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CONSTRUCTION OF VARIANCE BALANCED DESIGNS

PRAVENDER⁽¹⁾ B. L. PATEL⁽²⁾

ABSTRACT

This paper provide methods of construction of variance balanced (VB) designs using balanced incomplete block (BIB) designs and two-associate-class partially balanced incomplete block (2-PBIB) designs.

KEY WORDS

BIB design, 2-PBIB design, VB design, binary and non-binary designs, augmented design, kronecker product of matrices.

1. INTRODUCTION

Understanding the significance of non-equireplicate, non-proper VB designs, many have contributed in the construction of such designs. John (1964) constructed binary and ternary VB designs starting with a BIB design. Kulshreshtha, et al. (1972) generalized the method of John (1964). Augmented designs were introduced by Federer (1961). Das (1958), explaining the significance, introduced reinforced incomplete block designs and gave reinforced BIB design. As a significant contribution, Das and Ghosh (1985) introduced general efficiency balanced (GEB) designs unifying BIB designs, VB and EB designs and constructed new VB and EB designs using the technique of reinforcement. Kageyama and Mukerjee (1986) gave characterization of construction of GEB designs, non-existence theorem and unified method of construction of GEB designs. The basic approach in all such designs is to augment any standard design with a new set of treatments. In the literature a wide range of methods of construction of VB designs is available. Here we give new methods for the construction of VB designs using BIB designs and 2-PBIB designs. Note that serial numbers of 2-PBIB designs are according to Clatworthy (1973).

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2. NOTATIONS

Notations used in the present paper are given below :

\otimes : sign of kronecker product

$\mathbf{1}'_p \otimes N$: p replications of N

I_p : identity matrix of order p

$J_{p \times q}$: matrix of ones of order $p \times q$

$\mathbf{1}_p$: $p \times 1$ column vector of ones

$\mathbf{1}'_p$: $1 \times p$ row vector of ones

$O_{p \times q}$: null matrix of order $p \times q$

3. METHODS OF CONSTRUCTION

In this section, we describe methods of construction of binary and non-binary VB designs making use of the incidence matrices of BIB designs and 2-PBIB designs.

Theorem 3.1 : Let N_1 be the incidence matrix of a BIB design D_1 with parameters v, b, r, k, λ , then

$$N = \begin{bmatrix} x\mathbf{1}'_p \otimes N_1 & y\mathbf{1}'_{(2t-1)} \otimes I_{(v-1)} & O_{(v-1) \times t} \\ & O_{1 \times (2t-1)} \otimes I_{(v-1)} & z\mathbf{1}'_t \\ O_{(2t-1) \times pb} & u\mathbf{1}'_{(2t-1)} \otimes \mathbf{1}'_{(v-1)} & wJ_{(2t-1) \times t} \end{bmatrix} \quad \dots(3.1)$$

is the incidence matrix of a VB design D with parameters $v' = (v + 2t - 1)$, $b' = \{pb + (2t - 1)(v - 1) + t\}$, $r' = \{xpr + y(2t - 1)\mathbf{1}'_{(v-1)}, (xpr + zt), \{u(v - 1) + wt\}\mathbf{1}'_{(2t-1)}\}$ and $k' = \{xk\mathbf{1}'_{pb}, (y + u)\mathbf{1}'_{(2t-1)} \otimes \mathbf{1}'_{(v-1)}, \{z + w(2t - 1)\}\mathbf{1}'_t\}$, where x, p, y, u, w, z and $t (\geq 2)$ are positive integers to be selected such that

$$\frac{xp\lambda}{k} = \frac{uy}{(y+u)} = \frac{wzt}{\{z+w(2t-1)\}} = \frac{w^2t}{\{z+w(2t-1)\}}$$

Proof : Evidently the off-diagonal elements of the $C = (c_{ij})$ matrix of are :

$$c_{ij} = \frac{x^2 p \lambda}{xk} = \frac{xp\lambda}{k} \quad ; (i, j \leq v - 1 \text{ and } i \neq j) \text{ and } (i \leq v - 1 \text{ and } j = v)$$

$$c_{ij} = \frac{uy}{(y+u)} \quad ; i \leq v - 1 \text{ and } j \geq v + 1,$$

$$c_{ij} = \frac{wzt}{\{z + w(2t-1)\}} \quad ; i = v \text{ and } j \geq v + 1$$

$$c_{ij} = \frac{w^2t}{\{z + w(2t-1)\}} \quad ; i, j \geq v + 1 \text{ and } i \neq j$$

By Rao (1958) we get the required result upon equating off-diagonal elements.

Example 1 : Let N_1 be the incidence matrix of a BIB design with parameters (5, 10, 4, 2, 1). Then taking $p = u = w = x = y = z = 1$ and $t = 3$ the design with incidence matrix N as in (3.1) is a **binary** VB design with parameters $v' = 10$, $b' = 33$, $r' = \{91'_4, 71'_6\}$, $k' = \{21'_{30}, 61'_3\}$.

Example 2 : Let N_1 be the incidence matrix of a BIB design with parameters (16, 20, 5, 4, 1). Then taking $p = u = w = y = z = 1$ and $x = t = 2$ the design with incidence matrix N as in (3.1) is a **ternary** VB design with parameters $v' = 19$, $b' = 67$, $r' = \{131'_{15}, 12, 171'_3\}$, $k' = \{81'_{20}, 21'_{45}, 41'_2\}$.

Example 3 : Let N_1 be the incidence matrix of a BIB design with parameters (8, 14, 7, 4, 3). Then taking $p = 1$, $u = 6$, $w = 3$, $x = y = t = 2$ and $z = 3$ the design with incidence matrix N as in (3.1) is a **four-ary** VB design with parameters $v' = 11$, $b' = 37$, $r' = \{201'_8, 481'_3\}$, $k' = \{81'_{35}, 121'_2\}$.

Theorem 3.2 : Let N_1 be the incidence matrix of a BIB design D_1 with parameters v, b, r, k, λ , then

$$N = \begin{bmatrix} x\mathbf{1}'_p \otimes N_1 & y\mathbf{1}'_t \otimes I_{(v-1)} & O_{(v-1) \times t} \\ & O_{1 \times t(v-1)} & z\mathbf{1}'_t \\ O_{r \times pb} & u\mathbf{1}'_{t(v-1)} & wJ_t \end{bmatrix} \quad \dots(3.2)$$

is the incidence matrix of a VB design D with parameters $v' = (v + t)$, $b' = \{pb + t(v - 1) + t\}$, $r' = [(xpr + yt)\mathbf{1}'_{(v-1)}, (xpr + zt), \{ut(v - 1) + w\}\mathbf{1}'_t]$ and $k' = \{xk\mathbf{1}'_{pb}, (y + ut)\mathbf{1}'_{t(v-1)}, (z + w)\mathbf{1}'_t\}$, where x, p, y, u, w, z and $t (\geq 2)$ are positive integers to be selected such that

$$\frac{xp\lambda}{k} = \frac{uyt}{(y+ut)} = \frac{wz}{(z+w)} = \frac{u^2t(v-1)}{(y+ut)}$$

Proof : Can be proved on similar lines of the proof of Theorem 3.1.

Example 4 : Let N_1 be the incidence matrix of a BIB design with parameters (4, 6, 3, 2, 1). Then taking $p = w = y = z = t = 3$ and $u = x = 1$ the design with incidence matrix N as in (3.2) is a **ternary** VB design with parameters $v' = 7, b' = 30, r' = \{181'_4, 121'_3\}, k' = \{21'_{18}, 61'_{12}\}$.

Theorem 3.3 : Let N_1 and N_2 be the incidence matrices of 2-PBIB designs D_1 and D_2 whose parameters are respectively given by $v, b, r, k, \lambda_1, \lambda_2, n_1, n_2$ and $v^*, b^*, r^*, k^*, \lambda_1^*, \lambda_2^*, n_1^* = n_1, n_2^* = n_2$, then

$$N = \begin{bmatrix} x\mathbf{1}'_p \otimes N_1 & g\mathbf{1}'_p \otimes N_2 & y\mathbf{1}'_{(2t-1)} \otimes I_{(v-1)} & O_{(v-1) \times t} \\ & & O_{t \times (2t-1)(v-1)} & z\mathbf{1}'_t \\ O_{(2t-1) \times (pb+qb^*)} & & u\mathbf{1}'_{(2t-1)} \otimes \mathbf{1}'_{(v-1)} & wJ_{(2t-1) \times t} \end{bmatrix} \quad \dots(3.3)$$

is the incidence matrix of a VB design D with parameters $v' = (v + 2t - 1), b' = \{pb + qb^* + (2t - 1)(v - 1) + t\}, r' = \{[xpr + gqr^* + y(2t - 1)]\mathbf{1}'_{(v-1)}, (xpr + gqr^* + yt), [u(v - 1) + wt]\mathbf{1}'_{(2t-1)}\}$ and $k' = [xk\mathbf{1}'_{pb}, gk^*\mathbf{1}'_{qb^*}, (y + u)\mathbf{1}'_{(2t-1)(v-1)}, \{z + w(2t - 1)\}\mathbf{1}'_t]$, where x, p, g, q, y, u, w, z and $t (\geq 2)$ are positive integers to be selected such that

$$\frac{xp\lambda_1}{k} + \frac{gq\lambda_1^*}{k^*} = \frac{xp\lambda_2}{k} + \frac{gq\lambda_2^*}{k^*} = \frac{uy}{(y+u)} = \frac{wzt}{\{z+w(2t-1)\}} = \frac{w^2t}{\{z+w(2t-1)\}}$$

Proof : Can be proved on similar lines of the proof of Theorem 3.1.

Example 5 : Consider two 2-PBIB triangular designs $D_1(T1)$ and $D_2(T2)$ with same number of treatments and same association scheme having parameters $v = 10, b = 30, r = 6, k = 2, \lambda_1 = 1, \lambda_2 = 0, n_1 = 6, n_2 = 3$ and $v^* = 10, b^* = 15, r^* = 3, k^* = 2, \lambda_1^* = 0, \lambda_2^* = 1, n_1^* = 6, n_2^* = 3$, respectively. The block contents of D_1 and D_2 are (1,2), (3,4), (5,9), (6,7), (8,10), (1,3), (2,9), (4,7), (5,8), (6,10), (1,4), (2,3), (5,7), (6,8), (9,10), (1,5), (2,4), (3,6), (8,9), (7,10), (1,6), (2,5), (3,8), (4,10), (7,9), (1,7), (2,8), (3,10), (4,9), (5,6) and (1,8), (2,7), (3,9), (6,2), (7,3), (8,4), (4,5), (9,6), (5,10), (10,1), (1,9), (2,10), (3,5), (4,6), (7,8), respectively. Then using Theorem 3.3 with $p = q = g = u = w = x = y = z = 1$ and $t = 2$, we get a **binary** VB design D with parameters $v' = 13, b' = 74, r' = \{121'_9, 111'_4\}, k' = \{21'_{72}, 41'_2\}$.

Example 6 : Consider two 2-PBIB group divisible designs $D_1(SR1)$ and $D_2(SR2)$ with same number of treatments and same association scheme having parameters $v = 4, b = 4, r = 2, k = 2, \lambda_1 = 0, \lambda_2 = 1, m = 2, n = 2$ and $v^* = 4, b^* = 10, r^* = 5, k^* = 2, \lambda_1^* = 3, \lambda_2^* = 1, m^* = 2, n^* = 2$, respectively. The block contents

of D_1 and D_2 are (1,2), (3,4), (4,1), (2,3) and (1,3), (2,4), (1,3), (2,4), (1,3), (2,4), (1,2), (3,4), (1,4), (2,3), respectively. Then using Theorem 3.3 with $p = t = 2$, $q = g = x = 1$ and $u = w = y = z = 3$, we get a ternary VB design D with parameters $v' = 7$, $b' = 29$, $r' = \{181'_3, 151'_4\}$, $k' = \{21'_{18}, 61'_{9}, 121'_{2}\}$.

Theorem 3.4 : Let N_1 and N_2 be the incidence matrices of 2-PBIB designs D_1 and D_2 whose parameters are respectively given by $v, b, r, k, \lambda_1, \lambda_2, n_1, n_2$ and $v^* = v, b^*, r^*, k^*, \lambda_1^*, \lambda_2^*, n_1^* = n_1, n_2^* = n_2$, then

$$N = \begin{bmatrix} x\mathbf{1}'_p \otimes N_1 & g\mathbf{1}'_p \otimes N_2 & y\mathbf{1}'_t \otimes I_{(v-1)} & O_{(v-1) \times t} \\ & & O_{t \times (v-1)} & z\mathbf{1}'_t \\ O_{t \times (pb+qb^*)} & & u\mathbf{1}'_{t \times (v-1)} & w\mathbf{1}'_t \end{bmatrix} \quad \dots(3.4)$$

is the incidence matrix of a VB design D with parameters $v' = (v + t)$, $b' = \{pb + qb^* + t(v - 1) + t\}$, $r' = \{(xpr + gqr^* + yt)\mathbf{1}'_{(v-t)}, (xpr + gqr^* + zt), \{ut(v - 1) + w\}\mathbf{1}'_t\}$ and $k' = \{xk\mathbf{1}'_{pb}, gk^*\mathbf{1}'_{qb^*}, (y + ut)\mathbf{1}'_{t(v-1)}, (z + w)\mathbf{1}'_t\}$, where x, p, g, q, y, u, w, z and $t (\geq 2)$ are positive integers to be selected such that

$$\frac{xp\lambda_1}{k} + \frac{gq\lambda_1^*}{k^*} = \frac{xp\lambda_2}{k} + \frac{gq\lambda_2^*}{k^*} = \frac{uyt}{(y+ut)} = \frac{wz}{(z+w)} = \frac{u^2t(v-1)}{(y+ut)}$$

Proof : Can be proved on similar lines of the proof of Theorem 3.1.

Example 7 : Consider two 2-PBIB group divisible designs $D_1(SR1)$ and $D_2(R2)$ as mentioned in example 6. Now using Theorem 3.4 with $p = 2$, $q = g = u = x = 1$, and $w = y = z = t = 3$, we get a ternary VB design D with parameters $v' = 7$, $b' = 30$, $r' = \{181'_4, 121'_3\}$, $k' = \{21'_{18}, 61'_{12}\}$. The diagonal elements of the C matrix are 9 and off-diagonal elements are $3/2$.

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* * * * *



CASE STUDY FOR REPLACEMENT PROBLEM OF DIC IN AIR COMPRESSORS

SANJAY G. RAVAL*

ABSTRACT

This paper deals with a replacement model suitable for a costly machine or equipment whose maintenance cost changes with time and the value of money also does not remain the same through. Mathematical model is developed under the stated assumptions and the model is illustrated for an industrial application with its sensitivity analysis.

1. INTRODUCTION

Study of replacement models becomes very interesting as it is practicable in day to day life. When a machine or vehicle or equipment or instrument is purchased, it becomes very much essential that it is useful for its applicability and the purpose for which it is meant for.

One should think about the variable maintenance cost for the efficient running of the equipment, without which it may become obsolete very soon. A separate fund is needed to deal with its maintenance. When the equipment becomes more expensive by way of investing in machine cost or it becomes standstill and useless after some period, it needs to be replaced as soon as possible. A time comes when the equipment is to be thrown away at some negligible price in order to get rid of the equipment.

The standard models in the literature on replacement models assume that the maintenance cost remains the same throughout and the value of money may or may not change with the passage of time. In this paper a variable pattern of specific nature is considered for the maintenance cost function, the value of money also changes with the passage of time, and the resale value becomes zero for the equipment. A decision is to be taken as to when the equipment can be replaced by taking its optimum benefit.

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Assumptions are given in sec..2, and derivation of the model is given in the Appendix. Derived model is illustrated by means of an industrial application with it's sensitivity analysis in sec..3, 4 & 5.

2. ASSUMPTIONS

- (1) A costly equipment or machine or instrument is purchased at the total capital cost of Rs. C.
- (2) The equipment is under constant usage since its installation.
- (3) Maintenance cost during subsequent periods during usages of the equipment changes as per the passage of time.

To account for the variability of the maintenance cost. It is split up in two parts. One part is over head(fixed) cost and the other component varies with passage of time, with a lag structure.

Thus maintenance cost for the i^{th} year is given by

$$M(t) = a_0 M(t-1) \quad M(0) = 1 \quad (t = 1, 2, 3, \dots, n)$$

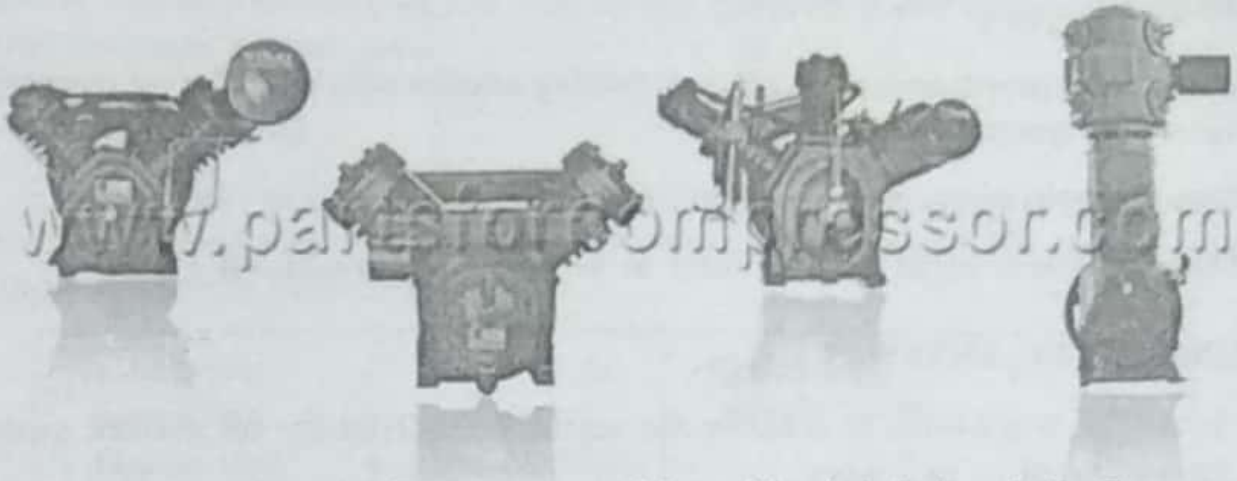
- (4) The value of money does not remain the same during the subsequent periods. If 1 rupee is invested today then after a period of n years it will realize to $(1+r)^n$. So that to realize 1 Rs. After n year, one should invest $(1+r)^{-n}$ Rs. Today. This is called present worth (value) Of 1 Rs. to be invested in n^{th} year from time to time.

If we put $d = \frac{1}{1+r}$ then d is the depreciation value or discount rate.

- (5) One very crucial assumption is that the equipment will be replaced when its resale value becomes zero. i.e. when it becomes totally useless.
- (6) Efficiency of equipment deteriorates with time.
- (7) We consider different cycles each of period n and within each such cycle the maintenance cost exhibits the same pattern of variation as described above in assumption(3).
- (8) A decision is to be taken to determine the optimal replacement cycle period n after which a new equipment will be purchased at the same capital cost Rs. C.

3. INDUSTRIAL APPLICATION

Let us consider a practical industrial application for modal considered here (derivation is given in appendix). It is pertaining to Air Compressor and its relevant parts.



Vikay is one of the leading exporters of from Mumbai, India of Air Compressors & Vacuum Pumps, from 2 HP to 30 HP, in Single Stage, Two Stage & Multi Stage. Our Field tests prove that our Two Stage Reciprocating Compressors has the most efficient design and offer the greatest value. The compressors are totally compatible or better in efficiency, component strength, quality construction, reliability, low maintenance requirement and service support.

Features :

- Frame 100% Cast Iron
- Removable Cylinder
- One-piece Connecting Rod
- Splash lubrication
- **DUCTILE IRON CRANKSHAFT**
- Finned Copper Intercooler
- Two/Three Stage Design
- Simple Combination Valves
- Simple multi finger valve
- Centrifugal Unloader

We consider here for our application the component known as Ductile Iron Crankshaft (DIC). The capital cost for DIC is Rs. 25,000 and market gives a discount value as purchased Rs. 24,750 (i.e., 250 Rs. discount on cash). Thus capital cost = $C = \text{Rs. } 24,750$.

For the stated model the coefficient = $a_0 = 3.40$,

market rate of interest = $r = 8\%$

$$\text{Hence } d = \frac{1}{1+r} = 0.925926$$

Using Excel programming, we get the following solution which satisfies the inequality (9)(derived in appendix).

Optimal replacement period = $n^* = 7$ years

Optimal present value of investment to be done = $P(n^*) = 71,064.57$ Rs.

4. SENSITIVITY ANALYSIS

It may be worthwhile to consider the sensitivity analysis for the derived model. This is considered in two ways.

- (1) Total sensitivity analysis
- (2) Partial sensitivity analysis

(1) Total Sensitivity Analysis :

We consider here the case when all the parameters and cost change their values simultaneously.

Original values : $C = \text{Rs. } 24,750$, $a_0 = 3.40$, $r = 8\%$, $d = 0.925926$

Change in parameter/ capital cost	Optimum period(n)	$P(n^*)$
10% Increases $a_0 = 3.74$ $r = 0.088$ $C = 27225$	6	74925.85 (5.43%)
10% Decreases $a_0 = 3.06$ $r = 0.072$ $C = 22275$	7	64414.32 (-9.36%)

(Note : Figure in parenthesis give % change in $P(n^*)$ as compared to the original solution)

Conclusions : From the above table, we conclude that 10% increase in cost and all the parameters, $P(n^*)$ increases by about 5.43% and similarly for 10% decrease in cost and all the parameters values, $P(n^*)$ decreases by 9.36% as compared to the original solution. For 10% increase in cost and all the parameters, the optimum replacement period decreases by one year.

(2) Partial Sensitivity :

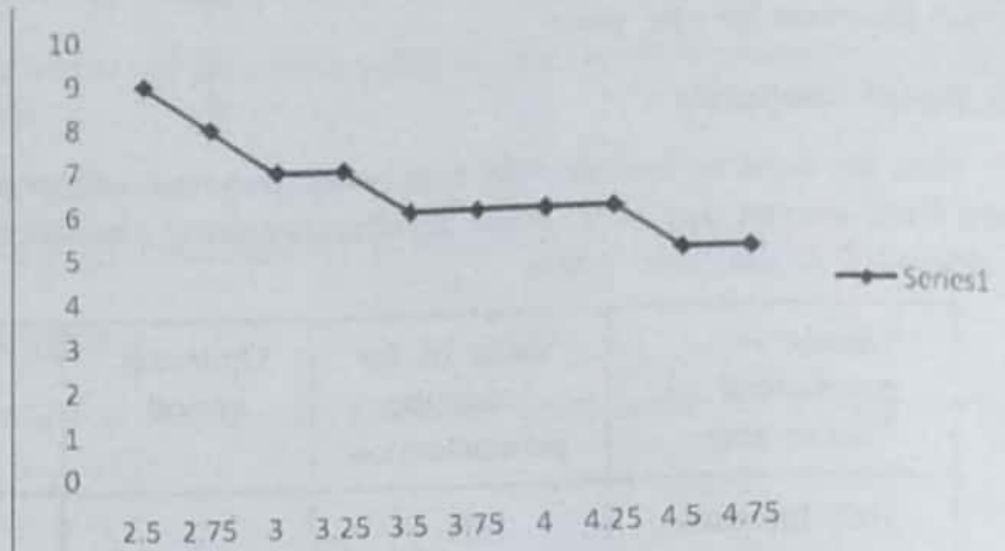
Here we want to consider the case when only one of the parameter changes by some fixed amount (say 10%) while all other remaining parameters are fixed. This case is illustrated in the table below.

Change in parameters/ Capital cost	Value of the changing parameter/cost	Optimum period	$P(n^*)$
10% Increase	1.05 C	7	77006.81 (8.36%)
10% Decrease	0.95 C	6	64392.26 (-9.39%)
10% Increase	1.05 a_0	6	73999.53 (4.13%)
10% Decrease	0.95 a_0	7	65292.46 (-8.12%)
10% Increase	1.05 r	7	65947.12 (-7.20%)
10% Decrease	0.95 r	6	77230.94 (8.68%)

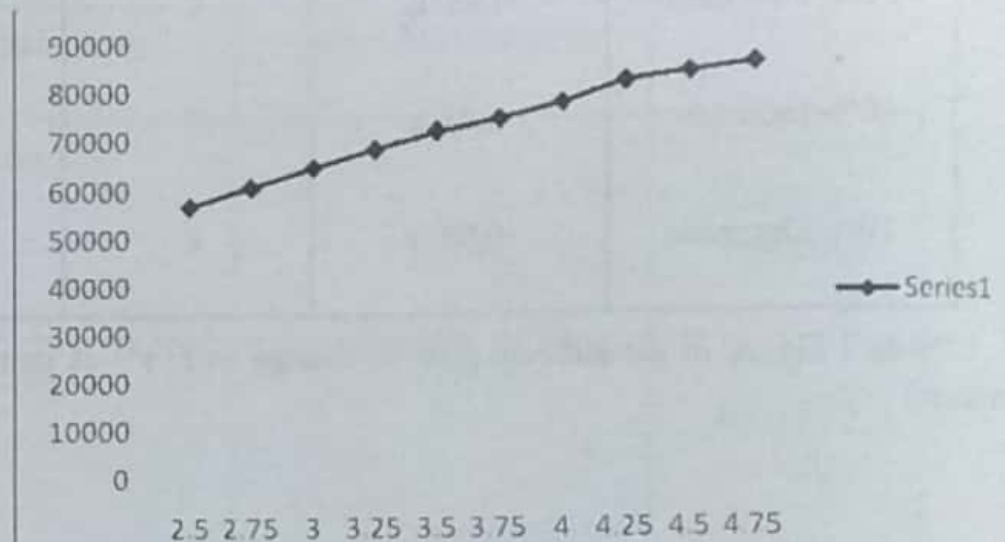
(Note : Figure in parenthesis give % change in $P(n^*)$ as compared to the original solution)

5. GRAPHICAL PRESENTATION

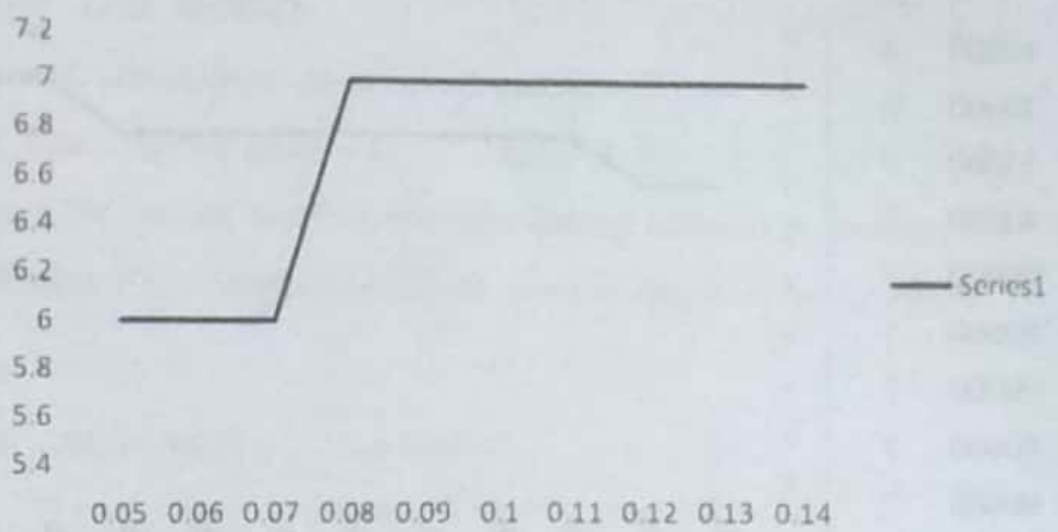
a_0	n^*
2.5	9
2.75	8
3	7
3.25	7
3.5	6
3.75	6
4	6
4.25	6
4.5	5
4.75	5



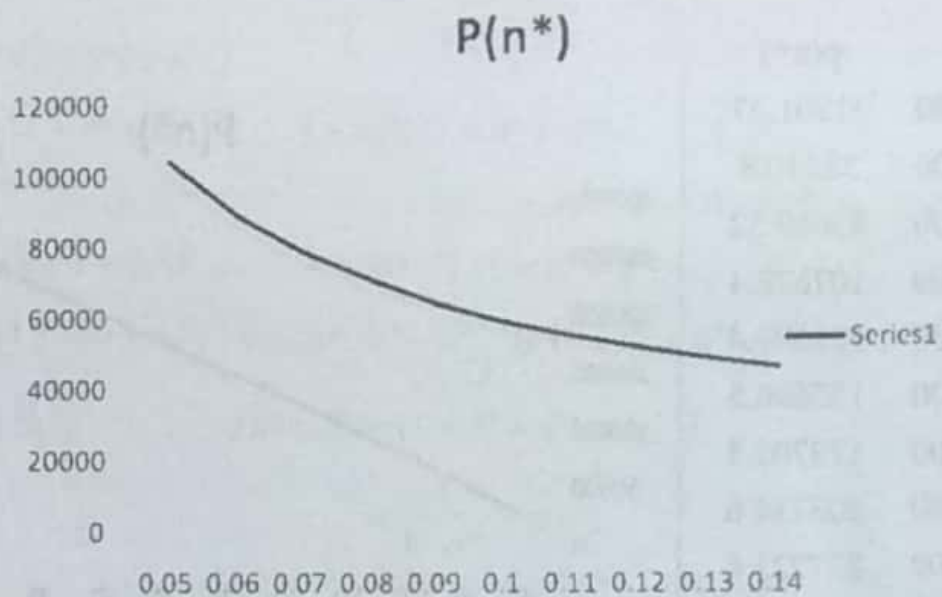
a_0	$P(n^*)$
2.5	56781.38
2.75	60668.04
3	64588.48
3.25	68096.91
3.5	71810.95
3.75	74106.11
4	77244.18
4.25	81457.9
4.5	83067.74
4.75	84682.42



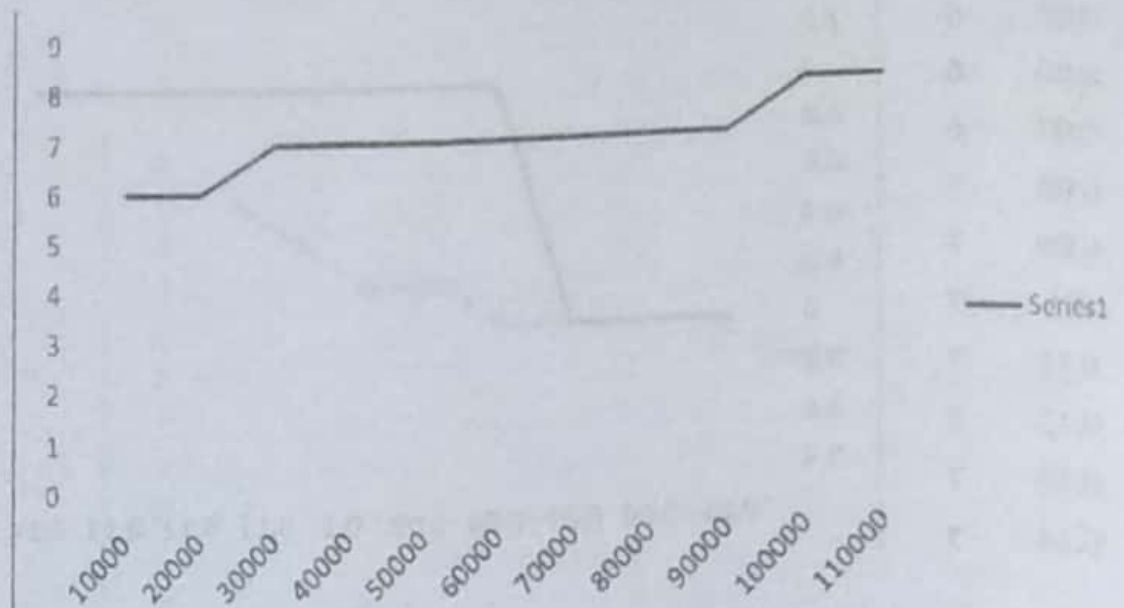
r	n*
0.05	6
0.06	6
0.07	6
0.08	7
0.09	7
0.1	7
0.11	7
0.12	7
0.13	7
0.14	7



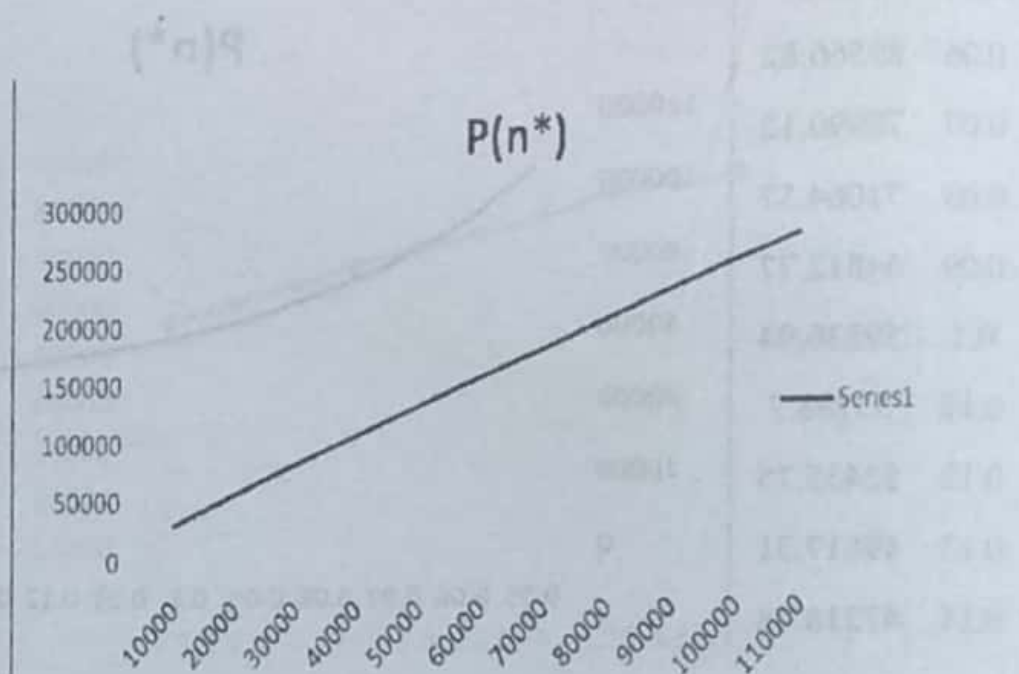
r	p(n*)
0.05	104418
0.06	89566.82
0.07	78990.12
0.08	71064.57
0.09	64812.77
0.1	59836.94
0.11	55788.7
0.12	52435.75
0.13	49617.31
0.14	47218.48



C	n*
10000	6
20000	6
30000	7
40000	7
50000	7
60000	7
70000	7
80000	7
90000	7
100000	8
110000	8



C	p(n*)
10000	31201.37
20000	58240.8
30000	83669.32
40000	107678.4
50000	131687.4
60000	155696.5
70000	179705.5
80000	203714.6
90000	227723.6
100000	250731.4
110000	272483.2



APPENDIX

DERIVATION OF THE MODEL

Under the stated assumptions as in sec.2 above

Maintenance cost : $M(t) = a_0 M(t-1)$ $M(0) = 1$ ($t = 1, 2, 3, \dots, n$)

This represents the annual maintenance cost during subsequent periods.

We now calculate PV of investment to be done during successive cycles.

For 1st cycle

$$PV_1 = C + M_1 + M_2 d + M_3 d^2 + \dots + M_n d^{n-1} \quad \dots(1)$$

For 2nd cycle

$$PV_2 = (C + M_1) d^n + M_2 d^{n+1} + M_3 d^{n+2} + \dots + M_n d^{2n-1} \quad \dots(2)$$

For 3rd cycle

$$PV_3 = (C + M_1) d^{2n} + M_2 d^{2n+1} + M_3 d^{2n+2} + \dots + M_n d^{3n-1} \quad \dots(3)$$

Here, $M_1 = a_0$, $M_2 = a_0^2, \dots, M_n = a_0^n$

$$P(n) = PV_1 + PV_2 + PV_3 + \dots$$

$$= (C + a_0) [1 + d^n + d^{2n} + \dots] + a_0^2 d [1 + d^n + d^{2n} + \dots] + a_0^3 d^2 [1 + d^n + d^{2n} + \dots] + \dots$$

$$= [C + a_0 + a_0^2 d + a_0^3 d^2 + \dots + a_0^n d^{n-1}] (1 + d^n + d^{2n} + \dots)$$

$$= [C + a_0 (1 + a_0 d + a_0^2 d^2 + \dots + a_0^{n-1} d^{n-1})] (1 + d^n + d^{2n} + \dots)$$

$$P(n) = (C + K_n) S_1$$

$$\text{Here, } S_1 = (1 + d^n + d^{2n} + \dots)$$

$$= \frac{1}{1-d^n}; \quad d < 1$$

$$K_n = a_0 (1 + a_0 d + a_0^2 d^2 + \dots + a_0^{n-1} d^{n-1})$$

$$= a_0 \left(\frac{m^n - 1}{m - 1} \right); \quad a_0 > 1, \quad d < 1, \quad m = a_0 d > 1$$

$$\begin{aligned}
 P(n) &= \left[C + a_0 \left(\frac{m^n - 1}{m - 1} \right) \right] \left(\frac{1}{1 - d^n} \right) \\
 &= \left[\frac{C}{1 - d^n} + \frac{a_0(a_0^n d^n - 1)}{(1 - d^n)(a_0 d - 1)} \right] \\
 &= \frac{1}{1 - d^n} \left[C + \frac{a_0(a_0^n d^n - 1)}{(a_0 d - 1)} \right] > 0 \quad \dots(4)
 \end{aligned}$$

$$\text{Hence, } P(n + 1) = \left[\frac{C}{1 - d^{n+1}} + \frac{a_0(a_0^{n+1} d^{n+1} - 1)}{(1 - d^{n+1})(a_0 d - 1)} \right] > 0 \quad \dots(5)$$

To determine the optimal replacement period we must have $P(n) < P(n + 1)$ as well as $P(n) < P(n - 1)$.

Now,

$$\begin{aligned}
 \Delta P_n &= P(n + 1) - P(n) \\
 &= \left[\frac{C}{1 - d^{n+1}} + \frac{a_0(a_0^{n+1} d^{n+1} - 1)}{(1 - d^{n+1})(a_0 d - 1)} \right] - \left[\frac{C}{1 - d^n} + \frac{a_0(a_0^n d^n - 1)}{(1 - d^n)(a_0 d - 1)} \right] \\
 &= \frac{-Cd^n(1 - d)}{(1 - d^n)(1 - d^{n+1})} + \frac{a_0}{(da_0 - 1)} \left[\frac{d^n a_0^n (da_0 - 1) - d^{2n+1} a_0^n (a_0 - 1) - d^n (d - 1)}{(1 - d^n)(1 - d^{n+1})} \right] \\
 &= \frac{a_0}{(da_0 - 1)} \left[\frac{d^n a_0^n (da_0 - 1) - d^{2n+1} a_0^n (a_0 - 1) - d^n (d - 1)}{(1 - d^n)(1 - d^{n+1})} \right] \geq \frac{Cd^n(1 - d)}{(1 - d^n)(1 - d^{n+1})} > 0 \\
 \therefore \frac{a_0}{(da_0 - 1)} \left[a_0^n (da_0 - 1) - d^{n+1} a_0^n (a_0 - 1) + (1 - d) \right] &> C(1 - d) \quad \dots(6)
 \end{aligned}$$

Similarly, $\Delta P(n - 1) = P(n) - P(n - 1) < 0$, so that

$$\Delta P(n - 1) < 0$$

$$\left[\frac{C}{1 - d^n} + \frac{a_0(a_0^n d^n - 1)}{(1 - d^n)(a_0 d - 1)} \right] - \left[\frac{C}{1 - d^{n-1}} + \frac{a_0(a_0^{n-1} d^{n-1} - 1)}{(1 - d^{n-1})(a_0 d - 1)} \right] < 0 \quad \dots(7)$$

$$\frac{-Cd^{n-1}(1-d)}{(1-d^n)(1-d^{n-1})} + \frac{a_0}{(da_0-1)} \left[\frac{(1-d^{n-1})(d^n a_0^n - 1) - (1-d^n)(d^{n-1} a_0^{n-1} - 1)}{(1-d^n)((1-d^{n-1}))} \right] < 0$$

$$\frac{a_0}{(da_0-1)} \left[\frac{(1-d^{n-1})(d^n a_0^n - 1) - (1-d^n)(d^{n-1} a_0^{n-1} - 1)}{(1-d^n)((1-d^{n-1}))} \right] < \frac{Cd^{n-1}(1-d)}{(1-d^n)(1-d^{n-1})}$$

$$\frac{a_0}{d^{n-1}(da_0-1)} \left[d^{n-1} a_0^{n-1} (da_0-1) - d^{2n-1} a_0^{n-1} (a_0-1) + d^{n-1} (1-d) \right] < C(1-d)$$

Which gives

$$\begin{aligned} \frac{a_0}{(da_0-1)} \left[a_0^{n-1} (da_0-1) - d^n a_0^{n-1} (a_0-1) + (1-d) \right] &< C(1-d) \\ &< \frac{a_0}{(da_0-1)} \left[a_0^n (da_0-1) - d^{n+1} a_0^n (a_0-1) + (1-d) \right] \end{aligned} \quad \dots(8)$$

Hence from (6) and (8), we get the following inequality,

$$\begin{aligned} \frac{a_0}{(da_0-1)} \left[a_0^{n-1} (da_0-1) - d^n a_0^{n-1} (a_0-1) + (1-d) \right] &< C(1-d) \\ &< \frac{a_0}{(da_0-1)} \left[a_0^n (da_0-1) - d^{n+1} a_0^n (a_0-1) + (1-d) \right] \end{aligned} \quad \dots(9)$$

The above inequality determines the optimal replacement period n^* and correspondingly we can compute $P(n^*)$ using equation (2) so that the optimal (PV) value of the investment will be determined from

$$P(n^*) = \left[\frac{1}{1-d^n} \left[C + \frac{a_0(a_0^n d^n - 1)}{(a_0 d - 1)} \right] \right]_{n=n^*} \quad \dots(10)$$

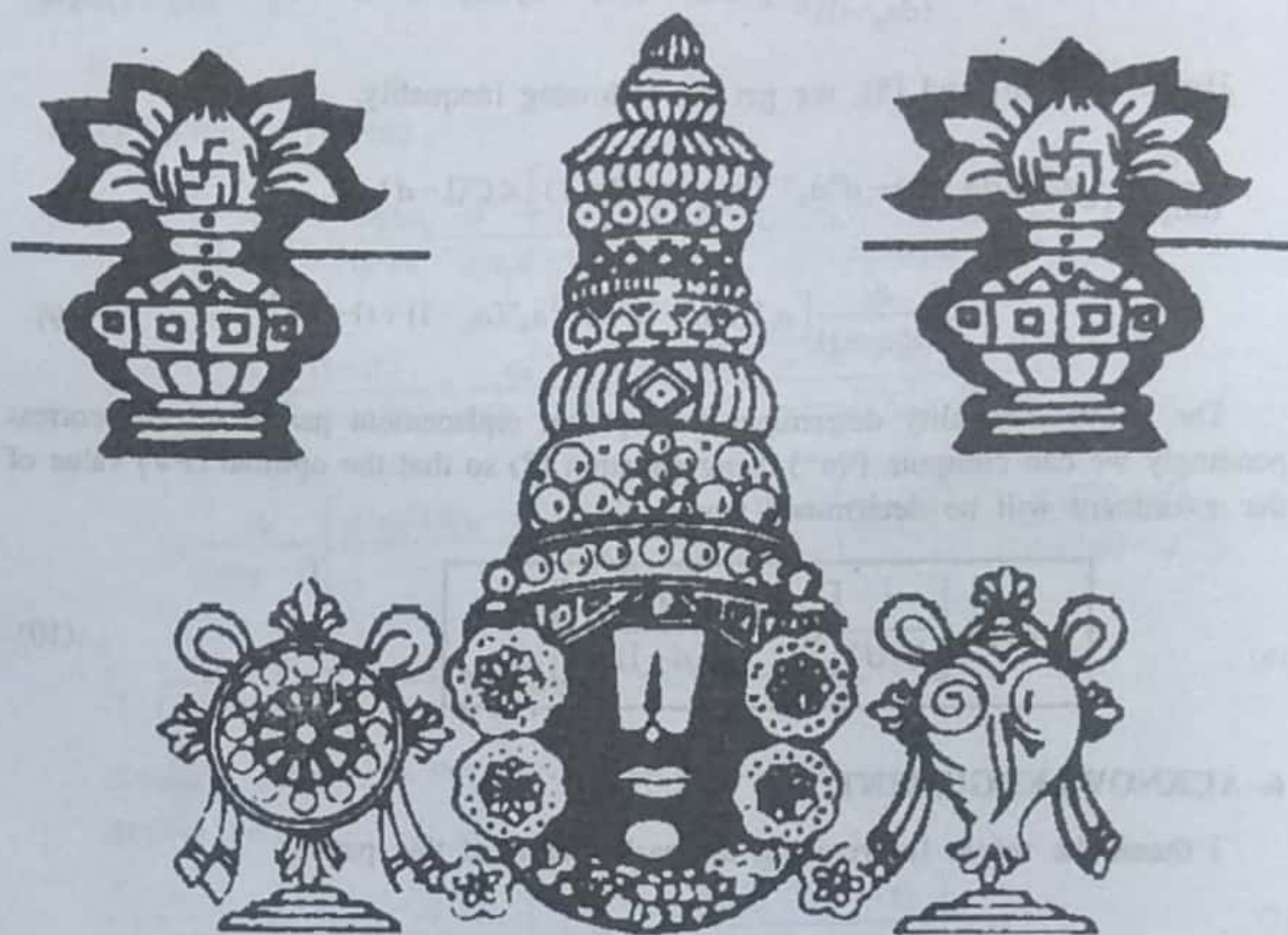
6. ACKNOWLEDGEMENT

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TQM IN EDUCATION

M. N. GOPALAN*

ABSTRACT

This article describes TQM concepts as applicable to education field. Grasham's law is discussed for different components with effective and suggestive conclusions.

INTRODUCTION

The progress and prosperity of a nation mainly depends on the quality of goods it produces and the quality of services it renders. There are many sectors of society which call for a high level of quality in the service rendered. For example, the quality of service offered in the health sector and the quality of service offered in the educational sector should be top-class, so that, the nation progresses in every sense of term. A nation with a high degree of excellence in the fields of health and education can become a beacon light to the rest of the world. The productivity of such a nation would be quite high as, every one would be healthy and educated.

1.1 DEFINITION OF QUALITY

Quality is defined in various ways. Some of the well-known definitions are listed below.

- (1) Quality means fitness for use.
- (2) Quality means achieving a zero-defect level in a process.
- (3) Quality means meeting the specifications prescribed for a product or a process.
- (4) Quality means customer's delight etc.

It is only, of late, customer has been recognized as an important component in deciding the quality of a product or a process. In a seller's market, the customer did not play any significant role. In a competitive environment, customer plays a very important

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role. It is the customer who decides the fate of an organisation. In a way, a customer is a king in a competitive environment. A customer can choose any brand of a product of his choice in the world market. With the advancement of technology, the world has become a global village. Modern communication system has made the world to shrink. A customer can avail of the vast information available about a product or a process within no time.

1.2 QUALITY COST

Quality is neither free nor costly. There is a price-tag attached to every level of quality of a product or a process. The cost of quality implies the cost associated with the various steps to be undertaken to improve the quality in a product or a process. The cost of quality is one of the several components in the cost of a product. The cost of a product can be greatly reduced if only the principles of Quality Management are implemented at every stage of production of a product or a process. It is essential to bring down the quantum of rework or scrap to zero level. It is thus advisable and necessary too to spend initially on the improvement of quality of a product or a process. Mere final inspection at the last stage results in the formation of mountains of scrap or rework. The principles of Quality Management as recommended by **Taguchi** during manufacturing should be implemented at all levels of a process. As the proverb goes, one should not be penny wise and pound foolish. By not adopting Taguchi philosophy, an organization cannot survive the stiff competition in the world market. In order to float in the world market, one should produce quality goods and offer quality services at competitive prices. Else, the organization's image gets tarnished. Once it is tarnished, it is not possible to erase it.

2.0 QUALITY OF EDUCATION [Fig. 5.1 – Fig. 5.5]

As said in the Introduction, the quality of service in the educational sector should be of very high level, so that, the nation progresses towards a welfare-state. The quality of education in general and in primary and secondary levels of education, in particular, depends upon four major factors, namely,

1. Parents
2. Management
3. Teachers
4. Students

Each of the above mentioned factors plays a vital role in the improvement of the quality of education. In fact, these components form a series system. As such, system performance decreases if, any of the components of the system does not perform well.

In what follows a brief description of each of the factors referred to above is given.

2.1 PARENTS

It is said that basic education starts at home and the parents of the tiny kids are their true teachers. This is indeed very true. It is rather unfortunate that the parents do not take as much of interest as they should due to various reasons. In fact, the parents hardly find any free time to come to know what the children are learning in their schools. This is more predominant in urban areas where, perhaps, both the parents go for jobs. As a result, the children have no opportunity to learn things from their parents. This is indeed most unfortunate. Many parents do not even bother to know what their children are learning in the schools. They feel that they have done their duty if they admit their children in the schools and it is the responsibility of the school to educate their children. In many situations, the parents are not educated properly. As a result, they are not in a position to help their children in their studies. In most of the villages, this is the unfortunate situation. The children are then in a great disadvantage and have to be content with whatever they learn in their schools. It is very essential to know the progress of the children by having a dialogue with the teachers concerned. A parent-teacher meeting must be organised very often wherein, the problems connected with the progress of the children can be discussed. This is rarely taking place. The parents should find time to teach basic moral values to their children above all other things, so that, the children could, in future, become good citizens of the country. Some of these basic moral values are truthfulness, discipline, cleanliness, respect for others, sincerity, devotion to duty, kindness etc. Unless these qualities are taught to the children at their tender age by their parents, they would become misfits to society at a later stage. The parents should neither pamper their children too much nor, they should be too harsh. In fact, the parents can contribute a lot to the national wealth if only, they cultivate their children in the right manner. After all, today's children are tomorrow's citizens of the country.

In what follows a comparison between Grasham's Law and the influence of parents and their children.

2.1.1 GRASHAM'S LAW AND PARENTS

It is rightly said that a child's home is its first school and its mother is its first teacher. It is the mother of the child who should teach the A, B, C of education to

her child. Unless the mother is educated, she cannot motivate the child. Many of the women in rural areas are illiterates even today. Consequently, the children do not learn the basics of education before they go to schools. In order to improve the situation, steps should be taken to educate the illiterate parents during their free-time. If the parents are not educated, the entire family suffers. More importantly, the nation suffers. Even a small crack in a dam results in heavy leakage of water from the dam and causes severe damage of the dam. So too, an illiterate family would affect the growth of a nation. In a way, Grasham's Law is applicable in this case. Illiterate parents of a child represent black money one refers to in Grasham's law and the nation represents white money.

2.2 MANAGEMENT

The management's responsibility towards education cannot be over-emphasized. A lot depends upon the management's capability to impart proper education to the children. It should have, first of all, an inner urge to do so. It should not become a money-earning agency. Unfortunately, the situation today in the country is extremely deplorable with educational institutions becoming centers of exploitation. Only those who can afford to pay huge sums of money as donations are able to get their children admitted to the schools, irrespective of whether the student is having merit or not. That is nothing but doing great injustice to the have-nots but otherwise qualified to get admitted to the schools. If the management adopts a sound educational policy, the students would invariably become an asset to the nation. Otherwise, they would turn out to be mere liabilities to society. The management should have clear-cut objectives before it above anything else. If not, it would be a carriage without the engine unable to pull. The management should have well-qualified teachers who could motivate the students. The selection of teachers is of utmost importance. Without qualified teachers, the management cannot carry on. The management should have a well-defined infrastructure, such as, school-building, library, laboratories, class-rooms, sports complex, toilets, seminar rooms etc. The size of the classes should be optimal, so that, the teachers can pay good attention to the students. Today's classes are over-crowded with the result, the teacher is not able to carry on his or her responsibilities. The management should adopt a "continuous evaluation" policy, so that, the students remain ever-alert. The management should organize parent-management meetings often to appraise the parents of their children's progress. The management should have a standard syllabus to be followed in the school. The syllabus should be uniform throughout the country, so that, a common policy can be adopted. The management should prescribe standard books for various subjects taught. They should be available in the library in good numbers, so that, the students could

make use of them. The books must be written by experts in the field and should be within the reach of the student community. They should be error-free and should motivate the students.

The management should hold periodic meetings of the teachers to discuss various matters pertaining to teaching of courses and other allied activities.

The management should organize periodical seminars in which the students take part as speakers to enhance/develop/improve their communication skills. The seminars could be either within the school or between the schools in the area or, at state or national level too. The topics of the seminars could be academic, or, on national topics.

The management should have faculty advisers from among the faculty to advise the students on matters of not only academic importance, but also, their personal problems. The proportion of faculty versus students should be as low as possible. About 10 to 15 students per faculty member would be ideal. The faculty should meet the students atleast once in a fortnight to know their progress and their problems. The faculty member should do his or her best to help the students overcome their problems. This would reduce this tension in the minds of students and helps them to fare better in their studies.

The management should appoint deans to look into various matters connected with the students. One dean would look after the academic matters and the other would look after the student affairs. The deans should be from among the faculty and should report to the head of the institution.

The management should establish an open-book library, so that, the faculty and the students could utilize the library to the maximum advantage. The librarian should possess a Degree in Library Science. The management should encourage the various departments to have departmental libraries to be looked after by one of the faculty members of the department.

In what follows, a comparison is made between Grasham's law and influence of educational institutions on the quality of education.

2.2.1 GRASHAM'S LAW AND EDUCATIONAL INSTITUTIONS

Educational institutions should be wedded to the philosophy of quality applied to the field of education. Educational institutions should be centers of excellence in the field of education. They should provide ample opportunities to the students to improve their power of analytical thinking. They should possess all the infrastructural facilities needed to impart quality education. They should encourage the students to excel in various fields

of education by allowing them to compete with other educational institutions. They should appoint qualified teachers endowed with an inborn desire to motivate the students. Unless the educational institutions are capable of imparting quality education, the nation suffers. In this context, one can apply Grasham's law to educational institutions. A nation's progress and prosperity are measured by the quality of educational institutions are not wedded to the philosophy of total quality management (TQM) and fail to impart quality education to the students, it will have a telling-effect on the nation as a whole. Poor quality of management represents black money one refers to in Grasham's law and the nation represents white money.

2.3 TEACHERS

Teachers are the most vital component in the educational system. They are the motivators of the students. They should be highly qualified and should act as moving libraries. They should, in fact, act as friends, philosophers and guides. They should create interest in the minds of the students in the subjects they teach. In addition, they should be disciplined, possess high moral values and should set an example to the students. They should not attend classes without proper preparation, lest, the students lose interest in the subject. Teachers should attend summer-schools and short-term courses periodically to update their knowledge in the field. The management should relieve their faculty to participate in such workshops. Teachers who undergo such training programmes (say, atleast two or three over a period of, say, five years) should receive due recognition by the management. The management should see that each teacher attends such training programmes. Teachers should not merely attend the workshops but must implement the recommendation thereof in their respective schools and see that their colleagues also implement the recommendations.

Teacher should be disciplined in every sense of the term. They should possess good personality and good voice. A teacher should be quite intimate with the students, so that, they can pour out their sufferings and seek remedial steps.

A teacher should command respect and affection by virtue of the academic qualities in him or her from the pupils he or she handles. Hence, management should be extra careful while recruiting persons for faculty positions.

Who is a teacher ? What qualifies a person to become a teacher ? The answer is partly found in the letters comprising the word 'teacher'.

T Talented

E Efficient

- A Active
- C Caring
- H Honourable
- E Energetic
- R Responsible

It is rightly said that, whereas an engine-driver minds the train, a teacher trains the mind of a pupil, nay, an entire group of students in every academic session he or she trains during his or her academic career.

In what follows, a comparison is made between Grasham's law and influence of faculty on the quality of education.

2.3.1 GRASHAM'S LAW AND TEACHERS

The main responsibility of a teacher is to mould the life of a child to become a useful citizen of the society. Unless this step is taken at the very early stage of the child, it is very difficult to mend the child later. A child possesses a very fertile mind that could absorb noble thoughts poured into its brain by its well-wishers, namely, the teachers. If the teachers do not perform their duty, namely, moulding the students properly, the child would get spoiled beyond repair. The child should not be allowed to learn bad habits lest, it becomes an addict to bad habits and becomes unfit to serve society. Bad habits are nothing but black money one refers to in Grasham's law. If allowed unchecked, it spreads like wild-fire and the child is lost. It is rightly said that prevention is better than cure. Both the parents and the teachers should ensure that the child does not indulge in any unsocial activity lest it grows to become a nuisance to society. Society represents white money.

It is rightly said that, where as an engine-driver minds the train, a teacher trains the mind. A teacher is indeed a multi-faceted personality. A teacher can be viewed as an agriculturist, an environmentalist, a doctor, a psychologist, a sculptor, a moulder, a builder, a philosopher, a guide and a friend.

A teacher should be a moving encyclopedia, ready to remove the doubts prevailing in the minds of the students. A teacher should not fail to help the pupils at times of need. It is rightly said 'beat the iron when it is hot'. By this, one means clearance of doubts from the mind of the pupils before it settles in the mind causing severe damage to the pupil and to society. Unless an individual is endowed with such noble qualities,

one should not accept the teaching profession. One should not 'try to fit a square-peg in a round-hole'. The damage caused could be harmful to society. A teacher should mould the student-community to enable it to shoulder the responsibilities for building a strong society. A lot of care has to be taken by the school management while selecting the right type of candidates for the teaching profession. An individual incapable of serving in the teaching profession can be considered as black money causing irreparable damage to society.

2.4 STUDENTS

Students should concentrate on the subjects taught to them and attend classes without fail with sufficient study at home. They should not indulge in unsocial activities detrimental to society. They should be disciplined and honest. They should try to supplement with whatever they have learnt in their schools by referring to various study-material available in the library. They should learn to think independently and put in hard-work. They should treat their elders with respect and develop regular healthy habits. They should not turn out to be anti-social elements by getting addicted to illicit drugs etc. They should keep good health by adopting sound habits, such as, playing games, etc. They should develop pleasing manners and serve the society with dedication. They should develop a competitive spirit and try to excel in all walks of life. Unless the children develop good habits in the early stage of their lives, they would become misfits in later years and would not be able to shoulder any responsibility. They should learn these qualities from the parents, teachers and friends. It is rightly said that, unless the plant is bent early, it cannot be bent in later years. This is true in one's life.

Who is a student ? The answer to this question is partly found in the letters comprising the word 'Student'.

S Studious

T Truthfulness

U Understanding

D Discipline

E Energetic

N Naive

T Talented

In what follows, a relationship is established between Grasham's Law and Students.

2.4.1 GRASHAM'S LAW AND STUDENTS

A student should be dynamic and show interest in learning not only what is taught in school but also, supplement knowledge with additional material available elsewhere. A student should develop analytical thinking and should not just memorize and repeat what is taught by teachers or, what is available in books. Unless one develops analytical skill from one's childhood, it would be difficult to analyse the problems one faces in the life at later stages. No problem on earth can remain complex and difficult if only it is analysed systematically. In fact, solution to a problem lies within the problem itself and only an analytical mind can visualize the fact.

A classroom can be viewed as a crucible. Even as a moulder tests the strength and the quality of the material used to prepare ornaments, etc. so too, a teacher tests the students to know whether they have gained enough knowledge to shoulder greater responsibilities at later stages of their lives. Students should desist from temptations that mar their future. The temptations look very lucid to start with. But, they grow like wild weed, if allowed unchecked in time.

The black money one refers to in Grasham's law is nothing but the temptations that are deadly to the physical and mental growth of the students. They should be nipped in the bud to arrest their influence on the students.

The environment around an educational institution should be insulated from evil influences lest, they damage the mind as well as the student community beyond repair. A young mind is quite inquisitive to absorb anything around it and as such, only noble ideas should be allowed to flow into the minds of the students. It is only when one's mind is clear, one can think rationally.

Figures 5.1 to 5.5 depict the quality of education as a function of the inputs, namely, Parents, Management, Teachers and Students.

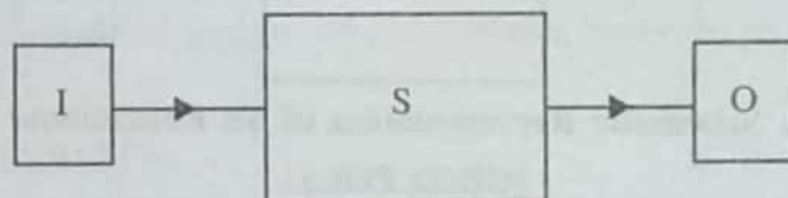
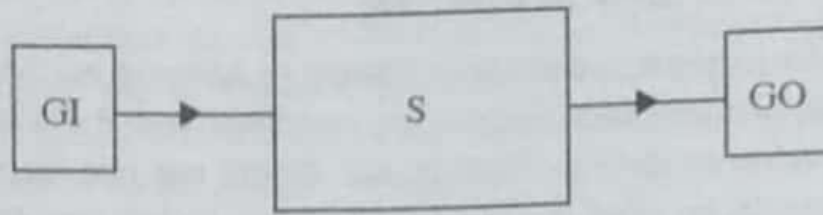


Fig. 5.1 : Schematic Representation of a System

LEGEND

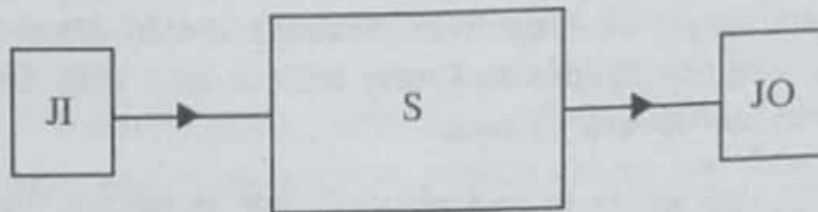
- I : Input/s
- O : Output/s
- S : System



**Fig. 5.2 : Schematic Representation of a System
(GIGO Policy)**

LEGEND

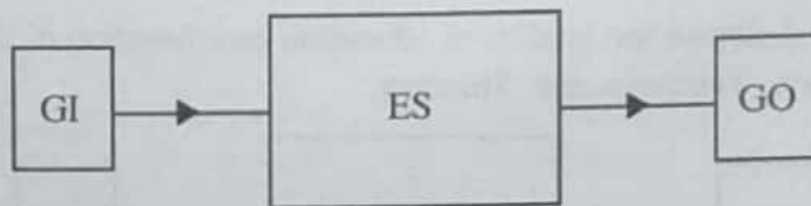
- GI : Good input/s
- GO : Good output/s
- S : System



**Fig. 5.3 : Schematic Representation of a System
(JIJO Policy)**

LEGEND

- Jl : Junk input/s
- JO : Junk output/s
- S : System



**Fig. 5.4 : Schematic Representation of an Educational System
(GIGO Policy)**

LEGEND

- GI : Good input/s

(Educated and motivated parents, educational institutions dedicated to impart quality education, qualified and motivated teachers, students with analytical bent of mind and desire to learn)

- GO : Good output/s
(Top-quality education helpful to society)
- ES : Educational system

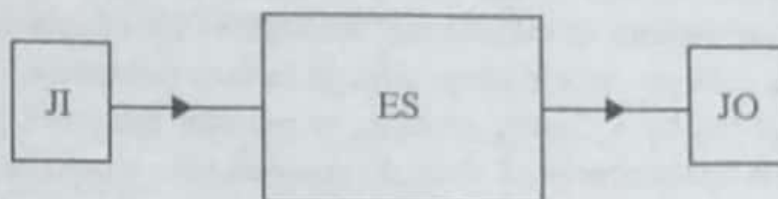


Fig. 5.5 : Schematic Representation of an Educational System (JIJO Policy)

LEGEND

- JI : Junk input/s
(Illiterate parents, management without dedication towards quality, ill-qualified teachers without professional interest, students without dedication towards learning)
- JO : Junk output/s
(Poor-quality education detrimental to society)
- ES : Educational system

3. CONCLUSIONS

There should be uniformity in our educational system throughout the country. The syllabi should be standardized for various levels of study. The Government of India should bring in education throughout the country under its fold and see that everyone in the country gets educated and the citizen casts his or her vote not on symbols as is the practice now but, on the names of the candidates appearing in the ballot paper. A war should be declared against illiteracy, so that, everyone gets educated before 2020 AD at the latest.

3.1 SOCIAL SERVICE

In order to achieve total literacy in the country the 2020 AD, it should be insisted that every student starting from Standard X and onwards should transform atleast 5 illiterates to literate category before receiving the certificate from the concerned Board of the University. It is most unfortunate that, even after several decades of independence, our country is suffering from this dreadful disease. It is high time that we wake up and rectify the situation before it becomes unwieldy. A nation's progress is measured

in terms of the literacy index it has achieved. Students should be advised to spend their vacation during summer and winter in villages and promote literacy programmes chalked out by the State and Central Governments. Such a scheme should be part of the school or college syllabi. Unless we implement such policies seriously, we cannot achieve any progress. We should be sincere in our efforts. We should set targets and achieve them in reality. Schools and colleges should adopt villages in their proximity. Teams of students should be formed and led by a faculty member to monitor the work being carried out by the students. A team could consist of about 10 students who would be allotted different types of duties, such as, teaching various subjects, environment, health and sanitation etc. A report must be submitted at the end of the training programme, highlighting the work executed by the team. Credit should be given for such social work. Students may be paid stipends during their stay in villages.

3.2 STANDARDIZATION OF EDUCATION

It is in this context that the Ministry of Human Resources Development, Government of India, should adopt the pattern of National Council for Educational Research and Training (NCERT) throughout the country. A common examination should be held throughout the country at various levels based on the syllabi fixed. The suggestion made should be adopted even at higher levels of education. Today, a candidate after 10 + 2 level appears for more than one examination, just to seek admission to professional courses. Government of India should conduct a comprehensive examination throughout the country after 10 + 2 level, so that, the ranks obtained by the candidates decide their future. This procedure avoids all sorts of litigation that is currently going on and the candidates would not suffer.

Thus, at the end, one should aim at providing an atmosphere in the country conducive for excellent quality in the field of education by optimum contribution of the factors listed earlier. Any deviation or dilution at any stage could harm the educational system. The damage cannot be repaired and could be catastrophic. It is hoped that every one concerned with the system realizes the role to be played to make the system function smoothly. A strong will is needed for implementing the policy. It is rightly said that, where there is a will, there is a way. Top-most priority should be given to education in our country. Expenditure on education should be treated as long-term investment. A scientific approach must be adopted at every stage to ensure maximum returns.

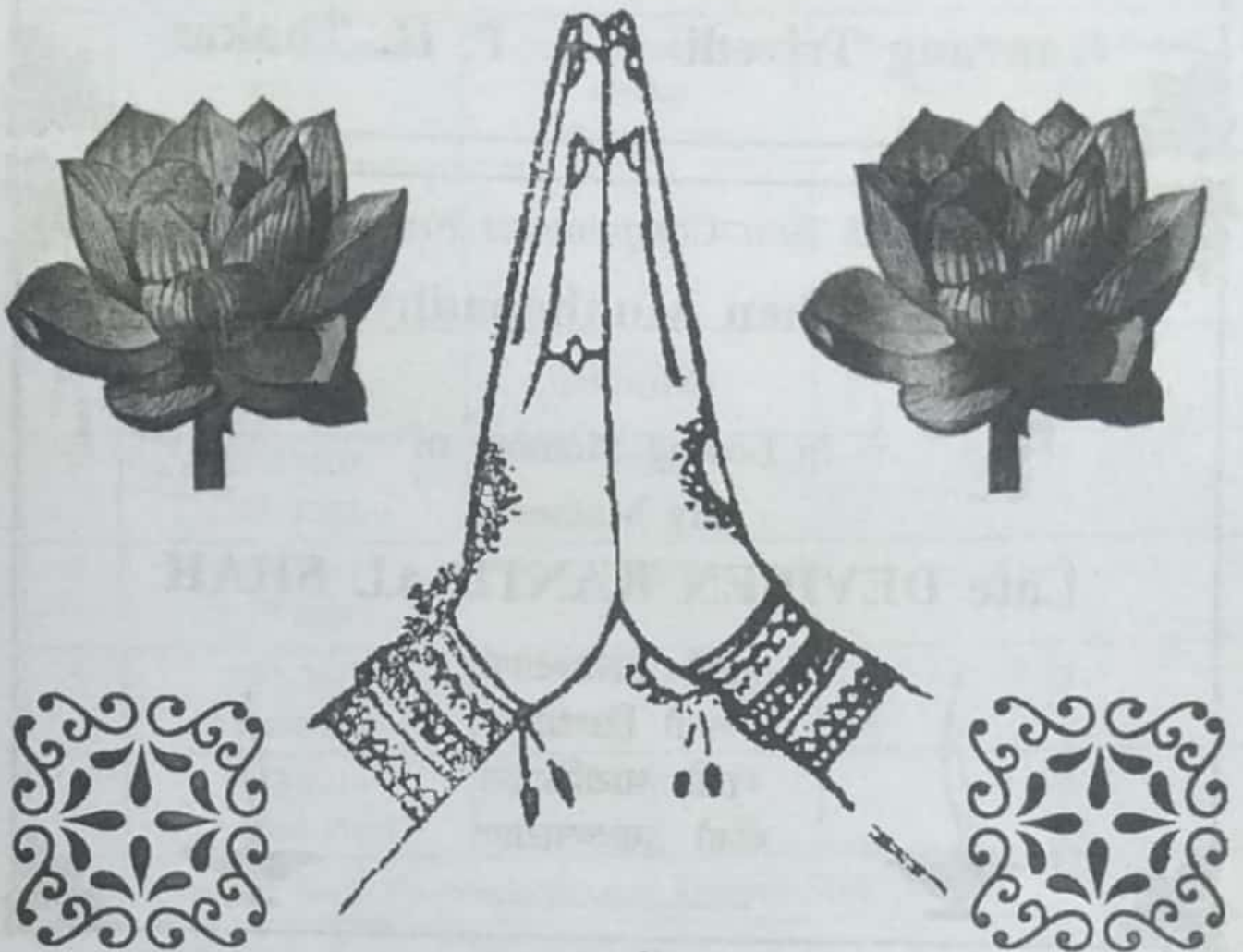
4. ACKNOWLEDGEMENT

I thank the referee to review the earlier draft of this article.

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Editorial Board thanks the following evaluators for assisting us in reviewing the articles submitted for this issue.



R. G. Bhatt

D. S. Dave

K. S. Rao

Gaurang Trivedi

P. H. Thakar

With Best Compliments From...

Ashaben Mukhopadhyay

(Mumbai)

In Loving Memory of
My Mother

Late DEVIBEN KANTILAL SHAH

नमो अरिहन्ताणं
नमो सिद्धाणं
नमो आयरियाणं
नमो उक्ज्सायाणं



BRIEF SUMMARY OF HOLISTIC DEVELOPMENT IN GUJARAT

P. H. THAKAR*

PLANNING

An outlay of Rs 58500 crore is allocated in Gujarat State Plan for the year 2013-14, registering an increase of nearly 15 per cent over previous year plan outlay. It is worth mentioning that 42 per cent of this State Plan Outlay is suggested for Social Sector Development,

Sr. No	Five Year/Annual Plan	State Total Plan Outlay (Rs in Crore)	% age Share of Social Sector outlay in State plan outlay
1	2	3	4
1	1992-1997 (8 th FYP)	11500	19.61
2	1997-2002 (9 th FYP)	28000	34.32
3	2002-2007 (10 th FYP)	47000	37.72
4	2007-2012 (11 th FYP)	128500	41.89
5	2012-2013 (Annual Plan)	50999	40.14
6	2013-2014 (Annual Plan)	58500	42.03

Source : Various Socio-Economic Reviews, Gujarat State

*Ex. Director, Bureau of Eco. & Stat., Gandhinagar.

The above State Planning allocation reveals that Gujarat Government has given due importance to *social sector development*, which is pioneer sector for uplifting Human Development Status of Gujarat.

MICRO LEVEL HUMAN DEVELOPMENT

As a result of integrated planning efforts through various development schemes in regard to Education, Health and Income during 2005-10, top eleven backward talukas according to Shri Cowlagi Committee have improved their status as per *Dr. THAKAR* exercise. These eleven talukas were observed to be better performing talukas in regard to all three Human Development components. These talukas are

Garbada, Limkheda, Jhalod, Devgadhi Baria, Fatepura, Amirgadh, Santrampur, Uchchhal, Sagbara, Umarpada and Nizar.

Source : Mid-Term Appraisal of State Flagship Schemes of Developing Talukas, November - 2011.

STATE ECONOMY

National/State Income normally measured in terms of Gross Domestic Product (G D P). The quick estimates of Gujarat State Income for the year 2011-12 are Rs. 611767 crore at current prices and Rs. 398884 crore at constant prices (2004-05) registering an increase of 15.3 per cent and 8.5 percent respectively over the previous fiscal year. Per capita income is estimated at Rs. 1.03 lakh for current prices and Rs.0. 67 lakh for constant prices. It is worthy to mention that state economy at current prices contributes substantially (nearly 7.5, per cent) in national economy for the year 2011-12.

Source : Directorate of Economics and Statistics, GoG, Gujarat.

POPULATION

Gujarat decadal Population Growth Rate was 22.7 per cent during 1991-2001, has gone down to 19.2 per cent during the first decade of twentieth century (2001-11). Further, according to Sample Registration Bulletin, R.G., GoI, New Delhi, Birth Rate declined from 25.0 to 21.3, Death Rate decreased from 7.8 to 6.7 and similarly Infant Mortality Rate drastically decreased to 41 per 1000 new born babies by 2010 from such *Rate* of 60 in 2001. This analysis explicitly reveals the excellent performance of family welfare activities in the State.

- Source : (1) Census of India 2011, Provisional Population Totals Paper-1 of 2011, Gujarat (page XII).*
(2) Socio-Economic Review 2011-12, Gujarat State (page S-72).

IRRIGATION

As a result of fruitful planning efforts for developing Gujarat Irrigation Sector, through Major Projects like SSNL and through minor irrigation schemes like Khet Talavdis, Check dams, Percolation Tank, Drip irrigation, Lift Irrigation and Safe Stage Works, State Irrigation Intensity (% age of Net Area Irrigated to Net Area Sown) has reached to 42.5 per cent in 2007-08 from 29.8 per cent in 2000-01. As consequences of efficient Water Management of Sardar Sarovar Narmada Project, at present, 8200 villages and 135 cities are provided with potable water

- Source : (1) Directorate of Agriculture, GoG, Gandhinagar.*
(2) Gujarat Samachar, 15th August, 2012 (P-18)

AGRICULTURE

In 2011-12, Gujarat State estimated production of Fruits, Vegetables, Spices and Flowers has increased to 77.63 lakh M.T., 100.50 lakh M.T., 11.68 lakh M.T. and 1.35 lakh M.T. respectively, showing an increase of production of Fruits 4 per cent, Vegetables 7.1 per cent, Spices 12.8 per cent and Flowers 6 per cent in 2011-12 over 2010-11, Moreover, during the year 2012-13, the production of fruits, vegetables, spices and flowers is estimated at 85.89 lakh tones, 101.70 lakh tones, 10.52 lakh tones and 1.59 lakh tones respectively. This clearly reveals diversification of growing traditional crops to Horticulture and Floriculture crops.

- Source : Directorate of Agriculture, GoG, Gandhinagar.*

ANIMAL HUSBANDRY

According to Director of Animal Husbandry, Government of Gujarat, provisional estimate of milk production of the State is 98.2 lakh M.T. during 2011-2012, revealing an increase of 5.3 per cent over such State production for the year 2010-11. Further, Gujarat had occupied fifth rank in respect of state wise milk production comparison for the year 2010-11.

Animal Health Check up programme is being implemented since September-2002. Up to December-2010, 70322 villages of the State are covered. Around 13 lakh animal

are given Medical Treatment, of which, 74 thousand are provided Surgical Treatment, 11 lakh animal were given Sexual Health Treatment, 76 lakh animal were given deworming treatment. 54 lakh animals and 15 lakh poultry/birds were vaccinated.

Source : Directorate of Animal Husbandry, GoG, Gandhinagar.

COMMUNICATION (UPDATION BAAKI)

As per Association of Unified Telecom Service Provider of India, as on 31st July, 2013, there were 4.18 crore simcards subscribers in Gujarat.

Source : Association of Unified Telecom Service Providers of India.

EDUCATION

Dropout Rate of Primary Education Students (Std-I to V) of Gujarat was 22.30 per cent in the year 1999-00, came down to 2.07 per cent by the end of 2011-12. In case of girls, this rate had declined from 20.83 per cent to 2.08 per cent for the period under reference. Similarly this Rate for boys has attained the level of 2.05 per cent from 23.77 per cent during the time span under study. This performance can be attributed to the resultant effect of Sarva Shiksha Abhiyan Mission (SSAM), Mid-Day Meal Programme, Vidya Laxmi Bond, Gunostav Programme, Shala Praveshostav Abhiyan, Kasturba Gandhi Balika Vidyalaya and Distribution of Cost Free Text Books. It is worth mentioning that Net Enrolment Ratio has increased from 95.65 per cent in 2004-05 to 98.87 per cent by 2011-12.

Source : Directorate of Primary Education, GoG, Gandhinagar (S.S. Mission).

HEALTH

- (1) In the State, since inception of 108 Emergency Ambulance Services (i.e. 29th August, 2007), at the end of April, 2012, 28.87 lakh emergency medical calls have been attended. More over 0.39 lakh calls of Police and Fire were attended.
- (2) School Health Check Programme was started in 1997. Since 2007-08, this programme is extended to secondary and higher secondary students. During 2011-12 out of estimated 1.56 crore children (0-18 years age group) either going to or not going to school, 1.49 crore children were examined. Out of these, 15.67 lakh children were treated on the spot, 1.01 lakh children were given spectacles, 1.12 lakh were provided with Referral Services, of which 4244 were treated for heart, 1367 for kidney and 1326 for cancer diseases.

CHIRANJIVI YOJANA PERFORMANCE (2009-12)

Year	Deliveries Registered under the Scheme
2009-10	155721
2010-11	150979
2011-12	150187

JANANI SURAKSHA, BAL SAKHA YOJANA AND FULLY IMMUNIZATION PROGRAMME PROGRESS

Scheme/Programme	Reference Time	Achievement
Janani Suraksha Yojana	2009-10	356263
	2010-11	343600
	2011-12	342211
Bal Sakha Yojana	2010-11	80515
	2011-12	92500
Fully Immunized Children (0-5 years)	2011	1.71 crore
	2012	1.73 crore

Source : Commissionerate of Health, Medical Services and Medical Education, GoG, Gadhinagar.

EMPLOYMENT STATUS

As per 66th round (2009-10) of NSS, Labour Force Participation Rate of Population (age group 15-59 years) of Gujarat is 63.5 per cent as per Usual Activity Status (Principal and Subsidiary taken together) is higher than the corresponding Rate of the country (59.6 per cent). Further, unemployment Rate of Gujarat Population (age group 15-59 years) is 1.2 per cent on the basis of usual activity status (Principal and Subsidiary taken together) is significantly lower than that of Country (2.3 per cent) and probably Gujarat State) is performing on the same par of Rajasthan, Chhatisgarh and Meghalaya (each having unemployment rate nearer to 1 per cent) and thus State occupying 4th Rank.

Distribution of workers by the broad categories of employment reveals that Gujarat has 51 per cent self employed, 18.4 per cent regular wage salaried persons and 30.5

per cent casual labourers as per usual activity status of population considering principal and subsidiary activity taken together.

Source : NSS 66th Round (2009-10) key indicators GoI, New Delhi.

POVERTY ESTIMATES

According to Planning Commission, the poverty estimates of Gujarat was 31.6 per cent in 2004-05, declined to 16.6 per cent by 2011-12. During 2004-10, the poverty estimate of Rural Gujarat decreased from 39.1 per cent to 21.5 per cent, while the same is declined from 20.1 per cent to 10.1 per cent in urban sector of the State for the period under reference (i.e. 2004-12). In the following table, comparative view of Gujarat and India in respect of poverty estimates by sectors for the years 2004-95 and 2011-12 is presented.

Table

Year	Rural		Urban		Combined	
	Gujarat	India	Gujarat	India	Gujarat	India
	(2)	(3)	(4)	(5)	(6)	(7)
2004-05	39.1	42.0	20.1	25.5	31.6	37.2
2011-12	21.5	25.7	17.9	10.1	16.6	21.9

Source : Press Note on Poverty Estimates, 2011-12 by Planning Commission, Govt. of India, New Delhi. July, 2013.

* * * * *



સ્વામિ અજરાત
1960-2010

NOTES

A NOTE ON TRENDS OF URBANISATION

R. R. PANDYA⁽¹⁾ R. G. BHATT⁽²⁾

1. Urbanization-Global Phenomena :

Urbanization is the increasing number of people that live in urban areas. It predominantly results in the physical growth of urban areas, be it horizontal or vertical. The United Nations projected that half of the world's population would live in urban areas at the end of 2008. By 2050 it is predicted that 64.1% and 85.9% of the developing and developed world respectively will be urbanized. At the turn of the 20th century, just 15% of the world population lived in cities. According to the UN the year 2007 witnessed the turning point when more than 50% of the world population was living in cities, for the first time in human history.

The rapid urbanization of the world's population over the twentieth century is described in the 2005 Revision of the UN World Urbanization Prospects report. The global proportion of urban population rose dramatically from 13% (220 million) in 1900, to 29% (732 million) in 1950, to 49% (3.2 billion) in 2005. The same report projected that the figure is likely to rise to 60% (4.9 billion) by 2030. According to the World Urbanization Prospects (the 1996 Revision), the urban population in the year 2025 will rise to 42.5 per cent (566 million).

According to the UN State of the World Population 2007 report, sometime in the middle of 2007, the majority of people worldwide will be living in towns or cities, for the first time in history; this is referred to as the arrival of the "Urban Millennium" or the 'tipping point'. In regard to future trends, it is estimated 93% of urban growth will occur in developing nations, with 80% of urban growth occurring in Asia and Africa.

Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization. Urbanization can describe a specific condition at a set time, i.e. the proportion of total population of area in cities or towns, or the term

(1) Directorate of Economics and Statistics, Gandhinagar, India.

(2) Dept. of Stat. Gujarat University, Ahmedabad-380009, India.

can describe the increase of this proportion over time. So the term urbanization can represent the level of urban development relative to overall population, or it can represent the rate at which the urban proportion is increasing.

2. Urbanization in India :

Urbanization in India is not different from a global urbanization phenomenon but it is almost similar to it. Indian urbanization has proceeded as a part and product of economic change. Occupational shift from agriculture to urban-based industry and services is one part of such economic change. Similarly, increased agricultural performance is also a cause of urbanization as it has been seen in several top rice and wheat producing districts in the country.

New industrial investments and expansion of the services industry in new location is also an important factor of urbanization. As for the magnitude, in 1901, only 25 million people constituting 10.84 per cent of population lived in urban areas in India. In the 100 years since then, the urban population has grown 12 times and it is now around 285 million people constituting 28 per cent of the total population. During the 1st decade of the 21st century, it has further grown up to 377 million people constituting about 31 percent of the total population as per Census-2011. In the following 20 years (2001-21), the urban population will nearly double itself to reach about 550 million.

2.1 Spatial Manifestation of Urban Growth :

It is very important to understand the past and present of urban growth. In 1991, there were 3768 UAs/towns. About one-third of the urban population in 1991 resided in 23 metropolitan cities; another one-third in the remaining 277 Class I cities and the rest in the 3468 UAs/towns. In 2011, there are 4041 Statutory towns and 3892 Census towns. In 2001 about 38% of the total urban population were residing in 35 metro cities, 30.6% in remaining 358 Class I cities and the rest in 3975 UAs/towns. According to a recent estimate, the number of metropolitan cities will be more than 50 by 2011 and 75 by 2021 AD. In addition, there would be 500 large cities (one lakh and above size) and 4430 medium and small towns (less than one lakh population size). The analysis of urbanisation pattern and projections for the next 20 years is indicative of the fact that bulk of the urban population will be living in metropolitan regions. This does not mean that the main cities within these regions will continue to grow at the same pace. In fact, in some cases, central city growth may decline but in the peripheries there will be new growth. Agglomerations covering several municipal jurisdictions will emerge as a distinct feature of India's urbanisation.

2.2 Causes of urbanization in India :

Migration of people from Pakistan after partition of India

The Industrial Revolution

Expansion in government services

Eleventh five year plan that aimed at *urbanization* for the economic development of India

Migration into cities for economic opportunities

Better infrastructure facilities in the urban areas

Growth of private sector .

2.3 The Challenges of Urbanization in India

Urbanization in India is expected to accelerate

Urbanization in India has occurred more slowly than in other developing countries and the proportion of the population in urban areas has been only 28 per cent based on the 2001 census which further increased up to 31 percent in 2011 census. The pace of urbanization is now set to accelerate as the country sets to a more rapid growth. Economic reform has already unleashed investment and growth offering its citizens rich opportunities. Surging growth and employment in cities will prove a powerful magnet. More than 300 million Indians currently live in towns and cities. Within 20-25 years, another 300 million people will get added to Indian towns and cities. This urban expansion will happen at a speed quite unlike anything that India has seen before. It took nearly forty years for India's urban population to rise by 230 million. It could take only half the time to add the next 250 million. If not well managed, this inevitable increase in India's urban population will place enormous stress on the system.

Urbanization occurs as individual, commercial, social and governmental efforts reduce time and expense in commuting and transportation and improve opportunities for jobs, education, housing, and transportation. Living in cities permits the advantages of the opportunities of proximity, diversity, and marketplace competition. However, the advantages of urbanization are weighed against alienation issues, stress, increased daily life costs, and negative social aspects that result from mass marginalization. Suburbanization, which is happening in the cities of the largest developing countries, was sold and seen as an attempt to balance these negative aspects of urban life while still allowing access to the large extent of shared resources.

Cities are known to be places where money, services, wealth and opportunities are centralized. Many rural inhabitants come to the city for reasons of seeking fortunes and social mobility. Businesses, which provide jobs and exchange capital, are more concentrated in urban areas. Whether the source is trade or tourism, it is also through the ports or banking systems that foreign money flows into a country, commonly located in cities.

Economic opportunities are just one reason people move into cities, though they do not go to fully explain why urbanization rates have exploded only recently in places like China and India.

2.4 Consequences of urbanisation :

The impact of all this growth on space, environment and quality of life will be, to say the least, tremendous. The provision of infrastructural facilities required to support such large concentration of population is lagging far behind the pace of urbanisation. As a consequence, the urban environment, particularly in large cities, is deteriorating very rapidly. All cities have severe shortage of water supply, sewerage, developed land, housing, transportation and other facilities. The level, quality and distribution of services have been very poor. Several studies have indicated large segments of urban population do not have access to drinking water, sanitation, basic health services and education. These deficiencies have serious health impacts particularly affecting the urban poor. Deteriorating infrastructure, weak municipal institutions and poor delivery systems have constrained the urban economy and its ability to generate employment, incomes and services for the poor. The impact of urbanisation may be considered in the context of urban infrastructure services comprising water supply, sanitation and solid waste management, land and urban environment.

One problem in which these migrant workers are involved with is growth of slum. In many cases, the rural-urban low skilled or unskilled migrant workers, attracted by economic opportunities in urban areas, cannot find a job and afford housing in cities and have to dwell in slums.

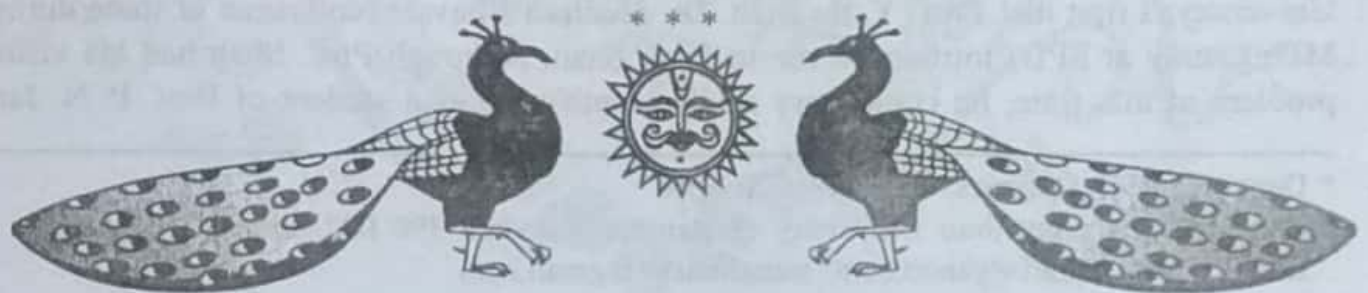
Rapid rise in urban population, in India, is leading to many problems like increasing slums, decrease in standard of living in urban areas, causing environmental damage and much more. India's urban decadal growth rate (2001-2011) is 31.8% which seems to be significant. India has around 300 million people living in metropolitan areas. This has greatly caused slum problems, with so many people over crowding cities and forcing people to live in unsafe conditions which also includes illegal buildings. Water lines, roads and electricity are lacking which is causing fall of living standards. It is also adding to the problem of all types of pollution.

3. Acknowledgement :

The paper has been benefited from suggestions and guidance provided by Dr.B.B.Jani former Head of Department of Statistics, School of Sciences, Gujarat University. I also thank the referee for his valuable suggestions.

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FANTASTIC TWO !

K. MUALIDHARAN*

“What is special about Weibull distribution?: He asked me. After some pose, I replied it is a life time distribution. That is fine. What is the connection between density function, survival function and hazard function? He asked me again. After some pose, I replied the hazard function is equal to He asked me to write down the pdf of Weibull distribution. I wrote the same. He then asked me to show both survival function and hazard function in the density function. I struggled for some time and started replying vaguely that for given hazard function, density function can be obtained uniquely by the relation ... I wrote down that as well. He again corrected me. That is fine- no needs to go so far. He said, I could see from what you have written. It went on ..”

The above dialogue was taken place during my lecturer post interview in M. S. University of Baroda in the year 1991, where I was interviewed by Prof. A. V. Gajjar and others. That was the first time, I happen to meet Prof. Gajjar in a close encounter. It was because of his style of asking questions, I could answer him satisfactorily. Although, I could not answer some of others questions satisfactorily, he boosted my confidence during the interview. It was a history for me as I became a permanent employee of Maharajah Sayajirao University of Baroda. Thereafter, I met him at many state level conferences, seminars and other functions at various places. He always treated me like his own students and remained a well wisher of me and appreciated my work at many occasions. I could very well describe him of a personality with rare combination of knowledge with modesty and concerns on others. He is really fantastic.

It was during one of the GSA conference held at department of Statistics at Gujarat University; I first met Prof. Y. K. Shah. Dr. Shailesh Bhavsar (colleague of mine during MPhil study at SPU) introduced me to Prof. Shah. Although Prof. Shah had his vision problem at that time, he could very easily identify me as a student of Prof. P. N. Jani

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of Sardar Patel University. We chatted for some time and discussed my current area of research and future carriers. He also appreciated my participation in two of the previous year GSA conference symposium held at Mehsana and Vapi. I was thrilled to hear from him all those minute details. Thereafter, we met few more times during conferences in the following years. Later on I heard that he rarely attends public functions as his vision problem has got aggravated. Having this handicap, he promoted the research activities by guiding students for research and projects. I personally appreciate his humbleness and efficiency. He too is fantastic.

Both Prof. Gajjar and Prof. Shah was really an asset of Gujarat University in terms of their academic contributions, research and administration. They have their own fan following and close aids. It really pained me when I heard their heavenly abode. Their legacy will be remembered for ever. The Department of statistics at Gujarat University will definitely find their space vacuum. A great loss for the statistics community of Gujarat.

I take this opportunity to remember both of them and hold them to my heart for being fantastic.

* * *



KARL PEARSON†

H. D. Budhabhatti*



Karl Pearson was born on March 27, 1857 at Islington, England. More commonly he was known as Karl (K.P.). His father was William Pearson and mother was Fanny Smith. He was educated privately at University college school after which he went to King's College, Cambridge in 1876 to study mathematics and he was graduated in 1879 as Third Wrangler in Mathematical Tripos. He then travelled to Germany to study Physics at the University of Heidelberg under G. H. Quincke and metaphysics under Kuno Fisher.

He next visited the university of Berlin where he was interested in the works on physiology with other subjects like Romanlaw, German literature etc.

In 1880 he went to Cambridge. He studied law until 1881 and then he returned to Mathematics. Deputizing for mathematics Professor at King's College, London and for the professor at University College, London in 1883.

In 1884, he was appointed to the Goldsmid Chair of Applied Maths. and Mechanics at University College, London. Karl became editor of **common sense of exact sciences** in 1885. In 1891, he was appointed to the professorship of Geometry at Grasham College. Here he met W. F. Raphael weldon, a zoologist having some interesting problems requiring quantitative solutions.

His collaboration in biometry and evolutionary theory was fruitful until weldon died in 1906. Weldon introduced KP to Charles Darwin's cousin Francis Galton who was interested in aspects of evolution such as heredity and eugenics. Pearson became Galton's statistical heir speaking literally. After Galton's death in 1911, KP embark on producing his definitive biography which was published in 1914, 1924 and 1930 in three volumes. He by himself self financed for these volumes which later on became famous universally. KP then was first holder of **Galton Chair in Eugenics** at University of London. Which

* Ex. CSO, Head, Statistics Department, GSRT Corporation, Ahmedabad.

† This article is adapted from Wikipedia (the free encyclopedia) through net collection.

was later remembered as **Galton Chair of Genetics**. He formed the department of Applied Statistics into which he incorporated the Biometric and Galton laboratories. He remained with the department until his retirement in 1933 and continued to work until his death in 1936.

CONTRIBUTIONS TO STATISTICS

Pearson's work was all embracing in the wide application and development of mathematical statistics and encompassed the fields of biology, epidemiology, anthropometry, medicine, psychology and social history.

In 1901, with Weldon and Galton, he founded the journal **Biometrika** whose object was the development of statistical theory. He edited this journal until his death. He also founded the journal **Annals of Eugenics** (now **Annals of Human Genetics**) in 1925. He published the **Drapers' Company Research Memoirs** largely to provide a record of the output of the Department of Applied Statistics not published elsewhere.

Pearson's thinking underpins many of the classical statistical methods which are in common use today. Some examples of his contributions are as under.

* **Correlation Coefficient** : It was defined as a product moment and its relation to linear regression was studied.

* **Method of Moments** : KP borrowed the concept of moments from physics and introduced to descriptive statistics and for fitting of distributions to samples.

* **Pearson's System of Continuous Curves** : A system of continuous univariate probability distributions that came to form the basis of the now conventional continuous probability distributions. Since the system is complete upto the fourth moment, it is a powerful complement to the Pearsonian method of moments.

* **Chi Distance** : A precursor and special case of Mahalanobis Distance.

* **P Value** : Defined as the probabilities measure of the complement of the ball with the hypothesized value as center point and chi distance as radius.

* **Foundations of the Statistical Hypothesis Testing Theory and Statistical Decision Theory** : Pearson proposed testing the validity of hypothesized values via the p values. The use of present evidence criteria the so called type I error probabilities was later on proposed by J. Neyman and E. Pearson.

* **Pearson's Chi-squared Test** : A hypothesis test using normal approximation for discrete data.

* **Principal Component Analysis** : The method of fitting a linear subspace to multivariate data by minimising the chi distance.

* **Coefficient of Racial Likeness** : In the course of his studies of race he defined this coefficient calculated from several measurement of the human skull. KP contributed heavily to generate new pioneering ideas useful for applying statistical ideologies to different fields. His work is spread up in about 40 volumes and about 40 research articles all universally wellknown today. A few of them can be listed as under :

- ❑ Grammer of Science (1892) (Walter-Scott Dover Publication)
- ❑ Mathematical Contributions to the Theory of Evolution (Trasactions of RS of London)
- ❑ A first Study of Statistics (1907) (London, Dulao & Co.)
- ❑ On the general theory of Skew Correlation and Nonlinear Regression. (London, Dulao & Co.)
- ❑ Tables for Statisticians and Biometricians (Cambridge Press)
- ❑ Tables for Incomplete Gamma Function (London Publication)
- ❑ Tables for Incomplete Beta Function (Cambridge Press)
- ❑ Pearsonian System of Statistical Distributions (Cambridge Press)

AWARDS FROM PROFESSIONAL BODIES

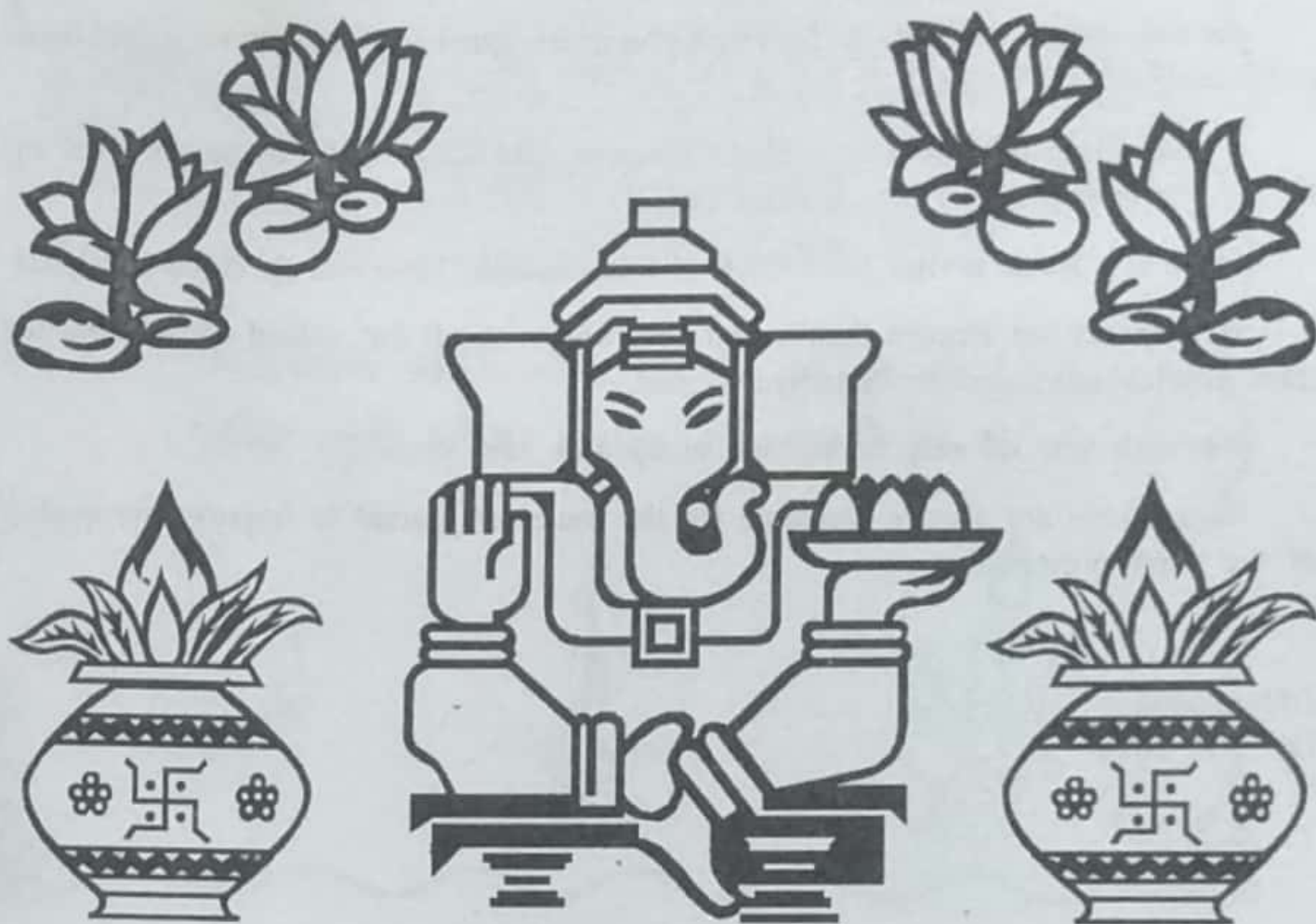
- ❑ 1896 : Elected as Fellow of Royal Society.
- ❑ 1898 : Awarded Darwin Medal.
- ❑ 1911 : Awarded the honorary degree of LLD from University of Andrews.
- ❑ 1911 : Awarded D.Sc. from the University of London.
- ❑ 1932 : Awarded the Rudolf Virchow medal by the Berlin Authropologische Gesellschaft.
- ❑ 1935 : Offered Knighthood (but he refused)

He was also elected an Hon. fellow of King's College Cambridge, the Royal Society of Edinburgh, University College of London and Royal Society of Medicine and a Member of Actuaries' Club.

SELECTED REFERENCES

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- [2] Herbert C. (2001) : Karl Pearson and the human from Divine. (Chicago Uni. Press)
- [3] Joliffe I.T. (2002) : Principal Component Analysis (New York, Springer Verlag)
- [4] Neyman J. Pearson E.S. (1928) : On the use and interpretation of certain test criteria for purposes of statistical inference. **Biometrika** Vol. 20
- [5] Provine W.B. (2001) : The origins of theoretical population Genetics (Uni. of Chicago Press)
- [6] Yule G.U., Filon L.N.G. (1936) : Karl Pearson 1857-1936 (Obituary Notices of FRS, England)

* * * * *



❁ Editorial ❁

This issue of Sankhya Vignan journal is NSV10, June 2014, No. 1 issue. We apologise for delay in its publication. It contains two research articles, two review articles, two notes, biography, book review etc.

First Research Article is pertaining to construction of a specified VBD done by Parvinder and B. L. Patel.

Second Research Article is a case study in O.R. particularly for replacement problems. A new model is developed with interesting industrial application done by Sanjay G. Raval.

A **Review Article** pertaining to Total Quality Management is done by M. N. Gopalan.

Another **Review Article** contains statistical data corresponding to the holistic development of Gujarat presented by P. H. Thakar.

There is a **note** on Trends of unurbanisation specific for India given by Rakesh Pandya.

Another note is given by K. Muralidharan in the memory of Late Prof. A. V. Gajjar and Late Prof. Y. K. Shah.

A brief **Biographical** sketch for the eminent statistician **Karl Pearson** is given by H. D. Budhabhatti.

There is a **Book review** for a book of Demography reviewed by Himanshu Dixit.

We express our sincere thanks and best wishes to all our valued contributors for their articles submitted for Sankhya Vignan.

We wish you all very happy and prosperous new year.

Suggestions are always welcome for the issues of journal to improve the quality of the work presented.

Ahmedabad

Dt. 1-11-2014

**WISH YOU A
VERY HAPPY
AND
PROSPEROUS NEW YEAR**

**WITH BEST COMPLIMENTS
FROM**

**Prof. H. S. MEDIWALA
(JAMNAGAR)**

**મહમ્મદ મદદગાર હામી અલિ હે ।
ફીર તુમે કિસ બાત કી કમી હે ॥**



પિતૃદેવો ભવ

સંખ્યાવિજ્ઞાનનો NVS 9 2013 ના વર્ષનો Combined Issue સ્મૃતિઅંક તરીકે પ્રગટ કરાયો હતો. અમને જણાવતાં આનંદ થાય છે કે આ અંક માટે પોતાના પરમ પૂજ્ય સ્વર્ગસ્થ પિતાશ્રીનું ઋણ અદા કરવાના ભાગરૂપે સ્વ. ડૉ. એ. વી. ગજજરના સુપુત્ર ડૉ. કેતન ગજજરે રૂ. ૧૧,૧૧૧/- ની રકમનું દાન આપેલ હતું. તે જ પ્રમાણે સ્વ. ડૉ. વાય. કે. શાહના સુપુત્ર શ્રી મેહુલકુમાર શાહે રૂ. ૧૧,૦૦૦/- ની રકમનું દાન આપેલ હતું.

આ એક એવો અવસર હતો કે જ્યારે પિતૃદેવોભવની ભાવના સાથે ઉપરની રકમ સ્મૃતિઅંક પ્રગટ કરવા માટે અને તેના ચાહકોને મળેલ છે.

અમે તેમના આ સત્કૃત્ય માટે અત્યંત આભારી છીએ.

અમદાવાદ

તા. 1-11-2014

Editorial Board

Book Review - પુસ્તક પરિચય

શિર્ષક : વસ્તીશાસ્ત્ર

લેખક : ડો. બી. કે. ભટ્ટ

પ્રકાશક : ન્યુ પોપ્યુલર પ્રકાશન, સુરત (આવૃત્તિ 2014)

ભાષા : ગુજરાતી

પૃષ્ઠ : 222

કિંમત : ₹ 140/-

આંકડામય સાગરમાં ડૂબકી

કોઈપણ રાષ્ટ્રના સર્વાંગી વિકાસ પર અસર કરતાં અનેક પરિબલો છે, તેમાંનું એક મુખ્ય પરિબલ છે વસ્તી. વસ્તીનું કદ, ગુણવત્તા, સ્ત્રી-પુરુષનું જાતિપ્રમાણ, સાક્ષરતાનું પ્રમાણ, બાળ મૃત્યુદર, સરેરાશ આયુષ્ય જેવી વિવિધ બાબતોનો વૈજ્ઞાનિક ઢબે અભ્યાસ કરવાનું શાસ્ત્ર છે, જે વસ્તીશાસ્ત્ર (Demography)ના નામે ઓળખાય છે.

આ વિષય ઉપર ઘણા પુસ્તકો ઉપલબ્ધ છે, પરંતુ ગુજરાતી ભાષામાં કદાચ ઘણા જૂજ પુસ્તકો જોવા મળે છે. તેમાં આ પુસ્તક ઉમેરો કરે છે અને તેનો વિશિષ્ટ અભિગમ પ્રશંસનીય છે.

આ પુસ્તકમાં કુલ છ પ્રકરણો છે. ભારતમાં વસ્તી ગણતરી શરૂ થઈ ત્યારથી 2011ની છેલ્લી વસ્તી ગણતરીના આંકડાઓનું તબક્કાવાર, વર્ગીકૃત રીતે વિશ્લેષણ કરવામાં આવ્યું છે, તેમજ 1901થી 2011 સુધીની ભારતની વસ્તીને તેની લાક્ષણિકતા મુજબ વર્ગીકૃત કરીને તે માટેના આંકડાઓ આપવામાં આવ્યા છે.

ભારતમાં વસ્તીના વલણો, વસ્તીની સાક્ષરતા, રાજ્યવાર સાક્ષરતા, સ્ત્રી-સાક્ષરતા, પુરુષ-સાક્ષરતા, ગીચતાનું પ્રમાણ, શહેરીકરણ, ખેતી, ઉદ્યોગ, સેવાક્ષેત્રમાં રોજગારી સહિતના વર્ષ પ્રમાણે તથા રાજ્ય અનુસાર આંકડાઓ તથા તેમનું વિશ્લેષણ આ પુસ્તકમાં લેખકે કરેલું છે.

સ્થૂળ આંકડા કશું બોલતા નથી, પરંતુ જ્યારે તેમને કોઈક ચોક્કસ સંદર્ભમાં ગોઠવવામાં આવે ત્યારે જાણે કે તેમને વાચા આવે છે. દા.ત., ભારતમાં બદલાતી સાક્ષરતા, સ્થળાંતર થતી વસ્તીના આંકડા, વધતું શહેરીકરણ, પરિવર્તન પામતી સામાજિકતા, કુટુંબરચના, વયોવૃદ્ધ વસ્તીની સલામતીનું વિશ્લેષણ વગેરે મુદ્દાઓ આ બાબતની સાબિતી છે.

વસ્તીશાસ્ત્રનો એક મહત્વનો ભાગ વસ્તીનીતિ છે. વસ્તીનીતિ એટલે વસ્તીની ગુણવત્તા, તેના કદને નિયંત્રિત કરવાની નીતિ. આ પુસ્તક ભારતની વસ્તીનીતિને પણ વિગતે ચર્ચા કરે છે અને છેલ્લે વસ્તીનો સ્વાસ્થ્ય, પર્યાવરણ, ગરીબી, સામાજિક અસમાનતા વગેરે જેવા મહત્વના મુદ્દાઓ સાથેના કાર્યકારણના સંબંધને પણ ચર્ચે છે, જે સંશોધકો માટે પણ મદદરૂપ થાય તેમ છે.

આમ છતાં આ પુસ્તકમાં જો નીચે દર્શાવેલી બાબતોનો ઉમેરો કરવામાં આવે તો વસ્તીશાસ્ત્રના અભ્યાસીઓ માટે તે કદાચ વધારે મદદરૂપ થઈ શકત.

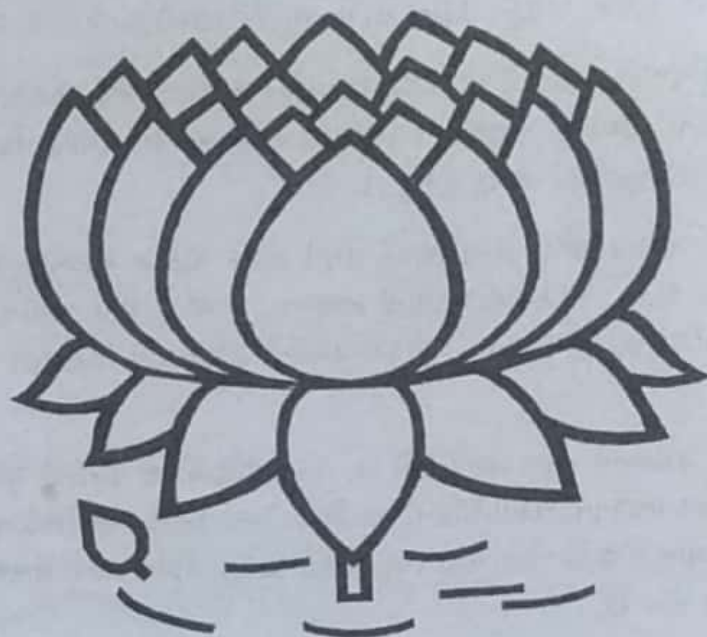
(૧) પુસ્તકની શરૂઆતમાં વસ્તીશાસ્ત્ર એટલે શું ? તેના વિવિધ પરિરૂપો, વસ્તી ગણતરી ભારતમાં તે કઈ રીતે થાય છે અને તેમાં ધ્યાન રાખવાની બાબતોની ચર્ચા કરવામાં આવે તો આગળ ઉપરની તે અંગેની વિગતવાર ચર્ચાને સમજવામાં તે વધુ ઉપયોગી બની શકે.

(૨) BRICS રાષ્ટ્રો જે પાંચ વિકાસશીલ રાષ્ટ્રોનો સમૂહ છે અને તેનો સર્વપ્રથમ ખ્યાલ વિખ્યાત બ્રિટીશ અર્થશાસ્ત્રી Jim O'Neil દ્વારા રજૂ કરાયો હતો. ભારત આ પાંચ રાષ્ટ્રોમાંનું એક રાષ્ટ્ર છે. તેથી ભારતની વસ્તીનીતિની સરખામણી અન્ય રાષ્ટ્રોની વસ્તીનીતિ સાથે કરીને તેનાં રસપ્રદ તારણો રજૂ કરી શકાયા હોત.

પ્રસ્તુત પુસ્તક લેખકે આ વિષય પર કરેલો એક સ્તુત્ય અભિગમ છે. આંકડાશાસ્ત્ર, સમાજશાસ્ત્ર, અર્થશાસ્ત્ર, રાજ્યશાસ્ત્ર વગેરે સાથે સંકળાયેલા અભ્યાસીઓ માટે તે ઘણું જ ઉપયોગી બની શકે તેમ છે. અનેક સેમિનાર, વર્કશોપ, પરિસંવાદ, અધિવેશનો તથા સંકલન સાથે સંકળાયેલ અને કાર્યરત લેખકે ઉઠાવેલી ભારે જહેમત પ્રશંસનીય છે. આ પુસ્તક તેના સુજ્ઞ વાચકોને, વિદ્યાર્થીઓને, સંશોધન કરનારને ચોક્કસ રીતે મદદરૂપ થશે.

— ડૉ. હિમાંશુ એમ. દિક્ષિત
અધ્યક્ષ,
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આર્ટ્સ એન્ડ કોમર્સ કોલેજ,
પિલવાઈ (N.G.)

* * * * *



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The editorial board invites research articles, brief summary of research project reports, review articles, informative articles, research notes, class-room notes, statistical queries and other problems of interest as well as any relevant informations that can highlight significantly the applications part pertaining to Applied Statistics.

Accordingly the editorial board welcomes articles in the field of industrial statistics, agricultural statistics, operations research and operations management, economic statistics and econometrics, statistical quality control, information and coding theory, statistical planning, computer programming with applications, environmental statistics, demographical research etc. The articles should be submitted in English or Gujarati. **Two** copies of the manuscript should be sent to the **Editor, 'Sankhya Vignan' C/o. Statistics Department, Gujarat University, Ahmedabad-380 009. (India). Please submit CD of the article along with the hard copies.**

The manuscript should be typed on a bond paper in double space with sufficient margins on all the sides of the paper. The title of the article should include the name(s) and address of author(s). All references should be listed at the end of the article and it should be numbered in alphabetical sequence of the author(s) and it should be produced in an appropriate manner indicating the year of publication, details of publication etc. The material presented for publication by the contributors should be as concise and compact as possible.

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* * *



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R.No. E2502 A'bad-1974

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----------------	-------------------------

KARL PEARSON*



Karl Pearson FRS (27 March, 1857 – 27 April, 1936) (originally named **Carl**) was an influential English mathematician and biometrician. He has been credited with **establishing the discipline of mathematical statistics**, and contributed significantly to the field of biometrics, meteorology and theories of Social Darwinism and eugenics. A major proponent of eugenics, Pearson was also a protege and biographer of Sir Francis Galton.

In 1911 he **founded the world's first university statistics department at University College London**. A sesquicentenary conference was held in London on 23 March 2007, to celebrate the 15th anniversary of his birth.

Special Awards given to KP :

- * Fellow of Royal Society (FRS) (1896)
- * Darwin Medal (1898)
- * D.Sc. Degree from University of London (1911)
- * Rudolf Virchow Medal from Berlin (1932)
- * Offered Knighthood (but refused by him)

KP gave very significant contributions for his pioneering works regarding Pearsonian system of Curves, Correlation Coefficient, Moments and Method of Moments, Chi Squared Test, Principal Component Analysis etc.

***(Brief Biographical sketch is given inside the journal)**

This page is specially donated by Prof. Shailesh Teredesai (Ex. Head), Statistics Dept., S. M. Patel Institute of Commerce, GLS, Ahmedabad.

Printed Matter

(Journal of GSA, Ahmedabad)

To,

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