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Export (vegetables) related queries answered by fitting statistical distribution

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Abstract
Global economy is, on an average and in general, associated with economy with each country. In this era any country cannot be self- supported without exporting with surplus production of what it produces or import of commodities and/or merchandize of its deficit or in capabilities of meeting with what it genuinely requires. In this note, we have devised statistical routines that analyses the given pattern of three years' export data of vegetables from different selected ports and represented them graphically. Further, on fitting proper discrete distribution we have found probability of export, as requested or specific enquiries of export merchants, of items greater than some specific data values. This helps planning, and production in different time slots and of different export worthy items.

Keywords: global economy, production, probability, statistical distribution

1. Introduction
As said earlier, in this note, we analyze the past records of different export of frozen vegetables having the highest demand and so in turn possess higher probabilities of export orientedness. We have selected three items (Potatoes, Methi and Karela) and collected corresponding export (units) data from different ports (Nahva sheva and Mundra) to some selected counties. The data ranges from 2014 up to 2016 spread over all 12 months for each year. This allows us to prepare 3 different tables. [Export data from a given port, for a given item in each one of the years 2014, 2015 and 2016 which range over all the months from January to December]
A step towards our objective is to make graphical presentation of data encompassing in each one of the different table.
Using the past records in tabular form and graphical presentation, we are able to derive statistical facts. In some cases it is important and highly necessary to enhance the results to real life situation problem. Its importance is only preserved when its application can be in vast area.
We thought on the same lines and searched for its application orientedness. During the same period we were confronted by some likely questions aroused from management authorities of some export units. The problems they faced and finally arrived to our desk were about the production of the items on hand. We faced their problems about the units of production of the three Vegetables (Potatoes, Methi and Karela) some frozen Vegetables export oriented vegetables that fall in frozen vegetables class items being exported by different vegetables industries from different ports to different countries.

The related questions were about

(i) Likely/probable demands that arise from time to time in different months from different ports that we have selected for the study purpose and they form a marginable segment of total quantum of export during a given time zone.
It was required to answer the question as in the production linkage, for the producers, it is a question of purchase of raw material, setup of machinery, and employment of labor force in stipulated time frame.
At the same time, required as per packing specifications directed by buyers and in addition, following the corresponding legal formalities and logistics to be followed as per the condition specified in the L.C (letter of credit) were associated problems. All these factors were highly necessary as to meet with buyers' line up with different vessels scheduled from different ports.
All these factors when taken on account, frame a highly attainable problem and hence the proper technical analysis is necessary to provide guidance considering all possible angles.

(ii) The next question confronted by us was to search for enhancing on export capability in a given period of time that helps plan production in stipulated time frame.
In the case where the buyers do not specify dispatch instructions with their order, the responsibility becomes
Part of export formalities of the exporter or to the export division of the company.
All these points have inspired us to work on in a direction that is capable enough to answer to all questions pertaining to this area.

2. Graphical presentation and Comprehensive Deduction
We have sufficient data to be classified as we have many variables and sub variables within that pop up at a time in the data. Source of the main variables on hand are: (1) Export item (2) Port of export (3) a list of companies involved in export business (4) Share of individual company in the total

export (5) month and year (6) Importing countries.
In fact, exhaustive classification and the technique of PCA (Principle Component Analysis) can help us arrive
At major decision, may be without loss of generality, in such cases.

2.1 Tabulation and Graphs

We have, as discussed above, three main points/ variables. They are

1. (Export) Vegetables: Potatoes, Methi and Karela
2. (Export) quantity: As shown in the table for each item
3. Time / year: January to December and 2014, 2015 and 2016

As discussed in above units the export quantity (in terms of '000 units) is a gross which is the total amount of export units made by different companies operating in the same business. To analyze further, we have worked on in the same line. This work shall appear very shortly.
As obtained from semi-official sources, there are four major companies engage in this business. Just in order to preserve privacy we code them in alphabetical order. In order not to diverge more from the current topic, in brevity, we analyze the export details for a particular month of a particular year described below,

1) Item: Potato
Highest Export: March 2014, June 2015, April, May, and June 2016
Export Amount: 65 units, 90 units, 110 units

Table 1

Companies↓ \Year→	2014	2015	2016
A_1	30	42	52
A_2	21	24	30
A_3	09	14	15
A_4	05	10	13
Total	65	90	110

The export data for each item has been tabulated below and for the classical deduction have been formatted in graphical mode of presentation. In our case three different tables and corresponding
Graphs have considered. Tables and graphs have been coded.

Item: Potato Port: Mundra
Export in terms of '000 units

	X1	X2	X3	
	2014	2015	2016	
January	27	38	100	
Feb.	36	63	101	
March	65	80	110	
Apr.	47	88	110	
May	33	79	110	
June	56	90	99	
July	55	80	105	
Aug.	39	90	97	
Sep.	45	103	100	
Oct.	33	89	85	
Nov.	29	57	55	
Dec.	36	96	100	
				Grand Total
Σx	501	953	1172	2626
			Avg.	72.944

Graphical presentation of Export

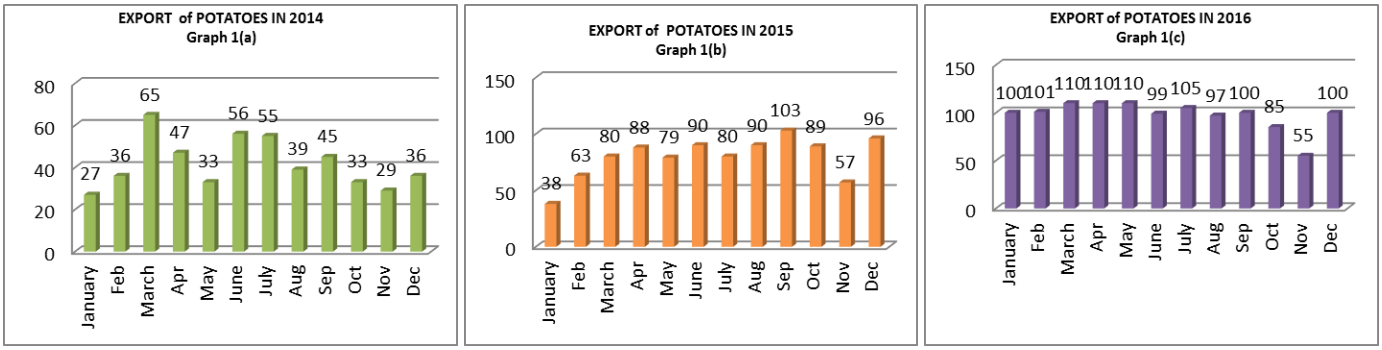

Fig 1

Some important Deductions from the Graphs:

1. In each year there are on an average three to four months where in the export quantities exceed that of the remaining months.
2. Export quantities increase steadily increase in each successive year and this appears in corresponding Months of each year also.

2) Items: Methi
Highest Export: 2014 December, October 2015, April, and September 2016
Export Amount: 99 units, 135 units, 140 units

Table 2

Companies↓ \Year→	2014	2015	2016
A_1	24	33	20
A_2	26	15	75
A_3	30	54	37
A_4	19	33	8
Total	99	135	140

The export data for each item has been tabulated below and for the classical deduction have been formatted in graphical mode of presentation. In our case three different tables and corresponding
Graphs have considered. Tables and graphs have been coded.

Item: Methi, Port: Mundra
Export in terms of '000 units

	X1	X2	X3	
	2014	**2015**	**2016**	
January	54	64	90	
Feb.	53	72	117	
March	65	94	134	
Apr.	45	100	135	
May	51	97	134	
June	68	102	122	
July	66	115	130	
Aug.	51	129	134	
Sep.	98	125	140	
Oct.	66	135	132	
Nov.	76	100	50	
Dec.	99	122	102	
				Grand Total
Σx	792	1255	1420	3467
			Avg.	96.30555

Graphical presentation of Export

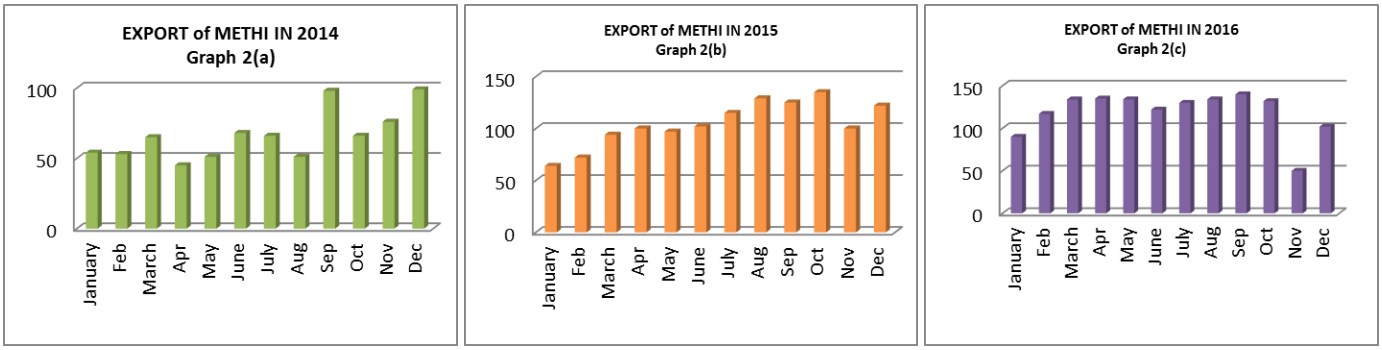

Fig 2

Some important Deductions from the Graphs:

1. In each year there are on an average three to four months where in the export quantities increase and decrease that of the remaining months.
2. Export quantities increase and decrease in each successive year and this appears in corresponding Months of each year also.

3) Item: Karela

Highest Export: 2014 March, October 2015, and September 2016

Export Amount: 47 units, 40 units, 40 units

Table 3

Companies↓ \Year→	2014	2015	2016
A_1	11	9	13
A_2	9	8	11
A_3	10	17	8
A_4	17	6	8
Total	47	40	40

The export data for each item has been tabulated below and for the classical deduction have been formatted in graphical mode of presentation. In our case three different tables and corresponding.

Graphs have considered. Tables and graphs have been coded.

Item: Karela, Port: Nahva sheva
Export in terms of '000 units

	X1	X2	X3	
	2014	**2015**	**2016**	
January	24	20	21	
Feb.	24	30	35	
March	47	27	30	
Apr.	32	23	26	
May	21	31	20	
June	37	35	29	
July	29	24	29	
Aug.	33	30	26	
Sep.	30	32	40	
Oct.	33	40	37	
Nov.	20	18	20	
Dec.	23	36	20	
				Grand Total
Σx	353	346	333	1032
			Avg.	28.66666

Graphical presentation of Export

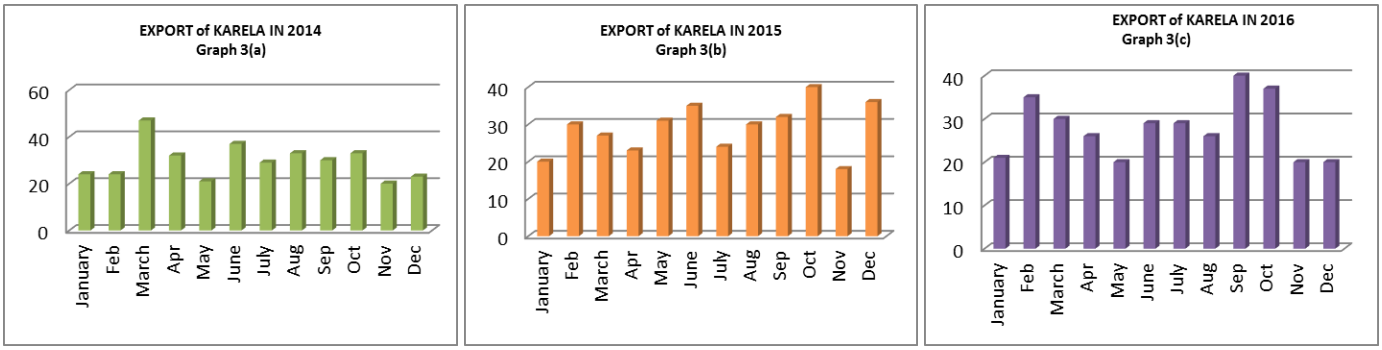

Fig 3

Some important Deductions from the Graphs:

1. In each year there are, on an average, three to four months where in the export quantities increase and decrease that of the remaining months.
2. Export quantities increase and decrease steadily in each successive year and this appears in corresponding
3. Months of each year also.

2.2 Search for a distribution

Now to face basic questions that arose while continuing with our work, we thought of applying a theoretical distribution and the best in this situation is the 'Uniform Distribution' within the given range of each item our proceedings are as follows.

$$E(x^r) = \sum_{x=a+1}^{b} x^r \cdot (1/(b-a)) \qquad (1)$$

where r = 1, 2, 3, ……..
for r=1 we get E(x)= Population Mean

$$= 1/(b-a) * [(a+1) + (a+2) + \ldots\ldots b]$$
$$= \frac{1}{b-a}\left[\left(\frac{b-a}{2}\right)(b+a+1)\right]$$
$$\therefore E(x) = \frac{1}{b-a}[S_n]$$

The given bracketed expression is an A.P. with a = a+1, d = 1, and n= b-a using summation formula we have,

$$S_n = \frac{n}{2}(2a + (n-1)\,d)$$
$$= \left(\frac{b-a}{2}\right)(2(a+1) + (n-1)(1))$$
$$= \left(\frac{b-a}{2}\right)(a+b+1)$$
$$\therefore S_n = \left(\frac{b-a}{2}\right)(b+a+1)$$

$\therefore$ Substituting this value, we get $E(x) = \frac{1}{b-a}\left[\left(\frac{b-a}{2}\right)(b+a+1)\right]$

$$\therefore \mu_1' = \text{Population Mean} = \frac{b+a+1}{2} \qquad (2)$$

$$\mu_2' = E(x^2) = \sum_{x=a+1}^{b} \frac{x^2}{b-a} = \frac{1}{b-a}\sum_{x=a+1}^{b} x^2$$

Second row moment

$$\sum_{x=a+1}^{b} x^2 = \sum_{x=1}^{b} x^2 - \sum_{x=1}^{b} x^2$$
$$= \frac{b(b+1)(2b+1)}{6} - \frac{a(a+1)(2a+1)}{6} \qquad (3)$$

Replacing population moment by sample moment using (2) & (3)

$$\bar{x} = m_1' = \frac{a+b+1}{2}, \text{ and so } \mathbf{b = 2\bar{x} - a - 1,} \qquad (4)$$

Where a & b are parameters

$$E(x^2) = \frac{\sum x_i^2}{36}$$

P(x) = x > k_1 **P(x)** = $\frac{1}{b-a}$ *(b-x)

For v_1, v_2 & v_3 fixed k_1 & k_2 say the distribution of units exported is *rectangular distribution*
P(X=x) = p(x) (Discrete uniform distribution)
X = a+1, a+2, ……., b where a & b are the parameters of distribution.

POTATOES

Table 4: Probability of Export

a	b	X	p(x)
24	120	30	0.9375
24	120	40	0.833333
24	120	50	0.729167
24	120	60	0.625
24	120	70	0.520833

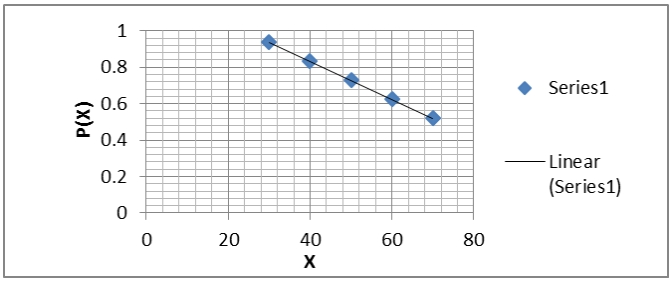

Fig 4: Graphical presentation for probability of Export (Potato)

METHI

Table 5: Probability of Export

a	b	x	p(x)
43	149	50	0.933962
43	149	60	0.839623
43	149	70	0.745283
43	149	80	0.650943
43	149	90	0.556604

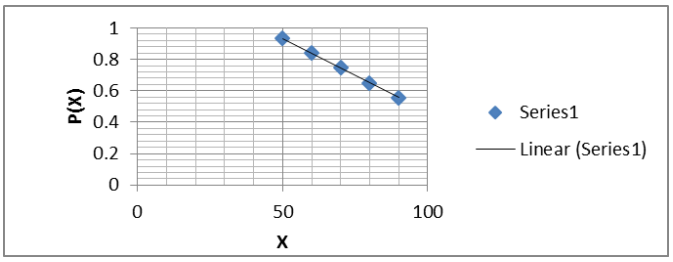

Fig 5: Graphical presentation for probability of Export (Methi)

KARELA

Table 6: Probability of export

a	b	x	p(x)
16	40	20	0.833333
16	40	24	0.666667
16	40	28	0.5
16	40	32	0.333333
16	40	36	0.166667

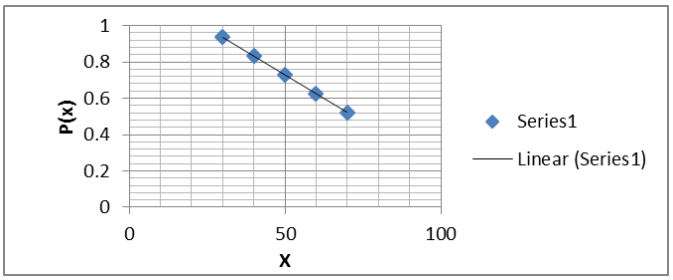

Fig 6: Graphical presentation for probability of Export (Karela)

2.3 Comprehensive Study

Simultaneous movements of graphs imposed on one graph sheet help us derive better decisions from comparative studies of different graphs drawn for each item on agenda. It is our basic purpose to make prediction regarding export of certain items and counseling export merchants. The following tables and graphs establish our efforts.

Intersecting Graph all vegetables

Table 7

x	P(X)1	P(X)2	P(X)3
20	0.9375	0.933962	0.833333
50	0.83333	0.839623	0.666667
80	0.729167	0.745283	0.5
110	0.625	0.650943	0.333333
130	0.520833	0.556604	0.166667

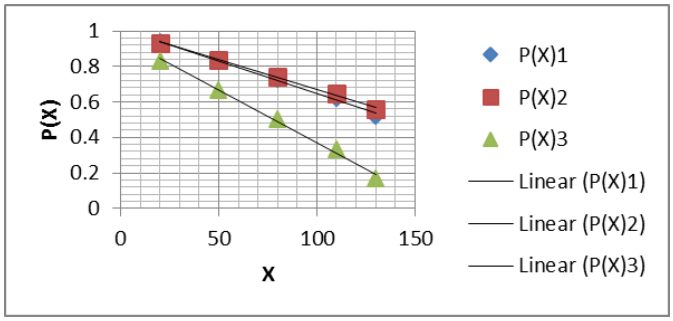

Fig 7: Intersecting graph of probability for all vegetables

Important Deduction

The above depicted tabular data and its corresponding graph help us Derive important conclusions regarding suggestions of likely movements in export.

1. The entire graphs show decreasing trend as the export quantities increase.
2. That the trend in decline of export in Potatoes and Methi is closer to that one in Karela.
3. The decline rate in Potatoes and Methi remains constant.

These findings above help us in production activities and resolving export related queries.

3. Conclusion

The contents in the proceedings above have constructively helped us derive important inferences related to data analysis and the different types of queries raised by different vendors engaged in the export area. The queries related to actually real life situations have proved useful and constructive in applications in the area that we work in.

4. Vision

That what we have learnt from the findings above have inspired us to continue in the same direction keeping focus on exports made from different ports of varied items to major countries.

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