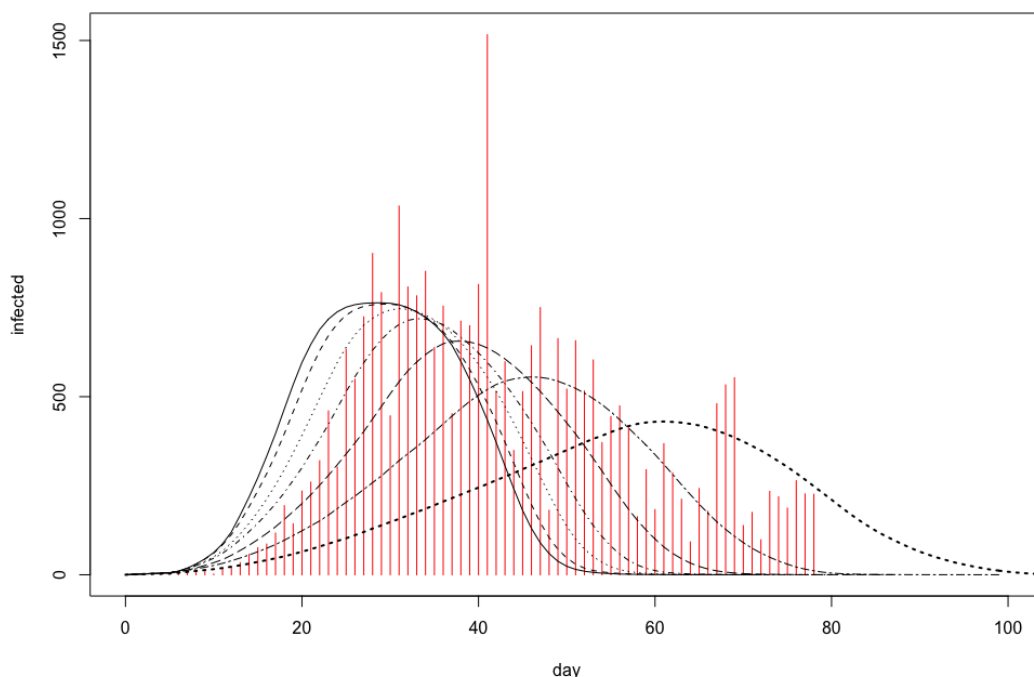


HOMEWORK CLASS 12

After doing several simulations with BehaviorSpace with the epidemic.nlogo model of Covid-19* spreading among a population, we obtained the following plot for simulations with the following parameters:

```
["density" 0.9]  
["infectioness" 0.9]  
["mortality" 1.4]  
["speed" [1.0 0.5 4.0]]
```



The different curves correspond to the average value of the variable 'infected' during 30 runs the Netlogo model for the above different values of the parameter "speed", present in the attached "experiment_2_aggregated.csv". The red bars correspond to the variable 'infected' in the data present in the attached "infected_portugal_01032020-17052020.csv" file.

A simple definition of the Least Squares Method is given in Wikipedia:

https://en.wikipedia.org/wiki/Least_squares

“The objective of the Least Squares Method consists of adjusting the parameters of a model function to best fit a data set. A simple data set consists of n points (data pairs) (x_i, y_i) , $i = 1 \dots n$, where x_i is an independent variable and y_i a dependent variable whose value is found by observation. The model function has the form $f(x_i, \beta)$ where m adjustable parameters are held in the vector β . The goal is to find the parameter values for the model that "best" fits the data. The fit of a model to a data point is measured by its residual, defined as the difference between the actual value of the dependent variable and the value predicted by the model:

$$r_i = y_i - f(x_i, \beta)$$

The least-squares method finds the optimal parameter values by minimizing the sum, S , of squared residuals:

$$S = \sum_{i=1}^n r_i^2$$

“

1. Using this definition of the Least Squares Method how can you apply the method (which assumptions should be made for the variables i , x_i , y_i , f , m and β in the above definition) to find the best value for the parameter speed that best fits the real world data.
2. Using an Excel worksheet (or other tool) and the following attached files:
 - a. "infected_portugal_01032020-17052020.csv"
 - b. "experiment_2_aggregated.csv"

Apply the methodology described to report the value of speed that best fits the real-world data.

*Class Materials/code/epidemic folder in Teams Classroom platform