

Fitting a Nonlinear Curve to the Ratio (Positive/Tested) of COVID-19 in Japan

Cheng-Yen TSAI*, Yuki Tanaka**, Masao Igarashi***

*Taiwan Agricultural Research Institute, Council of Agriculture, Executive Yuan**

*College of Bioresource Sciences, Nihon University ***

*College of Bioresource Sciences, Nihon University (Retired)****

Kanagawa Fujisawa Kameino 1866 252-0880, Japan

Abstract

We examine the number of people infected with COVID-19 in Japan from March 1st, 2020 to November 19th, 2022. To estimate the trends of infected people, we introduce a ratio defined by the number of “Positive” people to “Tested” people. The bar graphs of the ratios increase rapidly from November, 2021. We divide the ratios into 3 intervals (increasing, decreasing, and oscillating) along the time series and evaluate the fitting curve for each interval.

Mathematica built-in function named FindFit is applied to calculate the coefficients of the curve. When FindFit does not converge within the given iteration times, we slightly change the initial value, reverse the sign of the coefficients of the curve, or increase the number of parameters for the curve. As the results, the number of iteration times and the residual errors are reduced.

Keywords : COVID-19, PCR tested, Tested positive, Ratio, Week sum, Sinc(x), Nonlinear curve

1 Introduction

Let $\{x_i\}$ be the number of PCR-tested people (the daily or the mean of one week) and $\{y_i\}$ be the number of tested positive people (the daily or the mean of one week). Put $r_i = y_i/x_i$, $i = 1, 2, 3, \dots, n$ where n is the data size. Both cases (daily and week), $\{r_i\}$ are simply called the ratio, unless confuse.

Fig. 1 shows the bar graphs of the positive ratios classified by the day of the week, such as Saturday ratio, Sunday ratio, \dots and Friday ratio. The figure shows that the ratio is highly dependent on the day of the week, that is Sunday and Saturday are high bar, and other days of the week are low bar. In order to remove, the day of the week dependency, the mean of one week is introduced to estimate the trends of infected people.

Fig. 2 shows the bar graphs of the mean for one week positive ratio. This graph periodically changes between 10 and 20 weeks. For this periodicity, the sign \pm in the biological growth curve (1) of section 3 is chosen minus for the increasing intervals and plus for the decreasing interval.

Fig. 3 and Fig. 4 show the mean of one week positive ratio (dots) and the fitting biological growth curves, respectively.