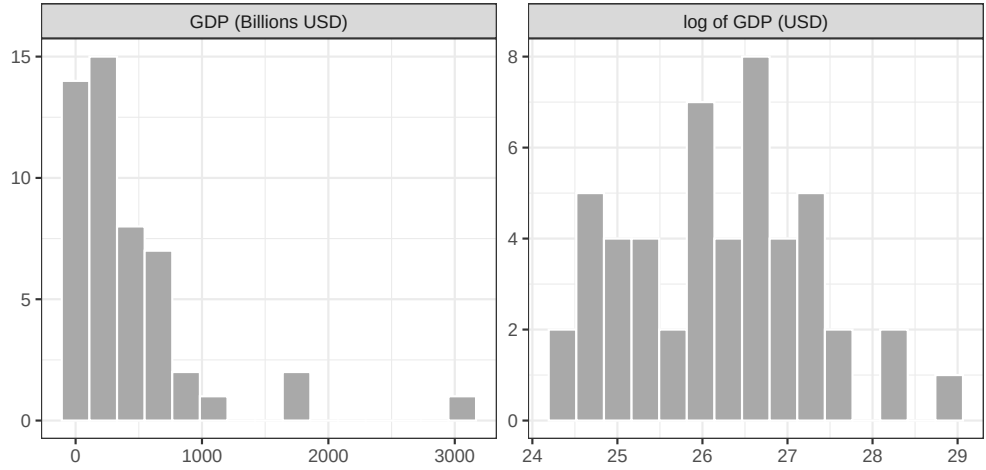
Today's Agenda

Extending the OLS Regression

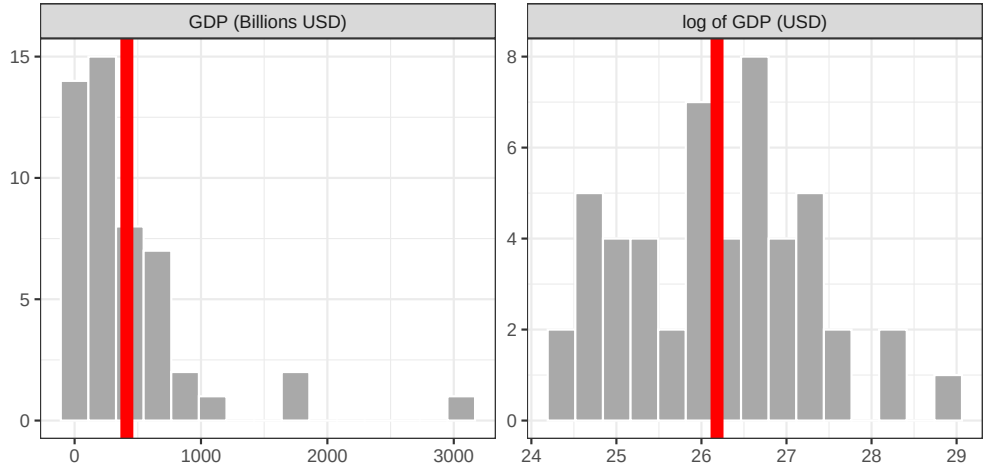
1. Week 9: Dichotomous and categorical predictors
2. Tuesday: Transforming the variables
3. Today: Transforming the model

Justin Leinaweaver (Spring 2022)

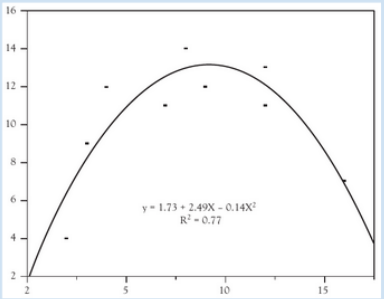
Transformation 2: Natural Logarithms

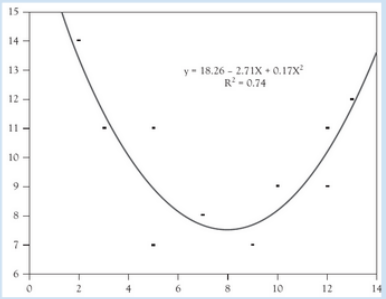


Transformation 2: Natural Logarithms

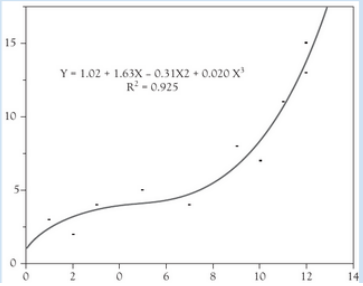


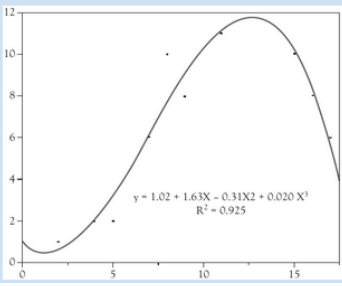
Quadratic Function





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^2
3. Manufacturing + Manufacturing^2 + Manufacturing^3

	GDP (billions)		
	(1)	(2)	(3)
Manufacturing	1.92*	0.77*	2.10*
	(0.16)	(0.35)	(0.77)
Squared		0.001*	−0.002
		(0.0003)	(0.002)
Cubed			0.0000
			(0.0000)
Constant	−51.20	87.00	1.36
	(53.79)	(61.08)	(74.17)
Observations	50	50	50
Adjusted R^2	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

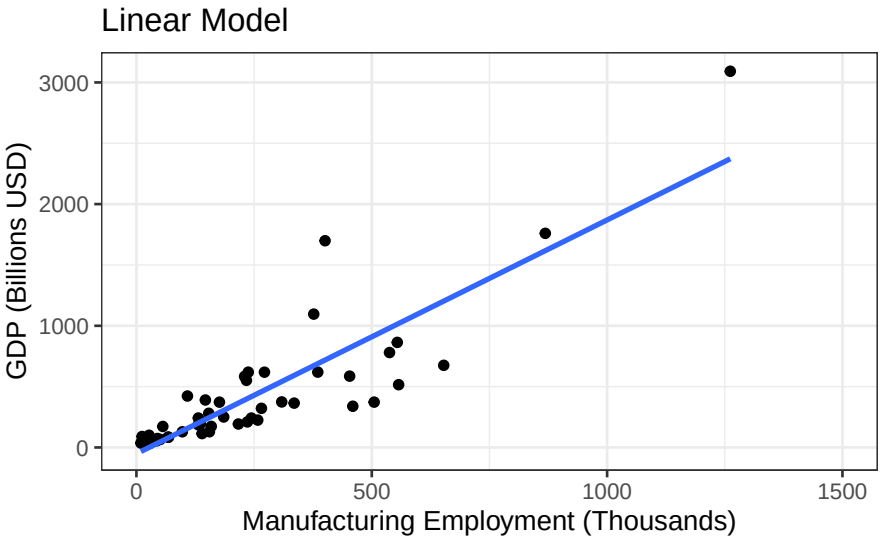
Make a Marginal Effects Plot

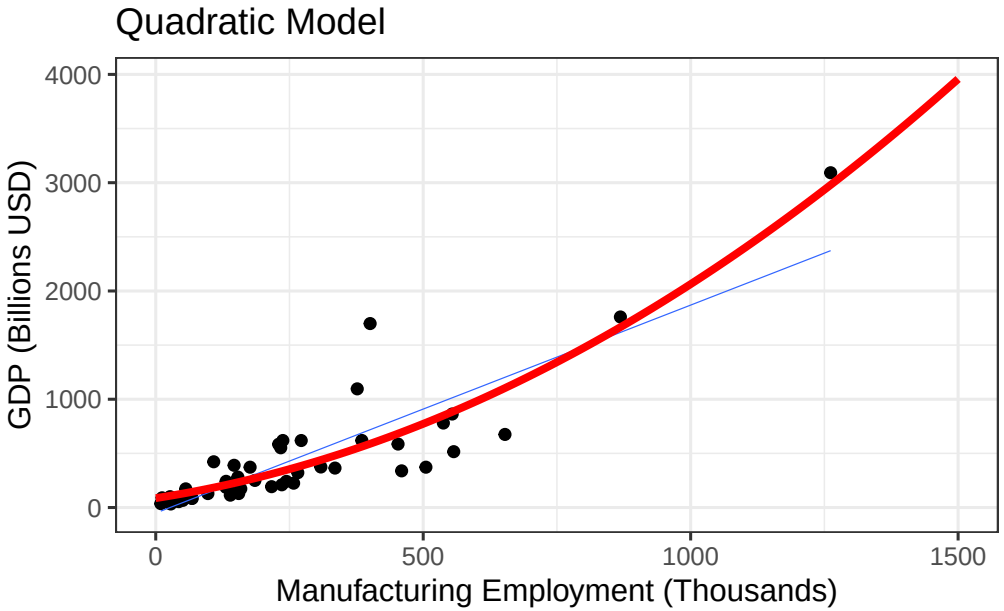
Manufacturing	Manufacturing2	Predicted
0	0	
300	90000	
600	360000	
900	810000	
1200	1440000	
1500	2250000	

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
GDP (Billions USD)
3000
2000
1000
0
0
500
1000
1500
Manufacturing Employment (Thousands)


Quadratic Model
GDP (Billions USD)
4000
3000
2000
1000
0
0
500
1000
1500
Manufacturing Employment (Thousands)

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*	−579.69*	−6,694.52*
	(12.70)	(212.84)	(2,976.30)
Squared		3.90*	96.59*
		(1.59)	(45.03)
Cubed			−0.47*
			(0.23)
Constant	4,301.63*	21,723.19*	155,210.00*
	(879.84)	(7,122.48)	(65,182.20)
Observations	50	50	50
Adjusted R^2	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)

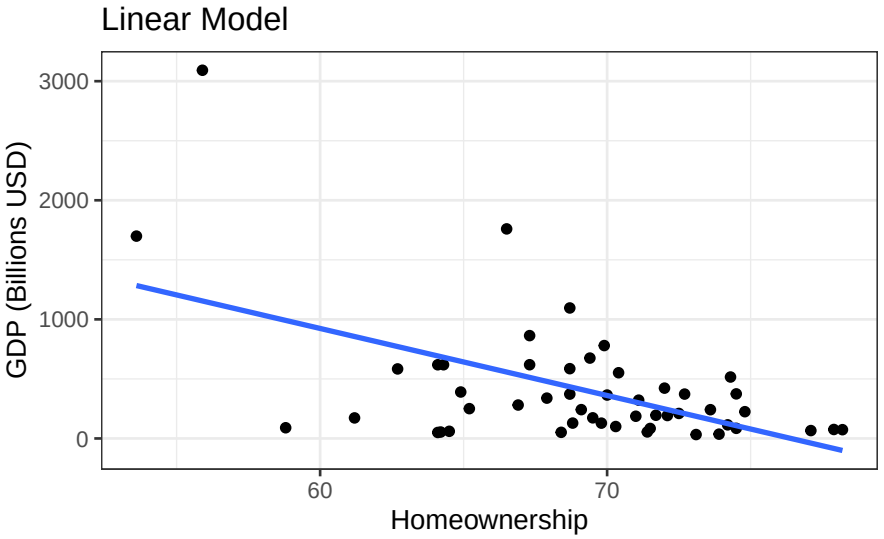
Note: *p<0.05

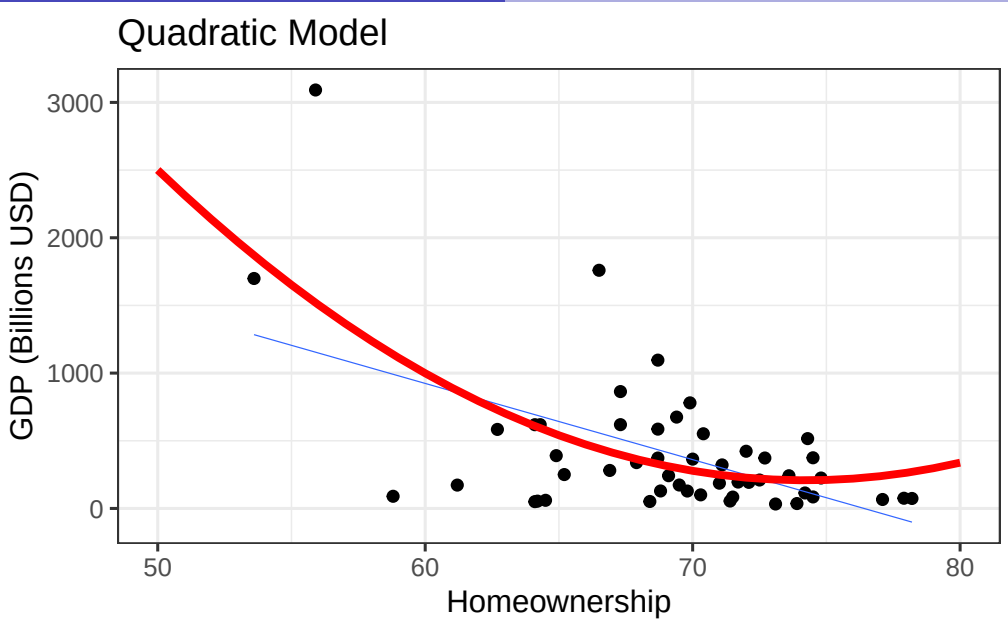
Make a Marginal Effects Plot

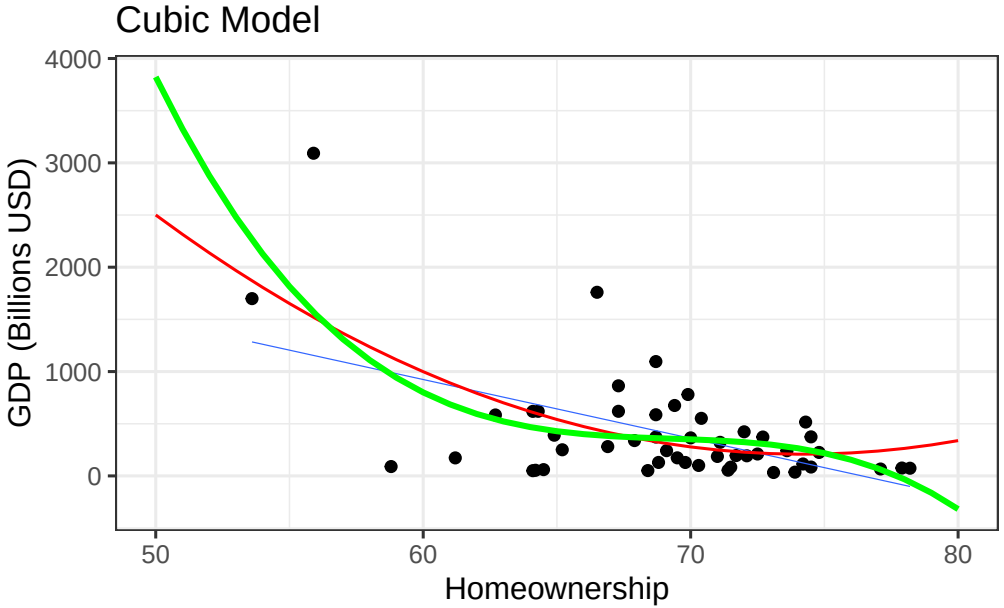
Homeownership	Homeownership2	Homeownership3	Predicted
50			
55			
60			
65			
70			
75			

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
GDP (Billions USD)
3000
2000
1000
0
60
70
Homeownership


Quadratic Model
GDP (Billions USD)
3000
2000
1000
0
50
60
70
80
Homeownership


Cubic Model
GDP (Billions USD)
4000
3000
2000
1000
0
50
60
70
80
Homeownership

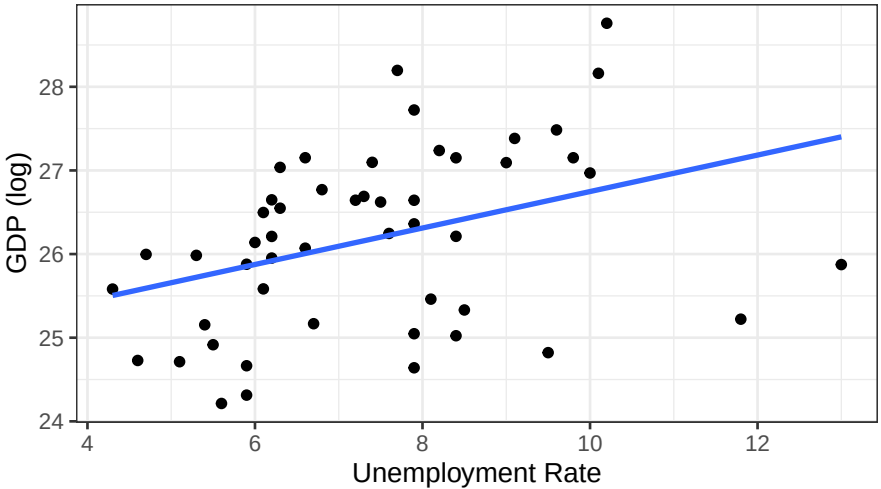
Put it All Together! Does unemployment explain the size of the economy?

Regress GDP (log) on Unemployment as:

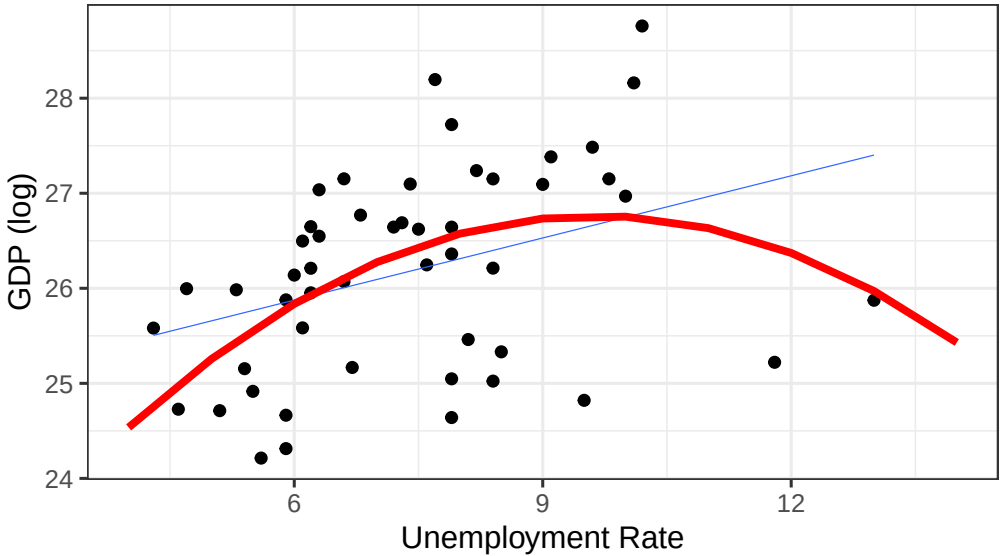
1. A standard, simple OLS model
2. An OLS with a quadratic function
3. An OLS with a cubic function

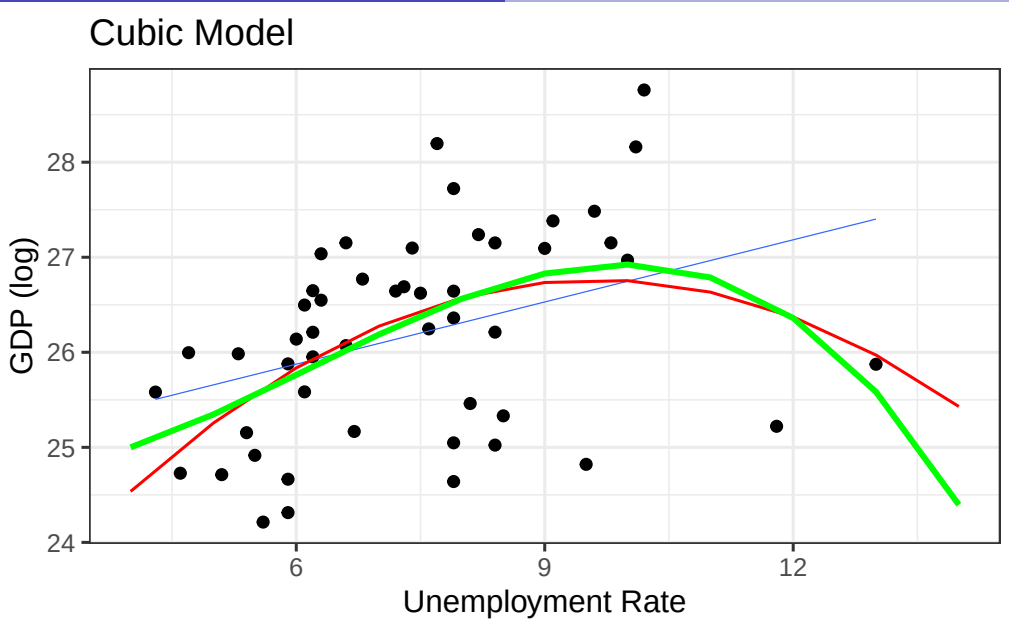
	GDP (log)		
	(1)	(2)	(3)
Unemployment	0.22*	1.35*	−0.71
	(0.08)	(0.48)	(2.50)
Squared		−0.07*	0.19
		(0.03)	(0.31)
Cubed			−0.01
			(0.01)
Constant	24.57*	20.26*	25.51*
	(0.60)	(1.88)	(6.55)
Observations	50	50	50
Adjusted R^2	0.12	0.20	0.20
Residual Std. Error	1.01 (df = 48)	0.96 (df = 47)	0.96 (df = 46)
F Statistic	7.80* (df = 1; 48)	7.17* (df = 2; 47)	4.99* (df = 3; 46)
Note:			*p<0.05

Linear Model

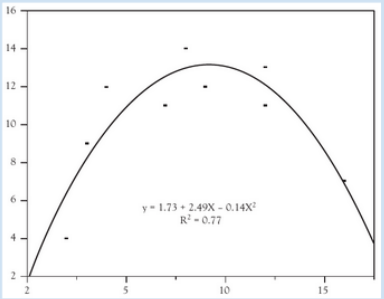


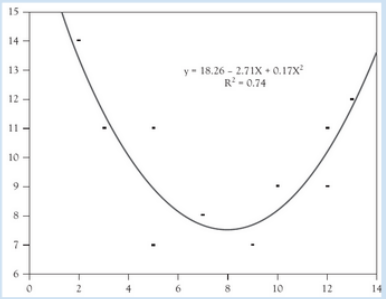
Quadratic Model




Cubic Model
GDP (log)
28
27
26
25
24
6
9
12
Unemployment Rate

Quadratic Function





Cubic Function