**MATH133 – Unit 3 Individual Project**

**NAME (Required): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Please show all work details with answers, insert the graph, and provide answers to all of the critical thinking questions on this document.**

In 1967, Dr. Gene Amdahl developed Amdahl’s Law for predicting speed-up gained using multiple processors in parallel while executing a computer program. One version of Amdahl’s Law states that the speed-up (or efficiency) of using multiple parallel processors can be calculated approximately using the rational function:

$$S(x) = \frac{x}{px+(1-p)}$$

Here, $x$ is the number of processors used and $p$ is the **decimal equivalent** of the percent of the program that ***must be run sequentially***.

**For each question, be sure to show all your work details for full credit.** **Round all value answers to three decimal places.**

1. Based on the first letter of your **LAST** name, in the table below choose a percent of a program that must be run sequentially. If your choice is not a whole number percent then use at most two decimal places. Using the decimal equivalent for your chosen value of $p$, write your version of this speed-up rational function, $S(x)$, here.

|  |  |
| --- | --- |
| **First letter of your LAST name.** | **Possible values for** $p$**.** |
| A-F | 6.00% $-$ 8.00% |
| G-L | 11.00% $-$ 13.00% |
| M-R | 16.00% $-$ 18.00% |
| S-Z | 21.00% $-$ 23.00% |

1. Calculate the corresponding values of $S(x)$ for each $x$-value in the table below and then complete the table. (See part 6 below for the reason why one $x$-value has to be 20.) In order to receive full credit, be sure to show all of your calculation details. **Show calculation details for** $x=20$ **and one other** $x$**-values only.**

|  |  |
| --- | --- |
| **Chosen** $x$**-values** | **Calculated** $S(x)$**-values** |
| 20 |  |
| 50 |  |
| 80 |  |
| 110 |  |
| 150 |  |
| 200 |  |

1. Graph your speed-up function, $S(x)$, using Excel or another graphing utility. (There are free downloadable programs like [Graph 4.4.2](http://www.padowan.dk/) or Microsoft’s [Mathematics 4.0](https://www.microsoft.com/en-us/default.aspx); or online utilities like [this](http://www.desmos.com) [site](https://www.desmos.com/) ; and there are many others.) Insert the graph into the supplied Word Student Answer Form. **Be sure to label and number the axes appropriately so that the graph matches the calculated values in part 3 above.**
2. Given a computer program with your chosen value of $p$ the graph shows the relation between the number of parallel processors used and the efficiency obtained by using multiple processors. Looking at your graph, what appears to be the maximum possible speed-up? How did you arrive at this conclusion?
3. Suppose the amount of the program that must be completed sequentially could be reduced by 3% (i.e., your value of $p\%$ minus $3\%$). What would be the new speed-up for $x=20$ parallel processors? Since the function, $S(x)$, represents how many times faster a program will run when $x$ parallel processors are executing portions of the program at exactly the same time, what is the impact on the execution time of reducing the amount of code that must be executed sequentially by 3%?

**References**

*Desmos*. (n.d.). Retrieved from <https://www.desmos.com/>

*Graph 4.4.2*. (n.d.). Retrieved from the Graph Web site: http://www.padowan.dk/

*Mathematics 4.0*. (n.d.). Retrieved from the Microsoft Web site: https://www.microsoft.com/en-us/default.aspx