Calculus $11 \times 11 \times 11$

Dr. Pamini Thangarajah (Mount Royal University),
Manny Estabrooks(Red Deer College),
Tiina Hohn (Grant MacEwan University)
Dr. Peter Zvengrowski (University of Calgary)
Dr. Bill Hackborn (University of Alberta Augustana Campus)

November 11-13, 2011

1 Overview of the workshop

During the May 2011 North-South Dialogue Meeting and the Alberta College Conference ongoing issues concerning introductory calculus were discussed. It was apparent that there were many common issues facing post secondary institutions in Alberta, and an initiative to organize a meeting at the Banff International Research Station (BIRS) was undertaken. Some of the challenges arising:

- Concern about standards varying from instructor to instructor and institution to institution both with regards to curriculum and assessment.
- Perceived pressure on mathematics departments and individual mathematics faculty both by administration and other departments to meet some success rate in the introductory calculus classes.
- Questioning of the value of calculus and its aims by other departments and administration.
- Stress and anxiety felt by students who are taking or are planning to take Introductory Calculus.

There is need for leadership in the province in meeting these challenges in the age of technology and the prevalence of the internet. Related to these issues mentioned above is the notion of where technology fits, what should be the role of the calculator in a calculus course, what role does/can/should the internet play in addressing some of the issues outlined above. The plan was to address many of these outstanding issues in a coordinated way and consequently increase the student satisfaction and success rates at the various institutions in their introductory calculus courses.

The outcome of all this was the 2-day workshop "Calculus $11 \times 11 \times 11$," held November 11-13, 2011, at the BIRS. All six Alberta universities were present and many of the Alberta post secondary colleges, plus one college from BC. The primary focus was the teaching of calculus in the high schools, colleges, and universities in Alberta. It also included representatives from Alberta Education, and two students who presented valuable insights from their point of view.

2 Objectives

The objectives of this workshop were to identify all the common challenges faced by Alberta post secondary institutions with regards to their introductory calculus courses and look for common solutions. Ideally partic-

ipants would leave with a summary document to be disseminated among all the participating post secondary institutions. Consequently, some of the principal items for discussion were:

- Decide if a common core curriculum is needed and if so what is it going to be.
- Decide whether it is appropriate to have common assessment criteria and if so what the criteria should be.
- Decide on the role of technology in calculus.

Introductory Calculus is an important course both to students and post secondary institutions, and is taken by many thousands of students in Alberta every semester. Any improvements that can be made should be made. This has been studied throughout the years (for example see [1], [2]). British Columbia has had a core calculus curriculum document [3] for several years now; it is both timely and relevant that we consider this approach as well.

3 Presentation Highlights

The workshop was started Friday Nov. 11 at 6:30 pm with a splendid presentation from representatives from University of Alberta. On Saturday morning presentations from Alberta Education about the new high school curriculum were given. Saturday afternoon reports from all the other institutions present regarding calculus: #Sections, success rates, tests & exams, assignments, use of calculators, on-line usage, marking schemes, common tests/exams, diagnostic tests, pre-calculus review efforts etc. Also, Cathleen Sullivan from Pearson Canada discussed the correlation between instructors' attitudes and students' performance (MAA survey 2010, David at UBC, 212 post-secondary institutes in US), and the use of technology for assignments.

4 Progress Made

Sunday was spent addressing several issues including: i) a Calculus stream for commerce & social sciences, ii) assessment & diagnostic instruments & how we might share these, iii) various other issues identified during the previous session. We outlined a plan for the development of a document on our 'findings' (see Section 5 below).

5 Outcome of the Meeting

A document about the meeting and the recommendations it arrived at is being produced, and should hopefully appear by February 2012. We are hoping to organize a future workshop to update and finalize this document.

6 List of Participants

Aiffa, Mohammed (University of Calgary)
Chanasyk, Donna (Edmonton Highschools(Paul Kane High School))
Chisholm, Sarah (University of Calgary)
Connolly, Dennis (University of Lethbridge)
Davis, Tyler (Univerity of Calgary)
de Vries, Gerda (University of Alberta)
Estabrooks, Manny (Red Deer College)
Freed, Bill (Concordia University College)
Gale, Susan (Memorial Composite High School)
Hackborn, Bill (University of Alberta, Augustana campus)
Henzel, Christine (Alberta Education)
Hlede, Tony (Alberta Education)
Hohn, Tiina (Grant MacEwan University)
Kooistra, Remkes (The Kings University College)
Martinig, April (University of Calgary)
McNeilly, David (University of Alberta)
Nosal, Eva (PIMS, University of Calgary)
Peschke, Julie (University of Athabasca)
Roettger, Eric (Mount Royal University)
Sullivan, Cathleen (Pearsons)
Thangarajah, Pamini (Mount Royal University)
Tomoda, Satoshi (Okanagan College, BC)
Torres, Maria (University of Athabasca)
Zvengrowski, Peter (University of Calgary)

References

[1] Michel Helfgott, *Can we do something to improve the teaching of first-year calculus?*, http://www.icme-organisers.dk/tsg12/papers/helfgott-tsg12.pdf.

[2] C.C. MacDUFFEE, *Objectives in Calculus*, American Mathematical Monthly,vol.54(1947),pp.335-337

[3] *First-Year Core Calculus*,British Columbia Council on Admissions and Transfer, (2002) http://www.bccat.ca/pubs/calculus.pdf