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Tackling Wicked Problems in Applied Economics:

An Application to the Bears Ears National Monument

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Abstract

The term "wicked problems" is not well recognized in the field of applied economics. Normally used to describe situations or scenarios that are difficult to solve using standard modeling methods, these problems are often highly complex and span multiple disciplines. As a result, traditional methods for teaching economists how to problem-solve may not suffice. In this paper, we assess whether or not the case study method is an possible strategy to better equip students to deal with, account for, and solve wicked policy problems in applied economics. We focus on a single, but highly timely and relevant wicked-type policy problem: "Whether or not to change the designation and/or size of the Bear's Ears National Monument in Utah." The Bears Ears issue has all the hallmarks of a wicked-type problem. There are many sides to the issue and thus many diverse key stakeholders involved. To address this issue we ask students in an advanced applied economics course to role-play as members of a private a consulting firm hired to and to determine the "socially optimal" size of the Bears Ears National Monument, using economics criteria discussed throughout the semester. Based on their results, students are asked to offer policy recommendations and explain in detail the limitations of their results. We assess student learning outcomes using a pre- and post-survey, a take-home assignment, and an in-class group presentation. To discourage the free-rider problem, we assess individual contributions by having students complete individual evaluations.

Keywords: Wicked Problems, Student Learning Outcomes, Economic Valuation, Quantitative and Qualitative Decision Making

The term “wicked problems” is not well recognized in the field of applied economics (Batie 2008). Normally used to describe situations or scenarios that are difficult to solve using standard modeling methods, these problems are often highly complex and span multiple disciplines (Dentoni, Hospes, and Ross 2012; Rittel and Webber 1973). By their nature, wicked problems cannot be divided into smaller more manageable parts based on any prior maintained assumptions (Weber and Khademian 2008). Thus, the standard reductionist analytical tools favored by most applied economists may not suffice when attempting to manage and find solutions to wicked problems. In addition, currently, the broader and perhaps more holistic problem-solving skills necessary to undertake and properly examine these types of problems are neither being taught in applied economics graduate programs nor do they appear to be being rewarded in research institutions (Batie 2008).

Therefore, we propose the following case study exercise as a method to teach, train, and educate graduate-level applied economics students how to deal with, account for, and “solve” wicked-type policy problems in agricultural, natural resource, and environmental economics. In contrast to the previous literature, our case study approach uses an interactive classroom exercise where students are divided into groups, representing consulting teams who have been “hired” to evaluate a wicked-type policy problem. For this case study, we focus on a single, but highly timely and relevant wicked-type policy problem, namely: “What is the “socially optimal” size of the Bear’s Ears National Monument in Utah.”

The Bears Ears National Monument was originally established by President Barak Obama in December 2016 as one of his last acts in office. Under the authority granted to

him via the Antiquities Act of 1906, President Obama sought to add an additional layer of protection to lands already in the public domain (public lands), and in particular the cultural legacy of these lands, by establishing these lands as a new National Monument. This new Bears Ears National Monument originally encompassed about 1.35 million acres to be managed jointly by the U.S. Forest Service and U.S. Bureau of Land Management (BLM). . However, almost exactly one year later in December 2017, after reviewing recommendations from the secretary of the interior at the time, Ryan Zinke, President Donald Trump took executive action to reduce the size of the Bears Ears National Monument to encompass just over 201,000 acres which includes the Bears Ears buttes, so named by Native Americans since these natural buttes resemble bear's ears, and significant Native American cultural sites.

The re-sizing of the Bears Ears National Monument represents a wicked-type policy problem for three main reasons. First, there are many sides to the issue and thus, many diverse key stakeholders involved, all of whom have their own opinions and ideas on how the monument should be managed. Secondly, there is considerable risk and uncertainty involved in many of the economic values associated with the area, especially the potential economic value and environmental risks associated with proposed uranium mining. Third, the context of the problem, which involves changing the status of a national monument designated by one President of the United States (POTUS) by another POTUS, involves complicated legal issues which will influence proposed and final solutions and outcomes to re-sizing problem.

In order to address the Bears Ears National Monument re-sizing problem, we ask students in a graduate-level applied economics course to role-play as members of a

private consulting firm hired to evaluate the Bears Ears National Monument and provide policy recommendations with respect to what is the "socially optimal" size of the Monument. Prior to the start of the case study, students completed a pre-survey, the results of which were used to access their level of understanding of wicked-type policy problems, prior to participating in the case study. We then presented students with four in-class case study exercises and some background information on the Bears Ears National Monument wicked policy problem. The objective of the in-class exercises was to guide students through a traditional, quantitative economic problem-solving process, including how to identify goods and services supported by an area of interest, how to determine theoretically appropriate welfare measures to be used, how to assign economic values and how to compare benefits and costs.

Following the completion of the in-class case study exercises, we assigned an individual take-home assignment to students, the results of which were used to gauge each student's ability to determine the economic values associated with changes and goods and services brought about by a proposed policy change. The values identified for the individual take-home assignment were then used to conduct benefit-cost analysis using net present value calculations for the final group presentations. In the final group presentations, students also identified additional quantitative and qualitative technique for assessing the policy problem.

The final group presentations can be thought of as formal "policy briefs," which are commonly delivered by economists who are hired to evaluate policy changes. For the presentations, students were asked to first present information on the economic value of eight specific changes in nonmarket and market goods and services they identified. Each

team of "private consultants" then presented their recommendations as to what constitutes the "socially optimal" size of the Bears Ears National Monument, based on their quantitative and qualitative assessments,.

During the final presentations, students were also asked to explain in detail any limitations of their results, and how they adjusted for these limitations given the wicked nature of the Bears Ears National Monument re-sizing debate. To discourage the free-rider problem, students were asked to complete individual evaluations for each member of their team, the scores of which were factored into each student's final grade. The final group presentations were accompanied by a post-survey, the results of which were used to reassess each student's perceived understanding of wicked-type policy problems after participating in the semester-long project.

The remainder of this case study write-up is organized as follows. First, we provide a detailed description of the wicked policy problem of interest used in this study, including the various key stakeholders involved. We then present and discuss the specific teaching objectives, the target audience, and expected learning outcomes from participating in the case study. To motivate how the learning objectives are to be realized, we outline the three learning assessment strategies used: (1) the pre- and post-survey; (2) the individual take-home assignment; and (3) the final group presentations. [1] We follow the discussion of this outline with an explanation of the econometric techniques used for data analysis. In general, our results provide evidence that the case method may, in fact, be an effective tool for teaching and training future practitioners of economics how to deal with, account for, and approach wicked-type policy problems. In the last section, we offer some conclusions based on our results and discuss how the case study could be

modified and further developed to accommodate a larger class. A teaching note is attached for reference of the reader.

Wicked Problems

Wicked problems are inherently complex, difficult to define, and often involve dynamic public policy issues that span multiple disciplines (Batie 2008). Given their complex nature, wicked problems are never able to be completely "solved," but instead can become better or worse depending on solutions proposed by interested parties (Conklin 2006). From conflicts surrounding natural resource management methods to issues involving agribusiness operations, wicked problems emerge almost daily in the fields of agricultural, environmental, and natural resource economics. Examples addressed in the literature thus far include global climate change (Head 2014; Levin et al. 2012), city planning (Goodspeed 2015), fertilizer input subsidies (Ricker-Gilbert, Jayne, and Shively 2013), and housing developments (Adams 2011).

The Bears Ears National Monument re-sizing debate can be considered a wicked-type policy problem for three primary reasons. First, the "socially optimal" size of the Monument as a problem/issue to be solved is not clearly defined within the boundaries of traditional economics. As such, traditional quantitative economic valuation techniques and decision-making criteria, including benefit-cost analysis (BCA) may provide inadequate solutions to the Bears Ears National Monument re-sizing debate. Secondly, the decision to re-size the Monument has consequences that are neither completely controllable nor immediate. Thus, the decision to resize today has the potential to impact future generations in ways that are unknown in the present. Third, given the diverse interests of the various key stakeholders involved, there are innumerable possible

solutions to the "socially optimal" size of the Monument. As a practitioner of economics, it would be impossible to consider each proposed solution individually.

Why is the Bears Ears National Monument Debate Considered a Wicked Problem?

Originally, the Bears Ears National Monument contained 1,351,849 acres of federally protected land located in San Juan County, Utah. It was established via a presidential proclamation, under the Antiquities Act of 1906, on December 28th, 2016 by President Barack Obama. As a national monument, the Bears Ears was and still is being jointly managed by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) in partnership with five members of the Bears Ears Inter-Tribal Coalition. The National Monument status was put in place to offer additional protection to public lands containing and surrounding the Bears Ears buttes (so named by Native Americans since these natural buttes resemble a pair of bear's ears) and e over 100,000 archeological and historic cultural sites located in the area.

However, on June 12th, 2017, Secretary of the Interior, Ryan Zinke, issued an interim report recommending that Utah's Bears Ears National Monument, along with the Grand Staircase Escalante National Monument, also located in Utah, both be significantly reduced in size. His reasoning included "to provide a much-needed change for the local communities who border and rely on these lands (Turkewitz and Friedman 2017)." Zinke's suggestions included re-sizing the Bears Ears National Monument to include just enough area to cover the two historical buttes for which the monument was originally named (~160,000 acres) (Turkewitz and Friedman 2017). Zinke's recommendations were taken into consideration by the administration and just shy of six months later on December 4th, 2017 the Bears Ears National Monument was cut by 85%, leaving a little

over 201,000 acres including the Bears Ears buttes and significant Native American cultural sites.

The original decision to designate the Bears Ears National Monument in 2016 and the re-sizing of 2017 have both involved the interests of many diverse key stakeholders including, Native American tribes, local ranchers and miners, local and nonlocal recreational users, and other people across the United States, all of whom obtain benefits from the market and nonmarket goods and services provided by the area. For example, the establishment of the Bears Ears National Monument in 2016 represented an important day in history for local Native American tribes, who frequent the area to collect traditional herbs and visit sacred sites (Larsen 2016). Gaining the National Monument status offered additional federal protection from looters and vandalists who could potentially harm the area beyond the more limited federal protection provided when the public lands in the Monument were managed only as USFS and BLM lands.

However, while local lawmakers agreed that the Bears Ears area contained many unique cultural and historical artifacts that deserved protection, they also strongly believed local officials were better suited than the Federal government to care for, preserve, and manage these public lands (Larsen 2016). Furthermore, in addition, to be celebrated for its cultural resources, the Bears Ears area is also home to a wealth of recreational opportunities and has a history of traditional land uses including grazing, gathering, and timber production. While the establishment of the Bears Ears National Monument in 2016 still permitted recreational such as hiking and backpacking, many felt the seasonal service industry jobs brought on by the recreation and tourism industry did

not compare to the year-round, high-paying industry jobs that may be lost under the more restrictive National Monument designation (Buhay 2017).

For example, in President Obama's 2016 proclamation, he urged the USFS to honor any livestock grazing and/or timber production permits already in place. However, he also specified that no new permits or leases were to be administered. Concerns among Utah residents began to surface about how the monument designation was actually causing economic harm by not allowing for extraction of economically feasible resources such as, uranium that could provide revenue to the state (Buhay 2017; Quinlan 2017). Furthermore, according to Buhay (2017), many locals began to question how increased environmental regulations brought about by the monument status could end up compromising the land uses they had already built their businesses around.

As a result, many locals started advocating for the removal of the National Monument designation all together. More specifically, they felt if the monument designation was overturned, then the Trump Administration would be able to grant the state of Utah and its residents the opportunity to manage the area in such a way that provided economic opportunity. Their concerns were heard, and as a result, although the Bear's Ears National Monument was not completely eliminated, the Trump Administration took executive action to re-size (downsize) the Monument a little over one year later in December of 2017.

The proceeding evidence strongly suggests why the original decision to designate and then re-size the Bears Ears National Monument represents a wicked-type policy problem. Not only are there a broad range of stakeholders involved, they all have different opinions regarding the "socially optimal" size of the Monument (e.g., the 2016

Obama policy or the 2017 Trump policy). Additionally, there are innumerable costs and benefits associated with managing the area - some of which can be valued monetarily (e.g., maintenance costs) and some of which cannot (e.g., the value of sacred historical artifacts). Thus, it would be nearly impossible to determine which designation represents the "socially optimal" size using only traditional quantitative analysis techniques, such as benefit-cost analysis (BCA).

Although it would be convenient to boil the Bears Ears National Monument "optimal size" policy-decision down to a simple BCA decision rule such as, "approve the policy if the net present value (NPV) of the change is greater than zero", such a decision rule on its own would provide an inadequate solution to the wicked problem. Therefore, in order to better equip future practitioners of economics with the tools necessary to properly examine and provide solutions to wicked policy problems, we incorporate BCA within a broader perspective focused also on qualitative techniques, as suggested in the literature by Batie (2008). We achieve this task by having students evaluate the Bears Ears National Monument re-sizing debate using no fewer than two additional criteria, including at least one that uses qualitative assessment techniques.

Furthermore, with this case study exercise, we help students investigate how economic opportunities for interested stakeholders are affected by the Obama and Trump Administration sizing of the Bears Ears National Monument. Using this information and any other information they collect on the topic, we guide students through the steps necessary to conduct a formal policy analysis to answer the primary assessment question, "What is the "socially optimal" size of the Bears Ears National Monument?" More specifically, the students were asked to assess whether going from the current state-of-

the-world (e.g., 2017 Trump Administration policy) to a subsequent state-of-the-world (back to the 2016 Obama Administration policy) would be an improvement based on economic benefits and costs and other non-economic (social justice) considerations. Lastly, we showcase how wicked policy problems are never truly "solved," by having students explain in detail the limitations of their results.

Teaching Objectives and Expected Student Learning Outcomes

Because wicked problems are based in the real world, they do not always fit academic theory in a "neat and clear-cut" manner. Therefore, students are required to think carefully, critically, and practically about which theoretical and empirical concepts to use and how to use them when addressing such problems (Batie 2008). In addition, most often the proposed solution to a wicked problem also depends on how the problem is framed and presented. That is context matters. Thus, traditional methods for teaching and training economists how to problem-solve may not suffice.[2] As an alternative or supplement, our case study approach involves teaching graduate-level applied economics students how to incorporate traditional quantitative problem-solving techniques into a broader, pragmatic approach that also integrates qualitative analysis techniques and skills.

With wicked problems, students must also consider what assumptions realistically fit the problem at hand. Therefore, rather than assigning one single criterion by which to evaluate the Bears Ears National Monument re-sizing debate, we assign students to present results from at least two additional economics criteria before providing final policy recommendations. At least one criterion students recommend must be quantitative (e.g., benefit-cost analysis) and one must be qualitative (e.g., social justice analysis). Our goal with respect to allowing them to choose the criteria is two-fold. First, as graduate-

level economists in training, it is imperative that they can adequately choose from a set of evaluation criteria. Secondly, by presenting the results from two or more criteria, students should be able to see how the criteria chosen can influence their results and policy recommendations.

Upon completion of the case study, students should be able to: (1) understand the general complexity presented by wicked problems in applied economics; (2) have a better understanding of how the application of economic principles improves decision-making with wicked problems; (3) understand the importance of engaging with multiple stakeholders; (4) understand the limitations of traditional economic valuation techniques and decision-making criteria to resolve wicked problems; and (5) have a better grasp on the importance of integrating quantitative and qualitative methods for assessing wicked-type problems in applied economics.

We assessed student learning outcomes using a pre- and post-survey, an individual take-home assignment, and grades received on the final oral presentations (e.g., policy briefs). The pre- and post-surveys, copies of which can be found in the appendix, were used to gauge each individual student's understanding of wicked problems, prior to and after participating in the case study. For the final presentations, we separated students in the class into five separate groups. To encourage participation within the groups and discourage the free-rider problem, we assessed individual contributions by asking students to complete evaluations for each of their team members. The scores received by their peers were factored into each student's final grade. These evaluations focus on student effort, participation, cooperation, and most importantly, interpersonal communication.

Study Design

Our study was implemented in a graduate-level applied economics course taught at the University of Georgia during the spring of 2018. The course is an elective course offered to any Master's or Ph.D. level student with an interest in environmental and natural resource economics and understanding the types of criteria available for proper policy evaluation and economic decision-making. At the start of the semester, nineteen students consented to participate in the study and completed the pre-survey. The pre-survey assessed participants' understanding of wicked problems prior to the start of the study by asking a series of questions related to the nature of wicked policy problems in general, coming up with solutions to such problems, and whether or not the students had prior training in assessing wicked problems. A five-point Likert scale was utilized to assess items. [3]

Once the pre-survey was completed, each student was randomly assigned to one of the five groups. These groups were then provided with some information on the wicked policy problem of interest (e.g., the re-sizing of the Bears Ears National Monument) and assigned some background reading on the topic via the course website. Once students had accessed these materials, they were then provided with four in-class case study exercises, to be completed throughout the semester on designated "case study" exercise days. These case study exercises introduced concepts related to economic valuation including: (1) identifying ecosystem functions supported by the different biotic and abiotic components of the area of interest; (2) reviewing understanding of the "with" and "without" principle; (3) defining theoretically appropriate welfare measures for changes in market and nonmarket goods and services; and (4) reviewing some valuation

concepts, and empirical valuation and decision-making tools used most frequently by applied economists. [4]

The four in-class case study exercises were also used to motivate students to start thinking critically and constructively about their final group projects, which were to be completed and presented during the final exam period. For these final presentations, students were asked to identify eight separate changes in the market and nonmarket goods and services resulting from the re-sizing of the Bears Ears National Monument. They were then prompted to assess the "with" and "without" net economic value of the eight separate changes identified considering two separate states-of-the-world (e.g., two separate policy scenarios):

a. State-of-the-world A: The "without" policy scenario state-of-the-world, which we define as the current size of the Bears Ears National Monument (~201,000 acres) as set by the Trump Administration in December 2017.
b. State-of-the-world B: The "with" policy scenario state-of-the-world, which we define as the previous size of the Bears Ears National Monument (~1.35 Million acres) as set by the Obama Administration in December 2016.[5]

In addition to estimating the economic value of the eight changes in the market and nonmarket goods and services identified by their group, each team was also asked to estimate the net present value (NPV) of changing the size of the monument going from State-of-the-world A to State-of-the-world B using their estimated economic values. After presenting the results from the BCA test, each group was then required to choose one additional quantitative decision-making criterion and one qualitative decision-making criterion (e.g., social justice analysis) to assess the problem at hand. Based on their results

from all three criteria, students advised their "clients" (e.g., the professor and teaching assistant role-playing as representatives from the USFS and BLM) on the "socially optimal" or "socially preferred" size of the Bears Ears National Monument.

Given the time and budget constraints of this project, to determine the economic value of the eight changes identified, students used benefit transfer completed in an individual take-home assignment where they walked through the steps of standard benefit transfer protocol.. The benefit transfer method works by transferring information from pre-existing studies (e.g., the "study" sites) to estimate the value of a change in a market or nonmarket good or service at a separate study area (e.g., the "policy" site). Using the 2016 Updated Recreation Use Values Database (RUVD) from Oregon State University and the Environmental Valuation Reference Inventory (EVRI), we instructed students to identify at least three comparable studies and use point or benefit function estimates to provide estimated values for the eight changes in goods and services their group had identified during the in-class case study exercises. [6]

Data Collection and Economic Analysis

The data for our study comes from graduate-level applied economics students studying either agricultural and applied economics or forestry economics at the University of Georgia. We collected data from nineteen students enrolled in the course during the spring of 2018. To analyze student learning outcomes, we collected data from a pre- and post-survey, grades received and responses given on an individual take-home assignment, and grades received and recommendations provided during each group's final oral presentations (e.g., policy briefs). The individual take-home assignment and rubric for the final group presentation are included in the Teaching Note.

We assess student learning outcomes according to the following set of criteria: 1) correctness of solutions found for the individual take home analytical benefit transfer exercise; 2) competency of information presented during the oral presentation including the policy recommendations provided; 3) proficiency of the material based on command of the subject matter (e.g., wicked problems) presented during both the oral presentation and written explanation of the analysis; and 4) ability to think critically and objectively by developing their reasoning based on the science and theory of economics, including the limitations of standard economic theory and techniques for resolving wicked-type problems.

Using the pre-survey data, we first examine whether or not any individual characteristics such as years of schooling, age, anticipated career outcomes, the average number of hours spent studying each week, or membership in a professional economics or environmental organization contribute to a student's familiarity with wicked problems prior to the start of the study. For this analysis, we estimated the following equation using a Tobit Model specification,

(1) $Agree_i = \beta_0 + \beta_1 ENV_i + \beta_2 Academia_i + \beta_3 Masters_i + \beta_4 ECON_i + \beta_5 Age_i + \varepsilon_i$

where ENV_i is equal to one if the individual is a member of an environmental organization, $Academia_i$ is a binary variable equal to one if the individual's career expectations are in academia, $Masters_i$ is a binary variable equal to one if the student already has a master's degree (e.g., is currently a Ph.D. student), $ECON_i$ is equal to one if the student is a member of a professional economics association, and Age_i is the student's reported age measured in years.

The dependent variable $Agree_i$ is a continuous variable equal to the number of times an individual agreed or strongly agreed with statements two through seven on the

pre-survey. For example, if a student agreed or strongly agreed with two out of seven questions, then $Agree_i = 2$ for that individual. Statements two through seven on the pre-survey represent declarative statements about wicked policy problems and ask students to answer whether they agree or disagree with these statements. Therefore, if a student agrees or strongly agrees with one or more of these statements, then we can assume that student has an adequate understanding of the nature of wicked problems and how to provide reasonable solutions to such problems. In addition, the greater the number of questions the student agrees or strongly agrees with, the more "knowledgeable" they are likely to be on how to deal with, account for, and offer solutions to wicked policy problems.

Using this method to quantify prior knowledge of wicked problems we can estimate the model in equation (1) using a Tobit model specification, assuming left censoring at zero (e.g., student neither agreed or strongly agreed with any of the true statements about wicked problems and therefore, has no prior knowledge or exposure) and right censoring at seven (e.g., student agreed or strongly agreed with all seven questions and therefore, has prior knowledge and has been exposed). Using the pre-survey results, we also compared responses reported by Ph.D. students with responses reported by Master's level students to the following two statements:

i. Prior to this study, you received formal training on how to solve wicked policy problems in an economics, applied economics, or another course taught here at the University of Georgia.

ii. Prior to this study, you were familiar with wicked policy problems.

Because our class was open to both Ph.D. and Master's level students interested in conducting applied policy analysis, by comparing their responses to these questions we are able to analyze whether or not this case study method is appropriate for a split-level course, or if it would be more appropriate for classes specifically targeting only Master's or only Ph.D. students. We compare the responses between groups using a Wilcoxon Rank Sum Test, also known as a Mann Whitney U Test.

To access student learning outcomes from participating in the case study exercise involving wicked policy problems we collected information from the individual take-home assignment along with the final group presentations and estimate the following equation:

(2) $Score_i = \alpha_1 + \alpha_2 Absent_i + \alpha_3 Masters_i + \alpha_4 Study_i + \alpha_5 Gender_i + \alpha_6 Assign_i + \mu_i.$

In equation (2), $Absent_i$ is equal to the number of classes the student missed or was absent from during the semester, $Masters_i$ is a binary variable equal to one if the student has a master's degree already, $Study_i$ is the average number of hours the individual student spends studying outside of the class each week, $Gender_i$ is equal to one if the student is a male, and $Assign_i$ is equal to the grade received by the student on the individual take-home assignment. The dependent variable $Score_i$ is equal to the grade received by the individual student on the final group presentation, including the weighted average of the individual evaluations received by each team member. After plotting the dependent variable, we noticed that the scores received on the final group presentations were distributed into four different quantiles. Therefore, we estimate equation (2) using a nonparametric quantile regression.

In order to examine whether or not participating in the case study exercise had an impact on each student's understanding of wicked policy problems, we combine the pre-

survey responses with the post-survey responses and conduct a Wilcoxon signed-rank test on individual responses to questions two through seven. As stated earlier, because questions two through seven represent declarative statements involving wicked-policy problems, we can assume if an individual student "strongly agreed" or "agreed" with any of these statements, then that student understands and has been exposed to wicked policy problems, in at least some capacity. The results of the Wilcoxon signed-rank test allow us to test our working null hypothesis that participating in the case study (e.g., being exposed to the case method) has a statistically significant effect on a student's understanding and comprehension of wicked policy problems.

Next, because we are ultimately interested in analyzing whether or not students understand more about wicked policy problems after participating in the case study, we use a simple nonparametric sign test and examine if and how the frequency of correct responses (e.g., the number of times an individual agreed or strongly agreed with true statements about wicked policy problems) changes after students have been exposed to a wicked policy problem using the case method. To test our hypothesis, we collect information on the frequency of correct responses for questions two through seven, prior to participating in the study, which we label as $agreeprior_i$, and the frequency of correct responses after participating in the case study, which we label as $agreeafter_i$.

Using the nonparametric sign test, we then examine if there are more positive differences in the frequency of correct responses, more negative differences in the frequency of correct responses, or no difference at all in responses between the pre-and post-survey at the individual level. If our results indicate significantly more negative differences than positive differences exist, then we fail to reject our null hypothesis in

favor of our alternative and can conclude participation in the case study significantly impacted each student's understanding of wicked policy problems in a positive way (e.g., they became more knowledgeable on wicked problems).

Typical with any experimental study of this nature, potential bias-related issues exist with our analysis. One problem is that although students were randomly assigned into groups, no measure was used to make sure groups were comparable. For example, it would have been possible that the random selection process used placed, for example, all male students and/or all Ph.D. students and/or all students in one major, into one or more of the five groups. Although it is possible for the random assignment process to result in groups being unbalanced, it is highly unlikely to affect the results as each group was provided with the same materials, same information, and same guidelines for completing the case study.

Another issue that may bias the results is student withdrawal. Range restriction (or survivor bias) challenges our analysis in that withdrawing students are left out of the final sample. Throughout the semester, we had only two students withdraw from the course. To prevent student withdraw from biasing our results, we do not include these students' results in our analysis. Only one of these students completed the pre-survey. However, this student chose to withdraw within the first four weeks of the course and therefore did not participate in any of the case study exercises. The second student, however, did participate in the case study exercises, but unfortunately did not consent to participate in the study because this student was absent when the pre-survey and consent form was administered to the class.

Lastly, given that our class size was small and only nineteen students were available and consented to participate in the study, we refrain from making any overarching claims about our results. We simply note the outcomes realized from our class participating in the case study and hope out results will be useful for those who plan to use the case in future. Given our small sample size, we also refrain from making any assumptions that our estimation results are unbiased. In addition, because the responses to the survey questions were given on a Likert scale, responses are ordinal in nature and therefore it should be noted that only nonparametric tests can be used to compare raw responses between groups. One way to avoid this issue would be to determine the median of the raw responses for each question and then compare between groups. However, as discussed in (Stevens 1946) descriptive statistics should not be used to make any inferences about the raw data.

Results and Discussion

Preliminary results indicate that at the start of the study, approximately 74% of the students participating felt they had not yet received formal training on how to solve wicked problems, but that training on how to deal with, account for, and solve them was important. Additionally, 64% of students indicated they had no prior knowledge of wicked problems and were unfamiliar with them all together prior to participating in the study. From the pre-survey, we can infer that students enrolled in the course spend on average approximately 15 hours outside of class studying per week. Furthermore, the majority of our students (~60%) learn by reading and writing, indicating a strong preference for learning methods that make use of verbal or linguistic learning techniques (e.g., lectures, assigned readings, taking notes). [7] Additionally, the pre-survey results

indicate that over half of the students participating (~53%) intend to pursue a career in academia upon graduation.

The results from our Wilcoxon signed-rank test on individual responses reveal that after students were exposed to the case method involving wicked policy problems, their understanding of wicked policy problems increased as measured by their responses to questions two through seven. More specifically, based on these results, we can reject the null hypothesis that the case study method had no effect on student's understanding of wicked policy problems as measured by their responses to the declarative statements at the $\alpha = 0.05$ level of significance. Furthermore, the results from the nonparametric sign test reveal that we can reject the null hypothesis that after participating in the case study, the difference in the frequency of correct responses for statements two through seven is not statistically different than zero, in favor of the alternative hypothesis that the difference in the frequency of correct responses is negative.

From the results of our nonparametric sign test, we can conclude participation in the case study leads to a greater understanding of wicked policy problems in general and the economics criteria available to justify and provide solutions to such problems. An independent analysis of our post-survey results reveals that after participating in the case study, approximately 68% of students felt wicked policy problems could not be boiled down to a simple NPV calculation. Additionally, approximately 89% of our students felt the solution to a wicked policy problem can be influenced by how the problem is presented. When prompted to identify if and why the Bear's Ears National Monument re-sizing debate represents a wicked policy problem, 42% of our students referenced the

many stakeholders involved, while over 50% referenced "contradictory beliefs" and "benefits and costs which are unable to be monetary valued."

To examine whether or not individual student characteristics contribute to a student's current perceived understanding of wicked problems in general, we estimate equation (1) using a Tobit model specification given the censored nature of our response data. The results from the Tobit model specification can be found in Table 4 and indicate that individual characteristics including age, whether or not the student already has a Master's degree, whether or not the student is a member of an environmental organization or professional economics organization, or whether or not the student is planning to pursue academia as a career significantly contribute to a student's understanding of wicked policy problems. According to the results of the Wilcoxon Rank-Sum Test, we find no significant difference exists between Ph.D. students and Master's in regards to questions nine and ten on the pre-survey, indicating this case study is appropriate for both M.S. and Ph.D. level students.

To estimate the quantile regression in (2), we first divided the class into four separate groups based on the grades they received on the final projects. Those who scored below an 85% ($n = 4$) were in the first quantile, those who scored between 86% and 95% ($n = 8$) were in the second quantile, those who scored between 96% and 98% ($n = 4$) were in the third quantile, and those who scored 99% and above ($n = 3$) were in the fourth quantile. Using this method of partitioning, our results from estimating equation (2) via the quantile regression indicate that none of the included variables had a statistically significant impact on the score received on the final presentation. We do find $absences$ negatively affect scores across quantiles, but not statistically significantly.

Similarly, we find as the number of hours spent studying ($study$) increases, scores are positively affected, but again not statistically significantly. The statistical insignificance of the included variable parameter estimates may simply be a result of our small sample size, rather than some underlying theoretical reason.

Concluding Remarks

Thinking and researching as an economist has the ability to transform students into better, more engaged learners and problem solvers (Santos and Lavin 2004). One way to achieve this is to implement an empirical economics research curriculum that teaches students how to access and interpret data, formulate conclusions, and prepare both written and oral briefs of their findings (Becker 2000). The case study method described above provides one specific way to do just what Becker (2000) suggests.

In our case study, students were presented with a wicked policy problem in the form of the re-sizing debate surrounding the Bears Ears National Monument. The Bears Ears re-sizing debate has all the hallmarks of a wicked-type problem. There are many sides to this issue and thus many diverse key stakeholders involved. Additionally, any proposed solution will depend on how the problem is framed and presented by these different stakeholders. There is also considerable risk and uncertainty involved in many of the economic values associated with the area, especially related to the potential economic value of proposed uranium mining in the area.

To address this re-sizing debate, we present students in a graduate-level applied economics course with separate two policy scenarios (i.e., two separate states-of-the-world affecting the size and management of Bears Ears National Monument) and ask them to make recommendations with respect to which state-of-the-world in socially

optimal or preferable based on traditional quantitative economic valuation and decision-making techniques, and non-economic, qualitative techniques. We access student learning outcomes from participating in the case study using a pre- and post-survey, a take-home assignment, and grades received on final group presentations.

Our results indicate that prior to participating in the study, the majority of students, whether at the Masters or Ph.D. level, agreed or strongly agreed that they are unfamiliar with wicked policy problems. Furthermore, almost three-fourths of the students enrolled in the course, indicate they agree or strongly agree that it is important for students studying applied economics to receive formal training on wicked policy problems. Based on the results provided by the Wilcoxon signed-rank tests, we find participating in our case study leads to a greater understanding of wicked policy problems.

Our empirical results from the nonparametric model indicate that participation in our case study enabled students to better understand wicked problems in general, the limitations of using quantitative economic valuation decision-making tools to assess such problems, and the value of integrating quantitative and qualitative assessment tools to assess such problems and offer more holistic and effective solutions. In addition, by participating in this case study, students gained practical experience necessary to work individually and as part of a group to assess and offer solutions to complex, multi-dimensional problems. Such experience and skills are imperative given that graduates in economics face a world where career opportunities are contingent upon being able to interact with a diverse group of stakeholders including lobbyists, politicians, and other

practitioners of science (Bergstrom and Randall 2016; Karunaratne, Breyer, and Wood 2016).

Moving forward, we hope to increase our sample size by implementing the case study with another class (or classes) in the future. Also, we would like to explore some additional, different nonparametric statistical techniques available to analyze the learning outcomes achieved from participating in the case study. In addition to the analysis discussed previously, we had also hoped to examine whether or not a student's self-reported political affiliation influenced their policy recommendations. However, given the policy recommendations were consistent across all group we were unable to perform this analysis.

However, this case study may be of interest to other instructors in the future who have a larger class size which might produce opposing recommendations across groups. To help those interested in conducting a similar case study, we also generate a master list of the changes in market and nonmarket goods and services identified by each group, as well as how those goods and services fit into the six separate categories used in the exercises (e.g., recreation, timber/minerals, ceremonial and historical, waterways, grasslands, and wilderness). This list is included in Table 6.

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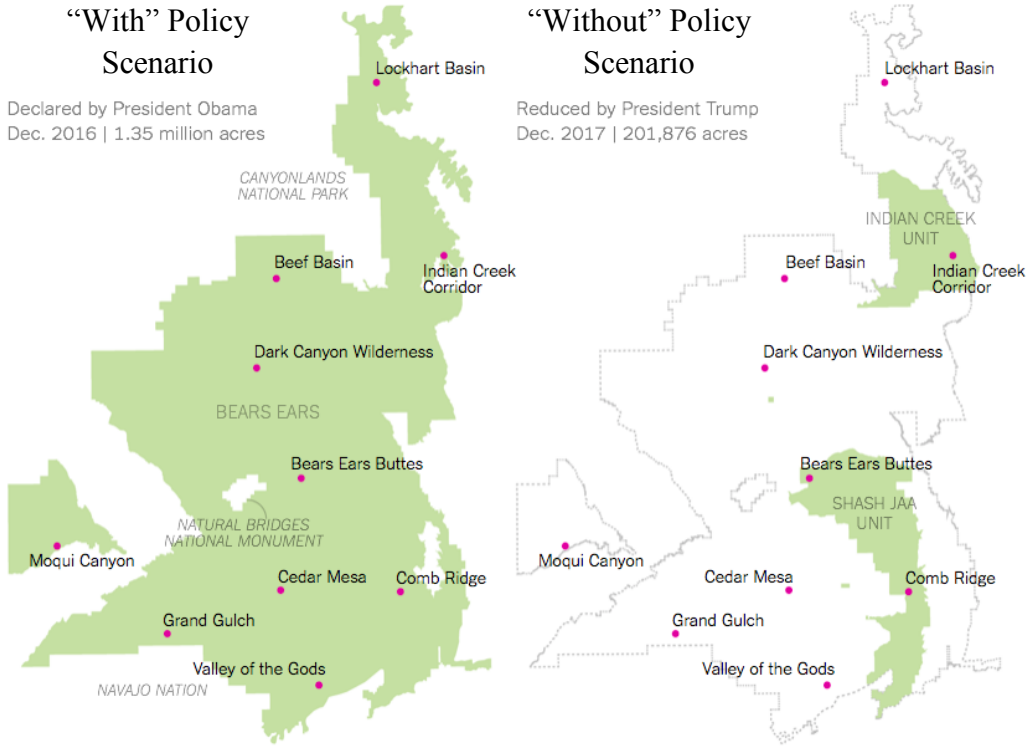
Figure 1. Areas included in the "with" and "without" policy scenarios



Note: The above image is from the New York Times. It appeared in an online article published by Nadja Popovich online on December 8th, 2017.

Figure 2. Student's self-reported learning style

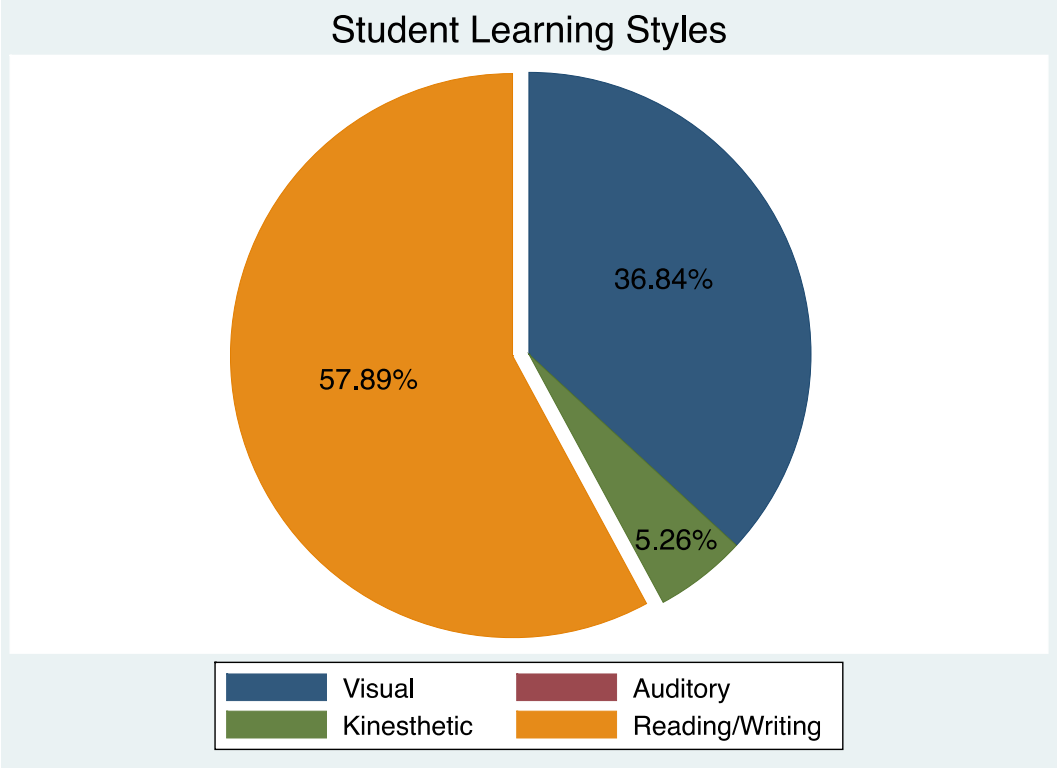


Figure 3. Student's self-reported career expectations

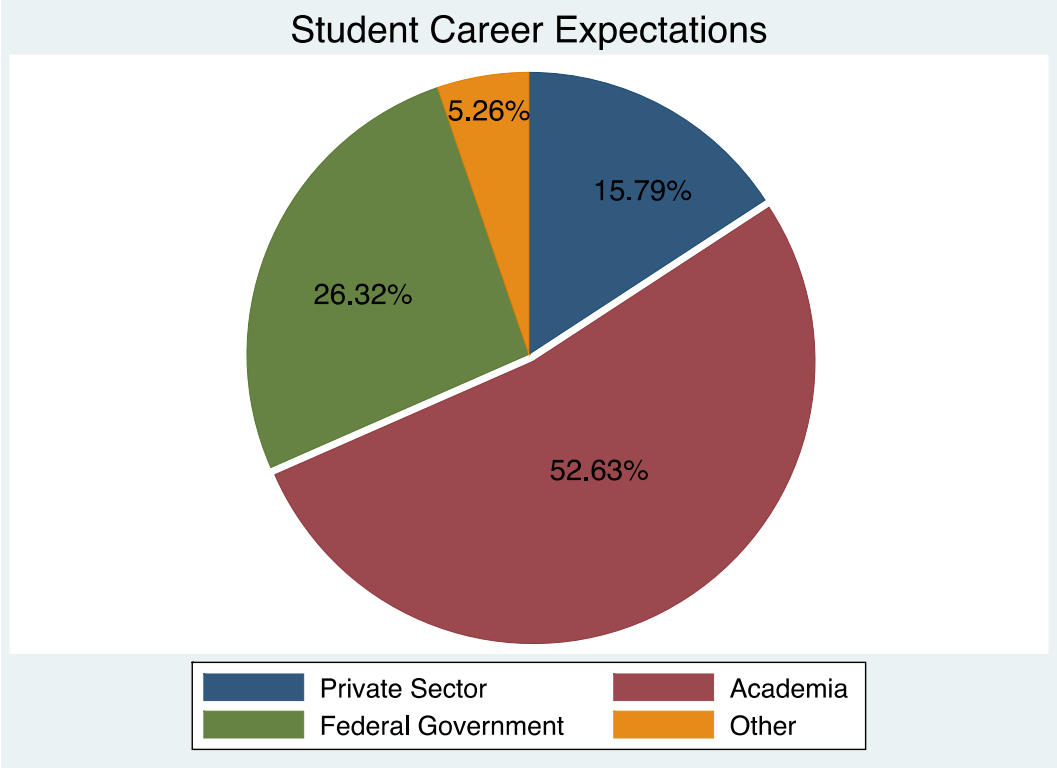


Figure 4. Survey Question #2 Responses

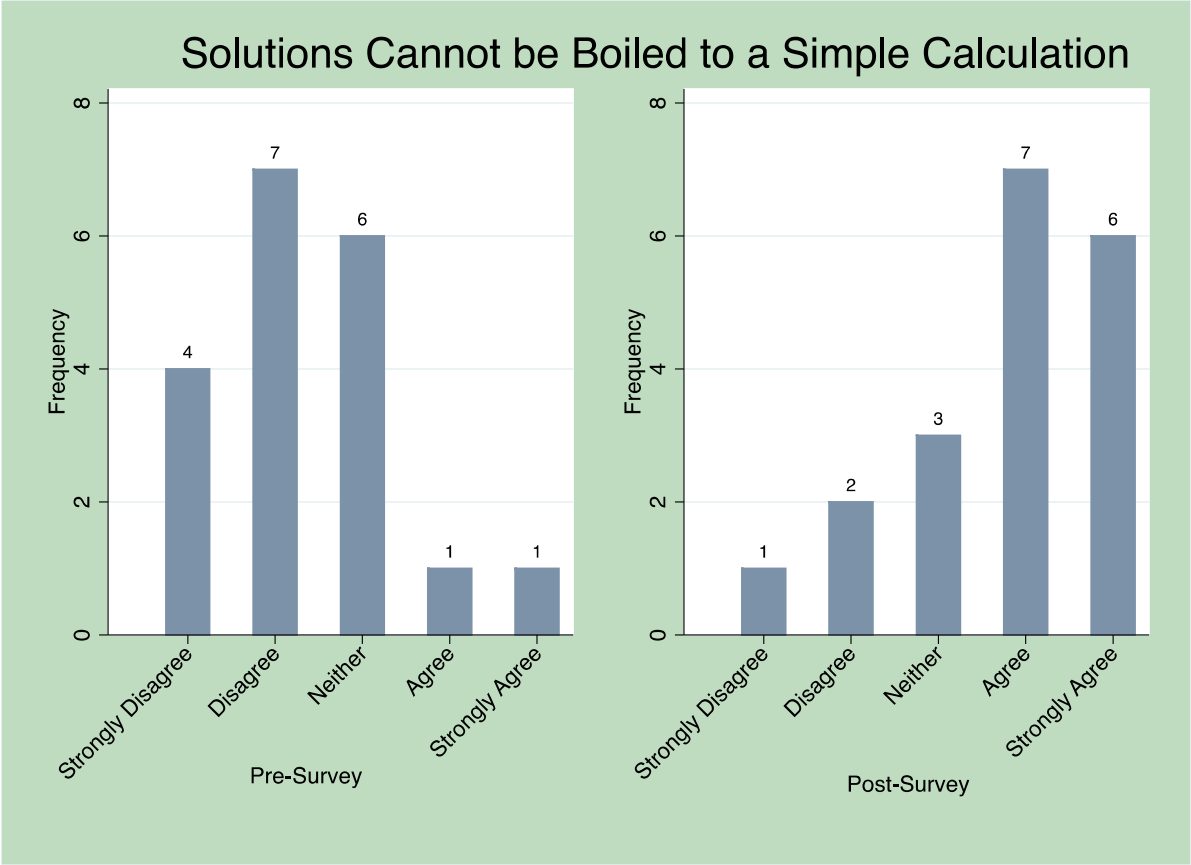


Figure 5. Survey Question #3 Responses

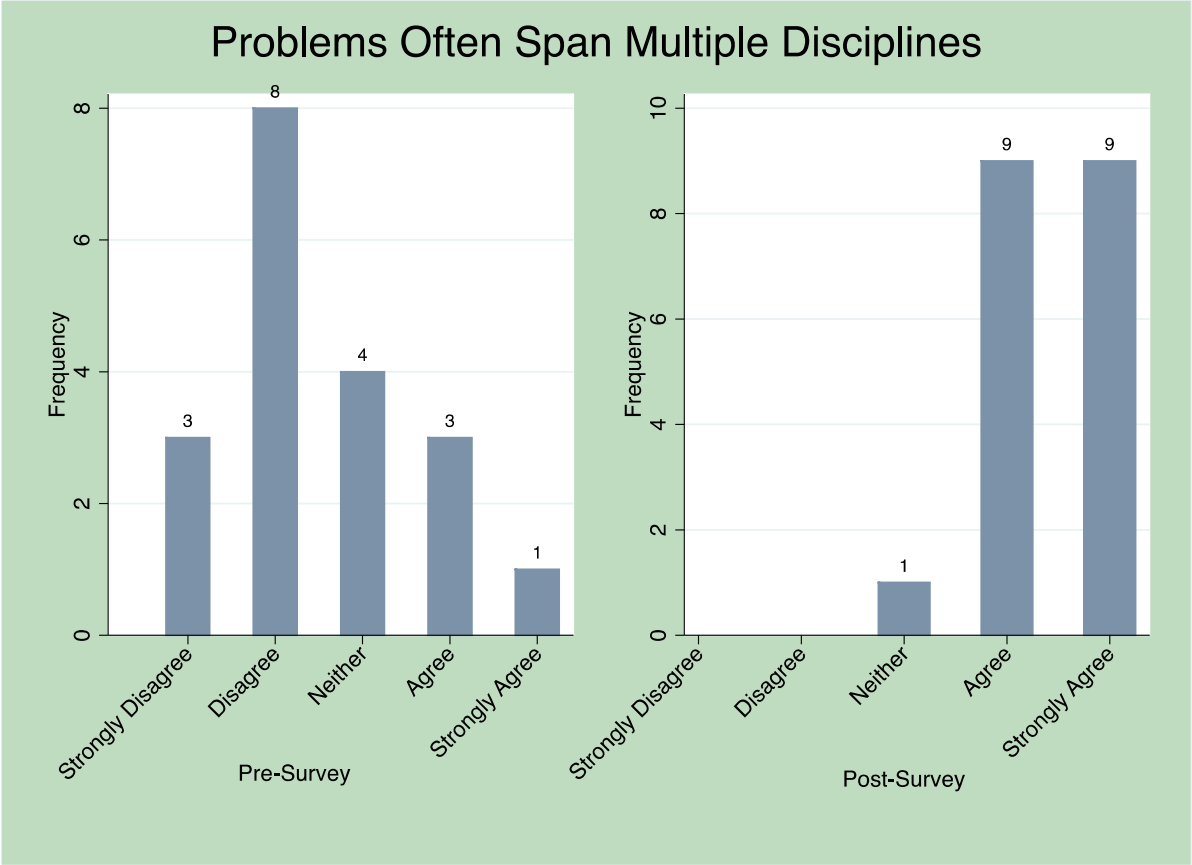


Figure 6. Survey Question #4 Responses

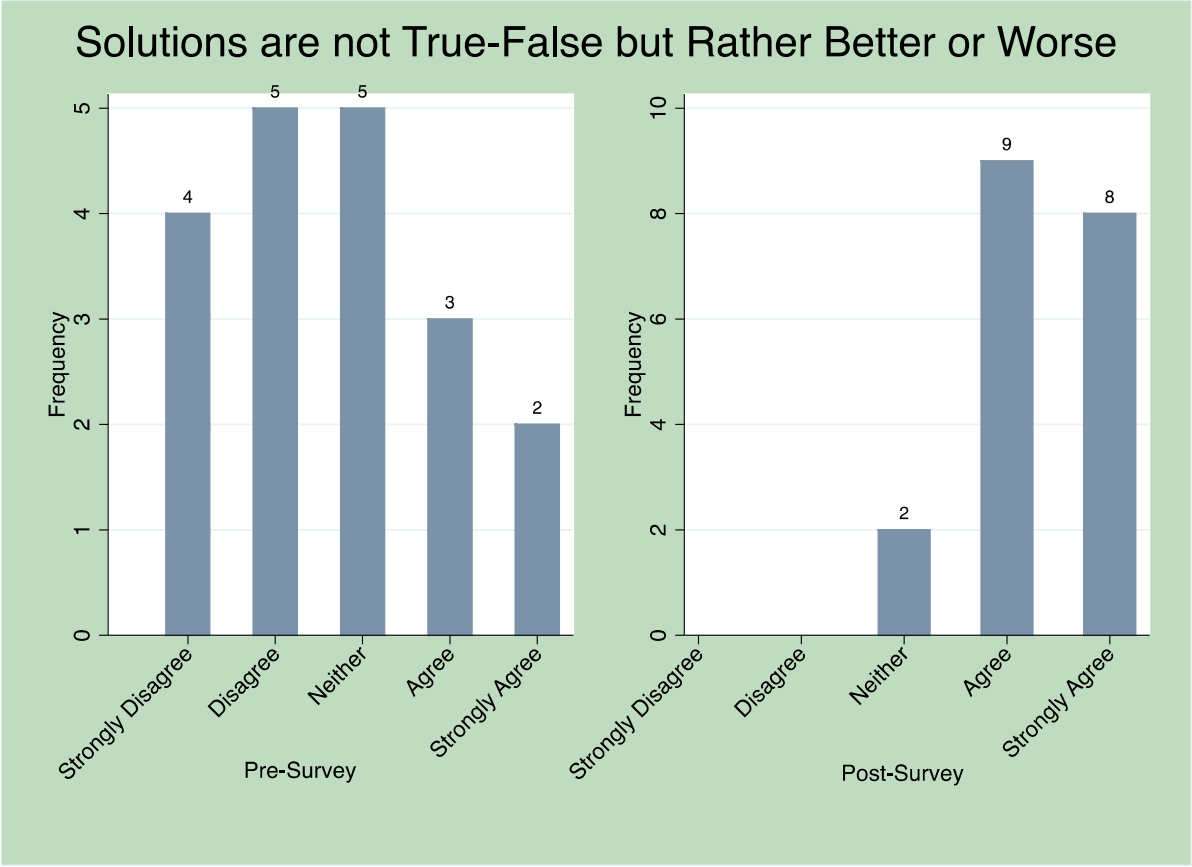


Figure 7. Survey Question #5 Responses

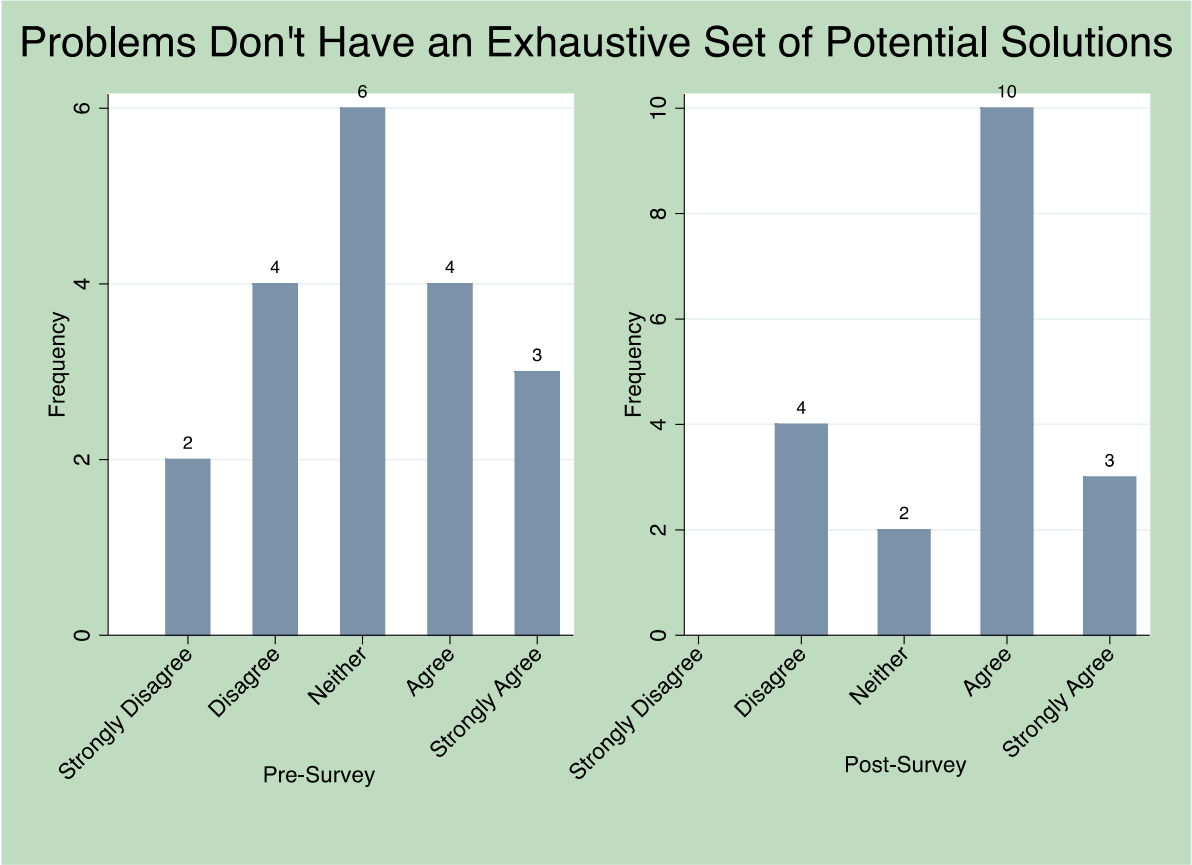


Figure 8. Survey Question #6 Responses

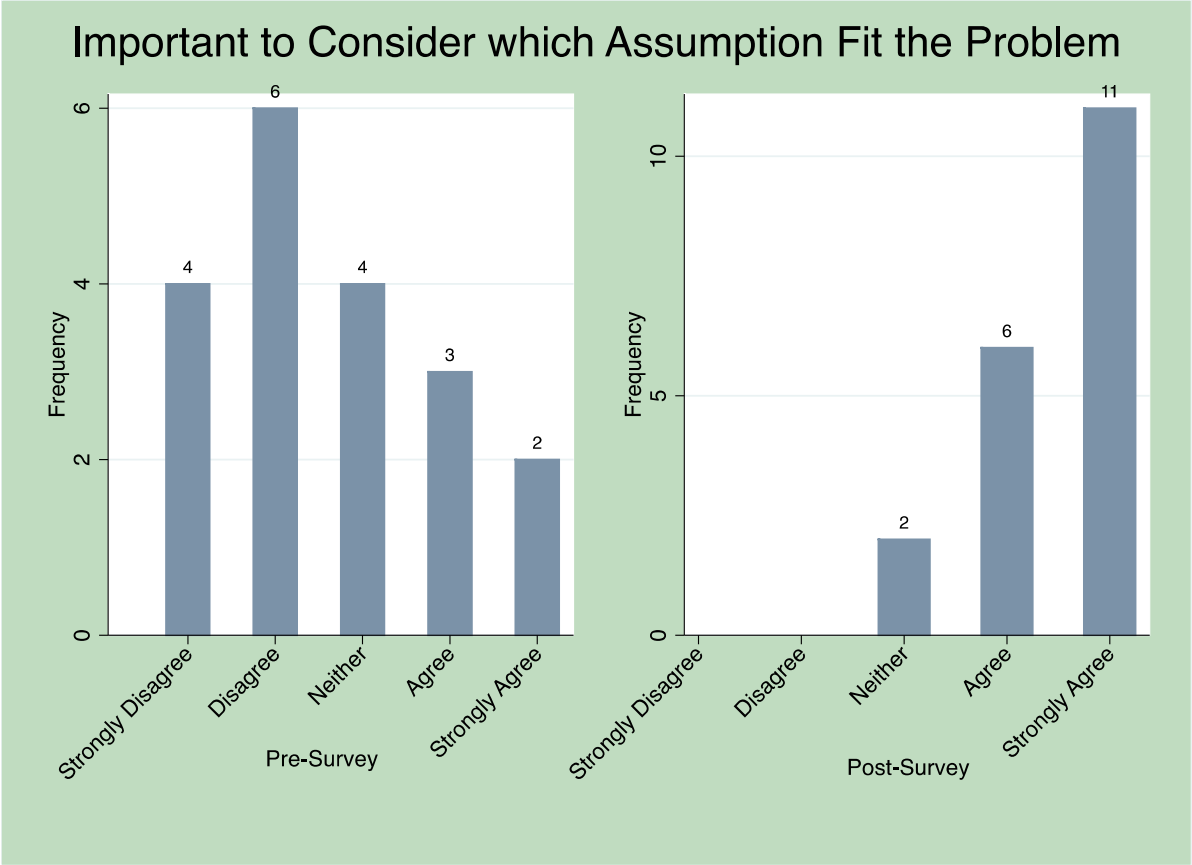


Figure 9. Survey Question #7 Responses

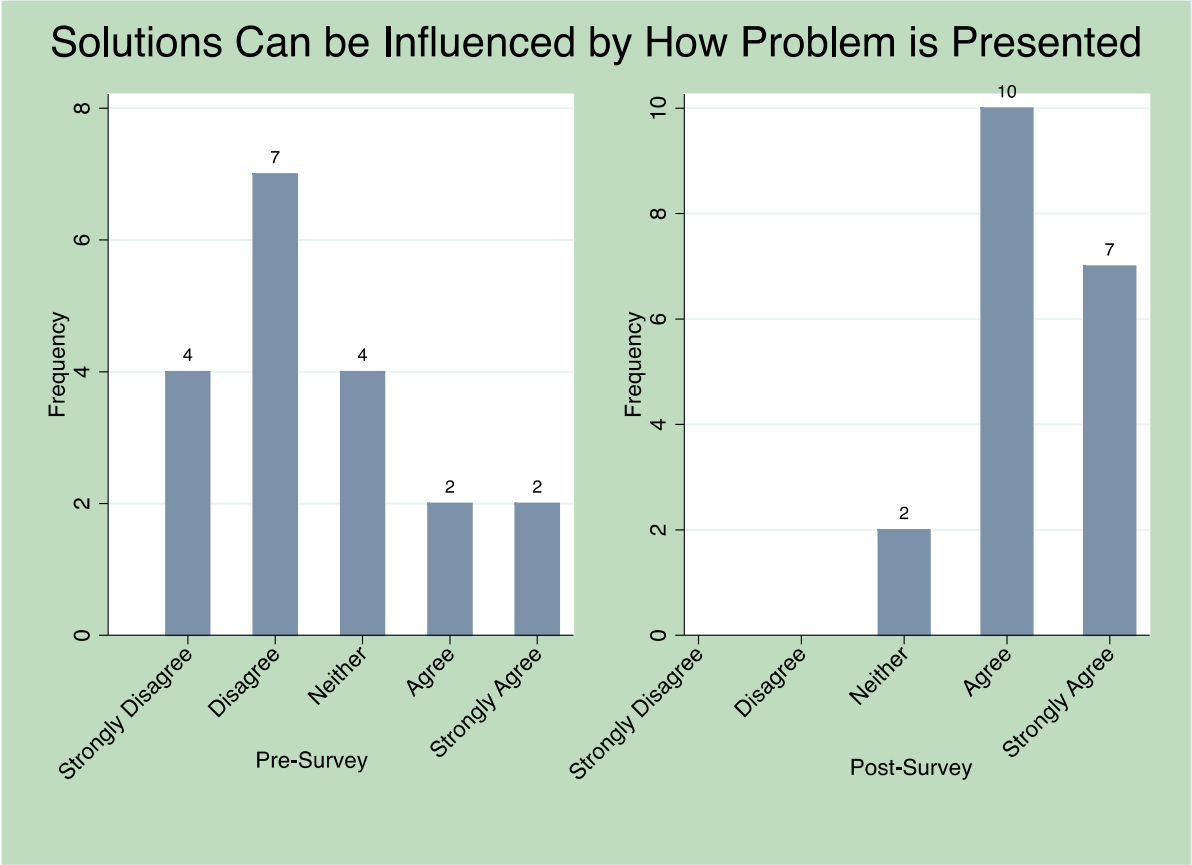


Table 1. Summary of Student Participants Characteristics (N=19)

Variable	Variable Definition	Mean	St. Dev.	Min	Max
Age	Age (Years)	26	4.09	21	36
Env. Org.	=1 if member of an environmental group or organization	0.05	0.23	0	1
Econ. Org.	=1 if member of a professional economics organization	0.21	0.41	0	1
Learning Style	=1 if reported learning style is writing and reading	0.58	0.51	0	1
Studying Hours	Average number of hours spent studying	15	5.27	7.5	20
Career Path	=1 if expected career path in academia	0.53	0.51	0	1
Race	=1 if an individual identifies as Caucasian	0.37	0.49	0	1
College	=1 if highest education level completed is Bachelor's degree	0.42	0.50	0	1
Masters	=1 if highest education level completed is Master's degree	0.58	0.50	0	1
Gender	=1 if respondent identifies as Male	0.63	0.49	0	1
Conservative	=1 if respondent identifies as Conservative	0.11	0.32	0	1
Moderate	=1 if respondent identifies as Moderate	0.53	0.51	0	1
Liberal	=1 if respondent identifies as Liberal or Progressive	0.37	0.50	0	1

Table 2. Pre-Survey Results

Statement	Disagree or Strongly Disagree (%)	Neither (%)	Agree or Strongly Agree (%)
The term "wicked problems" is not well recognized or discussed in the field of applied economics.	21%	21%	58%
The solutions to wicked policy problems can be boiled down to a simple calculation (e.g. net present value).	58%	32%	10%
Wicked policy problems often span multiple disciplines.	58%	21%	21%
Solutions to wicked problems are not true-or-false, but better or worse.	48%	26%	26%
Wicked problems do not have an exhaustive set of potential solutions.	32%	32%	39%
It is important to consider what assumptions hold when considering solutions to wicked problems.	53%	21%	26%
It is imperative that students studying applied economics receive formal training on wicked policy problems.	0%	26%	74%
The solution to a wicked policy problem could be influenced by how the problem is presented.	58%	21%	21%
Prior to this study, you received formal training on how to solve wicked policy problems.	74%	16%	10%
Prior to this study, you were familiar with wicked policy problems.	64%	11%	26%

Table 3. Post-Survey Results

Statement	Disagree or Strongly Disagree (%)	Neither (%)	Agree or Strongly Agree (%)
The term "wicked problems" is not well recognized or discussed in the field of applied economics.	21%	32%	47%
The solutions to wicked policy problems can be boiled down to a simple calculation (e.g. net present value).	16%	16%	68%
Wicked policy problems often span multiple disciplines.	0%	5%	95%
Solutions to wicked problems are not true-or-false, but better or worse.	0%	11%	89%
Wicked problems do not have an exhaustive set of potential solutions.	21%	11%	68%
It is important to consider what assumptions hold when considering solutions to wicked problems.	0%	11%	89%
It is imperative that students studying applied economics receive formal training on wicked policy problems.	0%	16%	84%
The solution to a wicked policy problem could be influenced by how the problem is presented.	0%	11%	89%
Prior to this study, you received formal training on how to solve wicked policy problems.	68%	11%	21%
Prior to this study, you were familiar with wicked policy problems.	53%	16%	31%

Table 4. Tobit Model Results

	Tobit
Environmental	0.4957
	(1.2092)
Academia	-0.5379
	(1.1052)
Professional	-0.2330
	(0.7252)
Master's Degree	0.9819
	(1.1215)
Age	0.0688
	(0.0788)
Constant	2.2299
	(1.8757)
Sigma	
Constant	1.0346***
	(0.1760)
Observations	19

Standard errors in parentheses

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Table 5. Quantile Regression Results

	Quantile 1	Quantile 2	Quantile 3	Quantile 4
Absences	-0.021	-0.370	-0.323	-0.470
	(1.666)	(1.206)	(0.357)	(0.447)
Master's	5.977	-0.134	0.023	-0.124
	(4.438)	(3.428)	(2.213)	(1.718)
Study Hours	0.001	0.113	0.090	0.104
	(0.419)	(0.271)	(0.174)	(0.174)
Gender	0.005	0.824	0.820	0.275
	(3.657)	(2.973)	(1.813)	(2.210)
Individual Case Study	-0.005	-0.034	0.009	-0.050
	(0.967)	(0.504)	(0.295)	(0.201)
Constant	42.266	48.548**	46.933***	50.223***
	(41.829)	(20.690)	(11.916)	(6.548)
Observations	4	8	4	3

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Market and Non-Market Goods and Services Identified

Good or Service Identified	Area of Interest
Mountain Biking	Recreation
Watershed Restoration	Waterways
Uranium Mining	Timber/Minerals
Archeological Site Visits	Ceremonial and Historical
Big Game Hunting (Deer)	Wilderness
Wingate Sandstone Viewing	Recreation
Species Preservation (Spotted Owls)	Wilderness
Grassland Restoration	Grasslands
Recreational Fishing	Recreation
Timber Production	Timber/Minerals
Natural Gas	Timber/Mineral
Overnight Camping Trips	Recreation
Bird Watching	Recreation
Water Rafting	Recreation
Carbon Sequestration	Wilderness
Soil Erosion Control and Stabilization	Grasslands
Water Quality	Waterways
Crude Oil	Timber/Minerals
Uranium	Timber/Minerals
Off Road Vehicle Activities	Recreation
Cultural Site Visits	Ceremonial and Historical
Unobstructed Mountain Views	Recreation
Cliff Dwellings	Recreation
Urban Forests	Wilderness
Rock Art Panels	Ceremonial and Historical
Trout Fishing	Waterways
Biodiversity	Wilderness
Historical Site Preservation	Ceremonial and Historical

Appendix

Consent Form

You are being invited to participate in a research study entitled Tackling Wicked Problems in Applied Economics: An Application to the Bears Ears National Monument. Our research hopes to find out whether or not graduate students studying applied economics have a sufficient understanding of "wicked" type policy problems. Additionally, we are interested in determining whether or not the case method is an effective tool for teaching and training students on how to deal with, account for, and solve "wicked" type policy problems. Your participation will involve allowing the researchers to use the information/data collected throughout your participation in the Bears Ears Case Study, to be included in their research. Data will be collected from a pre- and post-survey, your final oral presentations on the Bears Ears case study exercise, and the economic valuation homework assignment. As such, data will be collected periodically throughout the course. You don't have to do anything else.

Your participation in the research study, of course, is voluntary but would be greatly appreciated. You may choose not to participate or to withdraw your consent at any time without penalty or loss of benefits to which you are otherwise entitled. If you agree to the use of your information/data for this research project, please simply sign on the line below. If you don’t agree, none of your data will be included in the research but you will still be required to fully participate in the graded class activities for the Bears Ears Case study. Your decision about whether or not to participate will have no bearing on your grades or class standing. You have the option to withdraw your responses from the study at any point throughout the semester. However, if you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

The results of the research study may be published, but your name and/or any other identifying information will not be used. In fact, the published results will be presented

in summary form only. Only the two primary researchers listed on this consent form will have access to the data. Data including responses to the pre- and post-surveys, economic valuation homework assignment grades, and results of the in-class Bears Ears case study presentations will be kept completely confidential. Your responses will be coded with a random identification number prior to any data analysis. There are no known risks associated with this research.

The researchers conducting this study are Amanda Harker Steele and John C. Bergstrom. You may ask any questions you have now. If you have questions later, you are encouraged to contact them at the University of Georgia, (706) 543-0856 or (706) 542-0749, ajh98055@uga.edu or jberg@uga.edu .

Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 609 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

Research Subject's Consent to Participate in Research:

I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

_____	_____	_____
Name of Researcher	Signature	Date
_____	_____	_____
Name of Participant	Signature	Date

Please sign both copies, keep one and return one to the researcher.

Pre- and Post-Survey

Welcome! Thank you for choosing to participate in this study about "wicked" policy problems. We are interested in gauging your current level of understanding of these types of problems and other subjects related to economic decision-making criteria. The information you provide today is a very important contribution to ongoing research at the University of Georgia.

In this packet, you will be presented with a series of questions. These questions will ask you to rate your current level of understanding on a five-point scale. You should plan to answer the questions to the best of your ability.

Please follow the instructions carefully. To ensure accuracy, we ask that you please refrain from communicating with your fellow classmates during the time of the survey.

We would like to emphasize that all information collected today will only be used for group comparisons and general data analysis. No personal or individual information will be divulged at any time for any reason.

Please turn to the next page, and begin filling out the questionnaire. When you are finished, please turn your survey questionnaire over and a research team member will be around to collect your packet.

You will receive 5 bonus points for completing this survey.

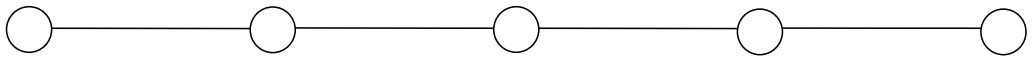
Please answer the following questions by filling in the bubble that most accurately represents your current level of understanding of the topic presented. Please try to answer all of the questions.

Wicked Policy Problems

A wicked policy problem is a problem that is difficult or impossible to solve due to incomplete or contradictory knowledge and the number of stakeholders involved (e.g. people with opposing value, beliefs, and opinions). Wicked policy problems are often interconnected with other problems. Common examples of wicked policy problems include poverty, sustainability, and equality.

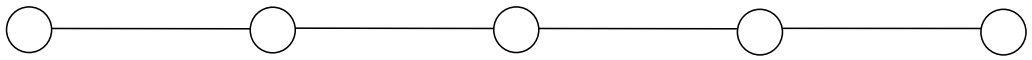
Please answer the following questions based on your current level of understanding of wicked policy problems.

1. The term "wicked problems" is not well recognized or discussed in the field of applied economics.



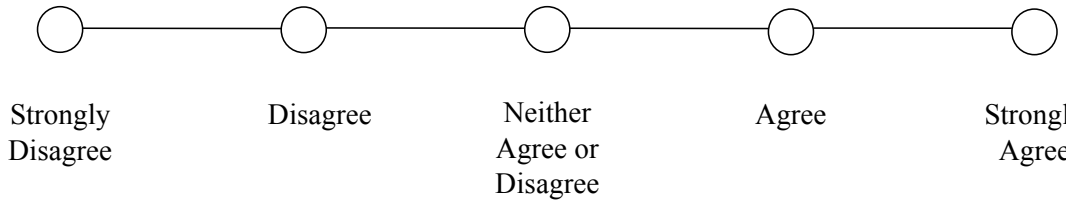
Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree

2. The solutions to wicked policy problems can be boiled down to a simple calculation (e.g. net present value calculation).

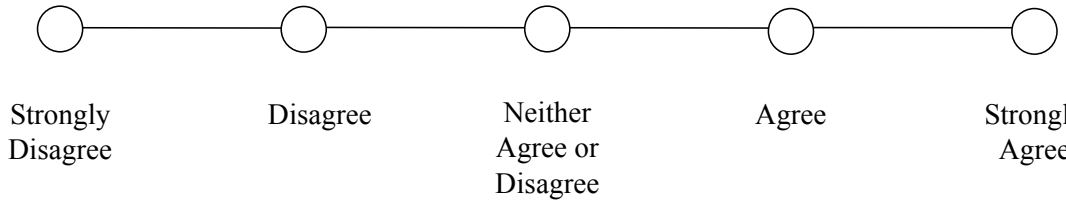


Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree

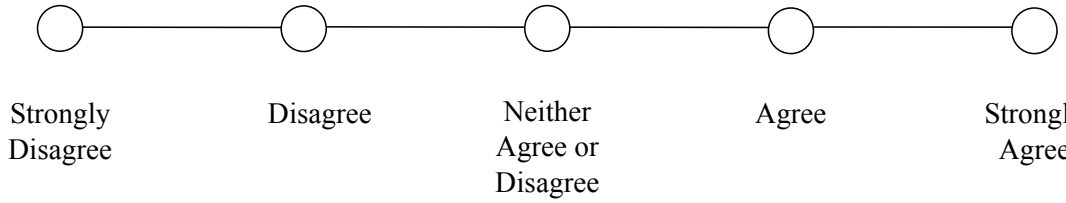
3. Wicked policy problems often span multiple disciplines.



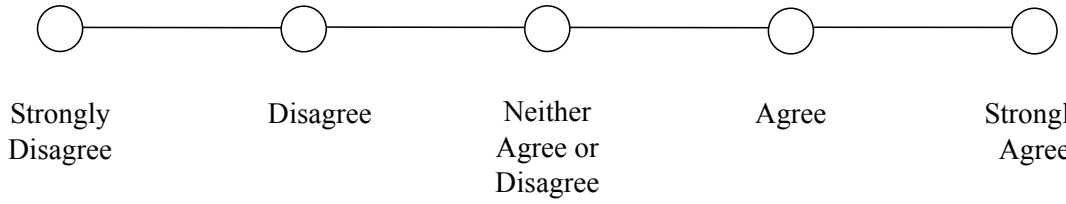
4. Solutions to wicked problems are not true-or-false, but better or worse.



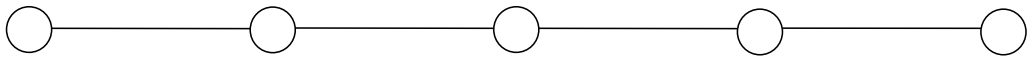
5. Wicked problems do not have an exhaustive set of potential solutions, nor is there a well-described set of permissible operations that may be considered when reaching a solution.



6. It is important to consider what assumptions realistically hold when solutions to wicked problems are determined.

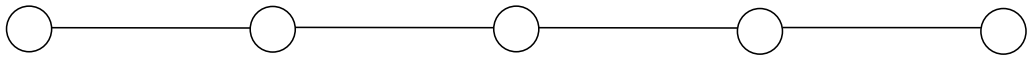


7. The solution to a wicked policy problem could be influenced by how the problem is presented.



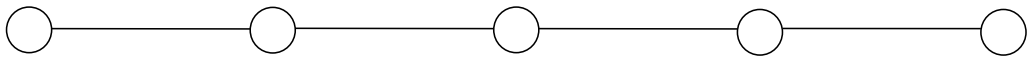
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

8. It is imperative the graduate students studying applied economics receive formal training on how to deal with, account for, and solve wicked policy problems.



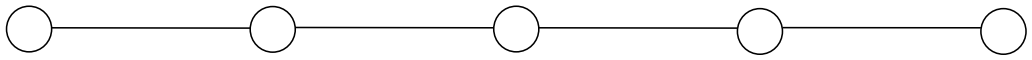
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

9. Prior to this study, you received formal training on how to solve wicked policy problems in an economics, applied economics, or other course taught here at the University of Georgia.



Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

10. Prior to this study, you were familiar with wicked policy problems.



Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

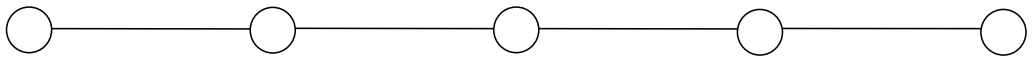
<u>Benefit-Cost Analysis</u>

Benefit-Cost Analysis (BCA) is an organizational framework used to identify, quantify, and compare the costs and benefits of a proposed policy or project. The final decision

"rule" is informed by a comparison of the total costs and benefits of the particular policy or project of interest.

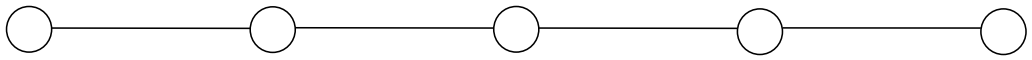
Using your current understanding and knowledge on the subject of BCA, please answer the following questions:

11. Benefit-cost analysis is an appropriate and effective tool that can be used to reach a conclusion regarding whether or not to pursue an economic policy or project involving a wicked problem.



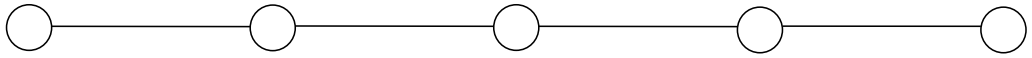
Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree

12. No matter the context of the problem at hand, an economist can and should always rely on the results of the benefit-cost analysis to support their policy recommendations.



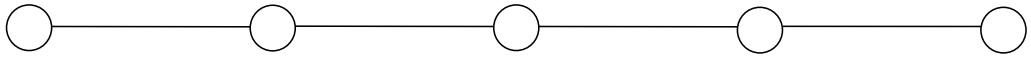
Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree

13. As a graduate student in applied economics, you should plan to analyze any economic policy or project using only benefit-cost analysis.



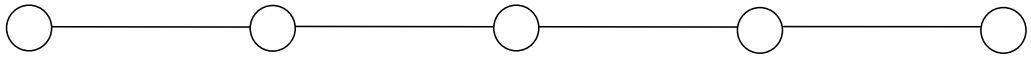
Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree

14. The results of a benefit-cost analysis exercise should always be the leading factor in the decision of whether or not to approve an economic policy or project involving a wicked policy problem.



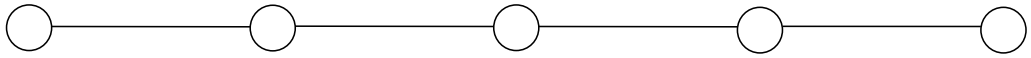
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

15. When a conducting benefit-cost analysis it can be difficult to identify and measure all relevant commensurable benefits and costs that can be monetized.



Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

16. You have received sufficient training on how to solve policy problems using benefit-cost analysis in either an economics or applied economics course here at the University of Georgia.



Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

Please answer the following questions by <u>circling</u> the appropriate choice or <u>filling in</u> the appropriate line.

1. What is your gender?

   Male

   Female

2. What is your age? _____

3. What is the highest level of schooling you have completed?

    2-year college degree

    4-year college degree

    Master's degree

4. What is your racial or ethnic background?

    Hispanic

    White (non-Hispanic)

    African-American

    Asian-American

    Native American

    Other (please fill in) _____

5. Which career path most accurately represents your plans after graduation?

    Private Sector

    Academia

    Federal Government

    Other (please fill in) _____

6. How many hours a week on average do you spend studying outside of school?

    1-5 hours

    6-10 hours

    10-15 hours

    15-20 hours

    More than 20 hours

7. Which of the following most accurately represents your learning style?

    Visual

    Auditory (Listening)

    Kinesthetic (Physical Activity)

    Reading/Writing

8. Are you a member of a professional economics organization?

    Yes

    No

9. Are you a member of an environmental group or organization?

    Yes

    No

Thank you for completing this survey. You are now finished and should turn the questionnaire over. A research team member will around to collect your responses.

[1] A copy of the four in-class case study exercises, final presentation grading rubric, and mid-semester check-in memo can all be found in the appendix.

[2] For example, a common problem-solving technique used in both undergraduate and graduate level natural resource economics courses is Benefit-Cost Analysis (BCA). Although it is convenient to boil a policy-decision down to a simple BCA decision rule such as "approve the policy if the net present value (NPV) of the change is greater than zero", such decision rules on their own are inadequate solutions to wicked problems

[3] To encourage students to participate in the study we offered students 5 bonus points for completing the pre-survey and 5 bonus points for completing the post-survey.

[4] Copies of the four in-class case study exercises are included in the appendix for reference.

[5] A graphical representation of these two policy scenarios can be found in Figure 1.

[6] Because this case study involved a semester-long project with many moving parts, we sent a memo via email to each group half-way through the semester. The memo simulated a request from their clients, the USFS and BLM, to show their consulting group's progress to date. Each group was given two weeks to submit documentation on the eight changes in goods and services they had identified, as well as the theoretically appropriate welfare measure they were planning to use to evaluate the changes. A copy of the memo can be found in the Appendix.

[7] See Figure 2. Student's Self-Reported Learning Style for a breakdown of the learning styles of all nineteen students in the course.

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Office of Research
Institutional Review Board

EXEMPT DETERMINATION

January 8, 2018

Dear John Bergstrom:

On 1/8/2018, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Tackling Wicked Problems in Applied Economics: An Application to the Bears Ears National Monument
Investigator:	John Bergstrom
Co-Investigator:	Amanda Harker Steele
IRB ID:	STUDY00005667
Funding:	None
Review Category:	Exempt 1

The IRB approved the protocol from 1/8/2018 to 1/7/2023.

Please close this study when it is complete.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Kate Pavich, IRB Analyst
Human Subjects Office, University of Georgia

Teaching Note for Case Study:

"Tackling Wicked Problems in Applied Economics: An Application to the Bears Ears National Monument"

Amanda Harker Steele [1]

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Teaching Note for Case Study: "Tackling Wicked Problems in Applied Economics: An Application to the Bears Ears National Monument"

Amanda Harker Steele[1] and John C. Bergstrom[2]

This teaching note accompanies the invited case study titled "Tackling Wicked Problems in Applied Economics: An Application to the Bears Ears National Monument" accepted for presentation at the 2018 AAEA Annual Meeting in Washington, D.C.

I. Synopsis of the Case

The objective of this case study is to examine whether or not the case method is an effective tool for teaching, training, and educating graduate level applied economics students how to deal with, account for, and offer solutions to wicked-type policy problems in agricultural, natural resource, and environmental economics. In contrast to the previous literature, our case study approach uses a set of interactive classroom exercises where students represent consultants, who are hired to evaluate a highly timely and relevant wicked-type policy problem. More specifically, students work in groups to determine "What is the socially optimal size of the Bears Ears National Monument?"

The Bears Ears National Monument in Utah was originally established by President Barrack Obama on December 28th, 2016 under the authority granted to him by the Antiquities Act of 1906. [1] On June 12th, 2017 Secretary of the Interior, Ryan Zinke, issued an interim report recommending that the Bears Ears National Monument be significantly reduced in size in order to "provide a much-needed change for the local communities who border and rely on these lands" (Turkewitz and Friedman, 2017). Following these recommendations, by executive action, President Donald Trump reduced the size of Bears Ears National Monument by 85% from about 1.35 million acres to about 102,000 acres of land still being managed as a national monument. The land area removed from national monument status by this executive action still remains in the public domain (public lands) and is managed by the U.S. Forest Service and U.S. Bureau

of Land Management, as was the case before President Obama first established the Bears Ears National Monument.

The down-sizing of Bears Ears National Monument represents a wicked type policy problem for three main reasons. First, it involves the interests of many diverse key stakeholders including some who support the down-sizing (e.g., local ranchers, miners, and timber companies who extract valuable resources from the area, motorized recreation enthusiasts,[2] and local government officials) and some who oppose it (e.g., Native American tribes, archeologists, conservationists, and non-motorized recreation enthusiasts). Secondly, there is considerable risk and uncertainty involved in many of the economic values associated with the area, especially related to the potential economic value and environmental risks of proposed uranium mining in the area. Third, the context of the problem involves complicated legal issues that will certainly influence proposed solutions and final outcomes.

Given the complex nature of the decision to down-size the Bears Ears National Monument, traditional methods used in economics to evaluate the "socially optimal" size of the Monument may not suffice. For example, a common method used in both undergraduate and graduate level environmental and natural resource economics courses to evaluate proposed policy changes such as re-sizing the Bears Ears National Monument is Benefit-Cost Analysis (BCA). Although it would be convenient to boil the policy-decision on the optimal size of the Monument down to a simple BCA decision rule such as "approve a re-sizing proposal if the net present value (NPV) of the proposal is greater than zero", a decision rules such as this on its own might not be satisfactory. Therefore, we propose this case study exercise as a method to teach, train, and educate students on how to deal with and account for the wicked nature of the Bears Ears National Monument re-sizing debate.

To begin this case study, we "hire" students in a graduate level applied economics course to assess the Bears Ears National Monument re-sizing debate. As part of their assessment, students are asked to identify abiotic and biotic components of the area, both non-market and market goods and services produced in the area, and the economic value associated with these goods and services. Upon completion of their assessment, students are asked to provide recommendations as to what is the "socially optimal" size of the

Bears Ears National Monument? Given the re-sizing debate goes beyond traditional economics, we have students assess re-sizing the Monument using BCA, additional quantitative techniques discussed throughout the semester, and qualitative assessment techniques. Results are presented in a formal presentation simulating a policy brief at the end of the semester.

II. Target Audience

The target audience for this case study includes graduate students majoring in agricultural and applied economics, environmental and natural resource economics, forestry economics, or ecological economics. This case study could also be used in an advanced undergraduate, applied natural resource and environmental economics and policy course.

III. Learning Objectives

Upon completion of this exercise, students should be able to:

1. Understand the general complexity presented by wicked problems in applied economics such as re-sizing the Bears Ears National Monument.
2. Have a better understanding of how the application of economic principles improves decision making with wicked problems.
3. Understand the importance of engaging with and understanding the viewpoints of multiple stakeholders.
4. Understand the limitations of traditional policy evaluation criteria used by economists to solve wicked policy problems.
5. Have a better grasp on the importance of undertaking applications that involve the integration of quantitative and qualitative science-based methods into decision-making processes.

IV. Teaching Strategy

If the instructor is interested in gauging student learning outcomes using the same procedures as this case study, the instructor should begin the exercise by administering the consent form and pre-survey to all of the students in the class at the beginning of the

semester. Once the survey and consent forms have been completed and collected, the instructor can proceed by dividing students into separate, but equal groups. The instructor should then advise each group to review background information on the wicked policy problem of interest, which in our case included information on the controversy surrounding the re-sizing of the Bears Ears National Monument.

For our case study, the background information, a list of which is included in the "required readings" section of this teaching note, was made available to each group via the course website. This method of delivery proved to be a convenient way to provide information to the students, given they could continue to access the information throughout the entire semester. Students were also provided with four in-class case study exercises via the course website to be completed throughout the semester. The exercises were designed to build off one another and provide students with a framework to economically evaluate a proposed policy change. Exercise objectives ranged from identifying goods and services within an area of interest to determining theoretically appropriate welfare (value) measures and techniques for quantifying economic values.

To encourage group participation during the in-class "exercise days," students were asked to sit with their group and work on the assigned exercise at their own pace while the instructor moved from group to group to help answer questions and guide students in the right direction. As a way to check each group's progress, about halfway through the semester, groups were presented with a "mid-semester" memo from their assumed "clients" (a lead economist with the Bureau of Land Management and a senior economist with the U.S. Forest Service). This memo asked each group to provide an update on their progress to date including a list of the changes in goods and services identified by their group.

This memo proved to be an excellent opportunity for the instructor to touch base with the groups and ensure they were on track to complete their final presentations at the end of the semester. An alternative to the mid-semester memo would be an in-person check-in, where the instructor(s), posing as their "client(s)", meets with each group one-on-one. Once all of the in-class exercises have been completed, and all of the groups have had a chance to respond to the memo, the instructor can move forward with the case study by assigning the individual take-home assignment.

The individual take-home assignment should be related to the final oral presentation in some capacity. For example, for the individual take-home assignment in our class, we had students apply the benefit transfer method to quantify the economic value of the unique changes in goods and services identified by their group. The information collected in the individual take-home exercises was then to be used to conduct a benefit-cost analysis of the proposed policy change being evaluated for the final oral presentations. Setting up the individual take-home assignment in this way not only allows students to see the connection to the overall topic more clearly, but also promotes a sense of individual responsibility for the group project.

The final oral presentations should provide students with an outline of the proposed policy change of interest, as well as any information on how the presentations will be evaluated and who will conduct the evaluation. These guidelines should be made available at least two weeks prior to the presentation date. If the instructor plans to use the surveys to gauge student learning outcomes, then the post-survey should be administered on the same day the presentations are to be given, which in our case was on the final day of class. This is also an appropriate time to have students evaluate their team members using an individual evaluation form similar to the one used in this study.

V. Discussion Questions

The following includes a list of discussion questions the instructor might use to help students understand the information included in each, in-class case study exercise. These questions can also be used to gauge student's understanding of how economics can be used to frame and solve wicked policy problems, as well as the caveats of any proposed solution.

1. Why are the ecosystem components you and your team have identified considered living and non-living?
2. What is an example of a natural resource input used to provide an ecosystem good or service?
3. What are natural resource inputs associated with all the different ecosystem goods and services your group has identified?

4. Why is the theoretical welfare measure chosen by your team most appropriate to evaluate the change in good or service identified?
5. What caveats or cautions should we consider with respect to the results of your benefit-cost analysis?
6. What about the same question as above for the results from the other quantitative criteria you or your team considered?
7. From the perspective of an economist, what do you believe are the limitations of benefit-cost analysis for evaluating wicked policy problems in general?
8. Considering changing the discount rate for your net present value (NPV) calculation. Do you notice anything about the results? For example, does changing the discount rate impact the recommendations? How do you think an appropriate discount rate to use in benefit-cost analysis should be determined and by whom?
9. When a conducting benefit-cost analysis it can be difficult to identify and measure all relevant commensurable benefits and costs that can be monetized. What method(s) would you suggest to ensure as many benefits and costs as possible are included in the analysis? Is this practical?
10. If the net present value is greater than zero or the benefit-cost ratio greater than one then re-sizing the Bears Ears National Monument to include fewer acres is considered a Potential Pareto Improvement (PPI). Why? What objections may people have about using the PPI criterion to evaluate a public policy?
11. How can we best integrate quantitative methods such as benefit-cost analysis with qualitative methods such as social and/or environmental justice assessment to develop solutions to complex problems such as the Bear Ears National Monument re-sizing issue?

VI. Background Reading

1. Bears Ears Information Background and Facts
2. Bears Ears: A Native Perspective
3. Bears Ears Fact Sheet U.S. Forest Service

4. Bears Ears National Monument Map
5. Bears Ears Visitor Information Fact Sheet

VII. Assessment

Student learning outcomes from the in-class case study exercises, individual take-home assignment, and final oral presentations should be assessed according to the following criteria: (1) correctness of solutions found for the analytical benefit-cost analysis exercise using the benefit transfer method to quantify economic values, (2) competency of information presented during the oral presentations including the proposed policy recommendations and individual goods and services identified in the area (e.g., are the goods and services native to the area of interest), (3) proficiency of the material based on command of the subject matter (e.g. wicked problems) presented during both the oral presentation and written explanations provided in the take-home assignment, and (4) ability to think critically and objectively by developing their reasoning based on the science and theory of economic criteria used to assess policy and management decisions; (5) ability to integrate quantitative and qualitative policy and management assessment criteria and techniques to develop more holistic and effective solutions to wicked problems.

VIII. Mid-Semester Memo

To: Bulldog Natural Resource and Environmental Consultants
From: Interagency Task Force on Bear Ears Area Management Plan
(Teaching Assistant), Economist and Task Force Chair, Bureau of Land Management
(Professor), Senior Economist, U.S. Forest Service, National Forest Programs

Subject: Economic Assessment Progress Report
Date: (insert date)

We are looking forward to your final report and presentation on (presentation date), at (time) providing the results of your economic assessment of the optimal size of the Bear Ears National Monument. The footprint of this national monument co-managed by the Bureau of Land Management and the U.S. Forest Service will affect the

management of the monument and adjacent public lands also managed by our two agencies.

In order to report to other members of the Task Force, we are requesting a progress report by COB (Eastern Standard Time), (date). This progress report should show expected changes in at least 8 ecosystem goods and services supported by the National Monument and should identify the theoretically appropriate welfare change measures (Hicksian consumer surplus) with associated WTP/WTA interpretations.

Your progress report should include at least one unique ecosystem goods or service change from each of our six resource management plan areas (Recreation Related; Urban Forests and Wilderness Areas; Timber/Minerals; Grasslands; Waterways; and Historical Artifacts). Please submit your progress report in table format (see attachment for an example of the table format and the needed level of detail for information presented in the table).

IX. Case Study Exercises

Exercise 1

Introduction to the Bears Ears National Monument

Exercise Objectives

1. Identify both biotic and abiotic natural resources of interest in the Bears Ears National Monument.
2. Identify ecosystem functions supported by these identified biotic and abiotic natural resources.
3. Identify goods and services supported by ecosystem functions.

4. Identify the different agencies involved in managing the natural resources of interest and the goods and services supported by these resources.

Bears Ears National Monument Case Study

Biotic and Abiotic Ecosystem Components

Biotic (Living) Components	Abiotic (Non-Living) Components

Bears Ears National Monument Case Study

Ecosystem Functions and Services

Function	Consumptive Goods and Services
Natural Development of Plants	
Natural Development of Wildlife	
Natural Development of Rocks & Minerals	
Natural Development of Water	
Natural Development of Air	
Natural Development of Soil	

Bears Ears National Monument Case Study

Ecosystem Functions and Services

Function	Non-Consumptive Goods and Services
Natural Development of Plants	
Natural Development of Wildlife	
Natural Development of Rocks & Minerals	
Natural Development of Water	
Natural Development of Air	
Natural Development of Soil	

Bears Ears National Monument Case Study

Agencies Involved in Managing Resources and Resource Based Services	
Federal	
State	
Local	
Tribal	

Exercise 2

Completing the Policy Analysis Scenario:

Application to the Bears Ears National Monument

Exercise Objectives

1. Review understanding of the "with" and "without" principle.
2. Practice proceeding from a general policy interest statement to a formal definition of the policy analysis scenario.
3. Identify measurable indicators of the "with" and "without" environment and goods and services.
4. Identify changes in goods and services to be valued.

Start with Policy of Interest Description

For the Bears Ears National Monument, briefly describe the policy issue or questions for each of the following resource or resource service areas we should consider when discussing the re-designation.

1. Recreation-Related

2.Wilderness Areas

3.Timber/Minerals

4. Grasslands

5. Waterways (Wild and Scenic Rivers)

6. Ceremonial/Historical/Cultural Related

Completing the Policy Analysis Scenario:

Application to the Bears Ears National Monument

To conduct Policy Analysis, we need to identify the following:

Without Policy Scenario

1. E^0 = "without new policy" environment (e.g. status quo level of ecosystem components)
2. S^0 = "without new policy" goods and services (e.g. status quo level of ecosystem services)

$$S^0 = f(E^0)$$

With Policy Scenario

3. E^1 = "with new policy" environment (e.g. new level of ecosystem components)
4. S^1 = "with new policy" goods and services (e.g. new level of ecosystem services)

$$S^1 = f(E^1)$$

Change in Goods & Services = "With" Goods & Services – "Without" Goods & Services

$$= S^1 - S^0$$

$$= f(E^1) - f(E^0)$$

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Recreation-Related

Describe the current condition of the recreation-related resources in the "Without New Policy" environment, E^0 including indicators.
Describe the current condition "Without New Policy" recreation-related goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of the recreation-related resources in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" recreation-related goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Recreation-Related

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Recreation-Related

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Urban Forests and Wilderness Areas

Describe the current condition of the urban forests and wilderness areas in the "Without New Policy" environment, E^0 including indicators.
Describe the current condition "Without New Policy" urban forests and wilderness area goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of the urban forests and wilderness areas in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" urban forests and wilderness areas goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Urban Forests and Wilderness Areas

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Urban Forests and Wilderness Areas

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Timber/Minerals

Describe the current condition of timber and mineral resources in the "Without New Policy" environment, E^0 including indicators.
Describe the current condition "Without New Policy" timber and mineral goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of timber and mineral resources in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" timber and mineral goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Timber/Minerals

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Timber/Minerals

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Grasslands

Describe the current condition of the grasslands in the "Without New Policy" environment, E^0 including indicators.
Describe the current condition "Without New Policy" of the grassland related goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of the grasslands in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" of the grassland related goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Grasslands

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Grasslands

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Waterways (Wild and Scenic Rivers)

Describe the current condition of the waterways (wild and scenic rivers) in the "Without New Policy" environment, E^0 including indicators.
Describe the current condition "Without New Policy" of the waterways (wild and scenic river) related goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of the waterways (wild and scenic rivers) in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" the waterways (wild and scenic rivers) related goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Waterways (Wild and Scenic Rivers)

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Waterways (Wild and Scenic Rivers)

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Ceremonial/Historical/Cultural Related

Describe the current condition of the ceremonial/historical/cultural related resources in the "Without New Policy" environment, E^0 including indicators.
Describe the current conditions "Without New Policy" of the ceremonial/historical/cultural related goods & services, $S^0 = f(E^0)$, including indicators.

Describe the desired future condition of the ceremonial/historical/cultural in the "With New Policy" environment, E^1, including indicators.
Describe the current condition "With New Policy" ceremonial/historical/cultural related goods & services, $S^1 = f(E^1)$, including indicators.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Ceremonial/Historical/Cultural Related

Goods & Services	Change in Goods & Services $S^1 - S^0$	Expected Direction of Change

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Ceremonial/Historical/Cultural Related

Change in Goods & Services $S^1 - S^0$	Expected Direction of Change	Affected Stakeholders

Exercise 3

Identifying the Appropriate Welfare Measures:

Application to the bears Ears National Monument

Exercise Objectives

1. Specify the changes in ecosystem goods and services resulting from policy/management changes associated with different resource areas.
2. Define the theoretically appropriate individual exact welfare (valuation) measure for each change in ecosystem goods and services.
3. Determine the WTP/WTA interpretation of the exact welfare change (valuation measure) for each change in ecosystem goods and services.

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Recreation-Related

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Urban Forests and Wilderness Areas

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Timber/Minerals

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Grasslands

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Waterways (Wild and Scenic Rivers)

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Completing the Policy Analysis Scenario

Application to the Bears Ears National Monument

Ceremonial/Historical/Cultural Related

Ecosystem Goods & Services	Change in Ecosystem Goods & Services $S^1 - S^0$	Appropriate Individual Exact Welfare Change Measure (CV,EV, CS,ES)	WTP/WTA Interpretation

Exercise 4

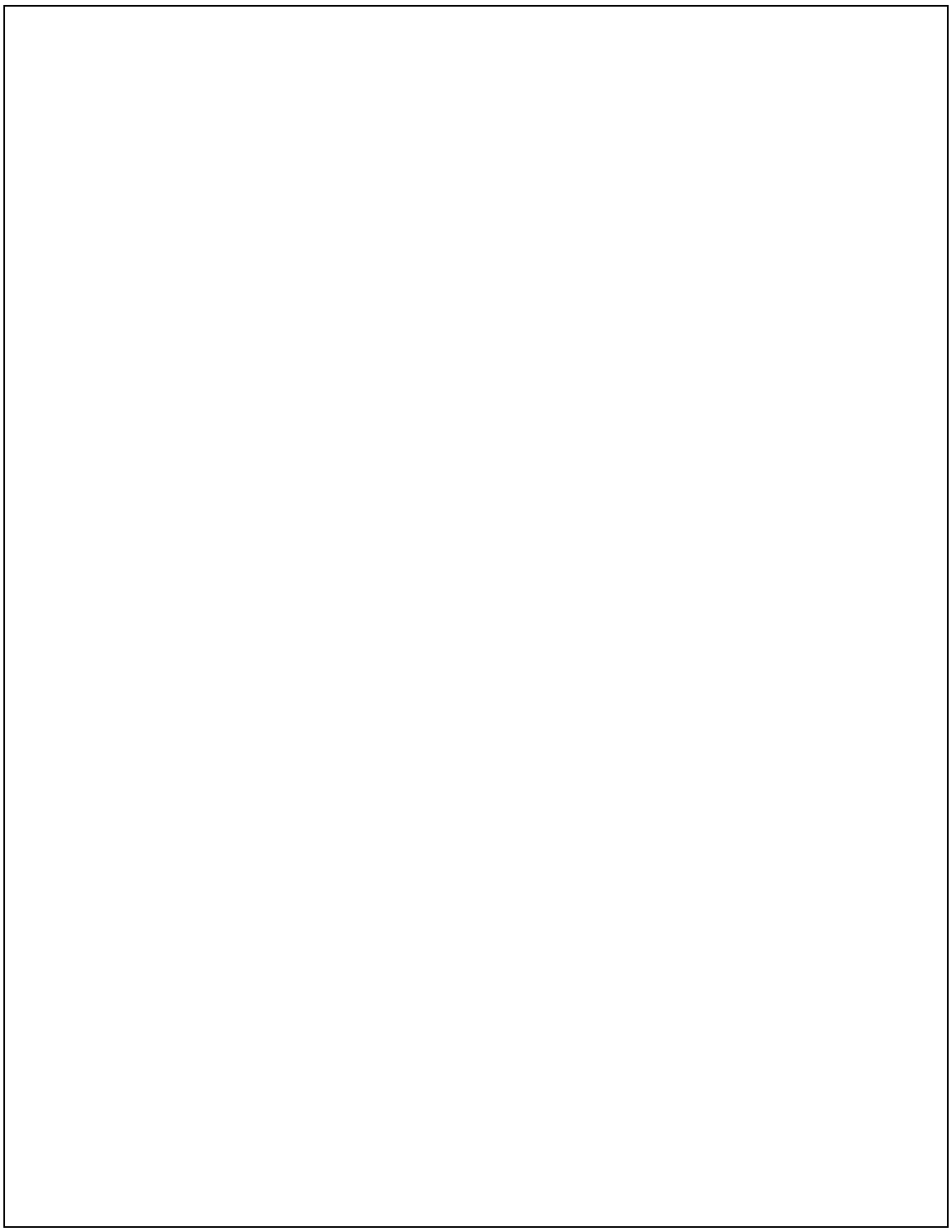
Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

Exercise Objectives

1. Review valuation concepts and empirical valuation tools.
2. Practice identifying which empirical valuation tools are appropriate for measuring different components of total economic value.
3. Practice identifying linkages between management actions, resource/environmental changes, changes in ecosystem goods and services, economic value changes, and valuation techniques.

Review of Total Economic Value Concepts

I. What are the components of total economic value?



II. Which components of total economic value are classified as economic benefits from a national economic efficiency perspective?

III. Which components of total economic value are classified as economic benefits from a regional economic development perspective?

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

Summary of Economic Valuation Tools & Techniques	
Valuation Tool or Technique	Used to Measure which Components of Total Economic Value
Revealed Preference Nonmarket Valuation techniques	
Stated Preference Nonmarket Valuation Techniques	
Market Valuation Techniques	
Input-Output Models	
Averting Behavior Models	
Damage Cost Models	

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

I. Recreation

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Change in Goods & Services $S^1 - S^0$	Exact Welfare Change Measure and WTP/WTA Interpretation	Alternative Valuation Techniques

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

II. Wilderness

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Desired Service Change (Goal)	Type of Economic Value Change	Alternative Valuation Techniques

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

III. Timber/Minerals

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Desired Service Change (Goal)	Type of Economic Value Change	Alternative Valuation Techniques

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

IV. Grasslands

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Desired Service Change (Goal)	Type of Economic Value Change	Alternative Valuation Techniques

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

V. Waterways (Wild and Scenic Rivers)

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Desired Service Change (Goal)	Type of Economic Value Change	Alternative Valuation Techniques

Matching Valuation Concepts to Empirical Valuation Tools: An Application to the Bears Ears National Monument

VI. Ceremonial/Historical/Cultural

Linking Resource/Environmental Changes, Service Changes, Value Changes, & Valuation Techniques		
Desired Service Change (Goal)	Type of Economic Value Change	Alternative Valuation Techniques

X. Take Home Assignment

Instructions: Your answers to the assignment should be typed in either Microsoft Word (MS Word) or LaTeX and submitted by email as a PDF attachment by (time and date). No late assignments will be accepted. With respect to format, use Times New Roman, 12-point, double-spaced, standard margins, left-hand justified. Points will be deducted for spelling and basic grammar/writing style errors. Make sure to document your work and answer each part completely to receive full credit.

The Benefit-Transfer Method:

Benefit transfer is a method used to estimate the economic value of changes in ecosystem goods and services when it is not possible to estimate the value with primary (first hand) data due to budget and/or time constraints. The benefit transfer method works by transferring information from a pre-existing study area (e.g. the "study" site) to estimate the value of a change in an ecosystem good or service at a separate study area (e.g. the "policy" site). For example, values for recreational hiking visitor days in a particular state may be estimated by transferring measures of value for recreational hiking visitor days from a study conducted in separate but similar site.

There are two sources of secondary data commonly used to conduct benefit transfer for natural resource and environmental goods and services. These secondary data sources are briefly described below.

1.) The **2016 updated Recreation Use Values Database (RUVD)** from Oregon State University (available on ELC and at http://recvaluation.forestry.oregonstate.edu/). The updated RUVD currently contains 421 documents of economic valuation studies that estimated the use value of recreation activities in the U.S. and Canada from 1958 to 2015. Activities within the RUVD are separated by activity mode. The recreation use value estimates provided are measures of net willingness-to-pay (WTP) or Consumer Surplus (CS) for access to a specific site, or for certain activities at a broader geographic scale. The values are listed in terms of per person, per activity day units.

2.) **Environmental Valuation Reference Inventory** (available at https://www.evri.ca/en). The Environmental Valuation Reference Inventory (EVRI) is a searchable compendium of summaries of environmental and health valuation studies. These summaries provide detailed information about the study location, the specific environmental assets being valued, the methodological approaches and the estimated monetary values along with proper contextualization. The EVRI database now contains over 4,000 summaries of valuation studies and information from new studies are being added on an ongoing basis (https://www.evri.ca/en/content/about-evri).

Background Reading:

Rosenberger, R. S., White, E. M., Kline, J. D. and Cvitanovich, C. (2017). Recreation economic values for estimating outdoor recreation economic benefits from the National Forest System. Gen. Tech. Rep. PNW-GTR-957. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 33 p.

Assignment:

For the changes in ecosystem goods and services you will present as part of your final project, using the RUVD, the EVRI, and any other sources of information on previous studies and secondary data you can find, identify at least three comparable studies and complete the following step-by-step procedure to provide the estimated value. You will need to identify at least three studies for each change, so you should have 6 studies all together.

For each of the two studies, you identify, fill in the following information. Be as detailed as possible and write in complete sentences when necessary.

1. Study Source and Publication Information:
    a. Author
    b. Title
    c. Publication Date
    d. Document Type (e.g. journal article, web report, thesis/dissertation, book chapter, proceedings paper, etc.)

2. Study Location:
    a. Country
    b. State
    c. Site Name
    d. Census region/ division location
3. Market or Non-Market Good or Service:
    a. List the recreation activity or species you are interested in determining the value for. The species or activity you identify should be identical to the one you are identifying in the Bears Ears. If you cannot find an identical species, then provide a detailed justification for how the species/activity is related to the one you are presenting for the Bears Ears study.
4. Characteristics of the Site Studied:
    a. Size of the site
    b. Environmental amenities available
    c. Public land type (e.g. national park, state forest, etc.)
    d. Primary environment (e.g. lake, desert, grassland, etc.)
5. Survey/Sample Characteristics:
    a. Survey type (e.g. mail, in-person, phone)
    b. The year the data was collected. This should be within the past ten years.
    c. Visitor type (e.g. resident, non-resident)
    d. The response rate for the survey
6. Valuation Method Used:
    a. Include all relevant information from the valuation technique used in the study you have chosen. For example, if the study you chose used a stated preference technique, then you would be expected to discuss the elicitation method used (e.g. payment card, dichotomous choice, etc.) the payment vehicle used (e.g. trip cost, access fee, license fee, etc.), and the payment type. In other words, the all of the information related to the valuation technique used in your study should be included in your write-up. Be as specific as possible. In addition, explain why you think the valuation technique used in the study was the "best" choice.

7. Benefit Measure
    a. The benefit estimate results reported in the study. Include a value of the point estimate, the corresponding confidence interval, and the standard error reported.
    b. Include a discussion of the results as they relate to the study. For example, what does the CS value measure and is it statistically significant?

Once you have collected the following information, find a copy of the study using a search engine such as Google Scholar. Identify at least one limitation of the study and in 150 words or less, explain how you plan to address the limitation as it applies to your results. Be brief, but also detailed. Remember, the studies you choose should be examining an area similar in nature to the Bears Ears National Monument, so listing the lack of similarity between study site and the policy site as a limitation is unacceptable.

You are welcome to "brainstorm" with your teammates if you need assistance, but each individual group member must submit their own original work. Remember as a group you are expected to present at least 8 changes in ecosystem goods and services and at least one unique ecosystem good or service change from each of our six resource management plan areas outlined in the case study exercise (e.g. Recreation Related; Urban Forests and Wilderness Areas; Timber/Minerals; Grasslands; Waterways; and Historical Artifacts).

XI. Final Oral Presentation Assignment

Scope of Work: Assess the "with" and "without" net economic value of a change in the size of the Bears Ears National Monument where, the "without" size is defined as the current (initial) size of the monument as recently set by the Trump Administration in December 2017 (state-of-the world A), and the "with" size is defined as the "with" change or subsequent size of the monument as set by the Obama Administration in December 2016 (state-of-the-world B).

Each team's assessment should include the following:

1) Definitions of the theoretically appropriate welfare change measures for 8 separate changes (2 changes per person) in ecosystem goods and services, resulting from a change in the size of the Bears Ears National Monument going from "State-of-the-world A" to "State-of-the-world B";
2) Estimates of the monetary values of the 8 changes in ecosystem goods and services, as defined in 1) using the benefit transfer method;
3) The estimated net present value (NPV) of changing the size of the monument going from "State-of-the-world A" to "State-of-the-world B" using the values estimated in 2);
4) A discussion of two other alternative approaches for advising the clients on how to decide which size of the monument is "socially optimal" or "socially preferred" in addition to recommendations from the results of the benefit-cost test conducted in 3).

Format and Expectations: The final presentation must include all of the sections below. Each section must be clearly labeled in the presentation slideshow using PowerPoint slides or other acceptable slide presentation program (e.g. Beamer). The slideshow presentation must be turned into the client by email by **(date).** The final presentation needs to follow a "lightening presentation" format with a strict 15 minute per team total time limit. During the presentation, each team member is required to present the theoretically appropriate welfare change measures and benefit transfer results for at least two of the minimum 8 changes in ecosystem goods and services defined and valued in 1) and 2) above.

If your team has more than 4 people, then you will be expected to present two additional changes per additional person and will be given 2 additional minutes per additional person on your total presentation time limit. For example, if your team has 5 members, then you will be expected to present 10 changes in ecosystem goods and services and your presentation cannot exceed 17 minutes. Each individual team member will still be responsible for presenting two of the changes per presentation.

Because the purpose of this exercise is to evaluate **changes** in ecosystem goods and services, it is not acceptable to include **no change** cases as part of your 8 or more changes in ecosystem goods and services as these are irrelevant to the benefit-cost analysis outcome.

Presentation Outline

1. Title Slide with Title, Authors, and Date of Presentation
2. Introduction and Background (2 minutes total)
    a. Problem Statement: "What is" the overall policy/management issue and "why", in general from an applied welfare economics perspective, is there a need for economic valuation? Also, include "who" are the parties affected by this issue?
3. Alternative Policy/Management Scenarios, Changes in Ecosystem Goods and Services, and Economic Values (10 minutes total)
    a. Description of the "where", "what", and "when" aspects of the Environment Under "State-of-the-world A" (Trump Dept. of Interior Plan) and "State-of-the-world B" (Obama Dept. of Interior Plan) including total acreage and associated biotic and abiotic components). (2 minutes)
    b. Valuing Changes in Ecosystem Goods and Services going from "State-of-the-world A" to "State-of-the-world B". "What are the changes being measured, how do we define the theoretically appropriate values for these changes, and what is the estimated value of these changes? (8 minutes)

        For the 8 separate changes in ecosystem goods or services identified by the team, present the: expected quantitative change in the good or service; the theoretically appropriate welfare change measure (CV, EV, CS, or ES) including the corresponding WTP/WTA interpretation for the change is good or service; and the monetary value of the change in good or service estimated from the benefits transfer method (1 minute per good or service). Each team member must present for at least two of the 8 changes

in ecosystem goods and services.

II.B.1. Good or Service 1
II.B.2. Good or Service 2
II.B.3. Good or Service 3
II.B.4. Good or Service 4
II.B.5. Good or Service 5
II.B.6. Good or Service 6
II.B.7. Good or Service 7
II.B.8. Good or Service 8

4. Benefit-Cost Analysis and Alternative Decision-Making Approaches (3 minutes total)
   a. Net Present Value going from "State-of-the-world A" to "State-of-the-world B"
   b. Alternative Decision-Making Approaches
      III.B.1. Alternative 1
      III.B.2. Alternative 2
5. Summary and Conclusions: Summarize your key results and implications of these results for policy and management.
6. References Cited: References should follow AJAE journal article format found at http://www.oxfordjournals.org/our_journals/ajae/for_authors/general.html (Note: reference list needs to be included at the end of the slideshow presentation, but does not need to be part of the oral presentation)

Due Dates:

Electronic Submission: Presentations must be submitted in (PDF) format to **(client's email)** by **(date)**. It is the responsibility of each team to ensure all equations, figures, and information displays correctly in the PDF prior to submitting to the professor.

Final Oral Presentation: Must be presented using PowerPoint or equivalent slides on **(date and time).** Order of presentations will be assigned randomly and announced in class. Attendance by all students at all presentations is required. Failure to stay for the whole time will result in an unforgivable automatic zero.

XII. Rubrics

Presentation Rubric

Team Number Students	
1. Title Slide	1 point
2. Introduction and Background: Problem Statement and Objective	4 points
3. Alternative Policy/Management Scenarios Description of the Environment Under "State-of-the-world A"	3 points
Description of the Environment Under "State-of-the-world B"	3 points
4. Valuing Changes in Ecosystem (8 changes) Expected quantitative change in the good or service	5 points
Theoretically appropriate welfare change measure (CV,EV,CS, or ES)	5 points
Corresponding WTP/WTA interpretation for the change in goods and services	5 points
The monetary value of the change in good or service estimated from the benefit transfer method.	10 points
5. Benefit-Cost Analysis and Alternative Decision-Making Approaches Net Present Value Calculation	4 points
Two Alternative Decision-Making Approaches	2 points
6. Summary and Conclusions	2 points
7. References Cited	1 point
TOTAL	45 Points

Individual Evaluation Rubric

Student Name: Weighted Average of Team Member Evaluations	5 points

Each Students final exam grade will be worth 50 points.

XIII. Individual Peer Evaluations

Your Name:_____

Group Number: _____

Write the name of each of your group members in a separate column. For each person, indicate the extent to which you agree with the statement on the left, using a scale of 1-5 (1=strongly disagree; 2=disagree; 3=neither agree nor disagree, 4=agree; 5=strongly agree).

Evaluation Criteria	Group Member:	Group Member:	Group Member:
Contributed to group discussions and participated in discussions willingly.			
Demonstrated a cooperative and supportive attitude.			
Prepared work in a quality manner.			
Remained unbiased throughout the case study and objectively analyzed results.			
Made a significant contribution to the work presented by the team.			
Demonstrated a desire to learn and engage with the subject material of the case study.			

[1] The Antiquities Act was designed to safeguard sites on public lands that were in danger due to haphazard digging and purposeful, commercial artifact looting taking place in the Midwest in the early 1900's.

[2] For example, All Terrain Vehicle (ATV) and other off-road vehicle riding enthusiasts.