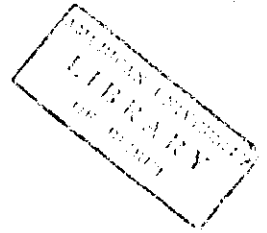




AMERICAN UNIVERSITY OF BEIRUT
Mathematics 236, Final Exam
Time = one hour
Spring 2000



(1) A factory has 100 employees, and each employee is identified with two-digit ID number. A complete list of the identification numbers is 00, 01, ..., 99. Assume there are four departments, A, B, C, and D, within the factory consisting of the following employees:

- A: 00, 01, ..., 09
- B: 10, 11, ..., 29
- C: 30, 31, ..., 59
- D: 60, 61, ..., 99

- (a) Explain how a simple random sample of 10 employees can be selected from the above population.
- (b) Explain how a stratified random sample with proportional allocation of 10 employees can be selected from the above population.
- (c) Explain how a systematic sample of size 10 can be selected.

(2) A simple random sample of n individuals has been selected from a population of size N , \bar{Y} the population average, and S^2 the population variance. Let $y_r; r = 1, \dots, n$ denote a selected individual to the sample.

- (a) What is the expected value of y_r ?
- (b) What is the covariance of y_r and y_s for $r \neq s$?

(3) While conducting survey sampling, Explain what is meant by NONRESPONSE BIAS and RESPONSE BIAS ?

(4) We wish to conduct a survey on a sensitive issue, e.g. to estimate the proportion P of individuals who have ever used narcotics. A Simple Random Sample of n individuals is chosen from a population of size N . Each is asked to answer, with respective probability α and $1 - \alpha$, either question A or question B, below without revealing which question they have answered.

Question A: Have you ever used narcotic drugs ?

Question B: Is your birthday in April ?

Of the n sampled individuals, m ($< n$) respond "Yes". Assuming that one in twelve of the population have birthdays in April, Show how you might estimate P . Discuss the effect of different choices of α , and explain any possible practical advantages of such a sampling scheme. Compare your result with the extreme (but more usual) case where $\alpha = 1$: That is to say where question B is not used.

