Quantitative Literature

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CSEPA
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Center for Statistics Education in PA at IUP

In This Issue:

Changes at CSEPA

Over the past few months a lot has been happening at CSEPA. Our long time Program Coordinator - Isabel Wiggins has left and joined her family in a move to New Jersey. We will miss her and wish her and her family all the best. Lynnan Mocek joined our group in July and has jumped in with both feet. Lynnan has a varied background. She is a registered Occupational Therapist and has taught on the Associate Level at Mount Aloysius College. She has recently completed all the requirements for her Masters in Adult and Community Education.

The Center has recently applied for a grant to the Pennsylvania Department of Education to provide workshops in *Real Data* to levels K through 10 and continue our workshop - Statistics for 11th and 12th grade teachers. Examples of *Real Data* can be found on page two. We are excited with the potential to expand our successful program into other areas.

From the Director: Larry Feldman :

The Mysteries of Statistical Studies and Riding Bicycles

I just came back from presenting at the National Summit on the Mathematical Education of Teachers. This was a big honor for the Center to be invited to a conference of this national import. I co-led the Working Group on "Teaching Statistics to Future K-8 Teachers". Dr. Richard Schaeffer, President of the American Statistical Association, introduced me by saying that Pennsylvania has become the national leader in Statistics Education. Those of you that have participated in a CSEPA activity have been an important part of this success story.

The main reason for the conference was the publication of the major new document called the Mathematical Education of Teachers. If you are interested in what future K-12 teachers should be learning to be prepared to teach mathematics, I would encourage you to get this document. The first part can be obtained at no charge and the whole document can be downloaded for free (see www.maa.org/cbms, ISBN: 0-8218-2899-1).

One of the concepts I was very happy to see from this document will require a major change in K-12 statistics teaching. In the section on the preparation of elementary teachers, they describe statistics as a three-step paradigm as follows. Similar statements are made for the middle school and high school levels.

1. Data production: designing studies to collect data relevant to questions of interest.
2. Data analysis: using graphical representations, tables, and numerical summaries to find and describe patterns in the data.
3. Interpretation: relating the results of data analysis back to original questions and stating conclusions; if necessary, designing and implementing a further study. (p. 87)

The first part (data production) is severely lacking in K-16 classrooms and in teacher preparation. An analogy is to compare statistics to a traditional murder mystery. In the first part, the mystery is set up – we learn about the setting and why many characters dislike the person who is going to be killed. The second part has the murder and much of the action. The final section has the unraveling of the clues leading to the murderer being found.

A statistics study follows a similar mode. In the first part, we set up the problem and the "characters". We create the interest in solving a puzzle. This involves developing a question, developing methods for collecting data, and refining those methods. In the second part, the "action" takes place where we go out and collect the data, display the data, and compute statistical measures. In the last part, we "solve the mystery" and answer the original question, interpret the results, describe problems and errors with the study, and present the findings. (Go to page 3 to continue)

Real Data Samples

The K-12 *real data* workshops will take the best ideas from the basic probability and statistics workshops, from the data-driven workshops, and from the multidisciplinary workshops and apply them for the first time to grades (K-12).

K-5 example: Teachers can motivate students to collect data about a topic that is of interest to them such as pets. First graders would get a blue Unifix cube for each dog, a red one for each cat, and a yellow one for other pets. (Unifix cubes are small plastic cubes that join together.) One first grade class might have a total of 17 blue cubes for dogs, 15 red cubes for cats, and 9 yellow cubes for other pets. They interpret these Unifix cube graphs as to which is most, which is least, that there are almost twice as many dogs as the other pets, etc. The children then make a stack of 10 blues and another stack of 7 blues to reinforce the place value concept that 17 means one group of 10 plus 7 more. They make a stack of 10 reds and another of 5 reds for the cats, along with a stack of 9 yellows. They will then combine the stacks for dogs, cats, and other and create as many stacks of 10 as possible. Then they have 4 stacks of 10 and 1 more, they learn that this is 41. This can be related to the standard symbolic addition process of 17+15+9 = 41.

A follow-up activity is to distribute these 41 cubes equally to the students in the class, suppose there are 18. Each child gets 2 cubes with 5 cubes left over. They learn several challenging topics for first graders, such as place value, representing numbers in written, oral, and physical form, creating and interpreting graphs, two-digit addition, the concept of fair share division, and the concept of the mean. All of these concepts are taught in a manner that is fun, meaningful, challenging to first graders, and in alignment with the Pennsylvania Standards.

Middle / secondary example: Mathematics teachers are very familiar with linear equations such as y=3x+70. However, many of them are not familiar with how to use real-life data to drive the teaching of such an equation. One activity is to have an entire class measure their height and the length of their forearms in centimeters. Each person's data is plotted on a scatter plot with the x-value being the forearm length and the y-value being the height. Every student uses a relatively simple technique - the "median fit line" to find an equation of a line that summarizes this data. Technology is used to compute the least squares line in a developmental sequence but the median fit line gives an intuitive hands-on introduction. Anthropologists actually use equations very close to y=3x+70 for this relationship. Students discover an equation very similar to this one by using the *real data* collected from the class. Students are able to answer questions such as, "If an anthropologist finds a forearm that is 34 cm. long, approximately how tall was the person, using our line?" Measurement is done in inches and the line is approximately y=3x+28. The mathematical concept of parallel lines between theses two lines is developed. Thus, teachers are learning techniques for data collection, for creating lines from scatter plots, using technology, and relating these techniques to the standard curriculum.

While many teachers are aware of the theory behind linear equations, many do not have the mathematical background to teach linear equations using hands-on Quantitative Literacy (QL) techniques.

Secondary teachers and/or the 11th / 12th grade example: Involves using spaghetti to understand the Triangle Inequality Theorem, which states that the lengths of any two sides of a triangle must be greater than the third side. While geometry teachers are very familiar with this theorem, many are not aware of a hands-on activity to illustrate it. In this activity, students are given pieces of uncooked spaghetti and asked to guess whether a triangle can be formed when a piece of spaghetti is randomly cut into three pieces. For example, if there are two tiny pieces and one large one, it is impossible to make a triangle. On the other hand, if all three pieces are approximately the same size, a triangle can be formed. After a great deal of data collection using students' haphazardly created cuts and then using random numbers, students can develop the theoretical probability, 1/4, for getting a triangle by this procedure. This important geometry theorem can be discovered by students using *real data* and integrating analytic and coordinate geometry and algebra.

Continued from page one

Most textbooks skip the first section and do a very poor job with the third part. They show the "action" of the middle part (graphing and computing measures) without the "character development" of a real problem. "Solving the mystery" (interpretation) is not taken seriously. It is difficult to spend a great deal of time interpreting data when there is no realistic context. Just as we would never ask students to only read the middle part of a novel, we should not ask students to only learn the middle part of statistics.

Last semester, I taught a course in statistics for elementary and middle school teachers. Most of the students were undergraduate elementary education majors who were concentrating in mathematics. The rest were graduate students in elementary and middle school mathematics education. These students put together the best set of statistics studies I have ever seen from this course. Their studies included: a comparison of sorority vs. fraternity advertisements in the school newspaper; the number of times college students and sixth graders could skip rope in 30 seconds; a comparison of the time it took to solve two different types of jigsaw puzzles, and four others. None of the studies were ready for publication in a professional journal but all of them at least made a serious attempt at going through the full story.

Unfortunately, today we cannot rely on most textbooks to help us with this three-step process. I am always amazed at how much time and thought it takes to do that first step, but it is time well spent. Most of you that are reading this newsletter have participated in a SEQuaL workshop in which you did a statistical study. I would encourage you to continue (or start) having your students do statistical studies. Perhaps you can use the handouts and the study you did at SEQuaL as a reference. I would be glad to share with you the handouts from my classes, which you might be able to adapt (email or write me). Also, I would encourage all of you to have your students enter the K- 12 Pennsylvania Statistics Poster Competition (see page 4). (As a side note, it is not always necessary to have students do a full-blown statistical study to get at the first part of the story.)

Where is the time for all this? Isn't this just one more add-on to an already cluttered curriculum? I will do the annoyingly overused "answer my own question" routine here. There is a great deal of other mathematics that can be learned by your students if they do a statistical study. We have three examples of the "real data" / data-driven approach on page 2 (first grade study on pets, discovering pi, and spaghetti triangles). Statistical studies can be used to supplement and / or replace units on number operations (whole numbers, fractions, percents, ratios, etc.), on geometry, on algebra (equations of lines and other functions, etc.), and on virtually all other mathematics topics K-12. I would strongly urge you and your colleagues to take one of the "real data" workshops that are planned (subject to funding approval) for Edinboro, Manheim Township (near Lancaster), and IUP. You will be given many ideas for integrating real data into the teaching of the mathematics topics you have always taught. As another reason for taking the time for statistical studies, our students will see hundreds of statistical studies in their lifetimes. It will be difficult to really understand what they are about without having actually done one themselves.

Another response to the time issue is a comic strip I remember from when I was young. Bazooka Joe was pushing his bicycle to school. When asked what he was doing he said that he was so late for school that he didn't have time to get on his bicycle. The analogy to teaching is that sometimes we are in such a hurry to get things done quickly that we don't feel we have the time for our students to "get on the bicycle". Seeing numbers used in a big picture problem like a statistical study may help some K-12 students "get on the bike."

I am really excited about going to the final session of the IUP workshop this spring. The accomplishments of K-12 teachers with their students at these final sessions over the past ten years all over Pennsylvania is staggering. It is good to see such positive accomplishments by so many people in a world that recently is so dominated by bad news.

K-6 Real Data Conference

A conference for educators interested in K-6 Real Data (pending funding)

April 12 & 13, 2002

We are looking for individuals to prepare a lesson plan/activity geared to K-3 or 3-6 addressing the PA Math Standards (witha focus on teaching topics beyond probability and statistics).

Our ultimate goal is to provide conference participants along with future workshop participants a guide with sample lesson plans using *Real Data* based on the PA Mathematics Standards.

Individuals who are present at the conference and who submit a final revised lesson plan will be provided a stipend of $150.

Criteria for Activity Submission:

- Lessons must directly relate to the PA standards
- Two categories K-3 and 3-6 are available
- Activities must use real data, preferably generated/compiled by the students
- The draft lesson plan can be loosely developed since feedback will be provided at the conference.
- Outline for activity must be submitted to CSEPA by March 1,2002.

  Outline could include:
  - Standard(s) used
  - Grade level(s) geared toward
  - How the activity uses real data
  - Brief overview of activity
- All submissions should be made either by email to lmocek@iup.edu or via disk to CSEPA office.

** ***Presenters should be prepared to present the activity at the conference for feedback.***

Format for the final lesson plan will be provided at the conference for lesson plan submission. Reimbursement fill follow the submission of the final lesson plan.

Act 48 credit hours are available to participants. Meals will be provided, and housing available upon request.

If you are interested in attending or submitting a lesson plan, call or email Lynnan at the CSEPA office - 724-357-6239 or lmocek@iup.edu

In Memory

Dr. Rebecca Stoudt

The Center for Statistics Education in Pennsylvania mourns the death of Dr. Rebecca Stoudt. She was one of the founders of SPIRAL (Science, Mathematics, Technology Preparation Involving Real-world Active Learning), another Eisenhower funded project at IUP.

Dr. Stoudt was dedicated to the use of technology and hands-on approaches in the teaching of mathematics. We send our condolences to her family and mourn her loss.

Information regarding 2002 Statistical Poster Contest

For complete information, please go to the website:
www.villanova.edu/PA_posters

Deadline for submission: ***February 28,2002***
All students in grades Kindergarten through grade 12 in PA are eligible to enter.
Prizes are awarded in each grade level category. (K-3, 4-6, 7-9, and 10-12)

Winners of the 2001 Pennsylvania Statitistics Poster Competition

Please go to website for winners names and poster information/picture

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Visit us on the web:

www.ma.iup.edu/projects/SEQual

Lauralee Neale is a local winner of the Pennsylvania Statistics Poster Competition

Her topic concerned the Indiana County Humane Society

Photo from Indiana Gazette April 8, 2001

From left are Lauralee's parents LuAnn and Dr. John Neale; Lauralee; Holly Lecce, teacher, now assistant principal and SEQuaL instructor; Dr. Tom Short, Villanova professor and competition organizer; and Dr. Larry Feldman, IUP professor and director of CSEPA

Of Statistical Interest To You - A Letter by Ken Schroder CESTA Director

A year or so ago I mentioned that I had results going back to the mid-fifties of my classes doing penny flips. I promised to send my figures, and, slowly true to my word, I am now doing so. All of my students over the years at George School, Bucks County Community College, St. Joseph's University, and the Commonwealth Excellence in Science Teaching Alliance (CESTA) Summer Institutes and Workshops participated. I taught at George School for 34 years, so I had many siblings and offspring of my students in that time. They were fascinated by the fact that their figures were now co-mingled with those of their family members.

The current figures: Heads – 141,387 Tails – 141,869
Head-Head – 24,218 Head-Tail – 47, 862 Tail-Tail - 23, 321

Once, back around 170,000 total flips, the Heads and Tails were only 75 apart. They have wandered up and down since that time. I offer no explanation for the difference between the Head-Head and the Tail-Tail figures, but there is a slight difference in method of flipping. At the beginning of the exercise, I split 250 pennies somewhat evenly among the class and give them a plastic cup with a lid. The cup is large enough that with sufficient shaking they can get the coins to flip over randomly. (Earlier, I had them cup their hands together and shake them, but decided that too many coins were not actually able to turn over, thus the cups.) This gives us 1000 flips in four times, and I keep the figures on the board. Then I have them take out two pennies and flip them to determine the other set of numbers. We do that as many times as time allows.

To write it up, I have them suggest the expected ideal results in the small individual samples, the class total sample, and the historical total. For each of these stages I have them calculate the percentage deviation of the actual from the expected figures, and finally have them explain the meaning of what we determined.

Of course, at the school level this is very elementary statistics, but they do begin to understand why statistics are primarily valid only in large samples, certainly not in the small individual or even class sample. I think they may even understand why I don't apply statistics to test grades, especially the so-called curve.

I hope these figures are of some interest to you. Use them any way you wish. I started keeping them in 1955, and the latest were added in 2000.

Flower Power

A Message from Barb Lamberski:
The cold mornings have taken their toll on the last of my summer flowers. It's time to clean up my garden. Purchasing tulip and daffodil bulbs to plant for the spring made me think of the Flower Power activity done by Rhonda Fedyk and Jackie Gentile's students. This week-end promises to be warm and sunny, so I will assemble my gardening tools, bulbs, soil, and popsicle sticks and dig in! Consider doing this activity with your students and enjoy the rewards of your efforts both in mathematics and in the beauty of spring's finest!

Mathematical Topic(s) Addressed via this Activity:
* Measurement * Perimeter and Area * Prediction

PA Math Standard(s) Addressed:
2.2.3 ABE, 2.3.5 ABC,2.3.8 AD, 2.4.3 AB, 2.6.3 ABC, 2.6.5 AD & 2.7.3 A

Prerequisite Skills: The student must be able to:
- Measure weight in grams
- Measure length in both inches and centimeters
- Determine perimeter and area
- Make a line graph or a bar chart

Materials/Handouts Needed:
* Accompanying Handout
* Bulbs (Tulips, Daffodils, other flowering bulbs)
* Shovel and Gloves
* Plant food, potting soil or topsoil
* Popsicle Stick

Procedures:
In the early part of the school year, students will study bulbs and make predictions about which will be the first to 'spring" from the ground, which blooms will be the largest and then plant different kinds of flowering bulbs.
In the spring, the students will make observations regarding how the bulbs grew.

Extensions:
Determine the area and perimeter of the garden
Determine the cost of fencing the garden

Flower Power Worksheet

You are going to study and then plant various types of flowering bulbs. You will predict which kinds grow best, which bulb will "spring" from the ground first, and which bulb will produce the largest bloom, and so on. In the spring when the flowers bloom, we will see how well you were able to predict.

1. Record the type of bulb you and your partner have in the table below.
2. Weigh each bulb in grams, and record the weight in the chart below.
3. Measure the height (in inches to the nearest 1/16 and in centimeters to the nearest tenth), and record it.
4. Measure the circumference of each at the fattest part (in inches to the nearest 1/16 and in centimeters to the nearest tenth), and record below.

	You	Your Partner
Bulb Type		
Weight (grams)		
Height (in)		
Height (cm)		
Circumference (in)		
Circumference (cm)		

5. Record other observations of your bulb.
   Is the bulb:
   Broken or cracked?
   Different colors?
   Firm or soft?
   Other observations?
6. With your partner, you will plant your bulb. You may need a shovel, gloves, a ruler, potting soil, plant food, and a popsicle stick. Follow the directions for planting that your teacher gives you. After you cover your bulb with dirt, mark your bulb by putting your name on the popsicle stick and sticking it in the ground. Record where your bulb is planted below.
7. Answer these questions with your partner.
   a. Which kind of bulb do you think will grow tallest?
   b. Which kind of bulb will grow the fastest?
   c. Which kind of bulb will spring first from the ground?

Spring has arrived! Now you will begin to collect data about your flower.

8. On what date did your flower sprout from the ground?
9. How many days did it take before your flower developed a bud?
10. How many days was your flower in bloom?
11. What color is your flower?
12. What was the largest diameter your bloom had?
13. How many leaves were part of your foliage?
14. Record the date, day number, and height (1/16 of an inch and tenth of a centimeter) of your flower in the table on the next page. Note: the first day you measure will be day number one; if you measure again two days later, you will record the day as day number three; if you measure four days later, record as day number seven.
15. Make a line graph or bar graph of your data, with the number of days on the horizontal axis and the height in centimeters on the vertical axis. Be sure to label all parts of your graph.

Date	Day #	Height (in)	Height (cm)

16. Write a brief report on your findings.

Indiana University of Pennsylvania

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Upcoming Events . . .

TBA	- Edinboro Final Session
March 9, 2002	- IUP QL Final Session
March 23, 2002	- Manheim K-8 QL Final Session
April 6, 2002	- Manheim Data-Driven Final Session
April 12, 2002	- IUP Statistics for 11th &12th Grade Final Session
April 12-13, 2002	- *Real Data* Conference (pending funding)
April 27, 2002	- Mansfield Data-Driven Final Session
May 2002	- Spring Presessions for *Real Data* workshops & Statistics for 11th & 12th Grade Teachers (pending funding)
June / July 2002	- Workshops for *Real Data* and Statistics for 11th & 12th Grade Teachers (pending funding)

Hope to see you there!