Notes for **Tuesday, February 3, 2004**

**Announcements**

By today you should have finished reading **Chapter 5**.
- Read Chapter 6, sections 1 and 2, for Thursday.
- Study Questions: 6.2 and 6.6

Problem Set 2 due.
Hand out Problem Set 3.
- Starting with problem set 3, I only want one homework assignment per group.

**Is Discounting Appropriate?**

**Factors Affecting Growth and Yield**

**Basic Growth and Yield Concepts**
- Yield vs. Growth
- Annual Increment
- Periodic Annual Increment
- Mean Annual Increment
- Compound Interest Rate of Growth

**Different Kinds of Growth and Yield Models**
- Stand level models
- Diameter distribution models
- Individual tree models
Is Discounting Appropriate?
   - Is discounting fair to future generations?

Factors Affecting Growth and Yield

- Forest Type
- Age
- Site Quality
- Density/Stocking
- Competition
- Genetics
- Past Treatments/Stand History
- Insects and Disease
Basic Growth and Yield Concepts

Figure 5.1. Example of a yield curve.

Things to note:
- sigmoid shape
- inflection point
Basic Growth and Yield Concepts

**Yield** \((Y_a)\) refers to the volume of usable wood fiber per unit area at a given age, \(a\).

**Growth** \((\dot{Y}_a)\) refers to the change in the yield over some period of time.

The **Annual Increment** \((\dot{Y}_a)\) is just the annual growth of the stand per unit of area at a given age. It is the difference between the yield at age \(a\) and the yield a year earlier, at age \(a-1\).

\[
\dot{Y}_a = Y_a - Y_{a-1}
\]

The **Periodic Annual Increment** \((\text{PAI}_{a_1, a_2})\) is the average annual increment per unit area over some period longer than one year. The PAI for ages \(a_1\) to \(a_2\) is:

\[
\text{PAI}_{a_1, a_2} = \frac{Y_{a_2} - Y_{a_1}}{a_2 - a_1}
\]
Growth and Yield Concepts (continued...)

The Mean Annual Increment (MAI$_a$) is the average annual growth rate per unit area up to age $a$. It is calculated by dividing the yield at age $a$ by the age:

$$MAI_a = \frac{Y_a}{a}$$

- The age where MAI is maximized is known as the Culmination of Mean Annual Increment or (CMAI)
- Managing on this rotation will maximize the average volume production of a given area over time.
  - For this reason, it is sometimes referred to as the optimal biological rotation.

The Compound Interest Rate ($r_{a_1,a_2}^Y$) of growth for a timber stand gives the average compound volume growth rate between ages $a_1$ and $a_2$. The compound interest rate of growth for a timber stand between ages $a_1$ and $a_2$ is calculated as follows:

$$r_{a_1,a_2}^Y = \left[ a_2 - a_1 \sqrt[\frac{Y_{a_2}}{Y_{a_1}}} \right] - 1$$
Types of Growth and Yield Models

L Stand-level Models (Yield tables)
- good for general predictions
- not very good for predicting the yield of a stand that is already in place
- don’t account for current stand density (basal area) or species composition
- typically don’t describe mix of products (e.g., veneer vs sawtimber quantity)
- not very useful for modeling thinning or other intermediate treatments

L Diameter Distribution Models
- widely used in plantations
- good for predicting mix of products that are dependent on size (diameter)
- not generally very good for predicting species composition
- useful for modeling thinning

L Individual Tree Models
- good for predicting mix of products by size and species
- good for modeling thinning and other intermediate treatments
- less accurate for long-range predictions
- require more data about the stand