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Exploring and analyzing records of export of some vegetables from different ports of India

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Abstract
It is well known that statistics and its mathematically derived and established methods are always reliable and applicable to explore past records in a way that many future decisions derived from, are very important for future planning for finance, marketing, and planning of production. In this paper the past export records of three successive years have been analyzed and studied to give better insight for decision making.
The content has been divided in two parts. The first part in which linear regression techniques help us derive future trends and the second one in which the coefficient of variations is used to measure consistency in export units of vegetables from different ports accounted in the records, are both of ultimate importance in term of future projection.

Keywords: linear trend, forecast, ports, vegetables, stability

Introduction

The content of this paper, as said earlier in abstract, has been classified in two parts. The paper targets at (1) Analyzing the export data of three years, 2014, 2015 and 2016. The data shows the units of different vegetable items (V_1, V_2, V_3, and V_4) exported from different active ports (P_1, P_2, and P_3). The data is shown in the annexure.
The first part of the data which is used for fitting a linear regression model is extended for estimating the amount in the near future years.
In the first part, we have fixed a port and a vegetable item exported from the port. What has been changing is the export quantity from January of a year to December of the same year. The years considered are 2014, 2015, and 2016. At the end, we get average units of one item exported from a particular port in a particular year. This, when subjected to statistical treatment helps derive linear trend. The same process is repeated for each vegetable item and from each active port.
The second part of the data is analysed that aims at measuring the stability / consistency of amount of vegetables on the basis of coefficient of variation. To put the same in procedural form, we have taken bi-monthly average for each vegetable item. Thus, we get for a fixed vegetable, year of export, exporting port and the destination port. We have six observations of bi-monthly averages and by using a unit free measure-coefficient of variation we shall be able to assess the stability of sales over a period of three years. It is known that the lowest positive value of the C.V. indicates consistency/stability of the item over the variability of other items. We can use this figure for comparison with C.V. of other vegetables items over the same period of time.

Part-I

In the following section, for a given port and a given vegetable as indicated below by the notation (P_1, V_1), we assume a linear trend and find a linear regression of different years over the annual average of export units. This will help us predict future trend also.

1) For the port P_1 and vegetable V_1:
{(P_1, V_1) Where P_1 = Mundra, V_1 = Bhindi
No. of years 1 = 2014, 2 = 2015, 3 = 2016}
Linear trend showing Average export

Table 1

Year(X)	Average (Y)	XY	X^2
1	10.33	10.33	1
2	14.33	28.66	4
3	17.25	51.75	9
$\sum X = 6$	$\sum Y = 41.91$	$\sum XY = 90.74$	$\sum X^2 = 14$

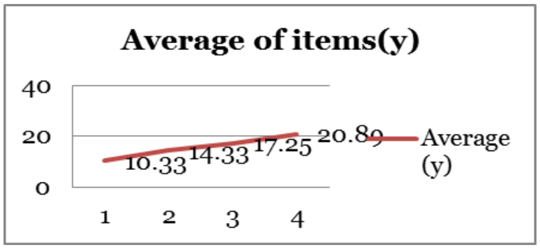

Fig 1

Here, we assume linear trend equation Y = ax + b and find normal equations,

$$Y = aX + b$$

$$\sum Y = a\sum X + 3b \therefore 41.91 = 6a + 3b \quad ...(1)$$
$$\sum XY = a\sum X^2 + b\sum X \therefore 90.74 = 14a + 6b \quad ...(2)$$

From equations (1) & (2) we get a = 3.46 and b = 7.05
So, the trend equation Y = ax + b, becomes Y = (3.46) X + 7.05

We use the above linear trend equation to find the forecast of the export for the year 2017 (x = 4).
Putting x = 4 in the above equation we get export forecast for the year 2017 which is Y = 20.89 units.

2) For the port P_1 and vegetable V_2
{(P_1, V_2) Where P_1 = Mundra, V_2 = Methi
No. of years 1 = 2014, 2 = 2015, 3 = 2016}
Linear trend showing Average export

Table 2

Year(X)	Average (Y)	XY	X^2
1	64.58	64.58	1
2	103.58	207.16	4
3	120.75	362.25	9
$\sum X = 6$	$\sum Y = 288.91$	$\sum XY = 633.99$	$\sum X^2 = 14$

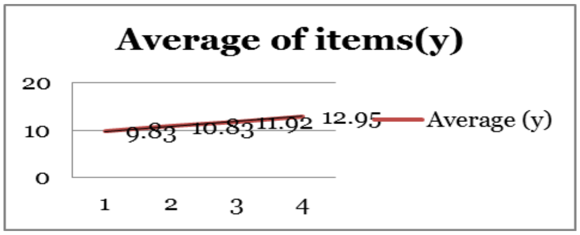

Fig 2

Here, we assume linear trend equation Y = ax + b and find normal equations

Y = aX + b

$\sum Y = a \sum X + 3b \therefore 288.91 = 6a + 3b$ ...(1)
$\sum XY = a\sum X^2 + b\sum X \ \therefore 633.99 = 14a + 6b$ ...(2)

From equations (1) & (2) we get a = 28.0 and b = 40.13
So, the trend equation Y = ax + b, becomes Y = (28.08) X + 40.13
We use the above linear trend equation to find the forecast of the export for the year 2017 (x = 4).
Putting x = 4 in the above equation we get export forecast for the year 2017 which Y = 152.45 units.

3) For the port P_1 and vegetable V_3
{(P_1, V_3) Where P_1 = Mundra, V_3 = Potatoes
No. of years 1 = 2014, 2 = 2015, 3 = 2016}
Linear trend showing Average export

Table 3

Year(X)	Average (Y)	XY	X^2
1	36.33	36.33	1
2	78.83	157.66	4
3	103	309	9
$\sum X = 6$	$Y = 218.16$	$\sum XY = 502.99$	$\sum X^2 = 14$

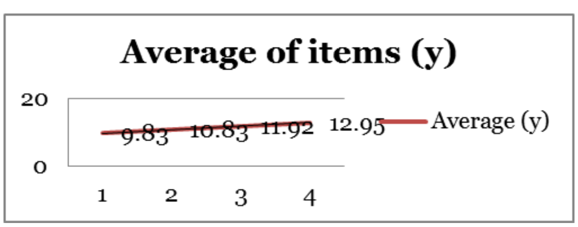

Fig 3

Here, we assume linear trend equation Y = ax + b and find normal equations,

Y = aX + b

$\sum Y = a \sum X + 3b \therefore 218.16 = 6a + 3b$ ...(1)
$\sum XY = a\sum X^2 + b\sum X \ \therefore 502.99 = 14a + 6b$ ...(2)

From equations (1) & (2) we get a = 33.33and b = 6.05
So, the trend equation Y = ax + b, becomes Y = (33.33) X + 6.05
We use the above linear trend equation to find the forecast of the export for the year 2017 (x = 4).
Putting x = 4 in the above equation we get export forecast for the year 2017 which Y = 139.37 units.

4) For the port P_1 and vegetable V_4
{(P_1, V_4) Where P_1 = Mundra V_4 = Karela
No. of years 1 = 2014, 2 = 2015, 3 = 2016}
Linear trend showing Average export

Table 4

Year(X)	Average (Y)	XY	X^2
1	9.83	9.83	1
2	10.83	21.66	4
3	11.92	35.76	9
$\sum X = 6$	$\sum Y = 32.58$	$\sum XY = 67.25$	$\sum X^2 = 14$

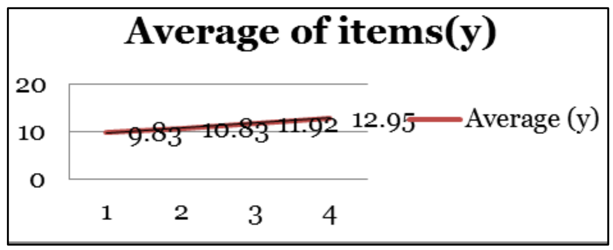

Fig 4

Here, we assume linear trend equation Y = ax + b and find normal equations,

Y = aX + b

$\sum Y = a \sum X + 3b \therefore 32.58 = 6a + 3b$ ...(1)
$\sum XY = a\sum X^2 + b\sum X \ 67.25 = 14a + 6b$ ...(2)

From equations (1) & (2) we get a = 1.045 and b = 8.77
So, the trend equation Y = ax + b, become Y = (1.045) X + 8.77
We use the above linear trend equation to find the forecast of the export for the year 2017 (x = 4).
Putting x = 4 in the above equation we get export forecast for the year 2017 which Y = 12.95units.
Similarly we have considered the different ports P_2 (Nahva Sheva) and P_3 (Bombay air cargo).
We have found the linear trend of forecast of each of the vegetables (V_1, V_2, V_3, and V_4) exported from each of the ports (P_1, P_2, and P_3). This helps us find the linear forecast of each vegetable. To represent the output in the compact form we put it in the tabular form as follows.
[Please refer to Annexure.]

5) Predicted forecast of different vegetables in the year span-2017

Table 5

Vegetables↓ /Ports→	Port 1-Mundra	Port 2- Nahva Sheva	Port 3- Bombay air cargo
V_1-Bhindi	20.89	26.12	-130.33 *
V_2 - Methi	152.45	116.82	-21.93 *
V_3-Potatoes	139.37	133.57	9.47
V_4-Karela	12.95	25.97	-105.38 *

* Negative values show downward trend if the uniform pattern is maintained.

Part II

Here we have taken bi-monthly averages of the data and have found the coefficient of variations. Here we have taken three different ports (P_1 = Mundra, P_2 = Nhava sheva, P_3= Bombay air cargo) And three different vegetables: (V_1 = Bhindi, V_2 = Methi, V_3 = Potatoes)

(P_1, V_1) Where P_1 = Mundra, V_1 = Bhindi

Table 6

Bimonthly avg.	1st	2nd	3rd	4th	5th	6th	Total
2014	5	13	11	12	12	9	62
2015	10	12	14	16.5	15	18.5	86
2016	19.5	16	20.5	17.5	18.5	11.5	103.5

Now, we find C.V. for the year 2014. Here, $\bar{x}$ = 10.33

Table 7

Division	Bi-monthly Average x_i	$xi - \bar{x}$	$(xi - \bar{x})^2$
1	5	-5.33	28.41
2	13	2.67	7.13
3	11	0.67	0.45
4	12	1.67	2.79
5	12	1.67	2.79
6	9	-1.33	1.77
Total	$\sum x_i = 62$		$\sum(\text{xi} - \bar{\text{x}})^2 = 43.34$

We find the average of these bi-monthly averages.

Here, n = 6, Σx = 62, ∴ $\bar{x} = \frac{62}{6}$ = 10.33 units

Now we find standard deviation using the formula $s = \sqrt{\frac{\sum(xi-\bar{x})^2}{6}}$ = 2.68 units

Using the above values of $\bar{x}$ and s, we find $CV_1 = \frac{s}{\bar{x}}$ = 0.2564

[CV_1: This indicates coefficient of variation for the year 2014, keeping the port –1 and vegetable-1 fixed. In the same way we find coefficient of variations for the year 2015 and 2016 under the same condition. We denote them as CV_2 and CV_3. These CV's are calculated on the basis of bi-monthly averages for each year.]

So, from above data the CV_2 = 0.1946 and CV_3 = 0.1704.

1) For the remaining data we have found the C.V. which is as follow,

The cells in the following table shows CV under the case of three variables; P –ports (P_1, P_2, P_3), V – vegetables (V_1, V_2, V_3) and years – 2014, 2015, 2016.

The data of the table help us take multiple decisions for consistency in exploring ports, vegetables and different years. The table given below has proved very important in deriving multiple decisions.

Table 8

Vegetables items	V_1			V_2			V_3		
year→ Port ↓	(2014)cv_1	(2015)cv_2	(2016)cv_3	(2014)cv_1	(2015)cv_2	(2016)cv_3	(2014)cv_1	(2015)cv_2	(2016)cv_3
P_1	0.2564	0.1946	0.1704	0.050	0.2476	0.2055	0.2518	0.29	0.1427
P_2	0.1099	0.095	0.3193	0.1741	0.1431	0.1949	0.499	0.2422	0.1714
P_3	0.7653	0.5581	0.5852	0.6318	0.38	0.5944	0.4523	0.22	0.2622

CV_1 = 2014, CV_2 = 2015, CV_3 = 2016

Case- I

Here, we keeping vegetables and ports as a constant the contents of the table help us predict the year in which consistent export has been achieved. To illustrate what we exactly want to convey, here is an example.

For the port –P_1, and vegetable- V_1, the year 2016 has proved consistent as its c.v, is the least among the three different c.v.s [(year – cv) (2014-0.2564, 2015-0.1946, 2016-0.1704)]

In the same way we can decisions for each vegetable and for each year. We have on list 9 such results. We can derive further conclusion also. In the same reference we can have;

Case-II

Here, we keep vegetables and years as a constant and we check the stability for the different ports:

For the Year-2014, and vegetable- V_1, the port -2(P_2) has proved consistent as its c.v, is the least among the three different c.v.s [(Ports – cv) (P_1-0.2564, P_2-0.1099, P_3-0.7953)]

Case-III

Here, we keep port and year as a constant and we check the stability for the different vegetables:

For the port –P_1, and year- 2014, the vegetable –2(V_2)has proved consistent as its c.v, is the least among the three different c.v.s [(Vegetables – cv) (V_1-0.2564, V_2-0.050, V_3-0.2518)]

Notations and Abbreviations

Ports: P1: Mundra, P2: Nahva Sheva, P3: Bombay air cargo

Name of Vegetables: V1: Bhindi, V2: Methi, V3: Potatoes, V4: Karela

Assumptions

The followings are the assumptions logically accepted to be followed in the procedure of handling current export data.

1) The demand pattern of different countries for importing considered in the data remains within a normal limit of fluctuation.
2) The export plans of different vendors exporting from selected ports to selected destinations (as the orders are received) do not change on a large scale.

Conclusion

The content of this paper which uses the past records of three years in export related data of particular vegetables items has focused attention to two major conclusion that the manufacturing units which are in the vicinity of the port of export has better scopes of export and their stability in export area either remains steady or increase over a period of time.

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