For Teachers

What is a *fair* insurance premium?

Developer: Claus Michelsen & Jan Alexis Nielsen
Institution: University of Southern Denmark
Country: Denmark

Proposed plan

- Groups should be established at the beginning of the first lesson.
- Midway through (e.g. after assignment 3) it may be a good idea to summarize and let each group present their considerations in front of the whole class.
- Ending with a similar presentation round can be beneficial.

Suggested teaching strategy

1. These open-ended activities afford opportunities for students to be reflective and critical of the mathematical models upon which decisions about well-known aspects of everyday life rest.

2. Students should work in groups of 3-5, and everybody should be encouraged to participate actively in the discussions. Students can be allowed to reveal to the teacher how they think about, and put to use, mathematics in specific situations, by being prompted to communicate and represent their ideas to other group members and other groups.

3. The teacher should play the role of an interpreter, by listening to students' proposed solutions and endeavoring to refine students' responses. The nature of the activities allows students to evaluate their proposed solutions themselves. It is not, as such, important that students find a "correct" solution. Rather, students should strengthen their deeper understanding of how to argue from mathematics and what it means to model complex and dynamics processes in society.

4. The teacher should use this interpretive role as a background for facilitating, stabilizing and refining students' usage of scientific, technological and mathematical concepts.

5. The students' work in groups should be backed up with 2 or 3 summative discussion-/presentation-sessions in which the entire class participates. These sessions allows the teacher to fine-tune students' usage of mathematical concepts.

6. If it is required the teacher may preface the activities by discussing what it means to construct mathematical models. Hereunder
    a. Introducing the different modeling tools (graphs, tables, equations, verbalizations, rules of thumb, etc.)
    b. Discussing the power to predict from models, and what it means to argue from a mathematical model)

    Further it may be beneficial to talk about how GPS navigators work.

7. In assignment 1, students should be encouraged to apply different modeling tools (drawing graphs, tabularizing, and/or working with equations) to find a pattern (there is no exact pattern hidden though factors such as age, experience, number of previous claims and mileage are presently considered most important by most insurance companies). Students should be encouraged to communicate to others in the group and to other groups how they navigate table 1 – i.e. students should be encouraged to communicate why a specific tool is chosen and how the application of that tool will provide a solution.

8. In assignment 2, the teacher may illustrate the problem at hand by mentioning some familiar classifications. E.g. the Tour de France classification of the difficulty of a mountain. Many diverse factors are at play here: steepness of the climb, length of the climb, position of the climb on the stage, altitude of the peak etc. Students should be made aware that quantitative data such as "there are X severe accidents per year on this stretch of road" is a *symptom* of the degree of dangerousness, and that they should also pursue the *reasons* for that symptom (e.g. is there a traffic median, are there traffic lights at the intersections, are there trees or are there guard rails alongside the road etc.)

9. In assignment 3, the students should be encouraged to give arguments for and against the importance of specific factors in determining individual premiums. The students should be made reflective of the fact that they will be talking about slight differences in dependence relations.

10. In assignment 4, the students should be encouraged to apply a number of modeling tools (graphs, tables, equations) on the problem at hand. Their arguments in the last assignment should be in the foreground of attention when considering how to weigh the factors chosen.

11. In assignment 5, students should be encouraged to be reflective and critical of their own solutions and mathematical modeling in general. The teacher should encourage students to think about and discuss how an overall implementation of their solution would affect society.

Learning outcomes per activity

Having engaged with **assignment 1**, students are expected to be able to

- Navigate tabularized data, by identifying focal variables.
- Communicate to other members of the group their ideas behind a choice of mathematical tool.
- Be reflective about the possibility that variables may have different weight.

- Be able to understand what it means mathematically that variables have different weight.

Having engaged with **assignment 2**, students are expected to be able to

- Identify factors which make roads dangerous.
- Use this identification as an argument for a general way to classify a given stretch of road.

Having engaged with **assignment 3**, students are expected to be able to

- Verbalize how and why chosen factors should determine individual auto insurance premiums by discussing dependence relations between the various factors and auto insurance premiums.
- Discussing the relative weight of the factors identified.
- Be reflective of the differences between qualitative and quantitative data

Having engaged with **assignment 4**, students are expected to be able to

- Apply a number of modeling tools so as to mathematize the verbal model touched upon in the last assignment.
- Use this mathematization as an argument for how to determine more fair premiums.

Having engaged with **assignment 5**, students are expected to be able to

- Be reflective of how this new technology and mathematical models such as theirs could have an influence on premiums, and other factors related to traffic (e.g. driving habits, safety, etc.)