

## Practice Assignment: Making Predictions

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Let's put together everything you've learned in this unit about simple linear regression. Our goal in this assignment is to use a cat's body weight to predict how much its heart weighs.

When veterinarians prescribe heart medicine for cats, the dose is often based on the size of a cat's heart. As you might imagine, it would be very difficult to weigh a cat's heart in a veterinarian's office, so we want to use a line of best fit that can be used to estimate the cat's heart weight based on its body weight.

The dataset<sup>1</sup> contains the body weight in kilograms (kg) and heart weight in grams (g) for 144 domestic cats. Here are the variables we will use:

*Sex*: Factor with levels "F" and "M"  
*Bwt*: Body weight in kg  
*Hwt*: Heart weight in g

The first 10 observations are displayed in the following table.

Sex	Bwt	Hwt
F	2	7
F	2	7.4
F	2	9.5
F	2.1	7.2
F	2.1	7.3
F	2.1	7.6
F	2.1	8.1
F	2.1	8.2
F	2.1	8.3
F	2.1	8.5

- 1) Before fitting a line of best fit, let's visualize the relationship between the heart and body weight of domestic cats.

Part A: What are the explanatory and response variables?

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<sup>1</sup> Venables, W. N. & Ripley, B. D. (2002). *Modern applied statistics with S*. (4th ed.). Springer.

Go to the *Linear Regression* tool at [https://lumen-learning.shinyapps.io/linear\\_regression/](https://lumen-learning.shinyapps.io/linear_regression/) and plot the data using the following steps: under “Enter Data,” select “Enter Own;” name the  $x$  (explanatory) and  $y$  (response) variables appropriately; copy and paste the data from DCMP\_STAT\_6E\_Cats (make sure the explanatory variable is in the first column and the response variable is in the second column); under “Plot Options,” select “Regression Line;” and click “Submit Data” button.

Part B: Use the plot to describe the relationship between body weight and heart weight for cats.

- 2) Use the tool to calculate a line of best fit to describe the relationship between the two variables.

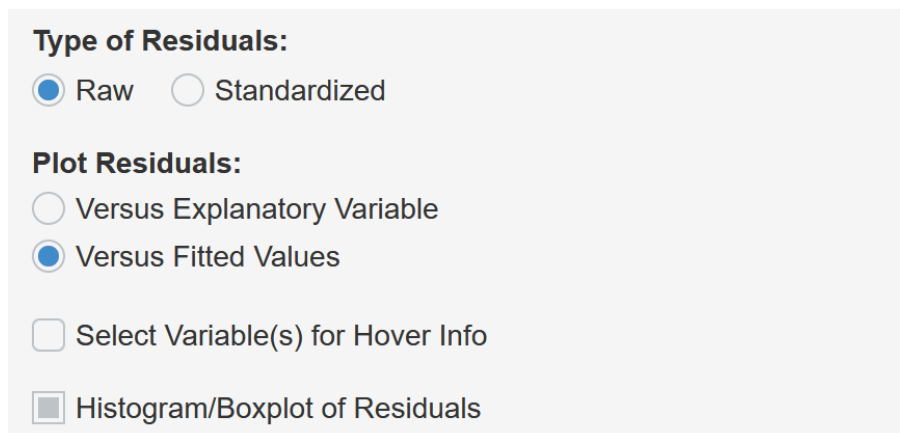
Part A: Write the equation of the line using customized variable names.

Part B: Interpret the slope of the model.

Part C: Does the intercept have a meaningful interpretation? If so, interpret the intercept. Otherwise, briefly explain why not.

- 3) Before using the line for prediction, let’s see if the model is an appropriate fit for the data and useful for prediction.

Part A: Make a scatterplot of the residuals versus predicted (“fitted”) values and a histogram of the residuals. To create the scatterplot and a histogram of the residuals, select the following options in the **Fitted Values and Residual Analysis** tab.



The image shows a screenshot of the 'Fitted Values and Residual Analysis' tab in a software interface. It contains several options for residual analysis:

- Type of Residuals:**
  - Raw
  - Standardized
- Plot Residuals:**
  - Versus Explanatory Variable
  - Versus Fitted Values
- Select Variable(s) for Hover Info
- Histogram/Boxplot of Residuals

Part B: Based on the scatterplot of the residuals versus predicted, is the line an appropriate fit for the data?

Part C: Calculate  $R^2$  and interpret this value.

Part D: Calculate the regression standard error. Briefly describe what this value means in the context of the data.

Hint: This value is called the “Residual Standard Deviation” in the “Model Summary.”

- 4) A veterinarian is preparing heart medicine prescriptions for three cats. She wants to use the line to predict their heart weights, which will help her determine the proper doses. For each cat, determine if it's appropriate to use the model to predict that cat's heart weight. If it is appropriate, calculate the predicted value. If it is not appropriate, explain why not.

Part A: Buttercup, who weighs 2.2 kg

Part B: Freckles, who weighs 6.5 kg

Part C: Tigger, who weighs 3.8 kg

- 5) Would you recommend the veterinarian use the predictions from your line as the sole values of heart weight used to determine the dosages of heart medicine prescribed to cats? Explain why or why not using your responses to Questions 3 and 4.