CHAPTER: 4

EMPIRICAL ANALYSIS AND FINDINGS

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4. EMPIRICAL ANALYSIS AND FINDINGS

In the time when 'power' proves as inevitable ingredient to industrial operation and production activities, no product can acquire its finished shape in absence of input of power. Any industry may it be normal life or special field of life, urban or rural or agriculture or other business, power stays as inevitable requirement today. Any disruption of power for seconds even cause wrinkles on any one's forehead, so life without electricity is beyond imagination for anyone in the present age.

In this respect, performance of a power company counts as most sensitive. In view of the current competitive market, it is necessary to examine like how far has a power distribution company resulted in overall performance with various aspects? How far have they provided quality of power and services to consumers? How far has it achieved reasonable degree of benchmark in the distribution losses? How far have various parameters affected the performance of a division or a power distribution company? Besides, what is the relationship of power supply reliability, DTR failure, revenue, losses and profit with other parameters of a division? So that performance can be reformed with supervising controllable parameters. This chapter examines these issues empirically & develops certain MODELS. It attempts to focus on improving performance of a division in power distribution companies in Gujarat. In the beginning of the chapter, MODELS are discussed for relationship of dependant variables like power supply reliability, DTR failure, distribution loss and profit/loss of a division with other parameters of a division, which may be an alternative method to measure the performance of a division.

At the end of the chapter, empirical findings related to power supply reliability, field maintenance service, metering & billing, cost & losses, safety, revenue, profitability, HR and project are outlined to improve the performance of a division vis-à-vis a distribution company. In order to improve the performance, various parameters have been processed using regression analysis and hypotheses have been tested to develop the model.

4.1 ANALYSIS THROUGH MODELS

MODELS and hypotheses are designed to analyze that there is a positive two-way casual relationship between DTR failure, loss, revenue on the one hand and effect of divisional activity or parameters on another hand.

4.1.1 TESTING HYPOTHESIS WITH MODELS

Suppose, Y = dependant variable, X = any variable/determinant, that has significant and direct impact on Y. It is to test hypothesis to measure relationship between dependant variable with independent variables keeping other variables constant.

DTR Failure Model

A Model, to test impact of various divisional parameters responsible for the failure of DTR (y); an alternative yardstick to measure the rate of DTR failure

...See Model (i)

MODEL 2: Distribution Loss Model

A Model, to test the impact of various parameters of a division on AT & C losses (y); an alternative yardstick to measure losses in quantitative figures.

...See Model (ii)

MODEL 3: Revenue & Collection Model

A Model, to test impact of various parameters of a division on revenue (y); an alternative yardstick to measure revenue and collection efficiency.

...See Model (iii)

MODEL 4: Power Supply Reliability Model

A Model, to test impact of divisional activities on power reliability (Y); an alternative yardstick to measure power reliability and its indices.

...See Model (iv)

MODEL 5: Profit / (Loss) Model

A Model, to test impact of various parameters of a division on profit (y); an alternative yardstick to measure profit of a division.

...See Model (v)

Variables are measured to arrive at interpretable and comparable quantitative information to derive conclusions. The following hypotheses are framed for this purpose.

Hypo: 1. H_0 = There is no relationship between DTR failure rate (y) with the number of agriculture consumers (x_1) in a division.

Hypo: 2. H_0 = There is no relationship between DTR maintenance (x_2) with DTR failure rate (y) of a division.

Hypo: 3. H_0 = There is no relationship between DTR failure rate (y) with number of agriculture consumers (x_1) and DTR maintenance (x_2) activity in a division.

Hypo: 4. H_0 = HT line length per feeder (x_1) is not a significant factor in Transmission & Distribution loss (y) of a division.

Hypo: 5. H_0 = There is no relationship between total LT line length of LT circuits (x_2) with T & D loss (y) of a division.

Hypo: 6. H_0 = There is no relationship between T & D loss (y) with the consumer mix (x_3) of a division.

Hypo: 7. H_0 = There is no relationship between T & D loss (y) to HT line length per feeder (x_1), total LT line length of LT circuits (x_2) and the consumer mix (x_3) of a division.

Hypo: 8. H_0 = There is no impact of the consumer mix on collection efficiency of a division.

Hypo: 9. H_0 = There is no relationship between Reliability Index to HT line length of 11 kV feeders in a division.

Hypo: 10. H_0 = There is no significant relationship between Reliability Index to number of feeders in a division.

Hypo: 11. H_0 = There is no significant effect of T & D loss (x_1) on profit (y) of a division on annual basis.

Hypo: 12. H_0 = There is no significant impact of collection efficiency (x_2) on profit (y) of a division on annual basis.

Hypo: 13. H_0 = There is no relationship between Profit Before Tax (y) to T & D loss (x_1) and Collection efficiency (x_2).

4.1.2 DATA FOR ANALYSIS

Another aim of the present research is to ascertain the impact of various divisional activities on divisional performance in terms of defined indicators and indicators to financial performance of a division. Necessary data for Model is collected for last three years from different types of 23 divisions from entire Gujarat. The data for other determinants and indicators are collected from MIS reports, annual administrative report, trial balance report, and Gujarat Electricity Regulatory Commission (GERC) reports. It is collected from respective circles or corporate offices or from government bodies. The period chosen for data collection is from April-2007 to March-2010.

4.1.3 METHODOLOGIES FOR MULTI- FACTOR MODEL

There are two different methodologies to estimate factor MODEL. In this analysis, a linear regression approach is used on various samples of divisions with the assumption that sensitivities of other factors are remained constant.

The MODEL is designed to find out the relationship between dependent variable with independent variables by using multiple linear regression technique. The cross sectional analysis is the second methodology and is less intuitive than time series analysis[1].

The regression MODEL is explained in (Equation 4.1) under certain assumptions. If the number of variables associated with or causing simultaneous change in another variable is two or more, the multivariate technique of analysis, rather than a uni - variate is necessary to give best output.[2] i.e., the multiple regression.

Equation 4.1 : Multiple Regression Model

Multiple Regression Model[3]

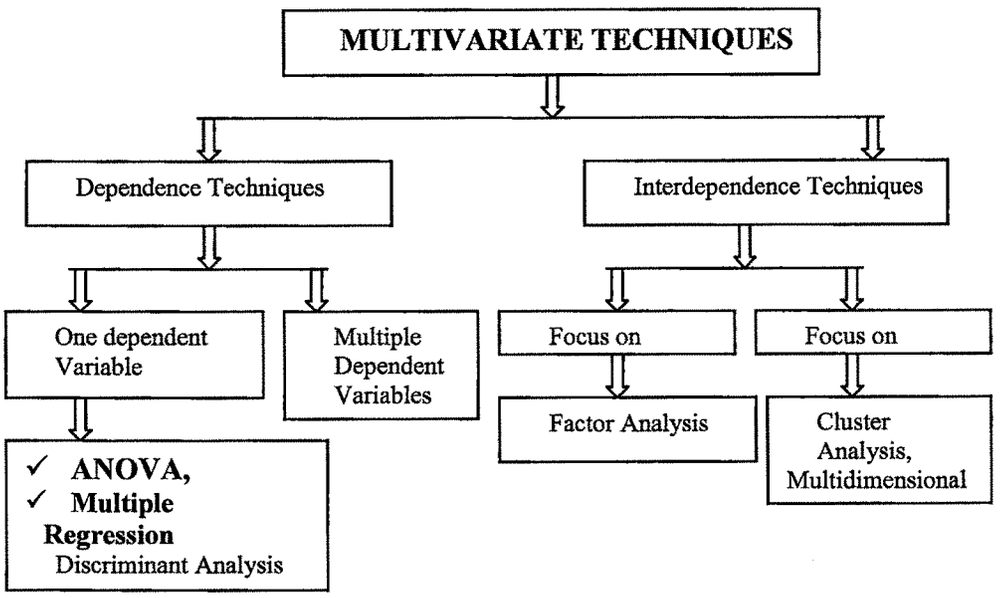
Regression relationship : $Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Y_j = Dependent Variable,

b_0 = Constant value,

$b_1X_{1j} = b_1$ slope for variable X_1

FIGURE 4.1 : MULTIVARIATE TECHNIQUES FOR DEVELOPING MODEL



Source: Rajendra Nargundkar (2003), Marketing Research: Text and Cases, 2nd Edition, p. 123

4.1.4 MODELS

Models are developed to understand relationship between different variables that have bearing on DTR failure, Distribution loss, Power reliability and Profit of a division. It is an alternative method to measure performance parameters (y) with divisional parameters (x) for a division. The following models are developed and tested for strength and efficiency of performance.

***(i)* DTR FAILURE MODEL**

$$DTRFailure = 7.0521 - 0.0005\ DTRMtce + 0.001\ CONS_{AG}$$

***(ii)* DISTRIBUTION LOSS MODEL**

$$T\&D\ loss = 14.1163 + 0.3969\ HTLength/Feeder + 0.0011\ LTLength - 3E\text{-}05\ CONS_{RL} + 8E\text{-}5\ CONS_{CL} - 0.0461\ CONS_{HTIND} + 0.0012\ CONS_{LTIND} + 0.0005\ CONS_{WW} - 0.0118\ CONS_{STL} + 0.0006\ CONS_{AG}$$

***(iii)* POWER RELIABILTY MODEL**

$$RI = 99.7026 - 0.0002HTLength$$

***(iv)* PROFIT MODEL**

$$PBT = -63975 - 495.2\ T\ \&\ D\ loss + 786.5\ CollEffy$$

Where as

$CONS_{RL}$ = Average number of residential including rural residential consumers in a division.

$CONS_{CL}$ = Average number of commercial consumers in a division.

$CONS_{HTIND}$ = Average number of HT industrial consumers in a division.

$CONS_{LTIND}$ = Average number of LT Industrial (L1, L2, L3 Tariff) consumers in a division

$CONS_{WW}$ = Average number of water work consumers in a division.

$CONS_{STL}$ = Average number of Street light (SL, TL, PL – Tariff) consumers in a division.

$CONS_{AG}$ = Average number of agriculture (A1, A2 and A3 Tariff) consumers in a division.

Feeders = Number of feeders of a division.

HTLength = Total HT line length of all feeders of a division in KM.

LTLength = Total LT line length of all LT circuits of a division in KM.

RI = Reliability Index of a division in percentage, on annual basis.

HTMtce = HT line maintenance carried out (in percentage) for a division in a year.

DTRFailure = Distribution transformer failure rate of a division (in percentage), on the annual basis.

DTRMtce = Distribution transformer maintenance carried out in respect of total transformers of a division during the year in percentage.

T&D Loss = Transmission and Distribution loss of a division in percentage on annual basis.

CollEffy= Collection efficiency of a division on annual basis in percentage.

PBT = Profit before tax of a division in lacs, on annual basis.

Measurement unit for T&D loss, AT&C loss, Collection efficiency, Arrear to Assessment, Reliability index, HT maintenance, DTR failure, DTR maintenance are in percentage (%). HT & LT line length in KM and other figures are in lacs / crores of Rupees or in numbers except HT/LT line in ratio.

4.2 RESULTS OF THE MODEL

Models are tested and it is revealed that there is a positive two-way causal relationship between divisional indicators with a characteristic of a division. Results of the Models are discussed as follows:

4.2.1 DTR FAILURE MODEL

4.2.1.1 DTR FAILURE RATE TO AGRICULTURE CONSUMERS

Hypothesis (Hypo: 1) is framed to test the relationship between rate of DTR failure with average agriculture consumers in a division. Results indicate that a relationship of rate of DTR failure (dependent variable) with average agriculture consumers (independent variable) in a division exists, as ANOVA p-value < 0.05 (i.e. 0.0000) and R^2 is 0.5656. It implies that 56.56% of variation in DTR failure is explained by number of agriculture consumers in a division (considering other factors as constant). Hence, Null Hypothesis (Hypo: 1) is rejected. Therefore, there is a significant relationship of DTR failure with number of agriculture consumers.

Simple Regression Model[4]

$$DTRFailure = 6.5932 + 0.001\ CONS_{AG}$$

(ANALYSIS A.b)

4.2.1.2 DTR FAILURE TO DTR MAINTENANCE

Hypothesis (Hypo: 2) is framed to test the relationship between rate of DTR failure with DTR maintenance. Results indicate that a relationship of rate of DTR failure (independent variable) with DTR maintenance (independent variable) exists, as ANOVA p-value < 0.05 (i.e. 0.0182). Because of R^2 value is 0.238 it implies that 23.8% of variation in DTR failure is explained by DTR maintenance (considering other factors as constant). Hence, Null Hypothesis is rejected (Hypo: 2). Therefore, there is a little relationship of DTR failure with DTR maintenance.

Simple Regression Model[5]

$$DTRFailure = 20.5832 - 0.1007\ DTRMtce$$

(ANALYSIS A.c)

While analyzing relationship of DTR failure with other variables of a division the ANOVA p-value is > 0.05. It indicates that there is only significant relationship between DTR failure with number of agriculture consumers and DTR maintenance in a division. The DTR failure model is given by equation as shown below:

Multi-Regression Model[6]

$$DTRFailure = 7.0521 - 0.0005\ DTRMtce + 0.001\ CONS_{AG}$$

(ANALYSIS A & A.a)

Results of the MODEL indicates that the value of $R^2 = 0.5660$ so that two variables together explain about 56.60% of variation in the rate of DTR failure. It is inferred from value of R^2 that coefficient of determination of the MODEL is agreeable. Thus, the MODEL can determine rate of DTR failure from given two variables. Hence, Null Hypothesis is rejected (Hypo: 3). It shows that there is a significant relationship between DTR failure with DTR maintenance and agriculture consumers in a division.

Discussion:

It is concluded that 56% variation in DTR failure is because of agriculture consumers and DTR maintenance. In other words, agriculture consumers are significant players for DTR failure as R2=56.56. In a division, 1% DTR failure comes as contribution from 1000 agriculture consumers (considering other parameters as constant). Further, with 10% increase DTR maintenance activities 1% rate of DTR failure can be saved.

4.2.2 DISTRIBUTION LOSS MODEL

4.2.2.1 T& D LOSS TO HT LINE LENGTH PER FEEDER

Hypothesis (Hypo: 4) is framed to test the relationship between HT line length per feeder with T & D loss of a division. Results indicate that a relationship of T & D loss (dependent variable) with HT line length per feeder (independent variable) of a division exists, as ANOVA p-value is < 0.05 (i.e. 0.0004) and R^2 – Coefficient of Determination is 0.4601. This implies that 46.01% of variation in T & D Loss is explained by HT line length per feeder of a division (considering other factors as constant across division). Hence, Null Hypothesis is rejected (Hypo: 4). Therefore, there is a significant relationship of T & D loss with HT line length per feeder.

Simple Regression Model[7]

T&DLoss = 9.8192 + 0.6062 HTLength/Feeder (ANALYSIS B.b)

4.2.2.2 T & D LOSS TO LT LINE LENGTH

Hypothesis (Hypo: 5) is framed to test the relationship between T & D loss with total LT line length in a division. Results indicate that a relationship of T & D loss (dependent variable) with total LT line length (independent variable) exists, as

ANOVA p-value is < 0.05 (i.e. 0.0003) and R^2 – Coefficient of Determination is 0.4699. It implies that 46.99% of variation in T & D loss is explained by total LT line length (considering other factors as constant across division). Hence, Null Hypothesis is rejected (Hypo: 5). Therefore, there is a significant relationship of T & D loss with total LT line length.

Simple Regression Model[8]

$$T\&DLoss = 10.538 + 0.00468\ LTLength$$

(ANALYSIS B.c)

4.2.2.3 T& D LOSS TO CONSUMER MIX

Hypothesis (Hypo: 6) is framed to test the relationship between T & D loss with the consumer mix of a division. Results indicate that a relationship of T & D loss (dependent variable) with the consumer mix (independent variable) of a division exists, as ANOVA p-value is < 0.05 (i.e. 0.0298) and R^2 – Coefficient of Determination is 0.5944. It implies that 59.44% of variation in T & D loss is explained by the consumer mix of a division (considering other factors as constant). Hence, Null Hypothesis is rejected (Hypo: 6) . Therefore, there is a significant relationship of T & D loss with consumer mix.

Multi-Regression Model[9]

$$T\ \&\ D\ Loss = 21.767 + 2.5E\text{-}05CONS_{RL} - 0.0002\ CONS_{CL} - 0.0494\ CONS_{HTIND} + 0.0010\ CONS_{LTIND} + 0.0048\ CONS_{WW} - 0.0137\ CONS_{STL} + 0.0009\ CONS_{AG}$$

(ANALYSIS B.d & B.e)

While analyzing relationship of T&D loss with other variables of a division the ANOVA p-value is > 0.05. It indicates that there is only significant relationship of T&D loss with HT Length/Feeder, LT Length and consumer mix of a division. The distribution loss model is given by equation as shown below:

Multi-Regression Model[10]

$$T\&D\ loss = 14.1163 + 0.3969\ HTLength/Feeder + 0.0011\ LTLength - 3E\text{-}05\ CONS_{RL} + 8E\text{-}5\ CONS_{CL} - 0.0461\ CONS_{HTIND} + 0.0012\ CONS_{LTIND} + 0.0005\ CONS_{WW} - 0.0118\ CONS_{STL} + 0.0006\ CONS_{AG}$$

(ANALYSIS B & B.a)

Results of the MODEL indicates that the value of $R^2 = 0.7264$ so that nine variables together explain about 72.60% of variation in T & D loss. It is inferred from value of

R^2 that the coefficient of determination of the MODEL is good. Thus, the MODEL can determine percentage of T & D loss from given nine variables.

While analyzing relationship of T & D loss with above independent variables, the ANOVA p-value is found < 0.05 (i.e. 0.0143), i.e. Null Hypothesis is rejected. It implies that there is a significant relationship between T & D loss and HT line length per feeder, LT line length and the consumer mix of a division. (Hypo: 7)

Discussion:

Hence, it is determined that by reducing HT line length per feeder or LT line length per feeder in a division it is possible to reduce T&D loss (considering other parameters constant). Further, it is possible to determine affect of commercial, HT industrial, streetlight consumers on T&D loss. It may decrease T&D loss with rise in such consumers. In line with it, rise in number of consumer under LT industrial, water works and agriculture category the loss may increase (considering other parameters as constant).

4.2.3 REVENUE COLLECTION MODEL

4.2.3.1 COLLECTION EFFICIENCY TO CONSUMER MIX

Hypothesis (Hypo:8) is framed to test the relationship of collection efficiency with consumer mix of a division. Result indicates that there is no relationship between collection efficiency (dependent variable) with the consumer mix (independent variable) in a division, as ANOVA p-value is > 0.05 (i.e. 0.6091). Hence, Null Hypothesis is accepted (Hypo:8). Therefore, there is no relationship between collection efficiency with independent variable consumer mix (ANALYSIS C & C.a).

Discussion:

Thus, it is observed that there is no relationship of collection efficiency with consumer mix of a division.

4.2.4 POWER RELIABILITY MODEL

4.2.4.1 RELIABILITY INDEX TO HT LINE LENGTH

Hypothesis (Hypo: 9) is framed to test the relationship of Reliability index with HT line length. Results indicate that a significant relationship of RI (dependent variable) with total HT line length of feeders (independent variable) in a division exists, as p-value is < 0.05 (i.e. 0.010). Hence, Null Hypothesis is rejected (Hypo: 9)

Simple Regression Model

RI = 99.7026 - 0.0002HTLength

(ANALYSIS D)

4.2.4.2 RELIABILITY INDEX TO NUMBER OF FEEDERS

Hypothesis (Hypo: 10) is framed to test the relationship of Reliability index with HT line length. Results indicate that no relationship of RI (dependent variable) with total number of feeders (independent variable) in a division, as p-value is > 0.05 (i.e. 0.1780) (ANALYSIS D.a). Hence, Null Hypothesis is accepted. (Hypo: 10) Therefore, there is no relationship between reliability Index with number of feeders in a division.

Discussion:

It is observed that reliability of power supply reduces due to total length of HT feeders, and not because of number of feeders in a division.

4.2.5 PROFIT MODEL

4.2.5.1 PROFIT BEFORE TAX TO T & D LOSS

Hypothesis (Hypo: 11) is framed to test the relationship of Profit Before Tax (PBT) with T & D loss of a division. Results indicate that a relationship of Profit Before Tax (PBT) (dependent variable) with T & D loss (independent variable) of a division exists, as ANOVA p-value is < 0.05 (i.e. 0.0017) and R^2 – Coefficient of Determination is 0.3823. It implies that 38.23% of variation in Profit Before Tax is explained by T & D loss of a division (considering other factors as constant). Hence, Null Hypothesis is rejected (Hypo: 11). Therefore, there is a significant relationship of Profit before tax with T & D loss.

Simple Regression Model[11]

PBT = 10146 - 489.93 T&D Loss

(ANALYSIS E.b)

4.2.5.2 PROFIT BEFORE TAX TO COLLECTION EFFICIENCY

Hypothesis (Hypo:12) is framed to test the relationship of Profit Before Tax with collection efficiency. Results indicate that a relationship of Profit Before Tax (dependent variable) with collection efficiency (independent variable) of a division exists, as ANOVA p-value is < 0.05 (i.e. 0.0200) and R^2 – Coefficient of

Determination is 0.2317. It implies that 23.17% of variation in Profit Before Tax is explained by collection efficiency of a division (considering other factors as constant). Hence, Null Hypothesis is rejected (Hypo:12). Therefore, there is a significant relationship of Profit Before Tax with Collection efficiency.

Simple Regression Model[12]

PBT = - 74623 + 773.16 CollEffy

(ANALYSIS E.c)

While analyzing relationship of PBT with other variables of a division the ANOVA p-value is > 0.05. It indicates that there is only significant relationship between PBT with T&D loss and collection efficiency of a division. The profit model is given by equation as shown below:

Multi-Regression Model[13]

PBT = - 63975 - 495.2 T & D loss + 786.5 CollEffy

(ANALYSIS E & E.a)

Results of the model indicates that value of R^2 = 0.6222 so that two variables together explain about 62.22% of variation in profit of a division. It is inferred from value of R^2 that coefficient of determination of the MODEL is strong. Thus, the MODEL can determine the profit of a division from given two variables.

While testing relationship of profit of a division with above variables, the ANOVA p-value is found < 0.05 (i.e. 0.00), i.e. Null Hypothesis is rejected (Hypo:13). It indicates that there is a significant relationship between profit before tax with T & D loss and collection efficiency.

Discussion

There is strong and significant relationship between Profit before tax with T & D losses and collection efficiency of a division. It is determined that 62.22% of variation in profitability is explained by T & D losses and collection efficiency on the part of a division with an assumption other factors remain constant. When T&D losses decrease to the tune of 10%, the profit shall increase by 13% while collection efficiency increase by 1%, the profit shall increase by 40% subject to the condition that other parameters are constant.

4.3 EMPIRICAL ANALYSIS AND FINDINGS

Improving divisional performance remains priority for a power distribution company. In order to achieve this objective findings and recommendations are framed as follows:

4.3.1 GENERAL CHARACTERISTIC

On an average, 5 to 6 subdivisions are working under one division. They provide services to about 250 to 1000 villages and that have 115000 consumers. These include an average of 87750 residential, 14400 commercial, 120 HT industrial, 3000 LT industrial, 450 water works, 250 street light, 100 trust light and 8000 agricultural consumers. It may be noted that industrial consumer base is in the southern part of Gujarat, while agricultural consumers are concentrated in the western part. For this reason, the DGVCL has got large number of industrial feeders, whereas PGVCL and UGVCL have significant number of rural and agricultural feeders.

Electrical network per division

Electrical network is planned and laid down in a division as per the requirement of electricity to end consumer. Usually, one division has total 110 feeders; they are distributed with HT-4, GIDC-5, Industrial-8, Urban-14, Rural + Ag. Dominant – 55 and JGY-20 feeders. There are about 3900 number of transformers in a division. However, an average of DTRs per feeder remains about 37.

Consumers to network ratio

A consumer per network is an important ingredient in performance evaluation. The average of consumers per feeder remains about 1500, with a maximum of 3648 numbers in the Surat urban division and minimum of 342 in the Radhanpur division. Average consumers per DTR remain at about 42.

Employee per division

During the study, it is observed that an average number of employees in a division are 320 employees. They include 25-engineers, 6-meter lab staffs, 170-line staff and 121-clerical staff.

4.3.2 POWER SUPPLY RELIABILITY

4.3.2.1 RELIABILITY INDEX

It is found that on an average of power supply reliability in Gujarat was more than 96% during the year 2009-10, which was higher by 1% compared to 2008-09. It is included with load shedding. The DGVCL accounted for 98%, the MGVCL 99%, the UGVCL 95% and the PGVCL 93% of reliability index. Despite the Transient Tripping (TT) and Sustain Faults (SF) registering an increase by 6%, but due to decrease in the duration of SF by 14%, emergency shutdown (ESD) by 10% and planned shutdown (PSD) by 6% power supply reliability index increased.

Further, it is found that the non availability of power supply per feeder due to SF + ESD remained less than 1%, that due to PSD about 1% and that due to LS remained 2%. When comparison was made between two industrial divisions viz; Vapi and Ankleshwar, considerable difference was noticed during 2007-08 in the reliability index - Vapi 99.95% and Ankleshware 98.97%. Thus, it can be concluded that the Ankeshwar division has lower power supply reliability, it was lower even than the Khambhaliya rural division. Therefore, it is recommended to improve the power reliability of the Ankleshwar division. Obviously, the Ankleshwar being an industrial division has high earning potential.

4.3.2.2 RELIABILITY INDICES

It is also observed that on an average SAIDI for a division was one hour and twenty minutes in the year 2008-09. It was lower than a benchmark of two hours. Hence, it can be stated that power supply reliability is good enough in Gujarat and it remained higher than the benchmark level. However, CAIDI for a division was about 150 minutes per division and it was higher than the benchmark level of 90 minutes. Thus, it can be stated that the supply restoration time taken is more than the benchmark and so it is necessary to improve it to bring down to the benchmark level.

Further, the reliability indices as registered through the performance of GUVNL show decreasing trend. It indicates a positive sign for power reliability to show that power supply reliability is improving in Gujarat. The SAIDI (in Hours) has decreased by 15% in comparison to that in 2008-09 to 2009-10. It means that an average time of customers' interruption has decreased by 15%. Similarly, CAIDI (in

minutes) has decreased by 14% and SAIFI as well has decreased by 3-4%. An average of SAIFI remained about 0.66 instances that was lower than the benchmark level of 1.3 instances. But individually it showed variation in divisions like it was quite high about 1.96 instances in the Khambhaliya division of the Jamnagar circle and it was quite good in the divisions like Vapi Industrial, Ankeshwar, Surat industrial & Lalbaug divisions. This makes good indication for reliability of power supply in the state of Gujarat.

The Reliability indices can be a perfect and absolute tool to measure reliability of power supply in predefined area for a specified time period. Looking to the indices that emerge from it can be concluded that power reliability in Gujarat is quite good and satisfactory. However, a fact remains that lot needs to be done in respect of CAIDI (In minutes). That means that the average time required to restore services is quite high as compared to the benchmark level. Power supply has to be restored within one and half hour of average time. This level can be achieved by putting equipments like Ring Main Units (RMU) and Fault Passage Indicator (FPI) and by implementing Supervisory Control And Data Acquisition (SCADA) System for effective results.

4.3.3 FIELD MAINTENANCE SERVICES

4.3.3.1 DTR MAINTENANCE & FAILURE

The rate of transformer failure plays a vital role in divisional performance of any power distribution company. As it springs from the data of year 2008-09, an average rate of transformer failure was about 12%. It remained very high about 40% in the Khambhaliya division of the Jamnagar circle operating under the PGVCL. Approximately 150 transformers were reported to have failed each month. However, the rate was as low as about 1% in the Lalbaug division of the Baroda city circle that operates under the MGVCL. In a year, each division usually carries out maintenance on an average of 66% of the transformers in a year. The rate of transformer failure has decreased by 3% every year. It is because transformer maintenance has increased by 4%.

The DISCOM wise rate of failure and maintenance was recorded as below:

TABLE 4 - 1 : COMPANY WISE DTR MAINTENANCE & FAILURE

DISCOM	Transformer Maintenance in %	Transformer Failure Rate in %
DGVCL	85.32%	14.41%
MGVCL	89.32%	9.44%
PGVCL	51.93%	17.93%
UGVCL	39.52%	17.59%
GUVNL TOTAL	**66.06%**	**14.88%**

Source: Analysis of MIS report of GUVNL & its subsidiary distribution companies for 2008-09.

It is desirable to reduce the transformer failure up to the benchmark level. However, agricultural consumers have a significant effect on failure of transformer. Thus, it is recommended to improve maintenance and load pattern of the transformers particularly in the segment of agricultural consumers. It shall reduce considerably the rate of transformer failure.

4.3.3.2 LINE MAINTENANCE

Line maintenance is a day-to-day operation. It is significant in view of all consumers to ensure uninterrupted flow of power supply. In view of it, each subdivision has to maintain networks of HT and LT lines to provide quality and reliable supply of power to end consumers. The analysis of data and reports articulate that a division in a year usually maintains 85% of total HT line and 75% of total LT line network. Compared to the earlier year, line maintenance work has increased by 12%. A division has to achieve the maximum level of line maintenance during a year to reach reliability up to the benchmark level and to improve customer satisfaction. In line with it, the management has to provide the adequate staff and effective support for the same.

4.3.4 METERING

Metering is another area that demands closer attention on the part of company's profitability. Any negligence at any level would lend directly to losses.

4.3.4.1 % UNMETERED CONSUMERS

The first factor in its line is a number of unmetered consumers that remains about 1% to 12% of the total consumers in a division. These consumers are usually

agricultural consumers. They use electricity without meter with flat rate of tariff. While on the other hand, out of total agricultural consumers, the percentage of unmetered tariff agricultural consumers varies as higher side 52% reported in the Vyara division to 91% in the Bhuj division. Similarly, unmetered sales with assessment of agricultural units are found to be varying from 3% to 76% of the total sale. Out of the total sale of electricity, 31% of energy is consumed by agricultural consumers and out of it, only 7.5% of energy is metered and about 23.5% goes unmetered.

The unmetered agricultural consumption has serious impact on the financial performance of a distribution company. The major difficultly reported is in measuring unit sales (agriculture assessment) as consumed by unmetered agricultural consumers. The Government of Gujarat has implemented "*Jyoti Gram Yojana*" in Gujarat specifically to segregate rural residential and commercial consumers from agricultural consumers. The scheme is meant for better transparency and energy accountability. It is viewed as the ultimate solution for power distribution business in the rural sector in India. Moreover, it is also recommended that energy meters must be installed on every agricultural consumer for better energy accounting even if the billing is based on flat (unmetered) tariff.

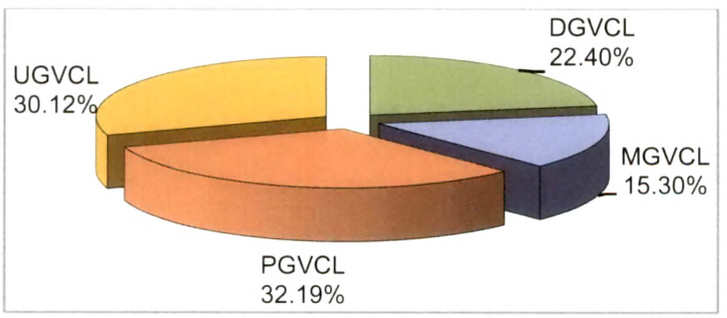
4.3.5 SALES AND CONSUMPTION

The analysis of consumption data gives a picture of sales and consumption of energy that the GUVNL supplies to consumers of Gujarat.

4.3.5.1 CONSUMPTION PATTERN

The company wise consumption break-up is shown below in the figure 4.2.

FIGURE 4.2 : COMPANY WISE CONSUMPTION



Source: Analysis of AT & C report of GUVNL & its distribution companies for 2008-09.

As the figure shows, the PGVCL reports maximum consumption in comparison to other companies. The reason is that it covers large geographical area and larger number of consumers accordingly. Power consumption in Gujarat is increasing as such at the rate of 8-10% per year. So the category wise increase in consumers' consumption can be understood as shown in the TABLE 4.2.

TABLE 4 - 2 : CATEGORYWISE INCREASE IN CONSUMPTION IN 09-10

Consumer Category	Rate
Residential	2.86%
Commercial	14.07%
HT Industrial	17.36%
LT Industrial	8.27%
Agriculture	2.79%
Water Works	5.98%
Others	11.13%
Total	**8.59%**

Source: Analysis of AT & C & MIS report of GUVNL for last three years.

The power consumption pattern that emerges from the analysis reveals that industrial consumers are about 39%. It is followed by 31% of agricultural consumers, 11% by residential, 5% by commercial consumers and 14% by licensee and other consumers.

Table 4.2 reveals that consumption by HT industries is rising at the rate of 17%. So, it is recommended to motivate HT consumers for new connections, load addition etc. Similarly employees too should be motivated to release such connection at the earliest. Beyond all these, the company has to ensure reliable power supply by providing alternative source of supply to HT industrial and commercial consumers. It will cause increased consumption and in turn increase the revenue.

4.3.5.2 SALES PER CUSTOMER PER DAY

"Sales per customer per day" was evaluated on the basis of sold out units in respect of consumer mix. It is useful to define priority of services. Data with respect to sales per consumer per day is shown in the TABLE 4.3.

TABLE 4 - 3 : CATEGORYWISE SALES PER CONSUMER PER DAY

(Sales in units)

Consumer Category	AVERAGE	MIN	MAX
Residential	2.78	0.89	13.01
Commercial	6.21	2.14	64.53
HT Industrial	4197.22	17.42	16980.49
LT Industrial	100.92	21.66	1993.18
Agriculture	26.29	21.97	108.41
Water Works	75.80	20.29	447.10

Source: Analysis of T & D and Trial balance report of GUVNL.

It is necessary to detect decrease in sale because analysis thereof may lead to detection of theft in particular area, village, feeder or DTR. Hence, adequate control system should be set to curb cases of theft. On the contrary, what is found is that additional facility and services are provided to those areas in which sales per day remains higher than the average and it is done on considering them as privilege customers, as they fetch better income to the company.

4.3.6 COST AND LOSSES

4.3.6.1 T&D LOSS

It is reported that the Transmission and Distribution loss of the GUVNL was about 24.22% for the financial year 2009-10 and in 2008-09 same was 21.14%. In Gujarat distribution loss revealed decreasing trend. The loss has gradually decreased from 30.64% in 2004-05 to 26.51% in 2005-06, and 22.20% in 2007-08.[14] The study revealed that T & D losses in a division ranged from 1% to 49%. The Ankleshwar division under the Bharuch Circle of the DGVCL incurred T & D loss of about 1%. On the contrary, the Vyara division reported 47% T & D loss in the financial year 2008-09. Further, 38% of profitability is explained by T & D loss. It means one percent reduction in T & D loss can increase profit/loss before tax (PBT) by ₹ 5 crores for a division.

4.3.6.2 LOSS PER CONSUMER

In Gujarat, the reported annual distribution loss per consumer in units is about 1000 units, which is decreasing at the rate of 4.48%. Further, annual distribution loss per consumer is valued about ₹ 2800. Similarly, on an average of ₹ 500 is accounted

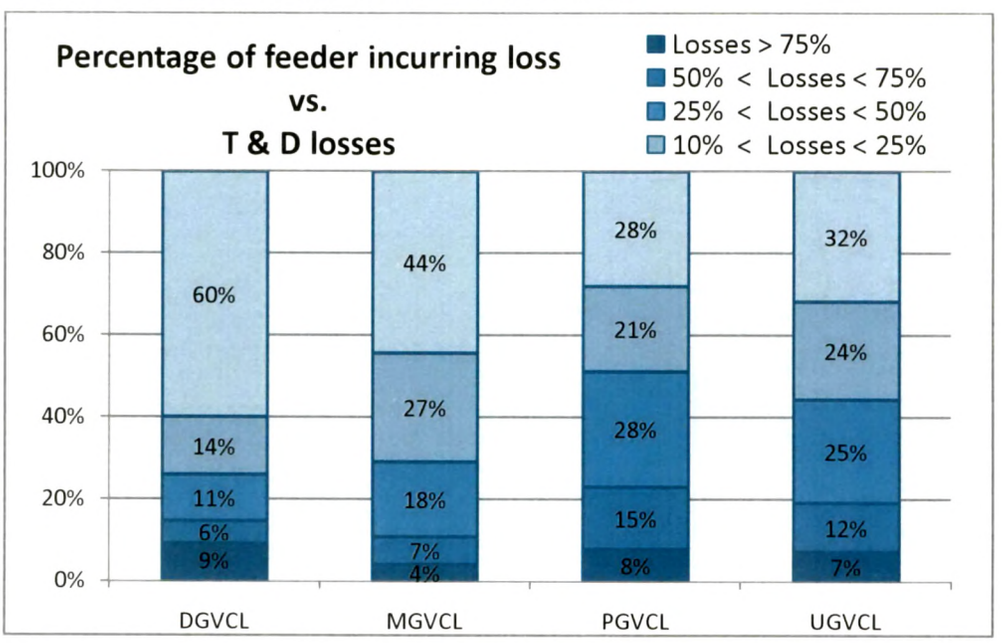
towards the collection loss leading to ₹ 3300 for the total (AT&C) loss per consumer in a division annually.

When comparison is done of two divisions (*See* TABLE 3.9 of Chapter 3) namely the Rajkot city-2 and the Dabhoi division, the Dabhoi division has accounted 39% of AT&C loss, while the Rajkot city-2 division records 19% of AT&C. But it is pertinent to note that losses per consumer remains little higher in the Rajkot city-2 division than it is shown for the Dabhoi division. Thus, the Rajkot city-2 has significant opportunity to reduce losses as compared to Dabhoi. Consequently, it is ascertained that T & D loss is not the only measure of performance and it is therefore, recommended to closely monitor losses per consumer even if T&D losses remain low or comparable.

4.3.6.3 FEEDERS INCURRING LOSS

In the GUVNL, some 8% of total feeders incur losses above 75%. The FIGURE 4.3 shows percentage of feeder incurring loss out of total feeders.

FIGURE 4.3 : PERCENTAGE OF FEEDERS VS LOSSES



Source: Analysis of AT & C Report of GUVNL and its subsidiary distribution companies for 08-09.

10% of total feeders show losses between 50% and 75%, 20% of them show 25% to 50% losses and 21% accounted for losses between 25% to 10% and 39% of total feeders had losses below 10%. Number of feeders, having loss of more than 75%,

has decreased by 20% in comparison to the last financial year. In Morbi division operating under PGVCL, 20% of feeders accounted T & D loss more than 75%. Further, it is recommended to concentrate on 8% of feeders for which reported losses remain above 75%. It would be beneficial to the company. The strategy should be to achieve gradual reduction in number of feeders incurring loss in this category.

4.3.6.4 AT & C LOSS

AT & C loss means Aggregate Technical and Commercial loss. It was 25.03% in the financial year 2009-10. It showed drastic reduction from 32.36% in the year 2004-05 to 26.51% in 2005-06 and 23.68% in 2006-07. It decreased drastically about 18% from financial year 2004-05 to 2005-06, then gradually 10% from the year 2005-06 to the year 2006-07 and 4.73% from the year 2006-07 to the year 2007-08. AT & C losses were reported for the year 2008-09 approximately 16.69%, 14.85%, 32.46% and 12.75% respectively for four distribution companies, the DGVCL, the MGVCL, the PGVCL and the UGVCL. AT & C losses were reported at 32.46% for the PGVCL was on higher side than other distribution companies in Gujarat.

For a division, it ranges from the lowest with 3.94% for the Surat Industrial division to the highest of 49% for the Vyara division. If we estimate the AT&C loss in terms of rupees it may range from ₹ 9 crores (for the Lalbaug division) to ₹ 95 crores (for the Bhuj division) in one financial year. This gives an alarming indication. If AT & C losses of a division remains above 40% it means that out of 100 unit sale of energy only 60% energy is realized. So it is recommended to setup Loss Control Cell (LCC) and investigate the reasons for AT & C losses that remain above 40%.

4.3.6.5 O & M EXPENDITURE PER UNIT OF ENERGY INPUT

The O & M expenditure to one unit of energy input indicates proportion of O & M expenditure in respect of sent out units. The GUVNL has an average of about 6.50 paisa per unit which is less than the benchmark level of 10 paisa per unit. It is recommended not to reduce O & M expenses at the cost of consumer services which include power supply reliability. However, reduction in O & M expenses of industrial division is a sign of reduction in maintenance. As a result it, it may reduce power supply reliability which in turn reduces the profit margin.

4.3.7 SAFETY AND ACCIDENTS

During the review of the present study, number of accidents was reported and they are on the higher side. For the GUVNL, the company wise average accidents registered monthly is shown in the table 4.4.

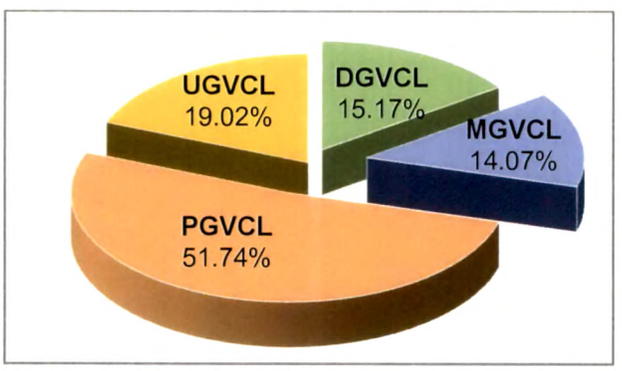
TABLE 4 - 4 : COMPANYWISE MONTHLY ACCIDENTS

Company	Fatal Human (FH)	Non Fatal Human (NFH)	Fatal Animal (FA)	Total
DGVCL	4	5	8	17
MGVCL	3	5	8	16
PGVCL	13	13	32	58
UGVCL	5	6	11	22
GUVNL	25	29	59	113

Source: Analysis of MIS Report of GUVNL & its subsidiary distribution companies for 2007-08.

From the available statistics, it is noted the accidents increased by 19% in the year 2007-08. There is almost 52% increase in Fatal Human accidents, which is quite perilous. Further; it was observed that there were four electrical accidents reported every day. Out of them, one was a fatal human accident, two were fatal animal accidents and one was non-fatal human accident. Electrical accidents reported company wise are as shown in the FIGURE 4.4.

FIGURE 4.4 : COMPANYWISE ELECTRICAL ACCIDENTS



Source: Analysis of MIS Report of GUVNL & its subsidiary distribution companies for 2007-08.

It was found that departmental accidents occurred to employees were about three accidents annually. It comprises of FH – 1 and NFH – 2. Four electrical accidents occurred per day. Accidents per one lac of consumers were about 16 in numbers during the financial year 2007-08 which was quite high as compared to those reported by other private players. It is recommended that management should take safety measures by providing trainings & safety equipments to line staff that is

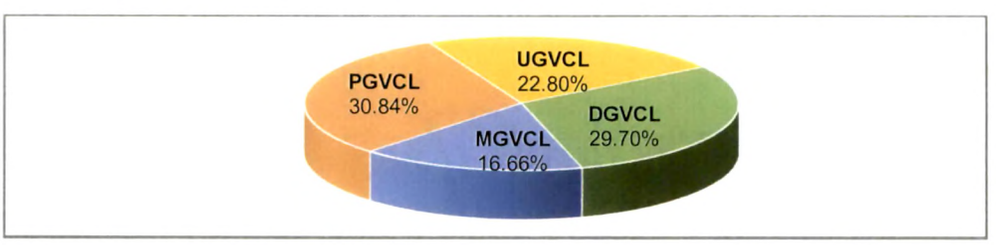
involved in erection of HT / LT & service line. They should follow electrical standards for the purpose and take effective measures to reduce accidents.

4.3.8 REVENUE AND COLLECTION

4.3.8.1 REVENUE

In the year 2007-08, the Surat industrial division reported the highest revenue collection of about ₹ 812 crores compared to all other divisions. It is because many industries are located in this area. The division collects ₹ 450 crores from HT and ₹ 262 crores from LT industrial consumers. Similarly, the revenue received from residential and commercial consumers remained highest in the Surat urban division. It was about ₹ 108 crores and ₹ 43 crores respectively. The divisional average remained at ₹ 154 crores for the same time period. The revenue collection shows an increasing trend at the rate of 10%. It shows a sign of improving financial health of power distribution companies. The company wise average of revenue collection is displayed in the FIGURE 4.5.

FIGURE 4.5 : COMPANY WISE REVENUE COMPOSITION



Source : Analysis of Revenue collection report of GUVNL & its subsidiary distribution companies for 2007-08.

The urban divisions like the Lalbaug and the Junagadh City have about 40% of revenue collected from their residential, 20% of revenue collected from commercial consumers. On the other hand, industrial divisions like Ankeshwar and Vapi have more than 80% of revenue raised from HT / LT industrial consumers. Similarily, Radhanpur, Patan, Deesa-1 and Bhuj divisions show revenue collection of more than 75% of revenue collected from agriculture consumers.

Looking at the revenue collection figures, the Surat Industrial Division should be considered for long term investments, because it yields higher return on the investment and can ensure higher revenue realization per unit which is about ₹ 4.10 per unit. It is further proposed that resource allocation to urban or industrial division

should be decided on revenue realized per unit. Investment has to be directed to those divisions that show better prospects of higher return.

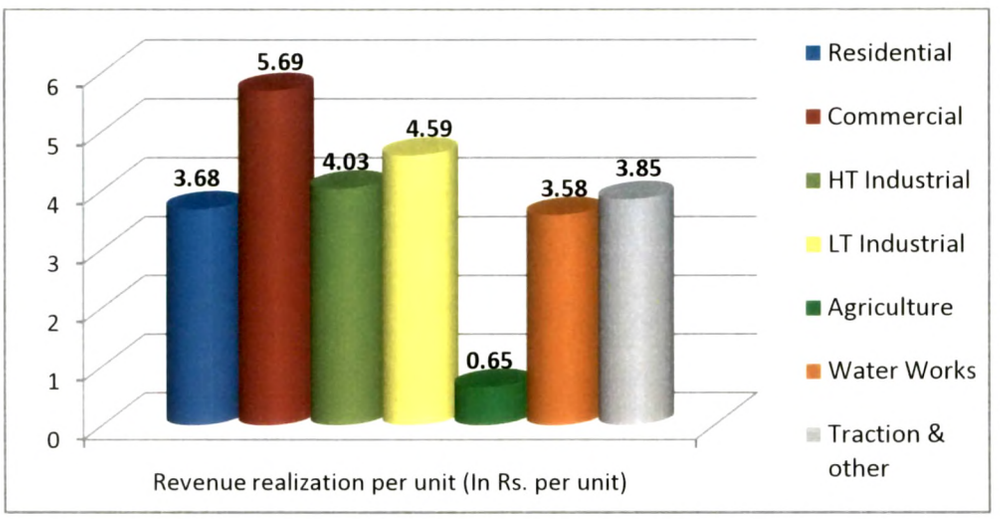
4.3.8.2 COLLECTION EFFICIENCY

In Gujarat, collection efficiency has improved to 98.8% in 2007-08. It was raised from the year 97.52% in 2004-05, 100.65% in the year 2005-06 and 98.09% in the year 2006-07. Collection efficiency shows an increasing trend although figures reported from its companies are somewhat different. For MGVCL and PGVCL, the collection efficiency shows an increase of 2 to 3%, while for DGVCL and UGVCL; it shows a slight decrease of 0.5% in 2007-08. Along with positive notes, different kinds of result too are reported from some other division and it is in terms of low collection efficiency. In view of divisions, it is found varying from 80% at the Deesa-1 to almost 104% at the Rajkot city division. It results in the form of collection loss to the tune of ₹ 5 crores per division every year. So these weak area demands closer attention for improvement in revenue collection. Collection efficiency explains 19.12% of variation in total income and 23% of variation in PBT. Rise of one percentage in collection efficiency can save collection losses to the tune of almost ₹ 7.5 crores per division. This can be affected through programs like disconnecting electricity supply to defaulting consumers.

4.3.8.3 REALIZATION PER UNIT

Realization per unit of power sold out plays a vital role to ensure sustainable growth for any power distribution company. It comprises a rupee realized from a sale of one unit of energy. Power distribution companies in Gujarat showed realization of an average of ₹ 3.46 per unit during the financial year 2007-08. It is observed that realization per unit for the Radhanpur division under the Palanpur circle remained about ₹ 0.85 per unit which remained very low across the whole of Gujarat. As against it, Ankleshwar, Lalbaug and Vapi industrial divisions have reported higher realization per unit like ₹ 5.05, ₹ 4.95 and ₹ 4.50 respectively. Realization per unit shows an increasing trend with a rate of 2.04% and it is good sign for DISCOMs. Revenue realization per unit for different categories of consumers is shown in the FIGURE 4.6

FIGURE 4.6 : CATEGORYWISE REVENUE RELALIZATION PER UNIT



Source: Analysis of revenue collection report of GUVNL & its subsidiary distribution companies for 2007-08.

Further, the revenue realization per unit is shown for some important divisions in the TABLE 4-5.

TABLE 4 - 5 : REVENUE REALIZATION OF MAJOR DIVISION

No	Division	Circle	Company	Realization per Unit (In
1	Ankleshwar	Bharuch	DGVCL	5.05
2	Lalbaug	Baroda city	MGVCL	4.95
3	Vapi Ind	Valsad	DGVCL	4.50
4	Bhuj	Bhuj	PGVCL	4.35
5	Talod	Himmatnagar	UGVCL	1.40
6	Patan	Mehsana	UGVCL	1.14
7	Deesa1	Palanpur	UGVCL	0.90
8	Radhanpur	Palanpur	UGVCL	0.85

Source: Analysis of revenue, trial balance of GUVNL & its subsidiary distribution companies for 2007-08.

It is recommended to invest for improving reliability of supply with adequate electrical infrastructure and innovative technology. The distribution areas under the Ankleshwar, Lalbaug and Vapi divisions should be considered for it so that even sale for single additional hour can have considerable addition to the company's profitability.

4.3.8.4 ARREARS

It is observed that the GUVNL and its subsidiaries accounted for usually 6% live arrears and 9% PDC arrears to the total assessment. But in monetary terms an

average of arrears per division remained about ₹ 26 crores. Out of it, ₹ 16 crores were of PDC consumers. Besides it, the percentage of consumers in arrear is reported as about 7%. At the end of the year 2008-09, the Lalbaug division of the Baroda city circle reported lowest live arrears of about 0.10%. On the other hand, the divisions like Deesa-1, Bhuj and Petlad showed highest live arrears of about 18%. Similarly, the Ankleshwar division had the highest PDC arrears of about ₹ 155 crores, while Lalbaug showed the lowest PDC arrears of about ₹ 2.50 lacs. Arrears in percentage are listed in the TABLE 4.6 for different distribution companies.

TABLE 4 - 6 : ARREARS

Company	Live arrears to assessment	PDC arrears to assessment
DGVCL	4.58%	17.91%
MGVCL	8.70%	4.83%
PGVCL	8.83%	10.01%
UGVCL	16.85%	4.69%
GUVNL	6.07%	9.79%

Source: Analysis of revenue report of GUVNL & its subsidiary distribution companies for 08-09.

On an average arrears are found to be considerably low compared to benchmark level. But it is proposed that live arrears may be reduced for Petlad, Patan, Bhuj, Dabhoi and Khambhaliya divisions since these divisions are 12% above the benchmark level. Similarly, PDC arrears for the Ankleshwar, Khambhaliya, Vyara and Botad divisions be reduced.

4.3.8.5 PROBABILITY OF DELAY PAYMENT

Delayed payment and mounting of arrears pose big hurdles to reduce profitability of the company. Any probability of delayed payment and arrears for different categories of consumers may call for priority to implement disconnection plan for the defaulters. The statistics analyzed on the point is shown in the TABLE 4.7.

TABLE 4 - 7 : PROBABILITY OF DELAY PAYMENT

Consumer Category	Probability of delay payment
Residential	5.09%
Commercial	3.85%
HT Industrial	8.78%
LT Industrial	2.57%
Agriculture	9.73%
Water works	93.53%
Street Light	22.75%

Source: Analysis of revenue and trial balance report of GUVNL & its subsidiary distribution companies for last two years.

Categories of consumers like water works and streetlight connections fall among consumers with whom there is maximum probability of delayed payment. It is mostly due to nature of organization - Government and Semi Government. It would be desirable to have different collection measures for these categories of users.

4.3.8.6 END TO END MONEY FLOW EFFICIENCY

End to end money flow is defined as collection of money deposited in bank in respect to energy delivered to each division in monetary term. The industrial benchmark determined for such efficiency is 92%. It is observed that in case of distribution companies of Gujarat end to end money flow efficiency remains close to 93%. For different types of divisions, it is like for industrial division 150%, for urban division 130% and for rural divisions it remains 67%. A divisional officer has to achieve the target of end to end money flow efficiency up to 92%.

4.3.9 THEFT PREVENTION BUSINESS

Theft of energy remains a major botheration for any power distribution company. Therefore, theft prevention business remains high priority for a power distribution company to prevent thefts and safeguard its business prospects. The steps taken by the GUVNL in this direction are summarized below:

4.3.9.1 METER REPLACEMENT

Meter replacement is a step necessary for reduction of commercial losses. It includes replacement of faulty, non-working, and non-quality/electrometrical meters. Some 7% to 10% of faulty meters are replaced annually in respect to total consumers. The ratio of meter replacement to total consumers remains about 11%, 6%, 8%, and 9%

respectively for the distribution company like DGVCL, MGVCL, PGVCL and UGVCL in the year 2007-08. Meter replacement is a work that has significant effect on reduction in commercial losses. Therefore, it is proposed to prepare a strategic plan considering how old meter is, viz. the Lalbaug division does not have single meter that is older than 2004. Thus, it can be concluded that up to the year 2004 the Lalbaug division has arranged to replace all non-quality meters with quality meters.

4.3.9.2 MMB INSTALLATION

Secondly, metal or plastic boxes are installed on energy meters. Such an arrangement would help to prevent theft with tampering of meters. Average of boxes installed in a division respect of total consumers is about 6-10%. It has been found that an average of boxes installation during the year 2008-09 in respect to total consumers remained respectively about 8%, 6%, 7% and 10% for the DGVCL, MGVCL, PGVCL and UGVCL.

For desired effect, it is required that proper strategic plan may be prepared for MMB installation. So it is possible to install boxes within 5 years on meters at all consumers. This would lead to reduction in losses and in turn improved profitability.

4.3.9.3 SEALING

Proper sealing is essential to put on every meter at the consumers. It makes a meter tamper proof and in turn helps to prevent theft. The statistics report that annually sealing is provided to 11% of meter with consumers out of total consumers. Analysis of data reveals that sealing is provided on the meters of consumers to total consumers are about 8%, 10%, 10% and 12% respectively for the DGVCL, the MGVCL, the PGVCL and the UGVCL during the 2008-09.

Sealing is a continuous process. A distribution company has to carry on this exercise on continuous basis every year even after sealing on meters with all consumers is completed duly. Constant vigilance is the rule to make it effective.

4.3.9.4 INSTALLATION CHECKING

Installation checking of consumer meter and service line is a key process for a power distribution business. It in fact is considered routine activity. It detects not only thefts but also cause fear in consumer's hearts for punishment for theft. The GUVNL as a whole during the year 2008-09 carried out checking with 24% of its consumers and out of them; only 2% of consumers were detected for theft. However,

out of the total assessment, 1.13% was found from consumers who were involved in acts of theft. The theft as assessed per consumer was about ₹ 10945. The assessment to total consumers checked was reported as about ₹ 435 in the year 2008-09. The TABLE 4.8 below furnishes the company wise statistics for it.

TABLE 4 - 8 : ASSESSMENT VS CHECKING

Company	2007-08		2008-09	
	Assessment per detected consumer	Assessment per checked consumer	Assessment to detected consumer	Assessment to checked consumer
DGVCL	17280	1141	18681	124
MGVCL	17660	284	12236	589
PGVCL	9182	1075	9971	144
UGVCL	9400	315	8125	628
GUVNL	11000	662	10945	435

Source: Analysis of revenue, trial balance & MIS report of GUVNL & its subsidiary distribution companies.

A strategic analysis & correct decision proves vital for installation checking because checking without planning and without proper analysis, it may cause unusual expenditure. Additionally, it would be necessary to conduct proper cost benefit analysis of mass installation checking drives. However, the fact that actual realization per theft consumer may be useful to select a division in which mass installation checking drives can be conducted.

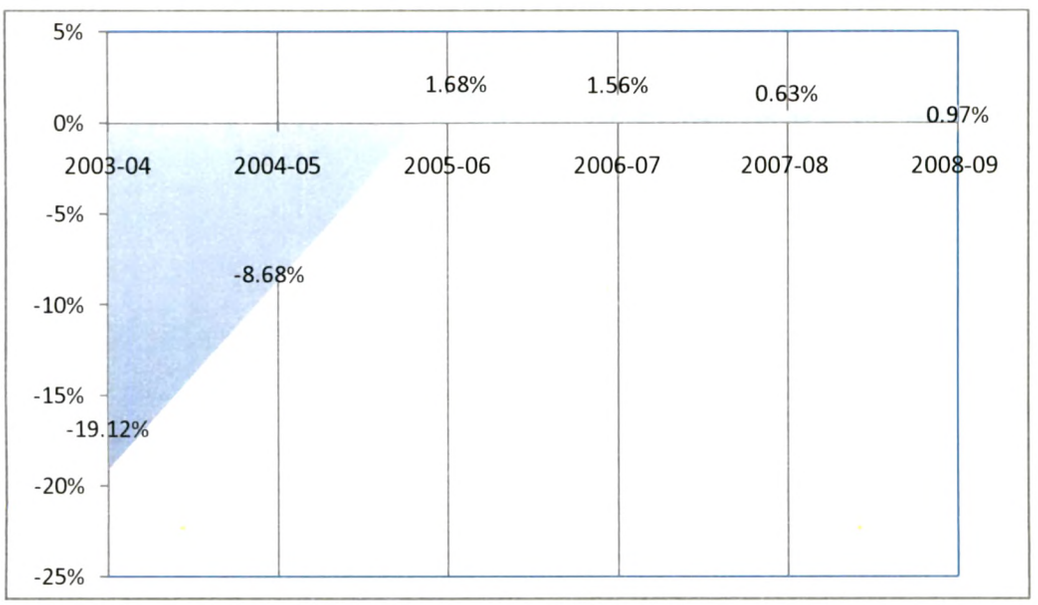
4.3.10 FINANCE AND PROFITABILITY

Finance remains a sensitive area for any business in the present context. This area has to be managed with due care and attention for profitability.

4.3.10.1 PROFIT BEFORE TAX (PBT)

On the assessment it is found that division wise profit/loss before tax ranged annually from ₹ (-) 205 crores in case of the Deesa-1 division to ₹ 304.33 crores for the Surat industrial division in the year 2006-07. Similarly, operating profit margin (operating profit to net sales) also varied from (-)342% to 50% for different divisions while the Net Profit Ratio (NP Ratio = Net profit to total revenue) varied from (-) 348% to 48%. The year wise net profit ratio (Net profit to total revenue) is shown in the FIGURE 4.7.

FIGURE 4.7 : NET PROFIT RATIO



Source: Trial balance of GUVNL & its subsidiary distribution companies.

Note: NP ratio is calculated for Net profit before tax excluding of ag. subsidy for a division.

It is necessary that the NP ratio of GUVNL may be compared with private players in the power industry, which is about 10%. Actually, it has changed drastically in GUVNL. But still lot needs to be done for achieving the global standards.

4.3.10.2 NET PROFIT PER UNIT

This is an important ratio to get higher rate of return by investing in power distribution business. For a division in Gujarat, it ranges from (-) ₹ 2.21 to ₹ 2.42 per unit. It means that sending one unit of energy makes loss of ₹ 2.21 per unit or profit of ₹ 2.42 per unit in a division. For GUVNL, the detail of energy unit sent is shown in the TABLE 4.9.

TABLE 4 - 9 : ENERGY UNIT SENT TABLE

Energy unit sent table	2004-05	2005-06	2006-07	2007-08	2008-09
Total Income	2.16	2.31	2.64	2.77	3.22
Power Cost	1.75	1.72	1.89	2.11	2.48
Other Expenditure	0.60	0.55	0.70	0.64	0.72
Total Expenditure	2.35	2.27	2.59	2.75	3.20
Net Profit / (Loss)	**-0.19**	**0.04**	**0.04**	**0.02**	**0.02**

Source: AT & C Report, Trial Balance of GUVNL & its subsidiary distribution companies for 2008-09.

It is recommended that a table for energy sent out and energy sold out may be prepared for each division to evaluate the financial performance of a division. Based on the table of energy unit sent/sold out and unit sales per customer per day, it is further suggested to calculate profit per customer per hour. Then, it is needed to prepare payback plan for new investment for a division. By doing it, profit can be maximized by improving power reliability for a single customer.

4.3.10.3 R & M EXPENDITURE PER CONSUMER

This ratio shows repair and maintenance expenditure that power distribution company has to incur towards selling of power to single consumer. The GUVNL is spending on R & M expense annually at an average of ₹ 250 per consumer. The R & M expense per consumer is reportedly increasing at the rate of 12%, however; it comprises only 2-3% of total expenditure for a division. The data shows that the annual R & M expenditure per consumer were critical for some divisions in the year 2008-09. As reports show it remained on the higher side for the Radhanpur and Deesa-1 divisions which was ₹ 550 per consumer and ₹ 450 per consumer for the Bavla, Surat Urban and Ankleshwar divisions. While on the lower side, there are Lalbaug and Rajkot city-2 divisions that registered R & M expenditure of ₹ 100 per consumer and there are Junagadh city & Vyara divisions that report it as ₹ 75 per consumer.

It reveals on calculation that the R & M expenditure is only 1-2% to the total expenditure. Hence by controlling R & M expenditure no significant impact can be noticed on profit / loss of a distribution company. If R & M expenditure are tightly controlled may exert adverse effect on the consumer service. The quality of power supply would deteriorate and in turn, sales & profit would go down for industrial or urban division. Hence, it is recommended not to reduce R & M expenditure at the cost of service to consumers.

4.3.10.4 OPERATING EXPENDITURE

Operating expenditure is another area that demands close monitoring. It was reported that the proportion of operating expenditure to total expenditure was about 4%, 12%, 8% and 6% respectively for the DGVCL, MGVCL, PGVCL and UGVCL in the year 2008-09. The operating expenditure per consumer remained about ₹ 900

per consumer. In the year 2008-09 the operating expenditure per unit was reduced to about 12% for the GUVNL.

The operating expenditure to total amount in respect of a unit sent out is about 11% for the GUVNL and its distribution companies, while for the MGVCL it is about 16%, for the PGVCL it is 10%, for the UGVCL it is 9% and for the DGVCL it is 7%. The proportion for operating expenditure to total expenditure remained high for the MGVCL. It was high because of high administrative expenses and employees' costs. It is therefore recommended to control and reduce administrative expenses and employee costs. But again, it should not go at the cost of consumer services.

4.3.11 HUMAN RESOURCES

In any business, as the business grows and customer base gets wider and more employees are needed. Hence, the customer to employee ratio has to be maintained in the interest of efficient human resource management.

4.3.11.1 CUSTOMER TO EMPLOYEE RATIO

In the case of the GUVNL, the customer to employee ratio depends on a type of division. An urban division can have a ratio of 600 customers per employee and for industrial divisions it may be about 350 per employee. As it reported, an average of customers per employee is about 400 in a division of power distribution companies of Gujarat. In the GUVNL, the ratio of consumers to line staff is 1250, that of consumer to non-tech employee is 800 and that of consumers to engineers is about 5000 in a division. In the year 2007-08, customer to employee ratio for the Surat urban division was about 1033 and it was 203 for the Ankleshware industrial division. Thus, it states that efficiency of employees is higher in the Surat urban division but only if customer services are satisfactory. At the same time, if services are not at satisfactory level then it is necessary to deploy additional man power.

4.3.11.2 INFRASTRUCTURE TO LINE STAFF RATIO

Infrastructure is a huge installation and open to sky for any power distribution company. To look after it properly, adequate and trained line staff is required. Infrastructure per line staff decides responsibility for line staff to keep up infrastructure in a system. An average of 2 line staffs per feeder and 25 DTRs per line staff is found in a division. Correspondingly, the ratio of KM line per line staff decides a responsibility of line staff to maintain HT & LT line in the interest of

reliable and quality power supply to end consumers. It has an average of about 33 KM per line staff. If the Infrastructure to line staff ratio remain lower and customer satisfaction also remains low then there is a need to improve the efficiency of employees in respective division.

4.3.12 PROJECT DEVELOPMENT

Growth of any business depends on how efficiently they operate and manage projects. It calls for innovativeness, initiative and leadership on the part of the knowledge and skill.

4.3.12.1 GROWTH RATE

Growth rate as reported for category of consumers is shown in the TABLE 4-10.

TABLE 4 – 10 : GROWTH RATE

Consumer Category	Average Growth Rate
Residential	5.39%
Commercial	4.54%
HT Industrial	9.27%
LT Industrial	4.20%
Agriculture	4.22%
Water Works	4.59%
Total	**5.18%**

Source: Analysis of Revenue collection report of GUVNL & its subsidiary distribution companies for 2007-08.

It is observed from data that HT industrial consumer registered an average growth rate as about 9% in the DGVCL. In the PGVCL, it showed an 8% growth rate. The LT consumers reported growth rate as high as about 7% in the DGVCL amongst other companies. Analysis of consumption data derives is to infer that the consumption of HT industries is rising at a rate of 17% and the total consumption of power is rising at a rate of 8% annually. Increase in demand calls for further investment for new projects and also to expand the existing ones with increased capacity and output.

4.4 CONCLUSION

In the power development scenario, an overall view of the power distribution sector plays a vital role for social & industrial development of the country. It can be noted from characteristics of most significant SBU, called division, in a power distribution business which draws overall picture about the entire distribution company and, in turn about the power distribution sector.

In line with it, several characteristics of a division and of a power distribution company in Gujarat are highlighted. Such as, Agriculture consumers are major players to cause DTR failure, while DTR maintenance activity has significant role to play for reduction of DTR failure. Likewise, Commercial and HT industrial consumers play a significant role for reduction of T&D loss. On the other end, water works and agricultural consumers play a vital role to increase of T & D. Besides it, reduction of 1% in T & D losses can increase profit by ₹ 5 crores, while with rise of one percentage in collection efficiency can save collection losses at the tune of ₹ 7.5 crores for a division.

It is therefore suggested to prepare a table for energy sent out and energy sold out for every division. It helps to evaluate financial performance of a division. Based on the energy sent out table and a unit sales per customer per day, it is suggested to calculate profit per customer per hour and prepare a plan for new investment / project in a division where company get maximum profit by improving its power reliability even by one hour.

DTR FAILURE MODEL

Data for Multiple Regression

ANALYSIS : A

DTR FAILURE vs. DTR MAINTENANCE & AG CONSUMERS

Division	Y		X1	X2
	DTRFailure%		DTRMtce%	$CONS_{AG}$
ANKLESHWAR	9.49%		65%	35
SURATIND	10.85%		127%	790
SURATURBAN	18.11%		107%	5779
VYARA	20.60%		20%	14223
NAVSARIRURAL	13.59%		92%	14350
VAPIIND	13.74%		69%	2223
MAHEMDABAD	10.43%		54%	9665
PETLAD	6.31%		53%	2384
LALBAUG	2.20%		146%	65
DABHOI	11.12%		54%	8406
GODHRA	13.40%		41%	2453
AMRELI1	24.13%		77%	15384
BOTAD	21.77%		10%	17037
BHUJ	13.86%		29%	8290
KHAMBHALIYA	40.57%		41%	16674
JUNAGADHCITY	3.53%		108%	123
RAJKOTCITY2	3.33%		128%	12
MORBI	16.34%		9%	12362
TALOD	16.78%		11%	19147
PATAN	10.32%		48%	5814
DEESA1	25.00%		40%	13413
RADHANPUR	16.35%		15%	10619
BAVLA	12.64%		36%	5021
<<Dependent Variable>>			**<<<Independent Variable>>>**	
DTR failure rate (Y)		=	**DTR maintenance (X1) and Ag. Consumers (X2)**	

DTRFailure% = DTR failure rate of division (In percentage)

DTRMtce% = DTR maintenance performed on % DTR out of total DTR of division (In percentage)

$CONS_{AG}$ = Average agriculture consumers of division during the year (In numbers).

DTR FAILURE MODEL

Multiple Regression Results

ANALYSIS : A.a

DTR FAILURE vs. DTR MAINTENANCE & AG CONSUMERS

	0	1	2	3	4	5	6	7	8	9	10
	Intercept	DTRMtce%	$CONS_{AG}$								
b	**7.0521**	**-0.0050**	**0.0010**								
s(b)	4.1118	0.0391	0.0003								
t	1.7151	-0.1272	3.8873								
p-value	**0.1018**	**0.9001**	**0.0009**								
VIF		1.6559	1.6559								

ANOVA Table

Source	SS	df	MS	*F*	$F_{Critical}$	*p*-value
Regn.	877.986	2	438.99	13.04	3.4928	0.0002
Error	673.285	20	33.66			
Total	1551.272	22				

s 5.8021

R^2 0.5660 Adjusted R^2 0.5226

Prediction Interval : Predict Value of (Y) here, based on MODEL & Enter data (X) below:

Given X

DTRMtce%	$CONS_{AG}$								

Y =

1-α	(1-α) P.I. for Y for given X
95%	+ or -

Y =

1-α	(1-α) P.I. for E[Y | X]
95%	+ or -

$Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Where Yj = Dependent Variable, b_0 = Constant value and $b_1X_{1j} = b_1$ slope for variable X

R^2	Coefficient of Determination	**df**	Degrees of Freedom	**SS**	Total Sum of square
R	Coefficient of Correlation	**MS**	Mean Square	**SSR**	Regression Sum of Squares
s (b_1)	Standard Error of Slope	**f Ratio**	f = MSR/MSE	**SSE**	Error Sum of Squares
s (b_0)	Standard Error of Intercept	**MSR**	(Mean Square Regression) = SSR/k		SS = SSR + SSE
s	Standard Error of prediction	**MSE**	(Mean Square Error) = SSE/n - (k+1)		

Simple Regression

DTR FAILURE TO AG. CONSUMERS

ANALYSIS : A.b

DTR FAILURE vs. AVERAGE AGRICULTURE CONSUMERS OF DIVISION

Div	$CONS_{AG}$	DTRFailure%	
	X	Y	Error
1	35	9.49	2.85987
2	790	10.85	3.47515
3	5779	18.11	5.78036
4	14223	20.60	-0.1072
5	14350	13.59	-7.2397
6	2223	13.74	4.93806
7	9665	10.43	-5.7503
8	2384	6.31	-2.645
9	65	2.20	-4.4565
10	8406	11.12	-3.8148
11	2453	13.40	4.37639
12	15384	24.13	2.27154
13	17037	21.77	-1.7242
14	8290	13.86	-0.9589
15	16674	40.57	17.4327
16	123	3.53	-3.1817
17	12	3.33	-3.2787
18	12362	16.34	-2.5152
19	19147	16.78	-8.8129
20	5814	10.32	-2.0402
21	13413	25.00	5.09958
22	10619	16.35	-0.7754
23	5021	12.64	1.06715

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	0.00099 + or - 0.00039

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	6.59323 + or - 4.00317

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

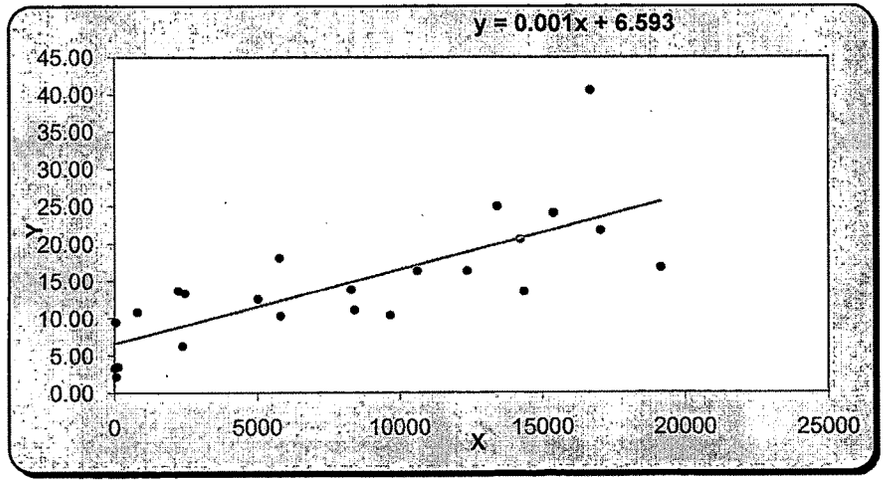
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.5656	Coefficient of Determination
r	0.7521	Coefficient of Correlation
$s(b_1)$	0.00019	Standard Error of Slope
$s(b_0)$	1.92496	Standard Error of Intercept
s	5.66455	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	877.442	1	877.442	27.3456	4.32479	0.0000
Error	673.83	21	32.0871			
Total	1551.27	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H1 = A relationship of dependent variable %DTR Failure to independent variable Average agriculture consumer in a division exists, as ANOVA p-value < 0.05 (i.e. 0.0000)

Hence, Null Hypothesis is rejected
(*See* Hypo : 1)

Simple MODEL

$DTRFailure\% = 0.001\ CONS_{AG} + 6.5932$

Simple Regression

DTR FAILURE TO DTR MTCE

ANALYSIS : A.c

DTR FAILURE vs. DTR MAINTENANCE PERFORMED OUT OF TOTAL TRANSFORMERS

Div	DTRMtce%	DTRFailure%	
	X	Y	Error
1	64.99	9.49	-4.5537
2	126.68	10.85	3.02075
3	107.04	18.11	8.29842
4	20.39	20.60	2.06632
5	92.26	13.59	2.29426
6	69.21	13.74	0.12065
7	53.96	10.43	-4.72022
8	52.98	6.31	-8.93672
9	145.60	2.20	-3.72602
10	54.34	11.12	-3.99558
11	40.79	13.40	-3.07373
12	77.19	24.13	11.3146
13	9.56	21.77	2.15081
14	28.88	13.86	-3.81703
15	41.18	40.57	24.1304
16	108.06	3.53	-6.1726
17	128.07	3.33	-4.36555
18	9.03	16.34	-3.33201
19	10.81	16.78	-2.71842
20	47.93	10.32	-5.43733
21	40.26	25.00	8.46978
22	14.91	16.35	-2.72903
23	36.29	12.64	-4.28813

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	-0.10066 + or - 0.08173

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	20.5832 + or - 5.88589

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

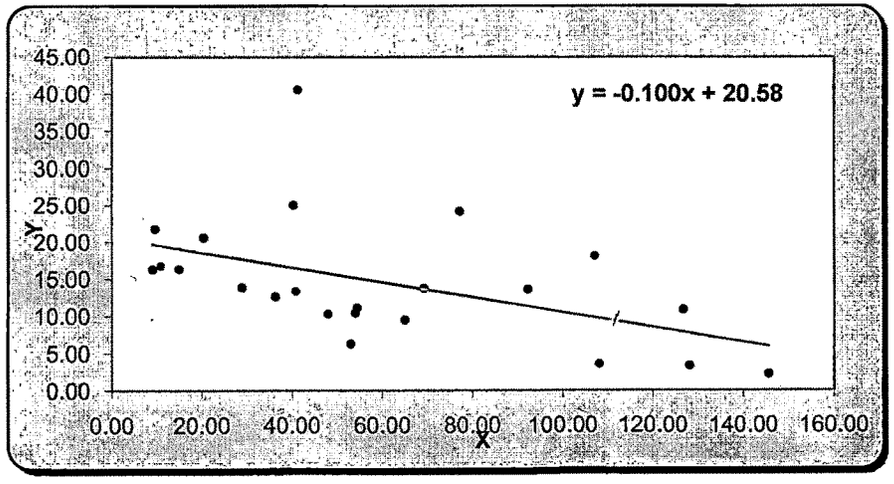
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.2380	Coefficient of Determination
r	-0.4879	Coefficient of Correlation
$s(b_1)$	0.0393	Standard Error of Slope
$s(b_0)$	2.83028	Standard Error of Intercept
s	7.50237	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	369.275	1	369.275	6.56075	4.32479	0.0182
Error	1182	21	56.2856			
Total	1551.27	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H1 = A relationship of dependent variable %DTR Failure to independent variable %DTR Maintenance exists, as ANOVA p-value < 0.05 (i.e. 0.0182)

Hence, Null Hypothesis is rejected
(*See* Hypo : 2)

Simple MODEL

DTRFailure% = 20.5832 - 0.1007 DTRMtce%

DISTRIBUTION LOSS MODEL

Data for Multiple Regression

ANALYSIS : B

T & D LOSS Vs. HTLENGTH/FEEDER, LT LENGTH AND CONSUMER COMPOSITION OF DIVISION

Division	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9
	T&D loss%	HTLength/Feeder	LTLength	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$/CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$
ANKLESHWAR	0.98%	5.62	150	23674	8323	272	1854	69	111	35
SURATIND	3.90%	4.06	322	52770	27805	557	15716	156	349	790
SURATURBAN	18.23%	12.90	2120	234585	36054	19	10185	545	1167	5779
VYARA	47.10%	46.01	6254	115221	7539	31	1614	700	634	14223
NAVSARIRURAL	22.35%	36.52	5079	186334	12723	28	2370	1578	1754	14350
VAPIIND	7.82%	9.70	1271	64034	13926	350	3906	82	295	2223
MAHEMDABAD	26.38%	35.02	3941	91008	9105	28	946	791	159	9665
PETLAD	23.51%	26.67	1778	103002	9827	20	2026	370	220	2384
LALBAUG	7.04%	5.35	698	109264	17044	70	3440	47	401	65
DABHOI	29.22%	49.21	5581	146415	12619	14	1168	966	650	8406
GODHRA	35.04%	46.99	3623	89323	10083	42	1242	227	216	2453
AMRELI1	34.94%	38.04	4666	101236	14575	25	2616	675	788	15384
BOTAD	45.27%	15.78	3427	77403	11032	15	3122	332	141	17037
BHUJ	34.95%	26.74	2829	97303	17710	26	1156	505	182	8290
KHAMBHALIYA	39.31%	36.41	4795	77884	14080	33	1126	322	104	16674
JUNAGADHCITY	23.33%	6.64	459	73039	19343	24	1783	780	240	123
RAJKOTCITY2	17.80%	8.85	595	94423	32449	70	6099	33	133	12
MORBI	19.20%	16.81	3320	101162	18891	381	3446	366	114	12362
TALOD	13.97%	26.27	4994	92707	7395	31	979	745	403	19147
PATAN	13.36%	19.28	1390	106377	13156	28	1087	443	417	5814
DEESA1	29.80%	20.83	4164	66679	10892	64	1172	390	257	13413
RADHANPUR	31.27%	20.23	3038	67866	8591	11	659	334	174	10619
BAVLA	29.59%	27.87	2152	120392	1027	56	2158	608	214	5021

<<Dependent Variable>> | **<<<Independent Variable>>>**

T & D loss (Y) = **HT length/feeder(X1), LT length(X2), Consumers in RL(X3), CL(X4), HTInd(X5), LTInd(X6), WW(X7), STL(X8) and AG(X9)**

T&D loss% = Transmission and Distribution loss of a division for financial year 08-09 (In percentage	$CONS_{HTIND}$ = Average HT Industrial consumers in a year of a division (In numbers).
HTLength/Feeder = HT line length per feeder (In kilometer)	$CONS_{LTIND}$ = Average LT Industrial consumers in a year of a division (In numbers).
LTLength = LT line length of all DTR in a division (In Kilometer)	CONSww = Average water work consumers in a year of a division (In numbers).
$CONS_{RL}$ = Average residential consumers in a year of a division (In numbers).	$CONS_{STL}$ = Average streetlight & public lighting consumers in a year of a division (In numbers).
$CONS_{CL}$ = Average commercial consumers in a year of a division (In numbers).	$CONS_{AG}$ = Average agriculture consumers in a year of a division (In numbers).

DISTRIBUTION LOSS MODEL

Multiple Regression Results

ANALYSIS : B.a — **T & D LOSS Vs. HTLENGTH/FEEDER, LT LENGTH AND CONSUMER COMPOSITION OF DIVISION**

	0	1	2	3	4	5	6	7	8	9	10
	Intercept	HTLength/Feeder	LTLength	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$	
b	**14.1163**	**0.3969**	**0.0011**	**-2.74E-05**	**7.73E-05**	**-0.0461**	**0.0012**	**0.0005**	**-0.0118**	**0.0006**	
s(b)	9.3269	0.4173	0.0048	0.0001	0.0004	0.0220	0.0011	0.0095	0.0097	0.0009	
t	1.5135	0.9512	0.2187	-0.3210	0.1906	-2.0939	1.0429	0.0547	-1.2109	0.6415	
p-value	**0.1541**	**0.3589**	**0.8303**	**0.7533**	**0.8518**	**0.0564**	**0.3160**	**0.9572**	**0.2475**	**0.5323**	
VIF		10.3564	23.7704	4.1156	3.2855	3.0734	4.5730	3.4173	4.3099	8.8317	

ANOVA Table

Source	SS	df	MS	*F*	$F_{Critical}$	*p*-value
Regn.	2562.385	9	284.709	3.835	2.714	0.014
Error	965.180	13	74.245			
Total	3527.565	22				

s = 8.61653234

R^2 = 0.7264

Adjusted R^2 = 0.537

Prediction Interval : Predict Value of (Y) here, based on MODEL & Enter data (X) below:

Given X	HTLength/Feeder	LTLength	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$	

Y =	1-α	(1-α) P.I. for Y for given X
	95%	+ or -

Y =	1-α	(1-α) P.I. for E[Y | X]
	95%	+ or -

$Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Where Yj = Dependent Variable, b_0 = Constant value and $b_1X_{1j} = b_1$ slope for variable X

R^2	Coefficient of Determination	**df**	Degrees of Freedom	**SS**	Total Sum of square
R	Coefficient of Correlation	**MS**	Mean Square	**SSR**	Regression Sum of Squares
s (b_1)	Standard Error of Slope	**f Ratio**	f = MSR/MSE	**SSE**	Error Sum of Squares
s (b_0)	Standard Error of Intercept	**MSR**	(Mean Square Regression) = SSR/k		SS = SSR + SSE
s	Standard Error of prediction	**MSE**	(Mean Square Error) = SSE/n - (k+1)		

Simple Regression

T & D LOSS TO HT LINE LENGTH / FEEDER

ANALYSIS : B.b

T & D LOSS vs. HT LINE LENGTH PER FEEDER IN A DIVISION

Div	HTLength/Feeder	T & D Loss%	
	X	Y	Error
1	5.62	0.98	-12.2508
2	4.06	3.90	-8.3838
3	12.90	18.23	0.58951
4	46.01	47.10	9.38316
5	36.52	22.35	-9.61113
6	9.70	7.82	-7.88421
7	35.02	26.38	-4.67026
8	26.67	23.51	-2.47338
9	5.35	7.04	-6.02444
10	49.21	29.22	-10.4363
11	46.99	35.04	-3.26738
12	38.04	34.94	2.05706
13	15.78	45.27	25.8774
14	26.74	34.95	8.91425
15	36.41	39.31	7.41309
16	6.64	23.33	9.4815
17	8.85	17.80	2.6137
18	16.81	19.20	-0.80914
19	26.27	13.97	-11.7756
20	19.28	13.36	-8.14815
21	20.83	29.80	7.3468
22	20.23	31.27	9.18125
23	27.87	29.59	2.87674

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	0.6063 + or - 0.29803

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	9.81923 + or - 8.14499

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

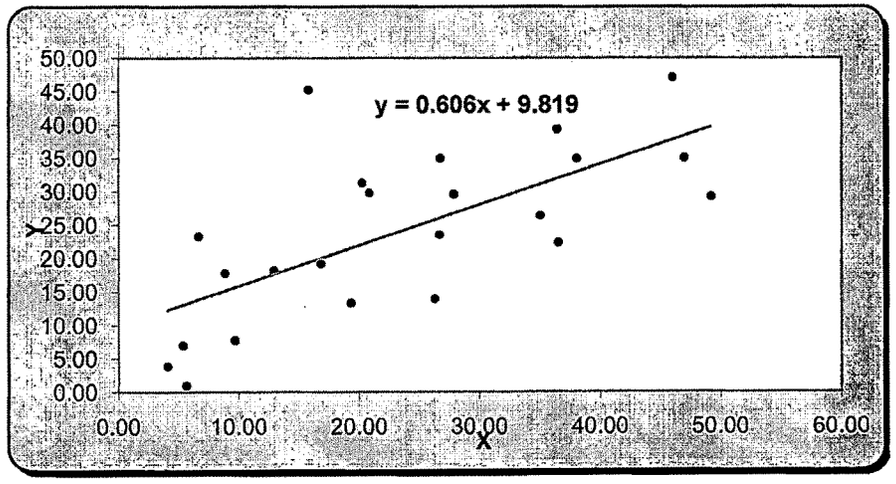
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.4601	Coefficient of Determination
r	0.6783	Coefficient of Correlation
$s(b_1)$	0.14331	Standard Error of Slope
$s(b_0)$	3.91659	Standard Error of Intercept
s	9.52287	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	1623.18	1	1623.18	17.8991	4.32479	0.0004
Error	1904.39	21	90.6851			
Total	3527.57	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H1 = A relationship of dependent variable T & D Loss to independent variable HT Line Length per feeder of division exists, as ANOVA p-value < 0.05 (i.e. 0.0004)

Hence, Null Hypothesis is rejected
(*See* Hypo : 4)

Simple MODEL

T&DLoss% = 9.8192 + 0.6063 HTLength/Feeder

Simple Regression

T & D LOSS TO LT LINE LENGTH

ANALYSIS : B.c

T & D LOSS vs. LT LINE LENGTH OF ALL DTR CIRCUITS IN A DIVISION

Div	LTLength X	T & D Loss% Y	Error
1	150	0.98	-10.2615
2	322	3.90	-8.14536
3	2120	18.23	-2.23481
4	6254	47.10	7.28696
5	5079	22.35	-11.9621
6	1271	7.82	-8.66898
7	3941	26.38	-2.60276
8	1778	23.51	4.65552
9	698	7.04	-6.76643
10	5581	29.22	-7.44334
11	3623	35.04	7.54171
12	4666	34.94	2.56241
13	3427	45.27	18.6859
14	2829	34.95	11.1679
15	4795	39.31	6.32318
16	459	23.33	10.6387
17	595	17.80	4.47368
18	3320	19.20	-6.87901
19	4994	13.97	-19.9454
20	1390	13.36	-3.68215
21	4164	29.80	-0.23316
22	3038	31.27	6.50731
23	2152	29.59	8.98176

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	0.00468 + or - 0.00226

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	10.538 + or - 7.71248

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

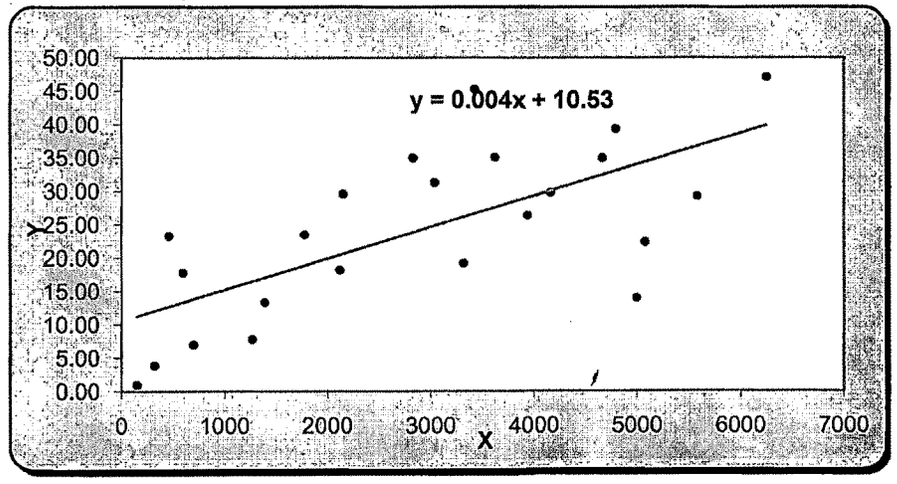
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.4699	Coefficient of Determination
r	0.6855	Coefficient of Correlation
$s(b_1)$	0.00108	Standard Error of Slope
$s(b_0)$	3.70861	Standard Error of Intercept
s	9.43623	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	1657.67	1	1657.67	18.6167	4.32479	0.0003
Error	1869.89	21	89.0425			
Total	3527.57	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H1 = A relationship of dependent variable T & D Loss to independent variable total LT line length exists, as ANOVA p-value < 0.05 (i.e. 0.0003)

Hence, Null Hypothesis is rejected
(*See* Hypo : 5)

Simple MODEL

T&DLoss% = 10.538 + 0.00468 LTLength

DISTRIBUTION LOSS MODEL

Data for Multiple Regression

ANALYSIS : B.d

T & D LOSS Vs CONSUMER MIX OF DIVISION

Division	Y		X1	X2	X3	X4	X5	X6	X7
	T&D loss%		$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$
ANKLESHWAR	0.98%		23674	8323	272	1854	69	111	35
SURATIND	3.90%		52770	27805	557	15716	156	349	790
SURATURBAN	18.23%		234585	36054	19	10185	545	1167	5779
VYARA	47.10%		115221	7539	31	1614	700	634	14223
NAVSARIRURAL	22.35%		186334	12723	28	2370	1578	1754	14350
VAPIIND	7.82%		64034	13926	350	3906	82	295	2223
MAHEMDABAD	26.38%		91008	9105	28	946	791	159	9665
PETLAD	23.51%		103002	9827	20	2026	370	220	2384
LALBAUG	7.04%		109264	17044	70	3440	47	401	65
DABHOI	29.22%		146415	12619	14	1168	966	650	8406
GODHRA	35.04%		89323	10083	42	1242	227	216	2453
AMRELI1	34.94%		101236	14575	25	2616	675	788	15384
BOTAD	45.27%		77403	11032	15	3122	332	141	17037
BHUJ	34.95%		97303	17710	26	1156	505	182	8290
KHAMBHALIYA	39.31%		77884	14080	33	1126	322	104	16674
JUNAGADHCITY	23.33%		73039	19343	24	1783	780	240	123
RAJKOTCITY2	17.80%		94423	32449	70	6099	33	133	12
MORBI	19.20%		101162	18891	381	3446	366	114	12362
TALOD	13.97%		92707	7395	31	979	745	403	19147
PATAN	13.36%		106377	13156	28	1087	443	417	5814
DEESA1	29.80%		66679	10892	64	1172	390	257	13413
RADHANPUR	31.27%		67866	8591	11	659	334	174	10619
BAVLA	29.59%		120392	1027	56	2158	608	214	5021
<<Dependent Variable>>			**<<<Independent Variable>>>**						
T & D loss (Y)		=	**Consumers in RL(X1), CL(X2), HTInd(X3), LTInd(X4), WW(X5), STL(X6) and AG(X7)**						

T&D loss% = Transmission and Distribution loss of a division for financial year	$CONS_{LTIND}$ = Average LT Industrial consumers in a year of a division (In numbers
$CONS_{RL}$ = Average residential consumers in a year of a division (In numbers).	CONSww = Average water work consumers in a year of a division (In numbers).
$CONS_{CL}$ = Average commercial consumers in a year of a division (In numbers).	$CONS_{STL}$ = Average streetlight & public lighting consumers in a year of a division
$CONS_{HTIND}$ = Average HT Industrial consumers in a year of a division (In numbers).	$CONS_{AG}$ = Average agriculture consumers in a year of a division (In numbers).

DISTRIBUTION LOSS MODEL

Multiple Regression Results

ANALYSIS : B.e

T & D LOSS Vs. CONSUMER MIX OF DIVISION

	0	1	2	3	4	5	6	7	8	9	10
	Intercept	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$			
b	**21.7677**	**2.51E-05**	**-0.0002**	**-0.0494**	**0.0010**	**0.0048**	**-0.0137**	**0.0009**			
s(b)	9.2360	0.0001	0.0004	0.0240	0.0013	0.0106	0.0108	0.0004			
t	2.3568	0.2678	-0.4817	-2.0610	0.8260	0.4491	-1.2680	2.4228			
p-value	**0.0324**	**0.7925**	**0.6370**	**0.0571**	**0.4217**	**0.6598**	**0.2241**	**0.0285**			
VIF		3.8586	2.8700	2.8291	4.3907	3.3036	4.1724	1.4154			

ANOVA Table

Source	SS	df	MS	*F*	$F_{Critical}$	*p*-value
Regn.	2096.615	7	299.516	3.140	2.707	0.030
Error	1430.951	15	95.397			
Total	3527.565	22				

s 9.76712448

R^2 0.5944

Adjusted R^2 0.405

Prediction Interval : Predict Value of (Y) here, based on MODEL & Enter data (X) below:

Given X

$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$			

Y =

1-α	(1-α) P.I. for Y for given X
95%	+ or -

Y =

1-α	(1-α) P.I. for E[Y | X]
95%	+ or -

$Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Where Yj = Dependent Variable, b_0 = Constant value and $b_1X_{1j} = b_1$ slope for variable X

R^2 Coefficient of Determination	**df**	Degrees of Freedom	**SS** Total Sum of square
R Coefficient of Correlation	**MS**	Mean Square	**SSR** Regression Sum of Squares
s (b_1) Standard Error of Slope	**f Ratio**	f = MSR/MSE	**SSE** Error Sum of Squares
s (b_0) Standard Error of Intercept	**MSR**	(Mean Square Regression) = SSR/k	SS = SSR + SSE
s Standard Error of prediction	**MSE**	(Mean Square Error) = SSE/n - (k+1)	

REVENUE COLLECTION MODEL

Data for Multiple Regression

ANALYSIS : C

COLLECTION EFFICIENCY Vs CONSUMER MIX OF DIVISION

Division	Y		X1	X2	X3	X4	X5	X6	X7
	CollEffy%		$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$
ANKLESHWAR	96.93%		23674	8323	272	1854	69	111	35
SURATIND	99.96%		52770	27805	557	15716	156	349	790
SURATURBAN	104.21%		234585	36054	19	10185	545	1167	5779
VYARA	96.03%		115221	7539	31	1614	700	634	14223
NAVSARIRURAL	97.47%		186334	12723	28	2370	1578	1754	14350
VAPIIND	98.10%		64034	13926	350	3906	82	295	2223
MAHEMDABAD	93.54%		91008	9105	28	946	791	159	9665
PETLAD	82.63%		103002	9827	20	2026	370	220	2384
LALBAUG	98.00%		109264	17044	70	3440	47	401	65
DABHOI	85.15%		146415	12619	14	1168	966	650	8406
GODHRA	94.80%		89323	10083	42	1242/	227	216	2453
AMRELI1	93.33%		101236	14575	25	2616	675	788	15384
BOTAD	103.88%		77403	11032	15	3122	332	141	17037
BHUJ	91.89%		97303	17710	26	1156	505	182	8290
KHAMBHALIYA	99.87%		77884	14080	33	1126	322	104	16674
JUNAGADHCITY	96.72%		73039	19343	24	1783	780	240	123
RAJKOTCITY2	99.05%		94423	32449	70	6099	33	133	12
MORBI	92.18%		101162	18891	381	3446	366	114	12362
TALOD	89.74%		92707	7395	31	979	745	403	19147
PATAN	80.45%		106377	13156	28	1087	443	417	5814
DEESA1	86.31%		66679	10892	64	1172	390	257	13413
RADHANPUR	92.02%		67866	8591	11	659	334	174	10619
BAVLA	98.21%		120392	1027	56	2158	608	214	5021
<<Dependent Variable>>			**<<<Independent Variable>>>**						
Collection Efficiency (Y)		=	**Consumers in RL(X1), CL(X2), HTInd(X3), LTInd(X4), WW(X5), STL(X6) and AG(X7)**						

CollEffy% = Collection efficiency of a division for financial year	$CONS_{LTIND}$ = Average LT Industrial consumers in a year of a division (In numbers
$CONS_{RL}$ = Average residential consumers in a year of a division (In numbers).	**CONSww** = Average water work consumers in a year of a division (In numbers).
$CONS_{CL}$ = Average commercial consumers in a year of a division (In numbers).	$CONS_{STL}$ = Average streetlight & public lighting consumers in a year of a divisior
$CONS_{HTIND}$ = Average HT Industrial consumers in a year of a division (In numbers).	$CONS_{AG}$ = Average agriculture consumers in a year of a division (In numbers).

REVENUE COLLECTION MODEL

Multiple Regression Results

ANALYSIS : C.a — **COLLECTION EFFICIENCY Vs. CONSUMER MIX OF DIVISION**

	0	1	2	3	4	5	6	7	8	9	10
	Intercept	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$			
b	**93.1800**	**0.0000**	**0.0000**	**-0.0081**	**0.0010**	**-0.0039**	**0.0030**	**0.0001**			
s(b)	6.1176	0.0001	0.0003	0.0159	0.0008	0.0070	0.0072	0.0003			
t	15.2314	-0.2397	-0.0098	-0.5122	1.2287	-0.5600	0.4120	0.5342			
p-value	**0.0000**	**0.8138**	**0.9923**	**0.6160**	**0.2381**	**0.5837**	**0.6862**	**0.6010**			
VIF		3.8586	2.8700	2.8291	4.3907	3.3036	4.1724	1.4154			

ANOVA Table

Source	**SS**	**df**	**MS**	***F***	$F_{Critical}$	***p*-value**
Regn.	230.567	7	32.938	0.787	2.707	0.609
Error	627.803	15	41.854			
Total	858.371	22				

R^2 0.2686 — ***s*** 6.4694318 — Adjusted R^2 -0.073

Prediction Interval : Predict Value of (Y) here, based on MODEL & Enter data (X) below:

Given X	$CONS_{RL}$	$CONS_{CL}$	$CONS_{HTIND}$	$CONS_{LTIND}$	$CONS_{WW}$	$CONS_{STL}$	$CONS_{AG}$			

Y =	**1-α**	**(1-α) P.I. for Y for given X**
	95%	+ or -

Y =	**1-α**	**(1-α) P.I. for E[Y | X]**
	95%	+ or -

$Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Where Yj = Dependent Variable, b_0 = Constant value and $b_1X_{1j} = b_1$ slope for variable X

R^2	Coefficient of Determination	**df**	Degrees of Freedom	**SS**	Total Sum of square
R	Coefficient of Correlation	**MS**	Mean Square	**SSR**	Regression Sum of Squares
s (b_1)	Standard Error of Slope	**f Ratio**	f = MSR/MSE	**SSE**	Error Sum of Squares
s (b_0)	Standard Error of Intercept	**MSR**	(Mean Square Regression) = SSR/k		SS = SSR + SSE
s	Standard Error of prediction	**MSE**	(Mean Square Error) = SSE/n - (k+1)		

Simple Regression

POWER RELIABILITY MODEL

ANALYSIS : D

POWER SUPPLY RELIABILITY vs. HT LINE LENGTH OF ALL FEEDERS IN DIVISION

Div	HT Length	RI %	
	X	Y	Error
1	231	98.97	-0.69391
2	418	99.81	0.182
3	1083	99.93	0.40909
4	3419	99.47	0.35139
5	3258	99.48	0.32563
6	915	99.95	0.39846
7	2963	99.39	0.19333
8	1777	99.42	0.01682
9	222	99.87	0.20806
10	4528	99.26	0.32162
11	2179	98.93	-0.40262
12	3302	99.09	-0.05162
13	2903	99.36	0.14748
14	4766	98.35	-0.54717
15	3715	97.61	-1.46344
16	218	99.40	-0.2658
17	341	99.66	0.01807
18	3159	98.75	-0.4206
19	2971	99.46	0.26418
20	3622	99.82	0.72727
21	5575	98.78	0.02432
22	5535	99.01	0.24661
23	3250	99.16	0.01083

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	-0.00017 + or - 0.00012

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	99.7026 + or - 0.3868

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

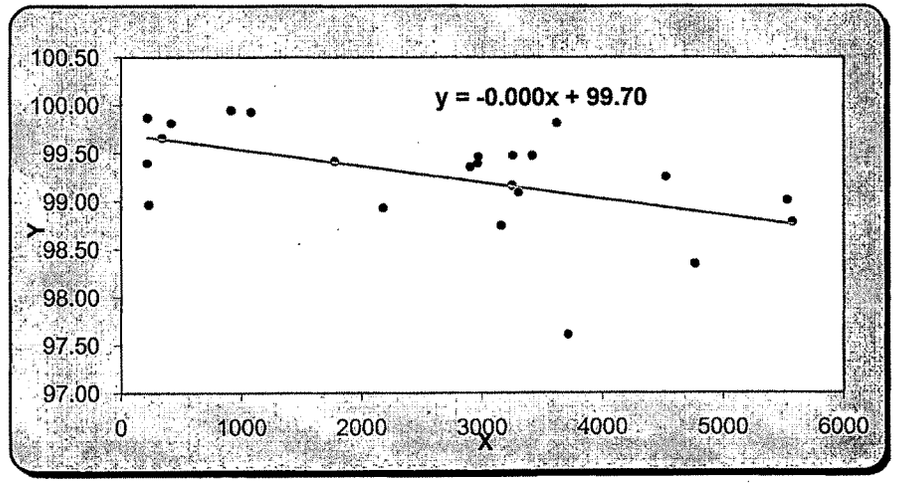
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.2765	Coefficient of Determination
r	-0.5258	Coefficient of Correlation
$s(b_1)$	6E-05	Standard Error of Slope
$s(b_0)$	0.186	Standard Error of Intercept
s	0.47761	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	1.83027	1	1.83027	8.02361	4.32479	0.0100
Error	4.79033	21	0.22811			
Total	6.6206	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H1 = A relationship of dependent variable RI to independent variable HT line length of feeders in division exists, as p-value < 0.05 (i.e. 0.010).

Hence, Null Hypothesis is rejected
(*See* Hypo : 9)

Simple MODEL

RI% = 99.7026 - 0.0002HTLength

Simple Regression

POWER RELIABILITY MODEL

ANALYSIS : D.a

POWER SUPPLY RELIABILITY vs. TOTAL FEEDERS IN DIVISION

Div	Feeders	RI %	
	X	Y	Error
1	41	98.97	-0.45848
2	102	99.81	0.53562
3	83	99.93	0.60336
4	75	99.47	0.12979
5	91	99.48	0.17071
6	94	99.95	0.64812
7	84	99.39	0.07113
8	67	99.42	0.05405
9	41	99.87	0.44502
10	91	99.26	-0.04876
11	46	98.93	-0.48531
12	87	99.09	-0.22389
13	179	99.36	0.26906
14	175	98.35	-0.75141
15	101	97.61	-1.67138
16	33	99.40	-0.04791
17	39	99.66	0.23
18	188	98.75	-0.32037
19	112	99.46	0.20949
20	189	99.82	0.75155
21	246	98.78	-0.1426
22	259	99.01	0.11848
23	114	99.16	-0.08626

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1		
95%	-0.00246	+ or -	0.00367

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0		
95%	99.5287	+ or -	0.46689

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.0847	Coefficient of Determination
r	-0.2910	Coefficient of Correlation
$s(b_1)$	0.00176	Standard Error of Slope
$s(b_0)$	0.22451	Standard Error of Intercept
s	0.53719	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	0.56048	1	0.56048	1.94222	4.32479	0.1780
Error	6.06012	21	0.28858			
Total	6.6206	22				

FINDINGS

H1 = A no any relationship of dependent variable RI to independent variable total number of feeders in Division, as p-value > 0.05 (i.e. 0.1780)

Hence, Null Hypothesis is accepted
(*See* Hypo : 10)

PROFIT MODEL

Data for Multiple Regression

ANALYSIS : E

PROFIT BEFORE TAX vs. T & D LOSS AND COLLECTION E

Division	Y		X1	X2
	PBT		T & D Loss%	CollEffy%
ANKLESHWAR	9653		0.98%	96.93%
SURATIND	27802		3.90%	99.96%
SURATURBAN	7994		18.23%	104.21%
VYARA	-4779		47.10%	96.03%
NAVSARIRURAL	-2399		22.35%	97.47%
VAPIIND	10675		7.82%	98.10%
MAHEMDABAD	-4285		26.38%	93.54%
PETLAD	-2266		23.51%	82.63%
LALBAUG	3044		7.04%	98.00%
DABHOI	-4022		29.22%	85.15%
GODHRA	2103		35.04%	94.80%
AMRELI1	-5463		34.94%	93.33%
BOTAD	-8070		45.27%	103.88%
BHUJ	-12792		34.95%	91.89%
KHAMBHALIYA	-6077		39.31%	99.87%
JUNAGADHCITY	146		23.33%	96.72%
RAJKOTCITY2	2421		17.80%	99.05%
MORBI	1631		19.20%	92.18%
TALOD	-5456		13.97%	89.74%
PATAN	-10473		13.36%	80.45%
DEESA1	-18628		29.80%	86.31%
RADHANPUR	-19019		31.27%	92.02%
BAVLA	36		29.59%	98.21%
<<Dependent Variable>>			**<<<Independent Variable>>>**	
PBT (Y)		=	**T & D loss (X1) and Collection efficiency (X2)**	

PBT = Profit before Tax of division (In lakhs)

T & D loss% = Transmission and Distribution loss of division during the year (In percentage)

CollEffy% = Collection efficiency of division during the financial year (In percentage)

PROFIT MODEL

Multiple Regression Results

ANALYSIS : E.a

PROFIT BEFORE TAX vs. T & D LOSS AND COLLECTION EFFICIENCY OF DIVISION

	0	1	2	3	4	5	6	7	8	9	10
	Intercept	T & D Loss%	CollEffy%								
b	**-63975**	**-495.2032**	**786.7962**								
s(b)	21007	108.9092	220.7757								
t	-3.045	-4.5469	3.5638								
p-value	**0.0064**	**0.0002**	**0.0019**								
VIF		1.0002	1.0002								

ANOVA Table

Source	SS	df	MS	*F*	$F_{Critical}$	*p*-value
Regn.	1378036532	2	689018266	16.47	3.4928	0.0001
Error	836669650	20	41833482			
Total	2214706181	22				

s = 6467.9

R^2 = 0.6222 Adjusted R^2 = 0.5844

Prediction Interval : Predict Value of (Y) here, based on MODEL & Enter data (X) below:

Given X	T & D Loss%	CollEffy%								

Y =	1-α	(1-α) P.I. for Y for given X
	95%	+ or -

Y =	1-α	(1-α) P.I. for E[Y | X]
	95%	+ or -

$Y_j = b_0 + b_1X_{1j} + b_2x_{2j} + ... + b_kX_{kj} + e_j \quad j = 1,.....n$

Where Yj = Dependent Variable, b_0 = Constant value and $b_1X_{1j} = b_1$ slope for variable X

R^2	Coefficient of Determination	**df**	Degrees of Freedom	**SS**	Total Sum of square
R	Coefficient of Correlation	**MS**	Mean Square	**SSR**	Regression Sum of Squares
s (b_1)	Standard Error of Slope	**f Ratio**	f = MSR/MSE	**SSE**	Error Sum of Squares
s (b_0)	Standard Error of Intercept	**MSR**	(Mean Square Regression) = SSR/k		SS = SSR + SSE
s	Standard Error of prediction	**MSE**	(Mean Square Error) = SSE/n - (k+1)		

Simple Regression

PBT TO T & D LOSS

ANALYSIS : E.c

PROFIT BEFORE TAX vs. T & D LOSS OF DIVISION

Div	T & D Loss%	PBT	
	X	Y	Error
1	0.98	9653	-13.6001
2	3.90	27802	19565.5
3	18.23	7994	6777.83
4	47.10	-4779	8150.53
5	22.35	-2399	-1594.59
6	7.82	10675	4359.04
7	26.38	-4285	-1505.63
8	23.51	-2266	-891.795
9	7.04	3044	-3653.29
10	29.22	-4022	146.786
11	35.04	2103	9124.71
12	34.94	-5463	1509.62
13	45.27	-8070	3961.02
14	34.95	-12792	-5816.37
15	39.31	-6077	3033.35
16	23.33	146	1427.35
17	17.80	2421	994.937
18	19.20	1631	891.093
19	13.97	-5456	-8758.29
20	13.36	-10473	-14073.5
21	29.80	-18628	-14176.9
22	31.27	-19019	-13846.5
23	29.59	36	4388.66

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1
95%	-489.931 + or - 282.602

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0
95%	10146.3 + or - 7657.78

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

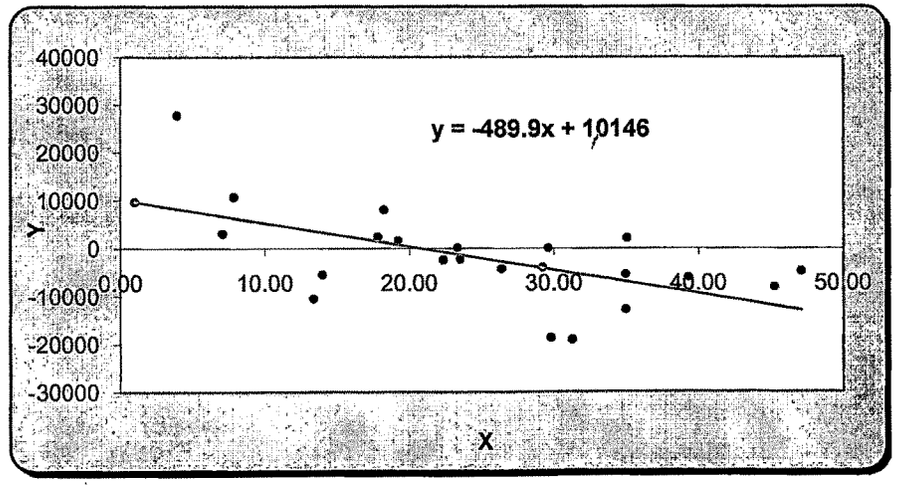
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.3823	Coefficient of Determination
r	-0.6183	Coefficient of Correlation
$s(b_1)$	135.891	Standard Error of Slope
$s(b_0)$	3682.31	Standard Error of Intercept
s	8071.05	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	8.5E+08	1	8.5E+08	12.9982	4.32479	0.0017
Error	1.4E+09	21	6.5E+07			
Total	2.2E+09	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H_1 = A relationship of dependent variable Profit Before Tax to independent variable T & D loss of division exists, as ANOVA p-value < 0.05 (i.e. 0.0017)

Hence, Null Hypothesis is rejected
(*See* Hypo : 11)

Simple MODEL

PBT = - 489.93 T&D Loss% + 10146

Simple Regression

PBT TO COLLECTION EFFICIENCY

ANALYSIS : E.c

PROFIT BEFORE TAX vs. COLLECTION EFFICIENCY OF DIVISION

Div	CollEffy%	PBT	
	X	Y	Error
1	96.93	9653	9335.27
2	99.96	27802	25141.3
3	104.21	7994	2047.13
4	96.03	-4779	-4401.03
5	97.47	-2399	-3133.92
6	98.10	10675	9454.58
7	93.54	-4285	-1985.73
8	82.63	-2266	8468.22
9	98.00	3044	1895.29
10	85.15	-4022	4768.62
11	94.80	2103	3434.14
12	93.33	-5463	-2996.32
13	103.88	-8070	-13765.6
14	91.89	-12792	-9211.61
15	99.87	-6077	-8672.04
16	96.72	146	-13.4034
17	99.05	2421	466.029
18	92.18	1631	4985.36
19	89.74	-5456	-215.166
20	80.45	-10473	1947.63
21	86.31	-18628	-10733.4
22	92.02	-19019	-15540.5
23	98.21	36	-1274.85

Confidence Interval for Slope

1–α	(1-α) C.I. for β_1		
95%	773.159	+ or -	638.919

Confidence Interval for Intercept

1–α	(1-α) C.I. for β_0		
95%	-74623	+ or -	60419.5

Prediction Interval for Y

1–α	X	(1-α) P.I. for Y given X
1%		+ or -

Prediction Interval for E[Y\|X]

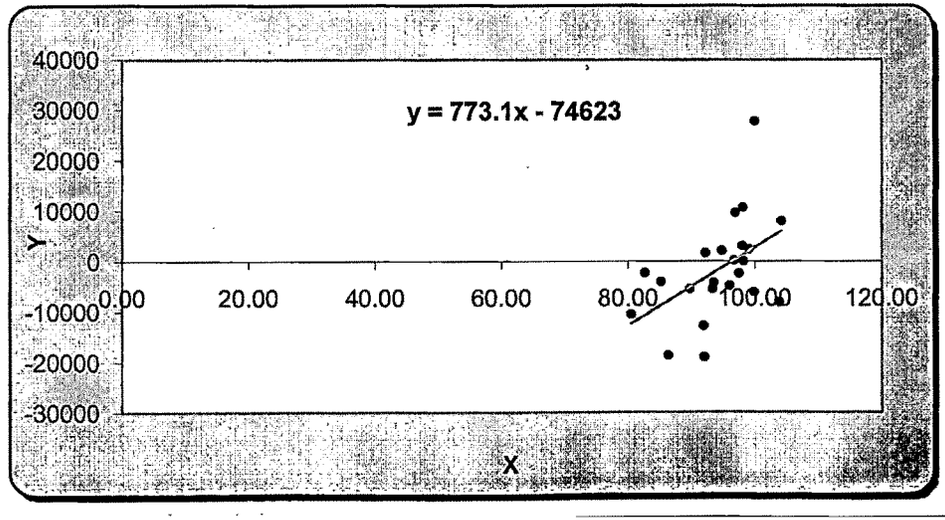
1–α	X	(1-α) P.I. for E[Y | X]
100%		+ or -

r^2	0.2317	Coefficient of Determination
r	0.4814	Coefficient of Correlation
$s(b_1)$	307.23	Standard Error of Slope
$s(b_0)$	29053.2	Standard Error of Intercept
s	9001.49	Standard Error of prediction

ANOVA Table

Source	SS	df	MS	F	$F_{critical}$	p-value
Regn.	5.1E+08	1	5.1E+08	6.33303	4.32479	0.0200
Error	1.7E+09	21	8.1E+07			
Total	2.2E+09	22				

Scatter Plot, Regression Line and Regression Equation



FINDINGS

H_1 = A relationship of dependent variable Profit Before Tax to to independent variable Collection efficiency in particular division exists, as ANOVA p-value < 0.05 (i.e. 0.0200)

Hence, Null Hypothesis is rejected
(*See* Hypo : 12)

Simple MODEL

PBT = 773.16 CollEffy% - 74623

END NOTES AND REFERENCES

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[5] Nargundkar, op. cit., pp. 260-279.

[6] Levin and Rubin, loc. cit.

[7] Nargundkar, op. cit., pp. 260-279.

[8] Nargundkar, op. cit., pp. 260-279.

[9] Levin and Rubin, loc. cit.

[10] Levin and Rubin, loc. cit.

[11] Nargundkar, op. cit., pp. 260-279.

[12] Nargundkar, op. cit., pp. 260-279.

[13] Levin and Rubin, loc. cit.

[14] Joshi, Rakesh Mohan (2008), "Gujarat Electricity Board's Turn Around", The Smart Manager, www.thesmartmanager.com, Feb-Mar, p. 52.