#### Chi-Square Independence/Homogeneity Tests in SPSS **STAT 314**

In a retail study, the traits of salespersons that were considered most important by sales managers were listed. These sales managers were also asked what traits they considered most important in a sales manager. The results are given in the analysis below. Are the two independent? Explain. Test at the 5% significance level.

1. Enter the row values (Manager: 1=Reliability, 2=Enthusiasm, 3=Other) into one variable, the column values (Salesperson: 1= Reliability, 2=Enthusiasm, 3=Other) into another variable, and the observed counts into a third variable (see left figure, below). Then weight the category variables (Manager, Salesperson) by the observed counts variable (see two right figures, below).



2. Select Analyze  $\rightarrow$  Descriptive Statistics  $\rightarrow$  Crosstabs... (see figure, below).

Reliability

Reliability

Reliability

Enthusiasm Enthusiasm

Other Enthusiasm

4 Enthusiasm

Enthusiasm

Other

Other

Reliability

Reliability

Reliability

Other

Other

Other

Enthusiasm

1

2

3

5

6

7

8

9



3. Select "Manager" as the row variable and "Salesperson" as the column variable (*see top figure*, *below*). Click the "Statistics..." button and be sure that "Chi-square" is selected (also "Phi and Cramer's V" in performing a test of independence...not for tests of homogeneity) (*see bottom-left figure*, *below*). Click the "Cells..." button and be sure that the "Observed" and "Expected" are selected (*see bottom-right figure*, *below*). Click "Continue" to close the "Statistics..." window, and then click "OK" to perform the analysis.



Crosstabs: Statistics		
Chi-square Nominal Contingency coefficient Phi and Cramér's V Lambda Uncertainty coefficient	Correlations Crdinal Gamma Somers' d Kendall's tau-b Kendall's tau-c	Continue Cancel Help
Nominal by Interval Eta Cochran's and Mantel-Haens Test common odds ratio equ	Kappa Risk McNemar szel statistics	



4. Your output should look like this.

									Chi-Square T	ests	
			Case Proce	ssing Sumn	nary				Value	df	Asymp. Sig. (2-sided)
				С	ases			Pearson Chi-Squar	re 13.6176ª	4	.0086
		Va	lid	Mi	ssing	To	tal	Likelihood Ratio	13.300	4	.010
Manager T	'raite *	N	Percent	N	Percent	Ν	Percent	Linear-by-Linear	.048	1	.827
Salespers	on Traits	120	100.0%	0	.0%	120	100.0%	N of Valid Cases	120		
								7 III PUS I I 201			
	м	mager Tra	aits ' Salesp	erson Traits	; Crosstabulati	on		minimum exp	ected count is 7.2	15.	
	М	anager Tra	aits * Salesp	erson Traits Sa	Crosstabulati	on		minimum exp	ected count is 7.2	15.	
	м	anager Tra	aits 'Salesp	erson Traits Sa Reliability	: Crosstabulati lesperson Trai Enthusiasm	on ts Other	Total	minimum exp	ected count is 7.2 Symmetric Me	asures	
Manager Traits	M. Reliability	nnager Tra Count Expect	aits ' Salesp - ted Count	erson Traits Sa Reliability 12 18.3333	Crosstabulati Iesperson Trai Enthusiasm 18 12.5000	on ts Other 20 19.1667	Total 50 50.0000	minimum exp	symmetric Me	asures	Approx Sig
Manager Traits	Reliability Enthusiasm	nager Tra Count Expect Count	aits ' Salesp - ted Count	erson Traits Sa Reliability 12 18.3333 23	Crosstabulati lesperson Trai Enthusiasm 18 12.5000 7	on Other 20 19.1667 11	Total 50 50.0000 41	Nominal by	Symmetric Me	asures Value	Approx. Sig
Manager Traits	Reliability Enthusiasm	Count Count Expect Count Expect	aits ' Salesp - ted Count ted Count	erson Traits Sa Reliability 12 18.3333 23 15.0333	Crosstabulati lesperson Trai Enthusiasm 12.5000 7 10.2500	on Other 20 19.1667 11 15.7167	Total 50 50.0000 41 41.0000	Nominal by	Symmetric Me	asures Value .337 2382	Approx. Sig
Manager Traits	Reliability Enthusiasm Other	Count Expect Count Expect Count Expect	aits ' Salesp - led Count led Count	erson Traits Se Reliability 12 18.3333 23 15.0333 9	Crosstabulati lesperson Trai Enthusiasm 18 12.5000 7 10.2500 5	on ts Other 20 19.1667 11 15.7167 15	Total 50 50.0000 41 41.0000 29	Nominal by Norvinal Norvinal	Symmetric Me Phi Cramer's V	asures Value .337 .2382 120	Approx. Sig .008
Manager Traits	Reliability Enthusiasm Other	Count Expect Count Expect Count Expect	ed Count ted Count ted Count	erson Traits Reliability 12 18.3333 23 15.0333 9 10.6333	Crosstabulati lesperson Trai Enthusiasm 12.5000 7 10.2500 5 7.2500	on ts Other 20 19.1667 11 15.7167 15 11.1167	Total 50 50.0000 41 41.0000 29 29.0000	Nominal by Nominal N of Valid Cases	Symmetric Me Phi Cramer's V	5. asures Value .337 .2382 .120	Approx. Sig .008
Manager Traits Total	Reliability Enthusiasm Other	Count Expect Count Expect Count Expect Count Expect Count	aits ' Salesp ted Count ted Count ted Count	erson Traits Reliability 12 18.3333 23 15.0333 9 10.6333 44	Crosstabulati lesperson Trai Enthusiasm 12.5000 7 10.2500 5 5 7.2500 30	on ts Other 19.1667 11 15.7167 15 11.1167 46	Total 50 50.0000 41 41.0000 29 29.0000 120	Nominal by Nominal Dy Not Cases a. Not assuming	Symmetric Me Phi Cramer's V g the null hypothes	5. asures Value .337 .2382 120 sis.	Approx. Sig .008

5. You should use the output information in the following manner to answer the question.

Step 1:	Hypotheses
	$H_0$ : Salesperson traits and Sales Manager traits are unrelated (Independent).
	$H_a$ : Salesperson traits and Sales Manager traits are related (Dependent).
<u>Step 2</u> :	Significance Level
	$\alpha = 0.05$
<u>Step 3</u> :	Critical Value and Rejection Region
-	Reject the null hypothesis if $p$ -value $\leq 0.05$ .
<u>Step 4.1</u> :	Calculate Expected Frequencies
	Manager Traite & Salespore on Traite Crosstabulation

manager traits	Salesperson mails crosstabulation	

			Salesperson Traits			
			Reliability	Enthusiasm	Other	Total
Manager	Reliability	Count	12	18	20	50
Traits		Expected Count	18.3333	12.5000	19.1667	50.0000
	Enthusiasm	Count	23	7	11	41
		Expected Count	15.0333	10.2500	15.7167	41.0000
	Other	Count	9	5	15	29
		Expected Count	10.6333	7.2500	11.1167	29.0000
Total		Count	44	30	46	120
1		Evnected Count	44.0000	20,0000	0000.34	1 120 0000

Step 4.2:

### Check Assumptions Chi-Square Tests

-								
	Value	df	Asymp. Sig. (2-sided)					
Pearson Chi-Square	13.6176ª	4	.0086					
Likelihood Ratio	13.300	4	.010					
Linear-by-Linear Association	.048	1	.827					
N of Valid Cases	120							
a 0 cells ( 0%) have	evnected co	unt lace than	3. 0 calle ( 0%) have expected count loce than 5. The					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.25.

All expected frequencies are  $\ge 5$  (smallest value is 7.2500) [from footnote, above].

# Step 4.3: Test Statistic

 $\chi^2$  = 13.6176, *p*-value = 0.0086 [from table, above]

### Step 5: Conclusion

Since *p*-value =  $0.0086 \le 0.05$ , we reject the null hypothesis.

## Step 6: State conclusion in words

At the  $\alpha$  = 0.05 level of significance, there exists enough evidence to conclude that salesperson traits and sales manager traits are related (Dependent).

b. Since the two variables are deemed to be dependent, use Cramer's V to determine the strength of the relationship between the traits the sales managers think are important for salespersons and for sales managers?

Symmetric Measures

		Value	Approx. Sig.
Nominal by	Phi	.337	.009
Nominal	Cramer's V	.2382	.0086
N of Valid Cases		120	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Cramer's V: (V: 0 = independence & 1 = complete dependence)

Since the coefficient value (V = 0.2382) is not close to 1, the relationship is not very strong.