CHAPTER 4

RESEARCH METHODOLOGY
ระเบียบวิธีวิจัย

Episode 4.4 Inferential Statistics

มหาวิทยาลัยราชภัฏนครปฐม
Nakhon Pathom Rajabhat University

WANPEN WAELVEERAKUP, Asst. Prof. Dr.
Email : wanpenw@webmail.npru.ac.th

Inferential Statistics

➢ Inferential statistics is a statistical method used to infer the results of the sample (statistic) to the population (parameter).

➢ It is a process of inductive reasoning based on the mathematic theory of probability.

There are two main uses of inferential statistics:

   1) making estimates about populations, and

   2) testing hypotheses to draw conclusions about populations.

(Frederick, Faltin, Kenett &Ruggeri, 2012; Academy, 2023)

What is a research (or scientific) hypothesis?

✓ A research hypothesis (also called a scientific hypothesis) is a statement about the expected outcome of a study.

Research Hypothesis

Null hypothesis

Alternative hypothesis

H_0 is a negative statement.
Ex. $\mu_1 = \mu_2$

H_1 or Ha is an opposite statement
Ex. $\mu_1 \neq \mu_2$

$\mu_1 < \mu_2$ or $\mu_1 > \mu_2$

(Frederick, Faltin, Kenett &Ruggeri, 2012; Academy, 2023)

Hypothesis Testing

Hypothesis

Ho: there is no difference in the health literacy score of people with hypertension between male and female adults in Thailand.

Ex. $\mu_1 = \mu_2$

H$_1$: there are differences in the health literacy score of people with hypertension between male and female adults in Thailand.

Ex. $\mu_1 \neq \mu_2$

A type II error (false-negative) occurs if the investigator fails to reject a null hypothesis that is actually false in the population.

A type I error (false-positive) occurs if an investigator rejects a null hypothesis that is actually true in the population.
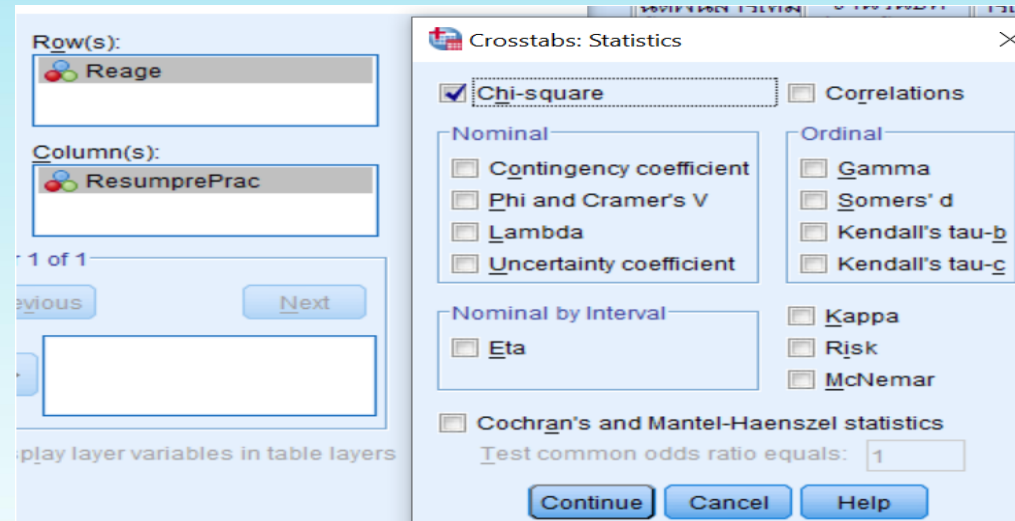
(Frederick, Faltin, Kenett &Ruggeri, 2012; Academy, 2023)

Chi-square test or χ2

Chi-square test or χ2

➢ A chi-squared test or Pearson's chi-square (also chi-square or χ2 test)

Chi-square test or χ2

➢ Pearson's chi-square test is used to determine whether the data are significantly different from what the expected.

➢ There are three types of Pearson's chi-square tests:
1. การทดสอบภาวะสารูปสนิทดี (Goodness of Fit)
2. การทดสอบความเป็นเอกภาพ (Homogeneity)
3. การทดสอบความสัมพันธ์เกี่ยวข้อง หรือความเป็นอิสระ (Association or Independence)

(Frederick, Faltin, Kenett &Ruggeri, 2012)

Pearson's chi-square assumption

A Pearson's chi-square test may be an appropriate option for data if all of the following are true:

➢ Researchers want to test a hypothesis about one or more categorical variables (กลุ่ม/หมวดหมู่).

➢ If one or more of your variables is quantitative, should convert the quantitative variable into a categorical variable by separating the observations into intervals.

➢ The sample was randomly selected from the population.

➢ There are a minimum of five observations expected in each group or combination of groups.

(Frederick, Faltin, Kenett &Ruggeri, 2012)

Chi-square test of independence

➢ Researchers use a chi-square test of independence when they have two categorical variables.

➢ It tests whether the two variables are related to each other, If two variables are independent (unrelated), the probability of belonging to a certain group of one variable isn't affected by the other variable. (ตัวแปรไม่มีผลต่อกัน)

Example: Chi-square test of independence
Null hypothesis (H_0): The proportion of people who are good at controlling blood pressure is the same for Thailand and Taiwan.
Alternative hypothesis (H_A): The proportion of people who are good at controlling blood pressure differs between nationalities.

How to interpret chi-square results?

- If the printout chi-square calculated value is greater than the chi-square critical value, then the researcher rejects their null hypothesis.

- If the printout chi-square calculated value is less than the chi-square critical value, then the researcher "fails to reject" their null hypothesis.

(Frederick, Faltin, Kenett &Ruggeri, 2012)

H_0: X1 = X2

The two variables are dependent on each other.

H_1. $X_1 \neq X_2$

The two variables are **independent** of each other.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.394ᵃ	2	.111
Likelihood Ratio	4.298	2	.117
Linear-by-Linear Association	1.494	1	.222
N of Valid Cases	187		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.14.

"Pearson Chi-Square" in this example, the value of the chi-square statistic is **4.394.**

➢ The p-value **(.111)** appears in the same row in the "Asymptotic Significance (2-sided)" column. The result is significant if this value is equal to or less than the designated alpha level (normally .05).

➢ In this case, the p-value is greater than the standard alpha value, so we'd reject the alternative hypothesis that asserts the two variables are independent of each other. (then the two variables are associated with each other ตัวแปรสองตัวมีความสัมพันธ์กัน)

How to Report a Chi-square Test

Report statistics in APA Style

- Chi-square using its Greek symbol, χ^2.
- Greek symbols should not be italicized. (ไม่เอน)

- If your chi-square is less than zero, the researcher should include a leading zero (a zero before the decimal point) since the chi-square can be greater than zero.
- Provide two significant digits after the decimal point.
- Report the chi-square alongside its degrees of freedom, sample size, and, p-value, following this format:

χ^2 (degrees of freedom, N = sample size) = chi-square value, p = p-value)

χ^2 (2, *N* = 187) = 4.39, *p* = .11

Thank you

Email:
wanpenw@webmail.npru.ac.th