This problem set requires the use of either Excel Solver or OpenSolver. Prior to starting, please ensure one of them is functional via the software validation module

PART A

(1/1 point)

Warm Up Exercises in Optimization

Parts a, b, c, and d are warm-up exercises in optimization. Each calls for the optimization of a single variable. In each case, we ask you first to solve it by trial and error and then ask you to solve it using Excel Solver. The spreadsheet you will work on can be downloaded here. *Google sheets version available here*

According to Wikipedia, "Reflection is the change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated." In this example, we consider the reflection as though nature were minimizing travel time.

Consider light originating at a point $p_1 = (0, 5)$. Suppose that the light will travel directly to a point $p_2 = (x_0, 0)$ on a surface, and then "reflects" off the x-axis and travels directly to a point $p_3 = (8, 2)$. Suppose further that light travels at a constant speed c. (Coordinates and units are chosen so that the time to travel a distance of 1 at speed c takes 1 time unit.) What is the value of x_0 that minimizes the

travel time? Solve the problem using the Excel Spreadsheet ps1_p1.xlsx/sheet 1a''. First solve it by varying the value in cell C4. Subsequently optimize using Excel Solver to verify your answer. (Use GRG Nonlinear as the Solver Method.)

What's the optimal x_0? Express your answer using two digits to the right of the decimal place.

5.71 ✔

5.71

You have used 1 of 5 submissions

PART B

(1/1 point)

According to Wikipedia, "Refraction is the change in direction of propagation of a wave due to a change in its transmission medium." In this example, we consider refraction as though nature were minimizing travel time.

Consider light originating at a point $p_1 = (0, 4)$. Suppose that the light will travel directly to a point $p_2 = (x_0, 0)$ on a surface at a speed c. (Coordinates and units are chosen so that the time to travel a distance of 1 at speed c takes 1 time unit.) After crossing the surface of the x-axis, it switches direction and travels at a speed $0.8c$ until it reaches the point $p_3 = (8, -4)$. What is the value of x_0 that minimizes the total travel time? Solve the problem using the Excel Spreadsheet ps1_p1.xlsx/sheet 1b''. First solve it by varying the value in cell C4. Subsequently optimize using Excel Solver to verify your answer. (Use GRG Nonlinear as the Solver Method.)

What is the value of x_0 that minimizes the total travel time? Express your answer using two digits to the right of the decimal place.

4.86 ✔

4.86

You have used 1 of 5 submissions

PART C

(1/1 point)

Consider 12 data points with values 5, 6, 7, 9, 11, 16, 20, 22, 23, 24, and 99. In this problem, you are to choose a single value x (not necessarily from these 12 points) that "represents" these 12 data points. The goal is to minimize the sum of the absolute deviations from x; that is, you are to minimize $|x-5|+|x-6|+\ldots+|x-99|$. Solve the problem using part c of the Excel Spreadsheet. Solve it by varying the Rep Value in B3. There is no need to use Excel Solver for this problem.

Is the optimum the mean, or median, or mode?

- ○ Mode
- ◉ Median ✔
- ○ Mean

You have used 1 of 1 submissions

PART D

(1/1 point)

Consider the same 11 data points from part c. In this problem, you are to choose a single value x that "represents" these 12 data points. The goal is to minimize the sum of the squared deviations from x; that is, you are to minimize $(x-2)^2+(x-6)^2+\ldots+(x-99)^2$. Solve the problem using the Excel Spreadsheet ps1_p1.xlsx/sheet 1d". Solve it by varying the Rep Value in B3. You may use Excel Solver for this problem if you are not confident that you have the optimum value.

Is the optimum the mean, or median, or mode?

- Mode
- Median
- Mean ✔

You have used 1 of 1 submissions