Stand Attributes and Stand Sampling Techniques

PROBLEM SET 3 – Due 17 Feb 2016

1. Stand Attributes. Some information measured on a 0.1-acre fixed-area plot randomly located in a stand from a forest under your care is available (Table 1). Compute and report the following stand attribute descriptors to characterize present conditions.
    a. number of trees per acre
    b. stand basal area per acre
    c. mean diameter, quadratic mean diameter
    d. Stand Density Index (SDI), relative SDI, and Curtis' Relative Density (RD)
    e. Mean height, Lorey's height, H40 (avg. height of 40 largest diameter trees per acre)
    f. species composition, using tree frequency first, then using basal area as the basis
    g. If stand b.h. age is 31 yr., what is Site Index according to King? Site Class? (Remember: For King's curves use only Douglas-fir trees to compute dominant height defined as the average height of trees in the 80th or higher percentile by DBH)

Challenges 2 & 3 are based on Figure 1, a "map" of a 40-acre "forest" exhaustively divided up into 0.10-acre plots. The numbers appearing in each "plot" represent 100's of bd-ft. on that plot.

2. Systematic sampling. Use a random number generator to pick a starting plot for a 25 plot systematic sample with a random start. Mark the systematically selected plots on the map (Figure 1) and append it to your answer sheet. Compute mean volume **per acre,** its standard error, and a 90% confidence interval. Compute the observed margin of error, E (the half-width of the confidence interval), you observed. From this, find observed percent error (E%).

3. Sample size calculation. Find the sample size necessary to achieve an allowable error, E%, of the same size as was observed as in (2), but instead using 70% confidence. Explain how your computed sample size compares with n = 25 from question (2).

4. Ratio Estimation. Weight scaling of sawlogs. We want to estimate the total volume of N truckloads of timber removed from a particular timber sale. Each truckload of logs has to be weighed (W in pounds) to pay the truckers, so we randomly sample n= 4 (*) of the N = 10 truckloads and scale the logs for board foot volume (V in BF). The data follow:

Load:	1	2*	3	4*	5	6*	7	8*	9	10
W (lbs):	51,000	43,600	68,000	60,000	52,000	49,400	56,000	63,000	48,000	54,000
V (BF):	-	5,000	-	5,600	-	5,800	-	6,400	-	-

    Derive an estimate for total volume using the ratio-of-means and a 90% confidence interval.

5. Double Sampling. [*Extra Credit.*] A very homogenous longleaf pine stand was systematically sampled using a sample size of six 1-acre plots and resulted in the data appearing in Table 2.
    a. What is the estimate of volume per acre from this systematic sample?
    b. Calculate the standard error of the estimate in part a.
    c. Now suppose that as part of the sampling tree counts only were obtained on ten additional plots. The number of trees observed on these plots is as follows:

        7, 11, 10, 7, 8, 10, 8, 6, 10, 5.

        What is the double-sampling estimate of volume per acre?
    d. Calculate the standard error of the estimate in part c.
    e. How do the two standard errors (from b and from d) compare? What is the relative efficiency of double sampling compared to systematic sampling for this case?

Table 1. Data from a 1/10-acre, fixed-area, circular plot (PLT) no. 1, in a 2nd-growth Douglas-fir forest. (NOTE: SPP = 202 is Douglas-fir, 492 is Pacific dogwood, 351 is red alder, 920 is willow)

PLT	SPP.	DBH (in.)	H (ft.)
1	202	5.5	45.8
1	202	5.6	46.7
1	202	6.8	56.7
1	202	7.5	62.5
1	202	7.7	64.2
1	202	8.8	73.3
1	202	9	75
1	202	9.2	76.7
1	202	10.2	85
1	202	10.2	85
1	202	10.5	87.5
1	202	10.6	88.3
1	202	11.4	95
1	202	11.5	95.8
1	202	11.5	95.8
1	202	11.5	95.8
1	202	11.8	98.3
1	202	12.1	100.8
1	202	12.5	104.2
1	202	12.8	106.7
1	202	12.8	106.7
1	202	14.1	117.5
1	202	14.3	119.2
1	202	14.9	124.2
1	202	15.1	125.8
1	351	4.5	37.5
1	351	5.1	42.5
1	351	5.4	45
1	351	6.5	54.2
1	351	6.8	56.7
1	351	11.5	95.8
1	492	5.8	48.3
1	492	6.5	54.2
1	920	4.7	39.2
1	920	4.9	40.8
1	920	5.2	43.3

Table 2. PLT refers to plot, No. Trees is the number of trees measured on the plot, Vol/ac refers to cubic-foot volume of longleaf pine trees.

PLT	No.Trees	Vol/ac
1	10	3523
2	7	2546
3	6	2201
4	9	3458
5	9	3520
6	9	3404

Measured volume on 0.1-acre plots in a 40 acre forest tract

(in 100 boardfeet)

22	26	26	19	34	18	17	25	20	28	0	0	2	0	6	0	3	0	0	4
21	18	23	22	28	24	33	36	23	15	17	0	2	11	15	0	17	5	2	8
30	28	23	21	29	18	14	30	25	28	20	14	8	1	15	2	5	0	0	4
28	19	21	20	26	20	38	23	20	27	24	11	6	4	0	5	5	9	2	5
17	14	20	26	25	22	22	19	15	20	25	26	15	9	12	0	0	16	8	5
38	42	37	39	22	44	47	17	25	29	34	39	20	24	14	10	12	1	0	0
43	34	23	46	47	46	39	35	31	30	24	35	23	26	18	25	21	12	5	1
36	45	47	36	35	29	49	44	31	42	33	47	31	28	15	18	20	23	9	12
38	48	42	51	17	54	47	52	30	34	30	46	24	12	21	12	32	29	27	16
17	24	45	47	52	28	43	45	46	27	40	32	51	28	25	41	20	27	14	21
47	56	43	37	30	60	56	43	29	33	41	30	30	20	15	18	20	23	13	28
38	36	27	38	24	31	48	32	25	31	35	31	22	15	10	24	22	19	18	16
46	54	34	46	37	43	44	34	25	44	43	40	28	14	26	33	18	34	17	31
47	47	35	40	39	39	50	28	50	36	44	27	16	21	36	17	27	21	33	31
22	37	11	29	28	33	29	35	53	18	26	20	29	12	23	25	15	17	26	21
37	22	20	22	14	29	25	21	30	31	27	16	21	36	17	27	21	17	14	12
18	25	26	20	27	26	26	22	19	30	15	2	7	3	4	15	9	7	0	3
22	34	37	17	24	28	26	25	30	33	18	6	0	3	0	0	6	5	7	6
13	28	27	27	31	20	21	21	16	27	12	0	17	3	1	1	0	0	0	5
32	31	30	22	16	26	8	32	19	22	3	3	0	0	0	2	0	5	10	2

Figure 1. "Map" of example population for use in designing a SYStematic sample (SYS) survey with random start.