Problem 9.1

A College has 10 classes of Calculus 101. Due to timetable conflicts, the number of students in each class has quite a large variation, as shown in the table below:

Class Index	1	2	3	4	5	6	7	8	9	10
Number of Students	23	50	14	20	62	17	33	27	54	29

Suppose a researcher wants to sample 5 classes with replacement, with probability proportional to size (pps), and then collect a set of questionnaire from some of the students in the selected classes.

a) Use the Lahiri's method and the following pairs of random numbers to determine which classes are to be selected in the sample:

$\{(f_i, s_i):\ (3,25), (7,23), (2,43), (6,30), (9,18), (2,52), (5,39), (10,28), (4,9)\}$

where f_i, s_i are random integers generated from 1 to 10, and 1 to 62, respectively.

b) Use the cumulative–size method and the following set of random numbers generated between 1 and 329, to determine the classes to be selected in the sample: $\{145, 287, 23, 98, 196\}$.

Problem 9.2

A university has a total of 807 faculty members in 27 academic units. The academic units range in size from 2 to 80. Suppose the Lahiri's method was used to choose 10 academic units with probabilities proportional to size and with replacement, and took an SRS of four (or fewer, if $M_i < 4$) members from each academic unit. For each selected faculty member, the number of refereed publications (y_{ij}) was recorded.

Sampled Unit (i)	M_i	ψ_i	y_{ij}
14	65	65/807	3, 0, 0, 4
23	25	25/807	2, 1, 2, 0
9	48	48/807	0, 0, 1, 0
14	65	65/807	2, 0, 1, 0
16	2	2/807	2, 0
6	62	62/807	0, 2, 2, 5
14	65	65/807	1, 0, 0, 3
19	62	62/807	4, 1, 0, 0
21	61	61/807	2, 2, 3, 1
11	41	41/807	2, 5, 12, 3

The results are given in the table above. Note that academic unit 14 appears three times in the sample; each time it appears, a different subsample was collected. Find the estimated total number of publications, along with its standard error.

Problem 9.3

A manufacturing plant has a total of 800 employees in 20 operational units. The operational units range in size (M_i) from 2 to 80. Suppose the Lahiri's method was used to choose 6 operational units with probabilities proportional to size and with replacement, and took an SRS of four (or fewer, if $M_i < 4$) members from each operational unit. For each selected employee, the number of days of sick leave (y_{ij}) in the past year was recorded. The results are given in the table below. Note that operational unit 13 appears two times in the sample; each time it appears, a different subsample was collected.

Sampled Unit (i)	M_i	ψ_i	y_{ij}
13	65	65/800	3, 8, 5, 4
20	26	26/800	2, 2, 2, 4
9	48	48/800	10, 6, 1, 5
13	65	65/800	2, 2, 1, 7
16	4	4/800	2, 3, 5, 8
6	62	62/800	9, 2, 2, 5

a) What are the primary and secondary units in this survey?
b) Find the estimated total number of days of sick leave for the manufacturing plant, along with its standard error.