Interactivity takes Interaction

DENNIS PEARL,
PENNSYLVANIA STATE UNIVERSITY

Overview

- Use of music is clearly an engaging way to present STEM material, to build a welcoming classroom culture, and to consolidate memory and encourage deeper exploration of that material by students.

- Most instructors, myself included, have little musical abilities – so how do we best create song-based resources, present, and integrate them with other resources to form lesson plans?

- Key is multi-disciplinary interactivity. Here I present an example from statistics, in teaching the Normal Approximation (Central Limit Theorem)

Step 1. Learning Objectives:

- The distribution of all possible sample means that might arise from a random sample, approximately follows the normal curve.

- This is true for any population with a finite variance if the sample size is large enough; but the approximation works better if the population is symmetric or close to the normal curve itself.

- Recognize the difference between the population distribution; the distribution of an individual sample; and the distribution of all possible sample means (called the “sampling distribution”).

- Use Savon & Middendorf’s “EEGP” learning model as a guide to optimize the pedagogy for these objectives.

Step 2. Lyrics and Tune:

Greg Crowther, Everitt Community College,

as part of artists collaborative in project SMILES

The sample means have a normal distribution
Even if the population does not.
Their center is the center of the population.
When this is true, you can sure do a lot.

CHORUS:

Whoa-oh-oh-oh, Central Limit Theorem
For populations with finite variance and mean.
If you know-oh-oh-oh the samples are independent
And distributed identically: that's a stat person's dream.

The further that the population is from normal,
The larger that your sample size must be.
If you're sampling Chicago household incomes,
Sample lots of them to use the CLT!

Step 3. Interactive Components

- Content: Larry Lesser (UTEP), Dennis Pearl (PSU), & John Weber (GSU)

- Programming: Bob Carey (PSU)

Step 4. Audio Recordings:

- Joshua Lintz and Valerie Parada, Students in the Commercial Music Program at UTEP

Step 5. Video Production:

- British cartoonist John Landers (www.landers.co.uk)

- Editing to time with music and integrate with learning objectives by Mike Fleck (PSU)

Step 6. Active Learning Web App:

- Chelsea Wang, Jiawei Wu, & Leah Hunt, Students in Book Of Apps for Statistics Teaching (BOAST) summer research program for undergrads

Step 7. Lesson Plan:

- Interactive components – Listen/watch - Explore

Step 8. Assessments:

- Multiple Choice items for Exams & HW
- Compare +/- music +/- app

Step 9. Web Analytics:

- Where do students have success, where is more help needed?

MORE INFO

Paper describing the SMILES project: Lesser, L.M., Pearl, D.K., Weber, J.J., Dousa, D.M., Carey, R.P., & Haddad, S.A (2019) Developing Interactive Educational Songs for Introductory Statistics, *Journal of Statistics Education,* 27:3, 238-252

Paper describing the BOAST app collection: *Wang, S.L., *Zhang, A.Y., *Messer, S. and Pearl, D.K. (2021) Student developed Shiny applications for teaching statistics. *Journal of Statistics and Data Science Education* 29: 218-227(* = PSU undergrad)

SMILES Project Website: https://CAUSEweb.org/smiles
CLT Interactive song/video: www.causeweb.org/smiles/songs/central_limit_theorem

BOAST Project Website: https://shinyapps.science.psu.edu
CLT Shiny App: https://psu-eberly.shinyapps.io/Central_Limit_Theorem/

Questions to: dkp13@psu.edu