Should We Use Survey Weights When Fitting Models?

Brady T. West

Review: Survey Weights

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Therefore

We consider the case where an analyst wants to fit a regression model to a dependent variable (DV) collected from a probability sample

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Using survey weights to fit regression models:

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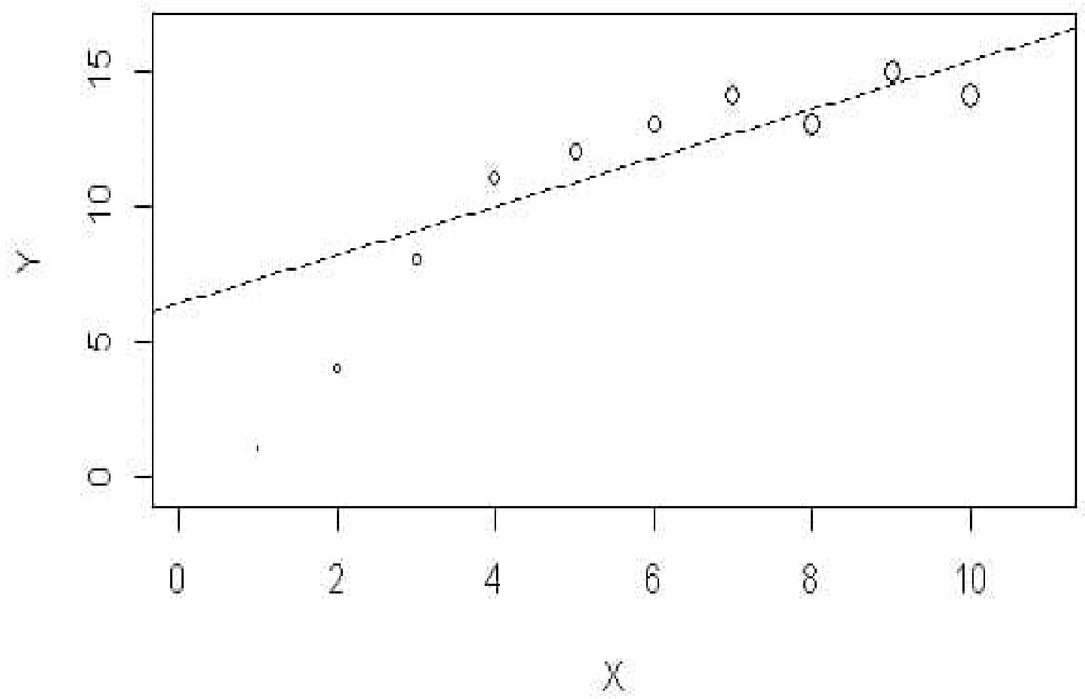
Unbiased estimates of the regression parameters

Incorrect model for the finite population of inference

BAD!

Example: Weights, Poor Model

- In this example data set, the size of the point represents the survey weight for the case



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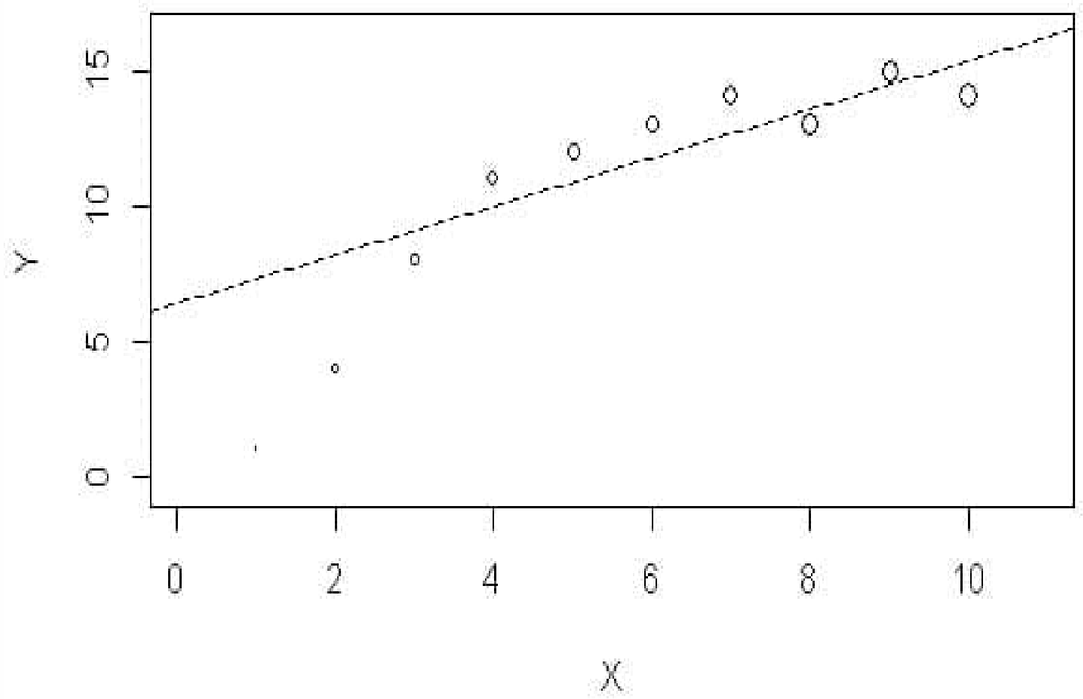

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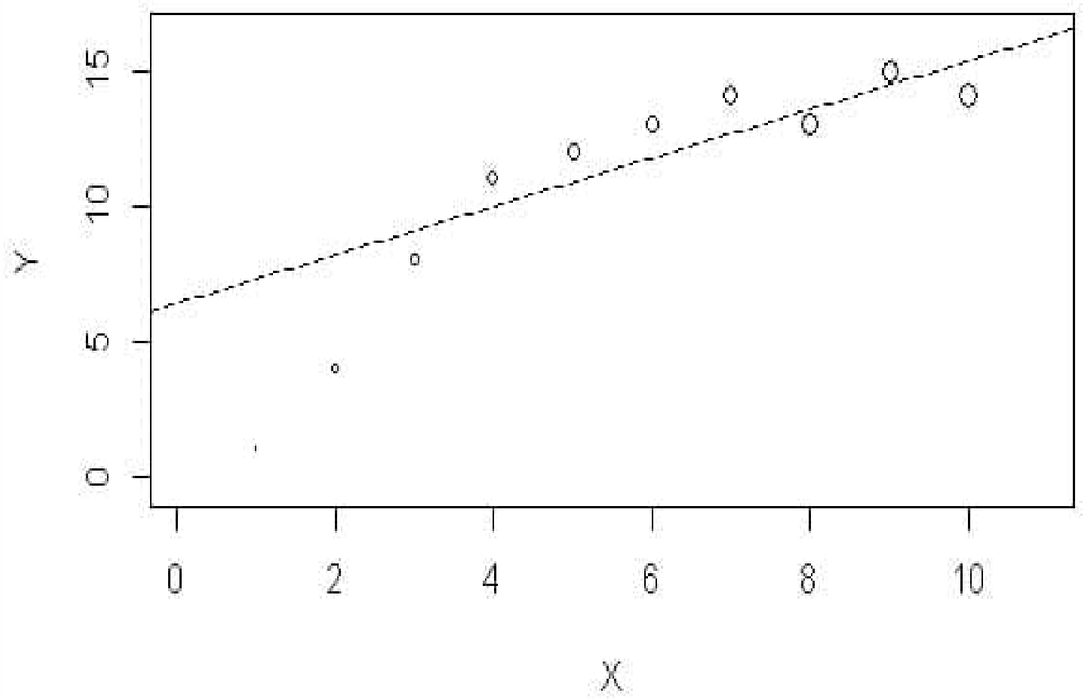
- Non-linear relationship between X and Y, but the analyst misspecifies the model and assumes a linear relationship
- The analyst still uses the weights though! We see an **unbiased** estimate of a **poor** population model.



Example: No Weights, Poor Model

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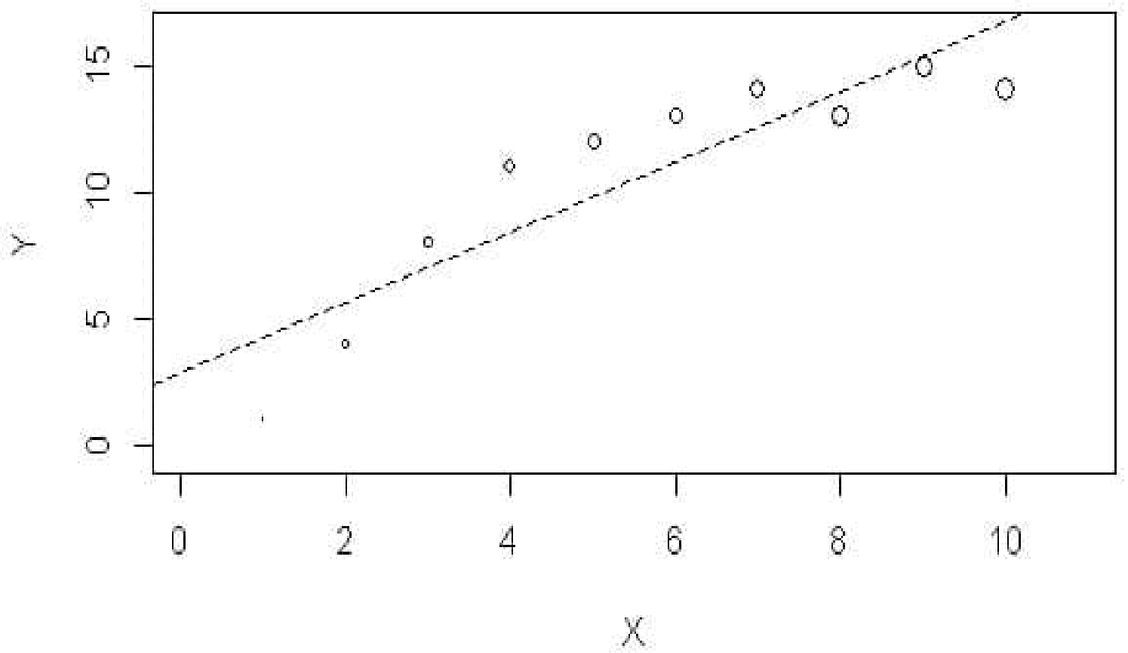

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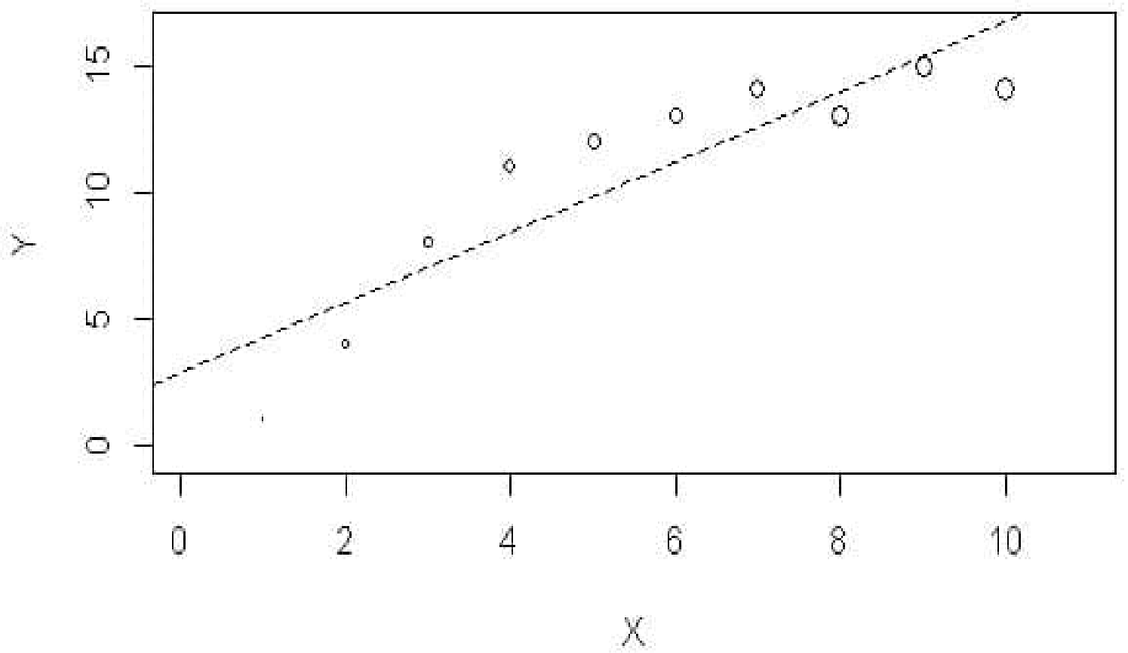

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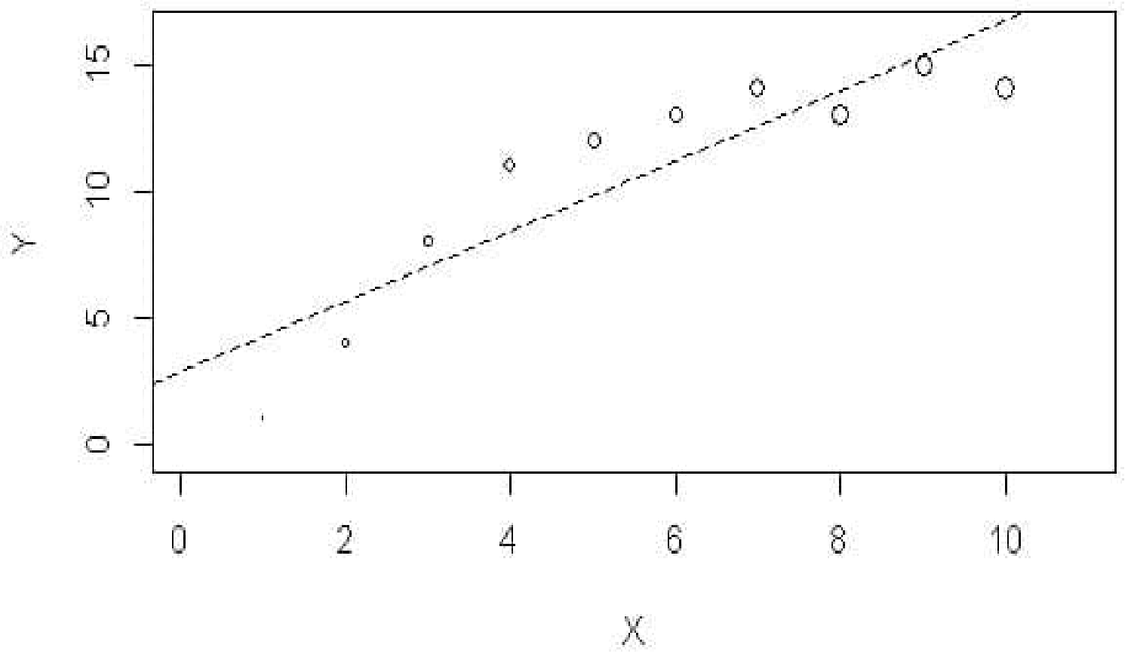
- Note: The fitted regression line is drawn toward the low-weight points (we want to take steps to avoid this situation in practice)



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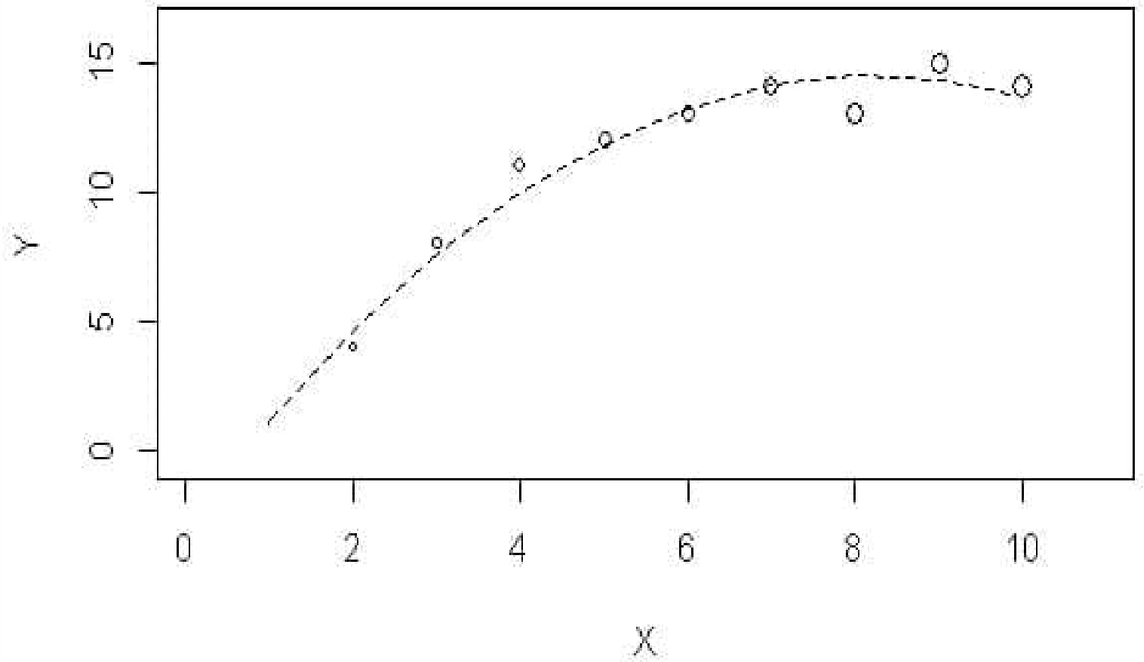

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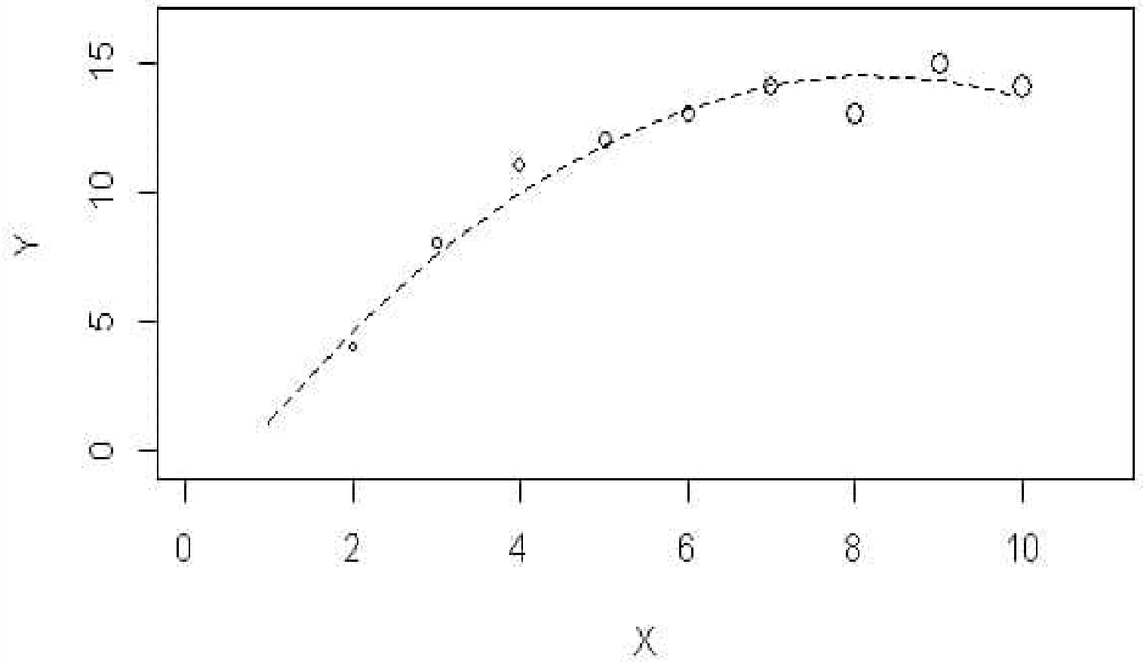

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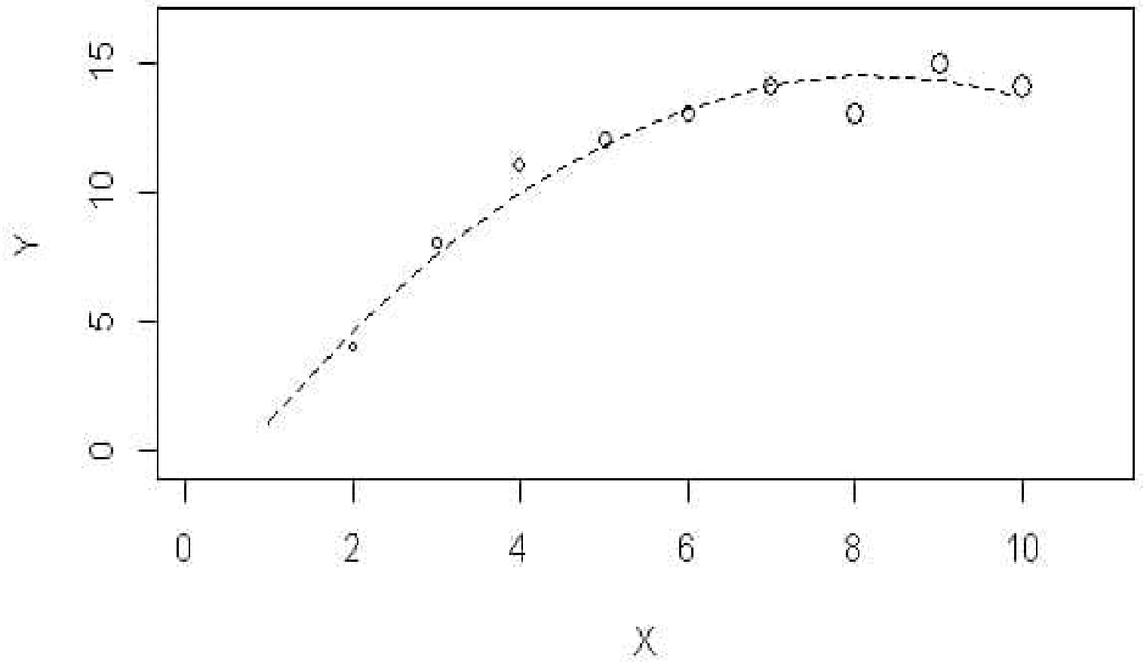
- Suppose the analyst ignores weights BUT correctly specifies the model
- We see that the **well-specified model** provides a good fit to the observed data!
- In this **model-based approach**, if the model is correctly specified, we may not need the weights to estimate the relationship in the population!



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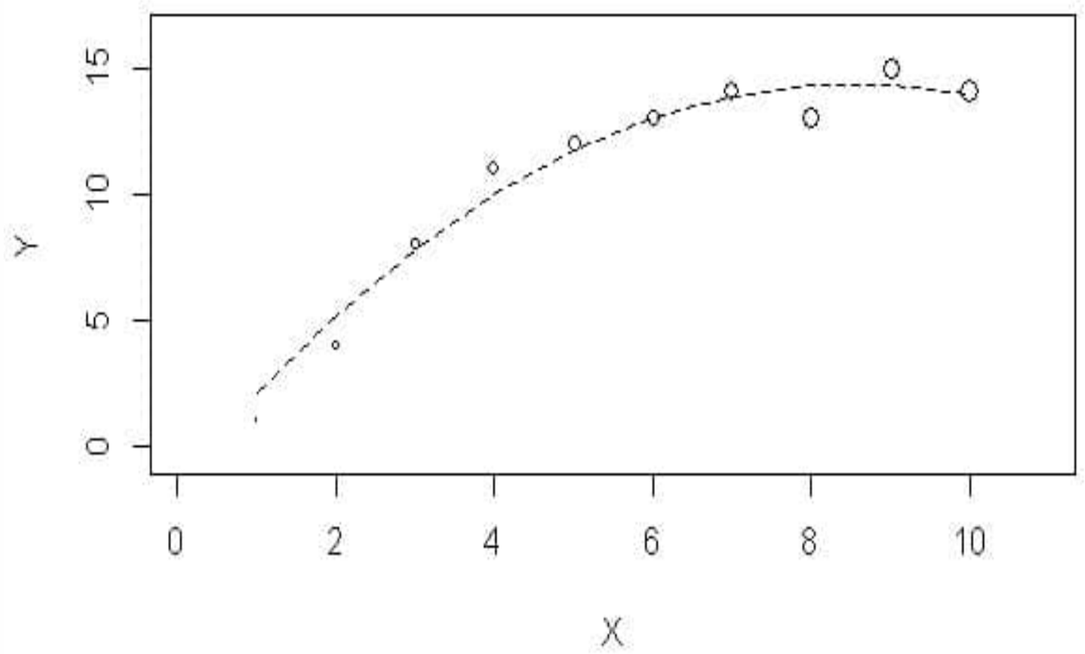
- Suppose the analyst uses the weights to estimate the model AND correctly specifies the model



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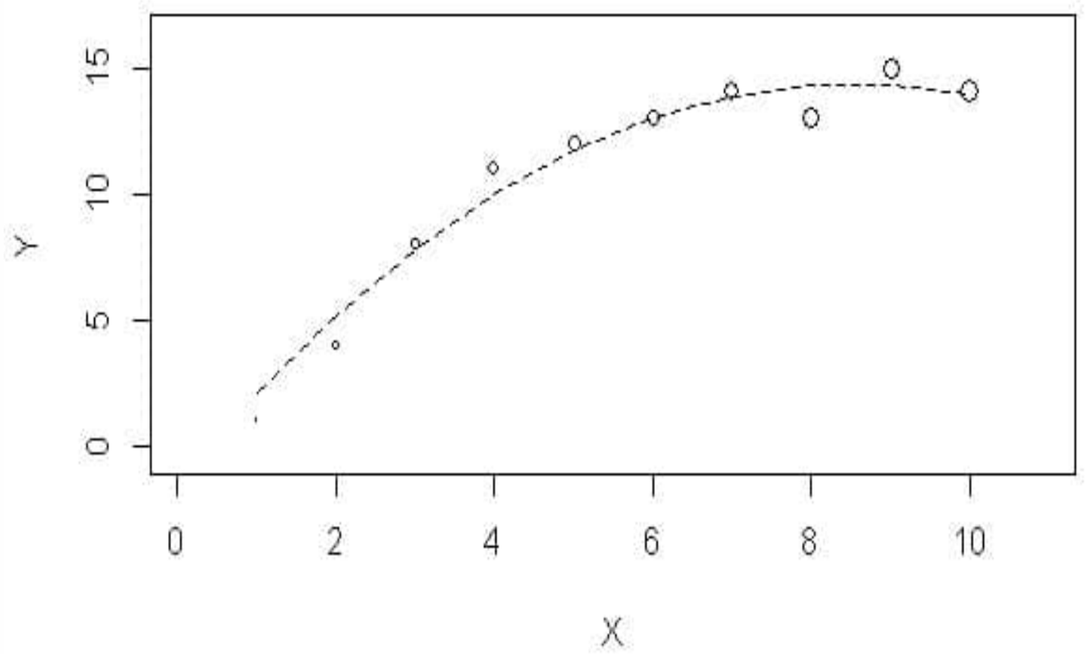

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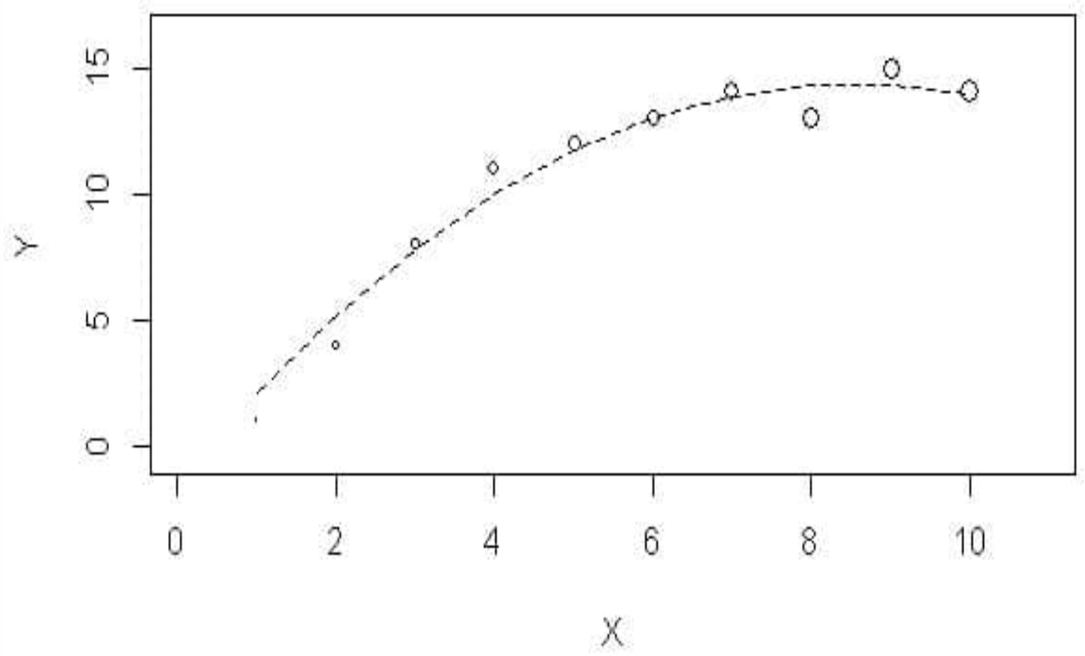
- Suppose the analyst uses the weights to estimate the model AND correctly specifies the model
- We have an **unbiased** estimate of the relationship from a **well-specified model.** But the fit is the same!
- In this situation, we would likely find that the estimated coefficients would have **larger standard errors** than in the unweighted case; unnecessary!



Recommendations for Practice

If survey weights are available for a probability sample, and you wish to fit a regression model:

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3. If estimated coefficients remain similar, but weighted estimates have larger standard errors, model has likely been specified correctly; weights are unnecessary.

And only inflate the sampling variance of your estimates!

Recommendations for Practice

If survey weights are available for a probability sample, and you wish to fit a regression model:

1. Do the best you can to specify the model correctly!
2. Fit the model with and without using the survey weights.
3. If estimated coefficients remain similar, but weighted estimates have larger standard errors, model has likely been specified correctly; weights are unnecessary.
4. If estimated coefficients change substantially, the model may have been misspecified. Weighted estimates should be reported to ensure they are at least unbiased with respect to sample design.

And only inflate the sampling variance of your estimates!

Recommendations for Practice

- It is **difficult** to specify every model correctly: when do we ever know what the true model is, especially with multiple predictors?

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- Modern statistical software (Python) makes it easy to fit unweighted/weighted models, if weights available

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- Modern statistical software (Python) makes it easy to fit unweighted/weighted models, if weights available
- Formal tests also exist for comparing weighted and unweighted estimates
  (See deep-dive reading this week!)

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