FSTY 405 — Silviculture II

Final Exam, 10th December 2005

Name:

Student number:

- Ensure that your name and student number are correctly entered above.
- Answer in the spaces provided after each question, writing down the intermediate steps. Use the reverse as scratch pad. Writing just the final numerical answer is *not* acceptable.
- Write legibly, and use ink, not pencil.
- Answer clearly and to the point. Nonsense will be penalized.
- Pages: 5. Questions: 8, worth 5 marks each, total 40.
- Time: 2.5 hours.
- Info (you may or may not need this):
  $a^x a^y = a^{x+y}$, $(a^x)^y = a^{xy}$, $y = a^x \Leftrightarrow x = \log_a y$,
  $\log_e x \equiv \ln x$, $e^x \equiv \exp(x)$,
  $\log_a xy = \log_a x + \log_a y$, $\log_a x^y = y \log_a x$.
  Area of circle of radius r: πr^2.

1. Give the name of a model used in BC (e.g., STIM, FPS,PrognosisBC, SORTIE, TADAM, DFSIM, TASS, TASSIE, FORCYTE, VDYP, VDYP7, SYLVER, TIPSY, STANLEY, MGM, SDMD) that fits each of the following descriptions

   (a) Distance-independent, boreal aspen, developed in Alberta:

   (b) Spatially explicit, based on detailed modelling of crown development:

   (c) Yield tables (functions), for natural stands:

   (d) Whole-stand differential equations, derived from TASS:

   (e) Distance-independent, for BC Southern Interior:

2. We have the following model:

$$\begin{aligned} \Delta H &= 0.04(50 - H) \\ \Delta N &= -0.02N \\ \Delta B &= (0.1N - 0.9B)/H \\ V/B &= 3 + 0.3H \end{aligned}$$

   where H is top height (m), N is stems per hectare, B is basal area (m^2/ha), and V is volume (m^3/ha). Increments are for 5-year periods. A 40-year-old stand has $H = 12$, $N = 800$, and $B = 18$. At age 45 there is a thinning that removes 50% of the trees and 40% of the basal area. Estimate the volume at age 50.

3. For the model of question 2, which are the state and output variables? Explain the concept of state variables, transition functions (rate equations), and output functions. How do they work in this example?

4. We have the following relationship between top height (H, metres) and age (A, years):

$$\ln H = 3.65 - b/A \ ,$$

where b varies with site quality. The site index (base age 50) is 21. Estimate the top height at age 32.

5. Describe two types of competition index. How do they work? In what type of growth models are they used?

6. Draw a System Dynamics (rate-level, Vensim) diagram for the model of question 2. Label the elements appropriately.

7. What is:

   (a) Ingrowth?

(b) Expansion factor (in a growth model)?

(c) Stochastic?

(d) Site intercept (or growth intercept)?

(e) Eichhorn's law?

8. Assume a simple yield equation

$$\ln V = 2.63 \ln H - 3.78 \ ,$$

and a site index model from the textbook of Clutter *et al*:

$$\ln S = \ln H + 5.190(\frac{1}{A} - \frac{1}{25})$$

(base age 25). V is volume/ha, H is top height, S is site index, and A is age. For site (index) 20, calculate the MAI (of volume) at age 28.