

## Homework 2: Specification – Ballistics

The main goal of the program is finding the angles for a trajectory, with a given distance, given wind speeds, given mass, given area, given starting velocity, then displaying the trajectories. Finally the program writes the data into a txt file.

**The current state of the menu is the following:**

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Main menu:
1. I would like to give information about the position of my target.
2. I would like to give information about the current wind.
3. I would like to give information about the mass of the projectile.
4. I would like to give information about the area of the projectile
5. I would like to give information about the muzzle velocity of the cannon.
6. I would like the program to begin the calculations.
7. I would like to exit the program.
Please enter the number of your choice: _
```

Below is the detailed description of the menu:

- [Option 1](#): The user can enter the target's position.
  - after entering 1, the user will be prompted to enter the distance to the target, in **m**.
    - if the user enters a negative number or zero, he will be prompted to enter a number greater than 0.
- [Option 2](#): The user can enter info about the wind.
  - after entering 2, the user will be prompted to enter the speed of the wind in **m/s**.
    - the user is also informed that he should enter 0 to indicate no wind, a positive number to indicate tailwind, and a negative number to indicate headwind.
- [Option 3](#): The user can enter the projectile's mass.
  - after entering 3, the user will be prompted to enter the mass in **kg**.
    - if the user enters a negative number or zero, he will be prompted to enter a number greater than 0.
- [Option 4](#): The user can enter the projectile's area.
  - after entering 4, the user will be prompted to enter the cross-sectional are of the projectile (which is a ball, so the area is the area of a circle) in **m<sup>2</sup>**.
    - if the user enters a negative number or zero, he will be prompted to enter a number greater than 0.
- [Option 5](#): The user can enter the muzzle velocity.
  - after entering 5, the user will be prompted to enter the muzzle velocity of the cannon in **m/s**, which for the calculations is equivalent with the starting velocity of the projectile.
    - if the user enters a negative number or zero, he will be prompted to enter a number greater than 0.
- [Option 6](#): The user can launch the calculations.

- after entering 6, the user will be asked whether or not he is sure that he wants to proceed. If the user says no, he will be returned to the menu (so that he can change the data), if the user says yes, the calculations begin.
  - the user can make this choice by entering a 1 for yes, proceed, and a 2 for no, return to menu.
  - If the user decides to proceed, the calculations begin.
    - If important data (distance, mass, area, velocity) is missing, the program will ask the user to enter the missing information first, returning to the menu.
    - If the target is too far away, the program will inform the user about this, and tell him to change some variables.
- Option 7: The user can exit the program.
  - after entering 7, the user will be asked whether or not he is sure that he wants to proceed. If the user says no, he will be returned to the menu (so that he can change the data), if the user says yes, the program exits, thanks the user, than stops.
- Other number entered: If the user enters a different number, he will be prompted to enter a number between 1 and 7.
- Entering something that is not a number: the program crashes. (Apparently case-switch is unable to handle such values.)

### **The output in the end:**

If the user enters all of the vital variables and chooses to launch the program, the calculations will give the two best angles that are optimal for a trajectory with the given variables.

If there is only one angle, then the program returns that, with the corresponding distance to that angle.

The angle will be returned to the user with an accuracy of 10 significant digits (although the computer may be off due to errors with the double precision)

The program will display the two trajectories in one “graph”. This is more meaningful than displaying them in a standalone way, as one can compare the two easier like this. Also, the differences between them will be more noticeable. The display will use the standard 25x80 console screen. The values will be scaled to fit there, and they will be scaled according to the highest x and y values they encounter during the flight.

In the end, the data will be written into a txt-file. This data will include all the important variables (mass, area, velocity, target distance, wind), the two optimal angles, the graphs of the trajectories, and the time it took the projectile to arrive. If there is no txt file, the program creates one. If there is a Ballistics.txt, then the program appends the new results to the end of the file. This means that if someone wants to calculate for several angles, the results will be there for him in the end, saved. Results where the program can't calculate an angle (because the variables should be changed, to increase the range) will not be saved.