

Instructions/Worksheet

NUS Statistics Enrichment Camp

07 Jun 2019

1 Goals

In this exercise, we shall try to address the following questions by collecting data on ourselves:

1. Does resting heart rate differ according to gender, height and weight?
2. How much is heart rate affected by
 - watching an exciting sports video?
 - working on a math problem?
3. How long does it take our heart rate to recover after moderate amount of physical activity?

As you proceed through this session, think about each step you are doing. The following questions may be interesting to ask at each stage:

- Why are we using *this* tool/program?
- What do I expect to see happen?
- What can I conclude from this output? Is the conclusion clear cut? Did I overlook any possibilities?

2 Setting Up

At any point, if you need help, please raise your hand.

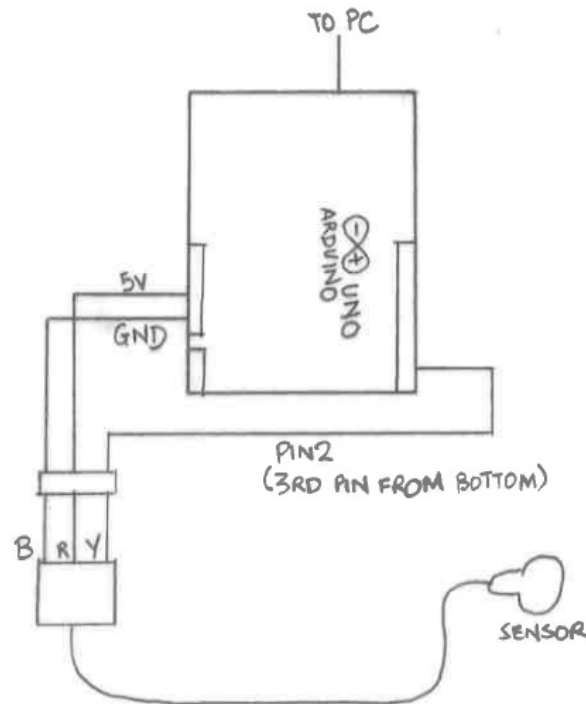
2.1 Programs That You Need

1. Log in to the PC in front of you. The user name (do not leave out the period and the backslash) and password are given on the whiteboard in front of you.
2. All the files you need are inside a folder, on the Desktop, entitled “stats_camp”.
3. Open up the folder. It should contain the following items:
 1. hr2b.ino - a file that is been loaded onto the Arduino.
 2. data_capture.ipynb - a Python notebook for data capture.
 3. math_problem.pdf - a mathematics problem for you to solve.

2.2 Arduino

1. Make sure that you and your teams have the following items:
 - 1 x Arduino UNO
 - 1 x USB cable
 - 3 x male-to-male jumper cables
 - 1 x Heart rate sensor

2. Connect the Heart-rate sensor to the Arduino according to the diagram below. The red cable should connect the the 5V power, the black cable to the Ground pin, and the yellow cable to PIN 2 on the right.



If you aren't sure, ask for help.

3. Connect the Arduino to one of the USB ports on the PC, and then double-click on the `hr2b.ino` program to open the Arduino IDE.
4. Once it is open, go to *Tools > Port* and select the COM port that your Arduino Uno is connected to. Write it down (e.g. COM4, or COM5 etc.) somewhere to remember it.
5. Clip the sensor onto the index finger on your non-master hand, and remain still. Ask one of your team to click on the magnifying glass icon on the top right of the Arduino program. You should see a new window pop up, with a number being printed continually. An LED on the Arduino should also blink each time this happens.

Take a look at the code in the Arduino window. What do you think it is doing? What are the numbers being printed?

Is the heart rate sensor working? How would you check?

2.3 Jupyter Notebooks

1. Open up the “stats_camp” folder that is on the Desktop.
2. Press Shift and Right-click within this window (not on any particular file, just in the empty space). A menu should pop-up. One of the options should be “Open Powershell here”. Click on that.
3. In the terminal that opens, type in

```
jupyter notebook
```

4. A browser tab should open, with the contents of the directory shown. Click on the `data_capture.ipynb` file.

What you see now is called a Jupyter notebook. It consists of Python code, interspersed with comments and text. The code chunks are referred to as cells. These are the sections that have the word

In [6]:

on the left.

To run a cell, use the up and down arrow keys to navigate to it, and then hit Ctrl-Enter.

5. Run the first two cells now. You will not have to run these again through-out the session. These two cells import the relevant Python libraries for communicating with the Arduino, and instantiate a progress bar.
6. The next cell specifies the port that the Arduino is connected to, and the file to which you wish to save the data. The default filename that you see is “testing_output_after_exercise.txt”. Edit the lines in this cell (**Don't run the cell yet!**) to correspond to the COM port that you noted earlier. For instance, if it was COM5, then the line should be

```
ser = serial.Serial('COM5')
```

Also, change the filename to which you wish to save the first batch of data. You will not have to change the COM port name for the rest of today, but you will have to change the filename for each person and each activity for which record the heart-rate. At this point, your cell might look like this:

```
In [8]: ser = serial.Serial('COM5')
        f=open('john_baseline.txt', 'w')
        total_time = 185
```

3 Data Capture

Every data capture phase consists of the following steps:

1. Edit the file name to correspond to your name and activity. For instance, you might change it from `testing_output_after_exercise.txt` to `john_baseline.txt`. Clip the sensor onto your non-master index finger, and then run this cell (underneath the *Create Connections* heading) to initiate the capture.
2. Run the cell underneath the *Start the capture* heading. This will begin the capture process. Each capture will take about 3 minutes; you should see a progress bar each time. Be as still as you can at this stage.
3. Run the cell underneath the *Close all connections* heading. This will complete one data capture phase. You should see the new file in your directory. Check that it is not empty.

If you encounter any errors, run the cell to close all connections, and then start again from the first step in this section.

Today, each of you will capture data *FOUR* times:

1. Your baseline heart rate.
2. Your heart rate while watching the sports video at this link:
<https://youtu.be/K148UvqF5zk>
3. Your heart rate while trying to solve a mathematics problem. It's ok if you cannot solve it; just try your best. If you solve it within 3 minutes, just relax and wait for it to finish.
4. Our lab is on the fifth floor. Walk (do not run, please) down the stairs to the ground floor, then back to the lab and immediately capture your heart rate.

4 Uploading

1. In a *new tab* in the browser, navigate to this address:

```
http://sta93.stat.nus.edu.sg:8000/vik/data_upload
```

2. Make sure the files that were created are not empty before proceeding. Fill up the entries on the page accurately, select the appropriate activity and hit Upload, one file at a time.
3. The device id can be found on a sticker on the back of the Arduino. Please enter it in full, so it should be of the form "Dxx". If you are not sure about your person id, check with the instructor.

4. Please ensure that you input your weight (in kg) and height (in metres) consistently. This is important in order to match the entries. If you made any incorrect entries, please inform one of the instructors.
5. Please upload the files in the activity order listed above, person by person. Take some time as you upload to think about the following:
 - When you uploaded the baseline file, what do the two entries show? What are the blue and red lines? What do you think is the difference between the two plots? Make a note of your average resting heart rate here.

- When you uploaded the video and math files, what did you observe? Was there a difference between this and your resting heart rate?

- When you upload the exercise file, try to estimate the time it took to return to normal. Write down your recovery time (in seconds) here.

- Is it fair to use your personal guess as your recovery time? If not, how can we automate this detection? What rule would you use? What is good and what is bad about it?
