

100 points

Name: _____

FINAL EXAM-2006
FO-3015 Forest Description and Analysis

1. Using the 1/5 acre, fixed-radius plot data collected on a 40 acre tract (next page) and the partial computations, compute the following:

A. Best estimate of Mean Volume Per Acre is: _____ (10)

B. Sampling Error (@ 95% level) associated with the mean volume is: _____ (15)

C. Best estimate of Total Tract Volume is: _____ (5)

D. Coefficient of Variation is estimated to be: _____ (10)

E. Additional plots needed to achieve a $\pm 10\%$ sampling error would be: _____ (15)

F. Compute the Current Stand and Stock Table computations:

Current Stand & Stock:	Total Trees per acre is: _____	(4)
	Total Basal area per acre is: _____	(4)
	Total Volume per acre is: _____	(4)

G. Complete the Future Stand and Stock Table computations:

Future Stand & Stock:	Total Trees per acre is: _____	(4)
	Total volume per acre is: _____	(4)

H. If the DBH Growth rate is for a 5 year period, the Periodic Annual Increment of board foot volume growth is computed to be: _____ bd. ft/acre/year.
(10)

Sample plot and stand table calculations from 1/5 acre plot cruise on 40 acres.

Sample plot Computations:

0.2 Tally			Per Acre	Per Acre	Plot	Doyle BF Per Tree		
Plot	DBH	Trees	Trees	Volume	Total	X ²	DBH	Volume
1	12	3	15	1080	3960	15681600	10	60
	10	4	20	1200			12	72
	14	4	20	1680			14	84
2	10	6	30	1800	4620	21344400	16	96
	12	2	10	720			18	108
	14	5	25	2100				
3	14	4	20	1680	3900	15210000		
	12	2	10	720				
	10	5	25	1500				
4	10	5	25	1500	4680	21902400		
	14	5	25	2100				
	12	3	15	1080				
5	10	3	15	900	3660	13395600		
	14	4	20	1680				
	12	3	15	1080				
Totals		58	290		20820	87534000		

Mean Volume	1 acre	<input type="text"/>	BF	Std. Dev.	458.1266
Total Volume	40 acres	<input type="text"/>	MBF	Std. Error	<input type="text"/>
Sampling Error%		<input type="text"/>		t @ 95%	<input type="text"/>
Coef. Variation%		<input type="text"/>			

Sample stand table computations:

Tally			Current			Future			
DBH	Trees	Volume/Tree	Trees	Basal Area	Volume	DBH	Growth	Trees	Volume
10	23	60	<input type="text"/>	12.54	<input type="text"/>	10	2.4	<input type="text"/>	0
12	13	72	<input type="text"/>	<input type="text"/>	<input type="text"/>	12	2.1	<input type="text"/>	<input type="text"/>
14	22	84	<input type="text"/>	<input type="text"/>	1,848.0	14	1.9	<input type="text"/>	<input type="text"/>
16	0	96	<input type="text"/>	0	0	16		21.55	2068.8
Totals		58	<input type="text"/>	46.27	<input type="text"/>	Total		<input type="text"/>	<input type="text"/>

2. POINT SAMPLE: You performed a point sample cruise with a BAF 10 prism on 25 points on 50 acres and obtained the following results:

Mean volume per acre = 4,250 board feet per acre (Doyle)

Total tallied trees = 225

Volume:basal area regression: $Y = 470 + 42.00(X)$

Small sample mean basal area per acre = _____ ft²/ac (5)

3. DOUBLE POINT SAMPLE: Suppose the point sample in Questions 2 above was the 25 volume points from a BAF 10 **double** sample with an 4:1 count to volume ratio.

Additional data from double sample cruise:

Count points = 100

Volume points = 25

Total Points = 125

Tree Tally: = 775 trees on 100 Count points

= 225 trees on 25 Volume points

Total trees = 1,000 trees on 125 Total BAF 10 points

a. Large sample (i.e. overall) basal area per acre = _____ ft²/ac
(5)

b. Adjusted Doyle volume/acre (w/linear regression adjustment formula)= _____
(5)

USEFUL FORMULAE

Variable Definitions:

a = plot size in acres

A = total tract area in acres

$N = A/a$ = total number of plots of size a on the tract

$a' = 1/a$ = factor for expanding plot values to per acre values

x_i = volume on the i th measurement plot

n = number of sample plots of size a measured for volume

$y_i = (a')x_i$ = volume per acre represented by the i th plot

$t_{d,p}$ = Student's t table value for " $d=n-1$ " degrees of freedom and probability level p

Statistical Formulae:

Per Plot Average:

$$\bar{x} = \frac{\left(\sum_{i=1}^n x_i \right)}{n}$$

Per Plot Standard Deviation: (variance = s_p^2)

$$s_p = \sqrt{\frac{\left(\sum_{i=1}^n x_i^2 - n\bar{x}^2 \right)}{n-1}} = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n}}{n-1}} = \sqrt{\frac{S_{xx}}{(n-1)}}$$

Per Plot Standard Error of the Mean:

$$s_{\bar{x}} = \sqrt{\frac{s_p^2}{n}} = \frac{s_p}{\sqrt{n}} \text{ or } s_{\bar{x}} = \sqrt{\frac{s^2}{n} \left(1 - \frac{n}{N} \right)}$$

Coefficient of Variation: $CV = \frac{s_p}{\bar{x}} (100) = \frac{s_a}{\bar{y}} (100)$

Sampling Error: $SE\% = \left(\frac{t_{d,p} s_{\bar{x}}}{\bar{x}} \right) 100$

Confidence Intervals:

Per Acre $\bar{y} - (t_{d,p}) s_{\bar{y}} \leq \text{true mean} \leq \bar{y} + (t_{d,p}) s_{\bar{y}}$

Sample Size Required to be Within Plus or Minus P_e Percent of the True Mean with Probability $1-p$:

$$n = \frac{1}{\frac{1}{N} + \left(\frac{P_e}{(t_{d,p}) CV} \right)^2}$$

If the maximum error is expressed in absolute terms (A_e), then the sample size estimation equation becomes,

$$n = \frac{1}{\frac{1}{N} + \left(\frac{A_e}{(t_{d,p}) s_a} \right)^2}$$

$$n = \frac{\left(\frac{A}{ps} \right) t^2 (CV\%)^2}{\left(\frac{A}{ps} \right) (AE\%)^2 + t^2 (CV\%)^2}$$

Point and Double Point Sampling:

Plot Radius Factor(PRF) - the factor a tree's dbh is multiplied by to determine its plot radius

$$PRF = \frac{8.696}{\sqrt{BAF}}$$

Plot Radius(PR) - a tree must be within this radius to be an in-tree

$$PR = (PRF) (dbh)$$

Basal Area Factor(BAF) - basal area per acre represented by each in-tree

$$BAF = \frac{75.625}{PRF^2}$$

Basal Area Per Acre(BA) - basal area per acre represented by the in-trees at a point

$$BA = (IN-TREE COUNT) (BAF)$$

Number Of Trees Factor(NTF) - number of trees per acre (also called PACF) represented by an in-tree on a point

$$NTF = \frac{BAF}{(\text{Tree basal area})} = \frac{BAF}{.0054541 (dbh^2)} = \frac{183.3483BAF}{dbh^2}$$

Volume Basal Area Ratio(VBAR) - the ratio of tree volume to tree basal area

$$\text{VBAR} = \frac{(\text{Tree volume})}{(\text{Tree basal area})} = \frac{\text{Tree volume}}{.005451 (\text{dbh}^2)} = \frac{183.3483 (\text{Tree volume})}{\text{dbh}^2}$$

Volume Per acre(VPA) - volume per acre represented by an in-tree at a point

$$\text{VPA} = (\text{NTF}) (\text{Tree volume}) = (\text{VBAR}) (\text{BAF})$$

Double point, volume estimate Regression adjustment formula

$$\overline{Y}_{adj} = \overline{y} + b (BA - ba)$$

where:

$$\mathbf{b} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sum X^2 - \frac{(\sum X)^2}{n}} = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{S_{xx}}$$

b= slope of regression = change in volume per 1 square foot of basal area

BA = large sample basal area per acre (count plus volume points)

ba = small sample basal area per acre (volume points only)

Regression coefficients

model: $Y = a + bX$

$$\mathbf{b} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sum X^2 - \frac{(\sum X)^2}{n}} = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{S_{xx}} = \frac{\text{corrected sum of } XY}{\text{corrected sum of } X^2}$$

$$a = \overline{y} - b \overline{X}$$

Log Rule

$$\text{Doyle bd. ft} = \frac{(D - 4)^2 L}{16}$$

Student's t-Table
Forest Description and Analysis

The Distribution of Probability

<u>df</u>	<u>0.5</u>	<u>0.4</u>	<u>0.3</u>	<u>0.2</u>	<u>0.1</u>	<u>0.05</u>	<u>0.02</u>	<u>0.01</u>	<u>0.001</u>
1	1.000	1.376	1.963	3.078	6.314	12.706	31.821	63.657	636.619
2	0.819	1.061	1.386	1.886	2.920	4.303	6.965	9.925	31.598
3	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	12.941
4	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	6.856
6	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	5.405
8	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.587
11	0.697	0.876	1.088	1.363	1.769	2.201	2.718	3.106	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.767
24	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.551
60	0.679	0.848	1.046	1.296	1.671	2.000	2.390	2.660	3.460
120	0.677	0.845	1.041	1.289	1.658	1.980	2.358	2.617	3.373
∞	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.291