LESSON PLAN

Lesson: Statists and Probability - Confidence Interval and Hypothesis Testing

Timeframe: The students should take two hours to complete the following tasks:

1. Watch following videos regarding the sampling distribution, confidence interval and hypothesis testing.
   a. *https://youtu.be/YKBzyJrdl1c?list=PLTrfnl2vPj4rav2H0OCY9QTu3IzPuM5dq*
   b. *https://youtu.be/YKBzyJrdl1c?list=PLTrfnl2vPj4rav2H0OCY9QTu3IzPuM5dq*
   c. *https://youtu.be/UG4C2qhjla4?list=PLTrfnl2vPj4rav2H0OCY9QTu3IzPuM5dq*
   d. *https://youtu.be/aC94fS3HBkE?list=PLTrfnl2vPj4rav2H0OCY9QTu3IzPuM5dq*
   e. *https://youtu.be/Y1c1iFvYA1w?list=PLTrfnl2vPj4rav2H0OCY9QTu3IzPuM5dq*
   f. *https://www.youtube.com/c3068c88-cbe7-47da-a8c8-2ac69516d8f4*
   http://www.vishay.com/docs/29053/ntcappnote.pdf
2. Read gascosumption.csv data table on blackboard
3. Work homework problems on blackboard.

Equipment needed: laptop or smart phone to watch the videos

Basic:

1. Students will learn the definition of sampling distribution and central limit theorem.

2. Students will learn how to develop an interval estimator (confidence interval) for a population average.

3. Students will learn how to set-up hypothesis testing for a population average.

Advanced:

1. Students will learn how to use confidence interval and hypothesis testing for making claims that are scientifically accepted in an industrial set-up.

2. Students will earn how to collect random data and diagnose normal distribution using statistical method (Chi Squared).

Background to the Lesson

Students will have to draw conclusion upon datasets collected form experiments or observed from a phenomenon. This is the prerequisite of statistical quality control, design of experiments, reliability, and queuing theory, which the students will take after this class. Then they will become familiarize with the use and application of concepts that they have learned in this class in real-life industrial problems.

Introduction to Lesson

This lesson will be a presentation of Central Limit Theory (CLT) and its role in developing confidence interval and hypothesis testing. First, we will learn how to test a hypothesis on a population average. When testing a hypothesis, first we need to consider a hypothesized value for the population average. Then we need to take a 3-step approach to test whether we have enough statistical evidence to support the claim that we have set up. Similar to the confidence interval, we need to accept some level of error (alpha) when we test hypotheses. Test of hypothesis is a very important concept that has application in variety of fields from engineering to medical, phycology and more. Basically, each time a scientific claim is made, unless there is a solid mathematical proof, it needs to be formally tested using hypothesis testing methods. For example, if a mechanical engineer claims that his newly designed platform meet the shock absorbance requirements, or a pharmaceutical company claims that their drug reduces blood pressure, they need to collect data and statically prove their claims using statistical hypothesis testing.

Before we start the lesson, I would like you to introduce the following equations which we will be using throughout this week.

Hypothesis Testing for Mean of a population

If $n \geq 30$, and σ is known

$H_0 : \mu = \mu_0$
$H_a : \mu \neq \mu_0$
$z_0 = \dfrac{\bar{X} - \mu}{\sigma / \sqrt{n}}$

$Accept\ H_0\ if:$
$z_0 \in [-z_{\alpha/2}, z_{\alpha/2}]$

$H_0 : \mu = \mu_0 (\mu \geq \mu_0)$
$H_a : \mu < \mu_0$

$z_0 = \dfrac{\bar{X} - \mu}{\sigma / \sqrt{n}}$

$Accept\ H_0\ if:$
$z_0 \in [-z_{\alpha}, +\infty)$

$H_0 : \mu = \mu_0 (\mu \leq \mu_0)$
$H_a : \mu > \mu_0$

$z_0 = \dfrac{\bar{X} - \mu}{\sigma / \sqrt{n}}$

$Accept\ H_0\ if:$
$z_0 \in (-\infty, z_{\alpha}]$

Students will work in groups to generate/collect data, set-up a hypothesis for the population average of the dataset, and test the hypothesis using the above set of equations. To complete the assignments students can refer to the videos posted.

Procedure [Time needed, include additional steps if needed].

Table 1 shows activities that students need to complete before arriving at the class. There will be a set of homework assignment that students need to complete after watching the videos and prior to coming to the class. Students without homework assignments will lose the class

participation grade for that session. The homework will be graded by other class members and turned in to the instructor. A grading guide will be included on the quiz.

Table 1. Preclass Activities

Steps	Purpose	Estimated Time	Learning Objective
Step 1 Watch a video on sampling distribution	Students will learn what a sampling distribution is	20 minutes	Students will learn the definition of central limit theorem and sampling distribution
Step 2.	Students will learn confidence interval and hypothesis testing for one population average	30 minutes	Students will learn how to use confidence interval and hypothesis testing for testing claims statistically.
Step 3.	Students will learn one-sided confidence interval and hypothesis testing for the difference between two population averages	30 minutes	Students will learn how to use confidence interval and hypothesis testing for testing claims statistically.

Table 2. In-Class Individual Space Activities and Resources.

Steps	Purpose	Estimated Time	Learning Objectives
Step 1. Students ask question from homework	Addressing problems and difficulties that students faced as they were working through the homework assignments	30 min	Reinforcing the learning process by resolving ambiguity of the homework problems.
Step 2. Students will grade another student's homework.	Students will learn one-sided confidence interval and hypothesis testing for the difference between two population averages	10 min	Pointing out possible mistakes and learning the correct method of working through the homework assignments.

Table 4. Post-Class Individual Space Activities and Resources.

Steps	Purpose	Estimated Time	Learning Objectives
Step 1. Assign homework problems from Blackboard	Student comprehends how to solve different kinds of hypothesis testing and confidence interval.	1 hr	Reinforcing students learning outcome
Quiz in the next session	To assess the students learning outcome	20 mins	

- I used Frank's template to develop this learning module.