world task, however, Data Fest does not end with a judges panel,³ but rather a presentation back to the community partner that everyone participates in. While other economics events tend to focus on banking and/or business applications (Patel et al. 2024), Data Fest emphasizes the social justice usages of econometrics. These aspects are potentially important for creating a space where students, particularly underrepresented students, feel belonging and opportunities for growth.

Well-studied best practices in higher education, commonly called high-impact practices, include both community-engaged learning (also known as service learning) and collaborative undergraduate research (Gitter 2021; Johnson and Stage 2018; Kilgo et al. 2015; Kuh 2008). Economics has generally been slower than other disciplines to adopt community-engaged learning (McGoldrick et al. 2000; McGoldrick and Ziegert 2002) but econometrics courses are an area where faculty have embraced research and project-based learning that provide opportunities for community engagement (Conaway et al. 2018; Kassens 2019; Hoyt 2002). Peers in the sciences refer to this as CURE and stress that embedding research into the curriculum allows instructors to provide the benefits of collaborative undergraduate research without the intensive one-on-one mentoring of individual research projects (e.g., Hensel 2023;

Linn et al. 2015). Data Fest is an intentional effort to combine these high-impact practices, which we think will be attractive to other econometrics professors who are working on project-based experiences for their students that include some community engagement (e.g., Hoyt 2021).

In what follows, we provide background information on this study's institutional setting and describe the Data Fest events in detail. We then provide an overview of our data and methods before describing the quantitative and qualitative results, organized by the different dimensions of outcomes we consider (relevance, belonging, growth mindset, and confidence). We conclude with ideas to help others interested in adopting this type of event on their campuses and discuss how Data Fest can be part of larger curricular reforms intended to help engage and retain diverse and underrepresented students in economics by building RBG and confidence.

Context and history

The Data Fest events and this study took place at St. Catherine University (St. Kate's), located in St. Paul Minnesota. St. Kate's is a liberal arts school and a minority serving institution that has a College for Women, College for Adults, and a Graduate School. Our research primarily focuses on the College for Women. At St. Kate's, 99.7% of undergraduate students identify as female in the College for Women (Office of Institutional Research (St. Catherine University) 2023). In addition, 48.6% of the students identify as Black, Indigenous, or People of Color (BIPOC). In 2023, 17.6% identified as Black or African American, 13.8% identified as Asian, and 12.6% as Hispanic/Latina. Pell Grant recipients make up 41.2% of the student body of the College for Women (Office of Institutional Research (St. Catherine University) 2023). An average of 15 students per year graduated from St. Kate's with an economics degree from 2018-2022 (U.S. Department of Education National Center for Education Statistics 2023).⁴ The

demographics of students in the economics major are similar to the university with 42.4% of students graduating with degrees in economics identifying as BIPOC (Office of Institutional Research (St. Catherine University) 2023), creating an ideal setting for studying interventions aimed at increasing persistence for underrepresented students in economics.

The student educational experience at St. Kate's is enhanced by faculty who are committed to high-impact teaching practices, such as community-engaged learning, in their classrooms. In 2018, the instructor for *ECON 3050 - Quantitative Impact Evaluation* (essentially an econometrics course) worked with the office of Community Work and Learning to design and embed a CURE that aligned with the needs of a community partner (West and Krafft 2022). Because of the COVID-19 pandemic, ECON 3050 met fully online in Spring 2021 and required modifications to the community-engaged project. In considering the range of virtual collaborative research options, the instructor decided to implement a hackathon experience hosted over Zoom, styled as "Data Fest." Simultaneously, the Data Science department was offering *DSCI 3200 – Analyzing Social Issues with Data*, and that instructor was invited to join the design and delivery of the event. The faculty decided to host two Data Fest sessions during the semester that built upon each other and culminated with a presentation for the community partner. Session one occurred at the start of the semester in the first month of class while session two occurred near the end of the semester within the last month of class. This format provided an introduction to the CURE and gave students support and encouragement as they first worked with the statistical software and then the second event emphasized growth, analysis, and data interpretation as well as a deliverable for the community partner.

Students in this first Data Fest used a dataset provided by the Ramsey County Economic Development office to explore factors contributing to upward mobility in neighborhoods. Data

Fest participants logged on to Zoom for each of the two sessions in the late afternoon and were promptly greeted with music, icebreakers, and games. The Zoom session started at 3:20pm, since this was the regularly scheduled class time for one of the courses. Students joined teams of 3-5 people (“R teams” and “Stata teams”) that were pre-arranged based on pre-event survey responses, which asked students for their preferences for which statistical software they wanted to learn/practice. Teams in this first and subsequent Data Fests included a mix of more experienced and newer students so that there were ample opportunities for peer mentoring. Professors and upper-level student mentors were available and moved in and out of team Zoom breakout rooms. The groups worked together until 5:00pm when they reconvened for a check in and some games. They returned to their groups and worked until around 7:00pm. In the first year, we had groups report back the next morning but decided after this instance that it was better to have the final reporting that night.

At the first Data Fest event, held early in the semester, there is a short orientation and introductions and then students are almost immediately given the data set⁵ and a direction sheet that walks them through some basic t-tests and regressions. The directions then prompt them to build on those examples by running more focused analyses on subtopics that their group chooses. For example, in 2024, one group emphasized the intersection of gender and race in determining labor market outcomes, while another group focused on why Alaska Native/American Indian (AIAN) households were unbanked.⁶

Groups are arranged so there is at least one student who has used Stata/R before who can help newer students. The first event is early enough in the semester that econometrics and data science students may have had one problem set or homework assignment that asked them to use Stata/R but many students are still apprehensive. At the close of the first event students

reconvene to share their initial findings in 2-4 slides. Professors and students emphasize the new skills students have acquired and interesting leads to explore in more detail for the second Data Fest.

At the second Data Fest event, held at the end of the semester, students are encouraged to pick up where they left off and add to their analysis. For students who are enrolled in an econometrics or data science course, this is an opportunity to use the tools they have learned in the course and to reflect on how much their skills have grown since the first Data Fest. Groups often do this by adding new control variables, conducting subgroup analyses and/or creating visualizations to explain their findings. Each group creates a short presentation to share with the community partner. The Minnesota Center for Diversity in Economics (MCDE) has a learning module on its website, which we also include as a supplemental online material, that includes sample directions and example group projects for readers who are interested in more detail.⁷

The following year, in 2022, ECON 3050 partnered once again with the Ramsey County Economic Development office and Data Fest transitioned from a virtual event to an on-campus event. Like the Zoom experience, the in-person event started with an orientation and introductions, followed by small-group work time. Dinner was provided in the middle of the event, before further small-group work time. The evenings concluded with small-group project presentations and encouragement. In 2023 and 2024, the community partner for Data Fest was the Center for Indian Country Development (CICD) at the Federal Reserve Bank of Minneapolis. The CICD's mission is to "support the prosperity of Native nations and Indigenous communities through actionable data and research" (The Center for Indian Country Development 2024). Student projects investigated a variety of socio-economic issues such as employment disparities, wealth, and banking access. After the second Data Fest, students had the opportunity to attend a

field trip to the Federal Reserve Bank of Minneapolis to present their findings. The online learning module from MCDE refers to the CICD partnership with Data Fest.

Data Fest is now an annual in person event that is included as a required component of at least one course in each of the two participating departments (Economics and Data Science). The specific courses to which Data Fest is linked vary from year to year depending on enrollments and course rotation schedules. For these courses, Data Fest provides an opportunity for students to see how the course content can be used for real-world applications. Other courses offer extra credit for student participation in Data Fest, and all students, regardless of discipline, are welcome to participate as a co-curricular opportunity. In the classes that are required to participate, faculty members build in pre and post assignments that help students integrate the Data Fest experience into their coursework. These assignments may take the form of problem sets that use the same data set or that ask students to plan for how they might apply skills they are learning to advance their Data Fest work. Generally, students are not in their Data Fest groups for these more traditional class assignments, but some professors give time for students in the same Data Fest group to debrief and plan together the class period just before or just after Data Fest. We have found it very helpful over the years to have one or two classes that take the lead and do this preparatory work – these are classes that are required to attend and for whom Data Fest is part of their grade, so these students are incentivized to take on a leadership role and keep their groups on track.

The majority of students who attend Data Fest are in one of the classes that require attendance. Often students who participate as a co-curricular/extra credit opportunity either took one of these classes in a previous year or are curious about taking one of these classes in the future. In our surveys, we did not ask if students were required to participate so we are unable to

disaggregate on this factor. All of our qualitative data comes from reflections from students in classes that are required to attend. These students have the added motivation that the Data Fest is included in their class grade. For example, in ECON 3050, participation in Data Fest comprises 25% of their final grade. The learning module on the MCDE website (also provided as supplemental online files) includes sample syllabi for reference.⁸

Data Fest events emphasize a fun and supportive vibe – not competition. Using funding from a small external grant, faculty provide food and “swag” to participants to increase the relaxed and celebratory atmosphere. When the event was online, students were sent a Data Fest mug with the slogan “This is What an Economist Looks Like” and a gift card to order food delivery. The on-campus events have t-shirts, bags and stickers emblazoned with data-related jokes – “Practice safe stats” was a favorite. The on-campus events created a friendly and welcoming environment. During dinner, there are trivia games and data charades where students act out words/phrases like “missing data” or “heteroskedasticity.” Prizes are given out throughout the event to encourage participation no matter the project outcome. Faculty members incentivize asking questions, giving compliments, and showing growth or curiosity. Faculty and upper-level student mentors help students frame frustration with a growth mindset using phrases such as “look at how much you have learned in just a few hours!” While the main objective of Data Fest is to support students to build on their econometrics skills, by holding a collaborative and fun extracurricular activity, secondary goals include building community, recruiting and retaining students, and helping students feel more confident and comfortable using statistical analysis to address social issues.

Data

Sample

We collected data from students participating in Data Fest over the course of three years (2021, 2022, 2023).⁹ Each year, there were two rounds of surveys distributed, the first survey was shared prior (pre) to the first Data Fest, and the second survey was shared after (post) the second Data Fest using Google Forms. The first survey also served as a sign-up and thus is not anonymous and we have high response rates. The second survey was not required, but 64% of those who responded to the first Data Fest pre-survey also answered the second Data Fest post-survey, on average across the three years. Data were also sometimes collected after the first Data Fest and prior to the second Data Fest in 2021 and 2022, but not necessarily with high response rates. The pre-surveys collected data on students' demographics (gender, race, ethnicity, major, and year in college) and asked a few extra logistical questions, e.g., about dietary restrictions. The pre and post surveys asked identical questions themed around RBG and confidence, inquiring about students' comfort and attitudes towards data and statistical software. The post survey included open ended questions about what could be improved for future Data Fest events. Our analysis makes use of the questions that repeat on both pre and post survey and thus can show change over time (students are matched by name). Example surveys are included in the supplemental online material (available at corresponding author's website).¹⁰

Data Fest targets undergraduate students; thus our analysis includes only data from undergraduates. Each Data Fest event had approximately 30-40 student participants, providing us with 226 observations from 93 unique individuals over three years. Of the 93 students we observe, 68 attended only one year, 22 attended two years, and three participated in all three years of Data Fest. We use all of these data in our multivariate models. Within this sample, we use for paired t-tests 48 pre-post pairs in the same year (representing 41 individuals, as some

individuals participated multiple years) who attended both events and filled out the pre-first event and post-second event surveys in the same year. Each observation is a student at a point in time (accounting for the calendar year of the event, pre-survey for the first Data Fest event or post-survey for the second Data Fest event).

Table 1 presents sample characteristics, by calendar year. Minority identity was coded into a dummy for identifying as BIPOC (including multiracial identities, e.g., “White and Asian”) versus identifying as white only. Gender identity was coded as a binary variable for identifying as female versus identifying as male or identifying as non-binary. Approximately half of the students (48%) were minority-identifying with the share increasing from 44% in 2021 to 53% in 2023. The vast majority (97%) of students identified as female, but from 2021 to 2023 the share identifying as other gender identities rose from 0% to 7%.

[Table 1 near here]

The percentage of first year students in Data Fest grew from 5-7% in the first two years to 15% in 2023. In contrast, the percentage of sophomores decreased from 30% to 10% over the three years of Data Fest. In 2021, seniors and juniors were equally represented (32%) but juniors were most common in 2022 and 2023 (44-46%). While some individuals could have multiple majors, the most common major was economics (41%), followed by political science or public policy majors (25%), other majors (21%, e.g., sociology, public health, biology, women’s studies), data/math majors (17%), internationally focused majors (14%, e.g. international studies, international business and economics, women and international development) and business majors (10%).

Outcomes

The outcomes in this study are the series of statements on RBG and confidence. Response options for attitudinal questions on RBG and confidence were asked on a Likert scale and coded (-2) Disagree (-1) Somewhat disagree (0) Neutral (1) Somewhat agree (2) Agree. Comfort questions were asked about R and Stata on a 1-5 scale from (1) Not comfortable/don't know the program to (5) Extremely comfortable. Specific statements asked are shown in Table 2.

[Table 2 near here]

We also factor all these comfort and attitudinal items into a single factor, using principal factor analysis, to measure the underlying latent construct of RBG and confidence (note that some items therefore have a negative scoring coefficient, e.g., frustration and stress). We keep the first factor (details of the factor analysis are presented in the supplemental online material, Table 4).¹¹

Methods

Our research question is, how is Data Fest correlated with students' RBG and confidence? We present descriptive and multivariate analyses of outcomes for students from pre- to post- Data Fest. We first present paired t-tests to compare attitudes from the pre-first Data Fest survey to the post-second Data Fest survey. These analyses may show the effects of both the semester's learning (from the first Data Fest early in the term to the second near the end of the term) as well as changes from each Data Fest event. Our multivariate analyses use individual fixed effects¹² ordinary least squares (OLS)¹³ models. Standard errors are clustered on the student level, and thus robust to heteroscedasticity and serial correlation. The regression controls for first versus second Data Fest of the term (*Event*), the calendar year (*Year*=2021, 2022, or

2023), and our key covariate of interest: *Post* (versus pre) Data Fest. Individual i at time t has outcome $Y_{i,t}$. We estimate how this outcome correlates with our covariates and include an individual fixed effect, η_i , as follows:

$$Y_{i,t} = \alpha + \beta_1 Post_t + \beta_2 Event_t + \beta_3 Year_t + \eta_i + \varepsilon_{it}$$

We hypothesize that Data Fest will be positively correlated with RBG and confidence, as measured by the β_1 coefficient. The individual fixed effect will control for any unobservable, time invariant characteristics of participants. For instance, the fixed effect controls for individual characteristics such as gender and minority identity.¹⁴ Because the model includes the event and year, the post variable measures the difference from pre- to post- Data Fest after accounting for whether it is the first or second Data Fest of the year, and any year fixed effects (e.g., if there were differences in 2022 and 2023, in person, versus 2021, online).¹⁵ Although we account for the evolution over the semester with first versus second Data Fest and time-invariant unobservables with the individual fixed effects, we note that we do not have a control group who did not attend Data Fest, and estimates are not causal.

To complement our quantitative analysis, we collected qualitative data through student reflections after Data Fest. The reflections were structured around open-ended prompts provided by professors. Participants were prompted to reflect on team activities, specific skills developed, and challenges encountered during the event. The qualitative data provided rich, contextual insights into how students perceived their learning and growth throughout the event. Student reflections were anonymized and analyzed thematically to identify recurring RBG and confidence patterns and themes across participants' responses.

Results

Figure 1 illustrates the outcomes with statistically significant differences (at a 10% level) from pre-first to post-second Data Fest in the t-tests. Full results for all outcomes are in Table 5, in the supplemental online material. Of the 23 outcomes, there are nine significant differences in the t-tests. All items are on a five-point scale from -2 to 2, except the factor is standardized to have a mean of zero and a standard deviation of one, and comfort is on a five-point scale from 1-5.¹⁶ Table 3 presents all regression models and Figure 2 presents the significant results for the post coefficient. The post coefficient is significant for 13 of the 23 outcomes. For the overall factor combining RBG and confidence, we see significant improvements in both the t-tests (mean of -0.19 pre-first to 0.31 post-second in the t-tests (Figure 1, Table 5) and the fixed effects models (coefficient of 0.351; standardized coefficient of 0.172¹⁷). The coefficient means that students had over a one-third standard deviation increase in their RBG and confidence from pre- to post-Data Fest events.

[Figure 1 near here]

[Figure 2 near here]

[Table 3 near here]

Relevance

Questions regarding students' relevance saw increases in all areas in the paired t-tests (Figure 1, Table 5). However, the only statistically significant difference in the paired t-tests was an increase in the belief that data analysis skills will make them employable (1.88 to 1.98 on a -2 to 2 scale). In the fixed effects models (Figure 2, Table 3), this employability outcome saw a significant increase from pre- to post- of 0.066 on the five-point scale (standardized coefficient of 0.107). There was also a significant increase of 0.134 in "I will have some application for data analysis and statistical software skills in my profession" (standardized coefficient of 0.103) and

of 0.189 in “Data analysis gives me a useful framework for thinking about issues that are important to my life” (standardized coefficient of 0.212).

The feelings of relevance in student reflections parallel our quantitative data findings. Students often noted that they liked working with “real” data or data applied to “real-world” issues. While many econometrics problem sets use real-world data, student comments from Data Fest suggest they felt particular relevance when working on data in collaboration with a community partner. Specifically (emphasis [**in bold**] added by the authors to highlight connections to RBG):

- “Data Fest was really fun. It was a chance to get our hands on some **real, actual data with real, actual application possibilities.**”
- “I was **really doing something rather than just watching or looking at what other people had done.** I felt like a real economist.”
- “Presenting my findings to Ramsey County made the experience feel surreal. **The fact that they listened to what we had to say and agreed with some of our policy recommendations made me feel validated** in my intelligence and my ability to make policy suggestions.”
- “Now at the end I have learned so much and I really think all of the information I learned about data will **help me in the future when I eventually get a job.**”

In the qualitative data, sentiments of relevance to real-world applications were robust. Students felt they could interact with policies and data that impact people's lives in a hands-on, empowering environment. Students believed in the value of their contributions and the added benefit of presenting to a community partner.

Belonging

Both belonging questions – (1) I feel different than the typical student in data science or economics, and (2) I feel comfortable asking questions in a group working on a data project – had significant increases in the paired t-tests (Figure 1, Table 5). The increase observed in the “feeling different” question is actually an observed *decrease* in belonging, the only case of an outcome being counter to expectations. However, it might be the case that students realized that “typical” economics courses do not tackle real world problems or engage with community partners. Data Fest is a “different” experience, but in the sense of a positive and constructive deviation from disciplinary norms. The increase in feeling comfortable asking questions in a group working on a data project is a more unambiguous improvement. Only the “feel different” item remained statistically significant in the fixed-effect models (Figure 2, Table 3), increasing by 0.250 on the five-point scale (standardized coefficient of 0.091).

In the qualitative data, students stressed a feeling of community with their classmates. By working in teams and combining the work with a fun and supportive environment, students had a positive co-curricular experience, reinforcing their sense of belonging.

- “Working with a group on data is so much better than working alone... It has actually made working with data alone easier too because **I feel more connected to those in the class.**”
- “It was one of the first college events I could attend because of COVID. It felt nice to be able to feel normal and **have a good time with my classmates.**”
- “Working in groups...reassured me that I would be able to succeed and it gave me an **opportunity to meet new people that I would be able to study with or ask about this class.**”

- “I think I pictured data as something that was worked on at a dark computer lab alone, but in reality, data work needs to take place in a **collaborative atmosphere**, and the people surrounding the data should be able to bring many lenses.”

Students primarily reported connection and collaboration, which encouraged their feelings of belonging in the qualitative data. Students indicated that they felt more connected to their classmates because Data Fest encouraged them to collaborate on data-related projects rather than alone.

Growth mindset

Although a number of growth mindset items were asked, only, “I find it easy to understand data analysis because of how I think” increased in the paired t-tests (Figure 1, Table 5). This outcome was not, however, significant in the fixed-effects models (Figure 2, Table 3). In the fixed effects models, “I can learn how to use statistical software” also increased significantly post by 0.050 on the five-point scale (standardized coefficient of 0.081), as did “I believe I can learn how to do data analysis,” by 0.112 (standardized coefficient of 0.125), and “I can learn how to analyze large data sets” by 0.113 (standardized coefficient of 0.098).

Students reported that they felt empowered by their ability to analyze and grow in unfamiliar environments in the qualitative data. Their reflections on self-efficacy and growth mindset are illustrated below:

- “After having completed one session of Data Fest now, I realized I did not have to be as worried and nervous as I was. **I was not expected to know everything perfectly and there was definitely room for improvement and to learn the things I didn't know perfectly.**”

- “The things that I learned during DataFest that I will take with me throughout my studies doesn’t only involve the skills but also a mindset. **I now won’t go into anything with a closed mindset** when I don’t understand or know how to do something because there is always a way of figuring things out in programming.”
- “Being able to see my **growth** in real time was truly the best part of data Fest.”

Students generally reported feeling hesitant or unsure if they could conduct data analysis prior to the events and that their participation in Data Fest helped them develop new skills in a safe environment, contributing to improvements in their belief that they can learn data analysis and econometrics.

Confidence

Where we see the most frequent and largest significant improvements in outcomes are around students’ confidence. A number of items were significant in both the paired t-test (Figure 1, Table 5) and the fixed effects regressions (Figure 2, Table 3). These key results included: Students reported feeling more confident in their ability to use statistical software to analyze data post-Data Fest (with a coefficient of 0.439 on the five-point scale, 0.161 as a standardized coefficient); Students reported increases in liking to use statistical software to analyze data (coefficient of 0.255, standardized coefficient of 0.144); Students reported increases in understanding the basics of how to analyze large data sets using statistical software (coefficient of 0.392, standardized coefficient of 0.166); Students reported increases in their comfort with Stata (coefficient 0.355, standardized coefficient of 0.125), although not R. Although not

significant in the paired t-tests, in the fixed-effects models feeling statistical software code is easy to understand increased 0.306 (standardized coefficient of 0.131).

Data Fest aims to improve students' econometric abilities and boost confidence, even for students who do not necessarily have high pre-Data Fest comfort with statistical software. The qualitative results highlight student recognition of their increasing confidence and enjoyment:

- “I truly had a lot of fun, and my **confidence** working with data improved immensely. This is possibly changing the direction I want to go in after college!”
- “At the beginning of the semester, I was super nervous and insecure about my Stata skills. I learned to be **confident and comfortable with my data analysis skills** which will prove to be helpful when I present my results to the Fed.”
- “At the first data fest, I was so scared to speak up because I honestly had the hardest time running basic regressions and cleaning data. However, by the second data fest I immediately said that I was **confident** in not only leading our group but also explaining it to anyone that was curious to listen. I enjoy working with data!”

Students emphasized that they were initially nervous about their data analysis skills. Once students worked with their peers in a collaborative and empowering environment, their confidence and interaction with the data grew.

Discussion

Increases in RBG and confidence

From pre- to post, participants in Data Fest had significant improvements in some of the measures of RBG and confidence related to data analysis and econometrics, as evidenced by both paired t-tests and fixed effects models. For relevance, one of the four measures was

significant in the t-tests and three of the four in the models. For belonging, both measures were significant in the t-tests and one in the models. For growth mindset, one of the seven measures was significant in the t-tests and three in the models. For confidence, four of the nine measures were significant in the t-tests and five in the models. The qualitative analyses further illustrated that students reported that the community-engaged format of Data Fest enabled them to recognize the practical relevance of econometric and data skills in potential career paths, fostering connections between classroom learning and real-world applications. Hosting Data Fest in two separate sessions early and at the end of the semester may help cultivate a growth mindset among students as the time between stimulates incremental skill building, reinforced by the framing by faculty, mentors, and peers around growth in skills.

Students enjoyed Data Fest in part because of the collaborative aspect. Before Data Fest, students felt that working on data was done alone in a hyper-individualized atmosphere. However, after Data Fest, students felt more comfortable working together, enjoyed collaborating, and appreciated the feelings of belonging that Data Fest encouraged. The team-based design may have fostered relationships for students with varying levels of prior experience in statistical software. The fun and supportive framing may have increased confidence, which was the area that had the most frequent significant results and largest magnitude coefficients in the quantitative analyses. One participant described building a growth mindset and confidence in tandem: “The mug and sticker prizes really make me feel smart. It gives me motivation to keep working hard because if I am still in this class and continue to keep pushing myself to get better, I can do almost anything.”

These increases in RBG and confidence, if caused by Data Fest, may be particularly helpful for students from underrepresented groups, who research shows have lower RBG (Bayer,

Bhanot, et al. 2020; Krafft et al. 2023). However, interestingly in terms of belonging, students increased their chances of feeling different than a typical economist, the only outcome where coefficients were significant and counter to expectations. This result may be increasing recognition among a majority female and substantially BIPOC population that the field of economics does not reflect their identities (Chari 2023; Committee on the Status of Minority Groups in the Economics Profession (CSMGEP) 2023). Alternatively, the increase in feeling different may be recognition that Data Fest is an innovative and unusual pedagogical model.

Future directions

Limitations and areas for future research

There are a number of important limitations to this research, which also point to areas for future research. Although, in the fixed effects models, we were able to account for time-invariant characteristics and mindsets of students, and we controlled for first versus second Data Fest and calendar year as we worked to identify the post- versus pre- differences, our estimates are not necessarily causal. The study lacks a control group that did not receive the Data Fest intervention. Additionally, there are limitations in disentangling Data Fest from learning and experiences during the semester, such as student motivation, continued relationship-building with their peers in the classroom, or courses students undertook simultaneously. Future research using stronger identification strategies, particularly randomized controlled trials is warranted. Given our finite, single institution sample size, we were not able to disaggregate results. Future research examining student RBG and confidence with statistical analysis and using statistical software could benefit from larger sample sizes, allowing for more robust analyses and the ability to disaggregate data and associations by race and gender. As a women's college and MSI, the study site was a unique setting, albeit a particularly important one for diversifying the

economics profession. Comparative studies with similar events across multiple universities with different characteristics may deliver additional insights on whether and for whom Data Fest and similar interventions are effective.

Furthermore, our focus is on students' self-reported feelings of RBG as well as confidence, therefore, future research should study how models such as Data Fest improve students' econometrics skills and ability to both run and interpret analyses. Disentangling Data Fest from other aspects of the semester-long courses is of particular interest so that faculty can sequence experiences for introductory econometrics students in a way that maximizes the chances that students will see how these tools apply to their interests and career paths. Other important outcomes to investigate in future research could include whether Data Fest increases the chances that students will take additional courses in economics, data science, or statistical analysis, and if they are more likely to pursue graduate education.

Undertaking Data Fest at other institutions

Since Data Fest is associated with increases in RBG, and these have been correlated with persistence (Bayer, Bhanot, et al. 2020; Krafft et al. 2024; 2023), Data Fest can potentially serve as an intervention to enhance recruitment into and persistence in economics. Institutions interested in adopting similar experiential learning approaches are encouraged to access the learning module available on the Minnesota Center for Diversity in Economics website and as supplemental online material to this article.¹⁸ This module includes event procedures, guidelines, class handouts, student code examples, and example student presentations. Guidance can help faculty plan and prepare for a successful Data Fest, detailing timelines and steps that worked well at St. Kate's.

Data Fest at St. Kate's was supported by our community-engagement office, who may be a helpful partner if available at other schools; however individual faculty or departments may also be able to identify and engage with potential community partners directly. Students' reflections indicate that a community partner is an important part of the Data Fest experience. Students rise to the challenge when the audience for their work is a "real-world" partner. Asking students to attend two long evenings of extra work to complete, for example, a traditional econometrics problem set in teams together, would likely not have the same impact. It is worth noting that since many students are new to econometrics, the results that they produce for the community partner should be considered preliminary and work-in-progress. Often, a few students who excelled at Data Fest continue to work with one of the faculty mentors over the summer through St. Catherine University's "Summer Scholars" program to further develop the Data Fest works-in-progress into a cohesive and polished product for the community partner.

In addition to community engagement, Data Fest can provide a valuable platform for interdisciplinary connections, bridging social science departments with colleagues in mathematics, statistics, epidemiology, and other fields that emphasize applied data analysis. Collaborating with colleagues in other disciplines can enhance learning, bring more students to the events, and also provide additional faculty to support the organization and implementation of the events. For community-building, a small budget (approximately \$1,000) for food and swag can help the event be a success. Small internal grants or budget allocations or external grants or sponsorships can help support Data Fest, however, the event could also be done without these aspects or as a "potluck" to still build community.

Fostering RBG and confidence in economics

Data Fest is part of a larger pantheon of interventions innovating economics pedagogy and curricula to enhance both student learning and RBG and confidence, ultimately working to recruit and retain more and more successful economics students. Data Fest blends both models of courses using big data to tackle economic and social issues (Bayer, Bruich, et al. 2020), and intensive “hackathon” style events (Lara et al. 2015; Nandi and Mandernach 2016; Richard et al. 2015). Like other types of collaborative learning in economics, it can potentially deepen knowledge and build self-efficacy (Leung and Nakagawa 2021; Monaco 2018). Additionally, it incorporates aspects of well-studied high-impact practices, specifically community engagement and undergraduate research (Kuh 2008). These innovations are an important part of moving economics away from a primarily “chalk and talk” discipline (Asarta et al. 2021).

Data Fest and other innovations seeking to increase RBG and confidence at the same time as enhancing learning may be particularly helpful for diversifying the economics profession. Research shows the importance of role models in recruiting students to economics (Lusher et al. 2018; Porter and Serra 2020; Rask and Bailey 2002), and Data Fest builds in role models by integrating teams of students with varying experience levels. Diversity in the content of topics can also help diversify the economics profession (Al-Bahrani 2022; Lopez and Wandschneider 2024), therefore Data Fest has focused on topics such as American Indian and Alaskan Native labor market outcomes or homelessness. As well as models such as Data Fest, materials to help diversify course content are readily available for the profession (Bayer 2021). Although curricular and pedagogical reforms have costs in time and effort, they can ultimately improve the learning environment and outcomes.

NOTES

¹ While Bayer, Bhanot, et al. (2020) found this pattern for a combined group of female and underrepresented minority students, Krafft et al. (2023) found lower RBG only for minority students, not women.

² The Data Fest events were inspired by similar events such as those hosted by the American Statistical Association (2024) but they were not formally affiliated nor exact replicas.

³ In this regard it is unlike the American Statistical Association (2024) DataFest events as well.

⁴ Includes all economics-related majors (Economics, Financial Economics, International Business & Economics, Women & International Development).

⁵ Data sets that work well for Data Fest tend to be well-documented with a finite number of variables provided so students do not get overwhelmed (although if using sources such as the Integrated Public Use Microdata Series students can go back for additional variables and create their own extracts if they wish to). Data can be from multiple years, but we have avoided panel data structures as working with those tends to require more advanced skills. For example, in 2024, one of the data sets provided to students was the Current Population Survey for our local state, with monthly cross-sectional data from 2019-2023. There were around 79,000 observations and 42 variables provided.

⁶ An example prompt from the 2024 event where the community partner was the Center for Indian Country Development: “Our overall goal in analyzing this data is to find interesting insights into disparities in the labor market between Alaska Native/American Indian (AIAN) and other racial groups. Some questions to consider throughout this project are:

- In what ways are AIAN respondents different from non-AIAN respondents?
- What variables might help explain the mechanisms for these differences?
- What differences are there within AIAN respondents (by geography, by gender, by age)?”

⁷ <https://www.stkate.edu/academics/shas/political-science-and-economics-department/mcde>
MCDE Research > Working Papers > Data Fest paper > Check out our Data Fest Learning Module!).

⁸ <https://www.stkate.edu/academics/shas/political-science-and-economics-department/mcde>
MCDE Research > Working Papers > Data Fest paper > Check out our Data Fest Learning Module!).

⁹ The study was reviewed by the St. Catherine University IRB (#1894) and determined to be exempt.

¹⁰ <https://carolinekrafft.com/publications/>

¹¹ We examined second and third factors as well, but they did not have a coherent and interpretable structure (for example, the second factor had negative loadings for comfort and confidence, but positive loadings for relevance). The first factor consistently aligned with confidence and RBG in the factor loadings.

¹² We tested random effects models, but for seven outcomes they failed the Hausman test, so we prefer to consistently present fixed effects models, which are unbiased even if they may be less efficient. Although we considered other models of repeated measures, such as random coefficient models, since our focus is on the changes from Data Fest, rather than learning variability, we prioritized the best estimation strategy for that goal.

¹³ In the supplemental online material, Table 6, we present alternative fixed effects ordered logit models, using the user-written feologit command (Baetschmann et al. 2020); for three outcomes these models are not estimable, and fixed effects OLS models are preferred.

¹⁴ In the supplemental online material, Table 7 presents models that include controls. Because controls were only collected on the pre-survey, this yields a smaller sample. Furthermore, only time-varying controls can be included in the fixed effects model (specifically year in college and major, which only changes occasionally within an individual, and may be endogenous).

¹⁵ In the supplemental online material, as a sensitivity analysis, Table 8 presents models that include only the first calendar year an individual participated (or was observed to participate per the surveys). Results are substantively similar to our main models.

¹⁶ To facilitate interpretation, in the supplemental online material, Table 9, we present means and standard deviations for all the outcomes. We use these and the key covariate’s standard deviation of 0.47 to calculate standardized versions of the coefficients in Table 5, which we report in the text.

¹⁷ In educational interventions, effect sizes of <0.05 are small, from 0.05 to <0.20 are medium, and 0.20 or greater are large (Kraft 2020). Thus, the magnitude of the overall factor coefficient is medium.

¹⁸ <https://www.stkate.edu/academics/shas/political-science-and-economics-department/mcde>
MCDE Research > Working Papers > Data Fest paper > Check out our Data Fest Learning Module!).

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Disclosure of interest

The authors report there are no competing interests to declare.

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Table 1. Sample Characteristics (Percentages), by Calendar Year

Survey year:	2021	2022	2023	Total
Minority				
White only	56	53	47	53
Minority	44	47	53	48
Gender				
Not female	0	4	7	3
Female	100	96	93	97
Year in college				
First-year	7	5	15	8
Sophomore	30	29	10	24
Junior	32	46	44	40
Senior	32	21	32	28
Majors (multiple possible)	0	0	0	0
Economics	39	46	37	41
Business	4	8	16	10
Data/math	23	10	16	17
International	13	12	18	14
Political science/public policy	21	26	27	25
Other major	23	18	21	21
Total	100	100	100	100
N (observations)	84	78	64	226

Source: Authors' calculations based on all observations

Table 2. Specific Statements on RBG and Confidence

Relevance

Data analysis skills will make me more employable

I will have some application for data analysis and statistical software skills in my profession

Data analysis gives me a useful framework for thinking about issues that are important to my life

Data analysis is relevant for social justice work

Belonging

I feel different than the typical student in data science or economics

I feel comfortable asking questions when I am in a group working on a data project

Growth mindset

I can learn how to use statistical software

I find it easy to understand data analysis because of how I think

I can learn how to analyze large data sets

Data analysis skills are quickly learned by most people

Learning statistical software requires a great deal of discipline

I can learn the skills I need to become a data scientist or economist

I believe I can learn how to do data analysis

Confidence

I like using statistical software to analyze data

I feel confident using statistical software to analyze data

Statistical software code is easy to understand

I understand the basics of how to analyze large data sets using statistical software

Data analysis is complicated

I get frustrated using statistical software to analyzing data

I am under stress while using statistical software to analyze data

How comfortable are you running R?

How comfortable are you running Stata?

Source: Authors' construction based on questionnaire

Table 3. Fixed Effects OLS Regression Models for Relevance, Belonging, and Growth Mindset Outcomes

	Relevance			Belonging			Growth mindset						
	Employable	Profession	Framework	Social justice	Feel different	Group questions	Learn software	Understand data	Learn analysis	Quick learning	Software req. discipline	Data sci. or econ.	Belief learn
Pre vs. post (pre omit.)													
Post Data													
Fest	0.066* (0.034)	0.134* (0.077)	0.189*** (0.063)	0.025 (0.035)	0.250** (0.125)	0.067 (0.076)	0.050* (0.030)	0.225 (0.137)	0.113* (0.063)	0.122 (0.124)	0.140 (0.100)	0.038 (0.070)	0.112** (0.055)
Calendar year (2021 omit.)													
2022	0.001 (0.007)	0.141 (0.126)	0.202* (0.109)	0.013 (0.019)	-0.572* (0.337)	0.160 (0.133)	0.058 (0.065)	0.270* (0.137)	0.135 (0.121)	0.366 (0.309)	0.148 (0.136)	0.289*** (0.097)	0.089 (0.109)
2023	0.019 (0.019)	0.295* (0.159)	0.298** (0.126)	-0.026 (0.051)	0.088 (0.448)	0.390*** (0.148)	0.096 (0.072)	0.118 (0.180)	-0.042 (0.114)	0.373 (0.312)	0.443** (0.214)	0.309** (0.121)	0.039 (0.115)
First or second Data Fest of the year (first omit.)													
Second Data													
Fest of the year	0.013 (0.032)	0.049 (0.089)	-0.083 (0.070)	-0.005 (0.031)	0.125 (0.131)	0.297*** (0.105)	-0.035 (0.025)	0.039 (0.104)	-0.119* (0.067)	-0.006 (0.117)	0.008 (0.122)	0.013 (0.070)	-0.034 (0.054)
Constant	1.896*** (0.025)	1.501*** (0.083)	1.661*** (0.078)	1.926*** (0.027)	0.313 (0.246)	1.191*** (0.089)	1.869*** (0.039)	0.553*** (0.100)	1.742*** (0.071)	-0.511** (0.194)	0.810*** (0.127)	1.560*** (0.079)	1.784*** (0.062)
N (Obs.)	226	226	226	226	226	226	226	226	226	226	226	226	226
N (individuals)	93	93	93	93	93	93	93	93	93	93	93	93	93
R-sq.	.0339	.0464	.1	.00698	.112	.112	.0485	.0489	.0495	.0254	.0437	.0345	.0352

Source: Authors' calculations based on all observations

Notes: Cells are coefficients. Clustered standard errors in parentheses. R-sq. is the R-squared; adjusted R-squareds are not readily available for fixed effects models. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

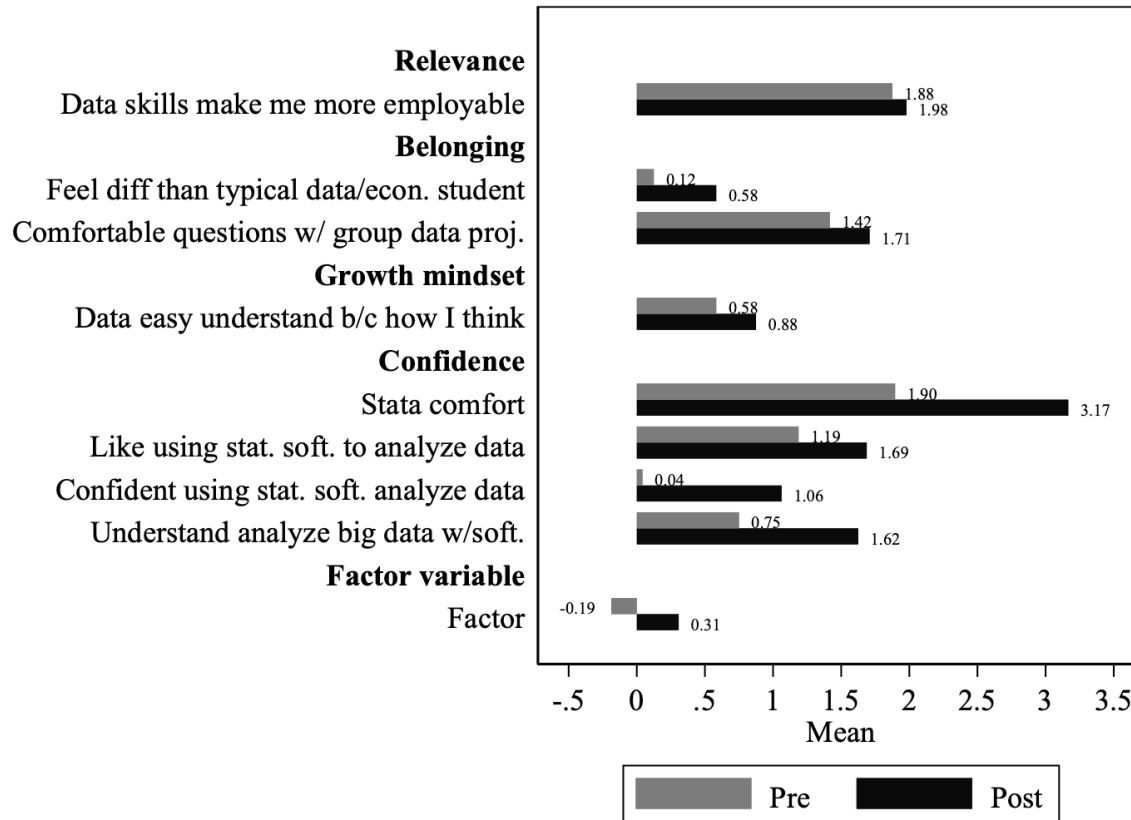
Table 3 Continued. Fixed Effects OLS Regression Models for Confidence and Factor Outcomes

	Confidence									Factor
	Like software	Confident software	Code easy	Software understanding	Complicated	Frustrated software	Stress software	R comfort	Stata comfort	Factor
Pre vs. post (pre omit.)										
Post Data Fest	0.255*** (0.086)	0.439*** (0.123)	0.306** (0.136)	0.392*** (0.101)	-0.013 (0.113)	0.119 (0.128)	-0.013 (0.123)	0.082 (0.157)	0.355** (0.150)	0.351*** (0.074)
Calendar year (2021 omit.)										
2022	0.234 (0.196)	0.329** (0.141)	0.201 (0.181)	0.299** (0.130)	0.176 (0.123)	-0.337 (0.261)	-0.083 (0.401)	0.754** (0.364)	-0.296 (0.317)	0.419*** (0.147)
2023	0.469* (0.273)	1.335*** (0.179)	0.064 (0.214)	1.151*** (0.232)	0.159 (0.183)	-0.296 (0.304)	-0.265 (0.427)	2.394*** (0.436)	-0.016 (0.399)	0.801*** (0.190)
First or second Data Fest of the year (first omit.)										
Second Data Fest of the year	0.308*** (0.093)	0.670*** (0.120)	0.110 (0.143)	0.543*** (0.116)	0.118 (0.097)	0.090 (0.130)	-0.180 (0.134)	0.123 (0.117)	0.871*** (0.156)	0.204*** (0.066)
Constant	0.950*** (0.157)	-0.486*** (0.102)	-0.232 (0.147)	0.298** (0.115)	0.790*** (0.105)	0.280 (0.175)	0.104 (0.254)	1.266*** (0.230)	2.067*** (0.205)	-0.579*** (0.099)
N (Obs.)	226	226	226	226	226	226	226	226	226	226
N (individuals)	93	93	93	93	93	93	93	93	93	93
R-sq.	.169	.383	.0623	.327	.018	.0273	.0189	.313	.258	.285

Source: Authors' calculations based on all observations

Notes: Cells are coefficients. Clustered standard errors in parentheses. R-sq. is the R-squared; adjusted R-squareds are not readily available for fixed effects models. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

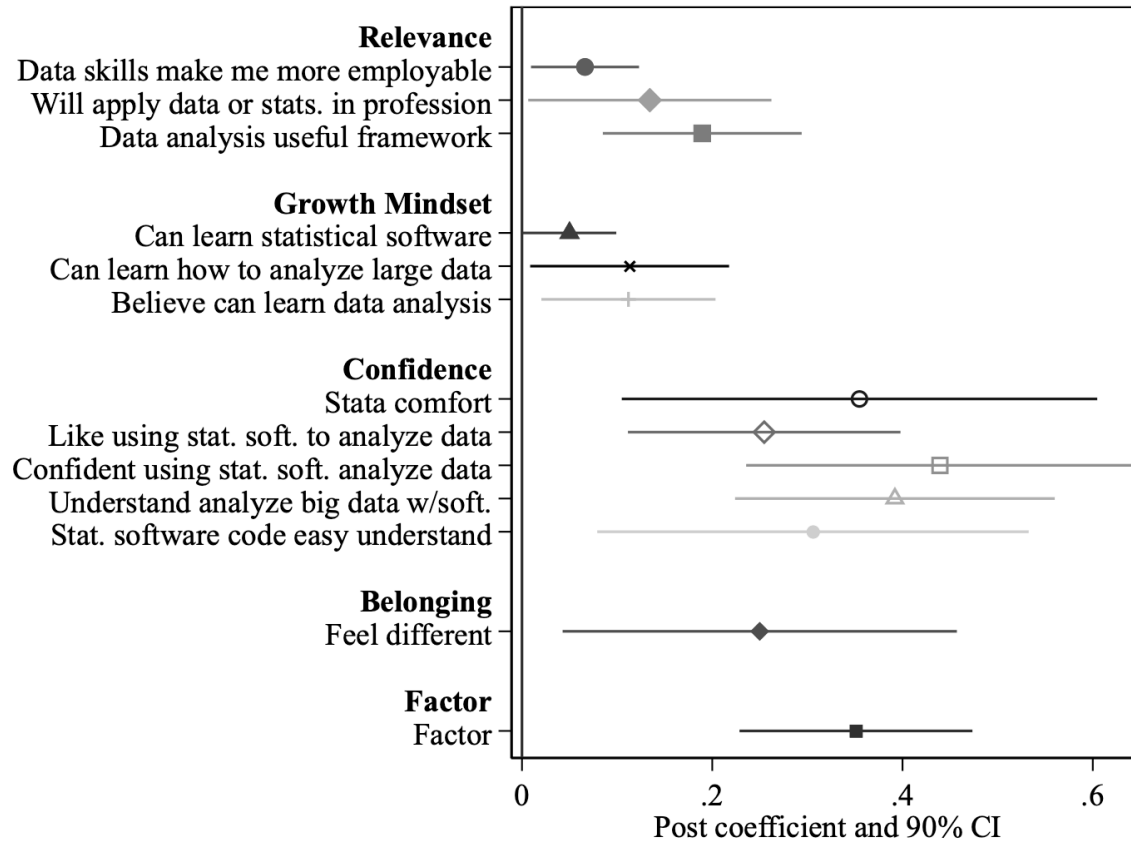
Figure 1. Means for outcomes with significant differences from pre-first to post-second Data Fest



Source: Authors' calculations based on pre-first and post-second Data Fest

Notes: Items with significant differences on paired t-tests, see full set of tests in Table 5

Figure 2. Post-Data Fest coefficient, outcomes with significant differences



Source: Authors' calculations based on all observations

Notes: Items with significant differences in fixed effects regression models, see full set of models in Table 3