

ECS 132, Data Modeling and Analysis

Norm Matloff

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Highlights

- hard copy of textbook is required, student-printed
- discussion section is required, weekly Quizzes given there
- heavy emphasis on Group work
- no final exam; instead, have Group project serving as final Homework
- it is required that you read the course Blog every day
- in-class Group Quiz, last day of lecture
- you can get a 10-point bonus on each Quiz by submitting an electronic version of your answers (very short)
- submission of work:
 - submit HOMEWORK via e-mail to the TA
 - submit QUIZZES via CSIF **handin** program

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1 Important Dates and Deadlines

- formation of Homework groups: January 11
- Midterm Exam: March 8
- Group Quiz: March 15
- Project due: March 22

2 Required Course Materials

2.1 Textbook

The textbook is my open source book, available at <http://heather.cs.ucdavis.edu/~matloff/132/PLN/ECS132Winter2012.pdf>.

We will cover the entire book. Note, though, that it is actually an abridged version of <http://heather.cs.ucdavis.edu/~matloff/132/PLN/ProbStatBook.pdf>, shortened by removing chapters on advanced material. I continually revise the long version, and you may find that sometimes the revised material is helpful, but it is NOT required.

You can print the book in town, say at Copyland on G Street and Davis Copy Shop on 3rd St., but you may find it's cheaper at Costco or the like. Cost, including binding, should be between \$20 and \$30.

It is required that you have a hard copy of the book, as it will be used during Tests.

2.2 R Manual

This is not actually required, but unless you already know R well, you'll find it very useful:

<http://heather.cs.ucdavis.edu/~matloff/145/PLN/RMaterials/145R.pdf>

3 What Is This Course?

This is intended to be a course in probability and statistics similar to STA 131A and MAT 135A. Like those courses, ECS 132 is mathematical in nature, but with the hugely important difference that it is tailored to computer science students and computer science applications. (Another important difference is that it covers both probability and statistics.) Starting in Fall 2009, ECS 132 has been required for CSE majors, instead of the old requirement to take STA 131A or MAT 135A.

In addition to the CS applications setting, some other distinguishing features of this course include:

- By interweaving the theory with real-world applications, you will get a much better practical understanding of probability and statistics.
- You will get some introduction to some methodologies that are “hot” in the business world today, notably **data and text mining**. These and related techniques form the very heart of the technology in search engines like those of Google, and in many other Artificial Intelligence applications. See the excellent *New York Times* article, at <http://www.nytimes.com/2009/08/06/technology/>

06stats.html, profiling a top statistician at Google, and an early research paper written by Google cofounder Sergey Brin as a grad student, http://portal.acm.org/ft_gateway.cfm?id=253327&type=pdf&coll=GUIDE&dl=GUIDE&CFID=78868360&CFTOKEN=91342207 (must access from a UCD computer). Also, watch the video at <http://www.lecturemaker.com/tag/cran/> in which some engineers at Google and Facebook explain how their firms use statistics and the R language.

Google and Facebook are just examples. There are many, many other tech firms, big and small, that make extensive use of this material.

- Your ability to put the theory to good practical use will be greatly enhanced by use of the R statistical programming language. R is the standard real-world statistical computational tool in use today. (Some of you may have taken STA 32, which uses a bit of R; our usage will go much further than that level.)

In fact, Google uses R extensively, and it has its own R coding style guidelines (<http://google-styleguide.googlecode.com/svn/trunk/google-r-style.html>). They're not to my taste, but you can see that R is a big deal at Google.

There was a nice *New York Times* article on R; see <http://www.nytimes.com/2009/01/07/technology/business-computing/07program.html>.

- Probability and statistics play major roles in our daily lives, in everything from Lake Tahoe casinos to buying insurance to voting in elections. Understanding these concepts enhances our lives. ECS 132, as a more practical, data-oriented course, better achieves this goal.

4 Workload

There will be approximately five assignments, consisting of mathematical work plus some light programming work. The math will be intellectually similar in spirit to “word problems” in calculus.

IN ORDER TO ACHIEVE A DECENT GRADE, PLAN TO SPEND SIGNIFICANT TIME ON CAREFUL READING OF THE TEXT, AT LEAST FIVE HOURS PER WEEK.

All in all, the number of hours per week you'll put in should be similar to something like ECS 60. Note, though, that much of this will be group work.

5 Prerequisites

The required background is:

- $\frac{d}{dt} \sin^2(t) = 2 \sin(t) \cos(t)$, $\int_0^\infty \lambda e^{-\lambda t} dt = 1$, $\sum_{i=0}^\infty p^i = \frac{1}{1-p}$ ($|p| < 1$)

Derivatives, integrals, infinite series.

- $\begin{pmatrix} a & b \\ c & d \end{pmatrix}^{-1} \begin{pmatrix} e \\ f \end{pmatrix}$

Basic matrix operations, i.e. addition, multiplication and inverse.

- `if (n > x+y) z = 168;`

Reasonable programming and debugging skill; basic awareness of the concepts of bits/bytes, memory addresses and data structures; experience in writing code to read and write files.

The R language and \LaTeX word processing software that we will use in this class are available for every major platform—Linux, Windows and Macs. However, **I strongly prefer to that you run on Linux, as that would make it easier for me to help you fix your bugs.** So, a basic background in Linux at the level of usage of ECS 40 would be helpful but not required. Prior background in R and \LaTeX themselves is NOT required, nor is any background in probability and statistics.

6 Post-STA 131A Courses

After successfully completing this course, you will be qualified to take any course which has STA 131A as a prerequisite, such as STA 131B (mathematical statistics) or MAT 135B (stochastic processes).

7 Machines

When you submit Homework code, it is not considered valid unless it works on the Linux PCs in CSIF.

HERE IS A SHOCK FOR SOME OF YOU: Most jobs obtained by UC graduates in the computer area are at firms that are either fully or partially based on Linux or some other kind of Unix. Google is such a strong Linux shop that it has developed its own version of Ubuntu Linux, Goobuntu.

You probably also know that Android, the popular OS for smartphones and tablets, is a variant of Linux. Apple's OSs, ranging from Macs to iPads to iPhones, are also Unix-based.

Intel has complained that UCD grads don't know Linux well. Of course, students from UC Berkeley know Linux thoroughly.

In other words: If you've been using Windows to do your CS Homework, you've been limiting your future career opportunities! Not a smart strategy, right?

So, if you don't know Linux, you should remedy that problem now, to enhance your future career prospects. And the only way to learn it is to **USE IT IN YOUR DAILY LIFE**—not just for coursework, but also for e-mail, writing term papers, developing Web pages, video editing, and so on.

I have a Linux installation and usage tutorial at <http://heather.cs.ucdavis.edu/~matloff/linux.html>. If you are going to use Linux in your daily life, as again I urge you to do, then I recommend installing on a dual-boot basis. Otherwise, install on USB key or an external hard drive. Instructions are given in my tutorial.

8 Analytical Work Must Be Done in \LaTeX

Most of the Homework questions will be mathematical in nature. It is REQUIRED that you write these up in the \LaTeX word processing package.

\LaTeX is widely used in engineering and the physical sciences. And did you know that \LaTeX is used as the math typesetting vehicle in Wikipedia?

You can learn enough \LaTeX for this course in about 10 minutes; start at <http://heather.cs.ucdavis.edu/~matloff/latex.html>.

Submit BOTH your **.tex** source file AND your **.pdf** file with your Homework.

It is expected that you do a professional job on your writeup. It should look clean and organized. You should

explain your steps in prose; **don't just write a bunch of equations without explanation.** Use professional notation. For instance, the use of * for multiplication should be limited to program code—i.e. it should NOT be used in equations, as it is not math notation. Use juxtaposition or the $\LaTeX\backslash cdot$ instead.

9 Each Student Must Have His/Her Own Course Materials

Note that Tests are open-book, and there is no sharing of books or other materials during Tests, nor are electronic devices allowed.¹ Thus every student must have his/her own hard copy of the textbook and any other course materials.

10 Bring the Course Materials with You to Class

Bring the entire textbook and other course materials to lectures, discussion sections and Tests.

11 Terminology

- the term *Midterm Exam* refers to the midterm examination given in lecture
- the term *Quizzes* refers to tests given in discussion section; see Section 12.2
- the term *Tests* refers to the Exam and Quizzes
- the term *Homework* includes both math and programming work (most courses, other than ECS 132/256, won't have math work)
- the term *Project* refers to the take-home Group project that serves as the final Homework assignment and is in lieu of a final exam

12 Tests

12.1 Exam Schedule

There will be one midterm Exam, exactly one week before the last day of lecture.

There are no early or late midterm Tests. Provisions for oral makeup Midterm Exams will be made if you have a medical excuse. Note: Oral Exams are very difficult for the student, and are difficult for me to grade. Try to avoid this situation if possible. There are no makeup Quizzes; if you miss a Quiz, it simply will become one of the two Quizzes you exclude from your grade.

12.2 Quizzes

A Quiz will be given almost every week in discussion section. Quizzes will not be announced; assume that there will be one each week.

¹An exception is the Group Quiz, given the last day of class.

Quizzes will consist largely of fill-in, multiple choice and very short-answer questions, and thus will not probe quite as deeply as the Exam will.

The last Quiz, given in lecture on the last day of class, will consist of an in-class Group effort.

12.2.1 Partial Credit on Quiz Problems

Quiz problems will be short answer, but you still may be able to get partial credit, in the case of arithmetic or algebra errors, or in the case of code, spelling or syntax errors. In fact, you will probably get full credit in those situations. But it is your responsibility to bring it to my attention.

12.3 10-Point Bonuses on Quizzes

You can get a 10-point bonus on Quizzes quite easily, as follows:

- Before you turn in your Quiz paper during the discussion section, copy your answers to another sheet; the Quiz problems will have only short answers, so this will be quick and easy.
- Later that day, type your answers into a file, and submit it to me using the CSIF **handin** program.
- My grading program will then automatically grade your answers (with some input from me)—and will automatically add 10 points to your score!
- As an added bonus, your grade on the Quiz, both letter and broken down by problems, will be automatically e-mailed to you as soon as the Quiz is graded.

Here are the details:

- Your file name will consist of your official UCD e-mail address plus **.txt**, e.g. **jsmith.txt**.
- The beginning of your answer to problem n must be **#n**, with a suffix of **a**, **b** etc. for parts. Say Problem 1 has the answer 1.23, Problem 2(a) and 2(b) have the answers 8 and 88, and Problem 3 consists of filling in two blanks in code, with answers **x*y** and **if**. Your answers file would then be

```
#1
1.23
#2a
8
#2b
88
#3a
x*y
#3b
if
```

- Log on to CSIF, and run (say for ECS 132, Quiz 6)
`handin matloff 132quiz6 jsmith.txt`

12.4 Coverage

Tests always cover all material through the most recent lecture, including all reading through the latest page covered in lecture. (Note: The instructor will not cover every word in every line on every page of the text. If at Test time the instructor has covered through page n, that means you are responsible for pages 1-n, unless he states otherwise.)

Conversely, during a Test you are not allowed to use material not yet covered in the course.

12.5 Open-Materials Policy

TESTS ARE TAKEN ON AN OPEN-MATERIALS BASIS. Bring the textbook and other course materials with you to each Test. You are also welcome to bring whatever other materials you wish, e.g. technical books, dictionaries, whatever you want. Whatever you bring, **make absolutely sure that you remember to bring all your course materials, as many of the Test questions will refer to specific pages in them.**

Please note that in program code on the Tests you are only allowed to use language, functions, etc. constructs presented in our course.

12.6 Electronic Devices

You are not allowed to use any electronic devices, **INCLUDING CALCULATORS**, during Tests.² (Only simple arithmetic computations will be required.)

13 Regarding Academic Dishonesty

An embarrassing subject which nevertheless must be mentioned is academic dishonesty, i.e. **cheating**.

If a student is found to be cheating, it will be treated as a VERY SERIOUS matter, not a harmless prank. It will harm his/her standing at the university, and also possibly make it difficult for him/her to get a job when seeking employment after graduation.

13.1 UC Davis Honor Code

You can find the UC Davis Honor Code at <http://sja.ucdavis.edu/files/CAC.PDF>. Our course will be conducted according to that code, as of course all classes are.

There is nothing surprising in the code; it's just common sense.

13.2 Tests

Official university policy³ forbids

“Wandering eyes,” talking during exams...or leaving the exam room without permission.

²The last Quiz will involve work on your own laptops, in your Groups.

³See the *Class Schedule and Registration Guide*.

Please work as follows during Tests:

- Try to sit in alternate seats if possible.
- **ABSOLUTELY NO TALKING** to classmates at any time during the Test, **ESPECIALLY INCLUDING** during the time the TA or I are collecting the Tests.
- Keep your Test paper covered when you are not actually writing, so that it will not be so exposed to view.
- It would be greatly appreciated if you **USE THE RESTROOM BEFORE THE EXAM STARTS, RATHER THAN DURING THE EXAM.** Please do not be offended if the instructor or TA reminds you of this policy. And never leave the exam room without permission.

Thanks very much for your help.

13.3 Homework

Outright copying of homework, whether in the form of code or algorithm or math, is of course a serious violation of university policy and personal ethics. Similarly, asking for advice on the Internet, or paying people for advice, is again a serious violation of university policy and personal ethics.

However, you are welcome, and indeed encouraged, trade tips with people in other Homework Groups. You may also on rare occasions ask people whom you know outside the class for hints, say friends or relatives who have some knowledge of the field.

You are also welcome to make reasonable use of the Web. For example, I'm a big fan of Wikipedia and there is a ton of material on there.

14 Lecture Format

14.1 Bring the Materials to Lecture

Make sure you bring the textbook to every lecture. It will play a very active role in the lectures.

I very seldom write on the blackboard. Instead, I talk about what's in the textbook. I typically will ask you to open to a certain page, and then will call your attention to various sentences, examples and pictures on that page. **The lectures will consist mainly of discussion and amplification of the examples in the textbook, with additional examples and comments.**

Since the textbook already contains my lecture, you don't take notes (other than miscellaneous comments in the margin). This frees your attention to ask questions and to engage in class discussion.

You are very much encouraged to bring up any questions you might have. Please don't be shy about asking questions; there is no such thing as a "dumb" question. Similarly, listen carefully to the questions the other students ask; this can be a very valuable source of insight, to which you should pay special attention.

14.2 Use of Laptops During Lecture

Really, this is rude. And though it has become commonplace, I (and many other professors) do not like it, and surveys have shown that many of your fellow students are annoyed by it too. It is very distracting. If

you wish to use a laptop in class, PLEASE SIT IN THE BACK OF THE ROOM.

Use of tablets is OK (during lectures, not Tests), as long as you do so quietly, with the device lying flat on the desk.

15 The Discussion Section

The discussion section is required. It will be used for the purpose of giving Quizzes, and for presenting material not covered in lecture. (That material will appear on Tests.)

16 Groups

The following will be done in Groups:

- Homework
- the last Quiz of the quarter, in class
- the take-home Project

So, get to be very good friends with your Group, as you be working with them constantly!

16.1 Forming Groups

Group size must be at least three (two if the class enrollment is under 25), and no more than four.

You must submit to the TA your Group membership lists by 11:59 p.m. of the day of the second lecture, or the first discussion section, whichever comes first (unless there is no first discussion section). Often, the TA will use the first discussion section to organize Groups.

In working with your partners, you should work TOGETHER, instead of simply dividing up the work among the partners. I've seen many cases in which the partners do the latter, with the sad result that they, for instance, miss an easy 30-point problem on a Test.

16.2 Group Participation

YOUR HOMEWORK PARTNERS DEPEND ON YOU. You must show up at agreed-upon meetings of your Group, or arrange virtual meetings either through e-mail, Skype, Google+ Hangouts etc.

If one or more members of a Group are engaging in little or no participation in a Group, the instructor may separate those students into a Group by themselves. **Consistent failure to work cooperatively with your Group may result in a substantial penalty being applied to your course grade, which could drop to an F.**

17 Our Class Web Page and Blog

Our class Web page is at <http://heather.cs.ucdavis.edu/~matloff/xxx.html>, where xxx is, e.g. 132 for ECS 132. It contains information on office hours and the like.

Our class Blog is linked to from our class Web page. **IT IS REQUIRED THAT YOU READ THE BLOG EVERY DAY**; it's used to announce Homework assignments (including clarifications), Exams and so on.

18 Homework

We will have approximately four to six Homework assignments through the quarter.

18.1 Homework Due Dates

The term *due date* means 11:59 p.m. of the stated date.

18.2 Announcements

Homework assignments will be announced in the class Blog. (Note: An assignment is not official until it is announced on the Blog; just because you see something on our Web page doesn't mean it's complete yet, or even that the final announced product will even be similar.) The Homework specs files themselves will be on the course Web site, so look there when an assignment is announced on the Blog.

Occasionally there will be news about a current Homework assignment, such as clarifications, hints and so on. These will be announced in the Blog.

18.3 Submitting Homework

It is REQUIRED that you use the Linux **tar** command to package all of your files, be it source code, **.pdf** or whatever, into one **.tar** file. The file name will be **email1.email2....tar** where the "email" fields are the official UCD e-mail addresses of the members of your Group, e.g. **jsmith.agutierrez.streddy.tjwong.tar**.

You then e-mail your **.tar** file to the TA.

18.3.1 Special Instructions for ECS 132

Your **.tar** package must include a file **Answers.txt**. The TA's automatic grading program will check these in order to get a preliminary grade on your submission, prior to the interactive grading.

18.4 Grading

We will use interactive grading. The TA will announce Homework grading times, and each Homework Group will sign up for a time slot. **All members of the Group must be present during the grading time.**

During a Group's time slot, the TA will ask each member of the Group questions about their Homework submission, such as "What if the problem had asked...?" or "Explain in detail why you did it this way..."

The purpose of these questions is to ensure that all partners are actively involved in all the work. **The TA will assign separate grades for each Group member. Normally these grades will be identical, but if there is a substantial disparity in the levels of understanding the different Group members have regarding the assignment, the TA will assign different grades to each member.**

18.4.1 Special Extra Credit for ECS 132

For each Homework program designated by me in the Homework specs, the TA will assign Extra Credit to the three fastest programs submitted, i.e. to the three top Groups. This will eventually be recorded in my records. Section 20 explains how I use Extra Credit.

18.5 Project

The final Homework assignment will be take-home and collaborative with your Homework Group, just as with your earlier assignments. It will be very different from regular assignments, though:

- it will be of a different nature, notably in its requirement that you submit a written report.
- it will involve less work than a regular assignment
- you submit your Project by e-mail to me, not to the TA, and I am the one who will grade it
- no late Projects will be accepted
- an especially good Project may substantially your course grade, much more than a regular assignment would

Details will be given later.

18.6 If You Need Help, Hints, Etc.

Please note that Homework assignments here will NOT lay out a detailed recipe, with tons of hints, telling you how to do the problems.

The work is designed to be challenging and thought-provoking. This thought-provoking nature of the assignments is the vehicle by which you get to really understand the concepts. You are not necessarily expected to see right away how to do an assignment. Instead, you are expected to spend a considerable amount of time pondering the assignment, gradually seeing more and more, until you finally see how to do the whole thing. It is that thought process which will develop insight into the course material.

The TA and I will be quite happy to help you, definitely including giving you hints—but only if, after giving a matter considerable thought, you still don't see what to do. Once you have reached the point where you cannot go any further, we very much encourage you to seek help from us. We want you to do well on the Homework!

18.7 Late Work

An assignment is late if it is submitted to the TA after the due date. If you are late, you will be assessed a 5% penalty the first late day, and 10%-per-day penalty after that in your grade for that assignment. (Since e-mail is available every day, each of the seven days of the week counts as one day.) The maximum total penalty is 50%.

Each Group will be allowed a total of 2 late days over the quarter, time which is not penalized. You can use this as being late 2 days with no penalty on one assignment, or as being late 1 day with no penalty in each of two assignments.

In order to use this option, you must submit your work during the time you are using as your grace period. If for example you are 3 days late on an assignment, you will not be allowed to use your grace period time on that assignment; it will simply be counted as 3 days late.

Don't squander your grace period days in the first assignment. The subsequent ones will almost certainly be more difficult, so save your grace time for then.

The TA will keep the appropriate records as to how many days of grace period you have used.

19 Grading

Grading is noncompetitive (there is no "curve"), so it is possible for everyone to do well.

19.1 Weighting

The formula used is

$$\text{course grade} = 0.45 \times \text{Quizzes grade} + 0.30 \times \text{Exam grade} + 0.25 \times \text{Homework grade}$$

where the Exam, Homework and Quizzes grades are each on the 4-point scale (4 for an A, 3 for a B, etc.).

Remember, the Project is also considered part of the Homework. If this is missing, it will not merely be treated as an F. Instead, you will be imposed a heavy penalty on your course grade.

19.2 + and - Grades

The threshold for a grade of n is (n-1).85; the threshold for an 'n-' grade is (n-1).6; the threshold for a '+' grade is n.2. So, for example, if your weighted average from the above formula is between 2.6 and 2.84, your course grade is B-; if the average is between 2.85 and 3.19, your course grade is B; if the average is between 3.2 and 3.59, your grade is B+.

19.3 Quizzes Grade

You will get a letter grade on each Quiz.

In recognition of the fact that on (rare) occasions you will not be able to attend discussion section, or you simply will have an "off day," your lowest two (letter) Quiz grades will be thrown out. Your other Quiz letter grades will be averaged to produce your overall Quizzes grade.

If you receive an F grade on many quizzes, your course grade will be reduced, possibly to an F, regardless of overall grades on the Quizzes, Midterm Exam and Homework.

19.4 Homework Grade

19.4.1 Assignment of Letter Grades

You will receive a letter grade on each Homework assignment. The instructor has directed the TA to evaluate your work as follows:

Assessment of the quality of a Homework Group's work is to be based on the TA's judgment, subject to the following guidelines. Since the TA and instructor provide whatever help is needed (though as a "last resort"), it is expected that most students will get A or A- grades on the Homework assignments, with an A- indicating that the work was correct except for minor problems. Grades in the B range are to be given if the material is "mostly correct," while grades below that range will be given for work of lesser quality.

Note carefully that students in a Homework Group are assigned grades individually. Though they typically will all get the same grade, that is not necessarily the case. See Section 16.

19.4.2 You Must Turn in All Assignments to Pass the Course

Note that all Homework assignments must be completed in order to get a passing grade in the course. **If you are missing any assignment, including being found not to have worked actively with your HomeworkK partners, your course grade will be substantially reduced, possibly to an F.**

19.4.3 You Should Get an A or A- on the Homework

I aim for the vast majority of the class to get an A or A- on the Homework. Lots of help is available, so this aim should be achievable. (And it is; I use this policy in every course I teach, and it always works out that most people get A or A- Homework grades.)

The most important part of getting a good Homework grade is to **start an assignment as soon as it is assigned**. Don't wait until a few days before the due date to start. **And make sure you have read the textbook thoroughly before starting.**

19.5 Getting Feedback from the TA

My agreement with the TA is that he/she must grade Homework within one week. TAs are students themselves, so this shouldn't be a completely firm rule, but if you find that the TA is consistently slow in grading, please remind him/her, and let me know as well.

19.6 Intangibles in Your Course Grade

This is not "CHEM 1A-style grading," calculated purely by formula, in which falling 0.5% below the cutoff point for an A results in a grade of B. The grade as determined above is just a lower bound. I can and often do use intangibles to increase your grade above that that the formula in Section 19 would give. I would estimate this occurs in 20-25% of all the course grades I assign.

Extra Credit counts, of course (Section 20). Also, I have an "all's well that ends well" view; that a record of marked improvement near the end of the course will be given very positive consideration, as it indicates insight into how all the course concepts integrate with each other.

Negatives can be an obstacle. Those who miss Quizzes (except for medical or similar reasons) will probably not receive the benefit of such intangibles. Again, though, no one will be given a grade below what the rules of the course provide.

Exceptionally good work on the Project may be rewarded in terms of increasing its weight in your course grade.

20 Extra Credit

I give Extra Credit (EC) for all kinds of things. If during lecture a student makes an insightful remark, or answers a tough question I throw out to the class, I record EC for the student. If a student gets a Test problem right that no other student gets, or only a couple of other students gets, then I give EC. In the case of ECS 158, I give EC for writing very fast programs.

So, how do I use EC? There are two main ways: (a) EC can and often does raise the student's course grade at the end of the quarter. (b) I make use of EC when recommending the student, for a job or grad school.

21 I Do Care!

I wish to emphasize that I care very much that you succeed in this course, and I look forward to getting to know all of you.