

GE2262 Business Statistics
Topic 7: Inference for the Proportion Exercises

Q1

In a survey conducted for American Express, 27% of small business owners indicated that they never check in with the office when on vacation. The sample size used in the study was not disclosed.

- a) Suppose that the survey was based on 500 small business owners. Construct a 95% confidence interval estimate for the population proportion of small business owners who never check in with the office when on vacation.
- b) Suppose that the survey was based on 1,000 small business owners. Construct a 95% confidence interval estimate for the population proportion of small business owners who never check in with the office when on vacation.
- c) Discuss the effect of sample size on the confidence interval estimate.

Q2

A study of 658 CEOs conducted by the Conference Board reported that 250 stated that their company's greatest concern was sustained and steady top-line growth.

- a) Construct a 95% confidence interval for the proportion of CEOs whose greatest concern was sustained and steady top-line growth.
- b) To conduct a follow-up study to estimate the population proportion of CEOs whose greatest concern was sustained and steady top-line growth to within ± 0.01 with 95% confidence, how many CEOs would you survey?

Q3

A bank recently has conducted a survey to explore differences in banking behavior between customers with e-banking account and customer without e-banking account. Suppose the survey was based on 200 respondents who have e-banking account and 400 respondents who don't have e-banking account. The numbers of respondents who visited the bank in person last month are as follows:

Service		With e-banking account	Without e-banking account
Visited the bank in person last month	Yes	102	288
	No	98	112
Total		200	400

Suppose the management of the bank plans to conduct another survey. What sample size is needed to estimate the population proportion of customers without e-banking account that visited the bank in person last month to within ± 0.03 with 95% confidence? What sample size is needed if the information from the previous survey is not available?

Q4

The manager of Pizza Delight claims that at least 95% of its orders are delivered within 15 minutes of the time the order is placed. A random sample of 150 orders revealed that 138 were delivered within the promised time.

- a) Test the manager's claim at the 0.1 level of significance by using a four-step p-value approach to hypothesis testing.
- b) Use the p-value obtained in part (a) to set up a decision rule for testing the manager's claim at other significance levels.

Q5

One of the biggest issues facing e-retailers is the ability to reduce the proportion of customers who cancel their transactions after they have selected their products. It has been estimated that about half of prospective customers cancel their transactions after they have selected their products. Suppose that a company changed its web site so that customers could use a single-page checkout process rather than multiple pages. A sample of 500 customers who had selected their products was provided with the new checkout system. Of these 500 customers, 210 cancelled their transactions after they had selected their products.

- a) At the 0.01 level of significance, is there evidence that the population proportion of customers who select products and then cancel their transaction is less than 0.50 with the new system?
- b) Suppose that a sample of $n=100$ customers (instead of $n=500$ customers) were provided with the new checkout system and that 42 of those customers cancelled their transactions after they had selected their products. At the 0.01 level of significance, is there evidence that the population proportion of customers who select products and then cancel their transaction is less than 0.50 with the new system?
- c) Compare the results of (a) and (b) and discuss the effect that sample size has on the outcome, and, in general, in hypothesis testing.

Q6

Grant, Inc., a manufacturer of women's dress blouses, knows that its brand is carried in 19 percent of the women's clothing stores in Hong Kong. Grant recently sampled 85 women's clothing stores in mainland China and found that 14 percent of the stores carried the brand.

- a) At the 0.05 level of significance, is there evidence that Grant has poorer distribution in mainland China than it does in Hong Kong?
- b) Interpret the decision you made in (i) in the situation being examined.
- c) What is the p-value in (i)? Do you make the same decision as in (i) at $\alpha = 0.05$ if you use the p-value approach?
- d) Suppose that the sample size $n = 85$ is fixed and further suppose that the penalty of committing type II is serious, which α value (0.05 or 0.10) do you choose for the hypothesis testing? Briefly explain your choice.

Q7

- a) In order to estimate the unemployment rate of Hong Kong, a random sample of 8500 people was selected in 2002 and 618 people were found to be unemployed. Find a 95% confidence interval for the unemployment rate of Hong Kong in 2002. Give your answer to the fourth decimal place.
- b) If you want to be 95% confident of estimating the unemployment rate of Hong Kong in part (a) to within $\pm 0.2\%$, what sample size is needed?
- c) According to the report given by the Census and Statistics Department of Hong Kong, the actual unemployment rate of Hong Kong in 2002 is 7.3%. In a survey of 620 people in Shatin, 34 people were found to be unemployed. Is there evidence that the Shatin unemployment rate was lower than the Hong Kong unemployment rate at the 0.05 level of significance?

Q8

- a) Suppose there is population with 4 customers. The interested categorical variable is the proportion of customers that prefer your brand. In this population, one of them prefers your brand, and the others do not.

- (i) Find the population proportion of customers that prefer your brand.

In the process of developing sampling distribution, all possible samples (taken with replacement) of size $n = 2$ are obtained. The sample proportion of customers that prefer your brand is considered as the sample statistic.

- (ii) Develop the probability distribution of the sample proportion.
 - (iii) Show that the sample proportion is an unbiased estimator for population proportion.
 - (iv) Does the sampling distribution of sample proportion follow a Normal Distribution? Explain.
- b) Your company markets a computer medical diagnostic programme. The programme scans the results of medical test on white blood cells. The patient could be referred to a doctor if the proportion of white blood cells is at most 5%, and however the patient can leave if the proportion of white blood cells is more than 5%.

In studying the effectiveness of the programme, your null hypothesis is that the population proportion of white blood cells is at most 5%, with the alternative hypothesis being that the population proportion of white blood cells is more than 5%.

- (i) Would you rather make a type I or a type II error? Explain.
 - (ii) You want to have 90% confidence of estimating the population proportion of white blood cells to within $\pm 1.95\%$. Because you have not previously undertaken such a study, there is no information available from past data. Determine the sample size needed.

Q9

MTR Corporation has to conduct surveys regularly to evaluate its service quality. According to previous studies, 87% of the passengers refuse to take part in such surveys.

- a) At minimum, how many passengers must be sampled so that the 95% confidence interval will specify the population proportion of responded passengers to within $\pm 6\%$?

MTR recently sampled 350 passengers, and only 28 of them responded to the survey.

- b) At the 0.05 level of significance, is there evidence that the response rate has been dropped?
c) Find a 95% confidence interval for the population proportion of passengers who are willing to respond to the survey.