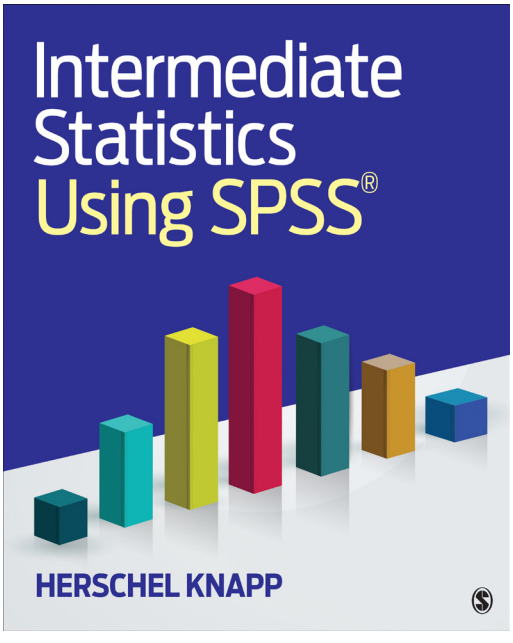
CHAPTER 10

Chi-Square

Solutions to Odd-Numbered Exercises



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EXERCISE 10.1, DATA SET A

(a)

H_0: There is no significant difference in bill-paying method in terms of age.

H_1: There is a significant difference in bill-paying method in terms of age.

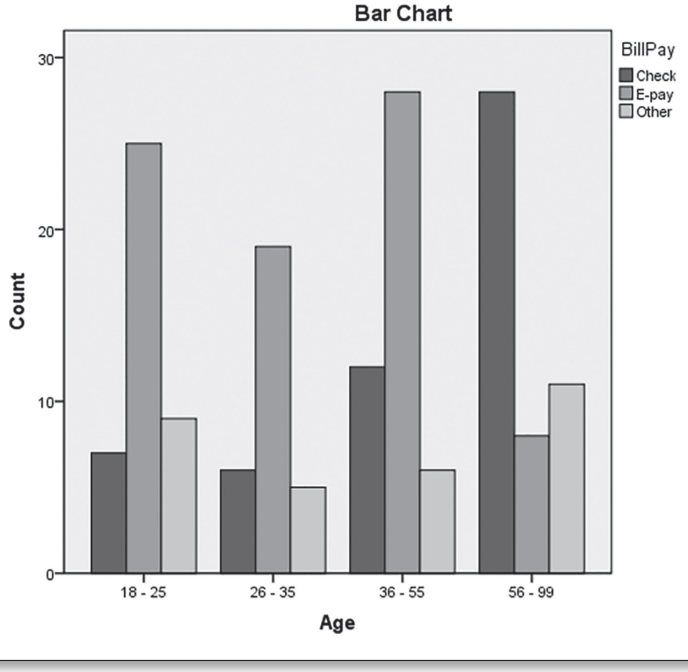
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criterion is satisfied.

Age * BillPay Crosstabulation

Count

		BillPay			
		Check	E-pay	Other	Total
Age	18 - 25	7	25	9	41
	26 - 35	6	19	5	30
	36 - 55	12	28	6	46
	56 - 99	28	8	11	47
Total		53	80	31	164



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .000, which is less than the specified .05 α level, indicating that there is a statistically significant difference among the age groups when it comes to bill-paying preference.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.983[a]	6	.000
Likelihood Ratio	32.731	6	.000
Linear-by-Linear Association	7.707	1	.006
N of Valid Cases	164		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.67.

(d)

To determine if age is associated with bill-paying method, we surveyed 164 adults. E-pay was the predominate method of payment for those between 18 - 55; specifically, 61% of 18 - 25 year olds use e-pay, as did 63% of those between 26 - 35, and 61% of 36 - 55 year olds, whereas 60% of those over 56 years old opted for paying by check. Our findings revealed a statistically significant difference in bill-paying method with respect to age ($p < .001$, $\alpha = .05$). As such, we reject H_0, and we do not reject H_1.

EXERCISE 10.1, DATA SET B

(a)

H_0: There is no significant difference in bill-paying method in terms of age.

H_1: There is a significant difference in bill-paying method in terms of age.

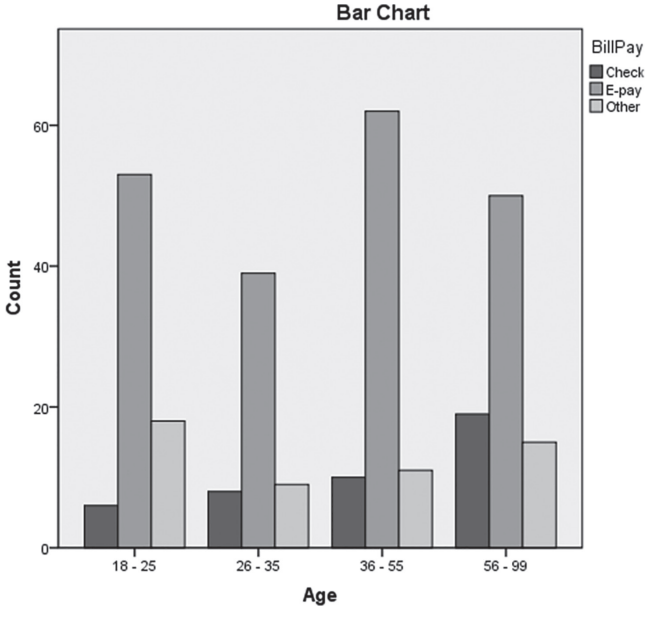
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criterion is satisfied.

Age * BillPay Crosstabulation

Count

		BillPay			
		Check	E-pay	Other	Total
Age	18 - 25	6	53	18	77
	26 - 35	8	39	9	56
	36 - 55	10	62	11	83
	56 - 99	19	50	15	84
Total		43	204	53	300



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .105, which is greater than the specified .05 α level, indicating that there is no statistically significant difference among the age groups when it comes to bill-paying preference.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.508[a]	6	.105
Likelihood Ratio	10.359	6	.110
Linear-by-Linear Association	4.866	1	.027
N of Valid Cases	300		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.03.

(d)

To determine if age is associated with bill-paying method, we surveyed 300 adults. E-pay was the predominate method of payment. Specifically, among 18 - 25 year olds, 69% opt for e-pay; among 26 - 35 year olds, 70% use e-pay; for 36 - 55 year olds, 75% use e-pay; and among those 56 and over, 60% use e-pay. Our findings revealed no statistically significant difference in bill-paying method with respect to age ($p = .105$, $\alpha = .05$). As such, we do not reject H_0, and we reject H_1.

EXERCISE 10.3, DATA SET A

(a)

H_0: The flu shot does not help prevent the flu.

H_1: The flu shot helps prevent the flu.

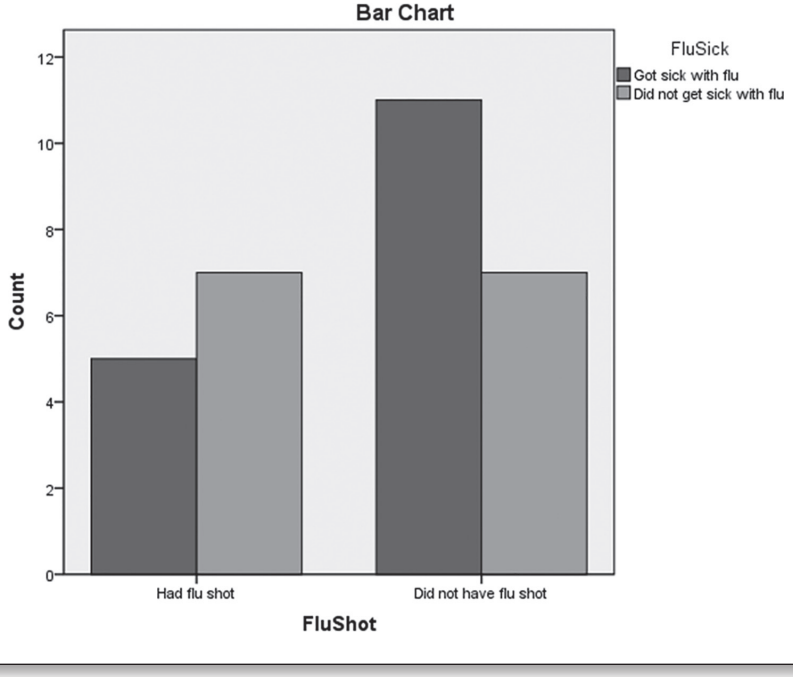
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criterion is satisfied.

FluShot * FluSick Crosstabulation

Count

		FluSick		
		Got sick with flu	Did not get sick with flu	Total
FluShot	Had flu shot	5	7	12
	Did not have flu shot	11	7	18
Total		16	14	30



(c)

The Chi-Square Tests table below shows a Sig. (p) value of .296, which is greater than the specified .05 α level, indicating that there is no statistically significant difference in flu sickness comparing those who got a flu shot to those who did not.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.094[a]	1	.296		
Continuity Correction[b]	.452	1	.501		
Likelihood Ratio	1.098	1	.295		
Fisher's Exact test				.457	.251
Linear-by-Linear Association	1.057	1	.304		
N of Valid Cases	30				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.60.
b. Computed only for a 2x2 table

(d)

To determine if there were significantly fewer cases of flu among those who had a flu shot compared to those who did not, we analyzed the health status of 30 participants. Sixty days after recruiting participants, our researcher contacted each one to find out if they had contracted the flu. We found that 12 had gotten flu shots, and 18 had not. Among those who got the flu shot, 41% reported that they had gotten sick with the flu, compare to 61% among those who did not get a flu shot. Even though there were proportionally fewer cases of flu among those who had a flu shot, chi-square analysis indicates that this difference is not statistically significant (p = .296, α = .05). As such, we do not reject H_0, and we reject H_1.

EXERCISE 10.3, DATA SET B

(a)

H_0: The flu shot does not help prevent the flu.

H_1: The flu shot helps prevent the flu.

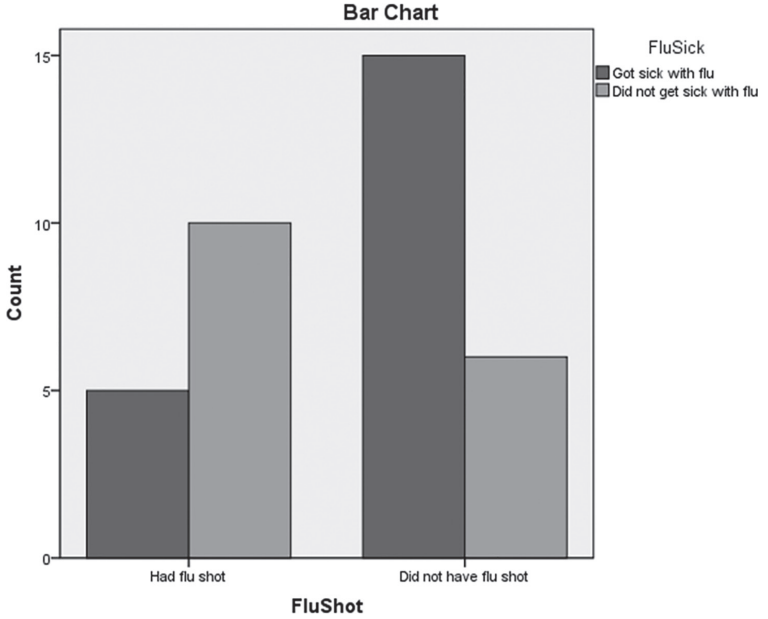
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criterion is satisfied.

FluShot * FluSick Crosstabulation

Count

		FluSick		
		Got sick with flu	Did not get sick with flu	Total
FluShot	Had flu shot	5	10	15
	Did not have flu shot	15	6	21
Total		20	16	36



(c)

The Chi-Square Tests table below shows a Sig. (p) value of .023, which is less than the specified .05 α level, indicating that there is a statistically significant difference in flu sickness comparing those who got a flu shot to those who did not.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.143[a]	1	.023		
Continuity Correction[b]	3.716	1	.054		
Likelihood Ratio	5.238	1	.022		
Fisher's Exact test				.041	.026
Linear-by-Linear Association	5.000	1	.025		
N of Valid Cases	36				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.67.
b. Computed only for a 2x2 table

(d)

To determine if there were significantly fewer cases of flu among those who had a flu shot compared to those who did not, we analyzed the health status of 36 participants. Sixty days after recruiting participants, our researcher contacted each one to find out if they had contracted the flu. We found that 15 had gotten flu shots, and 21 had not. Among those who got the flu shot, 33% reported that they had gotten sick with the flu, compare to 63% among those who did not get a flu shot. Chi-square analysis indicates that this difference is statistically significant ($p = .023$, $\alpha = .05$). As such, we reject H_0, and we do not reject H_1.

EXERCISE 10.5, DATA SET A

(a)

H_0: Responses are the same across media (face-to-face interview, mail-in survey, online survey) when it comes to asking about substance abuse.

H_1: Responses vary significantly across media (face-to-face interview, mail-in survey, online survey) when it comes to asking about substance abuse.

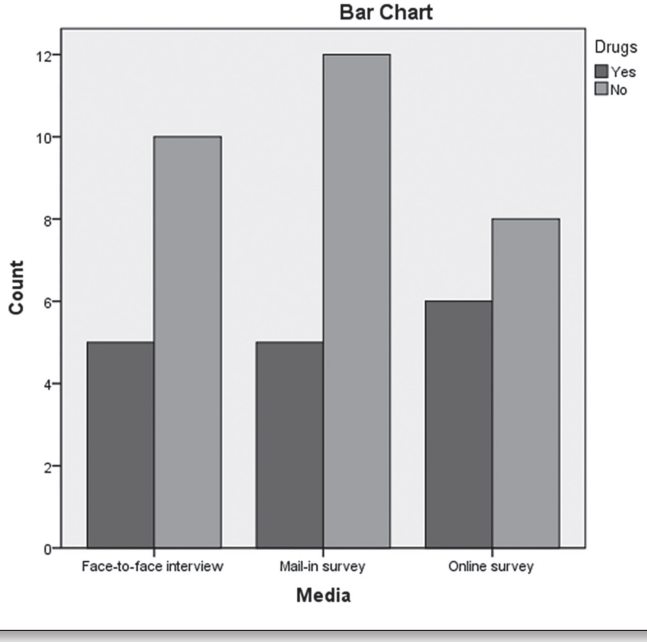
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criterion is satisfied.

Media * Drugs Crosstabulation

Count

		Drugs		
		Yes	No	Total
Media	Face-to-face interview	5	10	15
	Mail-in survey	5	12	17
	Online survey	6	8	14
Total		16	30	46



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .729, which is greater than the specified .05 α level, indicating that there is no statistically significant difference in responses across the three media tested: face-to-face interview, mail-in survey, and online survey.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.632[a]	2	.729
Likelihood Ratio	.626	2	.731
Linear-by-Linear Association	.270	1	.603
N of Valid Cases	46		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.87.

(d)

To determine if media makes a difference in responses when it comes to inquiries regarding illegal substance use, we recruited 46 subjects and asked each to respond to one question: "Have you ever used illegal drugs?" however our method of inquiry varied. Subjects were randomly assigned to one of three groups; the 15 participants in Group 1 were asked the question via face-to-face interview, the 17 people assigned to Group 2 responded via standard pencil and paper mail-in survey, and the 14 in Group 3 were directed to an online survey website. The results revealed that 33% of those that were asked the question via face-to-face replied "Yes," they had used illegal (drugs at least once), compared to 29% in the mail-in group, and 43% in the online group. Though there is some response variability among these media, chi-square analysis revealed that these differences are not statistically significant ($p = .729$, $\alpha = .05$). Hence, we do not reject H_0, and we do reject H_1.

EXERCISE 10.5, DATA SET B

(a)

H_0: Responses are the same across media (face-to-face interview, mail-in survey, online survey) when it comes to asking about substance abuse.

H_1: Responses vary across media (face-to-face interview, mail-in survey, online survey) when it comes to asking about substance abuse.

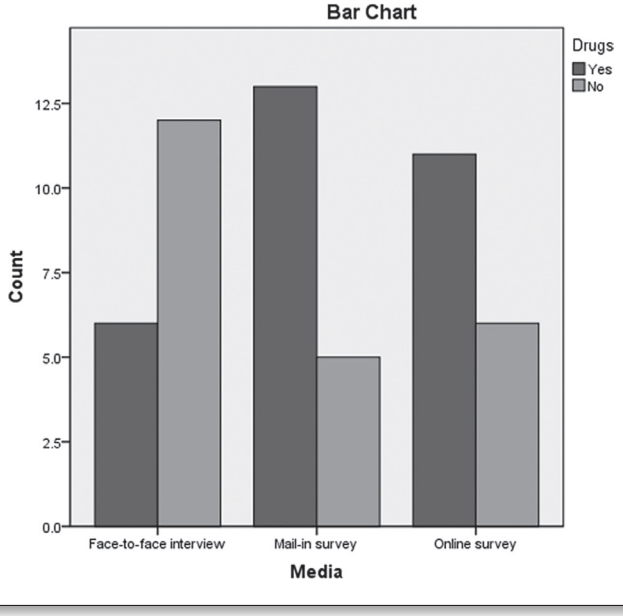
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criteria are satisfied.

Media * Drugs Crosstabulation

Count

		Drugs		
		Yes	No	Total
Media	Face-to-face interview	6	12	18
	Mail-in survey	13	5	18
	Online survey	11	6	17
Total		30	23	53



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .045, which is less than the specified .05 α level, indicating that there is a statistically significant difference in responses across the three media tested: face-to-face interview, mail-in survey, and online survey.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.210[a]	2	.045
Likelihood Ratio	6.287	2	.043
Linear-by-Linear Association	3.537	1	.060
N of Valid Cases	53		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.38.

(d)

To determine if media makes a difference in responses when it comes to inquiries regarding illegal substance use, we recruited 53 subjects and asked each to respond to one question: "Have you ever used illegal drugs?" however our method of inquiry varied. Subjects were randomly assigned to one of three groups; the 18 participants in Group 1 were asked the question via face-to-face interview, the 18 people assigned to Group 2 responded via standard pencil and paper mail-in survey, and the 17 in Group 3 were directed to an online survey website. The results revealed that 33% of those who were asked the question face-to-face replied "Yes," they had used illegal drugs (at least once), compared to 72% in the mail-in group, and 64% in the online group. Chi-square analysis revealed that these differences are statistically significant ($p = .045$, $\alpha = .05$). Hence, we would reject H_0, and not reject H_1. These findings suggest that when it comes to sensitive issues, participants who are interviewed face-to-face seem to "sanitize"/alter their responses to reveal less negative disclosure than those responding by less identifiable means (mail-in/online surveys).

EXERCISE 10.7, DATA SET A

(a)

H_0: Age is not associated with voting practices.

H_1: Age is associated with voting practices.

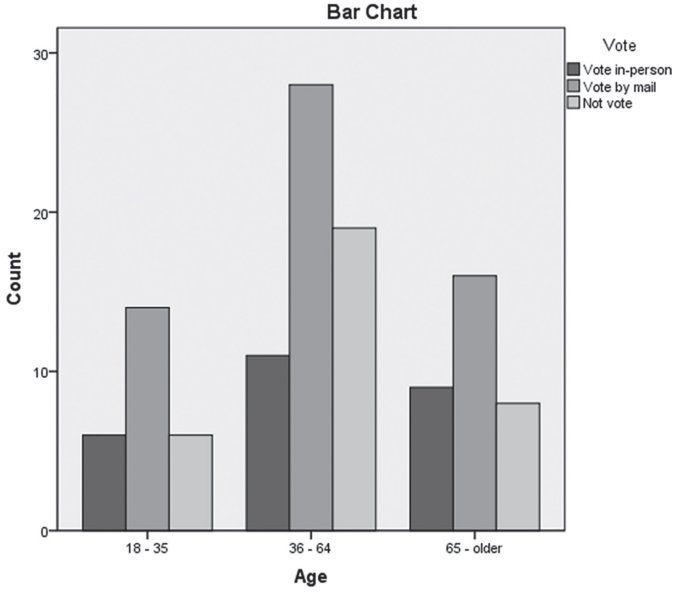
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criteria is satisfied.

Age * Vote Crosstabulation

Count

		Vote			
		Vote in person	Vote by mail	Not vote	Total
Age	18-35	6	14	6	26
	36-64	11	28	19	58
	65 - older	9	16	8	33
Total		26	58	33	117



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .802, which is greater than the specified .05 α level, indicating that there is no statistically significant difference in voting practices across age groups.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.640[a]	4	.802
Likelihood Ratio	1.630	4	.803
Linear-by-Linear Association	.068	1	.794
N of Valid Cases	117		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.78.

(d)

To determine if voting practices vary significantly across age groups, we surveyed a total of 117 participants in three age groups: 26 were 18 – 35, 58 were 36 – 64, and 33 were 65 or older, and asked each about how they voted in the last election: voted in person, voted by mail, or did not vote. Overall, half of those surveyed voted by mail. Twenty-two percent of those surveyed indicated that they voted in-person, and 28% did not vote. Among those who opted not to vote, the majority (58%) were in the 36 – 64 age group. Despite the moderate variability in voting practices observed among these groups, chi-square analysis indicates that these differences are not statistically significant ($p = .802$, $\alpha = .05$). Hence, we do not reject H_0, and we reject H_1. Among these groups, mail-in voting appears to be the preferred option.

EXERCISE 10.7, DATA SET B

(a)

H_0: Age is not associated with voting practices.

H_1: Age is associated with voting practices.

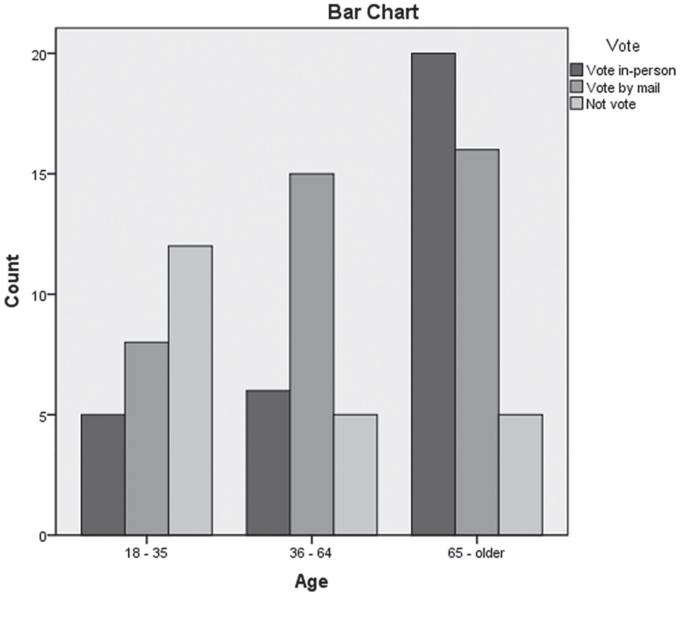
(b)

Per the Crosstabluaion table below, each cell contains an *n* of at least 5; hence, the pretest criteria is satisfied.

Age * Vote Crosstabulation

Count

		Vote			
		Vote in person	Vote by mail	Not vote	Total
Age	18-35	5	8	12	25
	36-64	6	15	5	26
	65 - older	20	16	5	41
Total		31	39	22	92



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .003, which is less than the specified .05 α level, indicating that there is a statistically significant difference in voting practices based on age groups.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.871[a]	4	.003
Likelihood Ratio	14.947	4	.005
Linear-by-Linear Association	11.533	1	.001
N of Valid Cases	92		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.98.

(d)

To determine if voting practices vary significantly across age groups, we surveyed a total of 92 participants in three age groups: 25 were 18 - 35, 26 were 36 - 64, and 41 were 65 or older, and asked each about how they voted in the last election: voted in person, voted by mail, or did not vote. Each group indicated a different majority: 48% of those in the 18 - 35 group did not vote, 58% of those in the 36 - 64 group voted by mail, and 49% of those 64 and older voted in-person. Chi-square analysis revealed that there is a statistically significant difference among age groups when it comes to voting practices ($p = .003$, $\alpha = .05$). Hence, we rejected H_0, and we did not reject H_1.

EXERCISE 10.9, DATA SET A

(a)

H_0: There is no significant difference in university admissions based on high school (public vs. private).

H_1: There is a significant difference in university admissions based on high school (public vs. private).

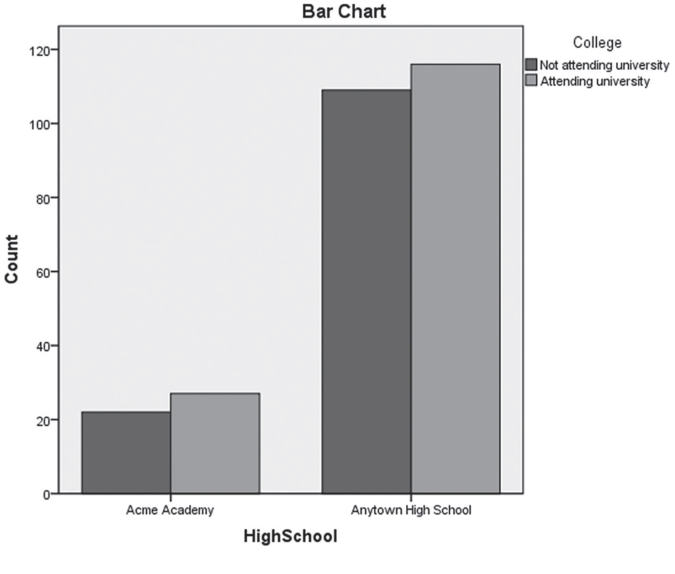
(b)

Per the Crosstabluaion table below, each (highlighted) cell contains an *n* of at least 5; hence, the pretest criteria is satisfied.

HighSchool * College Crosstabulation

Count

		College		
		Not attending university	Attending university	Total
HighSchool	Acme Academy	22	27	49
	Anytown High School	109	116	225
Total		131	143	274



(c)

The Chi-Square Tests table below shows a Sig. (*p*) value of .652, which is greater than the specified .05 α level, indicating that there is no statistically significant difference in university admissions based on school (public vs. private).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.203[a]	1	.652		
Continuity Correction[b]	.086	1	.770		
Likelihood Ratio	.203	1	.652		
Fisher's Exact test				.753	.386
Linear-by-Linear Association	.202	1	.653		
N of Valid Cases	274				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.43.
b. Computed only for a 2x2 table

(d)

We evaluated college admission rates from two schools: The Acme Academy, a private school with a graduating class of 49 students, and Anytown High school, a public school with a graduating class of 225 students. We found that 55% of those who graduated the Acme Academy were admitted to a university, compared to 52% of the students who graduated from Anytown High School. In terms of total students, Acme Academy launched a total of 27 students into higher education, compared to 116 students from Anytown High School. Despite the variability among these figures, chi-square analysis indicates that the difference is not statistically significant ($p = .652$, $\alpha = .05$). Hence, we do not reject H_0, and we reject H_1.

EXERCISE 10.9, DATA SET B

(a)

H_0: There is no significant difference in university admissions based on high school (public vs. private).

H_1: There is a significant difference in university admissions based on high school (public vs. private).

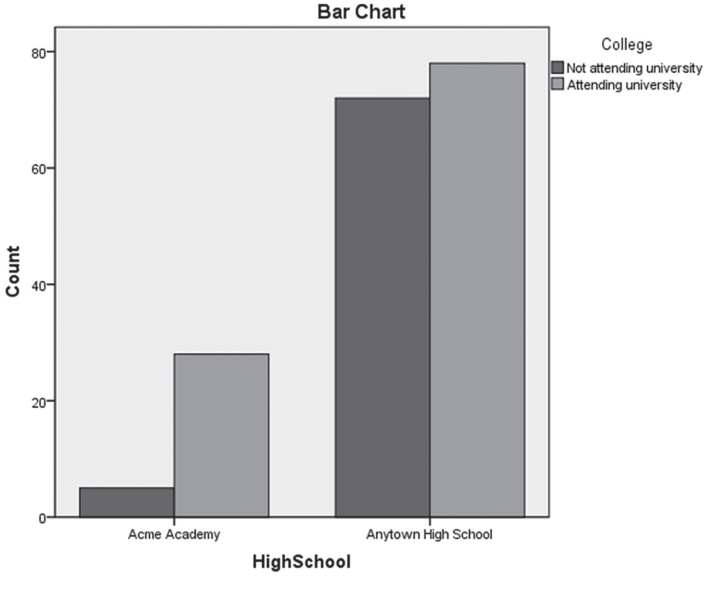
(b)

Per the Crosstabluaion table below, each (highlighted) cell contains an *n* of at least 5, hence, the pretest criteria is satisfied.

HighSchool * College Crosstabulation

Count

		College		
		Not attending university	Attending university	Total
HighSchool	Acme Academy	5	28	33
	Anytown High School	72	78	150
Total		77	106	183



(c)

The Chi-Square Tests table below shows a Sig. (p) value of .001, which is less than the specified .05 α level, indicating that there is a statistically significant difference in university admissions based on school (public vs. private).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.975[a]	1	.001		
Continuity Correction[b]	10.666	1	.001		
Likelihood Ratio	13.301	1	.000		
Fisher's Exact test				.000	.000
Linear-by-Linear Association	11.910	1	.001		
N of Valid Cases	183				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.89.
b. Computed only for a 2x2 table

(d)

We evaluated college admission rates from two schools: The Acme Academy, a private school with a graduating class of 33 students, and Anytown High school, a public school with a graduating class of 150 students. We found that 85% of those who graduated the Acme Academy were admitted to a university, compared to 52% of the students who graduated from Anytown High School. In terms of total students, Acme Academy launched a total of 28 students into higher education, compared to 78 students from Anytown High School. Despite the higher total number of students admitted to a university from the public school, chi-square analysis indicates that proportionally, the Acme Academy significantly outperformed Anytown Public High School when it comes to college admissions (p = .001, α = .05). Hence, we reject H_0, and we do not reject H_1.