Four Interactive Arcade Games to Teach Statistics

Jacopo Di Iorio

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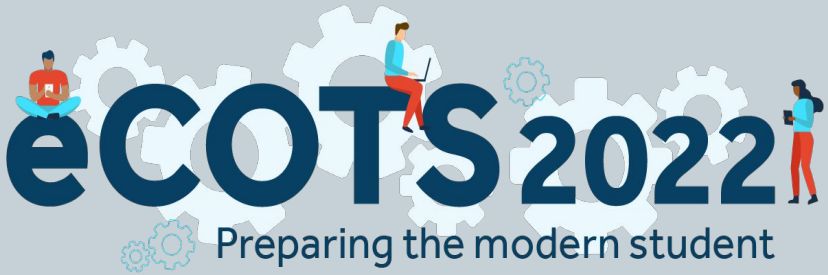

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Submission for Winter/Spring Projects: June 24, 2022

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Jacopo Di Iorio

Jacopo Di Iorio is a postdoctoral Eberly Fellow at the Department of Statistics of the Pennsylvania State University (State College, USA). Previously a postdoctoral research fellow at Scuola Superiore Sant'Anna (Pisa, Italy), in 2020 he got his Ph.D. in Mathematical Models and Methods in Engineering from Politecnico di Milano (Milano, Italy). His research interests lie primarily in the field of clustering and biclustering for multivariate and functional data, applied Statistics, and Statistics and Data Science education.

PennState

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Four Interactive Arcade Games to Teach Statistics

The context

Teaching some advanced statistical topics to a non-mathematical educated audience

Mean and standard deviation -
Clustering -
Principal Component Analysis -
Linear Regression -

Master students in Communication Design interested in Data Visualizations

Problem

Maths-Phobia - negative attitude toward mathematical disciplines (Gal and Ginsburg, 1994)

Lack of Interest -

Four Interactive Arcade games to Teach Statistics

General Characteristics

- **User-centric**
  it works with students' data collected during the class

- **Score-based**
  players have to minimize a statistical performance score. The score allows comparison within students

- **Interactive and touch-friendly**
  the interaction with the game environment is based on clicking/touching

Title	Topic	Interaction	Score
Point Blank 2D	Mean and Variance	Identify a dot	Variance
Point Blank Revolution	Clustering	Identify dots	Total WSS
Dimensions for Descent	Principal Component Analysis	Draw a line	Variance of the Orthoganal Residuals
Deadly Premonition	Linear Regression	Draw a line	OLS

Class Experience

Preparation

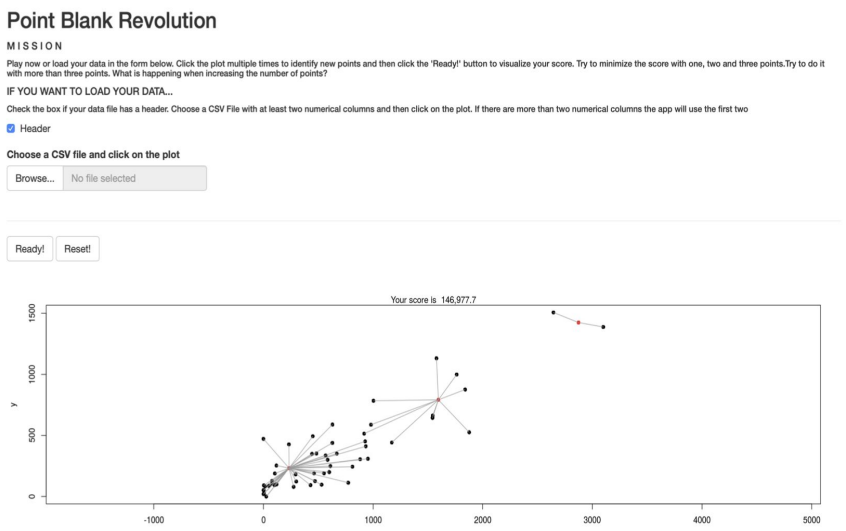
Theoretical Prerequisites

- Euclidean Distance
- Pythagorean Theorem

User-centric Experience

- Data Collection
- Preprocessing

The Game



[Cluster Game - Point Blank Revolution]

Post-Game

- Results and Score sharing and discussion
- Geometrical Meaning
- Statistical Meaning
- Connection with other result

Conclusion

Four experiences are meant to be played under the **supervision of an instructor** and they require **very basic theoretical background** (i.e., the notion of distance).

They **mix gameplay with interactive visualization** and they are **user-centric** because they allow the users to load their own data sets.

In the spirit of the old coin-op arcade games, the players can **share their scores** with the rest of the class. This idea makes the experience a real challenge where the student reaching the best (lowest) score within the class wins.

Thanks to their ease of use, they are **suitable for a wide range of students** and they can be proposed in courses of different level and background.

Indeed, they could be helpful not only as a qualitative introduction to the selected topics (in the case of advanced courses) but also as a way to bring students closer to the world of data analysis and to highlight the importance of statistical methodologies and algorithms (in the case of school students).

The results from a student questionnaire give us confidence that the experience has benefited students.

Next Steps

Improve the four arcade games.

Enlarge the user base, reaching also **kids** with more playable experiences.

All mean cats just want to have fun!

Presented at “MEETme Tonight 2019” (European Night of Researchers”), it was a first attempt to propose the mean game to a kids audience

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Thank You for Your Attention

Di Iorio, Jacopo, and Simone Vantini. "How to Get Away with Statistics: Gamification of Multivariate Statistics." *Journal of Statistics and Data Science Education* 29.3 (2021): 241-250.