Teaching undergraduates with quantitative data in the social sciences at University of California Santa Barbara: a local report

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Motivation & Background

This report details the investigation of practices of instructors who use quantitative data to teach undergraduate courses within the Social Sciences. The study was undertaken by employees of the University of California, Santa Barbara (UCSB) Library, who participated in this research project with 19 other colleges and universities (Appendix A) across the U.S. under the direction of Ithaka S+R. Ithaka S+R is a New York-based research organization, which, among other goals, seeks to develop strategies, services, and products to meet evolving academic trends to support faculty and students.

According to Ithaka S+R, this study is grounded on the growing need of higher education to equip students with foundational skills necessary for them to strive in today's data-driven world. These abilities are vital for preparing the next generation of data literate and critical citizens capable of identifying, assessing, analyzing, and communicating well and responsibly with data (Cooper, 2019)[1].

The field of Social Sciences has been notoriously known for valuing the contextual component of data and increasingly entertaining more quantitative and computational approaches to research in response to the prevalence of data literacy skills needed to navigate both personal and professional contexts. Thus, this

1 Cooper (July, 29 2019). Announcing Two New S+R Projects on Supporting Data Work. *Ithaka S+R Blog*. https://sr.ithaka.org/blog/announcing-two-new-sr-projects-on-supporting-data-work/

study becomes particularly timely to identify current instructors' practices and strategies to teach with data, as well as challenges and opportunities to help them advance their instructional efforts. The fundamental goal of this study is fourfold: 1) Explore the ways in which instructors teach undergraduates with data, 2) Understand instructors' support needs going forward, 3) Develop actionable recommendations for stakeholders, and 4) Build relationships within UCSB and across higher education institutions. The findings of this study will help to inform new services, policies, and practices not only at the University of California, Santa Barbara Library (UCSB Library), and the broader campus community, but also at other institutions seeking to advance their data instruction in the Social Sciences.

The remainder of this report is organized into four main sections. In the next section, for contextualization purposes, we provide a brief landscape of the Social Sciences at UCSB by describing the departments that fall under its umbrella. Then, we describe the research methods, including the steps for identifying and recruiting potential participants, as well as the procedures for data collection, processing, and analysis. In the following section we acknowledge the study limitations, present the demographics of participants along with the research findings highlighting the themes which emerged from our conversations with faculty. These themes are drawn from the pedagogical approaches used to teach with data; the ways in which students work with data, including the tools used to support the curriculum; the main barriers and challenges instructors face when teaching with data; how faculty usually advance their instructional skills; and what types of services and resources they wished were offered to support them and their students. Finally, we summarize the main takeaways from our interactions with instructors and present some questions and recommendations for the UCSB community and the higher-education community to improve support with instructional practices with quantitative and computational data in the Social Sciences.

Social Sciences at UCSB

Founded in 1909, UCSB currently ranks number five among U.S. public universities[2], and offers more than 200 majors, degrees, and credentials, over 90 undergraduate majors, and more than 50 graduate programs. With a current enrollment of over 26,000 students, the campus encompasses five schools and colleges with the College of Letters and Science being the largest which serves most of the undergraduate and graduate student population.

UCSB offers a wide range of courses in various fields and the campus is notoriously known for its tradition on Social Sciences and the Humanities. The division of Social

2 Complete U.S. News & World Report rankings are available at https://www.usnews.com/best-colleges/rankings/national-universities/top-public

Sciences alone comprises 12 departments with various programs and centers dedicated to train the next generation of practitioners and scholars capable of addressing pressing contemporary societal issues both locally and globally. It is core to the mission of the Social Sciences division to promote “research and an exceptional teaching and research environment in which students can develop an understanding of the social dynamics of today’s changing world.” (UCSB, 2021)[3].

From the 12 departments listed under the Social Sciences’ division, 10[4] offer undergraduate programs and minors, namely: Anthropology, Asian American Studies, Black Studies, Chicana & Chicano Studies, Communication, Economics, Feminist Studies, Global Studies, Political Science, and Sociology. A closer look at the course catalog provided by the Office of the Registrar listing all classes offered by these 10 departments from Fall 2019 until Fall 2020 (within a year prior to the effective beginning of the project), helped us to partially inform our recruitment strategies as detailed in the next section. The screening of the course list revealed that, collectively, six of these departments (Anthropology, Communication, Chicana & Chicano Studies, Economics, Political Science and Sociology) offer about two dozen courses at the undergraduate level aligned to quantitative and computational data[5], which provided us a means to map the current landscape of instructional efforts at UCSB.

Research Methods

This project followed a qualitative and exploratory approach to understand current practices of faculty teaching with data. The study was IRB approved and was exempt by the UCSB’s Office of Research in July 2020 (Protocol 1-20-0491).

The identification and recruitment of potential participants took into account the selection criteria pre-established by Ithaka S+R: a) instructors of courses within the Social Sciences, considering the field as broadly defined, and making the best judgment in cases the discipline intersects with other fields; b) instructors who teach undergraduate courses or courses where most of the students are at undergraduate level; c) instructors of any rank, including adjuncts and graduate students; as long as they were listed as instructors of record of the selected courses; d) instructors who teach courses where students engage with quantitative/ computational data.

3 University of California, Santa Barbara (2021). *Social Sciences*. https://www.socialsciences.ucsb.edu

4 Military Sciences and Exercise and Sport Sciences only offer non-degree programs.

5 We checked for course titles which included one or more of the following keywords: stats or statistics, analysis or analytical, research methods, methods, mapping, quantitative, data, data analysis, and metrics. Whenever we were unsure, we also checked for course descriptions and faculty websites. The list-wise inspection also helped us to identify courses with other quantitative data-related keywords such as data wrangling.

The sampling process followed a combination of strategies to more easily identify instructors on campus that would meet all of the abovementioned requirements. First, we reached out to peers and some stakeholders from various divisions known for supporting educational efforts at the undergraduate level within the Social Sciences such as Subject Librarians at UCSB Library, the Interdisciplinary Research Collaboratory (IRC) at UCSB Library, the Center for Innovative Teaching, Research and Learning (CITRAL), and The Institute for Social, Behavioral and Economic Research (ISBER). These conversations elicited a few names for an initial pool of potential interviewees which was complemented by a few names identified through the course list screening with a combination of snowball sampling, in cases where instructors we reached out about the study declined participation, but referred other people we could contact. Beyond the 12 departments listed under the Social Sciences' division, we also included Psychology and Brain Sciences and Geography in our pool as Ithaka S+R listed Geography and Psychology as social sciences disciplines. Finally, because there is a fine line between the exclusion or inclusion of some disciplines given the high level of interdisciplinarity in the academic sphere, our calls for participation explicitly highlighted the purpose of the study and the targeted group, meaning that only instructors who identify themselves as social scientists participated in the study.

A total of 22 instructors were invited to participate in this study. Invitations were sent by email (Appendix B) followed by two rounds of reminders. Our recruitment efforts resulted in 10 instructors who consented to be interviewed for the study. Interviews were conducted between September 2020 and January 2021, and followed a semi-structured interview guide (Appendix C) provided by Ithaka S+R, which were previously discussed and tested during training sessions with all participating institutions.

Due to COVID and the campus shutdown, all interviews were conducted remotely over Zoom and were audio recorded for transcription purposes. Whenever interviewees were comfortable with, and their connection allowed video, this option was preferred, taking into account the role of visual cues in the interviewing process. Regardless of whether or not the video was captured, transcriptions were generated for speech alone which produced approximately 12 hours of audio recording.

For some of the interviews, we enabled the auto-generated function on Zoom to facilitate the transcription process. Audio files were transcribed using a combination of techniques. Some used Otter.ai, others used Zoom's automated closed caption feature, and some were manually transcribed. Regardless of the strategy adopted, all transcripts were revised and compared to original audio to clarify and resolve inaudible passages and inconsistencies. Considering the small pool of interviewees and the fact that usually only a few instructors teach targeted courses within each

department in the Social Sciences, we performed the de-identification of the interviews' transcripts to remove any information that could potentially disclose interviewees' identity, including departmental affiliation, course names, mentions to the department and other names (e.g., partners, students, and other UCSB affiliates). Each transcript was assigned a code by order of interviewing (UCSB1...UCSB10). De-identified transcripts and metadata were shared with Ithaka S+R to perform aggregated analysis for the joint, national report and are publicly available in our institutional repository for future reuse[6].

For our local analysis we performed coding on MAXQDA 2020, one of the leading platforms designed for qualitative data analysis and to facilitate data organization and annotation. This platform was selected as it was licensed and readily available for researchers at UCSB and it allows for better cross-platform data exchange. A mixed-method approach to coding was adopted through the combination of both deductive (top-down) and inductive (bottom-up) strategies. We started with an initial code-tree which echoed the main topics present in interview prompts. This initial coding scheme evolved and was refined as we engaged more closely with the data through iterative rounds of readings and review, which helped us to identify, tag and rearrange themes that emerged from our conversations with faculty.

We conducted interviews with faculty who met the Ithaka S+R's pre-established criteria for participation and who voluntarily agreed to participate in the study. Through our recruitment efforts, we were able to interview 10 individuals from six departments within (or aligned with) the Social Sciences. Three of our interviewees were from Anthropology, two were from Sociology, two from Communication, and one interviewee each from Communication, Economics, Global Studies, Psychology & Brain Sciences. Predominantly, these individuals held a professorship with three individuals identifying their rank as assistant or associate. The remaining two interviewees self-identified as lecturers. Of the courses taught by these individuals, there was an even split between upper- and lower-division courses with the majority of them being large-enrollment classes that are accompanied by a lab often facilitated with the help of a teaching assistant.

While we sought departmental diversity to capture all the breadth of social sciences majors UCSB offers, this was not possible. Not all targeted departments provide undergraduate programs and teach quantitative or computational data-related courses, and not all faculty invited expressed interest in the study. This lack of representativeness from all departments added to the small-scale nature of this qualitative and exploratory study prevents us from making comparisons between departments as well as generalizing at the university level and to the field of Social Sciences, any of the results here presented.

6 doi:10.25349/D9402J

In addition, we acknowledge that the pandemic followed by the campus shutdown posed many challenges to higher education, which required all faculty to quickly adapt their pedagogical techniques to accommodate classes to the virtual setting. The interview questions were preceded with a prompt that interviewees could articulate their experiences with reference to their regular teaching practices, their teaching practices as adapted for the crisis situation, or both. The findings presented within this report generally express instructional practice without taking into account the modality of the course being offered online or altered to accommodate remote instruction.

Findings and Discussion

Data analysis allowed us to organize findings into four main categories: expected student learning outcomes and ways students engage with data, main challenges of teaching with data, instructors' training and resources sharing, and types of support needed, as described in the following sections.

Expected student learning outcomes and ways students engage with data

The desire to develop critical thinking skills and advance students' data literacy was consistently expressed at a high level across interviews. Faculty views of critical thinking can be widely defined as the ability for students to actively, and whenever possible, autonomously respond to problem-solving situations. More importantly, instructors desire students to understand the necessary procedural steps of working with data while constructing meaning from the data thoroughly and accurately to a specific question or problem.

Most faculty described that their classes are designed around opportunities for students to learn how to perform statistical tests while also actively applying learned concepts to assess statistical reports and to identify flaws in analyses and misleading data. One instructor stressed these skills while indicating the types of questions students should be able to answer when confronted with data:

> *"What is that? What does that even mean?" [...] So, those are like the critical thinking skills I want them to have to be able to assess right away, if you know, some representation of data that someone is putting out there is problematic. And usually, you can tell it's problematic, just, by the way, they have graphed it, there are ways to graph things to make the pattern look less*

> *clear and to make a pattern that's not there look like an actual pattern. (UCSB 1).*

For most interviewees, teaching students how to correctly interpret data and call out inaccurate statistical findings is key to preparing students to be critical consumers of data. “You don't want to just hear something and then take it in without being critical, you need to be a critical consumer to understand if you should believe what you’re being told” (UCSB 6). On a related note, while explaining pedagogical approaches to stimulate students critical thinking, UCSB 9 highlighted that students are required to analyze published findings in the field, which later launches “into a critical discussion of, you know, what are the accurate statements you can make based on these data, then which statements misinterpreting correlation as causation”, given that this is a common misconception in statistics.

Some instructors also described the importance of their courses as means to increase students’ chance to find a position in their field of study and how this is usually brought up in their classes to raise awareness about the value of learning statistics in the social sciences:

> *[...] if you're going into marketing and you want to do market research, you’re going to be collecting data from consumers, you know, or looking at sales figures. Or even if you’re Human Resources, you're going to be looking at statistics that are compiled about you know people within your organization or how your organization functions inside. I kind of go through some general examples like that, kind of hitting some of the careers that I know that our majors tend to gravitate towards (UCSB 6).*

The analysis of the transcripts allowed us to identify three main categories of learning goals: conceptual understanding, critical evaluation, and working with data and/or tools, which are herein defined in the scope of this project and based on interviewees’ narratives.

Conceptual understanding refers to an integrated view of theories, methods, and concepts, their possible applications, interconnectedness, and the kinds of scenarios they can be applied. It also reflects students’ ability to come up with reasonable questions which can be answered statistically. For example, a student learning about group comparisons should be capable of understanding the underlying theory and basic principles behind the most widely used statistical techniques for that purpose (e.g., T-Test, F-test, ANOVA, MANOVA, etc.), their main differences and relationships, as well as the specific assumptions (sample size, distribution, etc.) they should satisfy to be considered.

Critical evaluation here encompasses one’s capability to holistically understand and make an informed assessment of the methods and approaches followed by others,

understand the meaning behind the outputs, evaluate the validity and reliability of the assumptions or conclusions based on data. This learning goal also includes one's capability to identify limitations of collected data and identify potential ethical concerns. Critical evaluators would form a plan of action based on their conceptual understanding of disciplinary knowledge in tandem with their ability to identify issues or gaps in the data to synthesize meaning. Following the same example above, the student with critical evaluation data skills should be able to evaluate if a T-test was appropriate and correctly employed to analyze the data to answer a specific research question in a particular scenario and understand outputs. Relatedly, critical evaluators would be able to target deviations from an original research question and decide which would be the most appropriate test to answer that question and produce meaningful and effective reports. It thus translates from a general hypothetical scenario to a more real-world situation.

Working with data and/or tools comprises students' abilities to engage directly with raw data sets, identifying and selecting existing data sources, gathering, managing, and manipulating data, as well as operating (at least at a basic level) tools that can help them to produce analyses and data visualizations. This entails the application of concepts and evaluation to perform hands-on problem-solving beyond analytical reasoning. To satisfy this learning goal, students should feel confident to work with the dataset, perform their chosen statistical test using a tool such as R, Excel, Google Sheets, Stata, or SPSS to produce outputs.

As illustrated in Figure 1, the learning goals observed are complementary to each other and might play a more or less important role depending on the specificity of the course. Some faculty expressed that they dedicate most of their courses to explaining concepts and basic principles. Others focus more on the evaluation of other peoples' work and statistical reports. In contrast, others emphasize more hands-on practices with tools, and others try to balance all of them.

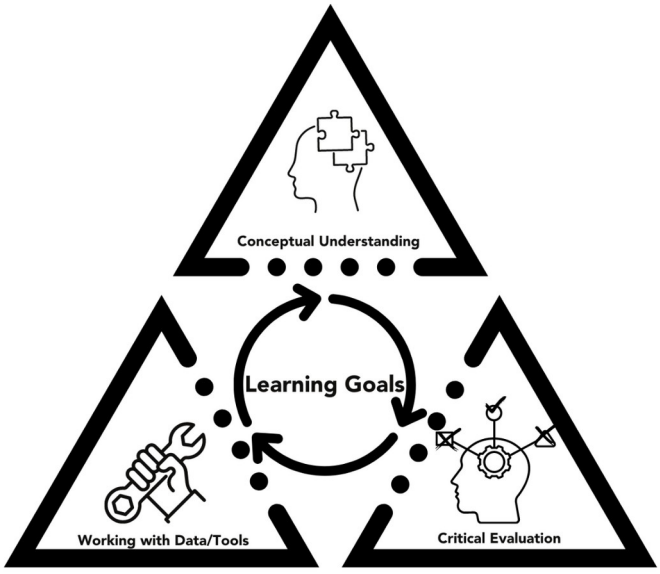

Figure 1 - Learning Goals

These three categories were developed based on the clustering of different skills interviewees revealed they expect students to achieve upon the completion of their courses, as detailed on Table 1 below:

Table 1 - Expected Learning Goals and Skills

Learning Goals	**Skills**	**Definition "Students should be able to…"**
Conceptual Understanding	Develop hypotheses	Identify relevant questions that could be asked and answered with statistical data.
	Ground stats into the discipline	Articulate potential applications as well as the advantages of statistics in the context of their field.
	Master key statistical concepts	Identify variable types, units of analyses, and measurements
Critical Evaluation	Identify patterns	Spot and observe trends and correlations in data sets.
	Extract meaning from data	Read 'beyond the numbers' and extract relevant associations from the data.
	Marry concepts and procedures	Make informed decisions about the best approaches to explore and analyze the data.
	Correctly interpret outputs	Successfully evaluate and explain statistical analyses and their results.
	Write reports	Produce statistical reports and effectively communicate findings while following recommended styles and conventions.

Working with Data/Tools	Locate and access data	Search, identify and access available data sources.
	Basic coding	Feel more comfortable with tools that require some coding and writing basic scripts to automate statistical analyses.
	Perform basic analysis	Run statistical tests which are more common to their field.
	Create visualizations	Create meaningful graphical representations to represent findings.
	Use new tools	Know how to use different software and statistical packages that could help them to more easily and efficiently work with data.
	Test hypotheses	Perform hypothesis testing and verify possible correlations and relationships.

Evidence of Learning Goals in Instructional Praxis

On the conceptual understanding realm, UCSB 4 described the importance of students to be introduced to the hypotheses development process:

> *I try to show them the older hypotheses, the gaps in the hypotheses, and you know how those gaps are illustrated by certain examples from the collated data [...] that is to get them to think about, you know, this is still a growing and developing field, perhaps they have some contributions to make and kind of trying to get them excited about it.*

The excerpt above describes the opportunity for students to get familiar with potential applications of stats to answer research questions in their field, while also challenging them to exercise their logical reasoning. Another excerpt also describes how an instructor attempts to foster a welcoming environment for students to learn key statistical concepts while understanding the story behind them.

> *Whenever I introduce a variable, first of all, they have to understand, they're obliged to understand every aspect of the definition of the units in which it's measured and the real-world process by which somebody arrived at that number. [...] The question is, what units is it measured in, what does it capture, who made the number, who invented the number, what are the components of the calculation that were imputed, who imputed them (UCSB 8).*

UCSB 2 expressed that their classes allow students to exercise their ability to "think synthetically with some of the data and take in data sources from a bunch of

different places that may not necessarily have obvious connections or sometimes have very obvious connections".

The importance of students being capable of critically evaluating the data and effectively communicating their insights and inferences was expressed by some instructors who assign statistical reports as deliverables for their classes:

> *The other thing that I think is important is the writing process. […] They write a research paper which is, you know, they introduce a problem, they review the literature on that problem so what do we know so far and what don't we know, and so how they're going to address a gap, and then present their data and methods. And then, present their results, and then come back to the original question and say "what does this tell us about this question?", or "how does this help us move the literature forward?". So I think that's a very useful skill to have and to be able to sort of communicating […] others what you've discovered through your analysis. (UCSB 4).*

UCSB 8 also sees that the process of producing their own statistical reports as an opportunity for students to become more data literate and critical about other people's work:

> *I really want students to be able to not just calculate statistics and values but to understand what those values mean on the other side. [...] We give them a data set and they work their way through statistical analyses and then they report those analyses in APA style. [...] How to report those values to someone else because I think that helps them with actually reading empirical papers. So, when they practice writing a results section, I think they are better equipped to actually read the results section of the paper.*

The ability for students to search, find and access relevant existing data sources was highlighted by a few faculty as a part of the skillset of their courses. UCSB 5, for example, described that they usually talk about "how one might obtain data sets as well, so I talked to them about some of the technicalities around [this process]. Finding data online using web scraper technology or using API technology to download data sets".

We observed, however, that instructors in this study most often supplied the data sets for class assignments, and only a few had students generate the data themselves. To provide the data sets to students, interviewees heavily relied on the institution's learning management system, GauchoSpace (Moodle), to access the data sets. It is worthwhile to note that one interviewee who had students generate their own data sets relied on a campus computer lab for students to upload the data they generated through their own study and completed the analysis and interpretation using installed software within the lab.

Most faculty indicated that at least some part of their course workload is dedicated to walking students through some basic functionalities of the statistical packages and software, which can help them to compute statistics more easily. These demonstrations are usually covered during lab sessions, and in some cases, complemented by step-by-step guidelines provided to students on how to use the tool. Of the data tools or software referenced, Microsoft Excel was most commonly used by instructors, and in some cases, interviewees expressed the necessity to move from Microsoft Excel to Google Sheets due to issues of access by their students. Other software or tools referenced in the order of prevalence by interviewees were: R, SPSS, Stata, Q-GIS, and Eviews. Four of the 10 interviewees combined Excel with one of the other aforementioned programs to analyze or interpret data.

To a lesser extent, some faculty introduce basic coding to their classes in order to make students more comfortable working with more sophisticated programs to run statistical tests. UCSB 5 includes “a small module on coding and programming or are the very basic fundamentals of programming”, while another interviewee emphasized that coding knowledge also allows students to have better control and understanding of the processes of working with data:

> *I want them to be able to see the logic of what they're doing and I find that writing code is a better way of keeping track of what they're doing to the data. So I have them write a program. I give them an example of my own program and, you know, I go through that line by line and I ask them to come up with their own research question. And to find variables that they can use to address that research question from the General Social Survey (UCSB 10).*

It is important to underscore that even though statistical tools and packages were generally considered important as a means to accomplish data analyses and visualizations, some instructors stressed the value for students to know how to use them as a future competitive differentiator for the job market while other interviewees considered the tool more secondary in the process of teaching with data. For those cases, instructors see the tool only as a means to computationally apply basic concepts covered in classes. The notion of choosing the tool that is easily accessible and “gets the job done” to demonstrate core statistical principles is illustrated below:

> *They use only Excel. You know, my philosophy of teaching students to work with data is that you know, the actual data manipulation is the easy part. And you know that you can sort of pick up in all kinds of ways with online help things and whatnot. What's really difficult to do, is to interpret what you get after you've manipulated it. So, I teach them to manipulate data very minimally in very simple ways and think through what they can learn from it.*

> *And all that you can just do in Excel, by using tables and simple functions like minimum, maximum, drawing scatter plots, putting lines of best fit through them (UCSB 9).*

Some faculty justified their decision to work with less sophisticated tools as they rely on tools that they were originally trained on as a part of their graduate degrees, such as SPSS and Stata. They also addressed the challenge of introducing advanced statistical tools along with complex statistical concepts and approaches to intro courses for an audience that is typically afraid of math, as will be described in the next section.

Beyond time in the classroom or lab, some interviewees described strategies for promoting extracurricular learning as means to help students to advance their data-related skills. UCSB 7, for example, created a series of optional short videos and demos that students can watch at their own pace while working on class' assignments. UCSB 5 often recommends students some YouTube videos and Khan Academy courses, and UCSB 2 referred to their syllabus which includes "all kinds of external resources that are both associated with the university and also just kind of wiki pages on the internet that are good for learning GIS and where people ask questions to learn how to do things. (UCSB 2). A few faculty noted that internships and working with undergraduate students in research projects helped them become more well-versed in quantitative approaches and computational tools. However, they recognize that only a tiny percentage of students have participated in such activities.

Main Challenges of Teaching with Data

Participants were invited to share their thoughts about ethical challenges they encounter while teaching with data. There were no major ethical concerns voiced by instructors, as the vast majority of the interviewees stressed that they are selective with the data sets they assign to students. They usually choose to use publicly available and previously de-identified data such as the national statistics, datasets that do not involve human subjects, or even develop assignments around dummy data.

A number of excerpts revealed consensus about how working with quantitative data opens up possibilities for students in the social sciences. The idea of thinking about the world differently was brought up by UCSB 4, while explaining the importance of students from the Social Sciences to be exposed to stats in a world where they are surrounded by data reports and big data. Some faculty mentioned that their classes help students to perceive research in a more systematic way by following a positivist approach where scientific evidence, in this case, data is used to construct

and validate a phenomenon or perceived reality. UCSB 9 elaborated about the value of such courses where students have the opportunity to work with quantitative data as means to think more critically about research processes and apply deductive reasoning in the context of the Social Sciences:

> *[…] using quantitative data in classes forces students to stand back and think about evidence in a way that does not presuppose the answer. [...] And the nice thing about quantitative data is that you know, the only way to analyze it is systematically, I mean, there are people who will try to manipulate it, etc., but if you give up on those dirty habits, then it's, you know, it's a systematic approach to data. So, you agree first on how am I going to analyze the data, how will I interpret what comes out, and only then do you get to see what comes out. And the effect of that is that often what comes out to be something that makes you think about the world differently. And that's one of the main goals in teaching this kind of stuff but particularly at the undergraduate level. (UCSB 9).*

It is essential to pinpoint that participants recognized that navigating students through the three learning stages (conceptual, evaluative, and application) is not a simple task. This challenge was expressed by UCSB 2, while describing that undergraduates in the Social Sciences are not always well-equipped to translate concepts into concrete applications, and that requires some extra effort and guidance from instructors:

> *Students are very good at following, you know, directions in a very, you know, sort of descriptive, like a normative way where you sort of like, say, do this, do A, B, and C, and they follow, they do A, B, and C and whatever else, but then once it comes time for them to sort of take A and B and combine it with C and D, and but you don't actually give them D, that's where, you know, kind of some of the sort of challenges [...] stoking some kind of imagination or sort of synthetic understanding of whatever is going on so that they will feel like they're really like learning the core elements of what it is that you're teaching and then are able to actually apply it in a concrete coherent way that's a little bit more complex.*

The vast majority of the interviewees see Social Sciences at UCSB as less inclined to positivist traditions. Some interviewees expressed that their classes are the only opportunity for undergraduate students to interact more closely with quantitative data. The lack of options added to the fact that most interviewees signaled that students choose their majors based on their higher predisposition to soft sciences poses some challenges to instructors responsible for introductory courses on quantitative data. Among these challenges is the common belief that undergraduates in Social Sciences majors have “fear of math”, as commented by UCSB 6:

> *I think the thing that's most relevant to classes involved in data analysis is just students' fear of math. And that's going to vary across the divisions, right? I mean, I'm sure engineering students have a lot less fear of math than Humanities and Social Sciences students do. (UCSB 6).*

UCSB 5 mentioned that students often make comments such as: "What, it involves math? Logic? No, I don't want to do that". Similarly, UCSB 9 mentioned that students are often quite "upset about having to touch numbers and having to work with numbers in the first place", and later complemented:

> *[...] to actually teach them anything about how to do quantitative analysis in any serious way is very difficult, because they're not seeing any of it in any other classes, many of them are taking classes where they're actually, you know, actively discouraged from dealing with quantitative social science. And you know they just don't have any training, many of them are math phobic. They have chosen [redacted, name of the course] because they are either afraid of mathematics or somehow, you know, have some issue with it (UCSB 9).*

The fear of dealing with tech or the lack of digital dexterity, even among those courses which introduce basic software such as Excel and Google Sheets, with no coding to perform statistical analysis was also observed by some of the instructors. For example, one interviewee expressed the expectation that students should be more comfortable handling computer systems, but, unfortunately, that is not always true: "And this is something which has sort of surprised me because I just assumed that over time, more and more people would be computer savvy and it does not seem to be going that way." (UCSB3). On the same note, UCSB 8 stated:

> *In fact, I've been quite surprised, for example even working with Excel some students have a difficult time and don't seem to have much experience in working with Excel or uploading something to R for example. I mean it requires a little bit of coding knowledge but the process is kind of similar, you know, similar to uploading a photo to an email. (UCSB 8).*

Besides the general understanding that most students in the Social Sciences are not as keen to learning statistical and computational approaches to analyze quantitative data, some faculty stressed the challenge to balance statistical with computational instruction in one course.

> *The whole point of the class is for them to learn how to use the software in addition to how to use the data that they use in the software. It's a challenge in the sense that the class is a challenge and I have to learn to use the*

> *software [...] you know, figure out how to parse these things out, right? (UCSB 2)*

Some faculty expressed concern about the amount of time spent teaching students how to navigate and operate statistical tools and how that can take away their ability to focus on the lessons' content. The dynamics of teaching with data varies significantly from other courses in the Social Sciences where students are presented with some material, and they have to feed that back into an exam. For statistical classes, on the other hand, they have to combine the concepts, exercise their critical evaluation, and perform tasks using tools:

> *[...] here's the task you'd like to accomplish. Here's an example of that kind of task and how it could be done. Now here is a new task. You now have to figure out which of the tools you've learned to apply and so forth. And for some people that is just fine but for a lot of them. This idea that they have not been told what to do, is actually pretty hard (UCSB3).*

Some interviewees expressed concern with the cognitive load and how this can negatively affect students' learning process and justified their choice to work with more simple tools. We believe that this may, at least partially, influence instructors to set a lower bar on their expectations towards students' accomplishments with their classes.

> *We do in the early part of that class, SPSS, we have them produce histograms, line graphs, you know, you can do box plots, you know, it has within SPSS, it has its own kind of data visualization. Nothing fancy. And the class, like I said, we keep the class very very simple and this is not an advanced class. This is a class for students who have an absolutely terrible fear of math and a fear of quantitative data and so we keep it very simple. [...] Again, these are students who are not strong enough, resent having to take anything related to math or data analysis and I don't want to overwhelm them, so I want to see how they, how they reached out to those kinds of students with big data (UCSB 6).*

Findings also show that most faculty have been adopting measures to mitigate such challenges, by making classes smoother and less intimidating for students and minimizing obstacles with tools that are easier to operate, and working with vetted data sets, which they have better control over, but at the same time, which are good enough to demonstrate some of the basic statistical concepts and applications. While we understand that this approach seeks to accommodate better students' needs and the idea of "leaving no one behind", this may reduce opportunities for students to engage more critically with the data to apply learned concepts and tools to different contexts. On the one hand, having more control can help students to better acclimate with statistics; on the other hand, it can narrow

opportunities for students to practice their problem solving and to translate general skills more autonomously to specific contexts.

Instructors' Training and Resource Sharing

Instructional training and resource sharing varied among interviewees. The most common training that instructors expressed receiving on teaching with data out of their graduate education was through professional development opportunities, such as academic conferences and workshops, including Carpentry Workshops offered at UCSB Library. Otherwise, the second most common method to learn the techniques to teach with data is through self-discovery, such as reading books and related literature on the topic or program, watching online video tutorials, and following trends with large technology companies such as Google, Facebook, and Microsoft.

Another method minimally referred to in these interviews was inter- or cross-departmental collaborations with other faculty. In these few instances, colleagues were often consulted as a resource for independent research to fine tune techniques in their research. In other cases, they consulted with colleagues for their expertise as an affiliated resource either for instruction or their research.

> *I've started to do some computational work or work that requires computational analyses with big data and I don't have the skill set to do that. I partner with computer scientists. So, I collaborate. I find people who have the data analysis skills that I don't. So that's how I do it (UCSB 6).*

As instructors engage in their own professional growth in teaching with data, they were also asked whether or not they have used instructional resources created by others to teach their classes, and whether or not they have shared their instructional resources with others. The majority of interviewees (8/10) said they were either willing to share or have shared their instructional resources with students and/or fellow instructors. However, only half of the interviewees have used shared resources to develop course materials. One respondent, in particular, expressed that they would not be able to use shared resources or conversely share their own instructional materials due to the nature of their class being the only one of its kind in the department. Any resource sharing that could be done inter-departmentally would not be usable for their needs. As such, they've developed most of their instructional content independently.

> *[...] you know that that's something I've entirely have to figure out on my own. And, you know, I get a lot of practice with that, because nobody else in my department teaches quantitative anything. So I've had to do a lot of it, and I just sort of learned through trial and error [...] (UCSB9).*

Through the evaluation of the responses to the training, instructors have received to teach with data and the ease of which they can either repurpose materials from other instructors and their willingness to share their own materials. For most instructors, it is clear that there is a great interest in engaging in a community of practice on these topics. Yet, respondents often cited difficulty engaging in professional growth and training in this area due to a lack of time. Anecdotal events were referenced, such as a summer institute where instructors were prompted to reflect and retool pedagogical techniques as a rich opportunity to interrogate their teaching practice and reimagine their approach to measuring student learning. However, examples like these were limited as a robust, integrative opportunity to retool their instructional praxis.

Types of support needed

The interactions we had with instructors allowed us to confirm the underlying assumption which motivated this study that there is a growing movement towards more computational and quantitative-oriented Social Sciences. Some faculty acknowledged student attentiveness and interest when courses were oriented around digital topics.

> *Well, I think that there is a trend in the field that is sort of broadly one, where people are interested in like anything digitally, I sort of attach the word digital to it, and people are all of a sudden, more attracted to it [...] there's this kind of thing where people are interested in data [...]. Those kinds of things are what people get a little bit more, it's certainly, for instruction gets a little bit of attention, because I think they're interested in developing translational skills (UCSB 2).*

Conversely, most of the interviewees recognized that their departments are not particularly ready to accommodate this trend, being unable to fulfill this demand at the moment since they are more heavily focused on qualitative research. During the interviews, most participants identified themselves as one of a few in their departments who conduct more statistical research and who are more directly involved with stats or computational data-related instruction. Some interviewees also emphasized how this more qualitative orientation affects Social Sciences degrees at UCSB to get students more inclined to work with quantitative data:

> *Faculty members are very, very few quantitative and that has been also a problem because we need more. In order to be able to be stronger in quantitative methods in [redacted - department name] here, and to be able to get more students that are quantitative, that want to do quantitative work, you need more faculty that does quantitative work. Because if not, you are signaling that this is a qualitative department (UCSB 7).*

Besides inviting participants to reflect on evolving trends in their field, we also asked them to describe the types of instructional support they need and receive for the purposes of teaching with quantitative data. As mentioned previously, the majority of the classes discussed were large enrollment classes with associated labs facilitated by teaching assistants. These teaching assistants were often referred to as “invaluable” to the course as they are the ones who align the critical intersections of theory and methodology with the available technologies.

> *In our courses they lead sections and so [...] in my classes that do data analysis they go over the homework problems with students and help them understand because students do data analysis by hand there and they lead the lab sessions. So, they are the ones teaching SPSS and showing them how to obtain the outputs to then interpret (UCSB6).*

While these teaching assistants structure the practical use and application of the technologies for students, they also, at times, aid the instructor-of-record with learning new technologies as well. For example, UCSB1 expressed a scenario where prior students in their course became teaching assistants for the same course and surpassed the instructor’s expertise with the latest statistical tools for the class:

> *[...] they've sent me all of the material [...] all the books that they think are the best ones, they've sent me the YouTube videos that walk you through it. So I have gotten all these resources from two students who have previously taken my quantitative class and did not know are at that time. So basically, I've taught them, they have gone beyond me, and now they're teaching me and that is the way learning should work [...].*

It was not an uncommon occurrence for instructors to express a desire for additional support with learning new programs and further support with technical aspects of the course, especially in a lab setting. For instance, interviewees expressed an interest in having a single, dedicated space on campus for hosting a training on programs and technologies for teaching with data. This suggestion was often affiliated with comments where instructors expressed a lack of time or financial resources to pursue these interests independently. As such, they would value a structural intervention by their department, program, or the university as a whole to centralize professional development in this area.

Other professional development interests expressed were around pedagogical approaches to teaching. Specifically, instructors are seeking support in shaping student learning experiences where they meaningfully construct disciplinary knowledge while synthesizing theoretical knowledge with practical applications. To do this, instructors repeatedly referenced the necessity of having ample and adequately equipped lab spaces with streamlined supportive services to ensure

operations run smoothly. Multiple interviewees expressed difficulty with being able to reserve lab times for their courses.

> *[...] if the campus wants to help us teach students to work with data, we need more of these labs, and we need a reservation system that is a little bit friendlier that we can sort of access far ahead of time, book far ahead of time so that those of us who are actually running classes get first dibs. You know what happens is you'll often find that the labs have been booked up for open hours, but you know open hours should be scheduled after sections [...] (UCSB9).*

Others have experienced difficulty with receiving assistance quickly when they have encountered technical problems in lab spaces and had trouble getting in contact with appropriate individuals to rectify the issue. But, above all else, the issue of not having enough labs was paramount in their responses. This particular issue was also connected to expressions of concern and interest to address diversity, equity, and inclusion for students who desire to study quantitative data. Multiple respondents noted gendered, racial, and socioeconomic disparities among students enrolled in their courses. To equitably address the technological gaps, they expressed the necessity to equip students with the appropriate technology either on-campus via more computer labs, or by offering the required software for a free or reduced cost.

> *[...] one of the things that I've actually been doing research on is sort of racial and economic stratification across majors at the UC's including UCSB. And so we now, we're increasingly seeing since, over the past 15 years, a segmentation where the stem STEM majors are increasingly getting filled up with students who went to better high schools, they are you know less likely to be students of color less likely to be from working class backgrounds. And so this argument that you can, you know, just have students work on this stuff on their own, and we don't need the centralized learning spaces for them is going to make that kind of thing worse (UCSB9).*

In summary, our conversations with faculty signal the need for more assistance at the university level spanning from infrastructure with better-equipped and more labs to accommodate hands-on sessions, to services and resources such as workshops on computational tools, which could be offered on an ongoing basis and considering their needs and availability. This kind of institutional support would help them to advance their instructional efforts and make quantitative and computational approaches to Social Sciences more accessible, refined, and inclusive on campus.

Main Takeaways and Recommendations

Even though we acknowledge that the small-scale nature of this research does not allow us to draw firm conclusions about how undergraduate majors in the Social Sciences at UCSB have been prepared to face todays' data-driven world, we believe that results from this project can help to inform subsequent studies and target further discussions and programming with stakeholders, faculty, and students on how the university can better support quantitative and computational data instruction in the field.

Question 1: What are campus needs associated with teaching quantitative data in the Social Sciences?

We learned from our conversations with faculty that most departments that participated in the study offer little opportunity for undergraduate students to engage deeply with statistics and computational tools. Some faculty identified themselves as the only people in their respective departments who teach such skills. In general, there is only one course dedicated to developing abilities to work with quantitative data. This finding suggests a need for further investigation into the data literacy, statistical, and computational data needs for undergraduates in the Social Sciences at UCSB. Future research is needed in this area to understand better the scope of course offerings and sequenced course curricula and existing opportunities for students to apply data skills to real-world scenarios, such as through internships, research projects, capstone projects.

To build on this research, we plan to deliver an executive summary of this report to participating departments highlighting our key findings and request their feedback and comments on the next steps. A follow-up survey targeting all instructors of record could help us to achieve a more thorough environmental scan of computational and stats-related courses within Social Sciences and their affiliated educational support needs. This data gathering can also help us better understand to what extent our initial findings reflect the needs of UCSB at large.

We also intend to reach out to the Quantitative Methods for the Social Sciences (QMSS)[7] coordinating committee, a group we only became acquainted with towards the end of this study, to share the results of this study and discuss how we could continue to explore this topic. Even though QMSS main focus is to advance quantitative work at PhD programs, this group could be a key partner in preparing domain-specific instructors, TAs and staff to support existing needs. It is our understanding that these needs may shift over time. In this sense, the Library could

7 www.qmss.ucsb.edu

partner with QMSS and other stakeholders to develop mechanisms for constantly re-assessing existing demands and re-defining priorities for teaching with data in the Social Sciences.

Question 2: How can computer labs better support teaching with data in the Social Sciences?

Our findings suggest that there is a need for more labs and IT support, in tandem with better information about the types of licensed software that are available to students and faculty free of charge on campus. Even though this information is available online, some faculty and students might not be aware where they could locate it. Thus, circulating an updated list of licensed tools among departments that could support data instruction quarterly, with the help of subject librarians, could minimize uncertainties, while creating a channel for new software acquisition requests.

While some faculty expressed some preference towards having a dedicated lab space for classes, it seems that the great challenge is to deal with different versions and installations of the software students may be using, which can cause unpredictable teaching disruptions and delays on the delivery of lesson content. To mitigate this issue, while considering the current ongoing re-activation scenario where some students are still remote and some instructors are offering blended classes, we see an opportunity for the Library to expand the support that the Interdisciplinary Research Collaboratory (IRC) began to offer last year with virtual machines, and reach out to instructors of these courses about how Azure Labs can assist data-related classroom activities. Azure Labs can help instructors quickly and easily provision pre-configured and identical learning environments for the students. We also see this approach as a means to discuss how the current system for scheduling labs for in person instruction can better accommodate the needs of the departments that raised that issue.

Our conversations with faculty also revealed a need for a centralized resource for identifying training options and other quantitative and computational data resources available across campus. This type of centralized resource would help with the preparation of course materials and instruction, and could also be a source for enrolled students to refer to. Given that the Library commonly maps existing resources together to make them more widely discoverable and accessible to the community, we foresee this project as one that could be spearheaded by the existing UCSB Research Data Community that launched in early 2021. Led by RDS and IRC, this community could create and maintain a joint catalog of existing data and computational support, which could serve not only the Social Sciences but other fields represented at UCSB.

Question 3: How can the Library and other instructional development partners better support quantitative data literacy skills for instructors in the Social Sciences?

Carpentry workshops on tools are offered on a regular basis by the UCSB Library's Interdisciplinary Research Collaboratory (IRC) in partnership with Research Data Services (RDS), other campus carpentry certified instructors, and volunteers. These workshops are open to all campus affiliates and offer attendees foundational computational skills on campus. The findings from this study suggest that they should be more broadly advertised as some faculty appeared to be not aware of their existence. The few faculty who were acquainted with Carpentry workshops expressed interest in participating but noticed that they often could not commit to a couple of hours of training during weekdays due to their other instructional, research, and services obligations. This finding suggests that future Carpentry instructors could consider surveying faculty interests and best availability before scheduling these sessions. If planning such workshops remains a challenge, there could be a consideration of workshops that could mix recorded asynchronous and self-paced lessons with some drop-in hours and on-demand live coding activities.

Also, Carpentry workshop organizers could consider polling potential attendees to gauge interest in faculty-only workshops. Instructors might feel more comfortable participating in training sessions where only fellow instructors are present. A mixed audience with students and instructors may cause instructors to be less inclined to express the difficulties they are experiencing with using the tool for their disciplinary research and instructional needs when they are in the presence of students. Holding a position of status and authority, some instructors may be reluctant to position themselves in the role of a student in the presence of students when they perceive that they should already hold the expertise they seek with the technology.

In addition, with the expansion of both RDS and the IRC teams, there could be some planning in partnership with the Data Science Consulting Laboratory[8] (DataLab) to develop a series of workshops around lessons marrying open tools (e.g., R and Python) with statistical analysis and tests, similar to the portfolio of workshops at the University of California, San Francisco (UCSF)[9]. In this way, instructors would not only get familiar with the basic functionalities of theses tools, but, more importantly, would be able to translate the statistical skills they are comfortable to apply on proprietary (e.g., SPSS and SAS) or more basic tools (e.g., Google Spreadsheets), to more robust and reproducible open statistical tools.

Question 4: How can the Library and other instructional development partners better support quantitative data literacy skills for students in the Social Sciences?

8 https://www.pstat.ucsb.edu/resources/statlab
9 https://calendars.library.ucsf.edu/event/7738085

We have identified that instructors perceive students' fear of math and the lack of digital dexterity as the impetus for challenges with learning data literacy skills in their courses. Based on interviewees' comments, it is our understanding that students' self-limiting beliefs play an important role on their actual performance in classes, and consequently, this has resulted in some faculty reducing their expectations for student performance and modifying course curricula as a result. Opportunities that we see to abate these issues may be to blend programmatic interests with library partners, such as the Center for Innovative Teaching, Research and Learning.

One possible approach would be to co-develop assessment strategies with available data literacy tools and pedagogical techniques which could help instructors to more effectively identify students' entry knowledge, needs, and level of confidence with quantitative data and computational tools. Relatedly, departments within the library, such as Teaching and Learning that have a focused interest on lower-division undergraduate instruction can structure programming to aid students with foundational literacy skills with commonly used tools, such as Microsoft Excel and Google Sheets to ease student fears with using computational tools in their coursework. Correspondingly, other departments in the library, such as Research & Engagement that have a focus on upper-division undergraduate and graduate courses can pair their subject expertise with other departments within and outside the library to develop training programs open to undergraduates.

Research Data Services (RDS) at UCSB Library holds expertise on the different stages of the research data lifecycle, including data gathering, cleaning/wrangling, analysis, documentation, and archiving, and has been currently developing research data management (RDM) and data literacy modules at the graduate level for training programs such as the Responsible Conduct of Research (RCR) in partnership with the Mechanical Engineering Department and the Office of Research. Therefore, RDS could adapt these modules to the undergraduate level and tailor them around domain-specific case examples including critical topics in the field of Social Sciences (e.g., de-identification). RDS could also expand the promotion of the existing Data Literacy Series[10] among undergraduates, considering that these infographics unpacks basic concepts and tips which can be valuable for students working with data.

By focusing programming on discrete subjects or disciplinary areas students can more confidently interact with data in their research and deal with real-world challenges in their field. These programmatic approaches would serve to aid both instructors and students to achieve desired data literacy learning outcomes with courses that teach with data in the Social Sciences.

10 https://www.library.ucsb.edu/data-literacy-series

Appendices

Appendix A: Participating Institutions

1. American University
2. Boston University
3. Carnegie Mellon University
4. Florida State University
5. George Mason University
6. George Washington University
7. Grand Valley State University
8. Kansas State University
9. Michigan State University
10. North Carolina State University Raleigh
11. Purdue University
12. Rice University
13. University of California Santa Barbara
14. University of Chicago
15. University of Massachusetts Amherst
16. University of New Hampshire
17. University of North Carolina Chapel Hill
18. University of Richmond
19. Virginia Polytechnic Institute and State University
20. Washington University in St. Louis

Appendix B: Recruitment Email

Subject: Call for Participants: Study on Teaching Undergrads with Data in the Social Sciences

Dear Professor [First Name],

The UCSB Library is conducting a study on the practices of social science instructors in order to improve support services for their work. We are interviewing instructors whose undergraduate students engage with quantitative data, such as by conducting research using quantitative methods, analyzing or visualizing datasets, or learning to use specific tools or software to work with data.

Your name was selected by referral or because you have recently taught a class that is in scope with this project. Would you be willing to participate in a one-hour interview over Zoom to share your unique experiences and perspective?

Our local UCSB study is part of a suite of parallel studies at 19 other institutions of higher education in the U.S., coordinated by Ithaka S+R, a not-for-profit research and consulting service. The information gathered at UCSB will also be included in a landmark capstone report by Ithaka S+R and will be essential for UCSB to further understand how the support needs of social science instructors are evolving more broadly.

If you're interested in participating in this study, please contact us in the next two weeks. However, if you are unwilling or unable to participate at this time, we would welcome any suggestions you have of other contacts in your department or on campus. Thank you so much for your consideration. If you have any questions about the study, please don't hesitate to reach out.

Sincerely,
Renata Curty, Research Data Specialist - Social Sciences, rcurty@ucsb.edu
Rebecca Greer, Interim Director of Teaching & Learning, rrgreer@ucsb.edu
Torin White, Data Services & Digital Scholarship Librarian, whitet@ucsb.edu

Appendix C: Interview Instructions & Questions

Read:

Note regarding COVID-19 disruption: I want to start by acknowledging that teaching and learning has been significantly disrupted in the past months due to the pandemic. For any of the questions I'm about to ask, please feel free to answer with reference to your normal teaching practices, your teaching practices as adapted for the crisis situation, or both.

Background

I would like to start listening about your experience teaching undergraduate students.

Could you briefly describe your experience teaching undergraduates, including:

- How does your teaching relate to your current or past research?
- In which of the courses that you teach do students work with data?

Getting Data

In your course(s), how do your students usually obtain the data they engage with? (collect or generate themselves, search and identify pre-existing data, or you provide them the data sets)?

- Do your students collect or generate data sets, search for and select pre-existing data sets to work with, or work with data sets that you provide to them?
- **If more than one method - what's the primary method?**
- **Could you describe the general process students go through?**
- **Do you face any challenges relating to students' abilities to find data?**

If students collect or generate data sets themselves Describe the process students go through to collect or generate data sets in your course(s).

- Do you face any challenges relating to students' abilities to find or create data sets?

If students search for pre-existing data sets themselves: Describe the process students go through to locate and select data sets.

- Do you provide instruction to students in how to find and/or select appropriate data sets to work with?
- Do you face any challenges relating to students' abilities to find and/or select appropriate data sets?

If students work with data sets the instructor provides: Describe the process students go through to access the data sets you provide. *Examples: link through LMS, instructions for downloading from database*

- How do you find and obtain data sets to use in teaching?
- Do you face any challenges in finding or obtaining data sets for teaching?

Working with Data

How do students manipulate, analyze, or interpret data in your course(s)?

- What **tools or software** do your students use? *Examples: Excel, online platforms, analysis/visualization/statistics software*
- What ***prior knowledge of tools or software do you expect students to have***, and **what do you teach them explicitly**?
- **To what extent** are the tools or software students use to work with data **important for your teaching**?
- **Do you face any challenges relating to students' abilities to work with data**?

How do the ways in which you teach with data relate to the learning goals in your field?

- Do you teach your students to **think critically about the sources and uses of data they encounter in everyday life**?
- Do you teach your students **specific data skills** that will prepare them for future careers?

Do instructors in your field face any **ethical challenges** in teaching with data?

- To what extent are these challenges **important to your teaching**?

Have you observed any policies or cultural changes here at UCSB that influence the ways in which you teach with data?

Training and Support

In your course(s), **does anyone other than you provide instruction or support for your students in obtaining or working with data?** *Examples: co-instructor, librarian, teaching assistant, drop-in sessions*

- How does their instruction or support relate to the rest of the course?
- Do you communicate with them about the instruction or support they are providing? If so, how?

To your knowledge, are there any ways in which your students are **learning to work with data outside their formal coursework**? *Examples: online tutorials, internships, peers*

- **Do you expect or encourage this kind of extracurricular learning? Why or why not? If so, how?**

Your own training

Have you received training in teaching with data other than your graduate degree? *Examples: workshops, technical support, help from peers*

- What factors have influenced your decision to receive/not to receive training or assistance?
- Do you **use any data sets, assignment plans, syllabi, or other instructional resources** that you received from others? Do you make your own **resources available to others**?

Considering evolving trends in your field, what types of training or assistance would be most beneficial to instructors in teaching with data?

Wrapping Up

Is there anything else from your experiences or perspectives as an instructor, or on the topic of teaching with data more broadly, that you would like to share?