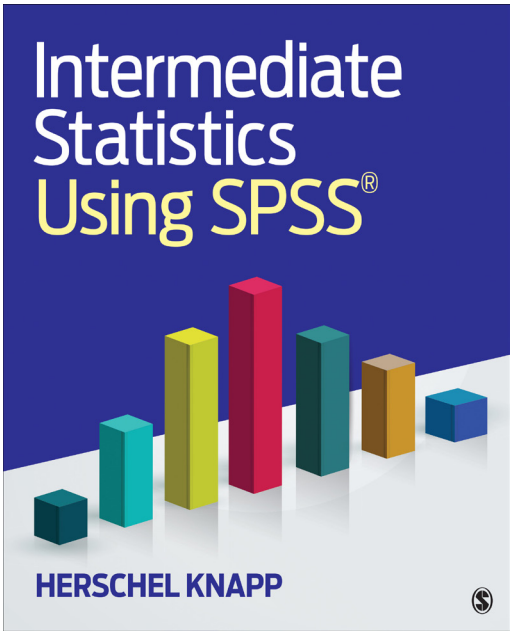
CHAPTER 13

Logistic Regression

Solutions to Odd-Numbered Exercises



Contents

EXERCISE 13.1A

(a)

H_0: Gender, getting a flu shot, having a chronic disease and age do not predict contracting the flu

H_1: Gender, getting a flu shot, having a chronic disease or age predict contracting the flu

(b)

Pretest criterion 1: Sample size:

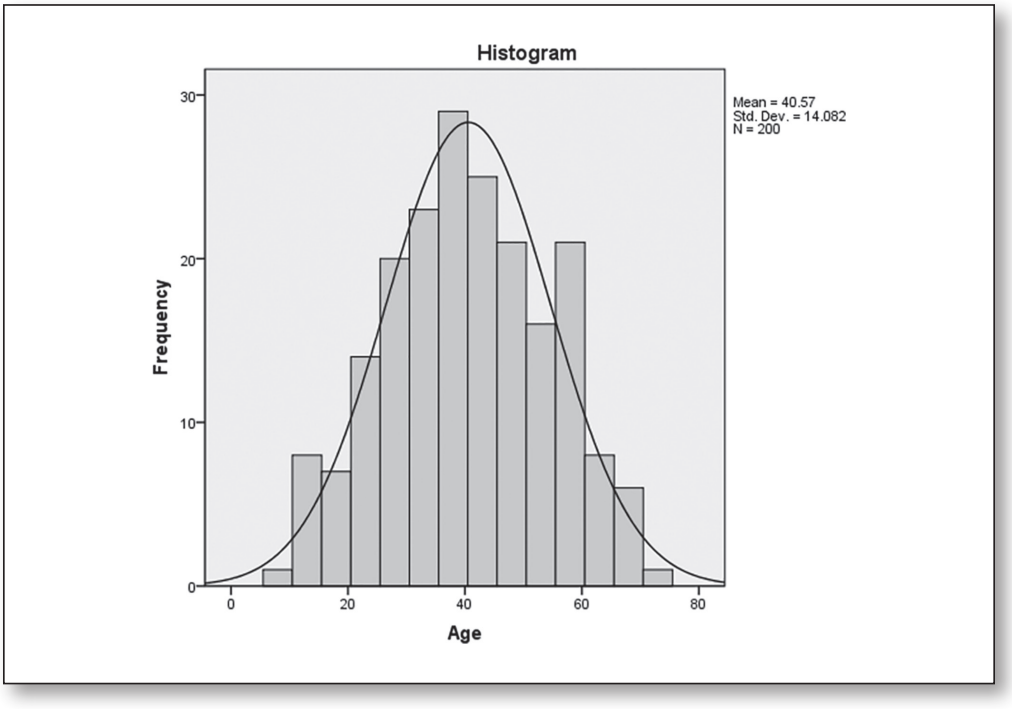
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Flu_shot	Categorical	10	
Chronic_disease	Categorical	10	
Age	Continuous		10
Total *n* quota = 40		30	10

The above table indicates that the *n* should be at least 40; the table below shows that the actual *n* for this data set is 200; hence, this criterion is satisfied.

Flu_sick

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Got the flu	157	78.5	78.5	78.5
	No flu	43	21.5	21.5	100.0
	Total	200	100.0	100.0	

Pretest criterion 2: Normality: Histogram of the continuous variable shows a normal symmetrical distribution of the data; hence this criterion is satisfied.



Pretest criterion 3: Multicollinearity: Since there is only one continuous variable in this model, multicollinearity is not an issue; hence, this criterion is satisfied.

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	41.008	4	.000
	Block	41.008	4	.000
	Model	41.008	4	.000

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .000 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	167.195[a]	.185	.287

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .287, suggesting that the model accounts for an estimated 28.7% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	1.097	.420	6.811	1	.009	2.996	1.314	6.830
	Flu_shot(1) **[0 = Got a flu shot, 1 = Did not get a flu shot]**	1.960	.489	16.038	1	.000	7.098	2.720	18.520
	Chronic_disease(1) **[0 = Has chronic disease(s), 1 = No chronic disease(s)]**	-1.117	.669	2.784	1	.095	.327	.088	1.215
	Age	-.035	.015	5.873	1	.015	.965	.938	.993
	Constant	-.918	1.016	.817	1	.366	.399		

a. Variable(s) entered on step 1: Gender, Flu_shot, Chronic_disease, Age.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

To determine the effects of the flu shot this season, we surveyed 200 people; logistic regression revealed that men had 3 times the odds of remaining flu-free compared to women (p = .009) (95% CI 1.31, 6.83), and those who received the flu shot had 7 times the odds of remaining healthy, compared to those who opted not to receive a flu shot (p < .001) (95% CI 2.72, 18.52). Finally, those who were younger remained healthier; for each additional year of age, the odds of contracting the flu increases by 3.5% (p = .015) (95% CI .94, .99).

EXERCISE 13.1B

(a)

H_0: Gender, getting a flu shot, having a chronic disease and age do not predict contracting the flu

H_1: Gender, getting a flu shot, having a chronic disease or age predict contracting the flu

(b)

Pretest criterion 1: Sample size:

Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Flu_shot	Categorical	10	
Chronic_disease	Categorical	10	
Age	Categorical	10	
Total *n* quota = 40		40	

The above table indicates that the *n* should be at least 40; the table below shows that the actual *n* for this data set is 200; hence, this criterion is satisfied.

Flu_sick

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Got the flu	157	78.5	78.5	78.5
	No flu	43	21.5	21.5	100.0
	Total	200	100.0	100.0	

Pretest criterion 2: Normality: This data set consists of categorical variables only; there are no continuous variables to violate the normality criterion; hence, this criterion is satisfied.

Pretest criterion 3: Multicollinearity: This data consists of categorical variables only; since there are no continuous variables in this model, multicollinearity is not an issue; hence, this criterion is satisfied.

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	45.030	4	.000
	Block	45.030	4	.000
	Model	45.030	4	.000

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .000 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	163.172[a]	.202	.312

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .312, suggesting that the model accounts for an estimated 31.2% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	.983	.424	5.365	1	.021	2.672	1.163	6.138
	Flu_shot(1) **[0 = Got a flu shot, 1 = Did not get a flu shot]**	2.283	.560	16.593	1	.000	9.802	3.269	29.398
	Chronic_disease(1) **[0 = Has chronic disease(s), 1 = No chronic disease(s)]**	-.852	.650	1.718	1	.190	.427	.119	1.525
	Age(1) **[0 = Pediatric, 1 = Adult]**	-2.658	.872	9.284	1	.002	.070	.013	.387
	Constant	-.231	1.043	.049	1	.824	.794		

a. Variable(s) entered on step 1: Gender, Flu_shot, Chronic_disease, Age.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

To determine the effects of the flu shot this season, we surveyed 200 people; logistic regression revealed that men had 2.7 times the odds of remaining flu-free compared to women ($p = .021$) (95% CI 1.16, 6.14), and those who received the flu shot had 9.8 times the odds of remaining healthy, compared to those who opted not to receive a flu shot ($p < .001$) (95% CI 3.27, 29.40). Finally, adults (age > 18) had 14.3 times the odds of remaining healthy, compared to pediatrics ($p = .002$) (95% CI .01, .39).

EXERCISE 13.3A

(a)

H_0: Age, gender, race, religion, or education do not predict death penalty opinions.

H_1: Age, gender, race, religion, or education predict death penalty opinions.

(b)

Pretest criterion 1: *n* quota:

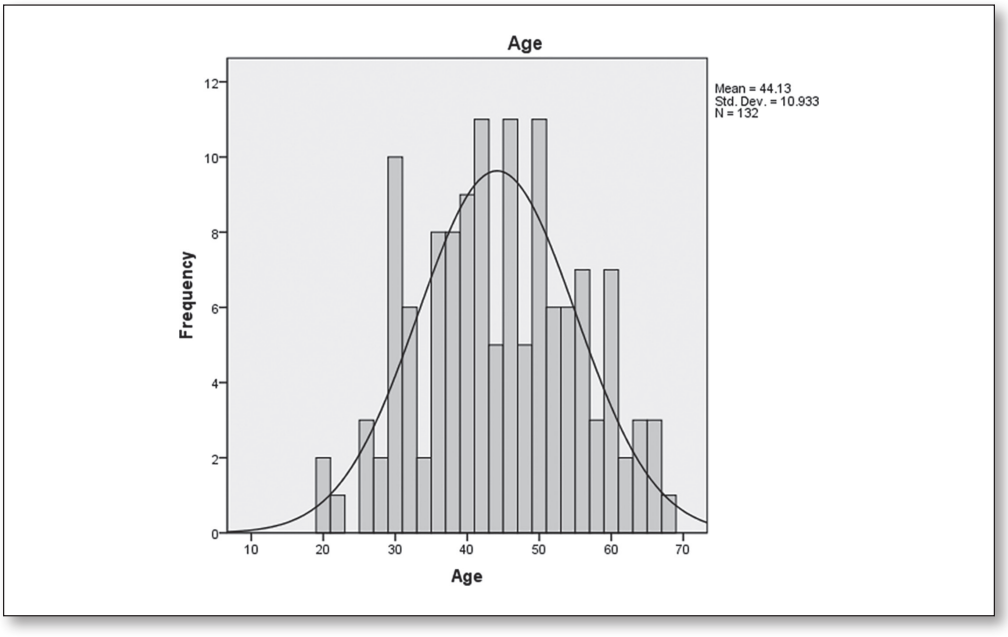
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Age	Continuous		10
Gender	Categorical	10	
Race	Categorical	40	
Religion	Categorical	50	
Education	Continuous		10
Total *n* quota = 120		100	20

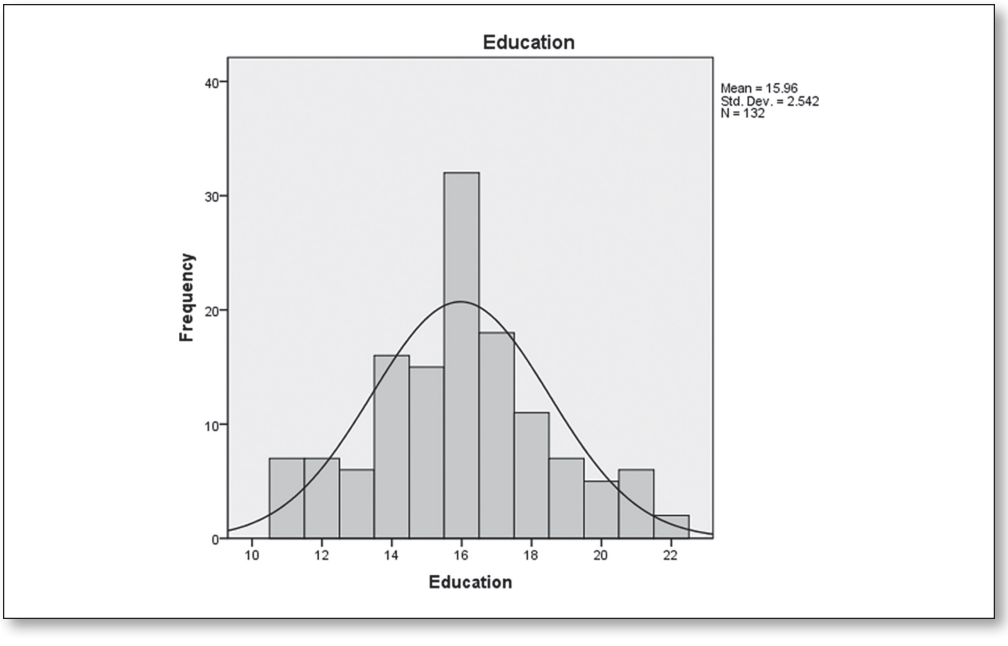
The above table indicates that the *n* should be at least 120; the table below shows that the actual *n* for this data set is 132; hence, this criterion is satisfied.

Death_penalty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Anti-death penalty	36	27.3	27.3	27.3
	Pro-death penalty	96	72.7	72.7	100.0
	Total	132	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variables show a normal symmetrical distribution of the data; hence this criterion is satisfied.





Pretest criterion 3: Multicollinearity:

Correlations

		Age	Education
Age	Pearson Correlation	1	.076
	Sig. (2-tailed)		.388
	N	132	132
Education	Pearson Correlation	.076	1
	Sig. (2-tailed)	.388	
	N	132	132

The correlation between these variables (.076) is between –.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	27.437	13	.011
	Block	27.437	13	.011
	Model	27.437	13	.011

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .011 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	127.255[a]	.188	.272

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

The Nagelkerke (pseudo) R^2 = .272, suggesting that the model accounts for an estimated 27.2% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Age	-.008	.021	.124	1	.725	.993	.952	1.035
	Gender(1) **[0 = Female, 1 = Male]**	1.269	.474	7.165	1	.007	3.557	1.405	9.008
	Race **[0 = African American]**			.254	4	.993			
	Race(1) **[1 = Asian]**	.091	.933	.010	1	.922	1.096	.176	6.818
	Race(2) **[2 = Caucasian]**	-.160	.602	.071	1	.790	.852	.262	2.772
	Race(3) **[3 = Latino]**	19.793	14037.813	.000	1	.999	3.943E8	.000	.
	Race(4) **[4 = Other]**	.149	.836	.032	1	.859	1.160	.225	5.972
	Religion **[0 = Atheist]**			4.918	5	.426			
	Religion(1) **[1 = Buddhist]**	-1.203	.894	1.811	1	.178	.300	.052	1.732
	Religion(2) **[2 = Catholic]**	.517	.517	1.000	1	.317	1.677	.609	4.621
	Religion(3) **[3 = Hindu]**	19.772	19012.066	.000	1	.999	3.864E8	.000	.
	Religion(4) **[4 = Jewish]**	.539	.948	.322	1	.570	1.714	.267	10.996
	Religion(5) **[5 = Other]**	20.132	16283.557	.000	1	.999	5.537E8	.000	.
	Education	-.124	.094	1.736	1	.188	.883	.735	1.062
	Constant	2.301	1.820	1.598	1	.206	9.979		

a. Variable(s) entered on step 1: Age, Gender, Race, Religion, Education.

Since there is at least one predictor (Gender) with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

To determine the variables associated with death penalty opinions, we surveyed 132 people. Logistic regression analysis revealed that men had 3.6 times the odds of being pro-death penalty compared to women (p = .007, α =.05) (95% CI 1.41, 9.01). The insignificant predictors in this group were race, religion and years of education.

EXERCISE 13.3B

(a)

H_0: Age, gender, race, religion, or education do not predict death penalty opinions.

H_1: Age, gender, race, religion, or education predict death penalty opinions.

(b)

Pretest criterion 1: *n* quota:

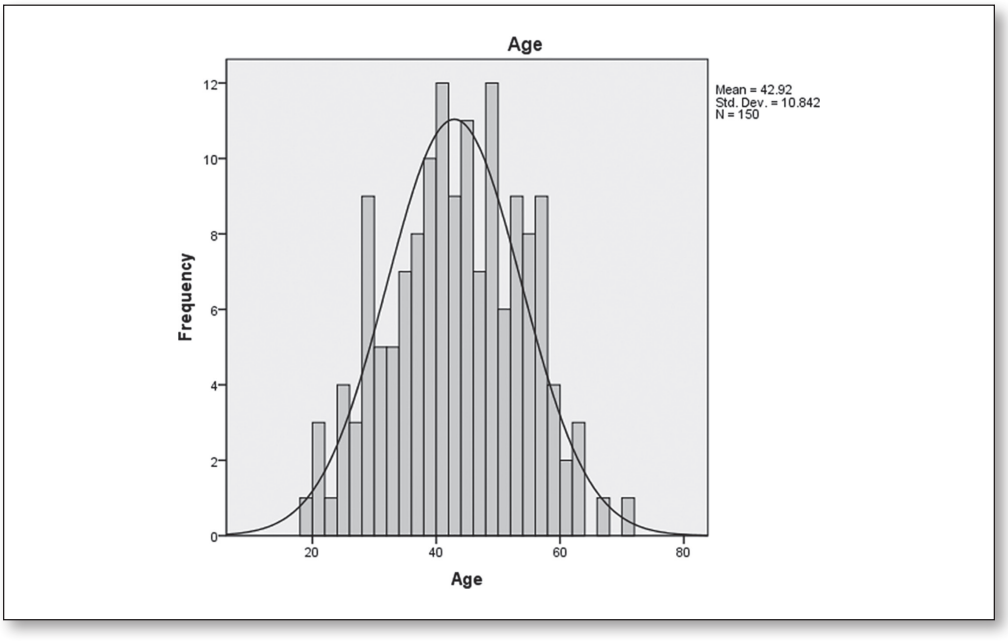
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Age	Continuous		10
Gender	Continuous	10	
Race	Categorical	40	
Religion	Continuous	50	
Education	Categorical		10
Total *n* quota = 120		100	20

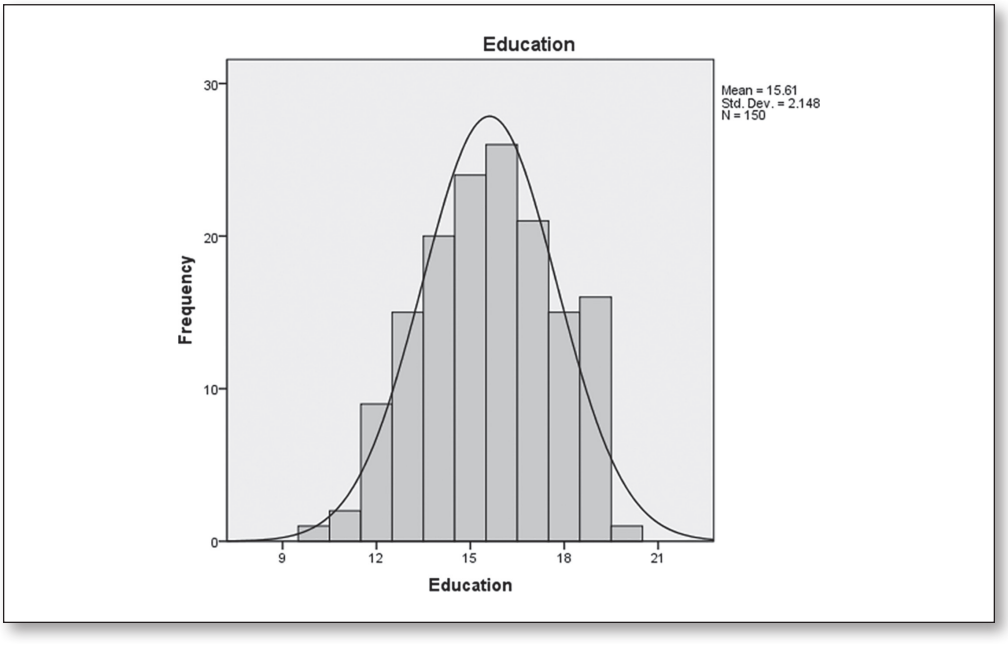
The above table indicates that the *n* should be at least 120; the table below shows that the actual *n* for this data set is 150; hence, this criterion is satisfied.

Death_penalty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Anti-death penalty	97	64.7	64.7	64.7
	Pro-death penalty	53	35.3	35.3	100.0
	Total	150	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variables show a normal symmetrical distribution of the data; hence this criterion is satisfied.





Pretest criterion 3: Multicollinearity: The correlation between these variables (–.063) is between –.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

Correlations

		Age	Education
Age	Pearson Correlation	1	-.063
	Sig. (2-tailed)		.446
	N	150	150
Education	Pearson Correlation	-.063	1
	Sig. (2-tailed)	.446	
	N	150	150

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	55.936	12	.000
	Block	55.936	12	.000
	Model	55.936	12	.000

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .000 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	138.910[a]	.311	.428

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

The Nagelkerke (pseudo) R^2 = .428, suggesting that the model accounts for an estimated 42.8% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	-.010	.019	.275	1	.600	.990	.953	1.028
	Gender(1) **[0 = Female, 1 = Male]**	.221	.720	.094	1	.759	1.247	.304	5.116
	Race **[0 = African American]**			8.781	4	.067			
	Race(1) **[1 = Asian]**	-20.649	28419.356	.000	1	.999	.000	.000	.
	Race(2) **[2 = Caucasian]**	-42.584	40188.843	.000	1	.999	.000	.000	.
	Race(3) **[3 = Latino]**	-45.450	40188.843	.000	1	.999	.000	.000	.
	Race(4) **[4 = Other]**	-42.874	40188.843	.000	1	.999	.000	.000	.
	Religion **[0 = Atheist]**			.984	5	.964			
	Religion(1) **[1 = Buddhist]**	21.803	28419.356	.000	1	.999	2.943E9	.000	.
	Religion(2) **[2 = Catholic]**	41.012	40188.843	.000	1	.999	6.475E17	.000	.
	Religion(3) **[3 = Hindu]**	20.119	44926.357	.000	1	1.000	5.465E8	.000	.
	Religion(4) **[4 = Jewish]**	41.846	40188.843	.000	1	.999	1.492E18	.000	.
	Religion(5) **[5 = Other]**	41.707	40188.843	.000	1	.999	1.297E18	.000	.
	Education	-.522	.208	6.331	1	.012	.593	.395	.891
	Constant	9.318	3.975	5.494	1	.019	11135.138		

a. Variable(s) entered on step 1: Age, Gender, Race, Religion, Education.

Since there is at least one predictor (Education) with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

To determine the variables associated with death penalty opinions, we surveyed 150 people. Logistic regression analysis revealed that age was a statistically significant predictor; for every additional year of education, the odds of favoring the death penalty decreases by 40.7% (p = .012, α =.05) (95% CI .395, .891). The insignificant predictors in this group were gender, race, and religion.

EXERCISE 13.5A

(a)

H_0: Gender, age, number of academic units, work (job) hours, or treatment modality do not predict treatment effectiveness.

H_1: Gender, age, number of academic units, work (job) hours, or treatment modality predict treatment effectiveness.

(b)

Pretest criterion 1: *n* quota:

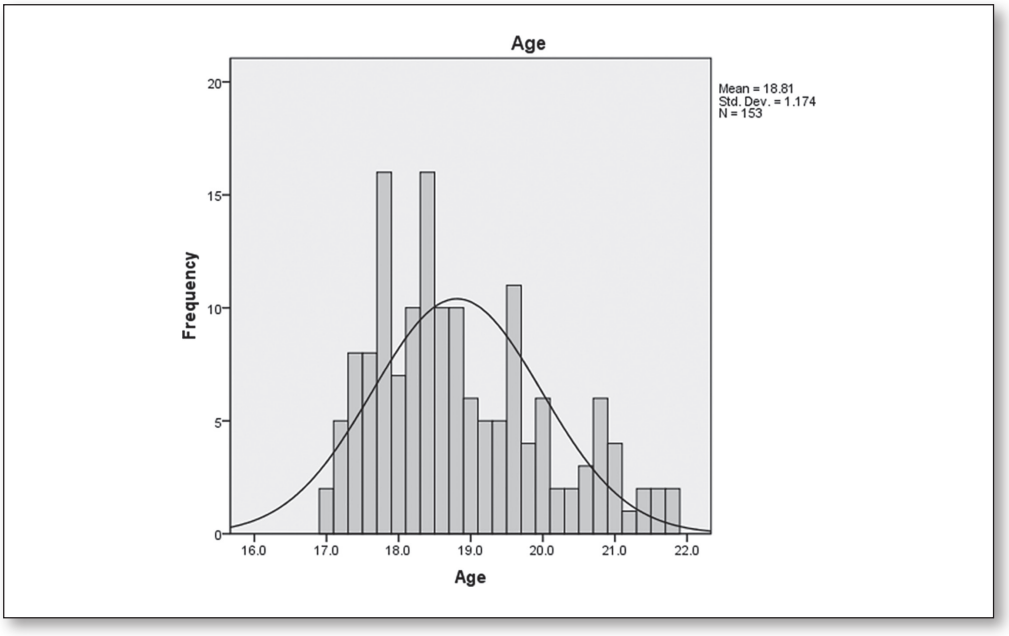
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Age	Continuous		10
Units	Continuous		10
Work	Continuous		10
Treatment_modality	Categorical	10	
Home	Categorical	20	
Total *n* quota = 70		40	30

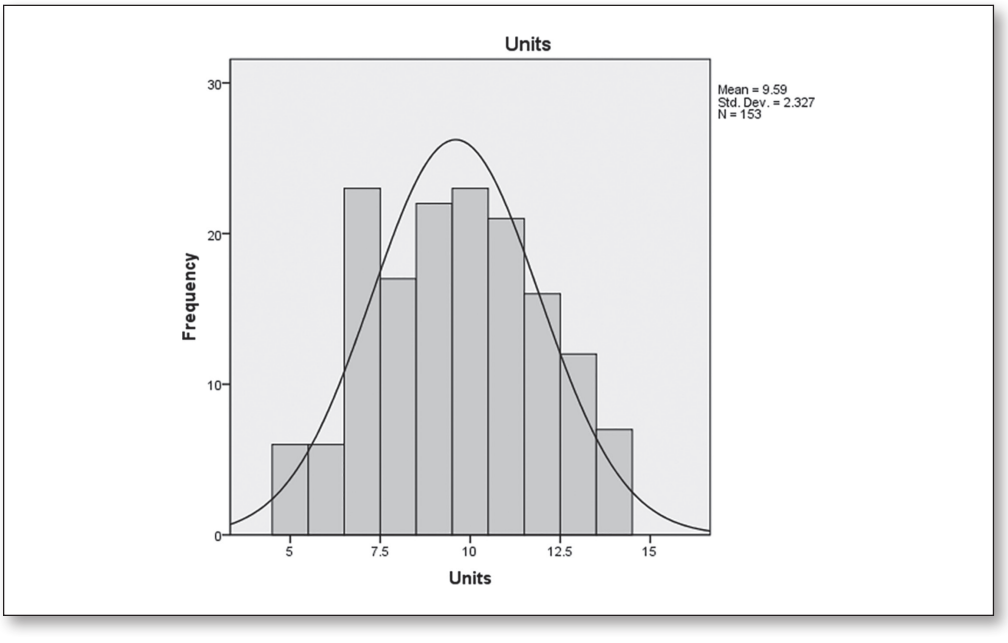
The above table indicates that the *n* should be at least 70; the table below shows that the actual *n* for this data set is 153; hence, this criterion is satisfied.

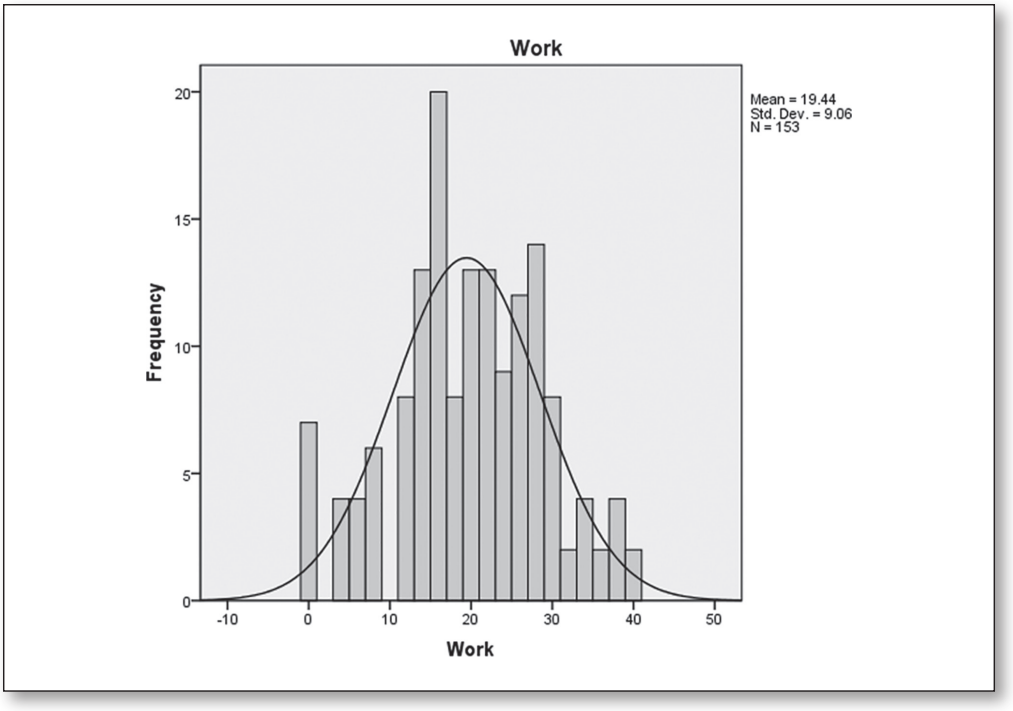
Treatment_effectiveness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Treatment ineffective	47	30.7	30.7	30.7
	Treatment effective	106	69.3	69.3	100.0
	Total	153	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variables show a normal symmetrical distribution of the data; hence this criterion is satisfied.







Pretest criterion 3: Multicollinearity: The correlations between these variables (−.002, −.044, −.077) are between −.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

Correlations

		Age	Units	Work
Age	Pearson Correlation	1	-.002	-.044
	Sig. (2-tailed)		.976	.591
	N	153	153	153
Units	Pearson Correlation	-.002	1	-.077
	Sig. (2-tailed)	.976		.344
	N	153	153	153
Work	Pearson Correlation	-.044	-.077	1
	Sig. (2-tailed)	.591	.344	
	N	153	153	153

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12.303	7	.091
	Block	12.303	7	.091
	Model	12.303	7	.091

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .091 for Step 1 (Step), suggesting that no statistically significant predictors have been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	176.448[a]	.077	.109

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .109, suggesting that the model accounts for an estimated 10.9% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	.390	.369	1.117	1	.291	1.477	.717	3.042
	Age	.027	.160	.029	1	.866	1.027	.750	1.407
	Units	-.144	.079	3.304	1	.069	.866	.741	1.011
	Work	-.023	.021	1.208	1	.272	.977	.937	1.019
	Treatment_modality(1) **[0 = Individual, 1 = Group]**	.871	.390	4.971	1	.026	2.388	1.111	5.133
	Home **[0 = Lives with family]**			.736	2	.692			
	Home(1) **[1 = Lives with roommate(s)]**	.379	.471	.646	1	.422	1.461	.580	3.678
	Home(2) **[2 = Lives alone]**	.233	.446	.273	1	.601	1.263	.527	3.027
	Constant	1.401	3.241	.187	1	.666	4.059		

a. Variable(s) entered on step 1: Gender, Age, Units, Work, Treatment_modality, Home.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

A therapist at the Acme College Counseling Center noted a high prevalence of adjustment disorder among incoming freshman, with depression being the predominate symptom. The clinicians want to determine the characteristics of those most amenable to therapy over a course of 10 sessions, and assessed the treatment effectiveness of 153 students. Logistic regression analysis revealed that the students who were assigned to the group counseling treatment modality had 2.4 times the odds of recovering compared to those who received individual therapy ($p = .026$, $\alpha = .05$) (95% CI 1.111, 5.133). The student's gender, age, number of units, number of work (employment hours) and living condition (living with family / with roommate(s), alone) were found to be statistically insignificant predictors in this sample. Per these findings, we reject H_0 and accept H_1. It may be that students, working in a group setting on a common problem, found a sense of normalization, community, and mutual support that is not possible in individual counseling settings.

EXERCISE 13.5B

(a)

H_0: Gender, age, number of academic units, work (job) hours, or treatment modality do not predict treatment effectiveness.

H_1: Gender, age, number of academic units, work (job) hours, or treatment modality predict treatment effectiveness.

(b)

Pretest criterion 1: *n* quota:

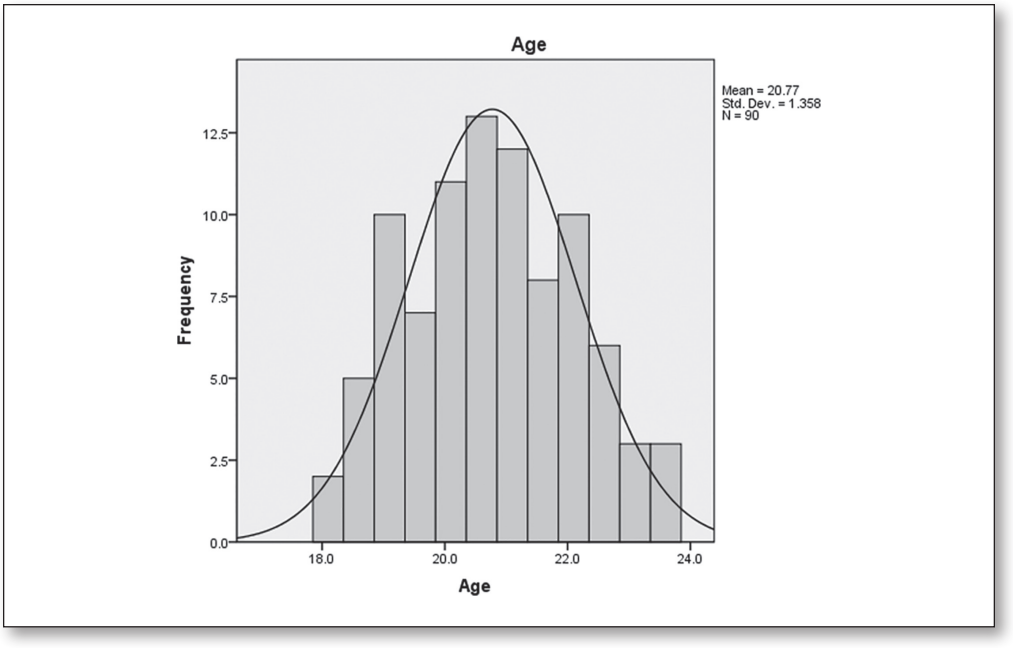
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Age	Continuous		10
Units	Continuous		10
Work	Continuous		10
Treatment_modality	Categorical	10	
Home	Categorical	20	
Total *n* quota = 70		40	30

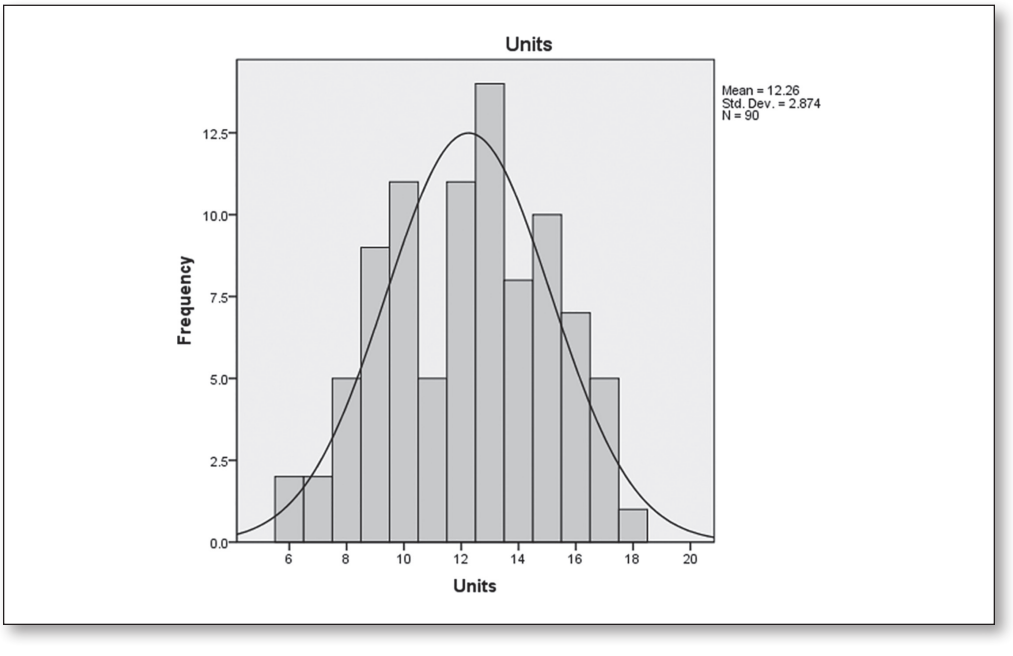
The above table indicates that the *n* should be at least 70; the table below shows that the actual *n* for this data set is 90; hence, this criterion is satisfied.

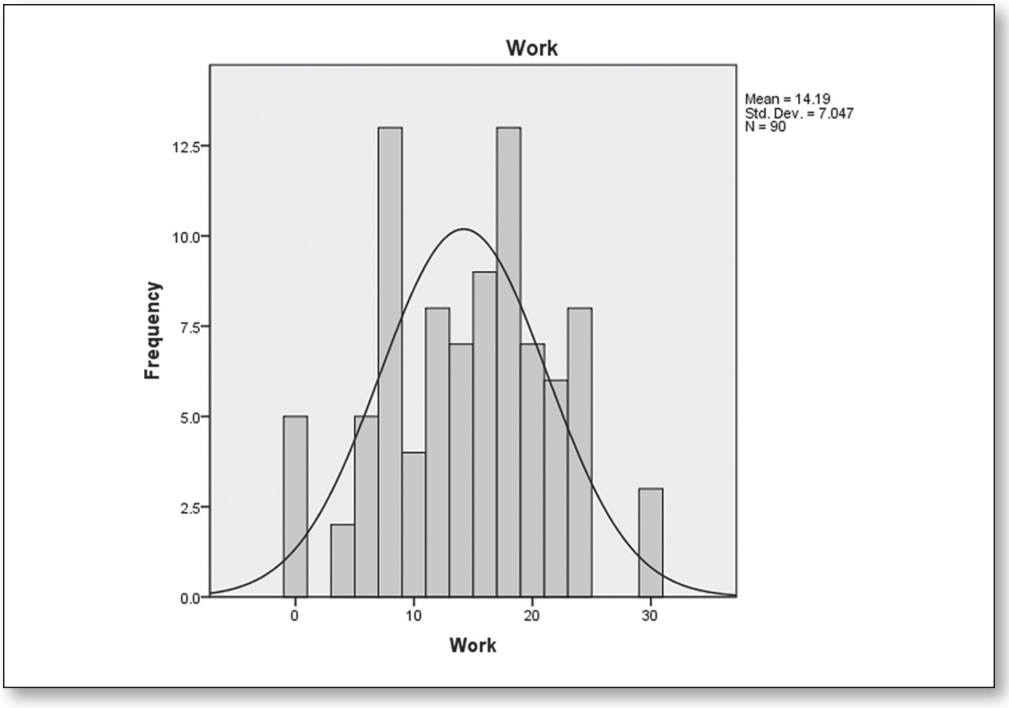
Treatment_effectiveness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Treatment ineffective	31	34.4	34.4	34.4
	Treatment effective	59	65.6	65.6	100.0
	Total	90	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variables show a normal symmetrical distribution of the data; hence this criterion is satisfied.







Pretest criterion 3: Multicollinearity: The correlations between these variables (−.053, .042, .158) are between −.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

Correlations

		Age	Units	Work
Age	Pearson Correlation	1	.158	.042
	Sig. (2-tailed)		.137	.693
	N	90	90	90
Units	Pearson Correlation	.158	1	-.053
	Sig. (2-tailed)	.137		.617
	N	90	90	90
Work	Pearson Correlation	.042	-.053	1
	Sig. (2-tailed)	.693	.617	
	N	90	90	90

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	17.181	7	.016
	Block	17.181	7	.016
	Model	17.181	7	.016

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .016 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	98.728[a]	.174	.240

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .240, suggesting that the model accounts for an estimated 24% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	-.008	.521	.000	1	.988	.992	.357	2.755
	Age	.052	.188	.078	1	.780	1.054	.729	1.523
	Units	-.077	.093	.685	1	.408	.926	.771	1.111
	Work	-.105	.039	7.284	1	.007	.900	.834	.972
	Treatment_modality(1) **[0 = Individual, 1 = Group]**	1.203	.517	5.425	1	.020	3.331	1.210	9.167
	Home **[0 = Lives with family]**			4.682	2	.096			
	Home(1) **[1 = Lives with roommate(s)]**	-1.275	.594	4.608	1	.032	.280	.087	.895
	Home(2) **[2 = Lives alone]**	-.760	.634	1.439	1	.230	.468	.135	1.619
	Constant	2.096	4.045	.268	1	.604	8.131		

a. Variable(s) entered on step 1: Gender, Age, Units, Work, Treatment_modality, Home.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

A therapist at the Acme College Counseling Center noted a high prevalence of adjustment disorder among incoming freshman, with depression being the predominate symptom. The clinicians want to determine the characteristics of those most amenable to therapy over a course of 10 sessions, and assessed the treatment effectiveness of 90 students. Logistic regression analysis revealed that for every extra hour the student works (at employment), the odds of benefiting from this therapy decreases by 10% (p = .02, = .05) (95% CI 1.210, 9.167); students who live with their family have 3.57 times the odds of benefiting from this therapy compared to those who live with roommates (p = .032, α = .05) (95% CI .087, .895). The student's gender, age, and number of units were found to be statistically insignificant predictors in this sample. Per these findings, we reject H_0 and accept H_1. It appears that longer work hours may be adding stress to the student's life, and that families may provide a more robust support system than roommate(s).

EXERCISE 13.7A

(a)

H_0: Age, gender, coffee brand, or income do not predict the likelihood of purchasing this product.

H_1: Age, gender, coffee brand, or income predict the likelihood of purchasing this product.

(b)

Pretest criterion 1: *n* quota:

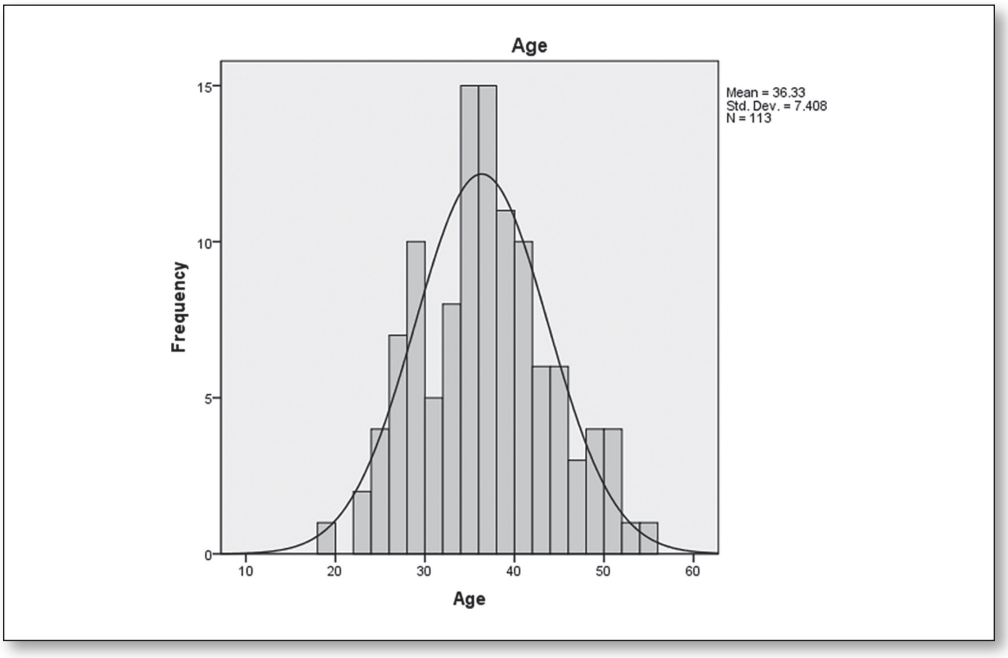
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Age	Continuous		10
Gender	Categorical	10	
Acme_Coffee	Categorical	10	
Income	Continuous		10
Total *n* quota = 40		20	20

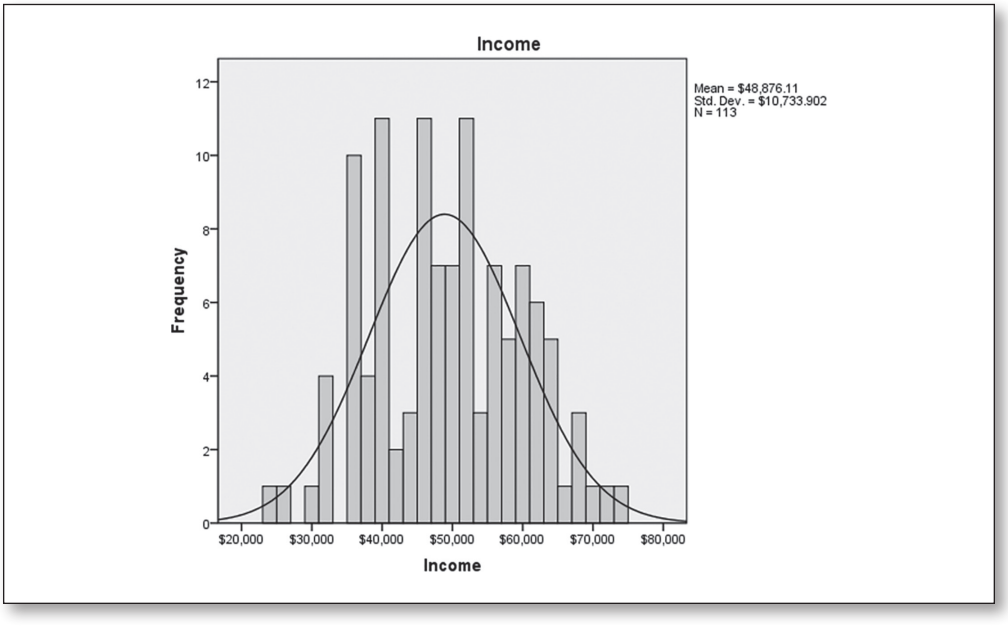
The above table indicates that the *n* should be at least 40; the table below shows that the actual *n* for this data set is 113; hence, this criterion is satisfied.

Buy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	66	58.4	58.4	58.4
	Yes	47	41.6	41.6	100.0
	Total	113	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variable show a normal symmetrical distribution of the data; hence this criterion is satisfied.





Pretest criterion 3: Multicollinearity: The correlation between these variables (.002) is between −.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

Correlations

		Age	Income
Age	Pearson Correlation	1	.002
	Sig. (2-tailed)		.986
	N	113	113
Income	Pearson Correlation	.002	1
	Sig. (2-tailed)	.986	
	N	113	113

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	17.417	4	.002
	Block	17.417	4	.002
	Model	17.417	4	.002

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .002 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	136.024[a]	.143	.192

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .192, suggesting that the model accounts for an estimated 19.2% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	-.036	.030	1.470	1	.225	.965	.910	1.023
	Gender(1) **[0 = Female, 1 = Male]**	-1.063	.436	5.946	1	.015	.345	.147	.812
	Acme_Coffee(1) **[0 = Doesn't drink Acme Coffee, 1 = Drinks Acme Coffee]**	1.027	.436	5.543	1	.019	2.794	1.188	6.572
	Income	.000	.000	.015	1	.902	1.000	1.000	1.000
	Constant	.883	1.450	.371	1	.542	2.418		

a. Variable(s) entered on step 1: Age, Gender, Acme_Coffee, Income.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

Acme Coffee, which currently sells gourmet coffee blends, is now considering selling a single-serve coffee maker that brews a cup of coffee in 30 seconds. They survey 113 people to help identify the characteristics of potential customers for this high-tech coffee brewer. Logistic regression analysis revealed that women have 2.9 times the odds of purchasing this unit compared to men (95% CI .147, .812), and the odds of buying this coffee maker are 2.8 times higher among those who currently drink Acme Coffee (95% CI 1.188, 6.572). Age and income were identified a statistically insignificant predictors (α = .05). Per these findings, we reject H_0 and accept H_1. These results suggest that promotional efforts should be directed primarily to women who drink Acme Coffee; we are considering including a product announcement or coupon for this device in packages of Acme Coffee.

EXERCISE 13.7B

(a)

H_0: Age, gender, coffee brand, or income do not predict the likelihood of purchasing this product.

H_1: Age, gender, coffee brand, or income predict the likelihood of purchasing this product.

(b)

Pretest criterion 1: *n* quota:

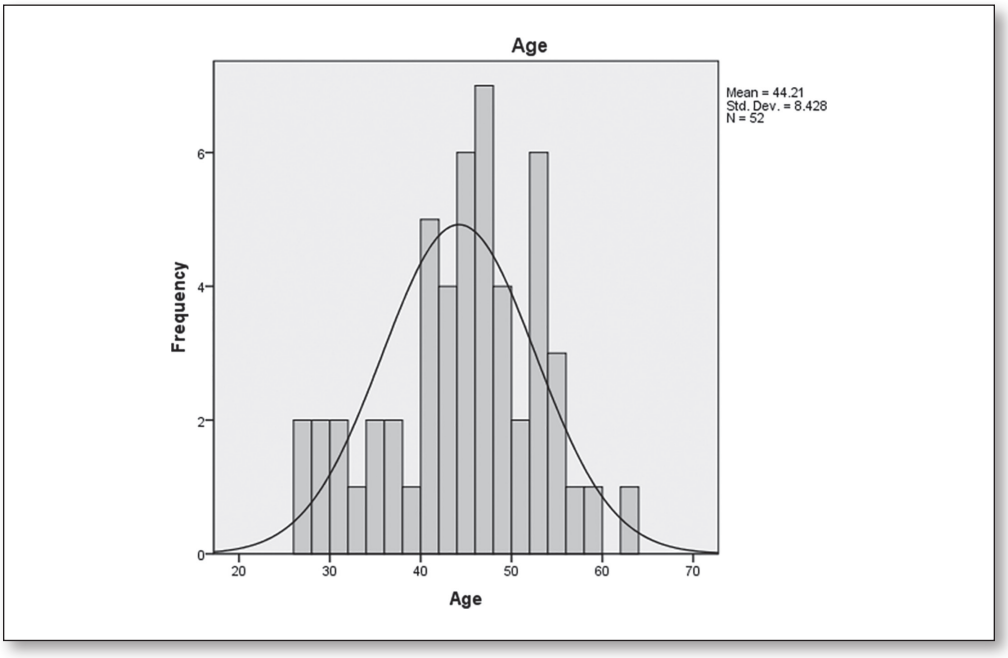
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Age	Continuous		10
Gender	Categorical	10	
Acme_Coffee	Categorical	10	
Income	Continuous		10
Total *n* quota = 40		20	20

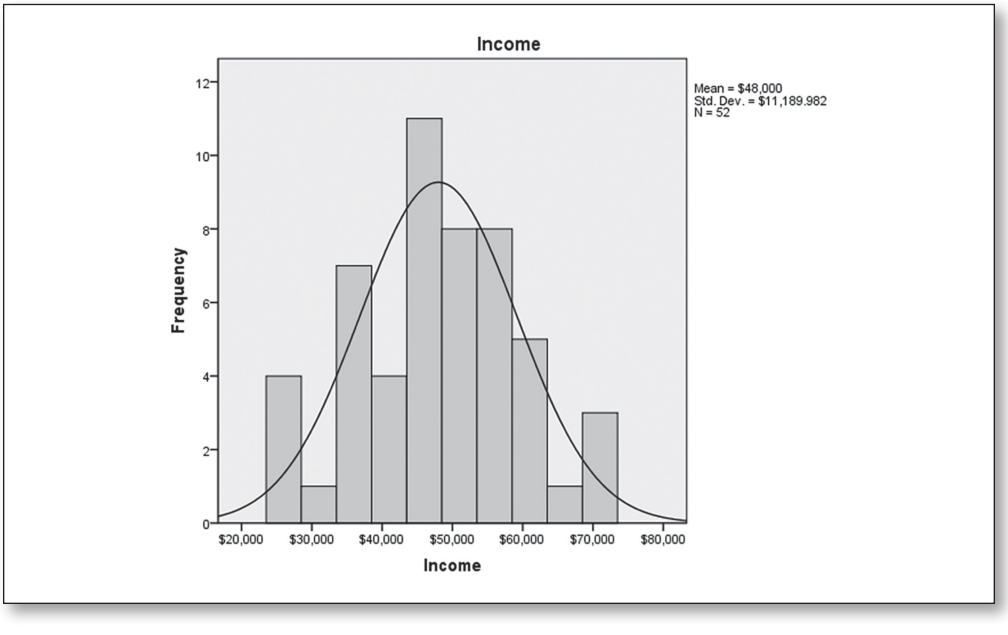
The above table indicates that the *n* should be at least 40; the table below shows that the actual *n* for this data set is 52; hence, this criterion is satisfied.

Buy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	37	71.2	71.2	71.2
	Yes	15	28.8	28.8	100.0
	Total	52	100.0	100.0	

Pretest criterion 2: Normality: Histograms of the continuous variable show a normal symmetrical distribution of the data; hence this criterion is satisfied.





Pretest criterion 3: Multicollinearity: The correlation between these variables (.121) is between −.9 and +.9, indicating that these variables are not strongly correlated with each other; hence this criterion is satisfied.

Correlations

		Age	Income
Age	Pearson Correlation	1	.121
	Sig. (2-tailed)		.391
	N	52	52
Income	Pearson Correlation	.121	1
	Sig. (2-tailed)	.391	
	N	52	52

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	15.525	4	.004
	Block	15.525	4	.004
	Model	15.525	4	.004

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .004 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	46.955[a]	.258	.369

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .369, suggesting that the model accounts for an estimated 36.9% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	-.140	.050	7.823	1	.005	.869	.788	.959
	Gender(1) **[0 = Female, 1 = Male]**	-1.429	.762	3.516	1	.061	.240	.054	1.067
	Acme_Coffee(1) **[0 = Doesn't drink Acme Coffee, Drinks Acme Coffee]**	-.134	.822	.026	1	.871	.875	.175	4.385
	Income	.000	.000	3.615	1	.057	1.000	1.000	1.000
	Constant	2.167	2.595	.698	1	.404	8.736		

a. Variable(s) entered on step 1: Age, Gender, Acme_Coffee, Income.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

Acme Coffee, which currently sells gourmet coffee blends, is now considering selling a single-serve coffee maker that brews a cup of coffee in 30 seconds. They survey 52 people to help identify the characteristics of potential customers for this high-tech coffee brewer. Logistic regression analysis revealed that for each additional year of age, the odds of purchasing this device decreases by 13.1% (95% CI .788, .959). Gender, coffee preference (Acme Coffee vs. other brand(s)) and income were identified as statistically insignificant predictors (α = .05). Per these findings, we reject H_0 and accept H_1. These results suggest that promotional efforts should be directed primarily to younger consumers.

EXERCISE 13.9A

(a)

H_0: Gender, age, religion, or SES do not predict organ donor willingness.

H_1: Gender, age, religion, or SES predict organ donor willingness.

(b)

Pretest criterion 1: *n* quota:

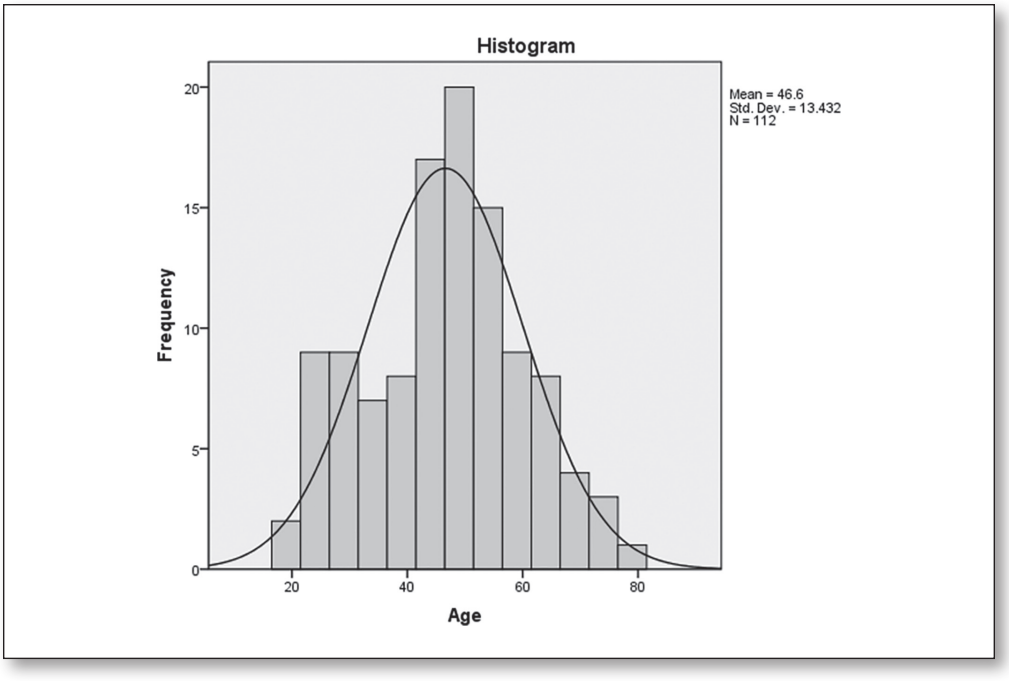
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Age	Continuous		10
Religion	Categorical	50	
SES	Categorical	20	
Total *n* quota = 90		80	10

The above table indicates that the *n* should be at least 90; the table below shows that the actual *n* for this data set is 112; hence, this criterion is satisfied.

Organ_donor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not organ donor	74	66.1	66.1	66.1
	Organ donor	38	33.9	33.9	100.0
	Total	112	100.0	100.0	

Pretest criterion 2: Normality: The histogram of the continuous variable shows a normal symmetrical distribution of the data; hence this criterion is satisfied.



Pretest criterion 3: Multicollinearity: Since there is only one continuous variable in this model, multicollinearity is not an issue; hence, this criterion is satisfied.

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	34.097	9	.000
	Block	34.097	9	.000
	Model	34.097	9	.000

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .000 for Step 1 (Step), suggesting that at least one statistically significant predictor has been detected within this model. Each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	109.388[a]	.262	.363

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .363, suggesting that the model accounts for an estimated 36.3% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	1.818	.568	10.252	1	.001	6.159	2.024	18.742
	Age	-.036	.019	3.582	1	.058	.965	.929	1.001
	Religion **[0 = Atheist]**			18.946	5	.002			
	Religion(1) **[1 = Buddhist]**	-2.851	1.009	7.984	1	.005	.058	.008	.418
	Religion(2) **[2 = Catholic]**	-1.718	.776	4.899	1	.027	.179	.039	.821
	Religion(3) **[3 = Hindu]**	-2.697	.856	9.923	1	.002	.067	.013	.361
	Religion(4) **[4 = Jewish]**	.758	.783	.938	1	.333	2.133	.460	9.890
	Religion(5) **[5 = Other]**	-.860	.815	1.114	1	.291	.423	.086	2.090
	SES **[0 = Lower class]**			2.834	2	.242			
	SES(1) **[1 = Middle class]**	.599	.589	1.035	1	.309	1.821	.574	5.778
	SES(2) **[2 = Upper class]**	-.445	.778	.326	1	.568	.641	.139	2.947
	Constant	.996	1.170	.726	1	.394	2.708		

a. Variable(s) entered on step 1: Gender, Age, Religion, SES.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

The nursing representative on the Transplant Committee surveyed 112 adults to determine the characteristics of voluntary organ donors. Logistic regression revealed that men have 6.16 times the odds of being voluntary organ donor, compared to women (95% CI 2.024, 18.742). We also found that atheists have 17 times the odds of being an organ donor compared to Buddhists (95% CI .008, .418); additionally, atheists have 5.6 times the odds of being an organ donor compared to Catholics (95% .039, .821), and atheists have 15 times the odds of being an organ donor compared to Hindus (95% .013, .361). Other variables that were assessed (age, socioeconomic status) were found to be insignificant predictors with respect to organ donation ($p > .05$). Based on these findings, we will be conducting two separate focus groups (one for women, one for men) to gain insights into this decision-making process. Additionally, it appears that atheists are particularly willing to provide organ donation. Insights gained from these focus groups will be used to develop and implement a public awareness / educational campaign.

EXERCISE 13.9B

(a)

H_0: Gender, age, religion, or SES do not predict organ donor willingness.

H_1: Gender, age, religion, or SES predict organ donor willingness.

(b)

Pretest criterion 1: *n* quota:

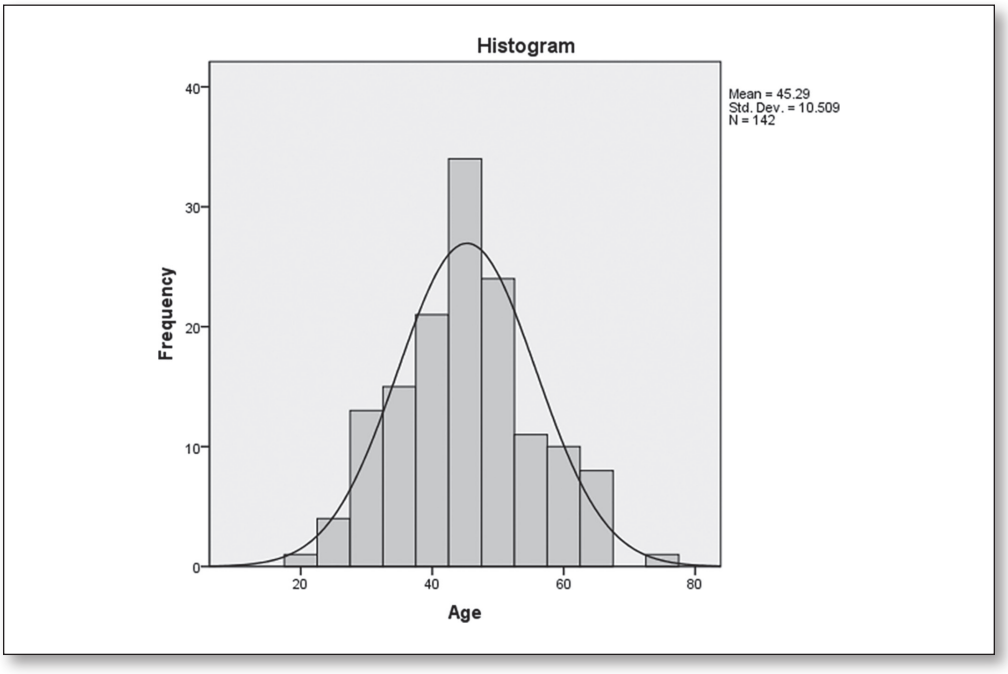
Variable	Type	Categorical (Categories – 1) × 10	Continuous 10
Gender	Categorical	10	
Age	Continuous		10
Religion	Categorical	50	
SES	Categorical	20	
Total *n* quota = 90		80	10

The above table indicates that the *n* should be at least 90; the table below shows that the actual *n* for this data set is 142; hence, this criterion is satisfied.

Organ_donor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not organ donor	127	89.4	89.4	89.4
	Organ donor	15	10.6	10.6	100.0
	Total	142	100.0	100.0	

Pretest criterion 2: Normality: The histogram of the continuous variable shows a normal symmetrical distribution of the data; hence this criterion is satisfied.



Pretest criterion 3: Multicollinearity: Since there is only one continuous variable in this model, multicollinearity is not an issue; hence, this criterion is satisfied.

(c)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12.670	9	.178
	Block	12.670	9	.178
	Model	12.670	9	.178

The *Omnibus Tests of Model Coefficients* table indicates a Sig. (*p*) of .178 for Step 1 (Step), suggesting that there are no statistically significant predictors in this model. To verify this finding, each predictor will be individually assessed in the *Variables in the Equation* table.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	83.120[a]	.085	.174

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The Nagelkerke (pseudo) R^2 = .174, suggesting that the model accounts for an estimated 17.4% of the variability in the outcome variable.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Gender(1) **[0 = Female, 1 = Male]**	-.700	.687	1.040	1	.308	.496	.129	1.907
	Age	-.075	.031	5.795	1	.016	.928	.872	.986
	Religion **[0 = Atheist]**			2.658	5	.753			
	Religion(1) **[1 = Buddhist]**	.174	1.085	.026	1	.873	1.190	.142	9.984
	Religion(2) **[2 = Catholic]**	-.262	.874	.090	1	.764	.769	.139	4.265
	Religion(3) **[3 = Hindu]**	-.818	.956	.733	1	.392	.441	.068	2.872
	Religion(4) **[4 = Jewish]**	-1.216	1.200	1.027	1	.311	.296	.028	3.113
	Religion(5) **[5 = Other]**	.346	.903	.147	1	.701	1.414	.241	8.293
	SES **[0 = Lower class]**			.055	2	.973			
	SES(1) **[1 = Middle class]**	-.184	.786	.055	1	.815	.832	.178	3.885
	SES(2) **[2 = Upper class]**	-.138	.843	.027	1	.870	.871	.167	4.544
	Constant	1.696	1.490	1.296	1	.255	5.455		

a. Variable(s) entered on step 1: Gender, Age, Religion, SES.

Since there is at least one predictor with a Sig. (p) less than α (.05), I would reject H_0 and accept H_1.

(d)

The nursing representative on the Transplant Committee surveyed 142 adults to determine the characteristics of voluntary organ donors. Logistic regression revealed that younger people were more likely to choose to be a voluntary organ donor; for every additional year of age, the odds of being an organ donor decreases by 7.2% (p = .016) (95% CI .87, .99). Other variables (gender, religion, and socioeconomic status) were found to be insignificant predictors (p > .30). Based on these findings, we will be conducting focus groups of samples gathered from the population (one for older, one for younger) to gain insights into this decision-making process. Insights gained from these focus groups will be used to develop and implement a public awareness / educational campaign.