Annals of "Dunarea de Jos" University of Galati
Fascicle I. Economics and Applied Informatics
Years XXI – nº2/2015
ISSN-L 1584-0409 ISSN-Online 2344-441X
www.eia.feaa.ugal.ro

Statistical Approaches Concerning the Relationship between the Health Index and the Life Expectancy, in Romania

Gabriela OPAIT ⋆

ARTICLE INFO

Article history:
Accepted May 2014
Available online 14 August 2014
JEL Classification
C 1, C 12, C 2

Keywords:
Health Index, Life Expectancy, Correlation Raport, T test

ABSTRACT

This research reflects the methodology for to achieve the statistical modeling of the trend concerning the correlation between the Health Index and the Life Expectancy in Romania, in the period 2005-2014. with the help of the „Least Squares Method", which is a method through we can to express the trend line of the best fit concerning a model. Also, this paper reflects the manner in which we can to measure the intensity regarding the correlation between the Health Index and the Life Expectancy in Romania, between 2005-2014 with the help of the Correlation Raport and how we can to reflect that there is a significant diferrence between the values of the Health Index in Romania and the values of the Health Index in U.S.A., respectively the values of the Health Index in Norway by means of the T test.

1. Introduction

In this paper, I present a personal contribution which reflects a statistical analysis of the trend model between the Health Index and the Life Expectancy in Romania, in the period 2005-2014. The purpose of the research reflects the possibility for to reflect the intensity of the correlation with the help of the Correlation Raport. The statistical methods used are the „Coefficients of Variation Method", respectively the „Least Squares Method" applied for to calculate the parameters of the regression equation and the Method of the Correlation Raport used for to reflect the intensity of the correlation between the Health Index and the Life Expectancy. The sections 2 presents the methodology for to achieve the trend model between the Health Index and the Life Expectancy in Romania, in the period 2005-2014, with the help of the „Least Squares Method". The section 3 reflects the intensity of the correlation between the Health Index and the Life Expectancy in Romania, between 2005-2014. The section 4 reflects how we apply the *t* test for to express if there is a significant diference between the Health Index in Romania and the Health Index in U.S.A respectively the Health Index in Norway, in the period 2005-2014. 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 trend between the Health Index and the Life Expectancy in Romania, between 2005-2014

In the period 2005-2014, we observe the next evolution concerning the Health Index and the Life Expectancy in Romania, according to the table no. 1:

Table no. 1 The evolution of the Health Index and the Life Expectancy in Romania, between 2005-2014

YEARS	THE HEALTH INDEX ROMANIA	THE LIFE EXPECTANCY ROMANIA
2005	0,805	71,35
2006	0,810	71,63
2007	0,814	71,91
2008	0,818	72,18
2009	0,820	72,45
2010	0,823	73,74
2011	0,825	73,98
2012	0,826	74,22
2013	0,828	74,45
2014	0,830	74,69

Source: „EUROSTAT ", CIA World Factbook

⋆Faculty of Economics and Business Administration, Dunarea de Jos University of Galati, Romania. E-mail address: gopait@ugal.ro (G. Opait)

We want to identify the trend model between the Health Index and the Life Expectancy for Romania, in the period 2005-2014, using the table no.1.

- if we formulate the null hypothesis H_0 *:* which mentions the assumption of the existence for the model of tendency concerning α factor, where α *= the Life Expectancy in Romania,* as being the function $\alpha_{t_i} = a + b \cdot \beta_i$, then the parameters *a* and *b* of the adjusted linear function, can to be calculated by means of the next system [1]:

$$\begin{cases} n \cdot a + b \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \alpha_i \\ a \sum_{i=1}^{n} \beta_i + b \cdot \sum_{i=1}^{n} \beta_i^2 = \sum_{i=1}^{n} \beta_i \cdot \alpha_i \end{cases}$$

Therefore,

$$a = \frac{\sum_{i=1}^{n} \beta_i^2 \sum_{i=1}^{n} \alpha_i - \sum_{i=1}^{n} \beta_i \sum_{i=1}^{n} \beta_i \alpha_i}{n \sum_{i=1}^{n} \beta_i^2 - (\sum_{i=1}^{n} \beta_i^2)}$$

$$b = \frac{n \sum_{i=1}^{n} \beta_i \alpha_i - \sum_{i=1}^{n} \beta_i \sum_{i=1}^{n} \alpha_i}{n \sum_{i=1}^{n} \beta_i^2 - (\sum_{i=1}^{n} \beta_i^2)}$$

Table no. 2 The estimate of the value for the variation coefficient in the case of the adjusted linear function, in the hypothesis concerning the linear evolution of the correlation between the Health Index in Romania and the Life Expectancy in Romania, between 2005-2014

YEARS	THE HEALTH INDEX Romania (β_i)	THE LIFE EXPECTANCY Romania (α_i)	*LINEAR TREND*			
			β_i^2	$\beta_i \alpha_i$	$\alpha_{\beta_i} = a + b\beta_i$	$\lvert \alpha_i - \alpha_{\beta_i} \rvert$
2005	**0,805**	**71,35**	0,648025	57,43675	70,83010519	0,52
2006	**0,810**	**71,63**	0,656100	58,02030	71,57839373	0,05
2007	**0,814**	**71,91**	0,662596	58,53474	72,17702455	0,27
2008	**0,818**	**72,18**	0,669124	59,04324	72,77565537	0,60
2009	**0,820**	**72,45**	0,672400	59,40900	73,07497079	0,63
2010	**0,823**	**73,74**	0,677329	60,68802	73,52394390	0,22
2011	**0,825**	**73,98**	0,680625	61,03350	73,82325932	0,16
2012	**0,826**	**74,22**	0,682276	61,30572	73,97291702	0,25
2013	**0,828**	**74,45**	0,685584	61,64460	74,27223243	0,18
2014	**0,830**	**74,69**	0,688900	61,99270	74,57154784	0,12
TOTAL	**8,199**	**730,6**	6,722959	599,10857	730,6000501	3,00

If we calculate the statistical data for to adjust the linear function, we obtain for the parameters *a* and *b* the values:

$$a = \frac{6,722959 \cdot 730,6 - 8,199 \cdot 599,10857}{10 \cdot 6,722959 - (8,199)^2} = -49,64434797$$

$$b = \frac{10 \cdot 599,10857 - 8,199 \cdot 730,6}{10 \cdot 6,722959 - (8,199)^2} = 149,6577058$$

Hence, the coefficient of variation for the adjusted linear function is:

$$v_I = \left[\frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^I \right|}{n} : \frac{\sum_{i=-m}^{m} \alpha_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^I \right|}{\sum_{i=-m}^{m} \alpha_i} \cdot 100 = \frac{3}{730,6} \cdot 100 = 0,41\%$$

- in the situation of the alternative hypothesis H_1 *:* which specifies the assumption of the existence for the model of tendency regarding α factor, where α *= the Life Expectancy*, as being the quadratic function $\alpha_{\beta_i} = a + b \cdot \beta_i + c\beta_i^2$, the parameters *a, b* şi *c* of the adjusted quadratic function, can to be calculated by means of the system [1]:

$$S = \sum_{i=1}^{n} (\alpha_i - \alpha_{\beta i})^2 = \min \Leftrightarrow S = \sum_{i=1}^{n} (\alpha_i - a - b\beta_i - c\beta_i^2)^2 = \min$$

$$\begin{cases} \frac{\partial S}{\partial a} = 0 \\ \frac{\partial S}{\partial b} = 0 \Rightarrow \\ \frac{\partial S}{\partial c} = 0 \end{cases} \begin{cases} 2\sum_{1=1}^{n} (\alpha_i - a - b\beta_i - c\beta_i^2)(-1) = 0 /(-\frac{1}{2}) \\ 2\sum_{1=1}^{n} (\alpha_i - a - b\beta_i - c\beta_i^2)(-\beta_i) = 0 /(-\frac{1}{2}) \Rightarrow \\ 2\sum (\alpha_i - a - b\beta_i - c\beta_i^2)(-\beta_i^2) = 0 /(-\frac{1}{2}) \end{cases}$$

Therefore,

$$\begin{cases} n \cdot a + b\sum_{i=1}^{n} \beta_i + c\sum_{i=1}^{n} \beta_i^2 = \sum_{i=1}^{n} \alpha_i \\ a\sum_{i=1}^{n} \beta_i + b \cdot \sum_{i=1}^{n} \beta_i^2 + c\sum_{i=1}^{n} \beta_i^3 = \sum_{i=1}^{n} \beta_i \cdot \alpha_i \\ a \cdot \sum_{i=1}^{n} \beta_i^2 + b\sum_{i=1}^{n} \beta_i^3 + c\sum_{i=1}^{n} \beta_i^4 = \sum_{i=1}^{n} \beta_i^2 \cdot \alpha_i \end{cases}$$

Table no. 3 The estimates of the value for the variation coefficient in the case of the adjusted quadratic function, in the hypothesis concerning the parabolic evolution of the correlation between the Health Index and the Life Expectancy in Romania, between 2005-2014

YEARS	THE HEALTH INDEX Romania (β_i)	LIFE EXPEC-TANCY Roma nia (α_i)	*PARABOLIC TREND*				
			β_i^3	β_i^4	$\beta_i^2 \alpha_i$	$\alpha_{\beta_i} = a + b\beta_i + c\beta_i^2$	$\left\|\alpha_i - \alpha_{\beta_i}\right\|$
2005	**0,805**	**71,35**	0,521660125	0,419936400	46,23658375	71,30890019	0,04
2006	**0,810**	**71,63**	0,531441000	0,430467210	46,99644300	71,52829804	0,10
2007	**0,814**	**71,91**	0,539353144	0,439033459	47,64727836	71,89428200	0,02
2008	**0,818**	**72,18**	0,547343432	0,447726927	48,29737032	72,42956891	0,25
2009	**0,820**	**72,45**	0,551368000	0,452121760	48,71538000	72,76070091	0,31
2010	**0,823**	**73,74**	0,557441767	0,458774574	49,94624046	73,33675962	0,40
2011	**0,825**	**73,98**	0,561515625	0,463250390	50,35263750	73,77370591	0,21
2012	**0,826**	**74,22**	0,563559976	0,465500540	50,63852472	74,00805120	0,21
2013	**0,828**	**74,45**	0,567663552	0,470025421	51,04172880	74,50848605	0,06
2014	**0,830**	**74,69**	0,571787000	0,474583210	51,45394100	75,05124663	0,36
TOTAL	**8,199**	**730,6**	5,513133621	4,521419891	491,3261279	730,5999995	1,95

If we calculate the statistical data for to adjust the quadratic function, we obtain for the parameters *a, b* and *c* the next values:

$$\begin{cases} 10\cdot a + 8{,}199\cdot b + 6{,}722959\cdot c = 730{,}6 \\ 8{,}199\cdot a + 6{,}722959\cdot b + 5{,}513133621\cdot c = 599{,}10857 \\ 6{,}722959\cdot a + 5{,}513133621\cdot b + 4{,}521419891\cdot c = 491{,}3261279 \end{cases} \Rightarrow$$

$$a = 3485{,}796077 \qquad b = -8500{,}623978 \qquad c = 5290{,}714286$$

So, the coefficient of variation for the adjusted quadratic function has the value:

$$v_{II} = \left[\frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^{II} \right|}{n} : \frac{\sum_{i=-m}^{m} \alpha_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^{II} \right|}{\sum_{i=-m}^{m} \alpha_i} \cdot 100 = \frac{1{,}95}{730{,}6} \cdot 100 = 0{,}27\%$$

- in the case of the alternative hypothesis H_2 *:* which describes the supposition the assumption of the existence for the model of tendency concerning α factor, where α *= the Life Expectancy in Romania*, as being the exponential function $\alpha_{\beta_i} = ab^{\beta_i}$, then the parameters *a* and *b* of the adjusted exponential function, can to be calculated by means of the next system [1]:

$$S = \sum_{i=1}^{n} (\lg \alpha_i - \lg \alpha_{\xi_i})^2 = \min \Leftrightarrow S = \sum_{i=1}^{n} (\lg \alpha_i - \lg a - \beta_i \lg b)^2 = \min$$

$$\begin{cases} \dfrac{\partial S}{\partial \lg a} = 0 \\ \dfrac{\partial S}{\partial \lg b} = 0 \end{cases} \Rightarrow \begin{cases} 2\sum_{1=1}^{n} (\lg \alpha_i - \lg a - \beta_i \lg b)(-1) = 0 \,/(-\frac{1}{2}) \\ 2\sum_{1=1}^{n} (\lg \alpha_i - \lg a - \beta_i \lg b)(-\beta_i) = 0 \,/(-\frac{1}{2}) \end{cases} \Rightarrow$$

$$\begin{cases} n\cdot \lg a + \lg b \cdot \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \lg \alpha_i \\ \lg a \sum_{i=1}^{n} \beta_i + \lg b \cdot \sum_{i=1}^{n} \beta_i^2 = \sum_{i=1}^{n} \beta_i \cdot \lg \alpha_i \end{cases}$$

Thus,

$$\lg a = \frac{\begin{vmatrix} \sum_{i=1}^{n} \lg \alpha_i & \sum_{i=1}^{n} \beta_i \\ \sum_{i=1}^{n} \beta_i \lg \alpha_i & \sum_{i=1}^{n} \beta_i^{\,2} \end{vmatrix}}{\begin{vmatrix} n & \sum_{i=1}^{n} \beta_i \\ \sum_{i=1}^{n} \beta_i & \sum_{i=1}^{n} \beta_i^{\,2} \end{vmatrix}} = \frac{\sum_{i=1}^{n} \lg \alpha_i \sum_{i=1}^{n} \beta_i^{\,2} - \sum_{i=1}^{n} \beta_i \lg \alpha_i \sum_{i=1}^{n} \beta_i}{n\sum_{i=1}^{n} \beta_i^{\,2} - \left(\sum_{i=1}^{n} \beta_i \right)^2}$$

and

$$\lg b = \frac{\begin{vmatrix} n & \sum_{i=1}^{n} \lg \alpha_i \\ \sum_{i=1}^{n} \beta_i & \sum_{i=1}^{n} \beta_i \lg \alpha_i \end{vmatrix}}{\begin{vmatrix} n & \sum_{i=1}^{n} \beta_i \\ \sum_{i=1}^{n} \beta_i & \sum_{i=1}^{n} \beta_i^2 \end{vmatrix}} = \frac{n \cdot \sum_{i=1}^{n} \beta_i \lg \alpha_i - \sum_{i=1}^{n} \lg \alpha_i \sum_{i=1}^{n} \beta_i}{n \sum_{i=1}^{n} \beta_i^2 - \left(\sum_{i=1}^{n} \beta_i \right)^2}$$

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 correlation between the Health Index in Romania and the Life Expectancy in Romania, between 2005-2014

YEARS	THE HEALTH INDEX Romania (β_i)	THE LIFE EXPECTANCY Romania (α_i)	*EXPONENTIAL TREND*				
			$\lg \alpha_i$	$\beta_i \lg \alpha_i$	$\lg \alpha_{\beta i} = = \lg a + \beta_i \lg b$	$\alpha_{\beta i} = ab^{\beta_i}$	$\lvert \alpha_i - \alpha_{\beta_i} \rvert$
2005	**0,805**	**71,35**	1,853393977	1,491982152	1,850336533	70,84945816	0,50
2006	**0,810**	**71,63**	1,855094951	1,502626910	1,854792285	71,58009740	0,05
2007	**0,814**	**71,91**	1,856789289	1,511426481	1,858356887	72,17003016	0,26
2008	**0,818**	**72,18**	1,858416878	1,520185006	1,861921489	72,76482489	0,59
2009	**0,820**	**72,45**	1,860038390	1,525231480	1,863703789	73,06405801	0,61
2010	**0,823**	**73,74**	1,867703133	1,537119679	1,866377241	73,51521654	0,23
2011	**0,825**	**73,98**	1,869114327	1,542019320	1,868159542	73,81753551	0,16
2012	**0,826**	**74,22**	1,870520950	1,545050305	1,869050692	73,96916089	0,25
2013	**0,828**	**74,45**	1,871864702	1,549903973	1,870832993	74,27334664	0,18
2014	**0,830**	**74,69**	1,873262459	1,554807841	1,872615294	74,57878330	0,11
TOTAL	**8,199**	**730,6**	18,63619885	15,28035315			2,94

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

$$\lg a = \frac{\begin{vmatrix} 18,63619885 & 8,199 \\ 15,28035315 & 6,722959 \end{vmatrix}}{\begin{vmatrix} 10 & 8,199 \\ 8,199 & 6,722959 \end{vmatrix}} = 1,132960427$$

$$\lg b = \frac{\begin{vmatrix} 10 & 18,63619885 \\ 8,199 & 15,28035315 \end{vmatrix}}{\begin{vmatrix} 10 & 8,199 \\ 8,199 & 6,722959 \end{vmatrix}} = 0,891150442$$

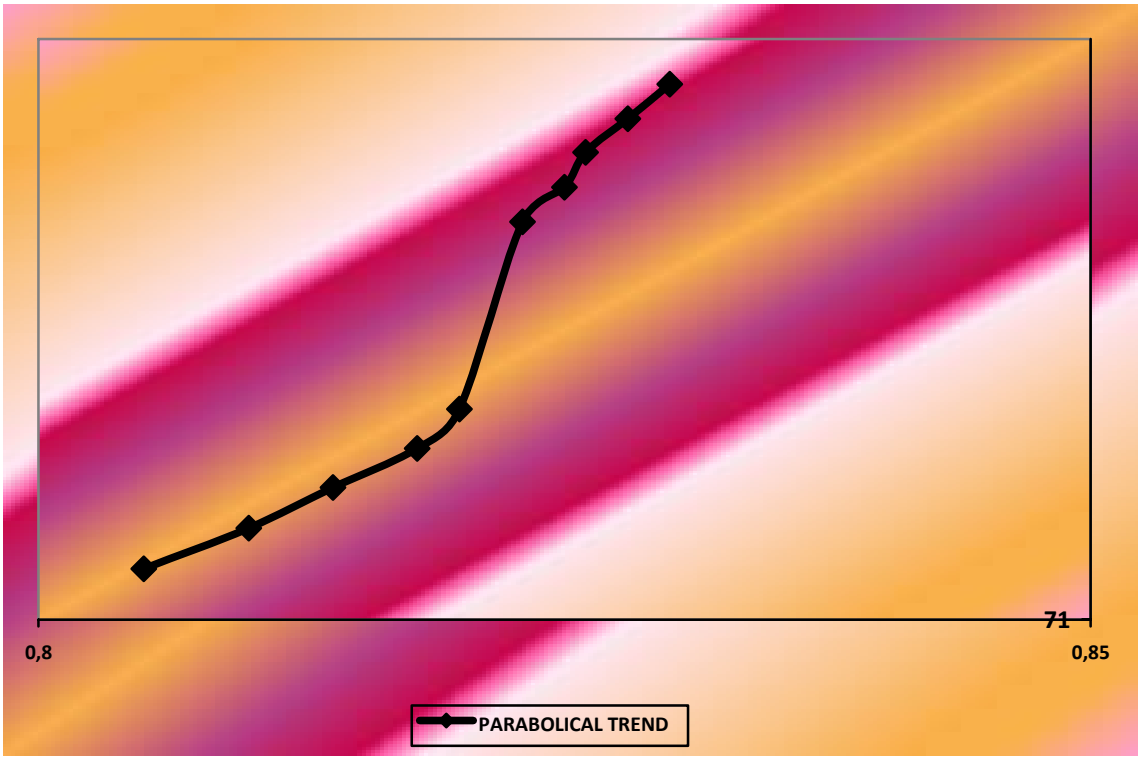
Accordingly, the coefficient of variation for the adjusted exponential function has the next value:

$$v_{\exp} = \left[\frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^{\exp} \right|}{n} : \frac{\sum_{i=-m}^{m} \alpha_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| \alpha_i - \alpha_{\beta_i}^{\exp} \right|}{\sum_{i=-m}^{m} \alpha_i} \cdot 100 = \frac{2,94}{730,6} \cdot 100 = 0,40\%$$

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

$$v_{II} = 0{,}27\% < v_I = 0{,}41\% < v_{\exp} = 0{,}40\%$$

So, the path reflected by the correlation between the Life Expectancy in Romania and the Health Index in Romania, between 2005-2014, is a parabolical trend of the shape $\alpha_{\beta_i} = a + b \cdot \beta_i + c\beta_i^2$, with other words it confirms the hypothesis H_1.



The type no. 1 The trend model of the values for the correlation between the Life Expectancy and the Health Index in Romania, in the period 2005-2014

We observe that, the cloud of points which reflects the values of the the Life Expectancy in Romania in function of the Health Index in Romania, between 2005-2014, it carrying around a parabolical model of trend, according to the type no.1.

3. The intensity of the correlation between the Health Index in Romania and the Life Expectancy in Romania, in the period 2005-2014.

For to reflect the intensity of the parabolical correlation between the Health Index in Romania and the Life Expectancy in Romania, in the period 2005-2014, we use the Correlation Raport noted with η [3]:

$$\eta = \sqrt{\frac{a\sum_{i=1}^{n}\beta_i + b\sum_{i=1}^{n}\beta_i\alpha_i + c\sum_{i=1}^{n}\beta_i^2\alpha_i - \frac{\left(\sum_{i=1}^{n}\alpha_i\right)^2}{n}}{\sum_{i=1}^{n}\alpha_i^2 - \frac{\left(\sum_{i=1}^{n}\alpha_i^2\right)}{n}}}$$

Table no. 5 The calculation of the value for the Correlation Raport in the case of the parabolical correlation between the Health Index and the Life Expectancy in Romania, between 2005-2014

ANII	THE HEALTH INDEX Romania (β_i)	THE LIFE EXPECTANCY Romania (α_i)	$\beta_i^2\alpha_i$	$(\alpha_i)^2$	$\beta_i\alpha_i$
2005	**0,805**	**71,35**	46,23658375	5.090,8225	57,43675
2006	**0,810**	**71,63**	46,99644300	5.130,8569	58,02030
2007	**0,814**	**71,91**	47,64727836	5.171,0481	58,53474
2008	**0,818**	**72,18**	48,29737032	5.209,9524	59,04324
2009	**0,820**	**72,45**	48,71538000	5.249,0025	59,40900
2010	**0,823**	**73,74**	49,94624046	5.437,5876	60,68802
2011	**0,825**	**73,98**	50,35263750	5.473,0404	61,03350
2012	**0,826**	**74,22**	50,63852472	5.508,6084	61,30572
2013	**0,828**	**74,45**	51,04172880	5.542,8025	61,64460
2014	**0,830**	**74,69**	51,45394100	5.578,5961	61,99270
TOTAL	**8,199**	**730,6**	491,3261279	53.392,3174	599,10857

$$\eta = \sqrt{\frac{a\sum_{i=1}^{n}\alpha_i + b\sum_{i=1}^{n}\beta_i\alpha_i + c\sum_{i=1}^{n}\beta_i^2\alpha_i - \frac{\left(\sum_{i=1}^{n}\alpha_i\right)^2}{n}}{\sum_{i=1}^{n}\alpha_i^2 - \frac{\left(\sum_{i=1}^{n}\alpha_i^2\right)}{n}}} =$$

$$= \sqrt{\frac{3.485,796077 \cdot 730,6 + (-8.500,623978) \cdot 599,10857 + 5.290,714286 \cdot 491,3261279 - \frac{(730,6)^2}{10}}{53.392,3174 - \frac{(730,6)^2}{10}}} = 0,99$$

In conclusion, because the value of the Correlation Raport tends to 1, there is a very strong intensity between the Health Index in Romania and the Life Expectancy in Romania, between 2005-2014.

4. The reflection of the methodology for to apply the T test.

According to the table no. 6, we observe between 2005-2014, the next evolution concerning the Health Index in U.S.A which is on the third place in the world regarding the Health Index.

Table no. 6 The evolution of the Health Index in U.S.A., between 2005-2014

YEARS	THE HEALTH INDEX (U.S.A.)
2005	**0,887**
2006	**0,890**
2007	**0,892**
2008	**0,895**
2009	**0,898**
2010	**0,900**
2011	**0,902**
2012	**0,905**
2013	**0,907**
2014	**0,909**

Source: Human Development Report 2014

Through the help of the T test and F test, we want to know if there is a significant diference between the values of the Health Index in U.S.A. and and the values of the Health Index in Romania, between 2005-2014.

Table no. 7. The calculation of the dispersion concerning the values of the Health Index in Romania, respectively the Health Index in U.S.A. in each year face to the average of values regarding the Health Index in Romania, respectively in U.S.A.

YEARS	THE HEALTH INDEX Romania (x_0)	THE HEALTH INDEX U.S.A. (x_1)	$(x_{0i} - \overline{x_0})^2$	$(x_{1i} - \overline{x}_1)^2$
2005	**0,805**	**0,887**	**0,000250**	**0,000144**
2006	**0,810**	**0,890**	**0,000100**	**0,000081**
2007	**0,814**	**0,892**	**0,000036**	**0,000049**
2008	**0,818**	**0,895**	**0,000004**	**0,000016**
2009	**0,820**	**0,898**	**0**	**0,000001**
2010	**0,823**	**0,900**	**0,000009**	**0,000001**
2011	**0,825**	**0,902**	**0,000025**	**0,000009**
2012	**0,826**	**0,905**	**0,000036**	**0,000036**
2013	**0,828**	**0,907**	**0,000064**	**0,000064**
2014	**0,830**	**0,910**	**0,000100**	**0,000121**
Total	**8,199**	**8,986**	**0,000624**	**0,000522**

$$\overline{x} = \frac{\sum_{i=1}^{n} x_{0i}}{n_0} = \frac{8,199}{10} = 0,8199 \text{ and } \overline{x}_1 = \frac{\sum_{i=1}^{n} x_{1i}}{n_1} = \frac{8,986}{10} = 0,896$$

$$s_0^2 = \frac{\sum_{i=1}^{n} (x_{0i} - \overline{x}_0)^2}{n_0 - 1} = \frac{0,000624}{10-1} = 0,000069333 ;$$

$$s_1^2 = \frac{\sum_{i=1}^{n} (x_{1i} - \overline{x}_1)^2}{n_1 - 1} = \frac{0,000522}{10-1} = 0,000058$$

$$F = \frac{s_0^2}{s_1^2} = \frac{0,000069333}{0,000058} = 1,19539655$$

For $\alpha = 0,01$ we observe through the table Fisher that $F_{tab} = F_{f_{11}, f_2, \alpha} = 2,5$, where $f_1 = n-1$ and $f_2 = n-1$

So, $F_{calc} = 1,19 < F_{tab} = 2,5$

Thus,

$$t_{calc} = \frac{\overline{x_1} - \overline{x_0}}{\sqrt{(n_0 - 1) \cdot s_0^2 + (n_1 - 1) \cdot s_1^2}} \cdot \sqrt{\frac{n_0 \cdot n_1 \cdot (n_0 + n_1 - 2)}{n_0 + n_1}} =$$

$$= \frac{0,896 - 0,8199}{\sqrt{(10-1) \cdot 0,000069333 + (10-1) \cdot 0,000058}} \cdot \sqrt{\frac{10 \cdot 10 \cdot (10+10-2)}{10+10}} = 21,32623433$$

So, $|t_{calc}| = 21,32623433 > t_{tab} = t_{18;0,01} = 2,88$. Consequently, for any $\alpha \geq 0,01$ there is a significant diference between the Health Index in U.S.A. and the Health index in Romania, in the period 2005-2014.

Also, we want to know if there is a significant diference between the values of the Health Index in Norway and and the values of the Health Index in Romania, between 2005-2014, where Norway is on the first place in the world regarding the values of the Health Index, according to the table no. 8.

Table no. 8 The evolution of the Health Index in Norway between 2005-2014

YEARS	THE HEALTH INDEX (NORWAY)
2005	0,922
2006	0,926
2007	0,930
2008	0,933
2009	0,937
2010	0,939
2011	0,942
2012	0,944
2013	0,946
2014	0,948
	9,367

Source: Human Development Report 2014

Table no. 9. The calculation of the dispersion concerning the values of the Health Index in Romania, respectively the Health Index in Norway in each year face to the average of values regarding the Health Index in Romania, respectively in Norway

YEARS	THE HEALTH INDEX Romania (x_0)	THE HEALTH INDEX Norway (x_2)	$(x_{0i}-\bar{x}_0)^2$	$(x_{2i}-\bar{x}_2)^2$
2005	0,805	0,922	0,000250	0,000225
2006	0,810	0,926	0,000100	0,000121
2007	0,814	0,930	0,000036	0,000049
2008	0,818	0,933	0,000004	0,000016
2009	0,820	0,937	0	0
2010	0,823	0,939	0,000009	0,000004
2011	0,825	0,942	0,000025	0,000025
2012	0,826	0,944	0,000036	0,000049
2013	0,828	0,946	0,000064	0,000081
2014	0,830	0,948	0,000100	0,000121
Total	8,199	9,367	0,000624	0,000691

$$\bar{x}_0 = \frac{\sum_{i=1}^{n} x_{0i}}{n_0} = \frac{8{,}199}{10} = 0{,}8199 \cong 0{,}820 \text{ and } \bar{x}_2 = \frac{\sum_{i=1}^{n} x_{2i}}{n_2} = \frac{9{,}367}{10} = 0{,}9367 \cong 0{,}937$$

$$s_0^2 = \frac{\sum_{i=1}^{n}(x_{0i}-\bar{x}_0)^2}{n_0-1} = \frac{0{,}000624}{10-1} = 0{,}000069333 ;$$

$$s_2^2 = \frac{\sum_{i=1}^{n}(x_{2i}-\bar{x}_2)^2}{n_2-1} = \frac{0{,}000691}{10-1} = 0{,}000076777$$

$$F = \frac{s_0^2}{s_2^2} = \frac{0{,}000069333}{0{,}000076777} = 0{,}90304388$$

For $\alpha = 0{,}01$ we observe through the table Fisher that $F_{tab} = F_{f_1, f_2, \alpha} = 2{,}5$, where $f_1 = n-1$ and $f_2 = n-1$

So, $F_{calc} = 0{,}90 < F_{tab} = 2{,}5$

Thus,

$$t_{calc} = \frac{\overline{x_2} - \overline{x_0}}{\sqrt{(n_0 - 1)\cdot s_0^2 + (n_2 - 1)\cdot s_2^2}} \cdot \sqrt{\frac{n_0 \cdot n_2 \cdot (n_0 + n_2 - 2)}{n_0 + n_2}} =$$

$$= \frac{0{,}937 - 0{,}820}{\sqrt{(10-1)\cdot 0{,}000069333 + (10-1)\cdot 0{,}000076777}} \cdot \sqrt{\frac{10 \cdot 10 \cdot (10+10-2)}{10+10}} = 30{,}60877166$$

So, $|t_{calc}| = 30{,}61 > t_{tab} = t_{18;0,01} = 2{,}88$. Consequently, for any $\alpha \geq 0{,}001$ there is a significant diference between the Health Index in Norway and the Health Index in Romania, in the period 2005-2014.

5. Conclusions

We can to synthesize that, there is a correlation of parabolical type between the values of the Health Index in Romania and the values of the Life Expectancy in Romania, between 2005-2014. Also, there is a strong intensity of the correlation between the Health Index in Romania and the Life Expectancy in Romania in the period 2005-2014. If we use the T test, we observe that, there is a significant diference between the values of the Health Index in Romania and the values of the Health Index in U.S.A., respectively the values of the Health Index in Norway, for any $\alpha \geq 0{,}01$, respectively for any $\alpha \geq 0{,}001$, in the period 2005-2014.

References

[1]. Gauss C. F. - „Theoria Combinationis Observationum Erroribus Minimis Obnoxiae", Apud Henricum Dieterich Publising House, Gottingae, 1823.

[2]. Kariya T., Kurata H. - „Generalized Least Squares", John Wiley&Sons Publishing House, Hoboken, 2004.

[3]. Pearson K. - „On the General Theory of skew correlation and non-linear regression", Dulau&Co Publishing House, London, 1905.

[4]. Wolberg J. - „Data Analysis Using the method of Least Squares: Extracting the Most Information from Experiments", Springer-Verlag New York – Berlin Heidelberg Publishing House, New-York, 2006.