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# STATISTICAL ANALYSIS OF REPORTED CASES OF MALARIA AT MORADABAD IN UTTAR PRADESH FOR THE PERIOD 2016 - 2020

**ANSHUL DUBEY AND RAJAN SINGH**

## ABSTRACT

*In this research "Statistical Analysis" on the reported case of malaria disease at Moradabad in Uttar Pradesh. A case study of Moradabad District, which has 8-blocks named, Tajpur, Bhojpur, Mundapanday, Kanth, kundarki, Bilari, Thakurdwara, Dilari, Moradabad, (2016-2020) is a reported. The regression between malaria disease and time factor in months. The Collected data is a secondary data and its unit in thousands, and the data comprises 60 data points which spread from 2016 to 2020. The study reviewed relevant literature to acquaint researchers on the rate of spread of malaria as shown on the graph. From the collected data the study used in the method of least square. From the analysis done the following finding were made; it was discovered that there was a linear relationship between prevalence of malaria attack and the various time of the year, the rate of decrease is more in female than in male. Generally, the reported number of malaria disease at Moradabad in Uttar Pradesh from 2016-2020 is decreasing. Nevertheless, recommendation is mandatory for public place, residential areas, Industrial areas, Companies, School and Colleges etc. be made clean to reduce breeding site for mosquitoes to reproduces.*

*Keyword: Regression Line for malaria disease, The Secondary data including 8-blocks, Mosquitoes Infection, The method of least square, Graph, Transmission and Treatment, SPSS Statistical Tool.*

## INTRODUCTION

Malaria is one of the most prevalent infection diseases and is a serious public health problem. The disease is spread through Protozoa Parasites of Plasmodium Genus. Only four types of plasmodium parasites affect humans, the most dangerous of which are considered Plasmodium falciparum and Plasmodium vivax as well as Plasmodium ovale and Plasmodium malariae. Also affect humans. This whole group is called "Malaria Parasite".

The carrier of the malaria parasite is the female Anopheles mosquito. On its bite, malaria parasites multiply by entering the real blood cells, causing symptoms of anemia (dizziness, breathlessness, ejaculation etc.) Apart from this, non-specific symptoms such as fever, cold, nausea and cold are also seen. In severe causes, the patient may go unconscious and even die.

Several measures can be taken to prevent the spread of malaria. Mosquito bites, so mosquitoes can be controlled by spraying pesticides and draining stagnant water (to which mosquitoes lay eggs. Although research on vaccines/for the prevention of malaria is ongoing, but no one has been available yet. To prevent malaria is often out of reach of the affected people. Most adult people in the malaria – dominant area have a tendency to have frequent malaria as well as have partial immunity against it but this immunity is reduced when they move to an area. That do not get affected by malaria. If they return to the affected areas, they should again take fall care. Malaria infection is treated with anti-malarial drugs such as quinine or artemisinin, are becoming increasingly common.

Moradabad is a city in the state of Uttar Pradesh. It was founded in 1600 by Murad, the son of the Mughal Emperor Shah Jahan; As a result, the city came to be known as Moradabad. It is an administrative headquarters of Moradabad district. Moradabad is located 167 km (104 mile) from the national capital, New Delhi, on the banks of the Ram Ganga River. Moradabad city is famous for its vast exports of brass handicrafts in North America and Europe and thus is also known as "Brass City" or Petal Nagri.

In this research paper, we have collected data from 8-blocks of Moradabad district, where the effect of malaria has been seen more, whose names are as follows: Tajpur, Bhojpur, Mundapanday, Kanth, Kundarki, Bilari, and Thakurdwara.

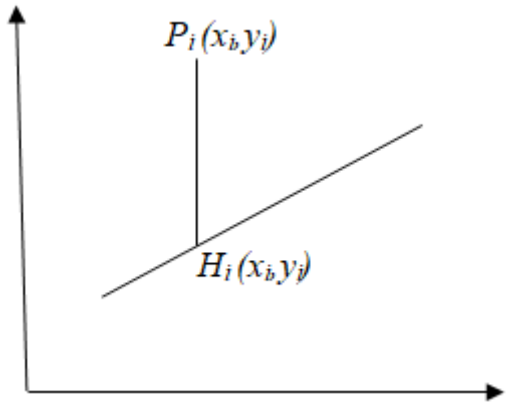
There are two types of cases found in Moradabad District, namely Plasmodium falciparum and Plasmodium vivax according to collected data (2016 – 2020).

| Years | Plasmodium Parasites | Patients |
|---|---|---|
| 2016 | Plasmodium - falciparum | 03 |

| | | |
|---|---|---|
| | Plasmodium – Vivax | 502 |
| 2017 | Plasmodium - falciparum | 01 |
| | Plasmodium – Vivax | 491 |
| 2018 | Plasmodium - falciparum | Nil |
| | Plasmodium – Vivax | 410 |

The literal meaning of regression is 'moving backward' or 'the return to the mean value' or 'stepping back towards the average'. Sir Francis Galton used this term in the study of heredity. Regression analysis is 'mathematical measure of the average relationship between two or more variables, in terms of the original units of the data.

In regression analysis, there are two types of variables. The variable, the value of which can be predicted, is called predicted or dependent variable and the variable which is used for prediction is called independent or predictor variable. In case there exists association or relationship between two variables X and Y, the dots of the scatter diagram will be more or less concentrated round a curve, which may be called the curve of regression and the relationship is said to be exp- pressed by means of curvilinear regression. When the curve is a strai- ght line, it is called the line of regression and the regression is said to be Linear. More precisely, the line of regression is the straight line, which gives the 'best' fit in the least square sense to the given frequency or probability distribution.




Analysis of Variance is a technique of splitting the total variation present in an exptl. Data into its component variations due to different factors to study their separately.

The ANOVA is a powerful statistical tool for tests of significance, which was introduced by Prof. R. A. Fisher in 1920`s to deal with problem in the analysis of agronomical data.

The total variation in any set of numerical data is due to a no. of causes which may be classified in to:

1- Assignable Cause.

2- Non – Assignable (chance) Cause.

The Variation due to assignable causes may be and can be measured, whereas the variation due to non-assignable causes is non-assignable and cannot be controlled. For example- consider random samples of students of different colleges in a city. A certain intelligence test is applied to selected students and their marks performances are noted. In this case there are two sources of variation present into, which the total variation may be partitioned. First, the variation in the average marks of students of different colleges may differ together- the variation average marks between the colleges. Secondly – there is a variation in marks within the college. Hence in this example the total variation in marks is classified in to two components namely within the colleges (Non–Assignable variable).

**RESEARCH METHODOLOGY**

The objectives are to statistically analysis the reported cases of malaria and its extent of treatment at Moradabad in Uttar Pradesh. The following Research Methodology is adopted for the proposed research paper.

- Identification of the Research Problem of Malaria Patients.
- Theoretical framework and study of related literature of Malaria Patients.

- Mathematical formulation of the research problem to analyzing the solution of reported cases of malaria patients (2016 – 2020).
- To find out the extent at which malaria parasites spread among people in Moradabad in terms of gender.
- To find out adopted presentation of malaria as well as the symptoms, diagnosis and treatment.
- Interpretation and statistical analysis or results.
- Conclusion.
- Recommendation.

**MATHEMATICAL FORMULATION OF THE RESEARCH PROBLEM:**
If assignable variation is expected through one source/ one way/ one direction, then it is a one-way class of ANOVA.

Layout Gr.

| | | | |
|---|---|---|---|
| *1* | $y_{11}$ | $y_{12}$……..$y_{1j}$ ……..$y_{1n1}$ | $n_1$ |
| *2* | $y_{21}$ | $y_{22}$……..$y_{2j}$……..$y_{2n2}$ | $n_2$ |
| $i^{th}$ | $y_{31}$ | $y_{i1}$……..$y_{ij}$……..$y_{ini}$ | $n_i$ |
| $j^{th}$ | $y_{k1}$ | $y_{k2}$……..$y_{kj}$……..$y_{knk}$ | $n_k$ |
| | | | $N$ |

**LINER MODEL**
$y_{ij} = \mu_i + e_{ij}$; i = 1, 2, 3……. k and j= 1, 2, 3…...$n_i$

Here $\mu_i$: $\mu + b_i$…….(1)

So $y_{ij} = \mu + b_i + e_{ij}$……. (2)

Where, $y_{ij}$ = obs. total variation / effect of $i^{th}$ group receiving $j^{th}$ group.

$\mu$ = common real effect.

$b_i$ = obs. real variation of $i^{th}$ group.

$e_{ij}$ = Error component such that $e_i \sim N(0,\sigma_e^2)$

Also $\sum_{i=1}^{k}(bi) = \sum_{i=1}^{k}(\mu i - \mu) = 0$

**ANOVA TABLE**

| Source | df | Sum of SQ | MSS | MSS= mean sum of SQ |
|---|---|---|---|---|
| Between Gr. | K-1 | $RHS_1$ | $S_1^2$ | $S_1^2 = RHS_1/k\text{-}1$ |
| Within Gr. (error) | N-K | $RHS_2$ | $S_E^2$ | $S_E^2 = RHS_2/N\text{-}K$ |
| Total | N-1 | L.H.S. | | |

Further to test the hypothesis

$H_o$: $\mu_1 = \mu_2 = \mu_3 = \ldots\ldots\ldots = \mu_k$

$H_1$: atleast two means are not same.

We may use F-test

$F = S_1^2 / S_E^2 \sim v_1, v_2$

Decision Rule:

**if** $F_{cal} \leq F_{.05}; v_1, v_2$

- $H_o$ is accepted against $H_1$ at 5% level of significance.
- $H_o$ is rejected in favour of $H_1$ at 5% level of significance.

$F_{cal} > F_{.01}; v_1, v_2$

- $H_o$ is strongly rejected in favour of $H_1$ at 1% level of significance.

- Linear Regression Model

$Y = B_0 + B_i X$

- Least Square Method: Least Square Method usually employed to contain the desired line of fit is known as the method of least squares, and the line obtained is called the least squares line for each sample observations $(X_i, Y_i)$ the method of least squares considered the deviation of each $Y_i$ from, its expected value, where $B_i$ and $B_o$ are given as;

$$B_i = \frac{n\,(\sum X_i Y_i) - \sum X_i \sum Y_i}{n \sum X_i{}^2 - (\sum X_i)^2}$$

$$B_o = \frac{\sum Y_i)}{n} - B_i \frac{\sum X_i)}{n}$$

i.e., $Bo = y - B_i x$ where $x$ and $y$ are the means of $X$ and $Y$ variables.

**COLLECTION AND DATA PRESENTATION:**

The data required for this study are monthly reported cases of malaria. It covers 2016 to 2020 with a total 60 points. The 8 -blocks in Moradabad chosen for this research paper. The data representation in table-1 shows the monthly figures of reported cases of malaria within five years period (2016-2020). A close look at the data shows that malaria cases are spread all over the period. The value of the table-2 shows the gender distribution of malaria cases within five years period (2016-2020).

**Table-1:** Reported Cases of Malaria from 2016 – 2020.

| Months/Years | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| January | 02 | 04 | 09 | 01 | 03 |
| February | 07 | 05 | 05 | 06 | 06 |
| March | 08 | 04 | 14 | 05 | 06 |
| April | 07 | 09 | 16 | 07 | Nil |
| May | 20 | 18 | 19 | 19 | Nil |
| June | 22 | 60 | 25 | 39 | 02 |
| July | 35 | 93 | 36 | 57 | 03 |
| August | 43 | 80 | 52 | 74 | 09 |
| September | 182 | 88 | 133 | 160 | 08 |
| October | 149 | 42 | 75 | 56 | 13 |
| November | 21 | 34 | 20 | 36 | 15 |
| December | 06 | 14 | 06 | 17 | 17 |
| Total | 502 | 451 | 410 | 477 | 82 |

The data above shows the total number of collected data on monthly reported cases of malaria from 2016 to 2020, from Moradabad in Uttar Pradesh.

**Table-2:** Gender Distribution of Malaria Cases from 2016 – 2020.

| Months/Years | 2016 | | 2017 | | 2018 | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Male | female | Male | female | Male | female | Male | female | Male | female |
| January | 01 | 01 | 02 | 02 | 05 | 04 | 01 | 00 | 02 | 01 |
| February | 07 | 00 | 05 | 00 | 01 | 04 | 04 | 02 | 03 | 03 |
| March | 03 | 05 | 03 | 01 | 10 | 04 | 03 | 02 | 04 | 02 |
| April | 02 | 05 | 05 | 04 | 08 | 08 | 03 | 04 | Nil | Nil |
| May | 10 | 10 | 12 | 06 | 10 | 09 | 11 | 08 | Nil | Nil |
| June | 11 | 11 | 28 | 32 | 09 | 16 | 18 | 21 | 01 | 01 |
| July | 20 | 15 | 57 | 36 | 22 | 14 | 31 | 26 | 01 | 02 |
| August | 24 | 19 | 39 | 41 | 31 | 21 | 43 | 31 | 04 | 05 |
| September | 122 | 60 | 53 | 35 | 72 | 61 | 73 | 87 | 05 | 03 |
| October | 67 | 82 | 21 | 21 | 33 | 42 | 33 | 23 | 06 | 05 |
| November | 14 | 07 | 18 | 16 | 15 | 05 | 23 | 13 | 08 | 07 |
| December | 03 | 03 | 05 | 09 | 05 | 01 | 10 | 07 | 11 | 06 |

**Source** Moradabad District in Uttar Pradesh

**Table-3:** Calculation of $B_o$ and $B_i$ using the data in Table 1.

| Year 2016 | $X_t$ | $Y_t$ | $X_tY_t$ | $X^2_t$ | $Y^2_t$ | Year2017 | $X_t$ | $Y_t$ | $X_tY_t$ | $X^2_t$ | $Y^2_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 1 | 2 | 2 | 1 | 4 | January | 13 | 4 | 52 | 169 | 16 |
| February | 2 | 7 | 14 | 4 | 49 | February | 14 | 5 | 70 | 196 | 25 |
| March | 3 | 8 | 24 | 9 | 64 | March | 15 | 4 | 60 | 225 | 16 |
| April | 4 | 7 | 28 | 16 | 49 | April | 16 | 9 | 144 | 256 | 81 |
| May | 5 | 20 | 100 | 25 | 400 | May | 17 | 18 | 306 | 289 | 324 |
| June | 6 | 22 | 132 | 36 | 484 | June | 18 | 60 | 1080 | 324 | 3600 |
| July | 7 | 35 | 245 | 49 | 1225 | July | 19 | 93 | 1767 | 361 | 8649 |
| August | 8 | 43 | 344 | 64 | 1849 | August | 20 | 80 | 1600 | 400 | 6400 |
| September | 9 | 182 | 1638 | 81 | 33124 | September | 21 | 88 | 1848 | 441 | 7744 |
| October | 10 | 149 | 1490 | 100 | 22201 | October | 22 | 42 | 924 | 484 | 1764 |
| November | 11 | 21 | 231 | 121 | 44 | November | 23 | 34 | 782 | 529 | 1156 |
| December | 12 | 6 | 72 | 144 | 36 | December | 24 | 14 | 336 | 576 | 196 |

| Year 2018 | $X_t$ | $Y_t$ | $X_tY_t$ | $X^2_t$ | $Y^2_t$ | Year2019 | $X_t$ | $Y_t$ | $X_tY_t$ | $X^2_t$ | $Y^2_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 25 | 09 | 225 | 625 | 81 | January | 37 | 01 | 37 | 1369 | 01 |
| February | 26 | 05 | 130 | 676 | 25 | February | 38 | 06 | 228 | 1444 | 36 |
| March | 27 | 14 | 378 | 729 | 196 | March | 39 | 05 | 195 | 1521 | 25 |
| April | 28 | 16 | 448 | 784 | 256 | April | 40 | 07 | 280 | 1600 | 49 |
| May | 29 | 19 | 551 | 841 | 361 | May | 41 | 19 | 779 | 1681 | 361 |
| June | 30 | 25 | 750 | 900 | 625 | June | 42 | 39 | 1638 | 1764 | 1521 |
| July | 31 | 36 | 1116 | 961 | 1296 | July | 43 | 57 | 2451 | 1849 | 3249 |
| August | 32 | 52 | 1664 | 1024 | 2704 | August | 44 | 74 | 3256 | 1936 | 5476 |
| September | 33 | 133 | 4389 | 1089 | 17689 | September | 45 | 160 | 7200 | 2025 | 25600 |
| October | 34 | 75 | 2550 | 1156 | 5625 | October | 46 | 56 | 2576 | 2116 | 3136 |
| November | 35 | 20 | 700 | 1225 | 400 | November | 47 | 36 | 1692 | 2209 | 1296 |
| December | 36 | 06 | 216 | 1296 | 36 | December | 48 | 17 | 816 | 2304 | 289 |

| Year 2020 | $X_t$ | $Y_t$ | $X_tY_t$ | $X^2_t$ | $Y^2_t$ |
|---|---|---|---|---|---|
| January | 49 | 03 | 147 | 2401 | 09 |
| February | 50 | 06 | 300 | 2500 | 36 |
| March | 51 | 06 | 306 | 2601 | 36 |
| April | 52 | Nil | Nil | 2704 | Nil |
| May | 53 | Nil | Nil | 2809 | Nil |
| June | 54 | 02 | 108 | 2916 | 04 |
| July | 55 | 03 | 165 | 3025 | 09 |
| August | 56 | 09 | 504 | 3136 | 81 |
| September | 57 | 08 | 456 | 3249 | 64 |
| October | 58 | 13 | 754 | 3364 | 169 |
| November | 59 | 15 | 885 | 3481 | 225 |
| December | 60 | 17 | 1020 | 3600 | 289 |

**CALCULATION**

Any of scientific studies are directed to words discovering the form of relationships between variables and predicting the values of a variable form some functional relationship, which is one of the important areas of applied statistics. Regression analysis is a statistical tool usually employed in this respect. This is because its values are dependent on the values of the other variable called predictor variables. From the above points one can see that regression analysis is very useful as it provides a summary or reduction of observed data in order to explore and present the relationship between the dependent and independent variables in a data set. The simplest form, which involves only one independent variable is called the simple linear regression. Also using the

"Statistical Package of Social Science (SPSS)" to run the data analysis. In this case the model describing the relationship between the dependent (Y) and independent variable (X) is expressed as:
$Y = B_o + B_1X$

| Descriptive Statistics | | | |
|---|---|---|---|
| | Mean | Std. Deviation | N |
| Malaria | 32.03 | 41.084 | 60 |
| Years | 30.50 | 17.464 | 60 |

| Model Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .152[a] | .023 | .006 | 40.957 | .023 | 1.366 | 1 | 58 | .247 |
| a. Predictors: (Constant), Years | | | | | | | | | |
| b. Dependent Variable: Malaria | | | | | | | | | |

* As obtained through SPSS.

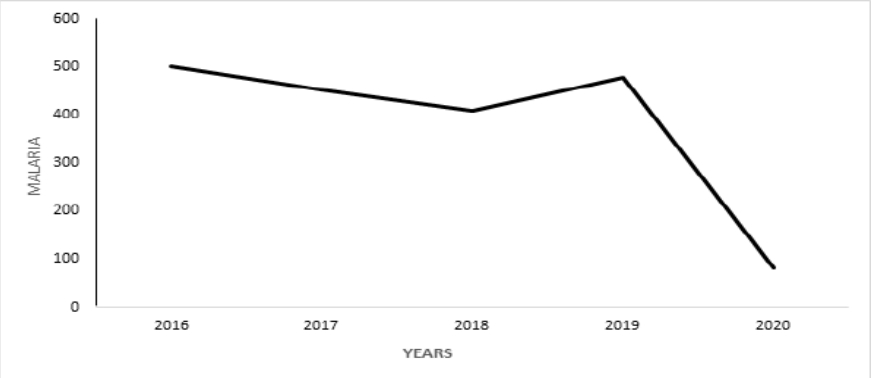
| ANOVA | | | | | | |
|---|---|---|---|---|---|---|
| Model | Sum of Squares | df | Mean Square | F | Sig. | |
| 1 | Regression | 2291.864 | 1 | 2291.864 | 1.366 | .247[b] |
| | Residual | 97292.070 | 58 | 1677.449 | | |
| | Total | 99583.933 | 59 | | | |
| a. Dependent Variable: Malaria | | | | | | |
| b. Predictors: (Constant), Years | | | | | | |

| Coefficients | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 10.709 | 10.709 | | 4.008 | .000 |
| | Years | .305 | .305 | -.152 | -1.169 | .247 |
| a. Dependent Variable: Malaria | | | | | | |

The regression equation is

Malaria = 42.918 -.357 Year

**Reported Cases of Malaria at Moradabad in Uttar Pradesh**




**CONCLUSION**

Based on the aims and objectives of this study the analysis carried out involving 1922 reported cases of malaria at Moradabad in Uttar Pradesh with in the period under study 2016 – 2020 yielded the following results. Out of the total number of 1922 reported patients? 1051 were males and 872 females. This shows the reported cases for males are 54.68% against 45.36% for females from 2016 – 2020. The data exhibited all the traditional components of seasonal indices from month march to October. One can see that these months belong to the period of rainfall. Which leads to water logged deposits, which increases breeding site. For mosquitoes to reproduce, this develops to adult and goes about spreading infection through bites. The negative linear trend of our data indicates the extent $B_i$ decreases on the average of time variable increases. Thus, the reduction in the number of reported cases of malaria patients for each unit change in various time.

**RECOMMENDATION**

From these findings, it is very clear that human beings get infected with malaria through the mosquito's bites. It is recommended here that precautions should be taken to prevent mosquito bites, as well as to reduce the exposure of mosquitoes indoors or encourage the use of pesticides in outdoor and sleeping areas.

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