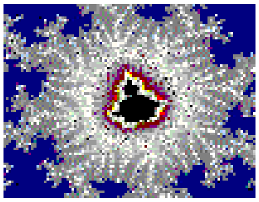

Sinclair Mathnet

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FROM THE CHAIR

You have a balance scale and 12 numbered billiard balls that are otherwise identical in appearance. Eleven of the balls are of standard weight. The twelfth is either light or heavy, but you don't know which. You may use the scale three times to compare the weight of any subset of the 12 balls to any other subset. The scale will only tell you which subset is heavier and which is lighter or that they are identical in weight. Describe a procedure for identifying the non-standard ball and determine whether it is light or heavy.

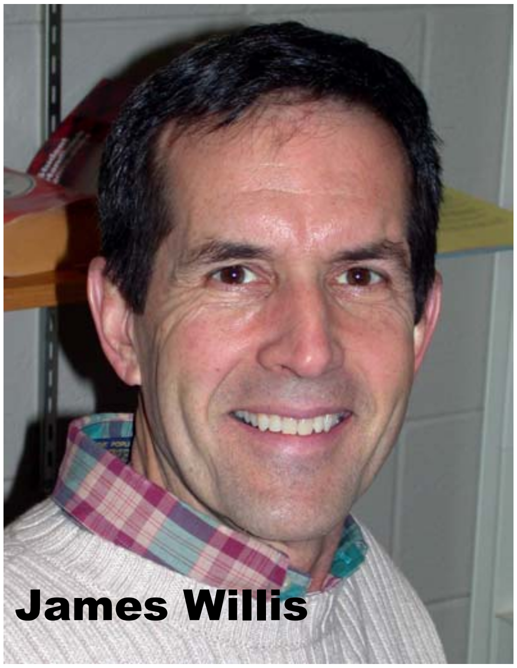
I first encountered this puzzle quite some time ago and have posed it to many people. I believe that only one has ever returned a satisfactory solution. To the first person that can provide the solution before February 15, I will relinquish this space in the next issue of *Mathnet* for them to expound on the topic of their choice and the rest of you will not have to hear from me again until Spring. Solutions may be submitted to me and will be adjudicated by the Mathnet editors and myself.

Let me offer a few comments about this puzzle and a couple of related observations that I have made in thinking about it for some time. First of all, you will note that since any of the 12 balls could be light or heavy, there are actually a total of 24 possible states. There are three outcomes for each use of the balance: the left side could go down, the right side could go down, or the two sides could balance. By the multiplication principle there are 27 different outcomes to the three uses of the balance, enough to distinguish between the 24 possible states. This might lead one to conjecture that if there were 13 balls then, since that would give rise to 26 possible states, the three weighings would be adequate to find the non-standard ball. But I believe I can show that there is no solution with 13 balls. (Interestingly enough, however, if a fourteenth ball known to be of standard weight is available for use, then the 13 ball problem is solvable.)

You may wish to begin by giving arguments to verify the following simpler conclusions. If there are 3 balls and two uses of the balance, then the nonstandard ball can be found. But with 4 balls and two weighings, no solution exists even though there are only 8 possible states and 9 outcomes. (Again, however, it turns out that the availability of a 5th ball, known to be of standard weight, makes the 4 ball problem solvable.) Or if you like it really simple, try one ball and one weighing. (Clearly there is no solution, but with a second ball known to be standard there is a solution.)

I suppose the ultimate problem would be to find the set S = {(n, m): the billiard ball problem is solvable for the case of n balls and m uses of the balance}. In general, if there are n balls and m uses of the balance, there will be 2n states and 3^m outcomes. Clearly there is no solution when $2n > 3^m$, and sometimes there is no solution even if $2n \leq 3^m$. Beyond this, all I believe I know so far is that (1, 1), (1, 2), (2, 2), (4, 2), (1, 3), (2, 3), and (13, 3) are not in S. But (3, 2), (3, 3), (4, 3) ... (12, 3) are in S. I have also been able to show that (39,4) is in S. Based on the results for m = 3, I suspect that (n, 4) is in S for $2 < n < 39$, *(Continued on page 4)*

Faculty Feature



One of our newest faculty members came to us by way of WSU. No, that is not the university across town, but Wayne State University in Detroit, Michigan. Jim Willis had been teaching as an adjunct instructor at both Wayne State University and Oakland Community College (also in the Detroit area) for 10 years before taking a position at Sinclair Community College and moving south to Dayton. When asked what brought him to Sinclair, he replies, "I was impressed by the resources available to students. Of foremost importance to me is the variety of help outside the classroom." He also adds, "I felt that my philosophy was in sync with the department. I believe in giving students all the help possible but requiring them to understand the material before passing them."

Jim holds a degree from both institutions in Detroit where he has taught. He earned an AA degree in Liberal Arts from Oakland Community College, and a BS in Mathematics and Computer Science from Lawrence Technological University. After working for a number of years at Ford Motor Company as a systems analyst, Jim realized what he really wanted to do was to teach math at the college level, so he returned to school and earned an MA in pure math from Wayne State University. Jim was given an award for academic achievement upon completion of his Master's degree.

Besides being a former systems analyst, Jim has also held many other positions. Among these are owner/operator of a residential light remodeling company, and manager for several franchise restaurants. He also adds, "I have remodeled many homes over the years, and am looking for a suitable multi-unit in Dayton."

Jim has been involved as an instructor in the Emerging Scholars Program, which originated at UC-Berkeley. The program offers a new approach to learning math, for students who are willing to work hard, by pairing normal lectures with workshops. Jim recently spoke about this program at a Math Department meeting, and about the possibility of offering a class here using the program.

When asked about his family, Jim says, "I come from a large extended family that is very close. We get together for most birthdays (especially the children's) and for all holidays." None of his immediate family live in the Dayton area, but he has a sister who often travels to Dayton for work as a Delphi employee.

Welcome to the department Jim!

Susan Harris ■

"Valentine"

You disintegrate my differential;
You dislocate my focus.
My pulse goes up like an exponential
Whenever you cross my locus.
Without you, sets are null and void,
So won't you be my cardiod?

Reminders

- If you are teaching a course that requires a C grade for students to go on to any subsequent course(s), please remind your students about that. It is a good idea for this information to be included in your syllabus.

- Remember that according to the department's Faculty Handbook, "Instructors are encouraged to avoid tests from the Instructor's Manual…," "…take home tests should be used cautiously if at all…," "…multiple choice tests are not encouraged…," "open book tests are not encouraged," and "…in no case should old copies of departmental finals be used to prepare students for final exams in Math 101 and Math 102."

- Grade books showing scores students earned on tests and other assignments used to calculate grades should be retained for two years and turned in to the Department Office if you leave the college. Graded exams and papers not returned to students should be retained for sixteen weeks after the course has concluded.

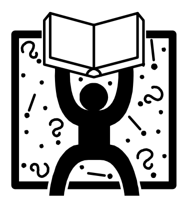
- Every effort should be made to return graded exams at the next class meeting and, in any case, certainly no more than one week after the exam. It is important for students to get immediate feedback on their mistakes while topics are fresh in their minds and before new material is covered.

- In most classes a specific homework assignment should be given on every section covered and 15 - 20 minutes should be set aside for each hour of class to answer questions on the homework.

Part-Time Math Faculty!

Do you feel like a nomad, wandering the halls, dragging all your worldly possessions with you? The Math Lab (room 1315) has created a small space just for you. We have a computer station, printer, locking cabinet drawer, and a small table with chair reserved for your use. When building 16 is too far away, and you just need a little space to sit down and take care of some class chores, come hang your hat in the Math Lab! (Monday-Thursday 8 am to 8 pm, Friday 8 am to 4 pm, Saturday 9 am to 3 pm)

DEPARTMENT COLLOQUIUM



We will have a Department Colloquium on Friday, February 13, 2004, at 2:30 in Room 1001. All faculty, students, and staff interested in mathematics are welcome. Speakers are:

1. Earl King, Mathematics Instructor, Sinclair Community College
   "Business Math (MAT 105) Instructional Enhancements"

2. Ed Gallo, Assistant Professor of Mathematics, Sinclair Community College
   "American Mathematical Association of Two-Year Colleges (AMATYC) Position Papers and Standards"

Refreshments will be served.

(Continued from page 1) but this is not obvious because the methods for solution differ somewhat for the cases (3, 3) to (12, 3). I also believe that (40, 4) is not in S.

A final word. I suppose that modern pedagogy would dictate that any discussion of a problem such as the above with students should be replete with an actual balance and a supply of billiard balls. But, while I fully agree that activity based learning is of immeasurable value, I also think that tackling problems like the one above with nothing more than pencil and paper or, better yet, without even that, is invaluable for developing many important thinking skills. Beside the skill of thinking creatively, these would include: the ability to pursue a solution in an orderly and systematic manner, to hold several thoughts in one's mind simultaneously, to find clear ways to formulate the statement of a problem and of a solution, and to be patient and perseverant. I think that anyone who seriously attempts to solve this problem will see this and will hone his or her thinking ability in the process.

Al Giambrone ■

Daniel Collins and Emily Enright receive their AMATYC Mathematics Competition awards. Dan and Emily took 2nd and 3rd place respectively. Not pictured is Jason Phelps who came in 1st place.

Emily Enright and Meagan Hauser tied for first place honors in the Fall Quarter Problem of the Week Contest facilitated by Susan Harris.

Harvey's Joke Corner

Fans of the "Golden Number" Phi ($\varphi = \frac{1+\sqrt{5}}{2}$) say that "Phi is an H of a lot cooler than Pi!"

Q: Why are snakes measured in inches?
A: Because they have no feet.

Q: Which pair of modern day presidents are "prime twins?"
A. George Bush, Sr. (# 41)
George Bush, Jr. (# 43)