





Material Subject: Central Limit Theorem

Undergraduate of Telecommunication Engineering

MUH1E3 - PROBABILITY AND STATISTICS

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TABLE OF CONTENTS:

- 1. Total Sample Distribution
- 2. Mean Sample Distribution

LEARNING OBJECTIVES:

After careful study of this chapter, student should be able to do the following:

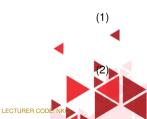
- 1. Understand the central limit theorem
- 2. Explain the important role of the normal distribution as a sampling distribution
- 3. Explain the general concepts of estimating the parameters of a population or a probability distribution



- The constellation of **n** random variables derived from the parent random variables **X**, that is: **X**₁, **X**₂, **X**₃, ..., **X**_n which is *Independent Identically Distributed* (IID) called *Random Sample*.
- The probability distribution of *Random Sample* called *Sampling Distribution*.
- Sampling Distribution of population / parent distributed Normal random variables
- Sampling Distribution of population / parent distributed Normal random variables, used CENTRAL LIMIT THEOREM.
- Sampling Distribution divided into Sampling Total dan Sampling Mean

$$T = \sum_{i=1}^{n} X_{i}$$

$$\overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_{i}$$







If random sample X_1 , X_2 , ..., X_n taken from the **NORMAL** distribution with $Mean = \mu$ dan $Variance = Var(x) = \sigma^2$, then:

1. Parent random variable

$$X \rightarrow NOR(\mu, \sigma^2)$$

- 2. Random variable of sample distribution is:
 - Sample Total

$$T \to NOR(n\mu, n\sigma^2)$$
 (3)

Sample Mean

$$\overline{\mathtt{X}} o \mathtt{NOR}(\mu, rac{\sigma^{\mathtt{2}}}{\mathtt{n}})$$







If random sample $X_1, X_2, ..., X_n$ taken from the **NON-NORMAL** distribution with $Mean = \mu$ dan $Variance = Var(x) = \sigma^2$, then:

- 1. Random variable of sample distribution is:
 - Sample Total

$$T \rightarrow NOR(n\mu, n\sigma^2)$$
 (5)

Sample Mean

$$\overline{\mathbf{X}} \to \mathsf{NOR}(\mu, \frac{\sigma^2}{\mathbf{n}})$$
 (6)







Example: From an airline's log-book data, data is obtained that baggage weight per passenger is known to have normal distribution with an average of 18 kg and a variance of 4 kg.

- a. Of the 25 baggage being queued for weighing, determine the probability that the AVERAGE luggage weight will be less than 17 kg
- b. Out of a total of 400 passenger baggage, determine the probability that the **TOTAL** weight will exceed 7150 kg

Answer: Parent random variables are Normal with an average of 18 kg and Variance of 4 kg:

$$extit{X}
ightarrow extit{NOR}\left(\mu, \sigma^{ extit{2}}
ight)$$

$$X \rightarrow NOR(18,4)$$







a. Of the 25 baggage being queued for weighing, determine the probability that the **AVERAGE** luggage weight will be less than 17 kg

The sampling distribution become:

$$\overline{X}
ightarrow extit{NOR}(\mu, rac{\sigma^2}{n})$$
 $\overline{X}
ightarrow extit{NOR}(18, rac{4}{25})$
 $P(\overline{X} < 17) = P\left(\overline{X} < rac{17 - 18}{\sqrt{rac{4}{25}}}\right) = P(Z < -2.5)$
 $\phi(-2.5) = 0.00621$





b. Out of a total of 400 passenger baggage, determine the probability that the **TOTAL** weight will exceed 7150 kg ...

Distribution Total Become:

$$T o NOR(n\mu, n\sigma^2)$$
 $T o NOR((400 \cdot 18), (400 \cdot 4))$
 $T o NOR(7200, 1600)$
 $P(T > 7150) = 1 - P(T \le 7150) = 1 - P\left(Z \le \frac{7150 - 7200}{\sqrt{1600}}\right)$
 $1 - P(Z \le -1.25) = 1 - \phi(-1.25) = \phi(1.25) = 0.89435$





Thank You

