Zanco Journal of Human Sciences (ZJHS)
ISSN (Print):2218-0222
ISSN (Online): 2412-396X

Vol.28 Issue3 2024
ID 1529 (PP 266 - 281)

https://doi.org/10.21271/zjhs.28.3.15

Research Article

Assessing By Model Fitting Criteria and Comparing Between Stirling and Aitken Interpolation Formulas to Determine the Preferred Treatment of ،Choice, (Surgery) Or (Surgery with Chemotherapy), For Lung Cancer In Kurdistan

Nazeera Sedeeq Al-Barznji / Department of Statistics and Informatics, College of Administration and Economics, Salahaddin University-Erbil
Duaa Faiz Abdullah/Department of Statistics and Informatics, College of Administration and Economics, Salahaddin University-Erbil
Rezan Sedeeq Kareem/ Polytechnic University
Bikhal Samad Sedeeq/Department of Statistics and Informatics, College of Administration and Economics, Salahaddin University-Erbil

CORRESPONDENCE
Nazeera Sedeeq Al-Barznji
nazeera.kareem@su.edu.krd

Reiceved 18/09/2023
Accepted 25/01/2024
Published 15/06/2024

Keywords:
Stirling's interpolation formula and Aitken interpolation formula, (surgery) or (surgery with chemotherapy) treatments, Model Fitting Criteria.

Abstract

Numerical analysis is a branch of mathematical science; Interpolation is a method in Numerical analysis used for creating a model for group of discrete data points. This paper focused on two interpolations methods [Stirling's and Aitken] in numerical analysis can use the applied mathematics, to identify the mathematical model which it is bio statistical model refers to the equation about the effect of the best type of treatment for the Lung cancer, where the Lung cancer is a dangers disease either starts in the lungs then extend to the lymphatic system or from cancer in the other part of body to the Lung.to determine the preferred treatment of lung cancer, by surgery, or surgery with chemotherapy. for this analysis data obtained from the doctor specialist in Lung cancer through ratio percentages success of treatment , and by [Stirling's and Aitken interpolation formula] we formulated, firstly two(equations) or models for (surgery with chemotherapy treatments) with the fourth and third degrees , and Secondly, another two equations for (surgery treatments) with second degree , this confirms that surgery with chemotherapy is preferred treatment of lung cancer patients, and since the Stirling interpolation equation in the fourth degree emphasize that it is the most appropriate formula for bio-statistical analyses. by Cox and Snell R-Square in both treatments refer to good ratio and in the statistical analysis, the model fitting criteria in both analyzes the p-values emphasize the best fit of the models indicates perfect prediction. Improvement.

About the Journal
ZANCO Journal of Humanity Sciences (ZJHS) is an international, multi-disciplinary, peer-reviewed, double-blind and open-access journal that enhances research in all fields of basic and applied sciences through the publication of high-quality articles that describe significant and novel works; and advance knowledge in a diversity of scientific fields. https://zancojournal.su.edu.krd/index.php/JAHS/about

1. Introduction

Numerical method is a branch of mathematical science; Interpolation is a method of used for creating a model for group of discrete data points. It is a method was used in earliest Babylon, for predictions to astronomical events. It had an important for the farmers, to their farming strategies depend on predictions. Uruk and Babylon in the final three centuries BC, the mathematician used that interpolation to fill the gaps in mathematical solution. The interpolation methods used in earliest Greece dates from about the same time. Archivist Toomer thinks that Hipparchus of Rhodes (190–120 BC) used linear interpolation in creation tables of "chord model" (concerning to the sine function) for calculating the location of planetariums .Pletzer, Alexander; Hayek, Wolfgang (2019). Meijering, Erik(2002).

This research focused on two type of interpolation formulas, [first type is Stirling interpolation formula and second type Aitken interpolation formula to determine the preferred treatment for lung cancer, by surgery, or surgery with chemotherapy. Cancer is a disease in which cells in the body extend out of control. When lung cancer is first diagnosed, tests are done to find out how far developed through the lungs, lymph nodes, and the rest of the body. This process is called staging. Lung cancer's patients have of five stages: Miller AB, Fox W, Tall R (2019). Goldstein SD, Yang SC (2011) first stage If the cancer's cell growth is between (30 - 50) millimeters, it treated by pharmacological treatment. Second stage If cancer's cell growth is between (50 - 70) millimeters.,it is treated by surgery, in which the cancer cell is cut out during a process, Removing the tumor with surgery is considered the best choice for when the cancer is localized and unlikely to have prevalence, this represents early stage lung cancers. Third stage: the lung cancer is construct in both the lung and lymph nodes in the middle of the chest. If a lung cancer prevalence on the same side of the chest from where it begun is treated by chemotherapy, the word chemotherapy is used when indicating to using medications or drugs to treat cancer, they are special medications used to reduce masses, meaning they can kill cancerous cells Fourth stage the cancer prevalence to either the opposite side of the chest or above the collar bone. is treated by radiation therapy, through using high-energy rays to kill the cancerous cells. Fifth stage: this is the maximum progressing stage of lung cancer is treated by targeted therapy. The data obtained from the results of patients' treatment using [(surgery) or (surgery with chemotherapy)] through the percentages of success of treatments for lung cancer patients in Kurdistan. Collins LG, Haines C, Perkel R, Enck RE (2007), Goldstein SD, Yang SC (2011) we obtained data through percentages of treatment success, and we formulated the model, and the following results appeared: First, in the use of [Stirling's interpolation formula and Aitken interpolation formula], two equations of the fourth and third degree were derived for (surgery with chemotherapy treatments). but Secondly, in (surgery treatments two equations with second degree were derived, this confirms that surgery with chemotherapy are the best treatment for lung cancer patients, and since the Stirling interpolation equation in the fourth degree confirms that it is the most appropriate formula for bio-statistical analyses. In the statistical analysis, the model fitting criteria in both analyzes the p-values emphasize the best fit of the models.

2.Objective

The Objective of this research is the process of linking Applied mathematics, Medicine, and Statistics, to finding the equation for choosing the best treatment for lung cancer

3. Methodology

This research used to find the mathematical models to compare the feasibility of the two different treatments to find the preferred treatment of choice [(surgery) or (surgery with chemotherapy) treatment] for lung cancer in Kurdistan by the following two numerical analyses methods of interpolation formula for two types of data

=First numerical analysis method is Stirling's interpolation formula for data with the equally spaced explanatory variables are (equal intervals)
=Second numerical analysis method is Aitken's interpolation formula when the explanatory variables are not spaced equally (in unequal intervals of)
-Finally the model fitting Criteria used for both analyses to identify the best fit of the models

4. Assumptions of Interpolation

1-May be the Interpolation used as some statistical methods for estimation and forecasting which through a study of the time series.
2-There are no abrupt changes in the values of dependent variable from one interval to another.
3-There is a sort of consistency in the rise or fall of the values of the dependent variable.
4-There will be no consecutive missing values in the series.
David Kincaid and Ward Cheney,"(2002), Green M, Svetlana Tkachenko1 (2023), Kumar, Rakesh (2020), Endre S¨uli and David F. Mayers (2003)

5. Previous Study

This is the first study done for finding the relation between practical mathematics, specially using Stirling's interpolation formula and Aitken's interpolation formula to analyze treatments for lung cancer or biostatistics.

6. Theoretical Aspect

6. 1 Finite Difference Formula

A finite difference is a mathematical term of the form $f(x + h) - f(x + h)$. If h difference $h=b - a$, the result is estimation the same as approximations defined as theoretical independent mathematical objects. [Hashem S. M.n, Li Wang1, John Young1 and Fang-Bao Tian1(2023), Milne-Thomson, Louis Melville (2000, Pal. Dr. Anita (2007) P.J. Davis, (1975)]

6.2 Central Difference Interpolation Formula

Central difference formula, If x takes values Green M, Svetlana Tkachenko1 (2023) P.J. Davis, (1975) $x_0 - 2h . x_0 - h \; . x_0 . \; x_0 + \; h . x_0 + 2h$ and the corresponding values of

$y = f(x)$ are $y_{-2} . y_{-1} . y_0 . y_1 . y$

$$\delta(f_n) = \delta_n = \delta_n^1 = f_{n+1/2} = f_{n-1/2} \quad \dots(1)$$

are arranged which is shown

$$\delta_{n+1/2} = \delta_{n+1/2}^1 = f_{n+1} - f_n \quad \dots(2)$$

$$\delta_n^2 = \delta_{n+1/2}^1 - \delta_{n-1/2}^1 = f_{n+1} - 2 f_n \quad \dots(3)$$

$$\delta_n^3 = \delta_{n+1}^2 - \delta_n^2 = f_{n+1} - 2 f_n + f_{n-1} = f_{n+2} - 3 f_{n+1} + f_{n-1} \quad \dots(4)$$

even and odd powers,

$$\delta_n^{2k} = \sum_{j=0}^{2k} (-1)^j \binom{2k}{j} f_{n+1-j} \quad \dots(5)$$

$$\delta_{n+1/2}^{2k+1} = \sum_{j=0}^{2k+1} (-1)^j \binom{2k}{j} f_{n+1-j} \quad \dots(6)$$

In addition, we can define Central Differences as follows:

$$\delta y_i = \delta f(x) = f\left(x + \frac{h}{2}\right) - f\left(x - \frac{h}{2}\right) \quad \dots(7)$$

$$\delta^2 y_i = \delta[\delta f(x)] = \delta\left[f\left(x + \frac{h}{2}\right) - f\left(x - \frac{h}{2}\right)\right]$$

$$\delta^2 y_i = f\left(x+\frac{h}{2}\right) - f(x) - f(x) + f\left(x-\frac{h}{2}\right)$$
$$\delta^2 y_i = f\left(x+\frac{h}{2}\right) - 2f(x) + f\left(x-\frac{h}{2}\right) \quad \dots (8)$$
$$\delta^3 y_i = \delta[\delta^2 y_i f(x)] = \delta\left[f\left(x+\frac{h}{2}\right) - 2f(x) + f\left(x-\frac{h}{2}\right)\right]$$
$$\delta^3 y_i = \left[f\left(x+\frac{3h}{2}\right) - 2f\left(x+\frac{h}{2}\right) + 2f\left(x-\frac{h}{2}\right) - f\left(x+\frac{h}{2}\right) + f\left(x-\frac{h}{2}\right) + f\left(x-\frac{3h}{2}\right)\right]$$
$$\delta^3 y_i = \left[f\left(x+\frac{3h}{2}\right) - 3f\left(x+\frac{h}{2}\right) + 3f\left(x-\frac{h}{2}\right) + f\left(x-\frac{3h}{2}\right)\right] = \delta^{2k-1} y_{i+\frac{1}{2}} - \delta^{2k-1} y_{i-\frac{1}{2}} . \quad (9)$$

Anita Pal (2017) , P. Sam Johnson (2020) , Richard L. Burden and J. Douglas Faires (2015)

Table (1) Central Differences

i	x_i	y_i	δ_{y_i}	$\delta^2_{y_i}$	$\delta^3_{y_i}$	$\delta^4_{y_i}$	$\delta^5_{y_i}$	$\delta^6_{y_i}$
-3	x_{-3}	y_{-3}						
			$\delta_{y\frac{-5}{2}}$					
-2	x_{-2}	y_{-2}		$\delta^2_{y_{-2}}$				
			$\delta_{y\frac{-3}{2}}$		$\delta^3_{y\frac{-3}{2}}$			
-1	x_{-1}	y_{-1}		$\delta^2_{y_{-1}}$		$\delta^4_{y_{-1}}$		
			$\delta_{y_{\frac{-1}{2}}}$		$\delta^3_{y_{\frac{-1}{2}}}$		$\delta^5_{y_{\frac{-1}{2}}}$	
0	x_0	y_0		$\delta^2_{y_0}$		$\delta^4_{y_0}$		$\delta^6_{y_0}$
			$\delta_{y_{\frac{1}{2}}}$		$\delta^3_{y_{\frac{1}{2}}}$		$\delta^5_{y_{\frac{1}{2}}}$	
1	x_1	y_1		$\delta^2_{y_1}$		$\delta^4_{y_1}$		
			$\delta_{y_{\frac{3}{2}}}$		$\delta^3_{y_{\frac{3}{2}}}$			
2	x_2	y_2		$\delta^2_{y_2}$				
			$\delta_{y_{\frac{5}{2}}}$					
3	x_3	y_3						

Where:

$$\delta_{y_{\frac{1}{2}}} = y_1 - y_0 \ , \quad \delta_{y\frac{-3}{2}} = y_{-1} - y_{-2}, \quad \delta_{y\frac{-5}{2}} = y_{-2} - y_{-3} \quad \dots (10)$$
$$\delta^2_{y_0} = \delta_{y_{\frac{1}{2}}} - \delta_{y_{\frac{-1}{2}}} \quad \dots (11)$$
$$\delta^6_{y_0} = \delta^5_{y_{\frac{1}{2}}} - \delta^5_{y_{\frac{-1}{2}}} \quad \dots (12)$$

6.2.1 Interpolation for explanatory variables are equally spaced (Equal intervals in (x_n)

Let $y = f(x)$ distinct set of points, $(x_i . y_i)$. $i = 0.1.2.3. \dots . k$ $. -1 < k < 1$ Where x_i's are equally spaced. The process of obtaining the values, $f(x_i + nh)$ is known as interpolation within equal intervals, where the height of the interval (h) is set. There are various ways of in shown: Kendall E. Atkinson, (2012), David Kincaid and Ward Cheney,"(2002) P.J. Davis, (1975)

1- Newton's Forward Interpolation Formula

2- Gaussian Forward Interpolation Formula

3- Gaussian Backward Interpolation Formula
4- Stirling's Interpolation Formula

6.2.1.1 Newton's Forward Interpolation Formula

Newton's forward interpolation formula is used to interpolate the values of the function $y = f(x)$ near the beginning ($x > x_0$) and to extrapolate the values when ($x < x_0$), within the range of given data points$(x_i . y_i)$. $i = 0,1,2,3,\dots,k$.

Let $f(x)$ take the values, $(y_0 . y_1 . y_2 . \dots . y_k)$ for the independent variable taking values, $(x_0 . x_1 . x_2 . \dots . x_k)$ where height of the interval (h) is fixed, such that

$x_1 = x_0 + h . x_2 = x_0 + 2h . \dots . x_n = x_0 + nh$

but $f(x) = x_0 + nh \quad E^n f(x_0) = (1+\Delta)^n y_0 \; since \; E = (1+\Delta) \; and f(x_0) = y_0$

$$f(x) \equiv \left(1 + n\Delta + \frac{n(n-1)}{2!}\Delta^2 + \frac{n(n-1)(n-2)}{3!}\Delta^3\right) y_0 \quad . x = x_0 + nh$$

$$f(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \cdots \quad \dots (13)$$

From the Newton's forward difference formula, we will prove the **Gauss's forward** Gauss central difference formula is used to interpolate the values of (y) Newton's forward difference formula is given by:

$$f(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \frac{n(n-1)(n-2)(n-3)}{3!}\Delta^4 y_0 + \cdots \dots (14)$$

Now $\Delta^3 y_{-1} = \Delta^2 y_0 - \Delta^2 y_{-1}$

$\rightarrow \quad \Delta^2 y_0 = \Delta^2 y_{-1} + \Delta^3 y_{-1}$ … (15)

Similarly $\Delta^3 y_0 = \Delta^3 y_{-1} - \Delta^4 y_{-1}$ … (16)

$\Delta^4 y_0 = \Delta^4 y_{-1} + \Delta^5 y_{-1}$ … (17)

Substituting $\Delta^2 y_0 \; . \; \Delta^3 y_0 \; . \; \Delta^4 y_0$

$$f(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \frac{n(n-1)(n-2)(n-3)}{3!}\Delta^4 y_0 + \cdots \quad \dots(18)$$

$$(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}(\Delta^2 y_{-1} + \Delta^3 y_{-1}) + \frac{n(n-1)(n-2)}{3!}(\Delta^3 y_{-1} - \Delta^4 y_{-1}) + \frac{n(n-1)(n-2)(n-3)}{3!}(\Delta^4 y_{-1} + \Delta^5 y_{-1}) + \cdots \quad \dots (19)$$

6.2.1.2 From Newton's forward interpolation formula, we will prove Gauss's Backward interpolation [Endre S¨uli and David F. Mayers (2003), Green M, Svetlana Tkachenko1 (2023) P.J. Davis, (1975)

Newton's forward difference formula is given by:

$$f(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \frac{n(n-1)(n-2)(n-3)}{3!}\Delta^4 y_0 + \cdots \quad (20)$$

Now $\Delta^2 y_{-1} = \Delta y_0 - \Delta y_{-1} \quad \rightarrow \quad \Delta y_0 = \Delta y_{-1} + \Delta^2 y_{-1}$ … (21)

Similarly $\Delta^2 y_0 = \Delta^2 y_{-1} + \Delta^3 y_{-1}$ … (22)

$\Delta^3 y_0 = \Delta^3 y_{-1} + \Delta^4 y_{-1}$ … (23)

Substituting $\Delta y_0 \; , \; \Delta^2 y_0 \; . \; \Delta^3 y_0 \; . \; \Delta^4 y_0$

$$f(x) \equiv y_0 + n\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \frac{n(n-1)(n-2)(n-3)}{3!}\Delta^4 y_0 + \dots$$

$$f(x) \equiv y_0 + n(\Delta y_{-1} + \Delta^2 y_{-1}) + \frac{n(n-1)}{2!}(\Delta^2 y_{-1} + \Delta^3 y_{-1}) + \frac{n(n-1)(n-2)}{3!}(\Delta^3 y_{-1} + \Delta^4 y_{-1}) + \frac{n(n-1)(n-2)(n-3)}{3!}(\Delta^4 y_{-1} + \Delta^5 y_{-1}) + \cdots \quad \dots (24)$$

$\Delta y_{-1} . \Delta^2 y_{-1} . \Delta^3 y_{-1} . \Delta^4 y_{-1} . \dots \quad we get$

$$f(x) \equiv y_0 + n\Delta y_{-1} + \frac{(n+1)n}{2!}\Delta^2 y_{-1} + \frac{(n+1)\,n(n-1)}{3!}\Delta^3 y_{-1} + \frac{(n+1)n(n-1)(n-2)}{3!}\Delta^4 y_{-1} + \quad \dots (25)$$

But $\Delta^3 y_{-1} = \Delta^3 y_{-2} + \Delta^4 y_{-2} \; and \; \Delta^4 y_{-1} = \Delta^4 y_{-2} + \Delta^5 y_{-2}$ … (26)

Using (6) in **(5)** , we get

$$f(x) \equiv y_0 + n\Delta y_{-1} + \frac{(n+1)n}{2!}\ \Delta^2 y_{-1} + \frac{(n+1)\,n(n-1)}{3!}\ \Delta^3 y_{-1} + \frac{(n+2)(n+1)n(n-1)}{3!}\ \Delta^4 y_{-1} + \cdots \qquad \ldots (27)$$

6.2.1.3 Stirling's Central Difference Formula

Stirling gave the most general formula for interpolating values near the center of the table

$$f(x) \equiv y_0 + n\frac{\Delta y_0 + \Delta y_{-1}}{2} + \left[\frac{n(n-1)}{2!} + \frac{(n+1)n}{2!}\right]\frac{\Delta^2 y_{-1}}{2} + \frac{(n+1)\,n(n-1)}{3!}\left[\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right] + \frac{(n+2)(n+1)n(n-1)}{3!}\ \frac{\Delta^2 y_{-1}}{2} + \cdots$$

$$f(x) \equiv y_0 + n\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) + \left(\frac{n^2}{2!}\right)\Delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\left[\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right] + \frac{(n^2)\,(n^2-1)}{4!}\ \Delta^4 y_{-2} + \ \ldots \ \ldots (28)$$

Expression given is known as **Stirling's central difference formula P**utting

$$\frac{1}{2}(\Delta y_0 + \Delta y_{-1}) = \frac{1}{2}(\delta y_0 + \delta y_{-1}) = \mu\delta y_0$$

$$\frac{1}{2}(\Delta^3 y_{-1} + \Delta^3 y_{-2}) = \frac{1}{2}\left(\delta^3 y_{\frac{1}{2}} + \delta^3 y_{\frac{1}{2}}\right) = \mu\delta^3 y_0$$

In terms of central differences, takes the form

$$f(x) \equiv y_0 + n\mu\delta y_0 + \left(\frac{n^2}{2!}\right)\delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\mu\delta^3 y_0 + \frac{(n^2)\,(n^2-1)}{4!}\ \delta^4 y_{-2} + \cdots \qquad \textbf{... (29)}$$

This is another form of **Stirling's central difference formula.** Steffensen, J. F. (2006). The difference table used to evaluate $f(x)$as per Stirling's formula, is shown below. Column wise averages of differences are taken while evaluation phase. [Romik, Dan (2000), Whittaker, E. T. & Watson, G. N. (1996), Robbins, Herbert (1955),]

Table (2) Stirling's Central Difference Formula

i	x_i	y_i	Δ_{y_i}	$\Delta^2_{y_i}$	$\Delta^3_{y_i}$	$\Delta^4_{y_i}$
-2	x_{-2}	y_{-2}				
			$\Delta_{y_{-2}}$			
-1	x_{-1}	y_{-1}		$\Delta^2_{y_{-2}}$		
			$\Delta_{y_{-1}}$		$\Delta^3_{y_{-2}}$	
0	x_0	y_0		$\Delta^2_{y_{-1}}$		$\Delta^4_{y_{-2}}$
			Δ_{y_0}		$\Delta^3_{y_{-1}}$	
1	x_1	y_1		$\Delta^2_{y_0}$		
			Δ_{y_1}			
2	x_2	y_2				

6.3 Interpolation for explanatory variables are not equal interval (set at unequal)

Aitken's Interpolation Analysis Humpherys, Jeffrey; Jarvis, Tyler J. (2020), Richard L. Burden and J. Douglas Faires (2015)

.

However,

$y = f(x)$

y_i at $x = x_0 . x_1 . \ldots . x_n$ are known, where $y_i = f(x_i)$.

$x_i$need not be equally spaced.

The Aitken iteration process is as follows: $(x_0,\ y_0)$ and $(x_j . y_j)$, j =1, 2. …, n is determined. This is the first approximation. In the second step, $(x_0,\ y_0)$, $(x_1,\ y_1)$ and $(x_j . y_j). j = 2. \ldots . n$

The second approximation is $(x_0,\ y_0)$ and $(x_1,\ y_1)$ be denoted by $p_{01}(x)$, for the arguments x_0 and x_j the linear polynomial is

$$p_{01}(x) = \frac{x - x_1}{x_0 - x_1} y_0 + \frac{x - x_0}{x_1 - x_0} y_1 = \frac{1}{x_1 - x_0}[(x_1 - x)y_0 + (x_0 - x)y_1]$$

$$= \frac{1}{x_1 - x_0} \begin{vmatrix} y_0 & x_0 - x \\ y_1 & x_1 - x \end{vmatrix}$$

x_0 and x_i is

$$p_{01}(x) = \frac{1}{x_j - x_0} \begin{vmatrix} y_0 & x_0 - x \\ y_j & x_1 - x \end{vmatrix} \ldots \qquad \ldots (30)$$

$(x_0 . y_0)$; $(x_1 . y_1)$; $(x_j . y_j)$. This polynomial is denoted by $p_{0ij}(x)$ and it is obtained as

$$p_{0ij}(x) = \frac{1}{x_j - x_1} \begin{vmatrix} p_{01}(x) & x_1 - x \\ p_{0j}(x) & x_j - x \end{vmatrix} \mathrm{j} = 2.3 \ldots . \mathrm{n}$$

In general, for the (k+2) points$(x_0 . y_0)$, $(x_1 . y_1)$,…, $(x_k . y_k)$and $(x_j . y_j)$ the $(k+1)th$

Degree interpolating polynomial is

$$p_{012\ldots kj}(x) = \frac{1}{x_j - x_k} \begin{vmatrix} p_{012,\ldots,k}(x) & x_1 - x \\ p_{012,\ldots,j}(x) & x_j - x \end{vmatrix} \ j = (k+1). \ldots . n \qquad \ldots (31)$$

The calculation represents in the table. [Islam, S., Y. Khan, N. Faraz and F. Austin, 2010]

Table (3) Interpolation for explanatory variables are not equally spaced (set at unequal intervals)

x_j	y_j	p_{0j}	p_{01j}	p_{012j}	p_{0123j}	$x_j - x$
x_0	y_0					$x_0 - x$
x_1	y_1	p_{01}				$x_1 - x$
x_2	y_2	p_{02}	p_{012}			$x_2 - x$
x_3	y_3	p_{03}	p_{013}	p_{0133}		$x_3 - x$
x_4	y_4	p_{04}	p_{014}	p_{0124}	p_{01234}	$x_4 - x$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
x_n	y_n	p_{0n}	p_{01n}	p_{012n}	p_{0123n}	$x_n - x$

6.4 Cox and Snell Pseudo R^2

The calculation of the percentage variation decreased including additional forms basis of. alternate goodness-of-fit metric obtained is Problematic the Cox and Snell index's of highest equation is as follows: Mertler, C.A., & Vannatta, R.A. (2015), Menard, S. (2022)

$$R^2_{MoF} = 1 - \left[\frac{L(O)}{L(\hat{\beta})}\right]^{\frac{2}{w}}$$

“Where $L(\widehat{\mathrm{B}})$the likelihood of the current is model; $\mathrm{L}(0)$ is the likelihood of the initial model BARZNJI, N. S, (2018), Karl, L. W. and P (2016),

6.5 Likelihood Ratio Test Formula(10)

is used to assess whether coefficients for predictor factors are statistically significant overall covariates are equal to zero.

$$LR = -2ln\left[\frac{Likelihood\ without\ the\ variable}{likelihood\ with\ the\ variable}\right] = -2ln\left(\frac{L\ \ at\ H_0}{L\ at\ MLE(s)}\right)$$

$$= -2L\ H_0 + 2L\ (MLE) \quad \text{… (32)}$$

When n is big, $LR \sim x^2$ has a degree of freedom equals the number of parameter estimates BARZNJI, N. S, (2018). Karl, L. W. and P (2016),

7.Practical Aspect

Objective to this section comprehensively compare the feasibility of two different treatment strategies for lung cancer (first (surgery) treatment and second by (surgery with chemotherapy)treatment) by two numerical analysis methods of interpolation formula for two types of data first type of data when the domain points are equally spaced (Equal intervals) by Stirling's interpolation formula and second type when the domain points are not equally spaced (Unequal intervals) by Aitken's interpolation formulas] described below Lung cancer's patients have of five stages.

First Stage: If the cancer's cell growth is between (30 - 50) millimeters.

Second Stage: If cancer's cell growth is between (50 - 70) millimeters.

Third Stage: the lung cancer is construct in both the lung and lymph nodes in the middle of the chest.

Fourth Stage: the cancer has prevalence to either the opposite side of the chest or above the collar bone.

Fifth Stage: this is the maximum progressing stage of lung cancer is treated by targeted therapy.

7.1Data Description

The data obtained from the results of patients' treatment using [(surgery) or (surgery with chemotherapy)] through the percentages of success of treatments for lung cancer patients in Kurdistan [Hecht SS (2012)

Explantory variables = x_i = Lung cancer's patients Stages = (1 − 5) Stages.

Response variable = y_i =[The success rate of kind of Treatments on the patient]

For surgery treatment only three stages are taken because the lung cancer prevalence only on the same side of the chest from where it startedBut for surgery with chemotherapy treatment all stages (five stages) is taken because the lung cancer spread to opposite lung . fluid surrounding the lung . and in the fluid surrounding the heart.

Table (4) The following data represents the success rates for each of the five Stages of Lung cancer's patients by (surgery) or (surgery with chemotherapy) treatments

Treatments y_i \ Stages x_i	First Stage	Second Stage	Third Stage	Fourth Stage	Fifth Stage
(surgery) treatment (The success rate)	66.3	46.2	40.9	0	0
(surgery with chemotherapy) treatment(The success rate of test)	88.7	63.2	51.5	43.9	37.5

table (4) shows the success rates for each of the five Stages of Lung cancer's patients by (surgery) or (surgery with chemotherapy) treatments

Analyses:

7.2-Stirling Interpolation Formula for Surgical treatment

Table (5) Stirling Interpolation Formula for Surgery

	surgery **treatment**			
i	x_i	y_i	δ_{y_i}	$\delta^2_{y_i}$
-1	1	66.3		
			-20.1	
0	2	46.2		14.8
			-5.3	
1	3	40.9		

Solution :

$$f(x) \equiv y_0 + n\mu\delta y_0 + \left(\frac{n^2}{2!}\right)\delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\mu\delta^3 + \frac{(n^2)(n^2-1)}{4!}\ \delta^4 y_{-2} + \cdots$$

$$f(x) \equiv y_0 + n\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) + \left(\frac{n^2}{2!}\right)\Delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\left[\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right] + \cdots$$

$$y_n = f(x) \equiv 46.2 + n\left[\frac{(-20.1)+(-5.3)}{2}\right] + \left(\frac{n^2}{2!}\right)(14.8)$$

$$y_n = 46.2 + n(-12.7) + \left(\frac{n^2}{(2).(1)}\right)(14.8) \qquad .. \quad (33)$$

$$y_n = 46.2 - 12.7n + 7.4n^2$$

$$x_n = x_0 + nh$$

$$x_n = 3 + n1$$

$$n = x_n - 3 \qquad \ldots (34)$$

By substitute the value of n from equation (34) in equation (33)

$$y_n = 46.2 - 12.7(x_n - 3) + 7.4(x_n - 3)^2$$

$$y_n = 46.2 - 12.7x_n + 38.1 + 7.4({x_n}^2 - 6x_n + 9)$$

$$y_n = 46.2 + 38.1 + 66.6 - 12.7x_n - 44.4x_n + 7.4\,{x_n}^2$$

$$y_n = 150.9 - 5.7.1x_n + 7.4\,{x_n}^2 \rightarrow$$

$y_n = 7.4\,{x_n}^2 - 5.7.1x_n + 150.9$ Model by Stirling interpolation method to treatment by using Surgery for Lung cancer in Kurdistan

7.3. Stirling Interpolation Formula for (surgery with chemotherapy treatment)

Table(6) Stirling Interpolation Formula for surgery with Chemotherapy

surgery with chemotherapy treatment						
i	x_i	y_i	δ_{y_i}	$\delta^2_{y_i}$	$\delta^3_{y_i}$	$\delta^4_{y_i}$
-2	1	88.7				
			-25.5			
-1	2	63.2		13.8		
			-11.7		-9.7	
0	3	51.5		4.1		6.8
			-7.6		-2.9	
1	4	43.9		1.2		
			-6.4			
2	5	37.5				

$$f(x) \equiv y_0 + n\mu\delta y_0 + \left(\frac{n^2}{2!}\right)\delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\mu\delta^3 + \frac{(n^2)(n^2-1)}{4!}\ \delta^4 y_{-2} + \cdots$$

$$f(x) \equiv y_0 + n\left(\frac{\Delta y_0 + \Delta y_{-1}}{2}\right) + \left(\frac{n^2}{2!}\right)\Delta^2 y_{-1} + \frac{n(n^2-1)}{3!}\left[\frac{\Delta^3 y_{-1} + \Delta^3 y_{-2}}{2}\right] + \frac{(n^2)(n^2-1)}{4!}\ \Delta^4 y_{-2}$$

$$y_n = f(x) \equiv 51.5 + n\left[\frac{(-11.7)+(-7.6)}{2}\right] + \left(\frac{n^2}{2!}\right)(4.1) + \frac{n(n^2-1)}{3!}\left[\frac{(-9.7)+(-2.9)}{2}\right] + \frac{(n^2)(n^2-1)}{4!}\ (6.8)$$

$$y_n = \ 51.5 + n\left[\frac{(-19.3)}{2}\right] + \left(\frac{n^2}{2!}\right)(4.1) + \frac{n(n^2-1)}{3!}\left[\frac{(-12.6)}{2}\right] + \frac{(n^2)(n^2-1)}{4!}\ (6.8)$$

$$y_n = 51.5 - 9.65n + 4.1\left(\frac{n^2}{2}\right) - 6.3\frac{n(n^2-1)}{(3).(2)} + (6.8)\ \frac{(n^2)(n^2-1)}{(4).(3).(2)}$$

$$y_n = \ 51.5 - 9.65n + 2.05n^2 - 1.05n(n^2-1) + (0.2833)\ (n^2)\ (n^2-1)$$

$$y_n = 51.5 - 9.65n + 1.05n + 2.05n^2 - 0.2833n^2 - 1.05n^3 + 0.2833\ n^4$$

$$y_n = \ 51.5 - 8.6\ n + 1.7667n^2 \ - 1.05n^3 + 0.2833\ n^4 \qquad \ldots (35)$$

$$x_n = \ x_0 + nh$$

$$x_n = \ 3 + n1$$

$$n = x_n - \ 3 \qquad \ldots\ (36)$$

By substitute the value of n from equation (36) in equation (35)

$$y_n = \ 51.5 - 8.6(x_n - \ 3) + 1.7667(x_n - \ 3)^2 - 1.05(x_n - \ 3)^3 + 0.2833\ (x_n - \ 3)^4$$

$$y_n = \ 51.5 - \ 25.8 - 8.6x_n + 1.7667({x_n}^2 - 6x_n + \ 9) - 1.05({x_n}^3 - 9{x_n}^2 + 27x_n - 27) + 0.2833\ ({x_n}^4 - 12{x_n}^3 + 54{x_n}^2 - 108x_n + \ 81)$$

$$y_n = \ 51.5 - \ 25.8 + 15.9003 + \ 28.35 + \ 22.9473 - 8.6x_n - 10.6002x_n - 28.35\ x_n - 30.5964x_n \ + 1.7667{x_n}^2 + 9.45{x_n}^2 + 15.2982{x_n}^2 - 1.05{x_n}^3 - 3.3996{x_n}^3 + 0.2833{x_n}^4$$

$$y_n = 92.8976 - 78.1466x_n + 26.5149{x_n}^2 - 4.4426{x_n}^3 + 0.2833{x_n}^4$$

$$y_n = 0.2833{x_n}^4 - 4.4426{x_n}^3 + 26.5149{x_n}^2 - 78.1466x_n + 92.8976$$

Model by Stirling interpolation method to treatment by using (surgery with chemotherapy) for Lung cancer in Kurdistan

7.4. Aitken Interpolation Formula for Surgery treatment

Table (7) general table for Aitken Interpolation Formula for Surgery treatment

Surgery treatment			
x_i	y_i		$x_i - x_n$
$x_0 = 1$	y_0		$x_0 - x_n = 1 - x_n$
$x_1 = 2$	y_1		$x_1 - x_n = 2 - x_n$
$x_2 = 5$	y_2	$p_{01}(x_n)\ p_{01}(x_n) = \frac{1}{x_1 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_1 & x_1 - x_n \end{vmatrix}$ $p_{02}(x_n)$ $p_{02}(x_n) = \frac{1}{x_2 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_2 & x_2 - x_n \end{vmatrix}$ $p_{012}(x_n)$= $p_{01j}(x_n) = \frac{1}{x_j - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{0j} & x_j - x_n \end{vmatrix}$ $.\ j = 2.3.4. \ldots\ \ .\ n$	$x_2 - x_n = 5 - x_n$

Table (8) for Aitken Interpolation Formula for Surgery treatment

Surgery treatment			
$x_0 = 1$	$y_0 = 66.3$	$p_{01}(x_n) = 89.05 - 22.75x_n$	$x_0 - x_n = 1 - x$
$x_1 = 2$	$y_1 = 43.55$	$p_{02}(x_n) = \frac{331.5 - 66.3x_n}{4}$	$x_1 - x_n = 2 - x$
$x_2 = 5$	$y_5 = 0$	$p_{012}(x)= 8.23x_n^2 - 115.7\,x_n - 372.667$	$x_2 - x_n = 5 - x$

Solution. The first approximation is calculated below.

$$p_{01}(x_n) = \frac{1}{x_1 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_1 & x_1 - x_n \end{vmatrix}$$

$$p_{01}(x_n) = \frac{1}{2-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 43.55 & 2 - x_n \end{vmatrix}$$

$$p_{01}(x_n) = \frac{66.3(2 - x_n) - 43.55(1 - x_n)}{2-1} =$$

$$p_{01}(x_n) = \frac{66.3(2-x_n)-43.55(1-x_n)}{1} = 132.6 - 66.3x_n - 43.55 + 43.55x_n = 132.6 - 43.55 - 66.3x_n + 43.55x_n = 89.05 - 22.75x_n$$

$$p_{02}(x_n) = \frac{1}{x_2 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_2 & x_2 - x_n \end{vmatrix}$$

$$p_{02}(x_n) = \frac{1}{5-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 0 & 5 - x_n \end{vmatrix} = \frac{66.3(5 - x_n) - 0(1 - x_n)}{4} = \frac{66.3(5 - x_n)}{4}$$

$$p_{02}(x_n) = \frac{331.5 - 66.3x_n}{4}$$

The second approximation is

$$p_{01j}(x_n) = \frac{1}{x_j - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{0j} & x_j - x_n \end{vmatrix} \quad .\ j = 2.3.4.\dots\ .\ n$$

$$p_{012}(x_n) = \frac{1}{x_2 - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{02} & x_2 - x_n \end{vmatrix}$$

$$p_{012}(x_n) = \frac{1}{5-2}\begin{vmatrix} 89.05 - 22.75x_n & 2 - x_n \\ \frac{331.5 - 66.3x_n}{4} & 5 - x_n \end{vmatrix}$$

$$p_{012}(x_n) = \frac{(89.05 - 22.75x_n)(5 - x_n) - \left(\frac{331.5 - 66.3x_n}{4}\right)(2 - x_n)}{3} =$$

$$y_n = p_{012}(x_n) = \frac{\frac{4(89.05 - 22.75x_n)(5 - x_n) - (331.5 - 66.3x_n)(2 - x_n)}{4}}{3} =$$

$$= \frac{4[445.25 - 89.05x_n - 113.75x_n + 22.75x_n^2] - [663 - 132.6x_n - 331.5x_n + 66.3x_n^2]}{12}$$

$$= \frac{1781 - 356.2x_n - 455x_n + 91x_n^2 - 663 + 132.6x_n + 331.5x_n - 66.3x_n^2}{3}$$

$$y_n = \frac{24.7x_n^2 - 347.1x_n + 1118}{3} \rightarrow$$

$y_n = 8.23x_n^2 - 115.7\,x_n - 372.667$ Model by Aitken Interpolation Formula for Surgery treatment for Lung cancer in Kurdistan

7.5. Aitkens's Interpolation Formula for (surgery with chemotherapy)treatments

Table(9) for Aitken Interpolation Formula for Chemotherapy with Surgical treatment

Chemotherapy with Surgical treatment			
x_i	y_i		$x_i - x_n$
$x_0 = 1$	$y_0 = 66.3$		$1 - x_n$
$x_1 = 2$	$57.35y_1 =$	$p_{01}(x_n) = \frac{1}{x_1 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_1 & x_1 - x_n \end{vmatrix}$	$2 - x_n$
$x_2 = 4$	$43.9y_2 =$		$4 - x_n$
$x_3 = 5$	$7.5y_3 =$	$p_{02}(x_n) = \frac{1}{x_2 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_2 & x_2 - x_n \end{vmatrix}$ $p_{012}(x_n) = \frac{1}{x_2 - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{02} & x_2 - x_n \end{vmatrix}$ $(x_n) = \frac{1}{x_3 - x_0}\begin{vmatrix} y_0 & x_0 - x_n \\ y_3 & x_3 - x_n \end{vmatrix}$ $p_{013}(x) = \frac{1}{x_3 - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{03} & x_3 - x_n \end{vmatrix}$ $p_{0123}(x_n) = \frac{1}{x_3 - x_2}\begin{vmatrix} p_{02} & x_2 - x_n \\ p_{03} & x_3 - x_n \end{vmatrix}$	$5 - x_n$

$$p_{01}(x_n) = \frac{1}{2-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 57.35 & 2 - x_n \end{vmatrix} = \frac{1}{2-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 57.35 & 2 - x_n \end{vmatrix}$$

$$= 66.3(2 - x_n) - 57.35(1 - x_n) =$$

$$p_{01}(x_n) = (132.6 - 66.3x_n) - (57.35 - 57.35x_n) = 57.35x_n - 66.3x_n - 57.35 + 132.6$$

$$p_{01}(x_n) = -8.95x_n + 75.25$$

$$p_{02}(x_n) =$$

$$\frac{1}{4-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 43.9 & 4 - x_n \end{vmatrix} = \frac{1}{2}\begin{vmatrix} 66.3 & 1 - x_n \\ 43.9 & 4 - x_n \end{vmatrix} = \frac{1}{3}[66.3(4 - x_n) - 43.9(1 - x_n)] =$$

$$p_{02}(x_n) = \frac{1}{3}[43.9x_n - 66.3x_n - 43.9 + 265.2] = \frac{1}{3}[-22.4x_n + 221.3]$$

$$p_{02}(x_n) = -7.4667x_n + 73.767$$

$$p_{012}(x_n) = \frac{1}{4-2}\begin{vmatrix} p_{01} & 2 - x_n \\ p_{02} & 4 - x_n \end{vmatrix} = \frac{1}{2}\begin{vmatrix} -8.95x_n + 75.25 & 2 - x_n \\ -7.4667x_n + 73.767 & 4 - x_n \end{vmatrix}$$

$$p_{012}(x_n) = \frac{1}{2}(-8.95x_n + 75.25)(4 - x_n) - (-7.4667x_n + 73.767)(2 - x_n)$$

$$p_{012}(x_n) = \frac{1}{2}[$$

$$8.95x_n^2 - 7.466x_n^2 - 35.8x_n - 75.25x_n + 14.9334x_n + 73.767x_n + 301 - 147.534]$$

$$p_{012}(x_n) = \frac{1}{2}[1.484x_n^2 - 22.357x_n + 153.466] = 0.742x_n^2 - 11.1785x_n + 153.466]$$

$$p_{03}(x_n) = \frac{1}{5-1}\begin{vmatrix} 66.3 & 1 - x_n \\ 7.5 & 5 - x_n \end{vmatrix} = \frac{1}{4}[66.3(5 - x_n) - 7.5(1 - x_n)]$$

$$p_{03}(x_n) = \frac{1}{4}[(331.5 - 66.3x_n) - (7.5 - 7.5x_n)] = \frac{1}{4}[331.5 - 7.5 - 66.3x_n + 7.5x_n]$$

$$p_{03}(x_n) = \frac{1}{4}[324 - 58.8x_n] = 81 - 14.7x_n$$

$$p_{013}(x) = \frac{1}{x_3 - x_1}\begin{vmatrix} p_{01} & x_1 - x_n \\ p_{03} & x_3 - x_n \end{vmatrix} = \frac{1}{5-1}\begin{vmatrix} -8.95x_n + 75.25 & 1 - x_n \\ 81 - 14.7x_n & 5 - x_n \end{vmatrix}$$

$$p_{013}(x) = \frac{1}{4}\,[(-8.95x_n\ +\ 75.25)(5-x_n)] - [(81-14.7x_n)(1-x_n)]$$
$$p_{013}(x) = \frac{1}{4}\,[(-8.95x_n^2 - 44.75x_n\ +\ 75.25x_n + 376.25)] - [(14.7x_n^2 - 81x_n - 14.7x_n + 81)]$$
$$p_{013}(x) = \frac{1}{4}\,[-8.95x_n^2 - 14.7x_n^2 - 44.75x_n + 14.7x_n\ +\ 75.25x_n + 81x_n + 376.25 - 81]$$
$$p_{013}(x) = \frac{1}{4}\,[-23.65x_n^2 + 126.2x_n + 295.25]$$
$$p_{013}(x) = -5.9125x_n^2 + 31.55x_n + 73.8125$$
$$p_{0123}(x_n) = \frac{1}{5-4}\begin{vmatrix} p_{012} & 4-x_n \\ p_{013} & 5-x_n \end{vmatrix} =$$
$$\frac{1}{5-4}\begin{vmatrix} 0.742x_n^2 - 11.1785x_n + 153.466 & 4-x_n \\ -5.9125x_n^2 + 31.55x_n + 73.8125 & 5-x_n \end{vmatrix}$$
$$p_{0123}(x_n) = (0.742x_n^2 - 11.1785x_n + 153.466)(5-x_n) - (-5.9125x_n^2 + 31.55x_n + 73.8125)(4-x_n) =$$
$$y_n = p_{0123}(x_n) \quad = (-0.742x_n^3 + 3.71x_n^2 + 11.1785x_n^2\ - 55.8925\,x_n - 153.466x_n + 767.33) - (5.9125x_n^3 - 23.65x_n^2 + 31.55x_n^2 - 31.55x_n^2 - 126.2x_n - 73.8125x_n + 295.25)$$
$$y_n = -0.742x_n^3 - 5.9125x_n^3 + 3.71x_n^2 + 11.1785x_n^2\ + 31.55x_n^2 - 23.65x_n^2 - 55.8925\,x_n - 153.466x_n + 126.2x_n + 73.8125x_n + 767.33 \mp$$

y_n =-6.6545x_n^3 +22.7885x_n^2 $-$ 9.346x_n + 472.08 Model by Aitkens's Interpolation Formula for (surgery with chemotherapy) treatment for Lung cancer in Kurdistan

7.6 Statistical Model Fitting

To emphasize the statistical model fitting we take two kinds of statistically analysis for both treatments as follows:

7.6.1 Pseudo R-Square (surgery treatment)

Table (10) Cox and Snell R-Square

Cox and Snell	0.889

Table (10) Shows Cox and Snell R-Square in (surgery treatment) equal (0.889.) it refers to the proportion of variance in the dependent variable that can be explained by the independent variable. with (0.889.) it is good ratio

7.6.2 Model Fitting Criteria (surgery treatment)

Table (11) Model Fitting Criteria (surgery treatment)

	Model Fitting scales	Likelihood Ratio Tests		
Effect	-2 Log Likelihood	Chi-Square test	d.f	p- value
Intercept	4.887	4.887	2	0.067
Final model	6.592	6.592	2	0.037

Table (11) shows Interpretation of the model information the Likelihood Ratio equal -2(Log Likelihood). and. represents unexplained variable tests for Intercept Only for (surgery treatment) equal (4.887),$\chi^2_{(2)}$= 6.592, has [P-value =.037< 0.05], indicating a good model fit

7.6.3 Model Fitting Information Analysis Surgery with Chemotherapy treatment for Lung cancer in Kurdistan

Table (12) Cox and Snell R-Square Surgery with Chemotherapy

Cox and Snell	0.960

Table (12) shows Cox and Snell Pseudo R-Square for Surgery with Chemotherapy treatment equal (0.960,.) it refers to the explaining with (0.960) it is best ratio .

7.6.4. Model Fitting Information for Surgery with Chemotherapy treatment

Table (13) Model Fitting Information Surgery with Chemotherapy treatment

Effect	Model Fitting scale	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square test	d. f	P- value.
Intercept	15.662	15.662	4	.004
Y	16.094	16.094	4	.003

Table (13) Interpretation of the Model Fit information the likelihood ratio shows tests for Intercept Only for Surgery with Chemotherapy treatment is (15.662) and for final model is (16.094) it is significant $\chi^2_{(4)}$= 16.094, has [P-value =..003< 0.05], greater , which proves a good fit of model.

8.1 Conclusion

1-The data in this table are taken from the records of several lung cancer specialists and show the percentage of success of both methods in patients with the disease
2-The field of applied mathematics, especially Numerical analysis by two methods [Stirling equally spaced of explanatory variable values and Aitken's not equally spaced of explanatory variable] spaced
3- Lung cancer has five stages of treatment. Stage 1, 2 and 3 only require surgery, but the worst are stages 4 and 5 (surgery with chemotherapy treatment).
4-The researchers formulated the model by Stirling and Aitken interpolation methods to determine the preferred treatment using surgical treatment and Surgery with Chemotherapy treatment for Lung cancer in Kurdistan.
5- For the Surgery treatment by both methods (Stirling and Aitken interpolation) interpolation the result were equations with second degrees
6- For the (Surgery with chemotherapy treatment). by (Aitken interpolation) method the result was the equation with third degree
7-For the (Surgery with chemotherapy treatment). by (Stirling interpolation) method the result was the equation with fourth degree
8- The above results emphasize that the treatment by Surgery with chemotherapy is very useful compared to using Surgery treatment in Kurdistan, and the (Stirling interpolation) method the
is more suitable than Aitken Interpolation Formula for bio statistical and clinical analyses.
9-by Cox and Snell R-Square analysis in both treatments refer to good ratio and in the statistical analysis, the model fitting criteria in both analyzes the p-values emphasize the best fit of the models indicates perfect prediction. Improvement.

8.2 Recommendations

1- Since this paper proved that the using of Stirling interpolation method is more suitable than Aitken Interpolation Formula for bio statistical and clinical analyses, the researchers recommend to use this analysis for every type of clinical data.

2- The researchers recommend to use practical mathematics in every research field.

References

-Anita Pal (2017) Numerical Analysis. Aitken's and Hermite's Interpolation Methods Department of Mathematics National Institute of Technology Durgapur Durgapur-713209 august 2017

-BARZNJI, N. S, (2018). Using Logistic Regression Analysis and Linear Discriminate Analysis to identify the risk factors of diabetes, Vol.22, No.6, (pp 248-268), ID No.2115).

-Collins LG, Haines C, Perkel R, Enck RE (2007). "Lung cancer: diagnosis and management". American Family Physician. 75 (1):56–63

-David Kincaid and Ward Cheney,"(2002) Numerical Analysis - Mathematics of Scientific Computing", American Mathematical Society, Providence, Rhode Island

-Endre S¨uli and David F. Mayers (2003) "An Introduction to Numerical Analysis"
2003Published in the United States of America by Cambridge University Press, New Yorkwww.cambridge.org

- Goldstein SD, Yang SC (2011). "Role of surgery in small cell lung cancer". Surgical Oncology Clinics of North America. 20 (4): 769–. doi:10.1016/j.soc.2011.08.001. PMID 21986271

-Hecht SS (2012). "Lung carcinogenesis by tobacco smoke". International Journal of Cancer. 131 (12):2724-32. doi:10.1002/ijc.27816. PMC 3479369. PMID 22945513

-Humpherys, Jeffrey; Jarvis, Tyler J. (2020). "9.2 - Interpolation". *Foundations of Applied Mathematics Volume 2: Algorithms, Approximation, Optimization*. Society for Industrial and Applied Mathematics. p. 418. ISBN 978-1-611976-05-2.

-Islam, S., Y. Khan, N. Faraz and F. Austin, 2010. "Interpolation and approximation, Numerical solution of logistic differential equations "Second edition, Dover, New York, NY, 1975. by using the Laplace decomposition method, World Appl. Sci. J., 8: 1100-1105.

-Kahaner, David, Cleve Moler, and Stephen Nash.(1989) Numerical Methods and Software. Englewood Cliffs, NJ: Prentice Hall.

-Karl, L. W. and P (2016), Binary Logistic Regression with SPSS, published in the Journal of Social Behavior and Personality, 13, P.P139-150.

-Kendall E. Atkinson, (2012) "An Introduction to Numerical Analysis", Wiley India.

-Kumar, Rakesh (2020) “Interpolation” (Deptt. Of Mathematics), P.G.G.C.G, Sec-11, Chandigarh.

-Meijering, Erik(2002). “A Chronology of Interpolation: From Ancient Astronomy to Modern Signal and Image Processing.” Proceedings of the IEEE. vol. 90, no. 3, pp. 319-42. March

-Menard, S. (2022). Applied Logistic Regression Analysis. SAGE. p. 91.

-Mertler, C.A., & Vannatta, R.A. (2015). Advanced and multivariate statistical methods: practical application and interpretation (3rd. edition). Glendale, CA: Pyrczak Publishing

-Milne-Thomson, Louis Melville (2000). "The Calculus of Finite Differences" AMS Chelsea Publishing. pp. 67–68. ISBN 9780821821077.

-Miller AB, Fox W, Tall R (2019). "Five-year follow-up of the Medical Research Council comparative trial of surgery and radiotherapy for the primary treatment of small-celled or oat-celled carcinoma of the bronchus". Lancet. 2 (7619): 501–5. doi:10.1016/S0140-6736(69)90212-8. PMID 4184834

-Pal. Dr. Anita (2007)” Numerical Analysis” Department of Mathematics National Institute of Technology Durgapur Durgapur-713209 email: anita.buie@gmail.com

-Pletzer, Alexander; Hayek, Wolfgang (2019-01-01). "Mimetic Interpolation of Vector Fields on Arakawa C/D Grids". *Monthly Weather Review*. **147** (1): 3–16. Bibcode:2019MWRv..147....3P. doi:10.1175/MWR-D-18-0146.1. ISSN 1520-0493. S2CID 125214770.

-P.J. Davis, (1975) "Interpolation and approximation" , Dover, reprint pp. 108–F.B.

-P. Sam Johnson (2020) Newton’s Interpolation Methods"(NITK) February 7, 2020 .1 / 47

-Richard L. Burden and J. Douglas Faires (2015)," Numerical Analysis - Theory and Applications", Cengage Learning, Singapore.

-Robbins, Herbert (1955), "A Remark on Stirling's Formula", *The American Mathematical Monthly*, **62** (1):26–29, doi:10.2307/2308012, JSTOR 2308012

- Romik, Dan (2000), "Stirling's approximation for : the ultimate short proof?", The American Mathematical Monthly, **107** (6): 556–557, doi:10.2307/2589351, JSTOR 2589351, MR 1767064

-Steffensen, J. F. (2006). *Interpolation* (Second ed.). Mineola, N.Y. ISBN 978-0-486-15483-1. OCLC 867770894

-Whittaker, E. T. & Watson, G. N. (1996), A Course in Modern Analysis (4th ed.), Newwork

هەڵسەنگاندن بە پێوەرەکانی جێگیرکردنی مۆدێل و بەراوردکردنی نێوان فۆرمیولەکانی ئینتەرپۆلەیشنی ستێرلینگ و ئایتکن بۆ دیاریکردنی چارەسەری پەسەندکراو بۆ هەڵبژاردنی ،(نەشتەرگەری) یان (نەشتەرگەری و چارەسەری کیمیایی)بۆ شێرپەنجەی سییەکان لە کوردستان

نەزیرە سەدیق بەرزنجی
بەشی ئامار و زانیاری، کۆلێژی کارگێری و ئابووری ،زانکۆی سەلاحەدین – هەولێر
nazeera.kareem@su.edu.krd

دوعا فایز عەبدوڵڵا
بەشی ئامار و زانیاری، کۆلێژی کارگێری و ئابووری ،زانکۆی سەلاحەدین – هەولێر
duaa.abdullah@su.edu.krd

ڕێزان سدیق کەریم
زانکۆی پۆلیتەکنیکی – سلێمانی /بەشی بیرکاری
rezan.barznji@gmail.com

بێخاڵ سەمەد سدیق
بەشی ئامار و زانیاری، کۆلێژی کارگێری و ئابووری ،زانکۆی سەلاحەدین – هەولێر
bikhal.sedeeq@su.edu.krd

پوختە

شیکاری ژمارەیی لقێکی زانستی بیرکارییە؛ ئینتەرپۆلاسیۆن شێوازێکە لە شیکاری ژمارەییدا کە بۆ دروستکردنی مۆدێلێک بۆ کۆمەڵێک خاڵە داتا جیاکراوەکان بەکاردێت. ئەم توێژینەوەیە تیشکی خستە سەر دوو شێوازی ئینتەرپۆلاسیۆن [ستیرلینگ و ئایتکن] لە شیکاری ژمارەییدا دەتوانێت بیرکاری کارپێکراو بەکاربهێنێت، بۆ دەستنیشانکردنی مۆدێلی بیرکاری کە مۆدێلی ئاماری بایۆیە ئاماژەیە بۆ هاوکێشەکە سەبارەت بە کاریگەری باشترین جۆری چارەسەرکردن بۆ شێرپەنجەی سییەکان، کە شێرپەنجەی سییەکان نەخۆشییەکی مەترسیدارە یان لە سییەکان دەست پێدەکات پاشان درێژدەبێتەوە بۆ سیستەمی لیمفاوی یان لە شێرپەنجەی بەشەکەی تری جەستەوە بۆ سییەکان.بۆ دیاریکردنی چارەسەری پەسەندکراوی شێرپەنجەی سییەکان، بە نەشتەرگەری، یان نەشتەرگەری بە چارەسەری کیمیایی. بۆ ئەم شیکارییە داتای بەدەست هاتوو لە پزیشکی پسپۆر لە شێرپەنجەی سییەکان لە ڕێگەی ڕێژەی سەدی سەرکەوتنی چارەسەرکردن ، و بە [فۆرمۆلە ئینتەرپۆلاسیۆنی ستێرلینگ و ئایتکن] ئێمە فۆرمولەمان کرد، سەرەتا دوو(هاوکێشە) یان مۆدێل بۆ (نەشتەرگەری لەگەڵ چارەسەری کیمیایی) لەگەڵ چوارەم و سێیەم پلە ، و دووەم، دوو هاوکێشەی دیکە بۆ (چارەسەرەکانی نەشتەرگەری) لەگەڵ پلەی دووەم ، ئەمە پشتڕاستی دەکاتەوە کە نەشتەرگەری بە چارەسەری کیمیایی چارەسەری پەسەندکراوە بۆ نەخۆشانی شێرپەنجەی سییەکان، و لەبەر ئەوەی هاوکێشەی ئینتەرپۆلاسیۆنی ستێرلینگ لە پلەی چوارەمدا جەخت لەوە دەکەنەوە کە گونجاوترین فۆرمولەیە بۆ شیکارییە بایۆ-ئامارییەکان.

وشەی سەرەتاییەکان: فۆرمیولەی ئینتەرپۆلەیشنی ستێرلینگ و فۆرمۆلەی ئینتەرپۆلەیشنی ئایتکن، چارەسەرەکان (نەشتەرگەری) یان (نەشتەرگەری بە چارەسەری کیمیایی) ، پێوەرەکانی جێگیرکردنی مۆدێل.

التقييم من خلال معايير ملائمة النموذج والمقارنة بين صيغ الاستيفاء Stirling وAitken لتحديد العلاج المفضل للاختيار، (الجراحة) أو (الجراحة مع العلاج الكيميائي)لسرطان الرئة في كردستان

نظيرة صديق البرزنجي
قسم الاحصاء والمعلوماتية،كلية الإدارة والاقتصاد،جامعة صلاح الدين – اربيل
nazeera.kareem@su.edu.krd

دعاء فايز عبدالله
قسم الاحصاء والمعلوماتية،كلية الإدارة والاقتصاد،جامعة صلاح الدين – اربيل
duaa.abdullah@su.edu.krd

ريزان صديق كريم
جامعة البولي تكنك – السليمانية / قسم الرياضيات
rezan.barznji@gmail.com

بيخال صمد صديق
قسم الاحصاء والمعلوماتية،كلية الإدارة والاقتصاد،جامعة صلاح الدين – اربيل
bikhal.sedeeq@su.edu.krd

ملخص

لتحليل العددي هو فرع من فروع العلوم الرياضية؛ الاستيفاء هو أسلوب في التحليل العددي يستخدم لإنشاء نموذج لمجموعة من نقاط البيانات المنفصلة. ركز هذا البحث على طريقتي الاستكمال [ستيرلينغ وآيتكين] في التحليل العددي ويمكن استخدام الرياضيات التطبيقية، للتعرف على النموذج الرياضي وهو نموذج إحصائي حيوي يشير إلى المعادلة حول تأثير أفضل نوع علاج لسرطان الرئة، حيث أن سرطان الرئة هو مرض خطير إما أن يبدأ في الرئتين ثم يمتد إلى الجهاز اللمفاوي أو من السرطان في الجزء الآخر من الجسم إلى الرئة. لتحديد العلاج المفضل لسرطان الرئة، عن طريق الجراحة، أو الجراحة مع العلاج الكيميائي. لهذا التحليل تم الحصول على البيانات من الطبيب المتخصص في سرطان الرئة من خلال نسب نجاح العلاج، ومن خلال [صيغة الاستيفاء ستيرلينغ وآيتكين] قمنا بصياغة أول معادلتين أو نموذجين لـ (الجراحة مع العلاج الكيميائي) مع الرابع والثالث وثانياً، معادلتان أخريان لـ (العلاجات الجراحية) من الدرجة الثانية، وهذا يؤكد أن الجراحة مع العلاج الكيميائي هي العلاج المفضل لمرضى سرطان الرئة، وبما أن معادلة استيفاء الاستيفاء في الدرجة الرابعة تؤكد أنها الصيغة الأنسب لـ التحليلات الإحصائية الحيوية.

الكلمات المفتاحية: [صيغة استيفاء ستيرلينغ وصيغة استيفاء آيتكين]، علاجات (الجراحة) أو (الجراحة مع العلاج الكيميائي)، معايير النموذج النموذجي