



Faculty of Science

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MEETING OF THE FACULTY COUNCIL OF THE FACULTY OF SCIENCE

A regular meeting of the Faculty Council of the Faculty of Science will be held on Wednesday, June 19, at 1:00 p.m. by WebEx.

AGENDA

1. **Regrets**
2. **Adoption of the Minutes of April 24, 2024** (pages 2-17)
3. **Business Arising from the Minutes**
4. **Correspondence:** No Correspondence
5. **Reports of Standing Committees:**
 - A. **Undergraduate Studies Committee:**

Presented by Shannon Sullivan, Chair, Undergraduate Studies Committee,

 - a) Department of Mathematics and Statistics – Calendar changes, amended courses MATH 1050 and 1051, Paper 5 A. a. (pages 18-26)
 - b) Department of Mathematics and Statistics - Calendar changes, amended courses MATH 1000, MATH 1005, MATH 1006, MATH 1090, MATH 109A and 109B, Paper 5.A.b. (pages 27-36)
 - c) Department of Mathematics and Statistics - Calendar changes, new course: MATH 4342, Paper 5.A.c. (pages 37-42)
 - B. **Graduate Studies Committee:**

Presented by Adrian Fiech, Chair, Graduate Studies Committee

 - a) Department of Physics and Physical Oceanography – Special Topics Graduate Course, PHYS 6061 approved by the Faculty Council Graduate Studies Committee and presented to Faculty Council for information only. Paper 5.B.a. (pages 43-49)
 - b) Department of Mathematics and Statistics – Calendar Changes, amendments in 32.17.2 Specific Requirements for the M.Sc. in statistics 5.B.b. (page 51)
 - c) Department of Mathematics and Statistics – Calendar Changes, amendments for 44.29.5.2 Statistics Paper 5.B.c. (page 52)
 - C. **Library Committee:** No business
6. **Report of the Dean:**
7. **Question Period**
8. **Adjournment**

Travis Fridgen, Ph.D.
Interim Dean of Science



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**FACULTY OF SCIENCE
FACULTY COUNCIL OF SCIENCE
Minutes of Meeting of April 24, 2024**

A meeting of the Faculty Council of the Faculty of Science was held on Wednesday, April 24, 2024 at 1:00 p.m. using a hybrid model of WebEx and in-person (C-2045).

FSC 3067 Present

Biochemistry

R. Bertolo, J. Brunton

Biology

M. Rise, Y. Wiersma

Chemistry

S. Pansare, S. Smith, M. Katz, N. Ryan, H. Therien-Aubin

Computer Science

S. Bungay, A. Fiech, M. Hatcher, J. Henderson, C. Hyde, O. Meruvia, L. Peña-Castillo, T. Tricco

Earth Science

K. Welford, P. Morrill

Mathematics & Statistics

J. Alam, I. Booth, D. Dyer, C. Evans, R. Haynes, J.C. Loredó-Osti, T. Stuckless, S. Sullivan

Ocean Sciences

D. Inkpen, P. Gagnon, C. Parrish, M. Roche, J. Santander, J. Wroblewski

Physics & Physical Oceanography

D. Coombs, M. Evstigneev, E. Hayden, H. Neilson, I. Saika-Voivod, L. Zedel

Psychology

S. Blandford, D. Hallett, K. Hourihan, A. Swift-Gallant, C. Thorpe

Dean of Science Office

J. Blundell, J. Bowering, S. Dufour, M. Fitzpatrick, T. Fridgen, S. Garasym, C. Hussey, G. Jackson, J. Kavanagh, P. MacCallum, J. Major, R. Newhook, D. Nichols, C. Sullivan

Student Representatives

S. Douglas, A. Ullah

Regrets

A. Chaulk

FSC 3068

Adoption of Minutes

Moved: Minutes of the meeting of February 21, 2024, be adopted.
(Bungay/Loredo-Osti) **Carried.**

FSC 3069

Business Arising: No Business

FSC 3070

Correspondence: No Report

FSC 3071

Reports of Standing Committees:

A.

Undergraduate Studies Committee:

Presented by Shannon Sullivan, Chair, Undergraduate Studies Committee

a) Department of Earth Sciences – Calendar Changes, amended program,
(Sullivan/Morrill) **Carried.**

b) Department of Earth Sciences- Calendar changes, EASC 2906, New course
proposal, (Sullivan/Morrill) **Carried.**

B.

Graduate Studies Committee:

Presented by Adrian Fiech, Chair, Graduate Studies Committee

a) Department of Computer Science - Calendar Changes (MSc), New
regulations: Program requirements, Consistent regulation regarding program
termination, removing the Work-term route, adding two new courses for
approval – COMP 611W and COMP 612W, (Fiech/Bungay) **Carried.**

C.

Library Committee: No business

FSC 3072

Report of Dean:

SEA Conference

The SEA Conference was a huge success! Many thanks to the many volunteers, judges, and presenters. There were nearly 350 registrants, and more than 150 oral and poster presentations. With support from the VPR, SGS, FoS, and our industry partners, I'm thrilled to announce that we were able to give out 45 student awards! If you have feedback as to how we can make the SEA conference even better, please email sciencegrants@mun.ca.

NSERC Results

The faculty was very successful with NSERC this round. While the university had a 69% success rate, the Faculty of Science had a success rate of over 80%, including early career applicants. I want to restate a message from last year, that while on a yearly basis early career funding rates are low relative to established researchers, within the first three years the funding rates are 90% for ECEs. So, if you were not funded this year, learn from the reviews, get advice from colleagues, our GFOs, and have hope for next year!

Budget

Dr. Fridgen presented a Power Point presentation to the members of Faculty Council. (Attached)

FSC 3073 Question Period:

Dr. Haynes asked what Core Research IT personnel is in the Faculty of Science. The Dean clarified that Science and IT support are collaborating on a model that would be centralized research IT support staff that would service all Science departments.

Regarding funding for Health and Safety lab personnel mentioned in the budget, Dr. Haynes suggested this be a shared position with other faculties.

Is there an opportunity to increase success on grants to try to get more overhead for the Faculty of Science from the funding portion? The Dean explained that the formula for overhead is set by the university but the split we have has allowed us to make the Grants Facilitation office positions permanent and can only be used for certain things. We don't know if it is possible to negotiate the formula however the Dean pointed out that this money also runs the VPR office who has had large cuts as well.

Dr. Neilson asked what the definition of a low enrollment course is. The Dean indicated that a low enrollment course is not easy to define but roughly has fewer than 5-10 students. The Dean went on to explain that the University Deans have

been asked why these low enrolment courses are being offered. In the near future, it is possible that faculties will have to start cancelling these courses.

Dr. Alam asked if there is a way to gain revenue. The Dean explained that it would be hard for Faculty of Science to grow our way out of budget cuts. It takes much more money than the \$650 per course to teach a student. Other Universities have funded back growth from their governments, unfortunately, Memorial does not have that support.

FSC 3074

Adjournment:

Meeting adjourned at 2:00pm.

Budget Presentation 2024



Faculty of Science

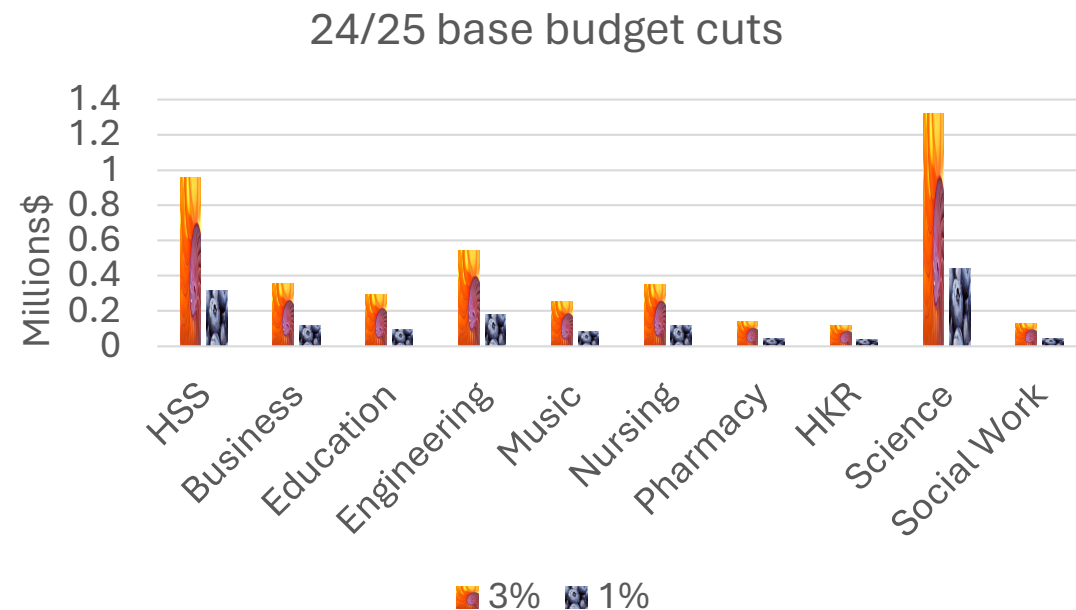
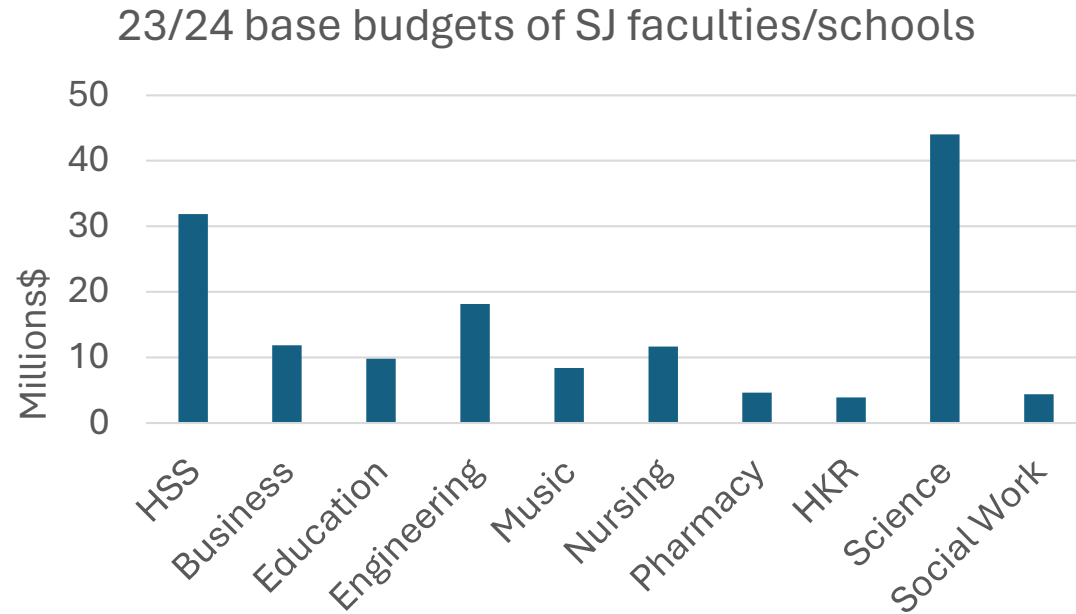
Travis Fridgen and Gina Jackson

\$14M cut from Memorial's operating grant last month.

“The provincial budget released today did not include any surprises for Memorial University,” said Dr. Neil Bose, president and vice-chancellor *pro tempore*. “We anticipated the decrease in our operating grant and have been planning towards that.” From the Gazette.

The government has planned a \$14M cut to Memorial for each of the next two year as well.

- **All Deans were asked to prepare for a scenario where we are given a 3% cut of our base budget = \$1.32M**



- ***“The projected tuition revenue from the Tuition Framework will not be sufficient to cover the cut to the grant.”***
- ***“Furthermore, escalating costs due to inflation will also have to be absorbed. Therefore, this strategic measure will enable us to maintain the University's financial stability and sustainability while safeguarding our commitment to academic excellence.”***
- ***“consolidation of sections and/or the phasing out low-enrolment programs”***
- ***“looking at programs or services where the demand is high but the cost of delivering them in their current form is prohibitive”***

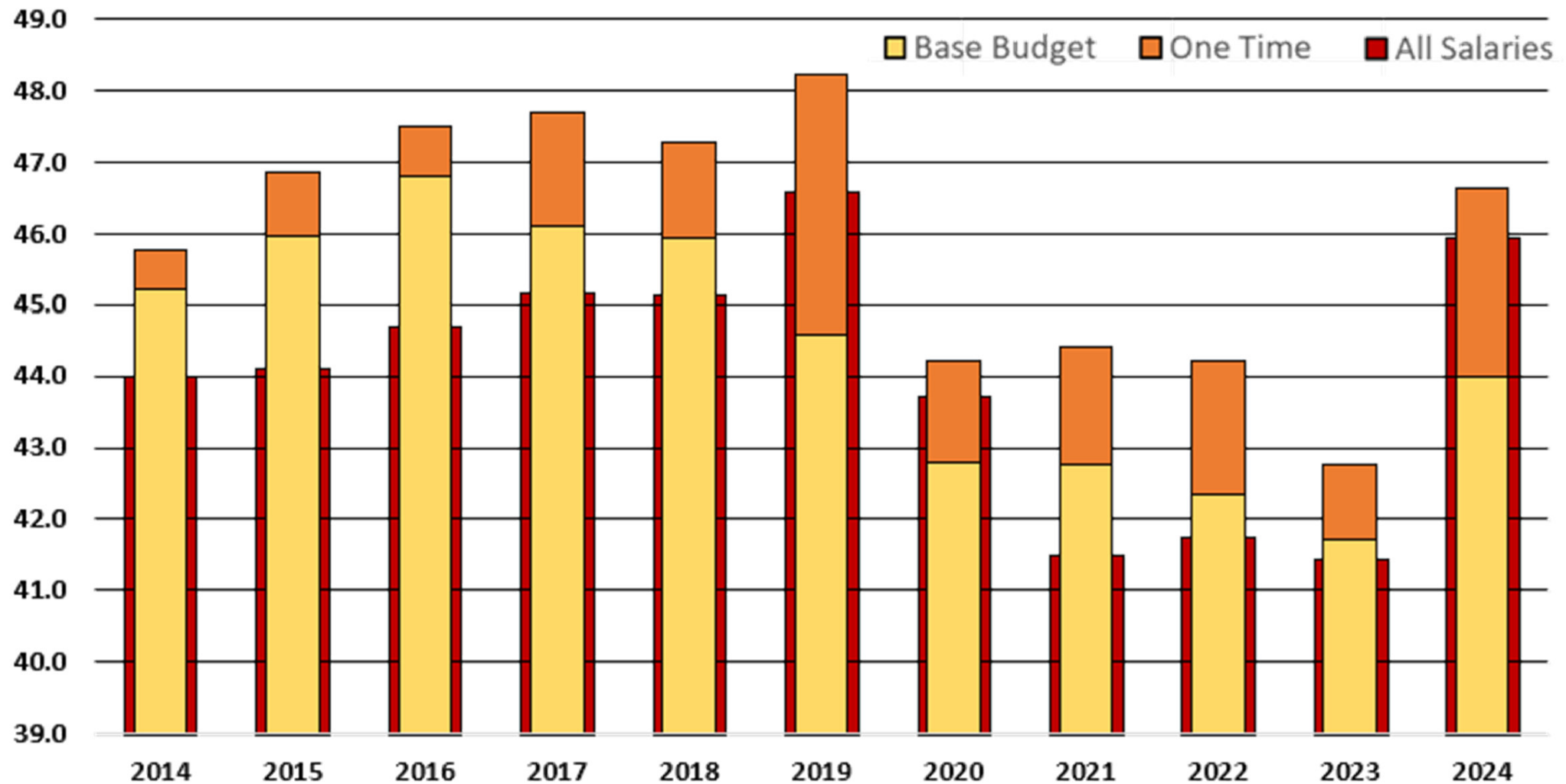
Past efficiencies to deal with >\$4M budget cuts in the last 5 years

- **administrative structures (ie. BIOC/BIOL/CHEM and others) and admin positions cut/vacant**
- **APOs, from 9 to 6, sharing between BIOL/OCSC, BIOC/CHEM, EASC/PHYS**
- **teaching/tech staff efficiencies/cuts in many departments**
- **several vacant IT positions**
- **faculty of science career advisor moved to student life (\$75K/year)**
- **seals have been relocated (100K/year)**
- **stopped funding ~\$500K in annual lab equipment requests**
- **shuttle service to OCSC reduced from >\$100K to \$50K**
- **17 vacant faculty positions (on top of cuts that occurred prior to 2020)**
- **carryover from COVID over the last few years was significant (>10%)**
 - **vacant positions, recruitment/relocation, no travel**
 - **we have been using this for the last few years to balance out budget, pay start up (no start -up line in budget), etc. but this is running out**

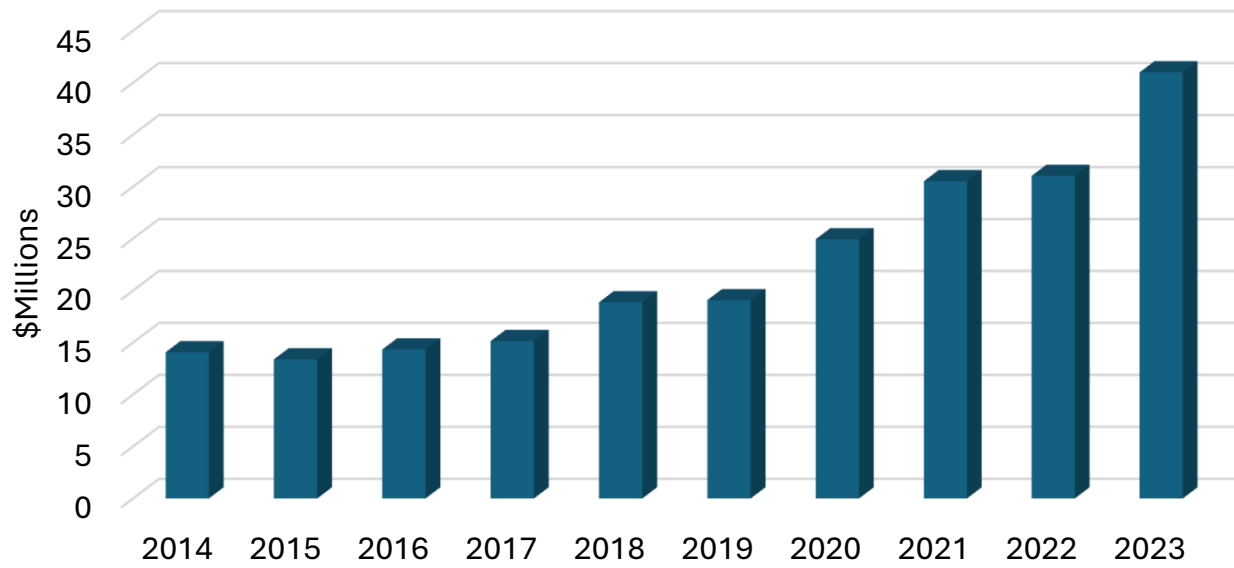
Overall Budget Requirements (Salaries and Operating)

- 3% reduction of our base budget is \$1.32 M
- \$250K shortfall in TA budget (TAUMUN increases) + LUMUN increases
- CSF (and other) costs: AV equipment, autoclaves, etc. costing ~\$100K/yr to service

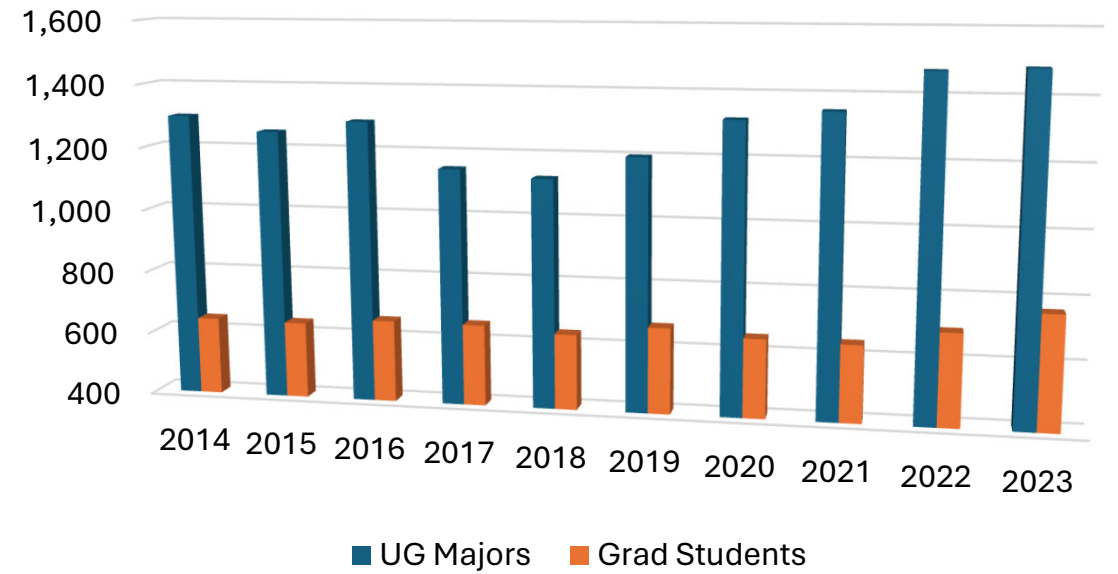
It is impossible to find \$1.32M in cuts to the FoS.



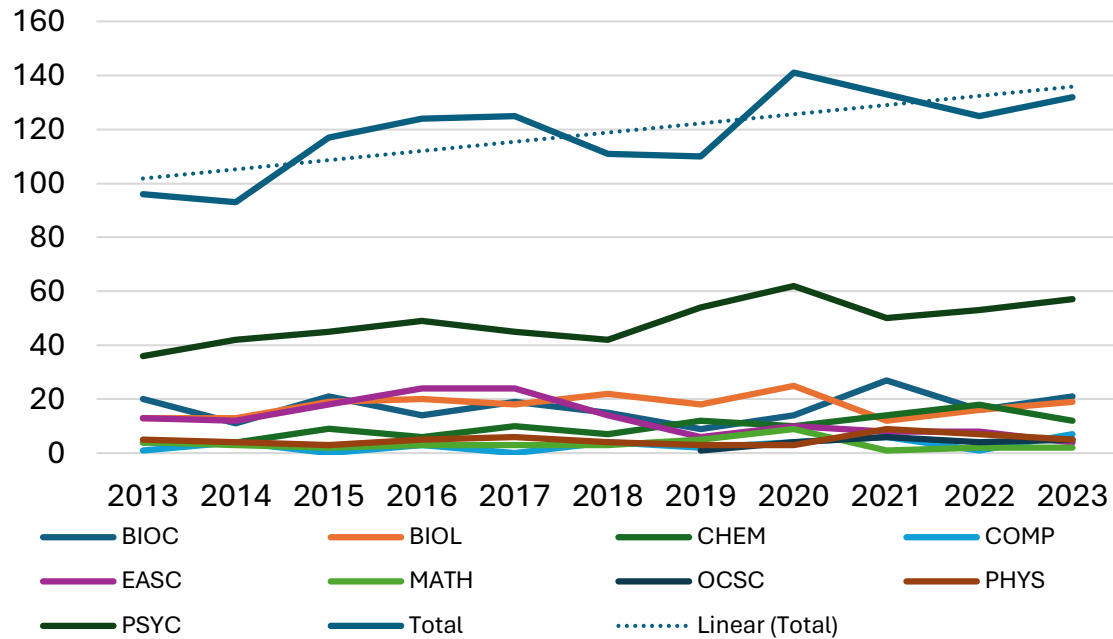
Grants/Contracts FoS



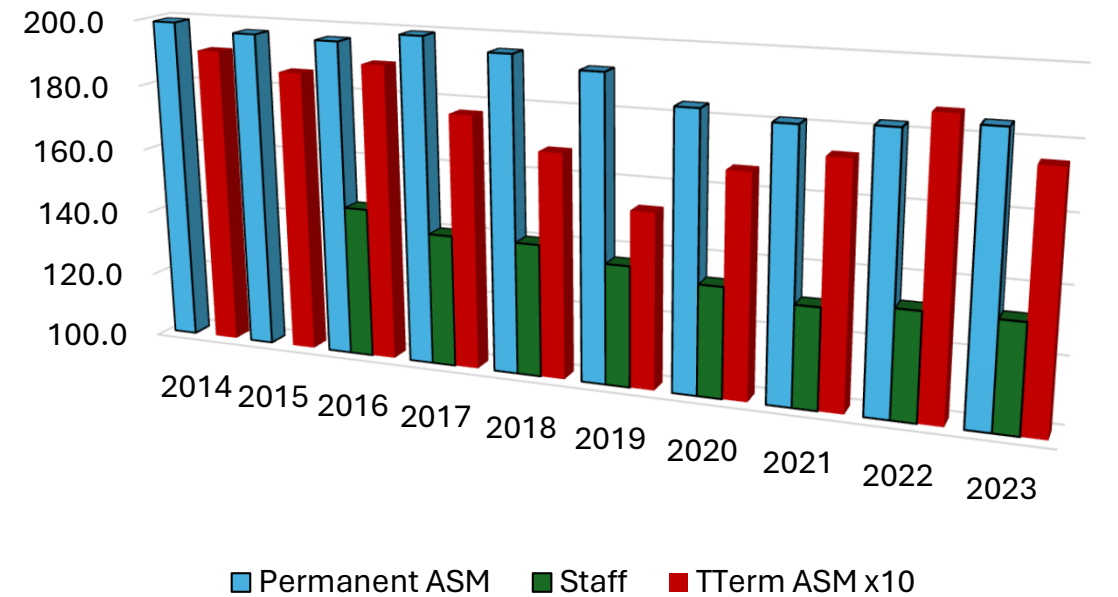
Declared Majors/Grad Students



Honours Course Enrollments



Staffing



Cuts

- ~~Contracts~~
- ~~Labs/lab sections~~

Further Efficiencies - Administration

- **Interdisciplinary courses administered through departments**
- **centralizing IT, moving some services/positions to ITS, keeping a core of research/LABNET IT to service the faculty/university**
- **combining the general offices of Computer Science and Earth Sciences**
- **potential merger of the departments of Biology and Ocean Sciences**

Investments - Administration

- **OSC Facility Director**
- **post-award grant facilitation**
- **lab demonstrator for the Psychology Department**
- **faculty of science labs health and safety position**

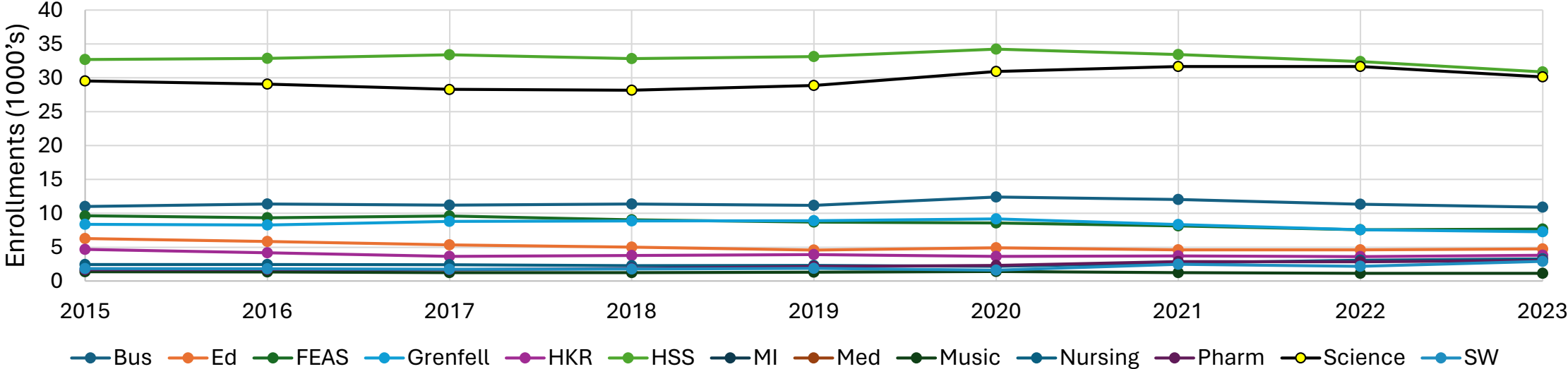
Revenue Generation

Paused

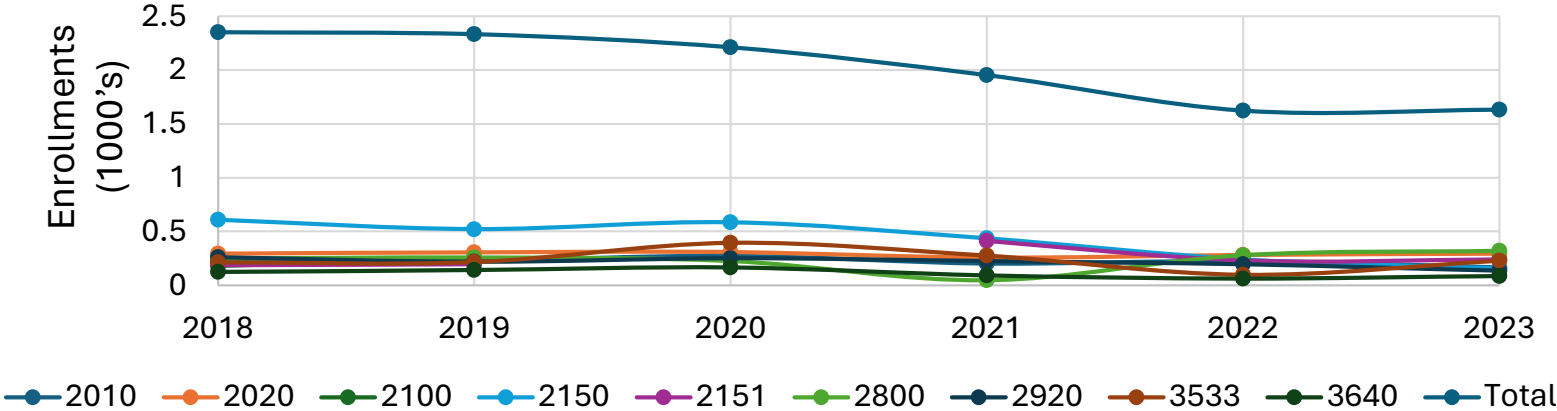
- we have requested ~\$2M to fund the PsyD program which has cohorts of 6 students per year
 - initial request was \$3M to continue to offer the program and grow it to cohorts of 10 students
 - was not announced in the March 24 budget, decision was made to pause intake for 2025
- special fees programs
 - AI and SE shared with FEAS
 - MDS*c*
 - Adding fees to MENVS (also paused as of February), PsyD (if unpaused), and our other course-based MSc programs
- add co-op to MDS*c* – as a *value-added* to attract more students
- *SciQuest* summer camps piloted this year, could generate ~\$50K per year
- considering fees for lab courses
- requesting money to cover instruction/TAs for high enrollment courses iff we bring in continuing education students (non-degree)

Revenue Generation

Total Course Enrollments by Fiscal year



High-enrolment non-major PSYC Courses

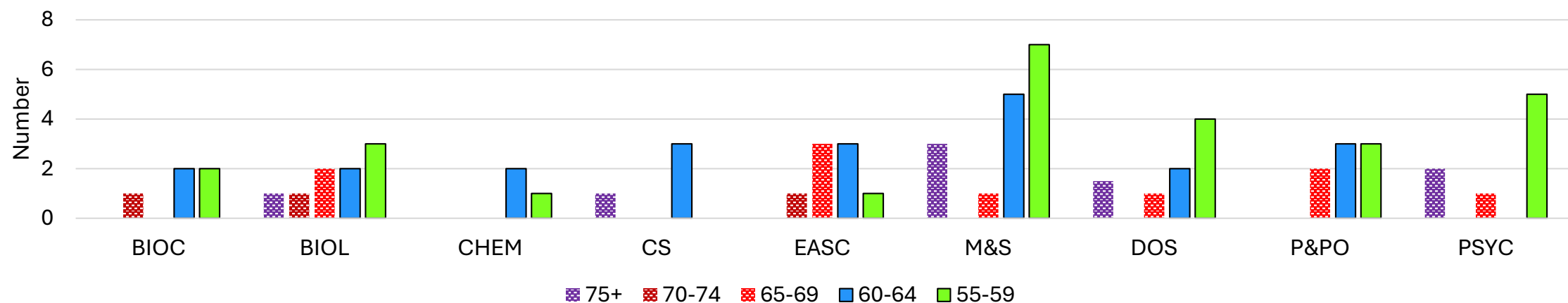


- **requesting money to cover instruction/TAs for high enrollment courses iff we bring in continuing education students (non-degree)**

Programs/People: It is *impossible* to find \$1.32M in immediate cuts to the FoS

Department	#Faculty	searches	pending retirements	vacancies	currently >65
Biochemistry	15	1		-2	1
Biology	21 + 1.66 TT	1		+1	4
Chemistry	15 + 2 TT	1		-2	
Computer Science	18 + 4 TT	2	1	-2	
Earth Sciences	23	-		-3	4
Math&Stats	35 + 7 TT	1 TT		-4	4
Ocean Sciences	11	-		-2	2.5
Physics&Physical Oceanography	17 + 1 TT	-		-2	2
Psychology	29 + 4 TT	2	1	-1	2
<hr/>					
	184 + 19.66 TT	7/1 TT	2	-17	19.5

Age Distributions, Tenured Faculty



Programs/People: It is *impossible* to find \$1.32M in immediate cuts to the FoS

- **3-5% growth initiative – how, when we are asked to find \$1.32M on top of other pressures to the budget?**
 - **BSc – Data Science, new this fall!**
- **the faculty of science has never had a deficit**
- **any cuts to the FoS will *likely* result in deficit**
- **~5-year plan to reduce our budget shortfalls due to structural deficits caused by cuts to base budget this year and for the next two years – not a result of fiscal mismanagement**
 - **reducing the number of tenure/tenure track ASMs by attrition >20 retirements over the next 5 years**
 - **we need to be able to replace tenure/tenure track faculty in some departments (ie BIOC, COMP, PSYC)**
 - **departments need to modify programs now to meet those cuts, reliance on teaching term ASMs**
 - **FoS needs to be held harmless for any deficits incurred**

The University needs to realize that these cuts will come with a decrease in research capacity as well as undergraduate and graduate training!!

What else can we do?

Start planning now

- **how can we put on our programs with less resources (e.g. sharing courses, rotating senior level courses, not offering low enrollment courses) – not just low enrolment programs**

Low enrollment programs could create attractive, flexible, inter-or multidisciplinary programs

- **that resonate with today's youth who are increasingly plugged-in and interested in challenges facing the globe**
- **that will provide the science training and the skills to solve those global challenges**
- **that are broad enough to allow students to pivot in new directions as new challenges emerge**

Government funding priorities

- **e.g. critical minerals**
- **creative joint positions e.g. research in one department, teaching needed in another**

Heads will open up discussions for ideas at upcoming departmental meetings and bring them to Heads Meetings this summer.

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- New course(s):
- X Amended or deleted course(s): Math 1050 and 1051: Finite Mathematics I and II
- New program(s):
- Amended or deleted program(s):
- New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- New, amended or deleted General Academic Regulations (Undergraduate)
- New, amended or deleted Faculty, School or Departmental regulations
- Other:

ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President: _____

Date: _____

Date of approval by Faculty/Academic Council: _____

Memorial University of Newfoundland

Undergraduate Calendar Change Proposal Form

Senate Summary Page for Courses

COURSE NUMBER AND TITLE

Math 1050: Finite Mathematics I

Math 1051: Finite Mathematics II

RATIONALE

This is a small update to the restrictions and prerequisites for MATH 1050 and 1051 that will simplify them and also officially recognize a practice that is already followed.

- 1) Simplification: There are multiple first year math courses that serve the needs of different constituencies. While it is recognized that some students may switch between the target groups, it is also the case that they should not be able to earn credit for all of these courses, particularly if they have already taken upper level math courses. Currently the restriction is imposed with a limit on the number of credits that can be taken from a list of courses. This list includes all first-year courses offered currently or in the last few decades in St. John's or Corner Brook except MATH 1001. Language is simplified and made more readable with an exclusive rather than inclusive list. To wit:

At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.

Becomes

At most 9 credit hours in Mathematics will be given for courses successfully completed with course number having the first digit "1", excluding MATH 1001.

- 2) Recognizing existing practice: To ensure that students are properly prepared, there are pre-requisites for first year MATH courses. For many years we were able to use public exam grades as these prerequisites, but with the cancellation of public exams we have had to return to the Mathematics Placement Test. However, there are circumstances in which a student may be given a waiver to register for a first-year course even if they don't technically meet those prerequisites.

Despite the numbering (and naming!) MATH 1050 and 1051 are actually independent courses and can be taken in either order. However, under the current regulations, if a student gets waived into one and passes it, they will still need to be waived separately into the other. This is inconvenient and

unnecessary: we take success in one as sufficient proof to indicate likelihood of success in the other. Hence

“PR: A combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F.”

becomes

“3 credit hours Mathematics courses, or a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F.”

Success in any first-year math course is then an acceptable prerequisite for either 1050 or 1051.

- 3) Re-structuring of F-slot courses: We propose to change the ‘lecture hours per week’ for each of the above from 4 to the standard 3, and to introduce 1 lab hour per week.

The extra lecture hour was needed in the past to provide more examples from the instructor of particular techniques. There are several reasons why converting the extra lecture hour to a lab hour is beneficial:

3.1) Equity for faculty: Instructors are not given any extra teaching credit for the extra time required for these courses. An instructor who teaches three sections from the list above receives no credit for doing an extra courses worth of lectures per week. To address this inequity in teaching load, sections with four lecture hours per week will be converted to the standard three lecture hours per week, with one lab hour to be supervised by a teaching assistant.

3.2) Meaningful TA experience: Supervision of a tutorial section gives graduate students an opportunity to teach and work directly with students, and to work closely with an experienced instructor. TAs will present materials prepared by faculty, and carry out short evaluations that will allow them to reflect on the effectiveness of their teaching.

3.3) Increased support for undergraduate students: Students will have access to a graduate student TA during the lab hour, who can provide alternate viewpoints and explanations, thus increasing learning opportunities.

This re-structuring has been successfully piloted in the 2023-24 academic year. There is overwhelming support amongst the faculty that teach these courses to formalize this change in practice.

ANTICIPATED EFFECTIVE DATE

Fall 2024

CALENDAR CHANGES

MATH 1050 Finite Mathematics I covers topics which include sets, logic, permutations, combinations and elementary probability.

CR: MATH 1052 and MATH 1053

LH: 1

LC: 4

PR: 3 credit hours in Mathematics courses, or a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.~~ At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

MATH 1051 Finite Mathematics II covers topics which include elementary number theory, numeration systems, voting systems, and geometry.

CR: MATH 1053

LH: 1

LC: 4

PR: 3 credit hours in Mathematics courses, or a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.~~ At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

CALENDAR ENTRY AFTER CHANGES

MATH 1050 Finite Mathematics I covers topics which include sets, logic, permutations, combinations and elementary probability.

CR: MATH 1052 and MATH 1053

LH: 1

PR: 3 credit hours in Mathematics courses, or a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

MATH 1051 Finite Mathematics II covers topics which include elementary number theory, numeration systems, voting systems, and geometry.

CR: MATH 1053

LH: 1

PR: 3 credit hours in Mathematics courses, or a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page

CONSULTATIONS SOUGHT:

Academic Unit	Response Received
Humanities and Social Sciences	F-slot "No concerns from HSS." PR-CR: "HSS supports the proposed changes."
Business Administration	F-slot: "Thank you for the opportunity to review. We think that the lab component adds a benefit for our students." PR-CR: "Thanks for the opportunity to review. We see no impact for Business."
Education	No response
Engineering and Applied Science	PR-CR:" At its meeting on Wed. March 20, the Committee on Undergraduate Studies for the Faculty of Engineering and Applied Science determined that the proposed changes have no impact on our programs."
Human Kinetics and Recreation	No response
Marine Institute	No response
Medicine	PR-CR: "On behalf of the Faculty of Medicine, there are no concerns with the proposed changes."
Music	F-slot: "Thank you for the opportunity to review these calendar changes (including PR, CR

Academic Unit	Response Received
	<p>and changing F-slot offering). On behalf of the School of Music we have have no concerns.”</p> <p>PR-CR: “Thank you for the opportunity to review these calendar changes. On behalf of the School of Music we see no impact on our students and have have no concerns. “</p>
Nursing	F-slot: “Dr. Pike, our interim dean, tells me that BScN students are not required to take a Math course during their course of studies, so this change should not have any impact from a nursing perspective.”
Pharmacy	No response
Science	No response
Biochemistry	No response
Biology	No response
Chemistry	No response
Computer Science	No response
Earth Sciences	No response
Mathematics and Statistics	Proposing department
Ocean Sciences	No response

Academic Unit	Response Received
Physics and Physical Oceanography	No response
Psychology	No response
Social Work	No response
Library	See below
Grenfell - Arts and Social Science	No response
Grenfell - Science and the Environment	No response
Grenfell - Fine Arts	No response
Labrador Institute	No response

LIBRARY REPORT:

F-Slot

Hello Ivan,

As these changes are primarily administrative in nature, they will not impact the library's ability to support the objectives of the courses.

Kathryn

PR-CR

Good Morning,

These changes will have no impact on the library, and we will continue to support these courses as required.

Kathryn

RESOURCE IMPLICATIONS

There are no resource implications associated with updating the pre-requisites and their wording.

For the tutorials, these changes formalize a pilot program of tutorials that has been running in both of these courses for the last year. The pilot was run out of the TA budget for Math/Stats. As a formalized program, it will continue to be run from the TA budget.

New resources are not needed.

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

LIST OF CHANGES

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- New course(s):
- Amended or deleted course(s): MATH 1000 Calculus I, MATH 1005 Calculus for Business, MATH 1006 Calculus for Life Sciences, MATH 1090 Algebra and Trigonometry and MATH 109A and 109B Introductory Algebra and Trigonometry
- New program(s):
- Amended or deleted program(s):
- New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
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Date: _____

Date of approval by Faculty/Academic Council: _____

Memorial University of Newfoundland

Undergraduate Calendar Change Proposal Form

Senate Summary Page for Courses

COURSE NUMBER AND TITLE

MATH 1000 Calculus I

MATH 1005 Calculus for Business

MATH 1006 Calculus for Life Sciences

MATH 1090 Algebra and Trigonometry

MATH 109A and 109B Introductory Algebra and Trigonometry

RATIONALE

- A. We propose to change the 'lecture hours per week' for each of the above from 4 to the standard 3, and to introduce 1 lab hour per week.

The extra lecture hour was needed in the past to provide more examples from the instructor of particular techniques. There are several reasons why converting the extra lecture hour to a lab hour is beneficial:

- 1) Equity for faculty: Instructors are not given any extra teaching credit for the extra time required for these courses. An instructor who teaches three sections from the list above receives no credit for doing an extra courses worth of lectures per week. To address this inequity in teaching load, sections with four lecture hours per week will be converted to the standard three lecture hours per week, with one lab hour to be supervised by a teaching assistant.
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- 3) Increased support for undergraduate students: Students will have access to a graduate student TA during the lab hour, who can provide alternate viewpoints and explanations, thus increasing learning opportunities.

This re-structuring has been successfully piloted in the 2023-24 academic year. There is overwhelming support amongst the faculty that teach these courses to formalize this change in practice.

- B. We propose a re-wording of the credit restriction limit on first year math courses (excluding Math 1001) in reaction to the increased number of different first year

courses in this list. A simplification is proposed to make the statement less cumbersome.

Finally, we take this opportunity to correct a small typo in the course description of MATH 1006. Currently it is not explicit that it is credit restricted with MATH 1000: the restriction is stated in the MATH 1000 description but not in 1006. This is fixed here.

ANTICIPATED EFFECTIVE DATE

Fall 2024

CALENDAR CHANGES

MATH 1000 Calculus I is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.

CR: MATH 1006 and the former MATH 1081

LC: 4

LH: 1

PR: MATH [1090](#) or [109B](#) or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, [1031](#), [1050](#), [1051](#), the former 1080, the former 1081, [1090](#), [109A/B](#), the former 1150 and 1151.~~ At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 1005 Calculus for Business is an introduction to differential calculus, including algebraic, exponential, and logarithmic functions. Applications include related rates and optimization in a business context and partial differentiation. This is a terminal course, not intended for those planning on taking further calculus courses. Business students who plan to take further calculus courses should complete MATH [1000](#) instead of MATH 1005.

LC: 4

LH: 1

PR: MATH [1090](#) or [109B](#) or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, [1031](#), [1050](#), [1051](#), the former 1080, the former 1081, [1090](#), [109A/B](#), the former 1150 and 1151.~~ **At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.**

MATH 1006 Calculus for Life Sciences is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions. Applications include biomechanics, ecology, infectious diseases, physiology, and modelling.

CR: MATH 1000 and the former MATH 1081.

LC: 4

LH: 1

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.~~ **At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.**

MATH 1090 Algebra and Trigonometry provides students with the essential prerequisite elements for the study of an introductory course in calculus. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH [1000](#), [1001](#), [109A/B](#), the former 1080, or the former 1081

LC: 4

LH: 1

UL: ~~at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, [1031](#), [1050](#), [1051](#), the former 1080, the former 1081, [1090](#), [109A/B](#), the former~~

~~1150 and 1151.~~ At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 109A and 109B Introductory Algebra and Trigonometry is a two-semester course which provides students with the essential prerequisite elements for the study of an introductory course in calculus, at a slower pace than MATH [1090](#). Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH [1000](#), [1001](#), [1090](#), the former 1080, or the former 1081

LC: 4

LH: 1

PR: a combination of placement test and high school Mathematics scores acceptable to the Department

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

CALENDAR ENTRIES AFTER CHANGES

MATH 1000 Calculus I is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.

CR: MATH 1006 and the former MATH 1081

LH: 1

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 1005 Calculus for Business is an introduction to differential calculus, including algebraic, exponential, and logarithmic functions. Applications include related rates and optimization in a business context and partial differentiation. This is a terminal course, not intended for those planning on taking further calculus courses. Business students who plan to take further calculus courses should complete MATH 1000 instead of MATH 1005.

LH: 1

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 1006 Calculus for Life Sciences is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions. Applications include biomechanics, ecology, infectious diseases, physiology, and modelling.

CR: MATH 1000 and the former MATH 1081.

LH: 1

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 1090 Algebra and Trigonometry provides students with the essential prerequisite elements for the study of an introductory course in calculus. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH 1000, 1001, 109A/B, the former 1080, or the former 1081

LH: 1

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

MATH 109A and 109B Introductory Algebra and Trigonometry is a two-semester course which provides students with the essential prerequisite elements for the study of an introductory course in calculus, at a slower pace than MATH 1090. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH 1000, 1001, 1090, the former 1080, or the former 1081

LH: 1

PR: a combination of placement test and high school Mathematics scores acceptable to the Department

UL: At most 9 credit hours will be given for the successful completion of Mathematics courses at the 1000 level, excluding MATH 1001.

**Memorial University of Newfoundland
Undergraduate Calendar Change Proposal Form
Appendix Page**

CONSULTATIONS SOUGHT:

Academic Unit	Response Received
Humanities and Social Sciences	"No concerns from HSS."
Business Administration	"Thank you for the opportunity to review. We think that the lab component adds a benefit for our students."
Education	No response
Engineering and Applied Science	No response
Human Kinetics and Recreation	No response
Marine Institute	No response
Medicine	No response
Music	"Thank you for the opportunity to review these calendar changes (including PR, CR and changing F-slot offering). On behalf of the School of Music we have have no concerns."
Nursing	"Dr. Pike, our interim dean, tells me that BScN students are not required to take a Math course during their course of studies, so this change should not have

Academic Unit	Response Received
	any impact from a nursing perspective.”
Pharmacy	No response
Science	No response
Biochemistry	No response
Biology	No response
Chemistry	No response
Computer Science	No response
Earth Sciences	No response
Mathematics and Statistics	Proposing department
Ocean Sciences	No response
Physics and Physical Oceanography	No response
Psychology	No response
Social Work	No response
Library	See below
Grenfell - Arts and Social Science	No response
Grenfell - Science and the Environment	No response

Academic Unit	Response Received
Grenfell - Fine Arts	No response
Labrador Institute	No response

LIBRARY REPORT:

F-Slot

Hello Ivan,

As these changes are primarily administrative in nature, they will not impact the library's ability to support the objectives of the courses.

Kathryn

RESOURCE IMPLICATIONS

There are no resource implications association with changing the pre-requisite wording.

For the tutorials, these changes formalize a pilot program of tutorials that has been running in all of these courses for the last year. The pilot was run out of the TA budget for Math/Stats. As a formalized program, it will continue to be run from the TA budget.

New resources are not needed.

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- New course(s): MATH 4342 Advanced Graph Theory
- Amended or deleted course(s):
- New program(s):
- Amended or deleted program(s):
- New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- New, amended or deleted General Academic Regulations (Undergraduate)
- New, amended or deleted Faculty, School or Departmental regulations
- Other:

ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President: _____

Date: _____

Date of approval by Faculty/Academic Council: _____

Memorial University of Newfoundland

Undergraduate Calendar Change Proposal Form

Senate Summary Page for Courses

COURSE NUMBER AND TITLE

MATH 4342 Advanced Graph Theory

RATIONALE

This course is meant to be the undergraduate counterpart to an existing graduate-level course, MATH 6340 Graph Theory. It is a sequel to Math 3240 Applied Graph Theory, and is almost identical to MATH 4345 from Grenfell. While it was originally proposed that St. John's might simply adopt the Grenfell course, the St. John's campus does not feel that MATH 2051 need be a pre-requisite, as it is used in the Grenfell version for a topic that would not typically be included in this version.

It is envisioned that MATH 4342 would be offered simultaneously with MATH 6340, as are the other 4000-level combinatorics courses. Further, this course could be put in rotation with Math 4340 and Math 4341 so that it would require no new teaching resources while giving undergraduate students access to new course options.

CALENDAR ENTRY AFTER CHANGES

MATH 4342 Advanced Graph Theory includes topics which may be chosen from matchings, factorizations, adjacency matrices, eigenvalues of graphs, strongly regular graphs, independent sets and cliques, network flows, cuts and connectivity, graph products, graph homomorphisms, edge colourings, domination, and graph searching.

PR: MATH 3240 or MATH 3340

CR: MATH 4345

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page

CONSULTATIONS SOUGHT

Academic Unit	Response Received
Humanities and Social Sciences	“The proposed Calendar change rises no concerns for HSS.”
Business Administration	“We see no impact for Business.”
Education	No response
Engineering and Applied Science	No response
Human Kinetics and Recreation	No response
Marine Institute	No response
Medicine	“On behalf of the Faculty of Medicine, we have no concerns with the proposed course.”
Music	See below
Nursing	“Dr. Pike, our interim dean at the Faculty of Nursing, tells me that she sees no implications in this Calendar Change Proposal for the Faculty of Nursing.”
Pharmacy	“ There is no impact on the School of Pharmacy.”
Science	No response
Biochemistry	No response

Academic Unit	Response Received
Biology	No response
Chemistry	No response
Computer Science	No response
Earth Sciences	No response
Mathematics and Statistics	Proposing department
Ocean Sciences	No response
Physics and Physical Oceanography	No response
Psychology	No response
Social Work	No response
Library	Yes – see below
Grenfell - Arts and Social Science	No response
Grenfell - Science and the Environment	No response
Grenfell - Fine Arts	No response
Labrador Institute	No response

The only question about content came from Music:

Dear Ivan,

Thank you for the opportunity to review these calendar changes. On behalf of the School of Music we have no concerns.

I have one observation regarding the wording of the calendar entry. As the entry is currently written it includes a list of topics from which the instructor might choose. The wording as it stands implies that a course instructor might choose none of the listed topics. (The course might include the following topics, but also might not include any of them.) Is that the intention of the department (i.e. that this course might include none of the topics listed in the rationale)? Or is it the intention of the department that the course will include at least one of the topics in the list? Something to consider.

Also, I did notice one typo in the rationale:

"Further, this course could be put in rotation with Math 4340 and Math 4341 so that it would require no new teaching resources ~~with~~ while(?) giving undergraduate students access to new course options."

Sincerely,
Michelle

MATH/STATS Response: Typo is corrected. The use of "may" is intentional. Typical topics are described but it is intended that the instructor have maximum discretion as to which topics are included in the course.

LIBRARY REPORT

After reviewing the course proposal for Advanced Graph Theory, and the rationale guiding this proposal, I feel comfortable with the library's capacity to support this course. There is very little reliance upon the library's resources, and we have supported the graduate counterpart in the past.

I would encourage any faculty who are teaching this course to explore the possibility of OERs instead of required textbooks. Textbook licenses and availability often present challenges for the library, and are usually quite expensive for students. The availability of OERs is constantly growing, and there may be a resource that is well suited for this course offering.

Kathryn

Kathryn Rose, MLIS, PhD (she/her) | Head, Collections Strategies

Memorial University Libraries

St. John's, Newfoundland, A1B 3Y1

+1 709 864-3139

www.library.mun.ca

RESOURCE IMPLICATIONS

This course will be taught in rotation with other undergraduate courses, and will be cross-listed with a graduate course, so there will be no resource implications.

ADDITIONAL INFORMATION REQUIRED FOR NEW COURSE PROPOSALS

Course Outline:

This course will act as a complementary course to Math 3240. As it is possible that students will not have completed that course, we will begin with some elementary graph theory, then follow with more advanced topics. A sample syllabus could be as follows, with approximate durations.

- Graph Basics (1 week)
- Matchings (2 weeks)
- Graph Products (1.5 week)
- Connectivity (2 weeks)
- Edge Colourings (1.5 week)
- Flows (2 weeks)
- Domination (2 weeks)

Method of Evaluation:

A typical marking scheme for this course would be: 4 assignments, worth 20%; 1 midterm, worth 30%; and 1 final exam, worth 50%.

Textbook:

Possible textbooks include *Graph Theory (5th Edition)*, by Reinhard Diestel or *Introduction to Graph Theory (2nd Edition)* by Douglas West.

Instructors:

Possible instructors include: Dr. Danny Dyer, Dr. David Pike, Dr. Nabil Shalaby, Dr. Daniela Silvesan. (Both Drs. Dyer and Pike have taught the graduate-level version of this course in recent years.)



Request for Approval of a Graduate Course

SCHOOL OF GRADUATE STUDIES

Adobe Reader, minimum version 8, is required to complete this form. Download the latest version: <http://get.adobe.com/reader>. (1) Save the form by clicking on the diskette icon on the upper left side of the screen; (2) Ensure that you are saving the file in PDF format; (3) Specify where you would like to save the file, e.g. Desktop; (4) Review the [How to create and insert a digital signature](#) webpage for step by step instructions; (5) Fill in the required data and save the file; (6) Send the completed form by email to: sgs@mun.ca.

To: Dean, School of Graduate Studies
From: Faculty/School/Department/Program
Subject: Regular Course Special/Selected Topics Course

Course No.: P6061

Course Title: Applications of classical and quantum formalisms in finance and other social sciences

I. To be completed for all requests:

A. Course Type: Lecture course Lecture course with laboratory
 Laboratory course Undergraduate course¹
 Directed readings Other (please specify)

B. Can this course be offered by existing faculty? Yes No

C. Will this course require new funding (including payment of instructor, labs, equipment, etc.)? Yes No
If yes, please specify:

D. Will additional library resources be required (if yes, please contact munul@mun.ca for a resource consultation)? Yes No

E. Credit hours for this course: 3

F. Course description (please attach course outline and reading list):
Please see course outline attached.

G. Method of evaluation:	Percentage	
	Written	Oral
Class tests	30%	
Assignments	15%	
Other (specify):		
Final examination:	55%	
Total 100%		

¹ Must specify the additional work at the graduate level

II. To be completed for special/selected topics course requests only

For special/selected topics courses, there is no evidence of:

1. duplication of thesis work
2. double credit
3. work that is a faculty research product
4. overlap with existing courses

Instructor's initials









Recommended for offering in the Fall Winter Spring 2025

Length of session if less than a semester:

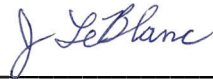
III. This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies

 (EMMANUEL HAVEN)

JUNE 3 - 2024

Course instructor

Date



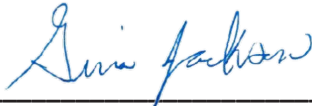
James LeBlanc
2024.06.04 10:39:32-02'30'

june 4, 2024

Approval of the head of the academic unit

Date

IV. This course proposal was approved by the Faculty/School/Council



June 13, 2024

Secretary, Faculty/School/Council

Date



MEMORIAL UNIVERSITY OF NEWFOUNDLAND

Department of Physics and Physical Oceanography

Physics 6061

3 credits

**Applications of classical and quantum formalisms in finance
and other social sciences**

Course Information and Schedule for Winter 2025

Academic Year 2024-2025

Times of meeting: TBC

CONTACT INFORMATION

Instructor: Emmanuel Haven

Office hours: Monday 10-12 in Room BN 2011 or by appointment. Please email me at: ehaven@mun.ca

Office phone: 864 -2069

IMPORTANT WEBSITES

- Student resources: <https://blog.citl.mun.ca/resourcesforstudents/>
- Student mental health and wellness: <https://www.mun.ca/studentwellness/>

COURSE DESCRIPTION and OBJECTIVES

The course is focussed on applying elementary formalisms from both classical and quantum mechanics to finance and other social sciences (notably economics and mathematical psychology). We shall consider the Hamiltonian framework (classical and quantum mechanical) in finance and economics. We shall present applications of quantum probability to decision making problems which have relevance in both mathematical psychology and economics. After completion of this course, students will be able to understand how classical and quantum probability do offer different viewpoints on important decision-making paradoxes. Students will also be able to appreciate how financial asset pricing models (like financial option pricing) can be constructed with some of the formalism from both classical and quantum mechanics.

Please note that this course is self contained. No previous knowledge is needed in either finance; economics or mathematical psychology.

Learning objectives

By the end of this course, you will be able to understand:

- How we use physics concepts like action in finance
- How an elementary Hamiltonian framework can have relevance in basic economics
- How the Fokker-Planck PDE has relevance in finance
- How the backward Kolmogorov PDE is constructed in financial option pricing
- What the role is of risk neutral probabilities
- How we solve the Black-Scholes PDE
- The difference between classical and quantum probability
- Why quantum probability provides an interesting tool for understanding decision making paradoxes
- The importance of the QQ equality
- How the semi-classical approach aids in fine tuning public financial information
- Why financial hamiltonians are not Hermitian
- The notion of open systems

COURSE MATERIALS

Course notes will be posted on the web after each class. Course notes will be made available on D2L (<http://online.mun.ca>).

- Haven, E.; Khrennikov, A. (2013). *Quantum Social Science*. Cambridge University Press (New York).
- Busemeyer, J., Bruza, P. D. (2014). *Quantum Models of Cognition and Decision*. Cambridge University Press (New York)
- Haven, E., Khrennikov, A. and Robinson, T. (2017). *Quantum Methods in Social Science: a First Course*. World Scientific Publishers.

All of the books are available at the MUN library and can be viewed online as Springer Ebooks.

COURSE FORMAT

Classes

This course meets weekly for a total period of 2 hours and 30 minutes per week.

Topics for each class are listed in the course schedule below.

Evaluation

Assignments (3 assignments): 15%

Midterm: 30%

Final: 55%

Important general University Policies:

- It is the student's responsibility to familiarize themselves with University guidelines.
- You can find them at University Calendar, School of Graduate Studies, Section 2
- Student Code of Conduct. <http://www.mun.ca/student/conduct/>
- Accommodations for Students with Disabilities
<http://www.mun.ca/blundon/accommodations/>

COURSE SCHEDULE

Dates	Topic
Week 1	Part I: Introduction <ul style="list-style-type: none"> • Basic tools of analysis in finance and economics: equilibrium measurement and Lagrangian optimization: what is it and how do we use it? • Using potential functions in showing equilibrium pricing in economics: how does it work?
Week 2:	<ul style="list-style-type: none"> • Potential functions in social science (cont'd) • Arbitrage taking in finance • Lagrangians and Principle of least action when applied to arbitrage
Week 3:	Part II: Classical mechanics formalism in finance <ul style="list-style-type: none"> • Momentum conservation in finance? Hamiltonians in finance? Can the Hamiltonian be conserved? • Assignment 1 due
Week 4:	<ul style="list-style-type: none"> • Development of the Fokker-Planck PDE in finance. The role of the master equation. • Example: volatility estimation • The Fokker Planck PDE 'cousin': the backward Kolmogorov PDE
Week 5:	<ul style="list-style-type: none"> • Option pricing theory with the Backward Kolmogorov PDE: wealth approach versus stochastic approach
Week 6:	<ul style="list-style-type: none"> • Option pricing continued • Assignment 2 due
Week 7:	<ul style="list-style-type: none"> • The idea of risk-neutral probabilities • Finding solutions to the Black-Scholes PDE
Week 8:	<ul style="list-style-type: none"> • Seminar sessions (exercises) on both parts I and II • Midterm (75 minutes)
Week 9:	Part III: Quantum mechanics formalism in finance and other social sciences <ul style="list-style-type: none"> • Wave function and superposition: why can it be useful in finance and other social sciences?
Week 10:	<ul style="list-style-type: none"> • Classical and quantum probability: decision making paradoxes in economics and psychology
Week 11:	<ul style="list-style-type: none"> • The idea of QQ equality • The extended Aumann theorem • Semi-classical approach: introduction • Fisher information; applications to financial non-arbitrage theory

Week 12:	<ul style="list-style-type: none"> • Using the potential function from the semi-classical approach to understand better public financial information • Universal Brownian motion: applications to financial option pricing • Assignment 3 due
Week 13:	<ul style="list-style-type: none"> • Issues of Hermiticity of financial Hamiltonians • The notion of open systems • Exercises seminar session on Part III.

From: [CS Grad Officer](#)
To: [deansciassistant](#)
Subject: Fwd: Changes to the Statistics degrees
Date: Thursday, June 13, 2024 2:43:30 PM
Attachments: [Stats changes, page 2.pdf](#)
[Stats changes, page 1.pdf](#)

Begin forwarded message:

From: "Dyer, T Danny" <dyer@mun.ca>
Subject: Changes to the Statistics degrees
Date: June 12, 2024 at 18:54:39 GMT+2
To: "Fiech, Adrian" <afiech@mun.ca>

Hi Adrian;

The Department of Mathematics and Statistics has passed the following two calendar changes that we'd like to bring to FoS Grad Studies.

In **32.17.2 Specific Requirements for the M.Sc. in Statistics** we've added STAT 6509 Statistical Inference as the appropriate entry-level graduate course to require, and removed STAT 6500 and STAT 6560. Also, some small changes to the list of courses required for those upgrading to a MSc from the MAS, giving graduate students more choice. (Additions in gold and removals are struck out.)

Since STAT 6500 and STAT 6560 are no longer required "core" courses for the MSc in Statistics, in **44.29.5.2 Statistics**, we are explicitly putting them on the list of courses available to PhD students, and removing the newly added course 6509. (Additions highlighted in yellow and removals struck out.)

Danny

Danny Dyer, Ph.D. (he/him/his)
Department of Mathematics and Statistics
Memorial University of Newfoundland

32.17.2 Specific Requirements for the M.Sc. in Statistics

Every student for the M.Sc. in Statistics is required to complete a minimum of 18 credit hours in graduate courses including [STAT 6509](#) and STAT 6510 ~~and one of STAT 6500 or STAT 6560~~ as well as the series STAT 697A/B or the completion of an additional 3 credit hour graduate course from the list below (~~courses STAT 6509 and~~ STAT 6519 cannot be used to satisfy this requirement). A thesis is required as per [General Regulations, Theses and Reports](#).

Students who already hold a Master of Applied Statistics are only required to complete STAT 6510 and one of STAT 6500, [STAT 6503](#), [STAT 6520](#) or STAT 6560, and a thesis as per [General Regulations, Theses and Reports](#).

44.29.5.2 Statistics

- 6500 Probability
- 6503 Stochastic Processes
- 6505 Survival Analysis
- 6520 Linear Models
- 6530 Longitudinal Data Analysis
- 6540 Time Series Analysis
- 6545 Computational Statistics
- 6550 Nonparametric Statistics
- 6559 Statistical Exploration of Data
- 6560 Continuous Multivariate Analysis
- 6561 Categorical Data Analysis
- 6564 Experimental Designs
- 6563 Sampling Theory
- 6571 Financial and Environmental Time Series
- 6573 Statistical Genetics
- 6570-6589 Selected Topics in Statistics and Probability (excluding 6571, 6573, 6586)
- Note that, although the courses 6160, 6310, 6332, 6351, ~~6500~~, 6509 and 6510 ~~and 6560~~ cannot be used to fulfill the 6 credit hours graduate courses requirement, any of them can be listed as part of the program of study as additional course work, whenever the supervisory committee deems it appropriate.