

Time series analysis

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Subjects

- 1. Time series: definition and characteristics.**
- 2. Classification of time series.**
- 3. Time series presentation.**
- 4. Indicators of time series.**
- 5. Adjustment of time series.**

Definitions and utility

- **A time series is a collection of data recorded over a period of time.** Most often, the measurements are made at regular time intervals – **hourly, weekly, monthly, quarterly or annually.**

A time series can be used:

- **by management to make current decisions and for long-term forecasting and planning;**
- **by health professionals to study the dynamics of health phenomena**

The characteristics of time series

- 1. The Variability**
- 2. The Homogeneity**
- 3. The Periodicity**
- 4. The Interdependence**

Classification of time series

I. From the point of view of changing in average or variance:

1. With Stationery Data
2. With Non-Stationery Data

II. From the point of view of time

1. Moment or point series
2. Interval (range) series

II. From the point of view of types of values

1. Simple series - With absolute values
2. Complex series –
 - a. With relative values
 - b. With central tendency values or average values etc.

Time series presentation

Specific graphs

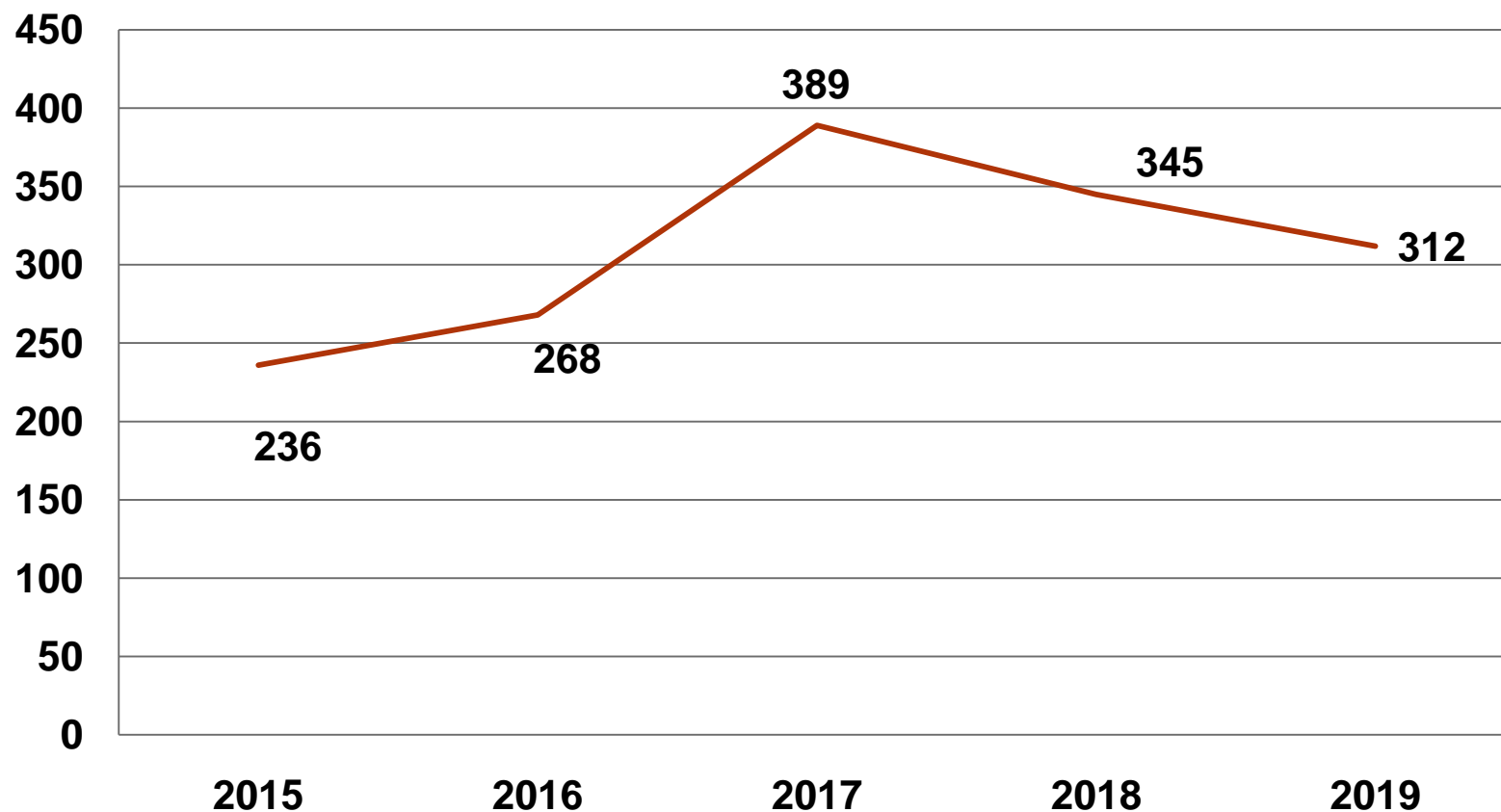
- **Line graphs**
- **Polar diagrams (radial or spiral)**
- **Tables**
- **Column Charts**

Less specific graphs

- **Bar Charts**

Line graph

Evolution of number of diseases in the district X during 5 years (abs.)



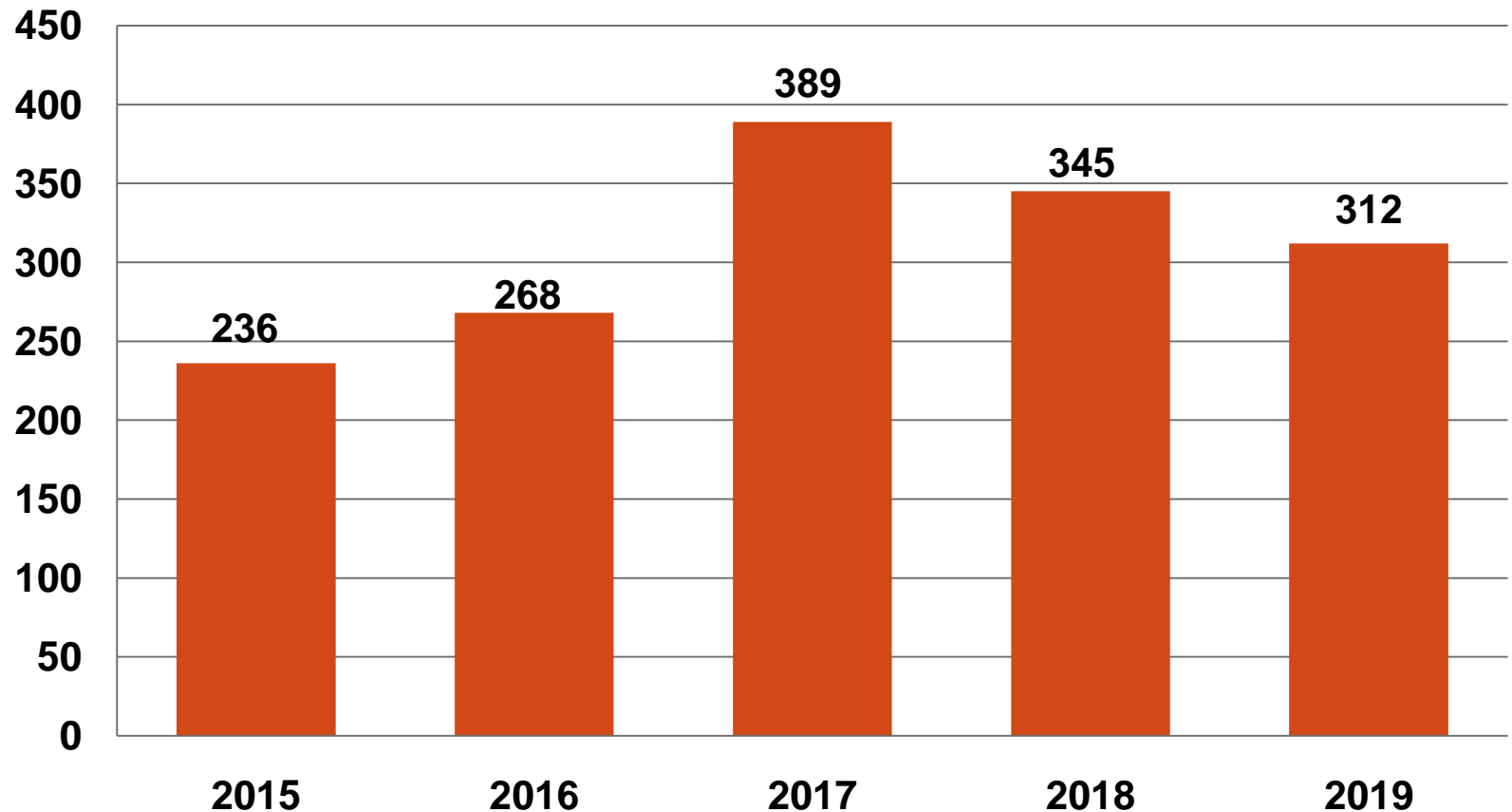
Table

Table 1. Number of diseases in district X during 5 years (abs.)

Years	2015	2016	2017	2018	2019
Number of diseases	236	268	389	345	312

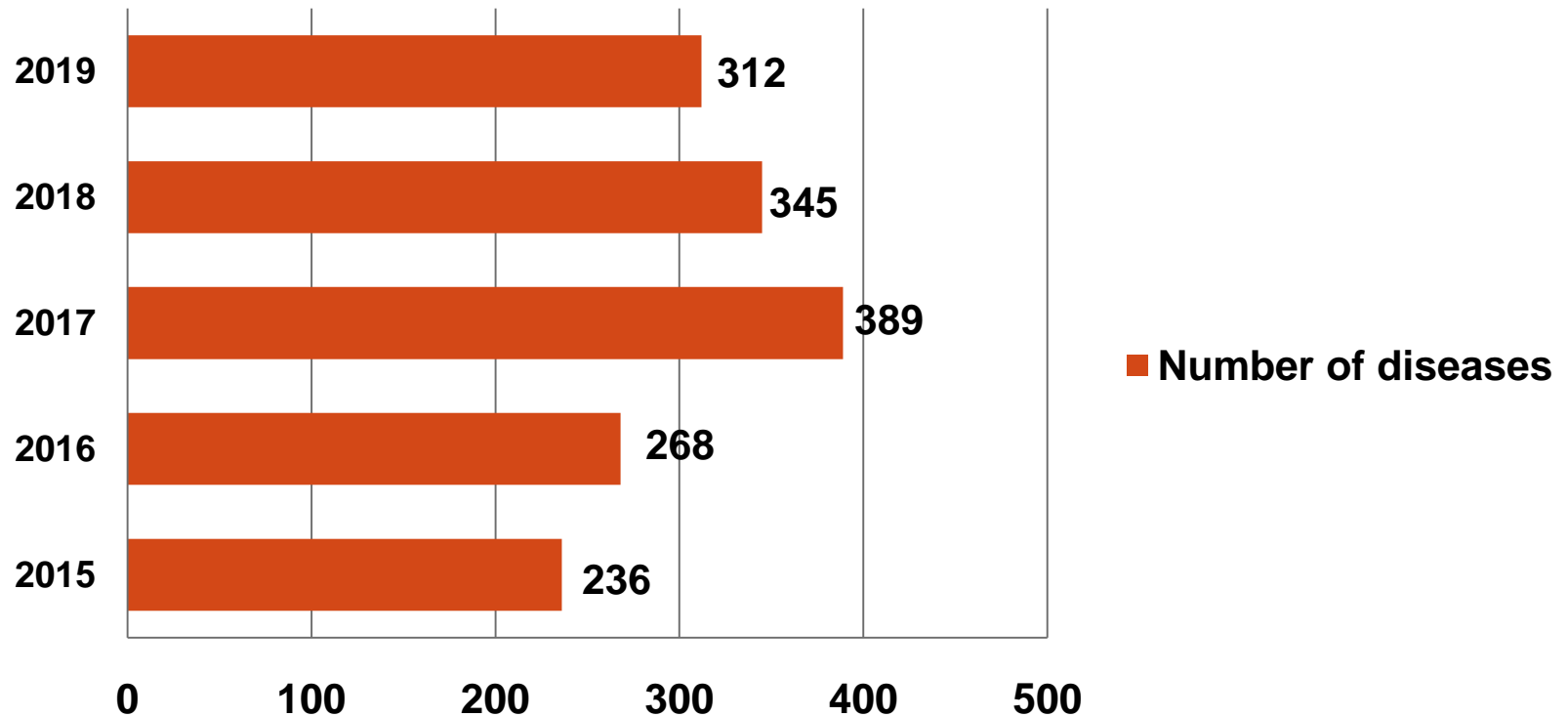
Column Chart

Evolution of number of diseases in the district X during 5 years (abs.)



Bar Chart

Evolution of number of diseases in the district X during 5 years (abs.)



Indicators of times series

I. Absolute

- 1. Individual absolute values**
- 2. The aggregate volume/ the amount/ the sum/ the total**
- 3. Absolute change(first differences, second differences)**

II. Relative

- 1. Index of dynamics**
- 2. The pace (rhythm) of dynamics**
- 3. A percentage of the absolute value of dynamic rhythm**

III. Average indicators

- 1. The average level**
- 2. The arithmetic mean of absolute changes with mobile base**

Time series with ABSOLUTE VALUES analysis

Table 1. Number of diseases in district X during 5 years (abs.)

Years	2014	2015	2016	2017	2018
Nr. of diseases, xi	243	256	210	240	252
Absolute change, fix base		13	-33	-3	9
Index of dynamics, fix base		1, 05	0,86	0,99	1,04
Index of dynamics, fix base, %		105, 3 5	86,42	98,77	103,7
The pace (rhythm) of dynamics, fix base, %		5,35	-13,58	-1,23	3,7
A percentage of the absolute value from dynamic rhythm, fix base		2,43	2,43	2,439	2,43

Absolute indicators

- 1. Individual absolute values
(243, 256, 210, etc.)**
- 2. The total volume
($243+256+210+240+252 = 1201$)**
- 3. The Absolute change**
 - a. With fixed-base ex. $256-243$;
 $210-243$**
 - b. With mobile-base ex. $256-243$;
 $210-256$**

Relative indicators

1. Index of dynamics

- a. With fixed-base ex. $256/243 \times 100$; $210/243 \times 100$
- b. With mobile-base ex. $256/243 \times 100$; $210/256 \times 100$

2. The pace (rhythm) of dynamics

- a. With fixed-base ex. $256/243 \times 100 - 100$; $210/243 \times 100 - 100$;
- b. With mobile-base ex. $256/243 \times 100 - 100$; $210/256 \times 100 - 100$;

3. A percentage of the absolute value from dynamic rhythm

Is equal: Absolute change/The pace (rhythm) of dynamics

- a. With fixed-base ex. $(256-243)/(256/243 \times 100 - 100)$; $(210-243) / (210/243 \times 100 - 100)$;
- b. With mobile-base ex. $(256-243) / (256/243 \times 100 - 100)$;
 $(210-256) / (210/243 \times 100 - 100)$;

Average indicators

1. The average level
 $(x_1 + x_2 + x_3 + x_4 + x_5) / 5 = 240,2$ diseases.
2. The arithmetic mean of absolute changes with mobile base.
3. Average index of dynamics – is a geometric mean of index of dynamic with mobile base.
4. Average pace of dynamics is the average of pace of dynamics.

Adjustment of time series

- Adjustment is the replacement of the real terms of series with theoretical terms in order to identify more clearly the evolution (the trend) of phenomenon.

Methods of adjustment

1. Graphical method.
2. Increasing the range between years.
3. Average method (make averages between 2 or 3 terms; ex. $(x_1+x_2)/2$; $(x_3+x_4)/2$;).
4. Method of mobile averages: $(x_1+x_2+x_3)/3$; $(x_2+x_3+x_4)/3$; $(x_3+x_4+x_5)/3$.
5. Analytical methods, using mathematical functions as linear, exponential, parabolic etc.