Mathematics of Music

Spring 2021

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O ce Hours: TBA

Overview and objectives: In this interdisciplinary course, we will explore some of the connections between mathematics and music. We will do this on di erent levels. First, we will see how fundamental concepts in music (for example, rhythm, time signature, scales, keys, intervals, intonation, tuning and symmetry) are based on mathematical principles (geometric series, least common multiples, sine functions, rational numbers, irrational numbers and group theory, to name but a few). On a physical level, we will study the science of sound and the mathematics underlying sound waves and pitch. Lastly, we will investigate how some composers have based their creations on mathematical concepts. Examples include Schoenberg and his twelve-tone music and modern composer Xenakis, who has used computers and probability theory to create stochastic music.

Apart from studying these connections in class, you will also get to explore them in practice. As part of the course, you will attend at least two local music productions or recitals and report on the mathematical connections you observed. You will also get to incorporate some of these mathematical connections in your own composition, which will serve as your nal project in this course.

Required resources:

description under Overview and Objectives).

Students completing this course will be able to:

make use of mathematical models for studying sound and music theory (QAR) (CLO (i), (iii));

re ect on the strengths and weaknesses of particular quantitative models or methods as tools in the study of sound and music theory (QAR) (CLO (i), (iii));

be able to interpret, re ect on, and use quantitative models and data in music composition (QAR) (CLO (i), (iii), (iv));

identify instances of abstract reasoning about abstract concepts in music theory (in the form of arguments, explanations, proofs, analyses, modeling, or processes of problem solving) (RA) (CLO (iii));

construct an instance of valid reasoning about abstract concepts in music theory (in the form of arguments, explanations, proofs, analyses, modeling, or processes of problem solving) (RA) (CLO (iii));

distinguish valid forms of reasoning about abstract concepts in music theory (in the form of arguments, explanations, proofs, analyses, modeling, or processes of problem solving) from invalid and/or fallacious forms of reasoning (RA) (CLO (iii)).

Grading: Your grade will be calculated as follows:

Class participation:	10%
Homework assignments:	20%
Two concert reports:	5% each
Two tests:	20% each
Final project:	20%

I will assign grades on the usual 90/80/70/60 scale; plus and minus grades will be assigned as appropriate. In borderline cases, I reserve the right to take into account consistency of attendance and participation.

Tentative schedule:

Week 1	Introduction Rhythm (Roberts Chapter 1)
Week 2	Rhythm (Roberts Chapter 1) Basic Music Theory (Roberts Chapter 2)
Week 3	Basic Music Theory (Roberts Chapter 2)
Week 4	The Science of Sound (Roberts Chapter 3, Benson Chapters 1, 3)
Week 5	The Science of Sound (Chapter 3, Benson Chapters 1, 3) Test 1
Week 6	Tuning and Temperament (Roberts Chapter 4)
Week 7	Tuning and Temperament (Roberts Chapter 4)
Week 8	Musical Group Theory (Roberts Chapter 5)
Week 9	Musical Group Theory (Roberts Chapter 5)
Week 10	Change (Bell) Ringing (Roberts Chapter 6, Fauvel Chapter 7)
Week 11	Test 2 Twelve-Tone Music and Serialism (Roberts Chapter 7)
Week 12	Twelve-Tone Music and Serialism (Roberts Chapter 7) Mathematical Modern Music (Roberts Chapter 8, Fauvel Chapter 8)
Week 13	Mathematical Modern Music (Roberts Chapter 8, Fauvel Chapter 8)
Week 14	Final Project: Mathematical Composition
Week 15	Final Project: Mathematical Composition

Technology:

Schedules and other notices will be posted on Canvas https://westmont.instructure.com/.

I will be using Canvas to post announcements, so please make sure that you receive Canvas noti cations about announcements right away.

During class, I expect you to be an active participant. Therefore, feel free to use your laptop, tablet, phone or calculator for note-taking or calculations, but make sure that it does not distract you or your classmates. I reserve the right to take away this privilege if it becomes a problem.

No electronic technology of any kind will be required or allowed during the exams.

O ce hours: As listed above, my scheduled o ce hours are .... O ce hours are times that I have reserved to be in my o ce, available to help you. You do not have to check with me beforehand; just drop in! To get the most out of a visit, I encourage you to come prepared the clearer you are about what you understand and what you don't understand, the better I can try to help you. Also, never feel

Contacting me: If you cannot reach me in person, the best way to contact me is via email (as listed above, my email address is mvanderwalt@westmont.edu). I typically respond quickly during working hours.

Connecting with professors: You are encouraged to take advantage of the Take a Professor to Lunch Program as an opportunity to get to know each of your professors over a shared meal. Feel free to contact me about this! ☺ I'm also always happy to talk over a cup of tea in my o ce (cookies included); you're welcome to pop in if you see me in my o ce or send me an email if you want to arrange something beforehand.

Attendance: If you miss a signi cant number of classes, you will almost certainly do poorly in this class. If you miss more than six classes without a valid excuse, I reserve the right to terminate you from the course with a grade of F this is in line with Westmont's attendance policy, which is available at http://www.westmont.edu/_o ces/registrar/academic_policies/attendance-policies.html. Students are responsible for obtaining information and assignments distributed during missed classes. Class notes for missed days should be obtained from a fellow student and not the instructor.

Academic integrity: Dishonesty of any kind may result in loss of credit for the work involved and the ling of a report with the Provost's O ce. Major or repeated infractions may result in dismissal from the course with a grade of F. Westmont's plagiarism policy is available at https://westmont.edu/_o ces/provost/Plagiarism/policydoc.pdf.

Accommodation procedure: Students who have been diagnosed with a disability (learning, physical or psychological) are strongly encouraged to contact the Disability Services o ce as early as possible to discuss appropriate accommodations for this course. Formal accommodations will only be granted for students whose disabilities have been veri ed by the Disability Services o ce. These accommodations may be necessary to ensure your equal access to this course. Please contact Sheri Noble, Director of Disability Services (310A Voskuyl Library, 805-565-6186, snoble@westmont.edu) or visit http://www.westmont.edu/_o ces/disability/.

Final comments: Lastly, I really want you to succeed in this course and to enjoy mathematics and music as much as I do! Please don't hesitate to contact me about anything.

> There is geometry in the humming of the strings, there is music in the spacing of the spheres.
> Pythagoras