CHAPTER - VIII

PRODUCT MIX AND PERFORMANCE : ANOVA, CORRELATION AND REGRESSION ANALYSIS

8.1 INTRODUCTION

Khandwalla (1981) studied the turn around strategies of the 9 sick enterprises and identified the major ingredients of successful turnarounds. One of the strategies adapted by them, was selective changes in the organizations product mix. Out of nine enterprises, one case study was of a textile mill. For the turnaround, the mill got some of its varieties of cloth polymerized for higher margins and brought out other profitable textile products which it could produce in its mills. This way selective changes were made in product mix, to improve the performance. Thus, it can be seen that product mix is one of the critical decisions determining the performance of an organization. Now let us study, the impact of product-mix decision on the performance.

8.1 OBJECTIVES OF THE STUDY

In the previous chapters with the help of descriptive studies, an attempt was made to understand, describe and build up, the relationship between the product policy, management and the

Khandwalla Pradip N., 1981
performance, now, in this chapter with use of empirical data, the relationships between the product-mix and performance will be examined.

8.3 SELECTION OF VARIABLES FOR THE STUDY
On the basis of literature review and the personal interviews of the textile experts, a total of 11 variables were selected for this study, out of these 11, 7 are the performance related variables which include both short as well as long run variables, 3 are product-market related and one is investment related. The following list gives the 3 types of variables.

<table>
<thead>
<tr>
<th>Performance Variables</th>
<th>Product-Market Variables</th>
<th>Investment Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. R.O.I. (%)</td>
<td>1. Product Mix (%)</td>
<td>1. Working Capital Investment per 100 loom shift (Rs)</td>
</tr>
<tr>
<td>2. Contribution as a % of Production Value (%)</td>
<td>2. Exports (%)</td>
<td></td>
</tr>
<tr>
<td>3. G.P.M. On Sales</td>
<td>3. Yarn Sales (%)</td>
<td></td>
</tr>
<tr>
<td>4. Sales revenue per metre of cloth sold (Rs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Equity Dividend (Rs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Sales per loom shift (Rs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Contribution per 100 loom shift (Rs)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All these measures are used by ATIRA for inter-firm comparison in textile industry. Now, let me define each of these variables one by one.
8.31 R.O.I. (%) 

R.O.I., means return on investment. This variable was selected on the basis of literature review. It is also commonly used as a performance measure. Schoeffler (1974), Macmillan (1982), and Rumelt (1982) have used ROI, as the single performance measure. The term investment includes both short term as well as long term.

8.32 CONTRIBUTION AS A % OF PRODUCTION VALUE

Garde and others (1987), have used this variable to measure the profitability in the textile industry. Apart from these ATIRA has also used this measure to compare the performance of various textile mills. As per the industry people also, this variable is used in practise to evaluate the performance of mills. The term contribution means production value - Variable costs. Production value = sales (excluding excise duty) + processing charges received + closing stock - opening stock.

Variable costs = the direct cost of raw material + yarn duty + yarn purchase + cloth purchase + colors and chemicals + packing materials + processing charges paid + commission and brokerage + Royalty and other variable costs. However, it does not include interest and depreciation as they are considered as fixed expenses. Thus
mathematically it can be expressed as

\[
\text{Production Value - Variable Cost} \div \text{Production Value} \times 100
\]

8.33 G.P.M. ON SALES (%)

Nathanson and James (1982) and Palepu (1985) used average return on sales and its growth as the performance variable. Again, this is commonly used measure in the textile circles to compare the performances.

The gross profit Margin is before interest but after depreciation. Sales excludes excise duty. In other words it is a ratio of gross profit Margin on sales.

\[
\text{G.P.M.} \div \text{SALES} \times 100
\]

8.34 SALES REVENUE PER METRE OF CLOTH SOLD (RS)

Garde and others (1987) have used this variable, as an indicator of product mix while in this study, it is being used as the performance variable. In textile industry, performance of the mills is compared by average price realised per metre of cloth, so I have used it as the performance variable. In the absence of any other product mix variable this, could be taken up as an indicator of product mix. This ratio can be mathematically
expressed as,

\[
\text{Sales revenue per metre of cloth sold} = \frac{\text{Sales}}{\text{No. of metre of cloth sold}}
\]

**8.35 EQUITY DIVIDEND (Rs)**

Varadarajan (1986), and Chakravarthy (1986), have used return on equity as the profitability measure. Hence, this measure is used. It is defined as dividend declared per equity share.

**8.36 SALES PER LOOM SHIFT (Rs)**

This is a common measure used in the composite textile industry to compare individual performance over the years, as well as for comparison with others. Loom shift is defined as working of one loom for eight hours. Thus, it is

\[
\text{Sales per loom shift} = \frac{\text{Sales}}{\text{No. of loom shifts}}
\]

**8.37 CONTRIBUTION PER 100 LOOM SHIFT (Rs)**

According to the textile experts, contribution per loom shift is the most critical performance variable. In the absence of per loom shift data, I have taken per 100 loom shift. This takes into consideration, along with costs, sales, production efficiency as well. Thus, it is the most reliable measure of performance i.e. in terms of
profitability. Both the concepts of contribution as well as loom shift have already been defined. The variable means:

\[
\text{Contribution per 100 loom shift} = \frac{\text{Contribution}}{100 \text{ loom shift}}.
\]

**8.38 PRODUCT - MIX (%)**

Has been defined as the proportion of cotton Vs. non-cotton or synthetics. The sales mix of cotton and non-cotton has been taken as an indicator of product mix. Even in product life cycle studies sales has been used as an indicator of PLC. In the absence of the availability of production mix data, this gives the direction in which mills are moving as far as product mix is concerned. On the basis of few interviews, it was found that proportion of blend was a very critical product mix decision. Hence, it has been taken as product mix. It can be defined as follows:

\[
\text{Product Mix} = \frac{\text{Sales of Non-cotton}}{\text{Total Sales}} \times 100
\]

**8.39 EXPORTS (%)**

This is expressed in terms of exports as a % to total sales.

\[
\frac{\text{Export sales}}{\text{Total Sales}} \times 100
\]
8.40 **YARN SALES (%)**

Like exports, yarn sales also is % of the total sales.

\[
\frac{\text{Yarn Sales}}{\text{Total Sales}} \times 100
\]

Apart from these variables, other variables like cost of raw materials, consumption etc. are used while examining the factors influencing product mix decisions.

8.4 **DATA BASE**

Initially the data base for the study had data on 20 different variables for 95 composite mills. Out of these, only mills who had data, on all the variables were selected. Others were eliminated. Thus, the sample size was reduced to 72 mills and variables were also reduced to 14. Some of the variables were deleted on the basis of opinion of textile executives. So, it has data base across the textile industry for the year 1983.

8.5 **ANOVA ANALYSIS**

8.51 Vardarajan (1986) has used this statistical technique of analysis of Variance (ANOVA) for data analysis. In this study, also with the use of ANOVA technique the relationship between the performance and the product mix is measured.
8.52 As Rumelt (1974) has divided the organizations into different categories, in this study also at first, the 72 mills were divided into 3 distinct groups on the basis of the share of the synthetic fabric sales to the total sales of a firm. Accordingly,

1. Only cotton Mills that is mills producing no synthetics (28 mills)
2. Mills producing 1-40% of synthetics (28 mills) and.
3. Mills producing 40-100 % of synthetics (16 mills)

8.53 At first, simple mean standard deviations and coefficient of variation, of the selected 8 performance variables, of all the 72 mills together and the 3 groups separately, were calculated to see whether there is any difference between the groups. The following Table 8.1 presents the results of the analysis:
<table>
<thead>
<tr>
<th>Variable</th>
<th>All mills Mean</th>
<th>Only Mills with cotton Mean</th>
<th>Mills with 1% to 40% synthetic production Mean</th>
<th>Mills with 40% to 100% synthetic production Mean</th>
<th>All mills Standard Deviation</th>
<th>Only Mills with cotton Standard Deviation</th>
<th>Mills with 1% to 40% synthetic production Standard Deviation</th>
<th>Mills with 40% to 100% synthetic production Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ROI (%)</td>
<td>-6.84</td>
<td>-18.71</td>
<td>-8.74</td>
<td>18.16</td>
<td>23.03</td>
<td>29.7</td>
<td>24.55</td>
<td>7.55</td>
</tr>
<tr>
<td></td>
<td>(-422%)</td>
<td>(159%)</td>
<td>(-281%)</td>
<td>(42%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Contribution as a % of Value of output (%)</td>
<td>45.52</td>
<td>49.11</td>
<td>44.35</td>
<td>41.29</td>
<td>7.02</td>
<td>8.64</td>
<td>6.13</td>
<td>6.05</td>
</tr>
<tr>
<td></td>
<td>(15%)</td>
<td>(14%)</td>
<td>(14%)</td>
<td>(15%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-108%)</td>
<td>(-96%)</td>
<td>(-96%)</td>
<td>(121%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sales Revenue per (Rs)</td>
<td>8.45</td>
<td>5.24</td>
<td>7.36</td>
<td>15.99</td>
<td>5.19</td>
<td>1.01</td>
<td>2.40</td>
<td>5.89</td>
</tr>
<tr>
<td></td>
<td>(81%)</td>
<td>(19%)</td>
<td>(33%)</td>
<td>(36%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Equity Dividend (Rs)</td>
<td>4.06</td>
<td>0.88</td>
<td>3.00</td>
<td>11.82</td>
<td>8.00</td>
<td>2.45</td>
<td>5.74</td>
<td>7.81</td>
</tr>
<tr>
<td></td>
<td>(186%)</td>
<td>(361%)</td>
<td>(361%)</td>
<td>(121%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Sales per loom shift (Rs)</td>
<td>310.14</td>
<td>195.58</td>
<td>295.09</td>
<td>538.97</td>
<td>363.21</td>
<td>76.88</td>
<td>158.76</td>
<td>684.63</td>
</tr>
<tr>
<td></td>
<td>(117%)</td>
<td>(33%)</td>
<td>(50%)</td>
<td>(120%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Working capital investment per 100 loom shift (Rs)</td>
<td>65.96</td>
<td>36.46</td>
<td>81.96</td>
<td>69.75</td>
<td>68.89</td>
<td>27.76</td>
<td>73.47</td>
<td>88.64</td>
</tr>
<tr>
<td></td>
<td>(104%)</td>
<td>(75%)</td>
<td>(75%)</td>
<td>(100%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Contribution per 100 loom shift (Rs)</td>
<td>13400.88</td>
<td>9720.46</td>
<td>13381.71</td>
<td>19915.69</td>
<td>8201.84</td>
<td>2940.71</td>
<td>5925.90</td>
<td>12648.41</td>
</tr>
<tr>
<td></td>
<td>(61%)</td>
<td>(30%)</td>
<td>(44%)</td>
<td>(64%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in the bracket are coefficient of variation (%)
The table clearly shows that the mean of groups are different. ROI and GPM which is negative becomes positive with the change in product mix. Also, sales revenue per metre of cloth, sales per loom shift, equity dividend, contribution per 100 loom shift and working capital investment per 100 loom shift, increased with the change in the product mix. Contribution as a percentage of value of output is the only performance factor, which has shown a decline with the change in product mix. This means that the proportion of contribution has increased more than the proportionate change in the product mix. This is very much expected. This finding can be supported by Garde (1987) and others who also found, that the contribution as percentage of value of output decreased with the increase in selling price. Thus, we can conclude that as the mills are increasing their synthetic sales, performance is also improving.

The analysis of standard deviation and co-efficient of variation shows, that the overall deviation from the mean is lowest in contribution as a percentage of value of output (15%). This is followed by, Sales revenue per metre of cloth and contribution per 100 loom shift (61%). Rest of the factors are all above 100, working capital (104%), followed by sales per loom shift (117%), equity dividend (168%), gross profit margin (-188%), and ROI has shown the maximum variations of (-422%).

Further, to examine the level of significance of the difference between the means of 3 different groups, of mills, ANOVA one way or one factor test was used. Thus on the basis of the discussion and the analysis, a formal statement of the hypothesis is made as follows:-
Ho : $M_1 = M_2 = M_3$  \hspace{1cm} \text{Null hypothesis} \\
$H_1 : M_1, M_2, M_3$ are not all equal  \hspace{1cm} \text{alternative hypothesis.} \\

so, if the means of 3 groups do not differ significantly, we accept null hypothesis and infer that the product mix, does not have any impact on the performance. On the other hand, if we find a significant difference between the means of groups, we accept the alternative hypothesis and conclude, that product mix does effect performance. The $F$ ratio statistic is used to test the level of significance at .01 level. $F$ ratio is calculated as follows:

Between - Column Variance \\
\[ BCV = \frac{\sum_{j} n_j (x_j - \bar{x})^2}{K - 1} \]  \hspace{1cm} (1) \\

\( n_j = \text{the size of the jth sample} \) \\
\( x_j = \text{the sample mean of the jth sample} \) \\
\( \bar{x} = \text{the grand mean} \) \\
\( K = \text{the no. of samples} \)

Within Column Variance

\[ WCV = \frac{\sum_{j} (n_j - 1) s_j^2}{n_T - K} \]  \hspace{1cm} (2) \\

\( n_j = \text{the size of the jth sample} \)
\[ s_j^2 = \text{the sample variance of the } j\text{th sample} \]
\[ K = \text{the no. of samples} \]
\[ n \tau = \text{Total sample size} \]
\[ F \text{ ratio} = \frac{\text{BCV}}{\text{WCV}} \]

The ANOVA analysis was done for each of the performance variable. Table 8.2 presents the results of the analysis.

**TABLE 8.2**

**ANALYSIS OF VARIANCE**

<table>
<thead>
<tr>
<th>Variable</th>
<th>F ratio</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contribution as a % to production value</td>
<td>176.50</td>
<td>S</td>
</tr>
<tr>
<td>2. Sales Revenue per Metre of Cloth</td>
<td>60.05</td>
<td>S</td>
</tr>
<tr>
<td>3. Equity Dividend</td>
<td>22.49</td>
<td>S</td>
</tr>
<tr>
<td>4. ROI</td>
<td>12.52</td>
<td>S</td>
</tr>
<tr>
<td>5. Contribution per 100 loom shift</td>
<td>9.65</td>
<td>S</td>
</tr>
<tr>
<td>6. GPM On Sales</td>
<td>7.44</td>
<td>S</td>
</tr>
<tr>
<td>7. Working capital investment per 100 loom shift</td>
<td>5.14</td>
<td>S</td>
</tr>
<tr>
<td>8. Sales per loom shift</td>
<td>4.98</td>
<td>S</td>
</tr>
</tbody>
</table>

\[ S = F. \text{ ratio significant at .01 level (4.98) with 2.69 degrees of freedom.} \]
8.57 Table 8.2 shows that on all performance variables, the means between the groups are significantly different. Hence, we can accept the alternative hypothesis and conclude that product mix does influence the performance. As far as degree is concerned, we notice that difference between the means is maximum. in contribution as a % of value of output, followed by sales revenue per metre of cloth, equity dividend, ROI, contribution per 100 loom shift, GPM on sales, working capital investment per 100 loom shift and least is sales per loom shift.

8.6 REGRESSION MODELS

8.61 After having examined the significance of impact of product mix on each of the performance variable, with the use of regression analysis the level of impact is further studied. Earlier in the literature review we have seen that most of the studies, Garde and others (1987); Macmillan and others (1982), Jacquemin and Berry (1977), Bass (1978) and Rhoades (1973) used regression as a statistical tool, to study the relationship between performance and diversification.

8.62 MODELS ESTIMATED

The two main functions to be estimated from the cross section data are:

(a) Performance function, and

(b) Product Mix function
(a) Performance Function Model:

\[ Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) \]

Where

- \( Y \) = dependent variable (performance)
- \( X_1 \) = Product Mix (%)
- \( X_2 \) = Exports (%)
- \( X_3 \) = Yarn sales (%)
- \( X_4 \) = Working capital per days sales (Rs)
- \( X_5 \) = Working capital investment per 100 loom shift (Rs)
- \( X_6 \) = Sales revenue per metre of cloth sold (Rs)
- \( X_7 \) = Raw material cost (Rs per Kg)
- \( X_8 \) = Dummy variable - Mills producing only cotton 0 and others 1

(b) Product - Mix Function Model:

\[ Y = f(X_1, X_2, X_3, X_4) \]

Where

- \( Y \) = dependent variable (product mix)
- \( X_1 \) = Average cost of cotton (Rs)
- \( X_2 \) = Average cost of synthetic raw material (Rs)
- \( X_3 \) = Working capital investment per 100 loom shift (Rs)
- \( X_4 \) = Synthetic raw material consumption (%)

Performance function is taken as a dependent variable, using 6 different factors. These are:

1. Contribution per 100 loom shift
2. Return on Investment
3. Gross Profit Margin on Sales
4. Sales per loom shift
5. Equity Dividend
6. Sales Revenue per metre of cloth sold
7. Contribution as a % of production value

The theoretical models estimated are as follows:

MODELS

CONTRIBUTION PER 100 LOOM SHIFT (C)

\[ \log C = \log a + b \log (X_i) \]

RETURN ON INVESTMENTS (R)

\[ \log R = \log a + b \log (X_i) + c \log (X_2) \]
\[ \log R = \log a + b \log (X_i) + c \log (X_2) + d \log (X_3) \]
\[ \log R = \log a + b \log (X_i) + c \log (X_2) + d \log (X_3) + e \log (X_6) \]
\[ \log R = \log a + b \log (X_i) + c \log (X_2) + d \log (X_3) + e \log (X_6) \]

GROSS PROFIT MARGIN ON SALES (GPM)

\[ \log GPM = \log a + b \log (X_i) \]
\[ \log GPM = \log a + b \log (X_1) + c \log (X_2) \]
\[ \log GPM = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) \]
\[ \log GPM = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) + e \log (X_6) \]
\[ \log GPM = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) + e \log (X_6) \]
S A L E S  P E R  L O O M  S H I F T  (S)

\[ \log S = \log a + b \log (X_1) \]  \hspace{1cm} (12)
\[ \log S = \log a + b \log (X_1) + c \log (X_2) \]  \hspace{1cm} (13)
\[ \log S = \log a + b \log (X_1) + c \log (X_3) \]  \hspace{1cm} (14)
\[ \log S = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) \]  \hspace{1cm} (15)

E Q U I T Y  D I V I D E N D  (E)

\[ \log E = \log a + b \log (X_1) \]  \hspace{1cm} (16)
\[ \log E = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) \]  \hspace{1cm} (17)
\[ \log E = \log a + b \log (X_1) + c \log (X_2) + d \log (X_3) + e \log (X_5) \]  \hspace{1cm} (18)

S A L E S  R E V E N U E  P E R  M E T R E  O F  C L O U T H  (SR)

\[ \log SR = \log a + b \log (X_1) \]  \hspace{1cm} (19)
\[ \log SR = \log a + b \log (X_1) + b \log (X_2) \]  \hspace{1cm} (20)
\[ \log SR = \log a + b \log (X_1) + b \log (X_2) + c \log (X_3) \]  \hspace{1cm} (21)

C O N T R I B U T I O N  A S  A  %  O F  P R O D U C T I O N  V A L U E  (CP)

\[ \log CR = \log a - b \log (X_1) \]  \hspace{1cm} (22)
\[ \log CR = \log a - b \log (X_1) + c \log (X_2) + - d \log (X_3) \]  \hspace{1cm} (23)
\[ \log CR = \log a - b \log (X_1) + c \log (X_2) + - d \log (X_3) + e \log (X_7) \]  \hspace{1cm} (24)
\[ \log CR = \log a - b \log (X_1) + c \log (X_2) + - d \log (X_3) + e \log (X_8) \]  \hspace{1cm} (25)

P R O D U C T  M I X  F U N C T I O N  M O D E L  (PM):

\[ \log PM = \log a + c \log (X_1) + d \log (X_2) \]  \hspace{1cm} (1)
\[ \log PM = \log a + c \log (X_1) + d \log (X_2) + e \log (X_4) \]  \hspace{1cm} (2)

8.63 The results of the estimate of equations of performance function are presented in Table 8.4.

8.64 The results of the estimate of equations of product mix function are presented in Table 8.5.
8.65 The tables are followed by 8 graphs depicting the relationship between product mix and the selected performance variables.
# Table 8.4

## Estimates of Performance Function Equations

<table>
<thead>
<tr>
<th>No.</th>
<th>Equation</th>
<th>$r^2$</th>
<th>DW</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\log C = 9765.4 + 158.57 \log X_1$</td>
<td>.34</td>
<td>1.55</td>
<td>36.7 *</td>
</tr>
<tr>
<td></td>
<td>(9.61) (5.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$\log R = -17.7 + .51 \log X_1 + 1.05 \log X_2$</td>
<td>.34</td>
<td>1.93</td>
<td>17.86 *</td>
</tr>
<tr>
<td></td>
<td>(-4.94) (5.11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$\log R = -26.66 + .58 \log X_1 + 3.03 \log X_2 + 1.24 \log X_3$</td>
<td>.22</td>
<td>1.81</td>
<td>21.03 *</td>
</tr>
<tr>
<td></td>
<td>(-5.41) (4.11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$\log R = -.40 + .17 \log X_1 + .17 \log X_4 + -.09 \log X_5 + 2.64 \log X_6$</td>
<td>.33</td>
<td>1.83</td>
<td>23.76 *</td>
</tr>
<tr>
<td></td>
<td>(-3.58) (.66)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$\log R = -26.44 + 8.13 \log X_1 + 2.88 \log X_2 + 1.22 \log X_3 + -5.57 \log X_8$</td>
<td>.22</td>
<td>1.75</td>
<td>4.60 *</td>
</tr>
<tr>
<td></td>
<td>(5.31) (1.68)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Contribution Per 100 Loom Shift (C)

- $\log C = 9765.4 + 158.57 \log X_1$

## Return on Investment (R)

1. $\log R = -17.7 + .51 \log X_1 + 1.05 \log X_2$
2. $\log R = -26.66 + .58 \log X_1 + 3.03 \log X_2 + 1.24 \log X_3$
3. $\log R = -.40 + .17 \log X_1 + .17 \log X_4 + -.09 \log X_5 + 2.64 \log X_6$
4. $\log R = -26.44 + 8.13 \log X_1 + 2.88 \log X_2 + 1.22 \log X_3 + -5.57 \log X_8$

## Gross Profit Margin on Sales

1. $\log GPM = -8.58 + 16 \log X_1$
2. $\log GPM = -9.95 + .17 \log X_1 + .38 \log X_2$
3. $\log GPM = -11.48 + 2.50 \log X_1 + 1.24 \log X_2 + .21 \log X_3$
4. $\log GPM = -11.88 + .09 \log X_1 + .02 \log X_4 + .61 \log X_5 + -1.0 \log X_7$
<table>
<thead>
<tr>
<th>No.</th>
<th>EQUATION</th>
<th>( r^2 )</th>
<th>DW</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>( \log GPM = -11.44 + 2.94 \log X_1 + 1.21 \log X_2 + 0.21 \log X_3 - 1.06 \log X_6 )</td>
<td>.29</td>
<td>1.63</td>
<td>5.98 *</td>
</tr>
<tr>
<td></td>
<td>((-6.61) (1.75) )</td>
<td>((1.74) (.35) )</td>
<td>(- .27)</td>
<td></td>
</tr>
</tbody>
</table>

**SALES PER LOOM SHIFT (S)**

| 2) | \( \log S = 182.71 + 5.55 \log X_1 \) | .21 | 1.71 | 19.16 * |
|     | \((3.76) (4.98)\) | | | |
| 3) | \( \log S = 5.17 + .19 \log X_1 + .04 \log X_2 \) | .39 | 1.42 * | 24.11 * |
|     | \((73.20) (6.91)\) | \((1.13)\) | | |
| 4) | \( \log S = -404.73 - 12.50 \log X_1 + 119.53 \log X_6 \) | .81 | 1.89 | 149.36 * |
|     | \((-8.76) (-9.13)\) | \((14.82)\) | | |
| 5) | \( \log S = 5.18 + .25 \log X_1 + .04 \log X_2 - 0.15 \log X_6 \) | .39 | 1.44 | 16.13 * |
|     | \((72.62) (2.71)\) | \((1.00)\) | | |

**EQUITY DIVIDEND (E)**

| 6) | \( \log E = .76 + .14 \log X_1 \) | .41 | 1.66 | 48.69 * |
|     | \((.97) (8.9)\) | | | |
| 7) | \( \log E = -.02 + .40 \log X_1 - .09 \log X_2 + .00 \log X_3 \) | .36 | 1.63 | 12.93 * |
|     | \((-1.11) (5.91)\) | \((-0.96) (.15)\) | | |
| 8) | \( \log E = -.02 + .43 \log X_1 + .09 \log X_2 + .00 \log X_3 + .00 \log X_6 \) | .36 | 1.62 | 9.57 * |
|     | \((-1.10) (1.92)\) | \((-0.97) (-.16)\) | | |

**SALES REVENUE PER METRE OF CLOTH (SR)**

| 9) | \( \log SR = 4.96 + .15 \log X_1 \) | .79 | 1.70 | 268.32 * |
|     | \((13.98) (18.32)\) | | | |
| 10) | \( \log SR = 1.55 + .23 \log X_1 - .02 \log X_2 \) | .71 | 1.69 | 83.49 * |
|     | \((32.79) (12.79)\) | \((-0.96)\) | | |
| 11) | \( \log SR = 1.55 + .20 \log X_1 + .02 \log X_2 + .07 \log X_3 \) | .71 | 1.72 | 55.09 * |
|     | \((32.34) (3.31)\) | \((-0.88) (.45)\) | | |

**F ratio:**
- 6.98 *
- 19.16 *
- 24.11 *
- 149.36 *
- 16.13 *
- 48.69 *
- 12.93 *
- 9.57 *
- 268.32 *
- 83.49 *
- 55.09 *
<table>
<thead>
<tr>
<th>EQUATION</th>
<th>( r^2 )</th>
<th>DW</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log CP = 47.3 + 10 \log X_1 )</td>
<td>.19</td>
<td>1.76</td>
<td>15.8 *</td>
</tr>
<tr>
<td>( (\log CP) )</td>
<td>(50.27)</td>
<td>(-3.99) #</td>
<td></td>
</tr>
<tr>
<td>( \log CP = 49.49 + 3.99 \log X_1 + .04 \log X_2 + -.06 \log X_3 )</td>
<td>.39</td>
<td>1.84</td>
<td>14.40 *</td>
</tr>
<tr>
<td>( (\log CP) )</td>
<td>(25.09)</td>
<td>(-1.99) #</td>
<td></td>
</tr>
<tr>
<td>( \log CP = 49.49 + 3.99 \log X_1 + .04 \log X_2 + -.06 \log X_3 + .25 \log X_7 )</td>
<td>.45</td>
<td>1.73</td>
<td>13.65 *</td>
</tr>
<tr>
<td>( (\log CP) )</td>
<td>(119.04)</td>
<td>(-1.18)</td>
<td></td>
</tr>
<tr>
<td>( \log CP = 3.99 + -.04 \log X_1 + .00 \log X_2 + -.08 \log X_3 + .01 \log X_9 )</td>
<td>.39</td>
<td>1.83</td>
<td>10.65 #</td>
</tr>
<tr>
<td>( (\log CP) )</td>
<td>(119.04)</td>
<td>(-1.18)</td>
<td></td>
</tr>
</tbody>
</table>

* DW significant at 1% level
* F significant at .01% level
# t values are given in the bracket and is significant at .10 level.
<table>
<thead>
<tr>
<th>No.</th>
<th>EQUATION</th>
<th>$r^2$</th>
<th>DW</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>log PM = $-29.1 + 2.04 \log X_1 + 0.30 \log X_2 + 0.90 \log X_3$</td>
<td>.44</td>
<td>1.65</td>
<td>23.72 *</td>
</tr>
<tr>
<td></td>
<td>($-2.74$) ($2.62)^\dagger$ ($5.24)^\dagger$ ($2.65)^\dagger$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>log PM = $-2.16 + .26 \log X_1 + 0.08 \log X_2 + 0.02 \log X_3 + 1.37 X_4$</td>
<td>.88</td>
<td>1.78</td>
<td>158.42 *</td>
</tr>
<tr>
<td></td>
<td>($-0.41$) (.98) ($1.96)^\dagger$ ($1.88$) ($17.81)^\dagger$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* F significant at .31 level  
° t values are given in the bracket and is significant at .10 level
FIGURE 3
GROSS PROFIT MARGIN AS A % OF SALES

PRODUCT MIX %

% GPM

Y

+50

+40

+30

+20

+10

0

-10

-20

-30

-40

-50

X

0

10

20

30

40

50

60

70

80

90

100

X

Y
FIGURE 4
SALES PER LOOM SHIFT
FIGURE 5
RETURN ON INVESTMENT

PRODUCT MIX %
CONTRIBUTION AS A OF PRODUCTION VALUE

Figure 8

Y

%'

55

54

53

52

51

50

49

48

47

46

45

44

43

42

41

40

39

38

37

36

35

34

33

32

31

0 10 20 30 40 50 60 70 80 90 100

PRODUCT MIX %

Y
The scatter diagrams show that the predicted values are closer to estimated value in sales realised per metre of cloth followed by contribution per 100 loom shift. On other variables, the values lay much scattered. For working capital per 100 loom shift, values are widely scattered.

The figures show that, only in case of contribution as a percentage of production value, the relationship is negative. So as you increase the blends the contribution as a % of production value will go down. Garde and others (1987) have also got the similar results that contribution as % of production value decreases as the price of per metre of cloth sold increases. This means that contribution rate goes up much faster than the rate of increase in production value. Because of this contribution as a percentage of production value decreases.

The t values for product mix variable are found to be significant in most of the equations. It shows, that the product mix is found to be a significant explanatory variable for all the performance factors. Thus, as per theory, as well as statistical analysis product mix plays an important role in determination of performance.

The equations are all found to be statistically significant, as F ratios are found to be statistically significant.

The Durbin Watson test for the first degree of auto correlation proved that the disturbances in all regressions were free of auto correlation, except in case of working capital per 100 loom shift.

The $R^2$ value which indicates the explained variations in the performance data is found to be by and large low in most of the equations, except in sales per loom shift and sales revenue per metre of cloth. Thus, the regression does not explain the variations in the performance data. Even though, it is statistical significant. The statistical
significance is due to the large sample size. Same could be true for $F$ ratios also. According to Wesolowsky\cite{1}, $R^2$ may have high or low values as a result of chance or peculiarities in the data. He argues that a low value of $R^2$ does not necessarily mean that a good linear relationships does not exist, but may simply indicate that there was not enough variation in the $Y$ values. Also, that with large samples even very small values of $R^2$ may be significant at say .01 level of significance. This means that even though the fitted linear relationship has little explanatory value we may still be able to reject the hypothesis. He further points out that it is not entirely correct to say that a low $R^2$ means that a regression has no value. We may find that one or more of the coefficients are significant. Thus, to that extent it does have a value.

In the present study, as mentioned earlier, because of large sample size, values are all found to be statistically significant. Thus, before reaching any conclusion some of the chief executives of textile mills were shown the results and interviewed. The final conclusions were reached after the discussions.

The chief executives were of the opinion that in textile industry, ROI is not a good measure of performance for comparison across various mills, because the investments vary quite a bit. Machinery had become very old, and rate of modernization also, differ from mill to mill. This we have discussed in the introduction chapter. Similarly as regards equity dividend, also majority of the mills do not pay any equity dividend. Thus, even this was not considered as an appropriate measure of performance. They feel that even if there is statistical relationship between these variables, in practice there is no such relationship existing. The contribution was considered essentially a market factor, governing the profit performance, since price of raw material and the cloth is

1. Wesolowsky, George, 1976
derived by the market force or economic environment. Thus to increase the contribution rate mills have to change the product mix as per the market forces. So, contribution was the best performance variable selected as it takes into account costs as well. Within that contribution per loom shift is considered to be the most appropriate indicator of performance.

8.73 On the basis of $r^2$ values, the choice of model for estimating the performance function would be, to measure sales per 100 loom shift, with product mix and sales revenue realised per metre of cloth as the independent variable (model no. 14). Here, the $r^2$ value is as high as .81. This could be because of multicollinearity between product mix and sales realised per metre of cloth which has $r^2$ value of .79. However, the equation shows the negative signs which is not as per the theory. The next choice falls on the model no (1Q) which has sales realised per metre of cloth as performance function with product mix being independent variable. The $r^2$ is .79. This model is as per theory. So, statistically, theoretically as well as practically, model no.(1Q) would be the choice for performance function.

8.74 To understand and identify the factors, influencing the product mix decisions, multiple regression analysis was done with product mix as a dependent variable. The independent factors included were the cost of cotton, cost of synthetic raw material, % of synthetic raw material consumption. In the first model, raw material consumption was dropped and later on it was added.

8.75 From Table 8.5 we can see that by the addition of synthetic raw material consumption, the $r^2$ value has improved. From .75, the value has gone upto .88. So, for measurement of product mix function, the second model (2) would be the choice. In first model all the independent
variables were found to be statistically significant while in the second model, average cost of synthetic raw material and synthetic raw material consumption were found to be significant.

8.8 CONCLUSIONS

8.81 On the basis of the discussion of results it can be concluded that, product mix decision had the maximum impact on sales. It does effect the sales growth. However, unless it has impact on contribution the profits will not improve. The ANOVA analysis suggests that product mix does have an impact on the contribution. In regression also product mix is shown as a significant explanatory variable. To that extent, it does influence contribution.

8.82 Sales could be predicted more accurately than contribution with the help of these models. Other models serve mainly as an explanatory model, not so much as predictive model. This is corroborated, with the views of chief executives, who say that contribution and profit are difficult to predict in textile industry because of (a) government policies and (b) raw material prices.

8.83 Like previous studies in this study also it is shown that, product mix variable is found to have significant relationship when used as a discrete variable rather than as continuous variable. Rumelt (1974), Vardarajan (1986), could establish the relationship because of using diversification as a discrete variable while other studies could not establish the relationship to that extent. In regressions the variable is continuous whereas in ANOVA it is discrete. Thus, in the present study also the impact is brought out clearly in ANOVA analysis.