Honors 1500: Adventures in Mathematics

Syllabus and Course Schedule Spring Semester 2016

Classroom: LI227
Time: 10:30 TTh
Text Book: No text is required for this course

Instructor: Dr. Todd M. Johnson and Dr. Brad Carroll
Office: SL 609 and SL 211
E-Mail: tmjohnson@weber.edu and bcarroll@weber.edu
Phone: 626-7971 and 626-7921
Office hrs: TBA

General Information:
This course is designed to present mathematics from a historical and cultural perspective and bring relevance and understanding to a subject that is often intensely disliked or even despised. No prior university level math experience is required; basic junior or senior high-school math and an open mind are all you need. (Although this course is not designed for science or math majors, they would probably benefit from this class as well.) Some of the mathematical fundamentals will be presented from an historical perspective wherein the students will have the opportunity to understand the problems that have faced humanity for centuries and allow them, through activities, to design their own mathematical systems and solutions. Numeracy is more than just an exercise in formal mathematical operation. It is a worthy pursuit for anyone who considers themselves a critical thinker.

Although no text is required for this course, you will receive a number of handouts from a variety of sources to read about the topics you will encounter in this course. Every week will consist of a lecture/discussion about that week’s topic, followed by an activity that will give you practice and a greater appreciation for the topic and its historical and cultural setting.

Week 1 – Jan 12, 14 History of numbers I
a) symbolic representations of physical realities – a new language
b) what are large numbers and how do you present them?

Activity – define own number system without zero

Week 2 – Jan 19, 21 History of numbers II
a) different base systems
b) significance of zero in Arabic notation
c) significance of zero as a concept
d) natural numbers, real numbers, integers, imaginary numbers
e) the odd characteristics of prime numbers

Activity – base systems with and without zeros

Week 3 – Jan 26, 28 Classical and Medieval Math Using Numbers/ Units
a) Trade or commerce – common systems
b) Calculating land area of unusual shapes
c) Structural engineering – triangles and angle side relationships

Activity – measure and calculate land or other odd shape areas

Week 4 – Feb 2, 4 Surveying and Estimation
a) Concept of the ratio/ the Greek method for problem solving
b) Estimating numbers from real examples

Activity – estimations
Week 5 – Feb 9, 11  Practical Math and Puzzles
   a) Using ratios to solve problems
   b) Historical introduction to Al Jabar and problem solving
   c) Playing with numbers – intellectual pursuit – equations

Activity – ratios/measurements and puzzles – solving Sudoku with color

Week 6 – Feb 16, 18  Lies and Statistics
   a) Why statistics?
   b) Introduction to statistical analysis and margin of error
   c) Use and misuse of statistics

Activity – statistics and the popular media
   Activity – assigning a number to something that seems interesting
   Activity – finding statistical errors

Week 7 – Feb 23, 25  Probability
   a) What is a probability?
   b) What is random chance and how do we account for it?
   c) Fudging numbers and gambling

Activity – what are the odds?

Week 8 – March 1, 3  Combining Probability and Statistics
   a) Models using probability and statics?
   b) Medical testing and dependent probabilities?
   c) Voting and death

Activity – access CDC records and calculate the probability of dying within the year

Week 9 – Spring Break

Week 10 – March 15, 17  Graphing – a visual approach to math
   a) Introduction to coordinates?
   b) Effective use and analysis of graphical data
   c) Misleading graphs and interpretations

Activity – analyze and interpret graphical data
   Activity – projections and false extrapolations – use color and intensity analysis

Week 11 – March 22, 24  Exponentials and growth – nonlinear life
   a) What is an exponential?
   b) Properties of different exponentials vs. polynomials
   c) Examples of exponentials in physical phenomena

Activity – a model of radioactive decay / comparison to spreadsheet fitting functions
   – one-page project proposal due

Week 12 – March 29, 31  Perspective of math in nature and art
   a) The discovery of perspective in art?
   b) Zero and infinity – vanishing points
   c) Three dimensional perspective and projections in space

Activity – create 3-dimensional art using perspective
Week 13 – April 5, 7  Zero and Infinity the Ying and Yang  
   a) Historical infinity and counting to infinity?  
   b) Multiple infinities/ Cantor and the universe?  
   c) Unusual aspects of infinity  

Activity – write a short story about infinity

Week 14 – April 12, 14  The philosophy of Calculus: The language of the universe  
   a) Zeno’s paradox – problems of calculating unusual volumes?  
   b) small intervals and infinity – Newton’s approach  
   c) simple applications in our world  

Activity – calculus and the real world

Week 15 – April 19, 21  Codes and Informational Theory  
   a) What is information and how is it measured – its power?  
   b) Redundancy in codes and breaking codes  
   c) Organization of information and entropy  

Activity – coding/decoding activity

Final Exam  Presentation of course projects

Honor Code:
Academic integrity is important. You are responsible for your own work. A description of cheating and possible sanctions may be found in the WSU Student Code. You can find it at http://www.weber.edu/ppm/Policies/6-22_StudentCode.html. Please read Section IV.D.2.

Grading:
Course grades will be determined based on the total number of accumulated points with a total of 380 possible. The activities are worth 20 points each, each day of attendance is worth 2 points, and the course project is worth 50 points, for a total of 380 points. The following percentages of the total accumulated points will be given the indicated grade. This scale is a guarantee ---- everyone who receives 93% and above will be given an "A"; regardless of numbers. We reserve the right to lower minimum percentages so that grades may be higher than indicated, e.g. 93% “A” could be lowered to 90%.

93%  A  87%  B+  80%  B-  73%  C  67%  D+  55%  D-
90%  A-  83%  B  77%  C+  70%  C-  60%  D below  55%  E

Students with Disabilities:
Any student requiring accommodations of services due to disability, must first contact the Services for Students with Disabilities (SSD) in room 181 of the Student Service Center. SSD will assist in defining testing procedures and will also arrange to provide course materials in alternative formats if necessary. You must either inform the instructor or have SSD inform the instructor regarding any disability you may have, otherwise no special accommodations will be made in your behalf.

Assessment:
There will be no math tests in this course. (We are not trying to teach you new mathematics, but how to appreciate and better understand the mathematics you already know.) Your grade will be based on  
1) your scores on the weekly activities  
2) your class attendance (2 points earned per day of attendance)  
3) your score on a course project.
The project should be something original and creative, and must be related to something we have discussed during the course. With your project you must hand in a short written paper that describes what you did and how it is connected to the course. No last-minute projects will be approved. You will present and explain your project to the class on the day of the final exam. Your project should be something we can both be proud to share with the rest of the class!

**WSU’s Physical Science General Education Requirements**

After completing the natural sciences general education requirements, students will demonstrate their understanding of general principles of science (LO is the abbreviation for Learning Outcomes):

(LO 1) **Nature of science.** Scientific knowledge is based on evidence that is repeatedly examined, and can change with new information. Scientific explanations differ fundamentally from those that are not scientific.

(LO 2) **Integration of science.** All natural phenomena are interrelated and share basic organizational principles. Scientific explanations obtained from different disciplines should be cohesive and integrated.

(LO 3) **Science and society.** The study of science provides explanations that have significant impact on society, including technological advancements, improvement of human life, and better understanding of human and other influences on the earth’s environment.

(LO 4) **Problem solving and data analysis.** Science relies on empirical data, and such data must be analyzed, interpreted, and generalized in a rigorous manner.

Students will demonstrate their understanding of the following features of the physical world:

(LO 5) **Organization of systems:** The universe is scientifically understandable in terms of interconnected systems. The systems evolve over time according to basic physical laws.

(LO 6) **Matter:** Matter comprises an important component of the universe, and has physical properties that can be described over a range of scales.

(LO 7) **Energy:** Interactions within the universe can be described in terms of energy exchange and conservation.

(LO 8) **Forces:** Equilibrium and change are determined by forces acting at all organizational levels.