Kelly Findley

kfindley@fsu.edu

Introduction

What is PhET?

The Physics Education Technology (PhET) Project, housed at the University of Colorado Boulder, produces high-quality, research-based, interactive simulations to support students' learning of topics in math and science. These sims are freely available at https://phet.colorado.edu/ along with helpful tips for incorporating PhET sims as well as sim-specific activities and lesson plans.

Student Autonomy and Ownership

PhET sims are designed to provide "implicit scaffolding" to students. This means that students are guided by the affordances and constraints of the sim and require little to no instruction from the teacher to learn the controls and begin discovering ideas. When given the opportunity to interact freely with the sim, students are encouraged to take ownership of their learning by noticing patterns in the virtual environment. PhET sims focus students' attention on conceptual ideas rather than procedures.

Statistics Simulations

PhET currently has three sims available that can be leveraged to teach statistical ideas, two of which are featured here. As our field continues to find value in incorporating simulations into the statistics classroom, we hope to encourage other sim developers and teachers to incorporate sims that put students in the driver's seat and to create a fun, engaging environment.

Plinko Probability
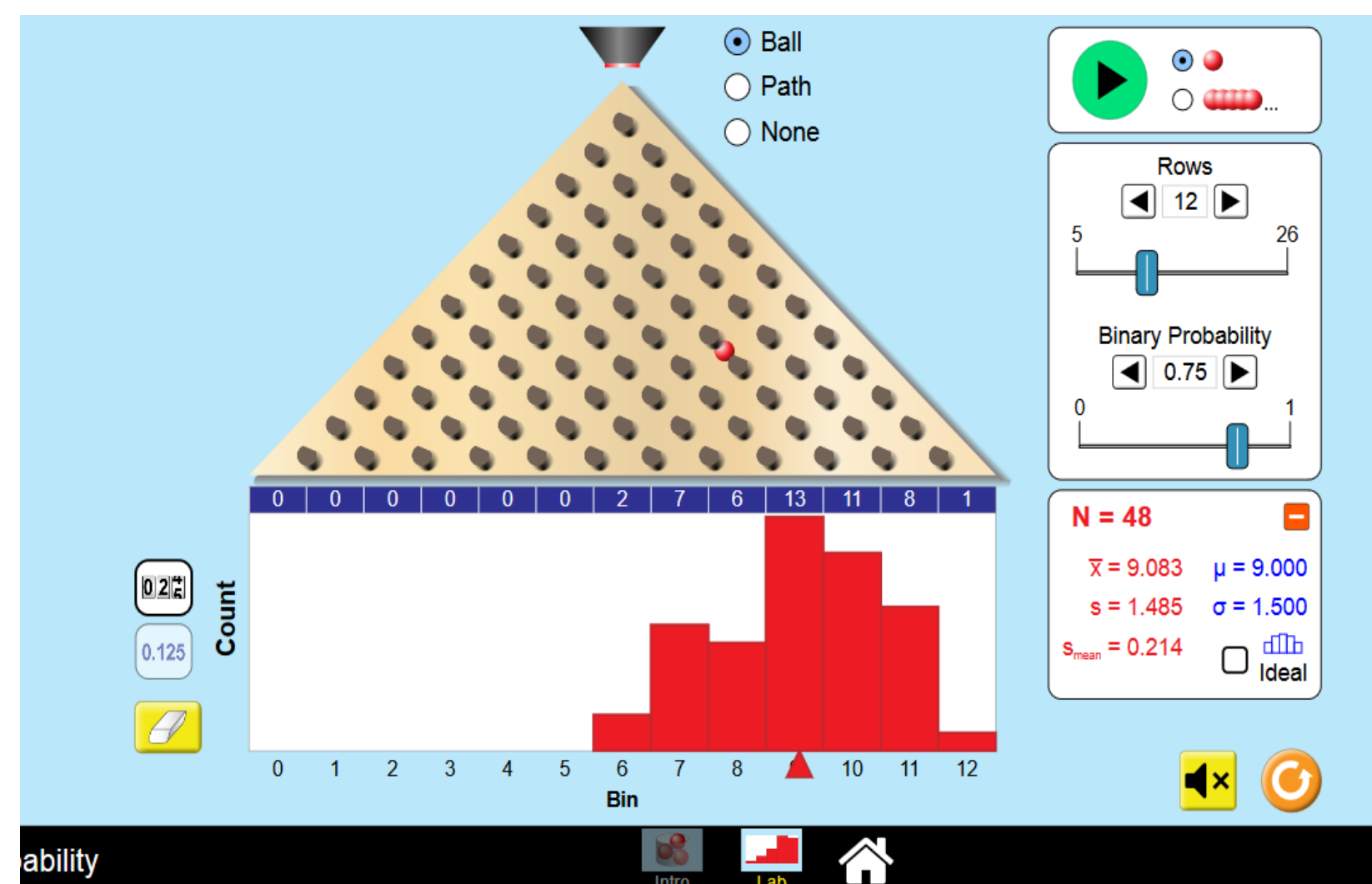
Design Features

Students are often mesmerized as they click the play button and watch balls weave through a series of pegs to bins below. The number of rows can be adjusted from 5-26 and the binary probability scale sets the probability that a ball will bounce to the right after hitting a peg. A window containing both theoretical and empirical measures of mean and standard deviation provides opportunity to connect to measures of center and spread, but can also be hidden from view by clicking the red square in the corner.

Plinko Probability lends itself well to discussions of long-run probability and prediction. One activity we offer is to have one student set the binary probability to some value and have another student try to pick a "winning" bin number that they think the ball is most likely to land in. Such games can lead to discussion about predicting results from repeated trials.

Least-Squares Regression
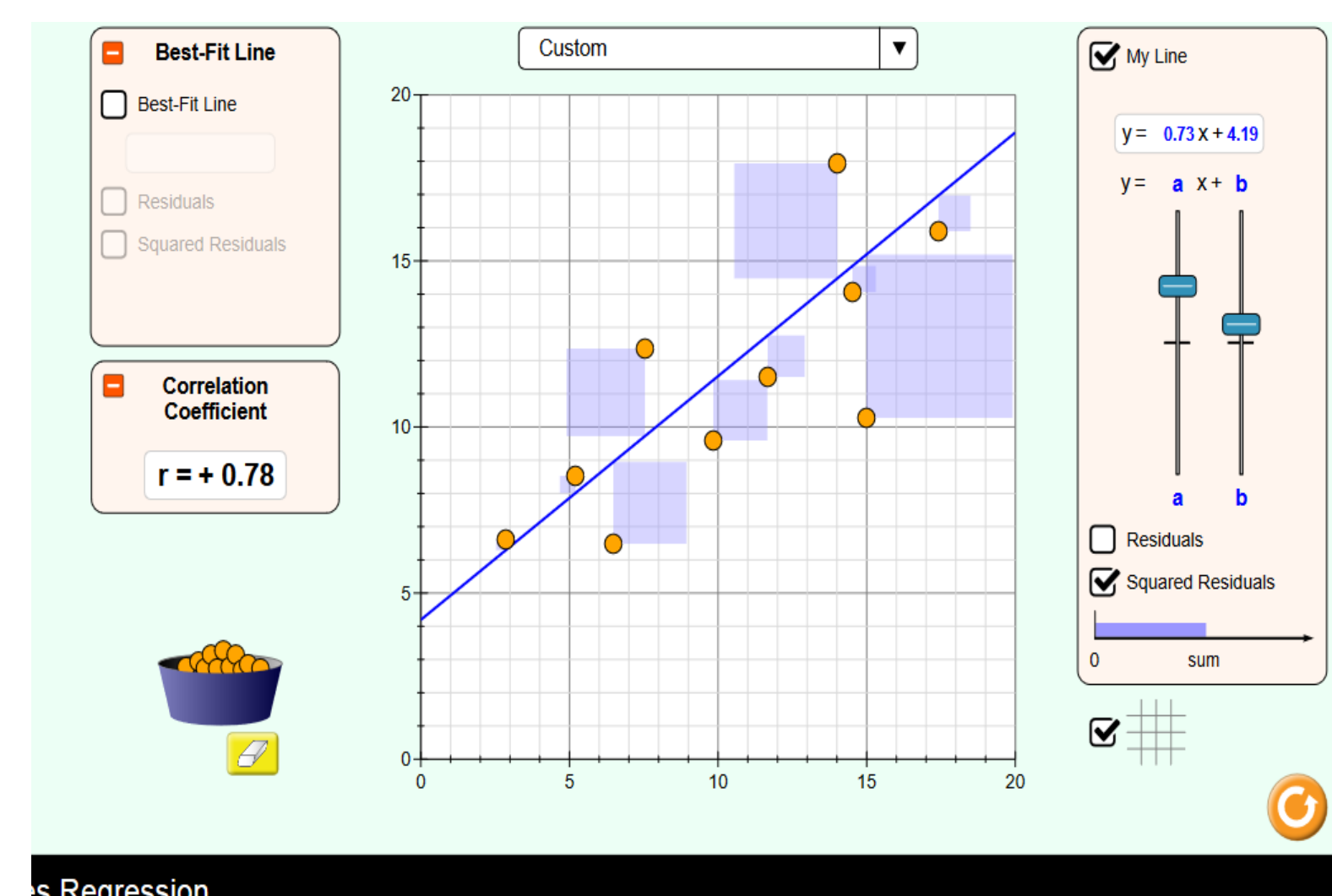
Design Features

The concept of fitting regression lines using the least-squares criterion can often be difficult and abstract for students to grasp. This sim makes squared residuals a much more accessible idea and provides space for students to interact within the environment freely. Students can place data values on the scatterplot and try fitting their own best fit line before revealing the actual regression line. A drop down menu provides a 14 real datasets to plot.

This sim can be integrated into a range of grade levels, from the 8th grade standards on scatterplots to introductory college statistics material. Teachers can challenge students to make a realistic scatterplot that might model the relationship between certain variables or to look for a relationship between the correlation coefficient and the sum of squared residuals.

Our Project

NSF Grant Work

Our current project, in collaboration with the PhET research and development team, is concerned with the effective design of interactive computer simulations for middle school mathematics content. This project involves the development of 15 mathematics simulations and associated lesson modules over the next three years. The research questions concern simulation design, simulation use, and student outcomes.

This project will support middle school math teachers in effectively teaching challenging mathematics content by engaging students in problem solving, conjecturing, and argumentation around interactive computer simulations. We are developing "unit replacement" lesson plan and activity sets that incorporate our sims into the relevant topics. In addition to a stand-alone, 2-day activity for Plinko Probability for Grade 7 and a 3-day activity with Least-Squares Regression for Grade 8, we are also creating a 9-day probability unit for Grade 7 that incorporates Plinko Probability throughout the unit. We are also creating unit replacement sets for about 9 other middle school mathematics units.

Pilot Study

Over the 2017-2018 school-year, we will be running a pilot study with 4-5 teachers in Tallahassee and 4-5 teachers in Boulder to try out the unit replacement plans. We plan to use the results from our study to fine tune our unit plans and offer them to all teachers on the PhET website.