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ภาคผนวก

ก. วิธีวิเคราะห์ทางสถิติ

1. ค่ากลางเลขคณิต (mean value, \bar{X})

$$\bar{X} = \frac{X_1 + X_2 + \dots + X_n}{n} \dots\dots\dots(1)$$

เมื่อ n คือจำนวนตัวอย่าง

X_n คือตัวข้อมูลที่ผันแปร

2. ความเบี่ยงเบนมาตรฐานของตัวอย่าง (sample standard deviation, S)

$$S = \sqrt{\frac{(X_i - \bar{X})^2}{n - 1}} \dots\dots\dots(2)$$

3. ความสัมพันธ์ระหว่างข้อมูล 2 สิ่ง

3.1 ความสัมพันธ์ของข้อมูลแบบเส้นตรง (linear regression) มีสมการทั่วไป คือ

$$Y = a + bX \dots\dots\dots(3)$$

เมื่อ Y คือสัดส่วนที่แปรผันกับ X

a คือ interception ของ Y

b คือ regression coefficient หรือ slope

และ X คือข้อมูลที่ผันแปร

การหาค่า a และ b หาได้จากสมการความสัมพันธ์ดังนี้

$$b = \frac{\sum xy}{\sum x^2} \dots \dots \dots (4)$$

$$\sum xy = \sum XY - \frac{1}{n} \sum X \sum Y$$

$$\sum x^2 = \sum X^2 - \frac{1}{n} (\sum X)^2$$

$$\text{และ } \sum y^2 = \sum Y^2 - \frac{1}{n} (\sum Y)^2$$

$$a = \bar{Y} - b\bar{X} \dots \dots \dots (5)$$

เมื่อ \bar{Y} และ \bar{X} คือค่าตัวกลางเลขคณิตของ Y และ X ตามลำดับ

3.2 การหาค่าสำคัญของสมการเส้นตรง

3.2.1 linear correlation coefficient (r)

มีสมการทั่วไปคือ

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}} \dots \dots \dots (6)$$

3.2.2 t-test ซึ่งหาได้ดังนี้คือ

$$\begin{aligned} \sum d_{y.x}^2 &= \text{sum of square of deviation} \\ &= \sum y^2 - \frac{(\sum xy)^2}{\sum x^2} \end{aligned}$$

$$S_{y.x}^2 = \text{mean square deviation from regression}$$

$$= \sum d_{y.x}^2 / n - 2$$

$S_{y.x}$ = sample standard deviation
from regression

$$= \sqrt{S_{y.x}^2}$$

S_b = sample standard deviation
from regression coefficient

$$= \frac{S_{y.x}}{\sqrt{\sum x^2}}$$

และ $t = b/S_b$; d.f. = $n - 2$

4. การวิเคราะห์หาค่ายเวเรียน (Analysis of variance)

ใช้สำหรับวิเคราะห์หาความแตกต่างและนัยสำคัญของเปอร์เซ็นต์รอกของลูกกับชนิดของอาหาร วิธีการวิเคราะห์หาค่ายเวเรียน สรุปได้ดังตัวอย่างดังนี้

Treatment (i)	observation (j)	X_i	\bar{X}_i
A_1	$X_{11} \quad X_{12} \quad X_{13} \quad X_{14} \quad X_{15} \quad X_{16}$	X_1	\bar{X}_1
A_2	$X_{21} \quad X_{22} \quad X_{23} \quad X_{24} \quad X_{25} \quad X_{26}$	X_2	\bar{X}_2
A_3	$X_{31} \quad X_{32} \quad X_{33} \quad X_{34} \quad X_{35} \quad X_{36}$	X_3	\bar{X}_3

วิธีคำนวณ

ถ้า X_i คือผลรวมของแต่ละ treatment

\bar{X}_i คือค่ากลางเลขคณิตของแต่ละ treatment

X_{ij} คือค่าสังเกตที่ j ใน treatment ที่ i

$i = 1, 2, \dots, t; j = 1, 2, \dots, r$

t คือจำนวน treatment

r คือจำนวนที่ซ้ำในแต่ละ treatment

การคำนวณ

1. $S_T =$ Total SS.

$$= \sum_i^t \sum_j^r (X_{ij} - \bar{X}_{ij})^2$$

2. $S_B =$ Between group or treatment SS.

$$= \sum_i^t \sum_j^r (X_i - \bar{X}_{ij})^2$$

3. $S_E =$ Within group or error SS.

$$= \sum_i^t \sum_j^r (X_{ij} - \bar{X}_i)^2$$

4. $S_T = S_B + S_E$

5. $S_T /$ = mean square of total

$$= \frac{i}{rt - 1} S_T$$

$$6. \quad S_B' = \text{mean square of treatment}$$

$$= \frac{1}{rt - 1} S_B$$

$$7. \quad S_E' = \text{mean square of error}$$

$$= \frac{1}{t(r-1)} S_E$$

ผลการวิเคราะห์เวเรียน สรุปได้ดังตารางภาคผนวกที่ 1

ตารางภาคผนวกที่ 1 การวิเคราะห์เวเรียน สำหรับข้อมูลจำแนกทางเดียวที่มีจำนวนเท่ากัน

Source of variation	d.f.	Sum of Square	Mean of Square	Obtained F ratio
Between	t-1	S_B	$S_B/(t-1) = S_B$	$F = \frac{S_B}{S_E}$
Within	t(r-1)	S_E	$S_E/t(r-1) = S_E$	d.f. = t-1, t(r-1)
Total	rt-1	S_T	$S_T/(rt-1) = S_T$	

5. การวิเคราะห์ทางโคเวเรียน (Analysis of covariance)

เป็นวิธีทางสถิติที่ขยายมาจากวิธีการวิเคราะห์เวเรียน และ

เกี่ยวข้องกับข้อมูลตัวแปรอย่างน้อย 2 ตัว และในการศึกษาครั้งนี้ข้อมูลตัวแปรทั้ง 2 ตัว คือ ขั้นตอนการเจริญ (Development) และระยะเวลา ซึ่งมีค่าผันแปรไปตามชนิดของอาหารที่เลี้ยง

วิธีการคำนวณเกี่ยวกับโคเวเรียน อาจสรุปได้ดังตารางภาคผนวกที่ 2

ตารางภาคผนวกที่ 2 การวิเคราะห์ทางโคเวเรียนซ์เพื่อเปรียบเทียบการเปลี่ยนแปลงขั้นตอนการเจริญ

Source of variation (treatment)	d.f.	$\sum x^2$	$\sum xy$	$\sum y^2$	b	Deviation from Regression		
						d.f.	SS	MS
1	a-1				b_1	a-2	SS_1	$SS_1/a-2$
2	b-1				b_2	b-2	SS_2	$SS_2/b-2$
⋮					⋮	⋮	⋮	⋮
⋮					⋮	⋮	⋮	⋮
10	j-1				b_{10}	j-2	SS_{10}	$SS_{10}/j-2$
						n-10	$\sum SS$	$\sum SS/n-20$
pooled	n-10	$\sum \sum x^2$	$\sum \sum xy$	$\sum \sum y^2$	b_p	n-11	SS_p	$SS_p/n-11$
difference between slopes						9	$SS_p - \sum SS$	$(SS_p - \sum SS)/9$

Comparison of slopes $F = \frac{(SS_p - \sum SS)/9}{\sum SS/n-29}$
 (d.f. = 9, n-20)

เมื่อ a', b', \dots, j' เป็นจำนวนตัวอย่างของแต่ละ treatment

$n = a' + b' + \dots + j'$

SS = Sum of square of deviation

$= \sum y^2 - \frac{(\sum xy)^2}{\sum x^2}$

MS = mean square of deviation

$= SS/d.f.$

ประวัติเขียน

นางเพ็ญศิริ ปิยะธีรธิตินกุล สำเร็จการศึกษาวิตยาศาสตรบัณฑิต
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กระทรวงเกษตรและสหกรณ์

