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การทดสอบสมมติฐาน


Tests of Hypotheses Based on a Single Sample

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สมมติฐาน

Hypotheses and Test Procedures

ข้อสังเกต
 ข้อสังเกต parameter เปรียบเทียบกับ ระบบเดิม/โปรแกรมเดิม
 เปรียบเทียบค่าในระบบเก่าให้ดีกว่าเดิม

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Introduction

- Parameter can be estimated from sample data either by
 - 1 ○ single number (Point Estimate) or ^{จุดเดียว} ^{ค่าเดียว} ^{ค่าประมาณ}
 - 2 ○ entire interval of plausible values (Confidence Interval) ^{ช่วงค่าที่น่าจะเป็นไปได้}
- However, objective of investigation is not to estimate parameter but to decide which of two contradictory claims about parameter is correct ^{ตัดสินในสมมติฐานที่ตรงกันข้าม (เลือก)}
- Methods for accomplishing this comprise the part of ^{สถิติเชิงอนุมาน} statistical inference called

การทดสอบสมมติฐาน (Hypothesis Testing)

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Hypotheses and Test Procedures

- **Statistical Hypothesis**, or just *hypothesis*, is a ^{ข้อสมมุติ} **claim** or ^{กล่าวอ้าง} **assertion** either about
 - value of single parameter (population characteristic or characteristic of probability distribution),
 - values of several parameters, or about the form of entire probability distribution.

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Hypotheses and Test Procedures

- One example of a hypothesis is claim $\mu = 0.75$, where μ is the true average inside diameter of a certain type of PVC pipe.



$$p = \frac{\text{จำนวนแผงวงจรเสีย}}{\text{จำนวนแผงวงจรทั้งหมด}}$$

- Another example is statement $p < 0.10$, where p is proportion of defective circuit boards among all circuit boards produced by a certain manufacturer.



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Hypotheses and Test Procedures

- In any hypothesis-testing problem, there are two contradictory hypotheses under consideration.
- One hypothesis might be
 - the claim $\mu = 0.75$ and
 - the other $\mu \neq 0.75$, or
- the two contradictory statements might be
 - $p \geq 0.10$ and
 - $p < 0.10$.



- The objective is to decide, based on sample information, which of the two hypotheses is correct.

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Hypotheses and Test Procedures

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- There is familiar analogy to this in **criminal trial**.
- **One claim** is **assertion** that **accused individual** is **innocent**.
- In the **U.S. judicial system**, this is **claim** that is **initially believed** to be **true**.
- Only in the face of **strong evidence** to **contrary** should **jury reject this claim** in favor of **alternative assertion** that **accused** is **guilty**.



- In this sense, **claim of innocence** is **avored** or **protected hypothesis**, and **burden of proof** is placed on those who **believe in the alternative claim**.

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Hypotheses and Test Procedures

- Similarly, in testing statistical hypotheses, problem will be formulated so that one of **claims** is **initially favored**.
- This **initially favored claim** will **not be rejected** in favor of **alternative claim** unless **sample evidence contradicts it** and provides **strong support** for **alternative assertion**.

① Claim เริ่มต้น ← เริ่มต้นด้วย H₀ (1)
 ② Claim ทางเลือก H_a (2)

Sample Intervention
 - เริ่มต้นด้วย H₀
 - เปลี่ยน H_a

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Hypotheses and Test Procedures

→ H_0 : _____
 H_a : _____

Definition

- **Null Hypothesis**, denoted by H_0 , is claim that is initially assumed to be **true** ("prior belief" claim).
- **Alternative Hypothesis**, denoted by H_a , is assertion that is **contradictory to H_0** .
 - Accept H_0
 - reject H_0 → H_a
- Null hypothesis will be rejected in favor of the alternative hypothesis only if sample evidence suggests that **H_0 is false**.
- If **sample** does not strongly contradict H_0 , we will continue to believe in plausibility of null hypothesis.
- **Two possible conclusions** from hypothesis-testing analysis are then **reject H_0** or **fail to reject H_0** .

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Hypotheses and Test Procedures

- **Test of hypotheses** is method for using sample data to decide whether **null hypothesis** should be rejected.
- Thus we might test
 $H_0: \mu = 0.75$ against the alternative
 $H_a: \mu \neq 0.75$.
 $\mu = 0.80$
- Only if sample data strongly suggests that μ is something other than 0.75 should null hypothesis be rejected.
- In absence of such evidence, H_0 should not be rejected, since it is still quite plausible.



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Hypotheses and Test Procedures

- Sometimes investigator does not want to accept particular assertion unless and until data can provide strong support for assertion.
- As an example, suppose company is considering putting new type of coating on bearings that it produces.
 

$\mu = 1000 = H_0$
 $\mu > 1000 \rightarrow$ ดีกว่า
- True average wear life with current coating is known to be 1000 hours.
- With μ denoting true average life for new coating, $H_a: \mu > 1000$ company would not want to make a change unless evidence strongly suggested that μ exceeds 1000.

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Hypotheses and Test Procedures

- Appropriate problem formulation would involve testing

$H_0: \mu = 1000$ against $H_a: \mu > 1000$.
 Accept \rightarrow H_0
 reject \rightarrow H_a
- Conclusion that change is justified is identified with H_a and it would take conclusive evidence to justify rejecting H_0 and switching to the new coating.

H_0 ไม่คุ้ม H_a คุ้ม
 H_0 [ไม่คุ้มค่าที่จะ] [ทำ] \rightarrow ดีกว่าหรือไม่? H_a
- Scientific research often involves trying to decide whether current theory should be replaced by more plausible and satisfactory explanation of phenomenon under investigation.

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Hypotheses and Test Procedures

- Conservative approach is to identify current theory with H_0 and researcher's alternative explanation with H_a .
- Rejection of ^{H_0} current theory will then occur only when evidence is much more consistent with new theory.
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- In many situations, H_a is referred to as “researcher’s hypothesis,” since it is claim that the researcher would really like to validate.

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Hypotheses and Test Procedures

- The word **null** means “^{မှန်ကန်မှုမရှိခြင်း}of no value, effect, or consequence,” which suggests that H_0 should be identified with the hypothesis of no change (from current opinion), no difference, no improvement, and so on.



- Suppose, for example, that 10% of all circuit boards produced by a certain manufacturer during a recent period were defective.
- Engineer has suggested a change in the production process in the belief that it will result in reduced defective rate.

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Hypotheses and Test Procedures

- Let p denote true proportion of defective boards resulting from changed process. $H_0: p = 0.10$
- Then research hypothesis, on which burden of proof is placed, is assertion that $p < 0.10$.
- Thus alternative hypothesis is $H_a: p < 0.10$.
- In our treatment of hypothesis testing, H_0 will generally be stated as equality claim. μ, p, σ, σ^2 พารามิเตอร์ที่เราสนใจทดสอบ
- If θ denotes parameter of interest, the null hypothesis will have the form $H_0: \theta = \theta_0$ null value
where θ_0 is specified number called null value of parameter (value claimed for θ by null hypothesis).

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Hypotheses and Test Procedures



- As example, consider circuit board situation just discussed.
- Suggested alternative hypothesis was $H_a: p < 0.10$, claim that defective rate is reduced by process modification.
การที่ สัดส่วนของแผงวงจรบกพร่อง / ทำผิดพลาดนั้น
- Natural choice of H_0 in this situation is claim that $p \geq 0.10$, according to which new process is either no better or worse than one currently used.
- We will instead consider $H_0: p = 0.10$ versus $H_a: p < 0.10$.
 10% ' (circled)

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Hypotheses and Test Procedures

- Rationale for using this simplified null hypothesis is that any reasonable decision procedure for deciding between

$$H_0: p = 0.10 \text{ and } H_a: p < 0.10$$

will also be reasonable for deciding between the claim that $p \geq 0.10$ and H_a .

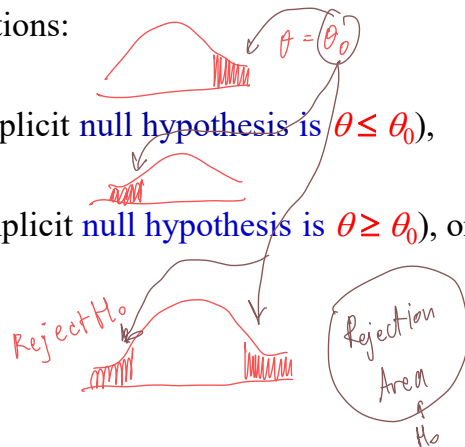
- The use of simplified H_0 is preferred because it has certain technical benefits, which will be apparent shortly.

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Hypotheses and Test Procedures

- Alternative to null hypothesis $H_0: \theta = \theta_0$ will look like one of following three assertions:

1. $H_a: \theta > \theta_0$ (in which case implicit null hypothesis is $\theta \leq \theta_0$),
2. $H_a: \theta < \theta_0$ (in which case implicit null hypothesis is $\theta \geq \theta_0$), or
3. $H_a: \theta \neq \theta_0$



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Hypotheses and Test Procedures



- For example, let σ denote standard deviation of distribution of inside diameters (inches) for certain type of metal sleeve.
- If decision was made to use sleeve unless sample evidence conclusively demonstrated that $\sigma > 0.001$, the appropriate hypotheses would be

$$H_0: \sigma = 0.001. \text{ versus } H_a: \sigma > 0.001.$$

- The number θ_0 that appears in both H_0 and H_a (separates the alternative from the null) is called the **null value**.

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Test Procedures

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