

# To Flip or Not To Flip?

2013 US Conference on Teaching Statistics

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## What is a Flipped Classroom?

- Discipline-specific
- Students do work ahead of time
- Class-time spent clarifying misconceptions and “high-touch” activities
- Leverages power of technology



## Module Structure

	Before Practice Class	During Practice Class	After Practice / Before Lab	During Lab
Professor	<ul style="list-style-type: none"> <li>• Learning outcome guide</li> <li>• Learning resource guide</li> <li>• Pre-assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Respond to muddiest points (Reviews material)</li> <li>• Guide students on problems (with a range of DOK)</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare quiz</li> <li>• Prepare lab</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor quiz</li> <li>• Guide students on lab</li> </ul>
Student	<ul style="list-style-type: none"> <li>• Reviews learning outcome guide</li> <li>• Books, videos, applets, other</li> <li>• Complete pre-assessment</li> <li>• Complete “muddiest point” (and which resources used)</li> </ul>	<ul style="list-style-type: none"> <li>• Clarifies misconceptions (group/individuals)</li> <li>• Engaged with material at their level</li> </ul>	<ul style="list-style-type: none"> <li>• Review material, study for quiz</li> </ul>	<ul style="list-style-type: none"> <li>• Practice</li> <li>• Deeper value and understanding</li> <li>• “Play” with data</li> </ul>

### Learning Outcome 10 – Correlation and Regression (for two numeric variables)

Scatterplots are a graphical representation of the relationship between two numeric variables.

Y is the dependent and X is the independent variable

Describe four things:

1. Linear or non-linear
2. Nature and strength of relationship (see correlation)
3. Constant variance
4. Other interesting facts, including outliers

Correlation – describes nature (pos/neg) and strength (how close to line) of relationship

Only describes linear relationship

Guide: 0-0.3 = weak, 0.3-0.7 = moderate, 0.7-0.9 = strong, 0.9-1 = very strong

0 is no linear relationship, 1 is perfect linear relationship

R<sup>2</sup> is the % of variation in Y explained by X.

$$\hat{\rho} = r = \frac{\text{Cov}(X, Y)}{\sqrt{\text{Var}(X) \text{Var}(Y)}} = \frac{S_{XY}}{\sqrt{S_{XX} S_{YY}}}$$

$$\text{Typically, we test } H_0: \rho = 0 \text{ vs. } H_1: \rho \neq 0 \text{ using } t_{n-2} = \frac{r - \rho}{\sqrt{\frac{1-r^2}{n-2}}}$$

Assumptions: Independent observations, bivariate normal

Regression – produces the line of best fit

The equation:  $y = \beta_0 + \beta_1 x + \epsilon$

The estimate:  $\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$  or  $y_i = b_0 + b_1 x_i$

residual = observed (from data) – predicted (from line)

Line is determined by minimizing the sum of the squared residuals

Should be able to predict a value of y for a given value of x

$$b_0 = \bar{y} - b_1 \bar{x}$$

$$b_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} = \frac{S_{XY}}{S_{XX}}$$

$$\text{Typically, we test } H_0: \beta_1 = 0 \text{ vs. } H_1: \beta_1 \neq 0 \text{ using } t_{n-2} = \frac{b_1 - \beta_1}{SE(b_1)}$$

$$\text{Where } SE(b_1) = \frac{\sigma}{\sum (x_i - \bar{x})} \text{ and } \hat{\sigma} = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{n-2}}$$

Assumptions: errors are  $N(0, \sigma^2)$  and independent of each other

## Example of Learning Resources

Index	Medium	Statistical Topic	Application Area	Source	Title
InfSP-1	Book	Sample size (for CI) - one mean		Ott & Longnecker	Chapter 5.5
InfSP-2	Book	Sample size (for CI) - two means		Ott & Longnecker	Chapter 6.6
InfSP-3	Book	Types of Errors		Ott & Longnecker	Chapter 5.4
InfSP-4	Book	Power		Ott & Longnecker	Chapter 5.4
InfSP-5	Video	Power		ProfessorPartis	
InfSP-6	Video	Power	Health	Michael Karzy	
InfSP-7	Video	Power		StaceyP14	
InfSP-8	Video	Types of Errors and Power		Mr. Tartou	
InfSP-9	Video	Sample size calculation (for CI)		Khan Academy	
InfSP-10	Natural/Analog	Types of Errors and Power		Tom Rogers	

## Traditional vs. Flipped Classroom

	Traditional	Flipped
Time on Task	Class-time, homework	Pre-learning, Class-time, studying for quiz
Making Connections	Some time on real-world applications	More time on real-world applications (during lab) Individual connections
Real-time Feedback	Homework feedback given 1+ weeks later	Misconceptions clarified in class Quiz feedback given next class
Competing Mental load	Learning time controlled by professor	Allows (but relies on) student-centered learning

## Examples of "Labs"

- Determining the number of smoke detectors needed to install in order to detect a fire reliably (probability)
- Determining optimal pizza production to maximize profit (expected value and graphics)
- Who is the best hitter in baseball (standardization)
- How many stars are in the sky (sampling)
- Tangram competition (inference and design)
- Predicting house values (regression)
- The effect of leaf removal on fruit growth (combined methods)
- Getting repair estimates from garages (paired vs. independent tests, power calculation)

## Reflections on Flipping

- **My Reflections**
  - Preparation time is different and much more (at beginning)
  - Student-centered learning works well if students are motivated
  - Be clear regarding expectations/assignments
  - I covered more material and had time for student projects
- **Student Feedback**
  - I don't like it. I like learning in class.
  - Complain to Chair – "no teaching" going on and he didn't warn us about the class
  - ? It has been challenging adjusting, but I have faith in the idea
  - ? It was hard at the beginning but became easier
  - + I like it a lot!!!! I wish more classes, especially math and science ones, ran this way. It just makes sense - particularly at a college level - that you as an individual spend more time learning the basics and then come in to class where the professor serves to help fine-tune what you've learned and make sure you have your cards in the right order.
  - + I like this set up because it allows me to spend as much time as I need to learn the material and then stop once I understand the material. In many classes, teachers either spend too much time or too little on topics making the classes harder to follow and some hw harder to complete. I also like the flipped because it allows me to do more problems in class where I can get help from classmates or the teacher if needed.