

# SimSE Educational Game C: Estimation with Functional Requirements

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Audience: Students

## Editors:

Alain Abran



## Key contributors:

Sion Israel Sion, Ling Guo, Jean-Marc Desharnais, Monica Villavicencio



## Sponsors:



Software product & project  
management chair  
École de technologie supérieure - Montréal



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## 1. Introduction/Background

This SimSE game contains 10 data subsets and 10 well-established regression models and some questions for students to answer in each model. This game provides detailed steps of building up a regression model for students to understand. The simulation game teaches students how to interpret a regression model correctly from the statistical characteristics. It focuses more on statistical interpretation rather than data calculation.

## 2. How to Use this Module

This module is designed to be used as part of a course on software functional size measurement and its usage in software estimation.

SimSE is intended to be used as a *complementary* component to a course, not as a standalone instructional tool.

Therefore, software functional size measurement in general as well as statistical linear regressions should be introduced to students either before, or in parallel with the students' exposure to the game (either through lectures (see Section 6), readings (see Section 7), or some other method).

SimSE's main strength lies in its ability to allow students to put concepts into practice that they otherwise would not have the opportunity to experience through other instructional methods.

Before students are given the assignment to play a SimSE game, it is imperative that they watch the SimSE Gameplay video tutorial. It is strongly recommended that they also watch the Explanatory Tool and Game Branching video tutorials as well. All video tutorials are available at <http://www.ics.uci.edu/~emilyo/SimSE/downloads.html#Videos>.

Our experience with SimSE has shown again and again how crucial the instructions a student receives in learning to play the game are to their success in learning from it.

These video tutorials have been designed to specifically highlight and address aspects of SimSE that are critical for students to understand for a maximally effective educational experience. Therefore, we suggest that you not only assign the students to watch these videos on their own time, but, if time and resources allow, show them in class as well, emphasize how important they are to watch, and also point them to the SimSE player's manual, available at <http://www.ics.uci.edu/~emilyo/SimSE/downloads.html#Docs>.

If time and resources further warrant, students should be required to attend a teaching-assisted (TA) -lead training session, in which they are shown the videos, given a printed player's manual and, and then allowed to try playing the game for a while with the TA (who should have already studied the manual and played SimSE themselves) available to answer any questions they may have.

Students should be given the questions to answer for this module (see Section 8) at the time they are asked to play the model. Having the questions to refer to while they play helps point them to some of the more subtle lessons encoded in the model, as well as provides you, as an instructor, with a way to assess whether or not they have completed the assignment and learned the concepts. One could use this module as a mandatory part of a course, or else make it an extra-credit assignment.

### 3. Learning Objectives

. The following three model-specific learning objectives were implemented in this SimSE model:

- *The understanding of the detailed steps of building up a regression model in 10 scenarios.* Although the game focus on interpretation rather than calculation, the students can read and understand the detailed steps thoroughly after answering all the questions for the 10 models, which is a solid foundation for practical statistical analysis in the future.
- *Make a match among the meaning, the threshold and the data of a given project variable.* For each model, there are four followed-up questions. Although all the details for building a regression model are documented, in the Excel file, students must find out which variables in the details are the targets that we ask in the questions, as the way a question is asked has been interpreted. In addition, how to make the right level judgement relies on the knowledge of a threshold criteria that a student possesses.
- *Iterative understanding with retro simulations.* During the game, once a student finishes the questions for a regression model, the game will present the questions for the next regression model. However, the student's understanding of the game might improve as students read and explore more regression models: Regression models could be compared with each other to help students make a proper decision. The game allows students to set up a branch at any time during the game to update their choices.

### 4. Prerequisites

A student (a game player) should have a basic understanding of software engineering and management perspectives. (See Sections 6 and 7 of this document for ways to achieve this.)

For this game, participants do however, even though this game is called statistical interpretation game, but it is not necessary to have practical knowledge on statistics. The main idea of this game is to teach students how to interpret the variables in the established regression models, rather than do the calculation.

### 5. Time Commitment

The average time to play a single game is 10-15 minutes, but, of course, it is likely to take several times playing the game for the student to learn the concepts and be able to answer the questions. Participants should be given at least one week of out-of-class time to explore the game and answer the questions (see Section 8).

## 6. Suggested Supporting Lectures

The book ‘Software Project Estimation’ - by Alain Abran is recommended.

## 7. Optional Supplementary Readings

1. Navarro, E.O. “*The Fundamental Rules*” of Software Engineering. 2008 [Available from: [http://www.ics.uci.edu/~emilyo/SimSE/se\\_rules.html](http://www.ics.uci.edu/~emilyo/SimSE/se_rules.html)].

## 8. Assignment

### Instructions

Step 1) Watch the SimSE video tutorials at:

<http://www.ics.uci.edu/~emilyo/SimSE/downloads.html#Videos>.

Step 2) Download the SimSE player’s manual at:

<http://www.ics.uci.edu/~emilyo/SimSE/downloads.html#Docs>.

Note 1: Be sure to watch the video and read the manual carefully, as they will highlight several important things that will significantly help you in successfully playing SimSE and correctly answering the questions.

Step 3) Next, download the Measurement game at:

<https://chairegestionproduitsprojetslogiciels.github.io/simse-software-estimation-capability/games/game-c-statistical-regression.html#downloads>.

The download consists of a “readme” text file and an executable game, which you can run by simply double-clicking on it. If you do not have the current version of Java installed on your machine, you will have the opportunity to install it when you try to run a game.

### Questions

We recommend choosing approximately three of the following questions to use with this module.

1. What is the meaning of MMRE for software effort estimation purposes?
2. How to decide how many outliers detected in the dataset for a regression model?
3. When a  $R^2$  is higher, what does it mean?
4. Why is the dataset size important for the interpretation of a linear regression model?
5. If one student finishes all the questions with 50% correctness in 10 minutes, and another student has the same answers but uses half an hour, will the final score be different?

## 9. How to Use This SimSE Module with Other Modules

This module has been successfully used in conjunction with other measurement-related SimSE modules, making an assignment that consists collectively of three models/modules and associated questions

## 10. Other Notes

There are several other potentially effective uses for SimSE, most of which have yet to be fully explored:

- Have more advanced students modify an existing model (or build one from scratch, which should only be used with extremely advanced students) using SimSE's Model Builder tool and one of the existing models (available at <http://www.ics.uci.edu/~emilyo/SimSE/downloads.html>).
  - This has been tried, and results published in T. Birkhoelzer, E. Oh Navarro, and A. van der Hoek. *Teaching by Modeling instead of by Models*. Sixth International Workshop on Software Process Simulation and Modeling, May 2005 (available at <http://www.ics.uci.edu/~emilyo/papers/ProSim2005.pdf>).
- Our experience has suggested that an observer presence can have a positive effect on learning in SimSE. Although we have not tried this ourselves in classroom settings (only in controlled experiment settings), some suggested ways to try this are having students play SimSE in pairs, or having them play SimSE in a lab setting while observed by an instructor or TA.
- Have students play in teams, especially teams that have also done, or are doing, a class project together. This can add both a collaborative aspect to learning and, if set up to be a competition between teams, can add a competitive aspect.
- Make the assignment mandatory, rather than optional or extra-credit, to increase motivation.
- Have students play in a lab setting, both to add a competitive aspect and to allow them to collaborate.
  - Keep in mind, however, that a lab setting generally does not provide enough time to play a game enough to be able to answer all the questions.
  - An appropriate approach might be to allow students to play the game first in a lab session (this would also allow them to ask any questions that may arise), and then let them complete the rest of their playing and question-answering out of class.
- If a project is also being done as part of the course, have students pick one or more of the SimSE models and write an essay on comparisons between the SimSE process model(s) and the one followed in their project.

## 11. Feedback?

If you have any comments, suggestions, feedback, or experience regarding this course module or SimSE in general, please send an email to Alain Abran<[Alain.Abran@etsmtl.ca](mailto:Alain.Abran@etsmtl.ca)>

## References

1. COSMIC. (2020). *Early Software Sizing with COSMIC: Practitioners Guide*.
2. COSMIC. (2020). *Early-Sizing-Experts-Guide-May-2020-1*. <https://doi.org/10.13140/RG.2.1.4195.0567>

3. *Abran, A. (2015). Software project estimation: The fundamentals for providing high quality information to decision makers. John Wiley & Sons.*