

Project 4: Learning activities

This document lists the learning activities for the course on Introduction to Probability and Statistics in Civil Engineering. The learning objectives of my class state that at the end of the course students will be able to:

1. Interpret, formulate, and solve problems involving elementary combinatorics, probability distribution, and inferential statistics
2. Conduct basic descriptive and inferential statistical analysis of data using a software program such as R
3. Identify and demonstrate the use of probability and statistical methods for applications in civil engineering

The learning activities are borrowed from my past experiences as a student and a teacher, and from different active learning techniques applied in practice at different institutions. The activities range from being very intensive on technical content to casual conversations about interpretation and usefulness of the learnt methods. The learning activities are divided into three categories: activities within the classroom; activities during the lab session; and activities outside the classroom.

1.1 Activities within the classroom

1.1.1 Traditional lecture

Learning outcome addressed: 1 and 3

This activity will be used for introducing a new topic or for explaining a concept. Both didactic and practical approaches will be used based on the topic. For example, the concept of set theory, axioms of probability and Venn diagrams will be explained using didactic approach starting from the basic notations, whereas the concept of confidence interval will be explained by starting with a practical motivation and then deriving the formula which align with the original motivation.

1.1.2 Group discussions

Learning outcome addressed: 1

This activity will pair up students in a group of two and will encourage them to discuss a concept or problem. There will at least be one group discussion activity during every lecture since this activity brings the energy back into the classroom. Some example topics of group discussions include: discuss how to formulate a given word problem in terms of given notation; map the stated random variable to the type of distribution; intuitively guess the probability of a certain event and then compare it with what is obtained from solving it exactly etc.

1.1.3 Concept mapping

Learning outcome addressed: 1, 2 and 3

This activity, designed for the last or the second last class will be a group activity where the whole class will brainstorm to create a map of all terms, notations, and concepts learnt throughout the course. Students will be paired into groups of three and each group will be

encouraged to come write some concept on the white board and connect it to the structure. As an instructor, I will provide appropriate direction to this activity (like filling in for some missing concept). The activity will take 30-45 minutes of class time and will be structured towards the end of the class considering it being a high energy activity.

1.1.4 Games and Paradox demonstration

Learning outcome addressed: 1

The field on probability and statistics is filled with paradoxes and games which can be very easily involved in class room discussions to motivate students about this field. Common examples for possible games which can be replicated in class include the Monty-hall problem, the game of poker, roulette etc. As an instructor, I will ensure that the concepts from the lecture are tied well with how to make informed decisions while playing different games. Next, different paradoxes like Simpson paradox, “why airplanes feel more dangerous than road when the data says otherwise” etc. will be explained to understand biases in interpretation of probability and statistics in real life.

1.1.5 Probability and statistics in a typical day of a civil engineer: stories and discussions

Learning outcome addressed: 3

One class will be devoted to this activity where I will introduce stories for engineers in different fields of Civil engineering and will explain the types of settings where the concepts of probability and statistics are used in design and decision making. I will also introduce how current research in civil engineering use several of these concepts, possibly motivating students towards applications in Civil engineering. The activity will be conducted as a group activity followed by some discussion, or by possibly inviting two guest speakers (senior graduate students from specializations of civil engineering) to share their experiences. The activity will offer a prelude and insight towards how to approach the group project assignment worth 20% of students’ grade.

1.1.6 Explaining concepts using interactive websites

Learning outcome addressed: 1

There are several online tools which can offer visual interpretation of different concepts of probability and statistics, like the seeing theory [website](#), the random services [website](#) etc. The lecture teachings will be accompanied with these online tools at regular intervals for a better grasp on the concepts.

1.2 Activities during the lab session

This course comprises of one lab session every week which focuses on problem solving and learning the statistical software R for practical purposes.

1.2.1 Active review session

Learning outcome addressed: 1

Each lab session relates to the concept from the lectures from past week, so a review will be necessary before students start working on different problems. The activity will be designed to be an active review involving students moving from their desks to write something on board, responding to a yes/no poll, filling the missing blanks on definitions etc.

1.2.2 Practice in R using handouts

Learning outcome addressed: 2

Each lab session will be geared towards using some tools in the statistical software R following a certain handout. Students will follow the handouts and practice the tools in R with assistance of a TA.

1.2.3 Filling blanks in a predesigned file in R: pair quiz

Learning outcome addressed: 2

Before some lab sessions, students will be assigned an incomplete R script file which will contain necessary outline for solving a certain problem and students will be given 5-10 minutes to brainstorm and fill in the blanks. This will be followed by swapping the work with the student sitting next and students will do a peer evaluation of their performance on different R syntax and commands.

1.3 Activities outside the classroom

1.3.1 Food-for-thought for the next class

Learning outcome: 1 and 3

At the end of some classes, students will be assigned an open-ended problem which follows from the current topic of discussion and they will be asked to think about it or solve it before the next class. In the following class, a discussion will be conducted on the same problem.

1.3.2 Fun data collection and reporting

Learning outcome: 1 and 3

During the first quarter of the semester, students will be assigned an activity where they must identify one random event around them and collect data on the event for a week to show possible randomness associated with the event. Possible events include observing their daily food expenditure, number of students they cross every day, amount of time spent on phone, temperature variation every day etc. A show-and-tell class discussion will then be conducted to showcase different applications of probability and statistics all around us.

1.4 Summary

A list of some activities has been proposed. These activities have the potential in assisting with students' learning. It is likely that it will not be possible to fit all of them in a one semester course; however, being aware of different methods will encourage me as an instructor to diversify the way I deliver a concept and the way students learn.