Description

Estimating the lifespan of a patient, a machine, a company product, etc., is very relevant information for institutions and individuals. One method involves recording specific data on different days. On each of these days, the following are recorded:

number of deaths that occurred that day (d)
number of individuals alive at the start of that day (n)
probability of dying on a given day, which is calculated by d/n
probability of surviving that day, which is given by 1−d/n
probability of being alive at the end of a specific period of time, given by the multiplication of survival probabilities in previous periods (see table)
As a real example of these records for a specific disease, consider Figure 1.

Construct a Python function that receives a list with records from different days (day number, number of deaths that day, and number of survivors)

Time of event (t)	No. of Pt. died (d)	Live at the start of the day (n)	Estimated probability		Probability of survivors at the end of time (L)
			death (d/n)	survival (1 - d/n)	
6	1	23	0.0435	0.9565	0.9565
12	1	22	0.0455	0.9545	0.9565 × 0.9545 = 0.9130
21	1	21	0.0476	0.9524	0.9130 × 0.9523 = 0.8695
27	1	20	0.0500	0.9500	0.8695 × 0.9500 = 0.8260
32	1	19	0.0526	0.9474	0.7826
39	1	18	0.0556	0.9444	0.7391
43	2	17	0.1176	0.8824	0.6522
89	1	14	0.0714	0.9286	0.6056
261	1	8	0.125	0.875	0.5299
263	1	7	0.1429	0.8571	0.4542
270	1	6	0.1667	0.8333	0.3785
311	1	4	0.25	0.75	0.2839

Figure 1: Illustrative Table .

At the start of the day, calculate the previously mentioned probabilities for each day. The input data for the function for k days are linearized in a list as follows: the first k elements are the days on which the data were recorded, the next k elements are the deaths recorded each day, and the following k elements are the survivors recorded each day.

In the end, the function should return: (i) a matrix with the provided and calculated data, (ii) the corresponding list of lists, as seen in the previous table, (iii) the list of local maxima from the column related to the number of deaths, and (iv) display the graph showing the evolution of the number of deaths (d) and the number of survivors at the start of the day (n) over time (t).

You should use matrices whenever possible, which means that the data from the initial input list should be transferred to a matrix data structure, and all operations should be performed on this type of structure. For example:

For the input list [6, 12, 21, 27, 32, 39, 43, 89, 261, 263, 270, 311, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 23, 22, 21, 20, 19, 18, 17, 14, 8, 7, 6, 4], the resulting list is [[6, 1, 23, 0.0435, 0.9565, 0.9565], [12, 1, 22, 0.0455, 0.9545, 0.9130], [21, 1, 21, 0.0476, 0.9524, 0.8695], ...] and the resulting matrix is the table presented above (except for the calculations of the last column in the second, third, and fourth rows).

Grading

The maximum grade for the practical work is 1 point (out of 20 points). Each group (two students) must develop a solution and submit it on Inforestudante by 11:59 PM on April 12, 2021. They must submit a .zip file containing a .py or .ipynb file and a .pdf of the code.

There are four levels of grading:

0 – the solution is incorrect;

0.5 - intermediate situation, i.e., a solution with a partially incorrect result, or with an incorrect result but an algorithm very close to the correct one;

0.75 - intermediate situation, i.e., a solution with a correct result, but with unoptimized code or that does not make adequate use of the materials taught in class;

1 - the solution is correct, with optimized code and makes appropriate use of the knowledge taught in class;

Defense rules:

each work is subject to defense, and each group member must be able to explain the solution and answer questions from the faculty;

the defenses take place in the last class dedicated to the topic, according to the course plan;

in online classes, students must have the camera and sound activated during the defense;

after the defense, the grade assigned to each student may be lower than the grade of the work, depending on the individual performance during the defense.