

HPS 621 Problem Solving: How Science Works

Fall 2003

Monday, Wednesday, Friday 12:00–12:50
321 Cathedral of Learning

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Office hours: Wednesday, Friday 11–12, and by appointment
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1. Course overview and aims

This course is intended for students who take it to satisfy their quantitative and formal reasoning skills requirement. The strategy is to impart these skills by examining how they are used in scientific reasoning. The goal is to understand how the use of numbers in science greatly extends the reach of our investigative tools.

The introductory part explains general material on how to deal with problems that scientific investigation faces. Students will in particular learn what controlled experiments are and why they are important. In the first main part of the course we take a look at the theory of thermodynamics, an instance of a set of few basic principles that govern a wide range of phenomena. Students will learn how to use thermodynamic concepts to discuss the performance of engines, e.g., in order to improve the efficiency of household appliances and explain why cars run on gasoline. In the second part of the term we try to understand how science deals with randomness, which occurs in many systems and populations studied by statistics. Large ensembles of objects that are subject to chance often form astonishingly orderly patterns, yielding for instance a bell curve. Students will learn how to use statistical notions such as ‘mean’, ‘standard deviation’, ‘bell curve’ and how they can be used to test statistical claims.

2. Required Text

John D. Norton, *How Science Works*, McGraw-Hill, New York, 1998. The textbook is available at the campus bookstore.

3. Prerequisites

This class is intended for students who do not normally take classes that involve quantitative skills. The mathematical content will be kept at an absolute minimum and no advanced techniques are presumed. However, elementary arithmetical skills such as performing calculations involving fractions are required.

The university has a Learning Skills Center and they are happy to provide tutoring for students with math problems. If you think that you might need tutoring, contact either me or the math specialist Donna Beard at the Learning Skills Center, 311 Pitt Union, Tel. 412-648-7920.

4. Courseweb

The course has a website at <http://courseweb.pitt.edu>. Use your Pitt username and password to log onto this site. I will post current announcements, comments on assignments, study guides, and your grades there. I also might send out e-mails to your Pitt account. If you use a different e-mail account, you are responsible for forwarding messages from your Pitt account to this address. If you do not know how to do this, ask at the Pitt computer labs.

5. Course requirements and grading

You are expected to fulfill the following requirements:

- Homework assignments (36%)
There will be a total of 12 homework assignments, each of which deals with one chapter from the textbook. The assignment can be found at the end of each chapter in the textbook. It is due at the beginning of the class indicated on the schedule at the end of the syllabus (this is the class following the completion of a textbook chapter). You can submit the assignment by bringing it to class. Alternatively, you can submit it before the due date by sending it to my e-mail address or by putting it into the folder attached to my office door. No late assignments will be accepted and no make-ups are possible. This said, only the 9 best of your submitted assignments will count towards your grade (each counts 4%). It is crucial for your understanding of the material and your performance on the exams to do the assignments. Do not view the 3 assignments that do not count as 3 weeks off, rather use them in case your are sick etc.
- The quiz (14%)
One quiz will be given, which counts 14% towards your grade. See the schedule below.
- The midterm exam (18%)
The midterm counts 18% toward your total grade. See the schedule below.
- The final exam (32%)
The final counts 32% toward your total grade. See the schedule below.
No make-up exams or quizzes will be given except in extreme circumstances (contact inb1@pitt.edu or the HPS office 624-5896 in case of emergency). In order to retake an exam you need to offer evidence for the extreme circumstance (such as a note by your physician).

Grading scale for the final grade:

97.0 – 100	A+	73.0 – 76.9	C+
92.0 – 96.9	A	69.0 – 72.9	C
89.0 – 91.9	A–	65.0 – 68.9	C–
85.0 – 88.9	B+	61.0 – 64.9	D+
81.0 – 84.9	B	56.0 – 60.9	D
77.0 – 80.9	B–	50.0 – 55.9	D–
		≤ 49.9	F

6. Attendance and participation

Attendance is not required, but strongly recommended. In class, you have the opportunity to get immediate feedback on some questions and problems we discuss.

7. Special needs

Please notify me in case of special needs. If necessary, you can contact Disability Resources and Services at 624-7890. Also inform me about schedule conflict that may arise from your varsity team's athletic schedule.

8. How to succeed

Attend class regularly. Come prepared to class, participate in class and do not hesitate to ask if something is unclear. You should expect that preparing the chapters from the book and doing the homework will take at least 5 hours per week outside class time. It is very important that you do the homework assignments; this helps you to apply the concepts and methods we learn in class and to obtain regular feedback on whether you understand the material. Make use of my office hours in case you have questions or problems.

Course schedule and assignments

Date	Topic	Assignment due
Aug 25 M	Introduction	
Aug 27 W	Chapter 1: Sir Cyril Burt and the inheritance of intelligence	
Aug 29 F		
Sep 1 M	No class (Labor Day)	
Sep 3 W	Chapter 2: To err is human: Scientists are human	Assignment 1
Sep 5 F		
Sep 8 M		
Sep 10 W	Chapter 3: How we know	Assignment 2
Sep 12 F		
Sep 15 M		
Sep 17 W	Chapter 4: The Conservation of Energy: The first law of thermodynamics	Assignment 3
Sep 19 F		
Sep 22 M		
Sep 24 W	Chapter 5: Application of the Law of the Conservation of Energy	Assignment 4
Sep 26 F		
Sep 29 M		
Oct 1 W	QUIZ	Assignment 5
Oct 3 F	Chapter 6: The theory of heat engines: The second law of thermodynamics	
Oct 6 M		
Oct 8 W		
Oct 10 F	Chapter 7: Major results of the theory of heat engines	Assignment 6
Oct 13 M		
Oct 15 W		
Oct 17 F	Chapter 8: Applications of the theory of heat engines	Assignment 7
Oct 20 M		
Oct 22 W		
Oct 24 F	MIDTERM EXAM	Assignment 8
Oct 27 M	Chapter 9: Chance and probability theory I: Introductory notions	
Oct 29 W		
Oct 31 F		
Nov 3 M	Chapter 10: Chance and probability theory II: We meet the bell curve	Assignment 9
Nov 5 W		
Nov 7 F		
Nov 10 M	Chapter 11: Application of the bell curve I: Testing hypotheses	Assignment 10
Nov 12 W		
Nov 14 F		
Nov 17 M	Chapter 12: Application of the bell curve II: Sampling and estimation	Assignment 11
Nov 19 W		
Nov 21 F		
Nov 24 M	Chapter 13: Science and the bell curve	Assignment 12
Nov 26 W	No class (Thanksgiving)	
Nov 28 F		
Dec 1 M	Chapter 13 continued	
Dec 3 W		
Dec 5 F	Review for the final	
Dec 12 F	FINAL EXAM Friday 2:00–3:50	