

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	C – Elective - II	21P2SME2 (B)	Time Series Analysis	4	5	25	75	100

Nature of Course			
Knowledge and skill	✓		Employability oriented
Skill oriented			Entrepreneurship oriented

Course Objectives:

1. To introduce the statistical techniques to evaluate processes occurring through time.
2. To teach students to understand, identify and acquire the necessary skills to create and analysis the time series data.

Unit	Description	Hours	K-level	CLO(s)
I	Models of Time Series – Additive and Multiplicative models – Analysis and forecasting – Elimination of trend – growth curve – Modified experimental curve (Method of three selected points only) - Gompertz curve- Logistic curve with examples.	12	K2	1
II	Stationary processes – Auto-covariance and autocorrelation functions and their properties – partial auto correlation function - Estimation of autocorrelation and its standard error – unit root test.	13	K3	2
III	Linear stationary models - stationary and invertability - Autoregressive and Moving average processes and their autocorrelation functions- Autoregressive moving average processes. Linear non-stationary models - Autoregressive integrated moving average processes – integrated moving average processes and Seasonal Autoregressive integrated moving average processes.	17	K3	3
IV	Box-Jenkins models: Identification techniques - Initial estimates for different processes –AR, MA, ARMA - choice between stationary and non stationary models – model diagnostic - model multiplicity - Study of residuals and diagnostic checking - Use of computer packages for the above techniques.	19	K4	4
V	Introduction to spectral analysis of weakly stationary processes - periodogram and correlogram analysis including computations based on Fourier transform. Use of spectral representation to show the existence of autoregressive processes and their representation as one-sided moving average processes.	14	K4	5

Books for Reference:

1. Anderson, T. W. (2011) *The Statistical Analysis of Time Series*, Wiley, New York.
2. Bloomfield, P. (2004) *Fourier analysis of Time Series - An Introduction*, 2/e, Wiley, New York.
3. Box, G. E. P. and Jenkins, G.M. and Reinsel, G.C. (2013) *Time Series Analysis - Forecasting and Control*, 4/e, Holden- Day, San Francisco.
4. Brockwell, P. J. and Davis, R. A. (2002) *Introduction to Time Series and Forecasting*. Taylor & Francis, San Francisco.
5. Chatfield, C. (1978) *The Analysis of Time Series - Theory and Practice*, 3/e Chapman & Hall, London.
6. Gupta, S. C. and Kapoor, V.K. (2007) *Fundamentals of Applied Statistics*, 4/e, Sultan Chand & Sons, New Delhi.
7. Hannan, E. J. (1960) *Time Series Analysis*, Methuen, London.
8. Kendall, M. G. and Stuart, A. (1976) *The advanced Theory of Statistics*, Vol.3, Charles Griffin, London.
9. Kendall, M. G. (1974) *Time Series*. Charles Griffin, London.
10. Koopmans, L. H. (1995) *The spectral analysis of Time Series*. Academic Press, New York
11. Montgomery, D. C. and Johnson, L. A. (1977) *Forecasting and Time Series analysis*. McGraw Hill, New York.
12. Priestley, M. B. (1981) *Spectral analysis and Time Series*. Griffin, London.

Web Resources:

1. Introduction to time series:
<https://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm>
2. Stationary process:
<https://www.youtube.com/watch?v=r98eALg-suE>
<https://towardsdatascience.com/stationarity-in-time-series-analysis-90c94f27322>
3. Seasonal ARIMA
<https://people.duke.edu/~rnau/411arim.htm>

Rationale for Nature of the course

- The course provides the knowledge on the forecasting techniques with suitable ARIMA models by analyzing the old data.
- The course identifies the best model to forecast the data

Activities having direct bearing on Skill development / Employability / Entrepreneurship

- Fitting suitable time series models to real time problems

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Models of Time Series – Additive and Multiplicative models	3	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Analysis and forecasting – Elimination of trend	2	
	growth curve – Modified experimental curve	2	
	Gompertz curve	2	
	Logistic curve	3	
II	Stationary processes	3	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Auto-covariance and autocorrelation functions and their properties	3	
	partial auto correlation function	3	
	Estimation of autocorrelation and its standard error – unit root test.	4	
III	Linear stationary models	2	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	stationary and invertability	3	
	Autoregressive and Moving average processes and their autocorrelation functions	2	
	Autoregressive moving average processes	3	
	Linear non-stationary models	2	
	Autoregressive integrated moving average processes	3	
	integrated moving average processes	2	
	Seasonal Autoregressive integrated moving average processes	4	
IV	Box-Jenkins models: Identification techniques	2	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Initial estimates for different processes –AR, MA, ARMA	3	
	choice between stationary and non stationary models	2	
	model diagnostic	3	
	model multiplicity	3	
	Study of residuals and diagnostic checking	2	
	Use of computer packages for the above techniques.	2	
V	Introduction to spectral analysis of weakly stationary processes	5	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	periodogram and correlogram analysis including computations based on Fourier transform	4	
	Use of spectral representation to show the existence of autoregressive processes and their representation as one-sided moving average processes	5	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO1	Describe times series model and apply various methods of analysis and forecasting in terms of time series data.	Up to K2
CLO2	Define the concept of stationary process.	Up to K3
CLO3	Discriminate between stationary, non-stationary time series and verify mathematical consideration for analysing time series, including concept of stationary, auto covariance and auto correlation.	Up to K3
CLO4	Create suitable times series models for the given dataset by transforming standard data into time series format using software packages.	Up to K4
CLO5	Demonstrate spectral analysis of weakly stationary processes.	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	1	2	3	1	3	3	2
CLO-2	2	2	2	2	2	2	2
CLO-3	1	2	2	2	2	2	1
CLO-4	2	2	2	2	2	2	3
CLO-5	1	2	2	2	2	2	1

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I :: BLUE PRINT

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	3	K1, K1, K2	2	K1, K2	1	K2
CLO 2	Up to K3	2	K2, K3	2	K2, K3	2	K3, K3
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15.00	55%
K2	4	10	10	24	40.00	
K3	2	5	20	27	45.00	45%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA-II Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	2	K1 , K2	2	K2, K3	1	K2
2	CLO 4	Up to K4	3	K1, K2,K3	2	K3, K4	2	K3, K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25	25%
K5	-	-	-	-	-	-
Total marks	10	20	30	60		

Summative Examination Blue Print

S.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)	
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)	
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of Section wise marks with K levels for summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	33.33
K2	2	2	10	10	24	20.00	
K3	4	4	10	20	38	31.67	31.67
K4	2	-	20	20	42	35	35
K5	-	-		-			
Total	10	10	50	50	120	100	100

Course Designers:

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