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Notes

This syllabus gives you detailed technical information about this class, and it describes proven techniques to succeed in Calculus. Make sure you read every word and take it to heart.

Time and Place: Our class meets MTWF 8:35-9:25am in PAB 103. There are two labs associated with this class. One, 1320-10, meets in LCB 222, on Thursdays, 7:30-8:20am. The other, 1320-11, meets in LCB 225, on Thursdays, 8:35am-9:25am. You register either for 1320-10 or for 1320-11, and you will be automatically enrolled in 1320-9.

Instructors: Peter Alfeld, JWB 127, 801-581-6842, pa@math.utah.edu. The Lab Sessions are run by Sanghoon Kwak, LCB Loft, 801-581-7653, kwak@math.utah.edu.

Office Hours: My formal office hours are after class, MTWF, 9:40-10:30. You are also welcome just to drop by my office, but of course I may not be there or I may be busy with someone else. If you need to make a special trip or arrangements to see me let’s make an appointment so you can be sure I’ll be available. Sanghoons office hours will be Tu, 1:30-2:30pm, in WEB 1705, and We, 9:30-10:30am, in the LCB loft.

Class Home Page: at

http://www.math.utah.edu/~pa/1320

Important Dates:

1/6/20 Classes begin
1/10/20 Last day to add a class without a permission code
1/17/20 Last day to drop a class without being charged tuition
3/6/20 Last day to withdraw from a class. You will be charged tuition.
4/21/20 Classes end.
4/22/20 Reading Day (no class)
4/23/20 Final Exam (8:00-10:00am)

Class Notes: I prepare for class by writing notes before class. These will be online and you can look at them before class. They will contain gaps that we will fill in together, during class. I plan to project those notes onto a screen and fill them in by writing on my Ipad. Later that day I will replace the online notes with their annotated version. An asterisk on our home page will mark that the replacement took place. The main purpose of making my notes available in this fashion is to enable you to pay full attention to our discussion without being distracted by having to take detailed notes yourself. However, otherwise these notes come without warranties expressed or implied. The notes may contain errors (that hopefully will be recognized and corrected in class), and I may deviate from them during class. In particular, these notes are not eligible for our one point contest (see below).

Grading: 14 WeBWorK Home Works (2% each), 1 final exam (28%), 3 midterm exams (8% each), Labwork (20%). As discussed below, the exams are closed books and notes, no electronics. You answer the questions on the exam itself. All you need to bring to the exam is a dependable writing utensil.

Fixed Scale: Grading is according to the following scale:

<table>
<thead>
<tr>
<th>≥ 90%</th>
<th>≥ 85%</th>
<th>≥ 80%</th>
<th>≥ 75%</th>
<th>≥ 70%</th>
<th>≥ 65%</th>
<th>≥ 60%</th>
<th>≥ 55%</th>
<th>≥ 50%</th>
<th>≥ 45%</th>
<th>≥ 40%</th>
<th>else</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>A−</td>
<td>B+</td>
<td>B</td>
<td>B−</td>
<td>C+</td>
<td>C</td>
<td>C−</td>
<td>D+</td>
<td>D</td>
<td>D−</td>
<td>E</td>
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The fact that this scale is fixed means that you are not competing with your class mates. You are not going to get a worse grade because somebody else is getting a better grade, and your grade is up to you alone!

Home Work: The primary purpose of home work is to give you a guided opportunity to practice and improve your skills. In this class you will receive personalized home work assignments that you do on the web at a time that’s convenient for you. If you give the wrong answer the computer will tell you so and you can try again. That way you will receive immediate feedback. The underlying software is called WeBWorK and details will be announced. Home works will open every Monday morning one minute after midnight, and close eight days later on Tuesday evenings, one minute before midnight. The first home work will be mostly an introduction to WeBWorK and a brief reminder of some prerequisites. The last home work will be a review of the entire semester. Otherwise, the home works will cover the material that we discuss in class during the time the home work is open. You will get the maximum benefit from the home works if you start working on each right after it opens, and you complete each problem after class on the day that we covered the relevant topic. However, if you fall behind you do have a few days to catch up while two home works are open simultaneously during the week.

Labs: The home work problems are mostly of a routine nature. In the labs you will work with partners on projects of greater depth to improve and solidify your understanding of the concepts we discuss in class. The last lab session, and those before a midterm exam, will be used for additional review. There is a link for more information on our home page, or you can go directly to

http://www.math.utah.edu/˜kwak/1320/1320lab_syllabus.pdf

Midterm Exams: We will have three midterm exams, one for chapters 6, and 8, one for chapters 9 and 10, and one for chapter 11. There is no exam specifically on chapter 12, but that chapter will be covered on the final exam. The exams will take place Fridays, with the idea that I hopefully can return the graded exam on the following Monday. You’ll be asked to answer the exam questions without using notes, books, or electronic devices of any kind. After each exam, you will receive an answer sheet that will detailed information (more than you need to provide on the exam) about each problem and its solution.

Final Exam: The final exam will be in our regular classroom (PAB 103) on

Thursday, April 23, 2020, 8:00-10:00am.

It will cover the entire semester, chapters 6 and 8–12, of our textbook, with approximately equal parts dedicated to each chapter. Like the midterm exams, the final will be closed books and notes, and no electronics.

One Point Contest: I want the assignments in this class to be perfect, and fix any errors as soon as possible. Therefore, if you discover a mathematical or factual error in the printed materials (i.e., the home work problems, exams, or exam answers) and you bring it to my attention before I can fix it, you will receive one extra percentage point towards your final grade. This is fair because it requires you to think deeply about a problem, and it may also alleviate your frustration due to, for example, WeBWorK having been given the wrong answer. But note that this contest only applies to mathematical and factual errors. I also appreciate if you bring other mistakes, like misspellings or grammatical errors, to my attention, but there are no extra points for those. The contest also does not apply to the daily class notes.

Make ups: You should make every effort to participate in all midterm exams. If you have to miss a midterm for a legitimate reason, then talk to me, preferably before, but no later than one week after the
midterm. I will add the weight of what you missed to the weight of your final. Thus effectively you will get the same percentage on the missed midterm as you will on the final. That’s reasonable since the final is comprehensive. If you need to miss an exam because of official university business and this procedure does not meet your needs please talk with me to make an alternative arrangement. You are required to attend the Labs. Weekly assignments will be handed out in the labs, and will be due a week later. There are no make-ups for lab assignments, but the worst two lab scores will be dropped from the calculation of your final grade. As far as the home works are concerned you are expected to finish each home work before the next one opens, but there is a two day grace period during which you can catch up if you fall behind. Because of that grace period, and since you can submit your home work online from anywhere, there will be no make-up for home works. Any make-up or substitute for the final exam itself will be an oral exam, and will be available only in exceptional circumstances.

Calculators, Computers, and Google Searches: I use calculators and computers all the time, and I search the internet many times every day. These are great tools, but they need to be used with care. There are pitfalls! Suppose you prepare to climb a mountain and your training program calls for jogging around the block a few times every day. You’d defeat the purpose if you used your car to drive around the block, even though that may appear easier at the moment. Technological devices carry the same risks for learning mathematics, they may reduce your mental fitness. The skills that you will learn in this class will enable you to solve problems of a complexity that will amaze and gratify you, and that are quite inaccessible to a mechanical use of technological resources. However, to build up to these skills you’ll be given simple exercises that you could in fact do on a calculator or computer, or for which you could find the answer by a Google search. But using these resources would deprive you of an opportunity to learn. It is also useful to build your number sense by doing simple calculations in your head rather than on a calculator. A calculator is good for handling messy arithmetic in a case where you already have a good idea of the answer. It’s much less useful, and may actually have a deleterious effect on your efforts, to get the first answer in a situation where you have no idea what to expect. I recommend you get into the habit of doing simple arithmetic in your head, and estimate mentally any answer before you actually compute it using some technological tool. To help you in this endeavor, calculators are not allowed on exams. The problems will be set up so that you don’t need them. Your numerical answers should consist of simplified algebraic expressions. For example, write

\[
\frac{2 + \sqrt{2}}{3}
\]

and just don’t worry about the fact that rounded to 6 digits this expression equals 1.138071. You may use any tools you like including calculators and computers for the homework. However, to prepare for the exams you should use these facilities only if you really need to, and always estimate mentally your expected answer before computing it. You can spend a lot of money on rather fancy calculators these days. Some calculators can manipulate mathematical expressions (rather than just numbers) and draw various graphs and display various types of data. However, much more powerful and convenient facilities for these latter two tasks are readily available on University computers, and can be purchased for home computers. In particular you may wish to explore the languages maple and matlab. The University has a site license for both of these programs. Also well known and widely used is Mathematica. I have owned several fancy graphing calculators but I have found that I only need a basic scientific calculator (that can evaluate trigonometric functions, exponentials, and logarithms), and that it is much better to use a full blown computer for more complicated tasks.

What it Takes:

Many students will do very well in this class. The following paragraphs are directed mostly towards those who may not.

In our introductory classes, when students are unsuccessful this is usually due to one or more of three specific reasons:

1. Failure to appreciate and utilize the fact that Mathematics is hierarchical. You cannot understand new mathematics if you don’t understand the mathematics that precede it. On the other hand, if you do have a solid understanding of the prerequisites you can acquire a working knowledge of new mathematics easily and efficiently.

For this class this means you must understand the topics taught in Math 1310. You can find a summary
of the class Math 1310-9 of Fall 2019 on our home page. If you do not understand these topics then you
would be spending your time inefficiently and unproductively in this class. You’ll be better off dropping the
class, and going back and preparing yourself better for taking Calculus. If you have any doubts about your
preparation for this class I’d be pleased to talk with you and make suggestions for your course of action.

Focus on understanding the subject rather than memorizing recipes for doing simple things. You understand
a piece of mathematics if you can explain it in terms of simpler mathematics, you can make multiple logical
connections between different facts and concepts, and you can figure out how to apply the mathematics to
solve new problems. Too much teaching of mathematics is directed towards memorizing and rehearsing the
application of simple recipes to narrow classes of problems. Focusing on the underlying connections and
learning how to figure things out is vastly more efficient and empowering than trying to memorize countless
formulas.

2. Failure to recognize the importance of acquiring and using precise language. If you don’t under-
stand the language you cannot think clearly about the subject, and if you can’t think about your subject
you can’t understand it.

It is crucial, it will save you time and effort, and it will deepen your understanding and appreciation of
Calculus, that whenever we introduce new terms and phrases you make sure you understand precisely what
those terms and phrases mean, and that you can and do use them when thinking about the subject and
talking with fellow students, tutors, or me, about the subject. To that end, utilize the index of the textbook,
and make a habit of having an ordinary dictionary handy when you study or work on your home work. Make
sure you do use the dictionary or textbook whenever you encounter a word and you are not dead certain
that you understand fully what the word means.

3. Not being able or motivated to spend the time necessary to learn the subject. You can’t learn
mathematics in a hurry. On the other hand, if you do spend the time it takes, and spend it wisely this
process feeds on itself and you will become much more effective and efficient in your studies. Taking any
math class is a serious enterprise that requires your commitment, time, and energy. We are all busy, and
there are many competing claims to our attention, all of which are legitimate. It’s not a moral problem if you
don’t have enough time to dedicate to this class. But it is a fact of life that understanding new mathematics
takes a great deal of time and effort, and if you are not prepared to spend that time and effort you will
not understand the mathematics. As a guide-line, when taking a math class on a subject you are not yet
familiar with, you should count on spending about three hours out of class studying and doing homework,
every hour in class. So for this 4 unit class you should count on spending a total of about 20 hours per
week (five hours in class and labs, and 15 studying and doing home work), approximately and on average.
Moreover, you should be able to spend that time in good sized chunks without distractions. Think of this
class as a full blown half time job! If you are unable to spend that kind of time, you are better off taking
Calculus during another semester when you do have the time.

Almost inevitably, when I mention to people that I am a mathematician I hear a response such as, I’m
not a Math Person or I’m just not good at math. But note that the above three reasons do not include a
general inaptitude for mathematics. Many people feel they are intrinsically unable to learn mathematics.
This feeling is usually sincere, but it’s also irrational, a poor excuse, and unnecessarily self-limiting. You
may not be able to make mathematics your career, but anybody can study mathematics successfully. If you
follow the suggestions given here in the next few paragraphs you will succeed.

Study Tips

Make sure you do not fall behind: This is the most important suggestion in these pages! If you
miss just one key idea you will not properly understand what we are doing and your subsequent time and
effort will be wasted. Saving two hours today may result in wasting days and weeks later.

Come to class each time: I will keep reminding you of the big picture, point out what parts of the
subject are crucial, explain the key ideas, and make suggestions for your study. Feel free to ask questions
during class, in fact, I encourage you to do so! If you have to miss class on occasion make sure you study
the relevant section in the textbook and ask a friend or myself what happened in class.

Before attending class: Read the relevant section of the textbook. Enabling you to do this is the
main reason for giving you the detailed schedule on the first two pages of this syllabus. You will receive
updates if the schedule changes. Even if you don’t understand everything at your prior reading, the discussion in class will be much clearer for you, and overall you will save time.

**After attending class and before attending the next class:** Make sure you understand what we did. Go over my notes (and any of your own), write a summary in your own words, do examples, choose and work exercises (see below), make sure you understand any new language, think about the big picture, question assertions made in class or in the textbook, try different arguments to get the same result, check things for plausibility and consistency.

**Seek Help:** Work with friends or study partners. One of the most enjoyable aspects of being a student is that you get to meet new people, and that you are exposed to new ideas, and new ways of thinking. Make use of that opportunity in the context of this class. To find study partners you can of course just ask the person sitting next to you. But if you like send me a detailed and complete message stating that you are looking for study partners and giving contact details and information on what places and times are suitable for you. I will forward that information verbatim to the whole class, and then it is up to your fellow students to contact you. It’s OK if you and your partner or partners have different levels of experience or ability. One of you will benefit from explaining something and the other from having something explained again in a different way. If there’s something none of you can figure out, use our free tutoring service (see the next item) or talk with me.

The **T Benny Rushing Mathematics Student Center** is located on the President’s Circle between the Widtsoe and Cowles buildings (JWB and LCB). It offers very pleasant study space, free tutoring, and a computer lab. My office is just down the hall from the center. For information on facilities and hours of the center call our director of student services, Aryn DeJulis, at 801-585-9478, send her e-mail at dejulis@math.utah.edu, or check out http://www.math.utah.edu/ugrad/mathcenter.html

**Private Tutors.** The Math Center has a list of private tutors you can hire for a fee. The ASUU tutoring center http://www.sa.utah.edu/tutoring/ also offers private tutoring (at subsidized rates). However, keep in mind that while tutors may be a great resource, they do not know exactly what we discussed in class. They know the mathematics, but they may tell you about a technique of solving a certain problem, or use a concept, that requires information which we did not discuss in class. I recommend that instead of spending money on tutors you find study partners in our class, as described above.

**Online Lectures:** The department offers online lectures covering Math 1010, 1030, 1050, 1060, 1210, 1220, 2210. (Our regular calculus sequence, Math 1210-1220-2210 covers the same topics as 1310-1320, although in a different sequence and with a different emphasis.) To see any of the lectures start at http://www.math.utah.edu/lectures/

**Exercises:** You can learn mathematics only by doing mathematics. In the context of a class like this, this means you work *exercises*. In this class you will of course do many exercises using WeBWorK, but you have to go beyond that. Which and how many additional exercises you should do depends on your background, your current understanding, and your interests. Rather than giving you a list of exercises I believe you are better served by your picking the exercises yourself and me giving you just some general guidelines. The best way to find good exercises is to make them up yourself, but there are also a great many exercises in the book, ranging from very simple problems letting you practice just one specific technique to quite sophisticated and deep questions. But don’t hesitate to make up your own exercises. Ask yourself “what if . . .” and see where it takes you. Follow these guidelines:

- It’s more useful to do a few involved exercises carefully and thoroughly than rushing through a large number of routine problems.
- Regarding most of the exercises in the book you should be *able* to do any of them unless they call for some mathematics that we didn’t cover, or there are some arcane details of a word problem that you are unfamiliar with.
• However, this does not mean you should do all of those problems. Instead, look over the problems. If it’s obvious how to do a particular problem, and it’s not otherwise interesting to you, skip it. If you are not sure, start the problem, and either finish it, or once it becomes clear what’s happening, drop it. If you have no idea how to do a problem, and your difficulties are related to the math we are doing, then go back over your notes, talk with people, figure out what you are missing, and then return to the problem.

Simplify Your Problem: A major problem solving technique that is often ignored by students is simplification. You will not solve a difficult problem on the first attempt. When a problem seems hopeless, then simplify it until you reach a problem that’s still related to the original problem but that you can solve. Then solve the simpler problem and use what you learned in the process for the solution of the more difficult problem. We’ll see many applications of this idea in the course of the semester.

Always Check your Answers: Everybody makes mistakes, and you simply have to recognize this fact and guard against it. You should always check your answers. The answers to odd numbered problems are in the book, but that should not discourage you from working even numbered problems or making up your own\(^1\). You can check your answers by computing the same result in different ways, by checking for plausibility and consistency, or by using more specific techniques such as substituting in the original function or equation, checking integration by differentiation, drawing a graph, or making sure that physical units are consistent. (For example, if your analysis calls for adding two seconds to a square foot than something must have gone wrong.) One major checking technique deserves its own paragraph:

Always Have Expectations: Before you enter into any calculations think about what kind of answer you expect. When you are through compare your answer to your expectations. There are several possibilities. Your answer may meet your expectations. That’s great, it will give you a warm and gratifying feeling, even though you may not have learned a lot. If the answer differs from your expectations then there are two possibilities: you made a mistake and you are now alerted to that fact, and you can figure out what went wrong. Or, and this is the most exciting case, there is something you misunderstood before you began work on this problem, and now you can improve and correct your understanding, and learn something new!

Hostile Testing: When checking your answers, to be effective in finding errors, apply what the air and space industry calls hostile testing. This means that you approach your answer with the expectation that it’s wrong and you try to prove that it is wrong. That way, if you fail, then maybe your answer is actually correct! Apply the same attitude to your textbook and to what your teacher tells you. (If you think I’m making a mistake in class, don’t hesitate to speak up!) You are more likely to find errors, and you end up processing what you read or hear with a much higher degree of awareness and effectiveness.

How to take Exams: There is only one fundamental way to prepare for an exam: make sure you understand the material. Rather than worrying about what specific problems might or might not be on the test, just make sure the mathematics covered by the test make sense to you, following the suggestions above. Here are some more suggestions specifically with respect to exams:

• Cramming does not work. That is particularly true in mathematics. Instead study steadily throughout the semester, and relax and do something fun the day or the night before the exam. Make sure that you are well rested for the exam.

• There is always someone late for the exam. It seems a trite thing to say, but make sure you come to the exam on time and unfuffled by having to rush and worry. Just allocate a little more time to coming to class than you would normally.

• When you actually receive the exam, relax, and read all the instructions and all the problems, before you start working on any of them.

• Then do those problems that are easy or obvious. Not only does that give you a good start but also it may teach you or remind you of something that’s useful for the other problems. There is rarely a good reason to do the problems in exactly the sequence in which they appear on your piece of paper.

• If you get stuck put that problem aside and return to it after you are done with the more tractable problems.

• When you are through and there is time left, don’t leave! Instead, check your answers and make sure they are correct. You’ve spent a lot of time and money getting to the stage where you are taking that exam, and a lot is riding on it. Being able to correct a mistake you made far outweighs the benefits of being able to spend 20 minutes more on whatever else you like to do.

\(^1\) If you are not sure of an answer to an even numbered problem, or one you made up, talk to me.
• Even if you feel you don’t understand a question, or several questions, at all, don’t just leave. Write what you do understand and spend all the time you have available trying to figure out even those problems that appear hopeless.

• After the exam go over the answers (which in this class you will receive as you walk out the door). The exam is not an end in itself, you are here to learn the subject, and reading and thinking about problems you have just wrestled with is extremely helpful in this process.

**Great Study-Guide:** Go to Google, enter the phrase “Understanding Mathematics”, and click on the first link after any Google Ads that you may see. The information you’ll find will resolve all your math issues.

**Great Math Book:** The book by Courant and Robbins: "What is Mathematics" (566 pages, 2nd edition, August 1996, Oxford Univ Press, ISBN: 9780195105193) was first published in the 1940s. The book has been phenomenally successful and is still in print. It has turned on untold numbers of youngsters to mathematics (including myself some time ago). It’s available as an inexpensive and highly recommended paperback.

**The \TeXbook:** During this semester you will receive a number of handouts (like this syllabus, tests, answer sets) containing **typeset** mathematics. I’m using the \TeX typesetting system which is a true work of genius\(^2\). You can use it yourself easily, and you may enjoy learning about it. To use it you need a computer supporting \TeX, which is in the public domain. Let me know if you are interested and I can tell you how to get going.

**The Keynote Speech** for this class is given by Sir Isaac Newton who lived 1643-1727 and was one of two independent inventors\(^3\) of Calculus. You want to learn how to reason nimbly and judiciously, rather than turn into a vulgar mechanic:

> A Vulgar Mechanick can practice what he has been taught or seen done, but if he is in error he knows not how to find it out and correct it, and if you put him out of his road, he is at a stand; Whereas he that is able to reason nimbly and judiciously about figure, force and motion, is never at rest till he gets over every rub.

Isaac Newton to Nathaniel Hawes, 25 May 1694

**Basic Principle:** I used to write long explanations of the dire consequences of waiting too long to begin work on a project, but after many years I managed to condense those treatises into three words. Believe me:

**Procrastination is Hazardous!**

You are going to learn some powerful stuff, and hopefully you’ll even have some fun in this class, but get going right away and make sure that you stay on top of things!

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\(^2\) The genius is Computer Science Professor Don Knuth of Stanford University. Calling \TeX a work of genius is controversial. I have also seen it called a “hideous hack”. I believe in my opinion, but you will have to form your own.

\(^3\) The other was Gottfried Leibniz, 1646-1716. Newton invented Calculus first, but Leibniz published his work first. The two of them carried on a bitter quarrel about who deserved credit.
Legal Matters

Student Information: The instructors in our department have access to the following information about the students registered in their classes: Name, preferred name (if entered in your CIS account), your contact information, your student ID number, and your photograph (to help us learn your names) on your University ID card. Most of us, including me in particular, do not have access to other parts of your University Record.

Note: The University requires the inclusion of the following items in any syllabus. However, while I have no special authority, training, or expertise, in any of the matters discussed in the following points, please don’t hesitate to talk with me privately and confidentially about your personal circumstances if you believe this may be useful.

Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for acting consistently with its content.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the course, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Sexual Misconduct: Title IX (of the Education Amendments Act of 1972) makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

Wellness Statement: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For support and confidential consultation, contact the Center for Student Wellness, 801-581-7776, https://wellness.utah.edu/, or the University Counseling Center, 201 S 1460 E, Rm 426, Student Services Building, 801-581-6826,https://counselingcenter.utah.edu/. For after-hours emergencies, contact the 24/7 Crisis Line 801-587-3000.

Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.