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The Japanese Statistical Perfume of the Cherry Blossoms

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ABSTRACT

In Japan, the cherry blossoms wake up genuine sensations which aim the ephemeral standard of the people's life and the nobility. In this real national festival, the positive energy predominates in anyplace and the celebration wields as scenography the Hanami play which consists in the views of the spectacular flowering of the cherry trees from Japan. The aim of this original statistical survey follows to record the estimations regarding the productions of cherries in Japan, Turkey and at worldwide level, between 2023-2025.

1. Introduction

This original research highlights the forecasts concerning the productions of cherries in Japan, a country where the Cherry Blossoms (Sakura) represents a national obsession, in Turkey which is the leader in this domanin and also, the predictions at the worldwide level. The blooming of the cherry blossoms trees in Japan represents an informal national festivity celebrated for many centuries which has as significances the nobility and the transition of the human life. In Japanese culture predominates the misconceptions of the correlations between the short lives regarding the flowers of cherries which are extreme beauty and the human existances. There are a lot of areas where we can meet the celebration of the Cherry Blossoms, such as: Tokyo with Shinjuku Gyoen (more than 100 cherry trees), Ueno Park (more than 1000 cherry trees), Chidorigafuchi (hundreds of cherry trees), Sumida Park; Yokohama with Sankeien and Mitsuike Park; Kamakura with Tsurugaoka Hachimangu Shrine (hundreds of cherry trees); Fuji Five Lakes with Northern Shores of Kawaguchiko and Chureito Pagoda; Saitama Prefecture with Gongendo Park (about 1000 cherry trees) and Kumagaya Sakura Tsutsumi (about 500 cherry trees); Kyoto with Philosopher's Path (hundreds of cherry trees), Maruyama Park, Arashiyama and Heian Shrine; Osaka with Kema Sakuranomiya Park (5000 cherry trees) and Osaka Castle (4000 cherry trees).

In Japan, we can observe in the category the most common cherry tree varieties, the next strains: Somei Yoshino, Yamazakura and Shidarezakura. Also, in the same country, there are some early blooming cherry trees varieties, such as: Kanzakura (the first cherry trees which bloom), Kawazuzakura, Kanhizakura and there are some late blooming cherry trees varieties, such as: Ichiyo, Ukon, Kanzan, Fugenzo, Shogetsu, Kikuzakura) wich is one of the latest blooming trees and Jugatsuzakura (october cherry) which is a variety that blooms in autumn.

In the Japanese culture, the cherry trees which bloom with more than five petals are named Yaezakura. The cherry trees highlight a lot of colors in the sensational Japanese show presented by the petals: light pink, dark pink, white, green and yellow. In several days, a blossom makes one's first appearance as white flower and cans modify the color to pink. The shape of the cherry trees can be: triangular, columnar, in V and weeping where in this situation, the cherry trees are called Shidarezakura.

In the first episode of this survey, we can see the estimations of the cherries's worldwide productions, between 2023-2025. In the second section, we can observe the predictions of the cherries's productions in Turkey in the same horizon of time. In the third segment of this paper, we can analysis the forecasts of the cherries's productions in Japan, in the period 2023-2025.

For to give colour to the predictions concerning the cherries's worldwide productions, respectively the cherries's productions in Turkey and Japan, we can use the forecast's method which was inserted in this paper. The prime mover of the „Least Squares Method" was Johann Carl Friedrich Gauss, a genuine whizz in statistics.

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2. The statistical investigation concerning the worldwide cherries's productions, in the period 2010-2020, which has as vectors the productions's predictions between 2023-2025

Table 1. The worldwide production of cherries between 2010-2020

YEARS	THE GLOBAL PRODUCTION OF CHERRIES (millions tons) (ξ_i)
2010	2,07
2011	2,11
2012	2,15
2013	2,22
2014	2,25
2015	2,23
2016	2,28
2017	2,43
2018	2,57
2019	2,60
2020	2,61

Source: „Statista Portal the United States of America"

- if the operational management, which designates the trend's image for the ξ variable, where ξ = **the worldwide production of cherries,** involves as specification a linear exposure, $\xi_{t_i} = a + b \cdot t_i$, *a* and *b* can be [1]:

Table 2 The field of vision which exhibits the values relative to the worldwide production of cherries, if these have a linear trajectory

YEARS	THE GLOBAL PRODUCTION OF CHERRIES (millions tons) (ξ_i)	LINEAR TENDENCY				
		t_i	t_i^2	$t_i\xi_i$	$\xi_{t_i} = a + bt_i$	$\left\lvert \xi_i - \xi_{t_i} \right\rvert$
2010	2,07	-5	25	-10,35	2,02045455	0,05
2011	2,11	-4	16	-8,44	2,08836364	0,02
2012	2,15	-3	9	-6,45	2,14627273	0
2013	2,22	-2	4	-4,44	2,20418182	0,02
2014	2,25	-1	1	-2,25	2,26209091	0,01
2015	2,23	0	0	0	2,32	0,09
2016	2,28	+1	1	+2,28	2,37790909	0,10
2017	2,43	+2	4	+4,86	2,43581818	0,01
2018	2,57	+3	9	+7,71	2,49372727	0,08
2019	2,60	+4	16	+10,40	2,55163636	0,05
2020	2,61	+5	25	+13,05	2,60954545	0
TOTAL	25,52	0	110	6,37		0,43

$$a = \frac{\sum_{i=1}^{n}\xi_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n}\xi_i t_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{25{,}52 \cdot 110}{11 \cdot 110} = 2{,}32 \quad b = \frac{n\sum_{i=1}^{n}\xi_i t_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n}\xi_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{11 \cdot 6{,}37}{11 \cdot 110} = 0{,}05790909$$

$$v_I = \left[\frac{\sum_{i=1}^{m}\left|\xi_i - \xi_{t_i}^I\right|}{n} : \frac{\sum_{i=1}^{m}\xi_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{m}\left|\xi_i - \xi_{t_i}^I\right|}{\sum_{i=1}^{m}\xi_i} \cdot 100 = \frac{0{,}43}{25{,}52} \cdot 100 = 1{,}68\%$$

- if the operational management, which designates the trend's image for ξ variable, where ξ = **the worldwide production of cherries,** involves as specification a quadratic exposure, $\xi_{t_i} = a + b \cdot t_i + ct_i^2$, *a* and *b* can be [1]:

Table 3 The field of vision which exhibits the values relative to the worldwide production of cherries, if these have a quadratic trajectory

YEARS	THE GLOBAL PRODUCTION OF CHERRIES (millions tons) (ξ_i)	PARABOLIC TENDENCY					
		t_i	t_i^2	t_i^4	$t_i^2\xi_i$	$\xi_{t_i} = a + bt_i + ct_i^2$	$\lvert\xi_i - \xi_{t_i}\rvert$
2010	**2,07**	-5	25	625	51,75	2,078881124	0,01
2011	**2,11**	-4	16	256	33,76	2,107734270	0
2012	**2,15**	-3	9	81	19,35	2,143044292	0,01
2013	**2,22**	-2	4	16	8,88	2,184811191	0,04
2014	**2,25**	-1	1	1	2,25	2,233034966	0,02
2015	**2,23**	0	0	0	0	2,287715618	0,06
2016	**2,28**	+1	1	1	2,28	2,348853146	0,07
2017	**2,43**	+2	4	16	9,72	2,416447551	0,01
2018	**2,57**	+3	9	81	23,13	2,490498832	0,08
2019	**2,60**	+4	16	256	41,60	2,571006990	0,03
2020	**2,61**	+5	25	625	65,25	2,657972024	0,05
TOTAL	**25,52**	0	110	1958	257,97		0,38

$$a = \frac{\sum_{i=1}^{n} t_i^4 \sum_{i=1}^{n} \xi_i - \sum_{i=1}^{n} t_i^2 \sum_{i=1}^{n} t_i^2 \cdot \xi_i}{n\sum_{i=1}^{n} t_i^{\,4} - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{1958 \cdot 25{,}52 - 110 \cdot 257{,}97}{11 \cdot 1958 - 110^2} = 2{,}287715618$$

$$b = \frac{\sum_{i=1}^{n} \xi_i t_i}{\sum_{i=1}^{n} t_i^{\,2}} = \frac{6{,}37}{110} = 0{,}05790909$$

$$c = \frac{n \cdot \sum_{i=1}^{n} t_i^2 \cdot \xi_i - \sum_{i=1}^{n} t_i^2 \cdot \sum_{i=1}^{n} \xi_i}{n\sum_{i=1}^{n} t_i^{\,4} - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{11 \cdot 257{,}97 - 110 \cdot 25{,}52}{11 \cdot 1958 - 110^2} = 0{,}003228438228$$

$$v_{II} = \left[\frac{\sum_{i=1}^{m} \left|\xi_i - \xi_{t_i}^{II}\right|}{n} : \frac{\sum_{i=1}^{m} \xi_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{m} \left|\xi_i - \xi_{t_i}^{II}\right|}{\sum_{i=1}^{m} \xi_i} \cdot 100 = \frac{0{,}38}{25{,}52} \cdot 100 = 1{,}49\%$$

- if the operational management, which designates the trend's image for ξ variable, where ξ **= the worldwide production of cherries,** involves as specification an exponential exposure, $\xi_{t_i} = ab^{t_i}$, *a* and *b* can be [1]:

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

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

Table 4 The field of vision which exhibits the values relative to the worldwide production of cherries, if these have an exponential trajectory

YEARS	THE GLOBAL PRODUCTION OF CHERRIES (millions tons) (ξ_i)	EXPONENTIAL TENDENCY					
		t_i	$\lg \xi_i$	$t_i \lg \xi_i$	$\lg \xi_{t_i} = \lg a + t_i \lg b$	$\xi_{t_i} = ab^{t_i}$	$\lvert \xi_i - \xi_{t_i} \rvert$
2010	**2,07**	-5	0,315970345	-1,579851727	0,310290097	2,043	0,03
2011	**2,11**	-4	0,324282455	-1,297129821	0,321043345	2,094	0,02
2012	**2,15**	-3	0,332438459	-0,997315379	0,331796593	2,147	0
2013	**2,22**	-2	0,346352974	-0,692705948	0,342549841	2,201	0,02
2014	**2,25**	-1	0,352182518	-0,352182518	0,353303089	2,256	0,01
2015	**2,23**	0	0,348304863	0	0,364056337	2,312	0,08
2016	**2,28**	+1	0,357934847	0,357934847	0,374809585	2,370	0,09
2017	**2,43**	+2	0,385606273	0,771212547	0,385562833	2,430	0
2018	**2,57**	+3	0,409933123	1,229799370	0,396316081	2,491	0,08
2019	**2,60**	+4	0,414973348	1,659893392	0,407069329	2,553	0,05
2020	**2,61**	+5	0,416640507	2,083202537	0,417822577	2,617	0,01
TOTAL	**25,52**	0	4,004619712	1,1828573			0,39

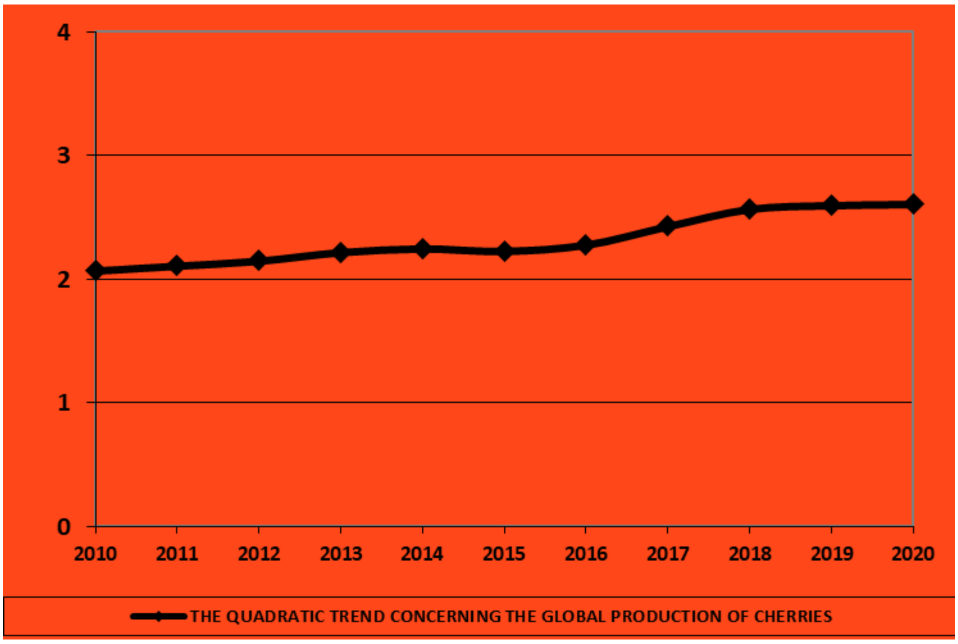
$$\lg a = \frac{4{,}004619716 \cdot 110}{11 \cdot 110} = 0{,}364056337 \qquad \lg b = \frac{11 \cdot 1{,}1828573}{11 \cdot 110} = 0{,}010753248$$

$$v_{\exp} = \left[\frac{\sum_{i=1}^{n} \left| \xi_i - \xi_{t_i}^{\exp} \right|}{n} : \frac{\sum_{i=1}^{n} \xi_i}{n} \right] \cdot 100 = \frac{\sum_{i=1}^{n} \left| \xi_i - \xi_{t_i}^{\exp} \right|}{\sum_{i=1}^{n} \xi_i} \cdot 100 = \frac{0{,}39}{25{,}52} \cdot 100 = 1{,}53\%$$

$$v_{II} = 1{,}49\% < v_{\exp} = 1{,}53\% < v_I = 1{,}68\%$$

The values regarding **the global production of cherries** reveal a quadratic „exposure" $\xi_{t_i} = a + b \cdot t_i + ct_i^2$

$$\xi_{2023}^{CHERRIES\_GLOBAL\_PRODUCTION} = 2{,}287715618 + 0{,}057909096 + 0{,}00322843828 \cdot 6^2 = 2{,}75\_millions\_tons$$
$$\xi_{2024}^{CHERRIES\_GLOBAL\_PRODUCTION} = 2{,}287715618 + 0{,}057909097 + 0{,}00322843828 \cdot 7^2 = 2{,}85\_millions\_tons$$
$$\xi_{2025}^{CHERRIES\_GLOBAL\_PRODUCTION} = 2{,}287715618 + 0{,}057909098 + 0{,}00322843828 \cdot 8^2 = 2{,}96\_millions\_tons$$



Graph 1 The quadratic „exposure" which unveils the global productions of cherries, between 2010-2020

3. The statistical investigation regarding the productions of cherries in Turkey, the leader at the worldwide level, which has as vectors the productions's predictions between 2023-2025

Table 5 The productions of cherries in Turkey between 2016-2020

YEARS	THE PRODUCTIONS OF CHERRIES TURKEY (1000 tons) (λ_i)
2016	**792,150**
2017	**809,006**
2018	**823,731**
2019	**846,389**
2020	**914,128**

Source: „Statista Portal the United States of America"

- if the operational management, which designates the trend's image for λ variable, where λ = **the production of cherries in Turkey***,* involves as specification a linear exposure, $\lambda_{t_i} = a + b \cdot t_i$, *a* and *b* can be [1]:

Table 6 The field of vision which unveils the values relative to the productions of cherries in Turkey, if these have a linear trajectory

YEARS	THE PRODUCTION OF CHERRIES TURKEY (1000 tons) (λ_i)	LINEAR TENDENCY				
		t_i	t_i^2	$t_i\lambda_i$	$\lambda_{t_i} = a + bt_i$	$\lvert\lambda_i - \lambda_{t_i}\rvert$
2016	**792,150**	-2	4	-1584,3	780,8130	11,337
2017	**809,006**	-1	1	-809,006	808,9469	0,0591
2018	**823,731**	0	0	0	837,0808	13,3498
2019	**846,389**	+1	1	846,389	865,2147	18,8257
2020	**914,128**	+2	4	1828,256	893,3486	20,7794
TOTAL	**4185,404**	0	10	281,339	**4185,404**	64,3510

$$a = \frac{\sum_{i=1}^{n}\lambda_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n}\lambda_i t_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{4185{,}404 \cdot 10}{5 \cdot 10} = 837{,}0808 \quad b = \frac{n\sum_{i=1}^{n}\lambda_i t_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n}\lambda_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{5 \cdot 281{,}339}{5 \cdot 10} = 28{,}1339$$

$$v_I = \left[\frac{\sum_{i=1}^{n}\left|\lambda_i - \lambda_{t_i}^I\right|}{n} : \frac{\sum_{i=1}^{n}\omega_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{n}\left|\lambda_i - \lambda_{t_i}^I\right|}{\sum_{i=1}^{n}\lambda_i} \cdot 100 = \frac{64{,}3510}{4185{,}404} \cdot 100 = 1{,}54\%$$

- if the operational management, which designates the trend's image for λ variable, where λ = **the production of cherries in Turkey***,* involves as specification a quadratic exposure, $\lambda_{t_i} = a + b \cdot t_i + ct_i^2$, *a* and *b* can be [1]:

Table 7 The field of vision which unveils the values relative to the productions of cherries in Turkey, if these have a quadratic trajectory

YEARS	THE PRODUCTION OF CHERRIES TURKEY (1000 tons) (λ_i)	PARABOLIC TENDENCY					
		t_i	t_i^2	t_i^4	$t_i^2\lambda_i$	$\lambda_{t_i} = a + bt_i + ct_i^2$	$\lvert\lambda_i - \lambda_{t_i}\rvert$
2016	**792,150**	-2	4	16	3168,600	796,4842857	4,334
2017	**809,006**	-1	1	1	809,006	801,1112572	7,895
2018	**823,731**	0	0	0	0	821,4095143	2,321
2019	**846,389**	+1	1	1	846,389	857,3790572	10,990
2020	**914,128**	+2	4	16	3656,512	909,0198857	5,108
TOTAL	**4185,404**	0	10	34	8480,507		30,648

$$a=\frac{\sum_{i=1}^{n}t_i^4\sum_{i=1}^{n}\lambda_i-\sum_{i=1}^{n}t_i^2\sum_{i=1}^{n}t_i^2\cdot\lambda_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{34\cdot 4185{,}404-10\cdot 8480{,}507}{5\cdot 34-10^2}=821{,}4095143$$

$$b=\frac{\sum_{i=1}^{n}\lambda_i t_i}{\sum_{i=1}^{n}t_i^{\,2}}=\frac{281{,}339}{10}=28{,}1339$$

$$c=\frac{n\cdot\sum_{i=1}^{n}t_i^2\cdot\lambda_i-\sum_{i=1}^{n}t_i^2\cdot\sum_{i=1}^{n}\lambda_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{5\cdot 8480{,}507-10\cdot 4185{,}404}{5\cdot 346-10^2}=7{,}835642857$$

$$v_{II}=\left[\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{II}\right|}{n}:\frac{\sum_{i=1}^{n}\lambda_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{II}\right|}{\sum_{i=1}^{n}\lambda_i}\cdot 100=\frac{30{,}648}{4185{,}404}\cdot 100=0{,}73\%$$

- if the operational management, which designates the trend's image for λ variable, where λ = **the production of cherries in Turkey**, involves as specification an exponential exposure, $\lambda_{t_i}=ab^{t_i}$ *, a* and *b* can be [1]:

$$\lg a=\frac{\sum_{i=1}^{n}\lg\lambda_i\sum_{i=1}^{n}t_i^{\,2}-\sum_{i=1}^{n}t_i\lg\lambda_i\sum_{i=1}^{n}t_i}{n\sum_{i=1}^{n}t_i^{\,2}-\left(\sum_{i=1}^{n}t_i\right)^2}=\frac{14{,}6111216\cdot 10}{5\cdot 10}=2{,}92222432$$

$$\lg b=\frac{n\cdot\sum_{i=1}^{n}t_i\lg\lambda_i-\sum_{i=1}^{n}\lg\lambda_i\sum_{i=1}^{n}t_i}{n\sum_{i=1}^{n}t_i^{\,2}-\left(\sum_{i=1}^{n}t_i\right)^2}=\frac{5\cdot 0{,}144017437}{5\cdot 10}=0{,}0144017437$$

Table 8 The field of vision which unveils the values relative to the productions of cherries in Turkey, if these have an exponential trajectory

YEARS	THE PRODUCTION OF CHERRIES TURKEY (1000 tons) (λ_i)	EXPONENTIAL TENDENCY					
		t_i	$\lg\lambda_i$	$t_i\ \lg\lambda_i$	$\lg\lambda_{t_i}=\lg a+t_i\lg b$	$\lambda_{t_i}=ab^{t_i}$	$\left\|\lambda_i-\lambda_{t_i}\right\|$
2016	**792,150**	-2	2,898807427	-5,797614853	2,893420833	782,3855720	9,764
2017	**809,006**	-1	2,907951743	-2,907951743	2,907822576	808,7654236	0,241
2018	**823,731**	0	2,915785410	0	2,922224320	836,0347320	12,304
2019	**846,389**	+1	2,927570010	2,927570010	2,936626064	864,2234851	17,834
2020	**914,128**	+2	2,961007012	5,922014023	2,951027807	893,3626821	20,765
TOTAL	**4185,404**	0	14,6111216	0,144017437			60,908

$$v_{\exp}=\left[\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{\exp}\right|}{n}:\frac{\sum_{i=1}^{n}\lambda_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{\exp}\right|}{\sum_{i=1}^{n}\lambda_i}\cdot 100=\frac{60{,}908}{4185{,}404}\cdot 100=1{,}45\%$$

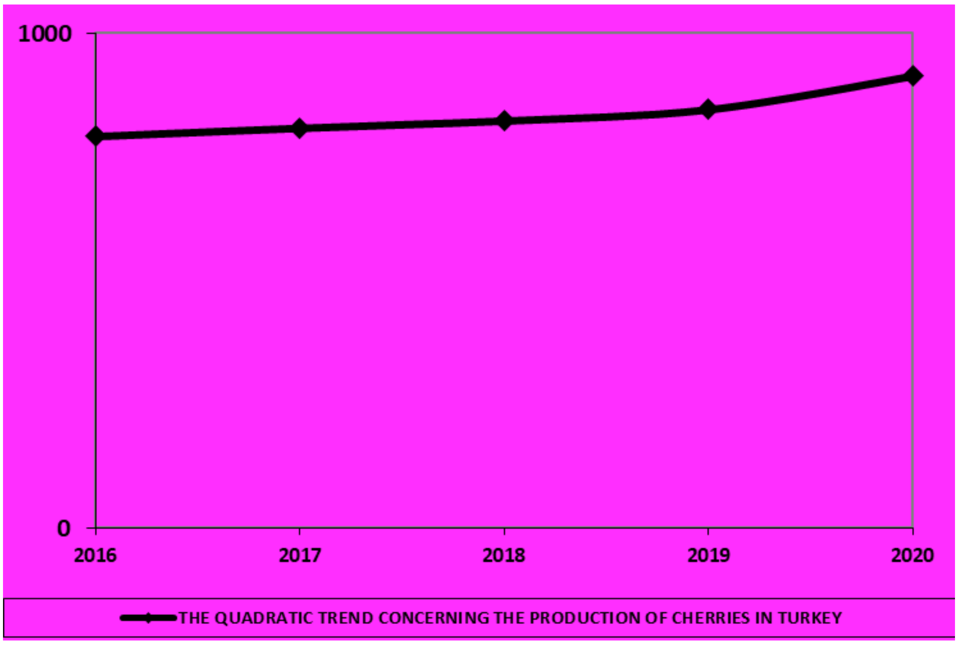
$$v_{II}=0{,}73\%<v_{\exp}=1{,}45\%<v_I=1{,}54\%$$

The values concerning **the production of cherries in Turkey** reveal a quadratic „exposure" $\lambda_{t_i}=a+b\cdot t_i+ct_i^2$

$$\lambda_{2023}^{TURKEY\_CHERRIES\_PRODUCTION}=821{,}4095143+28{,}1339\cdot 3+7{,}835642857\cdot 3^2=976{,}332\ \_(10^3\ tons)$$

$$\lambda_{2024}^{TURKEY\_CHERRIES\_PRODUCTION}=821{,}4095143+28{,}1339\cdot 4+7{,}835642857\cdot 4^2=1059{,}3154\ \_(10^3\ tons)$$

$$\lambda_{2025}^{TURKEY\_CHERRIES\_PRODUCTION}=821{,}4095143+28{,}1339\cdot 5+7{,}835642857\cdot 5^2=1157{,}970086\ \_(10^3\ tons)$$



Graph 2 The quadratic „exposure" which exhibits the productions of cherries in Turkey, between 2016-2020

4. The statistical investigation concerning the productions of cherries in Japan, which has as vectors the productions's predictions between 2023-2025

Table 9 The productions of cherries in Japan, between 2016-2020

YEARS	THE PRODUCTIONS OF CHERRIES JAPAN (1000 tons) (ω_i)
2016	**19,8**
2017	**19,1**
2018	**18,1**
2019	**16,1**
2020	**17,2**

Source: „Statista Portal the United States of America"

- if the operational management, which designates the trend's image for ω variable, where ω = **the production of cherries in Japan**, involves as specification a linear exposure, $\omega_{t_i} = a + b \cdot t_i$, a and b can be [1]:

Table 10 The field of vision which highlights the values referring to the productions of cherries in Japan, if these have a linear trajectory

YEARS	THE PRODUCTION OF CHERRIES JAPAN (1000 tons) (ω_i)	LINEAR TENDENCY				
		t_i	t_i^2	$t_i\omega_i$	$\omega_{t_i} = a + bt_i$	$\lvert\omega_i - \omega_{t_i}\rvert$
2016	**19,8**	-2	4	-39,6	19,70	0,10
2017	**19,1**	-1	1	-19,1	18,88	0,22
2018	**18,1**	0	0	0	18,06	0,04
2019	**16,1**	+1	1	+16,1	17,24	1,14
2020	**17,2**	+2	4	+34,4	16,42	0,78
TOTAL	**90,3**	0	10	-8,2	**90,3**	2,28

$$a = \frac{\sum_{i=1}^{n} \omega_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n} \omega_i t_i \sum_{i=1}^{n} t_i}{n \sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{90{,}3 \cdot 10}{5 \cdot 10} = 18{,}06 \qquad b = \frac{n \sum_{i=1}^{n} \omega_i t_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n} \omega_i}{n \sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{5 \cdot (-8{,}2)}{5 \cdot 10} = -0{,}82$$

$$v_I = \left[\frac{\sum_{i=1}^{n} \left| \omega_i - \omega_{t_i}^{I} \right|}{n} : \frac{\sum_{i=1}^{n} \omega_i}{n} \right] \cdot 100 = \frac{\sum_{i=1}^{n} \left| \omega_i - \omega_{t_i}^{I} \right|}{\sum_{i=1}^{n} \omega_i} \cdot 100 = \frac{2{,}28}{90{,}3} \cdot 100 = 2{,}53\%$$

- if the operational management, which designates the trend's image for ω variable, where ω = **the production of cherries in Japan***,* involves as specification a quadratic exposure, $\omega_{t_i} = a + b \cdot t_i + ct_i^2$, *a* and *b* can be [1]:

Table 11 The field of vision which highlights the values referring to the productions of cherries in Japan, if these have a quadratic trajectory

YEARS	THE PRODUCTION OF CHERRIES JAPAN (1000 tons) (ω_i)	PARABOLIC TENDENCY			
		t_i^4	$t_i^2\omega_i$	$\omega_{t_i} = a + bt_i + ct_i^2$	$\lvert\omega_i - \omega_{t_i}\rvert$
2016	**19,8**	16	79,2	20,07	0,27
2017	**19,1**	1	19,1	18,69	0,41
2018	**18,1**	0	0	17,69	0,41
2019	**16,1**	1	16,1	17,05	0,95
2020	**17,2**	16	68,8	16,79	0,41
TOTAL	**90,3**	34	183,2		2,45

$$a = \frac{\sum_{i=1}^{n} t_i^4 \sum_{i=1}^{n} \omega_i - \sum_{i=1}^{n} t_i^2 \sum_{i=1}^{n} t_i^2 \cdot \omega_i}{n\sum_{i=1}^{n} t_i^{\,4} - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{34 \cdot 90{,}3 - 10 \cdot 183{,}2}{5 \cdot 34 - 10^2} = 17{,}68857143 \qquad b = \frac{\sum_{i=1}^{n} \omega_i t_i}{\sum_{i=1}^{n} t_i^{\,2}} = -\frac{8{,}2}{10} = -0{,}82$$

$$c = \frac{n \cdot \sum_{i=1}^{n} t_i^2 \cdot \omega_i - \sum_{i=1}^{n} t_i^2 \cdot \sum_{i=1}^{n} \omega_i}{n\sum_{i=1}^{n} t_i^{\,4} - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{5 \cdot 183{,}2 - 10 \cdot 90{,}3}{5 \cdot 34 - 10^2} = 0{,}185714285$$

$$v_{II} = \left[\frac{\sum_{i=1}^{n} \left| \omega_i - \omega_{t_i}^{II} \right|}{n} : \frac{\sum_{i=1}^{n} \omega_i}{n} \right] \cdot 100 = \frac{\sum_{i=1}^{n} \left| \omega_i - \omega_{t_i}^{II} \right|}{\sum_{i=1}^{n} \omega_i} \cdot 100 = \frac{2{,}45}{90{,}3} \cdot 100 = 2{,}71\%$$

- if the operational management, which designates the trend's image for ω variable, where ω = **the production of cherries in Japan**, involves as specification an exponential exposure, $\omega_{t_i} = ab^{t_i}$, *a* and *b* can be [1]:

Table 12 The field of vision which highlights the values referring to the productions of cherries in Japan, if these have an exponential trajectory

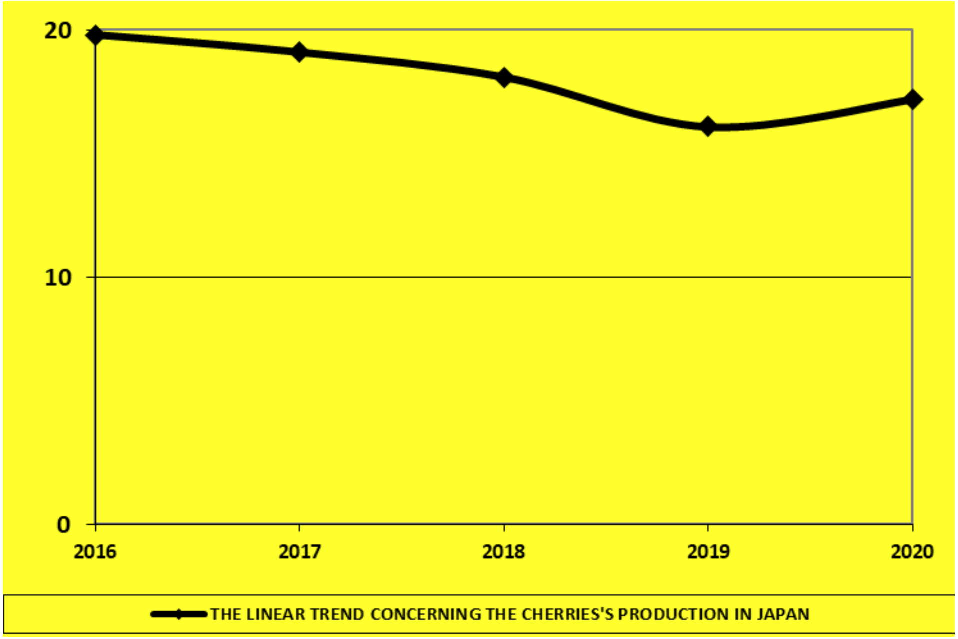
YEARS	THE PRODUCTION OF CHERRIES JAPAN (1000 tons) (ω_i)	EXPONENTIAL TENDENCY					
		t_i	$\lg\omega_i$	$t_i \lg\omega_i$	$\lg\omega_{t_i} = \lg a + t_i \lg b$	$\omega_{t_i} = ab^{t_i}$	$\lvert\omega_i - \omega_{t_i}\rvert$
2016	**19,8**	-2	1,296665190	-2,593330381	1,294842485	19,71707484	0,1
2017	**19,1**	-1	1,281033367	-1,281033367	1,275194388	18,84492390	0,3
2018	**18,1**	0	1,257678575	0	1,255546291	18,01135105	0,1
2019	**16,1**	+1	1,206825876	+1,206825876	1,235898194	17,21464987	1,1
2020	**17,2**	+2	1,235528447	+2,471056894	1,216250097	16,45318940	0,8
TOTAL	**90,3**	0	6,277731455	-0,196480978			2,4

$$\lg a = \frac{\sum_{i=1}^{n}\lg\omega_i\sum_{i=1}^{n}t_i^2 - \sum_{i=1}^{n}t_i\lg\omega_i\sum_{i=1}^{n}t_i}{n\sum_{i=1}^{n}t_i^2 - \left(\sum_{i=1}^{n}t_i\right)^2} = \frac{6,277731455\cdot 10}{5\cdot 10} = 1,255546291$$

$$\lg b = \frac{n\cdot\sum_{i=1}^{n}t_i\lg\omega_i - \sum_{i=1}^{n}\lg\omega_i\sum_{i=1}^{n}t_i}{n\sum_{i=1}^{n}t_i^2 - \left(\sum_{i=1}^{n}t_i\right)^2} = \frac{5\cdot(-0,196480978)}{5\cdot 10} = -0,019648097$$

$$v_{\exp} = \left[\frac{\sum_{i=1}^{n}\left|\omega_i - \omega_{t_i}^{\exp}\right|}{n} : \frac{\sum_{i=1}^{n}\omega_i}{n}\right]\cdot 100 = \frac{\sum_{i=1}^{n}\left|\omega_i - \omega_{t_i}^{\exp}\right|}{\sum_{i=1}^{n}\omega_i}\cdot 100 = \frac{2,4}{90,3}\cdot 100 = 2,66\%$$

$$v_I = 2,53\% < v_{\exp} = 2,66\% < v_{II} = 2,71\%$$



Graph 3 The linear „exposure" which unveils the cherries's productions in Japan, between 2016-2020

The values concerning **the cherries's production in Japan** reveal a linear „exposure" $\omega_{t_i} = a + b\cdot t_i$

$$\omega_{2023}^{CHERRIES\_PRODUCTION\_JAPAN} = 18,06 + (-0,82)\cdot 3 = 15,6\_(10^3\,tons)$$
$$\omega_{2024}^{CHERRIES\_PRODUCTION\_JAPAN} = 18,06 + (-0,82)\cdot 4 = 14,78\_(10^3\,tons)$$
$$\omega_{2025}^{CHERRIES\_PRODUCTION\_JAPAN} = 18,06 + (-0,82)\cdot 5 = 13,96\_(10^3\,tons)$$

5. Conclusions

We observe that, in the period 2023-2025, the global production of cherries will increase from 2,75 millions tons in 2023, from 2,96 millions tons in 2025. In the same horizon of time, the production of cherries will raise from 976,332 10^3 tons in 2023, to 1157,970086 10^3 tons in 2025. Also, we can see that, between 2023-2025, the production of cherries in Japan will decrease from 15,6 10^3 tons in 2023, to 13,96 10^3 tons in 2025.

The involvements in practice relative to this original statistical foray reside in to observe through predictions if, in the domains of production and trading as regards the cherries, can to appear phases of declin, which it means the emergences of the crisis and the prices's rises for these healthy fruits. We can specify that, the cherries outputs at worldwide level and in Turkey expose quadratic trend's shapes, towards the cherries yields in Japan which display a linear model and together depict in future the rises of the cherries yield.

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