Initial Spread of the Epidemic

Keywords: combinatorics, probability and statistics, statistics, data processing, arithmetic mean, geometric mean, regression analysis, GeoGebra

The most well-known recent epidemic is the COVID-19 pandemic, a viral disease caused by the SARS-CoV-2 coronavirus, which broke out in December 2019 in the city of Wuhan in Hubei province in central China.

The beginning of the COVID-19 epidemic in Europe dates back to January 2020. The first confirmed cases were reported in France on January 24, 2020. They were three patients who had recently returned from China, where the epidemic was already in full swing.

The disease then spread to the Czech Republic before March 1, 2020, when the first three cases were confirmed. As of March 18, 2020, 464 cases had already been confirmed in our country.

The early phase of an epidemic is typically characterized by exponential growth. As time progresses, the spread tends to slow down and follow a different trajectory (such as linear, logistic, etc.).

Typical Scenario of an Epidemic

Based on the collected data, we will try to model the number of infected individuals as a function of the number of days since the start of the epidemic. The table contains the data describing the number of infected individuals with respect to the number of days since the beginning of the pandemic.

Day (n)	Number of infected individuals (a_n)
1	3
2	3
3	5
4	6
5	9
6	20
7	27
8	33
9	39
10	64
11	95
12	117
13	142
14	190
15	299
16	384

Note. These are real data from the Czech Republic starting on March 1, 2020.

Exercise 1. Calculate the ratio of the number of infected individuals on a given day to the number of the previous day.

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Exercise 2. Calculate the arithmetic and geometric mean of the ratio of the number of infected. Which one is more appropriate in this case?

Exercise 3. Design a function that approximates the number of infected individuals on each day. Create a graph in GeoGebra (or another program).

Exercise 4. By applying regression analysis to the data, a more suitable function describing the behavior of the number of infected individuals can be obtained: $y = 1.9466 \cdot \mathrm{e}^{0.3376x}$. Compare your proposed function with this function in GeoGebra (or another suitable software). Calculate the values of all functions for days 14 to 16, rounding the result to the nearest whole number. Compare these values with those in the table.

Note. The exponential function obtained by regression analysis can be created using either a spreadsheet or Geogebra. In Geogebra, the points obtained from the table must be entered using the following command: `FitExp({(1,3), (2,3), (3,5),...,(16,384)})`.

Exercise 5. Will the epidemic continue to spread according to the designed function? What might influence its future behaviour?

Literature

- European Centre for Disease Prevention and Control *Novel Coronavirus: three cases reported in France*. Dostupné z https://www.flickr.com/photos/ecdc_eu/50321985653/in/dateposted/ [cit. 08.08.2024]
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