ECONOMETRICS: INTRODUCTION AND ITS SCOPE IN PUNE’S MANUFACTURING INDUSTRY

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ABSTRACT: In an interview, once a candidate used the term Econometrics; when asked to define it, the candidate said, “Econometrics is the application of Mathematical and Statistical theories to economics and in kind.” Actually this definition is also a fine one, but, there can still be other information about Econometrics not sufficiently presented in this definition: For example, how it works? What it contains? How effective it is? Where to apply? And lot more things. In this paper an attempt is made to introduce the use of Econometrics in management research. Today, research acquires the prime importance to every business in the world. Management research can be the first step towards the journey of excellence in the field of business of any kind. Econometrics, in simple words is the application of statistical method & models to solve the various problems specially related to economics. Econometrics has widened its scope in recent years. The example of which is financial econometrics, in which the quantitative problem arising from finance is studied using various statistical techniques & economic theory to address a variety of such a problems. Some research problems cannot attain the conclusion unless analyzed through econometrics. Hence this paper highlights the use of econometrics in research for various business operations. The concluding section of the paper contains utility of econometrics to research using the various methods like Regression, Correlation, Least squares, Probability & Simulations.

KEYWORDS: Statistical Theories, Economics, Research, Quantitative Problems, Management Excellence.


INTRODUCTION: The main aim of this study is to know the use of statistics & economics in the research & the applicability of the econometrics in research. A research work of any purpose has to be analyzed properly by using various tools for getting the results and solutions to that particular problems. For this, the collected raw data has to be sorted & restructured to get feasible output in which econometrics plays an important role, to integrate & empirically derive business for management excellence.

The goal of the present study is to understand the impact of Econometric Techniques and policies on research undertakings in the field of management with the help of following objectives.¹

- To discover solutions to various issues through application of scientific procedures.
- To find out hidden truth which is not visible yet.
- To gain familiarity with a phenomenon/case.

According to researchers, research constitutes Defining the problems, Collection of information, data and reviews, Hunt for knowledge, Scientific and methodical search for pertinent information on a specific topic, careful investigation or inquiry particularly through search for new facts in any branch of knowledge, systematized effort to gain new knowledge and finally a movement from known to unknown.

OBJECTIVE OF MANAGEMENT RESEARCH: Basic objective of management research includes to determine the frequency with which events occur or with which it is associated along with environmental factors and variables also to test relationship between these events and variables. It also includes understanding market trends, or finding the optimal marketing mix, devise effective policies, or find the best investment options to be made. This paper highlights utility of the econometrics to deal with stated objectives.

Let’s Begin With Introduction to the Econometrics: Econometrics, the statistical metric for economics, can be regarded as one of the main revolutions which turned 20th century economics into an engineering, or tool-based scientific approach, in which each application of economic theory requires special shaping to environments, whether for scientific purposes or in the policy domain (Morgan, 2001).²

RESEARCH METHODOLOGY AND HYPOTHESIS:

Universe of the Study: The study for Manufacturing Sector in Pune region of Maharashtra state in India is done involving application of the econometric techniques. Thus organizations using such techniques in Pune region form the universe of the study.

Sample Design: Random sample of 100 respondents is tested on the basis of a structured questioner.

Data Analysis and Interpretation: Appropriate statistical tools like regression, correlation, factor analysis, etc. will be used according to the requirements of the data.

HYPOTHESIS:
H₀: There exists significant number of organizations, applying the econometric tools for data analysis.
H₁: There does not exists significant number of organizations, applying the econometric tools for data analysis.
DEFINITIONS: There are many definitions available for econometrics; some of them are as follows: Econometrics, is a statistical and mathematical analysis of economic relations frequently serving as a basis for economic forecasting. Such information is occasionally used by administrators to set economic strategy and even by private business to help decisions on prices, and production. It is used mainly by economists to study relationships between economic variables. Econometrics may be defined as the "applications of mathematics and statistical methods viz regression and correlation to analyze economic data to interpret the results or solutions and form a trend for forecasting. Econometrics factually means 'Economic Measurements'. It is a combination of mathematical economical and statistical theories.

History of Econometrics: The first known use of the concept "Econometrics" was by Pawel Ciompa in the beginning of twentieth century, Ragnar Frisch is credited with coining the term in the sense that it is used today.

The growth or use of statistical tools for analysis of economic connected problems was noted in the early part of the 20th century and, by mid-century, problems had been defined, solutions approached and usable concepts developed, so that one could reasonably refer to a different body of knowledge embracing both, theory and practice. After 1950, Econometrics became established field and the leading method of Applied Economics.

The development of the econometrics could be classified in following stages:

- The Development Era
- The Mature Discipline
- History of Econometrics
- The Place in Economics
- Modern Econometrics

The Development Era: In the concluding 19th century, few economists started using graphs and tables of statistical data to provide experiential support for their advice, or to describe behavioral characteristics of economic phenomena (Klein 1997). It was the requirement of that time to develop a relationship between the variables, whose functions form the object to study their interdependence. For example to forecast demand, interdependency of the variables like cost, users, market and supply has to be established.

Establishing the Mature Discipline: These developments found a general form in the 1970s in the American econometrician- Christopher Sim's time-series versions of Wold’s models called Vector Auto-Regressions (VARs) (Qin and Gilbert 2001). VARs turn out to be the least subjective representation of the information in time-series data.

Econometrics and Economics: During the initial years of The Econometric Society, ‘econometrics’ was defined as the amalgamation of economics, statistics and mathematics. In evolving models, intermediaries based on mathematical economic theory (in said period), had established a distinctive path associated to those found in psychometrics and sociometrics in the same time. After 1950s, as economic hypothesizing became generally expressed in mathematical terms, the term econometrics steadied on its current sense: the use of statistical reasoning and approaches as means to define data-based descriptions of economic phenomena and empirically based counterparts for, and tests of, economic theories.

The Modern Econometrics: In recent years the econometrics has widened its scope to almost every kind of research. The modern econometrics is responsible for the quick and effortless analysis of the vast data.

Following are Some Common Difficulties or Deficiencies Faced by a Researcher:

1. The lack of a scientific training in the practice of research.
2. Overlapping of areas resulting in repetition, and wastage of resources.
3. Most of the business units do not have the confidence that the material supplied by them to researchers will not be misused.
4. It proves a resistant barrier to researchers.
5. For many researchers, it is mostly a cut and paste job without any insight shed on the collated materials.
6. There is insufficient interaction between the research departments and Business Establishments.

What do we need?
There is a need for generating the confidence that the information or data obtained from a business organizations will not be distorted. Good research is methodically organized with specified steps. Care should be taken that the guessing and intuition in arriving at conclusions should be avoided and the research should not go beyond the boundaries and limitations of the norms of research. Good research is empirical, as it is related basically to one or more aspects of a real situation and deals with tangible data that provides a basis for external validity to research results. Good research is replicable and should help in building a sound basis for decisions.
Further we are in need of proper mechanism or machine which will enable us to analyze the collected data. We have to establish a proper relationship between various variable to study and form a trend or forecast the various functions like demand.

**Utility of Econometrics:** The main determinations of econometrics are to give experiential content to economic theory and to empirically verify economic theories too. Perhaps the most significant tool of econometrics is regression. For instance, the relationship between inflation and GDP, sales and expenditure; sales and advertising costs; personal expenditure and demand etc. A simple example of relationship in econometrics is Personal Expenditure which can be represented as (Propensity to Spend * Income + random error) Let us discuss the important econometrics tools which help to solve the above puzzles in brief.

1. Correlation analysis.
2. Regression analysis.

**Correlation Analysis:** When we come across situations involving variation of two or more quantities at a time, if these quantities vary by the variation in any one of them, then these quantities are correlated. This degree of relationship between the variables is measured through the correlation analysis thus; correlation is analysis of co variation between two or more variables. Its understanding can enable a business executive to estimate cost, sales, price etc.

**Types of Correlation**
1. Positive or negative.
2. Simple, partial & multiple.
3. Linear & nonlinear co-relation Methods.

**Methods**
1. Covariance method.
2. Rank co relation method.

**Regression Analysis:** Regression analysis is a statistical device used for estimating or predicting unknown values of one variable called dependent variable from the known values of other called independent variable. This can be done through the regression line which describes the average relationship between the various variables. We better understand the application of various economic tools discuss earlier with the help of following cases.

**Case 1 (Correlation Analysis).** Study the interdependence between (degrees of correlation) the sales & expenses of 10 companies under study. The data regarding sales & expenses of 10 companies for a particular year is as follows.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sales (x)</th>
<th>Expenses (y)</th>
<th>dx</th>
<th>dy</th>
<th>dx^2</th>
<th>dy^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
<td>11</td>
<td>-8</td>
<td>-3</td>
<td>64</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>13</td>
<td>-8</td>
<td>-1</td>
<td>64</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>55</td>
<td>14</td>
<td>-3</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>60</td>
<td>16</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>65</td>
<td>16</td>
<td>7</td>
<td>1</td>
<td>49</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>65</td>
<td>15</td>
<td>7</td>
<td>1</td>
<td>49</td>
<td>1</td>
</tr>
<tr>
<td>G</td>
<td>65</td>
<td>15</td>
<td>7</td>
<td>1</td>
<td>49</td>
<td>1</td>
</tr>
<tr>
<td>H</td>
<td>60</td>
<td>14</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>60</td>
<td>13</td>
<td>2</td>
<td>-1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>J</td>
<td>50</td>
<td>13</td>
<td>-8</td>
<td>-1</td>
<td>64</td>
<td>1</td>
</tr>
<tr>
<td>Σ</td>
<td>600</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td>360</td>
<td>22</td>
</tr>
</tbody>
</table>

Where: dx & dy are deviations from their mean.

\[ \text{Correlation coefficient} = \frac{\sum d_x d_y}{\sqrt{(\sum d_x^2)(\sum d_y^2)}} \]

\[ = \frac{70}{(360*22)^{1/2}} \]

\[ = \frac{70}{(7920)^{1/2}} \]

\[ = \frac{70}{89} \]

\[ = 0.79 \]

**Coefficient of determination = (Correlation coefficient)^2 \]

\[ = (0.79)^2 \]

\[ = 0.6241 \]

\[ = 62.41\% \]

**Case 2 (Correlation Analysis):** The correlation coefficient between advertisement cost & sales for 10 different quarters for a particular company is 0.78. The mean of advertisement cost is 650 & that of the sales is 660 further we have total sale is 660k & total advertisement cost is 650. Further we have if advertisement cost as X & sales as Y then \[ \Sigma X^2 = 47648 \] \[ \Sigma Y^2 = 45784 \] and \[ \Sigma XY = 45604 \].

The problem arises in this case is that, while collecting the information the researcher had mistaken some observations in sales & advertisement costs. The main expectation is to get the correct correlation. Such types of problem arises many times in management research, Econometrics, specially correlation help to overcome this kind of issues as explained in following steps.

**Step 1**
Estimate correct \[ \Sigma X \] & \[ \Sigma Y \] by subtracting wrong values & adding correct.

**Step 2**
Estimate correct \[ \Sigma X^2 \] & \[ \Sigma Y^2 \] by subtracting squares of wrong values & adding correct.

**Step 3**
Estimate correct \[ \Sigma XY \] by subtracting product of wrong values & adding correct.

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Step 4
Estimate correct correlation coefficient to established correct relation.

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wpi</td>
<td>8.2</td>
<td>7.5</td>
<td>7.5</td>
<td>10.3</td>
<td>13.5</td>
<td>10</td>
<td>8.3</td>
<td>10.9</td>
</tr>
<tr>
<td>% Fd/GDP</td>
<td>8.1</td>
<td>7.8</td>
<td>7.9</td>
<td>8.4</td>
<td>5.9</td>
<td>5.7</td>
<td>7.7</td>
<td>6.1</td>
</tr>
</tbody>
</table>

The above problem can be solved i.e. the Wpi can be calculated when % Fd/GDP is 7% by forming a regression line of Wpi on % Fd/GDP as follows.

Let X & Y represent the Wpi & % Fd/GDP & hence we have to find regression line of X on Y.

\[
\begin{array}{|c|c|c|c|}
\hline
(Wpi)X & (% Fd/GDP)Y & XY & Y^2 \\
\hline
8.2 & 8.1 & 66.42 & 65.61 \\
7.5 & 7.8 & 58.5 & 60.84 \\
7.5 & 7.9 & 59.25 & 62.41 \\
10.3 & 8.4 & 86.52 & 70.56 \\
13.5 & 5.9 & 79.65 & 34.81 \\
10 & 5.7 & 57 & 32.49 \\
8.3 & 7.7 & 63.91 & 59.29 \\
10.9 & 6.1 & 66.49 & 37.21 \\
76.2 & 57.6 & 537.74 & 423.22 \\
\hline
\end{array}
\]

Mean Wpi is 9.525
Mean % Fd/GDP is 7.2
And regression coefficient ‘b’ is -1.28
Now regression line of X on Y is
\[
(X - \text{Mean } wpi) = \text{regression coefficient}*(Y - \text{mean } \% \text{ Fd/GDP})
\]
\[
= -1.28(Y - 7.2)
\]
i.e. X = 9.525 - 1.28(Y - 7.2)
\[
= -1.28Y + 9.216
\]
i.e. X = -1.28Y + 18.741 ....................(1)
Now, when % Fd/GDP i.e. Y= 7% hence from (1)
\[
X = -1.28*7 + 18.741
\]
\[
= -8.96 + 18.741
\]
Therefore, X = 9.781

CONCLUSION: The interrelationship between variables can be studied with regression analysis. In above case the wpi for 7% Fd/GDP is 9.78.

DATA ANALYSIS: The use of said techniques and its impact on the business is studied with the help of a questionnaire, analysis of the same is as follows.

Are you using the techniques of econometrics for analysis?

<table>
<thead>
<tr>
<th>Response</th>
<th>No of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>56</td>
<td>64%</td>
</tr>
<tr>
<td>No</td>
<td>31</td>
<td>36%</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td></td>
</tr>
</tbody>
</table>

1a. if no what is the reason behind it?

<table>
<thead>
<tr>
<th>Response</th>
<th>No of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>6</td>
<td>19%</td>
</tr>
<tr>
<td>Need</td>
<td>3</td>
<td>10%</td>
</tr>
<tr>
<td>Lack of expert</td>
<td>8</td>
<td>26%</td>
</tr>
<tr>
<td>don't want to change the traditional method</td>
<td>12</td>
<td>39%</td>
</tr>
<tr>
<td>others</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

1b. Are you interested in applying the same?
INFERENCES:

a. 64% organizations are using the techniques of econometrics whereas 36% are not.
b. Out of 36% those are not applying econometrics 45% (16% of the whole sample) are not interested in applying.
c. The major reason behind non users are lack of expert and resistant to change.

Does the applications of econometrics helps in improving the analysis?

<table>
<thead>
<tr>
<th>Response</th>
<th>No of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>34</td>
<td>50</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>Neutral</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Can’t Say</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>87</td>
</tr>
</tbody>
</table>

Is the econometrics or applications of statistical techniques to analysis is cost effective?

<table>
<thead>
<tr>
<th>Response</th>
<th>No of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>45</td>
<td>52</td>
</tr>
<tr>
<td>No</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>Neutral</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Can’t Say</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>other Reply</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td></td>
</tr>
</tbody>
</table>

To which type of data you generally apply econometrics?

<table>
<thead>
<tr>
<th>Response</th>
<th>No of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales and Marketing</td>
<td>26</td>
<td>46</td>
</tr>
<tr>
<td>Financials</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>Personnel</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Other type</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

INFERENCES:

a. Majority (50%) of the respondents agree that, the performance can be improved with the application of the econometrics.
b. Organizations are using econometrics mainly in the sales and marketing related analysis and forecasting followed by financial and HR related analysis.
c. The technique is cost effective according to 2% respondents, whereas about 18% does not think so.
CONCLUSIONS: Moving towards the conclusion part of this paper we list out some resulted applications of the econometrics in the field of management research. From the above prolonged discussion we draw following conclusions:

1. Econometrics has evolved from basic requirements of the research, time to time.
2. The study of econometrics helps one to understand the applicability of mathematics and statistics to the theories of economics and research.
3. Various data could be arranged in meaningful manner with the application of econometrics.
4. Issues in Management could be best solved by research using econometrics.

REFERENCES: