



# Interpreting (Even Tricky) Regression Coefficients

## Review of Regression Models with Continuous Predictors

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## Module 1 Outline



1. Review of Simple Linear Regression
2. Review of Multiple Linear Regression with Continuous Predictors
3. Roles and Measurement of Predictor Variables in Regression



## Review of Simple Linear Regression

## Simple Linear Regression



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

### Definitions:

$Y_i$  = Response for individual  $i$

$\beta_0$  = Intercept

$\beta_1$  = Coefficient of  $X$ ; slope

$X_i$  = Predictor for individual  $i$

$\varepsilon_i$  = Error for individual  $i$

## Simple Linear Regression



$$E(Y|X) = \hat{Y} = b_0 + b_1X$$

### Definitions:

$E(Y|X)$  = Expected Value of Y, accounting for X

$\hat{Y}$  = Predicted value of Y

$b_0$  = Intercept: the mean or predicted value of Y when  $X = 0$

$b_1$  = Coefficient of X; slope

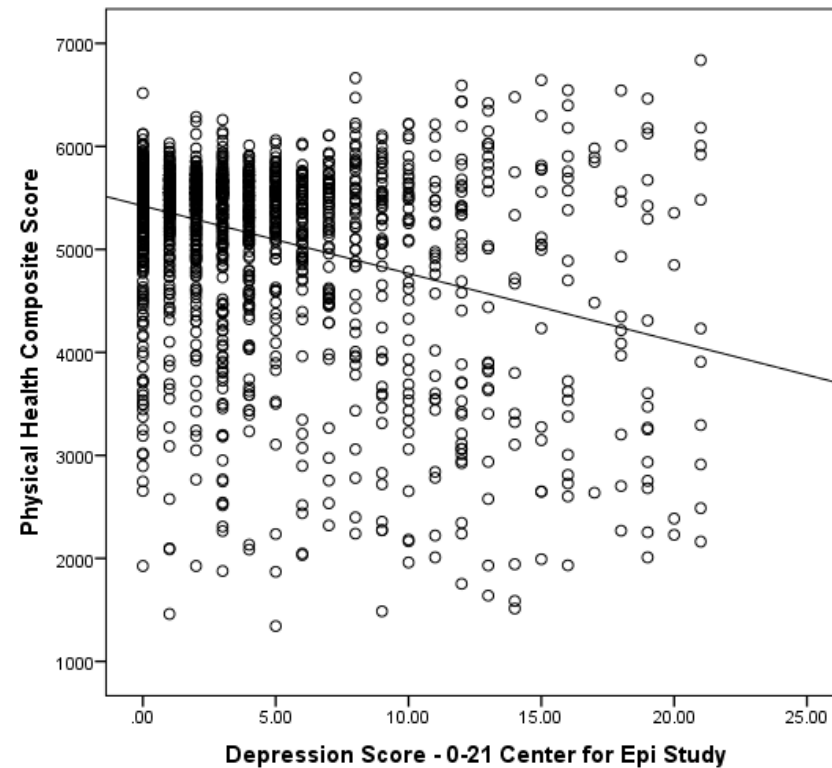
X = Predictor variable

## Simple Linear Regression



NLSY

Physical Health by Depression



## Simple Linear Regression



### *Regression Coefficients*

Dependent Variable: PCS

Variable	B	se	t	p	95% Confidence Interval	
Intercept	5421.387	21.707	249.748	.000	5378.816	5463.958
Depression	-65.629	3.848	-17.057	.000	-73.175	-58.084

$$E(\text{Physical Health}) = 5421.387 - 65.629(\text{Depression})$$



## **Review of Multiple Linear Regression with Continuous Predictors**



## Multiple Regression



### *Regression Coefficients*

Dependent Variable: PCS

Variable	B	se	t	p	95% Confidence Interval	
Intercept	5931.907	182.535	32.497	.000	5573.938	6289.877
Depression	-84.633	5.217	-16.222	.000	-94.865	-74.402
Education	30.748	6.753	4.553	.000	17.504	43.992
NumberChildren	34.881	12.772	2.731	.006	9.834	59.928
MCS	-.169	.026	-6.489	.000	-.221	-.118

$$E(\text{Physical Health}) = 5931.907 - 84.633(\text{Depression}) + 30.748(\text{Education}) + 34.881(\text{Number of Children}) - .169(\text{Mental Health})$$



## Multiple Regression

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i$$

### Definitions:

$Y_i$  = Response for individual  $i$

$\beta_0$  = Intercept

$\beta_1$  = Coefficient of  $X_1$

$X_{1i}$  = First predictor for individual  $i$

$\beta_2$  = Coefficient of  $X_2$

$X_{2i}$  = Second predictor for individual  $i$

$\beta_3$  = Coefficient of  $X_3$

$X_{3i}$  = Third predictor for individual  $i$

$\varepsilon_i$  = Residual for individual  $i$



## Multiple Regression

$$E(Y|X) = \hat{Y} = b_0 + b_1X_1 + b_2X_2 + b_3X_3$$

Interpretations:

$b_0$  = Mean or predicted value of Y when all X = 0

$b_1$  = Mean difference in Y for each one-unit difference in  $X_1$

$X_1$  = First predictor

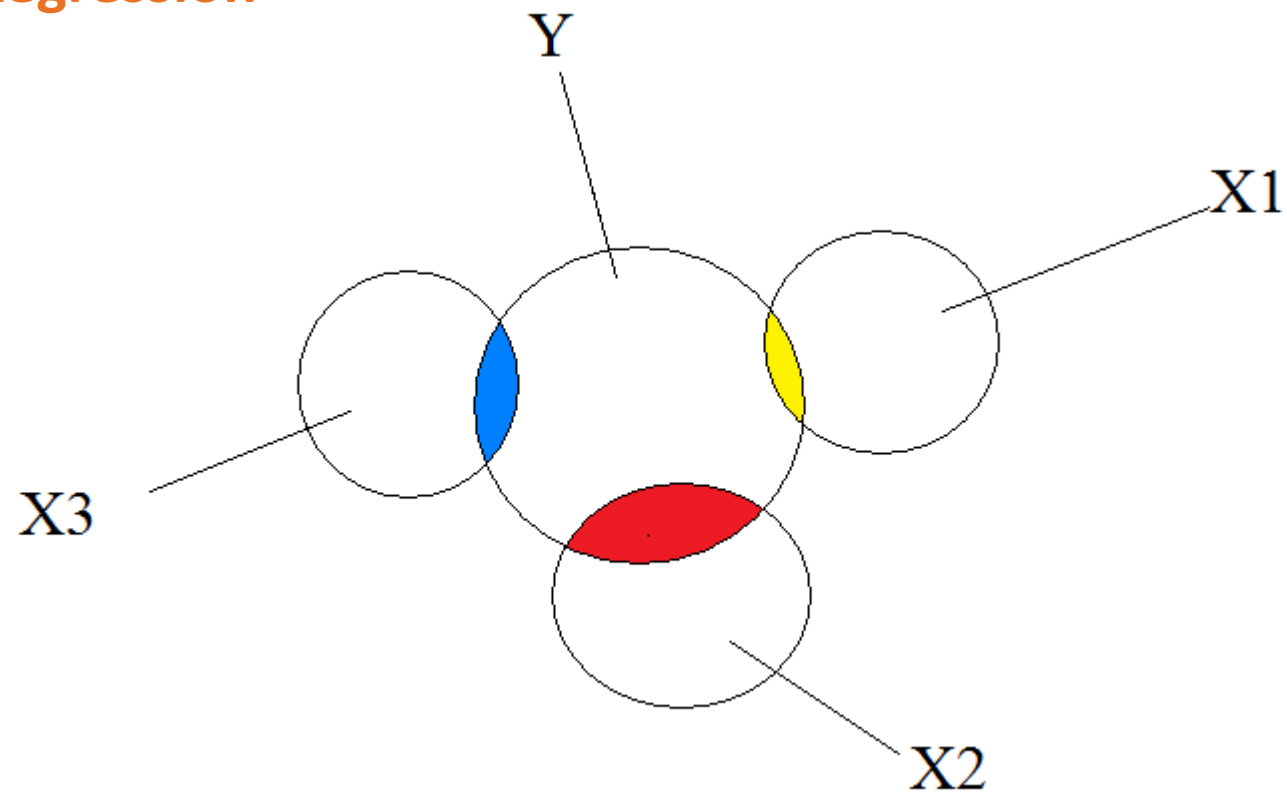
$b_2$  = Mean difference in Y for each one-unit difference in  $X_2$

$X_2$  = Second predictor

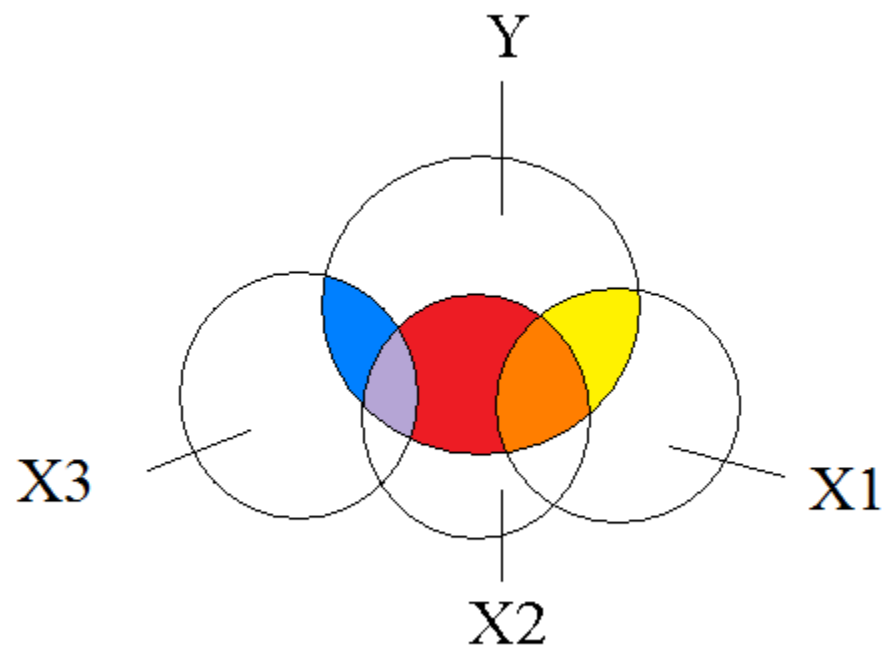
$b_3$  = Mean difference in Y for each one-unit difference in  $X_3$

$X_3$  = Third predictor

## Multiple Regression



# Multiple Regression



## Coefficients of Correlated Variables



### *Regression Coefficients*

Dependent Variable: PCS

Variable	B	se
Intercept	5421.387	21.707
Depression	-65.629	3.848

### *Regression Coefficients*

Dependent Variable: PCS

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## Coefficients of Correlated Variables



### *Correlations*

	Depression	Education	NumberChildren	MCS
Depression	1			
Education	-.178**	1		
NumberChildren	-.043	-.014	1	
MCS	-.676**	.077**	.017	1

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



## **Roles and Measurement of Predictor Variables in Regression**



## Types of Variables



### Response Variable:

- Continuous
- Unbounded
- Interval or Ratio Scale

### Predictor Variables:

- Numerical
- Categorical

## A Bit of Vocabulary: Relationships



- Explanation
- Prediction
- Causation
- Association
- Correlation

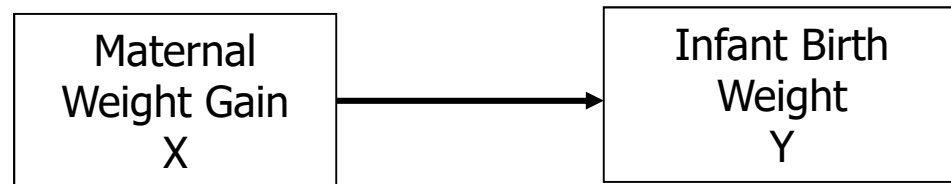
Maternal  
Weight Gain  
X

Infant Birth  
Weight  
Y

## A Bit of Vocabulary: Relationships



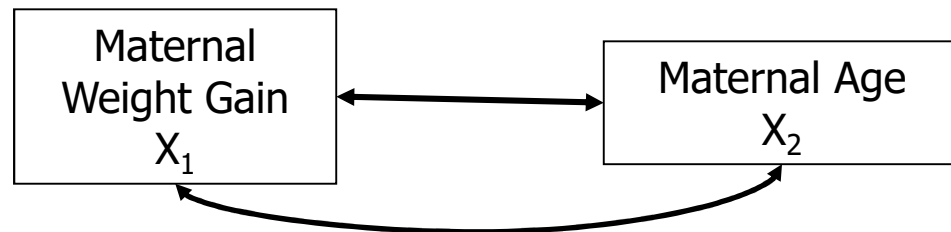
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## A Bit of Vocabulary: Xs

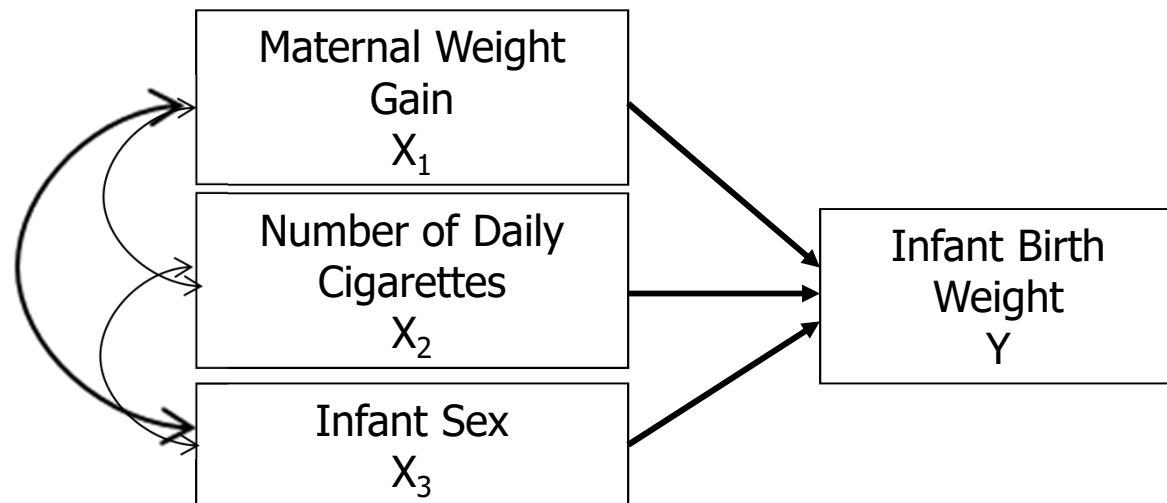


- Predictor Variable
- Independent Variable
  - Exposure
  - Risk Factor
  - Feature
- Covariate
- Confounder
- Suppressor
- Mediator
- Moderator

## A Bit of Vocabulary: Xs



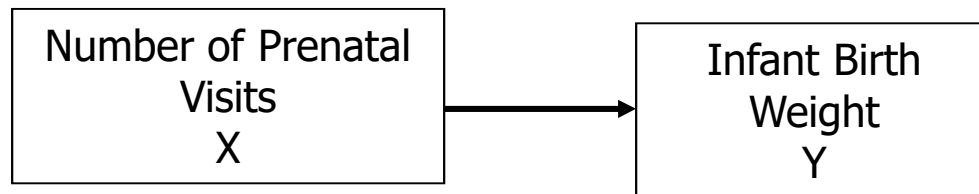
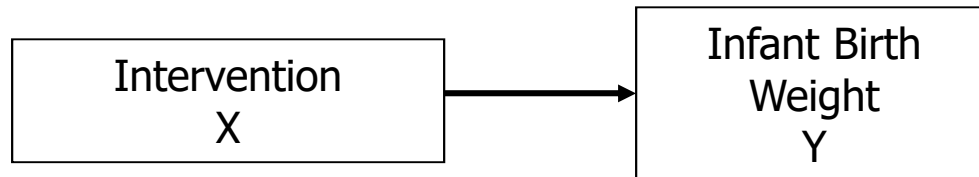
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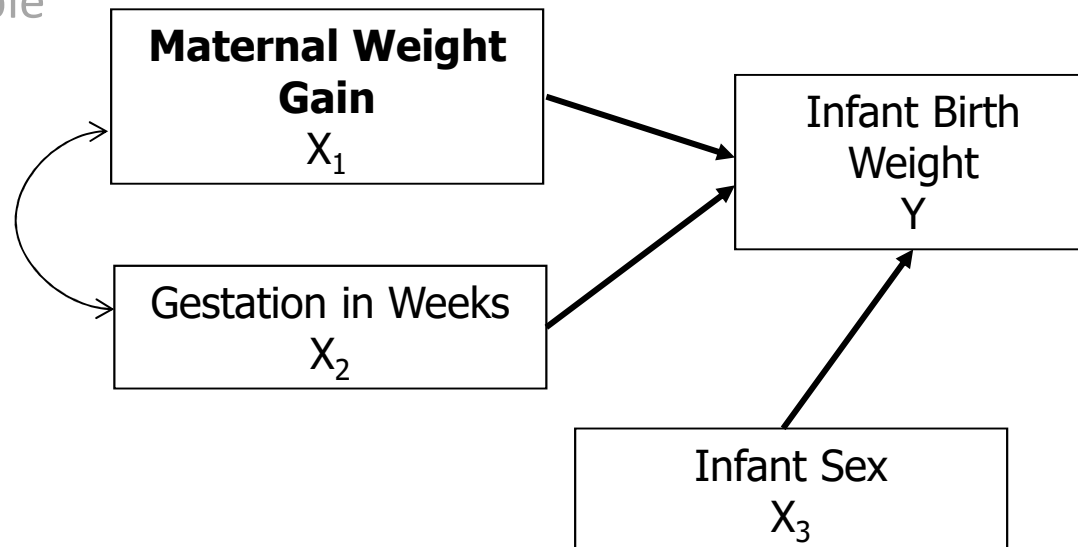
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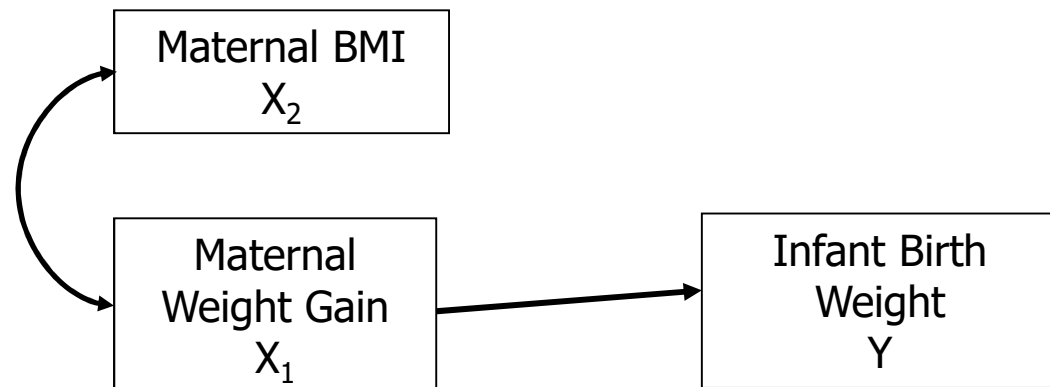




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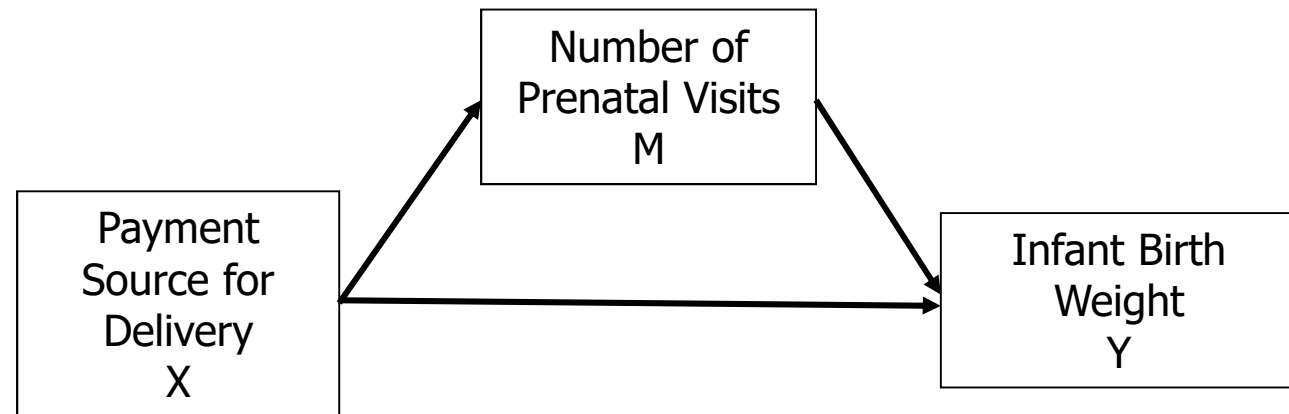
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