

## Quandaries and Queries: A mathematics question and answer service

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**Abstract** In September of 1995 three faculty members in Mathematics and Mathematics Education at the University of Regina in Western Canada created an Internet facility called Math Central <http://MathCentral.uregina.ca/>. The purpose was to provide a collection of services for students and teachers in mathematics from Kindergarten to grade 12. These services include the Resource Room, a searchable collection of teaching resources; Teacher Talk, a mailing list for teachers; a problem of the month; and much more. One of these services, called Quandaries and Queries, is a mathematics question and answer service, which operates in both English and French. This paper contains a brief overview of Quandaries and Queries, an outline of the technology used to deliver the service and a sample of the questions received and problems encountered. An unexpected source of questions has been people who are not in the educational system. Questions from business people, researchers and the general public demonstrate a use of Internet technology in mathematics education and learning, well beyond the point when formal education is finished.

### Introduction

The Quandaries and Queries questions and answers are stored in a database, which is accessible over the Internet through a web browser. The database can be searched by keyword or author. The decision was taken to use the web rather than electronic mail to answer the questions partly due to the nature of mathematics. Much of the communication in mathematics uses special notation and diagrams and the web allows for the inclusion of mathematical notation and diagrams.

Questions are sent to Quandaries and Queries either by electronic mail or by using a form on the Math Central website. These questions are automatically forwarded to a group of teachers, and university faculty and students, called the Quandaries and Queries consultants. Any of the consultants who wish to contribute to the answer to a question send their contributions to the administrator who formulates a response, posts it in the database and sends an email message indicating to the questioner how to locate the response. The technologies used are webserver software, mailing list software, a database and the necessary software to have them function together.

When this service began there were five consultants. The list of consultants has changed in composition and grown to now include fifteen people. A variety of expertises is extremely valuable as questions come from many areas, many requiring expertise in mathematics but some requiring an answer from an experienced teacher or counselor. To aid in addressing questions where we do not have the required expertise we have entered into an arrangement with the Virtual Reference Desk <http://www.vrd.org/>, a project dedicated to the advancement of digital reference and the creation and operation of human-mediated, Internet-based information services. It is sponsored by the United States Department of Education and the White House Office of Science and Technology Policy. We forward to them questions that we lack the competence to answer. These are usually scientific questions or questions concerning disabilities or learning styles. In return the Virtual Reference Desk sends us mathematical questions they receive but are unable to answer.

### Questions received:

We receive mathematically interesting questions from both teachers and students. Some come from class assignments and some from their own mathematical curiosity.

(The bulleted items below are a sample of questions sent to Quandaries and Queries. Only minor editing has been performed. The questions and our responses can be seen by going to

Math Central, <http://MathCentral.uregina.ca/>, and searching in the Quandaries and Queries section using the appropriate keyword.)

- A man goes out in time between 5 and 6 and when he comes back he observes that two hands have interchanged position. Find when the man did go out? [**Keyword**: clock]
- My name is Steven, I am 11 years old and in grade 6. In math we were finding the number of diagonals in a polygon. I was wondering if there was a shortcut. I fooled around with it and came up with a formula - the number of diagonals in a polygon with  $n$  sides is  $d = 2(n-3) + (n-4) + (n-5) + \dots + 3 + 2 + 1$ . Is there a way to improve this formula such as writing it in a shorter form? [**Keyword**: diagonals]
- My name is Chris and I have a math problem. I am in grade 10 but I think the question is far beyond grade 10 level. My dad got this problem while attending university and since I enjoy math he gave me this problem, which he has never found an answer to it. Here it is: There is a well and in the well there are 2 sticks one is 2 meters long the other is 3 meters long and they are opposite to each other. They are leaning against the wall of the well. The place where they touch is 1 meter of the bottom of the well. How wide is the well? [**Keyword**: well]
- Addition, subtraction and multiplications start with right most digit and proceed left, but division starts from left-most digits and goes right ... why? [**Keyword**: division]

As expected, students send us their homework assignments. In these cases we try to use Quandaries and Queries as a teaching service as well as a question and answer service. We offer hints and suggestions, we may solve one of the problems, and then encourage the students to try the other problems and ask us again if they get stuck. Homework questions also come from a parent who is helping a student. These are easier to deal with as the parent and student have worked on the problem and usually the question is focused on the precise point where the difficulty arises. . Often these questions concern areas that are new in the curriculum such as probability and statistics, problem solving or estimation.

- My 5th grade son brought home a math paper, the title of which reads, Reading Stem-and-Leaf Plots...can you explain this so I can explain it to him...There is no book, his teacher just sent this practice sheet home for him to complete and I have no clue! [**Keyword**: stem-and-leaf]
- I need some help to teach my daughter the functions and the techniques involved in solving histograms. She is in the 7th grade and is in a prealgebra class. [**Keyword**: histogram]
- Hope you can help !!!! my daughter is in the 4th grade.. she has brought home a homework paper and the subject is problem solving. she does not understand what is expected of her. I have tried to help, but I do not understand either. She is to use the Guess and check Strategy. [**Keyword**: guess]

Another type of questions we receive from students concern research projects. These commonly involve projects for Science Fairs but also teachers have begun directing students to use World Wide Web as they would any other information resource.

- Can you please tell me names of at least five female math teachers who changed history back then? [**Keyword**: women]
- What are some ways that we use the Pythagorean theorem in jobs, or even in everyday life? [**Keyword**: Pythagorean theorem]
- I am a 7th grade student and need to find the answer to this question. The length of a meter has been determined in three different ways. The first and original way was determined in

1798. The second way was determined in 1960. The third and current way was determined in 1983. What were the three ways and why were the first two abandoned? [**Keyword**: meter]

Teachers' questions often concern finding resources or different ways do present the material. Again their questions often come from areas that are new in the curriculum such as probability and statistics or estimation.

- Does the word "random" have a technical meaning in mathematics? [**Keyword**: random]
- I am looking for a proof for the normal distribution. I suppose "proof" was not a good choice of words. What I am looking for is a way to "derive" the normal distribution in simple terms so that the most average teenager can see the logic. Can you help me? [**Keyword**: normal distribution]

Some questions come up many times.

- Why is the slope of a line is designated by the letter m? [**Keyword**: slope]
- Is 1.9 repeating the same as 2? [**Keyword**: repeating decimal]
- How do you calculate a square root? [**Keyword**: square root]

Another source of questions is homeschoolers. Again the requests come from both students and parents. Most often the questions arise from problems that neither the student nor the parent can solve. More disturbing are the questions from homeschoolers where the mathematical topics are clearly well beyond the competence of the parent. In these situations we try to point out the importance of mathematics in the education of their children and suggest strongly that they find a tutor or some other form of extra help.

An unexpected source of questions has been people who are not in the educational system. Some of these come from intellectual curiosity or mathematics problems that arise in everyday situations.

- Please help with a problem presented in Parade magazine by Marilyn Vos Savant. Two ferry boats leave from opposite shores. One is faster than the other. They meet 720 yards from the nearest shore. They proceed to destination and upon returning they meet 400 yards from the other shore. What is the exact width of the river. The answer is 1,760 yards. Why? [**Keyword**: boats]
- I'm having a problem scheduling matches for a golf vacation. We have 12 people playing 7 rounds of golf in 7 days. We play 2 man teams vs. 2 man teams every day. Is there a formula so that you play WITH a different partner everyday and AGAINST as many different people as possible? [**Keyword**: golf]

Some come from the business or occupational world where people have serious mathematical questions that arise in their work.

- I have a roll of paper, wrapped around a corrugate core, whos diameter is 10.750 in. The outer diameter of the roll is approx. 60 in. The thickness of the paper is .014 in. I am trying to find out how much linear feet of paper is left on the roll, given only the diameter of paper remaining on the core. [**Keyword**: paper]
- If I want to put a lining in a chute that is cone shaped, how do I calculate the size steel plate I need to do that. The cone is 10' in diameter at the top and has a 20" hole at the bottom. The total height of the chute is 8'. [**Keyword**: cone]
- I'm a contractor and need to estimate how much time it will take me to do a specific job. A previous job I did was 6,480.16 Square Feet and I was able to paint it in 31.5 hours. In estimating my next job, how many hours will it take me to paint 11,000 Square Feet. [**Keyword**: estimation]

Some are just surprising.

- If sales for jan 2001 are 154 vs 105 for 2000 - the increase total presented to my office is +46% - how does that compute. Please give me the equation. I am a middle aged business man. [**Keyword:** percent]
- This is very embarrassing but since math and specifically percentages was my worst subject in school here goes. If I have a figure such as 425 and that amount represents 10% of the total amount how do I find out what the total amount is? [**Keyword:** percent]

**Problems and challenges:**

We have faced and continue to face a number of problems and challenges in operating, administrating and maintaining Quandaries and Queries. There is a bottleneck in the process that is caused by the questions and responses being posted by one person. The volume has reached the point where it is becoming difficult to keep up with the questions we receive and we are currently seeking support to hire a part-time student to help relieve some of the load.

Additionally, we would like to have more teachers on the list of consultants. Most of the consultants are university faculty and many questions need input from a classroom teacher.

The largest problem we face is spam. Approximately 25% of the electronic mail that comes to Quandaries and Queries is spam. The mailing list software includes an obscenity filter that blocks some of the unwanted mail but everything that passes through this filter is forwarded to the consultants. The only effective way to deal with this mail would be to have it screened by a real person before it is forwarded.

In the past five years the Internet has seen the growth of a great variety of sites which are sometimes called Expert Services. Some, like Quandaries and Queries, are subject specific; for example the ESL Help Center <http://www.eslcafe.com>, Ask a Scientist <http://is.dal.ca/~stanet/index.html> and Ask Dr. Math <http://www.vrd.org/locator/sites/dmath.shtml>. Others are more generic such as AskERIC <http://www.askeric.com/>, The Internet Public Library <http://www.ipl.org/> and the Virtual Reference Desk <http://www.vrd.org/>. They provide a resource of individuals and agencies with recognized credentials which can answer questions and give advise. Quandaries and Queries offers a valuable Expert Service for students, teachers and users of mathematics. It seems to be the only such mathematics service where the questions and answers are stored in a searchable database. When a questioner is directed to a response it is through a use the database search procedure and hence the questioner gains some experience with the operation of Quandaries and Queries. We know through comments from teachers and students that they use the site in this way, searching the database for problems that are similar to problems they have. Quandaries and Queries provides a venue where real people with real problems can ask questions, sometime anonymously and sometimes from outside the education system, and receive reliable, non-threatening response from experts in the field.