

Mathematics and Music

Math 109/Music 109M

Spring 2009

Instructor: David Wright
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Office Hours: MWF 2:10-3:00

Class Meetings: MWF 1:00-2:00 in Life Sciences, Room 118

Computer/Synthesizer Work Stations: Four work stations located in the Natural Sciences Learning Center, Life Sciences Room 117, will be dedicated to the course. Each station has an iMac G4 computer connected via a MIDI interface to a Kurzweil K2600 synthesizer. The computer has the musical notation/sequencing program Finale installed, as well as the sound editing/processing program Sound Studio. The usual hours for the lab are:

M-Th:	9:00am - midnight
F:	9:00am - 6:00pm
Sat:	closed
Sun:	noon - midnight

However, certain specific days are scheduled for Biology labs, and these labs have priority. Students should view the NSLC web page at <http://www.nslc.wustl.edu/nslc/hours.html> where a lab schedule will be posted.

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

Text: A preliminary version of the soon-to-be-published book *Mathematics and Music*, authored by the instructor, will serve as a text for the course. It is posted online at www.math.wustl.edu/~wright/ and can be download and printed chapter-by-chapter as the course progresses.

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 taught 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, equal and mean tone temperament, just intonation, overtones, timbre, 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 (if time permits) numerical integration.

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 is a part of the final grade. Students should discuss any necessary absences with the instructor, preferably in advance.

Exams: *In Class Exams:* February 13, March 20, April 17 (all are Fridays)
Final Exam: Wednesday, May 6, 1-3 pm

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: 1/26, 2/9, 2/23, 3/16, 3/30, 4/13 (all are Mondays)
Compositions: 2/2, 3/2, 4/6 (all are Mondays)

The written assignments will be collected and returned in a designated drawer in the Life Sciences lounge, Room LS 104. 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 electronically 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, 12-tone (or n-tone) games, and/or created sounds. 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 online 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: Michael Deutsch
Office hours: MW 12-1, Cupples I, Rm 8
Also Sunday 8-9:30 pm on 2/1, 3/1, 4/5
In LS Rm 117 (or in nearby conference room 110)
E-mail: mdeutsch@math.wustl.edu

Grading: The final grade will be based on the exams, homework, project, and class attendance as follows: 1/4 weighting on the exams, 1/4 weighting on the homework, 1/4 weighting on the project, and 1/4 weighting on class attendance/participation.