SOE 555 Modeling the Environment Fall 2018
3 credits; Prerequisites: none
Time and Location TBA

Dr. Allyson Beall King
Office: Fulmer 208; **email:** abeall@wsu.edu; **phone:** 335-4037. **Office hour**: Tuesday 2:00pm- 3:30pm. I am also available by appointment and email.

Required text: *Modeling the Environment 2nd edition.* Andrew Ford, 2010. Available at the Bookie, Crimson and Gray, or Amazon. The web support for the text or "bweb" may be accessed at http://public.wsu.edu/~forda/

Software: The course uses Stella Architect: You may purchase your own copy of Stella at http://www.iseesystems.com or you may use one of my lab licenses on your personal computer until the end of the semester. As of August 2016, Stella was available to students in a scheduled class @ $59 for a six-month student license and @ $129 for a perpetual student copy. It is available for both Macs and Windows computers. The software is also available on the Webster 1149 lab computers.

Course fee: $25.00

Class website: https://learn.wsu.edu/.

Overview: This course is designed to help students develop expertise for analyzing the complexities of human interactions with environmental systems using system dynamics and computer simulation. The course is open to ALL students at WSU; this is a systems course therefore students from all fields will benefit. It is assumed that students have learned introductory algebra and how to combine units of measurement. A proficiency in calculus or differential equations is not necessary because students will build computer models using system dynamics software. The *stock and flow* building blocks of system dynamics create a visual map of the system. The *stocks and flows* are linked with easy to understand algebraic relationships. The software integrates the resulting coupled, nonlinear, first-order differential (or integral) equations and finds the dynamic behavior through *numerical simulation*. This method of computer simulation helps us focus on the structure and dynamics of a system rather than the complexities of integration and coding.

Outcome: Students will have the foundation to utilize system dynamics to compare, analyze and evaluate the behavior of a variety of environmental systems and the impact that potential policies may have on those systems.

Course objective:
The objective is to develop understanding and proficiency in the development and use of system dynamics based computer simulation models. The course will focus on models that help us understand the dynamic behavior of environmental systems.

Students will also learn about systems concepts such as information feedback and homeostasis. Systems concepts are useful in a wide variety of fields including hydrology, ecology, anthropology, economics, engineering, business, planning, sociology, physiology, etc.

The course will explore case studies that are drawn from many of these fields. Several of the cases show the value of interdisciplinary models that reach across disciplinary boundaries to simulate the key feedbacks in the system.

Learning outcomes: Students will be able to:

- Describe the elements of system dynamics and system thinking that distinguish this method of inquiry and analysis
- Describe 6 patterns of dynamic behavior
- Differentiate between exogenous and endogenous behavior

- Describe how endogenous elements of a system creates behavior
- Evaluate the impacts of time delays and feedback loops
- Evaluate the impact of policy on dynamic environmental systems

Course Objectives

Course objectives will be attained utilizing the following learning goals: Critical and Creative Thinking; Quantitative Reasoning; Scientific Literacy; Information Literacy; Communication; and Depth, Breadth and Integration of Learning. Due to the interdisciplinary nature of environmental systems these goals cannot be attained, or topics described or understood in isolation. Therefore, the class will build upon many concepts and skills simultaneously.

Time expectations: This is a 3-credit class - Students should expect to spend 75 minutes in lecture twice weekly. Students may attend an optional lab session Thursday 2:50-4:05 location TBA. For each hour of lecture equivalent graduate students should expect to have a minimum of two hours of outside work.

Grading: Students should attend all classes, and participate in discussions. Grades will be calculated as a percentage of 1000 points. There are no exams or quizzes.

Assignments: 700 pts – weekly systems modeling assignments will be posted on blackboard and due by Sunday of the week assigned at midnight.
Project: 250 pts (see below) Due in class Dec 7th (no final exam)
Project proposal 50 pts Due Oct 26th

A 930-1000
A- 900-929
B+ 870-899
B 830-869
B- 800-829
C+ 770-799
C 730-769
C- 700-729
D+ 670-699
D 600-669
F < 600

Project: The highlight of the course is your class project. You will work in teams of two to improve an existing model from either the book or the book's website. You will then submit a team report on the improvements that you made to the model. Your job is to use the improved model to either refute or reinforce the conclusions drawn by the previous investigator. Graduate projects are expected to reflect the sophistication of a Masters or PhD student with model improvements well-grounded in the literature. Your report should include at least 10 references and be approximately 5000 words in length. Project proposals are worth 50 points and are due week 7.

Attendance policy and late work: Please notify me via email in advance of any excused absences such as field trips or conferences. In the event you are ill or have a family emergency please email me as soon as it is practical. Late work will be accepted without penalty for excused absences. For absences that are not excused late work will be accepted at a 10% per day penalty.

Reasonable Accommodation: "Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center [Pullman] or Disability Services at [name of campus] address on your campus] to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center or Disability Services. For more information contact a Disability Specialist on your home campus." Pullman or WSU Online: 509-335-3417, Washington Building 217; http://accesscenter.wsu.edu, Access.Center@wsu.edu
Spokane: https://spokane.wsu.edu/studentaffairs/disability-resources/
Tri-Cities: http://www.tricity.wsu.edu/disability/
Vancouver: 360-546-9138 http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services

Academic Integrity: "Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) will receive [*insert academic sanction (e.g., fail the course, fail the assignment, etc.*)], will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct.
Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of

Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating: http://app.leg.wa.gov/WAC/default.aspx?cite=504-26-010. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding.
If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at conduct.wsu.edu."

Classroom Safety Statement: "Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "**Alert, Assess, Act**," protocol for all types of emergencies and the "Run, Hide, Fight" response for an active shooter incident. Remain **ALERT** (through direct observation or emergency notification), **ASSESS** your specific situation, and **ACT** in the most appropriate way to assure your own safety (and the safety of others if you are able).
Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's Run, Hide, Fight video and visit the WSU safety portal."

Homework assignments will include modeling exercises, causal loop exercises and equilibrium exercises (using simple algebra) included in the text at the end of each chapter. Due to the nature of these modeling exercises you are encouraged to work in pairs or small groups. Please turn in your own work but feel free to problem solve with your peers. Readings from the system dynamics literature will also be assigned each week with a short writing assignment to be turned in with the modeling homework.

Date	**Lectures**	**Readings**	**Homework – assigned on blackboard**
Week 1	Introduction to Modeling	Ch 1	
	Stella Demo	Ch 2	**HW 70 pts**
Week 2	Levels, rates and accumulation	Apx A, Ch 3	
	Levels, rates and accumulation	Apx B, Ch 4	**HW 70 pts**
Week 3	The Mono Lake Case	Ch 5	
	Model of Mono Lake	Ch 5	**HW 70 pts**
Week 4	Equilibrium Diagrams	Ch 6	
	S Shaped Growth	Ch 7	**HW 70 pts**
Week 5	Epidemic Dynamics	Ch 8	
	Causal Loop Diagrams & Feedback	Ch 9	**HW 70 pts**
Week 6	Homeostasis & the Span of Control	Ch 10	
	Daisy World	Ch 11	**HW 70 pts**
Week 7	Bulls Eye & Review	Ch 12	
	The Modeling Process	Ch 13	**HW 70 pts**
Week 8	Cycles in predator prey	Ch 14	
	Intro to the Salmon Case Project discussion and development	Ch 15	**HW 70 pts**
Week 9	The Model of the Salmon Population	Ch 17	
	Adding loops Kaibab with forage	Ch 20	**HW 70 pts**
Week 10	Adding loops Kaibab with forage continued	Ch 21	
	Cyclic behavior **Proposals Due**	Ch 18	**Proposals 50 pts**
Week 11	Intervals of Uncertainty	Apx D	
	Communicating Insights from Models	Ch 24	**HW 70 pts**
Week 12	Work on class projects		Projects
	Work on projects in class		Projects
Week 13	Work on projects in class		Projects
	No class		
Nov 21/23	Thanksgiving break		
Week 14	Work on projects in class		Projects

	Work on projects in class		Projects
Week 15	Project presentations		
	Project presentations **Project Reports Due Thursday @10:35am**		**Project Reports 250 pts**