Today's Agenda

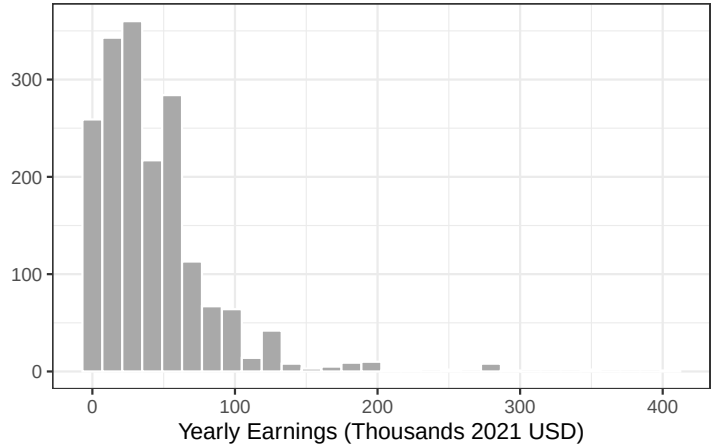
Evaluating simple OLS regressions

Justin Leinaweaver (Spring 2022)

For Today

1. Finish the model building work from class today
2. Use the four steps outlined in Wilson, Keating, and Beal-Hodges (2012) chapters 4 and 5 to evaluate the fit of our models of earnings.

Can we build a useful model of yearly earnings in the Ross (1990) dataset?



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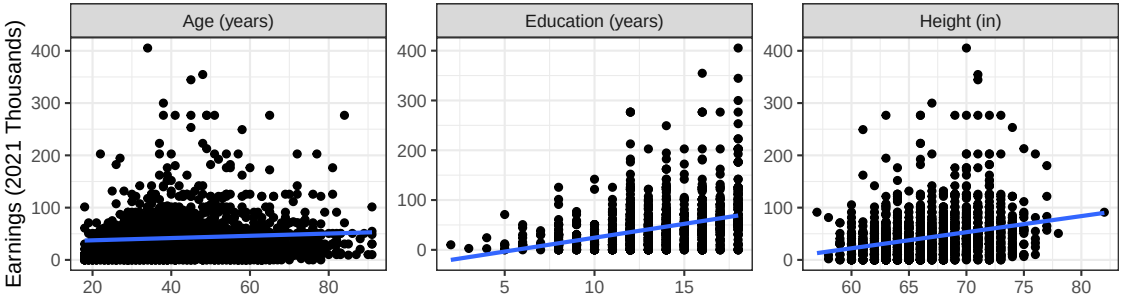

	Earnings (2021)		
	(1)	(2)	(3)
Height	3.08*		
	(0.25)		
Age		0.22*	
		(0.06)	
Education			5.57*
			(0.36)
Constant	−162.54*	33.17*	−31.34*
	(16.46)	(2.64)	(4.89)
Observations	1,815	1,815	1,813
Adjusted R^2	0.08	0.01	0.11
Residual Std. Error	40.28 (df = 1813)	41.81 (df = 1813)	39.50 (df = 1811)
F Statistic	155.52* (df = 1; 1813)	14.22* (df = 1; 1813)	235.79* (df = 1; 1811)

Note: *p < 0.05

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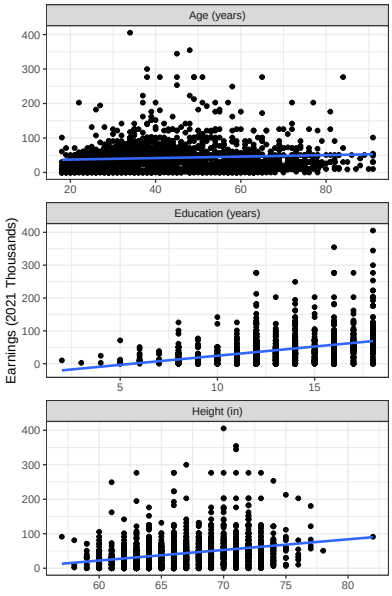

What are the predicted earnings...

For someone of average height in the sample?

- Avg height of 66.6 = \$42.6k

For someone of average age in the sample?

- Avg age of 42.9 = \$42.6k

For someone of average education in the sample?

- Avg education of 13.2 = \$42.2k

What are the predicted earnings...

Model 1: Height

- Avg = \$42.6k vs Maximum = ?

Model 2: Age

- Avg = \$42.6k vs Maximum = ?

Model 3: Education

- Avg = \$42.2k vs Maximum = ?

What are the predicted earnings...

Model 1: Height

- Avg = \$42.6k vs Maximum (82) = ?

Model 2: Age

- Avg = \$42.6k vs Maximum (91) = ?

Model 3: Education

- Avg = \$42.2k vs Maximum (18) = ?

What are the predicted earnings...

Model 1: Height

- Avg = \$42.6k vs Maximum (82) = \$90k

Model 2: Age

- Avg = \$42.6k vs Maximum (91) = \$53.2k

Model 3: Education

- Avg = \$42.2k vs Maximum (18) = \$68.9k

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Alternative Hypothesis (H_A)

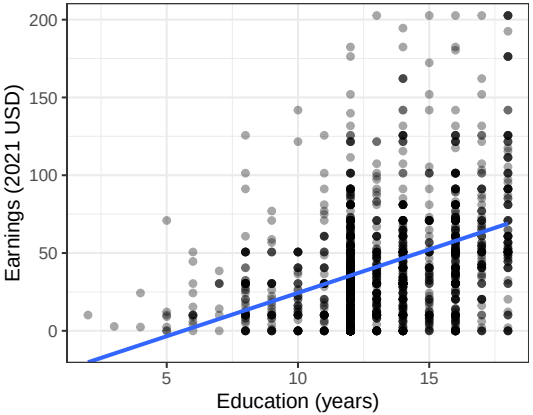
- Higher levels of education are associated with larger incomes.

Null Hypothesis (H_0)

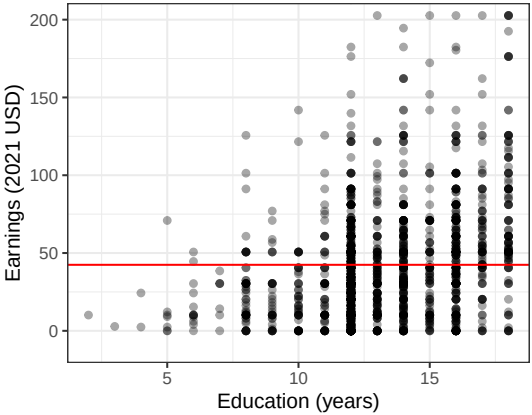
- Level of education is not associated with income.

What is statistical significance?

Alternative Hypothesis



Null Hypothesis



P-Values: A shortcut to determining statistical significance

"The p-value is the probability of observing another computed test statistic ... that is more extreme (either positive or negative) than the one computed for your sample. ... Therefore, the smaller the p-value, the more support for the alternative hypothesis" (p82).

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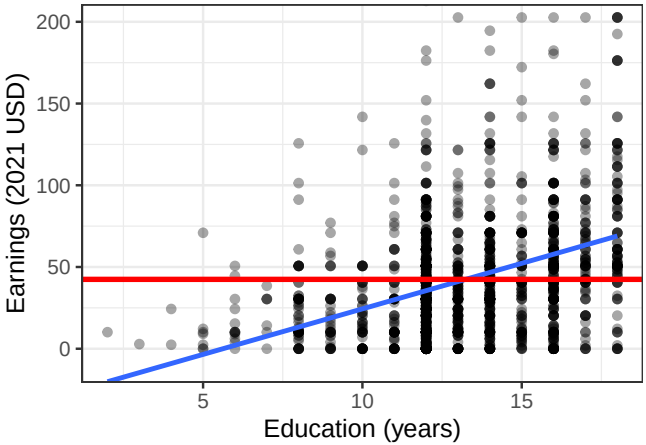

What is statistical significance?

	Earnings (2021)
Non-Smoker	3.01
	(2.26)
Constant	37.17*
	(4.07)
Observations	1,814
Adjusted R^2	0.0004
Residual Std. Error	41.97 (df = 1812)
F Statistic	1.77 (df = 1; 1812)
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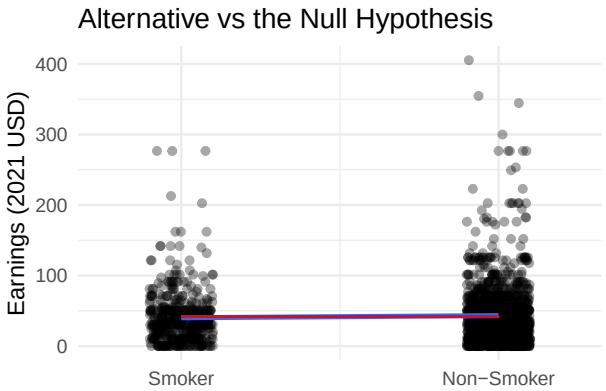

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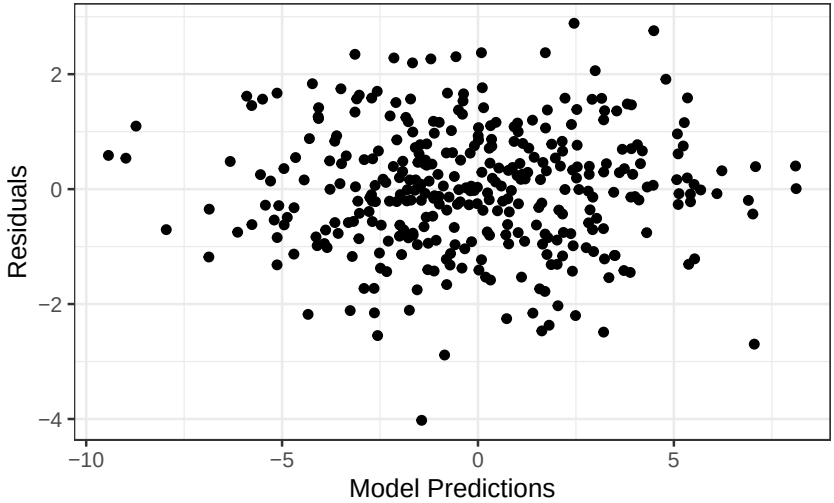
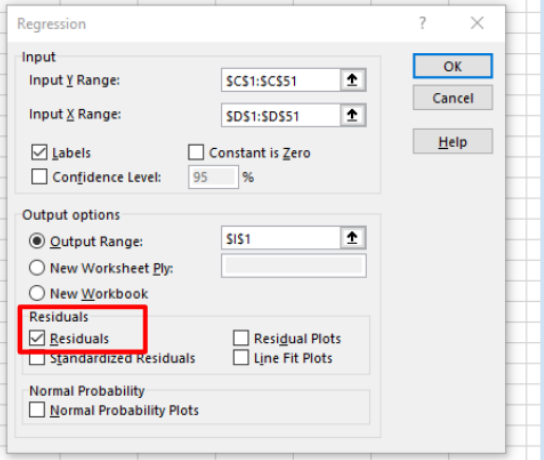
Step 4: Include a plot of the model's residuals



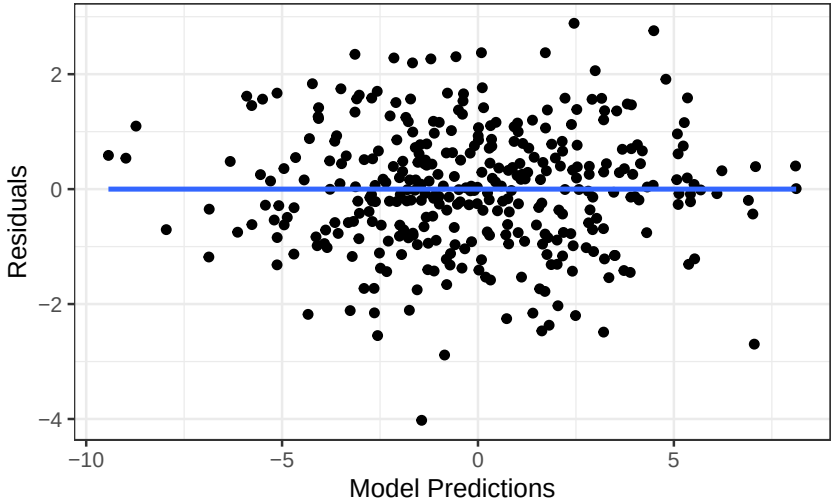
Step 4: Plot the Model's Residuals x Predictions



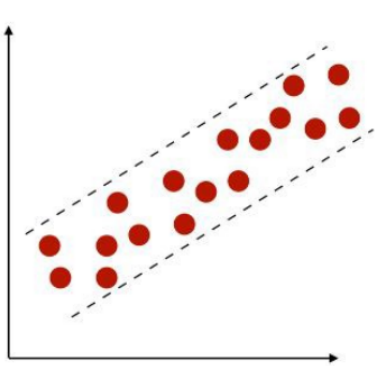
RESIDUAL OUTPUT

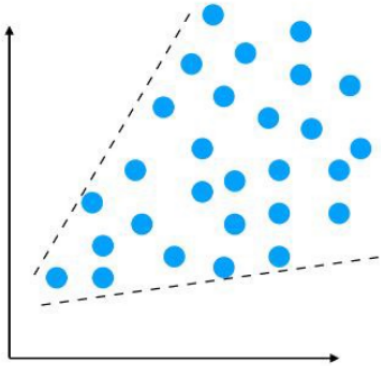
Observation	Predicted earnk	Residuals
1	32.23	17.77
2	20.08	39.92
3	17.04	12.96
4	18.56	6.44
5	15.52	34.48
6	23.12	38.88
7	15.52	35.48
8	17.04	-8.04
9	14.00	15.00
10	30.71	1.29
11	29.20	-27.20
12	29.20	5.80
13	29.20	-2.20
14	26.16	-19.63
15	15.52	-15.52

Step 4 Goal: Homoscedastic Errors

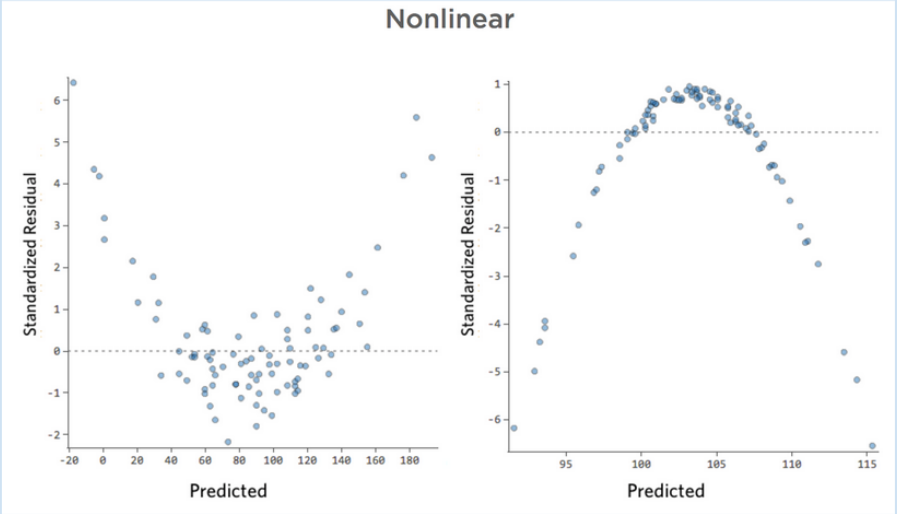


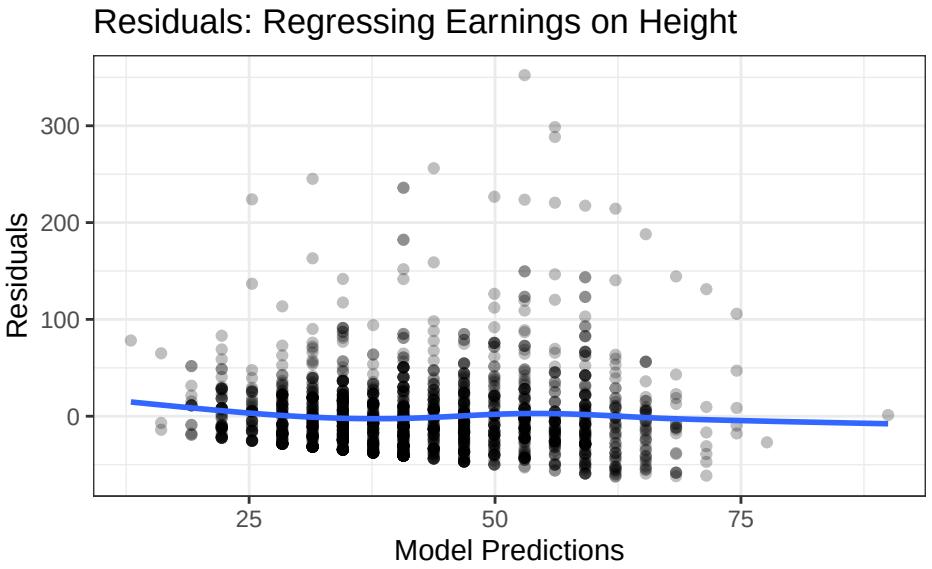
Bad: Heteroscedasticity

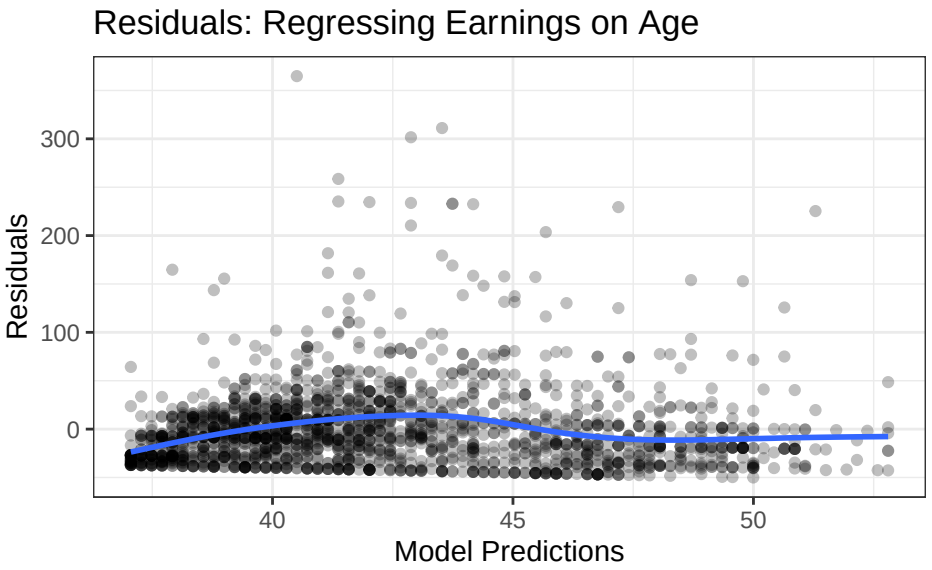


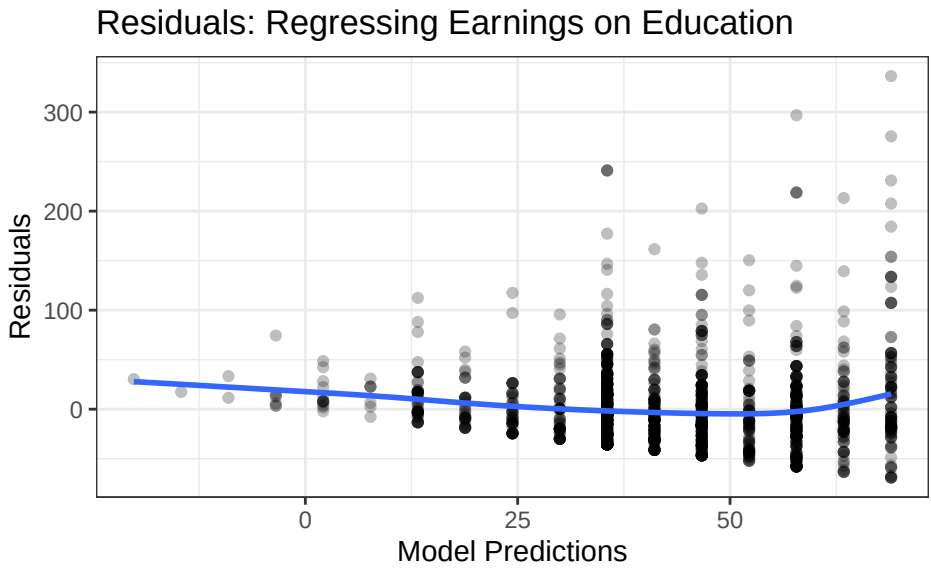


Bad: Nonlinear Residuals




Residuals: Regressing Earnings on Height
Residuals
300
200
100
0
25
50
75
Model Predictions


Residuals: Regressing Earnings on Age
Residuals
300
200
100
0
40
45
50
Model Predictions


Residuals: Regressing Earnings on Education
Residuals
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200
100
0
0
25
50
Model Predictions

	Earnings (2021)		
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Which is a better model of personal income (earnk):

1. Mother's education level, or
2. Personal exercise

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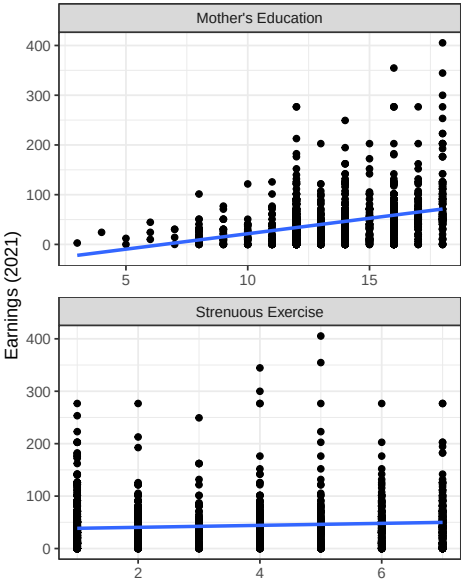
Step 1: Fit and evaluate both models

- Scatterplots, regression tables and residuals plots

	Earnings (2021)	
	(1)	(2)
Mother's Education	6.21*	
	(0.43)	
Exercise		1.88*
		(0.42)
Constant	−40.64*	36.69*
	(5.87)	(1.62)
Observations	1,570	1,815
Adjusted R^2	0.12	0.01
Residual Std. Error	40.45 (df = 1568)	41.75 (df = 1813)
F Statistic	212.09* (df = 1; 1568)	19.83* (df = 1; 1813)
Note:		*p < 0.05



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	(5.87)	(1.62)
Observations	1,570	1,815
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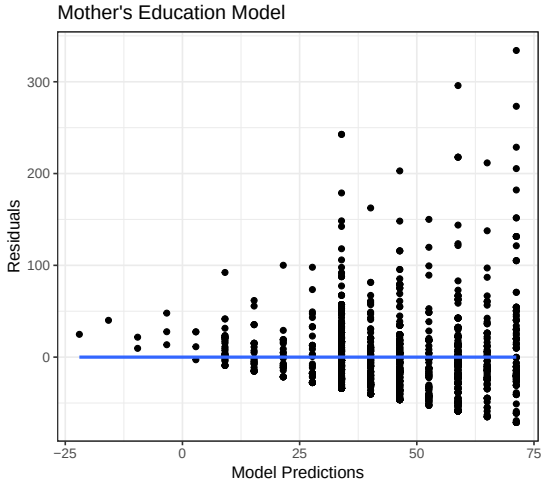
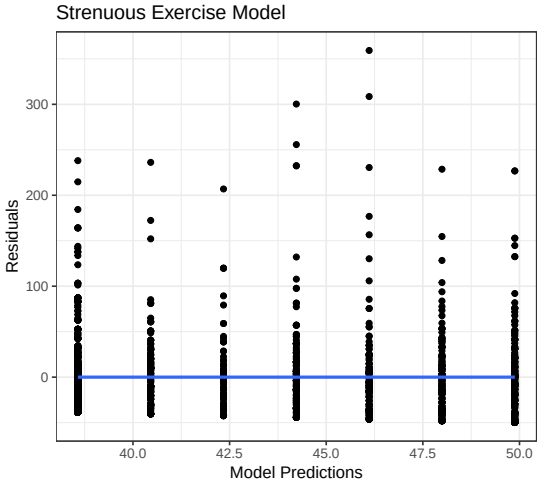
Note:		*p $<$ 0.05

Step 4 - Check the Residuals





Step 2: Make four predictions

Mother's Education Model

1. Mother completed high school (12)
2. Mother completed college (16)

Strenuous Exercise Model

1. No strenuous exercise (1)
2. Strenuous exercise $>$ 3x per week (7)

Step 2: Make four predictions

Mother's Education Model

1. Mother completed high school (12) = \$33.9k
2. Mother completed college (16) = \$58.7k

Strenuous Exercise Model

1. No strenuous exercise (1) = \$38.6k
2. Strenuous exercise $>$ 3x per week (7) = \$49.8k

For Tuesday

Use chapter 5 of the textbook to add confidence intervals to our four model predictions.