



conrad

School of Entrepreneurship and Business

Agenda

01

Recap

02

Hands-on
Exercise

03

Regression
Extensions

Numerical Measure of a Simple Linear Relationship

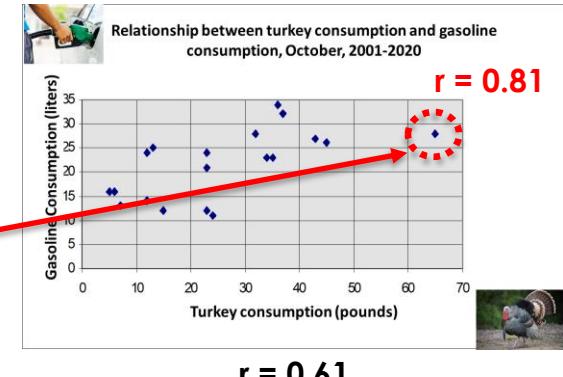
Correlation

- The relationship between two variables
- Measured with a correlation coefficient
- Most popularly seen **correlation coefficient: Pearson Product-Moment Correlation**
- Symbolized by r (*sample*) and ρ (*population*)
- A measure of degree of a **linear relationship**
- **Varies between 1 and -1**, where the sign refers to relational direction.
- **Based on covariance**
 - Measure of degree to which large scores on X go with large scores on Y, and small scores on X go with small scores on Y
- **Does not imply causation**

Factors Affecting r

- **Outliers**

- Overestimate Correlation
- Underestimate Correlation



- **Range restrictions**

- Looking at only a small portion of the total scatter plot (looking at a smaller portion of the scores' variability) **decreases r** .
- Reducing variability reduces r

- **Nonlinearity**

- The Pearson r (and its relatives) measure the degree of **linear** relationship between two variables
- If a strong non-linear relationship exists, r will provide a low, or at least inaccurate measure of the true relationship

Describing the Linear Relationship

Simple Linear Regression

- Simple linear regression describes the relationship between **two continuous variables**
- Simple linear regression gives the **equation of the straight line** that best describes the association between two interval and or ratio variables
- It enables the **prediction of one variable using information from another variable**
- The **dependent variable** is the variable to be predicted (i.e. the particular outcome interested in)
 - Also called **endogenous** or response variable
- The **independent variable** or **explanatory** variable is the variable used for predicting the particular outcome.
 - Also called **exogenous** variable(s)

Population Linear Regression

- Population Regression Line Is A Straight Line that Describes The Dependence of One Variable on The Other

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

Population Y intercept

Dependent (Response) Variable

Population Regression Line

Population Slope Coefficient

Independent (Explanatory) Variable

Random Error

Hands-on Analysis

- All questions below refer to the brand tracking questionnaire and data made available for this class on LEARN
 1. What is the nature of association between Brand Commitment and Likelihood to Recommend for the 6 brands included in the data ?
 2. Amazon is interested in knowing whether the satisfaction with their reward program differs by the gender and household income.
 3. JC Penny and Amazon are both interested in knowing whether there is a relationship between annual household income and the respective Likelihood to Purchase (time frame) for their brands.
 4. Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

Hands-on Analysis

- All questions below refer to the brand tracking questionnaire and data made available for this class on LEARN
 1. What is the nature of association between Brand Commitment and Likelihood to Recommend for the 6 brands included in the data ?
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What is the nature of association between Brand Commitment and Likelihood to Recommend for Brand X?

Brand Commitment						
Q11 Imagine you had to shop at a retail store, which of these statements best describes how much you would consider shopping at each of these stores? (Please select one answer for each brand)						
1 PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND.						
ACCEPT ONLY ONE ANSWER IN FIRST ROW "ONLY STORE WOULD CONSIDER"						
	Brand X	JC Penney Target	Kohl's	Nordstrom	Amazon	TJ Maxx
Favorite store; only one I consider	<input type="radio"/>					
Store I prefer and consider highly	<input type="radio"/>					
Store I consider equally with others	<input type="radio"/>					
Store I might consider, less so than others	<input type="radio"/>					
Not a store I usually consider	<input type="radio"/>					
Store I would never consider	<input type="radio"/>					
Likelihood Recommend						
Q13 How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend.						
PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND. SHOW EACH RETAILER ON SEPARATE SCREENS.						
	Brand X	JC Penney Target	Kohl's	Nordstrom	Amazon	TJ Maxx
0	<input type="radio"/>					
1	<input type="radio"/>					
2	<input type="radio"/>					
3	<input type="radio"/>					
4	<input type="radio"/>					
5	<input type="radio"/>					
6	<input type="radio"/>					
7	<input type="radio"/>					
8	<input type="radio"/>					
9	<input type="radio"/>					
10	<input type="radio"/>					

The screenshot displays two windows of the IBM SPSS Statistics Data Editor. The top window shows the 'Variable View' with 18 variables listed. The bottom window shows the 'Bivariate Correlations' dialog box with 'interview_start' selected in the 'Variables' list. A large blue arrow points from the top window down to the bottom window.

Name	Type	Width	Decimals	Label	Values	Missing	Column
1 respid	Numeric	8	0	respid	None	None	8
2 status	String	8	0	status	None	None	20
3 interview_start	Date	10	0	interview_start	None	None	8
4 interview_end	Double	8	0	interview_end	None	None	8
5 httotaltimein...	Double	8	0	Survey duration ...	None	None	8
6 userid	String	50	0	userid	None	None	50
7 subsid	String	50	0	SubsID	None	None	50
8 s1	String	8	0	Are you...	{1, Male}...	None	8
9 os2	String	5	0	Please enter yo...	None	None	5
10 dregion	String	8	0	dRegion	{1, NORTH...}	None	8
11 dregion1	String	8	0	dRegion1	{1, Northeas...}	None	8
12 s3	String	8	0	Please enter yo...	None	None	8
13 hage	String	8	0	PLEASE CODE...	{1, 1-17}...	None	8
14 s4_1	String	8	0	No, not of Hispa...	None	None	8
15 s4_2	String	8	0	Yes, Mexican, ...	None	None	8
16 s4_3	String	8	0	Yes, Puerto Ric...	None	None	8
17 s4_4	String	8	0	Yes, Cuban (Ar...	None	None	8
18 s4_5	String	8	0	Yes, Central / S...	None	None	8

Name	Type	Width	Decimals	Label	Values	Missing	Column
1 respid	Numeric	8	0	respid	None	None	8
2 status	String	8	0	status	None	None	20
3 interview_start	Date	10	0	interview_start	None	None	8
4 interview_end	Double	8	0	interview_end	None	None	8
5 httotaltimein...	Double	8	0	httotaltimein...	None	None	8
6 userid	String	50	0	userid	None	None	50
7 subsid	String	50	0	subsid	None	None	50
8 s1	String	8	0	s1	None	None	8
9 os2	String	5	0	os2	None	None	5
10 dregion	String	8	0	dregion	None	None	8
11 dregion1	String	8	0	dregion1	None	None	8
12 s3	String	8	0	s3	None	None	8
13 hage	String	8	0	hage	None	None	8
14 s4_1	String	8	0	s4_1	No, not of Hispan...	None	8
15 s4_2	String	8	0	s4_2	Yes, Mexican, ...	None	8
16 s4_3	String	8	0	s4_3	Yes, Puerto Ric...	None	8
17 s4_4	String	8	0	s4_4	Yes, Cuban (Ar...	None	8
18 s4_5	String	8	0	s4_5	Yes, Central / S...	None	8

What is the nature of association between Brand Commitment and Likelihood to Recommend for Brand X?

Correlations		
	Brand X	Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. Brand X)
Brand X	Pearson Correlation	1
	Sig. (2-tailed)	.000
	N	4331
Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. Brand X)	Pearson Correlation	-.705**
	Sig. (2-tailed)	.000
	N	4331

**. Correlation is significant at the 0.01 level (2-tailed).

There is a **negative significant** association between Brand Commitment and Likelihood to Recommend

Hands-on Analysis

- All questions below refer to the brand tracking questionnaire and data made available for this class on LEARN
 1. What is the nature of association between Brand Commitment and Likelihood to Recommend for the 6 brands included in the data ?
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 4. Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

Amazon is interested in knowing whether the satisfaction with their reward program differs by the gender and household income

S1 Are you...	GO TO
Male	S2
Female	

S8 Which of the following best describes your annual household income? (Please select one answer)	GO TO
Under \$25,000	
\$25,000 to less than \$35,000	Terminate
\$35,000 to less than \$50,000	
\$50,000 to less than \$75,000	
\$75,000 to less than \$100,000	
\$100,000 to less than \$125,000	S9
\$125,000 to less than \$150,000	
\$150,000 to less than \$200,000	
\$200,000 or more	

PROGRAMMER: IF CODED AS MARRIED AT S7, INCOME MUST BE AT LEAST \$50,000; OTHERWISE TERMINATE.

Q21. For the following programs that you are enrolled in, how satisfied are you with the value of the rewards? (only show responses of "enrolled" from previous question)

SAME ORDER AS Q20 and ONLY SHOW BRANDS ENROLLED IN	Very Satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied
Plenti Rewards					
Brand X Star Rewards					
Amazon Prime					
TJX Rewards Access					
Nordstrom Fashion Rewards					
Bloomingdales Loyalist					
JC Penney JCP Rewards					
Kohl's Rewards					
Banana Republic/Gap/Old Navy					
Sephora Beauty Insider					
Nordstrom Fashion Rewards					
Ulta Ultamate Rewards					
DSW Rewards					
Victoria's Secret Angel Card					

Name	Type	Width	Decimals	Label	Values	Missing	Column
1 respid		0	0	respid	None	None	8
2 status		0	0	status	None	None	20
3 interview_start		0	0	interview_start	None	None	8
4 interview_end		0	0	interview_end	None	None	8
5 htotaltimein...		0	0	Survey duration ...	None	None	8
6 userid		0	0	userid	None	None	50
7 subsid		0	0	Subsid	None	None	50
8 s1		0	0	Are you... {1, Male}...	None	None	8
9 os2		0	0	Please enter yo...	None	None	5
10 dregion		0	0	dRegion {1, NORTH...	None	None	8
11 dregion1		0	0	dRegion1 {1, Northeas...	None	None	8
12 s3		0	0	Please enter yo...	None	None	8
13 hage		0	0	PLEASE CODE... {1, 1-17}...	None	None	8
14 s4_1	Numeric	1	0	No, not of Hispan...	None	None	8
15 s4_2	Numeric	1	0	Yes, Mexican, ...	None	None	8
16 s4_3	Numeric	1	0	Yes, Puerto Ric...	None	None	8
17 s4_4	Numeric	1	0	Yes, Cuban (Ar...	None	None	8
18 s4_5	Numeric	1	0	Yes, Central / S...	None	None	8

Name	Type	Width	Decimals	Label	Values	Missing	Column
1 respid	Numeric	8	0	respid	None	None	8
2 status	String	8	0	status	None	None	20
3 interview_start							
4 interview_end							
5 htotaltimein...							
6 userid							
7 subsid							
8 s1							
9 os2							
10 dregion							
11 dregion1							
12 s3							
13 hage	Numeric	2	0	PLEASE CODE...	None	None	8
14 s4_1	Numeric	1	0	No, not of Hispan...	None	None	8
15 s4_2	Numeric	1	0	Yes, Mexican, ...	None	None	8
16 s4_3	Numeric	1	0	Yes, Puerto Ric...	None	None	8
17 s4_4	Numeric	1	0	Yes, Cuban (Ar...	None	None	8
18 s4_5	Numeric	1	0	Yes, Central / S...	None	None	8

Amazon is interested in knowing whether the satisfaction with their reward program differs by the gender and household income

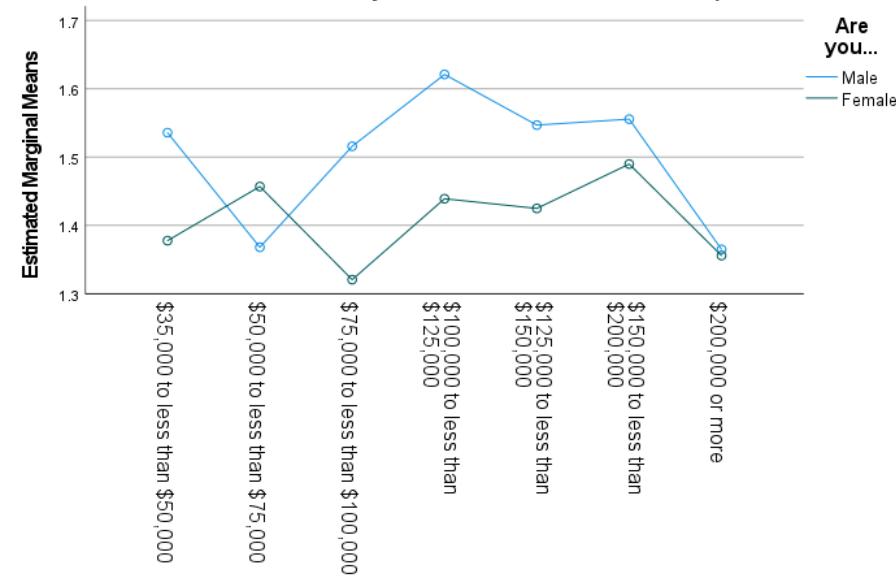
Tests of Between-Subjects Effects

Dependent Variable: Amazon Prime (For the following programs that you are enrolled in, how satisfied are you with the value of the rewards?)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13.871 ^a	13	1.067	1.762	.044
Intercept	2840.831	1	2840.831	4690.951	.000
s1	2.834	1	2.834	4.680	.031
s8	5.247	6	.874	1.444	.194
s1 * s8	5.184	6	.864	1.427	.200
Error	1315.965	2173	.606		
Total	5798.000	2187			
Corrected Total	1329.835	2186			

a. R Squared = .010 (Adjusted R Squared = .005)

Estimated Marginal Means of Amazon Prime (For the following programs that you are enrolled in, how satisfied are you with the value of the rewards?)



Are you... * Which of the following best describes your annual household income?

Are you...	Which of the following best describes your annual household income?	95% Confidence Interval			
		Mean	Std. Error	Lower Bound	Upper Bound
Male	\$35,000 to less than \$50,000	1.536	.147	1.247	1.824
	\$50,000 to less than \$75,000	1.368	.070	1.232	1.504
	\$75,000 to less than \$100,000	1.516	.069	1.380	1.652
	\$100,000 to less than \$125,000	1.621	.080	1.464	1.778
	\$125,000 to less than \$150,000	1.547	.097	1.356	1.738
	\$150,000 to less than \$200,000	1.556	.098	1.363	1.748
	\$200,000 or more	1.365	.090	1.187	1.542
	Female	1.378	.065	1.250	1.505
	\$35,000 to less than \$50,000	1.457	.038	1.383	1.531
	\$50,000 to less than \$75,000	1.321	.039	1.243	1.398
	\$75,000 to less than \$100,000	1.439	.050	1.342	1.536
	\$100,000 to less than \$125,000	1.425	.063	1.301	1.548
	\$125,000 to less than \$150,000	1.490	.064	1.364	1.616
	\$150,000 to less than \$200,000	1.356	.076	1.206	1.505
	\$200,000 or more				

1. Overall Model: **significant**
2. Gender Effect: **significant**
3. Income Effect: **non-significant**
4. Interaction Effect: **non-significant**

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 4. Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

Amazon is interested in knowing whether there is a relationship between annual household income and the respective Likelihood to Purchase (time frame) for its brand.

S8 Which of the following best describes your annual household income? (Please select one answer)	GO TO
Under \$25,000	
\$25,000 to less than \$35,000	Terminate
\$35,000 to less than \$50,000	
\$50,000 to less than \$75,000	
\$75,000 to less than \$100,000	
\$100,000 to less than \$125,000	
\$125,000 to less than \$150,000	
\$150,000 to less than \$200,000	
\$200,000 or more	S9

PROGRAMMER: IF CODED AS MARRIED AT S7, INCOME MUST BE AT LEAST \$50,000; OTHERWISE TERMINATE.

Likelihood to Purchase						
	Brand X	JC PenneyTarget	Kohl's	Nordstrom	Amazon	TJ Maxx
Within the next month	<input type="radio"/>					
Within next 1-3 months	<input type="radio"/>					
With next 3-6 months						
Within next 6-9 months	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Within 9 months – 1 year		<input type="radio"/>				
Longer than 1 year	<input type="radio"/>					
I'm not sure when I will shop there again						

Convert to missing??

The screenshot shows the IBM SPSS Statistics Data Editor interface. The 'Analyze' menu is open, and the 'Correlate' option is selected, which then displays the 'Bivariate' dialog box. In the 'Variables' list, 's8' and 'q12x23' are selected. The 'Test of Significance' section includes options for Pearson, Kendall's tau-b, Spearman, and Two-tailed. The 'OK' button is highlighted at the bottom of the dialog box.

Amazon is interested in knowing whether there is a relationship between annual household income and the respective Likelihood to Purchase (time frame) for its brand.

Correlations

		Which of the following best describes your annual household income?	Amazon	
Spearman's rho	Which of the following best describes your annual household income?		Correlation Coefficient	1.000
			Sig. (2-tailed)	.018
			N	4331
	Amazon		Correlation Coefficient	-0.059*
			Sig. (2-tailed)	.018
			N	1608
				1608

*. Correlation is significant at the 0.05 level (2-tailed).

There is a **negative significant** association between annual household income and Likelihood to Purchase (time frame) for Amazon.

Hands-on Analysis

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Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

Brand Love						
Q6 Which statement best captures how you feel about the following brands?						
PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND. RANDOMIZE						
	Brand I love	Brand I feel good about	No positive or negative feeling	Brand I feel somewhat negative about	Brand I dislike	Don't know enough about brand
Apple	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amazon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Target	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brand X	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
IKEA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kohl's	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole Foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TJ Maxx	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nordstrom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sephora	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Zappos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bed, Bath & Beyond	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H&M	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
JC Penney	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nike	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coca-Cola	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Convert to missing

Likelihood Recommend						
Q13 How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend.						
PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND. SHOW EACH RETAILER ON SEPARATE SCREENS.						
	Brand X	JC PenneyTa get	Kohl's	Nordstrom	Amazon	TJ Maxx
0	<input type="radio"/>					
1	<input type="radio"/>					
2	<input type="radio"/>					
3	<input type="radio"/>					
4	<input type="radio"/>					
5	<input type="radio"/>					
6	<input type="radio"/>					
7	<input type="radio"/>					
8	<input type="radio"/>					
9	<input type="radio"/>					
10	<input type="radio"/>					

Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

Data View **Variable View**

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
184	q5b_8	Numeric	1	0	Skincare...	None	None	8	Right	Nominal	Input
185	q5b_9	Numeric	1	0	Handba...	None	None	8	Right	Nominal	Input
186	q5b_10	Numeric	1	0	Jewelry ...	None	None	8	Right	Nominal	Input
187	q5b_11	Numeric	1	0	Home D...	None	None	8	Right	Nominal	Input
188	q5b_12	Numeric	1	0	Kitchen ...	None	None	8	Right	Nominal	Input
189	q5b_13	Numeric	1	0	Bedding ...	None	None	8	Right	Nominal	Input
190	q5b_98	Numeric	1	0	Other (Y...)	None	None	8	Right	Nominal	Input
191	hbrandq...	Numeric	1	0	Women's...	None	None	8	Right	Nominal	Input
192	hbrandq...	Numeric	1	0	Men's Br...	None	None	8	Right	Nominal	Input
193	hbrandq...	Numeric	1	0	Home Br...	None	None	8	Right	Nominal	Input
194	q6_1	Numeric	1	0	Apple (W... {1, Brand...)	None	8	Right	Nominal	Input	
195	q6_2	Numeric	1	0	Amazon (W... {1, Brand...)	None	8	Right	Nominal	Input	
196	q6_3	Numeric	1	0	Target (W... {1, Brand...)	None	8	Right	Nominal	Input	
197	q6_4	Numeric	1	0	BrandX (W... {1, Brand...)	None	8	Right	Nominal	Input	
198	q6_5	Numeric	1	0	IKEA (W... {1, Brand...)	None	8	Right	Nominal	Input	
199	q6_6	Numeric	1	0	Kohl's (W... {1, Brand...)	None	8	Right	Nominal	Input	
200	q6_7	Numeric	1	0	Whole F... {1, Brand...)	None	8	Right	Nominal	Input	
201	q6_8	Numeric	1	0	TJ Maxx (W... {1, Brand...)	None	8	Right	Nominal	Input	
202	q6_9	Numeric	1	0	Nordstro... {1, Brand...)	None	8	Right	Nominal	Input	
203	q6_10	Numeric	1	0	Sephora ... {1, Brand...)	None	8	Right	Nominal	Input	
204	q6_11	Numeric	1	0	Zappos ... {1, Brand...)	None	8	Right	Nominal	Input	
205	q6_12	Numeric	1	0	Bed, Bat... {1, Brand...)	None	8	Right	Nominal	Input	
206	q6_13	Numeric	1	0	H&M (W... {1, Brand...)	None	8	Right	Nominal	Input	
207	q6_14	Numeric	1	0	JC Penn... {1, Brand...)	6	8	Right	Nominal	Input	
208	q6_15	Numeric	1	0	Nike (Wh... {1, Brand...)	None	8	Right	Nominal	Input	
209	q6_16	Numeric	1	0	Coca-Co... {1, Brand...)	None	8	Right	Nominal	Input	
210	q6_17	Numeric	1	0	Google ... {1, Brand...)	None	8	Right	Nominal	Input	
211	dsel11_1	Numeric	1	0	Brand X... None	None	8	Right	Nominal	Input	
212	dsel11_2	Numeric	1	0	JC Penn... None	None	8	Right	Nominal	Input	
213	dsel11_11	Numeric	1	0	Kohl's (*... None	None	8	Right	Nominal	Input	
214	dsel11_3	Numeric	1	0	Nordstro... None	None	8	Right	Nominal	Input	
215	dsel11_23	Numeric	1	0	Amazon ... None	None	8	Right	Nominal	Input	
216	dsel11_15	Numeric	1	0	TJ Maxx ... None	None	8	Right	Nominal	Input	
217	q7_1	String	1	0	Thinking ... None	None	50	Left	Nominal	Input	
218	q7_2	String	1	0	Thinking ... None	None	50	Left	Nominal	Input	
219	q7_11	String	1	0	Thinking ... None	None	50	Left	Nominal	Input	
220	q7_3	String	1	0	Thinking ... None	None	50	Left	Nominal	Input	
221	q7_23	String	1	0	Thinking ... None	None	50	Left	Nominal	Input	

Linear Regression

Dependent: q13_1_2

Block 1 of 1

Independent(s): q6_14

Method: Enter

Selection Variable: Rule...

Case Labels:

WLS Weight:

OK Paste Reset Cancel Help

Does perceptions of Brand Love for JC Penny impact the Likelihood of Recommendation? What is the strength and nature of that relationship?

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.633 ^a	.401	.395	1.656	

a. Predictors: (Constant), JC Penney (Which statement best captures how you feel about the following brands?)

ANOVA ^a		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	176.246	1	176.246	64.246	<.001 ^b
	Residual	263.356	96	2.743		
	Total	439.602	97			

a. Dependent Variable: Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. JC Penney)

b. Predictors: (Constant), JC Penney (Which statement best captures how you feel about the following brands?)

Coefficients ^a		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	10.982	.497		22.116	<.001
	JC Penney (Which statement best captures how you feel about the following brands?)	-1.766	.220	-.633	-8.015	<.001

a. Dependent Variable: Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. JC Penney)

Predicted
Likelihood to Recommend = **constant** + **B** **Brand Love for JC Penny**
JC Penny

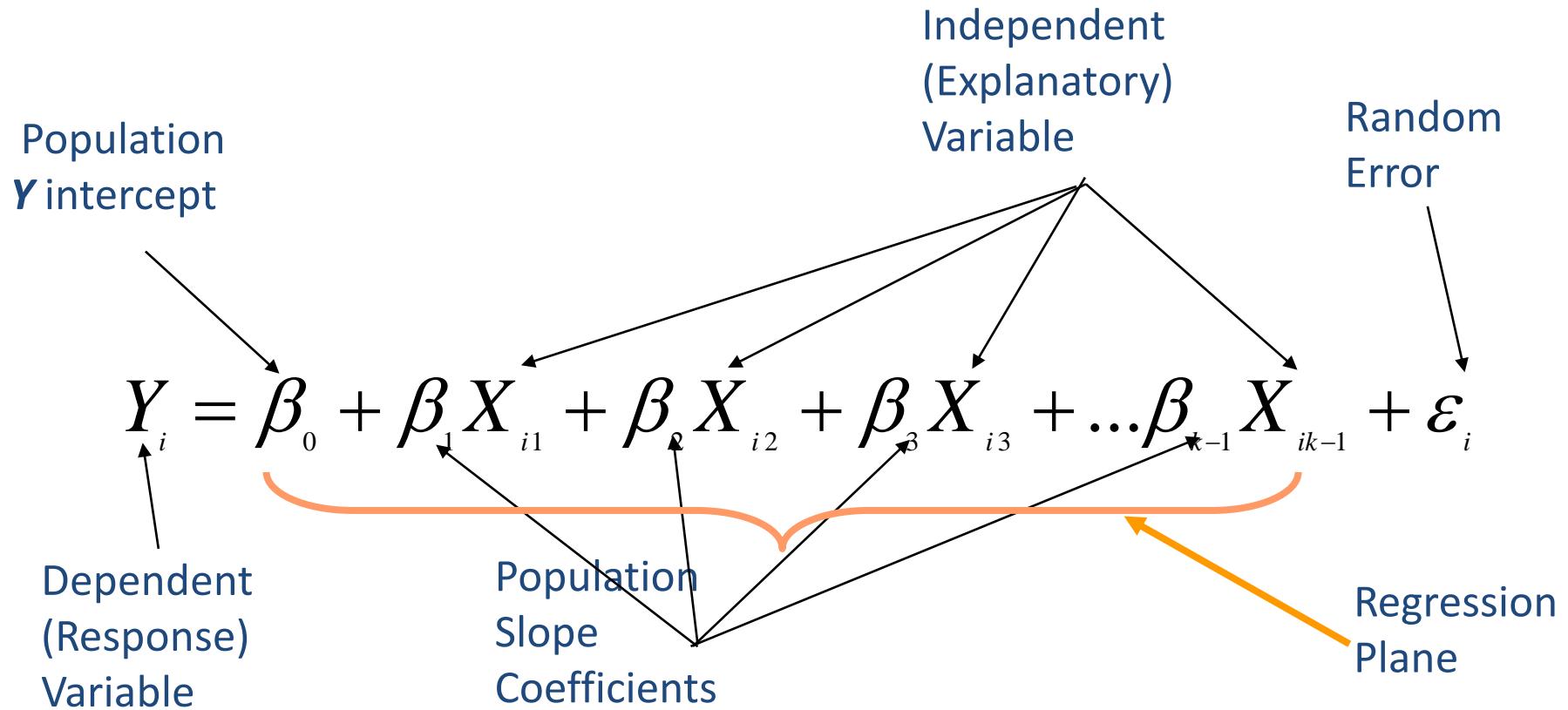
Predicted
Likelihood to Recommend = **10.982** + **(-1.766)** **Brand Love for JC Penny**
JC Penny

What if I have a Whole Bunch of Predictors?

Multiple Linear Regression

- Situations frequently occur when we are interested in the dependency of a variable on several explanatory (independent) variables.
- The joint influence of the variables, taking into account possible correlations among them, may be investigated using multiple regression
- Multiple regression can be extended to any number of variables, although it is recommended that the number be kept reasonably small

The Multiple Regression Model



The Multiple Regression Model

The Multiple Regression Model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p + \varepsilon$$

The Multiple Regression Equation

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p$$

The Estimated Multiple Regression Equation

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_p x_p$$

Least-Squares Property

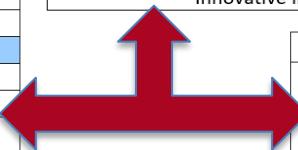
A plane satisfies this property if the sum of the squares of the residuals is the smallest sum possible.

Research Question

- Data on Brand Imagery with various attributes of Brand X were collected in the survey. Brand X is interested in looking at what attributes are related to Brand Commitment of Brand X customers

Brand Attribute– Brand X					
<p>Q14 Below is a list of different statements that people have made about retail stores. Please read each statement and rate (PIPE BRAND) on a scale of 1 to 5, where 5 means "Describes Extremely Well," and 1 means "Does Not Describe At All."</p> <p>Please select "N/A" if an option does not apply.</p>					
Add N/A Column					
Rotate options within each section					
	not at all 1	not very well 2	somewhat 3	very well 4	Extremely Well 5
Value Attributes (do not show header)					
Good value for the money					
Great sales					
Good shopper rewards program					
Product Attributes (do not show header)					
Top quality merchandise					
Has the latest styles & fashions					
Carries the brands I want					
Has brands/products I want, but can't find anywhere else					
Good place to shop for gifts					
Best selection of brands and designers					
A store I trust for important occasions					
Store Experience Attributes (do not show header)					
Is a store for people like me					
Easy to find what I'm looking for					
Store I am proud to shop at					

Fun and exciting shopping experience					
Service Attributes (do not show header)					
Has warm and friendly salespeople					
Has available salespeople					
Makes it easy to return items					
Brand Attributes (do not show header)					
I often discover new things to buy					
Helps express my personal style					
Inspires me to try new things					
Has merchandise worth paying more for					
Omnichannel (do not show header)					
Offers a consistent experience online and in store					
Offers convenient ways to shop in stores and online					
Innovative in making shopping easier					



Brand Commitment						
	Brand X	JC Penney Target	Kohl's	Nordstrom	Amazon	TJ Maxx
Favorite store; only one I consider	<input type="radio"/>					
Store I prefer and consider highly	<input type="radio"/>					
Store I consider equally with others	<input type="radio"/>					
Store I might consider, less so than others	<input type="radio"/>					
Not a store I usually consider	<input type="radio"/>					
Store I would never consider	<input type="radio"/>					

Testing Hypothesis

H_0 : There is **no linear relationship** between Brand Commitment for Brand X with any of the brand attributes related to Value, Product, Store Experience, Service, Brand and Omnichannel experience.

H_1 : There is a **linear relationship** between Brand Commitment for Brand X and at least one of the brand attributes related to Value, Product, Store Experience, Service, Brand and Omnichannel experience.

SPSS® Analyze | Regression | Linear

Linear Regression

Dependent: q11x1

Block 1 of 1

Previous Next

Block 1 of 1

Method: Enter

Selection Variable: Rule...

Case Labels:

WLS Weight:

OK Paste Reset Cancel Help

Statistics...
Plots...
Save...
Options...
Style...
Bootstrap...

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userid
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os2
dregion
dregion1
s3
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s4_4
s4_5
s4_6
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s5_3
s5_4

Good value for the money (Below is a list of different statements th...
Great sales (Below is a list of different statements that people have...
Good shopper rewards program (Below is a list of different stateme...
Top quality merchandise (Below is a list of different statements that...
Has the latest styles & fashions (Below is a list of different stateme...
Carries the brands I want (Below is a list of different statements tha...
Good place to shop for gifts (Below is a list of different statements t...
Best selection of brands and designers (Below is a list of different s...
A store I trust for important occasions (Below is a list of different st...

SPSS: 1. Coefficient of Determination

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.670 ^a	.449	.445	.839

- **R - coefficient of multiple correlation:** It is the correlation between Brand Commitment for Brand X with various Brand Imagery attributes (predictors)
- **R² - coefficient of multiple determination:** It is the proportion of variance in Brand Commitment for Brand X that can be accounted for by the combined predictors
- **Adjusted R²** – Adjusts for degrees of freedom. It penalizes unnecessarily complex models.

SPSS: 2. Linear Regression

ANOVA ^a					
Model		Sum of Squares	df	Mean Square	F
1	Regression	1685.328	23	73.275	104.097
	Residual	2066.693	2936	.704	
	Total	3752.022	2959		

a. Dependent Variable: Brand X

Interpretation of ANOVA table

- A statistically significant proportion of the variability in Brand Commitment for Brand X can be attributed to the regression model ($P<0.01$).

SPSS: 3. Regression Equation

Coefficients ^a						Has the latest styles & fashions (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A')	.071	.031	.058	2.311	.021
Unstandardized Coefficients		Standardized Coefficients		Beta	t	Sig.					
(Constant)	5.894	.079			74.311	.000					
Good value for the money (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A')	-.122	.028	-.106		-4.311	.000					
Great sales (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A')	-.038	.026	-.033		-1.486	.137					
Good shopper rewards program (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A')	4.629E-5	.021	.000		.002	.998					
Top quality merchandise (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A')	.045	.031	.036		1.442	.149					

Is a store for people like me (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'D	-.261	.030	-.240	-8.822	.000	Has available salespeople (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does	-.008	.026	-.007	-.286	.775
Easy to find what I'm looking for (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 mean	-.029	.027	-.026	-1.098	.273	Makes it easy to return items (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'D	-.023	.025	-.019	-.928	.354
Store I am proud to shop at (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Doe	-.125	.030	-.112	-4.185	.000	I often discover new things to buy (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 mea	-.073	.030	-.069	-2.441	.015
Fun and exciting shopping experience (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 m	.034	.030	.031	1.134	.257	Helps express my personal style (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means	-.117	.031	-.104	-3.730	.000
Has warm and friendly salespeople (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1)	-.004	.029	-.003	-.137	.891	Inspires me to try new things (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5,	-.015	.029	-.014	-.515	.607

Has merchandise worth paying more for (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1	-.014	.025	-.013	-.558	.577
Offers a consistent experience online and in store (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely	.015	.029	.013	.510	.610
Offers convenient ways to shop in stores and online (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely	-.046	.029	-.039	-1.574	.116
Innovative in making shopping easier (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 m	-.025	.027	-.023	-.911	.362

7 Significant Predictors + Constant

Brand Commitment = 5.894
+(-0.122* Good Value for Money)
+(0.071*Has Latest Styles)
+(-0.065*Has Brands I Want)
+(-0.261*Store for People like Me)
+(-0.125*Store Proud to Shop at)
+(-0.073*Discover New Things to Buy)
+(-0.117*Helps Express Personal Style)



Where should I focus my resources?

SPSS: Beta Weights

	Coefficients ^a				
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	5.894	.079		74.311	.000
Good value for the money (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does N	-.122	.028	-.106	-4.311	.000
Great sales (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does Not Describe A	-.038	.026	-.033	-1.486	.137
Good shopper rewards program (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Do	4.629E-5	.021	.000	.002	.998
Top quality merchandise (Below is a list of different statements that people have made about retail stores. Please read each statement and rate ^begin(1)^Brand X^end(1) ^ on a scale of 1 to 5, where 5 means 'Describes Extremely Well,' and 1 means 'Does	.045	.031	.036	1.442	.149

- Are used to compare the effects of different X's
 - Largest b* indicates variable with largest effect on Y
- Effectively put Y and Xs into same units (standard deviation units)
- Offers Comparative Analysis

Drivers of Commitment With Brand X:

Seven of the twenty-three individual attributes contribute significantly* to Commitment with Brand X

Attribute	Relative Importance: Beta weight	Relative Ranking of Importance
Good Value for Money	-0.106	
Has the Latest Styles and Fashion	0.058	
Carries the Brands I want	-0.055	
Is a Store for People like me	-0.240	
Store I am Proud to shop at	-0.112	
I often Discover new Things to buy	-0.069	
Helps Express my Personal Style	-0.104	

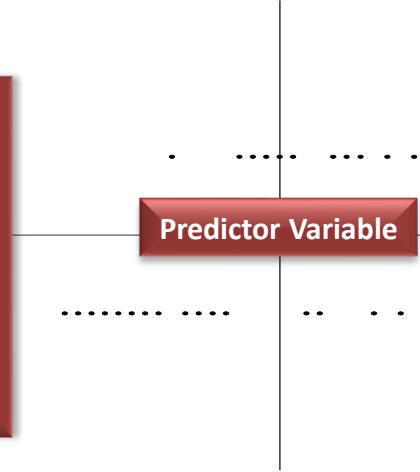
Model R² = 0.45

* - Only attributes significant with p <0.05 are shown

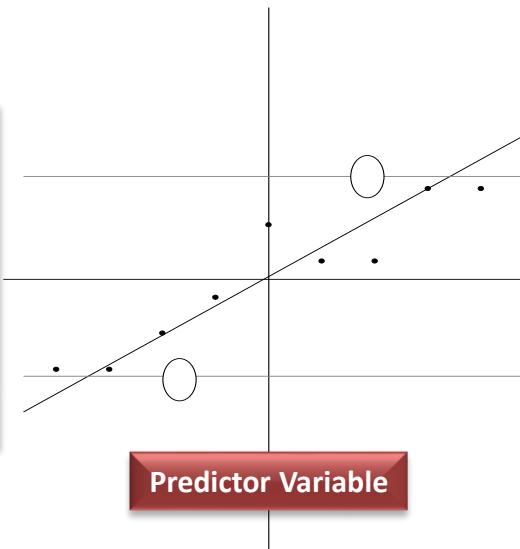
Dealing with Binary Dependent Variables

Problem with Linear Regression

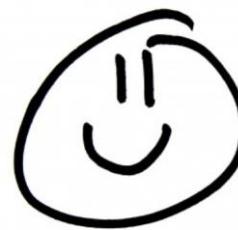
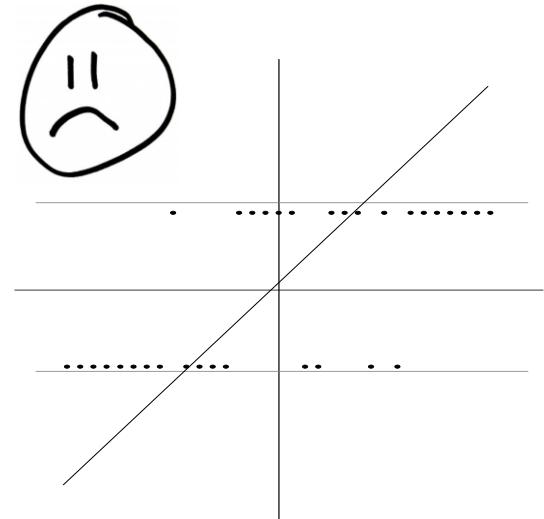
Suppose you have a binary outcome variable. The problem of having a non-continuous dependent variable becomes apparent when you create a scatterplot of the relationship.
Let's try creating a linear regression line.



Horrible Linear Regression Line



We could plot conditional probabilities as Y for each level of X.



Logistic Regression

Logistic Regression

- Logistic regression is used to predict a categorical (usually dichotomous) variable from a set of predictor variables
- For a logistic regression, the predicted dependent variable is a function of the probability that a particular subject will be in one of the categories

Logistic Regression - Examples

- A client wants to understand whether favorable reaction (purchase or not purchase product) to an advertisement is a function of the number of exposures, gender, income, age etc.
- A researcher wants to understand whether drug use (yes or no) can be predicted based on prior criminal convictions, drug use amongst friends, income, age and gender

Odds Ratios

Let's begin with probability. Let's say that the probability of success is .8, thus

$$p = .8$$

Then the probability of failure is

$$q = 1 - p = .2$$

The odds of success are defined as

$$\text{odds(success)} = p/q = .8/.2 = 4,$$

that is, the odds of success are 4 to 1. The odds of failure would be

$$\text{odds(failure)} = q/p = .2/.8 = .25.$$

This looks a little strange, but it is really saying that the odds of failure are 1 to 4.

The odds of success and the odds of failure are just reciprocals of one another, i.e., $1/4 = .25$ and $1/.25 = 4$.

Logistic Regression

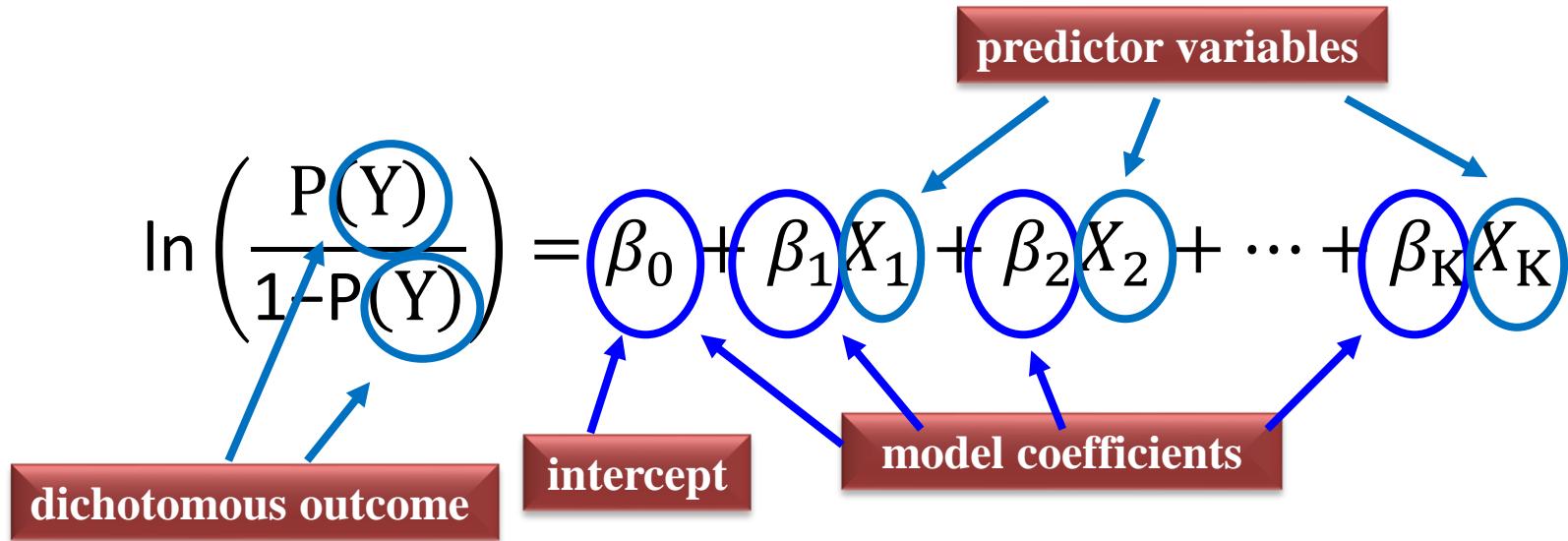
Logistic Regression:

$$\ln \left(\frac{P(Y)}{1-P(Y)} \right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_K X_K$$

Linear Regression:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_K X_K + \varepsilon$$

Logistic Regression



$\ln\left(\frac{P(Y)}{1 - P(Y)}\right)$ is the log(odds) of the outcome.

Form for Predicted Probabilities

$$\ln\left(\frac{P(Y)}{1-P(Y)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_K X_K$$

↔

The Logistic Regression Model

In campaign effectiveness studies, one of the main outcomes is purchase of the advertised product

There is much empirical evidence that the number of advertising exposures play a significant role in product purchase

A recent study examined the effect of the advertisement exposures, on the odds of product purchase

$$\ln\left(\frac{\Pr(\text{product purchase})}{1 - \Pr(\text{product purchase})}\right) = 0.67 + 0.13 * \text{Number of Exposures}$$

⇓

$$\ln \left(\frac{\Pr(\text{product purchase})}{1 - \Pr(\text{product purchase})} \right) = 0.670 + 0.13 * \text{Number of Exposures}$$

\Updownarrow

$$\Pr(\text{product purchase}) = \frac{\exp(0.67 + 0.13 * \text{Number of Exposures})}{1 + \exp(0.67 + 0.13 * \text{Number of Exposures})}$$

Q1. What is the effect of number of exposures on product purchase?

A.  OR_{product purchase} = $\exp(0.13) = 1.1388$

This implies that for every 1 increase in exposure, the odds of product purchase increases by approximately 1.14 times

Q2. What is the predicted probability of a 5 exposures on the probability of product purchase?

$$\Pr_{\text{product purchase}} = \frac{\exp(0.67 + 0.13 * 5)}{1 + \exp(0.67 + 0.13 * 5)} = 0.79$$

- A. From this model, 5 exposures have around a 79% of product purchase success

$$\ln\left(\frac{\Pr(\text{product purchase})}{1 - \Pr(\text{product purchase})}\right) = 0.670 + .13 * \text{Number of Exposures}$$

⇓

$$\Pr(\text{product purchase}) = \frac{\exp(0.67 + 0.13 * \text{Number of Exposures})}{1 + \exp(0.67 + 0.13 * \text{Number of Exposures})}$$

Q3. Okay, so how does the relationship between the odds ratio and probability work here again?

Recall $\text{OR}_{\text{Product Purchase}} = \exp(0.13) = 1.1388 = 1.14$

This implies that for every 1 increase in exposure, the **odds of product purchase increases by approximately 1.14 times**

Let's try it out

$$\Pr(\text{product purchase}) = \frac{\exp(0.67+0.13*5)}{1+\exp(0.67+0.13*5)} = 0.789, \text{ So } \Pr(\text{non purchase}) = 1-0.789 = 0.211$$

$$\text{So OR (product purchase)} = 0.789/0.211 = 3.739$$

$$\Pr(\text{product purchase}) = \frac{\exp(0.67+0.13*4)}{1+\exp(0.67+0.13*4)} = 0.767, \text{ So } \Pr(\text{non purchase}) = 1-0.767 = 0.233$$

$$\text{So OR (product purchase)} = 0.767/0.233 = 3.292$$

So going from 4 exposures to 5 exposures, the Odds of product purchase increase by ?

$$3.739/3.292 = 1.14$$

TILL
NEXT
TIME

