A Comprehensive Study on the Performance of Cheran Engineering Corporation Limited., in the Year 1974 - 75 to 1982 - 83

BY

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Introduction

CHAPTER I

INTRODUCTION

The Transport Industries which undertake movement of persons and things from one place to another have constituted one of the most important activities of men in every stage of advanced civilisation. To the effective functioning of the Transport Corporations, the engineering units which function to help them in engineering aspects are very important. The Engineering Corporations help the transport corporations to provide cheap and efficient services to the people.

In Tamil Nadu buses are maintained and Repair Works are done by Four important Engineering Corporations. They are Anna Engineering Corporation, Cheran Engineering Corporation, Cholan Engineering Corporation and Pandiyan Engineering Corporation.

Cheran Engineering Corporation was incorporated on 12th February, 1974, with Pollachi as its headquarters under the Companies Act, 1956 in pursuance of the decision of the Government of Tamil Nadu in G.O.Ms.No.798, Transport dated 24th December 1973, to implement the "half-a-million jobs programme" to provide employment opportunities to the unemployed engineers and technicians and also to provide maintenance facilities to Cheran Transport Corporation buses.

The share capital of this company is Rupees 38 lakhs of which Rupees 25 lakhs is contributed by the Government of Tamil Nadu and Rupees 13 lakhs by Cheran Transport Corporation.

The management is vested with the Board of Directors of the company under the Scheme of Employees participation. Two additional Directors representing debenture holder employees are inducted into the Board.

In order to have effective Co-ordination between Cheran Transport Corporation and Cheran Engineering Corporation, the Directors in the Board of Management for both the Corporations are almost the same except for 2 labour directors and a General Manager of Cheran Engineering Corporation. Now, over one decade the Corporation has grown and expanded its activities in the Engineering field of transport. Cheran Engineering Corporation consists of Bus Body Building Unit, which is constructing Bus bodies of all types, with all materials including Air-conditioned coaches. It meets the requirements of its own transport corporation and also for other sister corporations in the State and for APSRTC of Andhra Pradesh, KSRTC of Kerala and Karnataka State Transport, of Andaman and even for Delhi Transport Corporation. Now its capacity is 600 vehicles per annum.

It is having a fully mechanised Foundry producing quality Brake Drums which are marketed by the corporation throughout the country.

It has further expanded its activities, producing paint, spring assembles for Buses, Tyre Retreading Plant and Tread Rubber manufacturing plant at Mettupalayam.

It is reconditioning the bus assembles such as Engine, Gear-Boxes, Rearaxle, Front axle, etc., in the Engineering Corporation itself.

The objectives of Cheran Engineering Corporation are as follows:-

To Manufacture Automobile Accessories.

To undertake Body Building and repairs of buses and other Vehicles and Automobile Parts and Accessories.

To undertake Retreading and Recaping of tyres and vulcanising of tubes.

Activities of the Corporation:

The Corporation undertake the activity of Body Building, Reconditioning of Engines, Machinery, Tyre Retreading, Manufacturing of Brake Drums, Oil Reclamation and Purification.

Research and Development Cell:

The cell is conducting constant researches in conservation of fuel economy, Cost reduction by improved performance of the engines and tyres. This facilitates conducting research and development work, providing congenial and scholarly environment for the engineers and technicians to bring out the best of their creative abilities.

The Industrial relations between the employees and the company are excellant. The Corporation gives employment opportunities in and around Pollachi.

A maximum bonus of 20% has been paid to their employees from the inception of the Corporation. Besides, performance incentive for the past 3 years has been given. Payment of maintenance allowance and special allowance is made for their better performance.

The unit is imparting theoretical and practical training to the employees of the Cheran Transport Corporation Limited and also to those of sister transport corporations and outsiders. The Corporation has introduced the first pre-cured process Retreading Unit in India, causing surplus in labour and existing facilities. It introduced certain additional facilities like phosphating plant, Galvanising Plant and Fibre, Glass Re-inforced Plastic Unit.

It constructs mini-trains for Tamilnadu Tourism Development Corporation. It established an extruded aluminium fabrication unit to make window frames, jack knife doors and grills. It constructed 100% Fibre-Glass reinforced Plastic bus bodies and all aluminium composite steel bodies. One of the important reasons for the successful operation of Cheran Transport Corporation is the effective assistance given by Cheran Engineering Corporation in maintaining the vehicles owned by Cheran Transport Corporation. So far no scientific researches were conducted to evaluate performance of Cheran Engineering Corporation. The investigator desires to make "A comprehensive study on the performance of Cheran Engineering Corporation". This study was planned to analyse physical and financial performance of the Corporation with the following objectives:

1. To study the formation of Cheran Engineering Corporation.
2. To analyse the performance of Cheran Engineering Corporation by analysing the growth rate of the following for the selected period 1974-'75 to 1982-'83.

   (i) Labour charges
   (ii) Body building charges
   (iii) Retreading charges
   (iv) Total income

(v) Total expenditure

(vi) Material consumed

(vii) Salaries & fringe benefits.

3. To find out the profit or loss of Cheran Engineering Corporation.

4. Suggestions for sound functioning of Cheran Engineering Corporation.

5. To find out the role of capital and labour in the total production of Cheran Engineering Corporation.

6. To find out whether expenditure is the function of income.

The investigator feels that the finding of the study would reveal the actual functioning of Cheran Engineering Corporation and how for it would achieve the objectives with which it was started. This could be of much help to the administrators of Cheran Engineering Corporation in bringing about the necessary change in their working.

Limitation:

It has been a student research study with implied limitations of time and money. A sincere thoughtful attention was attempted to make this study as systematic as possible.

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The review of literature pertaining to the study of "The Performance of Cheran Engineering Corporation" is discussed under the following Heads:

1. The importance of transport in a developing economy
2. Importance of road transport in India
3. Road transport administration
4. The objectives of road transport corporation
5. Financing in state transport undertaking
6. Development of Road transport
7. Road transport in Tamil Nadu
8. Nationalised road transport undertaking in Tamil Nadu
9. Bus transport in Tamil Nadu
10. Road transport: Policy consideration
11. Studies on transport.

1. The Importance of Transport in a Developing Economy:

Transport may be defined as a service of facility which creates utilities, time or place, through the Physical transfer of goods and persons from one place to another. The need for conveyance of goods arises from the fact that they are often produced in one region and desired in another. Transportation is a vital factor in the advancement of

civilisation and economic development (S. Sankaran, 1984).

The Industrial development all over the world would have been impossible without corresponding improvement in the transport system. The mass production of goods in factories necessitates bringing all the necessary raw materials required for production and labourers for work to the places where the factories are located. The goods produced must reach the consumers from the factories who live in different places. The transport cost of the goods enters into the final prices of the goods. So there must be cheap transport system.

A good transport system facilitates trade between different regions and countries. Thus it brings about regional and international division of labour. It stimulates wants by increasing quantity and variety of consumer goods. Transport helps in reducing cost of production of goods. It facilitates the location of an industry. It helps the growth of large cities and urbanisation of the country side.

Apart from economic effects, transport system leads to certain social and political effects. It raises the standard of living; gives opportunities for better education; helps in the spread and interaction of different cultures. Politically it promotes national unity, integration and national defence.

2. Importance of Road Transport in India:

India being a developing economy road passenger transport deserves a high priority as it forms the backbone of both the passenger and freight movement. Road Transport is the principal carrier of the developmental process from one part of the country to another.

Mobility constitutes an inseparable part of the daily life so much so that its true significance is very often overlooked (P.G. Patankar, 1985).

In India the growth of the village industries and industrial transformation in the urban economy hinges on the ease with which the raw materials from farms reach the industrial centres and the consumer products of industries penetrate the rural market. The committee on Transport Policy and co-ordination in 1966 had rightly stated "The significance of the transport sector lies not only in the specific service it renders, but even more in the unifying and integrating influence it exerts upon the economy, enhancing productivity, widening the market, introducing new stimuli to economic activity and bringing villages, towns, remote and more developed regions closer and closer". (S. Neelakantan and S, Sundari, 1985).

3. Road Transport Administration:

The administration of road transport in India can be divided into 4 categories:

- In the first category will come undertakings set up under the Road Transport Corporation Act of 1950.

- In the second category come companies set up under the Companies Act of 1956.

- In the Third category are the departmental undertakings of the State Governments.

- In the fourth category are the undertakings managed by the municipalities.

The legal frame work of these undertakings is different. So also is their administrative set up. Though the Road Corporation Act is a Central Act, Rules and guidelines provided under it have been done by the State Governments (Chitra, 1985).

4. The Objectives of Road Transport Corporation:

The main objectives of Road Transport Corporations are

-To operate road transport services

- to buy, sell, operate and lease out all types of passenger and goods vehicles
- To co-ordinate with any form of road transport services
- To extend and improve the facilities of road transport in any area by providing efficient system of road transport service.

- To manufacture, purchase, sell, maintain and repair rolling stocks, vehicles, appliances plant, equipments or any other things required for the activities of the economy. (Chitra, 1985).

5. Financing in ~~the~~ State Transport Undertakings:

The financial position of many of the State transport undertakings, of late has become very tight because of high operational costs and the high costs of bus, Chases and tyres. The prices have almost doubled during the last seven years. Further, there have been three hikes in the prices of petroleum products. The Industrial Development Bank of India in the year 1982, introduced a scheme in which only those state road transport undertakings which are registered under the Companies Act are given direct finance.

The Life Insurance Corporation has started giving loans to the state Transport undertakings from 1979-'80 at a lower rate of interest. Till 1982 about fifty crores of rupees has been sanctioned by the Life Insurance Corporation to the state transport undertakings.

6. Development of Road Transport:

After independence the government of India became conscious of the need to improve the road transport. The

first plan recognised the importance of road transport. Second plan realised that road transport deserves a higher priority. The Motor Vehicles Act was amended in 1950. Long term permits extended to 5 year for carriage of goods, were given. They provided setting of Inter State Transport Commission for development of co-ordination and regulation. State road transport corporations were set up with the primary concern of movement of passengers. State Government helps these Corporations. At the time of independence, India had only 3,88,000 kms. of roads of which 1,46,000 kms. were surfaced and 2,42,000 kms. were unsurfaced. With planning over 3 decades it had increased to more than 12,00,000 kilometers of which 5,00,000 kms are surfaced. The road transport system pays a huge sum to the state by way of income tax and vehicle tax and other taxes.

At present, the Inter State Transport Commission looks after the development, co-ordination and regulation of transport services on inter-state routes. An association of state board transport undertakings was set up in 1963 to co-ordinate the activities of the undertakings and to secure procedural uniformity, higher standard of service and economic operation. (S. Sankaran, 1984).

7. Road Transport in Tamil Nadu:

Under companies Act, 1956, transport corporations

were registered in Tamil Nadu. This was in consequence with the government's pdicy of bringing the entire net work of passenger transport under public sector. At present in Tamil Nadu there are 14 public Corporations.

The Corporations in Tamil Nadu are entrusted with the responsibility of maintaining efficient, adequate, economical and viable system of road transport services in their operation. The services expected of the Corporations include elements such as capacity, frequency, reliability, speed, safety and financial viablity. The broad aim of the Corporation would be to provide a comprehensive net work of service including certain routes that may never make economic propositions. In consonance with the Governments policy of bringing the entire net work of passenger transport under public sector, transport Corporations were registered under Companies Act, 1956 in Tamil Nadu.

8. Nationalised Road Transport Undertakings in Tamil Nadu:

In Tamil Nadu we have 14 nationalised road transport undertakings. Details regarding dates of incorporation and actual commencement of buses are given in Table I.

TABLE I

NATIONALISED ROAD TRANSPORT UNDERTAKINGS IN TAMIL NADU

Name of the Corporation	Date of Incorporation	Commencement of Buses
1. Pallavan Transport Corporation Limited	10-12-1971	01-01-1972
2. Pandiyan Roadways Corporation Limited	10-12-1971	17-01-1972
3. Cheran Transport Corporation Limited	17-02-1972	01-03-1972
4. Cholan Roadways Corporation Limited	17-02-1972	01-03-1972
5. Anna Transport Corporation Limited	23-01-1973	15-02-1973
6. Kattabomman Transport Corporation Limited	12-12-1973	01-01-1974
7. Thanthai Periyar Transport Corporation Limited	09-01-1975	10-01-1975
8. Thiruvalluvar Transport Corporation Limited	01-03-1980	01-04-1980
9. Jeeva Transport Corporation Limited	28-12-1982	01-04-1983
10. Pattukkottai Alagirisamy Transport Corporation Limited	01-12-1982	01-12-1982
11. Nesamony Transport Corporation Limited	16-02-1983	01-04-1983
12. Marudhu Pandiyar Transport Corporation Limited	01-09-1982	01-04-1983
13. Deeran Chinnamalai Transport Corporation Limited	01-11-1984	01-04-1983
14. Rani Mankamma Transport Corporation Limited	01-04-1986	01-04-1983

Tamil Nadu has the distinction of being among the few Indian states which have achieved the target set in 1959 under Bombay for road development. As on 1st April 1983, the total length of road maintained by High Ways and Rural Works Department of Tamil Nadu were (a) National Highways 139 kms. (b) State Highways 1,814 kms; (c) Major District roads 14,028 kms. and (d) other District roads 20,415 kms. making a total of 36,396 kms. But the local bodies maintained 92,594 kms. of panchayat and panchayat union roads which is the highest figure for the country.

9. Bus Transport in Tamil Nadu:

After independence bus service in Tamil Nadu had a phenomenal growth. The Madras City Bus Services were Nationalised in 1947, the first among the series of nationalisation. State undertaking began to operate long distance routes in early sixties. In 1971, there was state take over of all routes ~~in Tamil Nadu~~ and buses of fleet operate owing not less than 50 permits under Tamil Nadu fleet Operators Stage Carriages Act. Under Ceiling Act of 1971, a person was allowed to own only 10 permits. Subsequently, small operators were defined as those owing not more than 5 permits. There are at present 14 independent State Transport Corporations established under Companies Act, each catering to the needs of a region, under its own jurisdiction with a fleet strength

of 8,442 buses. Out of the state's total of 13,559 in 1984, the state transport undertake to operate 62.26 percent of the buses.

Side by side with the increase in number of buses, there was an increase in number of routes. The routes increased from 4,675 in 1972-73 to 8,176 in 1982-83.

The State Transport Corporation at present operates more than 300 mini buses and short wheel base buses to interior villages in the rural area. They operate 10 "Shandy Buses", so that villagers could travel with their marketable produce to the Shandys (R.R. Khan, 1974).

10. Road Transport - Policy Consideration:

From time to time, there have been demands or suggestions for an increasing share of road transport for public sector since the Central Road Transport Corporation was set up in 1962 and the committee on transport policy of 1966 supported such increasing public sector participation. However Central Road Transport Corporation (CRTC) was found to be uneconomic and was closed down in 1977. The National Transport Policy Committee of the Planning Commission (1980) has now advised that states now running uneconomic goods service should rationalise these undertakings. The committee

also points out that since road transport is operated predominately by small owners with one or 2 trucks each, there is ample competition to promote the public interest and very little danger of development of monopoly position (Monthly Commentary, July 1982).

The planning commission appointed a high level committee, to formulate a comprehensive National Transport Policy for the next decade keeping in view the objectives and priorities set out in the five year plans. The committee is expected to recommend an optional intermodel mix on public systems and suggest appropriate technical choice within each system, keeping in view the need to generate maximum employment potential.

11. Studies on Transport:

1. Rajendrakumar Jain's study on "Pricing Policies in Public Utility Services with Reference to Motor Transport" (1969) says that transport services are usually known as part of public utility undertaking and is characterised by

(i) Supermacy of fixed costs over theoperating costs

(ii) It has an element of monopoly or semimonopoly and necessiates the making of conscious pricing policies with due regard to public interest.

State governments operate their own bus services on routes (1) which are completely nationalised

(2) exclusive monopoly

(3) sometimes in competition with private operators.

The State government's regulate fares and freights in the interest of the public. The growth of transport services help in pushing ahead economic development by raising the inducement to invest and the removal of transport obstacles. External economy favour low prices in public utility enterprises, the need for rapid growth generally favours pricing policies to earn profit to finance their needs.

2. National Transportation Planning and Research Centre conducted a detailed study on road transport and inland water transport in Kerala in the year 1978-79. The studies on road transport conducted by National Transportation Planning and Research Centre have clearly shown that the actual volume of good traffic in terms of tonnes and in terms of tonne kms. are much more than those estimated by National Transport Policy Committee and also that the modal split viz., distribution of traffic among various modes of transport is very much different. The future estimates made by National Transportation Planning and Research Centre reveal that by the end of this century road transport has to meet 65-70 percent of total passenger and goods transport demand in Kerala State. To meet such huge demands, the net work and quality of arterial roads need to be improved considerably unless substantial amounts are earmarked for the improvement of the roads in the state both by the Central and State governments. The road system, the

The road system, the condition of which is already very poor, will not be able to cope with the anticipated traffic growth resulting in considerable amount of economic losses to the society.

3. According to a study carried out by the association of Indian Engineering Industry, the export performance of the top 100 engineering units in the country has suffered a decline of 4% during 1977-78. The decline was more pronounced in the aluminium industry, iron and steel, machinery other than transport and electrical industry, private and public sector companies with sales exceeding Rs.10 crores. The fall in exports was due to international and domestic factors on the international front, protectionist measures adopted as rupee value of the U.S. dollar have affected earnings. On the national front, reduction in exportable surpluses caused by power shortage, industrial unrest and flood have affected production. It was also found that the sale turnover of a small multinational concern was many times greater than the top public sector company in India, BHEL.

4. In his paper on second India Studies - Transport Madhoo Pavaskar (1980) visualised the transportation system in India, in 2000. When population explosion would give rise to "Second India", serious problems would arise if the transport needs are not met efficiently. This necessitates the framing of a long term transport plan for the country.

Roads, railways and airways would be highly developed, and help for the movement of goods. However airways are confined to high value materials and perishable goods. Inland waterways, and all slow moving vehicles, coastal shipping, would find diminished importance.

5. Harry T. Dimitriou's study on "Transport and the urban poor in the third world" (1982) says that, "Impressive economic growth levels have been achieved by the developing world, yet 800 million persons live in poverty with the increase in urban population coupled with urban poverty, there would be an increased demand for transport and great pressure applied to meet the movement needs of the urban poor.

Accessibility is a relative value accruing to a parcel of land by virtue of its relationship to a transport system. Two facets of this with respect to economically weaker sections are

(i) consideration of affordability of public transport/ services

(ii) ease of accessibility onto a vehicle provided as part of a public transport system. 60% of the people in urban areas are poor. The fares charged by the transport system are by the Western standards very low. The introduction of metro system to improve city wide accessibility to

place would be of little assistance to the urban poor. Hence fares should be standardised and made affordable to the majority of the population.

6. In his study on the "Conceptual frame work for planning of rural bus transport system," Aiyaswamy, A. (1984) has highlighted the following aspects.

1. Identify "Transport regions and improve operation of rural services".

2. Research on "Rural transportation experiments" could be conducted by State transport undertakings in collaboration with research Institutes.

3. Various traffic characteristics of rural bus transportation system like parallel operation, daily and seasonal variation of traffic, origin destination of distribution, accessibility to villages and need for development of infrastructure facilities have to be studied. Rural transport has to be studied intensively and improved significantly based on the above data.

7. Patankar G.P. (1985) says that transport and communication play a vital role in economic and social well being of every country. Good roads are essential.

(i) To reduce operational costs

(ii) for fuel economy

(iii) to obtain sizable revenue

(iv) to serve as a catalyst for economic development and integrating the country. But it is not possible, to achieve good progress through nationalisation. Large funds are required for the purchase of buses and the development of the required infrastructure. Hence private buses are necessary to meet the requirements of the people.

Road transportation is a labour intensive sector interms of direct and indirect employment. The capital resources in state transport undertakings are constituted by Central and State governments, internal resources, debentures and loans. Fixation of fares is controlled by government. The state transport undertakings have a good record with respect to passenger mobility and a poor financial performance, due to (1) uneconomical fares, which are being kept low by the government. (2) Heavy incidence of taxation. Improvement is possible only in 3 main areas (a) personnel cost (b) fuel cost (c) Vehicle productivity. People are benefitted by state transport-undertakings than the private operators, since state transport undertakings operate even in most uneconomical routes, for social obligation. In future the most economic service has to be provided by the state transport undertakings and they should gain public confidence by ensuring that the cost of operation is the minimum, and this is attained by maximising output through increased productivity.

8. A case study was done by S. Sundaram in 1985 on the overall economy achieved by the use of fibre-glass Reinforced plastics in bus body construction by reduction in the weight of the super structure. The net financial savings achieved through use of fibre glass Reinforced components over the life span of the vehicle has been high lighted in the study. From this study, it is a definite financial saving using fibre glass Reinforced plastics caused by reduction in the weight of the superstructure. Structural sections (Channels, angles etc) in Fibre glass reinforced plastics are expected to be indigenously available over the next couple of years. Replacement of existing aluminium structural sections with fibre-glass reinforced plastics would result in a greater reduction in superstructure weight (approx. 15-20%) which would, in turn, result in greater economy.

9. A study conducted by Sampathkumar in Pollachi on the attitudes and expectation of workers of body building section in Cheran Engineering Corporation (in 1984-'85) found that all the workers seem to be members of one labour union or other. There is good relationship (88%) between them. About half of the number of workers feel that their words carry weight with the management such as accepting their suggestions. There is division of opinion among them

as 54:56 about the treatment from the management. More than 90% feel proud about their unit, creating opportunities for them to offer their suggestions for better management making them understand how policies are framed and enforced by the Corporation. What is needed is broad basing the incentive schemes to a large extent to create pleasant atmosphere and thus may ensure better job contentment.

10. A study conducted by Chitra in Pollachi, (1985) concludes that the Cheran Engineering Corporation Limited have been providing several employee benefit schemes and there is a high degree of job satisfaction among the employees. The performance of Cheran Engineering Corporation has a definite edge over other because of obvious constraints of the private sector.

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Methodology

CHAPTER III

M E T H O D O L O G Y

The following headings represents the different components of research procedure adopted:

a. Selection of the study Area
b. Selection and description of Cheran Engineering Corporation
c. Collection of data
d. Period of study
e. Statistical tools used.

a. Selection of the Study Area and Unit:

The present investigation was carried out in Pollachi, Coimbatore District in view of the following criteria.

1. Cheran Engineering Corporation occupies a significant place in Tamil Nadu Transport Industry.

2. This is the only Engineering Corporation that caters to the needs of Cheran Transport Corporation.

3. The company has maintained proper records to show the physical and financial performance of the Corporation.

Hence this Corporation was chosen for study by the investigator.

b. Selection and Description of Cheran Engineering Corporation Limited:

Cheran Engineering Corporation was incorporated in 1974 with Pollachi as its Headquaters. The company undertakes important jobs such as body building, retreading, R.C. Labour Charges. The Corporation was started with well established objectives. The investigator has analysed the physical and financial performance of this Corporation.

c. Collection of Data:

The investigator collected secondary data from the published annual reports of Cheran Engineering Corporation.

Secondary Data: Data those obtained from published or unpublished sources are known as secondary data. If an investigator is using data which have been collected by someone else, then such data are known as secondary data.

d. Period of Study:

The refernece period of study was 9 years period from 1974-75 to 1982-83. The data was collected in August 1985.

e. Statistical Tools Used:

The following statistical tools were used in the analyses of collected data (1) Percentages, (2) Exponential functions, (3) Average moving trend method, (4) Multiregression, (5) Ratio and (6) Regression analysis.

1. Exponential Functions:

Exponential function was used to estimate the growth rate of the variables such as R.C. Labour Charges, Body building charges, Retreading charges, and total income, material consumed, salaries and fringe benefits, and total expenditure.

2. Average Moving Trend:

Average moving trend method was used to estimate capital employed in Cheran Engineering Corporation.

3. Multi Regression Analysis:

The multi regression analysis model was applied to study the relationship between total production, net fixed assests, and labour employed.

4. Ratio Method:

Ratio method was used to findout capital output ratio, labour output ratio, capital labour ratio.

5. Regression Analysis:

Regression analysis was used to findout whether expenditure is the function of income.

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Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

The investigator in her study "The Performance of Cheran Engineering Corporation" has analysed the data collected effectively and the results are interpreted under the following headings:

I. Income received by Cheran Engineering Corporation during the period 1974-75 to 1982-83

II. Expenditure incurred by Cheran Engineering Corporation during the period 1974-75 to 1982-83

III. The rate of growth of selected item of incomes of Cheran Engineering Corporation.

IV. The rate of growth of the selected item of expenditure of Cheran Engineering Corporation.

V. Estimation of future increase in labour charges received by Cheran Engineering Corporation

VI. Estimated values of body building charges received by Cheran Engineering Corporation.

VII. Estimated values of retreading charges received by Cheran Engineering Corporation.

VIII. Estimated values of total income received by Cheran Engineering Corporation.

IX. Estimated values of total expenditure incurred by Cheran Engineering Corporation.

X. Estimated values of expenditure incurred for the item material consumed by Cheran Engineering Corporation.

XI. Estimated values of expenditure incurred for providing salaries and fringe benefits by Cheran Engineering Corporation.

XII. Capital employed by Cheran Engineering Corporation

XIII. Physical performance of Cheran Engineering Corporation.

XIV. The role of capital and labour, in the total production of Cheran Engineering Corporation.

XV. The relation between expenditure and income.

XVI. Profitability trend analysis.

I. Income received by Cheran Engineering Corporation During the Period 1974-'75 to 1982-'83:

The investigator in order to analyse the financial performance of Cheran Engineering Corporation has taken income as an item of her analysis.

Table II clearly reveals the income side of the budget of Cheran Engineering Corporation from the year 1974-'75 to 1982-'83.

TABLE II

INCOME RECEIVED BY CHEMAS ENGINEERING CORPORATION DURING THE PERIOD (1974-75 TO 1982-83) (Rs. IN LAKHS)

Income	1974-75	Percentage	1975-76	Percentage	1976-77	Percentage	1977-78	Percentage	1978-79	Percentage	1979-80	Percentage	1980-81	Percentage	1981-82	Percentage	1982-83	Percentage
MC Labour Charges	15.71	45.27	17.40	26.20	22.95	24.49	21.04	19.13	23.56	17.2021	23.68	17.38	23.15	13.39	28.78	10.34	45.50	14.528
Body Building Charges	13.41	37.87	16.04	24.15	19.78	21.11	27.63	25.13	32.28	23.5689	22.55	16.55	31.92	18.46	105.34	37.85	125.72	40.142
Retreading Charges	3.55	10.23	25.83	38.89	38.70	41.30	42.84	38.96	58.29	42.5599	65.68	48.20	80.04	46.29	79.96	28.73	53.01	16.926
Brake Drum Sales	0.42	1.21	3.60	5.42	7.18	7.66	10.39	9.45	13.96	10.1928	15.63	11.47	26.94	15.58	49.04	17.62	68.25	21.792
Oil Reclamation Charges	-	-	-	-	1.42	1.52	3.88	3.53	4.32	3.1542	4.98	3.66	6.40	3.70	10.92	3.92	15.41	4.920
Interest and Others	1.88	5.42	3.55	5.34	3.67	3.92	4.19	3.81	4.55	3.3221	3.74	2.75	4.46	2.58	4.29	1.54	5.30	1.692
Total	34.70		66.42		93.70		109.97		136.96		136.26		172.91		278.33		313.19	

The table reveals that in the year 1974-75 labour charges occupied the first place in its income (45.27%) body building charges also contributed a favourable amount (37.87%) in the total income received in that year. Income from Break Drum sales seemed to be minimum during that year. In 1975-76 retreading charges contributed much (38.89%). The Corporation received in its total income (26.20%) from R.C. labour charges and (24.15%) from body building charges. The Corporation did not receive anything from oil reclamation charges for the years 1974 to 1976. In 1976-77 (41.30%) of total income came from retreading charges. In this year Corporation has started getting income from oil reclamation charges (1.52%). The income for the year 1977-'78 showed that (38.96%) of the income came from retreading charges. The income from oil reclamation charges seemed to have increased (3.53%) than the previous year. In the year 1978-79 income from retreading charges amounted to (42.56%) of total income. The next source of income during that year was body building charges (23.56%). Retreading charges formed the major source of income during the year 1979-80 (48.20%). In 1980-81 also retreading charges contributed a major part of the total income of the corporation (46.29%). The trend seemed to change in 1981-82 and 1982-83 because during those years the Corporation got increased income from its body-building

charges (37.85%), (40.142%) respectively. An over all glance of the income side of the Corporation during the reference period shows that the corporation received major part of its income up to the year 1980-81 from retreading charges. Later, body building charges seemed to dominate the scene. It has started receiving income from oil reclamation charges only from the year 1976-77 and its contribution continued to increase thereafter, till 1982-83. The total income for the Corporation showed an increasing trend starting from Rs.34.70 lakhs, it increased year by year and reached the limit of Rs.313.19 lakhs in the year 1982-83. This shows generally there is a continuous improvement in the income side of Cheran Engineering Corporation during the reference period (1974-75 to 1982-83).

II. Expenditure Incurred by Cheran Engineering Corporation During the Period 1974-75 to 1982-83:

The Cheran Engineering Corporation has to incur a lot of expenditure to provide better services for Cheran Transport Corporation.

Table III clearly reveals the expenditure side of the budget of the Corporation.

TABLE III

EXPENDITURE INCURRED BY CHERAN ENGINEERING CORPORATION DURING THE PERIOD 1974 - 75 TO 1982 - 83

Expenditure	1974-75	Percentage	1975-76	Percentage	1976-77	Percentage	1977-78	Percentage	1978-79	Percentage	1979-80	Percentage	1980-81	Percentage	1981-82	Percentage	1982-83	Percentage
Material Consumed	9.16	26.674	30.10	48.12	33.72	43.37	41.51	44.23	56.16	47.96	67.09	49.74	99.73	58.02	169.60	61.16	175.13	56.44
Factory Expenses	1.88	5.474	2.04	3.26	3.10	3.99	2.94	3.13	4.26	3.64	4.35	3.26	6.11	3.55	16.36	5.88	24.98	8.05
Salaries and Fringe Benefits	19.38	56.435	24.97	39.92	32.04	41.21	40.47	43.13	48.98	41.82	53.98	40.02	53.86	31.33	74.76	26.91	89.77	28.93
Administration expenses	0.39	1.136	0.68	1.09	2.93	3.76	2.17	2.31	1.45	1.24	1.61	1.19	1.64	0.95	3.25	1.16	6.37	2.05
Interest	0.61	1.776	0.83	1.33	0.95	1.22	0.93	0.99	1.08	0.92	1.38	1.02	2.44	1.42	2.51	0.90	2.61	0.84
Preliminary Expenses	0.02	0.058	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.027	0.02	0.01	0.02	0.01	0.02	0.00	0.02	0.00
Depreciation	2.69	7.833	3.91	6.25	4.99	6.42	5.05	5.38	4.58	3.90	4.89	3.63	6.48	3.77	8.78	3.16	9.02	2.91
Investment Allowance/ and Development Rebate	0.21	0.611	-	-	-	-	0.75	0.80	0.59	0.50	1.57	1.16	1.62	0.94	2.50	0.89	2.39	0.77
Total	34.34		62.55		77.75		93.84		117.12		134.89		171.90		277.78		310.29	

One can find out from the table that the total expenditure of Cheran Engineering Corporation has increased continuously from year to year during the reference period. In the expenditure of 1974-75, salaries and fringe benefits (19.38%) occupied an important place. Next to it come the item material consumed. In 1975-76 the Corporation incurred high expenditure for the item expenditure for material consumed (30.10%). Expenditure for the item Investment and Development rebate occured in the year 1974-75 but this item was absent in 1975-76 and 1976-77. Again the Corporation started spending for this item in 1977-78 onwards. In the expenditure of 1977-78, material consumed occupied an important place. Next to it came the item of salaries and fringe benefits. From the year 1977-78 the Corporations major expenditure was for the item material consumed from (44.23%) in the year 1977-78, it has increased to (61.16%) of its total expenditure in 1981-82 but it suffered a slight reduction (56.44%) in the year 1982-83. In 1974-75 the Corporation spend for salaries and fringe benefit (56.4%) of its total expenditure but the expenditure on this item went on declining and in 1982-83 only (28.9%) of the total expenditure was spent for this. Other items occupied only minor portion of the total expenditure.

III. The Rate of Growth of Selected Items of Income of Cheran Engineering Corporation:

When we analyse the income side of Cheran Engineering Corporation, among the various items income from labour charges, body building charges, and retreading charges seemed to occupy important places. The investigator has calculated the growth rate of the income received from the above mentioned item during the reference period 1974-75 to 1982-83. Table IV indicates the growth functions of labour charges, body building charges, retreading charges and total income received.

TABLE IV

THE RATE OF GROWTH OF SELECTED ITEMS OF INCOME OF CHERAN ENGINEERING CORPORATION

Item	Initial Co-efficient	Growth (b) Co-efficient	R^2	t value
Labour Charges	14.2891	.0983	.7709	4.8523
Body Building Charges	8.7271	.2572	.8055	5.396
Retreading Charges	10.5625	.2680	.5739	3.1123
Total Income	37.1925	.2422	.9427	10.7347

The data on labour charges received by Cheran Engineering Corporation over 9 years was subjected to growth, rate analysis and the results are as follows:

The function is $_t = A_o e^{\lambda t}$

Y_t - Labour charges

A_ρ - Constant Co-efficient

λ - Growth Co-efficient

t - Time period

$$Y_t = 14.2891\ e^{.0983t}$$

The growth rate is 9.83% as seen by b value. The growth is highly significant as seen by R value .7709 which is significant at P = 0.01 level.

The data on body building charges of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = A_o e^{\lambda t}$

$$Y_t = 8.7271e^{0.2572t}$$

Here Y_t represents the body building charges.

The growth rate is 25.72% as seen by b value. The growth is highly significant as seen by R value. 0.8055 which is significant at P = 0.01 level.

The data on retreading charges of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function $Y_t = 10.5625e^{.2680t}$

The growth rate is 26.80% as seen by b value. The growth is highly significant as seen by R value .5739 which is significant as P = 0.01 level.

The data on total income of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function $Y_t = 37.1925e^{.2422t}$

The growth rate is 24.22% as seen by b value. The growth is highly significant as seen by R value .9427 level, which is significant at P = 0.01 level.

The analysis shows that there is favourable increase in the income of Cheran Engineering Corporation which indicates the successful functioning of Cheran Engineering Corporation Limited as for as income is concerned.

IV. The Rate of Growth of Selected Item of Expenditure of Cheran Engineering Corporation:

Cheran Engineering Corporation has to incur a lot of expenditure on various items since its activities are diversified it has to spend continously for many items to keep up the standard of its services. Among the expenditure items, the expenditure incurred for accumulating the material consumed and salaries and fringe benefits occupied prominent places. The investigator calculated the rate of growth of increase in expenditure on material consumed, salaries and fringe benefits and total expenditure.

Table V gives details about the rate of growth of the selected items of expenditure of Cheran Engineering Corporation.

TABLE V

THE RATE OF GROWTH OF THE SELECTED ITEM OF EXPENDITURE OF CHERAN ENGINEERING CORPORATION

Item	Initial Co-efficient	Growth(b) Co-efficient	R^2	t value
Material consumed	11.0214	.3272	.9316	9.8
Salaries & Fringe benefits	17.8307	.1791	.9781	17.2889
Total expenditure	31.4823	.2538	.972	15.5898

The data on expenditure incurred by Cheran Engineering Corporation for material consumed over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $y_t = A_o e^{\lambda t}$

$$y_t = 11.0214e^{0.3272t}$$

The growth rate is 32.72% as seen by b value. The growth is highly significant as seen by R value 0.9316 which is significant at P = 0.01 level.

The data on expenditure incurred by Cheran Engineering Corporation for salaries & fringe benefits over 9 years was subject to growth rate analysis and the results are as follows:

The function is $y_t = A_o e^{\lambda t}$

$$y_t = 17.8307e^{0.1791t}$$

The growth rate is 17.91% as seen by b value. The growth is highly significant as seen by R value 0.9781 which is significant at P = 0.01 level.

The data on total expenditure incurred by Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = A_o e^{\lambda t}$

$$Y_t = 31.4823e^{0.2538t}$$

The growth rate is 25.38% as seen by b value. The growth rate is highly significant as seen by R value. .972 which is significant at P = 0.01 level.

Since Cheran Engineering Corporation is a successfully operating concern it has to spend more for the above mentioned items. Side by side its income also increased. It shows that Cheran Engineering Corporation stands on a firm ground success so for.

V. Estimation of Future Increase in Labour Charges Received BY Cheran Engineering Corporation:

Based on the data available regarding the income received from labour charges from the year 1974-75 to 1982-83, the investigator has made an effort to estimate the future income which the Cheran Engineering Corporation may receive for the next 7 years 1983-84 to 1989-90.

The Table VI shows the estimated values of labour charges that may be received by Cheran Engineering Corporation.

TABLE VI

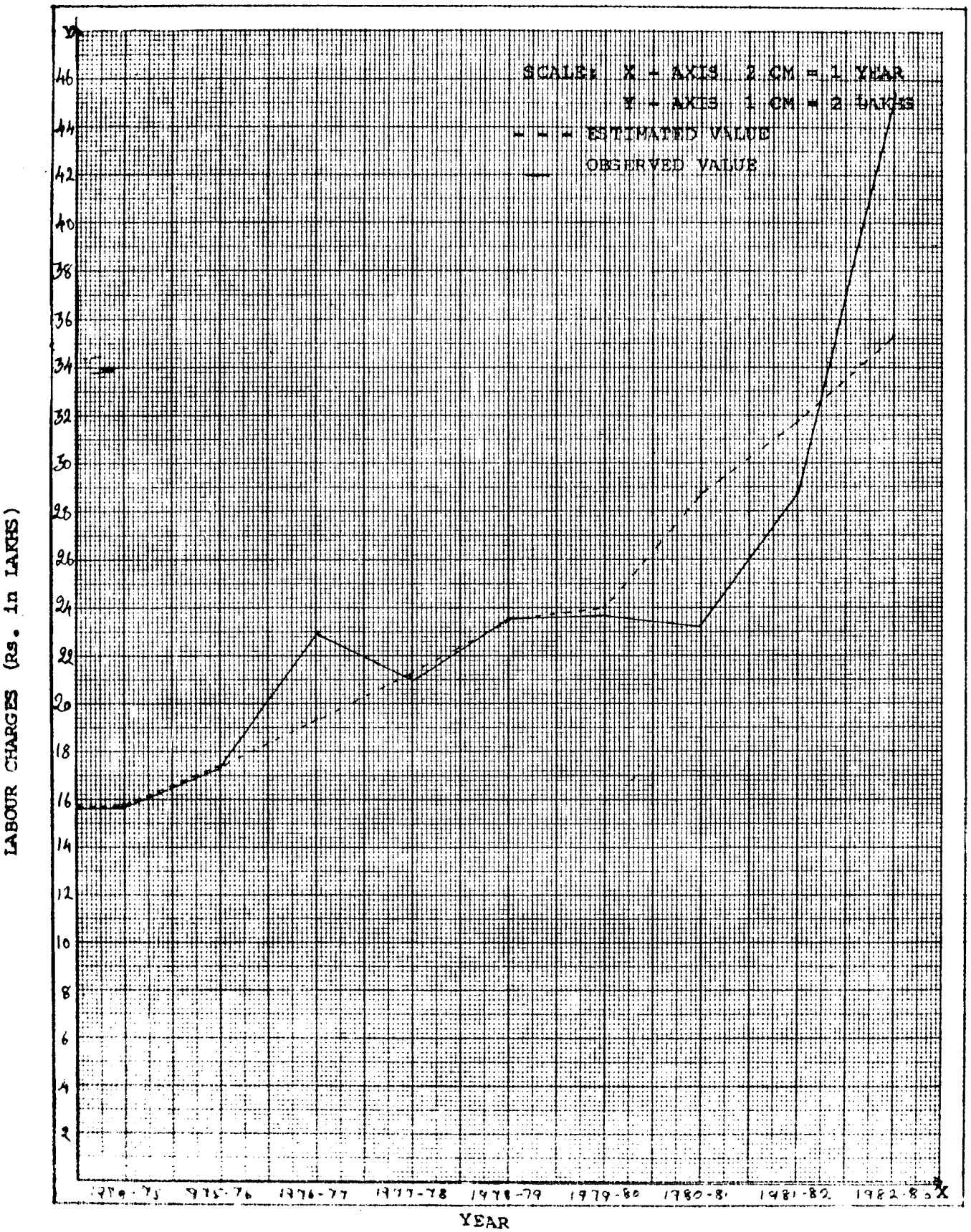
ESTIMATED VALUES OF LABOUR CHARGES RECEIVED BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	38.8421
1984-85	42.9273
1985-86	47.4412
1986-87	52.4310
1987-88	57.9452
1988-89	64.0395
1989-90	70.7739

The estimation showed that theincome from labour charges may certainly rise in the future. The investigator estimates that the income from labour charges may rise to Rs.52.4310 lakhs in 1986-87, it may be Rs.57.9452 lakhs, Rs.64.0395 lakhs and Rs.70.7739 lakhs during the years 1987-88, 1988-89, 1989-90 respectively. As a whole the Cheran Engineering Corporation has greater scope to receive more income from its labour charges in the future. The figure 1

FIGURE 1

THE OBSERVED VALUES AND ESTIMATED VALUES OF LABOUR CHARGES DURING THE PERIOD 1974-75 TO 1982-83



illustrates the observed values and estimated values of labour charges during the period 1974-75 to 1982-83.

VI. Estimated Values of Body Building Charges Received by Cheran Engineering Corporation:

Body building activity is an important activity undertaken by Cheran Engineering Corporation in recent years. Based on the data regarding the income received from body building activities during the reference period, the investigator has estimated the future income from this source for a period of 7 years. Table VII depicts the estimated values of body building charges.

TABLE VII

ESTIMATED VALUES OF BODY BUILDING CHARGES RECEIVED BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	117.5017
1984-85	143.5172
1985-86	193.7242
1986-87	236.6179
1987-88	319.3944
1988-89	431.1362
1989-90	526.5932

The estimation reveals that the Cheran Engineering Corporation may receive more income from this activity in the future. It may be Rs.236.6179 lakhs in 1986-87, Rs.319.3944 lakhs in 1987-88 and Rs.431.1362 lakhs in 1988-89 and Rs.526.5932 lakhs in 1989-90. The over all picture points out that this is an important source which may contribute significantly to the income side of Cheran Engineering Corporation in the near future. Figure 2 illustrates the observed values and estimated values of body building charges during the period 1974-75 to 1982-83.

VII. Estimated Values of Retreading Charges Received by Cheran Engineering Corporation:

Retreading is another important activity undertaken by Cheran Engineering Corporation in recent years. It receives considerable income from this activity. Based on the data available regarding the income from this source the investigator has estimated the future income from this for a period of 7 years.

Table VIII shows the estimated values of Retreading Charges received by Cheran Engineering Corporation for a period of 7 years 1983-84 to 1989-90.

FIGURE 2

THE OBSERVED VALUES AND ESTIMATED VALUES OF BODY BUILDING CHARGES DURING THE PERIOD 1974 - 75 TO 1982 - 83.

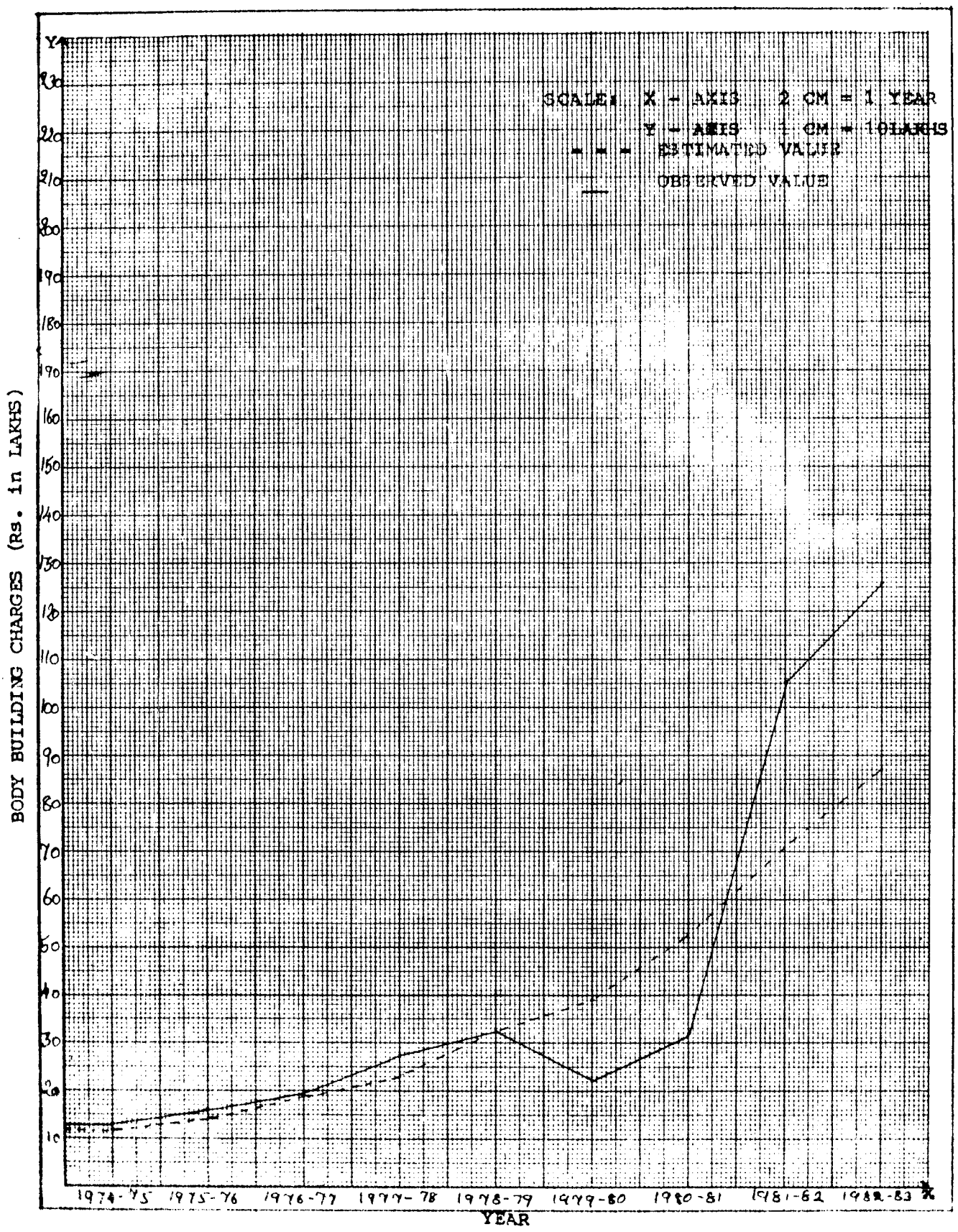


TABLE VIII

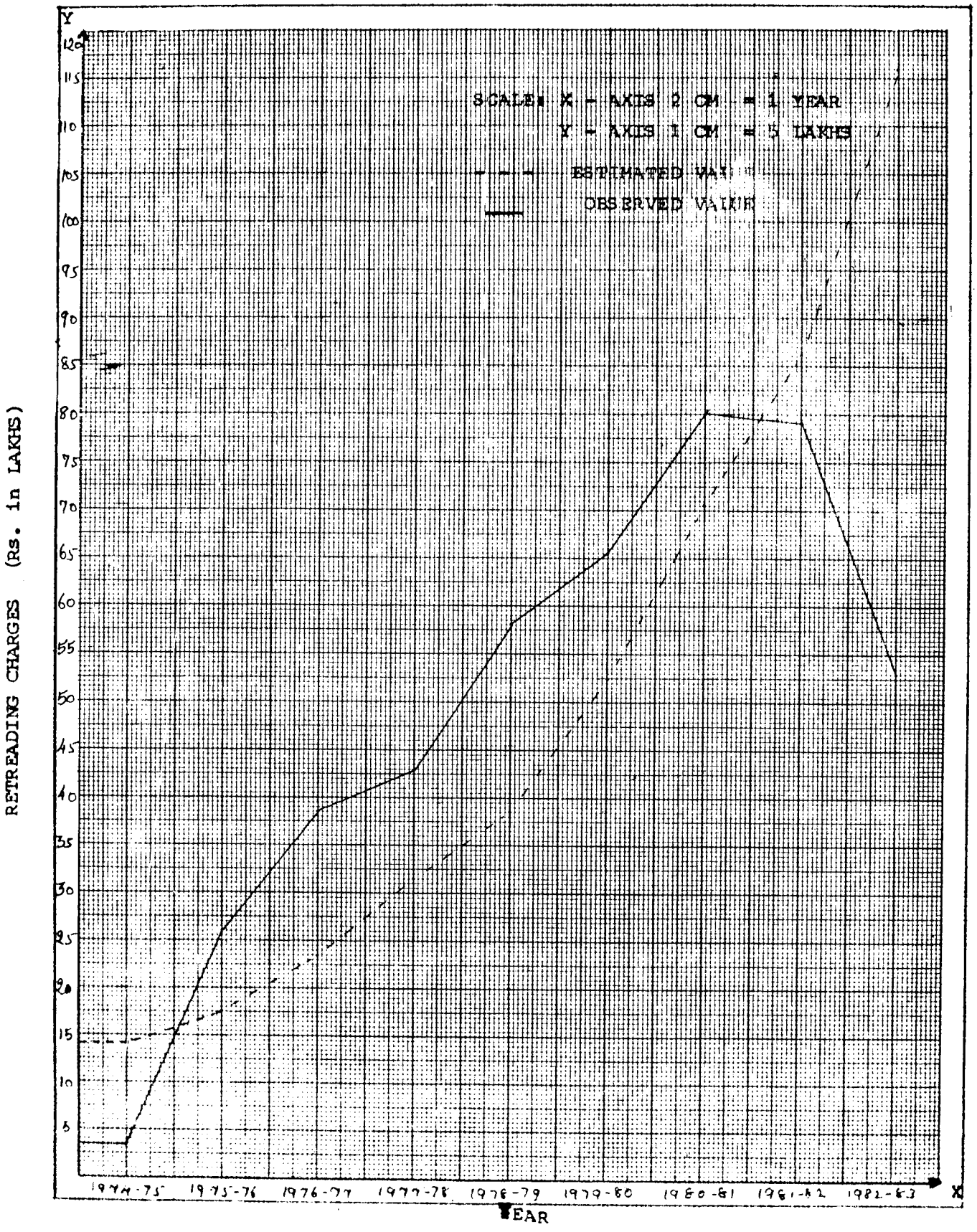
ESTIMATED VALUES OF RETREADING CHARGES RECEIVED BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	157.17
1984-85	191.9629
1985-86	259.1298
1986-87	349.7772
1987-88	472.1543
1988-89	576.6914
1989-90	778.4563

One can say from the table that Cheran Engineering Corporation may receive higher and higher income from this activity in the future. It is estimated that in 1986-87 the income from this source may be Rs.349.7772 lakhs and it may be Rs.472.1543 lakhs, Rs.576.6914 lakhs and Rs.778.4563 lakhs in the years 1987-88, 1988-89, 1989-90 respectively. We can say that the Cheran Engineering Corporation is in a favourable position to receive more income from its retreading activities in the future. Figure 3 illustrates the observed values and

FIGURE 3

THE OBSERVED VALUES AND ESTIMATED VALUES OF RETREADING CHARGES DURING THE PERIOD 1974 - 75 TO 1982 - 83.



estimated values of retreading charges during the period 1974-75 to 1982-83.

VIII. Estimated Values of Total Income Received by Cheran Engineering Corporation:

The facts collected reveal that as for the income side of the Cheran Corporation, the corporation functions successfully because its income shows continuous increasing trend.

Table IX shows the estimated value of the total income that may be received by this Corporation for the next 7 years.

TABLE IX

ESTIMATED VALUES OF TOTAL INCOME RECEIVED BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	409.9729
1984-85	553.4244
1985-86	675.9365
1986-87	825.5991
1987-88	1,114.436
1988-89	1,361.1711
1989-90	1,837.3838

The estimation proves that the total income may be Rs.825.5991 lakhs, Rs.1,114.436 lakhs, Rs.1,361.1711 lakhs, and Rs.1,837.3838 lakhs in the year 1986-87, 1987-88, 1988-89 and 1989-90 respectively. Figure 4 illustrates the observed values and estimated values of total income during the period 1974-75 to 1982-83.

IX. Estimated Values of TOTAL Expenditure Incurred by Cheran Engineering Corporation:

Starting with the main objective of serving the Cheran Transport Corporation in its engineering aspects the Cheran Engineering Corporation has incurred lot of expenditure to improve the standard of service given by it to promote better transport facilities in Coimbatore District. Among the expenditure items material consumed, and salaries and fringe benefits occupy prominent places.

Table X depicts the estimated value of total expenditure of Cheran Engineering Corporation for a period of 7 years.

FIGURE 4

THE OBSERVED VALUES AND ESTIMATED VALUES OF TOTAL INCOME DURING THE THE PERIOD 1974 - 75 TO 1982 - 83

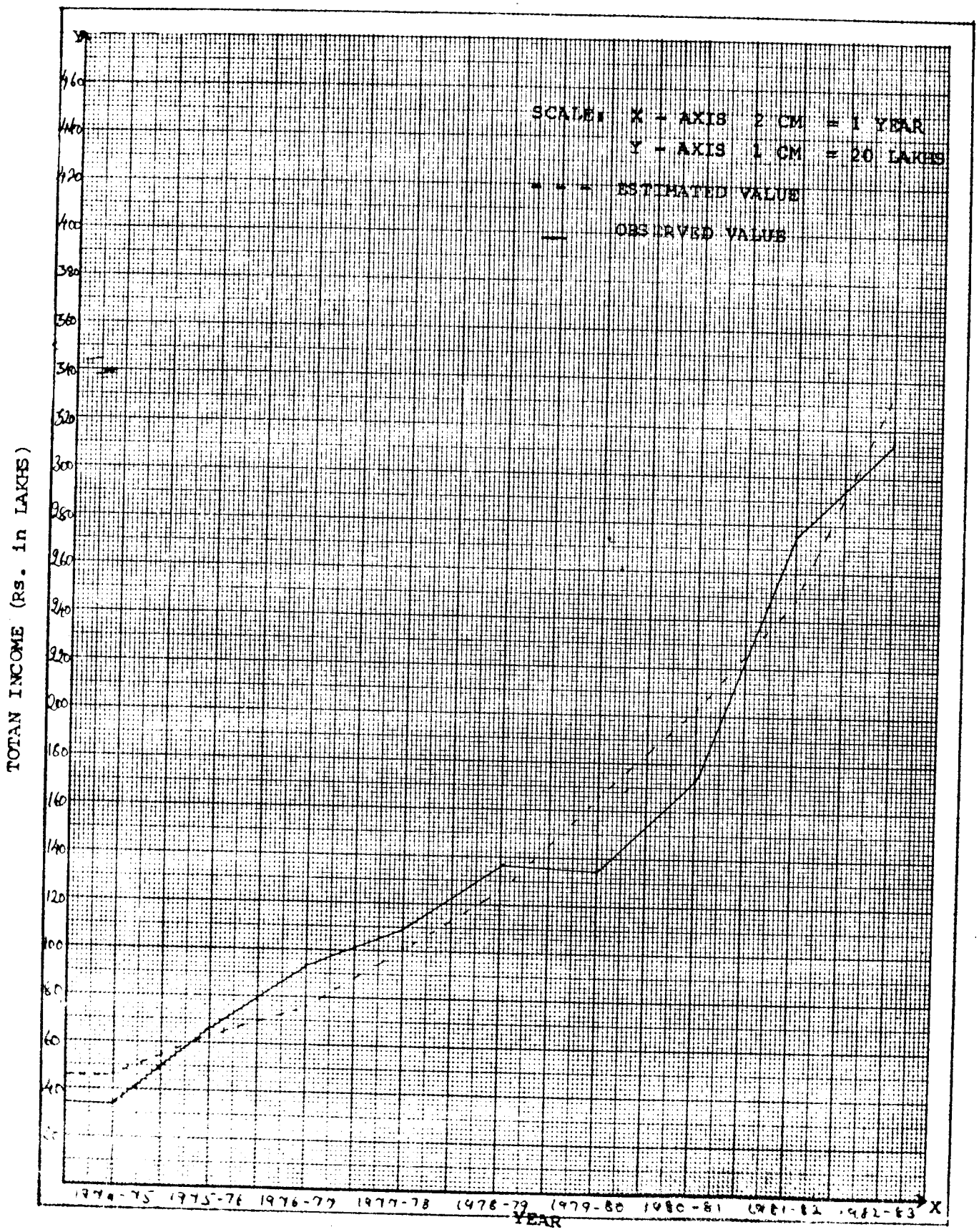


TABLE X

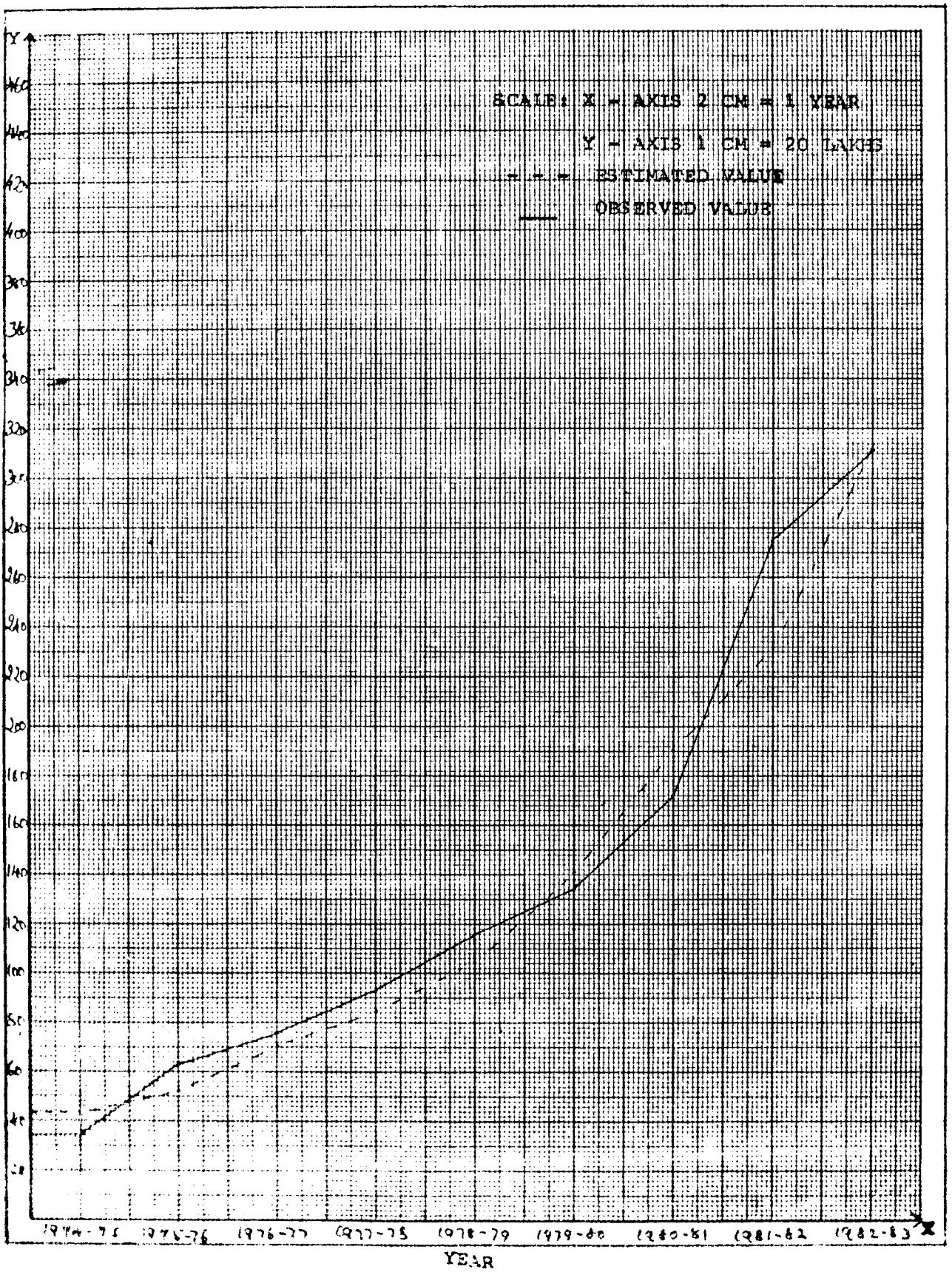
ESTIMATED VALUES OF TOTAL EXPENDITURE INCURRED BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	383.5489
1984-85	517.7264
1985-86	632.3535
1986-87	853.5796
1987-88	1,152.1892
1988-89	1,407.2902
1989-90	1,899.6419

It is estimated that the expenditure of Cheran Engineering Corporation for the year 1986-87 may be around Rs.853.5796 lakhs. This is expected to increase to Rs.1,152.1892 lakhs, Rs.1,407.2902 lakhs, Rs.1,899.6419 lakhs in the year 1986-87, 1987-88, 1988-89 and 1989-90 respectively. Figure 5 illustrates the observed values and estimated values of total expenditure during the period 1974-75 to 1982-83.

FIGURE 5

THE OBSERVED VALUES AND ESTIMATED VALUES OF TOTAL EXPENDITURE DURING THE PERIOD 1974 - 75 TO 1982 - 83.



X. Estimated Values of Expenditure incurred for the Item Material Consumed by Cheran Engineering Corporation:

In order to provide effective services the Cheran Engineering Corporation has to consume lot of materials. The expenditure on material consumed increased year by year. Table XI shows the estimated value of the expenditure on material consumed.

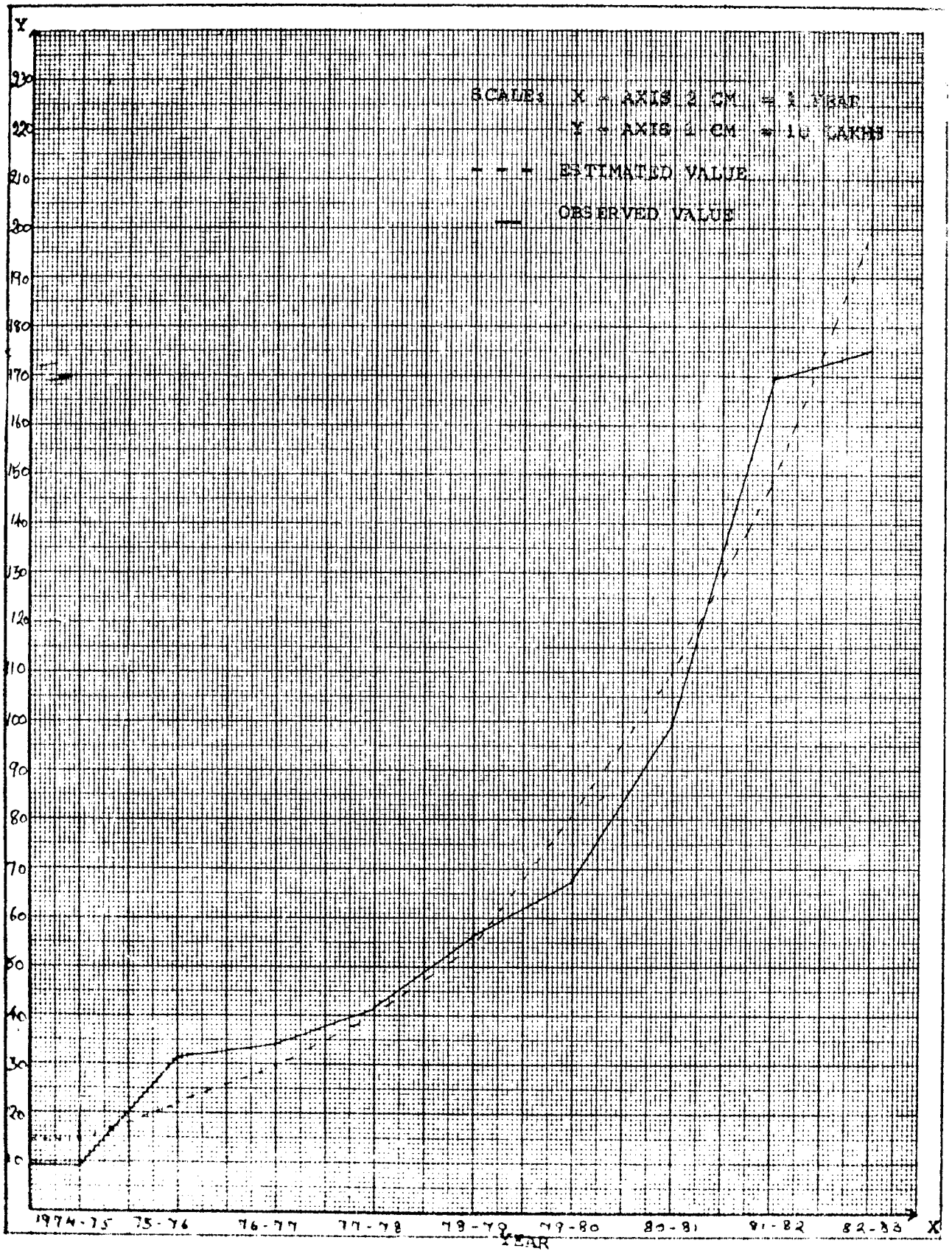
TABLE XI

ESTIMATED VALUES OF EXPENDITURE INCURRED FOR MATERIAL CONSUMED BY CHERAN ENGINEERING CORPORATION LIMITED

Year	Estimated Value (Rs. in lakhs)
1983-84	298.8232
1984-85	403.3612
1985-86	544.4792
1986-87	812.2772
1987-88	1,096.4529
1988-89	1,480.0638
1989-90	1,998.1798

FIGURE - 6

THE OBSERVED VALUES AND ESTIMATED VALUES OF MATERIAL CONSUMED DURING THE THE PERIOD 1974 - 75 TO 1982 - 83.



The above table shows the estimated value of expenditure on material consumed. It may be Rs.812.2772 lakhs in 1986-87 and expected to increase to Rs.1,096.4529 lakhs, Rs.1,480.0638 lakhs, Rs.1,998.1798 lakhs during the years 1987-88, 1988-89, 1989-90 respectively.

The picture reveals that there is an increasing trend on the expenditure for this item in the future. Figure 6 illustrates the observed values and estimated values of material consumed during the period 1974-75 to 1982-83.

XI. Estimated Values of Expenditure Incurred for Providing Salaries and Fringe Benefits by Cheran Engineering Corporation:

Cheran Engineering Corporation provides ample opportunities for employment. Since its activities are expanding year by year it has to provide more and more for giving salaries & fringe benefits.

Table XII gives details regarding the estimated value of salaries and fringe benefits incurred by Cheran Engineering Corporation.

TABLE XII

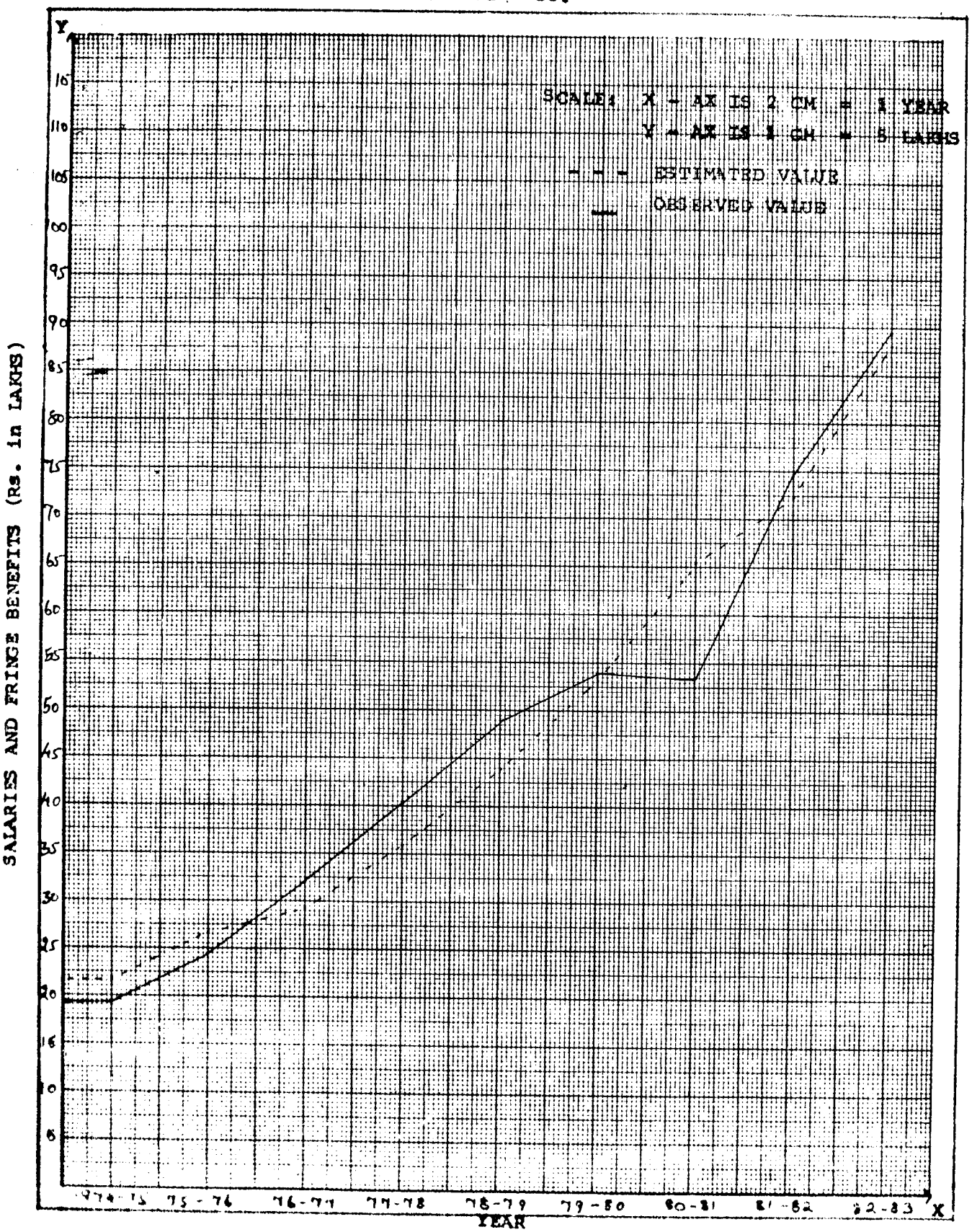
ESTIMATED VALUE OF EXPENDITURE INCURRED FOR PROVIDING SALARIES AND FRINGE BENEFITS BY CHERAN ENGINEERING CORPORATION

Year	Estimated Value (Rs. in lakhs)
1983-84	107.8686
1984-85	131.7528
1985-86	145.6091
1986-87	177.8470
1987-88	217.2314
1988-89	265.3208
1989-90	324.0551

A glance to the table shows that this item requires more spending by Cheran Engineering Corporation in the future. It has to spend Rs.177.8470 lakhs to give salaries & fringe benefits in 1986-87, Rs.217.2314 lakhs, Rs.265.3208 lakhs and Rs.324.0551 lakhs during the years 1987-88, 1988-89, 1989-90 respectively. It shows Cheran Engineering Corporation may generate more income in the economy by providing salaries & fringe benefits to its employees in the future. The figure 7 illustrates the observed values and estimated values of salaries and fringe benefits during the period 1974-75 to 1982-83.

FIGURE 7

THE OBSERVED VALUES AND ESTIMATED VALUES OF SALARIED AND FRINGE BENEFITS DURING THE PERIOD 1974 - 75 TO 1982 - 83.



XII. Capital Employed by Cheran Engineering Corporation:

The investigator has analysed the capital employed by Cheran Engineering Corporation for a period of 9 years. She has calculated 3 year and 5 year average moving trend of capital employed.

Table XIII shows the 3 year and 5 year average moving trend in capital employed by Cheran Engineering Corporation during the 9 year period (1974-75 to 1982-83).

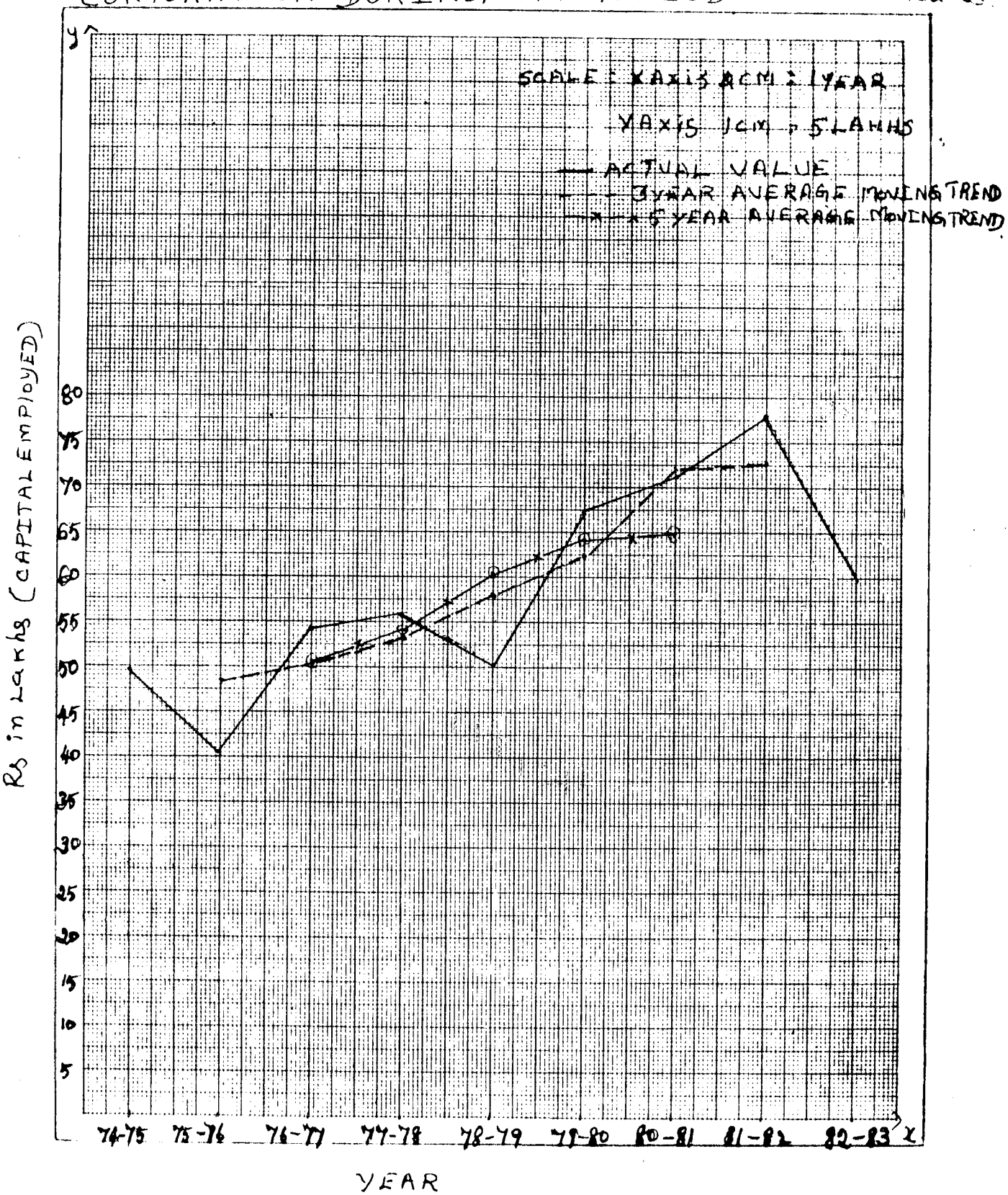
TABLE XII

CAPITAL EMPLOYED BY CHERAN ENGINEERING CORPORATION

Year	Actual Value (Rs. in lakhs)	3 Year Trend	5 Year Trend
1974-75	49.82	-	-
1975-76	40.94	48.56	-
1976-77	54.92	50.85	50.49
1977-78	56.68	53.90	54.00
1978-79	50.09	58.05	60.10
1979-80	67.37	62.97	64.76
1980-81	71.45	72.34	65.52
1981-82	78.20	70.04	-
1982-83	60.48	-	-

FIGURE 8

THE CAPITAL EMPLOYED BY CHERAN ENGINEERING CORPORATION DURING THE PERIOD 1974-75 TO 1982-83



3 year and 5 year average moving trend calculated shows that the capital employed by Cheran Engineering Corporation has increased year by year. Both five year and three year moving average trend reveal that there is an increasing trend. This proves that Cheran Engineering Corporation stands on a strong financial footing. Figure 8 illustrates capital employed by Cheran Engineering Corporation during the period 1974-75 to 1982-83.

XIII. Physical Performance of Cheran Engineering Corporation:

Apart from financial aspects the investigator has taken into consideration the physical performance of Cheran Engineering Corporation during the reference period (1974-75 to 1982-83). Table XIV indicates physical performance of Cheran Engineering Corporation during the period 1974-75 to 1982-83.

TABLE XIV

PHYSICAL PERFORMANCE OF CHERAN ENGINEERING CORPORATION LTD.

Year	Bus Bodies Built	Percentage	Brake Drums	Percentage	Tyre Retreading	Percentage	Oil Reclamation in K.Ltrs.	Percentage	Engines Reconditioned	Percentage
1974-75	94	5.016	199	0.248	1466	0.802	-	-	318	8.110
1975-76	125	6.670	2121	0.151	10405	5.693	-	-	437	11.145
1976-77	202	10.779	4369	5.442	15140	8.284	41	3.236	455	11.604
1977-78	190	10.139	6414	7.989	17317	9.377	111	8.761	356	9.079
1978-79	209	11.152	8778	10.946	21755	11.903	123	9.708	359	9.156
1979-80	179	9.552	8387	10.447	25880	14.160	142	11.208	440	11.222
1980-81	233	12.433	11927	14.856	28293	15.481	187	14.759	459	11.706
1981-82	301	16.061	18061	24.477	28593	15.645	282	22.257	521	13.287
1982-83	346	18.463	20017	24.933	34094	18.655	381	30.071	576	14.690
Total	1874		80283		182763		1267		3921	

During the reference period, totally the Cheran Engineering Corporation has built 1,874 buses. During the reference period the maximum number of buses were built in 1982-83 (346). Regarding its Brake Drums activities the total comes to 80,283, the maximum Brake drums were manufactured in the year 1982-83 (24.933). Regarding its tyre retreading activities in has retreaded 1,82,763 tyres. In the year 1982-83 it has retreaded 34,094 tyres which forms (18.655%) in the total tyre retreading. In the case of oil reclamation (in K.Ltrs.) the total comes to 1,267 in K. Ltrs. during the reference period. The Cheran Engineering Corporation has reconditioned 3,921 Engines during the reference period. In this also its contribution was high in 1982-83. The Cheran Engineering Corporation has started its oil reclamation work only from the year 1976-77. A glance at the table indicates that year by year physically also its performance improved throughout the reference period.

IVX. The Role of Capital and Labour in the Total Production of Cheran Engineering Corporation:

The investigator with a view to find out the role of Labour and Capital in the total production of Cheran Engineering Corporation has calculated Cob-Douglas

Production Function based on the data available from 1977-78 to 1984-85. The calculation is given in the appendix. .

The function is $Q = A K^{\alpha} L^{\beta}$

Q = Total output

K = Capital input

L = Labour input

α = Elasticity of output with respect to Capital

β = Elasticity of output with respect to Labour

A = Constant Co-efficient

$Q = A K^{\alpha} L^{\beta}$

$$Q = 0.712\ K^{1.0556}\ L^{0.7778}$$
$$(0.1667)\ (0.3575)$$

$R^2 = .8969 \quad Z_{\alpha} = 6.3323^{*}$

$Z_{\beta} = 2.1757$

$Z_{\alpha} = 6.3323^{*}$ is significant at both 5 per cent and 1 per cent level. Z_{β} is not significant. The high R^2 value of 0.8969 indicates that the fit is good. That is nearly 90 percent of the variation is due to the variation in capital and labour input. The capital and labour co-efficient was estimated to be 0.1667 + 0.3575 respectively. This means

that one unit changes in capital bring about 1.0556 percent change in output while one unit changein labour bring about only 0.7778 percent change in output. However, statistically it was proved that the labour co-efficient was not significant while the capital co-efficient was significant at 5% level. In short, the industry was proved to be capital intensive.

This implies that any variation in output is due to the variation in capital and the influence of labour was only incidental. From this it can be concluded that the Cheran Engineering Corporation is capital intensive in nature and by increasing the employment of capital, output can be increased.

The investigator, while calculating Cob-Douglas production function has calculated capital output ratio, labour output ratio, and capital labour ratio. They are given as follows:

$$\text{Capital output ratio} = \frac{279.66}{325299} = .00086$$

$$\text{Labour output ratio} = \frac{6686}{325299} = .0206$$

$$\text{Capital labour ratio} = \frac{279.66}{6686} = .0418$$

The capital output ratio shows that to produce one unit output 0.00086 unit of capital is required.

The labour output ratio shows that to produce one

unit of output 0.0206 unit of labour is required.

The capital labour ratio shows that to produce one unit of labour 0.0418 unit of capital is required.

XV. The Relationship Between Expenditure and Income:

The investigator through regression analysis tried to find out whether expenditure is the function of income.

The calculations are given in the appendix.

The equation is $E = a + bx$

$E = .03 + 1.0227\ x$

The high R^2 value of 0.9935 indicates that the fit is excellent. That is nearly 99 percent of the variation of expenditure is due to the variation in income. The regression coefficient was estimated to be 1.0227. This implies that one unit change in income brought about 1.02 per cent change in expenditure. Statistical analysis also indicates that the coefficient is significant at 5 percent level. From this it can be concluded that the actual expenditure of the concern is influenced by income earned and any improvement or changes in income will also bring about subsequent change in expenditure.

XVI. Profitability Trend Analysis:

The actual data relating to the profits/losses for Cheran Engineering Corporation have been used to calculate the trends upto the year 1990. Table XV shows this.

The equation is $Y_c = a + b\,x$

TABLE XV

PROFITABILITY TREND ANALYSIS TABLE

Year	Profit and Loss (Rs. in lakhs)	x - 1980			
x	Y	x	xY	x^2	Y_c (Rs. in lakhs)
1976	3.87	-4	-15.48	16	13.25
1977	15.95	-3	-47.85	9	11.71
1978	16.13	-2	-32.26	4	10.17
1979	19.13	-1	-19.13	1	8.63
1980	1.37	0	0.0	0	7.09
1981	1.01	1	1.01	1	5.55
1982	0.55	2	1.10	4	4.01
1983	2.90	3	8.7	9	2.47
1984	2.88	4	11.52	16	0.93
	$\Sigma Y = 63.79$	0	$\Sigma XY = -92.32$		

$$a = \frac{\Sigma Y}{N} = \frac{63.79}{9} = 7.09$$

$$b = \frac{\Sigma XY}{\Sigma x^2} = \frac{-92.39}{60} = -1.54$$

Profitability for the year 1990

$$Y_c = 7.09 + (-1.54)\ (10)$$

$$= 7.09 - 15.40$$

$$= -8.31$$

The Cheran Engineering Corporation has earned profits throughout the reference period. But there are wide fluctuations in the volume of profit earned. In 1977-78, it has increased to Rupees 15.95 lakhs from a low profit figures of Rupees 3.87 lakhs in 1976-77. In 1979-80 the profit has suddenly decreased to a level of Rupees 1.37 lakhs and touched the lowest point of Rupees 0.55 lakhs in the year 1981-82. However, the profits have increased in the last two years. The trend fixed for the year 1990 shows a loss of Rupees 8.31 lakhs as against a profit of Rupees 0.93 lakhs in 1983-84.

The management must take due notice of this trend and initiate steps to improve the position and thereby increase the profitability in the future. The figure 9 illustrates profitability trend of Cheran Engineering Corporation during the period 1976-1984.

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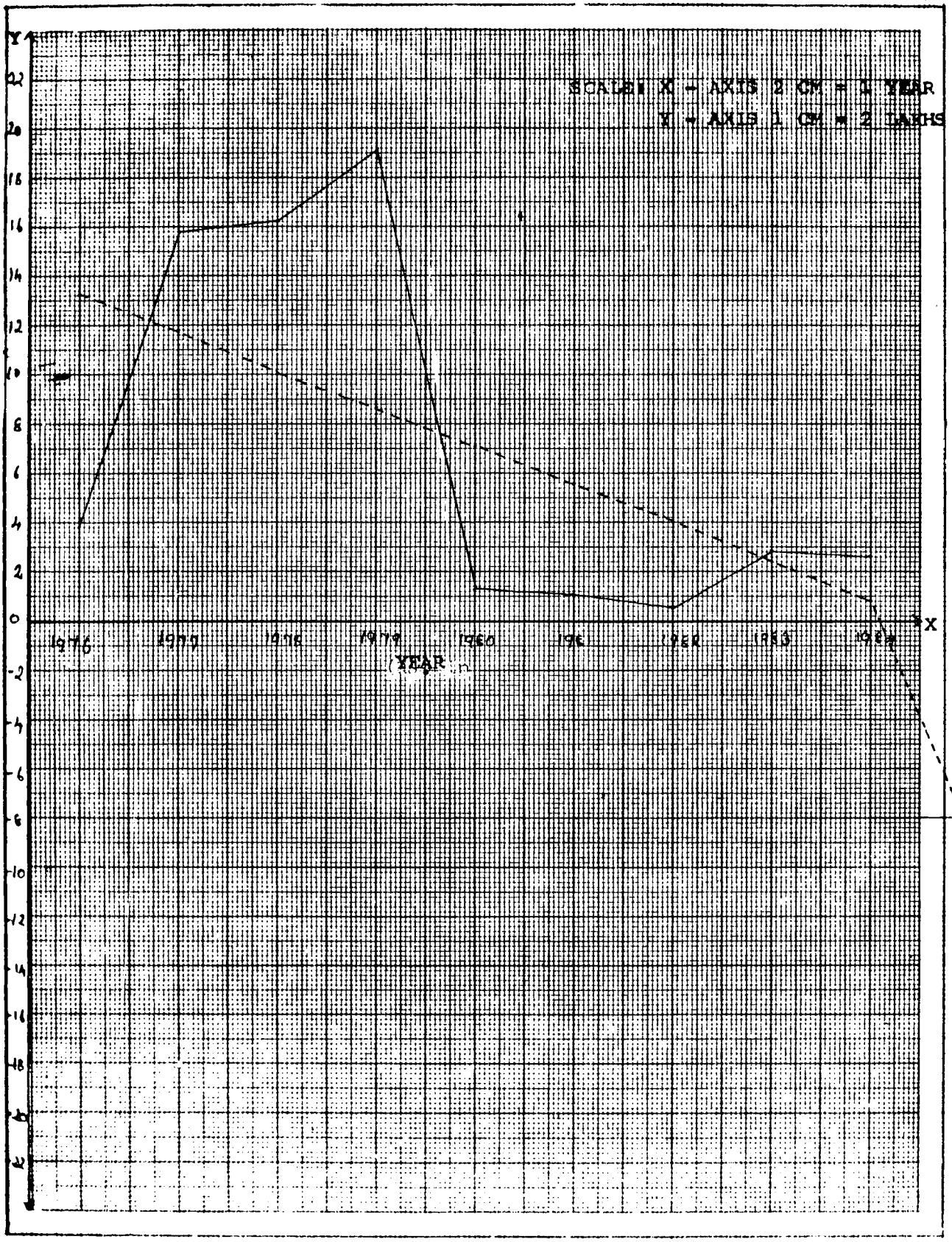
FIGURE 9

PROFITABILITY TREND OF CHERAN ENGINEERING CORPORATION DURING THE PERIOD 1976 - 1984.



Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

Among the Engineering Corporations prividing important services for transport industry in India Cheran Engineering Corporation has an important place. The investigator with the data provided by the authorities of Cheran Engineering Corporation has tried her level best to analyse "The performance of Cheran Engineering Corporation during the period 1974-75 to 1982-83. Her analysis reveals the following:

(1) An analysis of the income side of Cheran Engineering Corporation indicates that the income of the Corporation has increased from year to year. Starting from the income of Rs.34.70 lakhs in the year 1974-75 it has reached the limit of Rs.313.19 lakhs in the year 1982-83. Among the items included in the income side of the Corporation body building charges, RC labour charges, and retreading charges occupied the places of importance and increase of total income was twelve times more than the starting year.

(2) A study on expenditure side showed that the expenditure of the Corporation increased year by year. It shows the diversified activities undertaken by the Corporation for the sake of which it has to incur more expenditure year

by year. Starting from expenditure figure of Rs.34.34 lakhs in 1974-75 it has increased to Rs.310.29 lakhs in 1982-83 an increase of about twelve times more than the starting year. Among the items of expenditure material consumed, salaries and fringe benefits dominated the expenditure side.

(3) The data on labour charges for a period of 9 years was subjected to growth rate analysis.

The function is $Y_t = Ae^{\lambda t}$

$$Y_t = 14.2891\ e^{.0983\ t}$$

The growth rate is 9.83% as seen by b value. The growth is highly significant as seen by R value .7709 which is significant at P = 0.01 level.

(4) The data on body building charges of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = Ae^{\lambda t}$

$$Y_t = 8.7271\ e^{0.2572\ t}$$

The growth rate is 25.72% as seen by b value. The growth rate is highly significant as seen by R value .8055 which is significant at P = 0.01 level.

(5)The data on retreading charges of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = 10.5625e^{.2680t}$

The growth rate is 26.80% as seen by b value.

The growth rate is highly significant as seen by R value .5739 which is significant at P =0.01 level.

(6) The data on total income of Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = A_0 e^{\lambda t}$

$$Y_t = 37.1925e^{.2422t}$$

The growth rate is 24.22% as seen by b value.

The growth is highly significant as seen by R value .9427 level which is significant at P = 0.01 level.

(7) The data on total exependiture incurred by Cheran Engineering Corporation over 9 years was subjected to growth rate analysis and the results are as follows.

The function is $Y_t = A_0 e^{\lambda t}$

$$Y_t = 31.4823\ e^{0.2538\ t}$$

The growth rate is 25.38% as seen by b value.

The growth rate is highly significant as seen by R value .972 which is significant at P = 0.01 level.

(8) The data on expenditure incurred by Cheran

Engineering Corporation for material consumed over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = A e^{\lambda t}$

$$Y_t = 11.0214\ e^{0.3272\ t}$$

The growth is 32.72% as seen by b value.

The growth is highly significant as seen by R value 0.9316 which is significant at P = 0.01 level.

(9) The data on expenditure incurred by Cheran Engineering Corporation for salaries and fringe benefits over 9 years was subjected to growth rate analysis and the results are as follows:

The function is $Y_t = A e^{\lambda t}$

$$Y_t = 17.8307\ e^{0.1791\ t}$$

The growth rate is 17.91% as seen by b value.

The growth is highly significant as seen by R value 0.9781 which is significant at P = 0.01 level.

(10) The estimation showed that the income from labour charges may certainly rise in the future. The investigator estimates that the income from labour charges may rise to Rs.52.4310 lakhs in 1986-87 it may be Rs.57.9452 lakhs Rs.64.0395 lakhs and Rs.70.7739 lakhs during the year 1987-88, 1988-89 and 1989-90 respectively.

(11) The estimation reveals that the Cheran Engineering Corporation may receive more income from the body building activities in the future. It will be Rs.236.6179 lakhs in 1986-87, Rs.319.3944 lakhs in 1987-88 Rs.431.1362 lakhs in 1988-89 and Rs.526.5932 lakhs in 1989-90.

(12) It is estimated that in 1986-87 the income from the retreading charges may be Rs.349.7772 lakhs and it may be Rs.472.1543 lakhs, Rs.576.6914 lakhs and Rs.778.4563 lakhs in the years 1987-88, 1988-89 and 1989-90 respectively.

(13) The estimation proves that the total income may be Rs.825.5911 lakhs, Rs.1,114.436 lakhs, Rs.1,361.1711 lakhs and Rs.1,837.3838 lakhs in the years 1986-87, 1987-88, 1988-89 and 1989-90 respectively.

(14) It is estimated that the total expenditure of Cheran Engineering Corporation for the year 1986-87 may be around Rs.853.5796 lakhs. This is expected to increase to Rs. 1,152.1892 lakhs, Rs.1,407.2902 lakhs, Rs.1899.6419 lakhs in the years 1986-87, 1987-88, 1988-89 and 1989-90 respectively.

(15) The estimation proves that the expenditure on material consumed may be Rs.812.2772 lakhs in 1986-87, and expected to increase to Rs.1,096.4529 lakhs, Rs.1,480.0638

lakhs, Rs.1,998.1798 lakhs during the years 1987-88, 1988-89 and 1989-90 respectively.

(16) It is estimated that the expenditure on salaries and fringe benefits may be Rs.177.8470 lakhs in 1986-87 and it may be Rs.217.2314 lakhs, Rs.265.3208 lakhs and Rs.324.0551 lakhs during the years 1987-88, 1988-89 and 1989-90 respectively.

(17) The investigator took into consideration the amount of capital employed by Cheran Engineering Corporation during the reference period (1974-75 to 1982-83) for its operation. Both five and three years average moving trend reveals that there is an increasing trend that is the capital employed has increased from year to year starting from the amount of capital Rs.49.82 lakhs in 1974-75 to Rs.60.48 lakhs in 1982-83.

(18) The physical performance of Cheran Engineering Corporation was analysed. Among its activities the number of buses built by the corporation has increased from 94 to 346 and this increase is about 3 times than the starting years. Regarding the brake drums the increase is tremendous from 199 it has increased to 20,017. An increase about 10 times than the starting year. In the case of tyre tretreading from 1,466 the tyre retreaders had increased to 34,094, an increase about nearly 30 times than the starting period. Even though oil reclamation started in 1976-77 it has increased to 381 (in K.Ltrs.)

in 1982-83 an increase of about 6 times. It has reconditioned only 318 engines in 1974-75 which has increased to 576 in 1982-83 an increase of nearly 2 times than the initial period. As a whole physically its performance improved throughout the reference period.

(19) The high R^2 value of .8969 indicates that the fit is excellent. That is nearly 90 per cent of the variation is due to the variation in capital and labour input. The capital and labour coefficient was estimated to be 0.1667 + 0.3575 respectively. This means that one unit change in capital brings about 1.0556 per cent change in output. While 1 unit change in labour bring about only 0.7778 per cent change in output. However, statistically it was proved that the labour coefficient was not significant. While the capital coefficient was significant at 5 per cent level. In short the industry was proved to be capital intensive.

This implies that any variation in output is due to the variation in capital and the influence of labour was only incidental. From this it can be concluded that the Cheran Engineering Corporation is capital intensive in nature and by increasing the employment of capital, output can be increased.

The investigator while calculating Cob-Douglas production function has calculated the capital output

ratio, labour output ratio and capital labour ratio. Capital output ratio shows that to produce one unit of output .00086 unit of capital is required.

The labour output ratio shows that to produce one unit of output 0.0206 unit of labour is required.

The capital labour ratio shows that to produce one unit of labour 0.0418 unit of capital is required.

(20) The high R^2 value of 0.9935 indicates that the fit is excellent. That is nearly 99 per cent of the variation of expenditure is due to the variation in income. The regression coefficient was estimated to be 1.0227. This implies that one unit change in income brought about 1.02 per cent change in expenditure. Statistical analysis also indicates that the coefficient is significant at 5 per cent level. From this it can be concluded that the actual expenditure of the concern is influenced by income earned and any improvement or changes in income will also cause to subsequent change in expenditure.

(21) The profitability trend analysis reveals that the Cheran Engineering Corporation has earned profits throughout the reference years. But they are wide fluctuations in profit throughout the reference period.

The trend fixed for the year 1990 shows a loss of Rs.8.31 lakhs as against profit of Rs.0.93 lakhs in 1983-84. These figures of loss arise due to the fact that the company has earning diminishing rate of return in 1982-83.

Suggestions for Improvement:

The investigator feels that a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of the Cheran Engineering Corporation is a must to find out the reasons for their expected future loss and to improve their performance.

In conclusion the Cheran Engineering Corporation is on its path way to progress. If proper care is taken it may be possible to improve its positions in the future.

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Appendices

APPENDIX I

AN EXPONENTIAL FUNCTION FOR R.C. LABOUR CHARGES

Year(r)	x_t	x^2	R_t (Rs. in lakhs)	$y_t = \text{Log } R_t$	$y_t = (y_t - \bar{y}_t)$	$(y_t - y_t)^2 = y_t^2$	$y_t \cdot x_t$
1974-75	-4	16	15.71	1.1962	-0.1759	0.0309	0.7036
1975-76	-3	9	17.40	1.2405	-0.1316	0.0173	0.3948
1976-77	-2	4	22.95	1.3608	-0.0113	0.0001	0.0226
1977-78	-1	1	21.04	1.3230	-0.0491	0.0024	0.0491
1978-79	0	0	23.56	1.3722	0.0001	0.0000	0.0000
1979-80	1	1	23.68	1.3744	0.0023	0.0000	0.0023
1980-81	2	4	23.15	1.3646	-0.0075	0.0001	-0.0150
1981-82	3	9	28.78	1.4591	0.0870	0.0076	0.2610
1982-83	4	16	45.50	1.6580	0.2859	0.0817	1.1436
		60		12.3488		0.1401	2.5620

$$\bar{y}_t = \frac{12.3488}{9} = 1.3721$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{2.5620}{60} = .0427$$

$$\lambda = \frac{b}{\log e} = \frac{.0427}{\log 2.7183} = \frac{.0427}{.4343} = .0983$$

$$\bar{y}_t = a = 1.3721$$

$$R_o = \text{Anti}\hat{\log}\ (1.3721)$$

$$= 23.56$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2}$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2$$

$$= 0.1401 - (.0427)^2\ (60)$$

$$= 0.1401 - (.0018)(60)$$

$$= 0.1401 - (.108) = .0321$$

$$R^2 = 1 - \frac{.0321}{.1401} = 1 - .2291 = .7709$$

$$Z = \frac{b}{\hat{SE}b}$$

$$\text{Variance } b = \sigma u^2 / \Sigma x^2$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2} = \frac{.0321}{7} = .0046$$

$$\text{Variance} = \frac{.0046}{60} = .000077$$

$$\text{S. E.} = \sqrt{.000077} = .0088$$

$$Z = \frac{.0427}{.0088} = 4.8523$$

Estimated Function $R_t = 23.56e^{.0983x}$

$= 23.56e^{.0983(t-5)}$

$= 23.56e^{.0983t - 0.4915}$

$= 23.56e^{.0983t}\ e^{-0.4915}$

$= 23.56e^{.0983t} \times 0.6065$

$= 14.28914e^{.0983t}$

For the year 1989-90 $= 14.2891e^{.0983 \times 16}$

$= 14.2891 \times e^{1.6}$

$= 14.2891 \times 4.9530$

$= \underline{70.7739}$

For the year 1983-84 $= 14.2891e^{.0983t}$

$= 14.2891e^{.0983 \times 10}$

$= 14.2891 \times e^{1}$

$= 14.2891 \times 2.7183$

$= \underline{38.8421}$

For the year 1984-85 $= 14.2891 \times e^{.0983 \times 11}$

$= 14.2891 \times e^{1.1}$

$= 14.2891 \times 3.0042 = \underline{42.9273}$

For the year 1985-86 $= 14.2891 \times e^{.0983 \times 12}$

$= 14.2891 \times e^{1.2}$

$= 14.2891 \times 3.3201 = \underline{47.4412}$

For the year 1986-87 $= 14.2891 \times e^{.0983 \times 13}$

$= 14.2891 \times e^{1.3}$

$= 14.2891 \times 3.6693 = \underline{52.4310}$

For the year 1987-88 $= 14.2891\ e^{.0983 \times 14}$

$= 14.2891 \times e^{1.4}$

$= 14.2891 \times 4.0552 = \underline{57.9452}$

For the year 1988-89 $= 14.2891 \times e^{.0983 \times 15}$

$= 14.2891 \times e^{1.5}$

$= 14.2891 \times 4.4817 = \underline{64.0395}$

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APPENDIX II - AN EXPONENTIAL FUNCTION FOR BODY BUILDING CHARGES

Year	x_t (t-1978)	x^2	R_t (Rs. in Lakhs)	$y_t = \log R_t$	$y_t = (y_t - \bar{y}_t)$	y_t^2 $(y_t - \bar{y}_t)^2$	$y_t x_t$
1974-75	-4	16	13.14	1.1186	-0.3869	0.1497	1.5476
1975-76	-3	9	16.04	1.2052	-0.3003	0.0902	0.9009
1976-77	-2	4	19.78	1.2962	-0.2093	0.0438	0.4186
1977-78	-1	1	27.63	1.4414	-0.0641	0.0041	0.0641
1978-79	0	0	32.28	1.5089	0.0034	0.0000	0.0000
1979-80	1	1	22.55	1.3531	-0.1524	0.0232	-0.1524
1980-81	2	4	31.92	1.5041	-0.0014	0.0000	-0.0028
1981-82	3	9	105.34	2.0226	0.5171	0.2674	1.5513
1982-83	4	16	125.72	2.0994	0.5939	0.3527	2.3756
		60		13.5495		0.9311	6.7029

$$\bar{y}_t = \frac{13.5495}{9} = 1.5055$$

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

$$= \frac{6.7029}{60} = 0.111715$$

$$\lambda = \frac{b}{\log e} = \frac{0.111715}{\log 2.7183}$$

$$= \frac{0.111715}{.4343} = \underline{0.2572}$$

$$a = 1.5055$$

$$R_o = \text{Anti}\hat{\log}\ (1.5055) = \underline{32.026}$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2}$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2 = .9311 - (0.1117)^2\ (60)$$

$$= .9311 - 0.75 = \underline{0.1811}$$

$$R^2 = 1 - \frac{0.1811}{0.9311} = \underline{0.8055}$$

$$Z = \frac{b}{\hat{SE}b}$$

$$\text{Variance } b = \sigma u^2 / \Sigma x^2$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2}$$

$$= \frac{0.1811}{7} = 0.0259$$

$$\text{Variance} = \frac{0.0259}{60} = \underline{0.00043}$$

$$= \underline{0.00043}$$

$$\text{S.E.} = \sqrt{0.00043} = \underline{0.02074}$$

$$Z = \frac{b}{SE\,\hat{b}} = \frac{0.1117}{0.0207} = \underline{5.396}$$

Estimated Function $R_t = 32.026\ e^{0.2572\ x}$

$= 32.026\ e^{0.2572\ (t-5)}$

$= 32.026\ e^{0.2572\ t-1.3}$

$= 32.026\ e^{0.2572\ t}\ e^{-1.3}$

$= 32.026\ e^{0.2572\ t} \times 0.2725$

$= 8.7271\ e^{0.2572\ t}$

For the year 1989-90 $R_t = 8.7271\ e^{0.2572 \times 16}$

$= 8.7271 \times e^{4.1}$

$= 8.7271 \times 60.340 = \underline{526.5932}$

For the year 1983-84 $= 8.7271\ e^{0.2572 \times 10}$

$= 8.7271\ e^{2.6}$

$= 8.7271 \times 13.464 = \underline{117.5017}$

For the year 1984-85 $= 8.7271\ e^{0.2572 \times 11}$

$= 8.7271\ e^{2.8}$

$= 8.7271 \times 16.445 = \underline{143.5172}$

For the year 1985-86 $= 8.7271\ e^{0.2572 \times 12}$

$= 8.7271\ e^{3.1}$

$= 8.7271 \times 22.198 = \underline{193.7242}$

For the year 1986-87 $= 8.7271\ e^{0.2572 \times 13}$

$= 8.7271\ e^{3.3}$

$= 8.7271 \times 27.113 = \underline{236.6179}$

For the year 1987-88 $= 8.7271\ e^{0.2572 \times 14}$

$= 8.7271\ e^{3.6}$

$= 8.7271 \times 36.598 = \underline{319.3944}$

For the year 1988-89 $= 8.7271\ e^{0.2572 \times 15}$

$= 8.7271\ e^{3.9}$

$= 8.7271 \times 49.402 = \underline{431.1362}$

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APPENDIX III - AN EXPONENTIAL FUNCTION FOR RETREADING CHARGES

Year	x_t= (t -1978)	x^2	R_t (Rs. in lakhs)	y_t= log R_t	$y_t = (y_t - \bar{y}_t)$	$(y_t - \bar{y}_t)^2$	$y_t x_t$
1974-75	-4	16	3.55	0.5502	-1.0382	1.0779	4.1528
1975-76	-3	9	25.83	1.4121	-0.1763	0.0311	0.5289
1976-77	-2	4	38.70	1.5877	-0.0007	0.0000	0.0014
1977-78	-1	1	42.84	1.6318	0.0434	0.0019	-0.0434
1978-79	0	0	58.29	1.7656	0.1772	0.0314	0.0000
1979-80	1	1	65.68	1.8174	0.229	0.0524	0.229
1980-81	2	4	80.04	1.9033	0.3149	0.0992	0.6298
1981-82	3	9	79.96	1.9029	0.3145	0.0989	0.9435
1982-83	4	16	53.01	1.7244	0.136	0.0185	0.544
		60		14.2954		1.4113	6.986

$$\bar{y}_t = \frac{14.2954}{9} = \underline{1.5884}$$

$$b = \frac{6.986'}{60} = \underline{0.1164}$$

$$\lambda = \frac{b}{\log e} = \frac{0.1164}{\log 2.7183} = \frac{0.1164}{0.4343} = \underline{0.2680}$$

$$a = 1.5884$$

$$R_o = \text{Anti}\hat{\ }\log (1.5884) = \underline{38.7614}$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2} =$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2 = 1.4113-(0.1164)^2(60) =$$

$$= 1.4113 - 0.81 = \underline{0.6013}$$

$$R^2 = 1 - \frac{0.6013}{1.4113} = 1 - 0.4261 = \underline{0.5739}$$

$$Z = \frac{b}{SE\ \hat{b}}$$

$$\text{Variance } b = \sigma u^2 / \Sigma x^2$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2} = \frac{0.6013}{7} = \underline{0.0859}$$

$$\text{Variance} = \frac{0.0859}{60} = \underline{0.0014}$$

$$\text{S.E.} = \sqrt{0.0014} = \underline{0.0374}$$

$$Z = \frac{b}{SE\ \hat{b}} = \frac{0.1164}{0.0372} = \underline{3.1123}$$

$$\text{Estimated Function } R_t = 38.7614\ e^{0.2680\ x}$$

$$= 38.7614\ e^{0.2680t-1.34}$$

$= 38.7614\ e^{0.2680t}\ e^{-1.34}$

$= 38.7614\ e^{0.2680t} \times 0.2725$

$= 10.562481\ e^{0.2680\ t}$

For the year 1989-90 $R_t = 10.5625\ e^{0.2680 \times 16}$

$= 10.5625 \times e^{4.3}$

$= 10.5625 \times 73.700 = 778.4563$

For the year 1983-84 $= 10.5625\ e^{.2680\ t}$

$= 10.5625\ e^{0.2680 \times 10}$

$= 10.5625\ e^{2.7}$

$= 10.5625 \times 14.880 = 157.17$

For the year 1984-85 $= 10.5625\ e^{0.2680 \times 11}$

$= 10.5625\ e^{2.9}$

$= 10.5625 \times 18.174 = 191.9629$

For the year 1985-86 $= 10.5625\ e^{0.2680 \times 12}$

$= 10.5625\ e^{3.2}$

$= 10.5625 \times 24.533 = 259.1298$

For the year 1986-87 $= 10.5625\ e^{0.2680 \times 13}$

$= 10.5625\ e^{3.5}$

$= 10.5625 \times 33.115 = 349.7772$

For the year 1987-88 $= 10.5625\ e^{0.2680 \times 14}$

$= 10.5625\ e^{3.8}$

$= 10.5625 \times 44.701 = \underline{472.1543}$

For the year 1988-89 $= 10.5625\ e^{0.2680 \times 15}$

$= 10.5625\ e^{4.0}$

$= 10.5625 \times 54.598 = \underline{576.6914}$

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APPENDIX IV - AN EXPONENTIAL FUNCTION FOR TOTAL INCOME

Year	x_t = (t-1978)	x^2	R_t (Rs. in lakhs)	y_t = log R_t	y_t= ($y_t - \bar{y}_t$)	$(y_t - \bar{y}_t)^2$	y_t x_t
1974-75	-4	16	34.70	1.5403	-0.5513	0.3039	2.2052
1975-76	-3	9	66.42	1.8223	-0.2693	0.0725	0.8079
1976-77	-2	4	93.70	1.9717	-0.1199	0.0144	0.2398
1977-78	-1	1	109.97	2.0413	-0.0503	0.0025	0.0503
1978-79	0	0	136.96	2.1366	0.045	0.0020	0.0000
1979-80	1	1	136.26	2.1344	0.0428	0.0018	0.0428
1980-81	2	4	172.91	2.2378	0.1462	0.0214	0.2924
1981-82	3	9	278.33	2.4446	0.353	0.1246	1.059
1982-83	4	16	313.19	2.4958	0.4042	0.1634	1.6168
		60		18.8248		0.7065	6.3142

$$\bar{y}_t = \frac{18.8248}{9} = 2.0916$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{6.3142}{60} = 0.1052$$

$$\lambda = \frac{b}{\log e} = \frac{0.1052}{\log 2.7183}$$

$$= \frac{0.1052}{0.4343} = 0.2422$$

$$a = 2.0916$$

$$R_o = \text{Anti}\hat{\log}\ (2.0916) = 123.48096$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2} =$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2$$

$$= 0.7065 - (0.1052)^2\ (60)$$

$$= 0.7065 - 0.666 = 0.0405.$$

$$R^2 = 1 - \frac{0.0405}{0.7065} = 1 - 0.0573 = 0.9427.$$

$$Z = \frac{b}{SE\ \hat{b}}$$

$$\text{Variance } b = \sigma u^2 / \Sigma x^2$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2} = \frac{0.0405}{7} = 0.0058$$

$$\text{Variance} = \frac{0.0058}{60} = 0.0000966$$

$$\text{S.E.} = \sqrt{0.0000966} = 0.0098$$

$$Z = \frac{b}{SE\ \hat{b}} = \frac{0.1052}{0.0098} = 10.7347$$

Estimated furnction R_t = $123.4810\ e^{0.2422\ x}$

= $123.4810\ e^{0.2422\ (t-5)}$

= $123.4810 e^{0.2422t - 1.211}$

= $123.4810 e^{0.2422} \times 0.3012$

= $37.1925\ e^{0.2422\ t}$

For the year 1989-90 R_t = $37.1925\ e^{0.2422 \times 16}$

= $37.1925\ e^{3.9}$

= 37.1925×49.402 = 1837.3838

For the year 1983-84 = $37.1925\ e^{0.2422\ t}$

= $37.1925\ e^{0.2422 \times 10}$

= $37.1925\ e^{2.4}$

= 37.1925×11.023 = 409.9729

For the year 1984-85 = $37.1925\ e^{0.2422 \times 11}$

= $37.1925\ e^{2.7}$

= 37.1925×14.880 = 553.4244

For the year 1985-86 = $37.1925\ e^{0.2422 \times 12}$

= $37.1925\ e^{2.9}$

= 37.925×18.174 = 675.9365

For the year 1986-87 = $37.1925\ e^{0.2422 \times 13}$

= $37.1925\ e^{3.1}$

= 37.1925×22.198 = 825.5991

For the year 1987-88 $= 37.1925\ e^{0.2422 \times 14}$

$= 37.1925\ e^{3.4}$

$= 37.1925 \times 29.964 = \underline{1114.436}$

For the year 1988-89 $= 37.1925\ e^{0.2422 \times 15}$

$= 37.1925\ e^{3.6}$

$= 37.1925 \times 36.598 = \underline{1361.1711}$

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APPENDIX V - AN EXPONENTIAL FUNCTION FOR TOTAL EXPENDITURE

Year	x_t = (t-1978)	x^2	R_t (Rs. in Lakhs)	y_t = log R_t	y_t = $y_t - \bar{y}_t$	$(y_t - \bar{y}_t)^2$ = y_t^2	$y_t x_t$
1974-75	-4	16	34.34	1,5358	-0.5269	0.2776	2.1076
1975-76	-3	9	62.55	1.7962	-0.2665	0.0710	0.7995
1976-77	-2	4	77.75	1.8907	-0.172	0.0296	0.3440
1977-78	-1	1	93.84	1.9724	-0.0903	0.0082	0.0903
1978-79	0	0	117.12	2.0686	0.0059	0.0000	0.0000
1979-80	1	1	134.89	2.1300	0. 0673	0.0045	0.0673
1980-81	2	4	171.90	2.2353	0.1726	0.0298	0.3452
1981-82	3	9	277.78	2.4437	0.381[illegible]	0.1452	1.1430
1982-83	4	16	310.29	2.4918	0.4291	0.1841	1.7164
		60		18.5645		0.7500	6.6133

$$\bar{y}_t = \frac{18.5645}{9} = 2.0627$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{6.6133}{60} = 0.11022$$

$$\lambda = \frac{b}{\log e} = \frac{0.11022}{\log 2.7183} = \frac{0.11022}{0.4343} =$$

$$= 0.2538$$

$$a = 2.0627$$

$$R_o = \text{Anti}\hat{\log}\ (2.0621) = 115.5314$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2} =$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2$$

$$= 0.75 - (0.11022)^2\ (60)$$

$$= 0.75 - 0.729 = 0.021$$

$$R^2 = 1 - \frac{0.021}{0.75} = 1 - 0.028 = 0.972$$

$$Z = \frac{b}{SE\hat{b}}$$

Variance b $= \sigma u^2 / \Sigma x^2$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2} = \frac{0.021}{7} = 0.003$$

Variance $= \frac{0.003}{60} = 0.00005$

S.E. $= \sqrt{0.00005} = 0.007071$

$$Z = \frac{b}{SE\hat{b}} = \frac{0.11022}{0.00707} = 15.5898.$$

Estimated Function R_t = $115.5314e^{0.2538\ x}$

= $115.5314e^{0.2538(t-5)}$

= $115.5314e^{0.2538-1.3}$

= $115.5314e^{02538t}$ x 0.2725

= $31.4823e^{0.2538t}$

For the year 1989-90 R_t = $31.4823e^{0.2538\ x\ 16}$

= $31.4823\ e^{4.1}$

= 31.4823 x 60.340 =1899.6419

For the year 1983-84 = $31.4823e^{0.2538\ x\ 10}$

= $31.4823\ e^{2.5}$

= 31.4823 x 12.183 = 383.5489

For the year 1984-85 = $31.4823\ e^{0.2538\ x\ 11}$

= $31.4823\ e^{2.8}$

= 31.4823 x 16.445 = 517.7264

For the year 1985-86 = $31.4823\ e^{0.2538\ x\ 12}$

= $31.4823\ e^{3}$

= 31.4823 x 20.086 = 632.3535

For the year 1986-87 = $31.4823\ e^{3.3}$

= 31.4823 x 27.113 = 853.5796

For the year 1987-88 = $31.4823\ e^{3.6}$

= 31.4823 x 36.598 = 1152.1892

For the year 1988-89 = $31.4823\ e^{0.2538\ x\ 15}$

= $31.4823\ e^{3.8}$

= 31.4823 x 44.701 = 1407.2902

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APPENDIX VI - AN EXPONENTIAL FUNCTION FOR MATERIAL CONSUMED

Year	x_t= (t-1978)	x^2	R_t (Rs.in lakhs)	Y_t = log R_t	Y_t = (Y_t- $\bar{Y}_t$)	$(Y_t - \bar{Y}_t)^2$	$Y_t x_t$
1974-75	-4	16	9.16	0.9619	-0.7752	0.6009	3.1008
1975-76	-3	9	30.10	1.4786	-0.2585	0.0668	0.7755
1976-77	-2	4	33.72	1.5279	-0.2092	0.0438	0.4184
1977-78	-1	1	41.51	1.6182	-0.1189	0.0141	0.1189
1978-79	0	0	56.16	1.7494	0.0123	0.0002	0.0000
1979-80	1	1	67.09	1.8269	0.0896	0.0080	0.0896
1980-81	2	4	99.73	1.9988	0.2617	0.0685	0.5234
1981-82	3	9	169.60	2.2294	0.4923	0.2424	1.4769
1982-83	4	16	175.13	2.2434	0.5063	0.2563	2.0252
		60		15.6343	1.3622	1.301	8.5287

$$\bar{Y}_t = \frac{15.6343}{9} = 1.7371$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{8.5287}{60} = 0.1421$$

$$\lambda = \frac{b}{\log e} = \frac{0.1421}{\log 2.7183} = \frac{0.1421}{0.4343} = 0.3272$$

$$a = 1.7371$$

$$R_o = \text{Anti log } (1.7371) = 54.5884$$

$$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2} =$$

$$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2 = 1.301 - (0.1421)^2(60)$$

$$= 1.301 - 1.212 = 0.089$$

$$R^2 = 1 - \frac{0.089}{1.301} = 1 - 0.0684 = 0.9316$$

$$Z = \frac{b}{SE\ \hat{b}}$$

$$\text{Variance } b = \sigma u^2 / \Sigma x^2$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-2} = \frac{0.089}{7} = 0.0127$$

$$\text{Variance} = \frac{0.0127}{60} = 0.00021$$

$$\text{S.E.} = \sqrt{0.00021} = 0.0145$$

$$Z = \frac{b}{SE\ \hat{b}} = \frac{0.1421}{0.0145} = 9.8$$

$$\text{Estimated Function } R_t = 54.5884\ e^{0.3272x}$$

$$= 54.5884\ e^{0.3272(t-5)}$$

$$= 54.5884\ e^{0.3272t - 1.6}$$

$$= 54.5884\ e^{0.3272} \times 0.2019$$

$$= 11.0214\ e^{0.3272t}$$

For the year 1989-90 = $11.0214\ e^{0.3272 \times 16}$

= $11.0214 \times e^{5.2}$

= 11.0214×181.3 = 1998.1798

For the year 1983-84 = $11.0214\ e^{0.3272t}$

= $11.0214\ e^{0.3272 \times 10}$

= $11.0214\ e^{3.3}$

= 11.0214×27.113 = 298.8232

For the year 1984-85 = $11.0214\ e^{0.3272 \times 11}$

$11.0214\ e^{3.6}$

11.0214×36.598 = 403.3612

For the year 1985-86 = $11.0214\ e^{0.3272 \times 12}$

= $11.0214\ e^{3.9}$

= 11.0214×49.402 = 544.4792

For the year 1986-87 = $11.0214\ e^{0.3272 \times 13}$

= $11.0214\ e^{4.3}$

= 11.0214×73.700 = 812.2772

For the year 1987-88 = $11.0214\ e^{0.3272 \times 14}$

= $11.0214\ e^{4.6}$

= 11.0214×99.484 = 1096.4529

For the year 1988-89 = $11.0214\ e^{0.3272 \times 15}$

= $11.0214\ e^{4.9}$

= 11.0214×134.29 = 1480.0638

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APPENDIX VII - AN EXPONENTIAL FUNCTION FOR SALARIES AND FRINGE BENEFITS

Year	x_t= (t-1978)	x^2	R_t (Rs.in lakhs)	Y_t= log R_t	$Y_t = (Y_t - \bar{Y}_t)$	$(Y_t - \bar{Y}_t)^2$	$y_t x_t$
1974-75	-4	16	19.38	1.2874	-0.3546	0.1257	1.4184
1975-76	-3	9	24.97	1.3974	-0.2446	0.0598	0.7338
1976-77	-2	4	32.04	1.5057	-0.1363	0.0186	0.2726
1977-78	-1	1	40.47	1.6071	-0.0349	0.0012	0.0349
1978-79	0	0	48.98	1.6900	0.048	0.0023	0.0000
1979-80	1	1	53.98	1.7322	0.0902	0.0081	0.0902
1980-81	2	4	53.86	1.7313	0.893	0.0080	0.1786
1981-82	3	9	74.76	1.8737	0.2317	0.0537	0.6951
1982-83	4	16	89.77	1.9531	0.3111	0.0968	1.2444
		60		14.7779		0.3742	4.668

$\bar{Y}_t = \frac{14.7779}{9} = 1.6420$

$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{4.668}{60} = 0.0778$

$\lambda = \frac{b}{\log e} = \frac{0.0778}{\log 2.7183} = \frac{0.0778}{0.4343} = 0.1791$

$a = 1.6420$

$R_o = \text{Anti}\hat{\ }\log (1.6420) = 43.8531$

$R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2} =$

$\Sigma e^2 = \Sigma y^2 - b^2 \Sigma x^2$

$= 0.3742 - (0.0778)^2 (60)$

$= 0.3742 - 0.366 = 0.0082$

$R^2 = 1 - \frac{0.0082}{0.3742} = 1 - 0.0219 = 0.9781$

$Z = \frac{b}{SE\hat{b}}$

Variance $b = \sigma u^2 / \Sigma x^2$

$\sigma u^2 = \frac{\Sigma u^2}{n-2} = \frac{0.0082}{7} = 0.0012$

Variance $= \frac{0.0012}{60} = 0.00002$

S. E. $= \sqrt{0.00002} = 0.0045$

$Z = \frac{b}{SE\hat{b}} = \frac{0.0778}{0.0045} = 17.2889$

Estimated Function $R_t = 43.8531\, e^{0.1791x}$

$= 43.8531\, e^{0.1791\,(t-5)}$

$= 43.8531\, e^{0.1791t - 0.8955}$

$= 43.8531 e^{0.1791t} \times 0.4066$

$= 17.83067 e^{0.1791t}$

For the year 1989-90 $R_t = 17.83067e^{0.1791t}$

$= 17.83067e^{0.1791 \times 16}$

$= 17.83067\ e^{2.9}$

$= 17.8307 \times 18.174 = \underline{324.05514}$

For the year 1983-84 $= 17.8307\ e^{0.1791 \times 10}$

$= 17.8307\ e^{1.8}$

$= 17.8307 \times 6.0496 = \underline{107.8686}$

For the year 1984-85 $= 17.8307\ e^{0.1791 \times 11}$

$= 17.8307\ e^{2.0}$

$= 17.8307 \times 7.3891 = \underline{131.7528}$

For the year 1985-86 $= 17.8307\ e^{0.1791 \times 12}$

$= 17.8307\ e^{2.1}$

$= 17.8307 \times 8.1662 = \underline{145.6091}$

For the year 1986-87 $= 17.8307\ e^{0.1791 \times 13}$

$= 17.8307\ e^{2.3}$

$= 17.8307 \times 9.9742 = \underline{177.8470}$

For theyear 1987-88 $= 17.8307\ e^{0.1791 \times 14}$

$= 17.8307\ e^{2.5}$

$= 17.8307 \times 12.183 = \underline{217.2314}$

For the year 1988-89 $= 17.8307\ e^{0.1791 \times 15}$

$= 17.8307\ e^{2.7}$

$= 17.8307 \times 14.880 = \underline{265.3208}$

APPENDIX VII

MULTI REGRESSION ANALYSIS

ROLE OR CAPITAL AND LABOUR IN THE TOTAL PRODUCTION

						y	Σy^2	x_1	x_1^2	x_2^2					
Q	K	L	q=log Q	K = logK	l=logL	$(q-\bar{q})$	$(q-\bar{q})^2$	$(k-\bar{k})$	$(k-\bar{k})^2$	$(l-\bar{l})$	$(l-\bar{l})^2$	yx_1	yx_2	x_1x_2
24208	22.92	805	4.3840	1.3602	2.9058	-.2113	.0446	-.168	.0282	-.0128	.0002	.0355	.0027	.0022
31234	24.45	894	4.4946	1.3883	2.9513	-.1007	.0101	-.1399	.0196	.0327	.0011	.0141	.0033	-.0046
35028	26.23	894	4.5444	1.4188	2.9513	-.0509	.0026	-.1094	.0120	.0327	.0011	.0056	-.0017	-.0036
41099	31.77	1075	4.6138	1.5020	3.0314	.0185	.0003	-.0262	.0007	.1128	.0127	-.0005	.0021	-.0030
47758	42.03	796	4.6790	1.6236	2.9009	.0837	.0070	.0954	.0091	-.0177	.0003	.0080	-.0015	-.0017
55414	45.65	780	4.7436	1.6594	2.8921	.1483	.0220	.1312	.0172	-.0265	.0007	.0195	-.0039	-.0035
51845	43.08	736	4.7147	1.6343	2.8669	.1194	.0143	.1061	.0113	-.0517	.0027	.0127	-.0062	-.0055
38713	43.53	706	4.5879	1.6388	2.8488	-.0074	.0000	.1106	.0122	-.0698	.0049	-.0008	.0005	-.0077
325299	279.66	6686	36.762	12.2254	23.3485	-.0004	.1009	-.0002	.1103	-.0003	.0237	.0941	-.0113	-.0274
			8	8	8									
			=	=	=									
			4.5953	1.5282	2.9186									

$$\hat{\alpha} = \frac{(\Sigma x_1 y)\ (\Sigma x_2^2) - (\Sigma x_2 y)\ (\Sigma x_1 x_2)}{(\Sigma x_1^2 \Sigma x_2^2) - (\Sigma x_1 x_2)^2}$$

$$= \frac{(0.0941)\ (0.0237) - (-0.0113)\ (-0.0274)}{(0.1103)\ (0.0237) - (-0.0274)^2}$$

$$= \frac{(0.0022) - (0.0003)}{.0026 - .0008} = \frac{0.0019}{0.0018} = \underline{1.0556}$$

$$\hat{\beta} = \frac{\Sigma x_2 y\ (\Sigma x_1^2) - (\Sigma x_1 y)\ (\Sigma x_1 x_2)}{\Sigma x_1^2 \Sigma x_2^2 - (\Sigma x_1 x_2)^2}$$

$$= \frac{(-0.0113)\ (0.1103) - (0.0941)\ (-0.0274)}{(0.1103)\ (0.0237) - (-0.0274)^2}$$

$$= \frac{.0014}{.0018} = \underline{0.7778}$$

$$R^2 = \frac{\alpha \Sigma x_1 y + \hat{\beta} \Sigma x_2 y}{\Sigma y^2} = \frac{1.0556\ (.0941) + 0.7778(-0.0113)}{0.1009}$$

$$= \frac{0.0905}{0.1009} = \underline{0.8969}$$

$R^2 = 0.8969$

T test $\quad t_\alpha = \dfrac{\alpha}{SE\alpha}$

$$SE\alpha = \sqrt{Var(\alpha)}$$

$$\sigma u^2 = \frac{\Sigma y^2 - \alpha \Sigma y x_1 - \beta \Sigma y x^2}{n - k}$$

$$= \frac{0.1009 - 1.0556\ (0.0941) - .7778\ (-0.0113)}{5}$$

$$= \frac{0.1009 - (0.0993) - (-0.0088)}{5} = \frac{0.0104}{5}$$

$$= \underline{0.0021}$$

$$\text{Var}\,\hat{\alpha} = \frac{0.0021 \quad x(0.0237)}{0.1103 \times (0.0237) - (0.0274)^2} = \frac{.00005}{.0018}$$

$$= 0.0278$$

$$\text{S.E.} = \sqrt{0.0278} = 0.1667$$

$$\text{t.test} \quad t_{\alpha} = \frac{1.0556}{0.1667} = 6.3323$$

$$\sigma u^2 = 0.0021$$

$$\text{Var}\,\hat{\beta} = \frac{0.0021 \times 0.1103}{.0018} = \frac{.00023}{.0018} = 0.1278$$

$$\text{SE}\ \hat{\beta} = \sqrt{0.1278} = 0.3572$$

$$Z\ \hat{\beta} = \frac{0.7778}{0.3575} = 2.1757$$

$$A = \bar{Y} - \alpha\bar{K} - \beta\bar{L} = 4.5953 - 1.0556\ (1.5282) - 0.7778(2.9186)$$

$$4.5953 - 1.6132 - 2.2701$$

$$A = 0.712$$

$$Q = 0.712\ K^{1.0556}\ L^{0.7778}$$

$$(0.1667)\ (0.3575)$$

$$R^2 = 0.8969$$

$$Z_{\alpha} = 6.3323$$

$$Z\beta = 2.1757$$

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APPENDIX IX - A SIMPLE REGRESSION ANALYSIS

RELATIONSHIP BETWEEN TOTAL EXPENDITURE AND INCOME

Y	$Y - \bar{Y}$	$(Y - \bar{Y})^2$	x	$((x - \bar{x})$	$(x - \bar{x})^2$	$(x-\bar{x})(Y - \bar{Y})$
34.34	-107.93	11,648.88	34.70	-114.46	13,101.09	12,353.67
62.55	- 79.72	6,355.28	66.42	- 82.74	6845.91	6,596.03
77.75	- 64.52	4,162.83	93.70	- 55.46	3075.81	3,578.28
93.84	- 48.43	2,345.46	109.97	- 39.19	1,535.86	1,897.97
117.12	- 25.15	632.52	136.96	- 12.2	148.84	306.83
134.89	- 7.38	54.46	136.26	- 12.9	166.41	95.20
171.90	29.63	877.94	172.91	23.75	564.06	703.71
277.78	135.51	18,362.96	278.33	129.17	16,684.89	17,503.83
310.29	168.02	28,230.72	313.19	164.03	26,905.84	27,560.32
$\bar{Y} = \frac{1,280.46}{9}$	$\frac{0.03}{y}$	$\frac{72,671.05}{y^2}$	$\frac{1,342.44}{}$	$\frac{0}{x}$	$\frac{69,028.71}{x^2}$	$\frac{70,595.84}{xy}$

$\bar{Y} = 142.2733$

$\bar{x} = 149.16$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{70595.84}{69028.71} = 1.0227$$

$$a = \bar{Y} - b\bar{x}$$
$$= 0.03 - (1.0227)(0)$$
$$a = 0.03$$

$$R^2 = b\frac{\Sigma xy}{\Sigma y^2} = \frac{1.0227\ (70595.84)}{72671.05} = \frac{72198.37}{72671.05}$$

$$R^2 = 0.9935$$

$$\sigma u^2 = \frac{\Sigma e^2}{n-k} = \frac{\Sigma y^2 - b^2 \Sigma x^2}{n-k}$$

$$\sigma u^2 = \frac{72671.05 - (1.0227)(69028.71)}{7} = \frac{2075.39}{7}$$

$$= 296.4843$$

$$\sigma u^2 = 296.4843$$

$$\text{Var } b = 296.4843 \times \frac{1}{69028.71}$$

$$\text{Var } b = \frac{296.48}{69028.71} = 0.0043$$

$$\text{S E } b = \sqrt{\text{Var } b} = \sqrt{.0043} = 0.0656$$

$$t_b = \frac{1.0227}{0.0656} = 15.5899$$

$$E = 0.03 + 1.0227\ x$$

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THE OBSERVED VALUES AND ESTIMATED VALUES OF LABOUR CHARGES DURING THE PERIOD (1974-75 to 1982-83)

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	15.71	15.79
1975-76	17.40	17.45
1976-77	22.95	19.29
1977-78	21.04	21.32
1978-79	23.56	23.56
1979-80	23.68	24.06
1980-81	23.15	28.78
1981-82	28.78	31.80
1982-83	45.50	35.15

Estimated Value for the year 1974-75 $= 14.2891\ e^{.0983 \times 1}$

$= 14.2891\ e^{.1}$

$= 14.2891 \times 1.1052 = \underline{15.79}$

For the year 1975-76 $= 14.2891\ e^{.0983 \times 2}$

$= 14.2891\ e^{0.2}$

$= 14.2891 \times 1.2214 = \underline{17.45}$

For the year 1976-77 = $14.2891\ e^{.0983 \times 3}$

= $14.2891\ e^{.3}$

= 14.2891 x 1,3499 = 19.29

For the year 1977-78 = $14.2891\ e^{.0983 \times 4}$

= 14.2891 x 1.4918 = 21.32

For the year 1978-79 = $14.2891 \times e^{.0983 \times 5}$

= $14.2891\ e^{.5}$

= 14.2891 x 1.6487 = 23.56

For the year 1979-80 = $14.2891\ e^{.6}$

= 14.2891 x 1.8221 = 26.04

For the year 1980-81 = $14.2891\ e^{.7}$

= 14.2891 x 2.0138 = 28.76

For the year 1981-82 = $14.2891\ e^{.0983 \times 8}$

= 14.2891 x 2.2255 = 31.80

For the year 1982-83 = $14.2891\ e^{.0983 \times 9}$

= $14.2891\ e^{0.9}$

= 14.2891 x 2,4596 = 35.15

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THE OBSERVED VALUES AND ESTIMATED VALUES OF BODY BUILDING CHARGES DURING THE PERIOD (1974 - 75 to 1982 -83).

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	13.14	11.78
1975-76	16.04	14.39
1976-77	19.78	19.42
1977-78	27.63	23.72
1978-79	32.28	32.02
1979-80	22.55	39.11
1980-81	31.92	52.80
1981-82	105.34	71.27
1982-83	125.72	87.05

Estimated Value for the year 1974-75

$= 8.7271\ e^{0.2572 \times 1}$

$= 8.7271\ e^{0.3}$

$= 8.7271 \times 1.3499 = \underline{11.78}$

For the year 1975-76

$= 8.7271\ e^{0.2572 \times 2}$

$= 8,7271\ e^{0.5}$

$= 8.7271 \times 1.6487 = \underline{14.39}$

For the year 1976-77 = $8.7271\ e^{.2572 \times 3}$

= $8.7271\ e^{0.8}$

= 8.7271 x 2.2255 = 19.42

For the year 1977-78 = $8.7271\ e^{0.2572 \times 4}$

= $8.7271\ e^{1}$

= 8.7271 x 2.7183 = 23.72

For the year 1978-79 = $8.7271\ e^{1.3}$

= 8.7271 x 3.6693 = 32.02

For the year 1979-80 = $8.7271 \times e^{1.5}$

= 8.7271 x 4.4817 = 39.11

For the year 1980-81 = $8.7271\ e^{1.8}$

= 8.7271 x 6.0496 = 52.80

For the year 1981-82 = $8.7271\ e^{2.1}$

= 8.7271 x 8.1662 = 71.27

For the year 1982-83 = $8.7271\ e^{0.2572 \times 9}$

= $8.7271\ e^{2.3}$

= 8.7271 x 9.9742 = 87.05

.....

THE OBSERVED VALUES AND ESTIMATED VALUES OF RETREADING CHARGES DURING THE PERIOD (1974 - 75 TO 1982 - 83).

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	3.55	14.26
1975-76	25.83	17.41
1976-77	38.70	23.51
1977-78	42.84	31.73
1978-79	58.29	38.76
1979-80	65.68	52.32
1980-81	80.04	70.62
1981-82	79.96	86.26
1982-83	53.01	116.43

Estimated value for the year 1974-75 $= 10.5625e^{0.2680x1}$

$= 10.5625\ e^{0.3}$

$= 10.5625 \times 1.3499 = \underline{14.26}$

For the year 1975-76 $= 10.5625\ e^{0.2680 \times 2}$

$= 10.5625 \times e^{0.5}$

$= 10.5625 \times 1.6487 = \underline{17.41}$

For the year 1976-77 = $10.5625\ e^{0.2680 \times 3}$

= $10.5625\ e^{0.8}$

= 10.5625×2.2255 = 23.51

For the year 1977-78 = $10.5625\ e^{1.1}$

= 10.5625×3.0042 = 31.73

For the year 1978-79 = $10.5625\ e^{0.2680 \times 5}$

= $10.5625\ e^{1.3}$

= 10.5625×3.6693 = 38.76

For the year 1979-80 = $10.5625\ e^{0.2680 \times 6}$

= $10.5625\ e^{1.6}$

= 10.5625×4.9530 = 52.32

For the year 1980-81 = $10.5625\ e^{.2680 \times 7}$

= $10.5625\ e^{1.9}$

= 10.5625×6.6859 = 70.62

For the year 1981-82 = $10.5625\ e^{.2680 \times 8}$

= $10.5625\ e^{2.1}$

= 10.5625×8.1662 = 86.26

For the year 1982-83 = $10.5625\ e^{.268 \times 9}$

= $10.5625\ e^{2.4}$

= 10.5625×11.023 = 116.43

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THE OBSERVED VALUES AND ESTIMATED VALUES OF TOTAL INCOME DURING THE PERIOD (1974 - 75 TO 1982 - 83)

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	34.70	45.43
1975-76	66.42	61.32
1976-77	93.70	74.90
1977-78	109.97	101.10
1978-79	136.96	123.48
1979-80	136.26	166.69
1980-81	172.91	203.59
1981-82	278.33	248.67
1982-83	313.19	335.66

Estimated value for the year 1974-75 $= 37.1925\ e^{.2422 \times 1}$

$= 37.1925\ e^{0.2}$

$= 37.1925 \times 1.2214 = 45.43$

For the year 1975-76 $= 37.1925\ e^{0.2422 \times 2}$

$= 37.1925\ e^{0.5}$

$= 37.1925 \times 1.6487 = 61.32$

For the year 1976-77 = $37.1925\ e^{0.2422 \times 3}$

= $37.1925\ e^{0.7}$

= 37.1925×2.0138 = 74.90

For the year 1977-78 = $37.1925\ e^{.2422 \times 4}$

≥ $37.1925\ e^{1.0}$

= 37.1725×2.7183 = 101.10

For the year 1978-79 = $37.1925\ e^{.2422 \times 5}$

≥ $37.1925\ e^{1.2}$

= 37.1925×3.3201 = 123.48

For the year 1979-80 = $37.1925\ e^{.2422 \times 6}$

≥ $37.1925\ e^{1.5}$

= 37.1925×4.4817 = 166.69

For the year 1980-81 = $37.1925\ e^{.2422 \times 7}$

≥ $37.1925\ e^{1.7}$

= 37.1925×5.4739 = 203.59

For the year 1981-82 = $37.1925\ e^{.2422 \times 8}$

≥ $37.1925\ e^{1.9}$

= 37.1925×6.6859 = 248.67

For the year 1982-83 = $37.1925\ e^{0.2422 \times 9}$

= $37.1925 \times e^{2.2}$

= 37.1925×9.025 = 335.66

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THE OBSERVED VALUES AND ESTIMATED VALUES OF TOTAL EXPENDITURE DURING THE PERIOD (1974-75 TO 1982-83)

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	34.34	42.50
1975-76	62.55	51.90
1976-77	72.75	70.06
1977-78	93.84	85.58
1978-79	117.12	115.52
1979-80	134.89	141.09
1980-81	171.90	190.46
1981-82	277.78	232.63
1982-83	310.29	314.01

Estimated value for the year 1974-75

$= 31.4823\ e^{0.2538 \times 1}$

$= 31.4823\ e^{0.3}$

$= 31.4823 \times 1.3499 = 42.50$

For the year 1975-76

$= 31.4823\ e^{0.2538 \times 2}$

$= 31.4832\ e^{0.5}$

$= 31.4823 \times 1.6487 = 51.90$

For the year 1976-77 $= 314823\ e^{0.2538 \times 3}$

$= 31.4823\ e^{0.8}$

$= 31.4823 \times 2.2255 = 70.06$

For the year 1977-78 $= 31.4823\ e^{0.2538 \times 4}$

$= 31.4823\ e^{1}$

$= 31.4823 \times 2.7183 = 85.58$

For the year 1978-79 $= 31.4823\ e^{0.2538 \times 5}$

$= 31.4823\ e^{1.3}$

$= 31.4823 \times 3.6693 = 115.52$

For the year 1979-80 $= 31.4823\ e^{0.2538 \times 6}$

$= 31.4823\ e^{1.5}$

$= 31.4823 \times 4.4817 = 141.09$

For the year 1980-81 $= 31.4823\ e^{0.2538 \times 7}$

$= 31.4823\ e^{1.8}$

$= 31.4823 \times 6.0496 = 190.46$

For the year 1981-82 $= 31.4823\ e^{0.2538 \times 8}$

$= 31.4823\ e^{2.0}$

$= 31.4823 \times 7.3891 = 232.63$

For the year 1982-83 $= 31.4823\ e^{0.2538 \times 9}$

$= 31.4823\ e^{2.3}$

$= 31.4823 \times 9.9742 = 314.01$

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THE OBSERVED VALUES AND ESTIMATED VALUES OF MATERIAL CONSUMED DURING THE PERIOD (1974-75 TO 1982-83)

Year	Actual Value (Rs. in Lakhs)	Estimated Value (Rs. in Lakhs)
1974-75	9.16	14.88
1975-76	30.10	22.19
1976-77	33.72	29.96
1977-78	41.51	40.44
1978-79	56.16	54.59
1979-80	67.09	81.44
1980-81	99.73	109.93
1981-82	169.60	148.39
1982-83	175.13	200.30

Estimated value for the year 1974-75 $= 11.0214\ e^{0.3272 \times 1}$

$= 11.0214\ e^{0.3}$

$= 11.0214 \times 1.3499 = 14.88$

For the year 1975-76 $= 11.0214\ e^{0.3272 \times 2}$

$= 11.0214\ e^{0.7}$

$= 11.0214 \times 2.0138 = 22.19$

For the year 1976-77 = $11.0214\ e^{0.3272 \times 3}$

= $11.0214\ e^{1}$

= 11.0214×2.7183 = 29.96

For the year 1977-78 = $11.0214\ e^{.3272 \times 4}$

= 11.0214×3.6693 = 40.44

For the year 1978-79 = $11.0214\ e^{1.6}$

= 11.0214×4.9530 = 54.59

For the year 1979-80 = $11.0214\ e^{0.3272 \times 6}$

= $11.0214\ e^{2.0}$

= 11.0214×7.3891 = 81.44

For the year 1980-81 = $11.0214\ e^{.3272 \times 7}$

= 11.0214×9.9742 = 109.93

For the year 1981-82 = $11.0214\ e^{.3272 \times 8}$

= $11.0214\ e^{2.6}$

= 11.0214×13.464 = 148.39

For the year 1982-83 = $11.0214\ e^{.3272 \times 9}$

= $11.0214\ e^{2.9}$

= 11.0214×18.174 = 200.30

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THE OBSERVED VALUES AND ESTIMATED VALUES OF SALARIES AND FRINGE BENEFITS DURING THE PERIOD (1974-75 TO 1982-83)

Year	Actual Value (Rupees in Lakhs)	Estimated Value
1974-75	19.38	21.78
1975-76	24.97	26.60
1976-77	32.04	29.40
1977-78	40.47	35.91
1978-79	48.98	43.86
1979-80	53.98	53.57
1980-81	53.86	65.43
1981-82	74.76	72.31
1982-83	89.77	88.32

Estimated value for the year 1974-75 $= 17.8307\ e^{0.1791 \times 1}$

$= 17.8307\ e^{0.2}$

$= 17.8307 \times 1.2214 = 21.78$

For the year 1975-76 $= 17.8307\ e^{0.1791 \times 2}$

$= 17.8307\ e^{0.4}$

$= 17.8307 \times 1.4918 = 26.60$

For the year 1976-77 $= 17.8307\ e^{0.1791 \times 3}$

$= 17.8307\ e^{0.5}$

$= 17.8307 \times 1.6487 = 29.40$

For the year 1977-78 $= 17.8307\ e^{0.1791 \times 4}$

$= 17.8307\ e^{0.7}$

$= 17.8307 \times 2.0138 = 35.91$

For the year 1978-79 $= 17.8307\ e^{0.1791 \times 5}$

$= 17.8307 \times 2.4596 = 43.86$

For the year 1979-80 $= 17.8307\ e^{0.1791}$

$= 17.8307\ e^{1.1}$

$= 17.8307 \times 3.0042 = 53.57$

For the year 1980-81 $= 17.8307\ e^{0.1791 \times 7}$

$= 17.8307\ e^{1.3}$

$= 17.8307 \times 3.6693 = 65.43$

For the year 1981-82 $= 17.8307\ e^{0.1791}$

$= 17.8307 e^{1.4}$

$= 17.8307 \times 4.0552 = 72.31$

For theyear 1982-83 $= 17.8307\ e^{0.1791}$

$= 17.8307\ e^{1.6}$

$= 17.8307 \times 4.9530 = 88.32$

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