The goal for the project is to determine the economic tradeoffs involved in logging old growth timber in the Pacific Northwest. Those who argue in favor of logging old growth claim that it is an important part of the region's economy, and that unemployment and job losses would result if logging were banned. Those who oppose logging argue that the benefits that uncut old growth forests provide to society outweigh the economic gain that would result from cutting them. To make wise decisions, policy-makers clearly need accurate information on the size of the contribution logging would make to employment and forest industry profits and on the size of the benefits these forests provide in their standing state. This project will develop such information.

**General premise and assumptions:**

Our analysis will examine the forests of Washington and Oregon. Assume the total acreage of forests in Washington and Oregon, including both old growth and 'second growth,' will remain constant in the future. Old growth forest is acreage that has never been cut. Second growth forest is acreage that has been harvested at least once and is now being used to grow trees that will be harvested in the future. Thus, when old growth is harvested it becomes second growth forest, and we will assume that it will remain second growth forest in the future. We will assume all forests involved consist entirely of one species, Douglas fir.

Harvesting an acre of old growth forest will result in a certain volume of harvested timber, and this can be determined from biological information on the density of wood on old growth acreage. Harvesting an acre of second growth forest will result in a volume of timber that depends on the age of the forest at the date of harvest. The relationship between 'harvest age' and 'harvest volume' can also be determined from biological data on forest growth. In deciding whether or not to harvest a marginal acre of old growth forest, assume that society values both the employment and forest industry profits that would result from harvesting as well as the service flow that the old growth forest would provide if the forest were left standing.

**Timetable:**

The overall research project is split into 5 components and each component is assigned to a team of students. Topics to be covered are described in “Research Task Assignments” below. To complete this project successfully you will need to obtain information of various types. A link to internet sources of economic data, forest growth information and relevant information is shown in the syllabus.

Sometime in April I will arrange to meet with each team to discuss research strategies and organization. On a date shown below, each team will submit a one page typed outline stating the information sources and research strategy you will use. Near the end of the quarter teams will make in class presentations (15 minutes each). A team may designate one or two members to
make the presentation. On the last day of class each student will turn in a typed (one page maximum) typed statement describing how they individually contributed to their team's project.

Dates and events:
- Tuesday, April 6: Team preferences due
- Thursday April 8: Team assignments made.
- Week of April 20: I meet with each team to plan a research strategy.
- Tuesday May 4: Turn in outline with info and data sources, and strategy.
- Thursday, May 13: Turn in team written reports.
- Th., Tu., June 1, 3: Class presentations.

Research Task Assignments:

What follows is a description of six individual research tasks that form separate components of the overall project. Each student will be assigned to a team responsible for completing one of these tasks. The team’s goal is to answer the “Research questions” posed for your component of the project. The following descriptions also spell out “Specific tasks and questions;” these items are intended to help you make progress toward this goal by focusing your attention on subtasks you will need to complete.

(Note: Data sources sometimes use different units in reporting timber volumes, e.g., board feet and cubic meters. One board foot equals a volume 1 foot by 1 foot by 1 inch. One million board feet equals about 2,333 cubic meters.)

Team 1 Research Questions. What harvest age (in years) will maximize the present value of harvest profits, net of costs, assuming that the forest will be replanted and re-harvested in the future an indefinite number of times? What are the harvest volume (millions of board feet per acre) and the present value of forest industry profit (dollars per acre) for commercial forests harvested at this age? What (one time) harvest volume and profit would be obtained by harvesting one acre of old growth forest? (Assume the interest rate is 3 percent.)

You may find it useful to organize your efforts around the following specific tasks:

- Determine the growth function (volume per acre at different ages) for Douglas fir. For purposes of this project, assume the land is described by ‘Site index’ = 140.

- Determine the average price of timber ($ per unit volume) net of harvest costs for Washington and Oregon. (Price net of harvest cost is commonly referred to as the ‘stumpage price’.)

- Determine the average forest replanting cost per acre for forests in Oregon and Washington.

- For questions involving old growth forests, assume the volume of timber per acre in old growth forests equals the volume associated with the oldest age forest for which your growth function is available. The one time profit from immediately harvesting an old growth forest is just the stumpage price times that volume.
**Team 2 Research Questions.** What is the employment effect, in person years of employment, of harvesting an extra million board feet of timber? (Your answer may involve a fraction of an employment position. Assume there is a direct relationship between the volume of timber harvested and employment in the logging industry.)

Specific tasks and questions:

- Obtain data (either over time, or across forests or regions) on forest industry employment and forest harvests in Washington and Oregon.

- Identify a set of relevant 'forest industry occupations' e.g., loggers, mill occupation. Coordinate the occupations you identify with Team 3.

**Team 3 Research Questions.** What is the value to society of one 'forest industry' job, specifically, one ‘person-year of employment?’

Note: Your answer should be in dollars per person year of employment, and you should consider different types of forest industry jobs. Keep in mind that when a worker loses a specific job, he/she may suffer a one-time bout of unemployment and, when eventually employed elsewhere, may receive a lower wage. The economy loses the worker’s output while he/she is unemployed. If this worker eventually returns to work at a different wage, this wage reflects the value the economy places on his/her output. Also keep in mind that there are a variety of forest industry jobs and the answer you obtain may differ by job type. For example, an out-of-work log truck driver may be able to apply her skills elsewhere in the trucking industry with little job search. On the other hand, the person who actually cuts the trees may have few alternative uses for her skills.

Specific tasks and questions:

- Choose a set of relevant 'forest industry occupations,' e.g., loggers, mill workers, truck drivers, and these coordinate with Team 2.

- What do forest industry workers typically earn in these occupations?

- In qualitative terms, what skills do these occupations require and how well would these skills transfer to other industries? In quantitative terms, what wages could they expect to earn in alternative jobs, and how do their prospects for skill transfer affect the time it would take them to find alternative employment?

- How long an episode of unemployment might workers in these occupations experience if their jobs disappear?
**Team 4 Research Questions.** What value (dollars per acre per year) should society assign to the services that old growth forests provide? Be sure to distinguish between the marginal value of preserving an extra acre and the total value of such services on all old growth forests.

Specific tasks and questions:

- List the specific services provided by old growth forests. Do they differ in kind from the services provided by second growth forests?

- What methods have economists used to estimate the value of goods and services that are not traded in markets (so prices are not observed?) Have any of these valuation methods been applied to the value of old growth forests?

**Team 5 Research Questions.** (This team has two sub-tasks)

(i) **Background:** What is the extent, in acres, of both old growth and second growth forests in Washington and Oregon? What is the current state of the policy debate surrounding their protection?

(ii) **Analytics:** Using input from Teams 1-4, what is the optimal amount of old growth forest to leave standing in Washington and Oregon? Determine and explain the correct theory to apply to this problem

Use the following assumptions and notation in your analytics:

- logging one acre of old growth forest will generate a one-time harvest of \( X_0 \) million board feet of timber and a one-time immediate profit of \( \Pi_0 \);
- the optimal (present value maximizing) harvest age for forests that are harvested, replanted, reharvested, etc. is \( T^* \) years;
- logging one acre of second growth forest at age \( T^* \) will generate \( X_s \) million board feet of timber at each harvest;
- the present value of profit from harvesting, replanting, re-harvesting, etc. an acre of forest at age \( T^* \) is \( \Pi_s \);
- increasing forest harvests by one million board foot of timber will require employment of \( E \) person years of forest industry labor;
- the marginal value society places on a job in the forest industry is \( V_j \) per person year;
- the marginal value society places on the services of an acre of standing old growth is \( V_o \) per acre per year;
- the interest rate is \( r\% \) per year.

(Note: To avoid a technical complication associated with calculating the employment benefits from harvesting second growth forests, you may assume that cutting an acre of old growth will
immediately and permanently increase the second growth acreage harvested each year by \(1/T^*\) acres.)

Specific tasks:

- Using the notation provided, what is the permanent annual benefit society obtains from cutting an additional acre of old growth forest, considering both the value of employment gained and forest industry profits? What is the permanent annual cost society experiences from cutting a marginal acre, i.e., the reduction in old growth services? What economic condition determines whether or not society should cut an additional acre of old growth? (If some category of benefit or cost is received only once, it can be turned into a permanent annual flow by use of the interest rate.)

- Work through a practice problem, using artificial data: Assume \(X_0=0.20\), \(X_s=0.11\), \(T^*=50\) years, \(E=1.0\), \(V_j=$180,000\), \(V_o=$17,000\), \(\Pi_o=$50,000\), \(\Pi_s=$15,000\), and \(r=.03\). Should an extra acre of old growth be cut?

- Second practice problem: Suppose the value society assigns to a marginal acre of old growth depends on how much remains standing. Specifically, assume \(V_o=k/S_o\), where \(S_o\) is the stock of old growth forest in millions of acres and \(k\) is a constant equal to 4,000. Plot the \(V_o\) curve. What is the optimal stock of old growth forest to preserve? Explain.