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Comparative Analysis of Gum Arabic Production using Newton's Interpolating Method and Simple Linear Regression

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Abstract

Gum Arabic is sengalia Senegal or acacia Senegal – it is a natural poly scalded, it is colorless, even the brown color which melts in hot water and makes chick strings is scentless. The ultimate aim of the field of numerical analysis is to provide convenient methods for obtaining useful solutions to mathematical problems and for entrancing useful information from available solutions which are not expressed in tractable forms. Such problems may be formulated, for example, in terms of an algebraic or transcendental equation, or an integral equation, or in terms of asset of such equations. In statistical modeling, regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. This paper aims to estimate and analyze the production data of Gum Arabic and the influence of rains of production in two methods and to determine which method is best. A mathematical analysis method is followed in this study by using Newton's interpolating method and simple linear regression method. It is known that both methods study two variables. The production is dependent variable and a rain its independent variable for the study. Finally, we estimate a certain relation between rain and production and we found in two methods when the rain increases the production increases, also the simple linear regression method is practically faster and easier due to less error.

1. Introduction

T In this paper the statistical data is analyzed using Newton's interpolating method and simple linear regression using (SPSS) program .Both methods depend on studying variables (dependent and independent) statistical data of Gum Arabic in North Kordofan State in the period (2005/2006 – 2014/2015) are used to study the relation between the production as a dependent variable (y) and the amount of rain as an independent variable to measure its influence on production then make comparison between Newton's interpolating method and simple linear regression using (SPSS) to present and display results .Gum Arabic needs a certain environmental conditions. Factors that influence its production are different. Gum Arabic is one of the most important agricultural exports of North Kordofan State, it is used in various industries. It's found that Gum Arabic is planted during the rainy season. Despite continuous rain fall in autumn in North Kordofan State and its planting of Gum Arabic, we note that there is fewness in production which leads to fewness in the exports of Gum Arabic sol joined between rains amount and its influence on production.

1.1 Hypothesis of Research:

- There is a relationship between Gum Arabic production and rains fall.
- There is no relationship between the production of Gum Arabic and rain fall.

1.2 Definition of Newton's Interpolating Method

This method is used whether differences of independent variable are constant or changeable, it is contrary to Newton's forward method, so Newton's interpolating method use different steps to find the polynomial which is not more than (P_{R+1}) from the polynomial not more than degree of (P_R) from scheduled data [1].

x_0	x_1	x_2	…	x_R	x_{R+1}
y_0	y_1	y_2	…	y_R	y_{R+1}

1.3 Mathematical Definition of Newton's Method

In this method there are two cases to find the polynomial.

First Case: If there is an obvious relation between values of depended variable and independent variable, the polynomial will be:

$$P_{R+1}(x) = P_R + C_{R+1}(x-x_0)(x-x_1)(x-x_2)\dots(x-x_R) \quad (1)$$

$$c_{R+1} = \frac{y_{R+1} - P_R(x_{R+1})}{(x_{R+1}-x_0)(x_{R+1}-x_1)(x_{R+1}-x_2)\dots(x_{R+1}-x_R)} \quad (2)$$

Second Case: If there is no obvious relation between the values of dependent and independent variable, to find the polynomial we follow a group of points of not clear relation.

Suppose that:

$$p_0(x) = c_0 = y_0$$

$$p_1(x) = p_0(x) + c_1(x-x_0)$$

$$c_1 = \frac{y_1 - p_0(x)}{(x_1-x_0)}$$

$$p_2(x) = p_1(x) + (x-x_0)(x-x_1)$$

$$c_2 = \frac{y_2 - p_1(x_2)}{(x_1-x_0)(x_2-x_1)}$$

$$p_3(x) = p_2(x) + c_3(x-x_0)(x-x_1)(x-x_2)$$

$$c_3 = \frac{y_3 - p_2(x_3)}{(x_3-x_0)(x_3-x_1)(x_3-x_2)}$$

$$p_4(x) = p_3(x) + c_4(x-x_0)(x-x_1)(x-x_2)(x-x_3)$$

$$c_4 = \frac{y_4 - p_3(x_4)}{(x_4-x_0)(x_4-x_1)(x_4-x_2)(x_4-x_3)}$$

$$P_{R+1} = P_R(x) + C_{R+1}(x-x_0)(x-x_1)(x-x_2)\dots(x-x_R) \quad (3)$$

$$c_{R+1} = \frac{y_{R+1} - p_R(x_{R+1})}{(x_{R+1}-x_0)(x_{R+1}-x_1)(x_{R+1}-x_2)(x_{R+1}-x_R)} \quad (4)\ [1]$$

1.4 Simple Linear Regression

In statistical modeling, regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. More specifically, regression analysis helps one understand how the typical value of the dependent variable (or criterion variable) changes when any one of the independent variables id varied, while the other independent variables are held fixed. Most commonly, regression analysis estimates the

conditional expectation of the dependent variable given the independent variables, that is the average value of the dependent variables are fixes [3].
In a narrower sense, regression may refer specifically to the estimation of continuous response variable, as opposed to the discrete response variables used in classification [11].

1.5 Classical Assumptions for Regression Analysis Include

- The error is a random variable with a mean to zero conditional on the explanatory variable.

$$E(u) = 0 \quad (5)$$

- The independent variables are measured with no error.[13]

Remark: If this is not so, modeling may be done instead using errors in variables model techniques.

$$Cov(xu) = E(u) = xE(u) = O \quad (6)$$

- The errors are uncorrelated, that is, the variance covariance matrix of the errors is diagonal and each non-zero element is the variance of the error.

$$cov(ui - uj) = E(ui - uj) - E(ui).E(uj) = E(ui.uj) = 0 \quad (7)$$

- The variance of the error is constant across observations. If not weighted squares of other methods might instead by used.

$$var(u) = E\big(u - E(u)\big)^2 = E(u)^2 = 6u^2 \quad (8). [13]$$

1.6 The Estimate Parameters of Simple Linear Model:

$$\sum_{i=1}^{n} y_i = n\,\hat{\propto} + \hat{\beta}\sum_{i=1}^{n} x_i \quad (9)$$

$$\sum_{i=1}^{n} x_i\, y_i = \hat{\propto}\sum_{i=1}^{n} x_i + \hat{\beta}\sum_{i=1}^{n} x_i^2 \quad (10)$$

Multiply (9) by $\sum_{i=1}^{n} x_i$ and (10) by n

$$\sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i = n\,\hat{\propto}\sum_{i=1}^{n} x_i + \hat{\beta}\left[\sum_{i=1}^{n} x_i\right]^2 \quad (11)$$

$$n\sum_{i=1}^{n} x_i\, y_i = n\,\hat{\propto}\sum_{i=1}^{n} x_i + n\hat{\beta}\sum_{i=1}^{n} x_i^2 \quad (12)$$

$$\hat{\beta} = \frac{n\sum_{i=1}^{n} x_i\, y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - \hat{\beta}[\sum_{i=1}^{n} x_i]^2} \quad (13)$$

or

$$\hat{\beta} = \frac{n\sum_{i=1}^{n} x_i\, y_i}{n\sum_{i=1}^{n} x_i^2} \quad (14)$$

Since $x_i = x_i - \bar{x}$, $y_i = y_i - \bar{y}$, $\sum_{i=1}^{n} x_i$

Multiply (13) by n

$$\propto = \bar{y} + \hat{\beta}\bar{x} = \frac{\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i^2 - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - \hat{\beta}[\sum_{i=1}^{n} x_i]^2} [7] (15)$$

1.7. Statistical Test

Use the variance of parameters $\hat{\beta}, \hat{\propto}$

$$\sigma^2 = \frac{\sum_{i=1}^{n} e^2}{n-2} \quad (16)$$

We find the variance of $\hat{\propto}$

$V(\hat{\propto}) = \frac{\sum_{i=1}^{n} x^2}{n\sum x}\sigma^2$ and stander error is $se = \sqrt{V(\hat{\propto})}$

We find the variance of $\hat{\beta}$

$V(\hat{\beta}) = \frac{\sigma^2}{\sum_{i=1}^{n} x^2}$and stander error is $se = \sqrt{V(\hat{\beta})}$.[8]

1.8 T-Test

The result above can be used to construct test statistic and confidence intervals. The general idea of hypothesis testing is as follows. Starting from a given hypothesis; the null hypothesis, a test statistic is computed that has a known distribution under the computed value of the test statistic is unlikely to come from this distribution, which indicates that the null hypothesis is unlikely to hold. Let us illustrate this with an example. Suppose we have a null hypothesis that specifies the value. [8] The $\propto H_0 : \propto = 0$

$$H_1 : \propto \neq 0$$

The $\beta H_0 : \beta = 0$

$$H_1 : \beta \neq 0$$

To test $\propto$

$t_c = \frac{\propto}{se(\propto)}$

t_0 test β.

$t_c = \frac{\beta}{se(\beta)}$.[10]

1.9 Analysis of Variance

The analysis of variance (commonly referred to as the ANOVA) is one of the most widely used statistical techniques. A basic idea of the ANOVA, that of partitioning variation, is a fundamental idea of experimental statistics. The ANOVA belies its name in that it is not concerned with analyzing variances but rather with analyzing variation in means. The technique of regression, in particular linear regression, probably wins the prize simple, multiple, parametric, nonparametric.

The total of variation $SST = \sum_{i=1}^{n}(y_i - \bar{y})^2$

Residual $SSE = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$

Regression $SSR = SST - SSE$. [10]

1.10 The R^2

Having estimated a particular linear model, a natural question that comes up is: how well does the estimated regression Linearly fits the observations?

A popular measure for the goodness – of-fit is the proportion of the (sample) variance of y that is explained by the model.

This variable is called the R^2 (R squared) and is defined as $R^2 = \frac{SSR}{SSE}$.[5]

1.11 Areas and Origins of Gum Arabic

Gum Arabic has sour taste and is a mixture of sugar proteins and poly sugar. It is a source of Aryans and rayon sugar which have been discovered for the first time and were separated from Arabian gum and named after it. Sudan knew Arabian gum production 6000 years ago. It contributed about 15% to the country's national income Kordofan and Darfur States are considered to be the largest production, they contribute 47% of total production of Sudan. They followed by the Blue Nile and Gadaref State in the late. In the South and 60th of the last century, Sudan was the largest country of Arabian gum production in the world with 50% of the total production [16].

1.12 Water Supply and Production

There is a good water supply of digging water in Bara and Um Rawaba basins, besides surface water in Rahad and Um Bader lakes. There is also considerable quantity of water in valleys and streams in Sheikan and Um Badir. Despite that, we notice scarcity in Arabian gum production Kordofan State, in 2006 and 2007 the production was 15114.98 tons and in 2015 was 1257 tons [2].

1.13 Season of Planting Gum Arabic

Gum Arabic planted in semi- deserts areas during rainy season.[8]

1.14 Soil:

According to soil, North Kordofan State is divided in to four groups.

- Sandy land is more than 70% of agricultural land.
- Mixed land about 20% of agricultural land.
- Muddy deposited land: is of high fertility.
- Muddy land.

The most suitable land for planting Arabian gum is the muddy land, but it grows in sand stone soil it affords immersion for two seasons and high temper fumes.[9]

1.15 Usages of Gum Arabic

- It raises the short series of fatty acids to protect the body from poisons.
- A suitable organic substance to be added to food, drink or drugs of people because it doesn't react chemically of physically [8].
- It is used in water dye coloring and printing of photographs.
- It is used in printers to prevent aluminum printing sheets oxygenation.[14]
- It forms a basic substance in refreshment and candy industries and many other industries.[15]

2.0 Statistical Data:

a.Data Analysis Using Newton's Interpolating Method:

Table 1: Group statistic of the Production of Gum Arabic during the period (2005/2006 - 2014/2015).Rain Amount is in Millimeters and Production is Tons

x	273.14	420.13	234.6	288.24	254.7	218.6	295.1	251.5	200.3	219.7
y	15114.98	15114.98	7332.7	8769.9	11115.73	1047.24	1257	6594	7384	8548

We note that $n = 9$ and thus many polynomial is as follows:

$$p_9(x) = P_8(x) + c_9(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)$$
$$(x - x_5)(x - x_6)(x - x_7)(x - x_8)$$

Create $P_0, P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9$

$$c_9 = \frac{y_9 - p_8(x_9)}{(x_9 - x_0)(x_9 - x_1)(x_9 - x_2)(x_9 - x_3)(x_9 - x_4)(x_9 - x_5)(x_9 - x_6)(x_9 - x_7)(x_9 - x_8)}$$

Let $P_0(x) = c_0 = y_0 = 15114.98$ (17)

$$P_1(x) = P_0(x) + c_1(x - x_0)$$

$$c_1 = \frac{y_1 - p_0(x_1)}{(x_1 - x_0)} = \frac{15114.98 - 15114.98}{420.13 - 273.14} = 0$$

$P_1(x) = 15114.98 + 0(x - 273.14)$ (18)

$$\therefore P_1(x) = 15114.98$$

$$P_2(x) = P_1(x) + c_2(x - x_0)(x - x_1)$$

$$c_2 = \frac{y_2 - p_1(x_2)}{(x_2 - x_0)(x_2 - x_1)} = \frac{7332.7 - 1511.98}{(234.6 - 273.14)(234.6 - 420.13)}$$

$$= \frac{5820.72}{-38.54 \times -185.53} = \frac{5820.72}{7150.3264} = 0.81405$$

$P_2(x) = 1511.98 - 0.81405(x - 273.14)(x - 420.13)$
$P_2(x) = 1511.98 - 0.81405(x^2 - 420.13x - 27.14x + 114754.31)$
$= 1511.98 - 0.8140x^2 + 342.007x + 222.34962x - 93415.7461$
$P_2(x) = -0.81405x^2 + 564.35662x - 91903.7661$ (19)
$P_3(x) = P_2(x) + c_3(x - x_0)(x - x_1)(x - x_2)$

$$c_3 = \frac{y_3 - P_2(x_3)}{(x_3 - x_0)(x_3 - x_1)(x_3 - x_2)}$$

$$= \frac{7332.7 + 0.81405 \times (288.24)^2 - 564.35662(288.24) + 91903.766}{(7332.7 - 273.14)(7332.7 - 420.13)(7332.7 - 234.6)}$$

$$c_3 = \frac{7332.7 + 67633.1444 - 162670.15215 + 91903.7}{7059.56 \times 6912.57 \times 70.98}$$

$$c_3 = \frac{4199.4583}{346385169516.24} = 0.00000002136666$$

$P_3(x) = -0.81405x^2 + 564.35662x - 91903.7661$
$+0.00000002136666(x - 273.14)(x - 420.13)(x - 234.6)$
$= -0.81405x^2 + 564.35662x - 91903.7661 + 0.00000002136666$
$(x^2 - 420.13x - 273.14x + 114754.31)(x - 234.6)$
$= -0.81405x^2 + 564.35662x - 91903.7661 + 0.00000002136666$
$(x^2 - 693.27x + 114754.31)(x - 234.6)$
$= -0.81405x^2 + 564.35662x - 91903.7661 + 0.00000002136666$
$(x^3 - 234.6x^2 + 162641.142x + 114754.31x - 26921361.13)$
$= -0.81405x^2 + 564.35662x - 91903.7661 + 0.00000002136666$
$(x^3 - 927.87x^2 + 277395,5x - 26921361.13)$
$= -0.81405x^2 + 564.35662x - 91903.7661 + 0.00000002136666x^3$
$-0.0000199x^2 + 0.00594x - 0.57612$
$P_3(x) = 0.0000000214x^3 - 0.8141x^2 + 564.37x - 91904.3$ (20)
$P_4(x) = P_3(x) + c_4(x - x_0)(x - x_1)(x - x_2)(x - x_3)$

$$c_4 = \frac{y_4 - P_3(x_4)}{(x_4 - x_0)(x_4 - x_1)(x_4 - x_2)(x_4 - x_3)}$$

$$c_4 = \frac{8769.9 - 0.0000000214(254.7)^3 + 0.8141(254.7)^2 - 564.37(254.7) + 91904.3}{(254.7 - 273.14)(254.7 - 420.13)(254.7 - 234.6)(254.7 - 288.24)}$$

$$= \frac{8769.9 - 0.3536 + 52812.4 - 143745.04 + 91904.3}{-18.44 \times -165.43 \times 20.1 \times -33.54}$$

$$= \frac{9741.21}{-205652642} = -0.000048$$

$P_4(x) = 0.0000000214x^3 - 0.8141x^2 + 564{,}37x - 919104.3$
$-0.00048(x - 273.14)(x - 420.13)(x - 234.6)(x - 288.24)$
$= 0.0000000214x^3 - 0.8141x^2 + 564.37x - 919104.3 - 0.000048$
$(x^2 - 420.13x - 273.14x + 114754.31)(x^2 - 288.24x - 234.6x$
$+67621.104)$
$= 0.0000000214x^3 - 0.8141x^2 + 564.37x - 919104.3 - 0.000048$
$(x^2 - 561.38x + 67621.104)(x^2 - 522.84x + 67621.104)$
$= 0.0000000214x^3 - 0.8141x^2 + 564.37x - 919104.3 - 0.000048$
$(x^4 - 522.84x^3 + 67621.104x^2 - 561.38x^3 + 293511.92x^2$
$-37961135.4x + 67621.104x^2 - 35355018.02x + 4572613706.18)$
$P_4(x) = 0.0521x^3 + 1807.21x^2 + 2261.411x - 316189.76 - 0.000048x^4$
$P_4(x) = -0.000048x^4 + 0.0521x^3 + 1807.21x^2 + 2261.411x$

-316189.76 (21)

$P_5(x) = P_4(x) + c_4(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)$

$c_5 = \dfrac{y_4 - P_4(x_5)}{(x_5 - x_0)(x_5 - x_1)(x_5 - x_2)(x_5 - x_3)(x_5 - x_4)}$

$c_5 = \dfrac{11115.73 + 0.000048(218.6)^4 - 0.05521(218.6)^3 - 1807.21(218.6)^2 - 2261.411(218.6) + 316189.76}{(218.6 - 273.14)(218.6 - 420.13)(218.6 - 234.6)(218 - 288.24)(218.6 - 254.7)}$

$c_5 = \dfrac{11115.73 - 109607.903 - 576724.26 - 86359264.8 - 494344.445 + 316189.76}{-54.54 \times -201.53 \times -16 \times -69.64 \times -36.1}$

$C_5 = \dfrac{-87222635}{-442120635.4} = 0.1973$

$p_5(x) = -0.000048x^4 + 0.0521x^3 + 1807.21x^2 + 2261.411x$
$-316189.76 + 0.1973(x - 273.14)(x - 420.13)(x - 234.6)$
$(x - 288.24)(x - 254.7)$
$= -0.000048x^4 + 0.0521x^3 + 1807.21x^2 + 2261.411x - 316189.76$
$+ 0.1973(x^2 - 420.13x - 273.14x + 114754.31)(x^2 - 288.24x$
$-234.6x + 67621.164)\ (x - 254.7)$
$= -0.000048x^4 + 0.0521x^3 + 1807.21x^2 + 2261.411x - 316189.76$
$+0.1973(x^2 - 693.27x + 114754.31)(x^3 - 254.7x^2 + 552.84x^2$
$+133167.35x + 67621.104x - 17223095.2)$
$= -0.000048x^4 + 0.0521x^3 + 1807x^2 + 2261.411x - 316189.76$
$+0.1973(x^2 - 693.27x + 114754.31)(x^3 - 777.54x^2 + 200788.5x$
$-1722095.2)$
$= -0.000048x^4 + 0.0521x^3 + 1807x^2 + 2261.411x - 316189.76$
$+0.1973(x^2 - 693.27x + 114754.31)(x^3 - 777.54x^2 + 200788.5x$
$-1722095.2)$
$= -0.000048x^4 + 0.0521x^3 + 1807x^2 + 2261.411x - 316189.6$
$+0.1973(x^5 - 1470.18x^4 + 854587.97x^3 - 245649804.8x^2$
$+3444389787x - 197642440600)$

$P_5(x) = 0.1973x^5 - 290.1x^4 + 168610.3x^3 - 48464899.3x^2$
$+67958331.4x - 3899800860$ (22)

$$P_6(x) = P_5(x) + c_6(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)(x - x_5)$$

$c_6 = \dfrac{y_5 - P_5(x_6)}{(x_6 - x_0)(x_6 - x_1)(x_6 - x_2)(x_6 - x_3)(x_6 - x_4)(x_6 - x_5)}$

$c_6 = \dfrac{1047.24 - 0.1973(295.1)^5 + 290.067(295.1)^4 - 168610.3(295.1)^3 + 48464899.3(295.1)^2 - 679578331.4(295.1) + 3899800860}{(295.1 - 273.14)(295.1 - 420.13)(295.1 - 234.6)(295.1 - 288.24)(295.1 - 254.7)(295.1 - 218.6)}$

$= \dfrac{-2757155945000}{3521833803} = -782.9$

$P_6(x) = 0.1973x^5 - 290.1x^4 + 168610.3x^3 - 48464899.3x^2 +$
$679578331.4x - 3899800860 - 782.9(x - 273.14)(x$
$-420.13)(x - 234.6)(x - 288.24)(x - 254.7)(x - 218.6)(6)$

$P_7(x) = P_6(x) + c_7(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)$
$(x - x_5)(x - x_6)$

$$c_7 = \frac{y_6 - P_6(x_7)}{(x_7 - x_0)(x_7 - x_1)(x_7 - x_2)(x_7 - x_3)(x_7 - x_4)(x_7 - x_5)(x_7 - x_6)}$$

$$c_7 = \frac{1257 - 0.1973(251.5)^5 + 290.1(251.5)^4 - 168610.3(251.5)^3 + 48464899.3(251.5)^2 - 679578331.4(251.5) + 3899800860 - 782.9(251.5 - 273.14)(251.5 - 420.13)(251.5 - 234.6)(251.5 - 288.24)(251.5 - 254.7)(251.5 - 218.6)}{(251.5 - 273.14)(251.5 - 420.1)(251.5 - 234.6)(251.5 - 288.24)(251.5 - 254.7)(251.5 - 218.6)(251.5 - 295.1)}$$

$$= \frac{1178377012000 - 782.9(-21.64 \times -168.63 \times 16.9 \times -36.74 \times -3.2 \times 32.9)}{-21.64 \times -168.63 \times 16.9 \times -36.74 \times -3.2 \times 32.9 \times -43.6}$$

$$c_7 = \frac{1069293292000}{-73624762890} = -14.5$$

$$P_7(x) = 0.973x^5 - 290.1x^4 + 168610.3x^3 - 48464899.3x^2 + 679578331.4x - 3899800860 - 782.9)[(x - 273.14)(x - 420.13)(x - 234.6)(x - 288.24)(x - 254.7)(x - 218.6)] - 14.5[(x - 273.14)(x - 420.13)(x - 234.6)(x - 288.24)(x - 254.7)(x - 218.6)(x - 295.1)] \quad (23)$$

$$P_8(x) = P_7(x) + c_8(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)(x - x_5)(x - x_6)(x - x_7)$$

$$c_8 = \frac{y_7 - P_7(x_8)}{(x_8 - x_0)(x_8 - x_1)(x_8 - x_2)(x_8 - x_3)(x_8 - x_4)(x_8 - x_5)(x_8 - x_6)(x_8 - x_7}$$

$$c_8 = \frac{6594 - 0.973(200.3)^5 + 290.1(200.3)^4 - 168610.3(200.3)^3 + 48464899.3(200.3)^2 - 679578331.4(200.3) + 3899800860 + 782.9[(200.3 - 273.14)(200.3 - 420.13)(200.3 - 234.6)(200.3 - 288.24)(200.3 - 254.7)(200.3 - 218.6)] + 14.5[(200.3 - 273.14)(200.3 - 420.13)(200.3 - 420.13)(200.3 - 234.6)(200.3 - 288.24)(200.3 - 254.7)(200.3 - 218.6)(200.3 - 295.1)]}{(200.3 - 273.14)(200.3 - 420.13)(200.3 - 234.6)(200.3 - 288.24)(200.3 - 254.7)(200.3 - 218.6)(200.3 - 295.1)(200.3 - 251.5)}$$

$$c_8 = \frac{610483925400 + 78.9(-72.8 \times -220 \times -34.3x - 87.9 \times -54.4 \times -18.3) + 14.5(-72.8 \times -220 \times -34.3 \times -87.9 \times -54.4 \times -18.3x - 94.8)}{-72.8 \times -220 \times -34.3 \times -87.9 \times -54.4 \times -18.3 \times -94.8}$$

$$c_8 = \frac{610483925400 + 11075070640000 - 66078988170000}{233327185800000} = \frac{-54393433600000}{233327185800000}$$

$$c_8 = -0.023$$

$$P_8(x) = 0.973x^5 - 290.1x^4 + 168610.3x^3 - 48464899.3x^2 + 679578331.4x - 3899800860 - 782.9[(x - 273.14)(x - 420.13)(x - 234.6)(x - 288.24)(x - 254.7)9(x - 218.6)] - 14.5[(x - 273.14)[(x - 220.13)(x - 234.6)(x - 288.24)(x - 2541.7)(x - 218.6)(x - 295.1)] - 0.023[(x - 273.14)(x - 220.13)(x - 234.6)(x - 288.24)(x - 254.7)(x - 218.6)(x - 295.1)(x - 251.5)] \quad (24)$$

$P_9(x) = P_8(x) + c_9(x - x_0)(x - x_1)(x - x_2)(x - x_3)(x - x_4)$
$(x - x_5)(x - x_6)(x - x_7))(x - x_8)$

$$c_9 = \frac{y_8 - P_8(x_9)}{(x_9 - x_0)(x_9 - x_1)(x_9 - x_2)(x_9 - x_3)(x_9 - x_4)(x_9 - x_5)(x_9 - x_6)(x_9 - x_7)(x_9 - x_8)}$$

$$c_9 = \frac{\begin{array}{c}7384 - 0.973(219.7)^5 + 290.1(219.7)^4 - 168610.3(219.7)^3 \\ -679578331.4(219.7) + 3899800860 + 782.9[(219.7 - 273.14) \\ (219.7 - 420.13)(219.7 - 234.6)(219.7 - 288.24)(219.7 - 254.7) \\ (219.7 - 218.6)] + 14.5[(219.7 - 237.14)(219.7 - 420.13) \\ (219.7 - 234.6)(219.7 - 288.24)(219.7 - 254.7)(219.7 - 218.6) \\ (219.7 - 295.1)] + 0.023[53.44 \times -200.43 \times -14.9 \times -68.54 \times -35 \\ \times 1.1 \times -75.4 \times -31.8]\end{array}}{\begin{array}{c}(219.7 - 273.14)(219.7 - 420.13)(219.7 - 234.6)(219.7 - 288.24) \\ (219.7 - 254.7)(219.7 - 218.6)(219.7 - 295.1)(219.7 - 251.5) \\ (219.7 - 200.3)\end{array}}$$

$$c_9 = \frac{\begin{array}{c}583715459800 + 7.82.9[-53.44 \times -200.43 - 14.9 \times -68.54 \\ \times -35 \times 1.1] + 0.023[-53.44 \times -200.43 \times -14.9 \times -68.54 \times -35 \\ \times 1.1 \times -75.4 \times -31.8] + 14.5[-53.44 \times -200.43 \times -14.9 \times -68.54 \\ \times -35 \times 1.1 \times -75.4]\end{array}}{\begin{array}{c}-53.44 \times -200.43 \times -14.9 \times -68.54 \times -35 \times 1.1 \\ \times -75.4 \times -31.8 \times -19.4\end{array}}$$

$$c_9 = \frac{\begin{array}{c}583715459800 - 499268759800 - 2322.4510850 \\ +460425768900\end{array}}{12991154070000}$$

$$c_9 = \frac{521647958100}{-12991154070000}, c_9 = -0.004$$

$P_9(x) = 0.973x^5 - 290.1x^4 + 168610.3x^3 - 48464899.3x^2$
$+679578331.4x - 3899800860 - 782.7[(x - 273.14)(x - 420.13)$
$(x - 234.6)(x - 288.24)(x - 254.7)(x - 218.6)] - 14.5$
$[(x - 273.14)(x - 420.13)(x - 234.6)(x - 288.24)(x - 254.7)$
$(x - 218.6)(x - 295.1)] - 0.023[(x - 273.14)(x - 220.13)$
$(x - 334.6)(x - 288.24)(x - 254.7)(x - 218.6)(x - 295.1)$
$(x - 251.5)] - 0.004[(x - 273.14)(x - 220.13)(x - 234.6)$
$(x - 288.24)(x - 251.5)(x - 254.7)(x - 218.6)(x - 295.1)$
$(x - 200.3)]$ (25)

b. Analysis of Data using Linear Regression by (SPSS):
Model Summary

Table 2: Group statistics of analyze by (SPSS)

Model	*R*	*R square*	*Adjusted R square*	*Std.Error of the Estimate*
1	0.4889 (a)	0.238	0.143	4449.77559

Table No. 2 note that the value of $R^2 = 0.24\%$ is the value of the coefficient of determination. This value represents the ratio of the variable due to the dependent variable which means that 0.76 of variation in dependent variable refers to other factors not included in the model.
Also from the table No 2 the value of $R = 0.47$ it is the value of the correlation coefficient between the independent variable and the dependent variable is positive value. This means that the relation between rain and production is a reverse.

Table 3: Group of Analysis of Variance

Model	*S.O.V*	*Sum of square*	*df*	*Mean square*	*F*	*Sig*
1	Regression	49534013.626	1	49534013.626	2.502	0.152(a)
	Residual	158404022.629	8	19800502.829		
	Total		9			

a predictors: (constant), rain.
b dependent variable: production.

Table 4 : Group of statistic using T- test to get the regression equation

Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
		B	*Std. Error*	Beta		
1	(Constant)	-1738.762	6456.558		-.269	.795
	Rain	37.525	23.725	.488	1.582	.152

We get to choose parameter and β using $a(T)$ test and $sig = 0.79$ greater than 0.05, which indicates that it is moral parameter. from the Table No. **4** we get the regression equation.

$$y = -1738.762 + 37.525x_i \tag{26}$$

from this equation, we can predict that the quantity produced from crop, knowing value of x or the amount of rain.

2.1 Comparison between Newton's Interpolating Method and Simple Linear Regression

- It is found that simple linear regression method studies the relationship between the two variables, the independent and the dependent, and its strength, by calculating correlation value and the directional of relationship between the two variables, if it is direct or reverse, or if there is no relationship between them, however this feature is not found in Newton's interpolation method.
- In Newton's interpolating method we ultimately obtain model of equation from different degrees, while in simple linear regression we obtain a linear equation.
- In the two methods we obtain a model that we can substitute in by knowing the value of x for the regression that helps in predicting the values of dependent variable y while in Newton's interpolating method, interpolation be internal or external by knowing the value of x or reverse by knowing the value of y.

2.2 Data Sources

The source of this data is Elobied crops market and the ministry of agriculture and forestry in the state of North Kordofan data has been analyzed for the production of Arabian gum analysis in the period 2005/2006 to 2014/2015.

2.3 Data Calendar

The data has been assessed from census center in Khartoum State assessment and the date were on production, where rain is represented as follows.
***X*:** The amount of rain which is the independent variable in millimeters.
***Y*:** Production in tons dependent variable.

3.0. The Results of Data Analysis

Firstly: Analysis by (SPSS).

Linear model which has been accessible from the regression model if the value of $X = 520.13$ to know the quantity produced substitute in the equation.

$$Y = -1738.762 + 37.525\ (520.13) = 17779.12$$

In other words, the amount of output it the amount of rain 520.13 online production is 17779.12

Secondly: Newton's Interpolating Method.

Newton's polynomial model that has been accessible:

$$y = p_9(x) = 0.973x^5 - 290.1x^4 + 168610.3x^3 - 48464899x^2 + 67957833.4x - 3899800860 - 782.7[(x-273.14)(x-420.13)(x-234.6)(x-288.24)(x-254.7)(x-218.6) - 14.5][(x-273.14)(x-420.13)(x-234.6)(x-288.24)(x-254.7)(x-218.6)(x-295.1)] - 0.023[(x-273.14)(x-420.13)(x-234.6)(x-288.24)(x-254.7)(x-218.6)(x-295,1)(x-251.5)] - 0.004[(x-273.14)(x-420.13)(x-234.6)(x-288.24)(x-254.7)(x-218.6)(x-295.1)(x-251.5)(x-200.3)]$$

Substitute the former polynomial if the value of $x = 520.13$ and is the case of extrapolation $-319154238 \times 10^{10}$through these values we found that there is a difference between the two methods.

$$P_9(520.13) = 0.973(520.13)^5 - 290.1(520.13)^4 + 168610.3(520.13)^3 - 48464988(520.13)^2 + 67957833.4(520.13) - 3899800860 - 782.7[(520.13-273.14)(520.13-420.13)(520.13-234.6)(520.13-288.24)(520.13-254.7)(520.13-218.6)] - 14.5[(520.13-273.14)(520.13-420.13)(520.13-234.6)(520.13-288.24)(520.13-254.7)(520.13-218.6)(520.13-295.1)] - 0.023[(520.13-273.14)(520.13-420.13)(520.13-234.6)(520.13-288.24)(520.13-254.7)(520.13-218.6)(520.13-295.1)(520.13-251.5)] + 0.004[(520.13-273.14)(520.13-420.13)(520.13-234.6)(520.13-288.24)(520.13-254.7)(520.13-218.6)(520.13-295.1)(520.13-251.5)(520.13-200.3)]$$

$$P_9(520.13) = 3704017760000 - 2123221697000 + 23725742480000 - 1311145763000 + 353469077500 - 3899800860 - 782.7[(246.9)(100)(285.5)(231.9)(274.4)(301.5)] - 14.5[(246.9)(100)(285.5)(231.9)(274.4)(301.5)(225.03)] - 0.023[(246.9)(100)(285.5)(231.9)(274.4)(301.5)(225.03)(268.6)] - 0.004[(246.9)(100)(285.5)(231.9)(274.4)(301.5)(225.03)(268.6)(319.8)]$$

$$P_9(520.13) = 38572066780000 - 1058509374 \times 10^7 - 4412734489 \times 10^8 - 1880068354 - 4412734489 \times 10^8 - 1045644973 \times 10^{10}$$

$$P_9(520.13) = -319154238 \times 10^{10}$$

Remark:

The negative signal means that there are other elements that affect the crop's production.

After we analyzing the data of Gum Arabic production using Newton's interpolating method and simple linear regression, we found that when the rain increases the production increases also and the results showed that the quantities of rain have an effect on production of Gum Arabic.

4.0 Conclusion

This paper has shown that the two methods are suitable for analyzing the data of Gum Arabic production, but **Newton's** interpolating method is more accurate and quicker because I obtained polynomials of different degrees.

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