Modeling III

Introduction

- Instructions
  - Download Supplement
  - Unzip Folder
  - Required Packages
    - `library(tidyverse)`
    - `library(modelr)`
    - `library(xtable)`
  - Open .Rmd File and Knit
- Within R, Run all Code Chunks for Parts 1,2, and 3 (This was Covered in Previous Lecture)

Part 4: Logistic Model

- Logistic Model

$$W = l + \frac{h}{1+e^{a-bA}} + \varepsilon$$

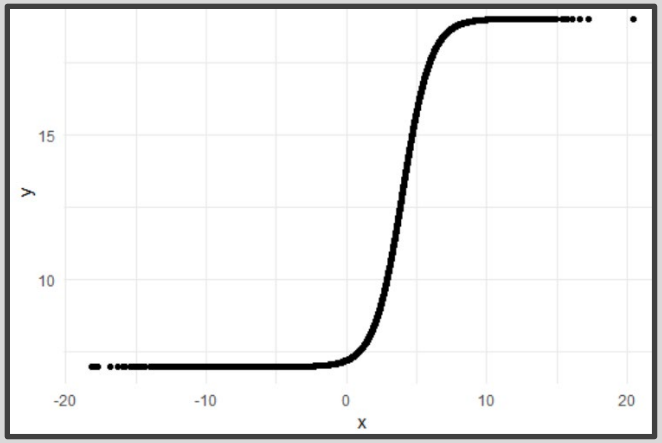
  - "Smart" Model Based On Physical Relationship Between A and W

  - Four Parameters
    - Controls the Shape of the Relationship
    - l and h
    - a and b

  - What Shape Do You Think This Function Makes?
    - Idea: Precalculus

Part 4:
Logistic Model

- Run Chunk 1
  - Plant that Seed
  - Example Model



  - Parameter Investigation
    - What Does 7 Represent?
    - What Does 12 Represent?
    - What Does 4 Represent?
    - What Does 1 Represent?

Part 4: Logistic Model

- Run Chunk 2
  - Creation of Modeling Function
  - Creation of MSE Function Specific to this Model
- Run Chunk 3
  - Use optim() Function With Smart Starting Values Based on Understanding of The Model
  - Finds Estimates Based on Minimization of MSE

Part 4: Logistic Model

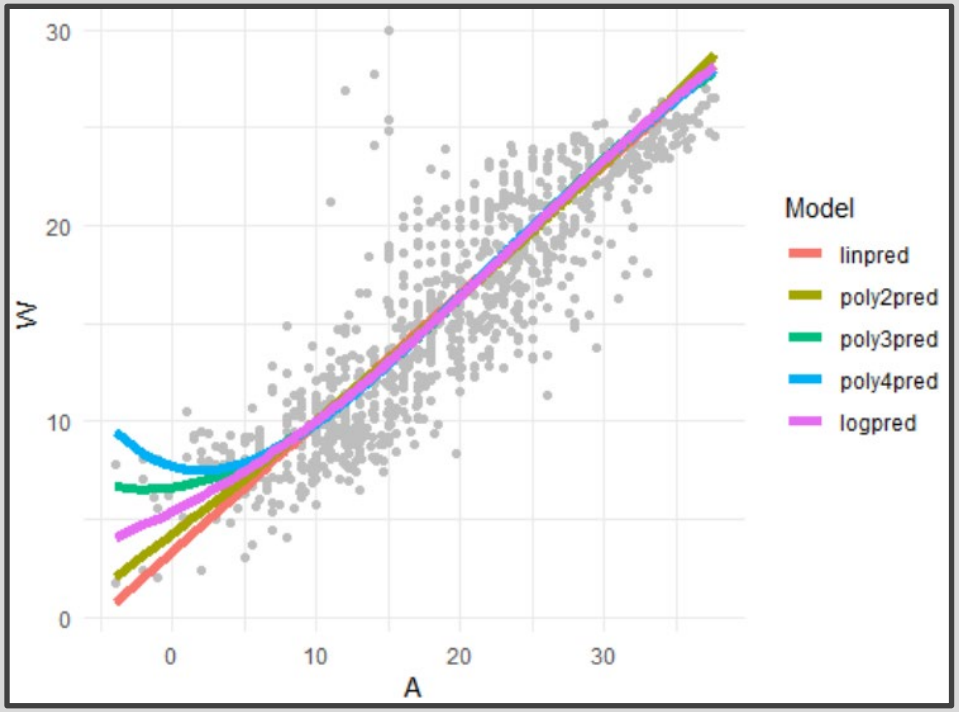
- Run Chunk 4
  - Use Logistic Model Function and Estimated Parameters from optim() to Obtain
    - Predictions
    - Residuals

Intermission

- Run Code Chunk
  - save.image() = Used to Save Workspace into .Rdata File
  - load() = Used to Load Workspace from .Rdata File
  - .Rdata = File Extension of R Workspace File (All Objects in Global Environment)

Part 5: Evaluation by Visualization

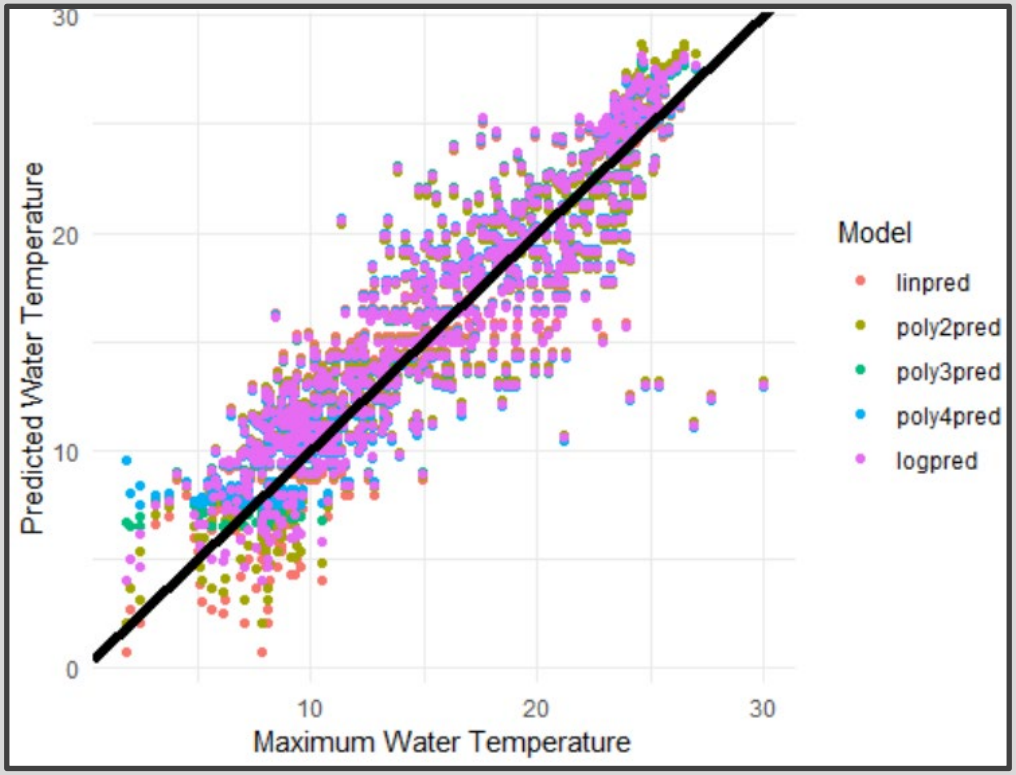
- Run Chunk 1
  - Plots of Different Models
  - What Can We Say About the Different Models?



- Which Model Would You Use?

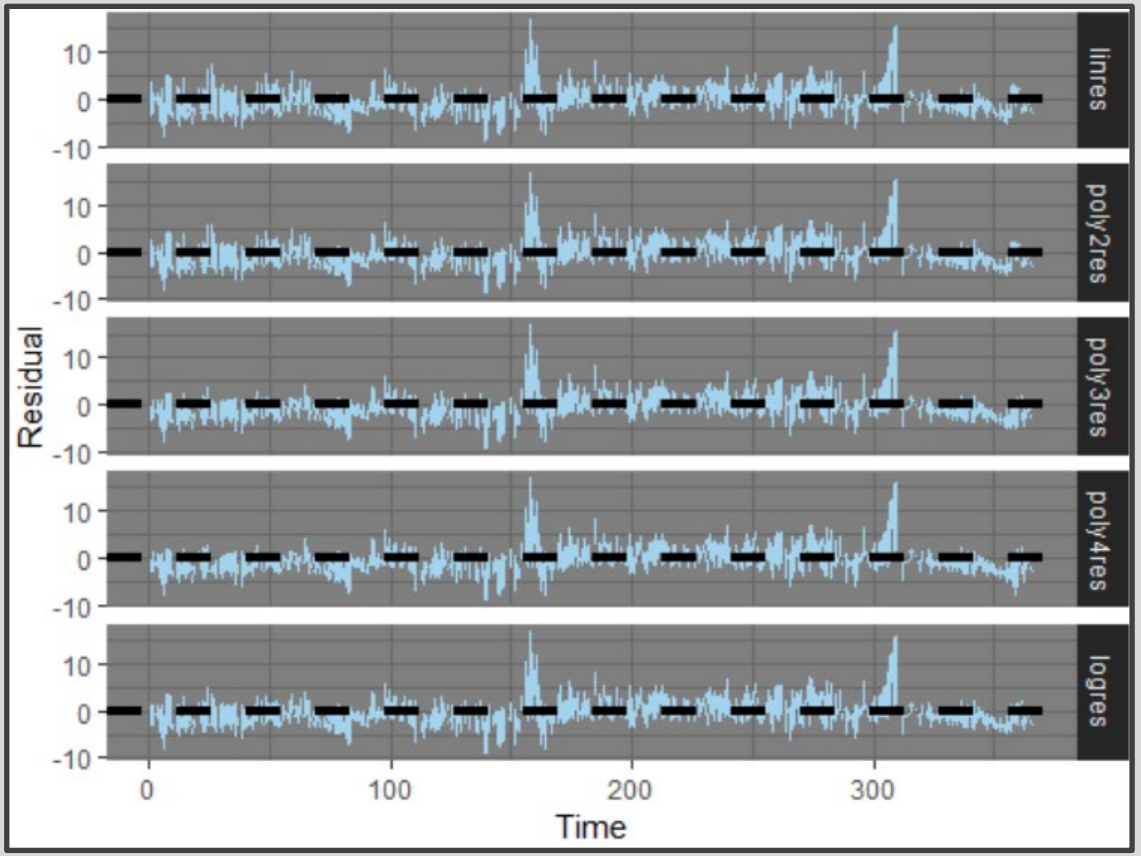
Part 5: Evaluation by Visualization

- Run Chunk 2
  - Comparing Predictions vs Actual Maximum Water Temperatures
  - Models Give Similar Predictions



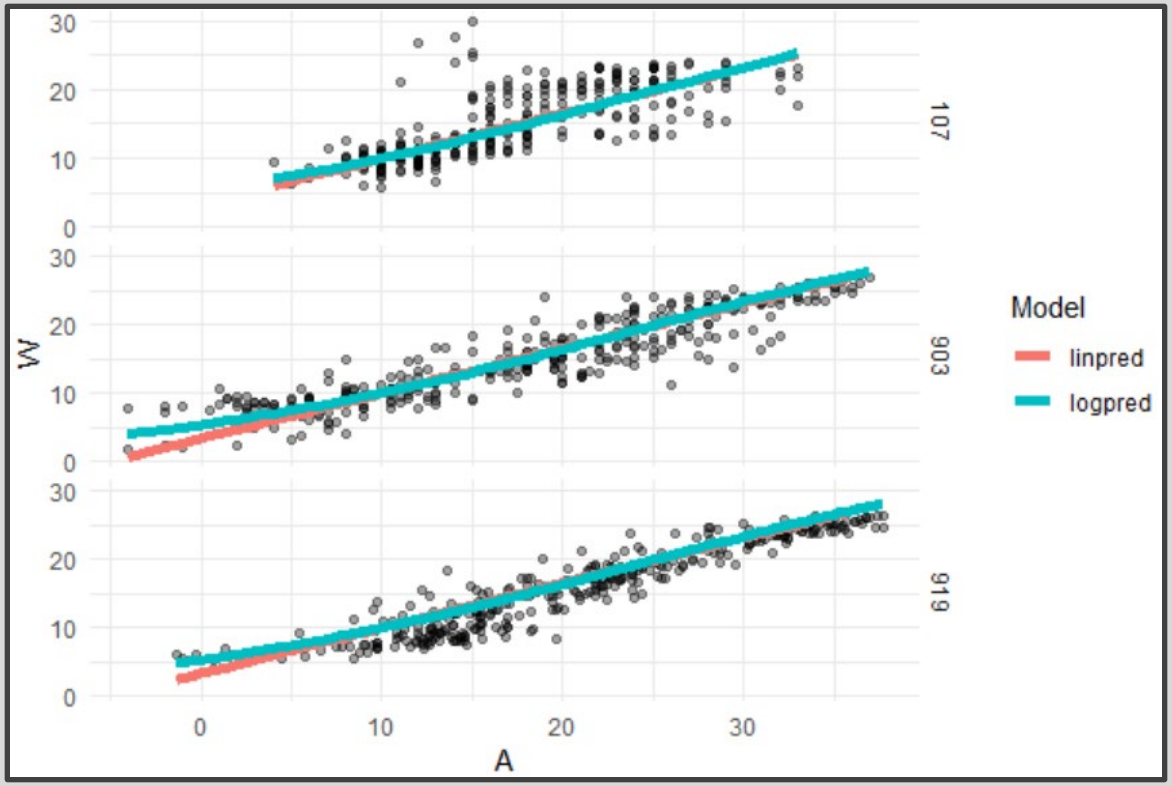
Part 5: Evaluation by Visualization

- Run Chunk 3
  - Shows Residuals Under the 4 Models Plotted Over Time
  - What is the Problem?



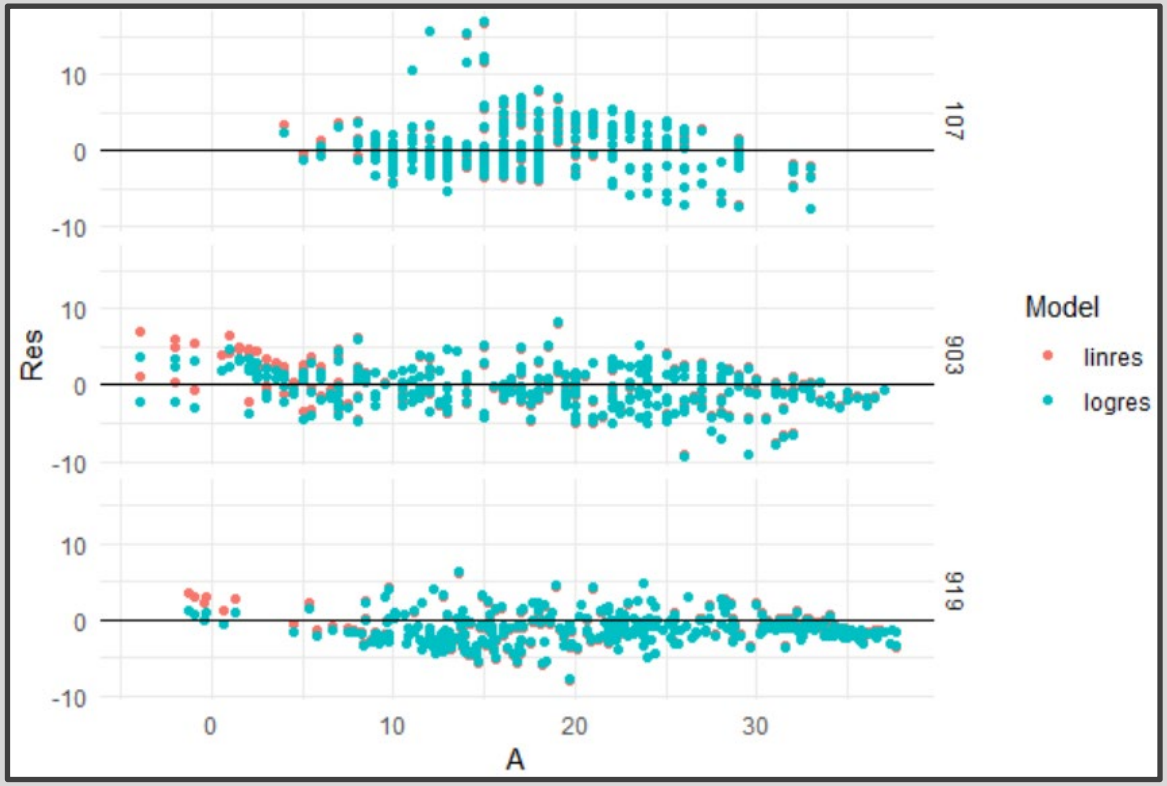
Part 5: Evaluation by Visualization

- Run Chunk 4
  - Evaluate Models For the Three Locations Separately



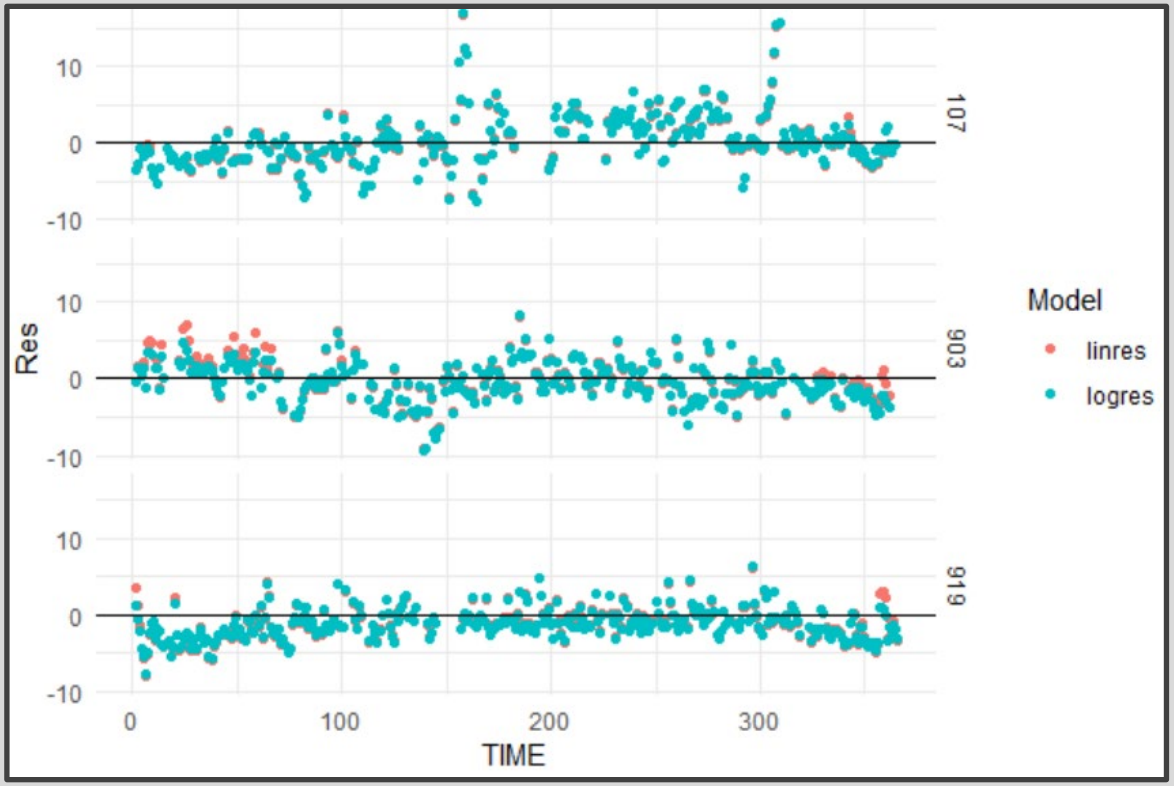
Part 5: Evaluation by Visualization

- Run Chunk 5
  - Evaluate Error For the Three Locations Separately (by A)



Part 5:
Evaluation by
Visualization

- Run Chunk 6
  - Evaluate Error For the Three Locations Separately (by Time)



Part 6: Evaluation by Numerical Summary

- Run Chunk 1
  - Mean Bias

$$\mathrm{MB} = \frac{1}{N}\sum \hat{\varepsilon}_k$$

  - Mean Absolute Error

$$\mathrm{MAE} = \frac{1}{N}\sum |\hat{\varepsilon}_k|$$

  - Root Mean Squared Error

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum \hat{\varepsilon}_k^2}$$

  - MB, MAE, and RMSE are in Degrees Celsius

Part 6: Evaluation by Numerical Summary

- Summarizing Table
  - Evaluate MB, MAE, and RMSE on Test Data to Choose Best Model Going Forward
  - Sketch of Table We Want

Model	MB	MAE	RMSE
Linear			
Poly(2)			
Poly(3)			
Poly(4)			
Logistic			

  - Before Writing Code, Have a Plan for the Output

Part 6: Evaluation by Numerical Summary

- Chunk 2
  - Run Line-By-Line
  - Think About Ways to Quickly Apply All 3 Functions to All Residuals
- Run Chunk 3
  - Combine rename(), gather(), group_by(), and summarize()
- Chunk 4
  - Change eval=F to eval=T and Knit the File (What is Seen?)

Part 6: Evaluation by Numerical Summary

- My Results Based on My Seed

	Model	MB	MAE	RMSE
	<fct>	<dbl>	<dbl>	<dbl>
1	Linear	0.953	2.75	3.35
2	Poly(2)	0.974	2.73	3.34
3	Poly(3)	0.990	2.71	3.33
4	Poly(4)	0.992	2.72	3.34
5	Logistic	0.786	2.68	3.29

- Simple Model that Adequately Predicts

Model	MB	MAE	RMSE
Linear	0.9534	2.7503	3.3516
Poly(2)	0.9742	2.7324	3.3449
Poly(3)	0.9904	2.7068	3.3289
Poly(4)	0.9920	2.7154	3.3387
Logistic	0.7856	2.6764	3.2917

Results="asis"

Closing

Disperse and Make Reasonable Decisions