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The Coop Yield Model: Background and Architecture

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The objective of our forest stand modelling effort is to provide the forestland manager with a tool for studying the possible development of forest stands under alternative management actions. That is, given a description of the stand provided by the user, to obtain a description of what the stand will look like at various points in time in the future under each of several alternative actions.

There are two conceptually different approaches that might be used in developing a computer model for this purpose. The traditional approach, which is used to project summary stand characteristics (e.g. total basal area), is to use what is called a "stand model." Using this approach, for example, the researcher would use historic measurement records to determine the basal area or volume of stands at various points in time to produce stand growth profiles as shown in Figure 1. The growth model then could consist of a mathematical equation of a line that is fitted to the points (e.g., the solid line fitted to points in Figure 1).

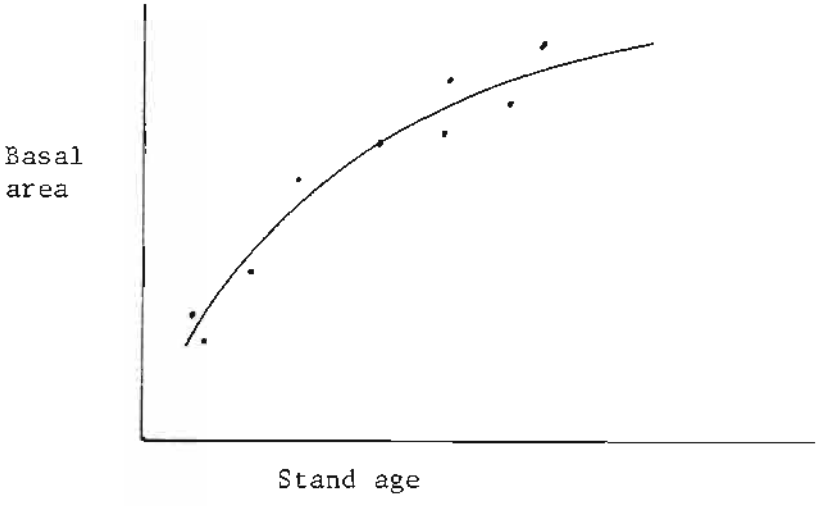

Figure 1. A stand projection model

There are numerous drawbacks to this traditional approach. First, the stand approach is unsuited for dealing with the diversity of conditions and age structures of the forest stands of California. Second, remeasurement data would have to be available for extended periods over many more stand conditions than it is practical to measure. Third, the model would be limitted by the types of stands, management histories, etc. that are available for study. Thus, unless one can produce a data base consisting of stands of sufficient diversity of composition, density, age, thinning history, etc., the model will be of little use in answering questions about the manager's intended actions.[1/]

Thus we have elected not to develop a stand projection model, but to use an individual tree modelling approach. Using this approach the individual tree records are processed by the computer to produce estimates of the tree descriptions after a growth cycle, harvest, thinning, etc. Stand statistics at any point are then obtained by adding the statistics of individual trees.

Model Architecture

The "architecture" of a computer model refers to the way in which one uses the model. Thus in our case the archtecture refers to the way in which the user interacts with the model (input and output) rather than the internal mathematical workings of the model.

As shown in Figure 2, there are 3 conceptual steps to using the overall model. First, the user must supply a description of the forest stand to be modelled. The complete description consists of both a tree list and several summary statistics. Since only partial information may be available for each tree (e.g., only DBH and species may be

[1/] Some exceptions to these comments exist for plantations of single species where there may be some advantage to using stand models.

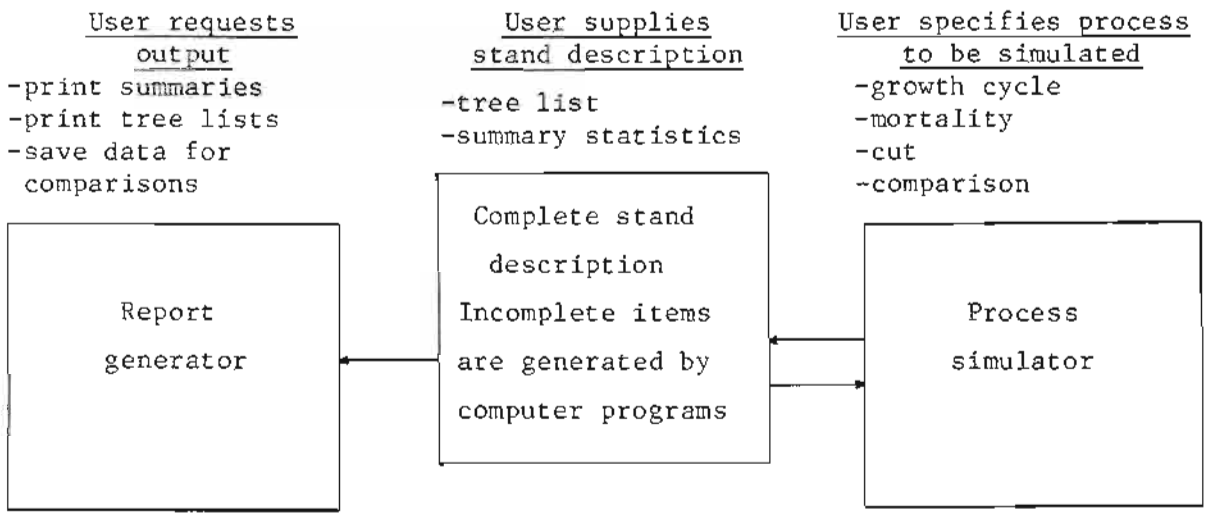

Figure 2. User interaction with model

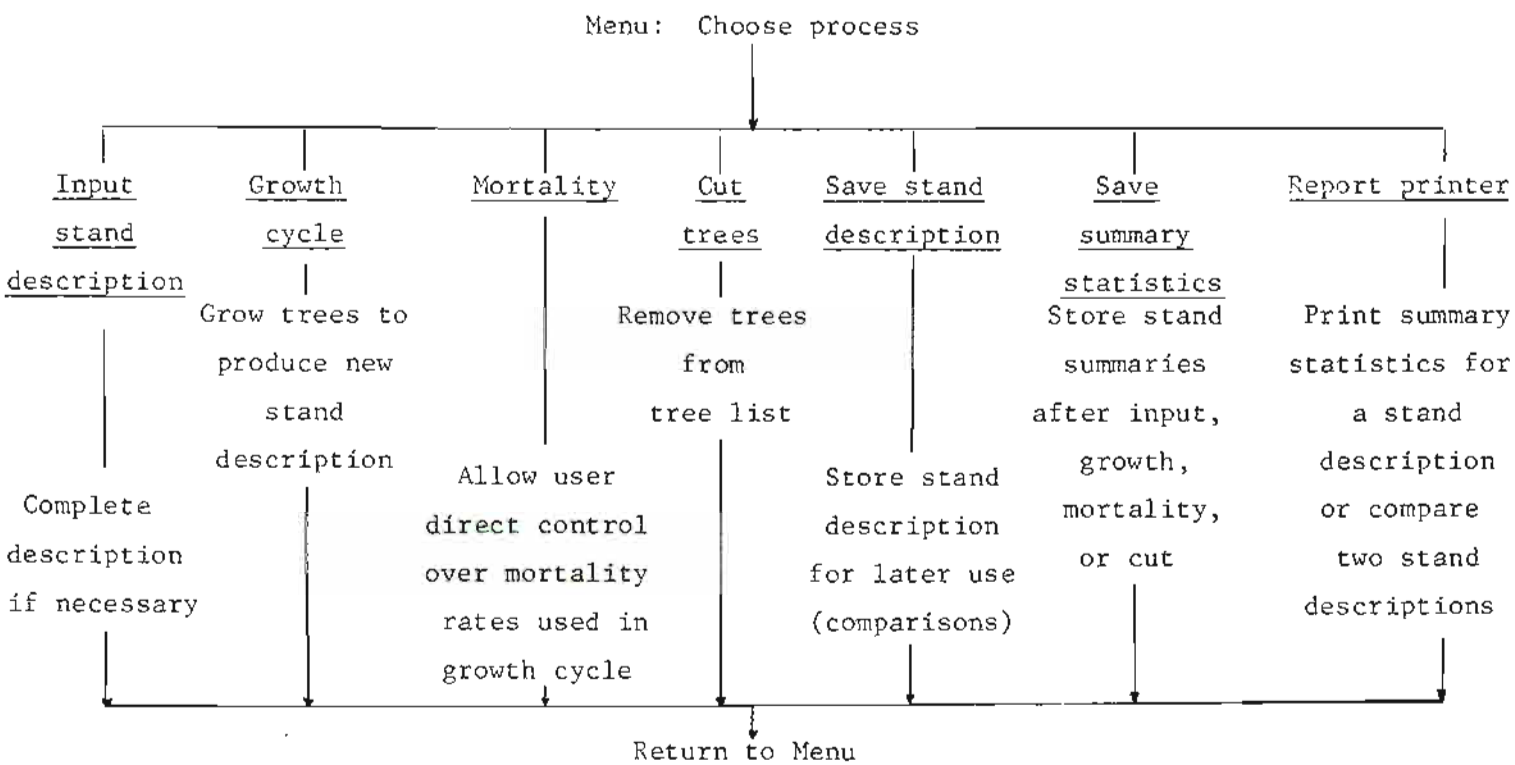

Figure 3. Organization of computerized model

available for some trees) the computer can be instructed to supply the missing data to obtain a complete stand description for modelling. However, when the user does not supply all the information requested the subsequent projections are less accurate than when full information is supplied.

Second, the stand description is modified by having the user specify the process to be simulated. In updating an inventory, for example, the user would select the "growth" process. However, in similating the response to a thinning the user might first elect the "cut" process and then the "growth" process. The "compare" process could then be elected to estimate the amount of growth as the difference between two stand descriptions.

Finally, the report generator would be used to produce a summary of either individual stand descriptions or differences between stand descriptions.

While Figure 2 stresses the user interaction with the model, Figure 3 better reflects the organization of the model in the computer setting. Note, however, that the user specifies each operation and then control is given back to the user (in the menu [1/]) before another operation is performed. Further, for each operation, the user will be asked questions or asked to supply data to the computer.

Initially we wish to have cooperator support in determining the range of processes that might be desired. Overlapping committees can be formed but each of the processes defined in Figure 3 will require some design help from the cooperators.

[1/] Menu refers to the list of options available to the user while operating the model.

A partial listing of the questions dealing with the model architecture are:

-What stand description alternatives will be provided for on input?

-What growth periods will be provided for?

-How will mortality be handled?

-What cutting options will be provided for?

-What stand description comparisons might be desired?

-What output summaries should be "standard"?

-What additional output flexibility is needed?

At the April 5 meeting we hope to organize groups to deal with some of these questions.