

100 points

Name: Key

**FINAL EXAM-2007
FO-3015 Forest Description and Analysis**

1. Using the single-phase, BAF10 prism data collected on a 40 acre tract (below) and the partial computations, compute the cruise computations (i.e complete the computations in the blank cells below) and answer the questions on page 2:

(20)

Sample plot and stand table calculations from BAF10 point cruise on 40 acres.

Sample point Computations:

10 Plot	Tally DBH	Tally Trees	Per Acre Trees	Per Acre Volume	Plot Total	DBH	Doyle BF Per Tree Volume
1	12	4	50.93	3667.03	7753.16	10	60
	10	3	55.01	3300.33		12	72
	14	1	9.35	785.79		14	84
2	10	2	36.67	2200.22	8224.63	16	96
	12	4	50.93	3667.03		18	108
	14	3	28.06	2357.38			
3	14	3	28.06	2357.38	8224.63		
	12	4	50.93	3667.03			
	10	2	36.67	2200.22			
4	10	3	55.01	3300.33	6705.43		
	14	2	18.71	1571.59			
	12	2	25.47	1833.52			
5	10	3	55.01	3300.33	6705.43		
	14	2	18.71	1571.59			
	12	2	25.47	1833.52			
Totals		40	544.98	37613.29			Std. Dev. 770.451
		Sum of Plots					Std. Error 344.556
		Mean Volume	1 acre	7522.66			t @ 95% 2.77
		Total Volume	40 acres	300.91			
		Sampling Error	%	12.71			
		Coef. Variation	%	10.24			

Sample stand table computations:

	Tally DBH	Tally Trees	Expanded Tally	Per Acre Trees	Per Acre Volume	Per Acre Basal Area
	10	13	238.36	47.67	2860.29	26.00
	12	16	203.72	40.74	2933.63	32.00
	14	11	102.90	20.58	1728.74	22.00
Totals		40	544.98	109.00	7522.66	80.00

A. Best estimate of Mean Volume Per Acre is: 7522.66 bd. ft Doyle (5)

$$\frac{37613.29}{5} = 7522.66$$

B. Sampling Error (@ 95% level) associated with the mean volume is: 12.71% (10)

$$S = 770.451 \rightarrow A^2 = (770.451)^2 \quad t_{4, 05} = 2.776$$
$$s_x = \sqrt{\frac{(770.451)^2}{5}} = 344.56 \quad SE = \frac{(2.776)(344.56)}{7522.66} \times 100$$

C. Best estimate of Mean Basal Area per acre is: 80 square feet (5)

$$BA/ac = \frac{(40)(10)}{5} = 80$$

D. Coefficient of Variation is estimated to be: 10.24% (5)

$$CV\% = \frac{770.45}{7522.66} \approx 10.24\%$$

2. **DOUBLE POINT SAMPLE:** Suppose the point sample in Questions 1 above was the 5 volume points from a BAF 10 **double** sample with an 4:1 count to volume ratio. The volume point results were used to obtain the following relationship between volume and basal area;

Volume:basal area regression: $Y = 2.66 + 94.00(X)$

Additional data from double sample cruise:

Count points = 20
Volume points = 5 (from question 1 above)
Total Points = 25

Tree Tally: = 173 trees on 20 Count points
= 40 trees on 5 Volume points (from question 1 above)
Total trees = 213 trees on 25 Total BAF 10 points

a. Large sample (i.e. overall) basal area per acre = 85.2 ft²/ac (5)

$$BA = \frac{(213)(10)}{25} = 85.2$$

b. Adjusted Doyle volume/acre (w/linear regression adjustment formula) = 8011.46 (5)

$$\hat{Y} = 7522.66 + 94[85.2 - 80.0]$$
$$= 7522.66 + 488.8$$
$$= 8011.46$$

3. Given the partial computations below for the regression model:
 $\ln(H) = b_0 + b_1 (\text{DBH}^{-1})$
 compute the final equation and fit statistics for 20 observations.

tree #	DBH	Ht	X	Y	X ₂	Y ₂	XY	(Y - \bar{Y}) ₂
1	2.9	33	0.34483	3.49651	0.11891	12.22557	1.20569	0.00901

(body of computations are omitted)

20	250.0	1343.0	Sum	2.21644	83.52118	0.36383	350.15446	8.86476	0.07032
n	12.5	67.2	Mean	0.11082	4.17606				
			CSS			0.11820	1.36511	-0.39121	

b ₁	-3.30973
b ₀	4.54285
r ²	0.94849
s _{y.x}	0.06250

$$b_1 = \frac{-0.39121}{0.11820} = -3.31$$

$$b_0 = 4.17606 - (-3.31)(0.11082) = 4.54$$

A. The equation in terms of H [not ln(H)] is: $H = 93.69 e^{\left(\frac{3.31}{\text{DBH}}\right)}$ (10)

$$\ln H = 4.54 + 3.31 (\text{DBH}^{-1}) = e^{4.54} e^{\left(\frac{3.31}{\text{DBH}}\right)}$$

B. The Index of Fit (I²) is: 94.8 % (5)

$$I^2 = \left(1 - \frac{0.07032}{1.36511}\right) = 0.948$$

C. The expected error of the regression estimate of height is: 1.06 feet (5)

$$s_{y.x} = 0.06250 \quad \text{errm} = e^{0.06250} = 1.06 \text{ ft.}$$

4. Given the following tally from 5- 0.2 acre fixed radius plots, complete the computations for a current and future stand and stock table using the 10 year radial growth per dbh class. (20)

.....Per Acre.....				Per Acre.....					
Tally										
DBH	Trees	Vol/Tree	Trees	BA/ac	Vol/ac	DBH	Growth	Trees	BA/ac	Vol/ac
10	40	60	40	21.8	2400	10	2.4	0.0	0.0	0
12	30	72	30	23.6	2160	12	2.1	32.0	25.1	2304
14	20	84	20	21.4	1680	14	1.9	37.5	40.1	3150
16	0	96	0	0.0	0	16	0.0	20.5	28.6	1968
Totals	90		90	66.8	6240	Total		90.0	93.8	7422

A. The current volume is: 6,240 board feet per acre. (2)

B. The future volume is expected to be: 7422 board feet per acre. (3)

Statistical Formulas

$$s^2 = \frac{\sum_{k=1}^n x_i^2 - \frac{\left(\sum_{k=1}^n x_i\right)^2}{n}}{n-1} \quad s_{\bar{x}} = \sqrt{\frac{s^2}{n} \left(1 - \frac{n}{N}\right)}$$

$$SE\% = \left(\frac{t_{n-1, \alpha} s_{\bar{x}}}{\bar{x}}\right) * 100\% \quad \bar{x} \pm (t_{n-1, \alpha}) s_{\bar{x}}$$

$$CV\% = \frac{\sqrt{s^2}}{\bar{x}} * (100\%) = \frac{s}{\bar{x}} * 100\%$$

$$PACF = \frac{1}{\text{plot size}} \quad \text{plot size} = \frac{ba}{BAF}$$

$$SS_y: \sum y^2 = \sum Y^2 - \frac{(\sum Y)^2}{n} \quad b_1 = \frac{\sum xy}{\sum x^2} = \frac{SP_{xy}}{SS_x}$$

$$SS_x: \sum x^2 = \sum X^2 - \frac{(\sum X)^2}{n} \quad b_0 = \bar{Y} - b_1 \bar{X}$$

$$SP_{xy}: \sum xy = \sum XY - \frac{\sum X \sum Y}{n}$$

$$TSS = SS_y = \sum y^2$$

$$ESS = \sum (Y - \hat{Y})^2$$

$$RSS = \frac{(SP_{xy})^2}{SS_x} = \frac{(\sum xy)^2}{\sum x^2} = b_1 \sum xy$$

$$r^2 = \left(1 - \frac{\text{Error SS (ESS)}}{\text{Total SS (TSS)}}\right)$$

$$s_{y,x} = \sqrt{\frac{\sum (Y - \hat{Y})^2}{n - 2}} = \sqrt{\frac{ESS}{n - 2}}$$

$$s_{y,x} = \sqrt{\frac{\sum y_i^2 - b_1 \sum xy}{n - 2}} = \sqrt{\frac{ESS}{n - 2}}$$

$$\text{Volume} = b_0 + \beta(ba)$$

$$\bar{Y}_{adj} = \bar{y}_2 + \beta(\overline{BA}_1 - \overline{ba}_2), \text{ where } n_1 = \text{number of large sample points, } n_2 = \text{small sample points}$$

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