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ON THE EFFECTS OF MOTOCYCLE ACCIDENTS AND ITS TRENDS (A CASE OF KENYA)

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Abstract. This study analyzes recent data of accidents' prevalence in Kenya and investigates whether there might be new trends in areas formerly not prone to accidents. Polynomials of order 6 are found best suited for accidents' prevalence data. The graphs show that seasonal variations explain over 90% of prevalence in Central, Eastern, Nyanza, Rift-Valley and Western Provinces. The highest variation is in Nyanza with 98.54% of the prevalence rate explained by the seasonal variation. The resulting graphs display a relationship of a time series nature. Using the scatter graphs, the total numbers of accidents explain very little about accidents prevalence. The value of R^2 for all the regression lines is very small. However, when the polynomials are fitted, the 6^{th} order polynomials are found to be the most suitable. The value of the R^2 varies from one province to another but is highest in North Eastern province at 87.38% and lowest in Western province at 63.72%. These figures are an indication of the significance of studying and modeling accidents' prevalence.

Introduction. The potential impact of accidents on human health has drawn local and international interest as evidenced by the recent world conference on disaster management and road safety. Many of the accidents that currently occur in the African region and particularly Kenya, are as a result of the upcoming modes of transport like the Motocycles. (Cook G 1996, Watson RC 1996).

The 2010 survey on safety shows that accidents claimed over 650,000 lives in the period 2005 – 2010. Not all continents are affected by the accidents as is the case in Africa and moreso Kenya. According to Philipe Martin and Myriam Lefebvre (1995), the resulting deaths from accidents may only be second to those resulting from Malaria in Africa is the worst, with 94 million clinical cases compared to 5 to 10 million in South East Asia, 1 to 2 million in Central and South America and fewer than 500, 000 cases in Europe including Turkey.

In Kenya the Lake Basin, Kisii Highlands, parts of the Rift Valley and the coastal region are characterized by unstable malaria transmission. The local population has little, if any or no immunity to the disease and according to Cox *et al* (2007), epidemics continue to be a significant public health issue resulting in significant morbidity and mortality. Now, if accidents are again left untended, then the mortality rates are bound to be alarming soon and it is inevitable that accidents, especially the motocylce accidents be modeled with a view to management.

Mathematical modeling of accidents, their prevalence and interventions was pioneered by Ronald Ross (1911). His study was however a clinical one in nature, but researchers have since made attempts to customize to the case of accidents. Since then more models have been developed to explore the fundamental features of particular scenarios.

Willem J.M Martens *et al(1995)* gave the density for susceptibility as:

$$\frac{N_2}{N_1} = K\left(\frac{-Log(P)}{a^2 p^n}\right)$$

Where: $\frac{N_2}{N_1}$ is the number of agents (N_2) per scene (N_1)

P is the probability of an agent surviving through any one day.
a is the average number of times per day that each agent can cause the event of interest, eg accident.
n is the period that the agent takes in a particular area.

The constant k incorporates variables which may be assumed and which a researcher may incorporate as appropriate. For instance discipline, knowledge of rules and even policies.

Paul Reiles (2001) gives an expression for the change of status as

$$C = \frac{ma^2 p^n}{-\log_e p}$$

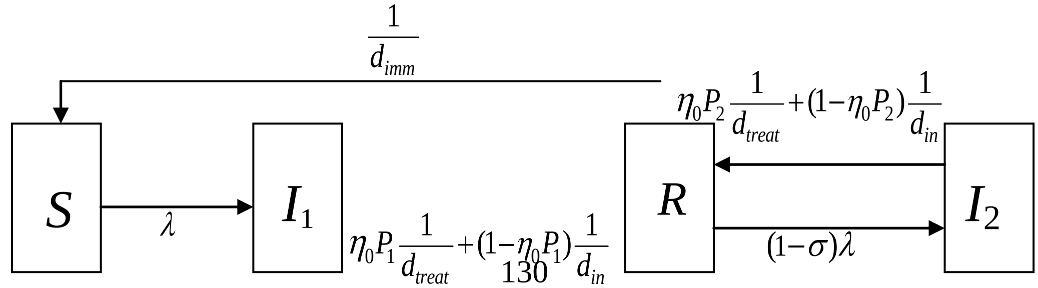
C is capacity of an agent to cause an accident
m is density of such agents per chosen study area
a is the average number of accidents per day caused by each agent.
p is the probability of an agent surviving through any one day.
n is the period of the agent in the chosen area.

Lisa J White *et al* (2008) had the following compartmental structure of a baseline model with time dependent variables:

S no event of accident but no knowledge of such
I_1 event of accident with no prior knowledge to the same
R no event of accident with prior knowledge of the accidents
I_2 event of accident with prior knowledge to the same

The Model output variables are:

C new accidents
P proportion of people receiving treatment or selective attention
Cc cumulative new accidents
Pc cumulative selective attention



The equations below describe this system:

$$\acute{S} = \frac{N}{L} - \left(\lambda + \frac{1}{L}\right)S + \frac{1}{d_{mm}}R$$

$$I'_1 = \lambda S - \left(\eta_0 P_1 \frac{1}{d_{treat}} + (1-\eta_0 P_1)\frac{1}{d_{in}} + \frac{1}{L}\right)I_1$$

$$I'_2 = \lambda R - \left(\eta_0 P_2 \frac{1}{d_{treat}} + (1-\eta_0 P_2)\frac{1}{d_{in}} + \frac{1}{L}\right)I_2$$

$$R' = \left(\eta_0 P_1 \frac{1}{d_{treat}} + (1-\eta_0 P_1)\frac{1}{d_{in}}\right)I_1 + \left(\eta_0 P_2 \frac{1}{d_{treat}} + (1-\eta_0 P_2)\frac{1}{d_{in}}\right)I_2 - \left(\lambda + \frac{1}{\dim m} - \frac{1}{L}\right)R$$

$$\lambda = R_0\left(\frac{1}{L} + \frac{1}{d_{\mathrm{im}\,m}}\right)\frac{I_1 + I_2}{N}$$

$$P_{res} = \frac{\frac{1}{d_{treat}} - \frac{1}{d_{treat0}}}{\frac{1}{d_{in}} - \frac{1}{d_{treat0}}}$$

$$C = P_1 I_1 + P_2 I_2$$

$$\tau' = -kPp_{res}\left(\tau - \frac{1}{d_{in}}\right)$$

$$P = \frac{\eta_0 (P_1 I_1 + P_2 I_2)}{I_1 + I_2}$$

$$d_{treat} = \frac{1}{\tau}$$

$$C_c^1 = C$$

$$P_c^1 = P$$

Methodology. The Kenya National Bureau of Statistics provided data on such accidents and these were analyzed per province as follows.

Table 1.1: OUTPATIENT MORBIDITY STATISTICS BY PROVINCE (1996-2007)

YEAR	CENTRAL	COAST	EASTERN	NAIROBI	N. EASTERN	NYANZA	R. VALLEY	WESTERN
1996	550792	587344	1099605	52891	53048	862219	927820	529033
1997	577000	504822	967756	68980	46033	749176	779098	454161
1998	540041	577089	1168398	100489	34554	753232	945030	404818
1999	603620	609637	1036905	54066	45974	869606	877117	412599
2000	557748	1242179	1102982	84225	52788	714068	806520	580046
2001	573691	245589	782749	17567	32889	626395	741323	242728
2002	478512	346846	972131	7626	2525	667886	533059	310770
2003	617638	234885	1058126	51931	17949	1176850	1359609	573651
2004	1090195	409108	1861231	84703	25680	1378259	1692309	1004056
2005	1120467	944033	2047156	90214	33812	1327696	1912953	1081517
2006	1228666	2286487	2286487	126604	194333	1362133	1898460	993980
2007	1111743	820026	2711735	7087	103295	2374716	1876405	605684

The ministry of planning, through the Kenya National Bureau of Statistics (KNBS) provided the data for population for each of the former eight provinces. It should be noted that censuses are conducted after every 10 years and so the data given are projections which are calculated from the censuses of 1999 and 2009 respectively.

Table 1.2: POPULATION PROJECTIONS FOR PROVINCES

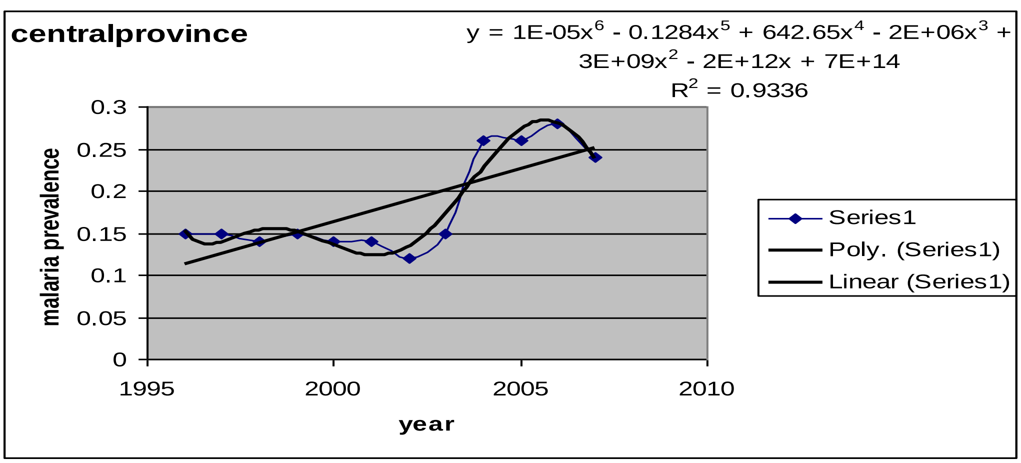
YEAR	CENTRAL	COAST	EASTERN	NAIROBI	N. EASTERN	NYANZA	R. VALLEY	WESTERN
1996	3783000	2302000	4768000	1932000	974000	4876000	6222000	3311000
1997	3852000	2353000	4882000	2009000	691000	4982000	6838000	3402000
1998	3919000	2404000	4994000	2086000	709000	5087000	7055000	3492000
1999	3983000	2453000	5104000	2164000	726000	5189000	7273000	3582000
2000	4044000	2501000	5211000	2243000	742000	5288000	7489000	367000
2001	3998451	2720976	5009725	2392051	1112114	4743133	7682381	3652732
2002	3998451	2720976	5009725	2392051	1144022	4850029	7951284	3768709
2003	4172565	2881447	5257344	2600859	1177831	4962268	8230346	3888828
2004	4268869	2968616	5393539	2710706	1215146	5083041	8524816	4014622
2005	4358629	3051639	5522403	2815838	1254706	5196581	8807933	4130915
2006	4454113	5658032	3138341	2924309	128113	5316234	9100482	4261120
2007	4556683	3228358	5802065	3034397	131848	5443919	9402491	4402161

The ratios of malaria prevalence to population were then calculated for each Province.

Table 2.1: OUTPATIENT MORBIDITY BY PROVINCE

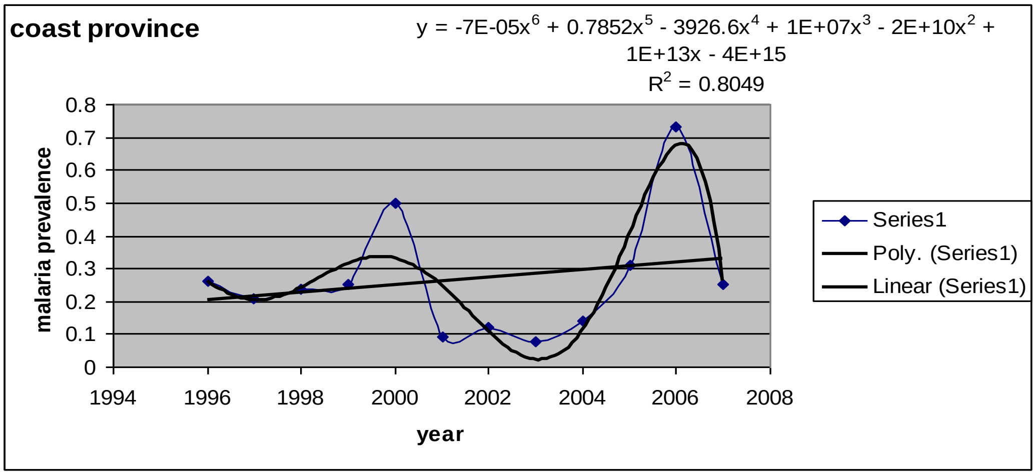
YEAR	CENTRAL	COAST	EASTERN	NAIROBI	N.EASTERN	NYANZA	R.VALLEY	WESTERN
1996	0.15	0.26	0.23	0.03	0.08	0.18	0.14	0.16
1997	0.15	0.21	0.20	0.03	0.07	0.15	0.11	0.13
1998	0.14	0.24	0.23	0.05	0.05	0.15	0.13	0.12
1999	0.15	0.25	0.20	0.02	0.06	0.17	0.12	0.12
2000	0.14	0.50	0.21	0.04	0.07	0.14	0.11	0.02
2001	0.14	0.09	0.16	0.00	0.03	0.13	0.10	0.07
2002	0.12	0.12	0.19	0.00	0.00	0.14	0.07	0.08
2003	0.15	0.08	0.20	0.02	0.02	0.24	0.17	0.15
2004	0.26	0.14	0.35	0.02	0.02	0.27	0.20	0.25
2005	0.26	0.31	0.37	0.03	0.03	0.26	0.22	0.26
2006	0.28	0.73	0.40	0.15	0.15	0.26	0.21	0.23
2007	0.24	0.25	0.47	0.08	0.08	0.44	0.20	0.14

From table 2.1, the following graphs were plotted. Also drawn were the polynomials and the regression lines.

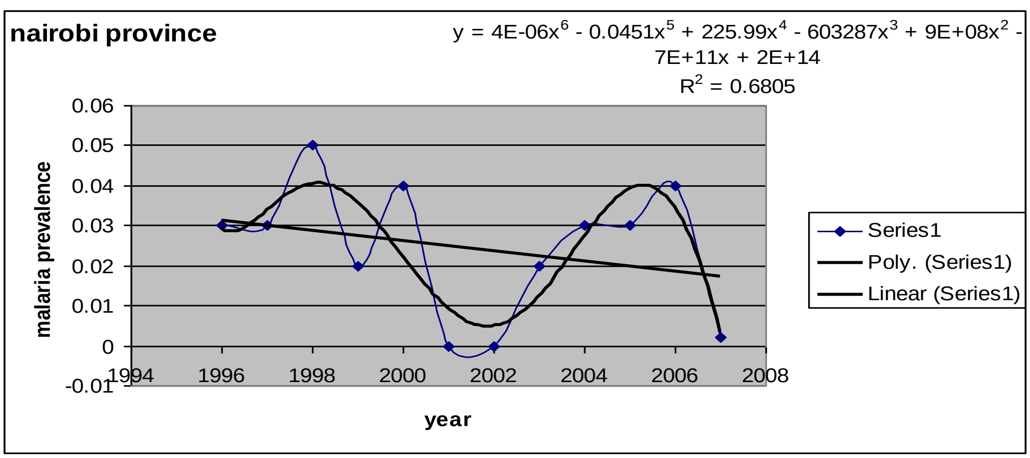


The graph shows that the period 1996 to 2003 was characterized by a near stable malaria prevalence. This however changed in 2004 when there was a sharp increase

rising to a peak in 2006. The regression line shows a steady rise in malaria prevalence. A polynomial of order 6 was found to be the best that would fit the curve.
$Y = (1 \times 10^{-5})\, x^6 - 0.1284x^5 + 642.65x^4 - (2 \times 10^6)\, x^3 + (3 \times 10^9)x^2 - (2 \times 10^{12})\, x + 7 \times 10^{14}$



Coast Province has had relatively high malaria prevalence. This was maintained during the period 1996 to 1999. In 2000, there was a sharp increase where upto 50% of the population was infected. This reduced considerably the following year when it went to a low of just 9% of the population. The low period was then maintained for four years. In fact in 2003, it even went down as low as 8%. This suddenly changed in 2005 when the prevalence rate rose to 31% and in 2006; it reached its peak where a whopping 73% was infected. This was the highest figure in the country during that period. The regression line shows a steady rise. Of the polynomials fitted on the curve, the best was one of order 6.
$Y = (-7 \times 10^{-6})\, x^6 + 0.7852\, x^5 - 3926.6x^4 + (1 \times 10^7)\, x^3 - (2 \times 10^{10})\, x^2 + (1 \times 10^{13})\, x - 4 \times 10^{15}$

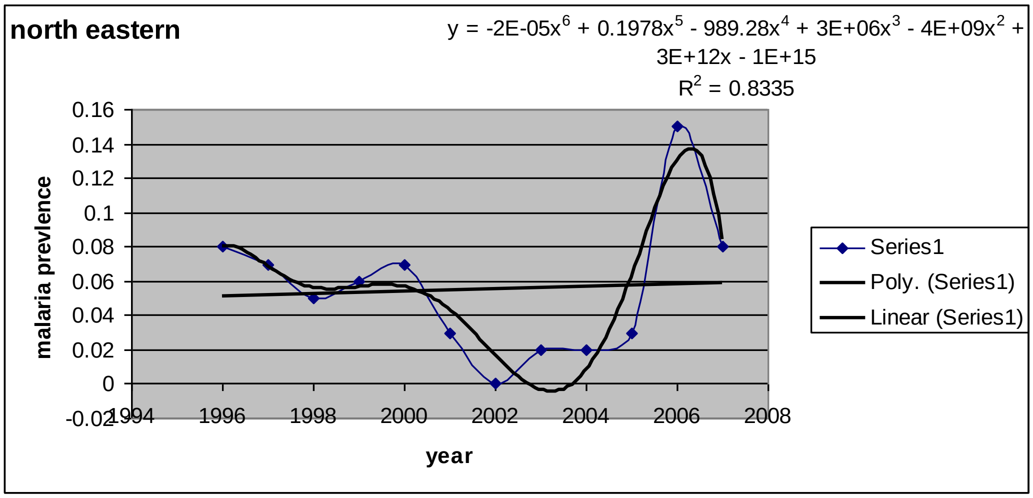


This region had a near steady malaria prevalence for close to 8 years beginning 1996, maintaining a prevalence rate of between 19% and 23%. This suddenly changed in 2003 when it started rising reaching a peak of 47% in 2007. The regression line shows a steady rise. A polynomial of order six best fitted the curve of Eastern province.

$Y = (3 \times 10^{-5}) x^6 - 0.3344x^5 + 1673.4x^4 - (4 \times 10^6) x3 + (7 \times 10^9) x^2 - (5 \times 10^{12})x + 2 \times 10^{15}$

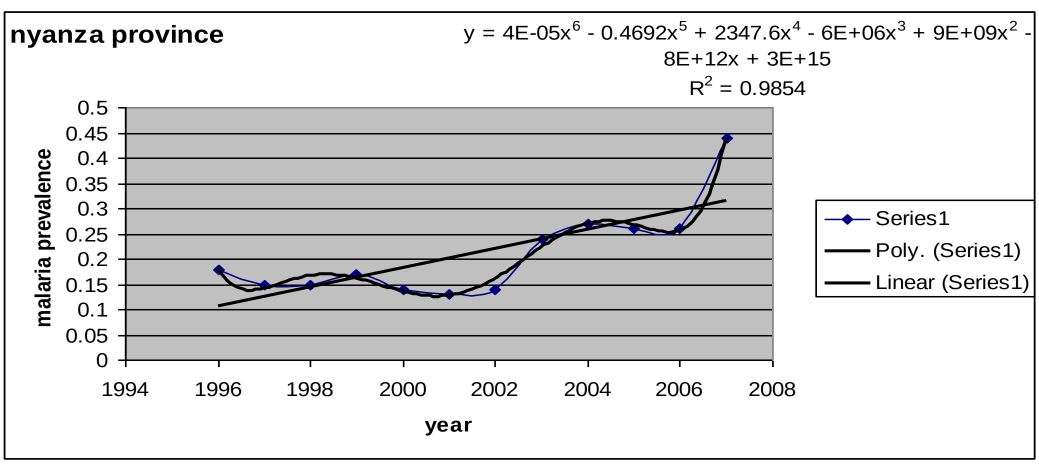
The graph shows an extremely low prevalence rate which has been on the decline since 1996, reaching a low of zero in the period 2001 to 2002 before it went up, albeit slightly rising to a paltry 4% in 2006 before it came down again to below 1% in 2007. The regression line shows a steady decline. The best fit for Nairobi Province was a polynomial of order 6:

$Y = (4 \times 10^{-6}) x^6 - 0.0451x^5 + 225.99x^4 - 603287x^3 + (9 \times 10^8)x^2 - (7 \times 10^{11} x + 2 \times 10^{14}$



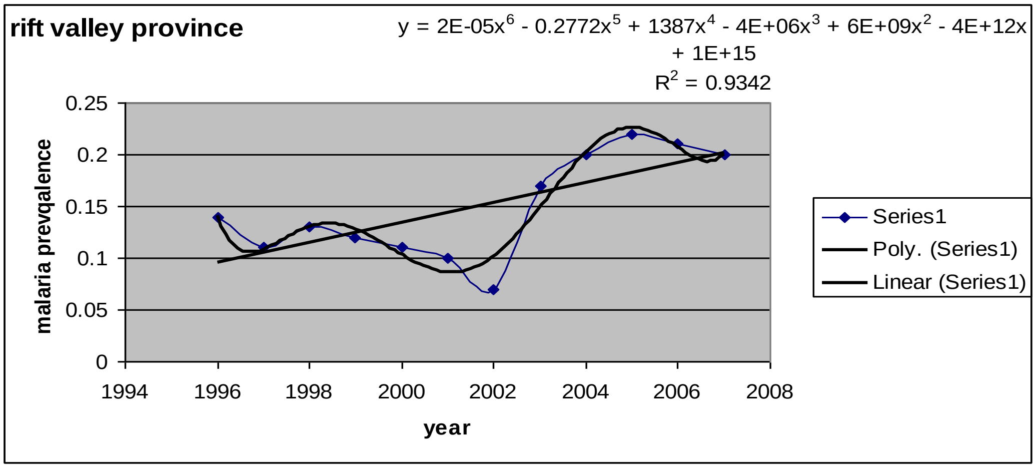
Just like Nairobi, the graph 0f North Eastern Province shows that this region has had very low malaria prevalence since 1996. This reduced steadily for three years before it started rising again in 1999 up to a mere 7% in 2000. This again reduced considerably to a low of 0% in 2002. From then on, it started rising again reaching a peak of 15% in 2006. The regression line shows a very slight increase. The best fit for North Eastern Province was a polynomial of order six:

$Y = -(2 \times 10^5) x^6 + 0.1978 x^5 - 989.28x^4 + (3 \times 10^6)x^3 - (4 \times 10^9)x^2 + (3 \times 10^{12}) x - (1 \times 10^{15})$



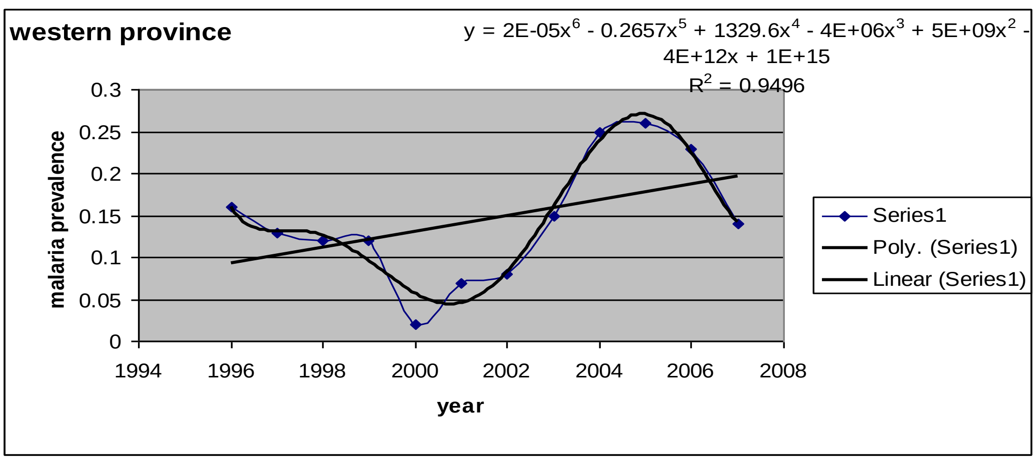
From the graph, one can notice that malaria prevalence in Nyanza was steady from 1996 until 2002. It started rising in 2002 and has been on the rise since then reaching a high of 44% in 2007. The period 2006 – 2007 shows a very sharp rise. The regression line shows that the prevalence rate is rising. A polynomial of order 6 best fitted the curve for Nyanza Province.

$Y = (4\ \mathrm{x}10^{-5})\ x^6 – 0.4692x^5 + 2347.6x^4 - (6\mathrm{x}10^6)x^3 + (9\mathrm{x}10^9)\ x^2 – (8\ \mathrm{x}10^{12})\ x + (3\mathrm{x}10^{15})$



One can notice from graph that this region had malaria prevalence declining slowly and very slightly from 1996. This went on until 2002 when it went down to as low as 7% of the population. From 2002 again it started rising again, reaching a peak in 2005 when the rate was 25%. The regression line shows an increase in prevalence from 1996. The best polynomial was that of order 6:

$Y=(2\mathrm{x}10^{-5})\ x^6 – 0.2772x^5 + 1387x^4 – (4\ \mathrm{x}10^6)\ x^3 + (6\ \mathrm{x}10^9)\ x^2 - (4\ \mathrm{x}10^{12})\ x + (1\ \mathrm{x}\ 10^{15})$



There is a clear indication that the prevalence rate in this region was on the decline from 1996 right up to 2000 when it went down to 2%. However the situation changed from that year and it started rising, reaching a peak of 26% in 2005. The regression line shows an increase in prevalence. The best polynomial was the one of order 6:

$Y= (2\mathrm{x}10^{-5})\ x^6 – 0.2657x^5 + 1329.6x^4 – (4\ \mathrm{x}10^6)\ x^3 + (5\ \mathrm{x}\ 10^9)\ x^2 – (4\ \mathrm{x}10^{12})x + (1\ \mathrm{x}\ 10^{15})$

Table 4: **Normalized Values**

	Central	**Coast**	**Eastern**	**Nairob i**	**N. Eastern**	**Nyanza**	**R. Valley**	**Western**
μ	0.18	0.27	0.27	0.03	0.06	0.21	0.15	0.14
σ	0.05	0.18	0.09	0.02	0.00	0.09	0.05	0.07

From Table 4, the standardized values, Z were obtained: $Z = \frac{x - \mu}{\sigma}$

Eastern Province		
Year	**X**	**Z**
1996	0.23	-0.4
1997	0.20	-0.8
1998	0.23	-0.4
1999	0.20	-0.8
2000	0.21	-0.7
2001	0.16	-1.2
2002	0.19	-0.9
2003	0.20	-0.8
2004	0.35	0.9
2005	0.37	1.1
2006	0.40	1.4
2007	0.47	2.2

Nairobi Province		
Year	**X**	**Z**
1996	0.03	0
1997	0.03	0
1998	0.05	1.3
1999	0.02	-0.7
2000	0.04	0.7
2001	0.007	-1.5
2002	0.003	-1.8
2003	0.02	-0.7
2004	0.03	0
2005	0.03	0
2006	0.04	0.7
2007	0.002	-1.9

Central Province		
Year	**X**	**Z**
1996	0.15	-0.6
1997	0.15	-0.6
1998	0.14	-0.8
1999	0.15	-0.6
2000	0.14	-0.8
2001	0.14	-0.8
2002	0.12	-1.2
2003	0.15	-0.6
2004	0.26	1.6
2005	0.26	1.6
2006	0.28	2.0
2007	0.24	1.2

Nyanza Province		
Year	**X**	**Z**
1996	0.18	-0.4
1997	0.15	-0.7
1998	0.15	-0.7
1999	0.17	-0.5
2000	0.14	-0.8
2001	0.13	-0.9
2002	0.14	-0.8
2003	0.24	0.4
2004	0.27	0.7
2005	0.26	0.6
2006	0.26	0.6
2007	0.44	2.7

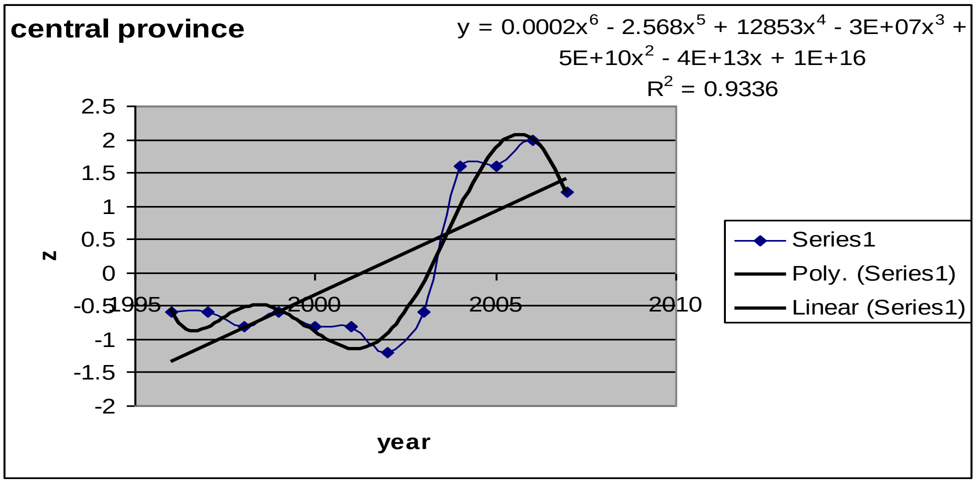
Rift Valley Province		
Year	**X**	**Z**
1996	0.14	-0.2
1997	0.11	-0.8
1998	0.13	-0.4
1999	0.12	-0.6
2000	0.11	-0.8
2001	0.10	-1.0
2002	0.07	-1.7
2003	0.17	0.4
2004	0.20	1.0
2005	0.22	1.5
2006	0.21	1.3
2007	0.20	1.0

Coast Province		
Year	**X**	**Z**
1996	0.26	-0.06
1997	0.21	-0.3
1998	0.24	-0.2
1999	0.25	-0.1
2000	0.50	1.3
2001	0.09	-1.0
2002	0.12	-0.8
2003	0.08	-1.1
2004	0.14	-0.7
2005	0.31	0.2
2006	0.73	2.6
2007	0.25	-0.1

North Eastern Province		
Year	**X**	**Z**
1996	0.08	0.6
1997	0.07	0.3
1998	0.05	-0.3
1999	0.06	0
2000	0.07	0.3
2001	0.03	-0.8
2002	0.002	-1.5
2003	0.02	-1.1
2004	0.02	-1.1
2005	0.03	-0.8
2006	0.15	2.4
2007	0.08	0.6

Western Province		
Year	**X**	**Z**
1996	0.16	0.3
1997	0.13	-0.1
1998	0.12	-0.3
1999	0.12	-0.3
2000	0.02	-1.7
2001	0.07	-1.0
2002	0.08	-0.9
2003	0.15	0.1
2004	0.25	1.6
2005	0.26	1.7
2006	0.23	1.3
2007	0.14	0

Graphs from the normalized tables confirm the malaria trends. For example below is the normalized graph for Central Province.



Interpretation of the Results. Each of these regions exhibits a unique characteristic as observed from the curves and the regression lines. The rise in prevalence rate in central, eastern, Nyanza, Riftvalley and Western started in 2001. While in Western it went down in 2006. in central it went down in 2007. In Nyanza and Eastern it has continued to rise. Coast Province has a relatively high prevalence rate which even rose to 73% in 2006. North Eastern and Nairobi display extremely low prevalence rates. While the rate in north eastern is rising albeit quite minimally Nairobi shows a decreasing trend.

Table 2.3: Table of Variances (R^2)

	Province	R^2 (%)
1.	Central	93.36
2.	Coast	80.49
3.	Eastern	96.7
4.	Nairobi	68.05
5.	North Eastern	83.35
6.	Nyanza	98.54
7.	Rift Valley	93.42
8.	Western	94.96

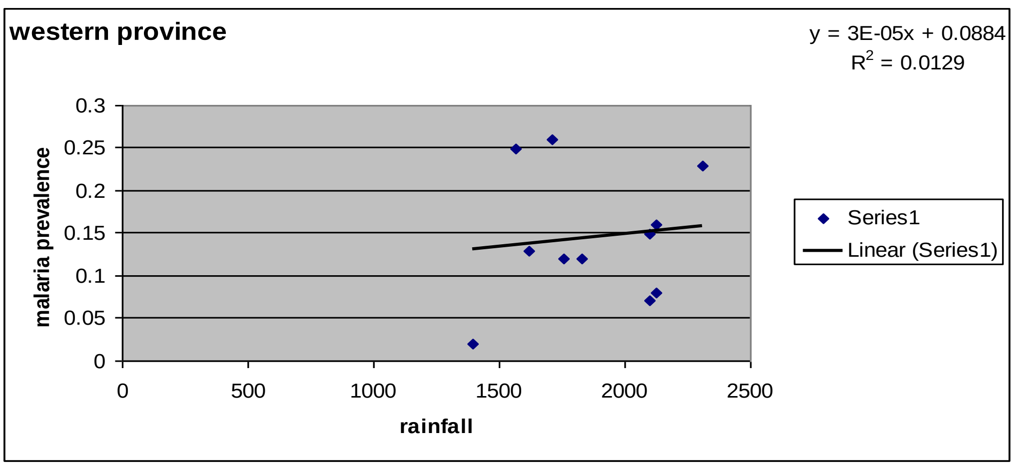
From the table of variances it is observed that the models for North Eastern and Coast provinces explains slightly above 80% of the prevalence rate. The model for Nyanza explains 98.54% of the prevalence rates. Only 68.05% of the prevalence rate in Nairobi is explained by the model.

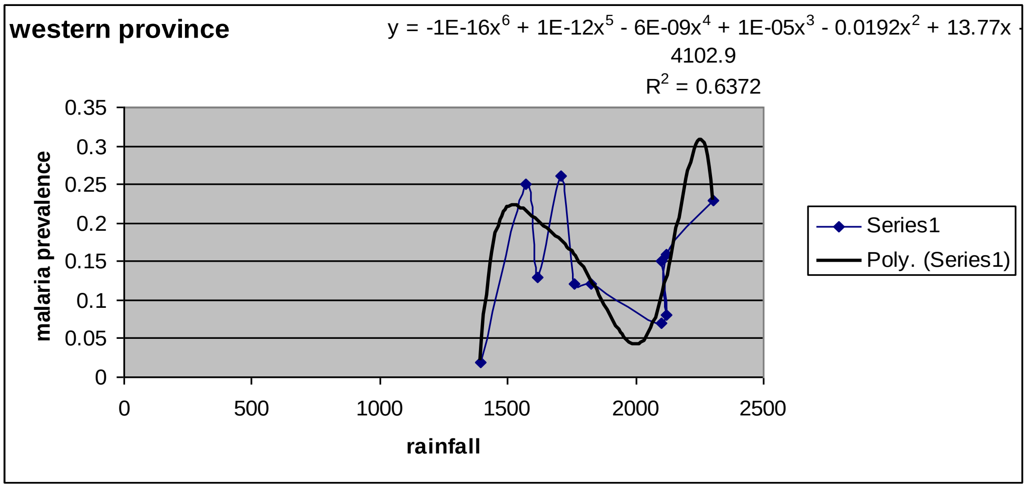
Modeling the Data using Rainfall and Prevalence Rate. The total annual rainfall in every weather station in each of the eight regions was recorded for the period 1996 to 2006. It is important to note that the number of weather stations varies from one region to another. Whereas Coast province has seven weather stations, Western Province has only one. The total annual rainfall in all the weather stations within a province was then worked out, giving the mean annual rainfall. The table below shows the mean rainfall for each of the eight provinces, for the period 1996 to 2006.

Table 3.1

Mean Rainfall							
	Central	coast	Eastern	Nairobi	N. Eastern	Nyanza	Rift Valley
96	791.95	891.54	773.37	604.87	214.13	1882.2	1051.58
97	1321.3	1816.86	1744.27	1100.67	1122.43	1819.65	1124
98	1285.55	1225.04	1273.93	1296.43	493.73	1489.45	1101.43
99	689	1029.39	904.17	792.13	269.6	1850.95	919.7
00	626.05	954.03	491.27	496.83	139.95	1641.85	805.8
01	1083.8	867.46	968.27	1203.4	296	1900.6	1141.75
02	1006.25	953.79	1427.71	1027.13	543.98	1979.1	1098.64
03	1008.8	727.79	1136.23	852.77	377.18	1721.65	1058.08
04	878.55	811.4	1050.1	933.77	419.25	1742.5	958.03
05	785.3	734.5	736.67	670.77	247.65	1427.05	902.05
06	1221.95	1368.63	1544.87	1137.23	645	1915.75	1285.95

A scatter graph for each of the eight regions was drawn with total annual rainfall on the x-axis and malaria prevalence on the y-axis. Regression lines were drawn and polynomials were fitted. For each of them, a polynomial of order 6 was found to be the best for all of them. Below is one of the scatter graphs and a graph of rainfall and prevalence rate.





Central Province

$y = (9\times10^{-17})\ x^6 + (4\times10^{-13})\ x^5 - (8 \times 10^{-10})\ x^4 + (8 \times 10^{-7})\ x^3 - (4 \times 10^{-3})\ x^2 + 0.0863x - 5.5665$

Regression line: $y = (3 \times 10^{-5})\ x + 0.1501$

Coast Province

Best fit was polynomial of order 6

$y = (2 \times 10^{-15})\ x^6 - (1 \times 10^{-11})\ x^5 + (4 \times 10^{-8})\ x^4 - (6 \times 10^{-5})\ x^3 + 0.056x^2 - 25.488x + 4771.7$

Regression line: $y = (4 \times 10^{-7})\ x + 0.2656$

Eastern Province

Best fit was polynomial of order 6

$y = (8 \times 10^{-17})\ x^6 + (5 \times 10^{-13})\ x^5 - (1 \times 10^{-9})\ x^4 + (2 \times 10^{-6})\ x^3 - 0.0016x^2 + 0.1682x - 97.163$

Régression line: $y = 9 \times 10^{-6}\ x + 0.255$

Nairobi Province

The best fit was polynomial of order 6

$y = -(8 \times 10^{-17})\ x^6 + (4 \times 10^{-13})\ x^5 - (9 \times 10^{-10})\ x^4 + (1 \times 10^{-6})\ x^3 - 0.0006\ x^2 + 0.1945x - 25.139$

Regression line: $y = (6 \times 10^{-6})\ x + 0.322$

North Eastern Province

Best fit was polynomial of order 6

$y = -(5 \times 10^{-16})\ x^6 + (1 \times 10^{-12})\ x^5 - (2 \times 10^{-9})\ x^4 + (9 \times 10^{-7})\ x^3 - 0.0003x^2 + 0.0389x - 2.0394$

Regression Line: $y = 0.0005x + 0.0555$

Nyanza Province

Best fit was a polynomial of order 6

$y = -(5 \times 10^{-15})\ x^6 + (5 \times 10^{-11})\ x^5 - (2 \times 10^{-7})\ x^4 + 0.0005x^3 - 0.5806x^2 + 391.09x - 109423$

Regression line: $y = (7 \times 10^{-5})\ x + 0.3218$

Rift Valley Province

Best fit was polynomial of order 6

$y = -(1 \times 10^{-14})\, x^6 + (9 \times 10^{-11})\, x^5 - (2 \times 10^{-7})\, x^4 + 0.0003x^3 - 0.2393x^2 + 96.852x - 16260$
Regression line: $y = -(5 \times 10^{-7})\, x + 0.1422$

Western province
Best fit was polynomial of order 6
$y = -(1 \times 10^{-16})\, x^6 + (1 \times 10^{-12})\, x^5 - (6 \times 10^{-9})\, x^4 + (1 \times 10^{-5})x^3 - 0.0192x^2 + 13.77x - 4102.9$
Regression line: $y = 3 \times 10^{-5}\, x + 0.0884$

Table 3.2: Table of Variances (R^2)

	Province	R^2(%)
1.	Central	46.16
2.	Coast	77.28
3.	Eastern	71.18
4.	Nairobi	76.13
5.	North Eastern	87.38
6.	Nyanza	76.54
7.	Rift Valley	69.27
8.	Western	63.72

Concluding Remarks. The scatter graphs indicated that, no linear or non-linear relationship is discernible between malaria prevalence and total annual rainfall. All the regression lines have their R^2 values below 6%. Polynomials of order 6 seem best suited for malaria prevalence and season (read year). The graphs show that seasonal variations explain over 90% of malaria prevalence in Central, Eastern, Nyanza, Rift-Valley and Western Provinces. The highest variation is in Nyanza with 98.54% of the prevalence rate explained by the seasonal variation. Nyanza is a highly endemic region. The 6th order polynomials can hence be used with certainty in these five regions to predict whether the coming season would require less or more preparedness by the government. Coast and North Eastern Provinces have over 80% of malaria prevalence explained by the seasonal variations. The polynomials for these two regions can be used effectively as a method of predicting the prevalence rate in the coming season. It is only Nairobi province where 68.05% of variations in malaria prevalence is explained by seasonal variations. The graphs display a relationship of a time series nature.

Using the scatter graphs, the total amount of rainfall explains very little about malaria prevalence. The value of R^2 for all the regressions lines is very small. However, when the polynomials are fitted, the 6th order polynomials are found to be the most suitable. The value of the R^2 varies from one province to another but is highest in North Eastern province at 87.38% and lowest in Western province at 63.72%. These figures are an indication of the significance of rainfall in malaria prevalence. It would be reasonable to conclude that only 6th order polynomials can best describe the relationship between: Malaria prevalence and year, Malaria prevalence and rainfall. The total annual rainfall does not give clear cut picture on malaria prevalence. However, the reasonably high value of R^2 for the polynomials shows that rainfall provides favourable climatic conditions for mosquito breeding. Since the total annual rainfall does not give a clear picture on its link with malaria prevalence, it would be prudent to use total monthly rainfall data in any other similar research.

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