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Estimating Marriage and Divorces and Comparing Them Using Numerical Method

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ABSTRACT

In this paper, we describe the cases of marriage and divorce in the city of Baghdad on both sides of Rusafa and Karkh, we collected the data in this research from the Supreme Judicial Council and used the cubic spline interpolation method to estimate the function that passing through given points as well as the extrapolation method which was applied for estimating the cases of marriage and divorce for the next year and comparison between Rusafa and Karkh by using the MATLAB program.

1. Introduction

The husband is the social bond that contributes to the formation of the family, which is the basic nucleus in building society, [1]. While the divorce leads to the demolition of the family and its dire consequences for women, family members and society as a whole. The marriage is the nucleus of family formation and gives Islam great importance to marriage and regarded it as a thick charter that strengthens the bonds of society, [2].

There are many reasons that lead to family disintegration and thus to divorce include the poor choice and coercion between the parties and incompetence, and the financial situation, and the incompatibility between the parties, early marriage and lack of consideration of the wife to her husband or vice versa and negligence of the parties towards the other and there are other reasons for divorce cases such as games Electronic and social media such as the Internet,

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television and other reasons that lead to family disintegration. In this paper we estimate for the next year the cases of marriage and divorce and comparison between Rusafa and Karkh after we presenting the data for marriages and divorces of the city of Baghdad for the years from 2012 to 2018 and analysis these data.

2. The Data

Collected data for the cases of marriage and divorce of the city of Baghdad as the center of Iraq for the years from 2012 to 2018 from the Supreme Judicial Council, and the data were divided into Rusafa and Karkh for different courts, explaining the cases of marriage and divorce as showing in the table (1).

Table (1)
Marriages and divorces of the city of Baghdad for Rusafa and Karkh

Years		2012	2013	2014	2015	2016	2017	2018
Rusafa	Marriages	28795	30269	33325	30722	35596	35730	37690
	Divorces	12194	14126	13556	16844	12877	13962	16724
Karkh	Marriages	25696	25186	21336	35096	26352	26811	21300
	Divorces	10176	7644	9620	12136	10850	12310	13304

3. Analysis data

From table (1) we note the following:

(1) The rates of marriage in the Rusafa area increased over the years (2012-2018). The total number of marriages reached 28795 cases in 2012 and 37690 cases in 2018, which increased the number of marriages by 8895 cases.

(2) The number of divorces recorded in the Rusafa Courts was increasing. In 2012, the total number of divorces was 12194 cases and became 16724 cases in 2018, an increase of 4530 cases.

(3) The rate of marriages was 2763 cases per month and 92 cases per day, which is equivalent to every 16 minutes one marriage.

(4) The rate of divorces per month was 1028 cases per month and per day divorce rates were 34 cases per day or every 43 minutes there is one divorce case.

4. The comparison by numerical method

4.1 Polynomial functio

We have a set of data for marriages (M) and divorces (D) in years (Y)

Y_1	Y_2	Y_3	…	Y_7
M_1	M_2	M_3	…	M_7
D_1	D_2	D_3	…	D_7

To find the function passing through the data for $(Y_i, f(Y_i) = M_i)$ for marriage and the function passing through the data $(Y_i, f(Y_i) = D_i)$ for divorces $\forall$ i =1, 2, 3, ..., 7 we use the fundamental theorem of algebra.

For the point $(x_i, f(x_i)), i = 1, 2, \dots, n$ there is a unique polynomial passing through the given point.

4.2. Applied Data in MATLAB

The Cubic splines interpolation is an important common method to define smooth curve passing through the data, we applied this method to find the polynomials.

From the data of table (1) we get four interpolating polynomials the first polynomial for marriages and the second polynomial for divorces in Rusafa, see figures (1) and (3), while third polynomial for marriages and the fourth polynomial for divorces in Karkh, see From the data of table (1) we get four interpolating polynomials the first polynomial for marriages and the second polynomial for divorces in Rusafa, see figures (1) and (3), while third polynomial for marriages and the fourth polynomial for divorces in Karkh, see the figures (2) and (4).

Figure (5) and (6) illustrate the compared between marriages and divorces in Rusafa and Karkh.

We consider the (Y_i, M_j) are given as:

$Y_i\, ; i = 0,1,2, \dots, 6$ and $M_j\, ;\, j = 0,1,2, \dots, 6$

There are $n - 1 = 6$ intervals. Each interval has its own cubic spline function $S_i(Y)$ for each interval between knots and it is represented generally by:

$$S_i(Y) = a_i + b_i\left(Y - Y_i\right) + c_i\left(Y - Y_i\right)^2 + d_i\left(Y - Y_i\right)^3, Y_i \le Y \le Y_{i+1}, i = 0, 1, \dots, 6 \qquad \dots(2)$$

This simplifies to

$$a_i = f\left(Y_i\right) = M_i \qquad \dots(3)$$

We determined the following conditions in [3], [4], [5] and [6]:

1. $S(y)$ must interpolate the data points and so in each subinterval $i = 0, \cdots, n - 1$, we must have $S_i(t_i) = y_i$ and $S_i(t_{i+1}) = y_{i+1}$.
2. $S'(y)$ must be continuous at each of the internal knots. Therefore for $i = 1, 2, \cdots, n - 1$ we must have $S'_{i-1}(t_i) = S'_i(t_i)$.
3. $S''(y)$ must be continuous at each of the internal knots. Therefore for $i = 1, 2, \cdots, n - 1$ we must have $S''_{i-1}(t_i) = S''_i(t_i)$.

When we applied the above conditions that each of the cubic spline function must join at the knots. For $n - 1$ knot, this can be represented as

$$M_i + b_i h_i + c_i h_i^2 + d_i h_i^3 = M_{i+1}\ ,\ h_i = Y_{i+1} - Y_i \qquad \dots(4)$$

To find the values of b_i, c_i, d_i, we derive equation (2) first and second derivatives at the interior nodes, $i + 1$ can therefore be written as

$$S_i'(Y) = b_i + 2c_i\left(Y - Y_i\right) + 3d_i\left(Y - Y_i\right)^2 \qquad \dots(5)$$

$$b_i + 2c_i h_i + 3d_i h_i^2 = b_{i+1} \qquad \dots(6)$$

And the second derivatives

$$S_i''(Y) = 2c_i + 6d_i\left(Y - Y_i\right) \qquad ...(7)$$

$$c_i + 3d_i h_i = c_{i+1} \qquad ...(8)$$

From equation above, we can find the value of d_i as

$$d_i = \frac{c_{i+1} - c_i}{3h_i} \qquad ...(9)$$

Now, substitute equation (9) in equation (4), we get

$$M_i + b_i h_i + \left(\frac{c_{i+1} + 2\,c_i}{3}\right)h_i^2 = M_{i+1} \qquad ...(10)$$

And substitute equation (9) in equation (6), we get

$$b_i + (c_{i+1} + c_i)h_i = b_{i+1} \qquad ...(11)$$

We solved equation (10) to find b_i

$$b_i = \frac{M_{i+1} - M_i}{h_i} - \left(\frac{c_{i+1} + 2\,c_i}{3}\right)h_i \qquad ...(12)$$

The index of equation (12) and equation (11) can be reduced by 1

$$b_{i-1} = \frac{M_i - M_{i-1}}{h_{i-1}} - \left(\frac{c_i + 2\,c_{i-1}}{3}\right)h_{i-1} \qquad ...(13)$$

$$b_{i-1} + (c_i + c_{i-1})h_{i-1} = b_i \qquad ...(14)$$

Substitute equations (12) and (13) in equation (14), we get

$$\frac{M_i - M_{i-1}}{h_{i-1}} - \left(\frac{c_i + 2\,c_{i-1}}{3}\right)h_{i-1} + (c_i + c_{i-1})h_{i-1} = \frac{M_{i+1} - M_i}{h_i} - \left(\frac{c_{i+1} + 2\,c_i}{3}\right)h_i \qquad ...(15)$$

Simply

$$h_{i-1}\,c_{i-1} + 2\left(h_{i-1} - h_i\right)c_i + h_i\,c_{i+1} = 3\frac{M_{i+1} - M_i}{h_i} - 3\frac{M_i - M_{i-1}}{h_{i-1}} \qquad ...(16)$$

We put the first Newton divided difference in equation (16)

$$f\left[Y_i, Y_j\right] = \frac{M_i - M_j}{Y_i - Y_j}\quad h_{i-1}\,c_{i-1} + 2\left(h_{i-1} - h_i\right)c_i + h_i\,c_{i+1}$$
$$= 3f\left[Y_{i+1}, Y_i\right] - 3f\left[Y_i, Y_{i-1}\right] \qquad ...(17)$$

Equation (17) can be written for the interior knots, $i = 2, 3...n-2$, which result in $(n-3)$ simultaneous tridiagonal equations with $(n-1)$ unknown coefficient $c_1, c_2, ..., {}_nc_{-1}$. Using the boundary condition in to the second derivative at the first node in equation (7) can be set to zero

$$S_1''(Y_1) = 0 = 2c_1 + 6d_1(Y_1 - Y_1) \rightarrow c_1 = 0 \qquad ...(18)$$

The same evaluation was made at the last node

$$S_{n-1}''\left(Y_n\right) = 0 = 2c_{n-1} + 6d_{n-1}h_{n-1} \qquad ...(19)$$

Recalling equations (8) and (19) became

$$c_{n-1} + 3d_{n-1}h_{n-1} = c_n = 0 \qquad ...(20)$$

We can write equation (17) in a matrix form as

$$\begin{bmatrix} 1 & & & & \\ h_1 & 2\left(h_1 + h_2\right) & h_2 & & \\ \ddots & \ddots & \ddots & & \\ & h_{n-2} & 2\left(h_{n-2} + h_{n-1}\right) & h_{n-1} & \\ & & & 1 & \end{bmatrix} \cdot \begin{Bmatrix} c_1 \\ c_2 \\ \vdots \\ c_{n-1} \\ c_n \end{Bmatrix} = \begin{Bmatrix} 0 \\ 3\left(f\left[Y_3, Y_2\right] - f\left[Y_2, Y_1\right]\right) \\ \vdots \\ f3\left[Y_n, Y_{n-1}\right] - f3\left[Y_{n-1}, Y_{n-2}\right] \\ 0 \end{Bmatrix} \qquad ...(21)$$

From equation (20) we can now solve for cubic spline equations (9) and (12) and used them to determine the remaining coefficient b and d.
So we applied this method in MATLAB vol.18b, and that formula represents the marriages polynomial.

We used the same step in the data of divorces to compute the interpolation polynomial for divorces (D) the (Y_i, D_j). We also extrapolation the data to estimating a new value for year that lies outside the range of the known base data, $y_1, y_2, \ldots, y_7$. So we applied this in matlab to find *f* (2019) for marriages and *f* (2019) for divorces in Rusafa and the same step in Karkh, figure (1) for Rusafa and figure (2) for Karkh.

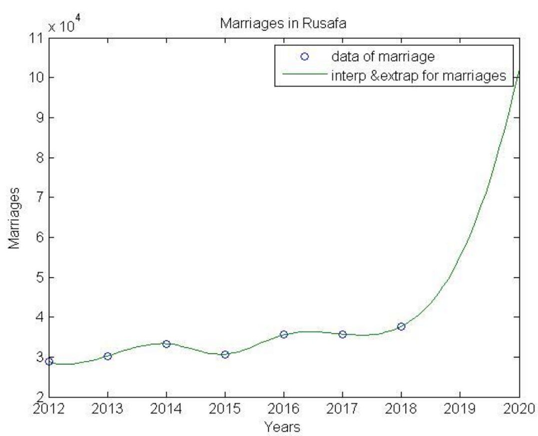

Figure (1)
The cubic spline interpolating polynomial for marriage in Rusafa

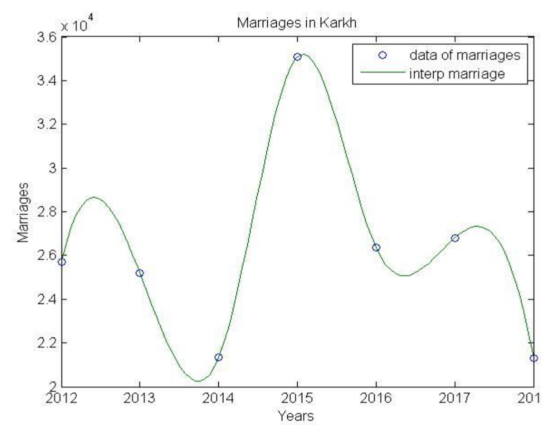

Figure (2)
The cubic spline interpolating polynomial for marriage in Karkh

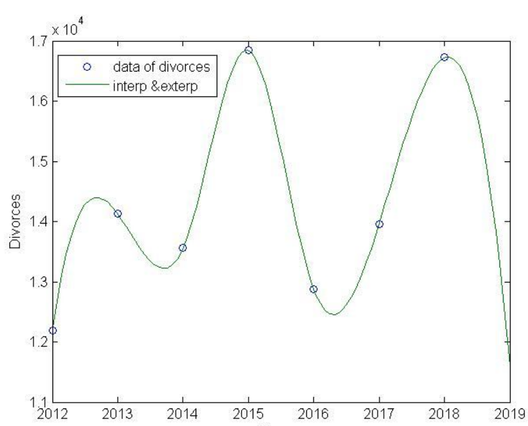

Figure (3)
The cubic spline interpolating polynomial for divorces in Rusafa

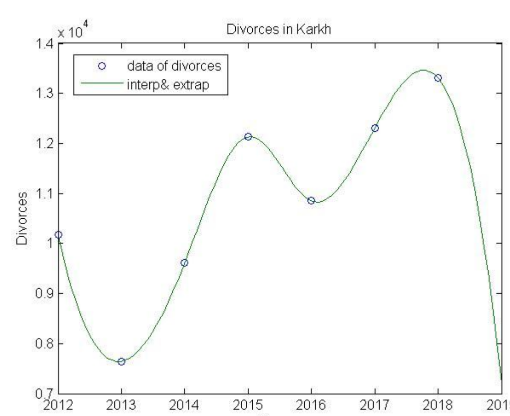

Figure (4)
The cubic spline interpolating polynomial for divorces in Karkh

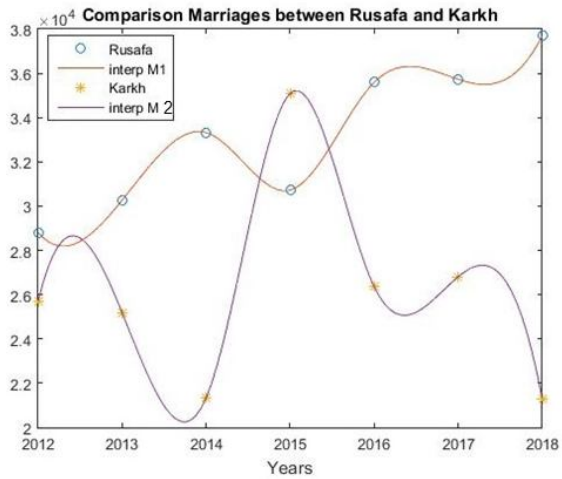

Figure (5)
The comparison of marriage cases between Rusafa and Karkh

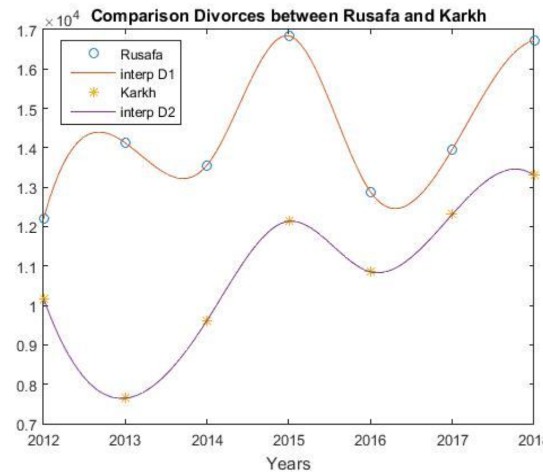

Figure (6)
The comparison of divorce cases between Rusafa and Karkh

5. Conclusion

Marriage and family formation are among the most important things that contribute to the formation of society.

From the data of our study we note that the number of marriages more than divorces was clarified using the numerical method cubic spline interpolation where this method is famous for finding smooth curves that pass points, and the application of data using matlab as well as extrapolation was used to know the cases of marriage and divorce in the coming year The error in this method is 0.01 for the real data, provided that the same conditions remain, ie, that none of the factors that change the status of marriage and divorce, such as wars and others.

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