

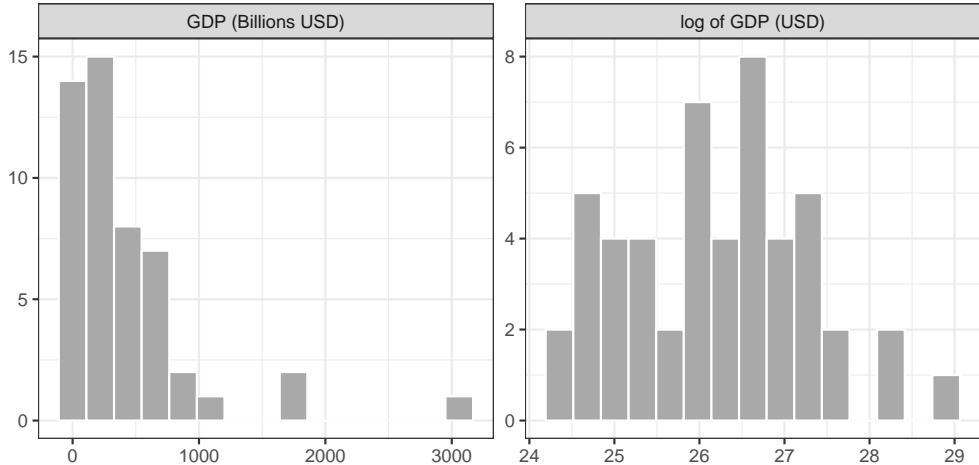
# Today's Agenda

## Extending the OLS Regression

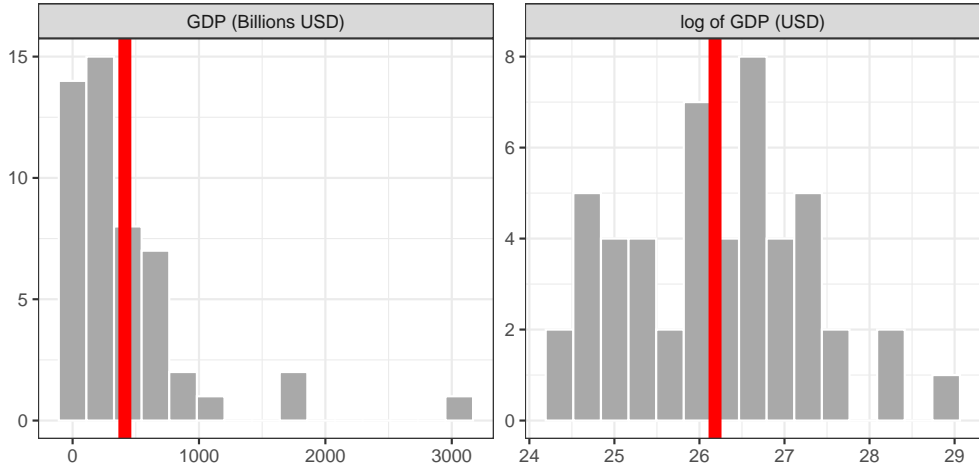
- 1 Week 9: Dichotomous and categorical predictors
- 2 Tuesday: Transforming the variables
- 3 Today: Transforming the model

Justin Leinaweaver (Spring 2022)

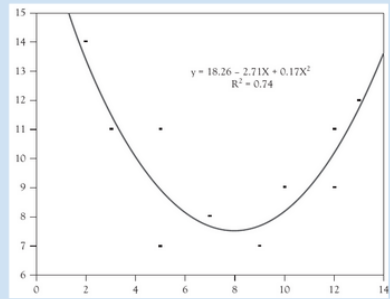
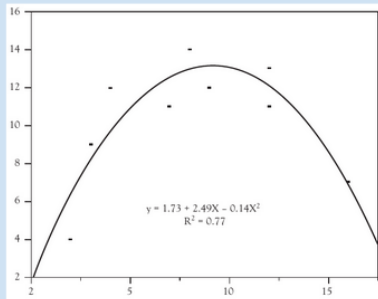
# Transformation 2: Natural Logarithms



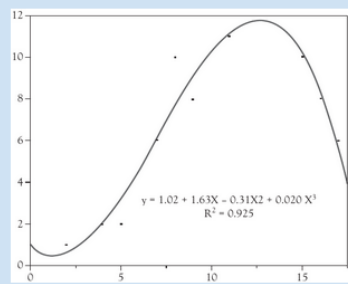
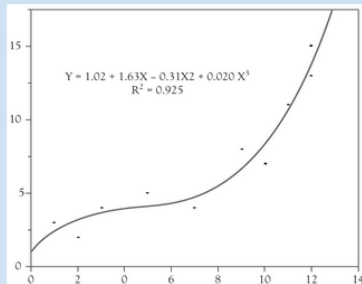
# Transformation 2: Natural Logarithms



# Quadratic Function



# Cubic Function



# Transforming the Model

**Fit three separate OLS models to the data.**

- 1 A standard, simple OLS model
- 2 An OLS with a quadratic function
- 3 An OLS with a cubic function

# Do states with more manufacturing have larger economies?

**Regress GDP (billions) on Manufacturing as:**

- 1 A standard, simple OLS model
- 2 An OLS with a quadratic function
- 3 An OLS with a cubic function

# Do states with more manufacturing have larger economies?

**Regress GDP (billions) on Manufacturing as:**

- 1 Manufacturing
- 2 Manufacturing + Manufacturing<sup>2</sup>
- 3 Manufacturing + Manufacturing<sup>2</sup> + Manufacturing<sup>3</sup>

	GDP (billions)		
	(1)	(2)	(3)
Manufacturing	1.92* (0.16)	0.77* (0.35)	2.10* (0.77)
Squared		0.001* (0.0003)	-0.002 (0.002)
Cubed			0.0000 (0.0000)
Constant	-51.20 (53.79)	87.00 (61.08)	1.36 (74.17)
Observations	50	50	50
Adjusted R <sup>2</sup>	0.75	0.80	0.81
Residual Std. Error	268.27 (df = 48)	239.24 (df = 47)	232.61 (df = 46)
F Statistic	148.54* (df = 1; 48)	100.07* (df = 2; 47)	71.81* (df = 3; 46)

*Note:*

\*p<0.05



# Make a Marginal Effects Plot

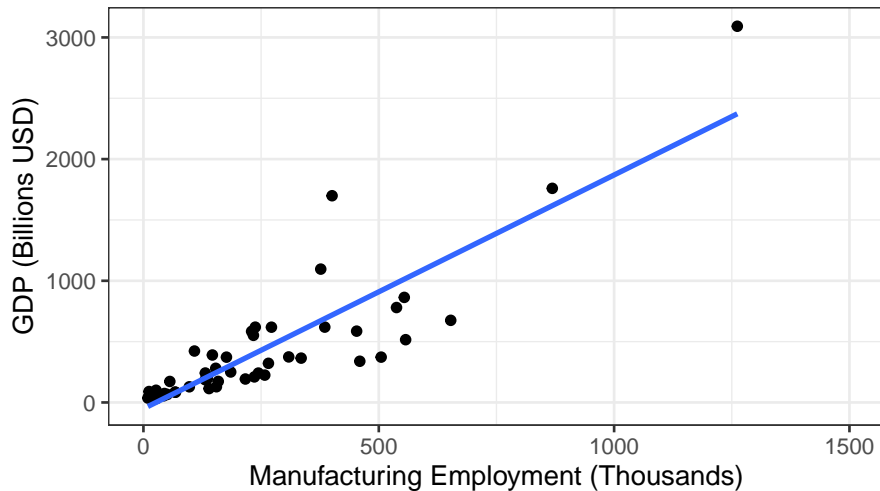
Manufacturing	Manufacturing2	Predicted
0	0	
300	90000	
600	360000	
900	810000	
1200	1440000	
1500	2250000	

# Make a Marginal Effects Plot

Manufacturing	Manufacturing2	Predicted
0	0	
300	90000	
600	360000	
900	810000	
1200	1440000	
1500	2250000	

$$\text{GDP} = 87 + 0.77(\text{Manufacturing}) + .001(\text{Manufacturing}^2)$$

## Linear Model



## Quadratic Model



# Does homeownership explain the size of the economy?

**Regress GDP (billions) on Homeownership as:**

- 1 A standard, simple OLS model
- 2 An OLS with a quadratic function
- 3 An OLS with a cubic function

	GDP (billions)		
	(1)	(2)	(3)
Homeownership	-56.30* (12.70)	-579.69* (212.84)	-6,694.52* (2,976.30)
Squared		3.90* (1.59)	96.59* (45.03)
Cubed			-0.47* (0.23)
Constant	4,301.63* (879.84)	21,723.19* (7,122.48)	155,210.00* (65,182.20)
Observations	50	50	50
Adjusted R <sup>2</sup>	0.28	0.34	0.39
Residual Std. Error	457.31 (df = 48)	434.93 (df = 47)	420.67 (df = 46)
F Statistic	19.64* (df = 1; 48)	13.89* (df = 2; 47)	11.31* (df = 3; 46)

Note:

\*p<0.05

# Make a Marginal Effects Plot

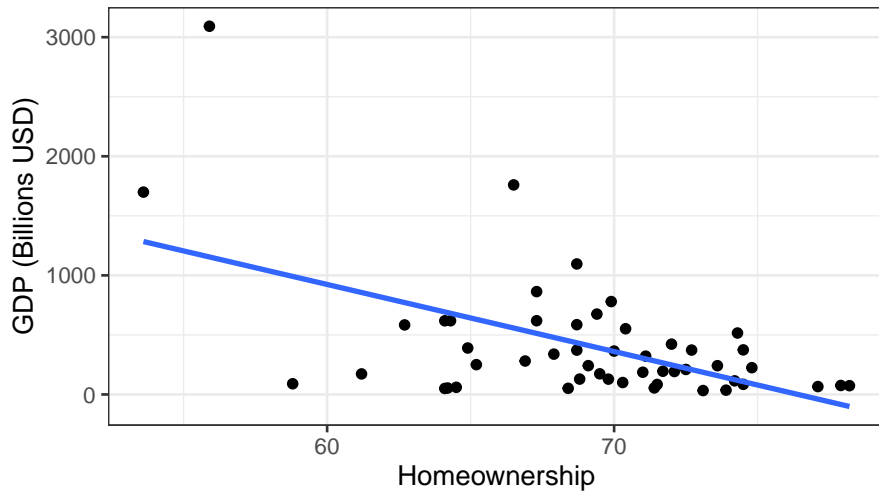
Homeownership	Homeownership2	Homeownership3	Predicted
50			
55			
60			
65			
70			
75			

# Make a Marginal Effects Plot

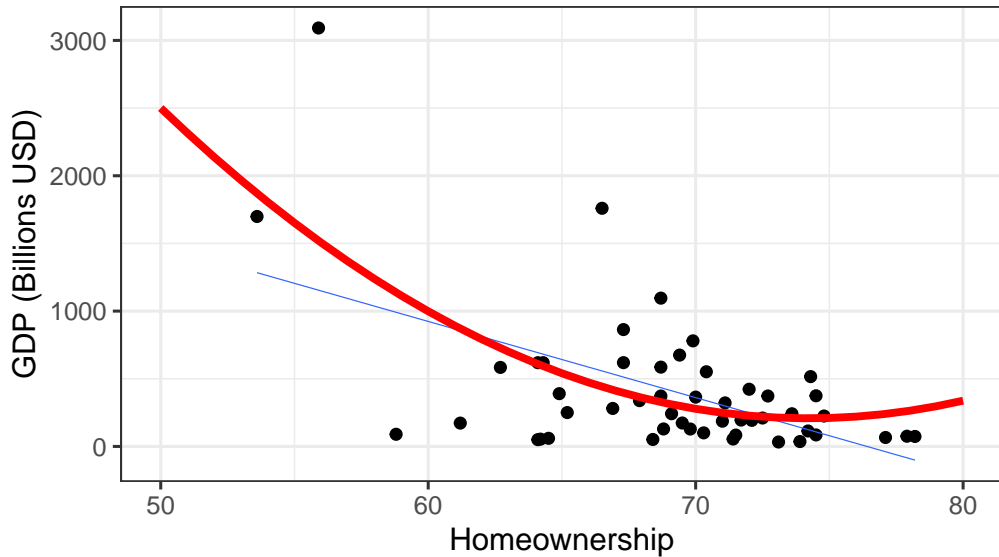
Homeownership	Homeownership2	Homeownership3	Predicted
50	2500	125000	
55	3025	166375	
60	3600	216000	
65	4225	274625	
70	4900	343000	
75	5625	421875	



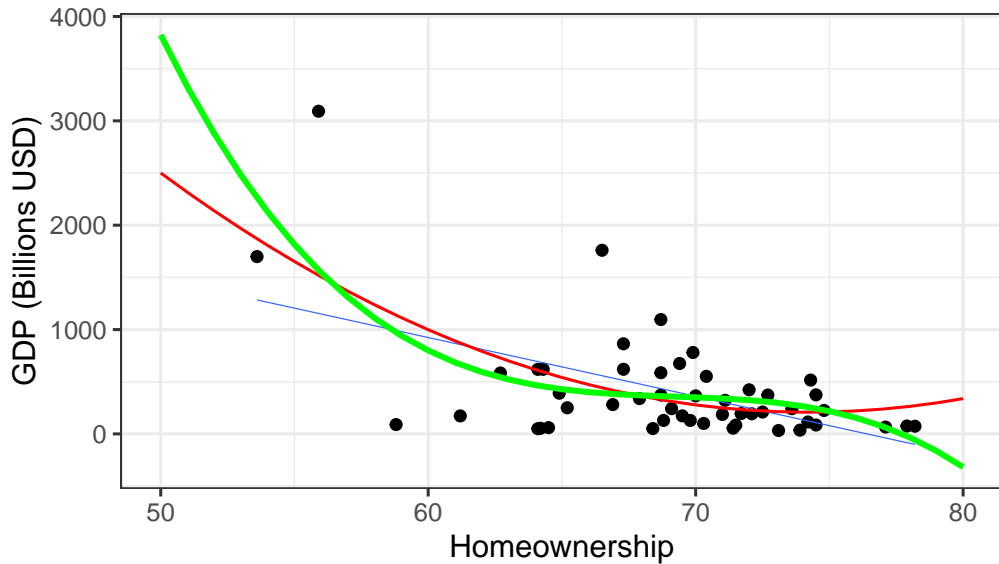
## Linear Model



## Quadratic Model



## Cubic Model



# Does unemployment explain the size of the economy?

**Regress GDP (billions) on Unemployment as:**

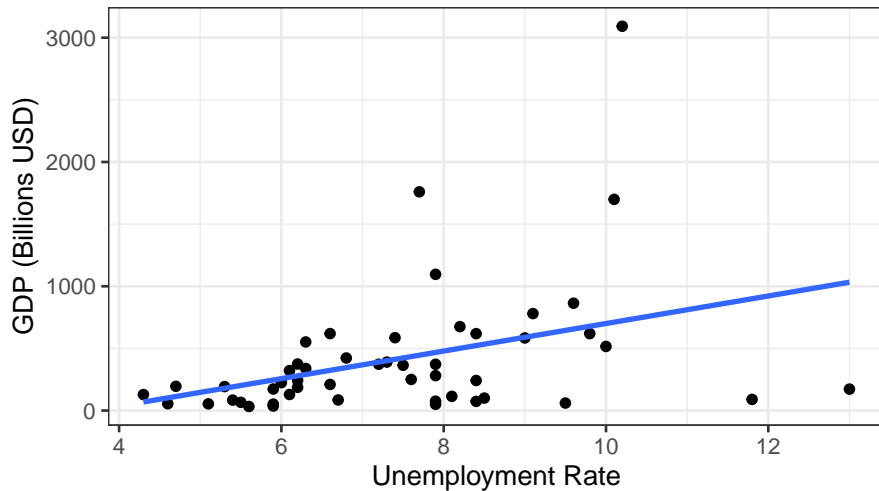
- ① A standard, simple OLS model
- ② An OLS with a quadratic function
- ③ An OLS with a cubic function

	GDP (billions)		
	(1)	(2)	(3)
Unemployment	110.80* (38.97)	451.98 (247.19)	-2,018.53 (1,253.15)
Squared		-21.11 (15.11)	285.01 (153.11)
Cubed			-12.01 (5.98)
Constant	-407.76 (297.43)	-1,706.80 (975.16)	4,602.56 (3,280.45)
Observations	50	50	50
Adjusted R <sup>2</sup>	0.13	0.14	0.20
Residual Std. Error	502.19 (df = 48)	497.28 (df = 47)	481.97 (df = 46)
F Statistic	8.09* (df = 1; 48)	5.10* (df = 2; 47)	4.96* (df = 3; 46)

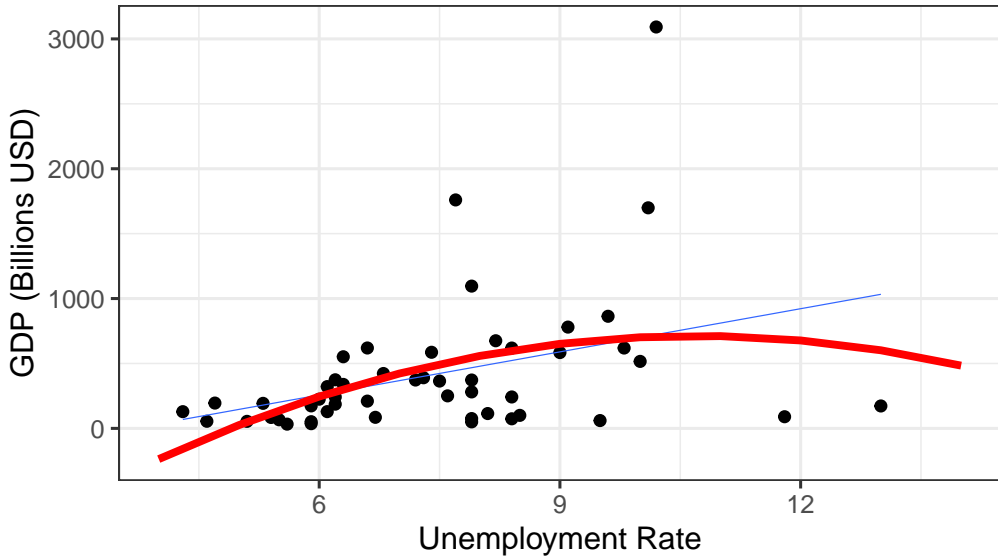
*Note:*

\*p<0.05

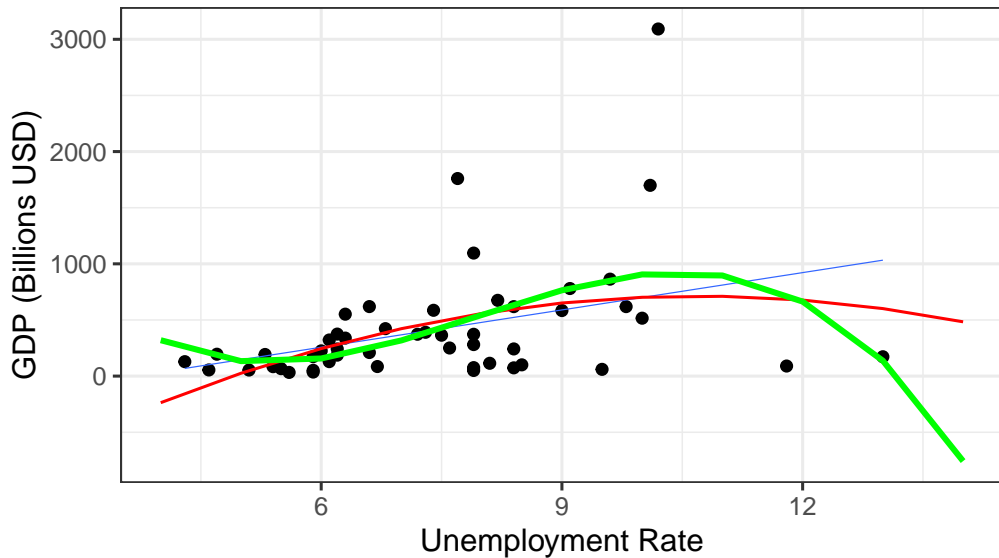
## Linear Model



## Quadratic Model

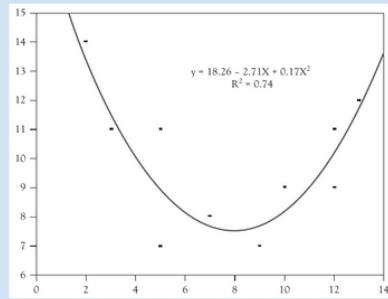
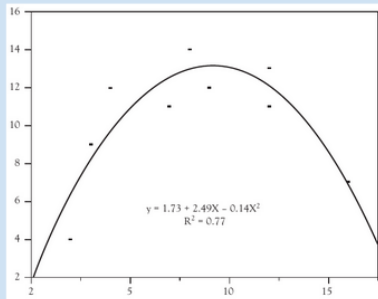


## Cubic Model





# Quadratic Function



# Cubic Function

