
The Modeling of Chikungunya Using Lagrange Method and Lagrange Method by Matlab

Abdel Radi Abdel Rahman Abdel Gadir¹, Subhi Abdalazim Aljily², Neama Yahia Mohammed³

¹Department of Mathematics, Faculty of Education, Omdurman Islamic University, Omdurman, Sudan

²Department of Mathematics, Faculty of Education, University of AL Butana, Rufaa, Sudan

³Department of Mathematics, College of Science, Tabuk University, Tabuk, Saudi Arabia

Email address:

dibdelradi78@gmail.com (A. R. A. R. A. Gadir)

To cite this article:

Abdel Radi Abdel Rahman Abdel Gadir, Subhi Abdalazim Aljily, Neama Yahia Mohammed. The Modeling of Chikungunya Using Lagrange Method and Lagrange Method by Matlab. *American Journal of Applied Mathematics*. Special Issue: *Numerical Analysis and Control Theory*. Vol. 9, No. 1, 2021, pp. 1-9. doi: 10.11648/j.ajam.20210901.11

Received: July 26, 2020; **Accepted:** December 5, 2020; **Published:** January 12, 2021

Abstract: Chikungunya virus (CHIKV) is a mosquito-transmitted alphavirus that causes acute fever and acute and chronic musculoskeletal pain in humans, there is currently no vaccine, cure or specific treatment for Chikungunya. Chikungunya originated in Africa and has since spread across the entire globe causing large numbers of epidemics that have infected millions of people in Asia, Indian subcontinent, Europe, the Americas, and Pacific Islands. Adequate coordinated efforts comprising active surveillance, early detection, vector control and public awareness at local, national and international level need to be adopted in endemic areas for the effective control of Chikungunya virus infection. There is a risk that the virus will be imported to new areas by infected travelers. There is no vaccine to prevent or medicine to treat chikungunya virus infection. Travelers can protect themselves by preventing mosquito bites. The aims of this paper is to study Chikungunya virus and to illustrate the possibility of its modeling by Lagrange method using Matlab. Also we made modeling of results of tests for patients with Chikungunya numerically using Lagrange interpolating method and using Lagrange interpolating method by Matlab which is one of the most famous mathematical programs in the mathematical modeling of mathematical problems. We followed the numerical method and applied mathematical method using Matlab. We found that the modeling using Lagrange interpolating method by Matlab is more accuracy and speed than the numerical method were we explained this fact that we have reached in three figures which proves the aptitude the usage of Matlab in mathematical modeling.

Keywords: Modeling, Chikungunya, Lagrange Method, Matlab

1. Introduction

Chikungunya fever is a viral infection affecting all age groups [6], Chikungunya virus, or the CHIK virus in short, is an RNA virus that belongs to the alpha virus genus of the Togaviridae family, the latter comprising viruses that are mostly transmitted by arthropods. Infection with CHIK virus results in chikungunya fever. The name Chikungunya derives from a root verb in the Kimakonde language meaning “that which bends up”, i.e. to become contorted. The name reflects the stooped appearance of sufferers with arthralgia [17], Mosquito-borne arboviruses like dengue (DENV), Zika (ZIKV), and Chikungunya (CHIKV) are important public health challenges in tropical and subtropical regions [10],

The disease was documented first time in the form of an outbreak in Tanzania [18], The chikungunya virus (CHIKV) is an enveloped, spherical, single-stranded positive-sense RNA alpha virus belonging to the family Togaviridae [1], The virus is a member of the Semliki Forest virus antigenic complex, which contains important arboviruses such as O'nyong-nyong virus (ONNV) from Africa, Mayaro virus (MAYV) from South America and Ross River virus (RRV) from the Oceania region [12] Chikungunya is a vectorborne viral disease that causes large outbreaks, mainly in tropical and subtropical countries [9] Chikungunya fever (CF) is a viral illness caused by an arbovirus transmitted by the Aedes mosquitoes. The disease was documented first time in the form of an outbreak in Tanzania. The name is derived from the 'makonde' dialect which means 'that which bends up',

indicating the physical appearance of a patient with severe clinical features. [15]

The general objectives of the guidelines are to assist member countries in preventing and controlling outbreaks of chikungunya fever by surveillance, case detection, investigation, and by triggering necessary public health actions. [7]

2. Signs and Symptoms

Depending on the duration of symptoms, CHIKV infection may be divided into acute (the first 3 weeks from onset), post-acute (from 21st day to the end of 3rd month) and chronic stage (after 3 months from onset) [13]. Depending on the duration of symptoms, CHIKV infection may be divided into acute (the first 3 weeks from onset), post-acute (from 21st day to the end of 3rd month) and chronic stage (after 3 months from onset) [5].

PROGNOSIS, OUTCOME, AND PREVENTION Several agents have demonstrated activity against CHIKV *in vitro*, and monoclonal antibodies have shown efficacy in animal models (17–175), but currently, there is no specific antiviral treatment for CHIKV and management remains symptomatic. Joint pain, the symptoms of acute chikungunya typically resolve over a few days to 1 week (1, 68). Approximately 50% of patients have chronic arthralgia and/or arthritis at 3 to 6 months, and over 25% of patients may still have symptoms at 12 months, which negatively impacts quality of life during recovery (68, 176–180). [8] Symptoms of chikungunya are fever and severe joint pain that can last for weeks. Other symptoms include muscle pain, headache, nausea, fatigue and rash. Most patients recover fully, but in some cases joint pain may persist for several months or even years. Occasional cases of eye, neurological and heart complications have been reported, as well as gastro intestinal complaints. Serious complications are not common but, in older people, the disease can contribute to the cause of death [3].

3. Treatment, Prevention and Indicators

There is currently no vaccine, cure or specific treatment for Chikungunya. Patient care is generally focused on providing comfort through relief of symptoms. Medicines for reducing fever and pain such as a cetaminophen, (commonly marketed as paramol, panadol, paracetamol, etc..) [13], Treatment is predominantly supportive and includes bed rest during the febrile period, adequate hydration, and antipyretics and analgesics [6], In acute stage, the treatment is mainly supportive and consists of fluids, analgesics and antipyretics [5]. There have been no case reports of laboratory transmission from blood products; however, a nurse reported acquiring CHIKV by drawing the blood of an infected patient (80). As such, continued caution is recommended when handling infected blood products or live virus in the laboratory due to the potential for transmission. [8] As CHIK fever is an emerging disease it has not received sufficient coverage yet in the medical curricula. Specific treatment is not available, and there is no vaccine. This publication comprises the experience of experts as published

in WHO/SEARO and PAHO/WHO guidelines [14]

Rate of positives of homes, Rate of positive utensils, Rate of virginity, Preto rate [6].

4. Clinical Findings and Diagnosis

The clinical findings of CHIKV infection very much similar to those of Dengue and Zika and in areas lacking laboratory diagnostic facilities, CHIKV is probably frequently under diagnosed or misdiagnosed as Dengue or Zika. The incubation period of CHIKV varies from 2 to 12 days following the bite of infected mosquito, with an average of 2 to 7 days. The disease is characterized by sudden onset of high fever and arthralgia or arthritis (Hoque and Ahmed, 2012). Several joints of the body may be affected, found swollen. The fever may persist for 8 to 10 days. [7] The percentage of subclinical infections fluctuates between epidemics and it depends on factors such as age, naïve population/herd immunity, and the circulating strain [2] The classic triad of symptomatic chikungunya includes an abrupt-onset febrile illness, severe and often debilitating arthralgias, and a rash [8], Many patients that progress to Subacute/Chronic phases have neuropathic pain (NP) besides the articular symptoms. The NP is associated with a less favorable outcome, with greater impact on quality of life and lower efficacy of treatment [4]

5. Causative Agent and Vectors

Chikungunya fever is primarily transmitted by bites of mosquitoes of the genus *Aedes*, the same mosquito that transmits Dengue Fever. Only the female mosquitoes are infective because they require a blood meal for the formation of the egg. Of the two vectors in Asia, *Aedes aegypti* is believed to be the principal vector responsible for transmission during human outbreaks. *Aedes aegypti* breeds in stored freshwater in urban and semi-urban environments, The *Aedes* mosquitoes breed in domestic settings such as flower vases, water-storage containers, desert coolers, etc and peridomestic areas such as construction sites, coconut shells, discarded household junk items (vehicular, plastic and metal cans, etc). Adult mosquitoes rest in cool and shady areas in domestic and peridomestic settings and bite humans during the daytime [17]

6. Polynomial Interpolation Method

If we have $(n + 1)$ points $\{(x_i, y_i); i = 0, 1, 2, \dots, n\}$ then we will be able to make polynomial interpolation from (n) degree $\{p_n(x)\}$ using any one of the interpolation methods mentioned (Nyazi Tawfeeg Ahmed, 2001).

The General Formula Is Given by

$$P_n(x) = \sum_{i=0}^n l_i(x) y_i$$

The terms $l_0(x), l_1(x), l_2(x), \dots, l_n(x)$ are known as

Lagrange polynomials and they can be obtained by the following relation:

$$l_i(x) = \prod_{\substack{j=0 \\ j \neq i}}^n \frac{x - x_j}{x_i - x_j}; \quad i = 0, 1, 2, \dots, n$$

(Nyazi Tawfeeg Ahmed, 2001) [11] polynomial function of the five degree which interpolates the depicted table.

7. Health Centers

7.1. Railway Health Center

Table 1. A table showing that the number of those who came to Railway Health Center and who were injured

Weeks	First week	Second week	Third week	Fourth week	Fifth week	Sixth week
Total came	208	395	389	258	256	120
Total patients	113	266	253	194	116	32

$$P_5(x) = l_0(x)y_0 + l_1(x)y_1 + l_2(x)y_2 + l_3(x)y_3 + l_4(x)y_4 + l_5(x)y_5$$

$$l_0(x) = \frac{(x - x_1)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_0 - x_1)(x_0 - x_2)(x_0 - x_3)(x_0 - x_4)(x_0 - x_5)}$$

$$l_0(x) = \frac{(x - 395)(x - 389)(x - 258)(x - 256)(x - 120)}{(208 - 395)(208 - 389)(208 - 258)(208 - 256)(208 - 120)}$$

$$l_0(x) = \frac{(x - 395)(x - 389)(x - 258)(x - 256)(x - 120)}{7148486400}$$

$$= \frac{1}{7148486400} (x - 395)(x - 389)(x - 258)(x - 256)(x - 120)$$

$$= \frac{1}{7148486400} (x^5 + 65144x^4 - 15006169x^3 + 10116415528x^2 - 2001607120x + 1227310093200)$$

$$l_1(x) = \frac{(x - x_0)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_1 - x_0)(x_1 - x_2)(x_1 - x_3)(x_1 - x_4)(x_1 - x_5)}$$

$$l_1(x) = \frac{(x - 208)(x - 389)(x - 258)(x - 256)(x - 120)}{(395 - 208)(395 - 389)(395 - 258)(395 - 256)(395 - 120)}$$

$$= \frac{1}{5491125222} (x^5 - 1231x^4 + 515138x^3 - 89829584x^2 + 5869990656x - 70634373120)$$

$$l_2(x) = \frac{(x - x_0)(x - x_1)(x - x_3)(x - x_4)(x - x_5)}{(x_2 - x_0)(x_2 - x_1)(x_2 - x_3)(x_2 - x_4)(x_2 - x_5)}$$

$$l_2(x) = \frac{(x - 208)(x - 395)(x - 258)(x - 256)(x - 120)}{(389 - 208)(389 - 395)(389 - 258)(389 - 256)(389 - 120)}$$

$$= -\frac{1}{5089850682} (x^5 - 1237x^4 + 592190x^3 - 137035184x^2 + 14943365760x - 70634373120)$$

$$l_3(x) = \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_4)(x - x_5)}{(x_3 - x_0)(x_3 - x_1)(x_3 - x_2)(x_3 - x_4)(x_3 - x_5)}$$

$$l_3(x) = \frac{(x - 208)(x - 395)(x - 389)(x - 256)(x - 120)}{(258 - 208)(258 - 395)(258 - 389)(258 - 256)(258 - 120)}$$

$$= \frac{1}{244079200} (x^5 - 1368x^4 + 72043680x^3 - 85465932x^2 + 21746903680x - 981818572800)$$

$$\begin{aligned}
 l_4(x) &= \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_5)}{(x_4 - x_0)(x_4 - x_1)(x_4 - x_2)(x_4 - x_3)(x_4 - x_5)} \\
 l_4(x) &= \frac{(x - 208)(x - 395)(x - 389)(x - 258)(x - 120)}{(256 - 208)(256 - 395)(256 - 389)(256 - 258)(256 - 120)} \\
 &= -\frac{1}{241366272}(x^5 - 1370x^4 + 722663x^3 - 182395366x^2 + 21886838640x - 989489030400) \\
 l_5(x) &= \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)}{(x_5 - x_0)(x_5 - x_1)(x_5 - x_2)(x_5 - x_3)(x_5 - x_4)} \\
 l_5(x) &= \frac{(x - 208)(x - 395)(x - 389)(x - 258)(x - 256)}{(120 - 208)(120 - 395)(120 - 389)(120 - 258)(120 - 256)} \\
 &= -\frac{1}{122175926400}(x^5 - 1506x^4 + 892663x^3 - 491277534x^2 + 176639748256x - 21089869931521) \\
 P_5(x) &= l_0(x)y_0 + l_1(x)y_1 + l_2(x)y_2 + l_3(x)y_3 + l_4(x)y_4 + l_5P_5(x) \\
 P_5(x) &= \left[\left(\frac{1}{7148486400}(x^5 + 65144x^4 - 15006169x^3 + 10116415528x^2 - 2001607120x + 1227310093200) \right) 113 \right] \\
 &+ \left[\left(\frac{1}{5491125222}(x^5 - 1231x^4 + 515138x^3 - 89829584x^2 + 5869990656x - 70634373120) \right) 266 \right] \\
 &+ \left[\left(-\frac{1}{5089850682}(x^5 - 1237x^4 + 592190x^3 - 137035184x^2 + 14943365760x - 70634373120) \right) 253 \right] \\
 &+ \left[\left(\frac{1}{244079200}(x^5 - 1368x^4 + 72043680x^3 - 85465932x^2 + 21746903680x - 981818572800) \right) 194 \right] \\
 &+ \left[\left(-\frac{1}{241366272}(x^5 - 1370x^4 + 722663x^3 - 182395366x^2 + 21886838640x - 989489030400) \right) 116 \right] \\
 &+ \left[\left(-\frac{1}{122175926400}(x^5 - 1506x^4 + 892663x^3 - 491277534x^2 + 176639748256x - 21089869931521) \right) 32 \right]
 \end{aligned}$$

7.2. Pante 42 Health Center

Table 2. A table showing that the number of those who came to Pante 42 Health Center and who were injured

Weeks	First week	Second week	Third weak	Fourth weak	Fifth weak	Sixth week
Total came	302	325	202	201	189	147
Total patients	232	130	34	49	151	18

$$\begin{aligned}
 l_0(x) &= \frac{(x - x_1)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_0 - x_1)(x_0 - x_2)(x_0 - x_3)(x_0 - x_4)(x_0 - x_5)} \\
 l_0(x) &= \frac{(x - 325)(x - 202)(x - 201)(x - 189)(x - 147)}{(302 - 325)(302 - 202)(302 - 201)(302 - 189)(302 - 147)} \\
 l_0(x) &= -\frac{(x - 325)(x - 202)(x - 201)(x - 189)(x - 147)}{4068734500} \\
 &= -\frac{1}{4068734500}(x^5 - 1064x^4 + 444153x^3 - 55942774x^2 + 9227449082x - 368438697900) \\
 l_1(x) &= \frac{(x - x_0)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_1 - x_0)(x_1 - x_2)(x_1 - x_3)(x_1 - x_4)(x_1 - x_5)} \\
 l_1(x) &= \frac{(x - 302)(x - 202)(x - 201)(x - 189)(x - 147)}{(325 - 302)(325 - 202)(325 - 201)(325 - 189)(325 - 147)}
 \end{aligned}$$

$$= \frac{1}{8492069568} (x^5 - 1041 x^4 + 426971 x^3 - 86384307 x^2 + 8629369308 x - 340669700532)$$

$$l_2(x) = \frac{(x - x_0)(x - x_1)(x - x_3)(x - x_4)(x - x_5)}{(x_2 - x_0)(x_2 - x_1)(x_2 - x_3)(x_2 - x_4)(x_2 - x_5)}$$

$$l_2(x) = \frac{(x - 302)(x - 325)(x - 201)(x - 189)(x - 147)}{(202 - 302)(202 - 325)(202 - 201)(202 - 189)(202 - 147)}$$

$$= \frac{1}{8794500} (x^5 - 1164 x^4 + 530168 x^3 - 118055946 x^2 + 12856967991 x - 548107191450)$$

$$l_3(x) = \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_4)(x - x_5)}{(x_3 - x_0)(x_3 - x_1)(x_3 - x_2)(x_3 - x_4)(x_3 - x_5)}$$

$$l_3(x) = \frac{(x - 302)(x - 325)(x - 202)(x - 189)(x - 147)}{(201 - 302)(201 - 325)(201 - 202)(201 - 189)(201 - 147)}$$

$$= -\frac{1}{8115552} (x^5 - 1165 x^4 + 488045 x^3 - 91377629 x^2 + 8678475432 x - 550834092900)$$

$$l_4(x) = \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_5)}{(x_4 - x_0)(x_4 - x_1)(x_4 - x_2)(x_4 - x_3)(x_4 - x_5)}$$

$$l_4(x) = \frac{(x - 302)(x - 325)(x - 202)(x - 201)(x - 147)}{(189 - 302)(189 - 325)(189 - 202)(189 - 201)(189 - 147)}$$

$$= \frac{1}{100691136} (x^5 - 1177 x^4 + 542843 x^3 - 122552555 x^2 + 13541836188 x - 585807686100)$$

$$l_5(x) = \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)}{(x_5 - x_0)(x_5 - x_1)(x_5 - x_2)(x_5 - x_3)(x_5 - x_4)}$$

$$l_5(x) = \frac{(x - 302)(x - 325)(x - 202)(x - 201)(x - 189)}{(147 - 302)(147 - 325)(147 - 202)(147 - 201)(147 - 189)}$$

$$= -\frac{1}{3441576600} (x^5 - 1219 x^4 + 586103 x^3 - 138992741 x^2 + 16272336156 x - 753181310700)$$

$$P_5(x) = l_0(x)y_0 + l_1(x)y_1 + l_2(x)y_2 + l_3(x)y_3 + l_4(x)y_4 + l_5(x)y_5$$

$$P_5(x) = \left[\left(-\frac{1}{4068734500} (x^5 - 1064 x^4 + 444153 x^3 - 55942774 x^2 + 9227449082 x - 368438697900) \right) 232 \right] \\ + \left[\left(\frac{1}{8492069568} (x^5 - 1041 x^4 + 426971 x^3 - 86384307 x^2 + 8629369308 x - 340669700532) \right) 130 \right] \\ + \left[\left(\frac{1}{8794500} (x^5 - 1164 x^4 + 530168 x^3 - 118055946 x^2 + 12856967991 x - 548107191450) \right) 34 \right] \\ + \left[\left(-\frac{1}{8115552} (x^5 - 1165 x^4 + 488045 x^3 - 91377629 x^2 + 8678475432 x - 550834092900) \right) 49 \right] \\ + \left[\left(\frac{1}{100691136} (x^5 - 1177 x^4 + 542843 x^3 - 122552555 x^2 + 13541836188 x - 585807686100) \right) 151 \right] \\ + \left[\left(-\frac{1}{3441576600} (x^5 - 1219 x^4 + 586103 x^3 - 138992741 x^2 + 16272336156 x - 753181310700) \right) 18 \right]$$

7.3. Pante 20 Health Center

Table 3. A table showing that the number of those who came to Pante 20 Health Center and who were injured

Weeks	First week	Second week	Third week	Fourth week	Fifth week	Sixth week
Total came	227	194	498	1764	2904	1725
Total patients	137	131	348	1742	2880	1688

$$\begin{aligned}
 l_0(x) &= \frac{(x - x_1)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_0 - x_1)(x_0 - x_2)(x_0 - x_3)(x_0 - x_4)(x_0 - x_5)} \\
 l_0(x) &= \frac{(x - 194)(x - 498)(x - 1764)(x - 2904)(x - 1725)}{(227 - 194)(227 - 498)(227 - 1764)(227 - 2904)(227 - 1725)} \\
 &= \frac{1}{55121024737086} (x^5 - 7085 x^4 + 17695524 x^3 - 18571291668 x^2 + 7387773316272 x - 853719821539200) \\
 l_1(x) &= \frac{(x - x_0)(x - x_2)(x - x_3)(x - x_4)(x - x_5)}{(x_1 - x_0)(x_1 - x_2)(x_1 - x_3)(x_1 - x_4)(x_1 - x_5)} \\
 l_1(x) &= \frac{(x - 227)(x - 498)(x - 1764)(x - 2904)(x - 1725)}{(194 - 227)(194 - 498)(194 - 1764)(194 - 2904)(194 - 1725)} \\
 l_1(x) &= -\frac{1}{65347903262400} (x^5 - 7118 x^4 + 17922927 x^3 - 19111127778 x^2 + 7895897735976 x - 998940203553600) \\
 l_2(x) &= \frac{(x - x_0)(x - x_1)(x - x_3)(x - x_4)(x - x_5)}{(x_2 - x_0)(x_2 - x_1)(x_2 - x_3)(x_2 - x_4)(x_2 - x_5)} \\
 l_2(x) &= \frac{(x - 227)(x - 194)(x - 1764)(x - 2904)(x - 1725)}{(498 - 227)(498 - 194)(498 - 1764)(498 - 2904)(498 - 1725)} \\
 &= -\frac{1}{307905017387387328} (x^5 - 6814 x^4 + 15910447 x^3 - 14664773010 x^2 + 4300399565928 x - 389145380500800) \\
 l_3(x) &= \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_4)(x - x_5)}{(x_3 - x_0)(x_3 - x_1)(x_3 - x_2)(x_3 - x_4)(x_3 - x_5)} \\
 l_3(x) &= \frac{(x - 227)(x - 194)(x - 498)(x - 2904)(x - 1725)}{(1764 - 227)(1764 - 194)(1764 - 498)(1764 - 2904)(1764 - 1725)} \\
 &= -\frac{1}{135824052452400} (x^5 - 5548 x^4 + 9517147 x^3 - 5799928308 x^2 + 1372382989596 x - 109860770685600) \\
 l_4(x) &= \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_5)}{(x_4 - x_0)(x_4 - x_1)(x_4 - x_2)(x_4 - x_3)(x_4 - x_5)} \\
 l_4(x) &= \frac{(x - 227)(x - 194)(x - 498)(x - 1764)(x - 1725)}{(2904 - 227)(2904 - 194)(2904 - 498)(2904 - 1764)(2904 - 1725)} \\
 &= \frac{1}{23460212495041200} (x^5 - 4408 x^4 + 6502987 x^3 - 3703501365 x^2 + 848488552236 x - 585807686100) \\
 l_5(x) &= \frac{(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)}{(x_5 - x_0)(x_5 - x_1)(x_5 - x_2)(x_5 - x_3)(x_5 - x_4)} \\
 l_5(x) &= \frac{(x - 227)(x - 194)(x - 498)(x - 1764)(x - 2904)}{(1725 - 227)(1725 - 194)(1725 - 498)(1725 - 1764)(1725 - 2904)} \\
 &= -\frac{1}{129392760675906} (x^5 - 5587 x^4 + 9666244 x^3 - 5913904716 x^2 + 1401970889808 x - 112344579414144)
 \end{aligned}$$

$$\begin{aligned}
 P_5(x) &= l_0(x)y_0 + l_1(x)y_1 + l_2(x)y_2 + l_3(x)y_3 + l_4(x)y_4 + l_5(x)y_5 \\
 &= \left[\left(\frac{1}{55121024737086} (x^5 - 7085x^4 + 17695524x^3 - 18571291668x^2 + 7387773316272x - 853719821539200) \right) 137 \right] \\
 &+ \left[\left(-\frac{1}{65347903262400} (x^5 - 7118x^4 + 17922927x^3 - 19111127778x^2 + 7895897735976x - 998940203553600) \right) 131 \right] \\
 &+ \left[\left(-\frac{1}{307905017387387328} (x^5 - 6814x^4 + 15910447x^3 - 14664773010x^2 + 4300399565928x - 389145380500800) \right) 348 \right] \\
 &+ \left[\left(-\frac{1}{135824052452400} (x^5 - 5548x^4 + 9517147x^3 - 5799928308x^2 + 1372382989596x - 109860770685600) \right) 1742 \right] \\
 &+ \left[\left(\frac{1}{23460212495041200} (x^5 - 4408x^4 + 6502987x^3 - 3703501365x^2 + 848488552236x - 585807686100) \right) 2880 \right] \\
 &+ \left[\left(-\frac{1}{129392760675906} (x^5 - 5587x^4 + 9666244x^3 - 5913904716x^2 + 1401970889808x - 112344579414144) \right) 1688 \right]
 \end{aligned}$$

8. Results and Discussion

8.1. Rail Way Health Center

Table 4. A table showing that the mathematical treatment using Matlab for the number of those who came to Railway Health Center and who were injured

Weeks	First week	Second week	Third week	Fourth week	Fifth week	Sixth week
Total came	208	395	389	258	256	120
Total patients	113	266	253	194	116	32

$$P_5(x) = l_0(x)y_0 + l_1(x)y_1 + l_2(x)y_2 + l_3(x)y_3 + l_4(x)y_4 + l_5(x)y_5$$

```

Solution
function [l,L] = lagranp(x,y)
%Input: x = [x0 x1... xN], y = [y0 y1... yN]
%Output: l = Lagrange polynomial coefficients of degree
N
% L = Lagrange coefficient polynomial
N = length(x)-1; %the degree of polynomial
l = 0;
for m = 1:N + 1
P = 1;
for k = 1:N + 1
if k ~= m, P = conv(P,[1 -x(k)])/(x(m)-x(k)); end
end
L(m,:) = P; %Lagrange coefficient polynomial
l = l + y(m)*P;
end
plot(x,y,'r')
xlabel('Total came')
ylabel('Total patients')
title('Rail way health center')
grid on
%do_lagranp.m
x = [208 395 389 258 256 120]; y = [113 266 253 194 116
32]; % given data points
l = lagranp(x,y) % find the Lagrange polynomial
xx = [-2: 0.02: 2]; yy = polyval(l,xx); %interpolate for [-
2,2]
clf, plot(xx,yy,'b', x,y, '*') %plot the graph
Result:
>> Lagrange(x, y)
ans =
1.0e+05 *
0.0000-0.00000.0000-0.00060.0684-3.0888
Plotting of Result:
    
```

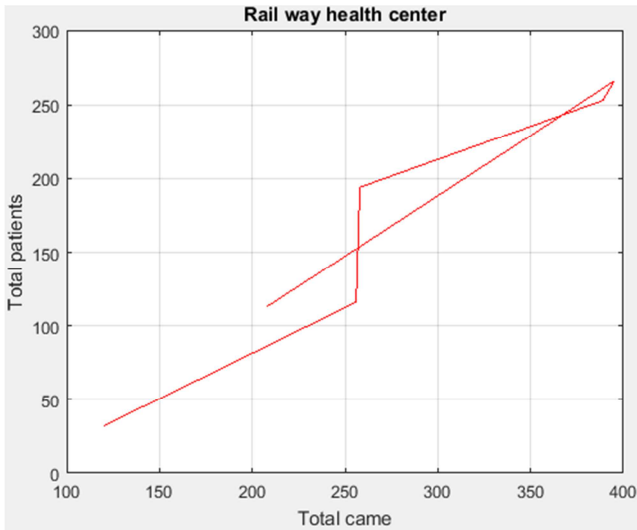


Figure 1. Instability of patients cases.

8.2. Pante 42 Health Center

Table 5. A table showing that the mathematical treatment using Matlab for the number of those who came to Pante 42 Health Center and who were injured.

weeks	First week	Second week	Third week	Four week	Five week	Six week
Total came	302	325	202	201	189	147
Total patients	232	130	34	49	151	18

Solution

```
function [l,L] = lagranp(x,y)
%Input: x = [x0 x1... xN], y = [y0 y1... yN]
%Output: l = Lagrange polynomial coefficients of degree
N
% L = Lagrange coefficient polynomial
N = length(x)-1; %the degree of polynomial
l = 0;
for m = 1:N + 1
P = 1;
for k = 1:N + 1
if k ~= m, P = conv(P,[1 -x(k)])/(x(m)-x(k)); end
end
L(m,:) = P; %Lagrange coefficient polynomial
l = l + y(m)*P;
end
plot(x,y,'r')
xlabel('Total came')
ylabel('Total patients')
title('Rail way health center')
gridon
%do_lagranp.m
x = [302 325 202 201 189 147]; y = [232 130 34 49 151
18]; % given data points
l = lagranp(x,y) % find the Lagrange polynomial
xx = [-2: 0.02: 2]; yy = polyval(l,xx); %interpolate for [-
2,2]
clf, plot(xx,yy,'b', x,y,'*') %plot the graph
Result:
```

ans =
1.0e+05 *
-0.00000.0000-0.00000.0008-0.08403.4794
Plotting of Result:

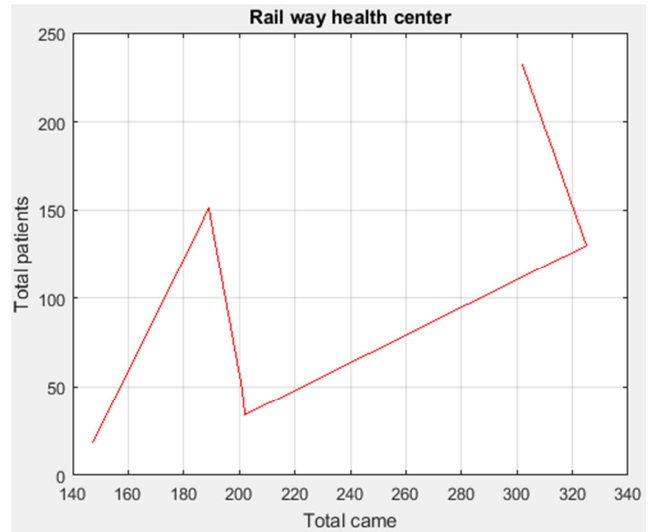


Figure 2. Unnatural Geometric Interpretation using Matlab for the number of those who came to Railway Health Center and who were injured

8.3. Pante 20 Health Center

Table 6. A table showing that the mathematical treatment using Matlab for the number of those who came to Pante 20 Health Center and who were injured.

Week	First week	Second week	Third week	Fourth week	Fifth week	Sixth week
Total came	227	194	498	1764	2904	1725
Total patients	137	131	348	1742	2880	1688

Solution

```
function [l,L] = lagranp(x,y)
%Input: x = [x0 x1... xN], y = [y0 y1... yN]
%Output: l = Lagrange polynomial coefficients of degree
N
% L = Lagrange coefficient polynomial
N = length(x)-1; %the degree of polynomial
l = 0;
for m = 1:N + 1
P = 1;
for k = 1:N + 1
if k ~= m, P = conv(P,[1 -x(k)])/(x(m)-x(k)); end
end
L(m,:) = P; %Lagrange coefficient polynomial
l = l + y(m)*P;
end
plot(x,y,'r')
xlabel('Total came')
ylabel('Total patients')
title('Rail way health center')
gridon
%do_lagranp.m
x = [227 194 498 1764 2904 1725]; y = [137 131 348 1742
2880 1688]; % given data points
```



```
l = lagranp(x,y) % find the Lagrange polynomial
xx = [-2: 0.02: 2]; yy = polyval(l,xx); %interpolate for [-2,2]
clf, plot(xx,yy,'b', x,y,'*') %plot the graph
Result:
>> Lagrange(x, y)
ans =
-0.00000.0000-0.00000.0055-1.5348255.7012
Plotting of Result:
```

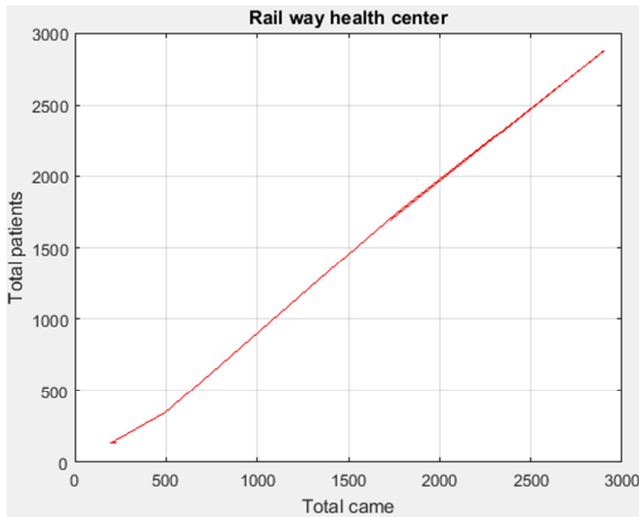


Figure 3. Natural Geometric Interpretation using Matlab for the number of those who came to Railway Health Center and who were injured.

9. Compare Between Numerical and Proposed Modeling

Table 7. Comparison between Numerical and Matlab solutions.

	Numerical Modeling	Proposed Modeling
Accurate	Non accurate	Accurate
fast	Not Fast	Fast
Multi Values	Non-Available	Available
General Results	Non Quality	Quality

10. Conclusion

Finally we note that from table 1 and table 2 Chikungunya disease start decreasing in third week but in table 3 we found that Chikungunya disease decreasing in sixth week also we explained the possibility of the modeling of Chikungunya disease using the Lagrange interpolating method by Matlab.

References

[1] Braiala Wahida, AmjadAli, Shazia Rafique, Muhammad Idrees, Global expansion of chikungunya virus:mapping the 64-yearhistory, International Journal of Infectious Diseases, Corresponding Editor: Eskild Petersen, Aarhus, Denmark, March 2017.

[2] Claudio Soto-Garita MSc Candidate, Jean-paul Carrera MSc, Sandra Lopez-verges Phd & Eugenia Corrales-Aguilar Advances in Clinical Diagnosis and Management of

Chikungunya Virus infection Neglected Tropical diseases (A Sanchez, Section Editor)Published: 08 May 2018.

[3] Dr. Margaret Chan, Director-General, World Health Organization, World Health Day 2014 – Vector-borne diseases.

[4] LF da Rochajr, HD delima, RM Correia, MRDA freitas, PRS de melo, AGL de Mattos, AFR de Olivera, CDL Marques, ALBP Duarte, O Lins, A Ranzolin, SAT0566 Electroneuro graphic findings in patients with subacute/chronic articular symptoms of chikungunya fever and neuropathic complaints – preliminary results, Copyright information:© 2017, Published by the BMJ Publishing Group Limited.

[5] M. Runowska, D. Majewski, K. Niklas, M. Puszczewicz, Chikungunya virus: a rheumatologist’s perspective, Clinical and Experimental Rheumatology 2018.

[6] Meghna R. Sebastian, RakeshLodha, and S. K. Kabra, Chikungunya Infection in Children, Indian Journal of Pediatrics, Volume 76—February 2009.

[7] Md. Tanvir Rahman, Chikungunya virus infection in developing countries - What should we do?, Journal of Advanced Veterinary and Animal Research, ISSN 2311-7710 (Electronic), Vol 4 No 2, Pages 125-131. June 2017.

[8] Muktha S. Natrajan, Alejandra Rojas, Jesse J. Waggoner, Beyond Fever and Pain: Diagnostic Methods for Chikungunya Virus, Copyright© 2019 American Society for Microbiology.

[9] Nazish Badar, Muhammad Salman, Jamil Ansari, Uzma Aamir, Muhammad MasroorAlam, Yasir Arshad, NighatMushtaq, Aamer Ikram, Javaria Qazi, Emergence of Chikungunya Virus, Pakistan, 2016–2017, Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 26, No. 2, February 2020.

[10] Nildimar Alves Honório, Keenan Wiggins, Bradley Eastmond, Experimental Vertical Transmission of Chikungunya Virus by Brazilian and Florida, 2019.

[11] Nyazi Tawfeeg Ahmed – Numerical Analysis proBm-lems – Sudan university of Science and Technology college of Engineering, 2001.

[12] Paul F Hord, Philippe buchy, Chikungunya, Article (PDF Available) in Revue scientifique et technique (International Office of Epizootics) 34 (2): 479-489 · August 2015 with 6,518 Reads.

[13] Pan American World Health Organization, World Health Organization, 2014.

[14] Pan American World Health Organization, World Health Organization Information for Health care Providers Chikungunya Fever January 2014 CHICKUNGUNYA.

[15] Samlee Plianbangchang, M. D., Dr. P. H. Regional Director, Guidelines on Clinical Management of Chikungunya Fever, World Health Organization 2008, Printed in India.

[16] Sudanese Federal Ministry of Health, October 2018.

[17] World Health Organization, Regional Office for South-East Asia, ISBN 978-92-9022-337-5, Printed in India, 2009.

[18] World Health Organization, Guidelines on Clinical Management of Chikungunya Fever, Printed in India, October 2008.