

CONTENTS

	Page No.
Dedication	i
Certificate of the Supervisor	ii
Abstract	iii-iv
Contents	v-xi
Preface	xii-iv
<u>CHAPTER - I</u>	
INTRODUCTION	1-23
1.1. Background of the Study	1
1.2. Review of Literature	3
1.3. Objective of the Study	8
1.4. Data Used in the Study	9
1.5. Methodology	10
1.6. Organization of the Contents	18
1.7. Findings of the Study	18
1.8. Policy Implications	23
<u>CHAPTER - II</u>	
SALIENT FEATURES OF ENERGY CONSUMPTION AND STRUCTURAL RELATIONSHIP	24-40
2.1. Statistical Properties of Energy Consumption	24
2.1.1. For Gas Consumption	24
2.1.2. For Electricity Consumption	25
2.2. Correlation With Other Factors	25
2.3. Structural Relationship	26
2.3.1. Step-wise Regression	27
2.3.1.1 Criteria For Selecting Appropriate Sub-set Regressors	27
2.3.1.2 Results of Step-wise Regression Analysis For Gas Consumption	30
2.3.1.3 Results of Step-wise Regression Analysis For Electricity Consumption	31
2.3.2. Selection of Sub-set Regressors by Factor Analysis	32
2.3.2.1 Results of Factor Analysis For Gas Consumption	33

2.3.2.2 Results of Factor Analysis For Electricity Consumption	33
2.4. Summary	34
A P P E N D I X I I	36-40

C H A P T E R - I I I

APPLICATION OF GROWTH MODEL	41- 61
3.1. Introduction	41
3.1.1. Definition of Growth Model	42
3.1.2. Models Considered in the Study	43
3.2. Transformation of Variables	44
3.3. Criteria Used for Selection of Model	46
3.4. Selection of Model for Gas Consumption	47
3.4.1. For Untransformed Series	48
3.4.2 For Log-transformed Series	49
3.5. Selection of Model for Electricity Consumption	50
3.5.1. For Untransformed series	51
3.5.2. For Log-transformed Series	52
3.6. Preference of Variables (Untransformed or Transformed)	53
3.6.1. For Gas Consumption	53
3.6.2. For Electricity Consumption	53
3.7. Summary	54
A P P E N D I X I I I	56-61

C H A P T E R - I V

APPLICATION OF ARIMA METHODOLOGY	62-115
4.1. Introduction	63
4.1.1. Three Basic Concepts of ARIMA(p,d,q) Methodology	63
4.1.2. Other Concepts Related to ARIMA Models	67
4.2. Characteristics of a Good ARIMA Model	73
4.3. Steps in the Box-Jenkins' Iteration Approach to Model Building	74
4.4. Criteria Used for Determination of the Order of Autoregression and the Degree of Differencing	76
4.5. Criteria Used for Testing the Validity of Model	80
4.6. Notation and Interpretation of ARIMA Model	80
4.7. Selection of ARIMA Model for Gas Consumption	82
4.7.1. For Untransformed Series	83

4.7.2. For Log-transformed Series	89
4.8. Selection of ARIMA Model for Electricity Consumption	92
4.8.1. For Untransformed Series	92
4.8.2. For Log-transformed Series	93
4.9. Preference of Variables (Untransformed or Transformed)	95
4.9.1. For Gas Consumption	95
4.9.2. For Electricity Consumption	95
4.10. Summary	96
APPENDIX IV	98 -115

CHAPTER - V

APPLICATION OF ANN TECHNIQUE	116-142
5.1. Introduction	116
5.1.1. The ANN Model in Brief	119
5.1.2. The ANN Modelling Cycle	126
5.2. Criteria Used for Selection of Model	127
5.3. Modelling Cycle for Gas Consumption	128
5.3.1. For Untransformed Series	128
5.3.2. For Log-transformed Series	130
5.4. Modelling Cycle for Electricity Consumption	131
5.4.1. For Untransformed Series	132
5.4.2. For Log-transformed Series	133
5.5. Preference of Variable (Untransformed or Transformed)	134
5.5.1. For Gas Consumption	134
5.5.2. For Electricity Consumption	134
5.6. Summary	135
APPENDIX V	137-142

CHAPTER - VI

COMPARISON OF THE FORECASTING	143 - 174
PERFORMANCE AND FINAL MODEL SELECTION	
6.1. Introduction	143
6.2. Criteria Used for Comparison of Forecasting Performance	145
6.2.1. Pair wise Accuracy Comparison	146
6.2.2. Individual Predictive Performance Comparison	151
6.3. Results And Discussion	154
6.3.1. For Untransformed Gas Consumption	155

6.3.2. For Log-Transformed Gas Consumption	157
6.3.3. For Untransformed Electricity Consumption	158
6.3.4. For Log-Transformed Electricity Consumption	160
6.4. Summary	161
APPENDIX VI	163- 174

CHAPTER VII

CONCLUDING REMARKS AND SUGGESTIONS 175 - 181

7.1. Major Findings of the Study	175
7.2. Policy Implications and Suggestions for Further Study	178
7.3. Concluding Remarks	179
7.4. Limitations of the Study	180
7.5. Epilogue.	181

BIBLIOGRAPHY 182-189

ABSTRACT OF THE PUBLISHED/COMMUNICATED PAPERS

LIST OF TABLES

Table Number	Particulars	Page No.
Table 2.1.	Pair wise correlation coefficients between different factors	36
Table 2.2.1.	Step-wise regression output for gas consumption	36
Table 2.2.2.	Values of diagnostic criteria of considered regression models for gas consumption	37
Table 2.3.1.	Step-wise regression output for electricity consumption	38
Table 2.3.2.	Values of diagnostic criteria of considered regression models for electricity consumption	39
Table 2.4.1.	Output of factor analysis for gas consumption (extraction of factors by maximum likelihood method)	40
Table 2.4.2.	Output of factor analysis for electricity consumption (extraction of factors by maximum likelihood method)	40
Table 3.1.1.	Values of diagnostic criteria for selecting growth models for untransformed gas consumption	56

Table 3.1.2. Values of diagnostic criteria for selecting growth models for log-transformed gas consumption	57
Table 3.1.3. Observed and predicted values obtained by selected growth models for gas consumption data	58
Table 3.2.1. Values of diagnostic criteria for selecting growth models for untransformed electricity consumption	59
Table 3.2.2. Values of diagnostic criteria for selecting growth models for log-transformed electricity consumption	60
Table 3.2.3. Observed and predicted values obtained by selected growth models for electricity consumption data	61
Table 4.1.1. Values of diagnostic criteria for selecting ARIMA models for untransformed gas consumption	98
Table 4.1.2. Values of diagnostic criteria for selecting ARIMA models for log-transformed gas consumption	99
Table 4.1.3. Observed and predicted values obtained by selected ARIMA models for gas consumption data	100
Table 4.2.1. Values of diagnostic criteria for selecting ARIMA models for untransformed electricity consumption	101
Table 4.2.2. Values of diagnostic criteria for selecting ARIMA models for log-transformed electricity consumption	102
Table 4.2.3. Observed and predicted values obtained by selected ARIMA models for electricity consumption data	103
Table 5.1.1. Values of diagnostic criteria for selecting ANN models for untransformed gas consumption	137
Table 5.1.2. Values of diagnostic criteria for selecting ANN models for log-transformed gas consumption	138
Table 5.1.3. Observed and predicted values obtained by selected ANN models for gas consumption data	139
Table 5.2.1. Values of diagnostic criteria for selecting ANN models for untransformed electricity consumption	140
Table 5.2.2. Values of diagnostic criteria for selecting ANN models for log-transformed electricity consumption	141
Table 5.2.3. Observed and predicted values obtained by selected ANN models for electricity consumption data	142
Table 6.1.1. Statistics for pairwise prediction accuracy comparison of selected models for untransformed gas consumption	163
(a) Absolute values of z statistics for sign test and WSR tests,	

	t-statistic for MGN tests	
	(b) Regression co-efficients for tests of encompassing-in-forecasts	
Table 6.1.2.	The values of the predictive performance comparison criteria for different types of selected models of untransformed gas consumption	164
Table 6.1.3.	Statistics for pair wise prediction accuracy comparison for log-transformed gas consumption	165
	(a) Absolute values of z statistics for sign test and WSR tests, t-statistic for MGN tests	
	(b) Regression co-efficients for tests of encompassing-in-forecasts	
Table 6.1.4.	The values of the predictive performance comparison criteria for different types of selected models of log-transformed gas consumption	166
Table 6.2.1.	Statistics for pair wise prediction accuracy comparison of selected models for untransformed electricity consumption	167
	(a) Absolute values of z statistics for sign test and WSR tests, t-statistic for MGN tests	
	(b) Regression co-efficients for tests of encompassing-in-forecasts	
Table 6.2.2.	The values of the predictive performance comparison criteria for different types of selected models of untransformed electricity consumption	168
Table 6.2.3.	Statistics for pairwise prediction accuracy comparison for log-transformed electricity consumption	169
	(a) Absolute values of z statistics for sign test and WSR tests, t-statistic for MGN tests	
	(b) Regression co-efficients for tests of encompassing-in-forecasts	
Table 6.2.4.	The values of the predictive performance comparison criteria for different types of selected models of log-transformed electricity consumption	170

LIST OF FIGURES

<u>Figure Number</u>	<u>Particulars</u>	<u>Page No.</u>
Figure 4.1.1.	ACF and PACF of gas consumption (untransformed original series)	104
Figure 4.1.2	ACF and PACF of differenced series of gas consumption (untransformed)	105
Figure 4.1.3.	ACF and PACF of error series of gas consumption (untransformed) for ARIMA(1,2,1) model	106
Figure 4.2.1.	ACF and PACF of gas consumption (transformed original series)	107
Figure 4.2.2.	ACF and PACF of differenced series of gas consumption (transformed)	108
Figure 4.2.3.	ACF and PACF of error series of gas consumption (transformed) for ARIMA(1,2,1) model	109
Figure 4.3.1.	ACF and PACF of electricity consumption (untransformed original series)	110
Figure 4.3.2.	ACF and PACF of differenced series of electricity consumption (untransformed)	111
Figure 4.3.3.	ACF and PACF of error series of electricity consumption (untransformed) for the ARIMA(1,2,1) model	112
Figure 4.4.1.	ACF and PACF of electricity consumption (transformed original series)	113
Figure 4.4.2.	ACF and PACF of differenced series of electricity consumption (transformed)	114
Figure 4.4.3.	ACF and PACF of error series of electricity consumption (transformed) for ARIMA(1,1,1) model	115
Figure 5.1.	Layout of a feed forward back propagation neural network	123
Figure 6.1.1.	Fitted values and observed series of gas consumption (untransformed)	171
Figure 6.1.2.	Fitted values and observed series of gas consumption (log-transformed)	172
Figure 6.2.1.	Fitted values and observed series of electricity consumption (untransformed)	173
Figure 6.2.2.	Fitted values and observed series of electricity consumption (log-transformed)	174