Hypothesis Testing

Data Science for Quality Management: Two Sample Hypothesis Testing

with **Wendy Martin**

Learning objective:

Recall the basic assumptions and concepts related to hypothesis testing

What is a Hypothesis?

- An assumption related to a process or population.

Hypothesis Testing

- A procedure which uses sample statistic(s) to make inferences about a population.

Statistical Significance

- Refers to the assumption that the observed difference or association/phenomenon represents a significant departure from what might be expected by chance alone.

Testing Statistical Hypotheses

- Statistical hypotheses are generated in pairs, representing all possible outcomes
  - Null hypothesis
  - Alternative hypothesis

The Null Hypothesis

- Symbol: H_0
- The hypothesis that states that no difference or relationship exists.
- Examples:

$$H_0: \mu = 50 \qquad H_0: \sigma_1^2 = \sigma_2^2$$

The Alternative Research Hypothesis

- Symbol: H_1
- The hypothesis statement that represents the decision if the null hypothesis is rejected.
- Examples: $H_1: \mu \neq 50$ $H_1: \sigma_1^2 \neq \sigma_2^2$

The Directional Research Hypothesis

- Directional hypotheses state not only that the null hypothesis is not true, but that there is a specific direction involved

$$H_1: \mu > 50$$

The Directional Research Hypothesis

- Therefore, the appropriate H_0 / H_1

$$H_0: \mu \leq 50$$

$$H_1: \mu > 50$$

Observations and Cautions

- We either accept or reject H_0; we have never proven that a difference exists
- In essence, we have found that we do, or do not, have sufficient statistical evidence to accept or reject a hypothesis, respectively

Observations and Cautions

- Development of the hypotheses takes place prior to the collection of the data

Observations and Cautions

- An alternative hypothesis will lead to a two-tailed hypothesis test
- A directional hypothesis leads to a one-tailed hypothesis test

Sources

- Luftig, J. An Introduction to Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1982