2018

[OBE DESIGN- STATISTICS DEPARTMENT]

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PREFACE

Outcome Based Education (OBE) is the educational approach which focuses on student centric education in the context of development of personal, social, professional and knowledge (KSA) requirements in one's career and life. It is the decade ago curriculum development methodology. The educational triangle of _LEARNING-ASSESSMENT-TEACHING_ is the unique nature of the OBE approach. The curriculum practices such as Competency Based Curriculum, Taylor's Model of Curriculum Development, Spadys' Curriculum principles, Blooms taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models/approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidenced Based Education, Systems' Approach, etc as the scientific and systematic approaches in curriculum design.

The authorities of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) in-lieu of accreditation standards of National Assessment and Accreditation Council, decided to opt for Outcomes Based Education (OBE). As the part of the decision, different meetings, workshops and presentations were held at the campus of university.

This document is the outcome of different meetings and workshops held at university level and department level. The detailed document is designed and the existing curriculum of the department is transformed in to the framework of OBE. This is the first step towards the implementation of OBE in the department. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the graduates/Post-graduates of the university department.

Head of Department

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OUTCOME BASED EDUCATION

Faculty of Science & Technology

Department of Statistics

1. Mission:

Mission Statement

- To improve continually the academic research dissemination and quality in statistics teaching and research.
- To promote quality of teaching, learning and research in the department.
- To encourage quality related research studies, consultancy and training programs.
- To collaborate with other stake holders of Statistical studies and campus employment.

2. Vision:

Vision Statement

- To strengthen the Statistics teaching, research and its applications.
- To start five year integrated programme in Statistics i.e. M. Stat.
- To develop the Department as canter for excellence in Statistics.

3. Title of the Program (s):
   a. **Master of Statistics**

4. Program Educational Objectives:
The program educational objectives (PEO) are the statement that describes the career and professional achievement after the program of studies (graduation/ post-graduation). The PEO s are driven form question no. (ii) of the Mission statement (What is the purpose of organization). The PEOs can be minimum three and maximum five.

PEO1: To have advance knowledge of statistics and statistical tools and apply rules in designing/solving problems.

PEO2: To provide the professional services to industry, research organization, institutes.

PEO3: To provide the professional consultancy and research support for the relevant organization in the domain of super specialization.

PEO4: To opt for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

PEO5: To provide, value based and ethical leadership in the professional and social life.

5. Program Outcomes:

The program outcomes (PO) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the graduate/ post-graduate will have by the end of program studies.
a. Apply solid general foundation and a mastery of statistical and quantitative techniques applicable in a wide variety of fields.
b. Apply statistical concepts for industries, institutions and other organization.
c. Application of technology to identify solutions through the use of computers, software and computer programming.
d. Interpret and communicate their results.
e. Apply solid basis for research in Statistics and prepare candidates for Ph.D. programme in statistics.
f. Report writing and LaTeX document production.
g. Practice of statistical analysis at an advanced level.

6. Course- Program outcome Matrix:

The Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, ***"to which POs his/her course in contributing?"***. So that one can design the learning experiences, select teaching method and design the tool for assessment. Hence, establishing the Corse-PO matrix is essential step in the OBE. The course-program outcomes matrix indicates the co-relation between the courses and program outcomes. The CO-PO matrix is the map of list of courses contributing to the development of respective POs.
The template is provided in the below table.

M. Sc. Statistics

Course Title	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
Mathematical Analysis	*	*	*				
Distribution Theory	*	*	*				
Probability Theory	*	*	*				
Statistical Inference-I	*	*	*				
Statistical Computing	*	*	*				

Practical-I	*	*	*				
Practical-II	*	*	*				
Design and Analysis of Experiments-I	*	*	*				
Stochastic Processes	*	*	*				
Sample Survey	*	*	*				
Statistical Inference-II	*	*	*				
Regression Analysis	*	*	*				
Practical-III	*	*	*				
Practical-Iv	*	*	*				
Multivariate Analysis			*	*	*	*	*
Design and Analysis of Experiments-II			*	*	*	*	*
Operation Research-I			*	*	*		
Industrial Statistics-I			*	*	*		
Actuarial Statistics-I			*	*	*		
Practical-V			*	*	*		
Practical-VI			*	*	*		
Statistical Analysis of clinical trials			*	*	*	*	*
Operation Research-II			*	*	*	*	*
Industrial Statistics-II			*	*	*	*	*
Actuarial Statistics-II			*	*	*	*	*
Project			*	*	*	*	*
Practical-VII			*	*	*	*	*
Practical-VIII			*	*	*	*	*

7. Course Outcomes (for all courses):

The course outcomes are the statement that describes the knowledge & abilities developed in the student by the end of course (subject) teaching. The focus is on development of abilities rather than mere content. There can be 5 to 7 course outcomes of any course. These are to be written in the specific terms and not in general. The list of course outcomes is the part of ***Annexure-B*** attached herewith.

8. Set Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

9. Set Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

10. Course Attainment Levels:

a. CO attainment is defined/set at three levels;

b. The CO attainment is based on end term examination assessment and internal assessment;

c. The Co attainment is defined at three levels in ascending order-

    i. e.g. For end term and internal examination;

    ii. Level-1: 40% students scored more than class average

    iii. Level-2: 50% students score more than class average;

    iv. Level-3: 60% students score more than class average.

d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 50% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.

e. CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

11. Program attainment Level:

a. PO attainment is defined at five levels in ascending order;

b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);

c. The PO attainment levels are defined / set as stated below;

    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1)- Poor

    ii. Level-2: 1.0>1.5-Average

    iii. Level-3: 1.5>2.0-Good

    iv. Level-4: 2.0>2.5-Very Good

    v. Level-5: 2.5>3.0 -Excellent

d. The PO attainment target level is set/defined (say, Level-3). It implies that, the department is aiming at minimum level-4 (good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;

e. PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

12. The Results of CO Attainment:

The Results of CO attainment is provided in Annexure-C

     e.g. For end term and internal examination;

  i. Level-1: 40% students scored more than class average

  ii. Level-2: 50% students score more than class average; iv.

  iii. Level-3: 60% students score more than class average

STA-511

Average Marks in External examination: 46.714 = i.e. 47

% Students score more than 54 is 13/21 i.e. 61.90% i.e. Levl-3

Average Marks in Internal examination= 11.14= i.e. 11.00

% Students score more than 11.00 is 12/21= 57.14%, i.e. Level-2

A(CO)GEO-404= 80% (3)+20(2)

    =2.4+0.4

     =2.80

Table No. 1.0: CO Attainment Level

Course Title	CO Attainment Value	Target Attainment Level	Fully Attained/ Not Attained	Remarks
Mathematical Analysis	2.8	2	**Fully Attained**	
Distribution Theory	2.2	2	**Fully Attained**	
Probability Theory	2.8	2	**Fully Attained**	

Statistical Inference-I	2	2	**Fully Attained**	
Statistical Computing	2.2	2	**Fully Attained**	
Practical-I	2	2	**Fully Attained**	
Practical-II	2	2	**Fully Attained**	
Design and Analysis of Experiments-I	2.8	2	**Fully Attained**	
Stochastic Processes	2.2	2	**Fully Attained**	
Sample Survey	3	2	**Fully Attained**	
Statistical Inference-II	2	2	**Fully Attained**	
Regression Analysis	2.2	2	**Fully Attained**	
Practical-III	2	2	**Fully Attained**	
Practical-Iv	3	2	**Fully Attained**	
Multivariate Analysis	2	2	**Fully Attained**	
Design and Analysis of Experiments-II	1.2	2	**Not Attained**	Remedial measures such as assignments, tutorials, exercises and coaching.

Operation Research-I	2.6	2	**Fully Attained**	
Industrial Statistics-I	2.2	2	**Fully Attained**	
Actuarial Statistics-I	1.8	2	**Not Attained**	Remedial measures such as assignments, tutorials, exercises and coaching.
Practical-V	2	2	**Fully Attained**	
Practical-VI	3	2	**Fully Attained**	
Statistical Analysis of clinical trials	2.8	2	**Fully Attained**	
Operation Research-II	2	2	**Fully Attained**	
Industrial Statistics-II	2.2	2	**Fully Attained**	
Actuarial Statistics-II	1.4	2	**Not Attained**	Remedial measures such as assignments, tutorials, exercises and coaching.
Project	2	2	**Fully Attained**	
Practical-VII	1	2	**Not Attained**	Remedial measures such as assignments, tutorials, exercises and coaching.
Practical-VIII	3	2	**Fully Attained**	

13. The Results of PO Attainment:

The Results of PO attainment is provided in Annexure-C.

For Example:

PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

$A(PO)a$= 80% (2+1.2+2.6+2.2+1.8+2+3+2.8+2+2.2+1.4+2+1)/13 +20% (2.58)

= 80% (2.085714) + 20 %(2)

= 1.66+0.4=2.08

=2.08

Table No. 2.0 PO Attainment Level

PO/PSO number	PO Attainment Value	Target Attainment level	Fully attained/ Not Attained	Remedial Measures
PO1	2.37	3	Fully attained	
PO2	2.37	3	Fully attained	
PO3	2.23	3	Fully attained	
PO4	2.09	3	Fully attained	
PO5	2.09	3	Fully attained	
PSO1	1.96	3	Fully attained	
PSO2	1.96	3	Fully attained	

14. Planned Actions for Course Attainment:

The CO attainment less than Level-2 shall be addressed by preparing the schedule. The assignment, exercises, tutorials and remedial coaching will be planned to attain the gaps.

15. Planned Actions for Program Outcome Attainment:

Not Applicable.

ANNEXURE-B
COURSE OUTCOMES

Mathematical and Statistical Analysis

1. To formulate complete, concise, and correct mathematical **proofs**.
2. To frame problems using multiple mathematical and statistical representations of relevant structures and relationships and **solve** using standard techniques.
3. To create quantitative **models** to solve real world problems in appropriate contexts.
4. To describe quantitative ideas both orally and in writing to a range of audiences.

Distribution Theory

1. Develop problem solving techniques needed to accurately calculate distributions.
2. Apply problem solving techniques to solving real-world events.
3. Apply selected distributions to solve problems.
4. Present the analysis of derived statistics to all audiences

Probability Theory

1. Develop problem solving techniques needed to accurately calculate probability.
2. Apply problem solving techniques to solving real-world events.
3. Apply selected probability distributions to solve problems.
4. Present the analysis of derived statistics to all audiences

Statistical Interface-I

1. To explain the fundamental principles for statistical inference.
2. To apply the method for construction of point and interval estimators, and hypothesis testing.
3. To evaluate estimators and tests.
4. To construct optimal estimators and tests.
5. To perform point estimation, hypothesis testing and interval estimation

Research Methodology

1. To classify the research studies.
2. Design a research study proposal
3. To measure and analyze data
4. To explain the principles of conducting ethical research
5. Apply concepts of hypothesis testing, p values, descriptive statistics
6. Estimate the effect of sample size and statistical power

7. Apply statistical tools in solving problems

Design and Analysis of Experiment-I

1. To identify the experimental design that has been followed,
2. To comment on the shortfalls of the design used.
3. To apply the tools and techniques to identify missing data.
4. To implement multiple comparison test to perform the appropriate analysis;
5. To apply experimental methods to solve the problems.

Stochastic Processes

1. To demonstrate the ability to bring together and flexibly apply knowledge to characterise, analyse and solve a wide range of problems
2. To describe the relationship between the purpose of a model and the appropriate level of complexity and accuracy.
3. To demonstrate the ability to locate and use data and information and evaluate its quality with respect to its authority and relevance.
4. To apply stochastic processes and their range of applications;
5. To demonstrate essential stochastic modelling tools including Markov chains and queuing theory;
6. To formulate and solve problems which involve setting up stochastic models

Sampling Theory and Methods

1. To apply the principles underlying sampling as a means of making inferences about a population

2. To describe the difference between randomization theory and model based analysis.

3. To explain the concepts of bias and sampling variability and strategies for reducing these.

4. To analyse data from multi-stage surveys.

5. To analyse the practical issues arising in sampling studies.

Regression Analysis

1. To describe and compare the different types of regression and when these are applicable.
2. To implement/ analyse uni-variable linear regression model fits.
3. To explain the role of residuals.

4. To implement multiple linear and logistics regression models and how these can be constructed
5. decipher output from a software package

Statistical Interface-II
1. To explain the fundamental principles for statistical inference.
2. To apply the different methods (CAN/Method of maximum likelihood/ double exponential) method for construction of point and interval estimators, and hypothesis testing.
3. To evaluate estimators and tests.
4. To construct optimal estimators and large sample tests.
5. To perform point estimation, hypothesis testing and interval estimation

Design and Analysis of Experiment-II
- To identify the experimental design that has been followed,
- To anaylse and describe the shortfalls of the design used,
- To design assumptions appropriate in modelling the data,
- To perform the appropriate analysis;
- To apply the principles of randomisation and replication nested designs, block designs, factorial designs and fractional layouts and response surface designs in problem solving.

Statistical Analysis and clinical trials

1. Select and apply methods of data summary and presentation
2. Describe basic statistical principles including probability, distributions and statistical inference
3. Select and apply statistical methods for analyses of clinical trials, in particular for differences between means, between proportions and for the association between categorical variables
4. Explain the concepts of correlation, linear regression and analyses of time-to-event (survival) data
5. Interpret results from the statistical methods covered on the programme
6. Explain the uses of baseline data in the analyses of clinical trials.

ANNEXURE-C
RESULTS OF CO-PO ATTAINMENT
M.Sc. STATISTICS

Course Title	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
Mathematical Analysis	2.8	2.8	2.8				
Distribution Theory	2.2	2.2	2.2				
Probability Theory	2.8	2.8	2.8				
Statistical Inference-I	2	2	2				
Statistical Computing	2.2	2.2	2.2				
Practical-I	2	2	2				
Practical-II	2	2	2				
Design and Analysis of Experiments-I	2.8	2.8	2.8				
Stochastic Processes	2.2	2.2	2.2				
Sample Survey	3	3	3				
Statistical Inference-II	2	2	2				
Regression Analysis	2.2	2.2	2.2				

Practical-III	2	2	2				
Practical-Iv	3	3	3				
Multivariate Analysis			2	2	2	2	2
Design and Analysis of Experiments-II			1.2	1.2	1.2	1.2	1.2
Operation Research-I			2.6	2.6	2.6		
Industrial Statistics-I			2.2	2.2	2.2		
Actuarial Statistics-I			1.8	1.8	1.8		
Practical-V			2	2	2		
Practical-VI			3	3	3		
Statistical Analysis of clinical trials			2.8	2.8	2.8	2.8	2.8
Operation Research-II			2	2	2	2	2
Industrial Statistics-II			2.2	2.2	2.2	2.2	2.2
Actuarial Statistics-II			1.4	1.4	1.4	1.45	1.4
Project			2	2	2	2	2

Practical-VII			1	1	1	1	1
Practical-VIII			3	3	3	3	3
	2.371429	2.371429	2.228571	2.085714	2.085714	1.961111	1.955556