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Technical Guide

Fingertips trend markers

Introduction

This guidance document describes the methodology used for the trend markers that are displayed on the Fingertips website. The algorithms set out below are carried out by Fingertips on-the-fly as the page is loading and are only applied to indicators that are proportions or rates (including crude rates and directly standardised rates), that have non-overlapping time periods, and have at least five points in the time series. The methodology described in this document was implemented on Fingertips in January 2020, and is a refinement of the previous method.

Process for testing for 'recent' statistical trend

These calculations are derived using the most recent five indicator values (x_i) in the time series as shown on the Trends display, their numerators (r_i) and their denominators (n_i) along with the time values (t_i).

If t_i are not straightforward numeric values (eg years) they must be converted into values – the actual values don't matter, but the intervals between time values used must be proportional to the real time intervals between the indicator values.

Using the test described below, test for trend on the last five points in the time series.

If no significant trend is detected, an amber trend marker will be displayed and no further analysis is done.

If a significant trend is found, the direction of the trend is noted, and the test is repeated five times, each time excluding one of the five points.

If removing any one of the five points results in a trend in the opposite direction from the trend based on all five points, then an amber trend marker will be displayed and no further analysis is done.

If the direction of the trend is the same for all six trends a red or green trend marker will be displayed, depending on whether the trend is in an unfavourable direction or a favourable one.

χ^2 test for trend

The test requires the numerators (r_i) and denominators (n_i) for each of the N values (x_i) in the series and the time values (t_i).

If only indicator values and numerators are present, calculate the denominators as:

$$n_i = \frac{r_i}{x_i}$$

If only indicator values and denominators are present, calculate the numerators as:

$$r_i = n_i x_i$$

For proportions and crude rates, the numerators and denominators are straightforward.

For directly standardised rates, the populations may be present, but the denominators should still be calculated as above and these derived denominators used.

Calculate the test statistic:

$$\chi_1^2 = \frac{\sum n_i \left(\sum n_i \sum r_i t_i - \sum r_i \sum n_i t_i \right)^2}{\sum r_i \left(\sum n_i - \sum r_i \right) \left(\sum n_i \sum n_i t_i^2 - \left(\sum n_i t_i \right)^2 \right)}$$

If $\chi_1^2 > 9.5495$ the trend is significant (p < 0.2%) and a red or green trend marker is shown.

Determining the direction of trend

The gradient of the trend, $\hat{\beta}$, is calculated as follows:

For proportions

$$\hat{\beta} = \frac{N \sum \left(\ln \frac{x_i}{1 - x_i} \right) t_i - \sum \ln \frac{x_i}{1 - x_i} \sum t_i}{N \sum t_i^2 - \left(\sum t_i \right)^2}$$

For all other value types

$$\hat{\beta} = \frac{N \sum (\ln x_i) t_i - \sum \ln x_i \sum t_i}{N \sum t_i^2 - \left(\sum t_i \right)^2}$$

If the test statistic has shown a significant trend, then the sign of $\hat{\beta}$ shows the direction of the trend. If $\hat{\beta} < 0$ then it is a falling trend and downward arrow will be displayed; if $\hat{\beta} > 0$ then it is a rising trend and an upward arrow will be shown. The polarity of the indicator is used to determine the colour of the arrow: eg where 'high is good' an upward arrow will be green and a downward arrow red. For indicators without a clear polarity, a blue marker is used to identify significant trends in either direction.

PHE Technical Guides

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