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Engaging Undergraduate Economics Students in Research Using Posters

Undergraduate research is a high-impact educational practice. Despite the immense value to students, many instructors have difficulty investing the time and resources needed to engage undergraduates in research. This paper provides materials and a detailed plan for instructors on how to incorporate a research project into their economics course, culminating in a poster project. This approach is widely applicable to various undergraduate and graduate courses. Advantages of posters include reduced costs to instructors for feedback and grading and an opportunity to build a culture of research from a poster event.

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1. Introduction

This paper presents a practical approach and corresponding materials that economics instructors can use to engage undergraduates in research in their courses. Students engaging in research with faculty is considered a high-impact practice. High-impact practices lead to positive outcomes, such as increased student retention rates and student engagement (Kuh, Schneider, & Association of American Colleges and Universities, 2008). Student research incorporated into the curriculum or as a graduation requirement can also help economics departments achieve many of their program learning outcomes. Myers, Nelson, and Stratton (2011) find that a majority of U.S. economics departments have learning outcomes such as thinking like an economist, critical thinking, applying existing knowledge, finding and using economic data, interpreting economic data, and asking relevant questions; these student learning goals can all be achieved through research with faculty. Economists have long recognized the value of undergraduate research. For example, Siegfried et al. (1991) argue that all economics students should be engaged in "doing economics" as part of their degree requirements. In addition, when undergraduates are exposed to research it enhances the economics Ph.D. pipeline (Ehrenberg, 2005).

Undergraduate research leads to the acquisition of valued skills necessary for success in future careers or graduate study. Hansen (2001) has long argued that economic education should focus on skill building or proficiencies. Proficiencies (also known as Hansen's proficiencies) that economics majors should obtain include the ability to access existing knowledge, display command of existing knowledge, interpret existing knowledge, interpret and manipulate economic data, apply existing knowledge, and create new knowledge. To obtain these proficiencies, each field course offered by a department should facilitate the acquisition of each proficiency, through activities like reading economics literature, working on empirical projects, and writing and presenting their ideas (Salemi & Siegfried, 1999). Although not explicitly stated, the mechanism through which Hansen's proficiencies are demonstrated is via strong written and oral communication skills. For example, to demonstrate and apply existing knowledge, a student can write a five-page analysis of a current economic problem. To demonstrate command of existing knowledge, a student can explain key economics concepts and describe how they are applied. The poster project presented in this paper helps students gain these important communication skills that are often not incorporated into economics curricula. By completing the related assignments and the poster project, students learn to summarize and present results using written and oral communication skills. Moreover, they gain valuable experience in how to receive constructive feedback and work as part of a team. Thus, the poster project provides a medium for students to demonstrate their mastery of Hansen's proficiencies as well as vital career skills needed for future success.

Despite the benefits of undergraduate research, many economics departments do not have a research requirement for majors in their field courses or as a culminating experience. Only 48 percent of departments have a capstone project and 18 percent have a senior thesis. A larger percentage of liberal arts and private institutions have these research requirements compared to public Ph.D. institutions (Allgood, Walstad, & Siegfried, 2015). This suggests that institutions with larger class sizes, higher teaching loads, and less funding for undergraduate research efforts are unable to support these valuable learning experiences. For public institutions that educate primarily underserved minorities like my own, the absence of an undergraduate research experience may be a barrier to obtaining a graduate degree, which

perpetuates the lack of racial and ethnic diversity among Ph.D. economists.[3] Illustrating this racial or ethnic discrepancy in high-impact practices, in 2018 nationwide, 50 percent of white seniors had participated in research with faculty, compared to only 38 percent of Hispanic or Latino seniors (NSSE 2018 High-Impact Practices, 2018). Sharpe and Swinton (2018) recommend more partnerships with Minority Serving Institutions to increase the representation of black and Latinx economists.

For departments that have no capstone or senior research project or for those hoping to increase research preparation for a culminating experience, one strategy for increased participation is to embed research into individual economics courses. While this seems like a logical solution, "chalk and talk" methods remain the most common teaching style (Watts & Schaur, 2011) and studies show that even instructors who believe that more interactive teaching methods are valuable are not willing to incorporate these methods into their lectures, due to the high costs of preparation and time (Goffe & Kauper, 2014; Allgood, Walstad, & Siegfried, 2015; Hoyt & McGoldrick, 2017). There are some resources available to instructors to foster research activities with students. For example, Feyrer (2017) describes the undergraduate research model at Dartmouth, and Brunnermeier (2017) offers advice for addressing the resource constraints in fostering student research. Some practical guides are available for instructors interested in incorporating research. For example, Fisher (2019) provides assignments that help incorporate research in introductory economics courses and VanderMolen & Spivey (2017) give guidelines on how to implement an infographic assignment in the classroom. The online portal Starting Point: Teaching Economics gives public access to pedagogical models on topics including undergraduate research (Maier, McGoldrick, & Simkins, 2012).[4] Yet more resources are needed to help instructors adopt these high-impact practices. To help alleviate the high costs of instructor preparation for embedding research into a course, this paper presents a set of research assignments and a detailed implementation plan for students to complete a poster as their final research product. In addition, practical strategies are provided on how to use the poster project as a way to foster a culture of research with students. This information is useful to instructors who wish to incorporate an element of research into their courses and need ideas on how to get started; it is also a contribution to the existing literature and publicly available course materials for economics instructors.

To further reduce the cost of implementation, I recommend that instructors adopt a poster as the final project, similar to posters designed for professional conferences. The main elements of the research project include students identifying a research question, gathering corresponding data, analyzing, graphing, and interpreting data, and constructing a poster with relevant information and findings. When both time and class composition allow, analyzing and interpreting data may involve performing a regression analysis and discussing the results. One advantage of a poster over a paper as the final project is that students can spend more of their time and effort developing a research question and gathering data. I have tried using the same research project but required a final paper instead of a poster. However, I found the papers to be low quality, because students simply do not have enough writing experience and need multiple revisions to produce a high-quality paper; the time and effort required for that

[1] California State University, Long Beach is a public, Hispanic-serving, master's granting institution, with 41percent of students identifying as Latinx in 2018-19. According to the NSF, in 2017 only 2.5 percent of earned U.S. doctorate recipients in economics is Hispanic or Latino (https://ncses.nsf.gov/pubs/nsf19301/data, accessed 7/24/19).

[2] See https://serc.carleton.edu/econ/studentresearch/index.html, accessed 7/18/19. Although the module on undergraduate research is an excellent resource for instructors, it is very general. The Starting Point module does include seven examples of term papers and research assignments, but more specific project examples are needed to reduce instructor preparation time.

is simply not realistic for most course settings. Instead, the poster can be high quality after one or two revisions, and the time that the instructor spends in providing feedback and grading is much lower than a paper. The poster project can be completed individually or in groups of two to five students for larger classes.

The pedagogical approach that I illustrate with the poster project is adaptable to fit a wide variety of courses. It can be used in almost any upper-level elective course in the economics major or applied graduate courses. In addition, elements of it can be altered to place an emphasis on different learning outcomes or accommodate different levels of technical knowledge. Section II includes a detailed explanation of the poster project and a description of how it is successfully implemented. Section III offers advice and strategies for scaling up a poster event into a successful department or even university research event. Section IV concludes.

2. Implementing the Poster Project

Section II.A includes a description of a poster project that can fit the majority of upper-level economics electives in the economics major. Section II.B contains suggestions for modifications that can be made to the poster to fit instructor preference and student experience.

A. Description of the Poster Project

I have used the poster project extensively in an upper-level, environmental and natural resource class that has a mix of economics majors and environmental science and policy majors. Prerequisites to this course include principles of microeconomics, principles of macroeconomics, any college-level statistics course, calculus, and either intermediate microeconomics (for majors) or another environmental economics class (for non-majors). However, this project can be successful in other upper-level economics courses with no statistics prerequisite. If the course is only for economics majors, I recommend embedding the project in a class that is taken after completing the intermediate theory courses and at least one statistics course, if you wish to incorporate regression analysis.

To aid instructors in planning, a general timeline for the poster and related assignments is provided in Appendix A, Table 1. About halfway through the course, I require students to begin exploring research topics. I purposefully do not provide specific ideas and allow them the flexibility to choose any topic related to the course. The first graded assignment I give related to the project is a research proposal, which is their first attempt at identifying a research question and corresponding data (Appendix B). This is a very low-stakes assignment (worth two percent of the total grade), since their first idea may not be feasible or need substantial changes. The proposal includes only minimal information on their research question, a link to or a copy of the corresponding data, and a description of their proposed dependent variable and independent variable of interest. At this point, it is fine to have only a partial dataset, but the final dataset must include more than two variables and a sufficient number of observations. Instructor feedback after this assignment is essential for progress. I give brief written feedback on proposals and meet with each group in class to advise them on how to move forward. Face-to-face conversations about their topics are recommended since students usually have several follow-up questions. Identifying a viable topic can be time-consuming and frustrating since students realize that data is everywhere, but it is not easy to find a ready-made dataset tailored to their chosen topics. However, I feel that this allows for a realistic simulation of what it is like to do economics research and students experience personal growth when forced to iterate and use feedback to create a feasible proposal.

Once I have approved their research topic, I give students several weeks to gather and clean data. About a week before the first draft of the poster is due, I have a full class period set

aside to meet with each group and view their preliminary results (see Appendix B). I allocate a few points to this activity but give full points for attendance and almost any attempt at a regression. This stage requires thoughtful instructor feedback. Regardless of the quality of their results, I aim to give all groups feedback on additional data to add for improvement (more variables or more observations), how to improve the model (variables to drop or add in the model), and how to use their results to make broader conclusions or policy recommendations. I expect this feedback to be incorporated into the poster.

I require a first and final draft of the poster. I have tried only requiring a final poster, but the projects are greatly improved after only one round of revisions. Because I have already given feedback on the regression analysis, feedback on the first poster draft is concentrated on improving the overall visual display, organization of information, and writing. Before the assignment is due, I present several good and bad examples of student posters in class, followed by a discussion of possible pitfalls and how to improve the visual display. The poster is a unique opportunity for students to be creative. Many students enjoy this aspect of the project and spend extra time working on incorporating a cohesive, visually pleasing poster. Regardless of the quality of the first draft, all students benefit from specific feedback on how to effectively use the space and how to improve their writing. Unlike papers, posters force students to be clear and concise about their findings. Long paragraphs and tables are not an effective use of space in posters. This reduces the time the instructor spends providing feedback compared to a paper draft.

The main sections of a poster include an introduction, model and data, results, and conclusion (see project instructions in Appendix C). In the introduction, a well-placed and relevant picture can help to draw interest in the topic. The research question should be set apart or highlighted so it is easily found. The model and data section includes information on relevant variables in the analysis. The results section will likely take up the largest part of the poster and include at least a graph, an abbreviated descriptive statistics table, and a results table. Highlighting the main empirical results clearly should be emphasized in the poster. To facilitate the feedback process, I give written feedback to each group and require at least one in-person meeting with me before the final draft is due. I allow the students to return for more feedback after making revisions if desired; the best posters come from groups that have elected to do several rounds of revisions. Make sure to remind students of the proper font size for text and tables and include that information in the assignment instructions.

After the final draft is due, schedule a poster exhibit for students to display their work. This event can be scaled up or down to the instructor's preference. The easiest event is a simple in-class poster exhibit. Tape the posters on the classroom walls and have students circulate to visit other posters. For a large class with many poster projects, posters can be displayed in multiple rounds. Have at least one group member stay at the poster at any given time, but otherwise encourage students to circulate, learn about other projects, and ask questions. To engage students, I distribute a participation worksheet that has specific questions that require thinking critically about other projects (Appendix D). Optionally, students can evaluate all posters and vote on the best overall poster or the one with the best visual display. To incorporate an additional element of oral communication or for a small class, tape the posters up and have students give a short presentation of their research and results at the beginning of the event. Then use the remaining class time for students to circulate and look at posters. If students are doing posters individually, post a blank sheet of paper next to each poster and have students write comments and questions about other projects on the sheets. For guidance on how to scale this event up, see Section III.

B. Modifications of the Poster Project

Throughout the semester, I use lectures and assignments to build the skills needed to complete the final research project (see the timeline in Appendix A, Table 1). My personal preference is to incorporate regression analysis; thus, I discuss this option at length in the first half of this section. Because regression analysis and interpretation can be difficult for students, I review regression analysis early in the semester. This includes a statistics review lesson, with an emphasis on how to assess the fit of the model, how to determine the statistical significance of coefficients, and how to interpret coefficients. I do an in-class lab by distributing a dataset, having students run the regression on their laptops in class, and going through each of these elements. Students repeat the regression analysis in two homework assignments (Appendix E, Homework 1 and Homework 2) and elements of regression analysis appear on exams, to reinforce the concepts. The repetition is key since it allows students to be proficient in generating and understanding regression output when completing the final project. In my environmental class, the data and regression examples I use are centered mostly on environmental valuation, like hedonic pricing, travel cost, and contingent valuation. This is easily altered to fit other applied fields. I require students to use Excel to run OLS regressions. Although Excel is inferior to more sophisticated statistical software, particularly with regression analysis, all students have access to it and have at least some basic knowledge of how to use it.[3] Because some students in my class are not economics majors, experiences with statistical software vary greatly. Even when students have exposure to regression analysis in a statistics class, they are not fully equipped to apply this knowledge without specifically being shown how to do it. Therefore, if you choose to require regression analysis for the project, I suggest spending about two hours in class on statistics and regression analysis and another 45 minutes of an in-class lab for students to practice running a regression on their own. This helps eliminate any procedural mistakes that might be made in related assignments.

If Excel is the main tool used for regression analysis, it has several pitfalls. One issue is that Excel does not automatically drop observations with missing values. In one assignment, I had students enter data into Excel from surveys they administered (Appendix E, Homework 2). Inevitably, respondents skip some questions, leading to missing values for multiple variables. If the selected data range for regression analysis contains a missing value, it will create an error message. Warn students in advance that observations with missing values will need to be manually deleted (filters will not work for this purpose). Similarly, creating dummy variables from a categorical variable is not as seamless as in Stata or other statistical software. For variable creation, I teach them to use filters as a way to save time and avoid mistakes from manual data entry. Finally, Excel regression output is not formatted in a presentable table that is appropriate for assignments. I present good and bad examples of descriptive statistics tables and regression results tables in class and require that students create nice tables (copying and pasting Excel output into assignments is not permitted). I have had difficulty getting students to create decent tables, even after discussing them in class. However, tables improved substantially when I began adding simple examples of tables directly in the assignment instructions (Appendix E, Homework 1).

There are some common issues that students have when analyzing regression output and communicating the results. First, students often have difficulty interpreting regression coefficients. These range from only reporting the sign of the coefficient, inverting the x and y

[3] Barreto (2015) argues that Excel can be a good choice for instructors not wanting to explicitly emphasize software. Yet excellent alternatives to Excel exist. For example, Gretl is an open-source option that comes with datasets from popular econometrics textbooks and articles and is superior to Excel in data analysis and producing visual displays.

values in the explanation, and misreporting the specific amounts. I suggest giving many examples and reviewing this concept throughout the semester to reinforce it. If assignments require the use of dummy variables, offer separate examples and explanations of how to interpret these coefficients. The meaning of the F-statistic and the process of hypothesis testing can be difficult concepts. If it is not particularly important to the instructor, the F-statistic can receive less attention for this project. Alternatively, present a solid explanation for the process of hypothesis testing and give plenty of examples of how to discuss the results. Students quickly learn which coefficients are statistically significant using p-values, yet it is important to emphasize what "significance" means, as they may not understand the underlying null hypothesis. Finally, students struggle with writing about data and empirical results. With descriptive statistics tables, students will either write too much by mentioning all of the statistics in the table or will write too little and fail to use any of the numbers from the table in their writing. I prepare students for pitfalls before the project by requiring them to write about data tables in a series of homework assignments (Appendix E). With regression results, students frequently do not know what information to include in their writing. I give a specific list of items that should be discussed in assignments to avoid this. I also present good and bad examples of writing about data in class, so that students practice evaluating writing and apply this to their assignments. Incorporating other elements of peer review can be effective if desired, since students are very quick to pick up mistakes in others' writing, more so than their own.

For graduate students or advanced undergraduates, modifications can be made to increase the rigor and quality of the research. I have used this poster project in a master's level research methods class with excellent results. To increase the rigor, add more emphasis on a proper literature review, require the use of statistical software and programming, or allow for more complex analysis (for example using discrete choice, panel, or time-series models). Graduate students tend to find a project idea faster than undergraduates and are much more comfortable with data cleaning and analysis. Even at the graduate level, I highly recommend meeting with students in class to offer regular feedback on the initial idea, preliminary results, and the first poster draft. Graduate students tend to focus on the analysis and modeling and if left alone, will not spend as much time on the visual display. Emphasize that the visual display is as important as the rest of the project and they will produce visually pleasing and creative posters.

For undergraduate students who have not been exposed to regression analysis, modifications can be made to decrease the rigor of the statistical analysis. Two of my colleagues have done this successfully by requiring some combination of descriptive statistics, correlations, or t-tests instead of regression analysis. To lighten the student workload, provide a dataset or a list of preselected topics for the projects. The final poster can place more emphasis on the existing literature, rather than original research and analysis. To streamline the poster, offer a preformatted poster template; this reduces the amount of instructor time spent on feedback for visual display.

Barriers to using the poster project include the cost and environmental impact of physically printing posters. On my campus, several departments can print posters for a fee of about $30 each. Some coordination with the poster printing service is required in advance to ensure printing is feasible for the event. Students may have to submit posters 24 to 48 hours in advance, to allow time for printing. I have successfully been able to get the poster printing costs covered by my department, to reduce the financial burden on students. But obtaining funds for such an event may not be feasible. In addition, a larger event may include other budget items like food and a way to display the posters, like large display boards. These items enhance the event but make it more costly and complex. To address these concerns, in the last five years, I have required electronic posters and displayed them on screens in an active learning

classroom. Examples of traditional and digital posters are given (Appendix F) and instructions for both types of posters are provided (Appendix C). Since the screens are not big enough to display a 2x3 foot poster, I have modified the poster to be a hybrid between a presentation and a poster. The electronic poster has five or six slides, but the use of space on each slide is similar to a traditional poster. I have students use prerecorded animations on a loop so that the poster cycles through the content seamlessly. The electronic poster model has worked better than I expected and I see no major downsides to using this format over printed posters. In our active learning classrooms, there are eight large display monitors. If there are many posters for the event, arrange several rounds of posters, with each round displaying posters for 20 or 30 minutes. If you do not have access to an active learning classroom nor have funding for poster printing, use the electronic poster assignment and have each group give an oral presentation to the class one project at a time.

3. Using the Poster Project to Foster a Culture of Research

In the economics education literature, it is recommended that departments foster a culture of research for undergraduates (Hoyt & McGoldrick, 2017). I argue that hosting a poster event is one strategy departments can use to foster a culture of research. Students find the poster event much more accessible than seminars and less intimidating than formal presentations. The event shows students that the department fosters, encourages, and rewards student research efforts. Students work very hard on their projects and generally enjoy presenting their work in this format. On the other hand, oral presentations in class are very intimidating to students. In addition, department events like research seminars are difficult for undergraduates to participate in, because the material is rigorous. For these reasons, it is difficult to encourage questions and discussion about student projects in traditional class presentation settings or department seminars, in my experience. However, the poster event is a relatively non-threatening environment, and with one-on-one interaction, students can easily engage with others about their ideas.

I run the poster event as a friendly competition, with first and second-place winners and a student-chosen winner for best visual display. I do not stress the competition aspect of the event much to my students, but it encourages them to do their best work on the poster and rewards students with very high-quality products. The competition also helps give the event more purpose, since students may not be as interested in research for research's sake, but they do like to learn who receives the awards after carefully evaluating the posters themselves. When I use the digital poster format, I organize posters into two or three rounds, for about 30 minutes each. To get others involved, I recruited three faculty judges to independently score each poster on predetermined criteria (visual display, quality of research, etc.). The highest ranked posters are discussed and the judges determine first and second place winners. The students get to vote for one poster, other than their own, with the best visual display. Prize winners are given small gifts from the university bookstore (for example, pens, paper pads, or reusable water bottles with the university name), and certificates with their name and award are printed after the event.

This event is easily modified to meet the needs and goals of a department. The competition aspect can be removed or the poster event can be one element of a university- or college-wide research event. For small departments, there may be opportunities to collaborate across departments; on my campus, multiple departments do some version of a research poster event, and combining events may be a way to collaborate and share resources. To set up the poster exhibit as a more formal department event, refer to the suggested timeline in Appendix A, Table 2.

4. Outcomes and Conclusion

I have held the poster exhibit as a department event annually for eight years in a row. We have had a total of 403 student participants engaging in research and presenting posters. Our largest event had about 80 student participants in three separate classes (with three instructors), including International Economics (300-level), Urban Economics (400-level), and Research Methods (master's level). I have recruited six faculty volunteers to participate as judges over the years, which is about half of the department's tenured and tenure-track faculty. The event has always gone very smoothly each year. After the initial setup of the event, things run fairly well without much effort on the part of the organizer. We now have a standing department research outlet, where students can come together and discuss research that has fostered a culture of research in the major. I have recruited three other faculty members to use this method in their classrooms, thus expanding the research experience to more than my students.

Beyond having a successful event, the students have a research product and research experience that they would not have had otherwise. Although I have not formally assessed this experience, from the final product, it is clear that students have achieved learning outcomes crucial to their major and obtained proficiencies that will serve them well beyond their degree. Students who complete the poster demonstrate that they can access existing knowledge, display command of existing knowledge, interpret and manipulate economic data, apply existing knowledge, and even create new knowledge. The current recommendation to foster student engagement is that undergraduates participate in one high-impact practice during their freshman year and one in the context of their major (Kuh. Schneider, & Association of American Colleges and Universities, 2008). Moreover, students who do research with faculty are more likely to persist, grow intellectually, and choose a career related to research (Kuh et al., 2007). Due to the rich student experience and benefits that undergraduate research provides, I believe that providing a research experience in the major should be the norm for all economics departments. Yet I realize that engaging in student research outside of class is extremely time-consuming for faculty and resources may not be available to implement a senior capstone or thesis. The method I provide of embedding a research experience into upper-level courses is a reasonable alternative. Although this will require more time than not engaging students in research at all, I have found this learning experience to be completely worth the effort and personally rewarding; you will be surprised at what your students can accomplish if given the opportunity for growth.

Students increasingly need these experiences to understand what economists do and to hone their skills for their future education and career. These rich learning experiences are even more crucial for underserved minorities for upward mobility and graduate education. Thus, our profession should be doing more to foster and fund high-impact practices at Minority Serving Institutions. In the meantime, the strategies described in this paper can help lower the individual time investment for instructors to facilitate a high-quality research experience in their courses.

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5. Appendices

Appendix A includes a general timeline for all assignments and a timeline for organizing the poster event. Appendix B provides the proposal instructions and Appendix C provides the poster instructions. Appendix D offers a list of participation questions for the poster event. Appendix E contains optional homework assignments that can prepare students for the poster project. Finally, Section F gives examples of the traditional and digital poster formats.

Appendix A. Timelines for Poster Project Assignments and Organizing a Poster Event

This is a suggested timeline for materials and assignments related to the poster project for a 15-week semester (suggested in-class hours are also included).

Table 1: Semester Timeline for Poster Project Assignments

Activity	Week	% of Course Grade	In-Class Hours Needed
In-class - Review statistics and data analysis concepts	2	0	1-2*
In-class - Lab on regressions or other data analysis	3	0	0.75
Homework 1 - Data Analysis & In-class review of answers	4	4%	0.5
Homework 4 - Finding a Journal Article in EconLit and Summarizing & In-class review of using EconLit**	5	4%	0.25
Homework 2 - Data Cleaning and Analysis (uses a more complex dataset) & In-class review of answers	7	4%	0.25
In-class - Lab on how to produce basic visual displays in Excel	12	0	0.75
Homework 3 - Finding Data and Creating Visual Displays	12	4%	0
Poster Project Proposal Assignment & In-class meeting with students about the proposal	10	2%	1.25
In-class - Meeting with students about preliminary results	14	1%	1.25
First Draft of Poster	15	9%	0
Final Draft of Poster	15	5%	0
Poster Event Attendance and Participation	15	3%	1-3***

* Rigor will dictate the time needed in class to explain the techniques. For regression analysis, I suggest two hours for descriptive statistics and one hour for correlations.
** Homework 4 can be removed completely or used as a starting point for a more careful literature review. This assignment can be moved to almost any week before the poster assignment begins.
*** This can range from one class period to several hours if it is part of a department or university event.

This is a suggested timeline for those who wish to set up a department or university poster event.

Table 2: Timeline for Organizing a Poster Event

Time	Activity
Before the semester starts	Talk with the department chair about funds and resources available for a poster event. The university may have small grants for high-impact practices or student research that are used for these events. Ask if it is feasible to fund the printing of posters, serve drinks and a snack at the event, or give small prizes to poster winners.
Before the semester starts	Ask if other instructors would like to incorporate the poster project in their class before the syllabi are finalized. I have found colleagues to be receptive to incorporating this project, particularly when I share assignment instructions and have secured funding for the event.
Start of the Semester	If applicable, make contact and arrange details for printing posters with the appropriate department or office.
Start of the Semester	Talk with staff about reserving an appropriately sized room for the event. For larger rooms, reservations may need to be made several months in advance.
One Month in Advance	After the time and place are finalized, construct a simple event flyer for distribution (to post on walls and for email distribution).
One Month in Advance	Invite department colleagues to attend formally and ask them to invite their students. Make sure to have a couple faculty members who like to ask a lot of questions lined up to attend. Consider inviting colleagues and administrators outside of the department (if you are not tenured, I recommend this!). They may not attend, but it increases the visibility of your efforts.
One Week in Advance	Prepare materials for the event. Optional items include a sign-up sheet for student attendance and guests, nametags, and ballots for voting. Recommended items include a placement chart that shows where each poster will be displayed and participation questions for students to stay engaged during the event.
Day of Event	Allow plenty of time for set up (30-40 minutes before the event starts). Have at least one student per poster arrive 10 minutes before the event starts to help display their poster. Check-in is always the busiest time. I often recruit a student volunteer to help get students signed in, show them where their poster will be displayed, and take pictures of each poster during the event.
After the Event	Display the posters and pictures of the event on the department website and social media accounts, if desired. Announce the winners on these platforms (if applicable) and congratulate all participants for a job well done. Thank anyone else who supported your efforts with funds or with their time.

Appendix B. Poster Proposal Instructions

Sample Research Proposal Instructions

Purpose

This assignment will help your group identify a research question, which can be answered using available data. This will be one part of the research project. The total research project is divided into a proposal, progress report, poster draft, final poster, and poster exhibit.

How to Identify a Research Question

I suggest starting with broad topics that you each are interested in. The topic must be related to the environment or natural resources. To get some ideas, you can look at the table of contents from our textbook. Next, try brainstorming on questions that you think might be interesting within that broad topic. Start with one of those questions and think about what data you would need to answer the question using regression analysis. Search for the data on the internet using keywords. Please use reputable, publicly available data (like government agencies, data provided on a university website through a research center, or well-known organizations that collect economic data). What you will likely find is that the data you need is not readily available (this is the challenging part). So, depending on your findings, you may decide to explore a different question or alter your question to fit a dataset that you find. This is an iterative process. Do not be surprised if you have to revisit new questions and datasets. Data availability will be the limiting factor. Remember, your goal is to run a regression where you are trying to explain one variable (dependent variable) with other factors (independent variables). With that in mind, data that are readily available or feasible to put together in the given period include survey data, detailed firm data, city data, state data, or country data. You may also need to pull data together from different sources. Please talk with me if you are having difficulties or have any questions.

Proposal Requirements

At this stage, I do not expect your research question to be polished or fully developed. But this should help organize your ideas and allow me to provide early feedback on your topic. In a Word document, you will need to include the following.

1. State the research question that you hope to answer.

   Example: What value do Long Beach residents place on living close to the Colorado Lagoon?

2. Briefly describe the dataset you have identified. Include the direct website URL and state the source of the data.

   Example: I will use housing data from Belmont Heights in Long Beach, paired with spatial data on the proximity to the Lagoon. The dataset includes all houses sold in the neighborhood in 2010, the house characteristics, and the distance from the Lagoon to the house. The data source is the LA Office of the Assessor (www.DirectLinkToTheData.com).

3. Briefly describe the variable that will be the dependent variable and the independent variable(s) you are most interested in (these should align with the research question that you've identified).

Example: The dependent variable is the sale price of the house and the key independent variable is the distance from the Lagoon.

Submission: Please submit your Word document by the due date. If your data source URL does not lead directly to your dataset, please also include your data in an Excel file).

Feedback and Preliminary Results

After you submit your proposal, I will provide you with feedback on your topic. Based on my feedback, you may need to change topics or focus, this is completely normal in research. Changing an approach or focus to address feedback or flaws makes research better. After I have approved your topic, you will get your dataset prepared for analysis and provide me with preliminary regression results in class on the due date. This can simply be results in an Excel spreadsheet with no special formatting necessary. You may still have to gather data or do more data cleaning, but this will help you make progress toward completing the analysis. I will meet with each group individually to review your results and provide feedback.

Appendix C. Poster Instructions and Grading Rubric

Sample Group Poster Project Instructions

Project Topics

You may do the group project on any environmental or natural resource topic. However, you may not use the same data from any previous assignments. The project proposal was designed to help you begin thinking about a viable topic. Hopefully, the feedback from the proposal can help guide you in a direction for the project. By week 13 of the semester or earlier, you should have a finalized topic and dataset for the project.

Poster Requirements

The posters will be in a digital format and displayed at a poster session on individual screens in an active learning classroom. Because of the screen size, not all of the information you want to convey will fit on one PowerPoint slide, like you would do for a traditional poster. So, you will have to fit the information on multiple slides. For the best visual display, don't use the traditional PowerPoint slide formatting that you would use in a face-to-face presentation. Instead, use textboxes to place information on each slide in an aesthetically pleasing way. Your slide show can be recorded and saved so that during the poster session, your presentation will run on its own and loop until you stop it. You will not be able to use audio for the poster session.

The digital poster should include at least one chart or graph, descriptive statistics for key variables, and results from a regression model. Consider adding additional charts, tables, statistics, and pictures if it will help the reader understand your results or topic. Any tables should be presented in an aesthetically pleasing way, so do not simply copy and paste output directly from Excel's output. Instead, organize the information in a concise table with clear headings, variable names, and titles.

The elements below are required in your digital poster.

Introduction: Introduce the research topic, provide background information to understand your topic, and make the research question and main objectives clear.

Data: Provide information about the data including the source, number of observations, important info on how data are collected, and what information/ variables are found in the data set. Use charts/graphs to show important trends or information that is central to your research question. Provide descriptive statistics (mean, standard deviation, minimum, and maximum) on variables that are important in the analysis. Especially for the poster, you want the descriptive statistics table to be a relatively small part of the poster, so you should not include all variables in the table.

Results: Provide regression results in one or more tables. Due to space constraints, you only want to provide the important information (e.g. coefficients, standard errors, p-values, adj. r-squared, sample size, F-stat). Make sure that the reader understands what the dependent variable is. Summarize your main results from the regression in a way that is easy to understand. Provide at least one interpretation of a coefficient from your regression results.

Conclusion: Summarize your research, answer the research question that you posed in your introduction, and provide information on how the study can be improved and the relevant policy implications.

Some of your text can be in paragraph form and some can be bullet points. However, long paragraphs should be avoided, since they will be hard to read. Use your judgment as to what is the best way to convey the information in the best possible way and be creative in using space on slides.

How to Make a Digital Poster

The easiest way to make a digital poster is to use PowerPoint. First, choose your background. PowerPoint has templates, but I recommend creating custom slides. Then figure out what type of layout you want for each slide. I suggest not using the pre-determined formatting for most of the content of your slides. Instead, start with a blank slide and insert text boxes, pictures, tables, and graphs where needed to use the entire slide. Once you are done editing your poster content, you can record the slide show. Go to the Slide Show tab, click on "Record Slide Show," then on "Start Recording from the Beginning." It will record the timing of when you move to the next animation or slide. When you are finished with all of your slides, right-click and select "End Show." It will automatically save your timings, just save your file once you are done. To have it loop, click on the "Set Up Show" and check the box "Loop continuously until Esc," click OK, and save. Now when you play your slide show from the beginning, it will scroll through your slides with your timed recording and loop. Try not to use a font size smaller than 18-point. Do not exceed five slides.

How to Make a Traditional Poster

Posters can be designed in PowerPoint with a size choice of square 36"x36" or rectangle 48"x36". To set the slide size, follow the below steps:

1. Go to the Design tab in PowerPoint.
2. Under Customize, click on Slide Size and select Custom Slide Size.
3. Enter the width and height (in inches) in the corresponding boxes, click OK.
4. In the pop-up box, select Ensure Fit.

Make sure to resize the document before starting to add content. Now you are ready to insert text boxes, pictures, tables, and graphs to create your poster. I suggest a 24-point font for text, 36-point font for subtitles, and 80-point font for the poster title.

In-Class Group Work and Progress Report

You will allowed the opportunity to work in groups in class. During one class period (week 13), you will meet with your group and I will be available for questions and feedback. In the next class period (week 14), each group will provide me with an informal report on your progress and show me the results of at least one regression using your data. The "progress report" does not have to be written, but you should be prepared to explain your research question, describe the variables in your model, and show me at least one regression result. I will provide additional feedback for each group. Use your in-class time wisely. Students are expected to attend class and work in your groups the entire class period on both days.

First and Final Draft of Poster

The first draft of your poster is due early in week 15. Once you submit your first draft, one or more members of your group should seek feedback from me sometime before the final draft is due. Based on this feedback, you will revise your poster. Submitting your work, getting feedback, and incorporating feedback to improve your work is part of any research project. Addressing feedback is a primary element of your final poster grade.

Poster Event

The poster event will be held at the end of week 15. You should arrive 10-15 minutes early with the poster file on a memory stick or laptop that can hook up directly to the screen. Before you enter the classroom, you will need to check in at the registration table. The exhibit is free and open to the public, so feel free to invite guests to come see your poster! Attendance and participation are mandatory and is part of your grade.

During the poster session, you will be evaluating your fellow students' posters and answering questions about your poster. At least one of your group members must be with your poster at any given time, so that attendees can ask questions about your research.

Your poster will be automatically entered in the Economics Department Poster Competition, which will be held at the same time. Posters are judged by a panel of faculty members and first and second place winners will be identified. The outcome of the competition is just for "bragging rights" and has no bearing on your grade for this assignment.

Poster Grading Rubric

To get full credit, you must submit your digital poster and the Excel file with the data you used, regression results, descriptive statistics, and any graphs/charts created.

Your total grade for the first poster draft will be based on the following elements (45 points):

Research Question (10%): The research question asked can be answered with data analysis and is on an appropriate natural resource topic.

Data Analysis (40%): Appropriate data are used, regressions are correctly run, and results are properly interpreted.

Information Provided on Poster (30%): All information is well organized. Each element of your poster is clearly described (intro, data, results, and conclusions). The writing is free of grammatical and typographical errors.

Visual Presentation and Creativity (20%): The information displayed is visually appealing and interesting. Text and information should fit properly on the poster slides. Graphs and data tables are labeled and are easily understood without written explanation.

Your total grade for the final poster draft will be based on the following elements (25 points):

Research question (10%): The research question should be prominently displayed and clearly stated in the poster.

Data Analysis (30%): Tables, graphs, explanations, and interpretation of results is clear and correct. All feedback from the draft was addressed.

Information Provided on Poster (30%): The information is well organized and all of the appropriate information is provided to understand your research. The writing is free of grammatical and typographical errors. All feedback from the draft was addressed.

Visual Presentation and Creativity (30%): The information displayed is visually appealing and interesting. Text and information fit properly on the poster. Graphs and data tables are labeled and are easily understood without written explanation. All feedback from the draft was addressed.

Poster Tips

- A Google search will provide many examples of academic posters. You can use these to get ideas on how to organize information. You may not copy any text from another poster, paper, or website and use it as your own. That means that all text, graphs, data analysis, and data interpretation must be your original work.
- Make sure the text will be visible by using light-colored backgrounds with black text.
- For your charts/graphs, make sure to label all axes and curves/lines and provide titles.
- I suggest using at least one picture. You can also be creative and make your own slide backgrounds with pictures. Be sure that the picture quality is high enough so that it doesn't appear pixelated upon display.
- Be creative! Unlike other assignments, for the poster assignment you are graded on visual display/creativity as well.
- Do any format changes of graphs or tables outside of PowerPoint (formatting can be more difficult in PowerPoint).
- Assume that the audience for your poster is an advanced undergraduate with an understanding of regression analysis. Keep it simple and limit the amount of technical information or jargon in your poster.

Appendix D. Participation Questions for Poster Event

Sample Poster Event Student Participation Questions

Instructions: You should make sure that one person in your group is near your poster and available to answer questions at all times. Other than that, you are encouraged to visit and discuss other student's posters during the poster session. Turn in this sheet before you leave.

There will be three rounds of posters. Try to use at least one poster from each round to answer the questions below. Keep your responses brief.

1. Choose any poster other than your own. Provide the round and table number of the poster and provide one suggestion for improvement on the visual display.

2. Choose any poster other than your own. Provide the round and table number of the poster and provide one suggestion for improvement of the data analysis.

3. Can you find one typo in any of the posters? Provide the round and table number of the poster and briefly mention the mistake. If you cannot find any, just say none.

4. Besides your poster, which poster did you think was the best overall? Explain why you chose this poster.

Appendix E. Homework Assignments Leading to the Project

For instructors planning to use regression analysis, I suggest at least three homework assignments that help students practice data cleaning, running a regression, interpreting results, and producing visual displays. I use very similar questions for the first two homework assignments but change datasets. In Homework 1, I provide a clean dataset (no missing values, all dummy variables coded, and no non-numerical text). In Homework 2, students use survey data that they collected, which typically includes missing values, data errors, and categorical variables that are non-numerical. To complete the assignment, they must learn to deal with missing values (if using Excel) and create their own dummy variables. This is excellent preparation for issues that will arise with real data gathered for their projects. Homework 3 focuses on finding data from a website and creating visual displays.

Modifications can be made to these assignments to exclude regression analysis or emphasize different aspects of research. For example, if you decide to only use descriptive statistics and correlations, in Homework 1 you can have students do all but questions (4) and (5) and replace them with the type of analysis and interpretation that you would like them to perform. You can still repeat the assignment with two different datasets for practice. Or, if you decide to emphasize visual displays, you could repeat Homework 3 instead, adding complexity to the type of displays students must produce the second time. Finally, you can add a journal article summary or annotated bibliography assignment to these, which adds emphasis on literature reviews and writing about economics research. An example of this type of assignment is given in Homework 4; I typically do this assignment immediately after Homework 1, but it can fit in at any point during the semester before the poster is due.

Homework 1 – Data Analysis

This assignment is designed to help you become familiar working with data in Excel and describing data and results. Homework 1 will rely on housing data from Long Beach (this is actually an example of a hedonic pricing model, which we will talk about in Chapter 4). The list below describes some of the details of the data set.

- Source: Zillow.com
- Each observation is a single-family home
- Houses are from Belmont Heights and Alamitos Heights in Long Beach, CA
- Variable definitions are found in the worksheet labeled "Variable Definitions"
- All houses in the sample were sold between 2000 and 2011
- The variable uniqueid should not be used in the data analysis; it is just a variable numbering each observation for your reference

Using this data set, answer each of the below questions.

1. In a short paragraph, provide a brief description of the data. This should include the following things: the data source, where houses are located/type of houses, number of observations, and a description of the variables found in the data set.

2. Generate descriptive statistics for each of the variables in Excel as we did in class. Use this to generate a table in Word that provides the mean, standard deviation, and maximum and minimum values for each variable (including dummy variables). Do not copy and paste the format of the output directly from Excel. Instead, organize the descriptive stats in a concise table with a clear title and variable names. See Table 1 for an example.

3. In a short paragraph, briefly describe the descriptive statistics table that you have created. You do not need to include every number in the table, but rather, choose to highlight some of the variables that you think are important in the data set. Talk about the last sale price variable and some of the house characteristics. If there is anything odd about the data (e.g., the mean is higher/lower than expected or there is an unexpected min/max value), be sure to mention that in the paragraph.

4. Run a regression in Excel, using the last sale price as the dependent variable and all other variables in the data set as the independent variables. Use your Excel output to generate a table of these results in Word; again, do not copy the result format directly from Excel, results should be in one table. For each independent variable, include the variable name, coefficient estimate, standard error, and corresponding p-value. Also include the F-stat, Significance F, adjusted r-squared, and number of observations, in the table. See Table 2 for an example.

5. Provide a paragraph or two describing the regression results. This should include: which variables are statistically significant (and state the confidence level you use), which variables are not statistically significant at your confidence level, interpret the coefficients on the distance variable and view the dummy variable, and describe the signs of the statistically significant coefficients (are they positive or negative). If any of the results are not as expected (in magnitude or the sign), say so. Based on the F-stat/ Significance F, discuss the overall significance of the model (i.e. do you reject the null hypothesis and what confidence level is used). Interpret the goodness of fit of the model using the adjusted r-squared value. How can the model be improved?

Example of a descriptive statistics table:

Table 3: Regression Results for Number of Trips to Wrightsville Beach

Variable	Mean	Standard Deviation	Min	Max
Plant Size in 1996 (in mega-watts)	693.443	680.565	23.224	4048.650
Firm Size in 1996 (in gigawatts)	5.354	5.641	0	23.301
Plant Age in 2004 (in years)	38.708	13.553	8	104
Number of Generating Unit Retirements in the Plant	0.127	0.605	0	6
Distance to PRB (in miles)	1281.650	566.920	3	2386
Plant SO_2 Emission Rate Standard (in lbs/mmBtu)	2.262	1.871	0.006	12.609

Example of a regression results table:

Table 4: Regression Results for Number of Trips to Wrightsville Beach

Variable	Coefficients	Standard Error	P-value
Intercept	-2.292	7.662	0.765
Household Income (in thousands of dollars)	-0.119	0.033	0.000
Travel Cost to Wrightsville Beach	-0.046	0.012	0.000
Travel Cost to Outer Banks	0.035	0.013	0.008
Beach Quality Rating	5.953	1.937	0.003
F-Stat		14.113	
Significance F		0.000	
Adjusted R Square		0.259	
Number of Observations		151	

Homework 2 – Data Cleaning and Analysis

This homework will focus on analyzing data collected from the contingent valuation survey completed in class. These instructions are posted along with the survey data.

For Homework 2, use this data set and do the following tasks:

1. In a paragraph, provide an introduction of the topic that is addressed by the in-class survey as well as a brief description of the survey and data. This should include the following things: how the sample was selected, what type of questions were asked on the survey, number of observations (total number of surveys), and a description of the variables.

2. As you start looking through the data, you will notice that there are a lot of variables. Using all of the variables in the model will not be the best possible model. You will use willingness to pay for the single-use plastics policy change (question 5.2, with variable name WTP_value) as your dependent variable. You will need to choose which variables you want to use as independent variables in your model. Usually, researchers do this partly based on what has been done in related studies, what theory says should be included, and what is the best model for your data. I would suggest selecting at least one variable from Part 1 and at least one variable from Part 3 of the survey. You must use a minimum of three independent variables. (You do not need to show any work or provide an explanation for this step.)

3. Once you have chosen your model, generate descriptive statistics for your dependent and independent variables. Your descriptive statistics table should include the mean, standard deviation, maximum and minimum values, and the number of observations for each variable (due to missing observations, this can vary across variables if you run the analysis before removing any observations). If you do the descriptive stats after removing missing data and the number of observations is the same for all variables, you can just provide observations in a separate row at the bottom of the table. As before, do not copy and paste directly from Excel. Instead, organize the descriptive stats in a concise table with clear headings (variables on the row, statistics on the column – see Table 1 from Homework 1 instructions).

4. In a paragraph, describe the descriptive statistics from the table that you have created. You do not need to describe every number in the table, but rather, choose to highlight some of the variables that you think are important or interesting. Definitely talk about the willingness to pay variable and some of the respondent's characteristics. If there is anything odd about the data (e.g. the mean is higher/lower than expected or there is an unexpected min/max value), be sure to mention that in the paragraph.

5. Run a regression in Excel, using willingness to pay for the policy changes (question 5.2, variable name WTP_value) as the dependent variable and use the variables you selected from #2 for independent variables. Use your Excel output to generate a table of these results and transfer it to Word (again, do not copy results directly from Excel and create one cohesive table with the results – see PS1 instructions, Table 2 for an example). For each independent variable, include the variable name, coefficient estimate, standard error, and corresponding p-value. Also include the F-stat and corresponding significance F, number of observations, and adjusted r-squared somewhere in the same table.

6. Provide a paragraph or two describing the regression results. This should include: which variables are statistically significant at a specific confidence level, interpret the coefficient for one significant variable (if none are significant, choose any), and describe the signs of the statistically significant coefficients (are they positive or negative). If any of the results are not as expected (in magnitude or the sign), say so. Based on the F-stat/Significance F, discuss the overall significance of the model (i.e. do you reject the null hypothesis and what confidence level is used). Interpret the goodness of fit of the model using the adjusted r-squared value. How can the model be improved?

***Note about the data**: Make sure to give yourself plenty of time to work with the data. Although you are answering the same questions as with Homework 1 (descriptive stats and regression), the data set now has missing values. For descriptive statistics, this is not a problem. But, for regression analysis, Excel cannot easily deal with this, so you will have to drop the observations (manually) that have any missing data before running a regression. This may impact your choice of independent variables (i.e. use variables that don't have many blank responses). You will also need to make sure that the independent variables you use are in columns that are next to each other. I will give you some tips on how to deal with these issues in class.*

Homework 3 – Finding Data and Creating Visual Displays

This assignment will focus on visual displays of data. Data for this problem set should come from the Energy Information Administration (EIA), which is part of the U.S. Department of Energy (www.eia.gov). Start by familiarizing yourself with the information that the EIA website provides. Topic areas range from information on depletable and renewable resources used for energy, electricity production and markets, environmental issues, and energy consumption.

For this report, you will produce two specific questions related to a single energy topic, gather data that will answer these questions from the EIA website, create two Excel charts to present your results in the report, and clearly explain what is in your charts.

You may choose any energy topic within the following parameters:

- The data you use must be gathered from EIA's website.
- You must generate your charts from EIA data. You may not copy and paste any charts or graphs from EIA, other students, or any other source. You will submit your Excel files to show your work (data and the charts you've created), as usual.
- The two questions that you answer should be on the same general topic.
- You must create two different types of charts (the main types in Excel are line, column, scatter, or pie charts).
- You may not choose the same topic that I use as an example below (U.S. oil imports).

To give you an example, suppose I was interested in U.S. oil imports. Using data from EIA (www.eia.gov), I can answer the two questions below.

How have U.S. imports of crude oil changed over time?

To answer this question, I can visit EIA's "Petroleum and Other Liquids" website and download U.S. Imports of Crude Oil and Petroleum Products data (which is monthly but can be aggregated to annual quantities). I can conveniently download an Excel file with this information to generate a line chart with years on the x-axis and thousands of barrels imported on the y-axis.

In 2017, what percentage of U.S. oil imports originated from OPEC and non-OPEC countries?

From EIA's "Petroleum and Other Liquids" section under U.S. imports by country of origin, total monthly imports can be obtained by the origin country. This can be aggregated to yearly data and be aggregated for OPEC and non-OPEC countries. I can generate a pie chart, with the percentages of these imports represented in the chart (or I could create a pie chart of imports from each country or groups of countries).

In your problem set, complete the following:

1. Provide an introduction paragraph that discusses your topic area and the two questions that you plan to answer. This can be a brief paragraph.

2. For each question, provide at least one chart and one corresponding paragraph describing the question/issue that you are explaining, the data that you are analyzing, mention the data source, and explain the information that is depicted in your chart.

3. In your problem set, mention any limitations that you faced (such as limited data availability on a specific topic, or any issues with the data). Also, discuss any findings that were not expected, if any.

4. Make sure all charts have titles, axis labels, and legends. You want to make sure that someone can understand your chart without any written explanation. Similarly, your paragraph should be detailed enough that one could understand the main point without the chart.

   Note: I suggest editing charts within Excel and then copy and paste it into your Word file once it is complete.

<u>Homework 4 – Finding a Journal Article in EconLit and Writing a Summary</u>

This assignment requires the identification of an environmental and natural resource economics journal article and writing a summary of that article. This will expose you to applications of economics and give you an idea of what published research in the field is like. You can use this assignment to explore a topic that you are interested in and even use this topic later for your research project. If you need any ideas on a topic, feel free to ask!

The article you choose must meet the following criteria:

- The topic must be in the area of environmental and natural resource economics.
- The article must be from a peer-reviewed published economics journal. Economics journals will often have economics in the journal name itself or will list economics in the journal scope. If you are not sure, please ask. Examples of environmental and natural resource economics journals include Journal of Environmental Economics and Management, Ecological Economics, Energy Economics, Resource and Energy Economics, Land Economics, and Environmental Economics and Policy Studies. The best database for economics research is EconLit, which can be accessed through CSULB's Library website. For this assignment, only published journal articles are allowed (no website content, working papers, dissertations, books, news articles, etc.). I don't recommend using Google as a search engine for this assignment, since you will get many non-economics, unpublished sources in the search results.

Read your chosen article and write a summary of the research from that journal article. The summary should be typed, be free of typographical and grammatical errors, and should not exceed 500 words. Points will be deducted for the summary if it is not of a reasonable quality (i.e., if the writing or the summary is poor).

In your summary, the following questions should be addressed:

1. What is the main purpose of the research (or main research question)?
2. What are the author's research methods (empirical or theoretical models)? That is, how does the author "answer" the main research question? Describe the data used, if applicable.
3. What are the author's main findings and how are their findings relevant to policy or real-world applications?

This summary should be written in essay format with perhaps one paragraph for each of these elements above (as a rough guide). Do not use direct quotes in your summary. Oftentimes, the researcher will use complicated models that you do not fully understand and that is to be expected (and you can skim the difficult portions of the paper). Your job is to summarize what the researcher has done more generally, so you do not need to include minute details about data, models, or theory. When describing empirical or theoretical models, you should report what it is that the model(s) accomplish in your own words, but again, you do not have to go into great detail. In general, when you write about research findings, your writing should be in the present tense (e.g., "Results show…" not "Results showed…"). You will also need to provide a full citation of your journal article in the Chicago Manual of Style, details on citations are provided below. Finally, please provide the full article you summarize in your submission.

Plagiarism Policy

You absolutely may not cut and paste any portion of the article into your summary. Doing so will be considered plagiarism. Quotations are rarely used in economics research papers, you will notice this as you read your journal article. Usually research findings from other papers are summarized in your own words, followed by a proper citation of this work. For this assignment, you may not use direct quotations of any kind. Plagiarism includes direct copying of partial sentences, full sentences, and full paragraphs. If you plagiarize, you will receive a zero for the assignment and additional actions will be taken.

Citation Guideline

You should use the Chicago Manual of Style when providing the full citation in your assignment. Here are two examples of a journal article citation.

(single author)

Chaloupka, Frank. 1991. Rational addictive behavior and cigarette smoking. *Journal of Political Economy* 99 (4): 722–42.

(multiple authors)

Becker, Gary S., and Kevin M. Murphy. 1988. A theory of rational addiction. *Journal of Political Economy* 96 (4): 675–700.

The number after the journal name is the volume, the number in parenthesis is the issue number, and the numbers after the colon are the page numbers. Please follow this format. You should not include information about when/where you accessed the paper (unless you are referencing a website or conversation) and the doi number is optional.

Appendix F. Student Poster Examples

Figure 1: Example of a Traditional Poster from an Undergraduate Environmental & Natural Resource Economics Course

The Natural Resource Curse: Hydropower – A Dead End Sector?

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Introduction

Climate change seems to stir up a great deal of emotion in today's society. With the planet warming at alarming rates, a tremendous amount of stress is being placed on our countries to reduce their greenhouse gas emissions. It has been observed that, because of this burden, many countries are beginning to look to the seas and the melting of the ice to answer this increasing demand for sustainable energy development. Since these countries have an abundance of the natural resource, water, developers want to exploit as much as they can in exchange for clean energy and increased productivity. Although according to the natural resource curse, this resource richness could have already set up these countries to have worse development outcomes.

So, with a greater hydro-dependence, could this natural resource be the key for reducing our pollutants while still promoting growth or will it simply end up as a dead-end sector?

Aim

When a country increases its hydroelectric capacity, this study aims to assess the effects it has on productivity and the human development index, including life expectancy and employment status.

Descriptive Statistics

Variable	Mean	St. Deviation	Min.	Median	Max.
electricity from hydroelectric plants (% of total capacity)	26.75	28.51	0	16.45	100
GDP per capita (current US$)	13864	19186	115	5076	102009
developed country_dummy	0.21	0.41	0	0	1
glacier_dummy	0.22	0.42	0	0	1
life expectancy (years)	70.05	9.43	44.84	73.27	82.98
unemployment rate (% of total)	8.88	5.79	0.50	7.70	32
CO2 emissions (metric tons per capita)	5.014	6.028	0.020	3.045	33.44
manufacturing (% of GDP)	13.45	7.74	0.87	13.45	47.92

Information was collected from the World Bank Data Inventory, the World Factbook-CIA, and the World Glacier Inventory. Of the 194 countries, 30 were omitted due to incomplete data. Dummy variables were created to control for variations within the model.

Regressional Analysis

Term	Description	Coef.	Std. Error Coef.	t-value	p-value
GDP per capita (current US$)	Reported GDP/capita	0.000132	0.000180	0.73	0.464
developed country_dummy	"1" if YES (country is developed), "0"otherwise	0.61	7.38	0.08	0.934
glacier_dummy	"1" if YES (country has glaciers), "0" otherwise	24.48	5.38	4.55	0.00
life expectancy (years)	Reported life expectancy	-0.731	0.317	-2.31	0.023
unemployment rate (% of total)	Reported unemployment percentage of total population	0.675	0.379	1.78	0.078
CO2 emissions (metric tons per capita)	Reported CO2 emissions	-1.791	0.545	-3.29	0.001
manufacturing (% of GDP)	Reported manufacturing percentage of GDP	-0.213	0.305	-0.70	0.488
Constant		76.9	20.6	3.74	0.00

Regression analysis yields four significant variables under a **90 percent** confidence level, including glacier_dummy, life expectancy, CO2 emissions, and unemployment rate.

Life expectancy **decreases** by 0.73 years, as hydroelectric capacity increases by one percent.

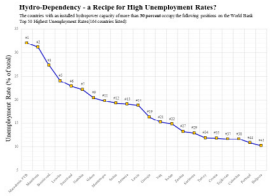
Unemployment rate **increase** by 0.68 percent, as hydroelectric capacity increases by one percent

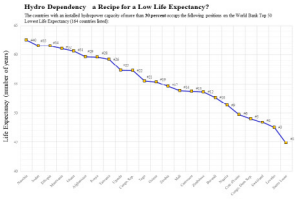
CO2 emissions **decrease** by 1.79 metric tons per capita, as hydroelectric capacity increases by one percent.

The adjusted R-square figure indicates that approx. 24.77 percent of variance in installed hydroelectric capacity is explained GDP per capita, developed country_dummy, glacier_dummy, life expectancy, unemployment rate, CO2 emissions, and manufacturing. The P-value supports this idea by adding explanatory power to the model.

Regression Stats			
F-stat	7.26	P-value	0.00
Observations	164	Adjusted R-squared	24.77%

Discussion





The following countries can be found on the World Bank Top 50 Highest Unemployment Rate **and** the World Bank Top 50 Lowest Life Expectancy (164 countries listed):

1. Lesotho (100% installed hydro-capacity)
2. Zambia (99.6% installed hydro-capacity)
3. Namibia (66.7% installed hydro-capacity)
4. Sudan (66.3% installed hydro-capacity)
5. Swaziland (40.3% installed hydro-capacity)
6. Mauritania (36.9% installed hydro-capacity)

Note: numbers above country data points indicate rank on the mentioned list.

Putting the United States in Perspective

The U.S. has a hydroelectric capacity of 7.6 % and ranks…

#35 on the World Bank Top 50 **Highest** Life Expectancy

#50 on the World Bank Top 50 Highest Unemployment Rates

Conclusion

In terms of productivity and the Human Development Index, this resource is a dead-end sector. Although increasing the hydropower capacity does allow the country to reduce its greenhouse gas emissions, it simply doesn't have much spill over into doing other things well. The life expectancy of the country actually decreases as the hydroelectric capacity increases. The same goes for the unemployment rate. As hydroelectric power increases, the unemployment rate will also increase. These effects will, in turn, impede economic growth.

So even though water may be an abundant source for many, a country should not focus all of its energies on this single renewable energy industry. If it neglects other major sectors, it will surely suffer.

Figure 2: Example of a Digital Poster from an Undergraduate Urban Economics Course