

Name: _____

FINAL EXAM-2001
FO-3014 Forest Description and Analysis

1. Fill in the blanks in the table below using a declination of 5° WEST:

<u>Magnetic Bearing</u>	<u>True Bearing</u>	<u>Magnetic Azimuth</u>	
N15°E	_____	_____	(2)
_____	N10°W	_____	(2)
_____	_____	240°	(2)

2. Define the following terms: (6)

a) Stand and Stock table -

b) Basal Area -

c) Scaling diameter

3. For a 160 acre stand and a desired 5 percent cruise with 0.1 acre plots:

a. You will need to distribute _____ total plots. (3)

b. If the desired grid spacing for plots must be approximately equal,
the plots could be spaced _____ chains apart (2)

on lines spaced _____ chains apart. (2)

4. Given the following information from a timber cruise:

Mean sawtimber volume = 4,500 bd.ft. per acre
 Sampling error at 95% Confidence = +/- 7.5 %
 Current timber value = \$400 per MBF

The 95% confidence interval on the mean VALUE per acre is:

Lower Limit \$ _____ (2)

Upper Limit \$ _____ (2)

5. You are drawing a map at a scale of 1:7920

a) The equivalent scale of the map is 1 inch = _____ chains. (2)

a) A gravel road that is 66 feet wide will be drawn _____ inches in width. (2)

6. Data analysis showed a 10 year DBH growth rate of 2.2 inches for the 12-inch DBH class (using 2-inch classes). If there are 60 trees in the 12-inch class now, complete the stand table below:

DBH Class	Future		(5)
	Current No. Trees	No. Trees (in 10 yrs.)	
12	60	_____	
—	—	_____	
—	—	_____	
—	—	_____	

7. Given the following cruise specifications:

stand acres = 180 Percent Cruise = 10%

plot size = 0.20 acre, fixed radius

Plot spacing = 4 chains; Line spacing = 5 chains

a. The first plot will be located _____ chains from the boundary. (2)

b. The first cruise line will be located _____ chains from the corner. (2)

8. You have completed a 15% fixed area plot cruise using a plot size of 0.25 acres. The volumes for the plots tallied are given below:

<u>Plot No.</u>	<u>Pulpwood Volume</u> (cords)	<u>Sawtimber Volume</u> (board feet)
1	4.8	2,750
2	1.5	3,250
3	1.2	2,500
4	6.5	3,500
5	2.0	3,000

The mean pulpwood volume per acre (in cords) for the cruise is _____. (2)

The mean sawtimber volume per acre (in **MBF**) for the cruise is _____. (2)

9. LOCAL VOLUME TABLE: You collected sample height data during a point sample cruise and computed the following height regression equations for use in local volume table construction. The height equation was used with a standard volume equation for Doyle board feet to construct a local volume table.

	<u>a</u>	<u>b</u>
$H_0 = a e^{\left[\frac{b}{dbh}\right]}$	93.95	-3.3079
Doyle(8")= a + b[(dbh ²)(h)]	-42.46	0.009747

Complete the local volume table below by filling in the blanks below:

<u>DBH</u>	<u>Total Height</u>	<u>Volume per Tree</u>	(4)
12	_____	<u>57.6</u>	
14	<u>74.2</u>	_____	
16	_____	_____	

10. POINT SAMPLE: You performed a point sample cruise with a BAF 10.0 prism on 8 points. (25)
 Acres = 40 BAF = 10.00 U.S. PACF = BAF/ ba
 n = 8.00 points tree ba = 0.005454D² (sq.ft.)

									Doyle BF
10		Tally		Per Acre	Per Acre	Plot			Per Tree
Plot	DBH	Trees		Trees	Volume	Total		DBH	Volume
1	12	3		38.20	2750.28			10	60
	10	4		73.34	4400.44			12	72
	14	4		37.42	3143.17			14	84
						10293.89		16	96
2	10	3						18	108
	12	2		25.47					
	14	5			3928.96				
						9062.81			
3	14	3		28.06	2357.38				
	12	3			2750.28				
	10	4		73.34	4400.44				
						9508.09			
4	10	5		91.68	5500.55				
	14	2		18.71	1571.59				
	12	3		38.20	2750.28				
						9822.41			
5	10	4		73.34	4400.44				
	14	5		46.77	3928.96				
	12	2		25.47	1833.52				
						10162.92			
6	14	3		28.06	2357.38				
	12	4		50.93	3667.03				
	10	5		91.68	5500.55				
						11524.96			
7	12	2		25.47	1833.52				
	10	3		55.01	3300.33				
	14	4		37.42	3143.17				
						8277.02			
8	14	6		56.13	4714.76				
	10	5		91.68	5500.55				
	12	3		38.20	2750.28				
						12965.58			
Totals		87	Sum of Plots	1129.53		81617.68	BF Doyle	Std. Dev.	1465.14203
			Mean Volume	1 acre			BF Doyle	Std. Error	
			Total Volume	40 acres		408.09	MBF Doyle	t @ 95%	2.365
			Sampling Error%						
			Coef. Variation%			14.36			
		Tally		Expanded	Per Acre	Per Acre			Per Acre
	DBH	Trees		Tally	Trees	Volume			Basal Area
	10	33		605.06		4537.95	BF Doyle		41.25
	12	22		280.12	35.02		BF Doyle		
	14	32		299.35		3143.17	BF Doyle		40.00
Totals		87		1184.53	148.07	10202.21	BF Doyle		

11. DOUBLE POINT SAMPLE: Suppose the point sample in Question 10 above was the 8 volume points from a BAF 10.0 **double** sample where 42 additional count points were taken:.

Additional data from double sample cruise:

Count points = 42
Volume points = 8 (from question #10 above)
Total Points = 50

Tree Tally: = 363 trees on 42 Count points
= 87 trees on 8 Volume points (question #10 above)
Total trees = 450 trees on 50 Total BAF 10.0 points

From the volume points regression, the relationship between board feet and basal area was calculated to be 63.2 board feet per 1 square foot of Basal Area.

a. Compute the large sample (i.e. overall) basal area per acre: (2)

b. Compute the adjusted Doyle volume per acre with the linear regression adjustment formula: (4)

12. Given the sample size equation for a finite population:

$$n = \frac{N t^2 (CV\%)^2}{N (AE\%)^2 + t^2 (CV\%)^2}$$

$$\text{where } N = \frac{\text{Acres}}{\text{plot size}}$$

a. The estimated number of 0.1 acre fixed-radius plots needed to achieve a +/- 15% sampling error in an 80 acre stand that has a coefficient of variation of 60% would be: (use $t = 2.0$)

_____ 0.1-acre plots (4)

b. If the plot size was doubled to 0.2 acres for the same coefficient of variation and desired sampling error as above, the estimated number of plots would: (circle the correct choice)
(show work or no credit given.)

- (1) Decrease by a factor of 2 (2)
(2) Increase by a factor of 2
(3) Decrease by less than 10 percent
(4) Increase by less than 10 percent

13. You have completed a fixed area plot cruise using a plot size of 0.10 acres. The tree tallies for the sample plots are given below:

<u>Plot No.</u>	<u>Plot Tally</u>		<u>Local Volume Table (Bd.Ft.)</u>	
	<u>DBH</u>	<u>Trees</u>	<u>DBH</u>	<u>Volume per Tree</u>
1	10	4	10	50
	12	3	12	80
2	12	5		
	10	6		
3	10	5		
	12	4		
4	12	3		
	10	4		
5	10	6		
	12	5		

- a) Complete the stand/stock table entries:

Per Acre Stand and Stock Table:

<u>DBH</u>	<u>Trees</u>	<u>BA</u>	<u>Volume</u>	
10	_____	_____	_____	(6)
12	_____	_____	_____	(6)
Totals	_____	_____	_____	(6)

- b) The overall estimate of mean volume per acre is _____ board feet. (3)

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 ith measurement plot

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

$y_i = (a')x_i$ = volume per acre represented by the ith 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:

$$s_{\bar{x}} = \sqrt{\frac{s_p^2}{n}} = \frac{s_p}{\sqrt{n}}$$

Per Acre Average: $\bar{y} = (a')\bar{x}$

Per Acre Standard Deviation: $s_a = (a')s_p$

Per Acre Standard Error of the Mean: $s_{\bar{y}} = (a')s_{\bar{x}}$

Statistical Formulae (continued):

Total Tract Estimate: $\text{Total} = (A) \bar{y} = (N) \bar{x}$

Total Tract Standard Error of the Estimate: $s_T = (A) s_{\bar{y}} = (N) s_{\bar{x}}$

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 Plot $\bar{x} - (t_{d,p}) s_{\bar{x}} \leq \text{true mean} \leq \bar{x} + (t_{d,p}) s_{\bar{x}}$

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

Per Tract $\text{Total} - (t_{d,p}) s_T \leq \text{true mean} \leq \text{Total} + (t_{d,p}) s_T$

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,

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

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

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

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

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

Double point, volume estimate adjustment formula

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

where:

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

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)