Name: Key

FO-2133 Forest Measurement
Exam 2 - 2008

1. Height measurement:

You just checked your Suunton clinometer with the peg method and found the double-error between 2 trees was +8.8 ft at a distance of 110 ft.

A. The percent error of the clinometer is computed (with sign) to be: +4 % (5)

$\%Error = \left(\frac{+8.8}{110}\right)/2 = +4\%$

Using the percent scale, you measure the total height of one of the peg-method trees at the specified horizontal distance above; i.e 110 ft..

the reading at the top = +85 ft
the reading at the ground line = -5 ft

B. The correct height of the tree is computed to be: 95 ft (10)

$H = \left(1 - .04\right)\left(\frac{110}{100}\right)[85 - -5] = (0.96)(1.1)(90)$

2. Volume computation:

Given: A single tree segment is 16.5 ft in length and has a butt diameter of 17.6 inches, o.b., with single bark thickness of 0.8 inches and a top diameter of 13.5 inches, o.b., with a single bark thickness of 0.5 inches.

A. The cubic volume, outside bark, of the total log is: 22.14 cubic feet (5)

$Ft^3_{ob} = \left[\frac{.005454(17.6)^2 + 0.005454(13.5)^2}{2}\right]16.5$

B. The cubic volume, inside bark, of the total log is: 18.54 cubic feet (5)

$Ft^3_{ib} = \left[\frac{.005454\left[16^2 + 12.5^2\right]}{2}\right]16.5$

C. The scaling length of the log for Doyle board foot volume is: 16 feet (5)

D. The scaling diameter of the log for Doyle board foot volume is: 13 inches (5)

E. The Doyle Board Foot volume of the single log is: 81 bd. ft (5)

$Doyle = \frac{(13-4)^2 16}{16}$

F. The board foot per cubic foot (o.b.) ratio of the log is: 3.66 (5)

$BdFt:Ft^3 = \frac{81}{22.14} = 3.66$

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Name: _____

3. Cruise volume and statistical computations:

Given the following tally from a 0.2 acre plot cruise on 40 acres, compute the volume estimates, precision statistics, and stand and stock table for the cruise.

Tree Equations: $H = 120e^{\left(\frac{-4.15}{DBH}\right)}$

Bd. Ft Volume = $10 + 0.01(D^2H)$

Plot#	DBH		#Trees							
1	10		1							
	12		2							
	14		3							
2	12		2							
	14		3							
	16		4							
3	10		3							
	14		2							
	16		2							
4	10		2							
	12		4							
	14		3							
	16		2							
							Sum			
							Mean			

s^2		(5)
s		(5)
s_xbar		(5)
t		(5)
SE%		(5)
CV%		(5)

Stand & Stock Table

DBH			DBH	Trees/ac	Volume/ac	Total Trees	Total Volume	
10								
10								
10			10					(4)
12								
12								
12			12					(4)
14								
14								
14								
14			14					(4)
16								
16								
16			16					(4)
			Totals					(4)

The best estimate of mean volume per acre is: _____ Bd. Ft. (5)

3. Cruise volume and statistical computations:

Given the following tally from a 0.2 acre plot cruise on 40 acres, compute the volume estimate and precision statistics for the cruise. (and Stand Stock table)

Tree Equations: $H = 120e^{\left(\frac{-4.15}{DBH}\right)}$

Volume = $10 + 0.01(D^2H)$

Plot#	DBH	Height	#Trees	PACF	Trees/ac	Vol/tree	Vol/ac	Plot Vol	Vol²
1	10	79	1	5	5	89	446		
	12	85	2	5	10	132	1323		
	14	89	3	5	15	185	2773	4542	20629284
2	12	85	2	5	10	132	1323		
	14	89	3	5	15	185	2773		
	16	93	4	5	20	247	4940	9036	81650123
3	10	79	3	5	15	89	1339		
	14	89	2	5	10	185	1849		
	16	93	2	5	10	247	2470	5657	32006201
4	10	79	2	5	10	89	892		
	12	85	4	5	20	132	2646		
	14	89	3	5	15	185	2773		
	16	93	2	5	10	247	2470	8781	77107508
					165	Sum	28016	28016	211393116
					41.3	Mean	7004	7004	

s^2	5054094	(5)	5056350
s	2248	(5)	2248.63
s_xbar	1113	(5)	1113.02
t	3.1820	(5)	$\alpha = .05$, $n-1=3$
SE%	51	(5)	50.56 = 51%
CV%	32	(5)	32.10%
		30	

DBH	Trees/ac	Vol/ac	DBH	Trees/ac	Volume/ac	Total Trees	Total Volume	
10	5	446						
10	15	1339						
10	10	892	10	7.5	669	300	26,772	(4)
12	10	1323						
12	10	1323						
12	20	2646	12	10.0	1,323	400	52,911	(4)
14	15	2773						
14	15	2773						
14	10	1849						
14	15	2773	14	13.8	2,542	550	101,675	(4)
16	20	4940						
16	10	2470						
16	10	2470	16	10.0	2,470	400	98,806	(4)
			Totals	41.3	7,004	1,650	280,165	(4)

Best Estimate of Mean Volume per acre is: 7,004 Bdft/ac (5)

Equation Formula Sheet

$$s^2 = \frac{\left[\sum_{i=1}^{n} x_i^2 - \frac{(\sum_{i=1}^{n} x_i)^2}{n}\right]}{(n-1)} \qquad s^2 = \frac{\left[\sum_{i=1}^{n} x_i^2 - \bar{x}\sum_{i=1}^{n} x_i\right]}{(n-1)} \qquad s = \sqrt{s^2}$$

$$CV\% = \left(\frac{s}{\bar{x}}\right)(100) \qquad s_{\bar{x}} = \sqrt{\frac{s^2}{n}(1 - \frac{n}{N})}$$

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

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

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

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

TSS $\qquad SS_y = \sum y^2 \qquad ESS = \sum (Y - \hat{Y})^2$

RSS $\qquad \frac{(SP_{xy})^2}{SS_x} = \frac{(\sum xy)^2}{\sum x^2} = b_1 \sum xy \qquad I^2 = \left(1 - \frac{Error\ SS}{Total\ SS}\right)$

$$S_{y.x} = \sqrt{\frac{\sum (Y-\hat{Y})^2}{n-2}} = \sqrt{\frac{ESS}{n-2}} \qquad S_{y.x} = \sqrt{\frac{\sum y_i^2 - b_1 \sum xy}{n-2}} = \sqrt{\frac{ESS}{n-2}}$$

$$height = \left(1 - \frac{\%\ error}{100}\right)\left[\frac{horizontal\ distance}{index\ distance}\right](Reading@top - Reading@bottom)$$

Smalian: $ft^3 = [(B + b)/2]\ L$
Huber: $ft^3 = [(B_{1/2})]\ L$
Newton: $ft^3 = [(B + 4B_{1/2} + b)/6]\ L$

Doyle Board Feet = $(D - 4)^2 L/16$
Scribner Board Feet = $(0.79D^2 - 2D - 4)L/16$
International 1/4 Board Feet
4 ft. log = $0.199D^2 - 0.6420D$
8 ft. log = $0.597D^2 - 1.3290D - 0.7143$
16 ft. log = $0.796D^2 - 1.3740D - 1.2295$

Student's t-Table

The Distribution of t

	Probability = α								
df	**0.5**	**0.4**	**0.3**	**0.2**	**0.1**	**0.05**	**0.02**	**0.01**	**0.001**
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