

Fundamental Concepts of Statistics

Exercise session 6

1. Two random samples of size n are taken from two populations, and two proportions p_1 and p_2 are estimated. It is expected that both population proportions are close to 0.5. What should the sample size n be so that the standard deviation of the difference $\hat{p}_1 - \hat{p}_2$ will be less than 0.02?
2. The value of a population mean increases linearly through time:

$$\mu(t) = \alpha + \beta t,$$

while the variance remains constant. Independent samples of size n are taken at times $t = 1, 2, 3$.

- a) Find the conditions on w_1 , w_2 and w_3 such that

$$\hat{\beta} = w_1 \bar{X}_1 + w_2 \bar{X}_2 + w_3 \bar{X}_3$$

(with \bar{X}_i denoting the sample average at time i , $i = 1, 2, 3$) is an unbiased estimator of β .

- b) What values of w_1 , w_2 and w_3 minimize the variance of $\hat{\beta}$ subject to the constraint that the estimator is unbiased?

3. Is \bar{X}^2 an unbiased estimator of μ_X^2 ? If not, what is the bias?

4. The typical estimator for a population proportion p is the sample proportion $\hat{p}_1 = \frac{X}{n}$ where X is the number of successes in a random sample of size n . However, in the case when the population proportion p is small and the sample size n is small, one might easily get zero successes and an estimate

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