Structured Decision Making in Natural Resource Management (FW 537)

Credit hours*:* This course combines approximately 60 hours of instruction, online activities, and assignments for 2 credits.

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Prerequisite(s): One year of college-level mathematics, one quarter of fish and wildlife management or similar course

Justification: Natural resource managers are increasingly being asked to work with diverse stakeholder groups and incorporate their values and objectives when developing conservation plans. Such decisions are fraught with the complexity and uncertainty associated with ecological system dynamics and multiple and potentially conflicting objectives under consideration. Structured decision making (SDM) is an approach that can incorporate multiple competing objectives and ecological uncertainties in a framework that is transparent and adaptable. It also is an ideal framework for interdisciplinary management teams to cooperate and create the most effective management strategies. The Department of the Interior (DOI) has recognized the importance of SDM and has directed DOI bureaus and offices to incorporate SDM and adaptive management strategies into their land and resource management decision-making. However, there are few courses on SDM and adaptive management available to students in natural resources and related fields. This course is intended to provide graduate students from diverse backgrounds (natural resources, ecological economics, civil engineering, political science, and others) with an understanding of the SDM process used for making natural resource management and policy decisions regardless of the level of complexity or uncertainty. Primary focus is exposing students to the logic and conceptual basis of each step of the SDM process to understand when an SDM process is appropriate and how the process produces and optimal decision when properly implemented.

Course content: The course consists of lectures and weekly discussions on Blackboard. Lectures cover the SDM concepts and approaches, while the discussions are intended to help students synthesize the information. Students also are expected to participate in a small group project to develop a simple decision problem. A brief outline of the weekly lessons is provided below.

Week 1 - Introduction to Structured Decision Making in Natural Resources Management

Discuss the history of decision making in natural resource management and provide an introduction to Structured Decision Making (SDM) as an approach for making the best decision even in the face of uncertainty. Compare and contrast traditional approaches with an SDM approach to illustrate the advantages of using the SDM approach when appropriate. Describe why natural resource decisions are often difficult due to complexity, multiple sources of uncertainty and the presence of multiple, and often competing, objectives. Provide a general overview of the SDM process (we will use the steps of the PrOACT process). Each step will be individually presented and described in detail in the following weeks and illustrated thru case studies and real-world examples.

Week 2 –Decision Making and Working with Stakeholders

Most natural resource issues include a wide variety of stakeholders and their input is critical for properly framing a problem and identifying objectives (see below). Thus, an understanding how people generally make decisions, group dynamics, and the role of facilitation is extremely important for working through the entire SDM process and for ensuring all parties are invested in and have ownership of the process and the resultant decisions. Concepts presented in this section will include discussion of prescriptive versus descriptive decision making; heuristics as potential sources of bias; how human behavior, values and beliefs can influence the SDM process; and how to conduct an effective stakeholder meeting by understanding various roles (e.g., facilitator, mediator, modeler, etc.) and how to recognize and ameliorate impediments of the SDM process.

Week 3 – Identifying, Quantifying, and Weighting Objectives

Establishing measurable objectives is an essential part of the SDM process because they allow you to assess how well your alternatives meet your objectives and provide a basis for evaluating trade-offs. However, establishing well defined and measurable objectives can be difficult in a complex, multi-stakeholder environment and confounded by an inability to distinguish fundamental objectives from means objectives. Consequently, this section will focus on: translating resource concerns or desired outcomes to objectives; identifying hidden objectives; creating measurable attributes for objectives; distinguishing fundamental objectives from means objectives (and why this is important); creating objective hierarchies; and assigning weights to objectives in multiple objective problems.

Week 4 - Identifying Decision Alternatives and Consequences

In natural resource problems, a wide variety of alternatives are often available to achieve the stated objectives. Often, the most obvious alternatives are not necessarily the best and innovative or novel sets of actions are needed to maximize objectives. Fortunately, approaches and tools are available that can help generate a creative and diverse set of alternatives, and these will be the focus of the first half of this section. Once a set of alternatives are defined, decision makers need to understand the consequences of the actions with respect to the objectives. Modeling plays an important role in predicting consequences so the second half of this section will focus on: the role of modeling in the SDM process; the benefits and limitations of models; different types of models (conceptual versus predictive models); and the use of consequence tables as a tool to succinctly relate the consequence of each action to each objective.

Week 5 - Uncertainty and Decision-Making

Students are introduced to the concept of uncertainty and the different types of uncertainty, e.g., linguistic, epistemological, statistical, environmental, structural. Uncertainty can be incorporated by using statistical distributions, alternative models, and subjective judgment. Students will be taught very basic probability, the use of subjective judgment as a valid measure of certainty, and strategies for minimizing the effects of linguistic uncertainty. Graphical methods, such as probabilistic networks and decision trees, will be introduced and used to demonstrate how uncertainty is propagated in decisions. This will prepare students for the concept of certainty-weighted outcomes, which will be used in the next course component (week 6).

Week 6 - Choosing the Best Decision Alternative and Evaluating the Effect of Uncertainty

A variety of tools are available to practitioners of SDM for evaluating trade-offs between different decision alternatives and identifying the optimal decision. These tools can range from simple to complex depending on the level of uncertainty and the number of objectives being simultaneously optimized. This section will introduce and familiarize students with a variety of tools and techniques that are used to assess trade-offs and identify the optimal or satisficing decisions. Students also will be taught common types of sensitivity analysis (e.g., one-way, two way, event sensitivity analysis) for identifying the factors that have the greatest effect on the decision. The emphasis will be on understanding and interpreting the various types of sensitivity analysis. In addition, students will be introduced to the concept that certain uncertainties have greater influence on decisions than others and that information, in a decision-making context, has value that is measurable in terms of the objectives (e.g., the value of information). This will provide the motivation for the next course component Adaptive Resource Management.

Week 7 – SDM as Adaptive Resource Management (ARM)

Many decisions in contemporary resource management need to be made or revisited on a recurrent schedule (e.g., annual harvest regulations). These types of decisions are especially amenable to an explicit structured approach that incorporates learning from one time step to the next. Adaptive management is essentially the sequential use of the SDM approach with specific, targeted monitoring to gain a better understanding of system dynamics or to resolve key uncertainties. Students will be introduced to the concept sequential dynamic decision-making in time and/or space and the use of monitoring data to reduce uncertainties that have the greatest effect on decision-making. In addition, the important attributes of a monitoring program will be identified and discussed in an ARM context.

Week 8 – Conflict Resolution and Knowledge Acquisition through ARM

In the previous lessons, students will be introduced to the idea of formally incorporating monitoring and sequential dynamic decision-making to improve future decision making. This section will conceptually cover more advanced adaptive management concepts, such as single and double loop learning and the use of ARM for reducing conflicts among stakeholders.

Week 9 - Advanced topics in SDM: Risk and Extreme Uncertainty

The concepts of uncertainty and associated risk will be prevalent throughout the course and briefly discussed in the preceding weeks because the ability to explicitly incorporate uncertainty and risk into the decision framework is one of the most important strengths of the SDM process. However, this section will be devoted to special topics in SDM: how to evaluate risk due to uncertainty and how to make sound decisions in the face of risk; and extreme uncertainty and how to make decisions in the face of extreme uncertainty.

Week 10 – Rapid Prototyping and Challenges for Future Resource Managers

This section is devoted to synthesis of the information presented in the proceeding weeks by working through a rapid prototyping process of an actual problem. Additionally, some final discussion and challenges to the students, as future resource managers and policy makers, to

ensure they feel confident facilitating and promoting the SDM approach for making resource management decisions within their hiring agency or organization.

Measurable Student Learning Outcomes: By the end of this course, all students should be able to:

- Recognize and incorporate different viewpoints into decision making to resolve stakeholder conflicts
- Use adaptive management to reduce conflicts among stakeholders and improve future decisions
- Work effectively with stakeholder groups using an SDM approach and recognize and ameliorate impediments to the process
- Understand and describe the principles of structured decision making and adaptive management
- Identify the different types of uncertainty and understand how each can be represented in a model
- Identify and classify stakeholder objectives and create diagrams representing their relationships
- Quantify stakeholder objectives and identify measureable outcomes from natural resource decisions
- Create and interpret graphical models of natural resource decisions
- Use the structured decision making process to work through a management problem with rapid-prototyping methods

Assessment of Student Performance: Student performance will be based on participation in the weekly discussion on Blackboard (30%), a written critique of a contemporary resource management decision that did not use an SDM approach and how the decisions would have benefited from an SDM approach (30%), and a small project to develop a rapid prototype of a simple decision problem (40%).

Students should note that weekly discussions count toward 30% of their grade. These discussions will be based on outside readings and lecture material and will be used to evaluate the first three measurable learning outcomes. Questions will be posted at the beginning of the week and students will be expected read the supplementary material provided and synthesize the information from previous readings and lectures. There are deadlines for discussion participation that will be posted in the announcements section of Blackboard. Once a discussion has ended, you will not be credited for additional posts. If students do not participate in a discussion before it closes, they will receive a 0 for that discussion question.

Students will be provided with an example of a contemporary resource management decision that did not use an SDM on Blackboard, but will be required to identify their own example to critique. The critique will be used to evaluate measurable learning outcomes 4-5. A list of potential sources for the contemporary resource management decisions will accompany the example on Blackboard.

The final course project is intended to evaluate the student's ability to synthesize the individual course elements and used the SDM process to work through a management problem including identifying and quantifying stakeholder objectives, identifying and incorporating alternative ideas of system dynamics to reduce potential conflicts, and creating graphical models of the decision. To reinforce the collaborative nature of the SDM process, the course project will be conducted by groups consisting of 2-4 students that are assigned by the instructor. Each group will choose a unique natural resource management issue and will use rapid-prototyping methods to identify stakeholders and their objectives, decision alternatives, outcomes, and the optimal management decision. Each group will write a final report describing the management issue and detailing the steps used to identify the optimal management decision. Individual group members will be required to identify their contribution to the project in the final report. Projects will be graded based on the appropriateness of the decision, how well students adhered to the rapid-prototyping methods, and the individual contributions of the student. An example of a final report will be available on Blackboard.

Grades will be assigned based on a standard percentage scale of the cumulative points earned from the participation in weekly discussion, the critique, and course project as: "A" 100-93; "A-" 92-90; "B+" 89-87; "B" 86-83; "B-" 82-80; "C+" 79-77; "C" 76-73; "C-" 72-70; "D+" 69-67; "D" 66-63; "D-" 62-60; "F" below 60. All grades will be posted on the Blackboard website.

Learning Resources: This course will be delivered via Blackboard where students will interact with each other and the instructor. Within the course Blackboard site, students will access the learning materials, tutorials, and syllabus; discuss issues; submit assignments; email other students and the instructor; and participate in online activities.

Students with Disabilities: Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 541-737-4098.

Expectations for Student Conduct: All students are expected to comply with the regulations pertaining to academic honesty detailed in the Oregon University System, Student Conduct Code (http://oregonstate.edu/admin/stucon/achon.htm). Students will be expected to treat all others with the same respect as they would want afforded themselves. Students also are expected to conduct themselves in the all aspects of the course (e.g., email, discussion boards) university's regulations regarding civility (http://oregonstate.edu/admin/stucon/regs.htm).

Course Evaluation: Students are encouraged to engage in the online course evaluation process each term. The evaluation form will be available toward the end of each term, and you will be

sent instructions by Ecampus. You will login to “Student Online Services” to respond to the online questionnaire. The results on the form are anonymous and are not tabulated until after grades are posted.