Cross-Validation

READING:	4.3
EXERCISES:	CH 4. 8-9
ASSIGNED:	HW 9
PRODUCER:	DR. MARIO

IMG CREDIT: ALEX RIEGERT-WATERS

Currently

- Two Linear Regression Models for Same Response Variable

  Model 1: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$

  Model 2: $Y = \beta_0 + \beta_1 X_3 + \beta_2 X_4 + \beta_3 X_5 + \epsilon$

- Question: *Which model is **better**? Can we use the Nested F-test?*

- We Have Used *SSE, RMSE,* and *R-squared* but these have issues

- We Learned About *Adjusted R-squared, Mallow's Cp, AIC,* and *BIC* Which Involve Penalties for Complexity

"Cross-Validation"

- All Previous Metrics are Based on **Fitted** Values
- We May Want to Consider Metrics **Based** on Predicted Values
- To Get Real Predictions We Have to Leave Data Out of Model Fitting
- Cross-Validation Methods Involve the Intentional Leaving-out of Data to Evaluate How Accurately a Model Would Predict Out-of-Sample

"Cross-Validation"

- Holdout-Method (Simplest form of Cross-Validation)
  - Split Data Into Training and Test Sets
  - Fit Models to Training Set
  - Predict onto Test Set
  - Evaluate Prediction Accuracy Using Metric (i.e. RMSE)

$$RMSE = \sqrt{\frac{\sum(y - \hat{y})^2}{n}}$$

← Notice We Are Not Dividing by n-1

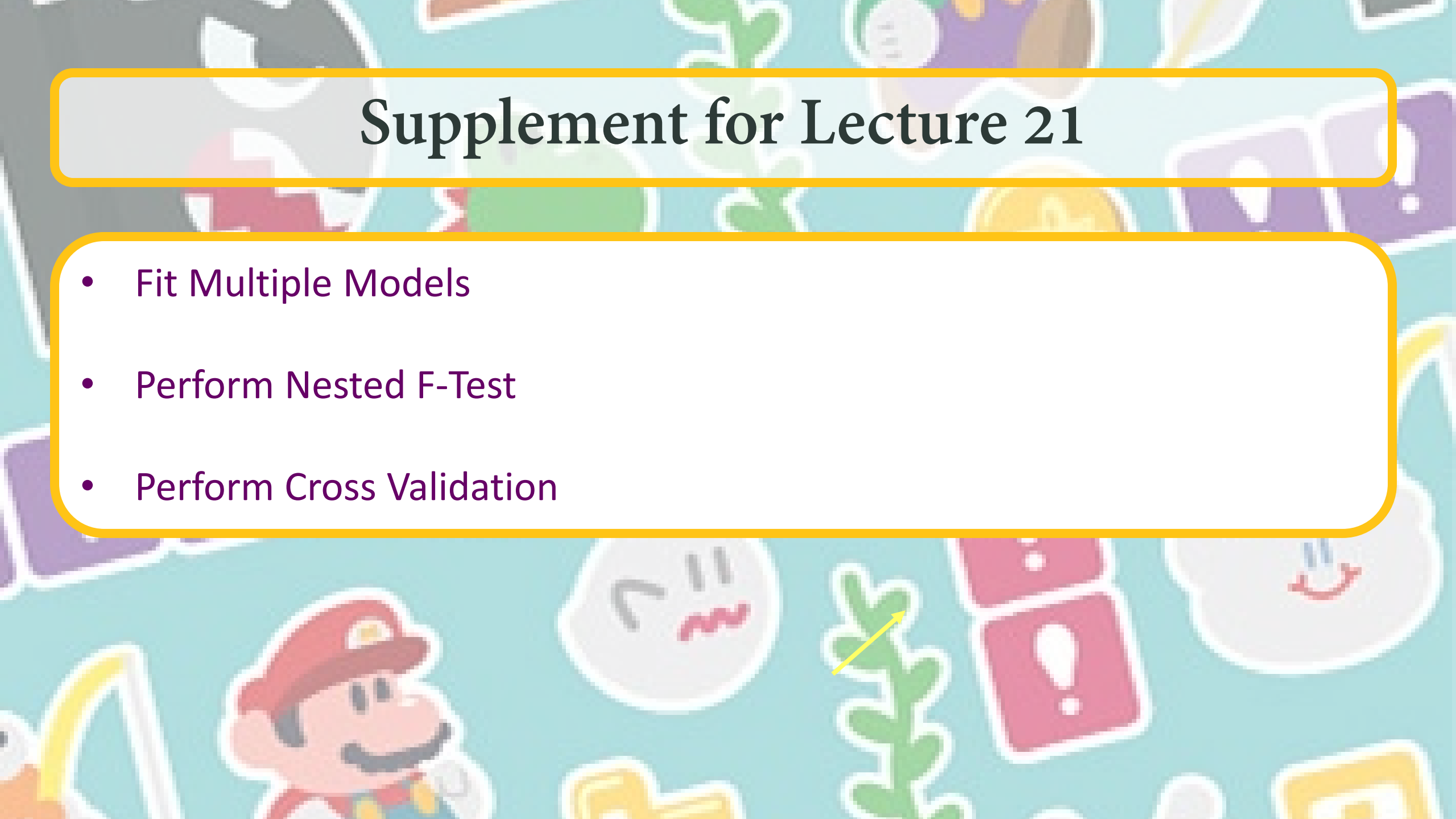
  - Compare RMSE in Training Set to RMSE in Testing Set

"Cross-Validation"

- **Shrinkage** is the Difference Between R-squared from the Model and R-squared Calculated on Predictions from Test Set
- You can Use the **Correlation** Between Y and $\hat{Y}$ to Calculate Out-of-Sample R-squared
- Book Says Shrinkage of **More Than 50%** is "Worrisome"
- *Should We Expect Shrinkage? What Does It Attempt to Measure?*

Supplement for Lecture 21

- Fit Multiple Models
- Perform Nested F-Test
- Perform Cross Validation



Conclusion

- Cross-Validation Methodology in the Textbook is Obsolete
- What are the Problems with the **Holdout Method**?
- Personally, I **Wouldn’t** Call What We Learned Cross-Validation
- Classic Cross-Validation is Called K-Fold Cross-Validation

Thank You

Make Reasonable Decisions