

Points & Angles

Newsletter of the Metropolitan Mathematics Club of Chicago
Volume XLIII No. 3, November 2008

Mozart's Dice Game and Other Beautiful Connections between Probability, Music, Art, and Drama

Ron Lancaster
University of Toronto

By PAUL CHRISTMAS

In 1787, Mozart developed a method for composing music that involved cutting and pasting pre-written measures of music with the order determined by the outcomes of the rolls of a pair of dice. As you will see and hear, Mozart's version always produces a very sweet sound in spite of the random elements. Mr. Lancaster will also discuss how other artists such as the painter Ellsworth Kelly, the playwright Helen Juvonen and the film maker Antonin Svoboda have made use of probability in their works.

Ron is presently a Lecturer in Mathematics Education at the University of Toronto. Prior to this he taught middle and high school mathematics for over 20 years in co-ed public schools as well as in an all-girls school. Ron has given over 1100 talks throughout North America and Asia. Ron has been a T³ National Instructor since 1994. He created and edited two popular on-going columns for the Mathematics Teacher (Media Clips and The Mathematical Lens) and he was a team leader and writer for mathematical activities for the CBS show NUMB₃RS (seasons 2 and 3).

Please reserve your seat(s) by the deadline. It helps Fountain Blue's preparation and room set-up. Also note that late reservations are accepted—we would hate for you to not come because you missed the deadline.



From I-90 & Southbound I-294: Exit at I-190 West to O'Hare; Exit onto North Mannheim Rd.; Take Mannheim Rd. North 2.25 miles.

From Northbound I-294: Exit at West Touhy Ave.; Take Touhy Ave. to Mannheim Rd.; Turn right on Mannheim Rd.

Public Transit: Take the CTA Blue Line to the Rosemont Bus Terminal; Take Pace Bus #223 to Touhy Ave. & Lee Rd.; Walk East on Touhy to Mannheim Rd.

Friday, November 7, 2008

5:30 PM Doors Open, 6:00 PM Social Hour,
7:00 PM Dinner and Talk

**Fountain Blue Banquets &
Convention Center**

2300 Mannheim Rd., Des Plaines
(847) 298-3636

\$31 for Members, \$37 for Nonmembers

Reserve by Noon, Monday, Nov. 3

reservations@mmcchicago.org or (847)
486-4690, day or night, leave a voicemail.

Points from the Interior

By PHIL GARTNER

I had the privilege of attending an excellent high school—Downers Grove South—and I had some terrific math teachers while there. Furthermore, I was fortunate to have professionally active teachers who were and still are involved with MMC. The teachers I speak of are Dane Camp and Mary Anderson. While I was in “Mrs. Anderson’s” Calculus BC class, “Mr. Camp” shared with me the information about MMC and its scholarship. I was encouraged to apply for the MMC Scholarship and more importantly had received some encouragement about going into teaching.

Encourage strong math students to consider a career in mathematics education. There are three scholarships that can be awarded this spring.

In those days there was only one scholarship. The applicant pool must have been rather weak back in 1992 because I was selected. I unfortunately did not make the trip to the

Como Inn to meet all of you that May, but I would be making many trips to the Como Inn (and later, Fountain Blue) in the years to come!

It brings me great pleasure to now give back to this organization that was so generous to me. Of course it is not just the money that I appreciate—I was grateful to get some extra money for college—but let’s face it, the real value of our scholarship is the way it can recruit strong mathematics students

into the education field that otherwise may not have considered the profession.

Some of us need that encouragement from a teacher to make such a career consideration. For me, I was considering careers in actuarial science, engineering, accounting, professional athlete, and *education* toward the end of my high school career. My father discouraged me from being a teacher for financial reasons. In society in general, I got the message that top students in mathematics do not go into teaching. The encouragement of MMC members made a difference for me. Without educators talking to me about the profession and encouraging me I may have ended up as an actuary or accountant. How dull that would have been! We never know how much our conversations and encouragement can shape the future of an adolescent.

Some of us are much more aggressive and successful at getting students to apply for the MMC scholarship than others. As many of you know, Evanston has had numerous applicants and winners in the past years. Some of this can be attributed to those math teachers at Evanston who are involved with MMC and who truly value recruiting top math students into teaching mathematics. How many times have we seen John Benson, for instance, introduce a scholarship winner over the years? On the other hand,

Points & Angles, Volume XLIII

Number 3, November 2008

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Points & Angles, published nine times per school year, is the official publication of the Metropolitan Mathematics Club of Chicago. Founded in 1913, the Metropolitan Mathematics Club is the National Council of Teachers of Mathematics’ first affiliate. The official club website: <http://mmchicago.org/>

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my school, Glenbrook South, has never had a winner. We have good company, though. Most schools have never even had an applicant.

This is the year. Let's encourage strong math students to consider a career in mathematics education. And strong student doesn't mean they have a math ACT of 34-36 and are in Calculus BC. The selection criteria value the essay, the nominating letter of recommendation, character, extra-curricular activities, and perceived commitment to teaching. Let's at least make the effort to recruit. There are three scholarships that can be awarded this spring (thank you for donating to the Scholarship fund and thank you to the Filliman estate), but more important are the dozens of conversations that seniors have with their math teacher. And it benefits MMC as an organization by exposing future teachers to the club. This introduces young prospective teachers to us so that they and their colleagues will be involved professionally when they complete college and get that first teaching job.

Details about the scholarship are in this issue of *Points & Angles* and on the web. You must be a member to nominate a high school senior. Who knows, the student you nominate just might win and go on to be MMC President. Or if not President, at least a Board member like Jenny Wexler who won the Scholarship in... well, let's just say a *few* years before 1992.

New Teacher Incentive

For this school year, 1st and 2nd year teachers who become members of MMC will receive ½ off their second and third dinner meetings! Take advantage of this tremendous opportunity to get involved with a great organization, hear top-notch speakers and meet fellow math teachers from throughout the Chicagoland area.

To participate, cut out the form below, bring it with you to all 3 dinner meetings, and have it signed at the registration desk. You will receive your 2nd dinner meeting for \$16 and your 3rd dinner meeting for only \$15!

Thanks to an anonymous MMC member for generously funding this program.

Name		FOR USE OF MMC REGISTRATION PERSONNEL ONLY		MMC 2008-09	
Name	Meeting 1	Date:	_____	Approved:	_____
		Approved:	_____		
	Meeting 2	Date:	_____	Approved:	_____
		Approved:	_____		
	Meeting 3	Date:	_____	Approved:	_____
		Approved:	_____		

Discovering Theorems Using Cabri 3-D

BY ILENE HAMILTON

For our second dinner meeting of the school year, MMC was pleased to welcome Dr. Stephen West from the State University of New York at Geneseo. Steve began his presentation with his Philosophy for Free: “Most math teachers spend 80% of their time teaching what technology can do better and only 20% of their time teaching what technology cannot do at all.” (He also stated that from what he knew about MMC, he did not believe this statement applied to us.) He then related this philosophy to the learning of basic skills. If you have a student who knows how to multiply but not when and another student who knows when to multiply but not how, which student will succeed when he leaves your class? Steve compared a math teacher to a coach, with one basic difference. Players on a team practice skills, leading up to playing a game. The teacher has the students practice skills, but the students rarely are allowed to play a game. Steve encouraged us to let the students see the mathematics and to let our students play the game.

Our students can discover and play by doing investigations. In the study of Geometry, many of the simplest investigations are the ones that extend theorems in 2-space to their analogues in 3-space. Steve used Cabri II Plus to construct the perpendicular bisector of a segment, asking us what was interesting about that perpendicular bisector. We “played” by putting a point on the perpendicular bisector and then found the distance from that point to each of the endpoints of the segment. By dragging that point on the line, we “discovered” that all the points on the perpendicular bisector of a segment were equidistant from the endpoints of the segment. This was justified by a proof using triangle congruence. Steve then used Cabri 3-D for the construction of the perpendicular bisector of a segment in 3-space. In this case, the perpendicular bisector was a plane passing through the midpoint, perpendicular to the segment. The distances from any point on this plane to each of the endpoints of the segment were the same. This result is analogous to the result in 2-space, and the given proof was similar.

Steve’s next investigation in 2-space involved the point of intersection of the 3 perpendicular bisectors of a triangle. This circumcenter, the center of the circumscribed circle, is equidistant from the 3 vertices of the triangle. He then moved his investigation to the 3-dimensional analog to a triangle, the tetrahedron. Using Cabri 3-D, Steve demonstrated that the planes

Notices

Help MMC through NCTM’s Affiliate Rebate Program! Any individual who joins or renews NCTM membership online will be given the option to select an affiliate to receive a rebate. You may select one affiliate on the form for the rebate. The list only shows those affiliates in the individual’s state and multistate and at-large affiliates. Selecting Metropolitan Math Club of Chicago as your affiliate directs a portion of your membership dues back to MMC.

NEW TEACHER INCENTIVE CARD
IMPORTANT DATES 2008-09

Friday, September 5th—Cathy Seeley
Friday, October 3rd—Steve West
Friday, November 7th—Ron Lancaster
Friday, December 12th—Angela Andrews
Friday, January 9th—John Diehl
Saturday, January 24th—Conference of Workshops
Friday, February 6th—Tony Peressini
Friday, March 13th—Claran Einfeldt
Friday, May 8th—Nick Jackiw

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that are the perpendicular bisectors of the edges of any face of a tetrahedron intersect in a line. He proved this in a way similar to a 2-space proof of the triangle. In this case, the 4 lines of intersection are concurrent at a point equidistant from all the vertices of the tetrahedron. Steve then showed us the circumsphere he constructed using Cabri 3-D.

Steve then guided us on an investigation of the incenter, which in 2-space is the intersection of the angle bisectors of the angles of the triangle, as well as the center of the inscribed circle. The analog in 3-space brought up an interesting question; how do you construct the angle bisectors of the dihedral angles of the tetrahedron? This involved the fact that in 2-space every point on the angle bisector is equidistant from the 2 sides of the angle. The analogy in 3-space would involve the angle bisector plane and the planes forming the sides of the dihedral angle. Steve demonstrated the solution in Cabri 3-D, stating it was probably easier to prove that the angle bisectors intersected in a point than to find that point of intersection. That point was used to construct the sphere inscribed in the tetrahedron.

We then investigated the point of intersection of the medians of the triangle, the centroid. Steve asked us how we would construct the centroid in 3-space. Since the sides of a tetrahedron do not have midpoints, Steve's "medians" were drawn from a vertex to the centroid of the opposite face. The lines containing these four "medians" intersected at one point, the centroid of the tetrahedron.

Steve then constructed the point of intersection of the altitudes, the orthocenter. We looked at the diagram he had *carefully* constructed in Cabri 3-D; this would lead one to believe that the altitude lines of the tetrahedron were concurrent. Surprise! As Steve moved the figure, we could see this was not true. However, Steve did demonstrate that if the tetrahedron has one altitude that passes through the orthocenter of the opposite face, then the tetrahedron will have an orthocenter and is called an orthocentric tetrahedron.

The next investigation involved the construction of the nine-point circle of a triangle. Using Cabri II Plus, Steve constructed the nine-point circle for a random triangle and then described how one might prove that these 9 identified points all lie on this circle. Steve explained that the analogue in "tetrahedron-land" will only exist for the orthocentric tetrahedron. Each of the faces of that tetrahedron has a nine-point

circle. Steve showed us his 24-point sphere, one that intersects each of the 4 faces of the tetrahedron in their nine-point circle (see figure, below).

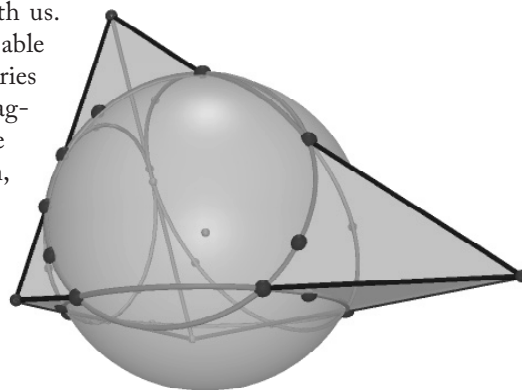
Steve then began a discussion on translations in 2-space as a composition of reflections over 2 parallel lines. In 3-space it is exactly the same, a composition of reflections over 2 parallel planes. He then demonstrated this in 3-space using a tetrahedron and 2 parallel planes. Steve also showed us in 3-space that half-turns are reflections over 2 perpendicular planes, analogous to the 2-space case of reflections over 2 perpendicular lines.

As we neared the end of the discoveries, Steve touched on two theorems that are true in 2-space but whose analogues when using Spherical Geometry are not necessarily true. The theorems are that the sum of the measures of the angles of a triangle equals 180° and that the measure of an exterior of a triangle is greater than the measure of each of its remote interior angles. He also showed a case of the Saccheri Quadrilateral on the sphere.

Steve concluded that these are good opportunities for students to investigate things that they have not been told. Students can make conjectures, whether in 2-space or 3-space and then explore, "playing the game" as Steve stated in the beginning of his talk.

Of course, Steve could not end a Geometry presentation without mentioning *Flatland*. We were "wowed" by his constructions to answer the question "If you lived in Flatland, what would you see if you were visited by a cube, or by a regular icosahedron?"

We thank Steve for sharing his explorations with us. Using Cabri 3-D, he was able to show us these discoveries rather than have us imagine them. Besides the "gift" of his presentation, Steve gave those in attendance a CD with these explorations, allowing us to continue our own discoveries.



24-point sphere: Each face of a tetrahedron is a triangle and hence has a nine-point circle. For each orthocentric tetrahedron, there exists a sphere that intersects each face in its nine-point circle.

MMC Scholarship

The Metropolitan Mathematics Club of Chicago is offering a \$1,500 scholarship for a high school senior who will pursue a career in the teaching of mathematics. Up to two additional Filliman Scholarships may also be awarded for the same amount (funded by a gift from the Filliman estate). The selected students, their parents and their sponsoring teachers will be invited to the May 8th MMC dinner meeting at which time the scholarship recipients will be honored.

The scholarship application form, along with the requirements, are on an insert in this newsletter.

A selection committee of MMC members appointed by the Executive Board will determine the scholarship awards. To be eligible, an applicant must submit the application, have an official transcript sent, and request a letter of recommendation from a member of the MMC such that all of the materials are received by March 13, 2009. The committee will establish its own guidelines for evaluating applications, and will make a recommendation to the Executive Board as to the awarding of the scholarship. No member of the selection committee may nominate nor recommend a candidate.

The guidelines used for selection shall be:

- A. Demonstration of overall academic scholarship with an inclusion of at least eight semesters of college preparatory mathematics. (A minimum cumulative grade point average of 3.0, where A = 4.)
- B. A statement of the intention to pursue a career in mathematics teaching.
- C. Indication of participation in extra curricular activities, especially those that may have a positive influence on a teaching career.
- D. Applicants must have a letter of recommendation from a member of the Metropolitan Mathematics Club who is familiar with the applicants academic performance and his or her potential as a mathematics teacher.
- E. Applicants must submit an essay (400-word maximum) explaining why they would like to be a mathematics teacher.

** Up to 3 awards are possible based on candidate qualifications. The organization reserves the right to award fewer scholarships if these are not met.

Web Bytes

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Algebra Boot Camp (<http://algebrabootcamp.com>) provides free downloadable resources, questions, and solutions on various algebra topics for students.

iLoveSchools.com (<http://iloveschools.com>) is a free donor-matching service for education. School teachers build Wish Lists of equipment, materials, and supplies. Donors locate teachers and offer their donations of new or used items or the cost of the teacher's Wish List.

Math Playground (<http://mathplayground.com>), a site for elementary and middle school students to practice their math skills, offers the opportunity to play logic games, solve word problems, and watch math videos.

Mathwire.com (<http://mathwire.com>) provides activities, worksheets, and creative ideas for teaching math that are classroom-tested by teachers.

Total Gadha (<http://totalgadha.com>) provides math lessons on various topics, in particular high school, and their applications in different contexts.

Details for Upcoming Events

UCSMP Grades 6–12 User's Conference, Chicago, IL, November 15–16. This weekend conference is designed for teachers and administrators who teach from UCSMP Grades 6–12 (third edition), are considering UCSMP Grades 6–12 (third edition), use or have used earlier editions of UCSMP middle and high school materials, or use or have used Everyday Mathematics.

The conference will introduce you to the program and provide

overviews of each course, teaching tips, technology usage, the research behind the materials, and more. On Saturday, take an in-depth look at books of your choice, devoting the morning to one text and the afternoon to another. On Sunday, you can attend as many as four sessions on special topics, and pre-register for a one-on-one meeting with a textbook author.

<http://social-sciences.uchicago.edu/ucsmf/Nov08.html>

Mathematics Educators Exploring Computer Algebra Systems (MEECAS) Meetings, Schaumburg High School, 9AM–12PM:

CAS For All, November 22. How CAS works in a classroom with diverse learners.

CAS Camp, January 31. Learn how to use CAS! Sessions for beginning and advanced users.

Precalculus, Calculus, and CAS, April 18. How CAS changes teaching topics in these courses.

<http://meecas.org/>

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ELECTRONIC-ONLY MEMBERSHIP Check the box below for electronic-only membership. You will receive an email with a direct link to each issue of <i>Points & Angles</i> when it is posted on the web site, often before paper copies are mailed. You will no longer receive <i>Points & Angles</i> by mail.		MEMBERSHIP TYPE Check one:	
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		SPEAKER FUND \$	
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Make check payable to **MMC**

MMC Membership and Change of Address Form

Mail completed form and check to:

MMC
415 S. Ridgeland Ave. #2
Oak Park, IL 60302



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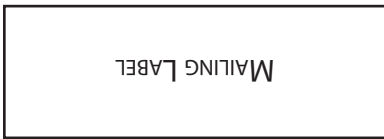
- Scholarship Application Form

Upcoming Events

<p>Fri., Nov. 7</p> <p><i>Nov. 15–16</i></p> <p><i>Nov. 22</i></p> <p>Fri., Dec. 12</p> <p>Fri., Jan. 9</p> <p>Sat., Jan. 24</p> <p><i>Jan. 31</i></p> <p>Fri., Feb. 6</p> <p>Fri., Mar. 13</p> <p><i>Apr. 18</i></p> <p>Fri., May 8</p>	<p>Ron Lancaster</p> <p><i>(see page 7)</i></p> <p><i>(see page 7)</i></p> <p>Angela Andrews</p> <p>John Diehl</p> <p>U. of C. Lab</p> <p><i>(see page 7)</i></p> <p>Tony Peressini</p> <p>Claran Einfeldt</p> <p><i>(see page 7)</i></p> <p>Nick Jackiw</p>	<p>Mozart’s Dice Game and Other Beautiful Connections between Probability, Music, Art, and Drama</p> <p><i>UCSMP Grades 6–12 User’s Conference</i></p> <p><i>MEECAS: CAS For All</i></p> <p>Focusing on the Big Ideas in Mathematics—Right from the Beginning</p> <p><i>e, i, 2π, oh! Come Explore What These Numbers Can Do</i></p> <p>MMC Conference of Workshops 2009</p> <p><i>MEECAS: CAS Camp</i></p> <p>Comparing Solutions of the Paper Roll Problem</p> <p>A Math Cursed Life</p> <p><i>MEECAS: Precalculus, Calculus, and CAS</i></p> <p>Using the Newest (Yet-to-be-Released!) Version of Geometer’s Sketchpad to Improve Learning</p>
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Send upcoming event items to ilg@chicagomath.org no later than the date of the MMC dinner meeting preceding the issue in which the item should appear. All items are subject to editing.

Your membership renewal date appears in the upper right corner of the label.



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