Course Information for
MATH 3808 Mathematical analyses of games of chance**, Winter 2021**

Instructor: Jason Z. Gao, email**:** zgao@math.carleton.ca
Online Lectures: Wednesday and Friday 11:35–12:55. cuLearn
Office hours: Tuesday and Wednesday 14:30–15:30, or by appointment.

Online Tutorials: Friday 13:35–14:25
TA: **Amanda** Chafee, amandachafee@cmail.carleton.ca
In each tutorial, you will work on some problems related to the material covered in lectures. Those problems are of the following three types: multiple choice, short answer, and detailed answers. Problems requiring detailed answers need to be done and submitted manually. The tutorials will be team work, and more details about this will be sent by Amanda.
The two tests will be held in the two specified tutorial hours, and they will be done *individually*. Please view the video posted on cuLearn for instructions on how to scan and submit your answers.

Course Description: This course covers mathematics used in the analysis of games of chance. The topics include probabilities, odds, house advantages and fairness of games, variance and risks, statistical testing for the honesty of games, optimal strategies, random walks and gambler's ruin, Kelly criterion, and gaming revenue estimation.
Examples are taken from various games such as Lottery, Roulette, Blackjack, Poker, and Bridge.

Textbook: There is no textbook for the course. My notes and slides will be available in cuLearn. This course will be delivered online using the BigBlueButton (BBB) in cuLearn. To access your courses on cuLearn go to http://carleton.ca/culearn. For help and support, go to http://carleton.ca/culearn/students. Any unresolved questions can be directed to Computing and Communication Services (CCS) by phone at 613-520-3700 or via email at ccs_service_desk@carleton.ca.

This class or portions of this class will be recorded by the instructor for educational purposes. These recordings will be shared only with students enrolled in the course. Your instructor will communicate how you can access the recordings.

Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy. Students requesting the use of assistive technology as an accommodation should contact the Paul Menton Centre. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as lectures slides, lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials or otherwise circulate these materials without the instructor's written permission. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

References

- R.C. Hannum and A.N. Cabot, *Practical Casino Mathematics*, Institute for the Study of Gambling & Commercial Gaming, University of Nevada, Reno. ISBN 0-942828-46-1
- S.N. Ethier, The Doctrine of Chances, Springer, 2010.
- J.Kilby, J. Fox, and A.F. Lucas, *Casino Operations Management*, John Wiley & Sons, Inc. ISBN 0-471-26632-9, HV6711.K55
- P.A. Griffin, The Theory of Blackjack, Huntington Press, 5th Ed. 1996.
- E.O. Thorp, Beat the Dealer, Vintage Books, 1966.
- Casino Mathematics for Managers and Players, Notes, B. Alspach and Z. Gao.
- www.bj21.com
- https://www.twoplustwo.com/
- Bridge Base Online
- https://www.olg.ca/en/home.html

Prerequisites: permission of the School. Background in counting techniques, probability and statistics which are covered in STAT 2655, STAT 2605, STAT 2507, STAT 2606, STAT 3502, MATH 3825/3855 will be very helpful.

Evaluation

Component	Percentage
Best 8 out of 9 Tutorials (4% each)	**32%**
2 Tests (14% each, on Feb 12, Mar 26)	**28%**
1 Final Project	**40%**

The final project should be done by a team of three people. It is strongly recommended that you form your team as soon as possible. Please note that the teams for the final project are not necessarily the same as the teams for tutorials. A list of topics related to the course material will be given out during the term. Each team chooses exactly one of the topics, and topics which have already been picked will become unavailable.
Plagiarism is a serious academic offence and may lead to a failure grade.

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:
Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www2.carleton.ca/equity/
Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www2.carleton.ca/equity/
Academic Accommodations for Students with Disabilities: The **Paul Menton Centre** for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (*if applicable*) at http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www2.carleton.ca/equity

Tentative lecture and tutorial schedule (subject to change)

Date	Topic	Tutorials and Tests
Jan. 13, 15	Examples of game of chance, random events and probabilities, random variables, expected value, house edge, variance and standard deviation.	**No** Tutorial
Jan. 20, 22	Counting rules, ordered and unordered selections with or without repetitions, payoff, payback, odds, Big/Small, Keno.	Tutorial 1
Jan. 27, 29	Poker hands, bridge hands, conditional probability, independent events and random variables.	Tutorial 2
Feb. 03, 05	Sum of independent random variables, central limit theorem, confidence interval, margin of error, volatility index, coefficient of variation, betting schemes.	Tutorial 3
Feb. 10, 12	Gambler's ruin, risk analysis, probability of rare events and Poisson approximation, Kelly criterion.	**Test 1**
Feb 15--19	Winter break	
Feb 24, 26	Testing randomness of game outcomes, detailed analyses of some games of pure chance such as Craps, and Baccarat.	Tutorial 4
Mar. 03, 05	Geometric distribution, analysis of some casino promotions, analysis of some games involving skill.	Tutorial 5
Mar. 10, 12	Let It Ride optimal strategies.	Tutorial 6
Mar. 17, 19	Three Card Poker, Caribbean Stud Poker.	Tutorial 7
Mar. 24, 26	Mathematical analysis vs. computer programming.	**Test 2**
Mar. 31	Video Poker, Blackjack.	
Apr. 07, 09	Hold'em Poker,	Tutorial 8
Apr. 14	Introduction to game theory.	Tutorial 9