FSTY 405 — Silviculture II

Midterm, 23rd October 2002

Name:

Student number:

- Ensure that your name and student number are correctly entered above.
- Answer in the spaces provided after each question, writing down clearly the intermediate steps. Use the reverse as scratch pad.
- Write clearly, and use ink, not pencil.
- Pages: 4. Questions: 3, worth 3 marks each.
- Time: 45 minutes.
- Info: $\ln xy = \ln x + \ln y$, $\ln x^y = y \ln x$, $y = \ln x \Leftrightarrow x = \mathrm{e}^y$, $\mathrm{e}^{x+y} = \mathrm{e}^x \mathrm{e}^y$

1. Assume a simple yield function

$$V = 19.8(H - 4.96) ,$$

with a site index model

$$H = 1.62S(1 - \mathrm{e}^{-0.0308t})^2 .$$

V is volume in m^3/ha, H top height in metres, t age in years, and S is the site index.

For site index 21, at what age does the volume reach 300 m^3/ha?

$$300 = 19.8\,(H - 4.96)$$

$$\frac{300}{19.8} = H - 4.96$$

$$H = \frac{300}{19.8} + 4.96 = 19.298$$

$$H = 1.625\,(1 - e^{-0.0308t})^2$$

$$\sqrt{\frac{H}{1.625}} = 1 - e^{-0.0308t}$$

$$e^{-0.0308t} = 1 - \sqrt{\frac{H}{1.625}}$$

$$-0.0308t = \ln\left(1 - \sqrt{\frac{H}{1.625}}\right)$$

$$t = -\ln\left(1 - \sqrt{\frac{H}{1.625}}\right)/0.0308 = \underline{45.4}\text{ years}$$

2. (a) What is stand density management, through what practices is it performed?

"... is the process of controlling tree density within a stand to achieve desired objectives."
"... practices include the espacement of planted trees, pre-commercial thinning (juvenile spacing) and commercial thinning."
[or words to that effect. The above is from the Preface of the BC MOF "Guidelines for Developing Stand Density Management Regimes".]

(b) Explain one important trade-off in stand density management decisions.

Thinning results in about the same, or somewhat less total volume production, and incurs a treatment cost. On the other hand, produces larger tree sizes, with improved utilization and value and lower logging cost.
From the Executive Summary of "Guidelines for Developing Stand Density Management Regimes":
"Stands regenerated or spaced to relatively low densities (e.g. 200-1000 sph) have, at harvest, larger piece sizes because more growing space is available to each tree, lower volumes per hectare because of slow site occupancy following treatment, and longer biological rotations. That is, there is a trade-off between tree diameter and stand volume..."
[other similar answers are acceptable]

3. Clutter *et al* present site index models as functions giving site index (or its logarithm) in terms of age and top height. E.g.,

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

where S is site index (base age 25), H is top height, and A is age.

(a) Write the corresponding height function, giving top height in terms of age and site index.

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

$H = S \exp\left[-5.190\left(\frac{1}{A} - \frac{1}{25}\right)\right]$ [OK]

or

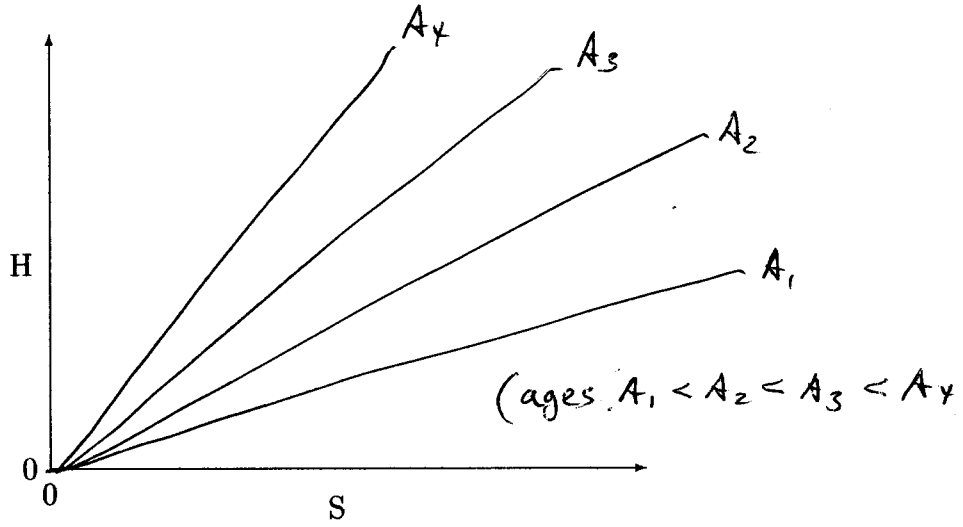
$H = S\, e^{-5.190/A}\, e^{5.190/25}$

$H = 1.231\, S\, e^{-5.190/A}$

(b) Is this an anamorphic or polymorphic model? Explain.

For given A, H is proportional to S (see (a)). Therefore, it is anamorphic (proportional).
See also (c).

(c) Sketch a graph of H over S for several given ages. Scale does not need to be right, but the form of the curves must be approximately correct over the full range of S.
Hints: See item (b). Recall the second part of Lab 6 (VDYP), on graphing functions with two independent variables.



See (a) and (b) : for fixed A, H is a constant times S, i.e., a straight line through the origin.