I. Introduction

II. Statistical and Notational Preliminaries

A. Introduction

B. Elements of Statistical Theory

1. Prerequisites:

- Random Variables
- Distributions: Population vs. Sample
- Descriptive Measures
- Estimation
- Sampling distributions.
- Inference: CIs and Hypothesis Testing.

Experiment: We repeatedly sampled from our population of used 2004 Honda Accords. What does the sampling distribution for the sample mean look like?

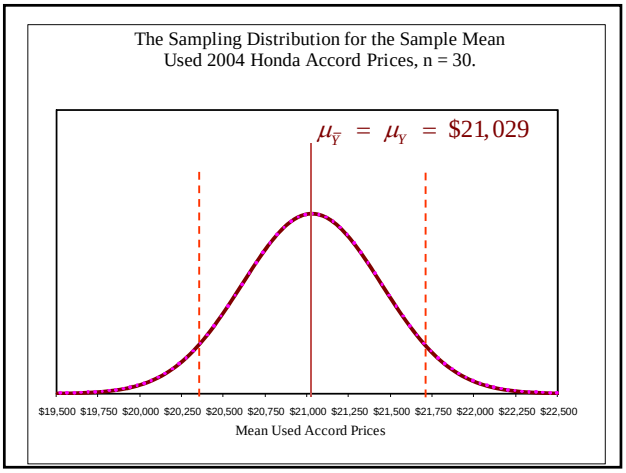
- The population distribution was not normal.
  - For samples of n=10, we can't apply our methods.
  - For samples of n=30:

1. Shape:
2. Center:
3. Variation:

Example: Sampling Distribution Probability interval.

- The Sampling Distribution (SD) tells us that in repeated sampling, 90% of our sample means will fall between these values:

$$P(\mu_Y - z_{\alpha/2} \cdot \sigma_{\bar{Y}} < \bar{Y} < \mu_Y + z_{\alpha/2} \cdot \sigma_{\bar{Y}}) = 0.90$$



❖ Inference: CIs and Hypothesis Tests

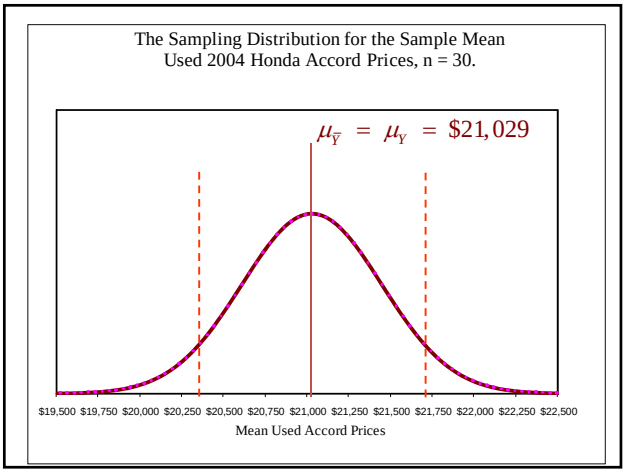
- Confidence Intervals – ***Before sampling***, you had a 90% chance of drawing a sample of size 30 that resulted in a sample mean between $20,339.19 and $21,718.73.
- So, ***before sampling***, there was a 0.90 probability that your sample would result in a 90% CI that contained the true population mean.
- This is why we say we are 90% confident that our interval contains the true population parameter value.

❖ *Inference*

♦ *CI* when σ_Y is known.

Procedure:

- Choose the level of confidence:
- Determine the correct ____ value.
- Select a sample and estimate:
- CI estimator:
- We can be $(1 - \alpha)$x100% confident that the sample we draw will result in an interval that contains the true value, μ_Y .



♦ ***CI*** when σ_Y is NOT known.

Procedure:

- Choose the level of confidence:
- Determine the correct ___ value.
- Select a sample – estimate:
- CI estimator:
- We can be $(1 - \alpha)$x100% confident that the sample we draw will result in an interval that contains the true value, μ_Y .

t-distribution:

- The ***t-distribution*** - "fatter tails" than the ***z***.
- ***More conservative –*** wider intervals given $(1-\alpha)$
- ***More uncertainty*** - we also estimated σ_Y .
- Shape depends on ***degrees of freedom***:
  df = (n – 1).
- ***Center is zero –*** standardized distribution***.***
- As ***df*** $\rightarrow \infty$, *t-distribution* converges to *z-distribution*.

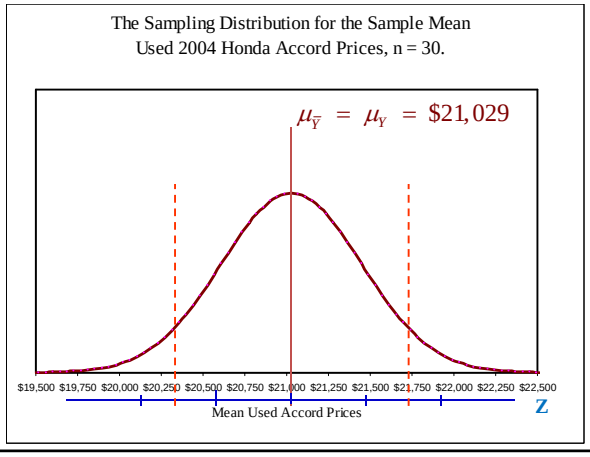
♦ *Hypothesis Testing - procedure.*

1. State the null (H_o) and alternative (H_a) hypotheses.
2. Choose the ***Level of Significance***:
3. Determine the critical values, either *Z* or *t* values. (Draw a picture of your test.)
4. Select a sample and estimate. Calculate your test statistic.
5. Compare – where does your test statistic fall?
6. Conclusion.

➢ *Hypothesis Test – Accord Prices.*

1. H_o = ; $H_a \neq$
2. Level of Significance:
3. Determine the critical values:

4. Select a sample and estimate. Calculate your test statistic.
5. Compare – where does your test statistic fall?
6. Conclusion:



PRS 4: You each have two sample means for *Used 2004 Accord Price* (n=30) drawn in lab. Complete Z-tests of the **true null hypothesis**.
Use $\alpha = 0.10$. **What are your conclusions?**

1. Fail to reject H_0 for both samples.
2. Reject H_0 for one sample, FTR for the other.
3. Reject H_0 for both samples.

➢ Hypothesis Test Decisions

- All your decisions can be organized as follows:

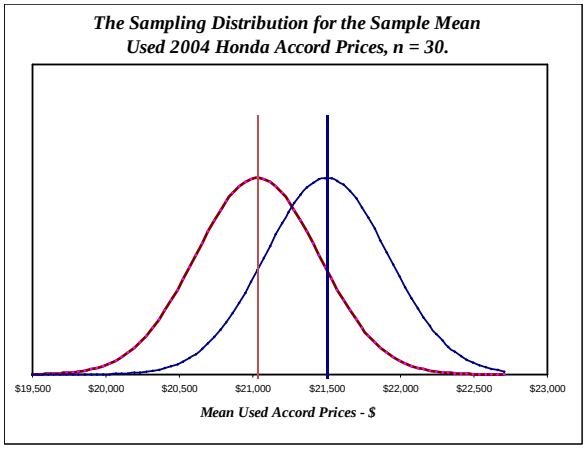
	The Null Hypothesis is:	
Your decision:	True (Right)	False
Reject H_0		
Fail to Reject H_0		

➢ Type I Error

- Given our hypothesis, prior to sampling, what was the chance you would make a Type I Error?

➢ Type II Errors

- The null hypothesis is false, but you fail to reject it.
- Illustrate. Our guess about the sampling distribution is centered in the wrong place.
- What is the probability that we make an error?



➢ Type II Error

- We've drawn the picture. Which distribution is the true sampling distribution?
- What area do you shade to illustrate the probability of a Type II Error.