Title: Teaching Statistics to Prospective Teachers

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Summary of Session: Recent reports from national agencies and professional organizations indicate that prospective teachers of mathematics at the K-12 grade levels need to develop a deep understanding mathematics and statistics as unified and coherent disciplines. Unfortunately, many of our undergraduate statistics courses for prospective teachers do a better job of preparing these educators for graduate studies in statistics than they do for teaching in grades K-12.

As part of a multi-year project called "Enhancing the Core," mathematicians, statisticians, and mathematics educators at Grand Valley State University (GVSU) in Allendale, Michigan joined together to enhance the core courses taken by all prospective teachers majoring in mathematics. One of the core courses that is taken by all K-12 prospective mathematics teachers is Probability and Statistics. The course is a calculus-based introduction to probability and statistics.

An important goal of the Enhancing the Core project was to develop teaching materials that build upon the mathematics and statistics content found in the K-12 curriculum. Exemplary K-12 materials were identified, adapted, and extended for use in the college classroom. By using exemplary K-12 curricula as source material, the project helps prospective teachers to gain an appreciation of the connections between the statistics taught to them in the undergraduate course and the statistics they will teach to their K-12 students.

In this breakout session we engage participants in three of the activities. These three activities are described below:

1. Rock, Paper, Scissors for Three – Is It Fair? – Students play the classic Rock, Paper, Scissors game modified for three players. Students are introduced to sample spaces, events, and probability. Special emphasis is placed on designing a "fair game."
2. Dolls and Data (based on an idea from David Coffey, GVSU) – Students are given a collection of action figures and asked to measure the distances from the elbow to the fingertip and from the shoulder to the fingertip. The resulting bivariate data is used to illustrate scatterplots, correlation, regression, and a very special ratio.
3. Coke, It's the Real Thing – or, Is It? – The class designs an experiment to determine whether or not a volunteer can distinguish between Coke and Pepsi. Concepts of hypothesis testing, Type I error, Type II error, p-values, and the binomial distribution are illustrated.

The second page of this summary provides a list of activities developed for the Probability and Statistics course as part of the Enhancing the Core project.

Probability and Statistics – Activity Grid
Investigators: Alverna Champion, Phyllis Curtiss, John Gabrosek
Enhancing the Mathematical Core

Activity Name	Source of Activity	Goals and Content Covered
Are All Samples Created Equal?	Core-Plus, Course 3, Part A, pp.124-127	Students apply the process of taking a simple random sample. Students discover that a simple random sample is more likely to generate a sample representative of the population than a convenience sample.
Uh, Let's Just Call Her Rho	Connected Math, Samples and Populations, Grade 6, pp. 6-18	Students calculate descriptive summaries of quantitative data and investigate the influence of an outlier on these summaries.
The Mighty Thumbtack	Everyday Mathematics, Fifth Grade, Vol. 1, pp. 107-08	Students perform a simple experiment to see that not all outcomes are equally likely. Students see the impact of sampling variability through a comparison of student-to-student results. Class data are used to demonstrate The Law of Large Numbers.
Rock, Paper, Scissors for Three	Investigations in Number, Data, and Space, Between Never and Always, Fifth Grade, pp. 48-55	Students play a modified version of Rock, Paper, Scissors for three. Students design a scoring system to make the game fair.
The Lottery	Developed by Alverna Champion	Students calculate conditional probabilities of various people winning in the short story "The Lottery."
I'm Dieing to Meet Your Expectations	Math Connections, Volume 3a, pp. 263-269	Students develop a strategy for finding the expected score of a discrete random variable. Students find the probability mass function and cumulative distribution function for the discrete random variable.
Making Cents Out of Pennies	Activity-Based Statistics by Richard Schaeffer	Students investigate the distribution of the class means for simple random samples drawn from a known population. Students generate histograms to investigate the Central Limit Theorem and the sampling distribution of the sample mean.
The Blob	Developed by John Gabrosek	Given an irregularly shaped object, students take a random sample and find an interval estimate of the object's area using confidence interval techniques.
Coke, It's the Real Thing–Or, Is It?	Coke or Pepsi, by Marita Levine and Raymond Rowling, Teaching Statistics, Vol. 15, No.1, p. 4-5.	The class designs and conducts an experiment to determine whether or not a volunteer can distinguish between Coke and Pepsi. Students investigate the relationships between Type I error, Type II error, and Power.
Can We Really Trust Those Martians?	Core Plus, Course 3, part A, p. 157	Students construct confidence intervals for the population proportion. Students use their intervals to investigate the truth of a claim.
Gulliver's Travels	Math Thematics, Book 1, module 6, pp. 396-411	Students collect data on thumb, wrist, and neck size. Students use their data to motivate a discussion of correlation and regression.