

# Homework 3

ESE 5420

**Problem 1.** [50pts] A particular area contains 8,000 condominium units. In a survey of the occupants with sample size 100, 12% of the respondents said they planned to sell their condos within the next year;

- (a) [15pts] Compute the 95% confidence interval for the estimated probability of people planning to sell. (Hint: The variance of the Bernoulli distribution with parameter  $p$  is given by  $p(1 - p)$ ).
- (b) [15pts] Suppose that another survey is done of another condominium project of 12,000 units. The sample size is 200, and the proportion planning to sell in this sample is 0.18. What is the standard error of this estimate? Give a 90% confidence interval for the estimate.
- (c) [0pts] Suppose we use the notation  $\hat{p}_1 = 0.12$  and  $\hat{p}_2 = 0.18$  to refer to the proportions in the two samples. Let  $\hat{d} = \hat{p}_1 - \hat{p}_2$  be an estimate of the difference,  $d$ , of the two population proportions  $p_1$  and  $p_2$ . Using the fact that  $\hat{p}_1$  and  $\hat{p}_2$  are independent random variables, calculate the variance and standard error of  $\hat{d}$ .
- (d) [0pts] Because  $\hat{p}_1$  and  $\hat{p}_2$  are approximately normally distributed, so is  $\hat{d}$ . Use this fact to construct 99%, 95%, and 90% confidence intervals for  $d$ . Is there clear evidence that  $p_1$  is really different from  $p_2$ ?

**Problem 2.** [30pts] Download data\_HW3.csv and load it into Python. The numbers are observations drawn i.i.d. from an exponential distribution with unknown parameter  $\lambda$ . Include your code in your homework write up.

- (a) [15pts] Compute estimates for the sample mean and sample variance without using inbuilt functions. Compare your answers with inbuilt numpy functions
- (b) [15pts] Suppose now that the standard deviation is known to be 4. Compute a 90% confidence interval for the population mean.(python libraries can be used to calculate the confidence interval)

**Problem 3.** [20pts] There are  $p = 25\%$  of total population that will vote for candidate A in a coming election. In a survey of sample size to be  $n = 100$ ,  $\hat{p}$  of interviewees said they would vote for A. Assume that the votes of interviewees are i.i.d.

- (a) [10pts] Find  $\delta$  such that  $P(|\hat{p} - p| \geq \delta) \approx 0.025$ .
- (b) [10pts] If, in the sample,  $\hat{p} = 0.25$ , will the 95% confidence interval for  $p$  contain the true value of  $p$ ?