University of Waterloo   STAT 332 – W. H. Cherry

Tutorial 2

T2 – 1. A (study) population has $N = 6$ elements with the following values for a quantitative response variate ($\mathbf{Y}$):

   9, 1, 5,   15, 19, 7.

   (a) List all the possible samples of size 2 under equiprobable selecting (EPS).

   (b) Tabulate the value ($\overline{y}$) of the average for each sample, together with its selection probability.

   (c) Use the probability function tabulated in (b) to find the mean and standard deviation of the random variable $\overline{Y}$ representing the sample average under EPS.

   (d) Verify that the values obtained in (c) are, respectively, $\overline{\mathbf{Y}}$, the population average and $\mathbf{S}\sqrt{\frac{1}{n} - \frac{1}{N}}$, the standard deviation of the sample average under EPS, $s.d.(\overline{Y})$.

   (e) For each sample, calculate the *square* of the sample (data) standard deviation (s) defined at the right. Using the probability function tabulated in (b), verify that the mean of the random variable S^2 is $\mathbf{S}^2$.
   $$s^2 = \frac{1}{n-1}\sum_{j=1}^{n}(y_j - \overline{y})^2$$

T2 – 2. In each of the following cases, explain how you would obtain, by EPS and using the table of equiprobable digits provided with Assignment 1,

   (a) fifty school buses from the 4,000 such buses registered in a province;

   (b) one hundred points in time (designated in minutes) during working hours next week (9:00 a.m. to 5:00 p.m., Monday through Friday).

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*__**T2 – 3.**__ A (study) population consists of $N = 9$ elements with the following responses for some quantitative response variate ($\mathbf{Y}$):   9, 17, 5,   10, 8, 18,   15, 19, 7. Suppose we wish to estimate the average of this population using the average of a sample selected from it.

   (a) Find the mean and standard deviation of the sample average based on two elements obtained by EPS from the population, using the results of EPS theory.

   (b) Suppose that a sample of size two is actually obtained by EPS from the population and the elements with responses 19 and 9 are obtained. Find the sample average and compare it with the population average. Are they equal? If not, explain why this does *not* contradict the fact that the random variable representing the sample average under EPS is an *un*biased estimator of the population average.

   (c) Using the sample described in (b), estimate the square of the population (data) standard deviation. Comment briefly on the value you obtain.

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