Partial regression and partial residual plots

FW8051 Statistics for Ecologists

Department of Fisheries, Wildlife and Conservation Biology

Learning Objective

Understand approaches for visualizing fitted multiple regression models

Visualizing Multiple Regression

$$Y \sim \beta_0 + X_1\beta_1 + X_2\beta_2 + \epsilon$$

β_1 reflects the "effect" of X_1 after accounting for X_2.

How can we visualize this "effect"?

- Added variable or partial *regression* plots
- Component + residual or partial *residual* plots

See the paper by Larano and Corcobado (2008) and description of visreg package (also on Canvas)

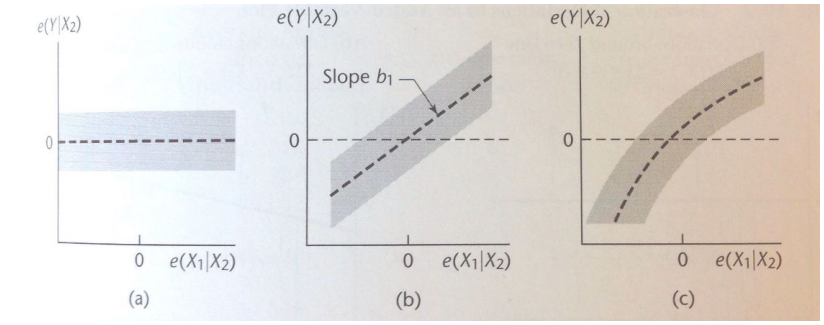
Added Variable Plots (for X_i)

1. Regress Y against X_{-i} (i.e., all predictors except X_i), and obtain the residuals
2. Regressing X_i against all other predictors (X_{-i}) and obtain the residuals
3. Plot the residuals from [1] against the residuals from [2].

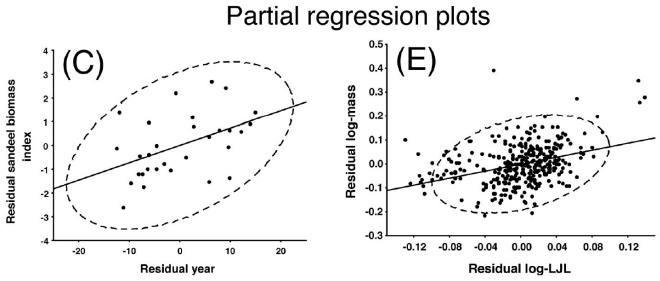
Plots the part of Y not explained by other predictors (i.e., X_{-i}) against the part of X_i not explained by the other predictors (X_{-i}).

Lets us visualize the effect of X_i after accounting for all other predictors.

Added variable plot for X_1 (with one other predictor, X_2)



- Slope is the same as that in the multiple regression model containing both X_1 and X_2
- Panel (a) suggests X_1 provides no additional information useful for predicting Y beyond that contained in X_2
- Panel (c) suggests we may need to allow for a non-linear relationship between X_1 and Y



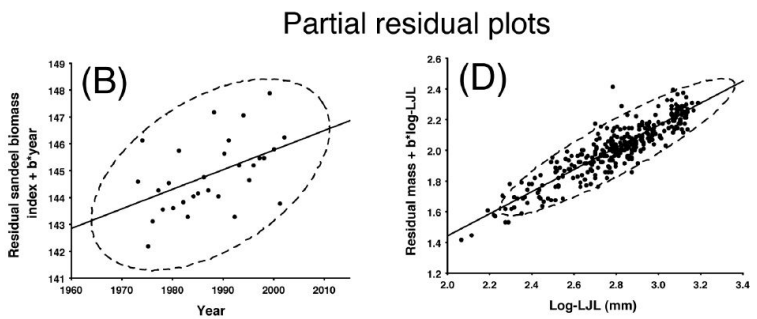
Shows the slope and the true scatter of points around the partial line in an analogous way to bi-variate plots in simple linear regression

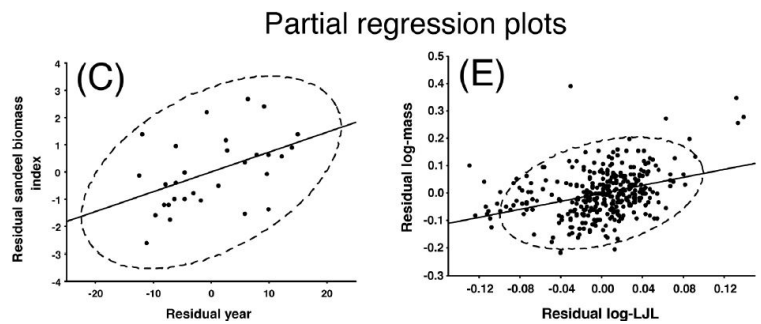
- Tells us about the importance of X_2 (given everything else already in the model)
- Can help with diagnosing non-linearities
- Helps visualize influential points and outliers

Component + residual plots or partial residual plot

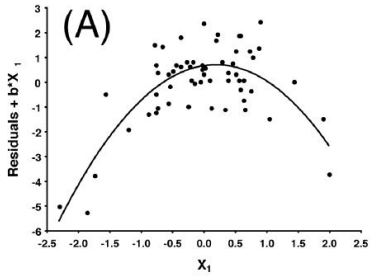
Plots $X_i\beta_i + \hat{\epsilon}_i$ versus X_i.

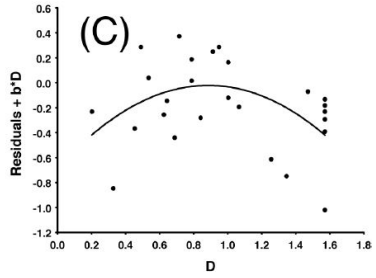
- Better for diagnosing non-linearities
- Not as good at depicting the amount of variability explained by the predictor (given everything else in the model).
- Easy to generalize to other regression models (see visreg package on Canvas)





Partial residual plots





Partial regression plots