Quantitative Methods Exam

2008 December, 12$^{\text{th}}$

1. An electronic components manufacturer has 90 plants located throughout Asia. She wants to estimate the average number of hours that the machines were down for repairs in the last year. As each plant contains many machines, she sample $n = 10$ plants and approximately 20% of the machines in each plant. Using the data shown in the next table,

   (a) Estimate the average downtime per machine, and place a bound on the error of estimation. The manufacturer knows she has a combined total of 4500 machines in all plants.

   (b) Estimate, also, the *total* amount of downtime during the last year for all the machines, and determine a bound of the error of estimation.

Plant	M_i	m_i	Downtime	$\bar{y}_i$	s_i^2
1	50	10	$5, 7, 9, 0, 11, 2, 8, 4, 3, 5$	5.40	11.38
2	65	13	$4, 3, 7, 2, 11, 0, 1, 9, 4, 3, 2, 1.5$	4.00	10.67
3	45	9	$5, 6, 4, 11, 12, 0, 1, 8, 4$	5.67	16.75
4	48	10	$6, 4, 0, 1, 0, 9, 8, 4, 6, 10$	4.80	13.29
5	52	10	$11, 4, 3, 1, 0, 2, 8, 6, 5, 3$	4.30	11.12
6	58	12	$12, 11, 3, 4, 2, 0, 0, 1, 4, 3, 2, 4$	3.83	14.88
7	42	8	$3, 7, 6, 7, 8, 4, 3, 2$	5.00	5.14
8	66	13	$3, 6, 4, 3, 2, 2, 8, 4, 0, 4, 5, 6, 3$	3.85	4.31
9	40	8	$6, 4, 7, 3, 9, 1, 4, 5$	4.88	6.13
10	56	11	$6, 7, 5, 10, 11, 2, 1, 4, 0, 5, 4$	5.00	11.80

2. Explain briefly the main ideas of *systematic sampling.*

   Suppose that a systematic sample, with a period of $k = 6$, is obtained from a voter registration list to estimate the proportion of voters in favor of a certain issue. Results are

Voter	Response
4	1
10	0
16	1
$\vdots$	$\vdots$
5760	0
5766	0
5772	1
	$\sum_{i=1}^{962} y_i = 652$

   Estimate p, the proportion of the $N = 5775$ registered voters in favor of the proposed issue. Give a bound on the error of estimation.

3. Explain briefly the techniques of *Tree Models* and Kohonen maps (*SOM*).