Mathematical Perspectives Dr. Gerry Wildenberg

1. Introduction.

This semester this section of Math 104 will use the world of games as a framework for exploring various topics in Mathematics.

The world of "games" provides a rich environment for mathematical discussions. Throughout the history of mathematics, mathematicians have been inspired to analyse games and to invent games. These analyses have led to the development of whole new areas of Mathematics and enriched many existing areas.

Alas, much of this material seldom finds its way into the curriculum of either the primary and secondary school or the college and university level. However that fact has a hidden advantage for us. Exactly because most of us have had little opportunity to analyse games, novel problems will occur when we begin to do so. This novelty will necessitate lots of "out of the box" thinking and will provide a novel collection of problems for us to examine. For some of the work in this course we will see new and surprising applications of familiar tools. Elsewhere we see very new (to us) tools developed to analyse games which turn out to have amazing other uses.

"What is a 'game'?" and "Which 'games' will we be discussing?" are possibly the very first questions which occur to us. The first of these is not a question to which I know the answer but I believe and expect that your notion of what a game is will be broadened by this course. (Surely everyone will learn lots of new games some of a quite novel nature.) The second is a question with which I have been wrestling for the last year as I designed this course. There are some topics that I can possibly add to my plans if time permits and there is a strong expression of student interest. So if Golf, for example, is a game you are dying to see mathematically discussed, let me know, and I'll see what we can do.

2. Class Format

The majority of the games we will discuss will be games that can be played with pencil and paper or cards or dice or other simple equipment. A frequent (but by no means universal) pattern we will see in class is: LPAD by which I mean we Learn, Play, Analyse and Discuss. By "Learn" I mean: gain an understanding of the rules of the game, the equpment used, number of players, objective, scoring and other similar factors. By "Play", I mean that you will play the game for a while to gain a feel for it and to begin to see what mathematical ideas can be applied. By "Analyse and Discuss", I mean that we will, in groups and as a class, try to develop theorems (mathematical facts) that either solve the game completely or give us insights into the game. These four categories are by no means disjoint. Frequently the rules won't become clear until we've played a few times. Analysis and discussion can certainly begin during the play.

It is **important** that during the play you record how the play proceeded and what results were obtained. Unfortunately that can be tedious and can interfere a bit with the fun of playing but I believe it is essential.

Most of the in-class work will be done as group work. Often the in-class groups will consist of two members.

3. Assessment

I will start this section confessing that *grading* is my least favorite activity (teaching is one of my favorites). That out of the way, here are some of the assessment methods that I'll use.

Class attendance, participation, enthusiasm, and contributions. While this is rather vague, I can usually tell who is "getting it" and who is not from my in-class observation. Since I love this material, I love seeing you really gettting into it. needless to say, I'll be doibg what I can to produce a sense of excitement about this material.

Homework. We're all adults so the h-word (h-----k) is acceptable. I'll give many specific assignments in class. These will be collected and graded – sometimes Pass/fail, sometimes numerically.

Final. We will *probably* have two class tests plus a final. examination. We may also have short quizzes. There will definitely be one paper required. That paper will deal with "real world" applications of the topics we discuss. I tell you that now so that when we're talking about games, you can be thinking about analogous situations in the real world.

I hope for lots of high grades. I'm not averse to lots of A's but I do need to see the effort and results.

4. Topics

Game Theory. It almost seems redundant to say that a course in Mathematics of Games will have Game Theory as a topic, but it is not. The term "Game Theory" refers to a special class of games of which we will have some interesting examples.

Nim and Nimbers. The game of Nim and its relatives gives rise to the "Sprague-Grundy" approach to analysing "take and break" games.

5. Text

I am going with no text this semester. Lots of handouts will be distributed. Take good notes.

6. Attendance policy.

An attendance sheet will circulate every day. Be sure to sign it. Any absence beyond two is grounds for failure. True medical emergencies or family issues will be dealt with on an ad hoc basis. Advice: Don't take unnecessary cuts and you'll find the maximum of two not to be onerous.

7. This course is a core P4 course. P4: Explorations of the natural and technical world **Description:** These courses are intended to explore specific scientific, mathematical, and technical topics and relate them to contemporary developments. These courses will apply and analyze a discipline-specific process to solve a problem. It will also highlight how other disciplines and the world have been influenced because of the themes of the course. Students are expected to complete two courses in this area of the core. These courses can be from any discipline or combination of disciplines that satisfy the course goals and are designated as core courses, unless your major dictates otherwise. Courses in this core area emphasize the interdisciplinary nature of the course content and its application to solve problems in the world around us, making them distinct from those courses satisfying SQ requirements, which are about the nature of science and mathematics.

Student Learning Goals

- 1. Students will formulate a question/hypothesis and design a methodology to test it based on a discipline-specific problem-solving process.
- 2. Students will compare and contrast two strategies for solving a problem related to the theme(s) of the course and articulate their rationale for why one is more effective or appropriate than the other.
- 3. Students will identify and discuss an interaction between the theme(s) of the course and other areas of science, mathematics and/or technology.
- 4. Students will cite and explain how aspects of the world around us are impacted by the themes of the course.
- 8. The following is the Fisher policy on disabilities.

In compliance with St. John Fisher College policy and applicable laws, appropriate academic accommodations are available to you if you are a student with a disability. All requests for accommodations must be supported by appropriate documentation/diagnosis and determined reasonable by St. John Fisher College. Students with documented disabilities (physical, learning, psychological) who may need academic accommodations are advised to refer to the Disability Services website http://home.sjfc.edu/AcademicAffairs/Disabilities/DisabilityOverview.asp

Questions should be directed to the Coordinator of Disability Services in the Office of Academic Affairs, Kearney 202. Late notification will delay requested accommodations.

As a P4 course (see below), we are required to conform to the Core description below. In particular, we will emphasize number 4 in the student learning goals below. While not everything we do will be "real world" oriented, you should easily find enough material which has "real world" implications to write a paper discussing course topics and their potential applications. Such a paper *will* be assigned during the second half of the semester and will be due about one week before the final exam.

P4: Explorations of the natural and technical world

Description: These courses are intended to explore specific scientific, mathematical, and technical topics and relate them to contemporary developments. These courses will apply and analyze a discipline-specific process to solve a problem. It will also highlight how other disciplines and the world have been influenced because of the themes of the course. Students are expected to complete two courses in this area of the core. These courses can be from any discipline or combination of disciplines that satisfy the course goals and are designated as core courses, unless your major dictates otherwise. Courses in this core area emphasize the interdisciplinary nature of the course content and its application to solve problems in the

world around us, making them distinct from those courses satisfying SQ requirements, which are about the nature of science and mathematics.

Student Learning Goals

- 1. Students will formulate a question/hypothesis and design a methodology to test it based on a discipline-specific problem-solving process.
- 2. Students will compare and contrast two strategies for solving a problem related to the theme(s) of the course and articulate their rationale for why one is more effective or appropriate than the other.
- 3. Students will identify and discuss an interaction between the theme(s) of the course and other areas of science, mathematics and/or technology.
- 4. Students will cite and explain how aspects of the world around us are impacted by the themes of the course.

Students will cite and explain how aspects of the world around us are impacted by the themes of the course.