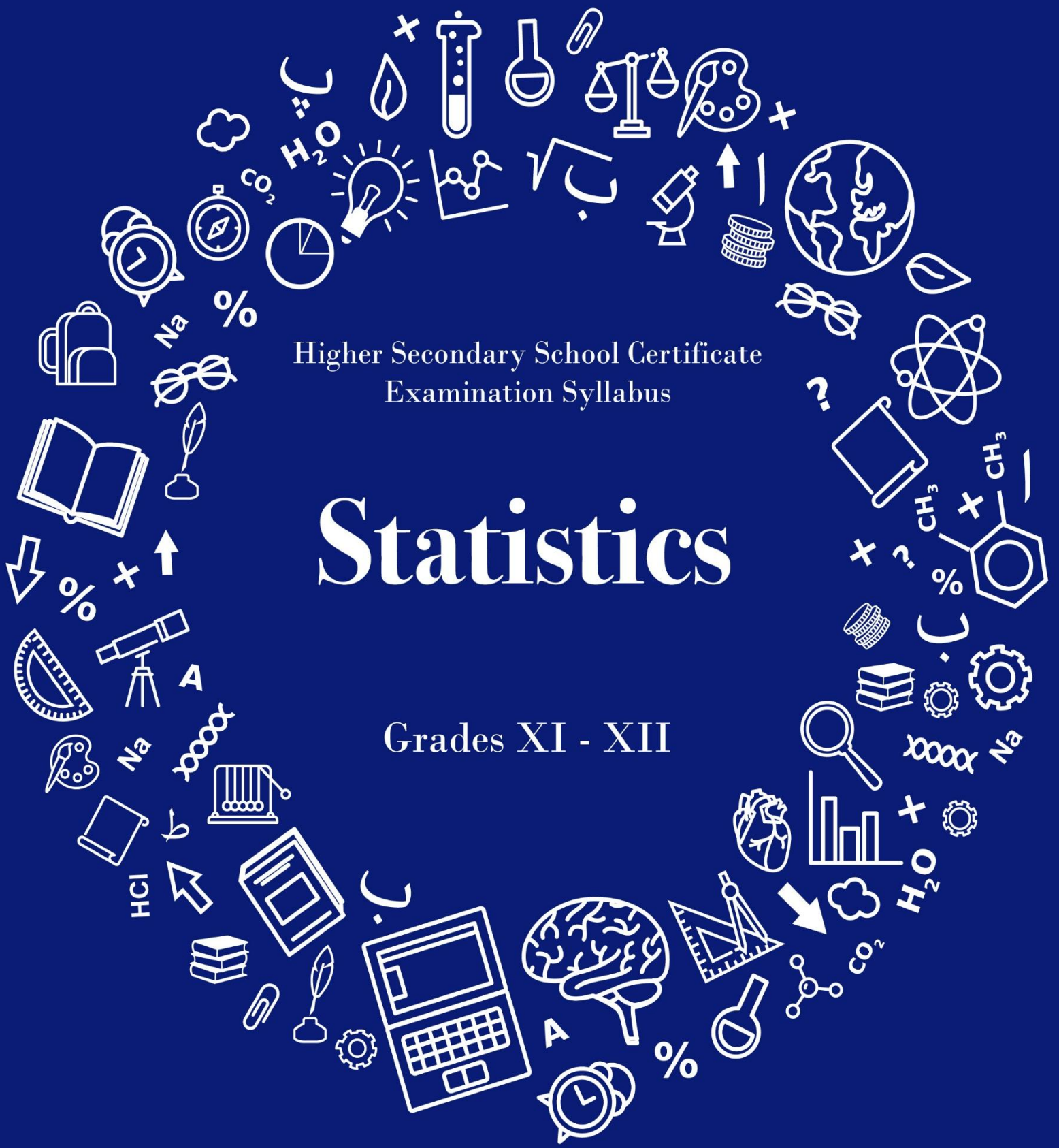
آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD



Higher Secondary School Certificate
Examination Syllabus

Statistics

Grades XI - XII

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GRADES XI-XII

This syllabus will be examined in both Annual and Re-sit Examination sessions from Annual Examinations 2023

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For queries and feedback

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Preface

Established in 2002 through the Pakistan government's ordinance, the Aga Khan University Examination Board (AKU-EB) is country's first private autonomous qualification awarding body for secondary (SSC) and higher secondary (HSSC) school certifications. Its vision is to be a model of excellence and innovation in education in Pakistan and the developing world.

AKU-EB achieves its vision by developing examination syllabi which inculcate conceptual thinking and higher order learning and are aligned with National/ trans-provincial curricula and international standards. AKU-EB revises its syllabi periodically to support the needs of students, teachers and examiners.

The aims of the syllabus review of SSC and HSSC are to:

- Ensure continued compatibility with the goals of the trans-provincial curricula of Pakistan.
- Review the content for inclusion of new knowledge and deletion of obsolete knowledge.
- Review the content for clarity and relevance as per the changing needs of students, teachers and examiners.
- Enhance and strengthen continuation and progression of content both within and across grades IX - XII (SCC and HSSC).
- Ensure the readiness of students for higher education.

During the syllabus review, the needs of all the stakeholders were identified through a needs-assessment survey. Students and teachers of AKU-EB affiliated schools from across Pakistan participated in the survey. Thereafter, a revision panel, which consisted of examiners, teachers of affiliated and non-affiliated schools, teacher trainers and university academicians, reviewed and revised the syllabus following a planned, meticulous and standardised syllabi review process.

The syllabus is organised into topics and subtopics. Each subtopic is further divided into achievable student learning outcomes (SLOs). The SLOs of the cognitive domain are each assigned a cognitive level on which they have to be achieved. These cognitive levels are 'knowledge', 'understanding' and 'application', the latter also including other higher order skills. This is followed by the Exam Specification which gives clear guidance about the weightage of each topic and how the syllabus will be assessed.

The development of the revised syllabus has been made possible by the creativity and relentless hard work of Curriculum and Examination Development unit and the constant support provided by all the other units of AKU-EB. We are particularly thankful to Dr Sohail Qureshi for his very useful feedback on revising the syllabus review process, to Dr Naveed Yousuf for his continued guidance and support throughout the syllabus revision process and to Raabia Hirani for leading the syllabi revision. We are also thankful to all the students and teachers who took part in the needs-assessment survey and to the principals of AKU-EB affiliated schools who made this endeavour possible by facilitating and encouraging their teachers to be a part of the survey and the syllabus revision panel.

With your support and collective hard work, AKU-EB has been able to take the necessary steps to ensure effective implementation of the best international and trans-provincial standards through this syllabus. We are confident that this syllabus will continue to provide the support that is needed by students to progress to the next level of education and we wish the very best to our students and teachers in implementing this syllabus.

Dr Shehzad Jeeva
Chief Executive Officer (CEO), Aga Khan University Examination Board
Associate Professor of Practice, Faculty of Arts and Sciences, Aga Khan University

Understanding of AKU-EB Syllabi

1. The AKU-EB syllabi guide the students, teachers, parents and other stakeholders regarding the topics that will be taught and examined in each grade (IX, X, XI and XII). In each syllabus document, the content progresses from simple to complex, thereby, facilitating a gradual, conceptual learning of the content.

2. The topics of the syllabi are divided into subtopics and **student learning outcomes (SLOs)**. The subtopics and the SLOs define the depth and the breadth at which each topic will be taught, learnt and examined. The syllabi also provide enabling SLOs where needed to scaffold student learning.

3. Each SLO starts with an achievable and assessable **command word** such as describe, relate, evaluate, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that the students are expected to undertake in the course of their studies. The examination questions are framed using the same command words or their connotations to elicit evidence of these competencies in students' responses.

4. The SLOs are classified under three **cognitive levels**: knowledge (K), understanding (U) and application and other higher order skills (A) for effective planning during teaching and learning. Furthermore, it will help to derive multiple choice questions (MCQs), constructed response questions (CRQs) and extended response questions (ERQs) on a rational basis from the subject syllabi.

5. By focusing on the achievement of the SLOs, these syllabi aim to counter the culture of rote memorisation as the preferred method of examination preparation. While suggesting relevant, locally available textbooks for achieving these outcomes, AKU-EB recommends that teachers and students use multiple teaching and learning resources for achieving these outcomes.

6. The syllabi follow a uniform layout for all subjects to make them easier for students and teachers to follow. They act as a bridge between students, teachers and assessment specialists by providing a common framework of student learning outcomes and **exam specifications**.

7. On the whole, the AKU-EB syllabi for Secondary School Certificate (SSC) provide a framework that helps students to acquire conceptual understanding and learn to critically engage with it. This lays a solid foundation for HSSC and beyond.

Subject Rationale of AKU-EB Statistics

What will you learn in AKU-EB Statistics?

Learning Statistics at higher secondary level should focus on improving statistical and critical thinking to enable students to develop a sense of distinction between relevant and irrelevant data. It will help the students in using and interpreting data efficiently and effectively. This syllabus provides students with the tools and ideas to make effective use of statistics and enable them to respond use the information presented to them to make inferences. In order to bring the use of statistics more closely in line with everyday life and to avoid rote learning, students will not be assessed on reproducing the material they have learned. Rather they will be assessed on the application of the statistical tools and concepts.

Where will it take you?

The AKUEB syllabus of statistics will provide the conceptual basis for higher studies in many subjects. For those who pursue statistics in higher studies, various career opportunities are available such as:

- Actuarial Scientist
- Data Analyst
- Data Scientist
- Social Scientist
- Financial Analyst
- Software Developer
- Market Researcher
- Data Base Administrator

Student Learning Outcomes of AKU-EB HSSC Statistics Syllabus

Part I (Grade XI)

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level[1]		
				K	U	A
1. Introduction to Statistics		Students should be able to:				
1.1 Introduction	1.1.1	describe statistics;			*	
	1.1.2	describe uses of statistics and its importance in different fields;			*	
	1.1.3	distinguish between: i. descriptive and inferential statistics ii. statistic and parameter iii. population and sample;			*	
	1.1.4	discuss the limitation of statistics;			*	
1.2 Statistical Data	1.2.1	describe primary and secondary data;			*	
	1.2.2	explain the methods of collection of primary and secondary data;			*	
	1.2.3	describe the term, 'questionnaire';			*	
	1.2.4	write the characteristics of a good questionnaire;		*		
	1.2.5	construct a simple questionnaire using *Google Forms* or *SurveyMonkey;*				CA[2]
	1.2.6	describe constant, variable, quantitative variable, discrete variable, continuous variable, qualitative variable;			*	
	1.2.7	distinguish between: i. constant and variable ii. quantitative and qualitative variables iii. discrete and continuous variables;			*	

[1] K = Knowledge, U = Understanding, A = Application and other higher-order cognitive skills
[2] CA= Classroom Activity, not to be assessed under examination conditions

Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
	Students should be able to:				
1.3 Measurement Scales	1.3.1	describe nominal scale, ordinal scale, cardinal scale, interval scale and ratio scale;		*	
	1.3.2	distinguish between: i. nominal and ordinal scale ii. cardinal and ordinal scale iii. interval and ratio scale.		*	

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
2. Presentation of Statistical Data		Students should be able to:				
2.1	Frequency Distribution	2.1.1	describe tabulation and its classification (one way and two way classifications);		*	
		2.1.2	describe class interval, tally marks/ frequency, upper class limit/ boundary, lower class limit/ boundary, class mark, class width;		*	
		2.1.3	construct a frequency distribution table for discrete data;			*
		2.1.4	construct a frequency distribution table for continuous data;			*
		2.1.5	calculate relative frequency, less than cumulative frequency and more than cumulative frequency;			*
		2.1.6	interpret relative frequency, less than cumulative frequency and more than cumulative frequency;			*
		2.1.7	construct stem and leaf diagram for: i. one set of data ii. two sets of data (back to back);			*
2.2	Graphical Representation	2.2.1	draw simple bar chart, multiple bar chart, components/ subdivided bar chart and pie chart;			*
		2.2.2	draw histogram, frequency polygon, frequency curve, cumulative frequency polygon, cumulative frequency curve;			*
		2.2.3	solve problems related to SLOs 2.2.1 and 2.2.2;			*
2.3	Types of Frequency Curves or Distributions	2.3.1	distinguish between the following types of frequency curves or distributions: i. symmetrical distribution ii. skewed distribution.		*	

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
3. Measures of Location		Students should be able to:				
3.1	Central Tendency	3.1.1	describe average and its types;		*	
3.2	Arithmetic Mean	3.2.1	describe arithmetic mean and weighted arithmetic mean		*	
		3.2.2	calculate the arithmetic mean for ungrouped and grouped data using formulas;			*
		3.2.3	calculate the weighted arithmetic mean;			*
		3.2.4	describe the following properties of arithmetic mean: i. if $X = a$ (a is constant), then $\bar{X} = a$ ii. if $Y = X \pm a$, then $\bar{Y} = \bar{X} \pm a$ iii. if $Y = bX$, then $\bar{Y} = b\ \bar{X}$ iv. if $Y = \frac{X}{a}$, then $\bar{Y} = \frac{\bar{X}}{a}$ *or* $\bar{Y} = \frac{1}{a}(\bar{X})$		*	
		3.2.5	apply the properties mentioned in SLO 3.2.4 to solve related problems;			*
		3.2.6	describe advantages and disadvantages of using arithmetic mean;		*	
3.3	Geometric Mean	3.3.1	describe geometric mean and its formula;		*	
		3.3.2	calculate the geometric mean for ungrouped and grouped data by using its i. definition ii. logarithm;			*
3.4	Harmonic Mean	3.4.1	describe harmonic mean and its formula;		*	
		3.4.2	calculate the harmonic mean for ungrouped and grouped data;			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
		Students should be able to:				
3.5	Relationship between Arithmetic Mean, Geometric Mean and Harmonic Mean	3.5.1	write the relationship between arithmetic mean, geometric mean and harmonic mean;	*		
		3.5.2	verify the relationship between arithmetic mean, geometric mean and harmonic mean for a given data;			*
3.6	Median and Quantiles	3.6.1	describe median and quantiles (quartiles, deciles and percentiles);		*	
		3.6.2	calculate median, quartiles, deciles and percentiles for ungrouped and grouped data;			*
		3.6.3	write the merits and demerits of median;	*		
		3.6.4	estimate median and quartiles through the cumulative frequency curve;			*
		3.6.5	draw (and interpret) 'stem and leaf diagram' and 'box and whisker plot';			*
		3.6.6	solve problems based on the 'stem and leaf diagram' and 'box and whisker plot'			*
3.7	Mode	3.7.1	define mode;	*		
		3.7.2	calculate the mode for ungrouped and grouped data;			*
		3.7.3	write the merits and demerits of mode;	*		
		3.7.4	estimate mode through histogram and stem and leaf diagram;			*
3.8	Empirical Relationship between Mean, Median and Mode	3.8.1	write the empirical relationship between arithmetic mean, median and mode;	*		
		3.8.2	apply empirical relationship mentioned in SLO 3.8.1 to solve related problems.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
4. Measure of Dispersion, Skewness and Kurtosis		Students should be able to:				
4.1	Dispersion	4.1.1	describe dispersion of data;		*	
4.2	Range	4.2.1	define range and semi range;	*		
		4.2.2	describe the range for ungrouped and grouped data;		*	
4.3	Quartile Deviation	4.3.1	describe interquartile range, quartile deviation (semi-interquartile range) and coefficient of quartile deviation;		*	
		4.3.2	find the interquartile range, quartile deviation (semi interquartile range) and coefficient of quartile deviation for ungrouped and grouped data;			*
4.4	Mean Deviation	4.4.1	describe mean deviation and coefficient of mean deviation from mean, median and mode;		*	
		4.4.2	find the mean deviation and coefficient of mean deviation from mean, median and mode for ungrouped and grouped data;			*
4.5	Variance and Standard Deviation	4.5.1	describe variance, standard deviation and coefficient of variation;		*	
		4.5.2	calculate variance and standard deviation for ungrouped data by using formulas: $\text{variance}: \sigma^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2$ or $\sigma^2 = \frac{\sum \left(x - \bar{x}\right)^2}{n}$ $\text{standard deviation}: \sigma = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$ or $\sigma = \sqrt{\frac{\sum \left(x - \bar{x}\right)^2}{n}}$;			*

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	4.5.3	calculate variance and standard deviation for grouped data by using formulas: $\text{variance}: \sigma^2 = \frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2$ or $\sigma^2 = \frac{\sum f\left(x-\bar{x}\right)^2}{\sum f}$ $\text{standard deviation}: \sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$ or $\sigma = \sqrt{\frac{\sum f\left(x-\bar{x}\right)^2}{\sum f}}$			*
	4.5.4	calculate the coefficient of variation for ungrouped and grouped data;			*
	4.5.5	solve problems related to variance, standard deviation and coefficient of variation;			*
	4.5.6	describe the following properties of variance and standard deviation: i. S.D. (a) = 0 and Var (a) = 0 ii. S.D. ($X + a$) = S.D. (X) *and* Var ($X + a$) = Var (X) iii. S.D. ($X – a$) = S.D. (X) *and* Var ($X – a$) = Var (X) iv. S.D. (aX) = a S.D. (X) *and* Var (aX) = a^2 Var (X) v. $\text{S.D.}\left(\frac{X}{a}\right) = \left(\frac{1}{a}\right)\text{S.D}(X)$ and $\text{Var}\left(\frac{X}{a}\right) = \left(\frac{1}{a^2}\right)\text{Var}(X)$		*	
	4.5.7	solve problems using formulas in SLO 4.5.6;			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
		Students should be able to:				
4.6	Moments	4.6.1	write the formula of moments about arithmetic mean and origin;	*		
		4.6.2	calculate to interpret moments about arithmetic mean and origin for ungrouped data;			*
4.7	Symmetry and Skewness of a Distribution	4.7.1	describe symmetry;		*	
		4.7.2	explain the following properties of a symmetrical distribution: i. mean = median = mode ii. third quartile – median = median – first quartile iii. all odd ordered moments about mean vanish		*	
		4.7.3	describe the skewness of a distribution (positive or negative);		*	
		4.7.4	find the coefficient of skewness using Karl Pearson's formulas;			*
		4.7.5	interpret the coefficient of skewness;		*	
		4.7.6	solve problems related to coefficient of skewness and symmetry;			*
4.8	Kurtosis	4.8.1	describe kurtosis and its types;		*	
		4.8.2	calculate coefficient of kurtosis to decide whether a symmetrical distribution is Platykurtic, Mesokurtic or Leptokurtic;			*
		4.8.3	solve problems related to kurtosis.			*

Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
5. Index Numbers		Students should be able to:			
5.1 Introduction to Index Numbers	5.1.1	describe index number and its types (price index, quantity index and aggregate index number);		*	
	5.1.2	write the uses of index numbers;	*		
	5.1.3	describe the steps involved in the construction of whole sale price index numbers;		*	
	5.1.4	write the limitations of index numbers;	*		
	5.1.5	describe the following properties of index numbers:		*	
		if $I_{a,b} = \frac{p_b}{p_a}$, then			
		i. $I_{a,a} = \frac{p_a}{p_a} = 1$			
		ii. $I_{a,b} = \frac{p_b}{p_a}$			
		$I_{a,b} = \frac{1}{\frac{p_a}{p_b}}$			
		$I_{a,b} = \frac{1}{I_{b,a}}$			
		iii. $I_{a,b} \times I_{b,c} \times I_{c,d} = \frac{p_b}{p_a} \times \frac{p_c}{p_b} \times \frac{p_d}{p_c}$			
		$I_{a,b} \times I_{b,c} \times I_{c,d} = \frac{p_d}{p_a}$			
		$I_{a,b} \times I_{b,c} \times I_{c,d} = p_{a,d}$			

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
		Students should be able to:				
		5.1.6	where: p_a, p_b, p_c and p_d are the prices of a commodity in the years *a*, *b*, *c* and *d* respectively. $I_{a,b}$ is in ratio and not a percentage. The factor 100 is neglected to avoid confusion. solve problems related to the properties mentioned in SLO 5.1.5 of index number;			*
5.2	Simple Relatives or Simple Index Numbers	5.2.1 5.2.2 5.2.3	describe simple index numbers; distinguish between simple and composite price index numbers; calculate simple price index numbers by using: i. fixed base method ii. chain base method;		* *	 *
5.3	Unweighted Index Numbers	5.3.1 5.3.2	describe the two methods of constructing unweighted index numbers: i. simple aggregate or aggregative method ii. simple average of relatives method; calculate composite price index numbers by using the method of simple aggregate or aggregative method;		*	 * *
5.4	Weighted Index Numbers	5.4.1 5.4.2	describe the two methods of constructing weighted index numbers: i. weighted aggregate method ii. weighted average of relatives method; calculate weighted aggregative composite price index numbers by using: i. Laspeyre's formula ii. Paasche's formula iii. Fisher's formula.		*	 *

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
6. Regression and Correlation		Students should be able to:				
6.1	Simple Linear Regression	6.1.1	describe independent variable (regressor) and dependent variable (regressand);		*	
		6.1.2	define regression;	*		
		6.1.3	describe scatter diagram;		*	
		6.1.4	draw scatter diagram to discuss the nature of the data;			*
		6.1.5	describe simple linear regression and its coefficient;		*	
		6.1.6	describe the method of least squares line of regression;		*	
		6.1.7	apply the method of least squares to fit a regression line of Y on X and X on Y;			*
		6.1.8	interpret regression coefficient;			*
		6.1.9	solve problems related to SLOs 6.1.3 to 6.1.8;			*
6.2	Simple Linear Correlation	6.2.1	describe correlation;		*	
		6.2.2	discuss the nature of correlation (positive correlation, negative correlation, non-linear correlation and no correlation);		*	
		6.2.3	distinguish between regression and correlation;		*	
		6.2.4	describe correlation coefficient 'r'(also called Pearson product-moment correlation coefficient);		*	
		6.2.5	calculate the coefficient of correlation by using the following formulas: i. $r = \frac{\sum XY - n\overline{X}\,\overline{Y}}{\sqrt{\left[\sum X^2 - n\overline{X}^2\right]\left[\sum Y^2 - n\overline{Y}^2\right]}}$ ii. $r = \frac{n\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[n\sum X^2 - \left(\sum X\right)^2\right]\left[n\sum Y^2 - \left(\sum Y\right)^2\right]}}$ iii. $r = \sqrt{b \times d}$ (product of two regression coefficients);			*
		6.2.6	write the properties of the coefficient of correlation;	*		

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	6.2.7	solve problems related to the coefficient of correlation.			*
6.3 Rank Correlation	6.3.1	describe rank correlation;		*	
	6.3.2	find the coefficient of rank correlation by using Spearman's formula for rank correlation;			*
	6.3.3	calculate the rank correlation for tied ranks.			*

Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
7. Time Series Analysis		Students should be able to:			
7.1 Concept of Time Series	7.1.1	describe time series;		*	
	7.1.2	draw an historigram for a given data;			*
	7.1.3	describe the following components of a time series: i. secular trend ii. seasonal variations iii. cyclical fluctuations iv. irregular movements;		*	
7.2 Measurement of Secular Trend	7.2.1	define linear trend and trend values;	*		
	7.2.2	explain the technique of coding the time variable;		*	
	7.2.3	describe the following measurement of secular trend: i. the freehand curve method ii. the method of semi-averages iii. the method of moving averages iv. the method of least squares;		*	
	7.2.4	find the trend values of a given data using the freehand curve method;			*
	7.2.5	apply the semi-average method to find the trend values of a given data;			*
	7.2.6	apply the moving average method to find the trend values of a given data;			*
	7.2.7	apply the least squares method to measure linear and quadratic secular trend for estimating trend values.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
8. Vital Statistics		Students should be able to:				
8.1	Introduction to Vital Statistics	8.1.1	define vital events and vital statistics ;	*		
		8.1.2	describe the sources of data, i.e. vital registration system, population census and sample survey;		*	
		8.1.3	describe the uses and limitations of vital statistics;		*	
8.2	Vital Ratios	8.2.1	distinguish between rates and ratios;		*	
		8.2.2	write the formulae of sex ratio, child-women ratio and vital index (birth-death ratio);	*		
		8.2.3	solve problems related to the concepts mentioned in SLO 8.2.2;			*
8.3	Mortality Rates	8.3.1	define mortality;	*		
		8.3.2	describe the terms with the help of formulae, crude death rate, infant mortality rate, neo-natal mortality rate, still birth rate, maternal death rate and specific death rates (age-specific, sex-specific and age-sex-specific);		*	
		8.3.3	solve problems related to the concepts mentioned in 8.3.2;			*
		8.3.4	describe the standardised death rate;		*	
		8.3.5	apply the direct and indirect methods to find the standardised death rate for a given data.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
9. Interpolation		Students should be able to:				
9.1	Introduction to Interpolation	9.1.1	identify arguments and entries in a given table of values $(x_i, y_i),\ i = 0,1,2,..n$;	*		
		9.1.2	distinguish between equally spaced and unequally spaced data;		*	
		9.1.3	describe interpolation;		*	
		9.1.4	define 'Δ' as a forward difference operator;	*		
		9.1.5	describe $\Delta y, \Delta^2 y, \Delta^3 y, ..., \Delta^n y,$ as 1st, 2nd, 3rd, ...nth differences from the table of values $(x_i, y_i),\ i = 0,1,2,..n$;		*	
		9.1.6	construct the forward difference table from a given equally spaced data;			*
9.2	Newton's Forward Difference Interpolation Formula	9.2.1	describe the Newton's forward difference interpolation formula;		*	
		9.2.2	apply the Newton's forward difference interpolation formula to find the interpolating polynomial for a given equally spaced data;			*
		9.2.3	apply Newton's forward difference formula to interpolate the value of y at a given x;			*
9.3	Lagrange's Interpolation Formula	9.3.1	describe Lagrange's interpolation formula;		*	
		9.3.2	apply Lagrange's interpolation formula to find interpolating polynomial for a given equally spaced data;			*
		9.3.3	apply Lagrange's formula to interpolate the value of y at a given x.			*

NOTE: *Linear programming is excluded from the examination syllabus, as it is being taught in HSSC II Mathematics.*

Part II (Grade XII)

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
10. Counting Techniques		Students should be able to:				
10.1	Fundamental Counting Principle	10.1.1	solve problems based on factorial notation ($n!$);			*
		10.1.2	describe fundamental principle of counting;		*	
		10.1.3	illustrate fundamental principle of counting using tree diagram for: i. repeated values ii. non-repeated values;			*
		10.1.4	solve problems related to fundamental principle of counting and tree diagram: i. repeated values ii. non-repeated values;			*
10.2	Permutation	10.2.1	describe permutation of n different objects taken r at a time and recognize the notation ${}^{n}P_{r}$;		*	
		10.2.2	solve problems based on formula; ${}^{n}P_{r} = \frac{n!}{(n-r)!}$; when $r < n$ and $r = n$;			*
10.3	Combination	10.3.1	describe combination of n different objects taken r at a time and recognize the notation ${}^{n}C_{r}$;		*	
		10.3.2	apply the formula ${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$; when $r < n$ and $r = n$ to solve related problems.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
11. Probability		Students should be able to:				
11.1	Introduction to Probability	11.1.1	describe: iii. random experiment iv. sample space, sample point and an event v. simple and compound events vi. impossible and sure events vii. complementary events viii. equally likely events ix. mutually exclusive and mutually inclusive (non-exclusive) events x. exhaustive events xi. dependent and independent events;		*	
		11.1.2	describe probability through the classical, relative frequency and axiomatic approaches;		*	
		11.1.3	write the formula for probability of occurrence of an event E, that is: $P(E)=\frac{n(E)}{n(S)}, 0 \le P(E) \le 1$;	*		
		11.1.4	apply the formula given in SLO 11.1.4 to find probability in simple cases;			*
		11.1.5	find the probability of occurrence of an event using Venn and tree diagrams;			*
11.2	Laws of Probability	11.2.1	explain the law of addition of probability $P(A \cup B)=P(A)+P(B)-P(A \cap B)$, where A and B are two non-mutually exclusive events;		*	
		11.2.2	explain the law of addition of probability $P(A \cup B)=P(A)+P(B)$ where A and B are mutually exclusive events;		*	

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	11.2.3	distinguish between dependent and independent events;		*	
	11.2.4	define conditional probability;	*		
	11.2.5	explain the law of multiplication of probability $P(A \cap B) = P(A) \times P(B \mid A)$ OR $P(A \cap B) = P(B) \times P(A \mid B)$ where $P(B\|A)$ and $P(A\|B)$ are conditional probabilities and A and B are dependent events;		*	
	11.2.6	explain the law of multiplication of probability $P(A \cap B) = P(A) \times P(B)$ where A and B are independent events;		*	
	11.2.7	apply the above mentioned laws of addition and multiplication of probability to solve related problems. **(Note**: Problem involving Venn and tree diagram are also included.)			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
12. Random Variables and Probability Distribution		Students should be able to:				
12.1	Concept of Random Variable	12.1.1	describe random, discrete random and continuous random variables;		*	
		12.1.2	distinguish between discrete and continuous random variables;		*	
12.2	Probability Distributions	12.2.1	describe the probability distribution of a discrete random variable;		*	
		12.2.2	find the probability distribution of a discrete random variable;			*
		12.2.3	describe the probability distribution function of a discrete random variable;		*	
		12.2.4	find the probability distribution function of a discrete random variable;			*
		12.2.5	describe the probability distribution and probability density function (p.d.f.) of a continuous random variable;		*	
		12.2.6	find the probability density function (p.d.f.);			*
12.3	Expectation and Variance of Discrete and Continuous Random Variable	12.3.1	describe the expected value of a discrete random variable;		*	
		12.3.2	find the expected value of a discrete random variable;			*
		12.3.3	write the properties of the expected value of a discrete random variable;	*		
		12.3.4	apply the properties of expected value of a discrete random variable to a given set of data;			*
		12.3.5	describe the variance and standard deviation of a discrete random variable;		*	
		12.3.6	find the variance and standard deviation of a discrete random variable;			*
		12.3.7	write the properties of variance and standard deviation of a discrete random variable;	*		

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
		Students should be able to:				
		12.3.8	apply the properties of expected value of a discrete random variable to a given set of data;			*
		12.3.9	describe the expected value and variance of a continuous random variable;		*	
		12.3.10	find the expected value and variance of a continuous random variable;			*
		12.3.11	solve problems related to expectation, variance and standard deviation of discrete and continuous random variables;			*
12.4	Combinations of Random Variables	12.4.1	describe the following properties about the expected value and variance for the sum and difference of two independent random variables X and Y: i. $E(X \pm Y) = E(X) \pm E(Y)$ ii. $E(aX \pm bY) = aE(X) \pm bE(Y)$ iii. $V(X \pm Y) = V(X) + V(Y)$ iv. $V(aX \pm bY) = a^2V(X) + b^2V(Y)$;		*	
		12.4.2	solve problems related to the properties mentioned in SLO 12.4.1.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
13. Special Discrete Probability Distributions		Students should be able to:				
13.1	Uniform Distribution	13.1.1	describe the discrete uniform probability distribution;		*	
		13.1.2	solve problems related to the discrete uniform probability distribution;			*
		13.1.3	calculate the mean, variance and standard deviation of discrete uniform probability distribution;			*
13.2	Binomial Distribution	13.2.1	describe the Bernoulli trial;		*	
		13.2.2	define binomial experiment and binomial random variable;	*		
		13.2.3	write the properties of binomial experiment;	*		
		13.2.4	describe the binomial probability distribution (Bernoulli distribution);		*	
		13.2.5	describe the binomial frequency distribution;		*	
		13.2.6	solve problems related to binomial probability distribution;			*
		13.2.7	calculate the mean, variance and standard deviation of binomial probability distribution;			*
13.3	Hyper Geometric Distribution	13.3.1	define hyper geometric experiment and hyper geometric random variable;	*		
		13.3.2	write the properties of hyper geometric experiment;	*		
		13.3.3	describe the hyper geometric probability distribution;		*	
		13.3.4	solve problems related to the hyper geometric probability distribution;			*
		13.3.5	calculate the mean, variance and standard deviation of hyper geometric probability distribution.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
14. Special Continuous Probability Distribution		Students should be able to:				
14.1	Uniform Distribution	14.1.1	describe the continuous uniform probability distribution;		*	
		14.1.2	solve problems related to the continuous uniform probability distribution;			*
		14.1.3	calculate the mean, variance and standard deviation of continuous uniform probability distribution;			*
		14.1.4	solve problems related to the above concepts mentioned in SLOs 14.1.1 to 14.1.3;			*
14.2	Normal Distribution	14.2.1	define normal random and standard normal random variables;	*		
		14.2.2	describe the normal and the standard normal distribution and their probability density functions;		*	
		14.2.3	describe the properties of a normal distribution with the help of a diagrams;		*	
		14.2.4	find the probabilities of the normal random variable and standard normal random variable using the standard normal distribution table;			*
		14.2.5	solve problems related to the normal distribution.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
15. Sampling and Sampling Distributions		Students should be able to:				
15.1	Concept of Sampling	15.1.1	define sampling, sampling units, sampling frame and sampling design;	*		
		15.1.2	distinguish between: i. finite and infinite population ii. sample and population iii. parameter and statistic;		*	
		15.1.3	write the merits and demerits of sampling;	*		
		15.1.4	distinguish between: i. probability and non-probability sampling ii. random sampling with and without replacement;		*	
		15.1.5	explain simple random sampling, stratified random sampling, systematic random sampling, quota sampling and cluster random sampling;		*	
		15.1.6	solve problems related to SLO 15.1.5;			*
15.2	Sampling Distribution of Sample Mean	15.2.1	define the sampling distribution and sampling errors of statistics;	*		
		15.2.2	define the sampling distribution of sample mean;	*		
		15.2.3	describe the properties of a sampling distribution of sample mean;		*	
		15.2.4	find the sampling distribution of sample mean and verify its properties;			*
15.3	Sampling Distribution of Difference between Two Sample Means	15.3.1	describe the sample distribution of difference between two sample means and its properties;		*	
		15.3.2	find the sample distribution of difference between two sample means and verify its properties.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
16. Estimation		Students should be able to:				
16.1	Point Estimation	16.1.1	define estimation of parameter, point estimation and point estimator;	*		
		16.1.2	distinguish between biased and unbiased estimators;		*	
		16.1.3	find the point estimates for population mean and population variance from the given random sample;			*
16.2	Interval Estimation	16.2.1	define interval estimation of a parameter and confidence interval;	*		
		16.2.2	estimate the confidence interval for: i. the mean of a normal population (known and unknown standard deviation) ii. the difference between means of two normal populations (known and unknown standard deviations) iii. the population proportion (large sample) iv. the difference between proportions of two populations (large samples).			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
17. Hypothesis Testing		Students should be able to:				
17.1	Introduction	17.1.1	describe statistical hypothesis and hypothesis testing;		*	
		17.1.2	distinguish between: i. null and alternative hypotheses ii. simple and composite hypotheses;		*	
		17.1.3	describe the null and alternative hypotheses for a given situation;		*	
		17.1.4	describe the following elements of hypothesis testing: i. test statistic ii. rejection and acceptance region iii. critical value iv. one tailed test v. two tailed test vi. Type I and Type II errors vii. level of significance viii. decision rule ix. conclusion;		*	
17.2	Hypothesis Testing	17.2.1	apply the test of hypothesis in the following cases concerning: i. the population mean when population standard deviation is known or unknown ii. the difference between two means of two different populations when populations' standard deviation are known iii. the population proportion iv. the difference between proportions of two populations when sample is large.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
18. Association of Attributes		Students should be able to:				
18.1	Attribute	18.1.1	describe attribute;		*	
		18.1.2	distinguish between variable and attribute;		*	
		18.1.3	identify the categorical data of two attributes;	*		
		18.1.4	describe the independence of two attributes;		*	
		18.1.5	define the association of attributes;	*		
		18.1.6	describe positive association, negative association, complete association and complete disassociation;		*	
		18.1.7	distinguish between correlation and association;		*	
		18.1.8	describe the coefficient of association;		*	
		18.1.9	find the coefficient of association;			*
18.2	Contingency Table	18.2.1	describe a contingency table and its degree of freedom;		*	
		18.2.2	describe the criterion of independence of two attributes in a contingency table;		*	
		18.2.3	describe the chi-square (χ^2) statistic;		*	
		18.2.4	describe the test for independence;		*	
		18.2.5	apply the chi-square (χ^2) statistic to test the association between the attributes.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
19. Design of Experiment		Students should be able to:				
19.1	Introduction	19.1.1	discuss the meaning of design of an experiment;		*	
		19.1.2	describe the following terms: i. the experimental unit ii. the treatment iii. the replication iv. the response v. the layout of an experiment;		*	
19.2	The Completely Randomised Design	19.2.1	define randomisation and completely randomised design;	*		
		19.2.2	describe the layout plan of a completely randomised design;		*	
		19.2.3	write the merits and demerits of a completely randomised plan;	*		
19.3	Analysis of Variance (one way)	19.3.1	describe analysis of variance;		*	
		19.3.2	write the basic assumptions of the analysis of variance;	*		
		19.3.3	write the definition and formulas of: i. the total sum of squares ii. the treatment sum of squares iii. the error sum of squares;	*		
		19.3.4	describe the relation of total sum of squares = treatment sum of squares + error sum of squares;		*	
		19.3.5	calculate the total sum of squares, the treatment sum of squares and the error sum of squares;			*
		19.3.6	calculate the degree of freedom for total sum of squares, the treatment sum of squares and the error sum of squares;			*
		19.3.7	calculate the treatment mean square and the error mean square;			*
		19.3.8	use an hypothesis to test the equality of means of normal populations.			*

Scheme of Assessment

Grade XI

Table 1: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub Topics	SLOs			Total
			K	U	A	
1.	Introduction to Statistics	3	1	11	0	12
2.	Presentation of Statistical Data	3	0	5	6	11
3.	Measures of Location	8	10	3	13	26
4.	Measure of Dispersion, Skewness and Kurtosis	8	4	9	12	25
5.	Index Numbers	4	2	7	5	14
6.	Regression and Correlation	3	2	10	7	19
7.	Time Series Analysis	2	1	5	5	11
8.	Vital Statistics	3	4	3	3	10
9.	Interpolation	3	2	5	5	12
	Total	**37**	**26**	**58**	**56**	**140**
	Percentage		**19**	**41**	**40**	**100**

Table 2: Exam Specifications

Topic No.	Topics	Marks Distribution		Total Marks
		MCQs	CRQs	
1.	Introduction to Statistics	4		4
2.	Presentation of Statistical Data	6	Total 4 Marks (1 CRQ)	10
3.	Measures of Location	10	Total 4 Marks (1 CRQ) Choose any ONE from TWO	14
4.	Measure of Dispersion, Skewness and Kurtosis	10	Total 8 Marks (2 CRQs) Choose any TWO from THREE	18
5.	Index Numbers	5	Total 4 Marks (1 CRQ)	9
6.	Regression and Correlation	5	Total 5 Marks (1 CRQ)	10
7.	Time Series Analysis	4	Total 4 Marks (1 CRQ)	8
8.	Vital Statistics	4	Total 3 Marks (1 CRQ) Choose any ONE from TWO	7
9.	Interpolation	2	Total 3 Marks (1 CRQ)	5
	Total	**50**	**35**	**85**
	Practical*			**15**
	Total Marks			**100**

Grade XII

Table 3: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub Topics	SLOs			Total Marks
			K	U	A	
10.	Counting Techniques	3	0	4	4	8
11.	Probability	2	2	7	3	12
12.	Random Variables and Probability Distribution	4	2	9	10	21
13.	Special Discrete Probability Distributions	3	4	5	6	15
14.	Special Continuous Probability Distribution	2	1	3	6	10
15.	Sampling and Sampling Distributions	5	4	5	3	12
16.	Estimation	2	2	1	2	5
17.	Hypothesis Testing	2	0	4	1	5
18.	Association of Attributes	2	2	10	2	14
19.	Design of Experiment	3	4	5	4	13
	Total	**28**	**21**	**53**	**41**	**115**
	Percentage		**18**	**46**	**36**	**100**

Table 4: Exam Specifications

Topic No.	Topic	Marks Distribution		Total Marks
		MCQs	CRQs	
10.	Counting Techniques	6	Total 3 Marks (1 CRQ) Choose any ONE from TWO	9
11.	Probability	8	Total 5 Marks (1 CRQ) Choose any ONE from TWO	13
12.	Random Variables and Probability Distribution	7	Total 5 Marks (1 CRQ) Choose any ONE from TWO	12
13.	Special Discrete Probability Distributions	6	Total 4 Marks (1 CRQ)	10
14.	Special Continuous Probability Distribution	6	Total 4 Marks (1 CRQ)	10
15.	Sampling and Sampling Distributions	5	Total 4 Marks (1 CRQ)	9
16.	Estimation	2	Total 3 Marks (1 CRQ)	5
17.	Hypothesis Testing	4	Total 3 Marks (1 CRQ)	7
18.	Association of Attributes	3	Total 4 Marks (1 CRQ)	7
19.	Design of Experiment	3		3
	Total	**50**	**35**	**85**
	Practical*			**15**
	Total Marks			**100**

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.
- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.

- Tables 1 and 3 indicate the number and nature of SLOs in each topic in grades XI and XII. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to Understanding (41% in HSSC I and 46% in HSSC II), Application and higher order skills (40% in HSSC I and 36% in HSSC II) to discourage rote memorisation. Tables 1 and 3 however do not translate directly into marks.
- There will be two examinations, one at the end of grade XI and one at the end of grade XII.
- In each grade, the theory paper will be in two parts: paper I and paper II. Both papers will be of duration of 3 hours.
- Paper I theory will consist of 50 compulsory, multiple choice items. These questions will involve four response options.
- Paper II theory will carry 35 marks and consist of a number of compulsory, structured questions.
- All constructed response questions will be in a booklet which will also serve as an answer script.

***Practical:**

- In each grade, practical examination will be conducted separate from the theory paper and will consist of 15 marks.
- Schools may design their own practical manuals based on the topics.
- Practical journal/ portfolio should be developed by students and endorsed by a figure of authority, such as a teacher or principal, and submitted at the time of the practical examination.

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