

CPSC 444 Tutorial: Models of Human Performance 1: Fitts' Law

Description:

- In this tutorial, you will learn the basics of Fitts' Law. In the first half of the tutorial, you will run a mini Fitts' experiment. In the second half, you will analyze your results to produce a plot of your data, which you will use to compare the two input device settings used for the experiment.

Objectives:

- By the end of the tutorial, you will have:
 - A basic understanding of Fitts' Law. You should be able to
 - Calculate the index of difficulty of a target (using Shannon's formulation)
 - Calculate the throughput of an input device
 - Assess the "goodness" of an equations fitt (R-squared value)
 - Know what effective target width is and what it is used for
 - Run a mini-Fitts' experiment, gathered some data, and analyzed the results
 - Used throughput to compare two input device settings
- *Note:* It is not expected that you will develop a deep theoretical / mathematical understanding of Fitts, but rather a familiarity with its components and a modest ability to interpret Fitts' data

Deliverables:

- At the end of the lab, each group must hand in their data plots and the results of their data analysis. This is an **unmarked** deliverable.

Tentative Schedule:

- Quiz + discussion (~15 min)
- Fitts' Law activity - data collection
 - the TA will demo the experiment software and explain what you are expected to do (~5 min)
 - data collection - see detailed task instructions below (~25 min)
- Fitts' Law activity - data analysis
 - the TA will display the Excel template and give an overview of what you are expected to do (~5 min)
 - data analysis - see detailed task instructions below (~35 min)
- Class Discussion (~15 min)
- Design brainstorm (time permitting)

Fitts' Law: Tutorial Instructions

Mouse acceleration controls the rate at which the pointer increases speed when moving. Generally low acceleration improves accuracy, while high acceleration increases responsiveness.

In this tutorial you are going to run a simple Fitts' experiment to compare *no acceleration* with *fast acceleration*. We will use a within-subjects design; that is, each of you is going to do the Fitts' task twice: once with each acceleration setting. To help minimize the effects of learning and fatigue on your results, half of your group should do the *no acceleration* condition first and half should do the *fast acceleration* condition first. This is called counter-balancing, and will help ensure that you don't reach the conclusion that one setting is better than the other either because (a) it always came first (when you were less fatigued), or (b) it always came second (after you had practiced more). You will learn more about study design (and techniques such as counter-balancing and within-subjects designs) later in the course.

To save time, your group should make use of the lab computer and one personal laptop computer during the data collection phase of the tutorial. Once you're done collecting data, you can re-group to analyze your results.

Caveat: You should note that the design and analysis we are doing today, is very simplified. If you were to do further Fitts' research (beyond this course) you would quickly discover that there are many subtle variations and adjustments that need to be taken into consideration.

Part 1: Data Collection (25 min)

In this part of the tutorial, you are going to run the experiment to collect data. Throughout this portion of the tutorial you are going to switch between three computer tasks: changing the mouse acceleration setting, running the Fitts' task, and copying the results of the Fitts' task into an excel spreadsheet for data analysis. It's probably a good idea to leave all these programs open throughout the task, so that you can quickly switch between them.

Step 1: Organizing your group (1 min)

The first thing you will need to do is assign each member of your group an integer participant id (starting with 1). Divide your group in half and decide which sub-group will do the fast acceleration setting first, and which will do the no acceleration setting first. Each half of your group should use one computer.

Step 2: Changing the mouse acceleration (2 min)

Change the mouse acceleration as was decided in the previous step:

- Go to Start -> Control Panel -> Mouse -> Pointer Options
- Note the current setting so that you can set it back when you are done
- For the fast acceleration condition, select Fast, for the no acceleration condition, select None
- Click on Apply (But don't close the window as you will need to come back to this later!)

Step 3: Setting up the software (3 min)

The software only runs consistently in Windows. If no one in your group has a Windows laptop, you should discuss alternative options with the TA.

Download the Fitts' Law Experiment files corresponding to the Java Runtime Environment installed on your computer. For computers in X360, use the 32-bit version. To check the version of the JRE installed on your computer, open Control Panel and search for "Java".

- <http://www.cs.ubc.ca/~cs444/tutorials/Fitts-32bits.zip>
- <http://www.cs.ubc.ca/~cs444/tutorials/Fitts-64bits.zip>

Unzip the contents somewhere in your home directory. In the unzipped directory you will find the software you are going to use to run the experiment, as well as an excel spreadsheet (Fitts_Analysis.xls) in which you are going to put the results.

Double click on Fitts_Analysis.xls to open the spreadsheet. Note that there are three worksheets (tabbed at bottom). You will use the first (Data Input) for inputting your log data, the second (Analysis) for analyzing your data, and the third (Discussion) for answering questions about your data. Note that you can only edit some of the table cells (the ones without shading).

Double-click on Fitts.jar to run the software; or open a console window, navigate to the appropriate directory and execute the command: `java -jar Fitts.jar`

Step 4: Collecting data (20 min)

In turn each member of your group should complete the Fitts' task as directed by the program. Remember to enter your participant id, and the current acceleration settings. Each member will complete the task twice in a row with different acceleration settings. At the end of the task, your results will appear in a window. Copy these and paste them into the appropriate section of the excel spreadsheet. (You only need to copy the results portion; i.e, everything below the row of asterisks).

Re-run the software and copy the results into the spreadsheet for each member of your group.

Once everyone has completed the task once, change the acceleration (as described in Step 2) to the other setting, and do the task again.

For example, if you have 4 members in your group would have the following orderings:

- member 1: none, fast
- member 2: fast, none
- member 3: none, fast
- member 4: fast, none

Part II: Data Analysis (35 min)

For this part of the tutorial you are going to use Microsoft Excel to analyze your data. You should rejoin your group and work together for this part of the tutorial.

Step 5: Regrouping (4 min)

Transfer one of the spreadsheets over to the other machine (by email, USB key, etc.). Open both excel spreadsheets, and copy the data from one to the other.

Step 6: Calculating the index of difficulty (6 min)

Although we are going to use Shannon's formulation of the index of difficulty, you should know both. Use the formulas from the pre-tutorial reading to fill in the columns for Index of Difficulty (Eqns 1 and 7). Adapting the formulas appropriately, also fill in the columns for Effective ID using the Shannon formulation. Note that the formula for effective target width has been provided for you.

Step 7: Plotting your data (10 min)

Here you are going to plot your groups data and calculate the regression equation. Ideally, you

would include data from many more people, but to get practice we are going to do it for just your group. Use the chart wizard to create a scatter plot of your data. Index of Difficulty (Fitts's) should be used for the x-axis and completion time along the y-axis. Each acceleration condition should be added as a separate series. Add the chart to your worksheet.

Now you should add a regression line. Click on your chart. Select Add Trendline from the Chart menu. In the Options tab ensure the Display equation on chart and Display R-squared value on chart options are selected. Do this for both the fast and normal acceleration data sets.

Now do the same thing two more times so that you have plots using the Shannon formulation of the index of difficulty, both with and without the adjustment for error.

Step 8: Interpreting your results (15 min)

Answer the questions at the bottom of the Excel worksheet. Carefully consider your answers because you will be discussing them with the class. When you are finished email your spreadsheet to the TA.

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