# MATH6005 VBA Coursework - Technical Document

## Notation

Denote the starting coordinates of the support ship by $(x_{s0}, y_{s0})$ and its speed by $s_0$ .

Consider ship $i$ in the task force, where $1 \leq i \leq n$. Denote its starting coordinates by $(x_{i0}, y_{i0})$. Its velocity is split into $x-$ and $y-$components, $v_{ix}$ and $v_{iy}$ , respectively. Therefore the position of ship $i$ at time $t > 0$ is given by

$$(x_{it}, y_{it}) = (x_{i0} + tv_{ix}, y_{i0} + tv_{iy}).$$

Note that the speed of ship $i$ is given by

$$s_i = \sqrt{v_{ix}^2 + v_{iy}^2}$$

## 1 Calculating intercept times

To calculate intercept times, it is simplest to reset the timescale so that $(x_{s0}, y_{s0})$ represents the current coordinates of the support ship and $(x_{i0}, y_{i0})$ represents the current coordinates of ship $i$ for $1 \leq i \leq n$. Then the time, $T$ , taken for the support ship to intercept ship $i$ is found by finding the smallest positive root of the quadratic equation

$$\alpha T^2 + bT + c,$$

In my view,It may mean to change all the roots to positive numbers and compare their values,the smaller one would be the optimal time.

where

$\alpha = v_{ix}^2 + v_{iy}^2 - s_0^2$ , $b = 2(v_{ix}(x_{i0} - x_{s0}) + v_{iy}(y_{i0} - y_{s0}))$ and $c = (x_{i0} - x_{s0})^2 + (y_{i0} - y_{s0})^2$.

## 2 User interface

The workbook should contain a user-interface (UI) implemented using a single UserForm. The UI should

- Have one TextBox that enables the user to specify the path and the filename.
- Have a CommandButton that can be pressed to load data from the specified file.
- Display the size of the dataset currently in memory (or 0 if there are validation errors).
- Have a CommandButton that can be pressed to run the heuristic; this should only be enabled if there is a valid data set in memory.
- Display the result of the most recent run of the greedy heuristic (i.e. the time the last ship was intercepted). Note that when a new dataset is loaded, this should be cleared.
- Have a CommandButton that can be pressed to write the dataset and solution to the Excel spreadsheet. Note that this should only be enabled when a valid dataset is in memory and the algorithm has been run successfully on it.

## 3 Input Data

The input data for each problem instance will be presented in a comma separated value (CSV) file. A correctly-formatted input file consists of $N$ rows of data, where $N \geq 2$. Row 1 corresponds to the support ship and consists of three pieces of information in the following order:

1. Start $x$-coordinate (real numeric data type).
2. Start $y$-coordinate (real numeric data type).
3. Ship speed (real numeric data type).

Rows $2, \ldots, N$ correspond to ships $1, \ldots, N-1$ , each containing five pieces of information in the following order:

1. Ship name/description (string data type).
2. Start $x$-coordinate (real numeric data type).
3. Start $y$-coordinate (real numeric data type).
4. Velocity $x$-component (real numeric data type).
5. Velocity $y$-component (real numeric data type).

**Note that it is assumed that the data conforms to U.S. and U.K. regional settings in which the decimal separator is represented by a full stop (.) symbol.**

## 4 Data validation

When validating an input file, you must check that:

- There is at least one ship in the task force.
- Each row conforms to the specified format, including data types.
- There are a suitable number of rows.
- The support ship is faster than all ships in the task force.

## 5 Miscellaneous

Other things to remember are:

- When the computer is busy, remember to change the mouse cursor to an hourglass. But also remember to change it back to its starting state when it has completed the task!

## 6 Writing data to the Excel spreadsheet

You should write data to the Excel spreadsheet **only** when the relevant CommandButton is pressed in the user interface. Your workbook should consist of two worksheets:

- **Input data:** The ships in the task force should be listed in the order in which they occurred in the input file.
- **Output results:** The ships in the task force should be sorted in the sequence of interception, specifying the time and location of each interception.