## B. Exercises

## For January 30

8. Compute the first and second order inclusion probability of the following procedure. You select units from a list. The first unit is selected with probability 1/8. If the first unit is selected the second one is not selected, but if the first unit is not selected the second one is selected with probability 1/6. The selection is then continued in the same way. If a unit is selected the next one is not but if a unit is not selected the next one is included with probability 1/6. The reason for this procedure is that it is impractical to interview to interview two units which are close to each other.

9. In order to measure the knowledge of the pupils in geography, when they leave the ninth grade a pedagogue selected 10 Swedish schools with SRS. All pupils in the ninth grade in these schools were asked to complete a simple test with 120 multiple choice questions. These questions were designed to measure how well the pupils performed according to the goals of the Swedish School board. (The result 60 % (or 72 correct questions) was considered to correspond to the grade pass).

School	А	В	С	D	Е	F	G	Н	Ι	J
# pupils (in	180	121	45	52	73	141	170	16	106	45
ninth grade)										
Average number	75	80	99	87	73	78	92	112	89	102
correct										
Proportion pass %	59	58	87	85	47	53	70	100	91	95

There are altogether 102 000 pupils in Sweden and altogether 1200 schools.

- a) Estimate how many correct answers an average Swedish pupil will get. (Help: put Y = the product of the first and second line and X = the first line)
- b) Estimate the proportion of Swedish students who will get a pass.
- c) Give the standard error of these estimates.

10. Someone has made a study of 100 supermarkets with SRS and he has asked about their turnover of dairy products, Y. The frame consists of 2300 supermarkets and it contains also the number of employees  $X_{1i}$  and the total turnover  $X_{2i}$  last year.

Data: In the frame: Total number of employees is 22 100 and the total turnover is 98 000 MSEK

In the sample:

Total sale of dairy products 320 MSEK, total number of employees last year 942, total turnover last year 3 900 MSEK. Estimated covariance matrix

	Dairy	Employees	Turnover	
	products			
Dairy products	132 000	2 700	1 250 000	
Employees	2 700	131	49 000	
Turnover	1 250 000	49 100	22 100 000	

- a) Estimate the total amount of sold dairy products using a regression estimator with only total turnover as auxiliary variable.
- b) Estimate the total amount of sold dairy products using a generalised regression estimator with both number of employees and turnover as auxiliaries
- c) Estimate the standard errors of these estimates.