THEORY OF ATTRIBUTES

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NOTATION AND TERMINOLOGY

For the sake of simplicity and convenience it is imperative to use certain symbols to represent different classes and their frequencies It is customary to use capital letters A and B to represent the presence of attributes and α and β to represent absence of attributes .

Thus 'α' = not A and 'β' = not B .

For example if A represents males then α would represent females . Similarly if B represents literates then β would represent illiterates .

Lets looks at the combination

(AB) : number of literate males

(Aβ) : number of illiterate males

(αB) : number of literate females

(αβ) : number of illiterate females

CONTINGENCY TABLE FOR TWO ATTRIBUTES

	B	β	TOTAL
A	(AB)	(Aβ)	(A)
α	(αB)	(αβ)	(α)
TOTAL	(B)	(β)	N

$(A) + (\alpha) = N$ | $(AB) + (A\beta) = (A)$ | $(AB) + (\alpha B) = (B)$

$(B) + (\beta) = N$ | $(\alpha B) + (\alpha\beta) = (\alpha)$ | $(A\beta) + (\alpha\beta) = (\beta)$

INDEPENDENT ATTRIBUTES

Let us consider two above attributes . We may be interested in finding out if these two attributes are related to each other or independent of each other

we can say that the two attributes are independent if

Proportion of male literates = proportion of female literates

$$\frac{(AB)}{(A)} = \frac{(\alpha B)}{(\alpha)}$$

NOTE – 1

We know that $\frac{a}{b} = \frac{c}{d} = \frac{a+c}{b+d}$

Therefore

$$\frac{(AB)}{(A)} = \frac{(\alpha B)}{(\alpha)} = \frac{(AB)+(\alpha B)}{(A)+(\alpha)} = \frac{(B)}{N}$$

$$\therefore \frac{(AB)}{(A)} = \frac{(B)}{N}$$

	B	β	TOTAL
A	(AB)	(Aβ)	(A)
α	(αB)	(αβ)	(α)
TOTAL	(B)	(β)	N

$$\therefore (AB) = \frac{(A) \times (B)}{N}$$

then attributes A and B are independent

NOTE – 2

Lets consider again ; $\frac{(AB)}{(A)} = \frac{(\alpha B)}{(\alpha)}$

$$\frac{(AB)}{(AB)+(A\beta)} = \frac{(\alpha B)}{(\alpha B)+(\alpha\beta)}$$

$$(AB)(\alpha B) + (AB)(\alpha\beta) = (AB)(\alpha B) + (A\beta)(\alpha B)$$

$$\therefore (AB)(\alpha\beta) = (A\beta)(\alpha B)$$

then attributes A and B are independent

POSITIVE AND NEGATIVE ASSOCIATION BETWEEN ATTRIBUTES

Two attributes are associated to each other if the two attributes are not independent . In such a case we say there is an association of two attributes

- If the actual frequency of the class AB is more than the computed frequency then the two attributes are said to be positively associated

$(AB) > \frac{(A) \times (B)}{N}$ then there is positive association between attributes A and B

- If the actual frequency of the class AB is less than the computed frequency then the two attributes are said to be negatively associated

$(AB) < \frac{(A) \times (B)}{N}$ then there is negative association between attributes A and B

- $(AB) = (A)$ and $(A\beta) = 0$

  $(AB) = (B)$ and $(\alpha B) = 0$

  then attributes A and B are said to be completely associated

- $(AB) = 0$ OR $(\alpha\beta) = 0$ then attributes A and B are said to be completely dissociated

YULE'S COEFFICIENT OF ASSOCITAION

The above methods fail to give us the amount of association existing between the two attributes

From the above discussion it comes to light that when the **attributes are not associated or dissociated i.e when they are independent**

$$(AB)(\alpha\beta) = (A\beta)(\alpha B)$$

which also implies that **when there is association or dissociation between A and B**

$$(AB)(\alpha\beta) \neq (A\beta)(\alpha B)$$

Hence we conclude ;

'(AB) (αβ) – (Aβ)(αB)' measures the amount of association

Yule's coefficient of association quantifies the association between the two attributes and is given by

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

Q SET 1 - EXAMINE TYPE OF ASSOCIATION

EXAMINE FOR ATTRIBUTES A AND B ARE INDEPNDENT / POSITIVELY ASSOCIATED / NEGATIVELY

01. N = 100 , (A) = 60 , (B) = 50 , (AB) = 30

SOLUTION

1) $\frac{(A) \times (B)}{N} = \frac{60 \times 50}{100} = 30$

2) (AB) = 30 ..... given

3) (AB) = $\frac{(A) \times (B)}{N}$

4) attributes A and B are independent

02. N = 200 , (A) = 80 , (B) = 50 , (AB) = 25

SOLUTION

1) $\frac{(A) \times (B)}{N} = \frac{80 \times 50}{200} = 20$

2) (AB) = 25 ..... given

3) (AB) > $\frac{(A) \times (B)}{N}$

4) there is positive association between attributes A and B

03. N = 500 ; (A) = 325 ; (B) = 310 ; (AB)= 160

SOLUTION

1) $\frac{(A) \times (B)}{N} = \frac{\overset{65}{\cancel{325}} \times 310}{\underset{10}{\cancel{500}}} = 201.5$

2) (AB) = 160 ..... given

3) (AB) < $\frac{(A) \times (B)}{N}$

4) there is negative association between attributes A and B

03. N = 500 ; (A) = 225 ; (B) = 325 ; (AB)= 155

SOLUTION

1) $\frac{(A) \times (B)}{N} = \frac{\overset{45}{\cancel{225}} \times 325}{\underset{100}{\cancel{500}}} = 146.25$

2) (AB) = 155 ..... given

3) (AB) > $\frac{(A) \times (B)}{N}$

4) there is positive association between attributes A and B

05. (AB) = 128 ;(αB) = 384 ;(Aβ)=24 ;(αβ) = 72

SOLUTION

1) (AB)(αβ) = 128 x 72 = 9216

2) (Aβ)(αB) = 24 x 384 = 9216

3) (AB)(αβ) = (Aβ)(αB)

4) attributes A and B are independent

06. (AB) = 30 ;(αB) = 120 ;(Aβ)=90 ;(αβ) =360

SOLUTION

1) (AB)(αβ) = 30 x 360 = 10800

2) (Aβ)(αB) = 90 x 120 = 10800

3) (AB)(αβ) = (Aβ)(αB)

4) attributes A and B are independent

07. (AB) = 256 ; (αB) = 768 ; (Aβ) = 48 ; (αβ) =144

SOLUTION

1) (AB)(αβ) = 256 x 144 = 36864

2) (Aβ)(αB) = 768 x 48 = 36864

3) (AB)(αβ) = (Aβ)(αB)

4) attributes A and B are independent

08.

Given A & B are independent attributes , N = 24 , (A) = 16 , (B) = 6 , find the ultimate class frequencies

1) since A and B are independent

$$(AB) = \frac{(A) \times (B)}{N} = \frac{16 \times 6}{24} = 4$$

2)

	B	β	TOTAL
A	(AB) = 4	(Aβ) = 12	(A) = 16
α	(αB) = 2	(αβ) = 6	(α) = 8
TOTAL	(B) = 6	(β) = 18	N = 24

09.

Given A & B are independent attributes , N = 200, (A) = 100 , (B) = 140 , find the ultimate class frequencies

1) since A and B are independent

$$(AB) = \frac{(A) \times (B)}{N} = \frac{100 \times 140}{200} = 70$$

2)

	B	β	TOTAL
A	(AB) = 70	(Aβ) = 30	(A) = 100
α	(αB) = 70	(αβ) = 30	(α) = 100
TOTAL	(B) = 140	(β) = 60	N = 200

Q SET 2 - SUMS ON YULE'S COEFFICIENT

01. 252 candidates , 140 were boys , 72 candidates were successful , among them 40 were boys . Obtain coefficient of association and comment on result

Solution : A ≡ candidate is a boy

B ≡ candidate is successful

successful →	B	β	TOTAL
boy A	(AB) = 40	(Aβ) = 100	(A) = 140
girl α	(αB) = 32	(αβ) = 80	(α) = 112
TOTAL	(B) = 72	(β) = 180	N = 252

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(40)(80) - (100)(32)}{(40)(80) + (100)(32)}$$

$$= \frac{3200 - 3200}{3200 + 3200}$$

$$= 0$$

Comment : attributes sex and success are INDEPENDENT

02. in a institute out of 200 students 150 were boys . In an examination 120 boys and 40 girls passed . Find Yule's coefficient of association between sex and success and comment on the result

Solution : A ≡ student is a boy

B ≡ student passed the examination

passed →	B	β	TOTAL
boy A	(AB) = 120	(Aβ) = 30	(A) = 150
girl α	(αB) = 40	(αβ) = 10	(α) = 50
TOTAL	(B) = 160	(β) = 40	N = 200

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(120)(10) - (40)(30)}{(120)(10) + (40)(30)}$$

$$= \frac{1200 - 1200}{1200 + 1200}$$

$$= 0$$

Comment : attributes sex and success are INDEPENDENT

03. Out of 200 students that appeared for M.B.A examination , 80 were married . Among 60 students who failed , 24 were married . Find the coefficient of association between marriage and failure in the examination . Comment on your result

Solution : A ≡ student is married

B ≡ student failed the examination

failed →	B	β	TOTAL
married A	(AB) = 24	(Aβ) = 56	(A) = 080
α	(αB) = 36	(αβ) = 84	(α) = 120
TOTAL	(B) = 60	(β) = 140	N = 200

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(24)(84) - (56)(36)}{(24)(84) + (56)(36)}$$

$$= \frac{2016 - 2016}{2016 + 2016}$$

$$= 0$$

Comment : attributes marriage and failure are INDEPENDENT

04. 400 students , 160 were married . Among 120 students who failed , 48 were married . Find coefficient of association between attributes marriage and failure

Solution : A ≡ student is married

B ≡ student failed the examination

failed →	B	β	TOTAL
married A	(AB) = 48	(Aβ) = 112	(A) = 160
α	(αB) = 72	(αβ) = 168	(α) = 240
TOTAL	(B) = 120	(β) = 280	N = 400

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(48)(168) - (112)(72)}{(48)(168) + (112)(72)}$$

$$= \frac{8064 - 8064}{8064 + 8064}$$

$$= 0$$

Comment : attributes marriage and failure are INDEPENDENT

05. A & B represent attributes ' going for morning walk & being physically fit ' . Compute Yule's coefficient

N = 200 ; (A) = 120 ; (B) = 100 ; (AB) = 80

Solution : A ≡ going for morning walk

B ≡ physically fit

	B	β	TOTAL
A	(AB) = 80	(Aβ) = 40	(A) = 120
α	(αB) = 20	(αβ) = 60	(α) = 80
TOTAL	(B) = 100	(β) = 100	N = 200

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(80)(60) - (40)(20)}{(80)(60) + (40)(20)}$$

$$= \frac{4800 - 800}{4800 + 800}$$

$$= \frac{4000}{5600}$$

$$= 0.71$$

ROUGH WORK

LOG CALC.
3. 6021
– 3. 7482
AL 1. 8539
0. 7144

Comment : there is a good positive association between attributes Morning walk & Physical fitness

06. Calculate Yule's coefficent of association between the weight of children and their respective economic condition

	Poor children	Rich children
Below normal weight	75	23
Above normal weight	5	42

Solution : A ≡ child is below normal weight

B ≡ child is poor

	B	β	TOTAL
A	(AB) = 75	(Aβ) = 23	(A) = 98
α	(αB) = 5	(αβ) = 42	(α) = 47
TOTAL	(B) = 80	(β) = 65	N = 145

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(75)(42) - (23)(5)}{(75)(42) + (23)(5)}$$

$$= \frac{3150 - 115}{3150 + 115}$$

$$= \frac{3035}{3265} = 0.9294$$

ROUGH WORK

LOG CALC.
3. 4821
– 3. 5139
AL 1. 9682
0. 7144

Comment : high positive association between attributes ' weight of children & their respective economic condition'

07.

	Not attacked	Attacked
Inoculated	431	5
Not inoculated	291	9

Examine the effect of inoculation in controlling hepatitis

Solution : A ≡ inoculated

B ≡ not attacked by Hepatitis

	B	β	TOTAL
A	(AB) = 431	(Aβ) = 5	(A) = 436
α	(αB) = 291	(αβ) = 9	(α) = 300
TOTAL	(B) = 722	(β) = 014	N = 736

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(431)(9) - (5)(291)}{(431)(9) + (5)(291)}$$

$$= \frac{3879 - 1455}{3879 + 1455}$$

$$= \frac{2424}{5334} = 0.4544$$

ROUGH WORK

LOG CALC.
3. 3845
– 3. 7270
AL $\bar{1}$. 6575
0. 4544

Comment : there is significant positive association between inoculation and not attacked by Hepatitis . Hence we can say inoculation was effective in controlling hepatitis

08. 400 saplings were planted , 210 got flowered . Fertilizers were applied to 100 of which 85 got flowered . Discuss whether application of fertilizers is useful in flowering of plants

Solution : A ≡ sapling got flowered

B ≡ fertilizer applied to sapling

fertilizer →	B	β	TOTAL
flowered A	(AB) = 85	(Aβ) = 125	(A) = 210
α	(αB) = 15	(αβ) = 175	(α) = 190
TOTAL	(B) = 100	(β) = 300	N = 400

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(85)(175) - (125)(15)}{(85)(175) + (125)(15)}$$

$$= \frac{14875 - 1875}{14875 + 1875}$$

$$= \frac{13000}{16750} = 0.7761$$

ROUGH WORK

LOG CALC.
3. 1139
– 3. 2240
AL $\bar{1}$. 8899
0. 7761

Comment : there is a good positive association between application of fertilizers and flowering of plants . Hence we can say application of fertilizers is useful in flowering of plants

09. 250 candidates appear for exam . 75 succeeded . 44 have received special coaching and out of them 25 were successful . Using Yule's coefficient of association , discuss whether special coaching is effective or not

Solution : A ≡ candidate succeeded

B ≡ candidate received spl. coaching

coaching	B	β	TOTAL
succeeded A	(AB) = 25	(Aβ) = 50	(A) = 75
α	(αB) = 19	(αβ) = 156	(α) = 175
TOTAL	(B) = 44	(β) = 206	N = 250

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(25)(156) - (50)(19)}{(25)(156) + (50)(19)}$$

$$= \frac{3900 - 950}{3900 + 950}$$

$$= \frac{2950}{4850} = 0.6082$$

LOG CALC.
3. 4698
– 3. 6857
AL $\bar{1}$. 7841
0. 6082

Comment : there is good positive association between success and special coaching . Hence special coaching is effective

10. Find Yule's coefficient of association between literacy and unemployment from the following observation .
" total adult males 200 , literate males 40 , employed males 188 , literate employed males 36"

Solution : A ≡ male is literate

B ≡ male is unemployed

unemployed	B	β employed	TOTAL
literate A	(AB) = 4	(Aβ) = 36	(A) = 40
α	(αB) = 8	(αβ) = 152	(α) = 160
TOTAL	(B) = 12	(β) = 188	N = 200

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(4)(152) - (36)(8)}{(4)(152) + (36)(8)}$$

$$= \frac{608 - 288}{608 + 288}$$

$$= \frac{320}{896} = 0.3572$$

LOG CALC.
2. 5051
– 2. 9523
AL $\bar{1}$. 5528
0. 6082

Comment : there is significant amount of positive association between literacy and unemployment

11. Find Yule's coefficient of association between literacy and employment using the following information

Total number of adults = 1000

Total number of literates = 129

Total number of unemployed = 139

Total number of literate unemployed = 82

Interpret the result

Solution : A ≡ adult is literate

B ≡ adult is employed

	employed B	β unemployed	TOTAL
literate A	(AB) = 47	(Aβ) = 82	(A) = 129
α	(αB) = 814	(αβ) = 57	(α) = 871
TOTAL	(B) = 861	(β) = 139	N = 1000

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(47)(57) - (82)(814)}{(47)(57) + (82)(814)}$$

$$= \frac{2679 - 66748}{2679 + 66748}$$

$$= \frac{-64069}{69427}$$

$$= -0.9228$$

ROUGH WORK

LOG CALC.

4. 8067

– 4. 8416

AL 1. 9651

0. 9228

Comment : there is high degree of negative association between literacy and employment

11. Find Yule's coefficient of association between intelligence of father and daughter

intelligent father with intelligent daughters = 125

intelligent father with non intelligent daughters = 40

non intelligent father with intelligent daughters = 45

non intelligent father with non intelligent daughters = 290

Solution : A ≡ intelligent father

B ≡ intelligent daughter

	B	β	TOTAL
A	(AB) = 125	(Aβ) = 40	(A) = 165
α	(αB) = 45	(αβ) = 290	(α) = 335
TOTAL	(B) = 170	(β) = 330	N = 500

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(125)(290) - (40)(45)}{(125)(290) + (40)(45)}$$

$$= \frac{36250 - 1800}{36250 + 1800}$$

$$= \frac{34450}{38050}$$

$$= 0.9053$$

ROUGH WORK

LOG CALC.

3. 5372

– 3. 5804

AL $\bar{1}$. 9568

0. 9053

Comment : there is high degree of positive association between intelligence of father and daughters

12. 400 candidates of both sex appeared for an examination . The boys outnumbered girls by 15% of the total . The number bof candidates who passed the examination exceeded the number of candidates who failed by 240. Equal number of boys and girls failed in the examination . Prepare a 2 x 2 table and find the coefficient of association . Comment on the result

Solution : A ≡ candidate is a boy

B ≡ candidate passed the examination

The boys outnumbered girls by 15% of the total

$(A) + (\alpha) = 400$

$(A) - (\alpha) = 60$

$2(A) = 460 \quad \therefore (A) = 230$

candidates who passed the examination exceeded the number of candidates who failed by 240

$(B) + (\beta) = 400$

$(B) - (\beta) = 240$

$2(B) = 640 \quad \therefore (A) = 320$

passed →	B	β	TOTAL
Boy A	(AB) = 190	(Aβ) = 40	(A) = 230
α	(αB) = 130	(αβ) = 40	(α) = 170
TOTAL	(B) = 320	(β) = 80	N = 400

ROUGH WORK

$$Q = \frac{(AB)(\alpha\beta) - (A\beta)(\alpha B)}{(AB)(\alpha\beta) + (A\beta)(\alpha B)}$$

$$= \frac{(190)(40) - (40)(130)}{(190)(40) + (40)(130)}$$

$$= \frac{7600 - 5200}{7600 + 5200}$$

$$= \frac{2400}{12800}$$

$$= 0.1875$$

Comment : there is low degree of positive association between being a boy and passing the examination

Q SET 3 - CONSISTENCY OF DATA

01. Out of 110 students interviewed for their liking in music 48 students liked Indian music , 73 liked Western music and 20 liked both . Find the number of students who did not like music ans : 9

Solution : A ≡ student likes Indian Music

B ≡ student likes western music

Indian \ western	B	β	TOTAL
A	(AB) = 20	(Aβ) = 28	(A) = 48
α	(αB) = 53	(αβ) = 9	(α) = 62
TOTAL	(B) = 73	(β) = 37	N = 110

number of students who did not like music = (αβ)

= 9

02. in a group of 200 persons , 142 read Marathi newspaper , 108 read English newspaper and 85 read both the papers . Find the number of persons reading

i) only Marathi newspaper ii) newspaper in only one language iii) no newspaper

ans : 57 ; 80 ; 35

Solution : A ≡ person reads Marathi newspaper

B ≡ person reads English newspaper

Marathi \ English	B	β	TOTAL
A	(AB) = 85	(Aβ) = 57	(A) = 142
α	(αB) = 23	(αβ) = 35	(α) = 58
TOTAL	(B) = 108	(β) = 92	N = 200

Hence number of persons reading

1) Only Marathi newspaper = (Aβ) = 57

2) Newspaper in only one language

= (Aβ) + (αB)

= 57 + 23 = 80

3) No newspaper = (αβ) = 35

03. 500 students appeared for an examination of whom 275 were boys . Out of 350 successful students , 150 were boys . Find number of

i) successful girls ii) unsuccessful girls iii)unsuccessful boys

ans : 200 ; 25 ; 125

Solution : A ≡ student is a boy

B ≡ student successfully passed

successful	B	β	TOTAL
Boy A	(AB) = 150	(Aβ) = 125	(A) = 275
Girl α	(αB) = 200	(αβ) = 25	(α) = 225
TOTAL	(B) = 350	(β) = 150	N = 500

1) successful girls = (αB) = 200

2) unsuccessful girls = (αβ) = 25

3) unsuccessful boys = (Aβ) = 125

04. Of 598 men in a locality exposed to a particular disease , 147 in all were attacked . Of 598 men 137 were inoculated and of those only 14 were attacked . Find the number of persons not inoculated but not attacked

ans : 328

Solution : A ≡ person is attacked by a disease

B ≡ person is inoculated

inoculated	B	β	TOTAL
Attacked A	(AB) = 14	(Aβ) = 133	(A) = 147
α	(αB) = 123	(αβ) = 328	(α) = 451
TOTAL	(B) = 137	(β) = 461	N = 598

number of persons not inoculated but not attacked

= (αβ)

= 328

05. In a group of 100 employees in a firm , there were 80 males . The number of married employees was 60 among whom 30 were males . Examine whether the information is correct

Solution : A ≡ employee is a male

B ≡ employee is married

	married	B	β	TOTAL
Male	A	(AB) = 30	(Aβ) = 50	(A) = 80
	α	(αB) = 30	(αβ) = –10	(α) = 20
	TOTAL	(B) = 60	(β) = 40	N = 100

Comment : Since (αβ) < 0 , information is incorrect

06. The data below , gives the information of jobbies of a group of 100 girls in a school . 20 girls liked singing , 35 enjoyed painting and 12 girls favored both the hobbies . Are the data consistent

Solution : A ≡ girl likes singing

B ≡ girl likes painting

	painting	B	β	TOTAL
Singing	A	(AB) = 12	(Aβ) = 8	(A) = 20
	α	(αB) = 23	(αβ) = 57	(α) = 80
	TOTAL	(B) = 35	(β) = 65	N = 100

Comment : Since all frequencies are positive , data is consistent

07. In a report of consumer's preference it was given that out of 500 persons surveyed , 410 preferred variety A , 380 preferred variety B and 270 persons showed liking for both. Is there any consistency in the data

Solution : A ≡ consumer preferred variety A

B ≡ consumer preferred variety B

	B	β	TOTAL
A	(AB) = 270	(Aβ) = 140	(A) = 410
α	(αB) = 110	(αβ) = –20	(α) = 90
TOTAL	(B) = 380	(β) = 120	N = 500

Comment : Since (αβ) < 0 , information is incorrect

08. 300 students appeared for oral and written test . 180 passed both the test . 90 students failed in both the test . 60 passed in oral but failed in written . Show that the information obtained must be incorrect

Solution : A ≡ student passed in oral test

B ≡ student passed in written test

	Written	B	β	TOTAL
oral	A	(AB) = 180	(Aβ) = 60	(A) = 240
	α	(αB) = –30	(αβ) = 90	(α) = 60
	TOTAL	(B) = 150	(β) = 150	N = 300

Comment : Since (αβ) < 0 , information is incorrect

09. the data below relate to sample survey of 200 persons in a village

Number of literate employed persons = 94

Number of literate unemployed persons = 84

Number of employed persons = 128

Show that the data are inconsistent

Solution : A ≡ person is literate

B ≡ person is employed

		employed B	β	TOTAL
literate	A	(AB) = 94	(Aβ) = 84	(A) = 178
	α	(αB) = 34	(αβ) = –12	(α) = 22
TOTAL		(B) = 128	(β) = 72	N = 200

Comment : Since (αβ) < 0 , information is incorrect

Q SET 4 - THREE ATTRIBUTE TABLE

CONTINGENCY TABLE FOR THREE ATTRIBUTES

ATTRIBUTE	C	γ	TOTAL
B	(ABC)	(ABγ)	(AB)
A β	(AβC)	(A$\beta\gamma$)	(Aβ)
TOTAL	(AC)	(Aγ)	(A)
B	(αBC)	(αBγ)	(αB)
α β	($\alpha\beta$C)	($\alpha\beta\gamma$)	($\alpha\beta$)
TOTAL	(αC)	($\alpha\gamma$)	(α)
B	(BC)	(Bγ)	(B)
β	(βC)	($\beta\gamma$)	(β)
TOTAL	(C)	(γ)	(N)

01. (ABC) = 15 ; (ABγ) = 25 , (AβC) = 22 ; (αBC) = 31 ;(A$\beta\gamma$) = 8 ; (αBγ) = 12 ; ($\alpha\beta$C) = 15 ; ($\alpha\beta\gamma$) = 9

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 15	(ABγ) = 25	(AB) = 40
A β	(AβC) = 22	(A$\beta\gamma$) = 8	(Aβ) = 30
TOTAL	(AC) = 37	(Aγ) = 33	(A) = 70
B	(αBC) = 31	(αBγ) = 12	(αB) = 43
α β	($\alpha\beta$C) = 15	($\alpha\beta\gamma$) = 9	($\alpha\beta$) = 24
TOTAL	(αC) = 46	($\alpha\gamma$) = 21	(α) = 67
B	(BC) = 46	(Bγ) = 37	(B) = 83
β	(βC) = 37	($\beta\gamma$) = 17	(β) = 54
TOTAL	(C) = 83	(γ) = 54	(N) = 137

02. (ABC) = 25 ; (ABγ) = 15 , (AβC) = 18 ; (αBC) = 23 ;(A$\beta\gamma$) = 13 ; (αBγ) = 28 ; ($\alpha\beta$C) = 21 ; ($\alpha\beta\gamma$) = 30

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 25	(ABγ) = 15	(AB) = 40
A β	(AβC) = 18	(A$\beta\gamma$) = 13	(Aβ) = 31
TOTAL	(AC) = 43	(Aγ) = 28	(A) = 71
B	(αBC) = 23	(αBγ) = 28	(αB) = 51
α β	($\alpha\beta$C) = 21	($\alpha\beta\gamma$) = 30	($\alpha\beta$) = 51
TOTAL	(αC) = 44	($\alpha\gamma$) = 58	(α) = 102
B	(BC) = 48	(Bγ) = 43	(B) = 91
β	(βC) = 39	($\beta\gamma$) = 43	(β) = 82
TOTAL	(C) = 87	(γ) = 86	(N) = 173

03. (ABC) = 50 ; (ABγ) = 72 , (AβC) = 33 ; (αBC) = 22 ;(Aβγ) = 21 ; (αBγ) = 30 ; (αβC) = 10 ; (αβγ) = 16

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 50	(ABγ) = 72	(AB) = 122
A β	(AβC) = 33	(Aβγ) = 21	(Aβ) = 54
TOTAL	(AC) = 83	(Aγ) = 93	(A) = 176
B	(αBC) = 22	(αBγ) = 30	(αB) = 52
α β	(αβC) = 10	(αβγ) = 16	(αβ) = 26
TOTAL	(αC) = 32	(αγ) = 46	(α) = 78
B	(BC) = 72	(Bγ) = 102	(B) = 174
β	(βC) = 43	(βγ) = 37	(β) = 80
TOTAL	(C) = 115	(γ) = 139	(N) = 254

04. N = 800 ; (A) = 224 ; (B)= 301 ; (C) = 150 ; (AB) = 125 ; (AC) = 72 ; (BC)= 60 ; (ABC) = 32

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 32	(ABγ) = 93	(AB) = 125
A β	(AβC) = 40	(Aβγ) = 59	(Aβ) = 99
TOTAL	(AC) = 72	(Aγ) = 152	(A) = 224
B	(αBC) = 28	(αBγ) = 148	(αB) = 176
α β	(αβC) = 50	(αβγ) = 350	(αβ) = 400
TOTAL	(αC) = 78	(αγ) = 498	(α) = 576
B	(BC) = 60	(Bγ) = 241	(B) = 301
β	(βC) = 90	(βγ) = 409	(β) = 499
TOTAL	(C) = 150	(γ) = 650	(N) = 800

05.

A ≡ player plays cricket

B ≡ player plays hockey

A ≡ player plays football

240 players	N = 240
105 play cricket	(A) = 105
126 play hockey	(B) = 126
75 play foot ball	(C) = 75
24 play both cricket and hockey	(AB) = 24
30 play both cricket and football	(AC) = 30
21 play hockey and football	(BC) = 21
9 play all three games	(ABC) = 9

Find the players playing

a) only two games

b) at least two games

c) only one game

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 9	(ABγ) = 15	(AB) = 24
A β	(AβC) = 21	(Aβγ) = 60	(Aβ) = 81
TOTAL	(AC) = 30	(Aγ) = 75	(A) = 105
B	(αBC) = 12	(αBγ) = 90	(αB) = 102
α β	(αβC) = 33	(αβγ) = 0	(αβ) = 33
TOTAL	(αC) = 45	(αγ) = 90	(α) = 135
B	(BC) = 21	(Bγ) = 105	(B) = 126
β	(βC) = 54	(βγ) = 60	(β) = 114
TOTAL	(C) = 75	(γ) = 165	(N) = 240

a) players playing only two games

= (ABγ) + (AβC) + (αBC)

= 15 + 21 + 12 = 48

b) players playing at least two games

= (ABγ) + (AβC) + (αBC) + (ABC)

= 15 + 21 + 12 + 9 = 57

c) players playing only one game

= (Aβγ) + (αBγ) + (αβC)

= 60 + 90 + 33 = 183

A ≡ student failed in Marathi

B ≡ student failed in English

C ≡ student failed in Hindi

06. 800 students $N = 800$

220 failed in Marathi $(A) = 220$

300 failed in English $(B) = 300$

150 failed in Hindi $(C) = 150$

125 failed in both Marathi and English $(AB) = 125$

70 failed in both Marathi and Hindi $(AC) = 70$

60 failed in both English and Hindi $(BC) = 60$

30 failed in all three exams $(ABC) = 30$

Find number of students who failed in

a) two languages

b) only one language

c) atleast one language

ATTRIBUTE	C	γ	TOTAL
B	$(ABC) = 30$	$(AB\gamma) = 95$	$(AB) = 125$
A β	$(A\beta C) = 40$	$(A\beta\gamma) = 55$	$(A\beta) = 95$
TOTAL	$(AC) = 70$	$(A\gamma) = 150$	$(A) = 220$
B	$(\alpha BC) = 30$	$(\alpha B\gamma) = 145$	$(\alpha B) = 175$
α β	$(\alpha\beta C) = 50$	$(\alpha\beta\gamma) = 355$	$(\alpha\beta) = 405$
TOTAL	$(\alpha C) = 80$	$(\alpha\gamma) = 500$	$(\alpha) = 580$
B	$(BC) = 60$	$(B\gamma) = 240$	$(B) = 300$
β	$(\beta C) = 90$	$(\beta\gamma) = 410$	$(\beta) = 500$
TOTAL	$(C) = 150$	$(\gamma) = 650$	$(N) = 800$

a) students failing in two languages

$= (AB\gamma) + (A\beta C) + (\alpha BC)$

$= 95 + 40 + 30 = 165$

b) students failing in only one language

$= (A\beta\gamma) + (\alpha B\gamma) + (\alpha\beta C)$

$= 55 + 145 + 50 = 250$

c) students failing in at least one language

$= N - (\alpha\beta\gamma) = 800 - 355 = 445$

07. –: 170 women interviewed

–: 95 from Pune and rest from outskirts

–: amongst the married women from Pune ;

25 were experienced and 10 were inexperienced

–: from outskirts of Pune ;

the corresponding numbers were 8 & 60

–:5 women were unmarried ,inexperienced , staying in outskirts

–: inexperienced women were 120

Hence find

Number of women from Pune who were unmarried & experienced

SOLUTION

A ≡ woman is from Pune , B ≡ woman is married

C ≡ woman is experienced

N = 170

(A) = 95 , (ABC) = 25 , (ABγ) = 10 , (αBC) = 8, (αBγ) = 60 ,

(αβγ) = 5 , (γ) = 120

ATTRIBUTE	C	γ	TOTAL
B	(ABC) = 25	(ABγ) = 10	(AB) = 35
A β	(AβC) = 15	(Aβγ) = 45	(Aβ) = 60
TOTAL	(AC) = 40	(Aγ) = 55	(A) = 95
B	(αBC) = 8	(αBγ) = 60	(αB) = 68
α β	(αβC) = 2	(αβγ) = 5	(αβ) = 7
TOTAL	(αC) = 10	(αγ) = 65	(α) = 75
B	(BC) = 33	(Bγ) = 70	(B) = 103
β	(βC) = 17	(βγ) = 50	(β) = 67
TOTAL	(C) = 50	(γ) = 120	(N) = 170

Number of women from Pune who were unmarried and

experienced = (AβC) = 15

THE BELOW Q'S CAN BE SOLVED WITHOUT TABLE USING RELATIONS

08. (ABC) = 50 ; (ABγ) = 75 , (AβC) = 40 ; (αBC) = 30 ;(A$\beta\gamma$) = 20 ; (αBγ) = 30 ; ($\alpha\beta$C) = 15 ; ($\alpha\beta\gamma$) = 10

Find (B) , (AC) , ($\alpha\beta$)

SOLUTION

- ✓ (ABC) + (AβC) = (AC) ∴ (AC) = 90
- ✓ (ABC) + (ABγ) = (AB) ∴ (AB) = 125
- ✓ (αBC) + (αBγ) = (αB) ∴ (αB) = 60
- ✓ ($\alpha\beta$C) + ($\alpha\beta\gamma$) = ($\alpha\beta$) ∴ ($\alpha\beta$) = 25
- ✓ (AB) + (αB) = (B) ∴ (B) = 185

09. (ABC) = 50 ; (ABγ) = 72 , (AβC) = 33 ; (αBC) = 22 ;(A$\beta\gamma$) = 21 ; (αBγ) = 30 ; ($\alpha\beta$C) = 10 ; ($\alpha\beta\gamma$) = 16

Find (A) , (AB) , (Aβ) , (AC) & (BC)

SOLUTION

- ✓ (ABC) + (ABγ) = (AB) ∴ (AB) = 122
- ✓ (AβC) + (A$\beta\gamma$) = (Aβ) ∴ (Aβ) = 54
- ✓ (ABC) + (AβC) = (AC) ∴ (AC) = 83
- ✓ (ABC) + (αBC) = (BC) ∴ (BC) = 72
- ✓ (AB) + (Aβ) = (A) ∴ (A) = 176

10. N = 100 ; (A) = 65 ; (B)= 55 ; (C) = 45 ; (AB) = 25 ; (AC) = 20 ; (BC)= 10 ; (ABC) = 8

FIND : (ABγ) , (Aγ) , (αB) , (βC)

SOLUTION

- ✓ (ABC) + (ABγ) = (AB)

  8 + (ABγ) = 25 ∴ (ABγ) = 17
- ✓ (AC) + (Aγ) = (A)

  20 + (Aγ) = 65 ∴ (Aγ) = 45
- ✓ (AB) + (αB) = (B)

  25 + (αB) = 55 ∴ (αB) = 30
- ✓ (BC) + (βC) = (C)

  10 + (βC) = 45 ∴ (βC) = 35