FSTY 405 — Silviculture II

Final exam, 7th December 2000

Name:

Student number:

- Ensure that your name and student number are correctly entered above.
- This is a closed book exam. Calculators are allowed.
- Time: 2.5 hours.
- Pages: 7. Questions: 10, worth 4 marks each.
- Answer in the spaces provided after each question or circle the answer, as appropriate.
- Show clearly the intermediate steps and reasoning.
- Use ink, write legibly.
- Area of circle of radius r: πr^2.

1. A 50 year-old stand has 800 stems per hectare, 24 m top height, and a (quadratic) mean dbh of 25 cm. We have the following stand volume table:

$$V = (0.9 + 0.3H)B$$

(with V in m^3/ha, H in m, and B in m^2/ha). Calculate the mean anual increment.

$$B = \pi \left(\frac{0.25}{2}\right)^2 \times 800 = 39.270$$ [using area of circle from page 1]

$$MAI = \frac{V}{t} = \frac{(0.9 + 0.3 \times 24) \times 39.270}{50} = 6.362 \ m^3/ha\text{-}yr$$

[Comment: One should use a number of significant figures consistently throughout all calculations to avoid unnecessary loss of precision. I suggest using 4 or 5 figures in all intermediate calculations, rounding the final results to 3 or 4 significant figures]

2. Classify the following models:

	TASS	Prognosis	MGM	VDYP
Dynamic	Y	Y	Y	N
Distance-independent	N	Y	Y	Y or N
Spatially explicit	Y	N	N	N
Whole stand	N	N	N	Y
Static	N	N	N	Y
Single-tree	Y	Y	Y	N

← [Depending on interpretation (?). Either one accepted]

Place in each box a **Y** for *yes*, or an **N** for *no*.

3. Fill in the blanks:

Age (years)	Yield (m^3/ha)	PAI (m^3/ha-yr)	MAI (m^3/ha-yr)
20	60		3
		4.5	
30	105		3.5
		5.5	
40	160		4

(Note that changes are on the intervals between ages).

4. You are given the top height growth model

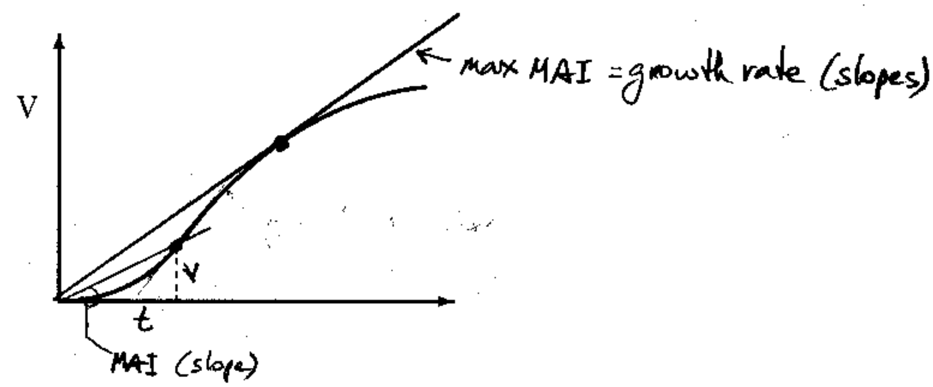
$$\ln H = 4.32 - b/t^{0.75} \ ,$$

with b a site-dependent parameter. The top height of a 35 years-old stand is 18 m. Estimate the site index (base age 50 years).

$$\ln 18 = 4.32 - \frac{b}{35^{0.75}} \longrightarrow b = 20.572$$

$$\ln S = 4.32 - \frac{b}{50^{0.75}} \longrightarrow S = 25.18$$

5. Using this yield curve diagram:



Locate the age of maximum MAI (no marks for that). How is the MAI related to the (instantaneous) growth rate at that age? Explain.

At any age the MAI is $\frac{v}{t}$, that is, the slope of the line joining the origin to the point on the curve. The maximum MAI is reached when the line becomes tangent to the curve.
The growth rate at any age is the slope of the tangent there.
Therefore, at the age of maximum MAI, the MAI and the growth rate are equal.
[Comment: the growth rate is NOT maximum at that point!!]

6. A normal yield table is one based on stands

(a) in good quality sites

(b) of high density

(c) with no mortality

(d) with a standard thinning regime

(e) representative of the average

7. We have the following model, with annual increments:

$$\Delta H = b_0 \quad (1)$$
$$\Delta B = (b_1 - b_2 B)/H \quad (2)$$
$$V = b_3 B H \quad (3)$$

$$b_0 = 1.8 \qquad b_1 = 170 \qquad b_2 = 1.8 \qquad b_3 = 0.3\ ,$$

where H is top height (m), B is basal area (m^2/ha), and V is volume (m^3/ha).

A 12 year-old stand has $H = 20$ m, and $B = 35$ m^2/ha. At age 13, half of the basal area is removed in a thinning. Predict the volume at age 14.

	t	H	B	ΔH	ΔB	V
	12	20	35	1.8	5.35	
before	13	21.8	40.35			
after	13	21.8	20.175	1.8	6.132	
	14	23.6	26.307			186.25

[Note: The basal area increment is a function of the current basal area and height]

8. In the model of question 7:

   A. V or (3) is/are:
      (a) state variable, (b) output function, (c) transition function, (d) control variable.

   B. This is a model:

	True/False	Opposite
(a) continuous	F	d
(b) individual-tree	F	f
(c) static	F	h
(d) discrete	T	a
(e) stochastic	F	g
(f) stand-level	T	b
(g) deterministic	T	e
(h) dynamic	T	c

   Enter **T** or **F** in the second column, and the letter for the opposite in the third one.

9. Assume that the Eichorn law holds (for all stand variables, not just volume). Would the number of trees per hectare at a given age be higher or lower in good sites compared to poor sites? Why? (No marks for the first question!)

Eichorn's law or rule says that (given the same initial conditions) trends of variables plotted over top height do not change with site (the original law relates specifically to volume over height).
If N is the same for given heights in good and poor sites, then for a given age it is lower in the better site (higher height).
[In other words, the relationships between stand variables are independent of site, things just happen faster in better sites]

[Comment: Opinions were about evenly divided on this one, with "plausible" arguments for and against. Shows the dangers of purely verbal or mental models.]

10. You have the following site index model:

$$H = 1.3 + 2.52 S\, e^{-\frac{46.2}{t}} ,$$

where H is top height (m), S is the site index (m), and t is age at breast height (years), Write down an equation to calculate site index from the 5-year growth intercept I. Assume that the age for the first whorl above breast height is half a year more than breast-height age.

$$I = H(5.5) - H(0.5)$$

$$= 1.3 + 2.52 S e^{-\frac{46.2}{5.5}} - 1.3 - 2.52 S e^{-\frac{46.2}{0.5}}$$

$$= 2.52 S \left(e^{-\frac{46.2}{5.5}} - e^{-\frac{46.2}{0.5}}\right)$$

$$= 0.00056667\, S$$

$$\therefore\ S = \frac{I}{0.00056667} = 1765\, I$$

[Note: As mentioned during the exam, the factor appears too high, indicating that this particular site index equation does not work well for young stands]