

Mathematics and Music

Math 109/Music 109M

Spring 2020

Instructor: David Wright

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Office Hours: MW 3:10-4:00, or by appointment

Class Meetings: MWF 1:00-2:00 in Cupples I, Room 199

Computer/Synthesizer Work Stations: Eight work stations located in the Music Tech Lab in Tietjens Hall will be made accessible to students in the course. Each station has an iMac computer connected AKAI MPK49 keyboard. The computers have the musical notation/sequencing program Finale installed. The lab is open at all hours to those who have access.

Equipment and Supplies: Students will need a scientific calculator with graphing capabilities and a small USB storage device. Students will also need musical staff paper for some of the homework assignments.

Text: Mathematics and Music, by David Wright, published by the American Mathematical Society.

Prerequisites: We assume familiarity with algebra, trigonometry, functions and graphs at the high school level. We assume familiarity with musical staves, standard clefs, and key signatures. Calculus and Music Theory are *not* prerequisites, although the student will be introduced to some of both.

Content: This course is a study of interrelationships between mathematics and music. It will review some background concepts in music and mathematics as they are encountered. Music concepts covered include diatonic and chromatic scales (standard and non-standard), intervals, rhythm, meter, form, melody, chords, progressions, temperament (equal, mean tone, Pythagorean), just intonation, overtones, timbre, and formants. Mathematical concepts covered include integers, rational and real numbers, equivalence relations, geometric transformations, logarithms, sequences and series, groups, rings, modular arithmetic, periodic functions, and (very basic) harmonic analysis.

Goals:

1. Understand relationships between mathematics and music.
2. Develop/enhance the students' musical knowledge and creativity.

3. Develop/enhance the students' skills in mathematics, abstract reasoning, and computation.
4. Integrate the students' artistic and analytic skills.
5. Introduce the computer and synthesizer as interactive tools for musical and mathematical creativity.

Class Attendance: The instructor strives to elicit lively, vigorous, interactive discussions in the class. Participation in class is an essential part of this learning experience. We will be spending some time listening to, evaluating, and discussing various aural examples, and students will be asked to express their reactions and contribute in other ways. Also, some important demonstrations on the use of the hardware and software will take place in class. Therefore attendance will be taken, and class attendance/participation is a part of the final grade. Students should discuss any necessary absences with the teaching assistant, preferably in advance.

Exams: *In Class Exams:* February 14, March 20, April 17 (all are Fridays)
 Final Exam: Take-home exam due Friday, May 1

Legitimate excuses for missing an exam (such as verified illness or serious family emergency) must be approved, preferably in advance. Except for the Final, there is no make-up exam in such cases. Instead, a grade for the missed exam will be calculated based on the other exam scores.

Homework: A total of nine assignments will be given. Six written problem sets will be assigned, due approximately every two weeks, and three compositions will be assigned. The due dates of these are:

Written Assignments: 1/27, 2/10, 2/24, 3/16, 3/30, 4/13 (all are Mondays)
Compositions: 2/3, 3/2, 4/6 (all are Mondays)

The written assignments will be submitted and graded using the online software Crowdmark (<https://crowdmark.com>). We will try to have the homework graded and returned with solutions on the Wednesday after the Monday on which it is due. The compositions will be submitted by email to the TA as mp3 files with accompanying Finale score and Word file documentation. Directions for creating the sound files in the proper format for online submission will be provided. No late homework will be accepted.

Project: Each student is required to turn in a project consisting of one or more musical examples/compositions that demonstrate concepts learned in the course. Examples might employ combinations of melodic transformations, polyrhythmic patterns, non-standard scales, micro tuning, modular arithmetic, and/or 12-tone (or n-tone) games. Various ideas for projects will be offered in class. The project should include audio examples in the form of one or more mp3 files submitted by email to the professor with accompanying musical scores and documentation. The project is due on Friday, April 24 (the last day of class). Projects turned in late will receive half credit.

Assistant and Grader: Daniel Hoffman, *E-mail:* daniel.hoffman@wustl.edu

Grading: The final grade will be based on the exams, homework, project, and class attendance/participation as follows: 40% weighting on the exams, 35% weighting on the homework, 15% weighting on the project, and 10% weighting on class attendance/participation.