COVID-19 CDC DATA AND MODEL FIT WITH EXTRAPOLATION TO FUTURE

MILLIONS UNIT: $M := 10^{6}$

US POPULATION: $Nus := 330 \cdot M$

CDC DATA

$\mathrm{rows}(DATA) = 1198.00$ $\quad Cases := \mathrm{col}(DATA, 3)$ $\quad Deaths := \mathrm{col}(DATA, 4)$ $\quad Days := \mathrm{col}(DATA, 2)$

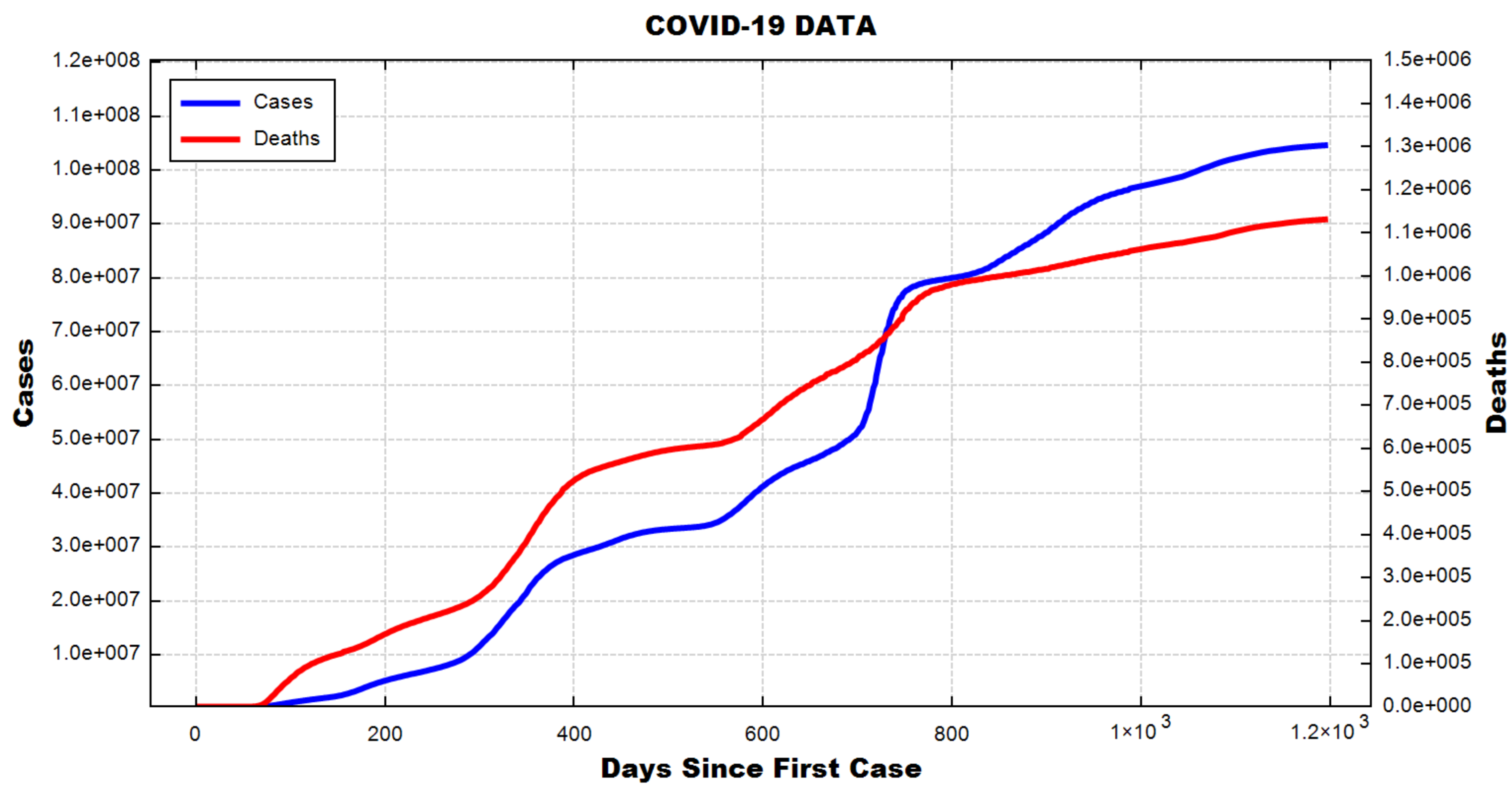
$Today := \mathrm{rows}(DATA) - 1 = 1197.00$ $\quad CASES := \mathrm{augment}(Days, Cases)$ $\quad DEATHS := \mathrm{augment}(Days, Deaths)$

$\max(Cases) = 1.05 \cdot 10^{8}$ $\quad \max(DEATHS) = 1.13 \cdot 10^{6}$

DATE DATA

$Date := \mathrm{col}(DATE, 1)$ $\quad \mathrm{rows}(Date) = 1806$

I DON'T KNOW HOW TO EXPRESS THE DATE AS A STRING, WHICH IS AUTOMATIC IF I USE THE IMPORT XLSX FUNCTION



$\begin{cases} CASES \\ DEATHS \end{cases}$

SEGMENT COUPLED FINITE DIFFERENCE MODEL PROGRAM TO FIT DATA

Ro SEGMENTS

SECOND COLUMN OF SEGMENTS IS THE VALUE OF THE REPRODUCTION RATE Ro TO FIT THE DATA FOR EACH DATA SEGMENT
SEGMENTS WERE DETERMINED BY THE DATE THAT I DOWNLOADED THE CDC DATA

$\mathrm{findrows}(SEGMENTS, 1197, 1) = [1197.0000000000 \ 1.1576985785]$

$\mathrm{findrows}(SEGMENTS, 1190, 1) = [1190.0000000000 \ 1.1576985785]$

$SEGMENTS = \begin{bmatrix} 37.0000000000 & 6.9030693470 \\ 58.0000000000 & 3.6377478000 \\ 68.0000000000 & 1.7724011124 \\ 87.0000000000 & 0.9760278905 \\ 140.0000000000 & 1.2820160123 \\ 190.0000000000 & 0.9068410963 \\ 252.0000000000 & 1.3488002904 \\ 315.0000000000 & 1.1803344675 \\ 367.0000000000 & 0.7242430823 \\ \vdots & \end{bmatrix}$

$R_o := \mathrm{col}(SEGMENTS, 2)$ $\quad \mathrm{rows}(R_o) = 57.00$ $\quad \mathrm{length}(R_o) = 57.00$

$R_{o\,\mathrm{rows}(R_o)} = 1.1576985785$ $\quad Today = 1197.00$ $\quad R_{o\,1} = 6.90$

$SEG := \mathrm{col}(SEGMENTS, 1)$ $\quad \mathrm{rows}(SEG) = 57.00$

$SEG_{\mathrm{rows}(SEG)} = 1197.00$ $\quad SEG_1 = 37.00$ $\quad R_{o\,\mathrm{rows}(R_o)-1} := 1.03605$

$I_{36} := 15$ $\quad R_{36} := 0$ $\quad S_{36} := Nus - I_{36}$ $\quad \gamma := \frac{1}{14}$ $\quad \delta t := 1$

$$
\begin{array}{l}
\text{for } n \in [1..(\mathrm{rows}(R_o) - 1)] \\
\quad \beta_n := R_{o\,n} \cdot \gamma \\
\quad \text{for } j \in [SEG_n .. SEG_{n+1}] \\
\quad\quad S_j := \mathrm{eval}\left(S_{j-1} - \frac{\beta_n \cdot I_{j-1} \cdot S_{j-1}}{Nus} \cdot \delta t\right) \\
\quad\quad R_j := \mathrm{eval}\left(R_{j-1} + \gamma \cdot I_{j-1} \cdot \delta t\right) \\
\quad\quad I_j := \mathrm{eval}\left(I_{j-1} + \left(\frac{\beta_n \cdot I_{j-1} \cdot S_{j-1}}{Nus} - \gamma \cdot I_{j-1}\right) \cdot \delta t\right)
\end{array}
$$

$\mathrm{rows}(R_o) = 57.00$ $\quad \mathrm{rows}(S) = 1197.00$ $\quad \mathrm{rows}(R) = 1197.00$ $\quad \mathrm{rows}(I) = 1197.00$

$I_{\mathrm{rows}(I)} = 1.83 \cdot 10^{5}$ $\quad MODELCASES := I + R$ $\quad \mathrm{rows}(MODELCASES) = 1197.00$ $\quad MODELCASES_{\mathrm{rows}(MODELCASES)} = 1.046075 \cdot 10^{8}$

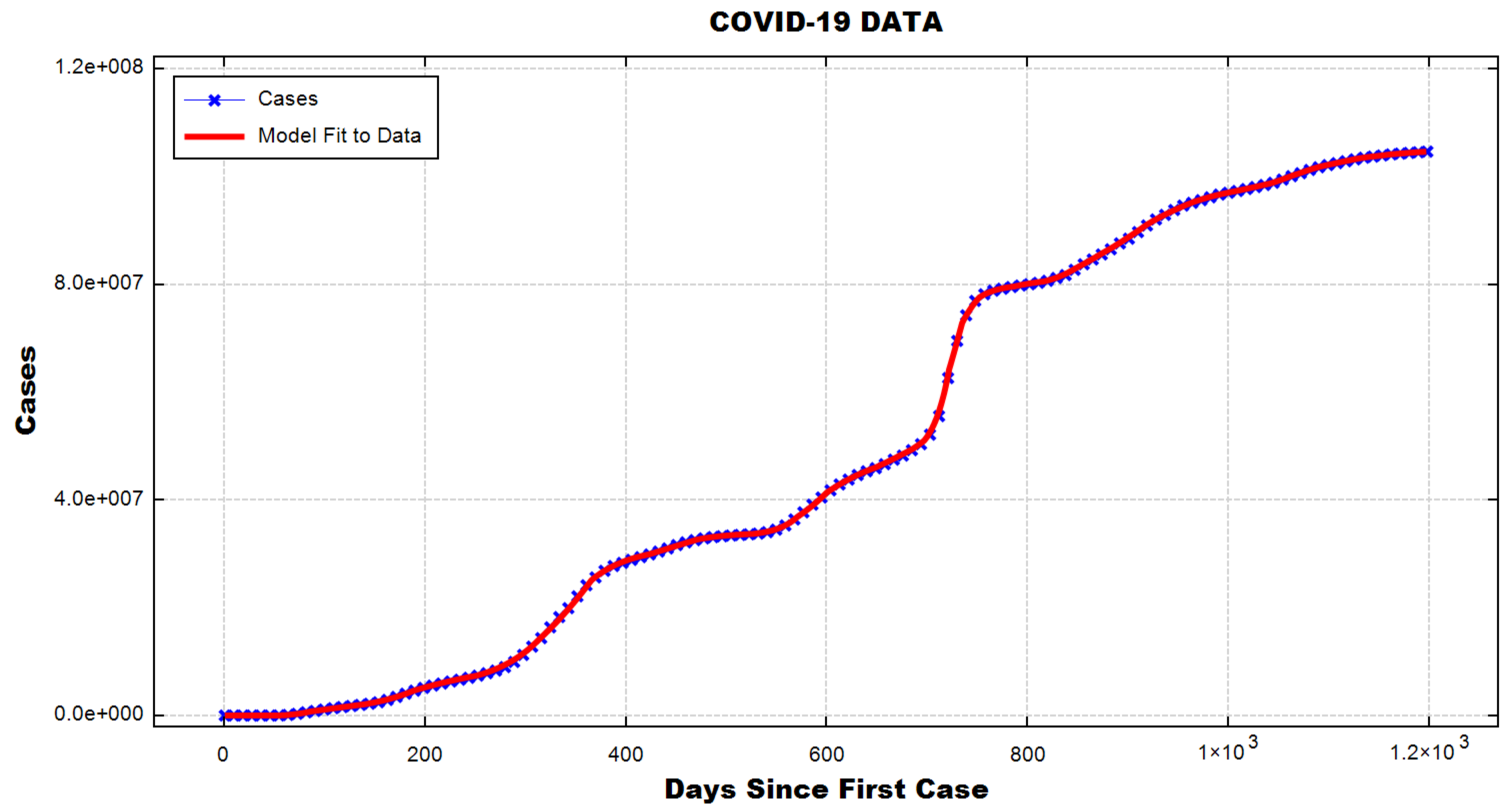
$MODELDAYS := \left[1..SEG_{rows(SEG)}\right]$

$MODELCASES_{Today} - Cases_{Today} = 0.7737$

$MODEL2 := augment(MODELDAYS, MODELCASES)$ $\quad rows(MODEL2) = 1197.00$

SELECT EVERY 10TH CASE POINT TO PLOT

$nselect := [1, 10..rows(CASES)]$ $\quad CASES := CASES_{nselect\ 2}$ $\quad CASES := augment(nselect, CASES)$



{CASES
{MODEL2

⊟— ODE

⊞— dsol

$str := "\beta(t):cases(0"$

for $k \in [1..rows(SEGMENTS)]$
 $str := concat\left(str, ",t<", num2str\left(SEGMENTS_{k\ 1}\right), ",", num2str\left(\gamma \cdot SEGMENTS_{k\ 2}\right)\right)$

$dummy := str2num(concat(str, ")"))$ $\quad \beta(0) = 0$ $\quad \beta(Today) = 0.0827$ $\quad \beta(t) = \{ 0 \ldots$

$N := S(t) + I(t) + R(t)$

$$\begin{cases} S'(t) = -\dfrac{\beta(t) \cdot I(t) \cdot S(t)}{N} \\ I'(t) = \dfrac{\beta(t) \cdot I(t) \cdot S(t)}{N} - \gamma \cdot I(t) \\ R'(t) = \gamma \cdot I(t) \end{cases}$$

$S(0) = Nus - 15$

$I(0) = 15$

$R(0) = 0$

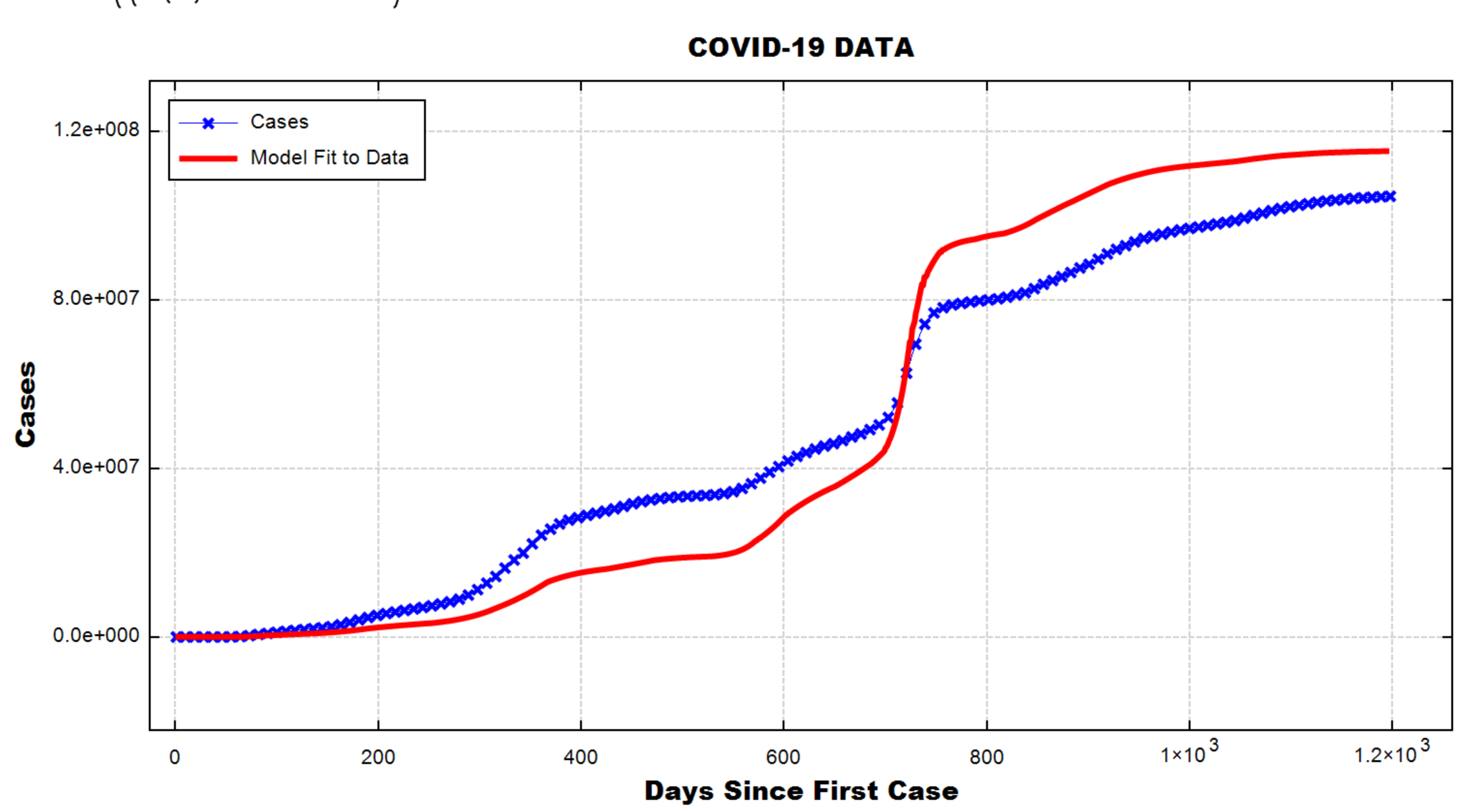
$dsolver = "Adams"$

$T := col(RK, 1)$ $\quad S_{RK} := col(RK, 2)$

$I_{RK} := col(RK, 3)$

$R_{RK} := col(RK, 4)$

$$RK := dsol\left(\begin{cases} S(t) \\ I(t), Today, 1000 \\ R(t) \end{cases}\right)$$



{CASES

$\text{augment}(T, I_{RK} + R_{RK})$

CUMULATIVE DEATH RATE CALCULATION