

# SciComp Blitz



Math and Physics Club, IIT Bombay

Time: 3 hours

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The data sets can be found in csv and xlsx format here: <https://goo.gl/83JwPG>  
To submit your solution, please write a report describing your method and answers.  
Upload the report on Drive along with the code and share the link to the folder in the Google form here:  
<https://goo.gl/forms/TBomJ1MSWazrOXDH2>  
Make sure you enable link sharing for the entire folder! Ask any of the volunteers if you're not sure how :)

## 1 Celestial man-hunt

Consider a star which is being constantly observed by a space telescope. The apparent magnitude of the star is  $m = +3.736$  and the surface temperature inferred from its spectrum is 5084 K. The distance to this star is 10.5 light years. We can infer the mass of the star from the theory of stellar structure ( $L \propto M^{3.5}$ ). From the light curve of the star one may infer the presence of an exoplanet. Assume that this planet's orbit is coplanar with the line of sight from the earth to the star (can you try to find a justification for this ?)

1. Find the luminosity (in Watts), radius (in m), and mass (in kg) of the star. The Mass, Apparent magnitude and the Luminosity of the sun are respectively  $2 \times 10^{30}$  kg,  $-26.81$  and  $3.95 \times 10^{26}$  W
2. The data recorded by the satellite about the apparent magnitude of the star at various times, is given to you. From this data, infer the radius of the exoplanet, and also its orbital radius (assuming it has a circular orbit)

Data to be used is exoplanetdataset.csv and exoplanetdataset.xlsx

## 2 In Preparation of Interstellar Exodus

An experiment to measure the acceleration due to gravity 'g' was conducted on Mars by us. To keep it simple, we tried doing this using a simple pendulum and measured the time taken for 10 Oscillations and by varying the initial angle made by the pendulum with the vertical. The data we collected can be found here. Now, your task is to get the value of g from this data and also its standard deviation.

Data:

Length of the pendulum (L) = 1.000 m

Time period measuring device has a least count of 0.0001 s

Other measuring devices used are assumed to be very accurate.

The Amplitudes given are in degrees.

Data to be used is MarsPendulum.csv and MarsPendulum.xlsx

## 3 Search for Life

After enough advancements in technology, we could go to the planet we found in the first question and Lo and behold, it was none other than Coruscant (The star wars galaxy capital). On landing, we tried to measure the viscosity of air there. Your objective is to get an estimate of the acceleration due to gravity and the viscosity of air by using stoke's law to model the interaction of bob with environment. For this, using a

camera based device, we noted down the angular position(in radians) of the bob after every 0.01 seconds.

Data:

Mass of the bob is 0.01 kg

Radius of the bob=0.05m

The length of the pendulum is 1.000 m.

Data to be used is CoruscantPendulum.csv and CoruscantPendulum.xlsx

**Bonus:** Now, try modelling the system including higher order corrections for velocity. Your task is to use the previous data set (Coruscant Data) and model the drag as  $F_d = bv + cv^2$  and obtain the value of b and c. You **may** use the value of g calculated in the first part.