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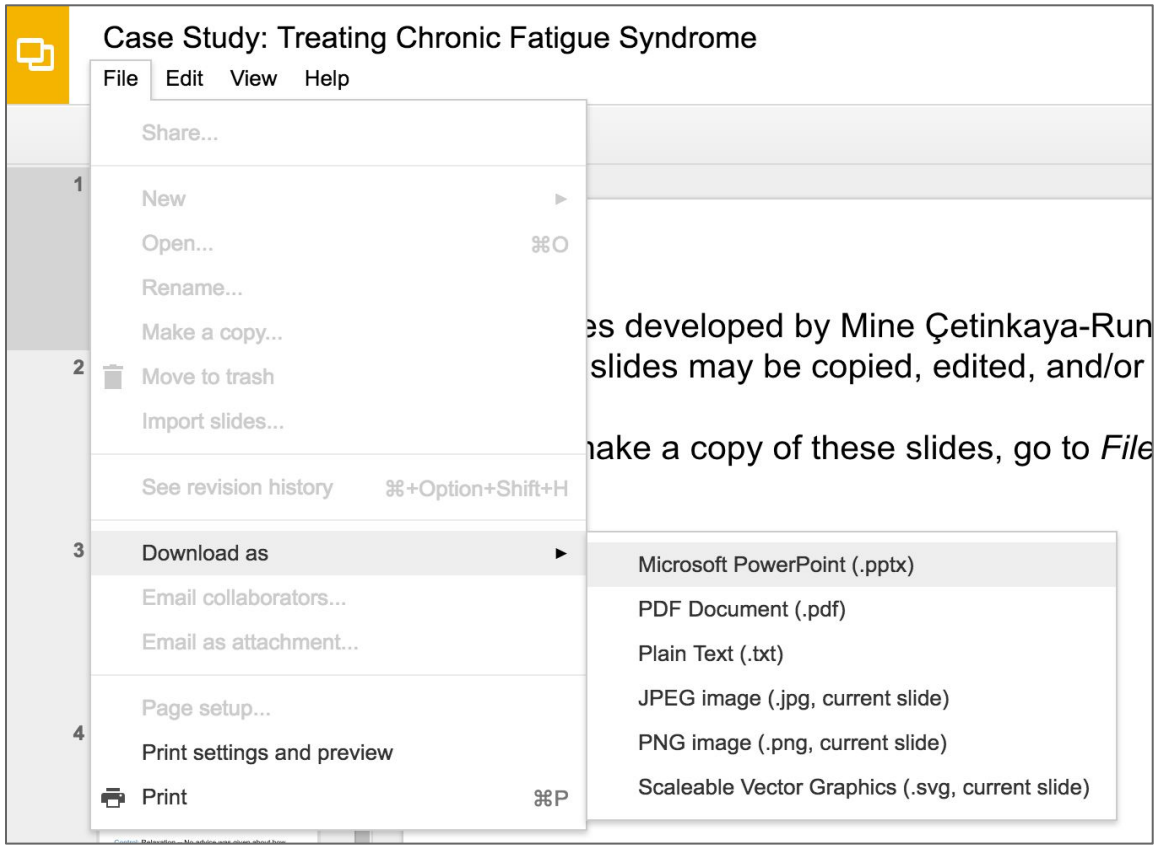


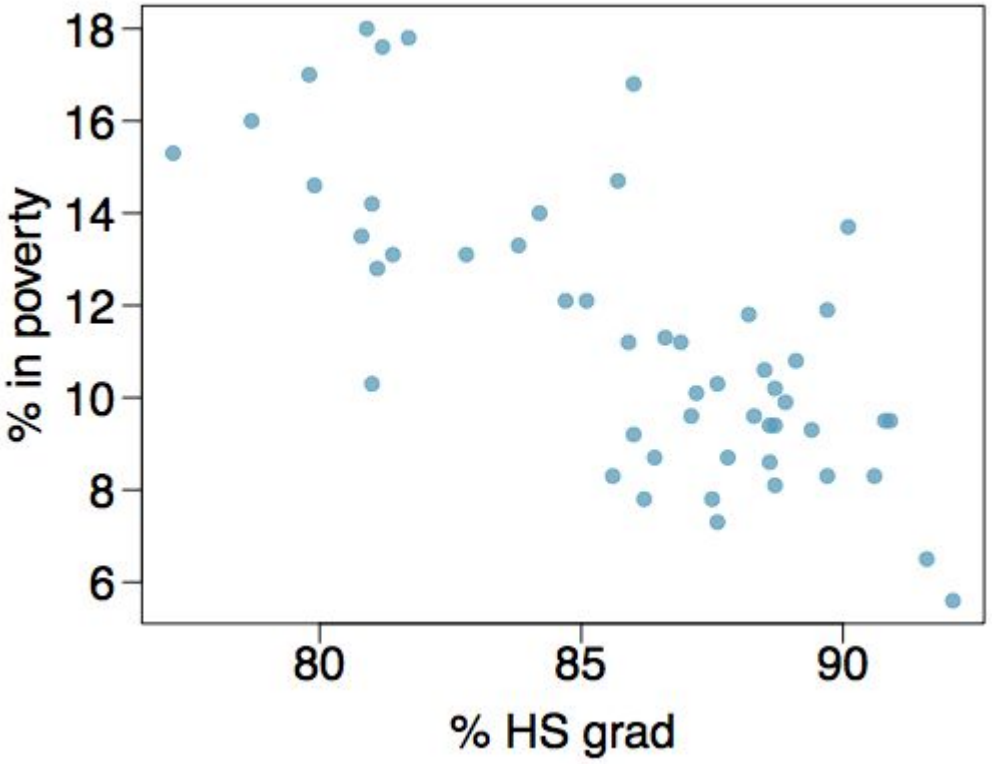
Line Fitting, Residuals, and Correlation

Modeling numerical variables

In this unit we will learn to quantify the relationship between two numerical variables, as well as modeling numerical response variables using a numerical or categorical explanatory variable.

Poverty vs. HS graduate rate

The *scatterplot* below shows the relationship between HS graduate rate in all 50 US states and DC and the percent of residents who live below the poverty line (income below $23,050 for a family of 4 in 2012).



Response variable?

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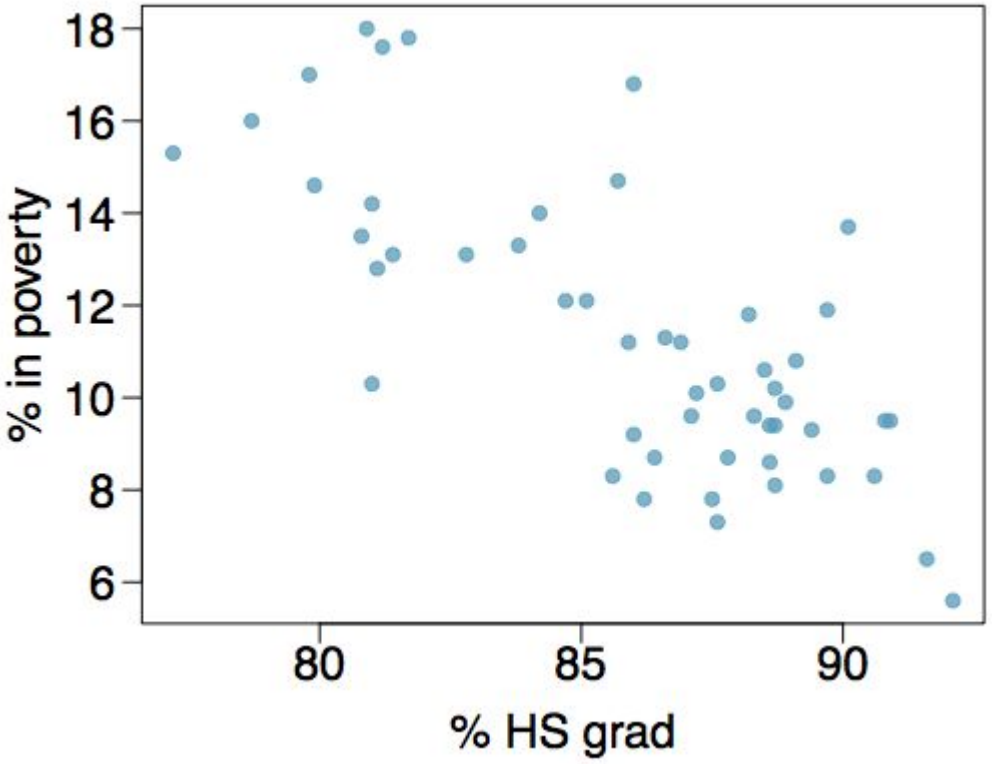

Response variable?

% in poverty

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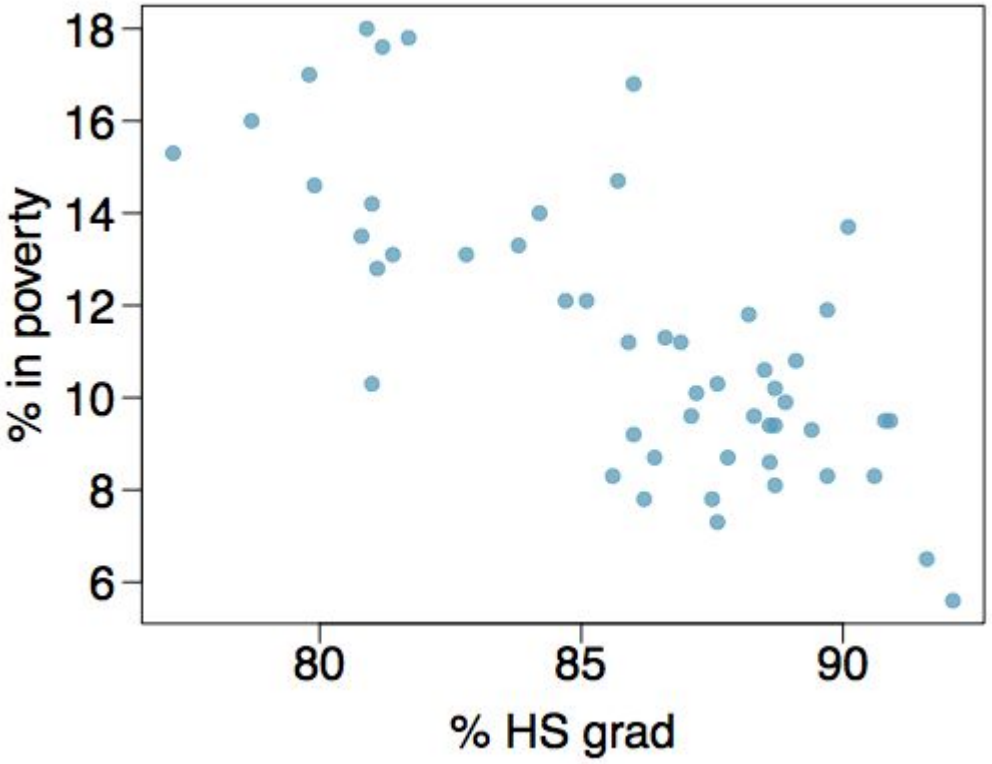

Response variable?

% in poverty

Explanatory variable?

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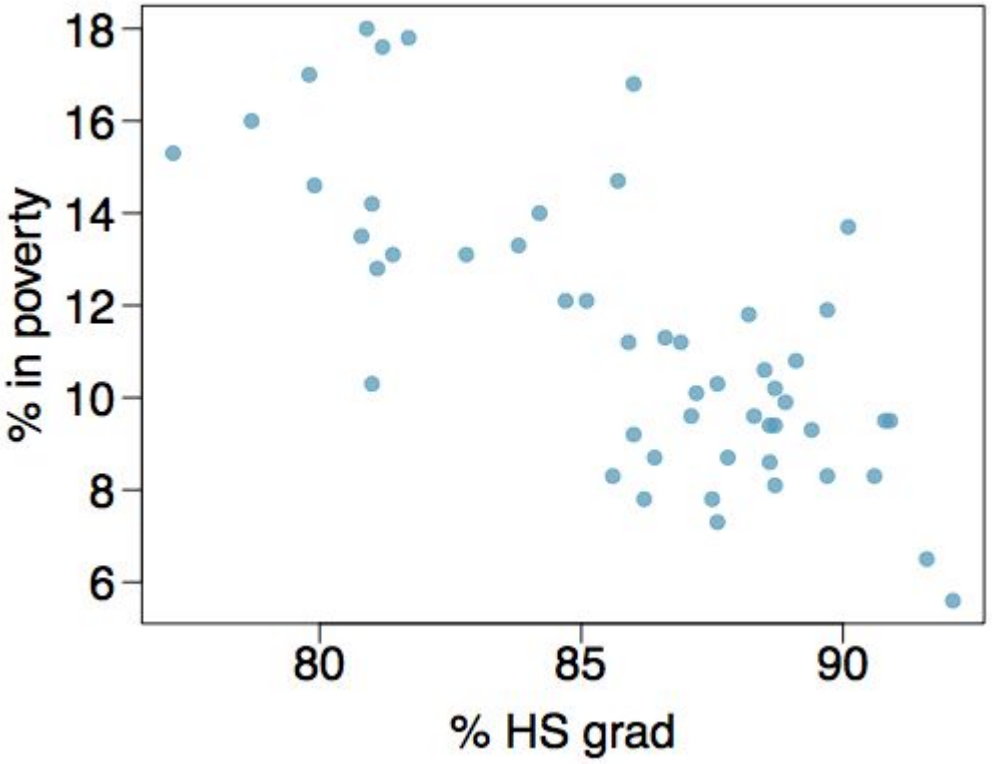

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Explanatory variable?

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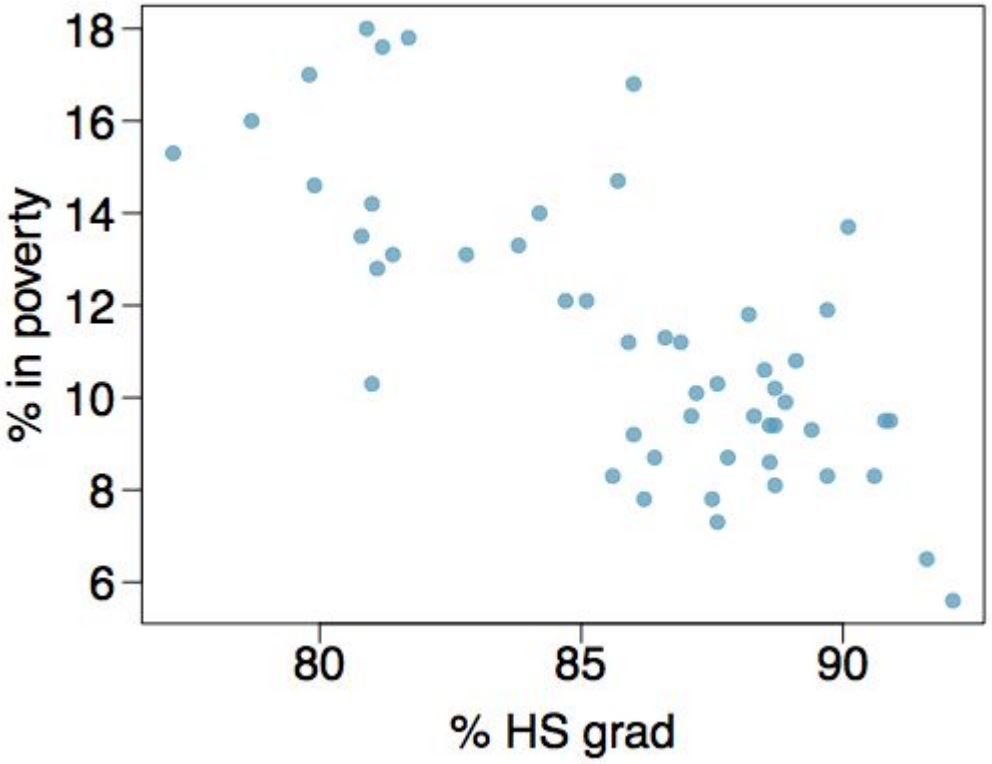

Response variable?

% in poverty

Explanatory variable?

% HS grad

Relationship?

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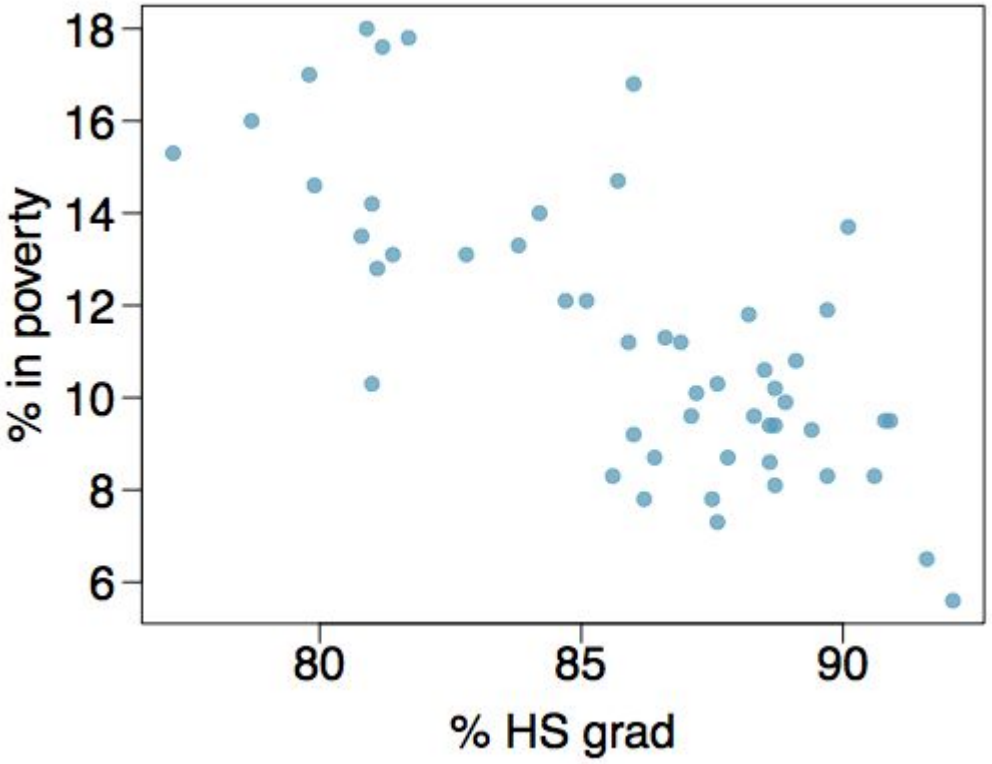

Response variable?

% in poverty

Explanatory variable?

% HS grad

Relationship?

linear, negative, moderately strong

Poverty vs. HS graduate rate

The linear model for predicting poverty from high school graduation rate in the US is

$$\hat{poverty} = 64.78 - 0.62 * HS_{grad}$$

The "hat" is used to signify that this is an estimate.

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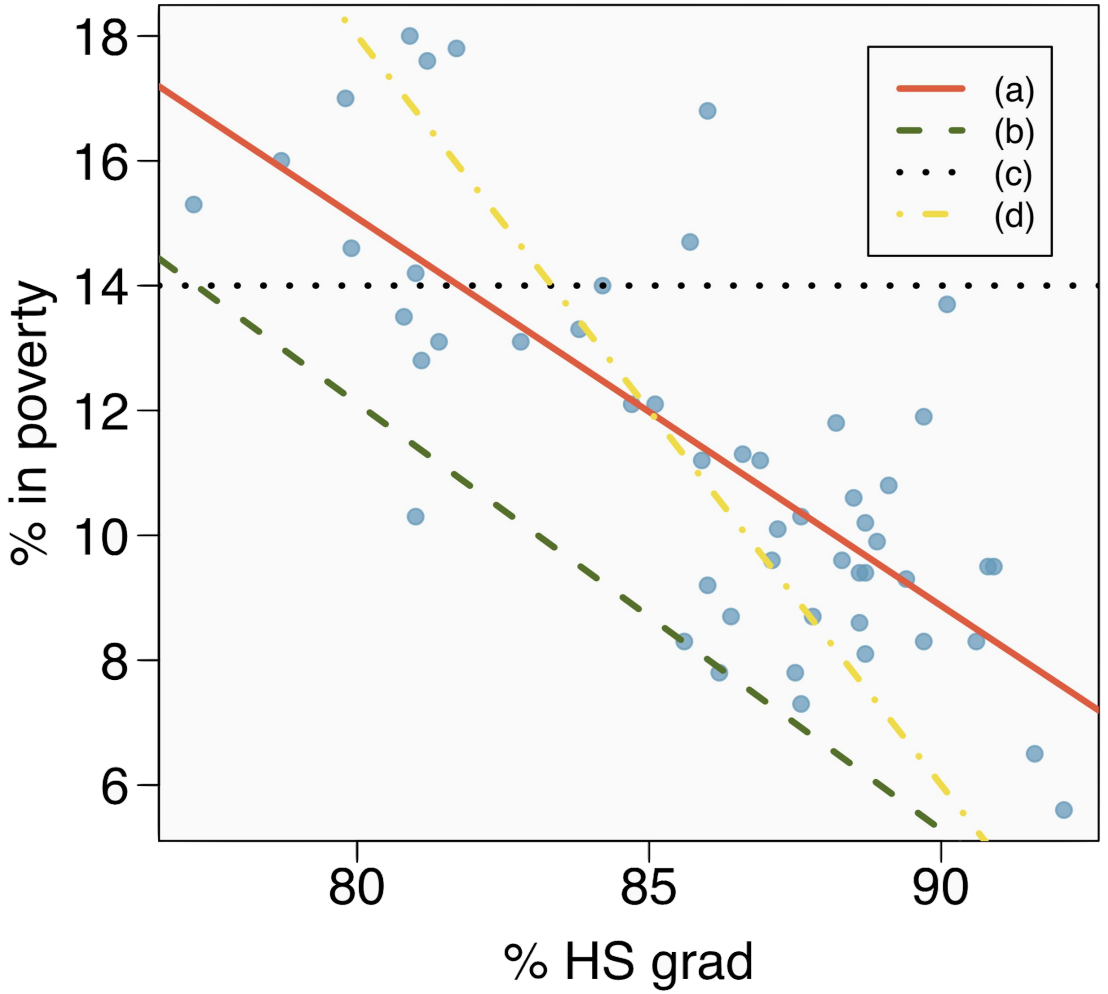
The high school graduate rate in Georgia is 85.1%. What poverty level does the model predict for this state?

64.78 − 0.62 x 85.1 = 12.018

Eyeballing the line

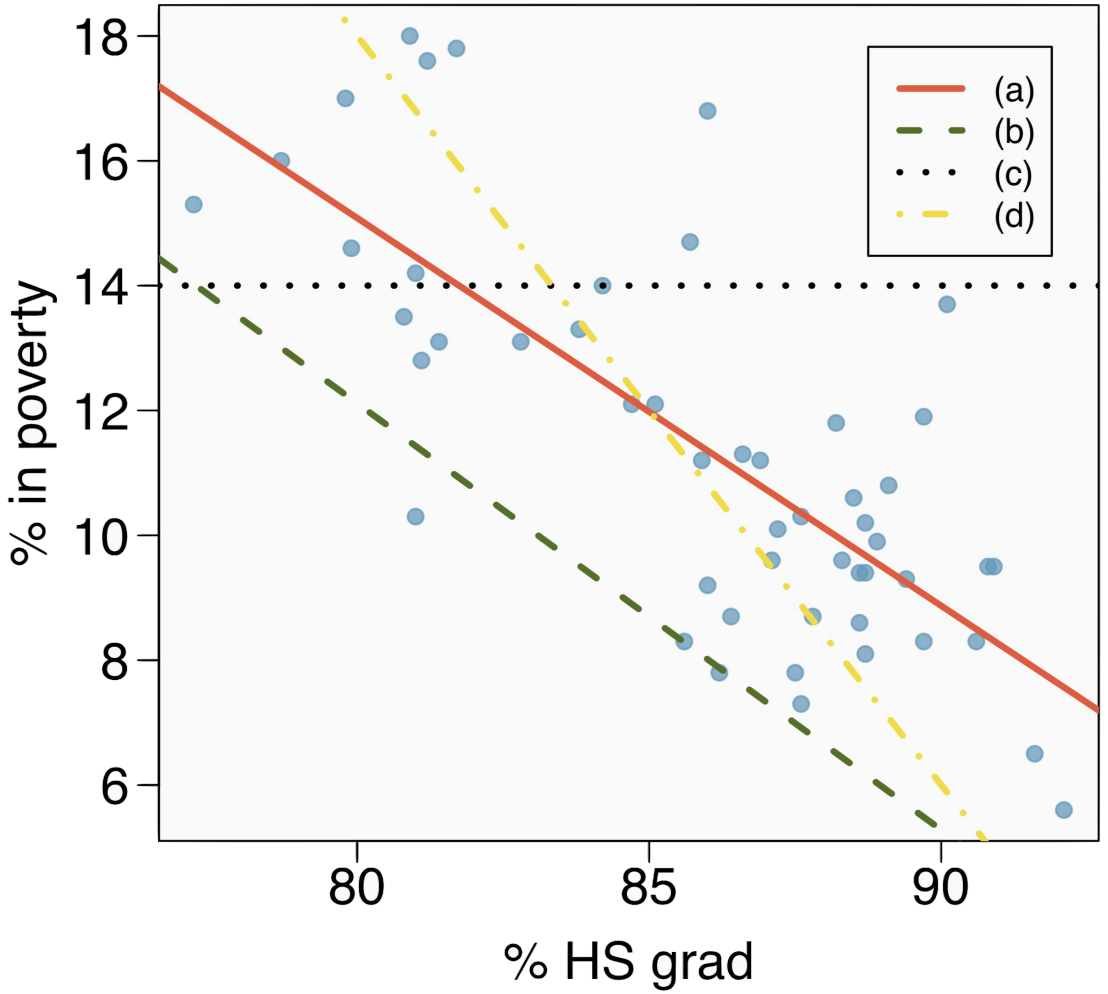
Which of the following appears to be the line that best fits the linear relationship between % in poverty and % HS grad? Choose one.



Eyeballing the line

Which of the following appears to be the line that best fits the linear relationship between % in poverty and % HS grad? Choose one.

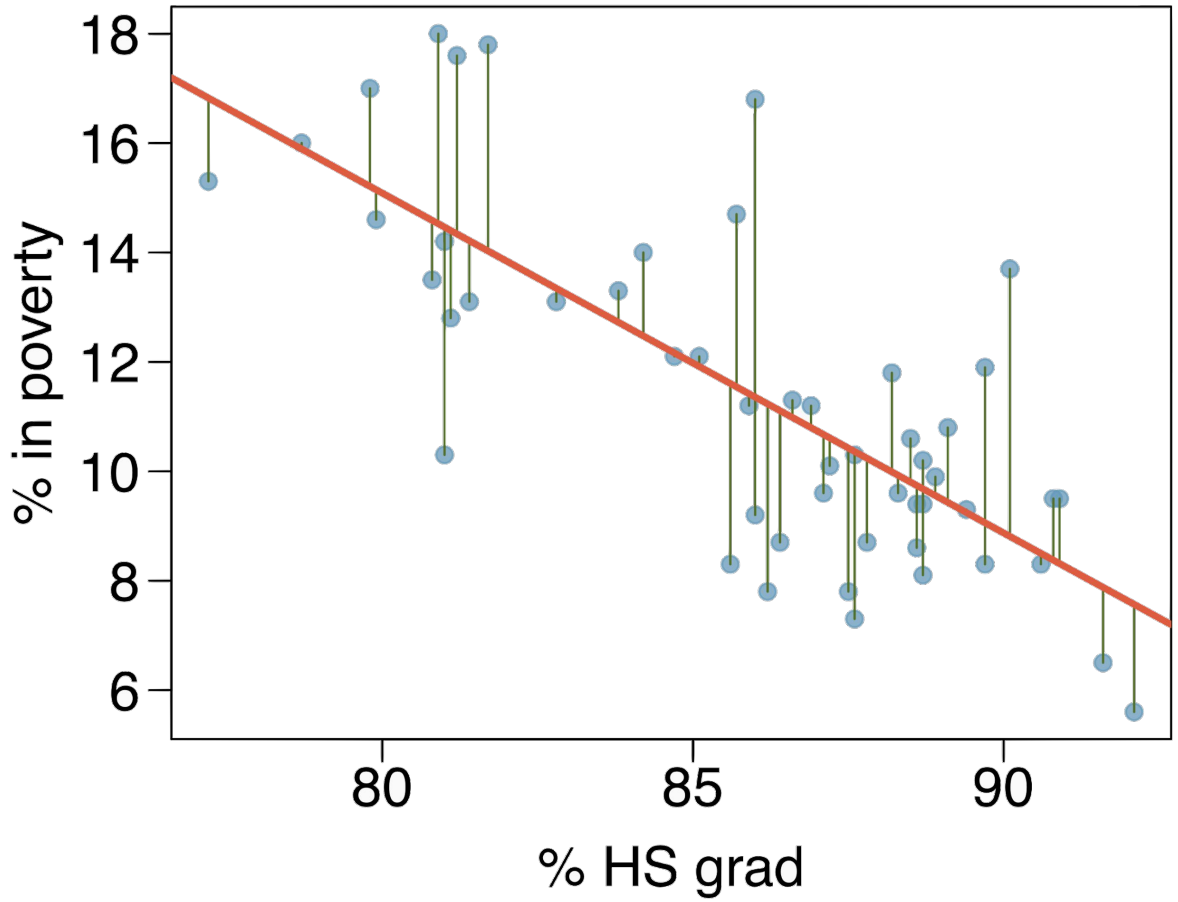
(a)



Residuals

Residuals are the leftovers from the model fit:

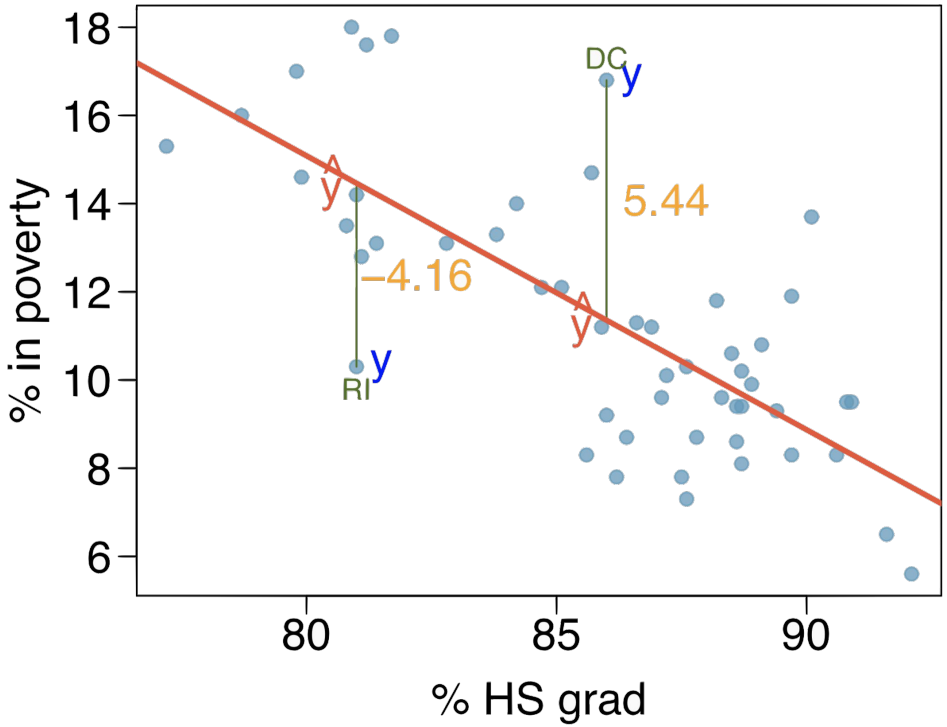
Data = Fit + Residual



Residuals (cont.)

Residual is the difference between the observed (y_i) and predicted $\hat{y}_i$.

$$e_i = y_i - \hat{y}_i$$



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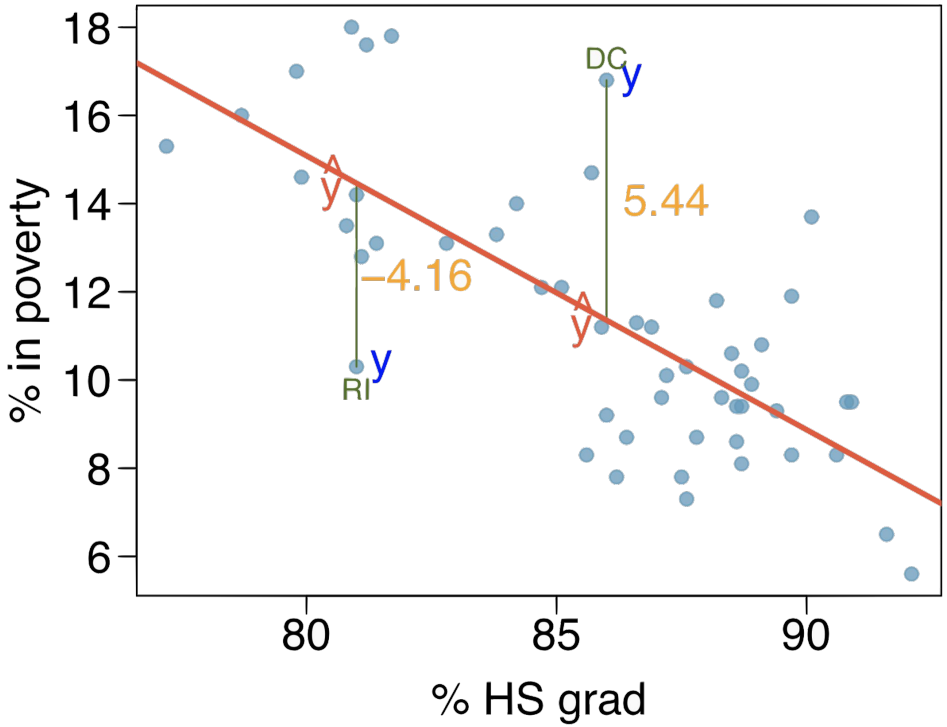

% living in poverty in DC is 5.44% more than predicted.

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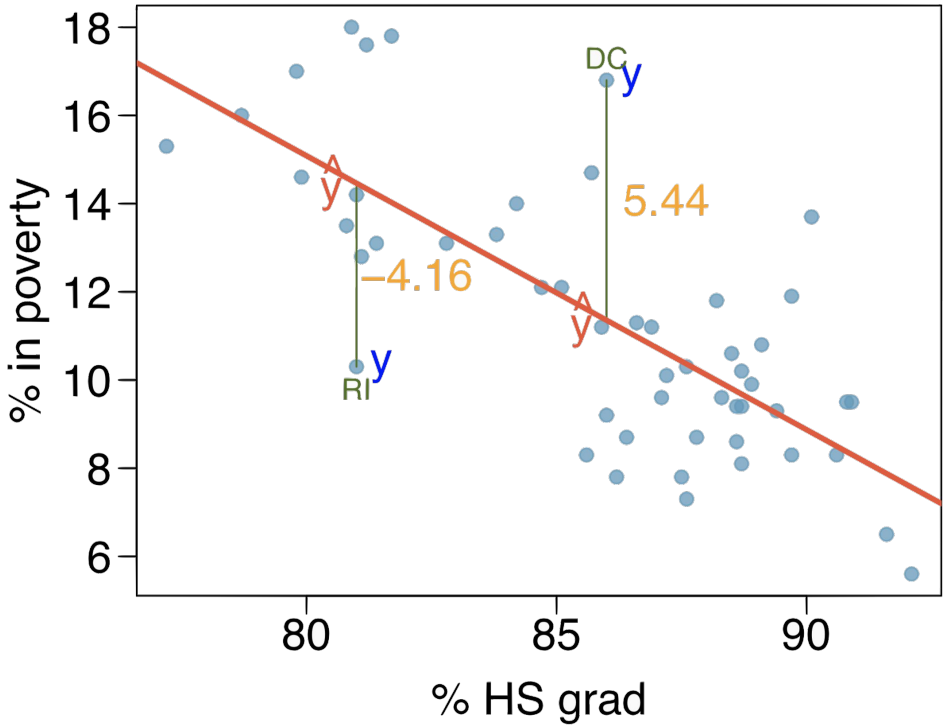

% living in poverty in DC is 5.44% more than predicted.

% living in poverty in RI is 4.16% less than predicted.

Quantifying the relationship

- *Correlation* describes the strength of the *linear* association between two variables.

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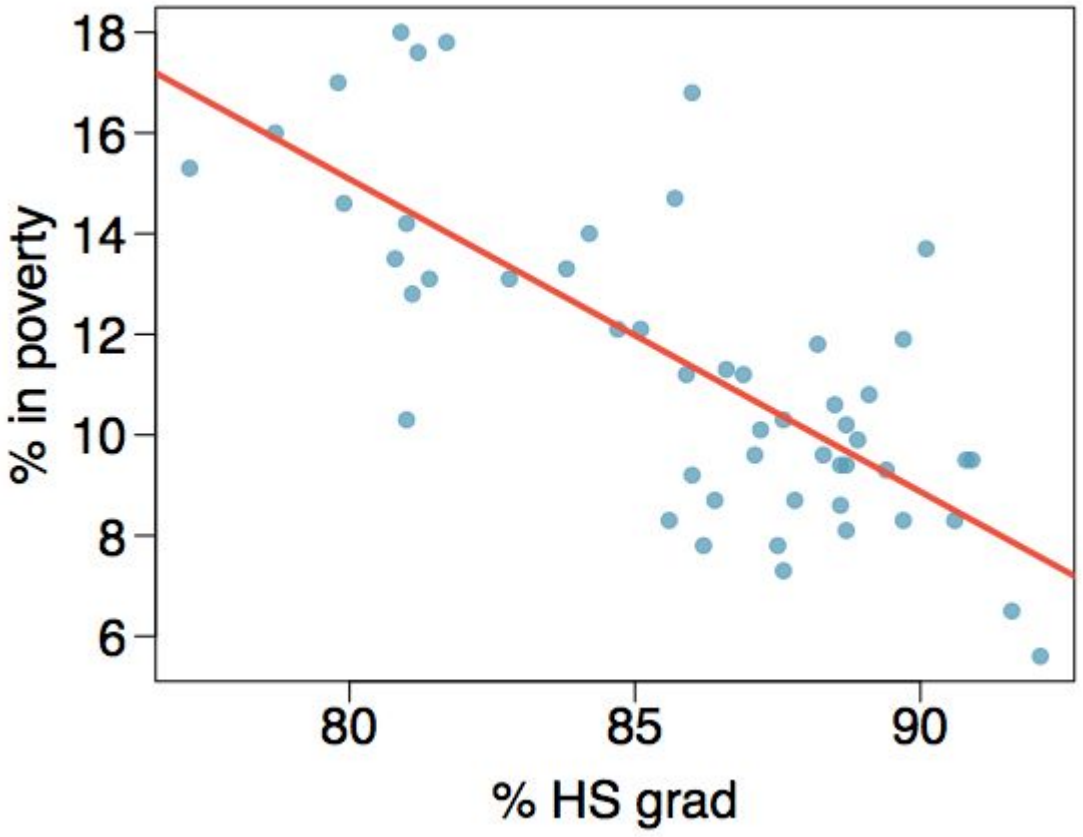
- It takes values between -1 (perfect negative) and +1 (perfect positive).

- A value of 0 indicates no linear association.

Guessing the correlation

Which of the following is the best guess for the correlation between percent in poverty and percent HS grad?

(a) 0.6
(b) -0.75
(c) -0.1
(d) 0.02
(e) -1.5



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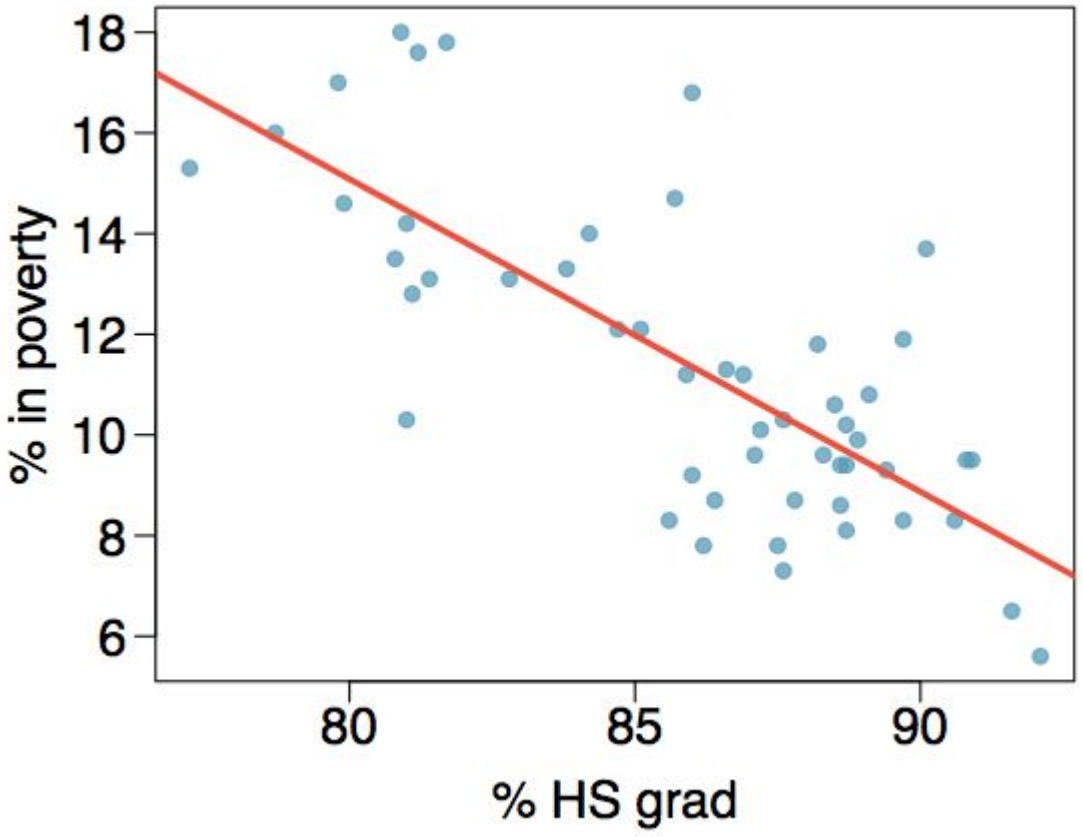
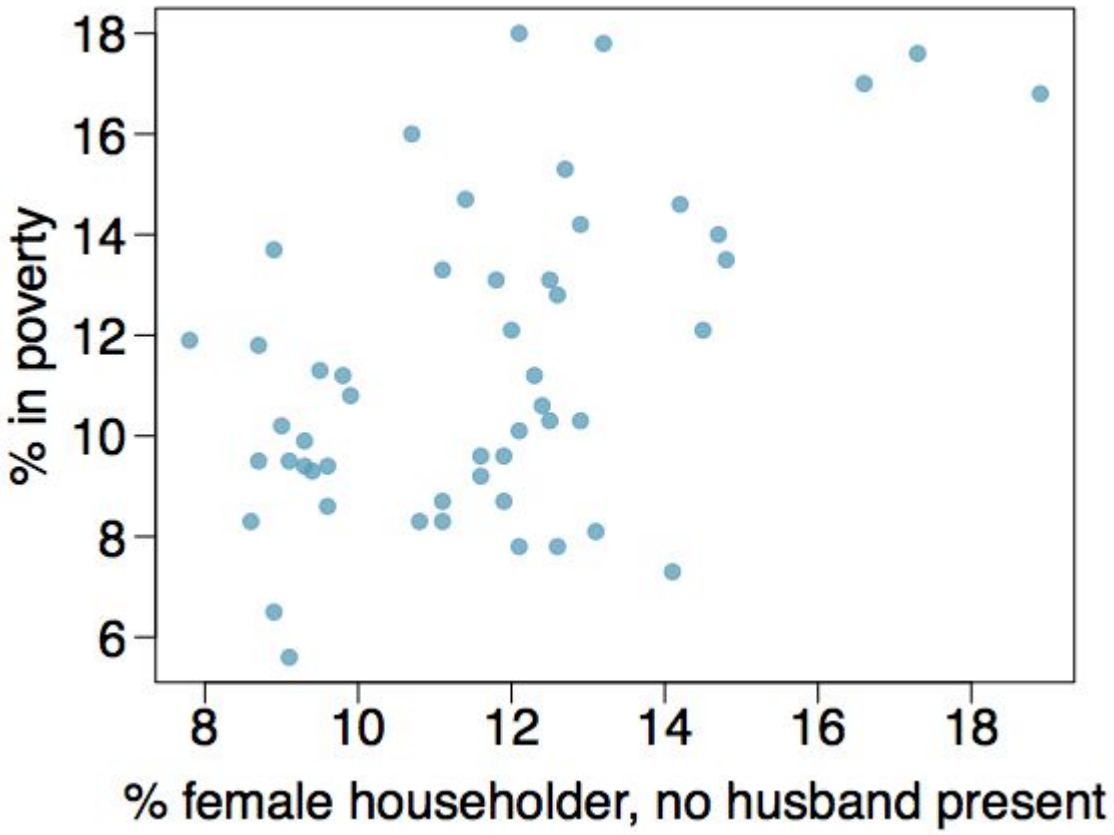


Guessing the correlation

Which of the following is the best guess for the correlation between percent in poverty and percent female householder?

(a) 0.1
(b) -0.6
(c) -0.4
(d) 0.9
(e) 0.5



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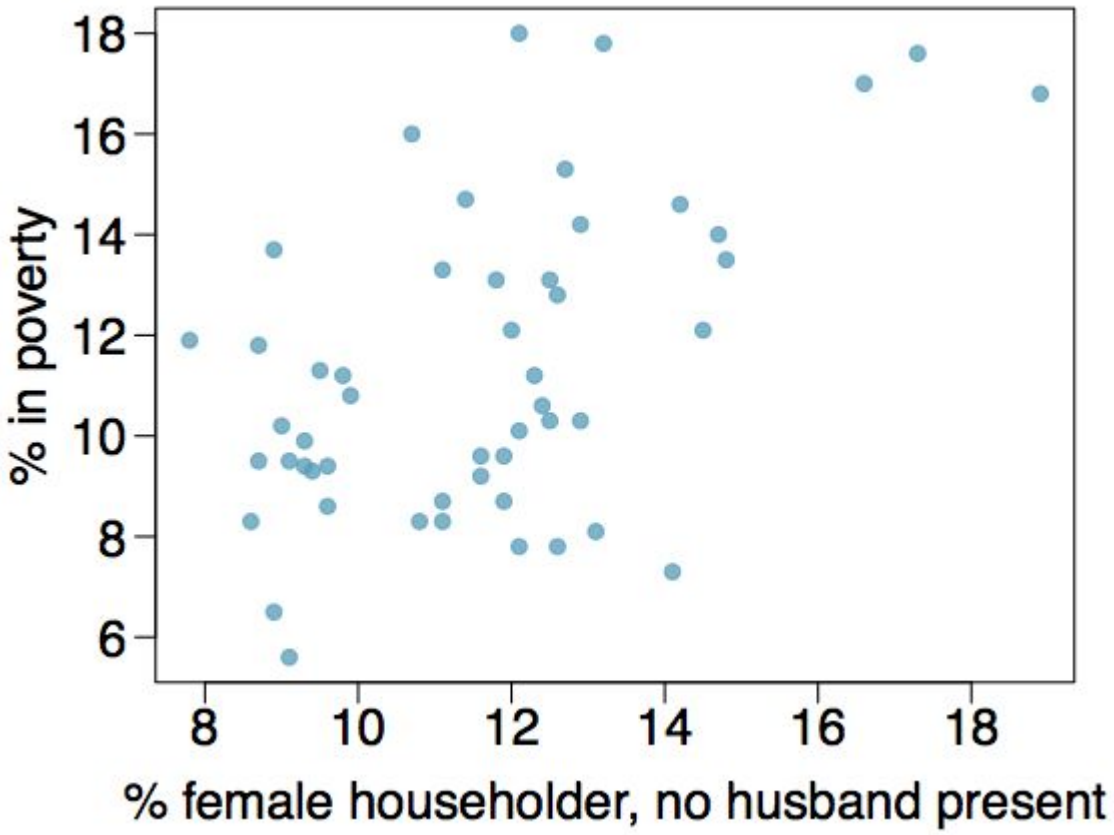
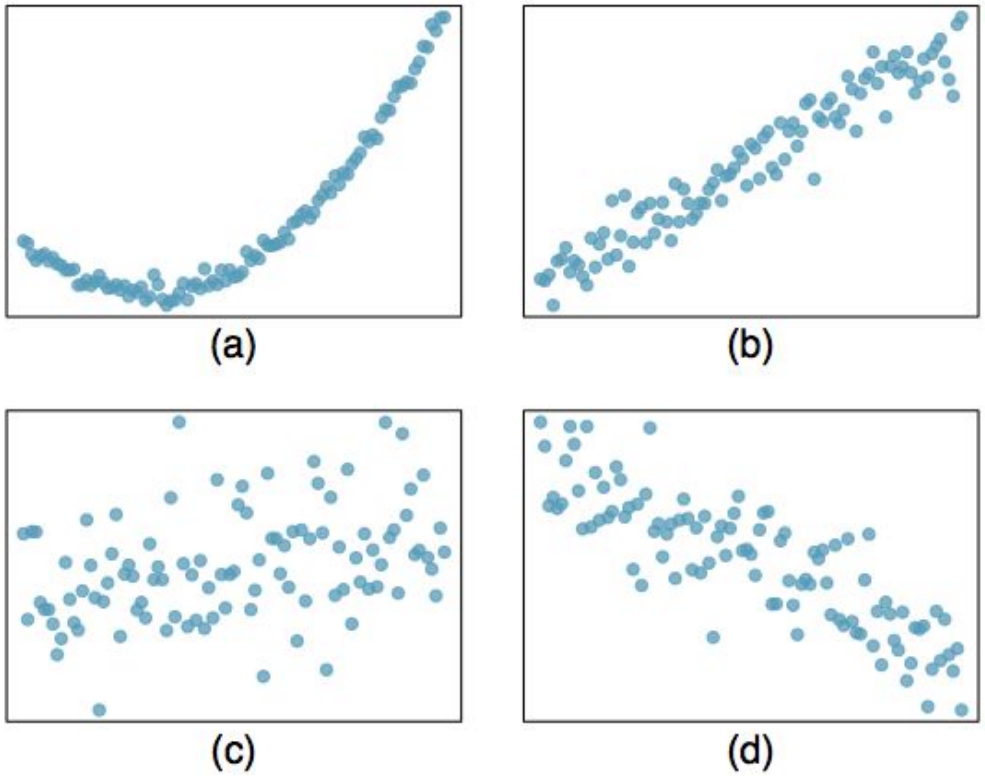


Assessing the correlation

Which of the following is has the strongest correlation, i.e. correlation coefficient closest to +1 or -1?



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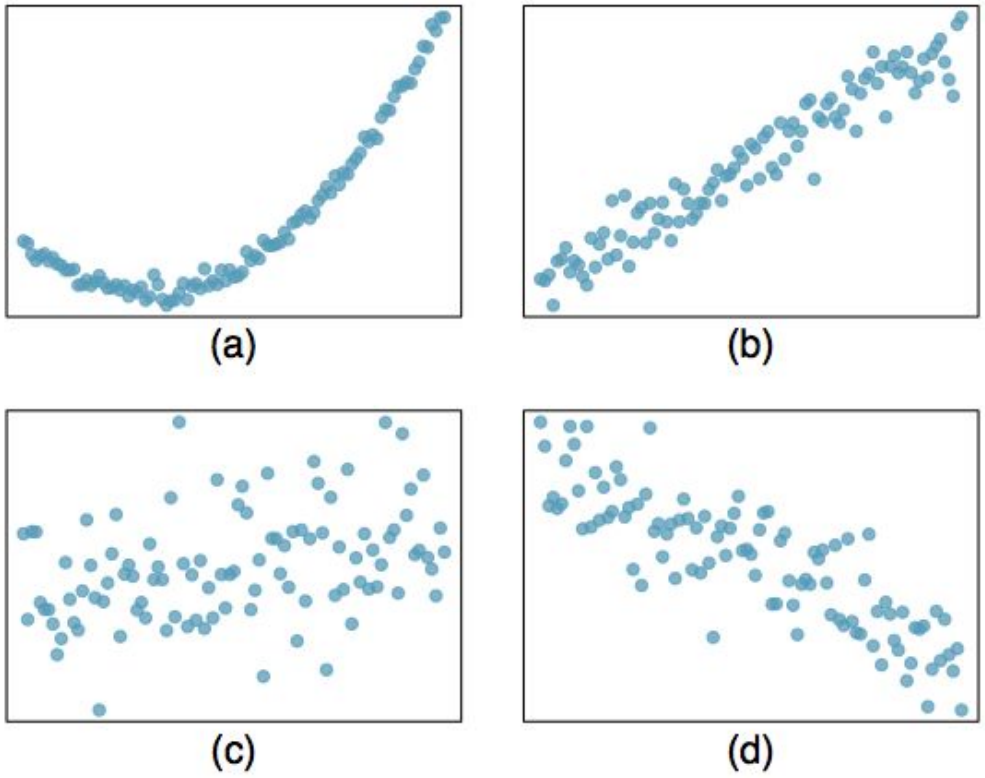

(b) → correlation means linear association

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