

# Creativity in math? Say it isn't so!

## Building data literacy in high schools

Joel Yan,  
Tom Steinke and  
Marie Brazeau

*What could creativity and math possibly have to do with each other? Ask Marie Brazeau and her Grade 10 Academic Mathematics class at St Pius X High School in Ottawa!*

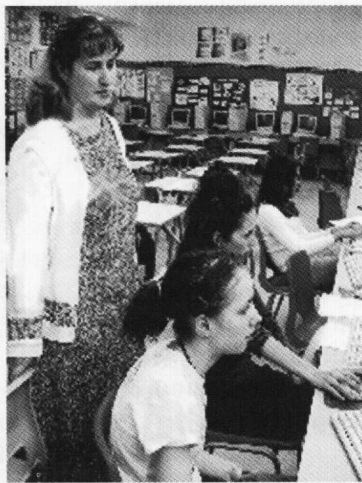
The students in Mrs. Brazeau's class explored data on topics that interested them, such as beer production and working mothers, in order to model data relationships using quadratic and linear functions. They discovered that mathematical equations can actually apply to the real world, help model past behaviour and predict future trends.

Mrs. Brazeau teamed up with Joel Yan of Statistics Canada and Tom Steinke of the Educational Programs Department of the Ottawa Carleton Catholic School

Board. Together, they developed and piloted an innovative approach to data-driven learning in math, while encouraging the students to compete for a creativity award.

How did the new approach work? Students first learned the basic math behind linear and quadratic functions and relationships from their math teacher. Next, in the computer lab, they were introduced to the content of the Statistics Canada website and learned the basics of using an analytical graphics software package, in this case, Fathom's *Dynamic Statistics Software*. With this basic training in hand, students started selecting topics that interested them and searching for relevant data on the StatCan website, principally through E-STAT<sup>1</sup>. Mrs. Brazeau prepared a performance task rubric to guide students in their data exploration. To add incentive, a non-traditional 'math contest' was initiated. The students with the most creative analysis and results would be selected as winners.

The project was carried out over a two-week period. Students were given approximately five periods of 75 minutes to work on the project in class,



*Mrs. Brazeau helps her students find data for their projects.*

including some half periods here and there as time permitted. The timeline in the "Stats-R-Us" rubric provided deadlines for formative evaluations of the project.

Students were to organize their data exploration and analysis around the following

headings:

- reasons for choosing this issue.
- their hypothesis.
- the data used.
- their findings about how the data could be modelled, including mathematical relationships discovered and the actual equations describing the relationships.
- predictions of future trends.
- conclusions and questions for further analysis.

Using Statistics Canada data, the

students indicated their wide-ranging interests by choosing topics that included:

- college enrolment and employed individuals.
- girls who feel the need to lose weight vs. boys who feel the need to lose weight.
- motor vehicle traffic deaths in Canada vs. the number of Canadian using a seatbelt.
- marriages versus births.

- youth employment versus youth crime (does employment decrease crime?).
- divorce rate and family income and how these affect the size of families in Canada.
- homicide rate in Canada vs. the most prevalent method of homicide, shooting.

Not all the students chose to use Statistics Canada data. Several students used other statistical databases for their projects, which included topics such as:

- coffee bean production and coffee use.
- hockey statistics: Paul Kariya and Teemu Selanne of the Anaheim Mighty Ducks.

How well did it work? For the Grade 10 students of St. Pius X, this project was their first step into the world of data-driven learning. Marie Brazeau remarked that this type of project environment was better suited to some students who performed poorly in a more traditional theoretical math setting that used more Socratic teaching methods and emphasized the drilling of concepts. In this new data-driven environment, such students were understanding concepts and methods faster and sometimes even better than students who had significantly higher results.

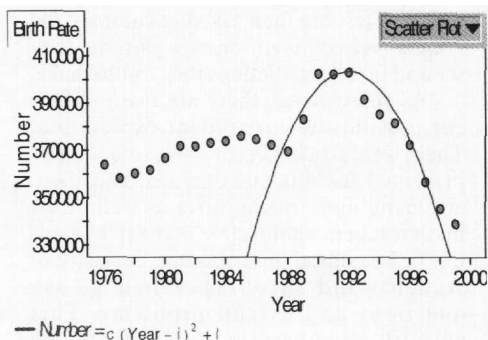
Students were very motivated to work on this project. Some participating students were so excited about it that they obtained permission to miss their physical education



activities to stay in the math class working on their project. Several students in other math classes taught by Mrs. Brazeau not involved in the project told her that they wanted to be part of this project too.

After the two-week period, the students presented a number of creative, high quality projects. A surprising number of students found relationships that could be well modeled by quadratic functions. Through doing these projects, students learned about real life applications of quadratic and linear functions and their role in modeling past behaviour and predicting future trends. It was difficult to select only three winners, but we selected the following students for a Mathematics Creativity Award: Ewa Kisilewicz, Mario Rizzo and Michael Brunet.

Ewa Kisilewicz used data from E-STAT to look at the relationship between women with full-time jobs and the incidence of childbirth in Canada between 1976 and 1999. Her model supported her hypothesis that with an increase of women working full-time, birth rates would decrease. She also found that the baby boom echo could be closely modeled by a parabola (see graph).

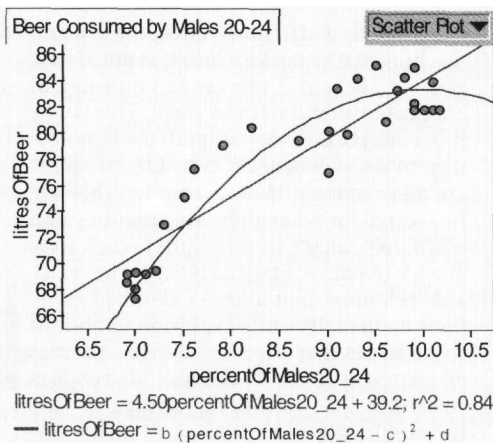


Mario Rizzo used data from E-STAT to look at the relationship between annual beer production, annual consumption per capita, and the percent of the population which are males 20 to 24 in Canada for the time period 1971 to 2000. With his model he concluded that there is a correlation between



Mr. Swords, the principal of St. Pius X H.S. presents the creativity award to Mario Rizzo, one of the 3 winners.

average beer consumption among Canadians and the percentage of males 20 to 24 years of age in the total population, as shown in the graph below. However, there was not a similar correlation between average beer consumption and the percentage of males of other age cohorts.



Michael Brunet used hockey statistics to look at the performance of Paul Kariya and Teemu Selanne of the Anaheim Mighty Ducks. With his model he proved that each player performed better when together than when apart and also that hockey statistics over a career can often be well modeled by a parabola reflecting the development, peaking and decline of skills with age.

**Comments from the teacher, Marie Brazeau;**

- It is unusual to give so much discretion to grade 10 math students. Most of the students were excited about being able to choose a topic of their own interest. However a few students needed help and wanted to be directed to a topic where they could (easily) find a relationship to model.
- As a teacher I had to provide general guidance (macro-manage) rather than micro-managing a specific lesson or exercise.
- It was helpful to have access to a specialist from StatCanada at the beginning of this project.
- The student learning and project work was interdisciplinary and covered not just math, but also technology, social sciences and family studies.

**Comments from the Statistics Canada facilitator, Joel Yan;**

- It was very important to provide a proper context for the data exploration

by the students. At first we went too quickly into using the massive E-STAT database. We found that most students lacked an overall understanding of the types of information they could find there. This led to some frustration at the beginning. Hence, in the second class we followed a structured orientation to the available information by:

1. Reviewing the Canada at a Glance booklet as an easy guide to the type of information available from Statistics Canada.
2. Reviewing Canadian Statistics tables on [www.statcan.ca](http://www.statcan.ca) to see the types of data included; these tables also contain specific links to the more detailed tables on E-STAT and CANSIM.
3. Showing students how to find (hundreds of) free articles on the site, in both The Daily and E-STAT, which provide textual overviews of the relationships and trends that students could explore using detailed data.

- A few students were not clear on some statistical concepts, such as the difference between an absolute number, and a rate. (e.g. the number of murders and the murder rate per 100,000 population). It is important to provide this type of clarification up-front.

- I found it very useful to see what topics were of interest to students and it was very rewarding to help students find data that helped them start their data exploration. Based on the projects of interest observed among these and other students, STC is starting to develop a collection of project ideas for student exploration and analysis in math. The plan is to load this on the students' page on the STC Learning resources website at [www.statcan.ca/english/edu/students.htm](http://www.statcan.ca/english/edu/students.htm)

The Ottawa Carleton Catholic School Board, Mrs. Brazeau and her students are real pioneers in this exciting new approach to bringing learning to life in our math classrooms. This type of project will become more and more common in schools across Canada, beginning with the new grade 12 Mathematics of Data Management course offered in Ontario for the first time in September, 2002. Students will be required to undertake a major data analysis project, using a large statistical dataset. E-STAT's rich source of online data at <http://estat.statcan.ca> is an ideal source to support students in such

independent explorations of topics that engage them.  
Watch for more creativity coming to a math class near you! ✦

Tom Steinke is secondary mathematics and science advisor for the Ottawa Carleton Catholic District School Board.

Joel Yan has worked with teachers and professors for ten years as part of the Learning resources team at Statistics Canada in Ottawa.

Marie Brazeau is the Mathematics and Business Studies Department Head at St. Pius X High School in the Ottawa Carleton Catholic School Board.

### Note on the analytical software

Ontario teacher librarians, please note that Fathom's *Dynamic Statistics Software* ([www.keypress.com](http://www.keypress.com)) has been licensed and shipped by the Ontario Ministry of Education to all publicly funded schools in the province. The Fathom CD-ROM contains a folder of Statistics Canada data, which include micro-data from the General Social Survey and the National Longitudinal Survey on Children and Youth, as well as extensive documentation on how to use them.

The Fathom tool is very visual and makes statistical analysis a fun activity. New analytical software tools like this one will enable teacher-librarians, students and teachers to model, graph and manipulate data more easily than ever before. A free demo of Fathom can be downloaded at [www.keypress.com/fathom/demo.html](http://www.keypress.com/fathom/demo.html)

<sup>1</sup> E-STAT is a huge database of statistical data provided free by Statistics Canada for Canadian schools at <http://estat.statcan.ca>.

# Applying math to real life

*One of the most important challenges of a teacher is to make the material s/he is teaching meaningful and relevant for the students.*

This is a difficult challenge when teaching mathematics, since it is not always easy to show the relevance or practical application of the math we teach. This is why it is so important that we grab the opportunity to do so whenever possible. Students are more motivated to learn when they are interested in what they are learning and when they can see its relevance to their lives outside of school. Statistics Canada has valuable resources that allow students to apply their math skills while exploring important social issues that affect Canadians. There is no reason why all teachers of all subjects should not be taking advantage of this incredible resource. Statistics Canada has made much of their data available for free for all Canadian educational institutions. Teachers and students can access census data and data collected from Statistics Canada surveys using E-STAT, Statistics Canada's educational research tool. Students can use E-STAT to learn how to handle and interpret data so that they can develop a deeper understanding of issues that concern them. The Statistics Canada website may seem quite overwhelming for a first time user; however, it is amazing how easy and straightforward it is to use with some simple instructions. See [www.statcan.ca](http://www.statcan.ca). *First visit to our site?*

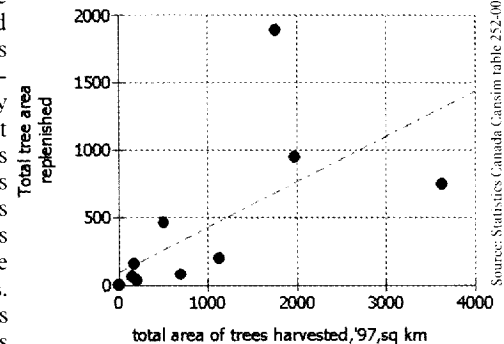
### An Activity for Students Using Environment Data

Under the E-STAT User Guides (<http://estat.statcan.ca>, *User Guides, Environmental database*), you will find a quick guide called *Analysing Relationships Using Scatter Graphs*. This is just one example of how Statistics Canada data and E-STAT can be used to raise questions and have students apply their math skills to explore issues. In this activity, the students explore statistics about tree planting and tree cutting in the provinces of Canada. The activity has six parts. In the first part, the students are asked to use different graphical forms to compare the tree cutting practices in the different provinces. Then they are asked to create a table showing the tree cutting and planting for each province.

In the third part they are asked to create a scatter plot for tree cutting versus tree planting. They are asked questions about the graph and the line of best fit that require them to look at the graph in a real life context and communicate the mathematical terms they have learned in the context of the problem. The fourth part looks at outliers. The students are asked to remove certain provinces from the graph and look at how the graph and line of best

fit is affected. In part five they are asked to compare the scatter graphs for two different years. And in the last part they are asked

### Area of trees harvested and replenished, 1997



to graph, by hand, the area of trees planted for two different provinces over a six-year period. They are then asked to compare the graphs and comment on any patterns they see and future predictions they would make.

As you can see, there are many different possibilities for student exploration. There were five different analysis activities presented for this one data set, and there are many more possibilities as well. Most math teachers would agree that a rich learning task is one that sparks the curiosity of students and encourages them to ask questions and extend problems. This activity demonstrates to students the opportunities for exploring mathematical ideas in the real world. Students will learn the importance of finding reliable data and representing it clearly, since there are many ways that incorrect messages can be sent with graphs. Students should be able to look at graphs and understand their meaning in a real life context. It is amazing how math concepts (i.e. slope, intercepts etc.) become much more clear to students when they can tie them to something that is familiar and meaningful to them. Students will also learn the importance of graphing and pattern analysis for predicting future outcomes. It is much easier to motivate students when they see the value of the tasks they are being asked to perform. ✦

*The scatter graph activity was developed by Michelle Classen in collaboration with Joel Yan, Coordinator, University Liaison Program at Statistics Canada, during her alternative practicum for her Bachelor of Education at Queens University. Michelle has just completed her B.Ed. with Mathematics and Computer Science teachable subjects and is currently finishing her B.Math at the University of Waterloo. Email: mickiclassen@hotmail.com*



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