FSTY 405 — Silviculture II

Final Exam, 10th December 2007

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: 6. Questions: 6, worth 5 marks each, total 30.

- 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. We have the following model:

$$\begin{aligned}
\Delta B &= (0.1N - 0.9B)/H \\
\Delta N &= -0.03N \\
\Delta H &= 0.10(38 - H) \\
V/B &= 3 + 0.3H
\end{aligned}$$

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 30-year-old stand has $H = 12$, $N = 1000$, and $B = 18$. At age 35 there is a thinning that removes 50% of the trees and 40% of the basal area. Estimate the volume at age 40.

2. What is:

   (a) Area potentially available (APA)?

   (b) Pressler's or pipe model theory?

   (c) State vector, state variable?

   (d) Guide curve?

   (e) Eichhorn's rule?

3. Trees are planted at a density of 1600 trees/ha and square spacing (i.e., on all points of a square grid). The crowns have the profile assumed by TASS: $w = 3.43 \ln(L/6.1 + 1)$, where w is crown radius and L is distance from the top. For trees of equal height, at what tree height do the crowns first touch? Show all your calculations. (Hint: draw pictures!)

4. Classify these models according to the categories that follow: TASS, Prognosis[BC], SORTIE, TADAM, VDYP6, VDYP7, MGM, Stand density diagrams (SDMD).

   - Yield table (or function):
   - Whole stand:
   - Distance independent:
   - Distance dependent:

5. Draw a System Dynamics (rate-level, Vensim) diagram for the model of question 1. Label the elements appropriately.

6. Consider two spruce stands planted at 2000 trees/ha, and harvested at 22 m top height; one unthinned, and the other thinned 50% (by number) at 8 m top height. On the following diagram, draw both state-space trajectories. Mark the ends clearly with a dot or small circle. What is the volume **per hectare** and mean dbh at harvest for each stand? Work as accurately as you can.

Stand Density Management Diagram
White Spruce (Planted Stands)

Version 1.30, Feb. 26, 1996

— ·· — Quadratic Mean Diameter

········· Top Height

Density Range For Maximizing CAI

– · – · – TASS-Predicted Mortality Curves

— ··· — Mean and Lower Limits of The Zone of Imminent Competition Mortality

Mean Tree Volume (m³) (y-axis): 2.0, 1.0, 0.5, 0.1, 0.05, 0.01, 0.005

Trees Per Hectare (x-axis): 300, 500, 1000, 2000, 4000

Top Height labels: 38 m, 34 m, 30 m, 26 m, 22 m, 18 m, 14 m, 10 m, 6 m

Quadratic Mean Diameter labels: 40 cm, 35 cm, 30 cm, 25 cm, 20 cm, 15 cm, 10 cm, 5 cm

Crown Closure