LIFE EXPECTANCY IN ROMANIA

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In this research we can to observe the statistical modeling concerning the Life Expectancy in Romania, between 2000-2013, through by means of the „Least Squares Method". The Life Expectancy reflects the average duration of the life concerning a person in a certain country analysed. The Life Expectancy cans to be divided in Healthy Life Expectancy and Life Expectancy without chronic diseases.

Key words: Life Expectancy for men, Life Expectancy for women, Least Squares Method.

JEL Code: C1, C12, C2.

1. Introduction

This paper reflects a statistical analysis of the trends concerning the Life Expectancy in Romania, respectivelly the Life Expectancy for men and the Life Expectancy for women, between the years 2000-2013. The purpose of the research reflects the possibility for to anticipate the values concerning these indices by means of the forecasting methods. The statistical methods applied are the „Coefficients of Variation Method", the „Least Squares Method", used for to calculate the parameters of the regression equation and the Forecasting Method through the „Least Squares Method". The sections 2 presents the methodology for to achieve the trends models for the Life Expectancy, respectively the Life Expectancy for men and the Life Expectancy for women, in Romania, in the period 2000-2013, with the help of the „Least Squares Method". The section 3 expresses the forecasting method through the „Least Squares Method". The state of the art in this domain is represented by the research belongs to Carl Friederich Gauss, who created the „Least Squares Method" [1].

2. The modeling of the trends concerning the Life Expectancy, in Romania, respectivelly the Life Expectancy for men and the Life Expectancy for women, between 2000-2013.

In the period 2000-2013, we observe the next evolution concerning the Life Expectancyin Romania, according to the table no. 1:

Table no. 1 The Life Expectancy in Romania, between 2000-2013

YEARS	THE LIFE EXPECTANCY IN ROMANIA	THE LIFE EXPECTANCY FOR MEN	THE LIFE EXPECTANCY FOR WOMEN
2000	71,20	67,70	74,80
2001	71,10	67,50	74,90
2002	71,00	67,40	74,70
2003	71,40	67,90	75,10
2004	71,90	68,50	75,50
2005	72,30	68,90	75,70
2006	72,80	69,50	76,20
2007	73,30	69,90	76,90
2008	73,50	69,90	77,20
2009	73,60	69,90	77,40
2010	73,80	70,20	77,50
2011	74,60	71,10	78,20
2012	74,50	71,00	78,10
2013	74,45	70,99	78,13

The sourse: dates debated from „Romania in dates 2010, 2012, 2013", I.N.S.S.E., Bucharest

First, we want to identify the trend model for the **Life Expectancy**, in Romania, in the period 2000-2013, using the table no.1.

- if we formulate the null hypothesis H_0 *:* who mentions the assumption of the existence for the model of tendency of the factor *X = the Life Expectancy,* right the function $x_{t_i} = a + b \cdot t_i$, then the parametres *a* and *b* of the adjusted function of the premier degree, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot a = \sum_{i=-m}^{m} x_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot x_i \end{cases}$$

Therefore, $a = \dfrac{\sum_{i=-m}^{m} x_i}{n}$ and $b = \dfrac{\sum_{i=-m}^{m} t_i \cdot x_i}{\sum_{i=-m}^{m} t_i^2}$

Table no. 2 The estimate of the value for the variation coefficient in the case of the adjusted function of the premier degree, in the hypothesis concerning the linear evolution of the Life Expectancy, in Romania, between the years 2000-2013

YEARS	THE LIFE EXPECTANCY IN ROMANIA (x_i)	LINEAR TREND				
		t_i	t_i^2	$t_i x_i$	$x_{t_i} = a + bt_i$	$\lvert x_i - x_{t_i} \rvert$
2000	71,20	-7	49	-498,40	70,84910714	0,35
2001	71,10	-6	36	-426,60	71,13035714	0,03
2002	71,00	-5	25	-355,00	71,41160714	0,41
2003	71,40	-4	16	-285,60	71,69285714	0,29
2004	71,90	-3	9	-215,70	71,97410714	0,07
2005	72,30	-2	4	-144,60	72,25535714	0,04
2006	72,80	-1	1	-72,80	72,36607140	0,43
2007	73,30	1	1	73,30	73,09910714	0,20
2008	73,50	2	4	147,00	73,38035714	0,12
2009	73,60	3	9	220,80	73,66160714	0,06
2010	73,80	4	16	295,20	73,94285714	0,14
2011	74,60	5	25	373,00	74,22410714	0,38
2012	74,50	6	36	447,00	74,50535714	0,01
2013	74,45	7	49	521,15	74,78660714	0,34
TOTAL	1019,45	0	280	78,75	1019,44999999	2,87

If we calculate the statistical dates for to adjust the liniar function, we obtain for the parametres *a* and *b* the values:

$$a = \frac{1019{,}45}{14} = 72{,}81785714$$

$$b = \frac{78{,}75}{280} = 0{,}28125$$

Hence, the coeficient of variation for the adjusted function of the premier degree is:

$$v_I = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^I \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^I \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2{,}87}{1019{,}45} \cdot 100 = 0{,}28\%$$

- in the situation of the alternative hypothesis H_1 *:* who specifies the assumption of the existence for the model of tendency of the factor *X = the Life Expectancy*, right the parabolical function $x_{t_i} = a + b \cdot t_i + ct_i^2$, the parametres *a*, *b* şi *c* of the adjusted function of the second degree, can to be calculated by means of the system [1]:

$$\begin{cases} n \cdot a + c\sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} x_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot x_i \\ a \cdot \sum_{i=-m}^{m} t_i^2 + c\sum_{i=-m}^{m} t_i^4 = \sum_{i=-m}^{m} t_i^2 \cdot x_i \end{cases}$$

Consequently, $$a = \frac{\sum_{i=-m}^{m} t_i^4 \cdot \sum_{i=-m}^{m} x_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} t_i^2 \cdot x_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

$$b = \frac{\sum_{i=-m}^{m} t_i \cdot x_i}{\sum_{i=-m}^{m} t_i^2} \quad \text{and} \quad c = \frac{n \cdot \sum_{i=-m}^{m} t_i^2 \cdot x_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} x_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

Table no. 3 The estimates of the value for the variation coefficient in the case of the adjusted function of the second degree, in the hypothesis concerning the parabolic evolution of the Life Expectancy in Romania, between the years 2000-2013

YEARS	THE LIFE EXPECTANCY IN ROMANIA (x_i)	PARABOLIC TREND					
		t_i	t_i^2	t_i^4	$t_i^2 x_i$	$x_{t_i} = a + bt_i + ct_i^2$	$\lvert x_i - x_{t_i} \rvert$
2000	71,20	-7	49	2.401	3488,80	70,78302238	0,42
2001	71,10	-6	36	1.296	2559,60	71,09389658	0,01
2002	71,00	-5	25	625	1775,00	71,40021322	0,40
2003	71,40	-4	16	256	1142,40	71,70197228	0,30
2004	71,90	-3	9	81	647,10	71,99917378	0,10
2005	72,30	-2	4	16	289,20	72,29181770	0,01
2006	72,80	-1	1	1	72,80	72,57990406	0,22
2007	73,30	1	1	1	73,30	73,14240406	0,16
2008	73,50	2	4	16	294,00	73,41681770	0,08
2009	73,60	3	9	81	662,40	73,68667378	0,09
2010	73,80	4	16	256	1180,80	73,95197228	0,15
2011	74,60	5	25	625	1865,00	74,21271322	0,39
2012	74,50	6	36	1.296	2682,00	74,46919658	0,03
2013	74,45	7	49	2.401	3648,05	74,72052238	0,27
TOTAL	1019,45	0	280	9.352	20380,45	1019,4503	2,63

If we calculate the statistical dates for to adjust the second function, we obtain for the parametres *a, b* and *c* the next values:

$$a = \frac{9.352 \cdot 1019{,}45 - 280 \cdot 20380{,}45}{14 \cdot 9.352 - 78400} = 72{,}86343284$$

$$b = \frac{78,75}{280} = 0,28125$$

$$c = \frac{14 \cdot 20380,45 - 280 \cdot 1019,45}{14 \cdot 9.352 - 78.400} = -0,002278785$$

So, the coeficient of variation for the adjusted function of the second degree has the value:

$$v_{II} = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{II} \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{II} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2,63}{1019,45} \cdot 100 = 0,26\%$$

- in the case of the alternative hypothesis H_2 *:* who describes the supposition the assumption of the existence for the model of tendency of the factor *X = the Life Expectancy in Romania*, right the exponential function $x_{t_i} = ab^{t_i}$, then the parametres *a* and *b* of the adjusted exponential function, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot \lg a = \sum_{i=-m}^{m} \lg x_i \\ \lg b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot \lg x_i \end{cases}$$

Thus, $\lg a = \dfrac{\sum_{i=-m}^{m} \lg x_i}{n}$ and $\lg b = \dfrac{\sum_{i=-m}^{m} t_i \cdot \lg x_i}{\sum_{i=-m}^{m} t_i^2}$

Table no. 4 The estimate of the value for the variation coefficient in the case of the adjusted exponential function, in the hypothesis concerning the exponential evolution of the Life Expectancy in Romania, between 2000-2013

YEARS	THE LIFE EXPECTANCY IN ROMANIA (*x_i*)	EXPONENTIAL TREND					
		t_i	$\lg x_i$	$t_i \lg x_i$	$\lg x_{ti} = \lg a + t_i \lg b$	$x_{ti} = ab^{t_i}$	$\left\| x_i - x_{t_i} \right\|$
2000	71,20	-7	1,852479994	-12,96735996	1,850421579	70,86333362	0,34
2001	71,10	-6	1,851869601	-11,11121760	1,852100027	71,13773397	0,04
2002	71,00	-5	1,851258349	-9,256291744	1,853778475	71,41319686	0,41
2003	71,40	-4	1,853698212	-7,414792847	1,855456923	71,68972641	0,29
2004	71,90	-3	1,85672889	-5,570186671	1,857135371	71,96732675	0,07
2005	72,30	-2	1,859138297	-3,718276595	1,858813819	72,24600203	0,05
2006	72,80	-1	1,862131379	-1,862131379	1,860492267	72,52575641	0,27
2007	73,30	1	1,865103975	1,865103975	1,863849163	73,0885192	0,21
2008	73,50	2	1,866287339	3,732574678	1,865527611	73,37153601	0,13
2009	73,60	3	1,866877814	5,600633443	1,867206059	73,65564874	0,06
2010	73,80	4	1,868056362	7,472225447	1,868884507	73,94086162	0,14
2011	74,60	5	1,872738827	9,363694137	1,870562955	74,22717891	0,37
2012	74,50	6	1,872156273	11,23293764	1,872241403	74,5146049	0,01
2013	74,45	7	1,871864702	13,10305291	1,873919851	74,80314387	0,35
TOTAL	1019,45	0	26,07039001	0,469965434		1019,444569	2,74

Consequently, if we calculate the statistical dates for to adjust the exponential function, we obtain for the parametres *a* and *b* the values:

$$\lg a = \frac{26{,}07039001}{14} = 1{,}862170715$$

$$\lg b = \frac{0{,}469965434}{280} = 0{,}001678448$$

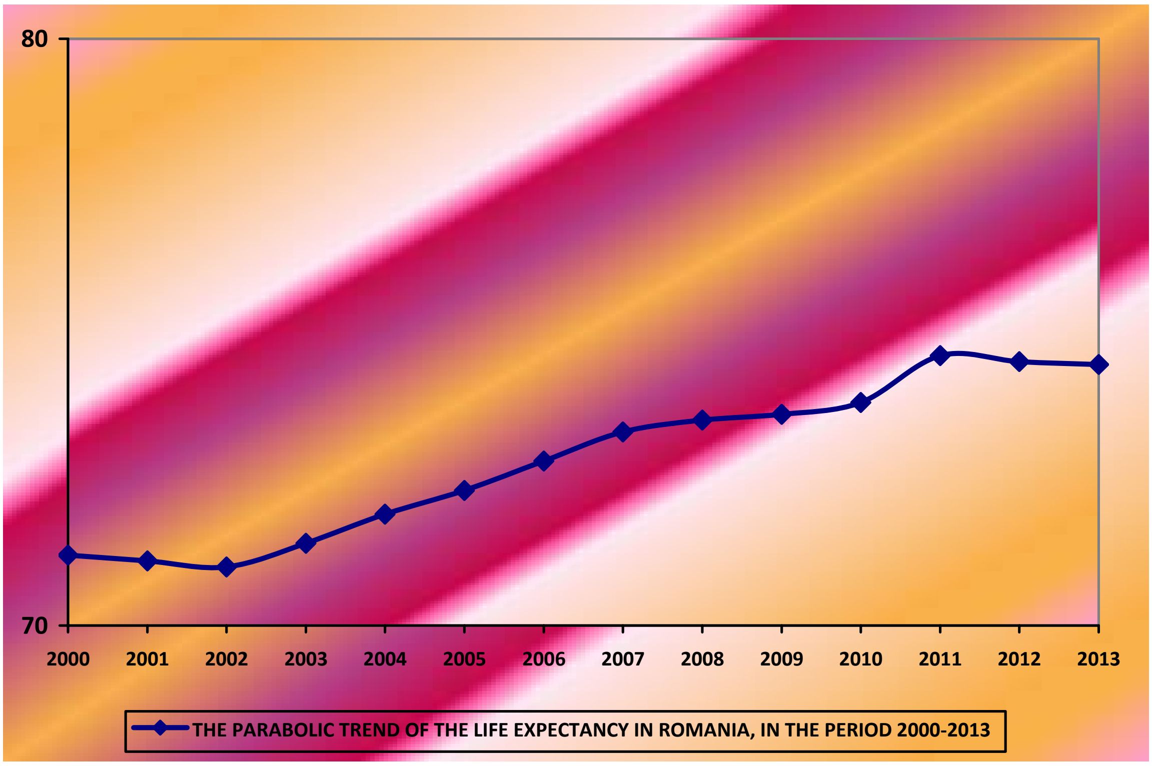
Accordingly, the coeficient of variation for the adjusted exponential function has the next value:

$$v_{exp} = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{exp} \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{exp} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2{,}74}{1019{,}45} \cdot 100 = 0{,}27\%$$

We apply the coefficients of variation method as criterion of selection for the best model of trend.
We notice that:

$$v_{II} = 0{,}26\% < v_{exp} = 0{,}27\% < v_I = 0{,}28\%$$

So, the road reflected by X factor, which represents the Life Expectancy in Romania, between 2000-2013, is a parabolic trend of the shape $x_{t_i} = a + bt_i + ct_i^2$, with other words it confirms the hypothesis H_1.



The type no. 1 The model of trend of the values for the Life Expectancy, in Romania, in the period 2000-2013

We observe that, the cloud of points which reflects the values of the Life Expectancy in Romania, between 2000-2013, it carrying around a parabolic model of trend, according to the type no.1.

- if we formulate the null hypothesis H_0^*: who mentions the assumption of the existence for the model of tendency of the factor *Y = the Life Expectancy for men,* right the function $y_{t_i} = a + b \cdot t_i$, then the parametres a and b of the adjusted function of the premier degree, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot a = \sum_{i=-m}^{m} y_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot y_i \end{cases}$$

Therefore, $a = \frac{\sum_{i=-m}^{m} y_i}{n}$ and $b = \frac{\sum_{i=-m}^{m} t_i \cdot y_i}{\sum_{i=-m}^{m} t_i^2}$

Table no. 5 The estimate of the value for the variation coefficient in the case of the adjusted function of the premier degree, in the hypothesis concerning the linear evolution of the Life expectancy for men in Romania, between the years 2000-2013

YEARS	THE LIFE EXPECTANCY FOR MEN IN ROMANIA (y_i)	LINEAR TREND				
		t_i	t_i^2	$t_i y_i$	$y_{t_i} = a + bt_i$	$\lvert y_i - y_{t_i} \rvert$
2000	67,70	-7	49	-473,90	67,35532143	0,34
2001	67,50	-6	36	-405,00	67,63507143	0,14
2002	67,40	-5	25	-337,00	67,91482143	0,52
2003	67,90	-4	16	-271,60	68,19457143	0,30
2004	68,50	-3	9	-205,50	68,47432143	0,03
2005	68,90	-2	4	-137,80	68,75407143	0,15
2006	69,50	-1	1	-69,50	69,03382143	0,47
2007	69,90	1	1	69,90	69,59332143	0,31
2008	69,90	2	4	139,80	69,87307143	0,03
2009	69,90	3	9	209,70	70,15282143	0,25
2010	70,20	4	16	280,80	70,43257143	0,23
2011	71,10	5	25	355,50	70,71232143	0,39
2012	71,00	6	36	426,00	70,99207143	0
2013	70,99	7	49	496,93	71,27182143	0,28
TOTAL	970,39	0	280	78,33	970,39	3,44

So, the parametres a and b have the next the values:

$$a = \frac{970{,}39}{14} = 69{,}31357143$$

$$b = \frac{78{,}33}{280} = 0{,}27975$$

Consequently, the coeficient of variation for the adjusted function of the premier degree is:

$$v_I = \left[\frac{\sum_{i=-m}^{m} \lvert y_i - y_{t_i}^I \rvert}{n} : \frac{\sum_{i=-m}^{m} y_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \lvert y_i - y_{t_i}^I \rvert}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{3{,}44}{970{,}39} \cdot 100 = 0{,}35\%$$

- in the situation of the alternative hypothesis H_1^* *:* who specifies the assumption of the existence for the model of tendency of the factor *Y = the Life Expectancy for men*, right the parabolical function $y_{t_i} = a + b \cdot t_i + ct_i^2$, the parametres *a*, *b* şi *c* of the adjusted function of the second degree, can to be calculated by means of the system [1]:

$$\begin{cases} n \cdot a + c\sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} y_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot y_i \\ a \cdot \sum_{i=-m}^{m} t_i^2 + c\sum_{i=-m}^{m} t_i^4 = \sum_{i=-m}^{m} t_i^2 \cdot y_i \end{cases}$$

Hence,
$$a = \frac{\sum_{i=-m}^{m} t_i^4 \cdot \sum_{i=-m}^{m} y_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} t_i^2 \cdot y_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

$$b = \frac{\sum_{i=-m}^{m} t_i \cdot y_i}{\sum_{i=-m}^{m} t_i^2}$$
and
$$c = \frac{n \cdot \sum_{i=-m}^{m} t_i^2 \cdot y_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} y_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

Table no. 6 The estimates of the value for the variation coefficient in the case of the adjusted function of the second degree, in the hypothesis concerning the parabolic evolution of the Life Expectancy for men in Romania, between the years 2000-2013

YEARS	THE LIFE EXPECTANCY FOR MEN IN ROMANIA (y_i)	PARABOLIC TREND					
		t_i	t_i^2	t_i^4	$t_i^2 y_i$	$y_{t_i} = a + bt_i + ct_i^2$	$\lvert y_i - y_{t_i} \rvert$
2000	67,70	-7	49	2.401	3317,30	67,24950856	0,45
2001	67,50	-6	36	1.296	2430,00	67,57669192	0,08
2002	67,40	-5	25	625	1685,00	67,89657784	0,50
2003	67,90	-4	16	256	1086,40	68,20916632	0,31
2004	68,50	-3	9	81	616,50	68,51445736	0,01
2005	68,90	-2	4	16	275,60	68,81245096	0,09
2006	69,50	-1	1	1	69,50	69,10314712	0,40
2007	69,90	1	1	1	69,90	69,38654584	0,51
2008	69,90	2	4	16	279,60	69,93145096	0,03
2009	69,90	3	9	81	629,10	70,19295736	0,29
2010	70,20	4	16	256	1123,20	70,44716632	0,25
2011	71,10	5	25	625	1777,50	70,69407784	0,41
2012	71,00	6	36	1.296	2556,00	70,93369192	0,07
2013	70,99	7	49	2.401	3478,51	71,16600856	0,18
TOTAL	970,39	0	280	9.352	19394,11	970,11389890	3,58

If we calculate the statistical dates for to adjust the second function, we obtain for the parametres *a, b* and *c* the next values:

$$\text{a} = \frac{9.352 \cdot 970{,}39 - 280 \cdot 19394{,}11}{14 \cdot 9.352 - 78.400} = 69{,}38654584$$

$$b = \frac{78{,}33}{280} = 0{,}27975$$

$$c = \frac{14 \cdot 19394{,}11 - 280 \cdot 970{,}39}{14 \cdot 9.352 - 78.400} = -0{,}00364872$$

So, the coeficient of variation for the adjusted function of the second degree has the value:

$$v_{II} = \left[\frac{\sum_{i=-m}^{m} \left| y_i - y_{t_i}^{II} \right|}{n} : \frac{\sum_{i=-m}^{m} y_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| y_i - y_{t_i}^{II} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{3{,}58}{970{,}39} \cdot 100 = 0{,}37\%$$

- in the case of the alternative hypothesis H_2^* : who describes the supposition the assumption of the existence for the model of tendency of the factor *Y = the Life Expectancy for men in Romania*, right the exponential function $x_{t_i} = ab^{t_i}$, then the parametres *a* and *b* of the adjusted exponential function, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot \lg a = \sum_{i=-m}^{m} \lg y_i \\ \lg b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot \lg y_i \end{cases}$$

Thus, $$\lg a = \frac{\sum_{i=-m}^{m} \lg y_i}{n} \quad \text{and} \quad \lg b = \frac{\sum_{i=-m}^{m} t_i \cdot \lg y_i}{\sum_{i=-m}^{m} t_i^2}$$

Table no. 7 The estimate of the value for the variation coefficient in the case of the adjusted exponential function, in the hypothesis concerning the exponential evolution of the Life Expectancy for men in Romania, between the years 2000-2013

YEARS	THE LIFE EXPECTANCY FOR MEN IN ROMANIA (y_i)	EXPONENTIAL TREND					
		t_i	$\lg y_i$	$t_i \lg y_i$	$\lg y_{ti} = \lg a + t_i \lg b$	$y_{ti} = ab^{t_i}$	$\left\| y_i - y_{t_i} \right\|$
2000	67,70	-7	1,830588669	-12,81412068	1,828461784	67,36926109	0,33
2001	67,50	-6	1,829303773	-10,97582264	1,830216330	67,64198285	0,14
2002	67,40	-5	1,828659897	-9,143299483	1,831970876	67,91580864	0,52
2003	67,90	-4	1,831869774	-7,327479097	1,833725422	68,19074292	0,29
2004	68,50	-3	1,835690571	-5,507071714	1,835479968	68,46679018	0,03
2005	68,90	-2	1,838219222	-3,676438444	1,837234514	68,74395492	0,16
2006	69,50	-1	1,841984805	-1,841984805	1,838989060	69,02224167	0,48
2007	69,90	1	1,844477176	1,844477176	1,842498152	69,58219938	0,32
2008	69,90	2	1,844477176	3,688954351	1,844252698	69,86387949	0,04
2009	69,90	3	1,844477176	5,533431527	1,846007244	70,14669987	0,25
2010	70,20	4	1,846337112	7,385348449	1,847761790	70,43066517	0,23
2011	71,10	5	1,851869601	9,259348004	1,849516336	70,71577999	0,38
2012	71,00	6	1,851258349	11,10755009	1,851270882	71,00204901	0
2013	70,99	7	1,851197176	12,95838023	1,853025428	71,28947690	0,30
TOTAL	970,39	0	25,77041048	0,491272967		970,381532	3,47

Consequently, if we calculate the statistical dates for to adjust the exponential function, we obtain for the parametres *a* and *b* the values:

$$\lg a = \frac{25{,}77041048}{14} = 1{,}840743606$$

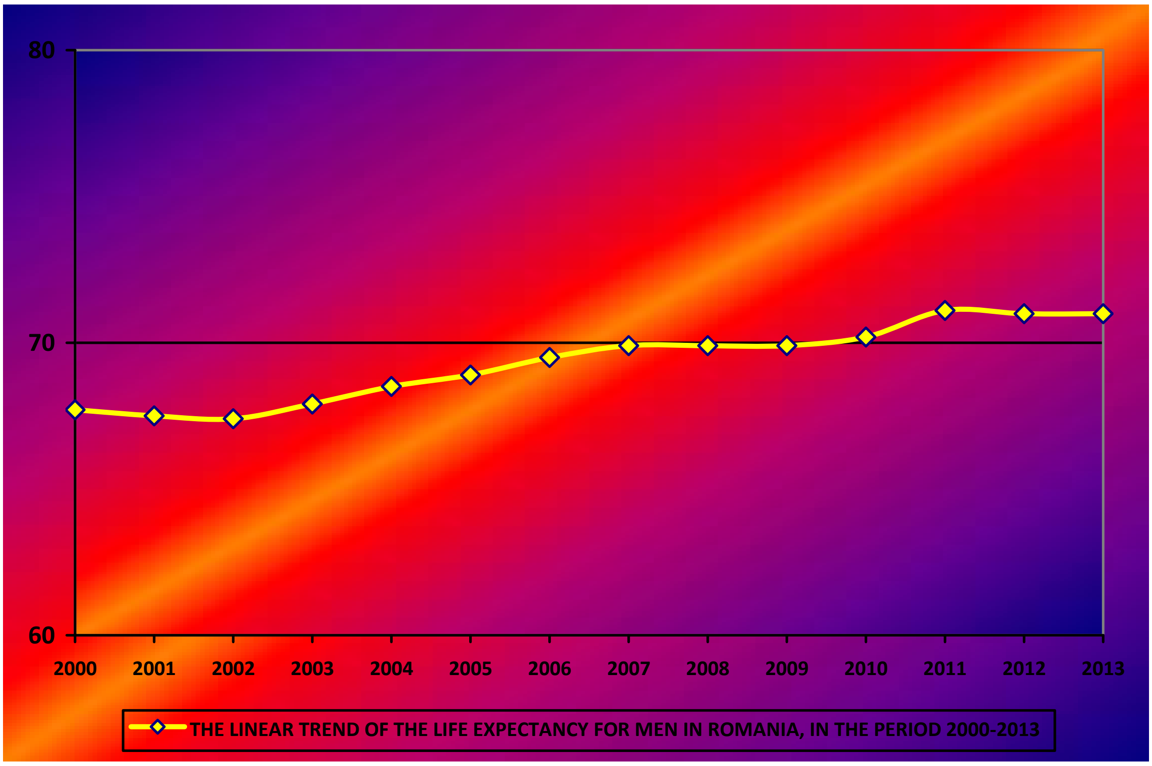
$$\lg b = \frac{0{,}491272967}{280} = 0{,}001754546$$

The coeficient of variation for the adjusted exponential function has the next value:

$$v_{exp} = \left[\frac{\sum_{i=-m}^{m} \left| y_i - y_{t_i}^{exp} \right|}{n} : \frac{\sum_{i=-m}^{m} y_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| y_i - y_{t_i}^{exp} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{3{,}47}{970{,}39} \cdot 100 = 0{,}36\%$$

We observe that: $v_I = 0{,}35\% < v_{exp} = 0{,}36\% < v_{II} = 0{,}37\%$

So, the road reflected by Y factor, which represents the Life Expectancy for men, between 2000-2013, is a linear trend of the shape $y_{t_i} = a + bt_i$, with other words it confirms the hypothesis H_0^*.



The type no. 2 The model of trend concerning the values for the Life Expectancy for men, in Romania, in the period 2000-2013

So, the cloud of points which reflects the values concerning the Life Expectancy for men in Romania, between 2000-2013, it carrying around a linear model of trend, according to the type no.2.

- if we formulate the null hypothesis H_0^{**} *:* who mentions the assumption of the existence for the model of tendency of the factor *Z = the Life Expectancy for women,* right the function $z_{t_i} = a + b \cdot t_i$, then the parametres *a* and *b* of the adjusted function of the premier degree, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot a = \sum_{i=-m}^{m} z_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot z_i \end{cases}$$

Therefore, $a = \dfrac{\sum_{i=-m}^{m} z_i}{n}$ and $b = \dfrac{\sum_{i=-m}^{m} t_i \cdot z_i}{\sum_{i=-m}^{m} t_i^2}$

Table no. 8 The estimate of the value for the variation coefficient in the case of the adjusted function of the premier degree, in the hypothesis concerning the linear evolution of the Life Expectancy for women in Romania, between the years 2000-2013

YEARS	LIFE EXPECTANCY FOR WOMEN (z_i)	LINEAR TREND				
		t_i	t_i^2	$t_i z_i$	$z_{t_i} = a + bt_i$	$\lvert z_i - z_{t_i} \rvert$
2000	74,80	-7	49	-523,60	74,47689286	0,32
2001	74,90	-6	36	-449,40	74,75907143	0,14
2002	74,70	-5	25	-373,50	75,04125001	0,34
2003	75,10	-4	16	-300,40	75,32342858	0,22
2004	75,50	-3	9	-226,50	75,60560715	0,11
2005	75,70	-2	4	-151,40	75,88778572	0,19
2006	76,20	-1	1	-76,20	76,16996429	0,03
2007	76,90	1	1	76,90	76,73432143	0,17
2008	77,20	2	4	154,40	77,01650000	0,19
2009	77,40	3	9	232,20	77,29867857	0,10
2010	77,50	4	16	310,00	77,58085714	0,08
2011	78,20	5	25	391,00	77,86303572	0,34
2012	78,10	6	36	468,60	78,14521429	0,05
2013	78,13	7	49	546,91	78,42739286	0,30
TOTAL	1070,33	0	280	79,01	1070,33	2,58

The parametres *a* and *b* have the next the values:

$$a = \frac{1070{,}33}{14} = 76{,}45214286$$

$$b = \frac{79{,}01}{280} = 0{,}282178571$$

Consequently, the coeficient of variation for the adjusted function of the premier degree is:

$$v_I = \left[\frac{\sum_{i=-m}^{m} \lvert z_i - z_{t_i}^{I} \rvert}{n} : \frac{\sum_{i=-m}^{m} z_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \lvert z_i - z_{t_i}^{I} \rvert}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2{,}58}{1070{,}33} \cdot 100 = 0{,}2411\%$$

- in the situation of the alternative hypothesis H_1^{**} *: who specifies the assumption of the existence for the model of tendency of the factor Z = the Life Expectancy for women*, right the parabolical function $z_{t_i} = a + b \cdot t_i + ct_i^2$, the parametres *a*, *b* şi *c* of the adjusted function of the second degree, can to be calculated by means of the system [1]:

$$\begin{cases} n \cdot a + c\sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} z_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot z_i \\ a \cdot \sum_{i=-m}^{m} t_i^2 + c\sum_{i=-m}^{m} t_i^4 = \sum_{i=-m}^{m} t_i^2 \cdot z_i \end{cases}$$

Hence,

$$a = \frac{\sum_{i=-m}^{m} t_i^4 \cdot \sum_{i=-m}^{m} z_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} t_i^2 \cdot z_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

$$b = \frac{\sum_{i=-m}^{m} t_i \cdot z_i}{\sum_{i=-m}^{m} t_i^2} \quad \text{and} \quad c = \frac{n \cdot \sum_{i=-m}^{m} t_i^2 \cdot z_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} z_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

Table no. 9 The estimates of the value for the variation coefficient in the case of the adjusted function of the second degree, in the hypothesis concerning the parabolic evolution of the Life Expectancy for women in Romania, between the years 2000-2013

YEARS	LIFE EXPECTANCY FOR WOMEN (z_i)	PARABOLIC TREND					
		t_i	t_i^2	t_i^4	$t_i^2 z_i$	$z_{t_i} = a + bt_i + ct_i^2$	$\lvert z_i - z_{t_i} \rvert$
2000	74,80	-7	49	2.401	3665,20	74,3078104	0,49
2001	74,90	-6	36	1.296	2696,40	74,6350314	0,26
2002	74,70	-5	25	625	1867,50	74,9553228	0,26
2003	75,10	-4	16	256	1201,60	75,2686846	0,17
2004	75,50	-3	9	81	679,50	75,5751168	0,08
2005	75,70	-2	4	16	302,80	75,8746194	0,17
2006	76,20	-1	1	1	76,20	76,1671924	0,03
2007	76,90	1	1	1	76,90	76,7315496	0,17
2008	77,20	2	4	16	308,80	77,0033338	0,20
2009	77,40	3	9	81	696,60	77,2681884	0,13
2010	77,50	4	16	256	1240,00	77,5261134	0,03
2011	78,20	5	25	625	1955,00	77,7771088	0,42
2012	78,10	6	36	1.296	2811,60	78,0211746	0,08
2013	78,13	7	49	2.401	3828,37	78,2583108	0,13
TOTAL	1070,33	0	280	9.352	21406,47	1069,369557	2,62

So, if we calculate the statistical dates for to adjust the second function, we obtain for the parametres *a, b* and *c* the next values:

$$\mathrm{a} = \frac{9.352 \cdot 1070{,}33 - 280 \cdot 21406{,}47}{14 \cdot 9.352 - 78.400} = 76{,}4528358$$

$$\mathrm{b} = \frac{79{,}01}{280} = 0{,}2821786$$

$$c = \frac{14 \cdot 21406{,}47 - 280 \cdot 1070{,}33}{14 \cdot 9.352 - 78.400} = -0{,}0034648$$

The coeficient of variation for the adjusted function of the second degree has the value:

$$v_{II} = \left[\frac{\sum_{i=-m}^{m} \left| z_i - z_{t_i}^{II} \right|}{n} : \frac{\sum_{i=-m}^{m} z_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| z_i - z_{t_i}^{II} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2{,}62}{1070{,}33} \cdot 100 = 0{,}25\%$$

- in the case of the alternative hypothesis H_2^{**} *:* who reflects the supposition the assumption of the existence for the model of tendency of the factor *Z = the Life Expectancy for women in Romania*, right the exponential function $x_{t_i} = ab^{t_i}$, then the parametres *a* and *b* of the adjusted exponential function, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot \lg a = \sum_{i=-m}^{m} \lg z_i \\ \lg b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot \lg z_i \end{cases}$$

Thus, $\lg a = \frac{\sum_{i=-m}^{m} \lg z_i}{n}$ and $\lg b = \frac{\sum_{i=-m}^{m} t_i \cdot \lg z_i}{\sum_{i=-m}^{m} t_i^2}$

Table no. 10 The estimate of the value for the variation coefficient in the case of the adjusted exponential function, in the hypothesis concerning the exponential evolution of the Life Expectancy for women in Romania, between the years 2000-2013

YEARS	LIFE EXPECTANCY FOR WOMEN (*z_i*)	EXPONENTIAL TREND					
		t_i	$\lg z_i$	$t_i \lg z_i$	$\lg z_{ti} = \lg a + t_i \lg b$	$z_{ti} = ab^{t_i}$	$\lvert z_i - z_{t_i} \rvert$
2000	74,80	-7	1,873901598	-13,11731119	1,872106259	74,49142101	0,31
2001	74,90	-6	1,874481818	-11,24689091	1,873709484	74,7669189	0,13
2002	74,70	-5	1,873320602	-9,366603009	1,875312709	75,04343569	0,34
2003	75,10	-4	1,875639937	-7,502559748	1,876915934	75,32097515	0,22
2004	75,50	-3	1,877946952	-5,633840855	1,878519159	75,59954105	0,10
2005	75,70	-2	1,879095880	-3,758191759	1,880122384	75,8791372	0,18
2006	76,20	-1	1,881954971	-1,881954971	1,881725609	76,1597674	0,04
2007	76,90	1	1,885926340	1,885926340	1,884932059	76,72414528	0,18
2008	77,20	2	1,887617300	3,775234601	1,886535284	77,00790064	0,19
2009	77,40	3	1,888740961	5,666222882	1,888138509	77,29270545	0,11
2010	77,50	4	1,889301703	7,557206810	1,889741734	77,57856357	0,08
2011	78,20	5	1,893206753	9,466033765	1,891344959	77,86547890	0,33
2012	78,10	6	1,892651034	11,35590620	1,892948184	78,15345536	0,05
2013	78,13	7	1,892817824	13,24972477	1,894551409	78,44249686	0,31
TOTAL	1070,33	0	26,36660367	0,448902926		1070,325943	2,57

Consequently, if we calculate the statistical dates for to adjust the exponential function, we obtain for the parametres *a* and *b* the values:

$$\lg a = \frac{26{,}36660367}{14} = 1{,}883328834$$

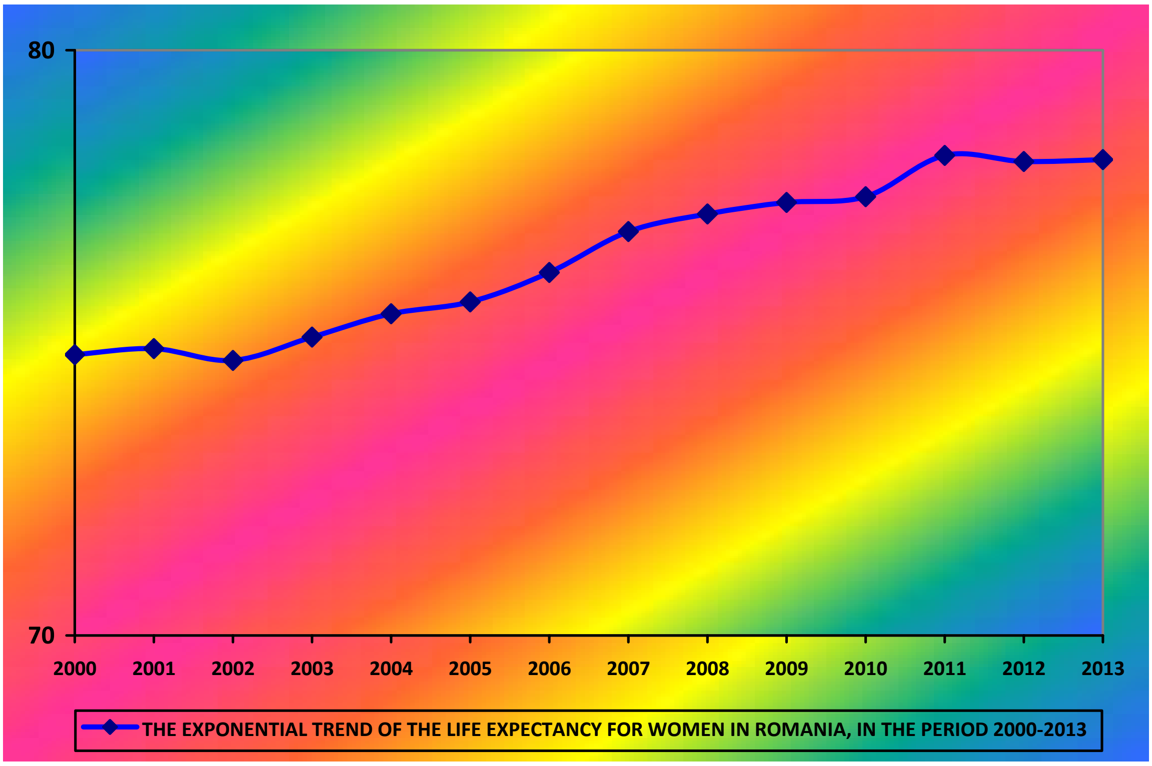
$$\lg b = \frac{0,448902926}{280} = 0,001603225$$

The coeficient of variation for the adjusted exponential function has the next value:

$$v_{\exp} = \left[\frac{\sum_{i=-m}^{m} \left| z_i - z_{t_i}^{\exp} \right|}{n} : \frac{\sum_{i=-m}^{m} z_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| z_i - z_{t_i}^{\exp} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{2,57}{1070,33} \cdot 100 = 0,2401\%$$

We observe that: $v_{\exp} = 0,2401\% < v_I = 0,2411\% < v_{II} = 0,25\%$

So, the road reflected by Z factor, which represents the Life Expectancy for women in Romania, between 2000-2013, is a exponential trend of the shape $z_{t_i} = ab^{t_i}$, with other words it confirms the hypothesis H_2^{**}.



The type no. 3 The model of trend concerning the values of the Life Expectancy for women in Romania, in the period 2000-2013

So, the cloud of points which reflects the values concerning the Life Expectancy for women in Romania, between 2000-2013, it carrying around a parabolic model of trend, according to the type no.3.

3. The forecasting method through the „Least Squares Method"

We know that the evolution of the *Life Expectancy* in Romania reflects a parabolic trend of the shape $x_{t_i} = a + bt_i + ct_i^2$. So, in 2014, the *Life Expectancy* in Romania will be:

$$\text{Life\_Expectancy}_{2014}^{\text{Romania}} = 72,86343284 + (0,28125) \cdot 8 + (-0,002278785) \cdot 8^2 = 74,9675906 \cong 74,97$$
years

The trend of the *Life Expectancy for men* in Romania is a linear trend of the shape $y_{t_i} = a + bt_i$. Thus, in 2014, the *Life Expectancy for men* in Romania will be:

$$\text{Life\_Expec}\tan \text{cy}_{2014}^{\text{mans}} = 69{,}31357143 + (0{,}27975) \cdot 8 = 71{,}55157143 \cong 71{,}55 \text{ years}$$

The model of trend concerning the *Life Expectancy for women* in Romania is a exponential trend of the shape $z_{t_i} = ab^{t_i}$. Consequently, in 2014, the *Life Expectancy for women* in Romania will be:

$$\lg(Life\_Expec\tan cy_{2014}^{womans}) = \lg a + t_i \cdot \lg b \Leftrightarrow$$

$$\Leftrightarrow \lg(Life\_Expec\tan cy_{2014}^{womans}) = 1{,}883328834 + 8 \cdot 0{,}001603225 \Leftrightarrow \lg(Life\_Expec\tan cy_{2014}^{womans}) = 1{,}896154634$$

$$Life\_Expec\tan cy_{2014}^{womans} = 78{,}73260735 \cong 78{,}73 \text{ years}$$

4. Conclusions

We can to synthesize that the Life Expectancy at birth is an estimate of the average number of years lived by a person, if the specific mortality rates by age of the reference year would remain unchanged during her whole life [4]. Life expectancy depends heavily on the criteria used for to select the group, while in countries with high infant mortality, the life expectancy at birth is greatly influenced by mortality in the first years of life [3].

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