



SOFAC Proposal Growth and Yield in a Multi- product Inventory Projection Model



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- The sawmills in basin x are currently using a mix of natural and plantation sawtimber (60 % natural; 40% plantation). The plantation sawtimber averages 32 years old. In five years and ten years what will this mix be and what will be the distribution of plantation ages be ?
- We want to develop a market for small sawlogs (7" - 8" dbh class). How much of this product is available through time in these basins. If such a mill is built in basin x how might it affect pulpwood and CNS inventory and price through time.
- Market pulp prices increase x percent due to improving markets. In basin x how might this increase ultimately impact pulpwood usage and price.



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■ Assumptions

- Products are important in decision-making. Hence, inventory projections should address products - not just growing stock. Both both harvest and inventory.
- There exist reliable stand-level growth and yield methodology for pine plantations and natural pine stands in the south.



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- Growth and yield in inventory projection models
 - start by defining inventory in strata or “buckets”
 - use FIA plot data and aggregate by owner, timber type, age, site productivity, management intensity, etc.
 - project growth for each strata from observed FIA remeasurement data.
 - remove harvest from the strata
 - Introduce some land use changes
 - start over again
 - Efforts have almost totally been focused on FIA data for both inventory and growth - less so for removals



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- Traditional growth and yield research in southern pine plantations
 - collected remeasurement data over a range of ages, site productivities, stocking levels, silviculture intensities, etc.
 - plots are generally 40 to 100 trees at a given location. All trees on the plot are measured.
 - Models developed using these data include whole stand compatible systems, diameter distribution systems, individual tree distance dependent and independent systems.



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- These models have provided useful estimates of plot, or possibly stand, growth and yield for use in stand and forest decision-making (harvest scheduling).
- While several efforts to use traditional growth and yield models in inventory projection systems have been undertaken the results have been frustrating.
 - Borders. SOFAC Project. Predicted total volume growth from stand variables, ownership, etc.
 - SRTS. Similar approach $dy/dt = f(\text{age, site, stocking, ownership, various interaction terms})$



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- In general, when we have tried to use traditional G&Y techniques in an inventory projection context the results have been variable.
 - Total volume and volume growth - O.K. maybe
 - diameter distribution efforts - ugly; why ?
- Problems revolve around what is a diameter distribution in the inventory projection context ?
- Garcia (1991) stated “diameter distributions vary by the extent of land considered.” This is definitely the case in inventory projection models.



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- Consider, for example, one strata in an inventory projection run. Industry plantations, age 15 to 20 on high sites with intensive management regime(s). We desire both total yield and product yields for the strata by period in the planning horizon.
 - Call dbh distribution model with age=17, sq=67, spa=412, ba=92 (based on FIA data for the run)
 - predicted distribution bears no relation to the strata dbh distribution. WHY ?
 - The strata diameter distribution is a mixture of thousands of stands representing the population of stands (and management regimes) in the strata.
- Again, consider the extent of the land associated with the distribution of interest



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- How to account for differences in the extent of land considered ?
 - Use FIA data to generate distributions of age, sq, density, etc. by owner.
 - Sample from these distributions using Monte Carlo simulation techniques and generate yield estimates consistent with these distributions.
 - Mix the resulting dbh distributions into an aggregate estimate for the strata.
- Now the resulting predicted distribution is consistent with the extent of land considered.



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- Growth to future periods in the planning horizon will be generated using the same models and input for inventory projection run for the acres left in the strata.
 - i.e. $age1=17.5$; $age2=22.5$; $sq=67$; $spa1=412$; $ba1=92$. Etc for each sample in the strata.
- Provides a conceptual framework that can use traditional G&Y techniques to project inventory in an inventory projection model.



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Pros

- provides dbh distn estimates by strata that are dynamic
- can map dbh distns to products by survey unit and owner
- change product specifications through time
- builds on traditional G&Y methodology
- stochastic solns provide information on uncertainty
- some available models have silviculture built into them - or easy to add
- can simulate impacts of a wide variety of management actions

Cons

- building consistency with FIA aggregate inventory estimates
- mountainous amounts of input data
- computationally intensive - maybe 1 to 2 hours per run
- uses traditional G&Y methodology