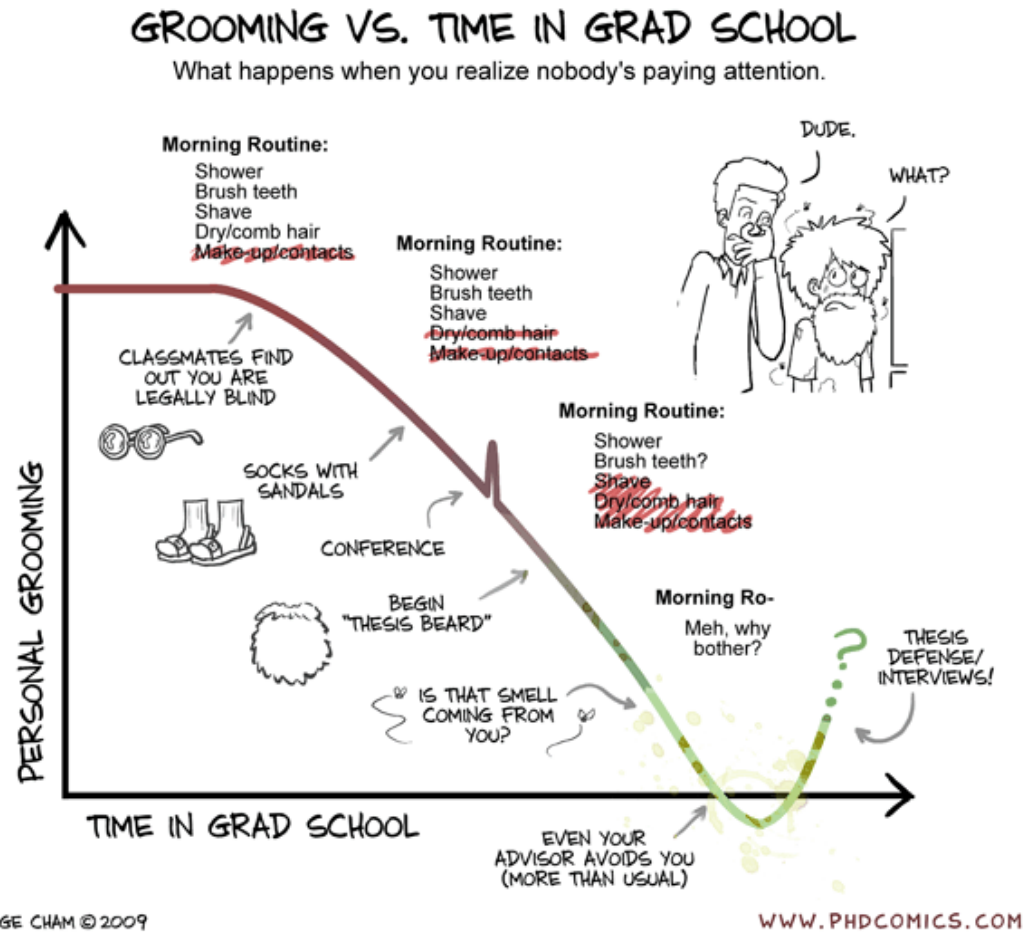
Linear Models

ENTMLGY 6707 Entomological Techniques and Data Analysis



Learning objectives

1) Understand when to conduct a simple linear regression

2) Interpret the outcome of a simple linear regression

3) Evaluate assumptions of simple linear regression

Simple linear regression

Table 4.1 Examples of the Generalized Linear Model as a Function of Independent Variable and Dependant Variable Type

		Responses				
		Continuous DV	*Binary DV*	*Unordered Multicategory DV*	*Ordered Categorical DV*	*Count DV*
Predictors	*Continuous IV*	OLS regression	Binary logistic regression	Multinomial logistic regression	Ordinal logistic regression	OLS, Poisson regression
	Mixed continuous and categorical IV					
	Binary/ categorical IV only	ANOVA and *t*-test	Log-linear models	Log-linear models		Log-linear models

ANOVA, analysis of variance; DV, dependent variable; IV, independent variable; OLS, ordinary least squares.

Chapter 4: Simple Linear Models With Continuous Dependent Variables: Simple ANOVA Analyses
In: Regression & Linear Modeling: Best Practices and Modern Methods

Linear regression

$$y = b + mx$$

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

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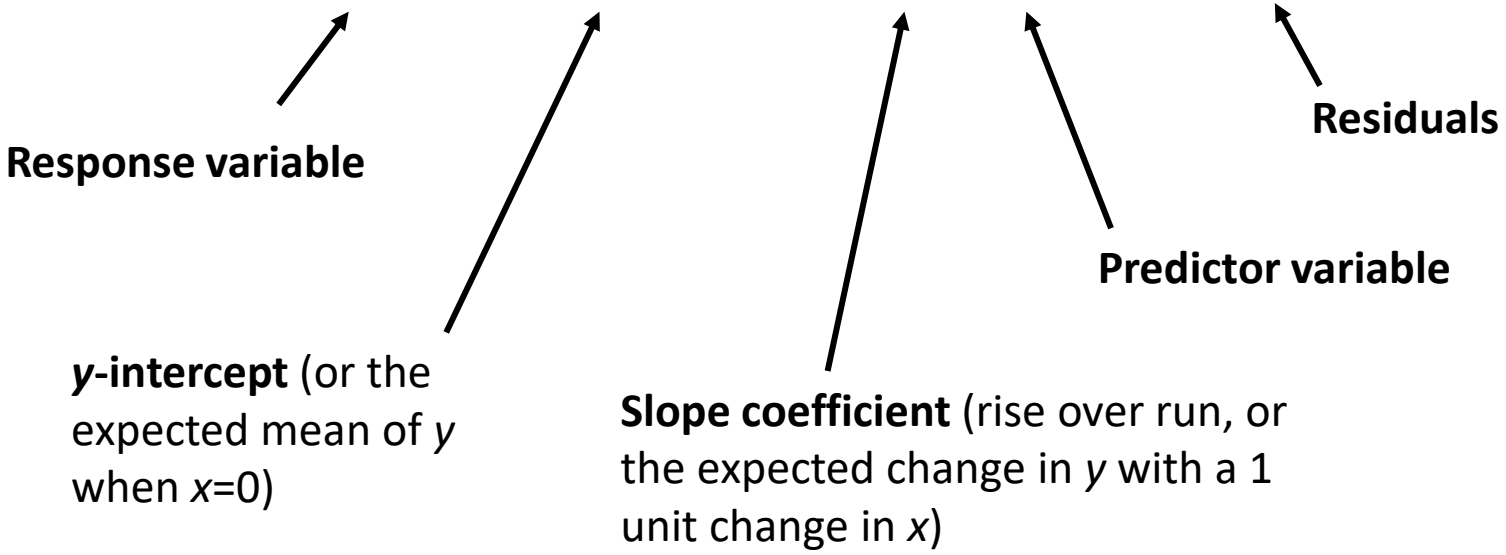
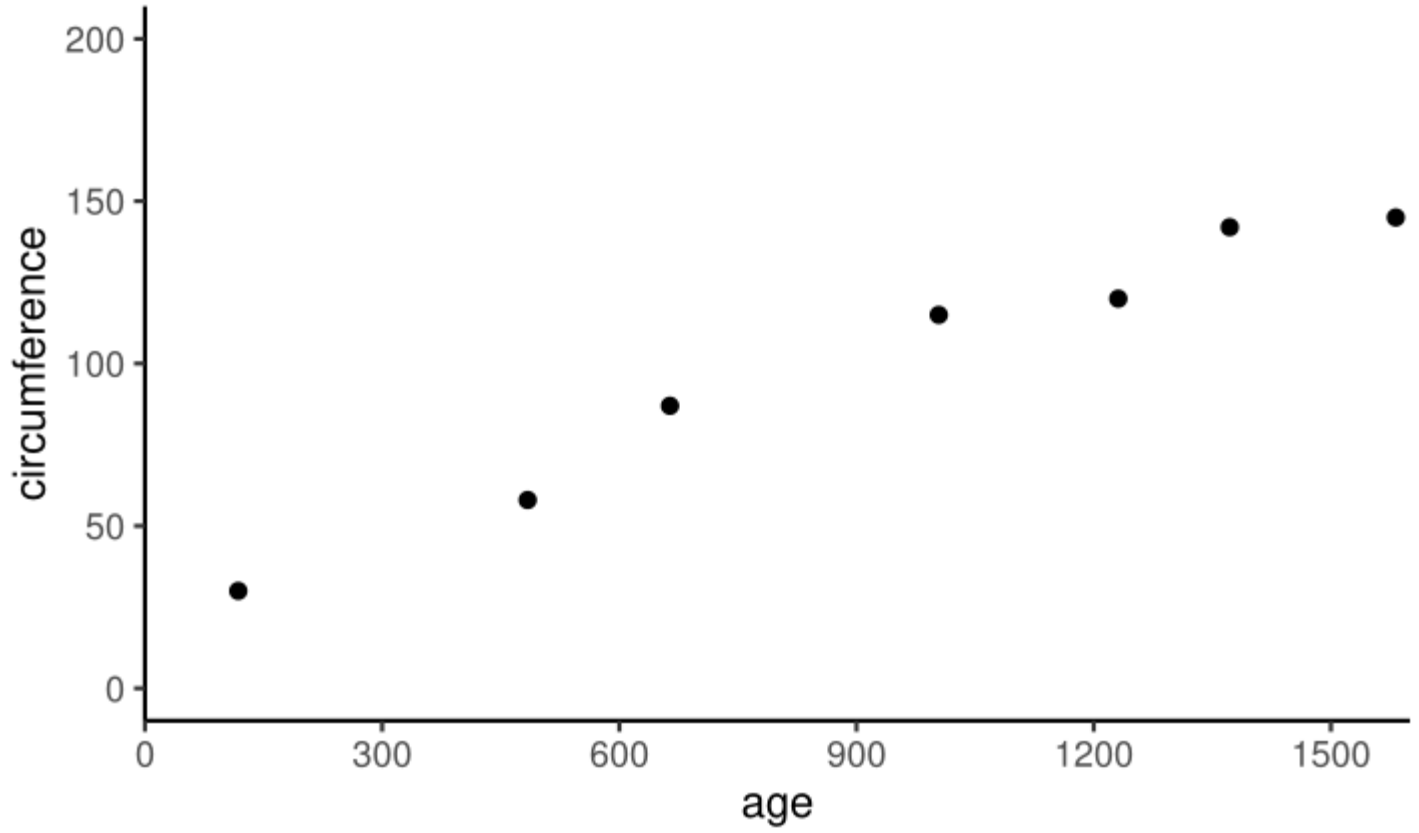
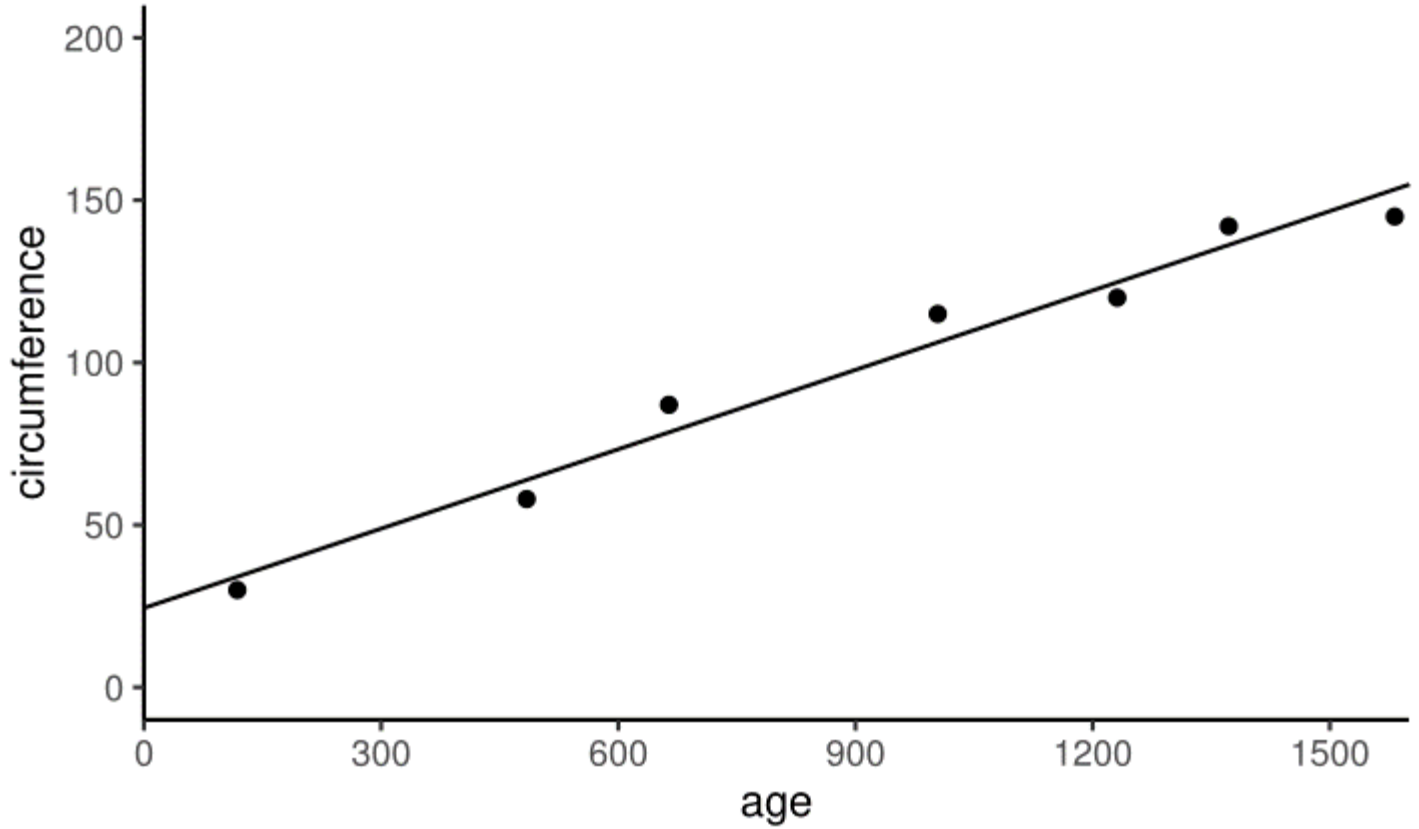


Example: size of orange trees



Example: size of orange trees

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$



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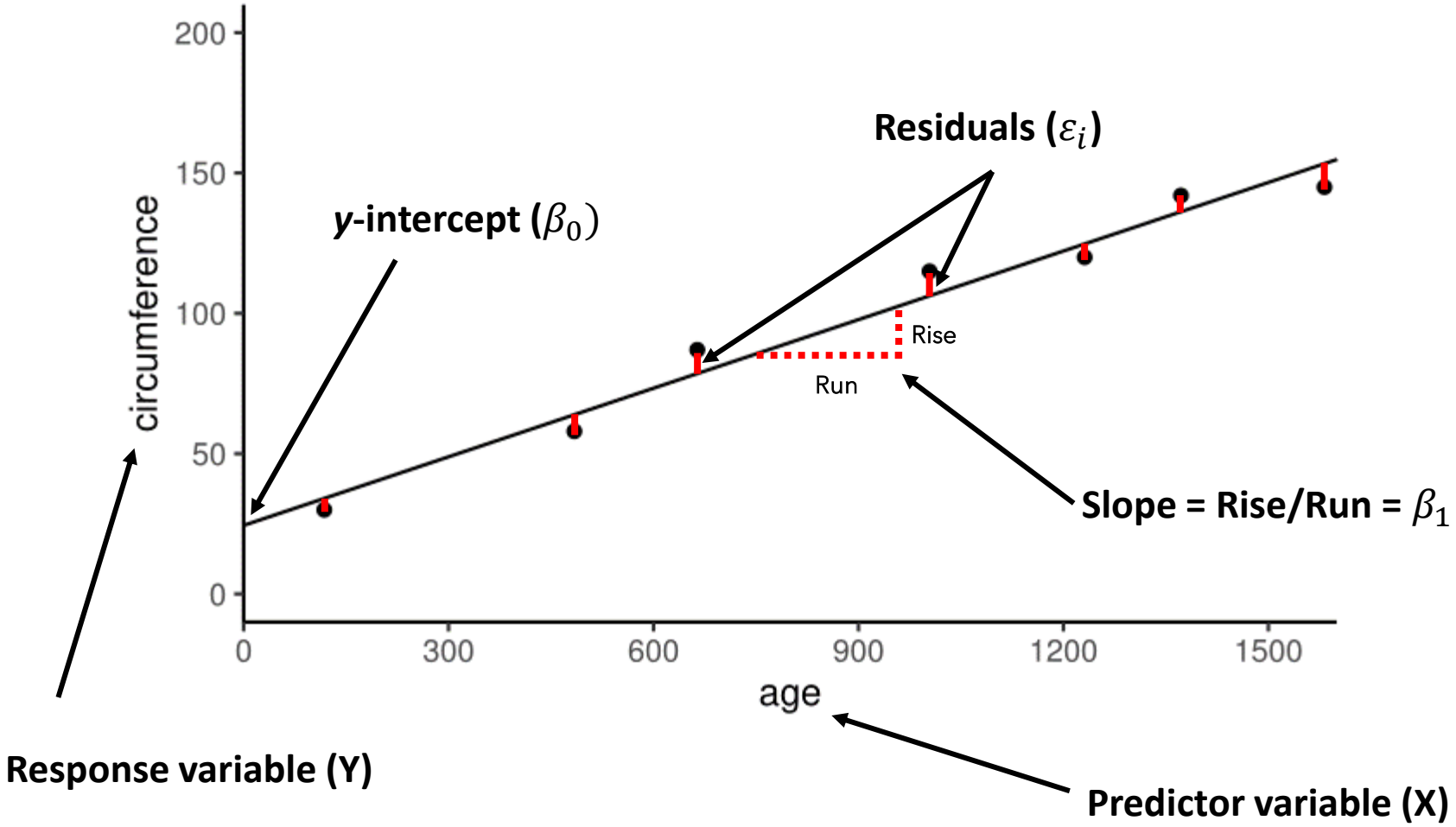


Linear regression in R

```
fit_oranges_1 <- lm(circumference~age, data=OT)
summary(fit_oranges_1)
```

```
##
## Call:
## lm(formula = circumference ~ age, data = OT)
##
## Residuals:
##      1      2      3      4      5      6      7
## -4.052 -5.873  8.461  8.759 -4.736  5.775 -8.335
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 24.437847   6.543311   3.735   0.0135 *
## age          0.081477   0.006281  12.973 4.85e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.056 on 5 degrees of freedom
## Multiple R-squared:  0.9711, Adjusted R-squared:  0.9654
## F-statistic: 168.3 on 1 and 5 DF,  p-value: 4.852e-05
```

e_i → Residuals

β_0 → (Intercept)

β_1 → age

Assumptions

1. The relationship between response and predictor is linear

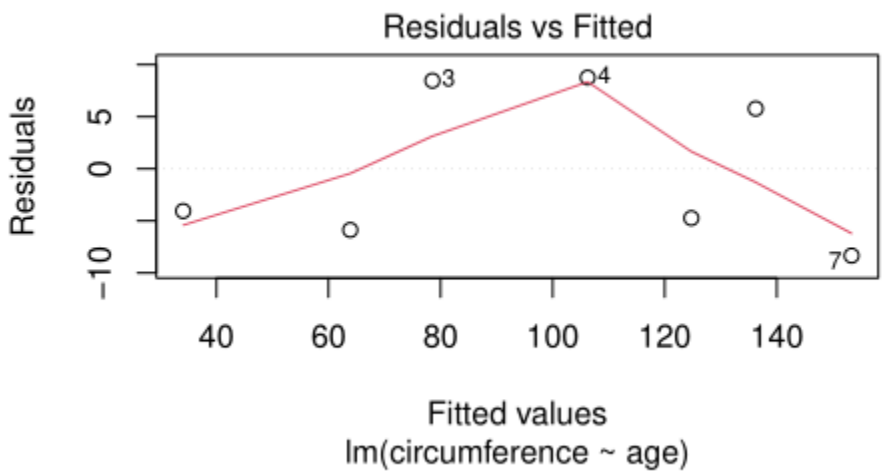
2. Residuals are independent

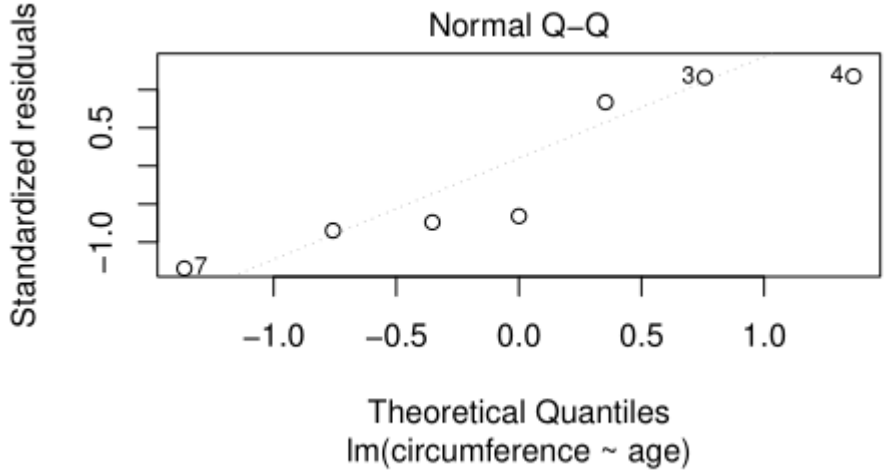
3. Residuals are normally distributed

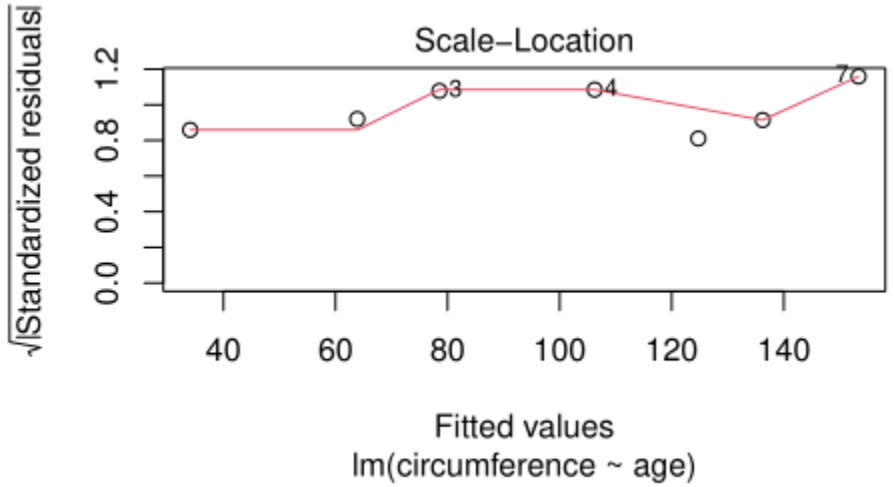
4. Residuals are homoscedastic (i.e., the variance in Y does not increase or decrease as X increases or decreases)

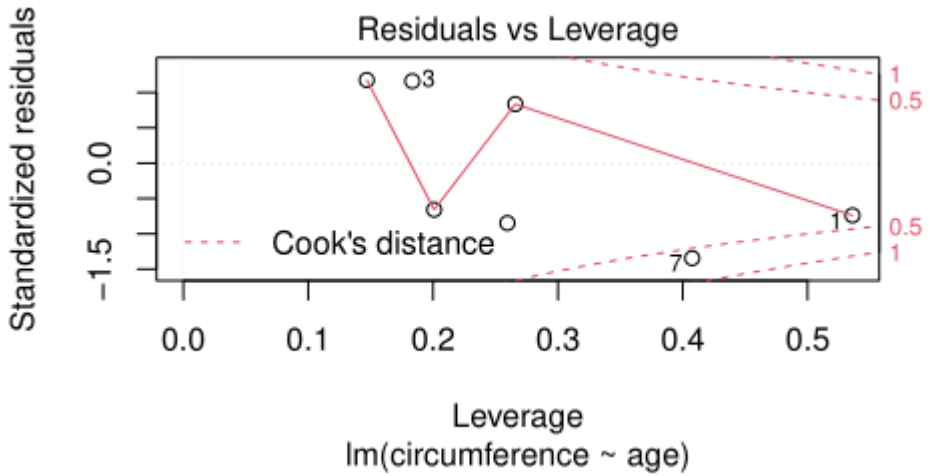
Linear regression in R

```
plot(fit_oranges_1)
```

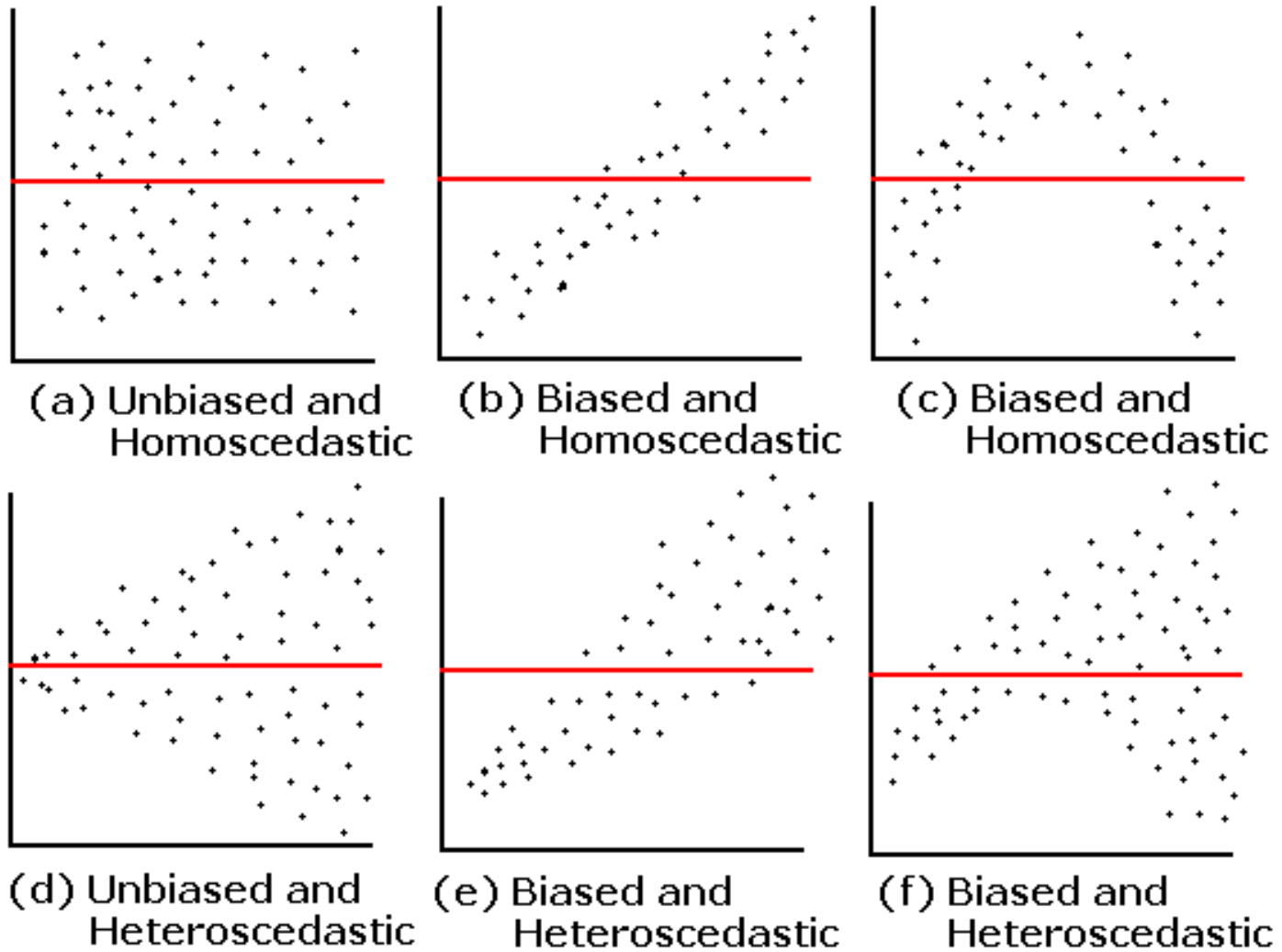








Residual plots



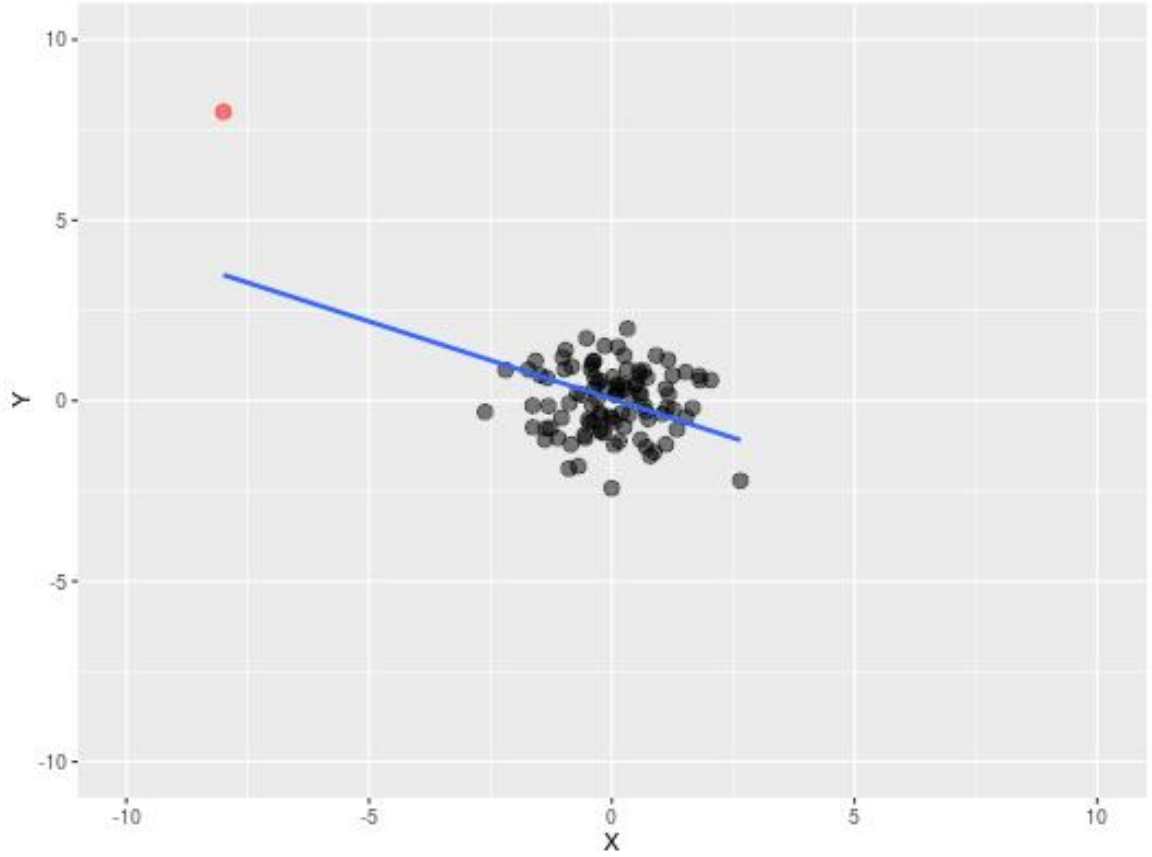
Leverage

Linear regression model coefficients

	Coefficient	Value
1	Intercept	0.04516
2	Slope	-0.42981

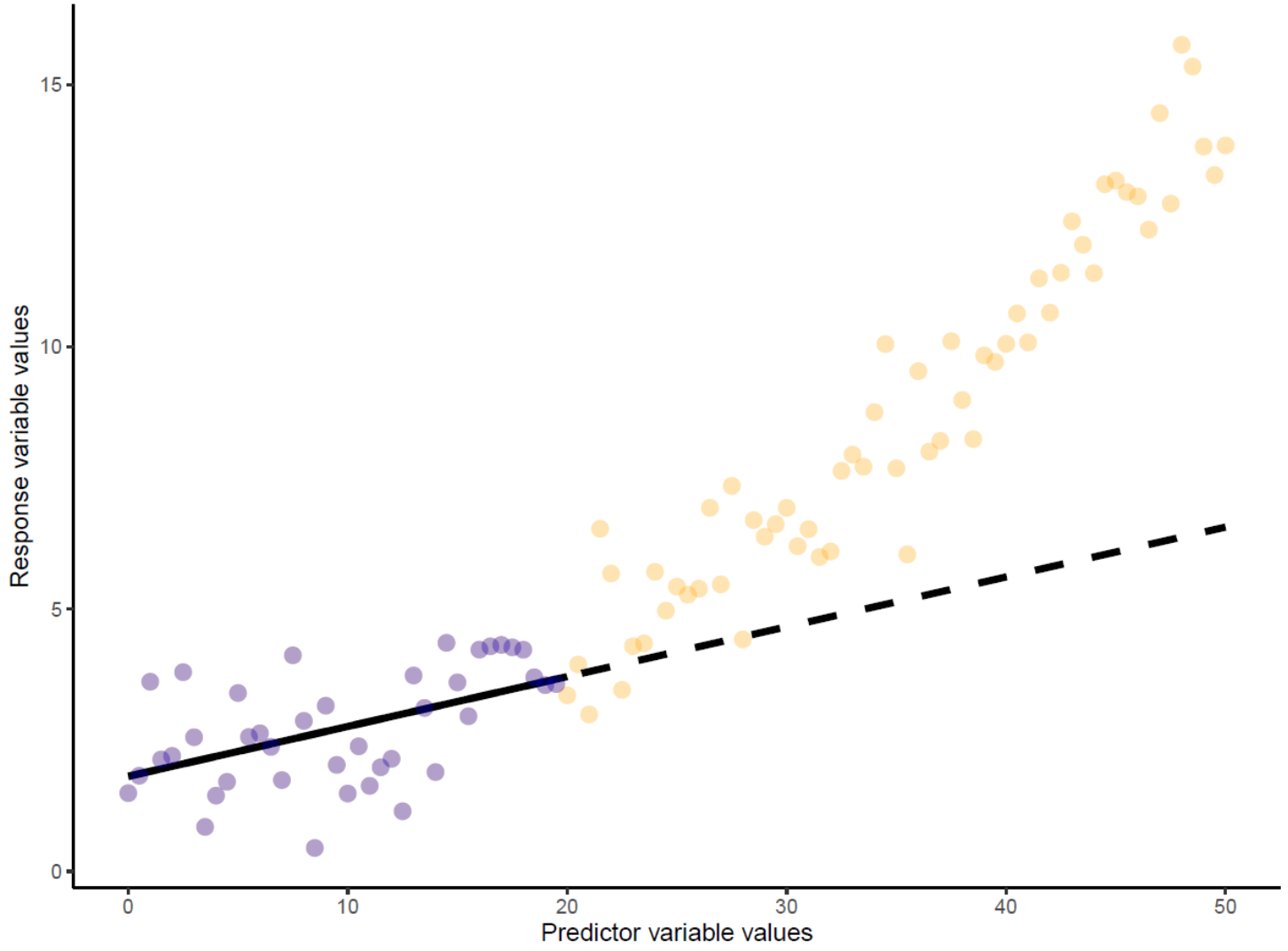
Influence measures for the adjustable point

	Measure	Value
1	hatvalue	0.41424
2	residual	4.51638
3	dfbeta.1	0.50038
4	dfbeta.x	-5.41604



https://www.r-bloggers.com/2016/06/leverage-and-influence-in-a-nutshell/

Interpolation vs. extrapolation



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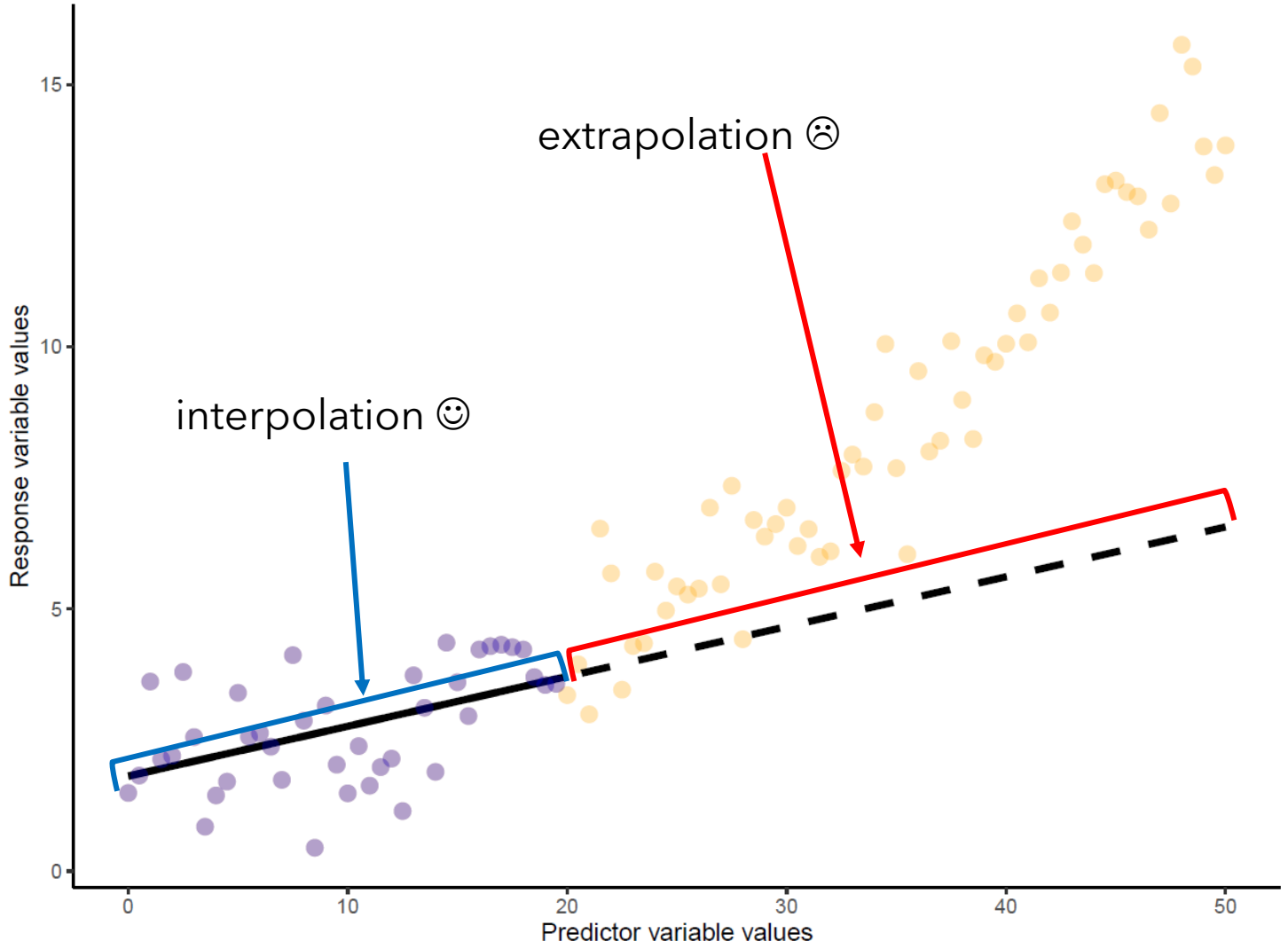

Example simple linear regression

RESEARCH ARTICLE

Ecology and Evolution Open Access WILEY

Evolutionary and plastic variation in larval growth and digestion reveal the complex underpinnings of size and age at maturation in dung beetles

Patrick T. Rohner | Armin P. Moczek

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Evolutionary and plastic variation in larval growth and digestion reveal the complex underpinnings of size and age at maturation in dung beetles

Rohner, Patrick T., Indiana University Bloomington, https://orcid.org/0000-0002-9840-1050

Moczek, Armin, Indiana University Bloomington

patrick.t.rohner@gmail.com

Published Feb 16, 2023 on Dryad. https://doi.org/10.5061/dryad.j9kd51cdc

Cite this dataset

Rohner, Patrick T.; Moczek, Armin (2023). Evolutionary and plastic variation in larval growth and digestion reveal the complex underpinnings of size and age at maturation in dung beetles [Dataset]. Dryad. https://doi.org/10.5061/dryad.j9kd51cdc

Abstract

Age and size at maturity are key life history components, yet the proximate underpinnings that mediate intra- and interspecific variation in life history remain poorly understood. We studied the proximate underpinnings of species differences and nutritionally plastic variation in adult size and development time in four species of

Data files

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