II. Quantitative Literacy in Forensics

a. We are proposing to add a more pronounced quantitative perspective to an existing course. This process has been ongoing since 2011. More than 40% of the lecture and more than 80% of the labs require logical or quantitative reasoning.

b. Forensics Science Studies Lecture (Phys 110, 2 credit hours) and Lab (Phys 111, 1 credit hour, co-requisite) will be taught by various instructors. All instructors will be given “maps” or lists with the topics covered and the learning objectives or tasks to be addressed with that topic (see attached in the end). Forensic Science Studies is a course taken by mostly sophomores and seniors and criminal justice majors.

c. Forensic Science is a natural fit for the inductive reasoning process. In science, hypotheses are formed on the basis of data. For many students, neither the data nor the hypotheses to be formed are of interest, because the impact of a false conclusion drawn from data is not apparent. In Forensics however, the lives of human beings are at stake. Sloppy measurements, ignorance of the error of measurement techniques, wrong logical inferences and sloppy expressions of probabilities lead to catastrophic results (FBI admits flaw in hair analysis). As such, the focus of the course is DILIGENCE in the measuring process as well as in the thought process. In this context, Quantitative Reasoning is a part of logical reasoning, e.g. if this piece of evidence is found at the crime scene, what can you infer? Another logical reasoning process is deductive reasoning, which is subconsciously (or consciously) often applied by jurors, judges and prosecutors: If the suspect is guilty, isn’t it likely that this piece of evidence is found? These two thought processes lead to different statistical inferences and are often confounded with inferences about the guilt or the innocence of the suspect.

   Students will get opportunities to analyze evidence found (by measuring and calculating) and compare the results to statements from witnesses about the event of a crime. They will have to detect contradictions or confirmations and justify their conclusions in writing based on their data. These written submissions will often be submitted as an “official” forensic or legal document (including header etc..) to make the students aware of the potential consequences of their work.

   In lecture we will explore various types of evidence, e.g. eye witness testimony, fingerprints, blood groups and blood spatter, etc.. and discuss their reliability and their statistical value. Students have to find the appropriate data from statistical information, apply it correctly and interpret how the data influence the conclusions they can draw about the guilt or innocence of a suspect. To improve learning, students will get immediate feedback in class discussions or CANVAS discussions. In lab we will analyze evidence in various ways, e.g. by measuring or comparing. Emphasis is put on
documenting the work done in graphs, photos and in written form. Quantitative reasoning will be applied when we discuss the meaning and the value of graphs, e.g. the dependence of blood spatter on the distance fallen or the statistical distribution of body measurements among class members. (Which form of a graphical representation is better to illustrate the most important message of the data?) It should be noted that the labs are hands-on, and are almost structured like a flipped class room. There is no lecture, students work in pairs and refer to the book for questions. Feedback about the measuring process in lab is immediate during the experiment. Feedback about written summaries (lab reports) is given individually through Canvas, in the next class for all and/or peer review though CANVAS. Students are given the opportunity to revise some (not all) reports based on the feedback provided.

A Student's comments in a journal:

Overall, I think that Forensic Science is different from other classes because it requires a different thought process. Many classes require pure memorization and repetition. While there is some of that in Forensic, there is a lot of objective thinking where you need to piece together facts and clues to form a conclusion. This logical thinking makes for a very different class because no matter how much you study one example, another example could require a whole different way of going about it mentally.
III. Examples

a. Example from Lab: Determination of the time of death

Hit and run accident in Royal Street!

Dog killed in car accident!

While on vacation at your grandmother’s house, you hear her suddenly scream on the street. You and her neighbor Mr. Nash run towards her, where she is bent over Maxwell, her beloved Queen City Dog\(^{(1)}\). The dog was obviously killed by a car and your grandmother accuses the neighbor (mainly because he is a foreigner and works at odd hours). The neighbor denies any involvement and claims he was on the telephone with his mom for the past 20 min. You can corroborate his story, because you heard him from the garden. You want to avoid that this incident creates a rift of suspicion between your grandma and Mr. Nash (who works in the computer business). Since the police will not invest a lot of time in this case, you take over. You carry the dog into the garden. It still feels warm to the touch and you start measuring its body temperature. Neither Lividity nor rigidity has set in. You have to use the decreasing temperature to find out when the dog died. This is the only way to exonerate the neighbor from the hit and run accident.

Your task is to clearly explain to the neighbor and your grandma why or why not his telephone conversation lets him of the hook in the hit and run accident.

\(\text{(1) From the Encyclopedia Cincinnatiense:}\)

The Queen City Dog (cane caldus reginae oppidi) is a dog with a short, stout body and very small -sometimes even vanishing- extremities. Because the Queen City Dog is very little, it has a very high core body temperature of 167° Fahrenheit, which is the reason for its nickname Hot Queen City Dog. It is also a favorite pet for old ladies.

A. Start measuring the temperature of your grandma’s dead dog:

1. Open the coolingV2 program on your computer.

2. Insert one temperature probe into the dog. Then press the green COLLECT button to begin measuring the temperature in Celsius\(^{(2)}\) as a function of time.
7. Measure the temperature for 20-30 minutes. You can change the time scale by pressing the CLOCK button to the left of the COLLECT button.

B. Meanwhile, you reflect on how you could use this measurement to figure out whether your grandma’s neighbor could have been the hit and run driver. First, you scribble a tentative cooling curve of Maxwell’s body -starting immediately after he died- on a piece of graphing paper. Questions that come to your mind are

1. What would be the axes?

2. What temperatures do I expect to measure? How long will it take Maxwell’s body to cool?

3. What temperature will Maxwell’s body reach? How will it reach it? Smoothly? Sharply?

C. Now you use the data from your measurement to draw the real cooling curve of the Dog into the same graph. You realize that you heard in your Forensics class that the process of cooling can mathematically be described by the function

\[ \text{Temperature} (t) = A \cdot e^{-rt} + B \]

1. How can you use your curve and this function to state or refute Mr. Nash’s alibi?

2. Remember that you have to crack or support the alibi of the computer guy, Mr. Nash. Design a big poster that explains your reasoning and the results of your reasoning to Mr. Nash and to your grandma. Use pictures, mathematics and a neat graph to support your claim.

(You can pick up big post-it notes from your instructor.)
b. Example from Lab: Interpreting blood stain patterns

Blood stains in the physics hallway!

What happened?

You are called to a crime scene where you have to evaluate the blood stain pattern. The victim is Mrs. Julia Morale. She has a head wound, is unconscious and has been transported to the hospital.

A witness, Mr. Warren Long, reports: “I entered the hallway and saw the victim standing in the center of the hallway. She was beaten by someone with an object that I could not see clearly. When he saw me, he ran away.”

Can you corroborate the statement of the witness by “reading” the blood stain pattern or do you have doubts regarding the statement?

You will have to find the answers to the following questions:

From where did the spatter originate? Where was the victim? And what instrument was used or NOT used? What might have happened? Or what did NOT happen?

Document! Document! Document!

(For example, on a sketched floor plan, draw a line showing the trajectory of the blood on its way from the origin to the spatter. Use a protractor to get the correct angles, and be very careful. Indicate where the spatter originated by labeling the height and the distance to the walls in meters. Use photographs if possible.)

Use your data to justify your conclusion and write a report in the attached format.

Procedure:

1. Were the stains created by low, medium or high velocity impact? What instrument might have been used? Determine the overall size of the stains and check your book or your notes.

2. Now, determine the point of convergence: You will need to place your ruler or meter stick along the longest axis of a spatter and draw a line from the trailing end of the spatter back along the ruler (Use ONLY dry erase markers). You will need to perform this step for a number of the blood spatters and you will see that the extensions of the lines through their length will all meet within an area on your paper or tag board.

3. In which direction relative to the spatter was the victim standing?:

Place a rod at the point of convergence of the lines drawn on your spatter surface. Be sure that the rod is as nearly at the point where the lines meet as possible. This way you have located the line from which the spatter originated. The origin of the spatter and thus the victim must have been positioned somewhere along the rod.
4. **How far along the rod was the origin?:**

Determine the angle of impact of a number of spatters in the pattern by measuring their widths and lengths. Record these measurements in a data sheet. Keep track of which spatter has what angle. You may find that not all of the values agree with each other.

5. Tape one end of the string to the surface upon which the spatter is seen, at the edge of the spatter closest to the point of convergence. Use your protractor to elevate the string to the angle of impact you determined for that spatter. Fasten the string to the rod, located at the point of convergence, by tying or by the use of tape. Continue these steps for all of your recorded spatters. You will end up with strings meeting the rod at heights that show the origin of the spatter and most likely the position of the victim during the progress of the crime. Do not expect that the strings will meet the rod at exactly the same place. The body of a person has mass and volume, so the strings will meet in an area of that body, not a single point. A bullet wound, producing spatters, will meet in a much tighter area than those produced by being struck with a large blunt object, such as a baseball bat.

6. **So from where did the spatter originate? Where was the victim? And what instrument was used or NOT used? What might have happened? Or what did NOT happen?**

   Document! Document! Document!

   (For example, on a sketched floor plan, draw a line showing the trajectory of the blood on its way from the origin to the spatter. Use a protractor to get the correct angles, and be very careful. Indicate where the spatter originated by labeling the height and the distance to the walls in meters. Use photographs if possible.)

   Use your data to justify your conclusion and write a report in the following format:
Blood Spatter analysis in the Case Julia Morale

Where:

When:

Results of the analysis: Succinctly state your conclusions here and justify them.

Respectfully submitted

Attachments: Add supporting material here, for example photos that you took and to which you refer in your conclusion.
c. Example from Lecture:

Was he the attacker?

The class is told the following story:

_The victim of an attempted rape in Cincinnati, a young woman, testified that she was too shocked to remember much but that she is sure her assailant was a white man with red hair, between 25 and 35 years old. A witness testified that he saw a Caucasian red haired man near the scene of the crime and drive away in a yellow car._

_Several days later, officers arrested a man who matched these descriptions. The victim identified him as the perpetrator, the witness was unsure. The accused man is an unemployed construction worker. The car was correctly registered in his name._

_For instructors:_

1. Pose the questions:
   - Is he guilty?
   - Could he be innocent?
   - On what does it depend?

2. After it is clear that frequencies of occurrence will play a role, use statistics available on the web to find quantitative answers to the following questions:
   - How many people in Cincinnati would be male?
   - How many people would be Caucasian?
   - How many would own a yellow car?
   - Etc...

   Use Venn Diagrams to visualize the connections among these groups.

   Discussion point: Does the information about the unemployment play a role?
   - How does the identification of the witness come into play?
   - What if the perpetrator or the suspect is not from Cincinnati?

3. After the number of people in the group of Caucasian, young, red haired owners of a yellow car has been estimated, pose the following question:

   _Given these considerations, what are the chances that he is innocent? What are the chances that he is guilty?_

   **Teaching point:** The frequency of occurrence of Caucasian, young, red haired owners of a yellow car is not equal to the probability of being guilty. (Prosecutor’s fallacy)

   **Discussion point:** How “much” probability of being guilty is necessary for an arrest? For a conviction?
**d. Example from Lab: Biometry**

**CAN A SET OF NUMBERS UNIQUELY IDENTIFY A PERSON?**

In 1882, Alphonse Bertillon, Director of the Identification Bureau of the Paris Prefecture of Police, developed a system known as **Bertillonage** that enabled the French authorities to identify known criminals. The United States adopted his system in 1887. Before Bertillon's work, such identification had been difficult and had relied on descriptions and some photographs (as in the other part of the lab). This made police records time-consuming to use and their storage cumbersome. Bertillon's system relied on the premise that the measurements of specific parts of a person's body gave a unique record of his or her identity. Following this system, police forces built up a system of such records, enabling them to track and identify criminals if they re-offended. These measurements also had the advantage of being rapid and easy to transmit by telegraph if it was necessary to identify a suspect quickly. In this experiment, you will make some typical measurements of the head that would have been part of the Bertillon system. We will then statistically evaluate the data from class to determine whether the Bertillonage system can uniquely identify a person.

1. Use calipers to measure and record the following distances of your partner's head in a data table.
   - **length of head** – crown to forehead
   - **width of head** – temple to temple
   - **length of right ear** - between the upper rim and lowest point of the lobe of the ear. Are the two ears at the same height of the head?
   - **width of cheeks** – from cheekbone to cheekbone

2. Switch with your partner.

3. In order to find out how accurate these measurements are, measure and record someone else’s data, so that we have two sets of data for each person. DO NOT read, compare or exchange the first set of data.

4. Write all your measured values on the blackboard under the name of the students they belong to. (*)

5. Do some students have the same set of data? Are some of the measurements the same? What does “same” mean? (**)  

6. Make a meaningful graph of these data with EXCEL. What main message do you want your graph to convey? (**) and (***)

7. Would you expect that there are people in Cincinnati who would have the same set of data as you? Why or why not? (****) What would this mean for the identification purpose of this set of data?
For the Instructor:

1. (*) Catch data that consistently have no millimeters or data like 15.43 cm. Ask students what they did or measured.

2. (**) Discussion: Are the two data sets for each student the same? Why or why not? Introduce error, average and the idea of a +/- interval for the uncertainty/error.

Once the data are averaged and intervals established,

3. (**) Discussion: Do some students have the same data within these intervals? How can we make a graph that shows that? Introduce the idea of binning and histograms. (For larger data sets, data from previous classes can be exploited).

4. (**) Discussion: What type of graph would best show the spread of each measurement?

5. (***) Would someone with a long head have a large width of cheeks? Are the measured distances independent of each other? What type of graph could “test” that? If the measured distances are NOT independent, what would that mean for the identification purpose?

6. (****) If time permits or for the better students: Assuming millimeter resolution or the one established in class, how many values are possible between the minimum and maximum for each category? How many total possible combinations of these measurements are there within this range? For simplicity, let’s assume all possible combinations are equally likely. How many adults in greater Cincinnati (population about 2 million) would have the same set of data? Why is the assumption that all possible combinations are equally likely not valid? Do you think the actual number of adults with characteristics like yours is larger or smaller than your answers to the last question?
QL FLAG ELEMENTS

Our Universe: Forensics

Basic QL skills students apply in this course:

• Averages and distributions (standard deviation)
• Frequency of occurrence
• Percent error, Percent difference
• Significant digits
• Reading out/making graphs
• Units

Quantitative reasoning tasks (and Map code)

• analyze various types of evidence with appropriate methods, i.e. by measuring length and angles in two and three dimensions, by measuring temperature or by comparing to reference samples, recognize the need for multiple measurements (Map Code 1)
• document work done with photos, sketches and/or in writing (Map Code 2)
• document data as tables and as graphs using EXCEL, recognize the need for a meaningful graph (Map Code 3)
• interpret graphs made from data in written form by using elementary statistics (average, standard deviation) or by using equations and solving for an unknown variable (Map Code 4)
• assess the statistical value of various types of evidence, frequency of occurrence (Map code 5)
• draw inferences about the guilt or innocence of a suspect or the sequence of events by using quantitative and logical considerations (Map Code 6)

Mapping of labs with Task codes1:

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Specific Tasks and Map Codes (in parenthesis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crime Scene Documentation</td>
<td>• measuring lengths and drawing lengths in two and three dimensions (Map Code 1)</td>
</tr>
<tr>
<td></td>
<td>• document work done with photos and sketches (Map Code 2)</td>
</tr>
<tr>
<td>Bertillonage</td>
<td>• measuring various parts of the body (Map Code 1)</td>
</tr>
<tr>
<td></td>
<td>• statistically evaluate these data of all students in class (Map Code 3, 4)</td>
</tr>
<tr>
<td></td>
<td>• determine whether the Bertillonage system individualizes a person (Map Code 4, 5)</td>
</tr>
<tr>
<td>Fingerprints</td>
<td>• statistically evaluate finger print data from students in class (Map Code 3, 4)</td>
</tr>
<tr>
<td></td>
<td>• use the Henry system to determine the possible culprit (Map Code 4, 6)</td>
</tr>
<tr>
<td>Voice Examination</td>
<td>• measuring the period of the voice’s sound wave (Map Code 1, 4)</td>
</tr>
<tr>
<td></td>
<td>• identify a person’s voice spectrum by comparison (Map Code 6)</td>
</tr>
<tr>
<td>Hair Examination</td>
<td>• estimating length in two dimensions (1)</td>
</tr>
<tr>
<td></td>
<td>• document work done with photos and sketches (2)</td>
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<tr>
<td></td>
<td>• assess the statistical value of hair (Map code 4)</td>
</tr>
<tr>
<td>Blood typing</td>
<td>• determine blood groups by agglutination with antibodies (Map Code 1)</td>
</tr>
<tr>
<td></td>
<td>• determine a possible match with a suspect (Map Code 6)</td>
</tr>
<tr>
<td></td>
<td>• assess the statistical value of blood groups as evidence (Map Code 4)</td>
</tr>
<tr>
<td>Topic</td>
<td>Tasks</td>
</tr>
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<td>---------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Blood spatter I     | • determine whether the width of blood stains depends on the distance fallen (Map Code 1, 2, 3, 4)  
|                     | • determine whether the shape of the blood stains depends on the angle of impact (Map Code 1, 2, 3, 4) |
| Blood spatter II    | • reconstruct the origin of a blood spatter (Map Code 1, 2)  
|                     | • use the result to confirm or refute a witness’s statement (Map Code 6) |
| Glass fractures     | • analyze glass fractures by comparing to reference samples (Map Code 1)  
|                     | • document fractures produced with photos and sketches (Map Code 2)  
|                     | • determine the sequence of events by using logical reasoning (Map Code 6) |
| Time of Death       | • measure temperature (Map Code 1, 3, 4, 6)  
|                     | • represent data in a graph (Map Code 3)  
|                     | • use graph to find the unknown variable time (Map Code 4)  
|                     | • draw inferences about a suspect’s involvement in the crime (Map Code 6) |
| Cryptography        | • encode and decode messages using basic mathematical skills (Map Code 1)  
|                     | • determine the number of possible keys using combinatorics (Map Code 1)  
|                     | • infer the security of an encryption by the number of keys (Map Code 6) |
Text: Criminalistics by Richard Saferstein and handouts by instructor

Course Description

Forensic Science is based on the inductive reasoning process. In an inductive reasoning process hypotheses are formed on the basis of data. This process is used in all sciences. For many people, however, neither the data nor the hypotheses to be formed are of interest, because the impact of a false conclusion drawn from data is not apparent to them. In Forensics however, the lives of human beings are at stake. A fair process can only be achieved by a proper investigation during which evidence was handled diligently and during which logical and quantitative conclusions were drawn carefully and responsibly. Sloppy measurements, ignorance of the error of measurement techniques, wrong logical inferences and sloppy expressions of probabilities lead to catastrophic results (FBI admits flaw in hair analysis). As such, the focus of the course is DILIGENCE in the measurement process as well as in the thought process. In this context, Quantitative Reasoning is a part of logical reasoning, e.g. if this piece of evidence is found at the crime scene, what can you infer?

You will get opportunities to analyze evidence found (by measuring and calculating) and compare the results to statements from witnesses about the event of a crime. You will have to detect contradictions or confirmations and justify your conclusions in writing based on your data. These written submissions will often be submitted as an official forensic or legal document.

In lecture we will explore various types of evidence, e.g. eye witness testimony, fingerprints, blood groups and blood spatter, etc.. and discuss their reliability and their statistical value. You will have to find the appropriate data from statistical information, apply it correctly and interpret how the data influence the conclusions you can draw about the guilt or innocence of a suspect.

In lab we will analyze evidence in various ways, e.g. by measuring or comparing. Emphasis is put on documenting the work done in graphs, photos and in written form. Quantitative reasoning will be applied when we discuss the meaning and the value of graphs, e.g. the dependence of blood spatter on the distance fallen or the statistical distribution of body measurements among class members.
Course Specific Student Learning Outcomes:

In Lecture:

Students will

- explain the role of science in Forensics
- identify the different steps of the scientific method
- distinguish between inductive and deductive reasoning
- learn the characteristics of various types of evidence
- assess the statistical value of various types of evidence
- draw inferences about the guilt or innocence of a suspect by using quantitative and logical considerations

In Lab:

Students will

- analyze various types of evidence with appropriate methods, i.e. by measuring length and angles in two and three dimensions, by measuring temperature or by comparing to reference samples
- document work done with photos, sketches and in writing
- document their data as tables and as graphs using EXCEL
- interpret graphs made from data in written form by using elementary statistics (average, percent error) or by using equations and solving for an unknown variable.
- assess the statistical value of various types of evidence
- draw inferences about the guilt or innocence of a suspect by using quantitative and logical considerations
Core Curriculum at Xavier

This course is part of the Xavier Core Curriculum, which aims to develop people of learning and reflection, integrity and achievement, in solidarity for and with others. It addresses the following core learning objectives at the introductory level:

Scientific Perspective

1a: Students recognize and cogently discuss significant questions in the humanities, arts, and the natural and social sciences.

The scientific method has resulted in historically unprecedented changes in our world. In this course you will learn how science proceeds, and practice the scientific method yourself in a weekly laboratory experience. You will learn the qualities of a good hypothesis or model, how to assess its validity, the significance of a scientific theory, and the elusiveness of “proof.” On completing the course, you will be better able to understand and evaluate scientific or pseudoscientific claims that have direct impacts on your personal and professional life.

Specific Objectives for a Scientific Perspectives Course

1.1 Students utilize the scientific method, and differentiate between hypotheses/models, theories and laws.

1.2 Students articulate the nature of evidence, objectivity, data interpretation, the elusiveness of “proof”, and reproducibility/replicability

1.3 Students compare various types of research studies (e.g. observational, experimental, correlational, mechanistic).

2.1 Students utilize analytical and quantitative skills to design experiments, collect data, and make measurements.

2.2 Students construct and interpret graphs and tables, and to calculate and interpret appropriate statistics (e.g. mean, variability, correlation).

3.1 Students analyze and distinguish claims based on science from misinformation based on pseudoscience

3.2 Students analyze claims and information that they encounter regarding science in their everyday lives based on their transfer and utilization of knowledge about science.
Quantitative Literacy

2b. Students evaluate problems using quantitative methods and arguments

In courses with the QR flag, you will practice making sense of quantitative information and interpreting this information in the context of the course material. One of the goals of the QR-flagged course is to lead students towards carefully and precisely presenting quantitative information as well as inferences that such information permits, within the broader disciplinary context. A portion of the course will be devoted to your reading, communicating, and reasoning with quantitative information, as such information provides an oft-neglected perspective and can lead to conclusions which otherwise might not have been possible. The insights gained from the quantitative aspects, in concert with other perspectives, will help you form a more rigorous and robust understanding of the broader course topic(s).

Specific Objectives for a Quantitative Literacy Course

4.1 Students get used to working with quantitative information within a disciplinary context and learn to make sense of the appropriate quantitative concepts well enough to decide when to apply them within a given context, and to discern conclusions that can be drawn from, or may be suggested by, quantitative information they encounter.

4.2 Students develop and/or strengthen their ability to communicate quantitative information in written, verbal, visual, and/or mathematical form, such as tables, graphs, and formulas, as appropriate.

4.3 Students learn to contextualize data and quantitative information as one of many avenues toward understanding complex issues better, to answer relevant questions, to suggest possible solutions, and to see how a quantitative perspective fits into, and supplements, a larger whole.
Homework assignments:

Homework will be assigned through CANVAS. Research has shown that active learning and metacognition (learning how you learn) are the best strategies for success. Therefore, the homework for each topic covered will typically encompass one online group discussion, one online quiz and one to three other assignments that require you to engage with the material in the book or in the power point presentation from the lecture. One of the assignments is an assignment that requires logical or quantitative reasoning. In the journal entry you are encouraged to reflect on your learning.

Instructions, Guidance and Feedback:

In lab reports and lecture assignments you will practice to express quantitative information verbally. This is part of quantitative reasoning. Because I do not expect you to be perfect in quantitative reasoning, you will get the opportunity to revise your work based on the feedback you will get from me or your peers. This feedback will take place through group discussions, peer reviews and comments in CANVAS or in class feedback from me.

Exams and Final:

There will be three midterm exams given and one comprehensive final exam. Only your best two midterm exam will count toward your final grade. Exams must be taken when scheduled. Missed exams will count for zero credit. A legitimate written excuse must be provided before any make-up exam will be considered.

Grading policy in Lecture:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Homework</td>
<td>50 %</td>
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<tr>
<td>Midterms</td>
<td>35 %</td>
</tr>
<tr>
<td>final</td>
<td>15 %</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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</table>

Each topic will have a homework where you have to use logical or quantitative reasoning and each exam will have such a component so that at least 40% of your grade will be based on logical or quantitative reasoning.
Grading policy in Lab:

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>9 Lab reports</td>
<td>55%</td>
</tr>
<tr>
<td>Photography project</td>
<td>10%</td>
</tr>
<tr>
<td>Crime Scene report</td>
<td>10%</td>
</tr>
<tr>
<td>Lab exam</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Eight lab assignments and the final lab exam will have quantitative components. Therefore at least 80% of your grade will be based on your logical or quantitative reasoning skills.

**Attendance:**

Class attendance is expected. You are responsible for the information presented in the lectures and for any assignments made during the class time. If you are late to class or absent, you are responsible for obtaining any pertinent information that was given during class.

**Scale:**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
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<th>C+</th>
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<th>D+</th>
<th>D</th>
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<td>96-100%</td>
<td>91-95%</td>
<td>88-90%</td>
<td>84-87%</td>
<td>81-83%</td>
<td>78-80%</td>
<td>74-77%</td>
<td>71-73%</td>
<td>68-70%</td>
<td>64-67%</td>
<td>60-63%</td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

If your final grade is within 2% of the next higher grade, your participation in class is taken into consideration. No opportunity for extra credit is given otherwise. For every 2 assignments which were turned in late, 1% is subtracted from your grade.
## Course Content

<table>
<thead>
<tr>
<th>Objectives covered</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 &amp; 3.2</td>
<td><strong>What is Forensic Science?</strong></td>
</tr>
</tbody>
</table>
| 1.2 & 1.3          | 1. What are the characteristics of the scientific method?  
|                    | Inductive versus deductive reasoning: examples in Forensics  
|                    | 2. How real are CSI TV shows? |
|                    | **The Crime Scene** |
| 1.2 & 1.3 & 3.1 & 4.2 | **How do we best document/record a crime scene and evidence?** |
|                    | 1. Does physical evidence always exist?  
|                    | 2. What types of evidence exists?  
|                    | 3. What does “Documentation” entail?  
|                    | LAB: measuring lengths and drawing lengths in two and three dimensions, proper documentation of work done with photos and sketches |
|                    | **Evidence** |
| 2.1 & 2.2 & 4.1 & 4.3 & 4.4 | **How reliable is direct evidence?** |
|                    | **How many people would fit to a correct eyewitness description?** |
|                    | 1. Estimation and use of statistical charts/graphs  
|                    | 2. Venn Diagrams |
|                    | **Why is evidence that possess class characteristics of value in a crime?** |
|                    | 1. Product rule and use of frequencies of occurrence  
|                    | 2. Venn Diagrams |
|                    | **Personal identification** |
| 2.1 & 4.1          | **What are the most reliable biometric techniques for personal identification?** |
|                    | 1. Bertillonage  
|                    | LAB: measuring various parts of the body, statistically evaluate these data of all students in class  
|                    | 2. Fingerprints  
|                    | LAB: statistically evaluate fingerprint data from students in class, use the Henry system to determine the possible culprit  
|                    | 3. Voice Examination  
|                    | LAB: measuring the period of the voice’s sound wave, identify a person’s voice spectrum by comparison |
|                    | **Glass** |
| 1.2 & 1.3 & 2.2 & 3.2 & 4.1 & 4.2 | **What is the value of glass as evidence?** |
|                    | 1. Refractive index  
|                    | 2. Fracture lines  
|                    | LAB: analyze glass fractures by comparing to reference samples, document fractures produced with photos and sketches, determine the sequence of events by using logical reasoning |
|                    | **Hair** |
| 1.2 & 1.3 & 4.1 & 4.3 | **How reliable is hair as evidence?** |
|                    | 1. Characteristics of hair  
|                    | 2. False positive hair comparison  
<p>|                    | LAB: estimating length in two dimensions, document work done with photos |</p>
<table>
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<th>Topic</th>
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| Blood                           | How much value as evidence do blood groups have? And what can we conclude from the shape and size of blood stain patterns? | 1. **Blood groups**  
   LAB: determine blood groups by agglutination with antibodies, determine a possible match with a suspect, assess the statistical value of blood groups as evidence  
   2. **Blood spatter**  
   LAB: determine whether the diameter of blood stains depends on the distance fallen, determine whether the shape of the blood stains depends on the angle of impact  
   LAB: reconstruct the origin of a blood spatter, use the result to confirm or refute a witness’s statement |
| Time of death                   | How do we know what the time of death is?                                 | 1. **Indicators for the time of death**  
   Sketch graphs that show how livor mortis, rigor mortis and algor mortis develop over time from information given  
   2. **Exponential function for cooling**  
   LAB: measure temperature, represent data in a graph, use graph to find the unknown variable time, draw inferences about a suspect’s involvement in the crime |
| Cyber crime                     | How secure is an encryption method?                                       | 1. **Types of encryption**  
   2. **Combinatorics**  
   LAB: encode and decode messages using basic mathematical skills, determine the number of possible keys using combinatorics, infer the security of an encryption by the number of keys |