آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Higher Secondary School Certificate Examination Syllabus

STATISTICS

CLASSES XI-XII

(based on National Curriculum 2009)

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Higher Secondary School Certificate Examination Syllabus

STATISTICS

CLASSES XI-XII

This subject is examined in the May Examination session only

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PREFACE

In pursuance of National Education Policy (1998-2010), the Curriculum Wing of the Federal Ministry of Education has begun a process of curriculum reform to improve the quality of education through curriculum revision and textbook development (Preface, National Curriculum documents 2000 and 2002).

AKU-EB was founded in August 2003 with the same aim of improving the quality of education nationwide. As befits an examination board it seeks to reinforce the National Curriculum revision through the development of appropriate examinations for the Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) based on the latest National Curriculum and subject syllabus guidance.

AKU-EB has a mandate by Ordinance CXIV of 2002 to offer such examination services to English and Urdu medium candidates for SSC and HSSC from private schools anywhere in Pakistan or abroad, and from government schools with the relevant permissions. It has been accorded this mandate to introduce a choice of examination and associated educational approach for schools, thus fulfilling a key objective of the National Curriculum of Pakistan: "Autonomy will be given to the Examination Boards and Research and Development cells will be established in each Board to improve the system" (ibid. para. 6.5.3 (ii)).

AKU-EB is committed to creating continuity of educational experience and the best possible opportunities for its students. In consequence it offered HSSC for the first time in September, 2007 to coincide with the arrival of its first SSC students in college or higher secondary school. Needless to say this is not an exclusive offer. Private candidates and students joining AKU-EB affiliated schools and colleges for HSSC Part 1 are eligible to register as AKU-EB candidates even though they have not hitherto been associated with AKU-EB.

This examination syllabus exemplifies AKU-EB's commitment to national educational goals.

- It is in large part a reproduction, with some elaboration, of the Class XI and XII National Curriculum of the subject.

- It makes the National Curriculum freely available to the general public.

- The syllabus recommends a range of suitable textbooks already in print for student purchase and additional texts for the school library.

- It identifies areas where teachers should work together to generate classroom activities and materials for their students as a step towards the introduction of multiple textbooks, another of the Ministry of Education's policy provisions for the improvement of higher secondary education (ibid. para. 6.3.4).

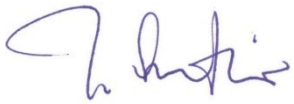
This examination syllabus brings together all those cognitive outcomes of the National Curriculum statement which can be reliably and validly assessed. While the focus is on the cognitive domain, particular emphasis is given to the application of knowledge and understanding, a fundamental activity in fostering "attitudes befitting useful and peaceful citizens and the skills for and commitment to lifelong learning which is the cornerstone of national economic development" (Preface to National Curriculum documents 2000 and 2002).

To achieve this end AKU-EB has brought together university academicians, teacher trainers, writers of learning materials and above all, experienced teachers, in regular workshops and subject panel meetings.

AKU-EB provides copies of the examination syllabus to subject teachers in affiliated schools to help them in planning their teaching. It is the syllabus, not the prescribed textbook which is the basis of AKU-EB examinations. In addition, the AKU-EB examination syllabus can be used to identify the training needs of subject teachers and to develop learning support materials for students. Involving classroom teachers in these activities is an important part of the AKU-EB strategy for improving the quality of learning in schools.

The Curriculum Wing of the Federal Ministry of Education has recently released new subject specifications and schemes of study to take effect in September, 2008. These documents are a major step forward towards a standards-related curriculum and have been welcomed by AKU-EB. Our current HSSC syllabuses have been revised to ensure conformity with the new National Curriculum 2006.

We stand committed to all students who have embarked upon the HSSC courses in facilitating their learning outcomes. Our examination syllabus document ensures all possible support.



Dr. Thomas Christie
Director,
Aga Khan University Examination Board
July 2009

1. Aims/objectives of the National Curriculum (2009)[1]

The main objectives to review the national curriculum are to make it more vibrant and more responsive to the modern, socio-economic, technical, professional, and labour market needs of the country. it should be improved and uplifted to make it comparable with international standards.

The National Curriculum of Statistics has been designed in the light of above recommendations coupled with the suggestions of our stakeholders. The following themes permeate the curriculum:

1.1 The learning outcomes oriented National Curriculum of Statistics extends the scope of rudiments of statistics falling under the fourth standard (Information Handling) of National Curriculum for Mathematics 2006.

1.2 It helps students to build the solid conceptual foundation in statistics that will enable them to apply their knowledge skilfully

1.3 It stresses on visual communication-representing data, interpreting and depicting situations

1.4 The curriculum is not merely centred on the theoretical underpinnings of the subject but emphasizes on real life problem which enable the students to link up their thinking to the real world contexts

2. Rationale of the AKU-EB Examination Syllabus

2.1 General Rationale

2.1.1 In 2007, the Curriculum Wing of the Federal Ministry of Education (MoE) issued a revised part-wise Scheme of Studies. All subjects are to be taught and examined in both classes XI and XII. It is therefore important for teachers, students, parents and other stakeholders to know:

(a) that the AKU-EB Scheme of Studies for its HSSC examination (Annex) derives directly from the 2007 Ministry of Education Scheme of Studies;
(b) which topics will be examined in Class XI and in Class XII;
(c) at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined;

[1] Government of Pakistan (2009), *National Curriculum; Statistics Grades XI-XII, Islamabad,* Ministry of Education (Curriculum Wing)

2.1.2 This AKU-EB examination syllabus addresses these concerns. Without such guidance teachers and students have little option other than following a single textbook to prepare for an external examination. The result is a culture of rote memorization as the preferred method of examination preparation. The pedagogically desirable objectives of the National Curriculum which encourage "observation, creativity and other higher order thinking [skills]" are generally ignored. AKU-EB recommends that teachers and students use multiple teaching-learning resources for achieving the specific objectives of the National Curriculum reproduced in the AKU-EB examination syllabuses.

2.1.3 The AKU-EB examination syllabuses use a uniform layout for all subjects to make them easier for teachers to follow. Blank sheets are provided in each syllabus for writing notes on potential lesson plans. It is expected that this arrangement will also be found helpful by teachers in developing classroom assessments as well as by question setters preparing material for the AKU-EB external examinations. The AKU-EB aims to enhance the quality of education through improved classroom practices and improved examinations.

2.1.4 The Student Learning Outcomes (SLOs) in Section 3 start with command words such as list, describe, relate, explain, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that candidates following the AKU-EB examination syllabuses are expected to undertake in the course of their subject studies. The examination questions will be framed using the same command words or the connotation of the command words, to elicit evidence of these competencies in candidates' responses. The definitions of command words used in this syllabus are given in Section 7. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.

2.1.5 The AKU-EB has classified SLOs under the three cognitive levels, Knowledge (K), Understanding (U) and Application of knowledge and skills (A) in order to derive multiple choice questions and constructed response questions on a rational basis from the subject syllabuses ensuring that the intentions of the National Curriculum should be met in full. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels.

2.2. Specific Rationale of the AKU-EB Statistics Examination Syllabus

2.2.1 The teaching of Statistics at higher secondary level should focus on improving statistical and critical thinking to enable the students to develop a sense of distinction between relevant and irrelevant data.

2.2.2 The revised national curriculum (2009) of statistics covers a wide range of topics that require to be looked at critically and give more time for deeper conceptual understanding of the topics. The mismatch in content weight has been balanced by allocating marks for each cognitive level e.g. Knowledge, Understanding and Application. This guidance will help both teachers and students to prepare for the AKU-EB examination leading to increased student achievements.

2.2.3 The study of statistics provides students with tools and ideas to make effective use of statistics and enable them to respond sensibly to the information presented to them. In order to bring the use of statistics more closely in line with everyday life and to avoid rote learning, students should not be assessed on reproducing the material they learned. Rather they will be assessed on the application of the statistical tools and concepts they learned.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part I (Class XI)

Topics		Student Learning Outcomes		Cognitive Level[2]		
				K	U	A
1. Introduction to Statistics		**Candidates 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	define primary and secondary data;	*		
		1.2.2	distinguish between primary and secondary data;		*	
		1.2.3	explain the methods of collection of primary and secondary data;		*	
		1.2.4	describe what the term questionnaire means;		*	
		1.2.5	write the characteristics of a good questionnaire;	*		
		1.2.6	construct a simple questionnaire;		*	
		1.2.7	describe constant , variable, quantitative variables/data ,discrete variables/data , continuous variables/data, qualitative variables/data;		*	
		1.2.8	distinguish between: i. constant and variable ii. quantitative variable and qualitative variable iii. discrete variable and continuous variable;		*	

[2] K = Knowledge, U = Understanding, A= Application (for explanation see section 7: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

				K	U	A
1.3	Measurement Scales	1.3.1 1.3.2	describe nominal scale, ordinal scale, interval scale and ratio scale; distinguish between: i. nominal scale and ordinal scale ii. interval scale and ratio scale.		* *	
2.	**Presentation of Statistical Data**	**Candidates should be able to:**				
2.1	Frequency Distribution	2.1.1 2.1.2 2.1.3 2.1.4 2.1.5 2.1.6	describe tabulation and its classification (one way and two way classifications); describe class interval, tally marks/frequency, upper class limit/boundary, lower class limit/boundary , class mark ,class width; construct a frequency distribution table for discrete data; construct a frequency distribution table for continuous data; calculate and interpret relative frequency; calculate and interpret less than cumulative frequency and more than cumulative frequency;		* * * *	 * *
2.2	Graphical Representation	2.2.1 2.2.2 2.2.3	draw and analyse information from simple bar chart, multiple bar chart, components/subdivided bar chart and pie chart; draw and analyse information from histogram , frequency polygon, frequency curve , cumulative frequency polygon , cumulative frequency curve ; solve problems related to the above mentioned graphs and charts;			* * *
2.3	Types of Frequency Curves or Distributions	2..3.1	distinguish between the following types of frequency curves or distributions: i. uniform distribution ii. symmetrical distribution iii. skewed distribution iv. u-shaped distribution v. bi-modal distribution.		*	

NOTES

			K	U	A
3. Measures of Location	**Candidates should be able to:**				
3.1 Summation Notations	3.1.1	identify summation/sigma '$\sum$' notation as sum of a sequence of observations;	*		
	3.1.2	use the following rules to manipulate sums expressed in $\sum$ notation:			*
		i. $\sum_{i=1}^{n}(x_i + y_i) = \sum_{i=1}^{n} x_i + \sum_{i=1}^{n} y_i$			
		ii. $\sum_{i=1}^{n} c\,x_i = c\sum_{i=1}^{n} x_i = c(x_1 + x_2 + x_3 + ... + x_n)$, where c is a constant			
		iii. $\sum_{i=1}^{n} c = nc$, where c is a constant			
		iv. $\sum_{i=1}^{n}\sum_{j=1}^{m}(x_{ij} + y_{ij}) = \sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} + \sum_{i=1}^{n}\sum_{j=1}^{m} y_{ij}$			
		v. $\sum_{i=1}^{n}\sum_{j=1}^{m} c\,x_{ij} = c\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij}$, where c is a constant			
		vi. $\sum_{i=1}^{n}\sum_{j=1}^{m} c = nmc$, where c is a constant			
		vii. $\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} = \sum_{j=1}^{m}\sum_{i=1}^{n} x_{ij}$			
		viii. $\sum_{i=1}^{n} x_i = x_1 + x_2 + x_3 + ... + x_n$			
		ix. $\sum_{i=1}^{n} x_i y_i = x_1 y_1 + x_2 y_2 + x_3 y_3 + ... + x_n y_n$			

NOTES

				K	U	A
3.2	Central Tendency	3.2.1	describe average and its types;		*	
		3.2.2	write the properties of a good average;	*		
3.3	Arithmetic Mean	3.3.1	define arithmetic mean , weighted arithmetic mean and write their formula;	*		
		3.3.2	calculate the arithmetic mean for ungrouped and grouped data by using: i. definition ii. assumed mean;			*
		3.3.3	calculate the weighted arithmetic mean;			*
		3.3.4	describe the following properties of arithmetic mean: i. if $X = a$ (a is constant), then $\overline{X} = a$ ii. if $Y = X \pm a$, then $\overline{Y} = \overline{X} \pm a$ iii. if $Y = bX$, then $\overline{Y} = b\ \overline{X}$ iv. if $Y = \frac{X}{a}$, then $\overline{Y} = \frac{\overline{X}}{a}$ *or* $\overline{Y} = \frac{1}{a}(\overline{X})$		*	
		3.3.5	apply the above mentioned properties to solve related problems;			*
		3.3.6	write the merits and demerits of arithmetic mean;	*		
3.4	Geometric Mean	3.4.1	define geometric mean and write its formula;	*		
		3.4.2	calculate the geometric mean for ungrouped and grouped data by using: i. definition ii. logarithm;			*
		3.4.3	write the merits and demerits of geometric mean;	*		
3.5	Harmonic Mean	3.5.1	define harmonic mean and write its formula;	*		
		3.5.2	calculate the harmonic mean for ungrouped and grouped data;			*
		3.5.3	write the merits and demerits of harmonic mean;	*		

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				K	U	A
3.6	Relationship between Arithmetic Mean, Geometric Mean and Harmonic Mean	3.6.1	write the relationship between arithmetic mean, geometric mean and harmonic mean;	*		
		3.6.2	verify the relationship between arithmetic mean, geometric mean and harmonic mean for a given data;			*
3.7	Median and Quantiles	3.7.1	define median and quantiles (quartiles, deciles and percentiles);	*		
		3.7.2	calculate median, quartiles, deciles and percentiles for ungrouped and grouped data;			*
		3.7.3	write the merits and demerits of median;	*		
		3.7.4	estimate median and quartiles through a graph;			*
		3.7.5	draw and interpret stem and leaf diagram;			*
		3.7.6	draw and interpret box and whisker plot;			*
3.8	Mode	3.8.1	define mode;	*		
		3.8.2	calculate the mode for ungrouped and grouped data;			*
		3.8.3	write the merits and demerits of mode;	*		
		3.8.4	estimate mode through a graph;			*
3.9	Relationship between Mean, Median and Mode	3.9.1	write the empirical relationship between arithmetic mean, median and mode;	*		
		3.9.2	use empirical relationship to solve related problems.			*

NOTES

				K	U	A
4.	**Measure of Dispersion, Skewness and Kurtosis**	**Candidates should be able to:**				
4.1	Dispersion	4.1.1 4.1.2	describe dispersion; identify types of measure of dispersion;	 *	*	
4.2	Range	4.2.1 4.2.2	define range and semi range; find the range for ungrouped and grouped data;	*		*
4.3	Quartile Deviation	4.3.1 4.3.2	define interquartile range, quartile deviation (semi interquartile range) and coefficient of quartile deviation; 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 4.4.2	define mean deviation and coefficient of mean deviation from mean, median and mode; 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 4.5.2	describe variance, standard deviation and coefficient of variation; 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 $\sigma = \sqrt{\frac{\sum \left(x - \bar{x}\right)^2}{n}}$;		*	*

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			K	U	A
	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	apply the above mentioned properties to solve related problems.			*
4.6 Moments	4.6.1	write the formula of moments about arithmetic mean, arbitrary point and origin;	*		
	4.6.2	calculate and interpret moments about arithmetic mean, arbitrary point and origin for ungrouped and grouped data;			*

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4.7	Symmetry and Skewness	4.7.1	describe symmetry;		*	
		4.7.2	explain the following properties of symmetrical distribution:		*	
			i. mean = median = mode			
			ii. third quartile – median = median – first quartile			
			iii. all odd ordered moments about mean vanish			
			iv. first moment ratio is equal to zero;			
		4.7.3	describe the skewness of a distribution (positive or negative);		*	
		4.7.4	find the coefficient of skewness by using:			*
			i. Lyon Bowley's formula			
			ii. Karl Pearson's formulae;			
		4.7.5	interpret the coefficient of skewness;		*	
		4.7.6	solve problems related to coefficient of skewness;			*
4.8	Kurtosis	4.8.1	describe kurtosis;		*	
		4.8.2	illustrate a given symmetrical distribution as platykurtic, mesokurtic or leptokurtic;		*	
		4.8.3	solve problems related to kurtosis.			*
5.	**Index Numbers**	**Candidates 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;	*		

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	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. $I_{a,b} \times I_{b,c} \times I_{c,d} = \frac{p_b}{p_a} \times \frac{p_c}{p_b} \times \frac{p_d}{p_c}$ $I_{a,b} \times I_{b,c} \times I_{c,d} = \frac{p_d}{p_a}$ $I_{a,b} \times I_{b,c} \times I_{c,d} = p_{a,d}$ where p_a, p_b, p_c and p_d be the prices of a commodity in the years *a*, *b*, *c* and *d* respectively. $I_{a,b}$ is only a ratio and not a percentage. The factor 100 is neglected to avoid confusion.		*	
	5.1.6	prove the above mentioned properties of index number;		*	
	5.1.7	solve problems related to the above mentioned properties of index number;			*

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5.2	Simple Relatives or Simple Index Numbers	5.2.1	describe simple index numbers;		*	
		5.2.2	distinguish between simple and composite price index numbers;		*	
		5.2.3	calculate simple price index numbers by using: i. fixed base method ii. chain base method;			*
5.3	Unweighted Index Numbers	5.3.1	describe the two methods of constructing unweighted index numbers: i. simple aggregate or aggregative method ii. simple average of relatives method;		*	
		5.3.2	calculate composite price index numbers by using the method of simple aggregate or aggregative method;			*
		5.3.3	calculate composite price index numbers by using the method of simple average (mean, median and geometric mean) of relative;			*
5.4	Weighted Index Numbers	5.4.1	describe the two methods of constructing weighted index numbers: i. weighted aggregate method ii. weighted average of relatives method;		*	
		5.4.2	calculate weighted aggregative composite price index numbers by using: i. Laspeyre's formula ii. Paasche's formula iii. Fisher's formula;			*
		5.4.3	calculate index number by weighted average of relative method: i. if base year value ($p_o q_o$) is used as weight ii. if current year value($p_n q_n$) is used as weight;			*

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5.5	Consumer Price Index	5.5.1	describe consumer price index;		*	
		5.5.2	calculate consumer price index numbers by using: i. aggregate expenditure method ii. household budget method.			*
6.	**Regression and Correlation**	**Candidates 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	discuss the relationship between two variables (positive relationship, negative relationship, non linear relationship and no relationship);		*	
		6.1.5	define simple linear regression and identify its regression coefficient;	*		
		6.1.6	describe the method of least squares line of regression;		*	
		6.1.7	use 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 the above mentioned concepts;			*

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				K	U	A
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 formulae:			*
			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. $r = \frac{n\sum D_X D_Y - \left(\sum D_X\right)\left(\sum D_Y\right)}{\sqrt{\left[n\sum X^2 - \left(\sum X\right)^2\right]\left[n\sum Y^2 - \left(\sum Y\right)^2\right]}}$			
			iv. $r = \sqrt{b \times d}$ (product of two regression coefficients);			
		6.2.6	write the properties of coefficient of correlation;	*		
		6.2.7	solve problems related to coefficient of correlation.			*
6.3	Correlation of Ranked Data	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.			*

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				K	U	A
7.	**Time Series Analysis**	**Candidates should be able to:**				
7.1	Concept of Time Series	7.1.1	describe time series;		*	
		7.1.2	draw 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;		*	
		7.1.4	describe additive and multiplicative models utilized for the analysis of time series;		*	
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	use the freehand curve method to find the trend values of a given data;			*
		7.2.5	write the merits and demerits of freehand curve method;	*		
		7.2.6	use the semi-average method to find the trend values of a given data;			*
		7.2.7	write the merits and demerits of semi-average method;	*		
		7.2.8	use the moving average method to find the trend values of a given data;			*
		7.2.9	write the merits and demerits of moving average method;	*		
		7.2.10	use the least squares method to measure linear and quadratic secular trend for estimating trend values.			*
		7.2.11	write the merits and demerits of the least squares method;	*		

NOTES

				K	U	A
8.	**Vital Statistics**	**Candidates 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, sample survey;		*	
		8.1.3	write 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 above mentioned concepts;			*
8.3	Mortality Rates	8.3.1	define mortality;	*		
		8.3.2	define and write the formulae of 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 above mentioned concepts;			*
		8.3.4	define standardized death rate;	*		
		8.3.5	describe the direct and indirect methods to find the standardized death rate for a given data;		*	
		8.3.6	use the direct and indirect method to find the standardized death rate for a given data;			*

NOTES

				K	U	A
8.4	Fertility Rates	8.4.1	define fertility;	*		
		8.4.2	describe crude birth rate, crude rate of natural increase, population growth rate and age-specific birth rate;		*	
		8.4.3	solve problems related to the above mentioned concepts;			*
		8.4.4	define standardized birth rate;	*		
		8.4.5	describe the direct and indirect methods to find the standardized birth rate for a given data;		*	
		8.4.6	use the direct and indirect method to find the standardized birth rate for a given data;			*
		8.4.7	describe general fertility rate, age-specific fertility rate and total fertility rate;		*	
		8.4.8	calculate general fertility rate, age-specific fertility rate and total fertility rate for a given data;			*
8.5	Reproduction Rate	8.5.1	describe gross reproduction rate and net reproduction rate ;	*		
		8.5.2	find the gross reproduction rate and net reproduction rate for a given data.			*
9.	**Interpolation**	**Candidates 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 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 forward difference table from a given equally spaced data;		*	

NOTES

				K	U	A
9.2	Newton's Forward Difference Interpolation Formula	9.2.1 9.2.2 9.2.3	describe Newton's forward difference interpolation formula; use Newton's forward difference interpolation formula to find the interpolating polynomial for a given equally spaced data; use Newton's forward difference formula to interpolate the value of y at a given x ;		*	 * *
9.3	Lagrange's Interpolation Formula	9.3.1 9.3.2 9.3.3	describe Lagrange's interpolation formula; use Lagrange's interpolation formula to find interpolating polynomial for a given equally spaced data; use 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 I Mathematics and also with the inclusion of vital statistics and interpolation in NC 2009, making the syllabus hefty.

NOTES

Part II (Class XII)

Topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
10. Counting Techniques		**Candidates should be able to:**				
10.1	Basic Counting Principle	10.1.1	identify *n!* as the notation to express the product of the first *n* natural numbers;	*		
		10.1.2	describe fundamental principle of counting;		*	
		10.1.3	illustrate fundamental principle of counting by using tree diagram;		*	
		10.1.4	solve problems related to fundamental principle of counting and tree diagram;			*
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	apply the formula ${}^{n}P_{r} = \frac{n!}{(n-r)!}$; when $r < n$ and $r = n$ to solve related problems;			*
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;			*

NOTES

				K	U	A
11. Probability		**Candidates should be able to:**				
11.1	Introduction to Probability	11.1.1	describe: i. random experiment ii. sample space, sample point and an event iii. simple and compound events iv. impossible and sure events v. complementary events vi. equally likely events vii. mutually exclusive and mutually inclusive (non-exclusive) events viii. exhaustive events ix. dependent and independent events;		*	
		11.1.2	describe probability through classical approach, relative frequency approach and axiomatic approach;		*	
		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 for finding the probability in simple cases;			*
		11.1.5	use a Venn diagram and a tree diagram to find the probability of occurrence of an event;			*

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			K	U	A
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;		*	
	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;			*

NOTES

				K	U	A
12.	**Random Variables and Probability Distribution**	**Candidates should be able to:**				
12.1	Concept of Random Variable	12.1.1	describe random variable, discrete random variable and continuous random variable;		*	
		12.1.2	distinguish between discrete and continuous random variable;		*	
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 and verify the properties of expected value of a discrete random variable for 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;	*		
		12.3.8	apply and verify the properties of expected value of a discrete random variable for a given set of data;			*

NOTES

			K	U	A
	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 variable;			*
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 above mentioned properties.			*
13. Special Discrete Probability Distributions	**Candidates 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 Bernoulli trial;		*	
	13.2.2	define binomial experiment, 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;			*

NOTES

			K	U	A
13.3 Hyper Geometric Distribution	13.3.1	define hyper geometric experiment, 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.			*
14. Special Continuous Probability Distribution	**Candidates 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 mentioned concepts;			*
14.2 Normal Distribution	14.2.1	describe the normal distribution and its probability density function;		*	
	14.2.2	define normal random variable and standard normal random variable;	*		
	14.2.3	describe standard normal distribution and its probability density function;		*	
	14.2.4	illustrate the properties of a normal distribution;		*	
	14.2.5	find the probabilities of the normal random variable and standard normal random variable using the standard normal distribution table;			*
	14.2.6	find the quartiles and percentiles for normally distributed population by using the standard normal table (de-standardization of the z-scores) and also find the parameters of a normal random variable.			*
	14.2.7	solve problems related to the normal distribution.			*

NOTES

				K	U	A
15.	**Sampling and Sampling Distributions**	**Candidates should be able to:**				
15.1	Concept of Random Variable	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	use the random number table to select a simple random sample from a given finite population;			*
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;			*

NOTES

			K	U	A
15.4 Sampling Distribution of Sample Proportion	15.4.1 15.4.2	describe sampling distribution of a sample proportion and its properties; find the sampling distribution of sample proportion to verify its properties.		*	 *
15.5 Sampling Distribution of Difference between Two Sample of Proportions	15.5.1 15.5.2	describe sampling distribution of difference between two sample proportions and its properties; find the sampling distribution of difference between two sample proportions to verify its properties.		*	 *
16. Estimation	**Candidates should be able to:**				
16.1 Point Estimation	16.1.1 16.1.2 16.1.3	define estimation of parameter, point estimation and point estimator; distinguish between biased and unbiased estimators; find the point estimates for population mean and population variance from the given random sample;	*	* 	 *
16.2 Interval Estimation	16.2.1 16.2.2	define interval estimation of a parameter and confidence interval; 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);	*		*

NOTES

			K	U	A
17. Hypothesis Testing	**Candidates 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.			*

NOTES

			K	U	A
18. Association of Attributes	**Candidates 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;		*	
	18.2.2	describe the criterion of independence of two attributes in a contingency table;		*	
	18.2.3	describe chi-square (χ^2) statistic;		*	
	18.2.4	describe the test for independence;		*	
	18.2.5	apply chi-square (χ^2) statistic to test the association between the attributes;			*
	18.2.6	describe Yates' correction for continuity;		*	
	18.2.7	apply Yates' correction for continuity to test the association between the attributes.			*

NOTES

				K	U	A
19. Design of Experiment		**Candidates 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 Randomized Design	19.2.1	define randomization and completely randomized design;	*		
		19.2.2	illustrate layout plan of completely randomized design;		*	
		19.2.3	write the merits and demerits of a completely randomized plan;	*		
19.3	Analysis of Variance (one way)	19.3.1	describe analysis of variance;		*	
		19.3.2	write the basic assumptions of analysis of variance;	*		
		19.3.3	write the definition and formulae of : i. the total sum of squares ii. the treatment sum of squares iii. the error sum of squares;	*		
		19.3.4	write the relation of the 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 hypothesis to test the equality of means of normal populations.			*

NOTES

3. Scheme of Assessment: Class XI

Class 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	2	12	0	14
2.	Presentation of Statistical Data	3	0	5	5	10
3.	Measures of Location	9	14	2	14	30
4	Measure of Dispersion, Skewness and Kurtosis	8	5	9	12	26
5.	Index Numbers	5	2	9	7	18
6.	Regression and Correlation	3	3	10	6	19
7.	Time Series Analysis	2	5	5	5	15
8.	Vital Statistics	5	9	6	7	22
9.	Interpolation	3	2	6	4	12
	Total	**41**	**42**	**64**	**60**	**166**
	Percentage		**25**	**39**	**36**	**100**

Table 2: Allocation of Marks for the Multiple Choice Questions (MCQs) and Constructed Response Questions (CRQs)

Topic No.	Topics	No. of Sub - Topics	Marks		
			Multiple Choice Questions	Constructed Response Questions	Total
1.	Introduction to Statistics	3	3	4	7
2.	Presentation of Statistical Data	3	5	6	11
3.	Measures of Location	9	5	7	12
4.	Measure of Dispersion, Skewness and Kurtosis	8	5	8	13
5.	Index Numbers	5	3	6	9
6.	Regression and Correlation	3	3	7	10
7.	Time Series Analysis	2	2	7	9
8.	Vital Statistics	5	3	5	8
9.	Interpolation	3	1	5	6
	Total	**41**	**30**	**55**	**85**

Table 3: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
1.	Introduction to Statistics	MCQs 3 @1 Mark CRQ 1 @ 4 Marks		7
2.	Presentation of Statistical Data	MCQs 5 @ 1 Mark CRQ 1 @ 6 Marks		11
3.	Measures of Location	MCQs 5 @ 1 Mark *CRQs 2 @ 7 Marks Choose any ONE from TWO		12
4.	Measure of Dispersion, Skewness and Kurtosis	MCQs 5 @ 1 Mark *CRQs 2 @ 8 Marks Choose any ONE from TWO		13
5.	Index Numbers	MCQs 3 @ 1 Mark *CRQs 2 @ 6 Marks Choose any ONE from TWO		9
6.	Regression and Correlation	MCQs 3 @ 1 Mark CRQ 1 @ 7 Marks		10
7.	Time Series Analysis	MCQs 2 @ 1 Mark CRQ 1 @ 7 Marks		9
8.	Vital Statistics	MCQ 3 @ 1 Mark *CRQs 2 @ 5 Marks Choose any ONE from TWO		8
9.	Interpolation	MCQ 1 @ 1 Mark CRQ 1 @ 5 Marks		6
	Total	**MCQs 30**	**CRQs 55**	**85**

* There will be TWO questions and the candidates will be required to attempt any ONE by making a choice out of the TWO.

Class XII

Table 4: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
10.	Counting Techniques	3	1	4	3	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	4	6	11
15.	Sampling and Sampling Distributions	5	4	7	5	16
16.	Estimation	2	2	1	2	5
17.	Hypothesis Testing	2	0	4	0	4
18.	Association of Attributes	2	2	11	3	16
19.	Design of Experiment	3	5	4	4	13
	Total	**28**	**23**	**56**	**42**	**121**
	Percentage		**19**	**46**	**35**	**100**

Table 5: Allocation of Marks for the Multiple Choice Questions (MCQs) and Constructed Response Questions (CRQs)

Topic No.	Topics	No. of Sub-Topics	Marks		
			Multiple Choice Questions	Constructed Response Questions	Total
10.	Counting Techniques	3	3	4	7
11.	Probability	2	5	6	11
12.	Random Variables and Probability Distribution	4	5	6	11
13.	Special Discrete Probability Distributions	3	3	6	9
14.	Special Continuous Probability Distribution	2	3	6	9
15.	Sampling and Sampling Distributions	5	3	7	10
16.	Estimation	2	2	3	5
17.	Hypothesis Testing	2	2	6	8
18.	Association of Attributes	2	2	7	9
19.	Design of Experiment	3	2	4	6
	Total	**28**	**30**	**55**	**85**

Table 6: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
10.	Counting Techniques	MCQs 3 @ 1 Mark *CRQs 2 @ 4 Marks Choose any ONE from TWO		7
11.	Probability	MCQs 5 @ 1 Mark *CRQs 2 @ 6 Marks Choose any ONE from TWO		11
12.	Random Variables and Probability Distribution	MCQs 5 @ 1 Mark *CRQs 2 @ 6 Marks Choose any ONE from TWO		11
13.	Special Discrete Probability Distributions	MCQs 3 @ 1 Mark CRQ 1 @ 6 Marks		9
14.	Special Continuous Probability Distribution	MCQs 3 @ 1 Mark CRQ 1 @ 6 Marks		9
15.	Sampling and Sampling Distributions	MCQs 3 @ 1 Mark *CRQs 2 @ 7 Marks Choose any ONE from TWO		10
16.	Estimation	MCQs 2 @ 1 Mark CRQ 1 @ 3 Marks		5
17.	Hypothesis Testing	MCQs 2 @ 1 Mark CRQ 1 @ 6 Marks		8
18.	Association of Attributes	MCQs 2 @ 1 Mark *CRQs 2 @ 7 Marks Choose any ONE from TWO		9
19.	Design of Experiment	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks		6
	Total	**MCQs 30**	**CRQs 55**	**85**

* There will be TWO questions and the candidates will be required to attempt any ONE by making a choice out of the TWO.

4.1 Tables 1 and 4 indicate the number and nature of SLOs in each topic in classes XI and XII respectively. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to the Understanding (39% in XI and 46% in XII), Application and higher order skills (36% in XI and 35% in XII) to discourage rote memorization. Tables 1 and 4, however, do not translate directly into marks.

4.2 There will be two examinations, one at the end of Class XI and one at the end of Class XII.

4.3 In each class, the theory paper will be in two parts: paper I and paper II. Both papers will be of duration of 3 hours.

4.4 Paper I theory will consist of 30 compulsory, multiple choice questions. These questions will involve four response options.

4.5 Paper II theory will carry 55 marks and consist of a number of compulsory, constructed response questions. There will be no choice among the topics in constructed response questions but it may be within the topic.

4.6 All constructed response questions will be in a booklet which will also serve as an answer script.

4.7 Practical examination will be conducted separate from the theory paper.

4.8 Practical examination to assess performance skills will carry 15 marks in Class XI and 15 marks in class XII.

4.9 Each school will be responsible to make sure that each student is provided the opportunity to do practicals throughout and maintain a proper record of these practicals.

5. Teaching –Learning Approaches and Classroom Activities

5.1 As the AKU-EB syllabus focuses on understanding and higher order thinking skills, teachers need to encourage activity and problem-based classroom practices.

5.2 The following strategies are recommended:

5.2.1 Before starting any topic, teachers should give the relevant information from that topic to build up and recall their previous knowledge if any.

5.2.2 Lecture should be well organised and completed within limited time period with current and practical examples.

5.2.3 To understand the cognitive level of ongoing topics, the teacher should provide hard copies of the examination syllabus to the students.

5.2.4 During the lecture, the teacher should ask questions randomly from the students to assess whether they are understanding or not.

5.2.5 If a teacher feels that a student does not understand, the student should be called to the board to clarify the concept. This will facilitate the student to comprehend more accurately

5.2.6 Encourage students to present selected and applied topics of the syllabus.

5.2.7 Arrange educational trips to different organisations and institutes, i.e. banks and other sort of financial institutions.

5.2.8 Assign tasks to the students to search relevant material from other sources, i.e. library, internet and news papers etc.

5.2.9 Organise group discussions among students to share their views about current topics.

5.2.10 Whenever possible organise a meeting of students with different professionals and intellectuals to broaden their horizon.

6. Recommended Texts, Reference Materials

Recommended Books

1. Beg M.Afzal, Mirza Miraj (2007). *Introduction to Statistics for Intermediate Part-I*. Lahore: Caravan Book House.
2. Beg M.Afzal, Mirza Miraj (2007). *Introduction to Statistics for Intermediate Part-II*. Lahore: Caravan Book House.

Reference Books

1. Crawshaw.J, Chambers.J (2001) fourth edition. *A concise course in advanved level Statistics.United Kingdom: Nelson Thornes Ltd*.
2. Jamal Shahid, (2004) second edition. *Statistics .Karachi: Ahmed Academy.*

Recommended Websites

http://learningsupport.akueb.edu.pk
http://www.analyse-it.com
http://www.mste.uiuc.edu/stat/stat.html
http://www.whfreeman.com/eesee/eesee.html
http://www.exploringdata.cqu.edu.au
http://www.onlinestatbook.com
http://www.pinkmoney.com/studyguides/subject/stat/contents.asp
http://www.onlinestatbook.com/rvls.html
http://www.shodor.org/interactive/lessons/
http://www.spss.com
http://www.statsoft.com
http://www.maplesoft.com
http://www.walfram.com/products/mathematica/index.htm
http://www.minitab.com/products/Minitab

7. Definition of Cognitive Levels and Command Words

7.1. Definition of Cognitive Levels

Knowledge

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories. It can be taught and evaluated through questions based on: which, when, where, what, list, define, identify, label, tabulate, name, state.

Understanding

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, seeing patterns, organising parts, making links, summarising, solving, finding evidence. It can be taught and evaluated through questions based on: why, how, describe, summarise, explain, prove, predict, compare, distinguish, report.

Application

This requires using information or concepts in new situations, solving problems, organising information and ideas, using old ideas to create new ones, generalising from given facts, analysing relationships, drawing conclusions. It can be taught and evaluated through questions based on: analyse, show relationship, propose an alternative, prioritise, categorise, illustrate, corroborate, design, formulate, rearrange, reorganise, predict consequences, interpret, solve.

7.2 Definition of Command Words

Knowledge

Define:	Only a formal statement or equivalent paraphrase is required. No examples need to be given.
Identify:	Pick out, recognizing specified information from a given content or situation.
Write:	To compose, execute or produce in words, characters or figures.

Understanding

Construct:	To set in order or something formulated or built systematically or frame a concept, model, or schematic idea.
Describe:	To state in words (using diagrams where appropriate) the main points of the topic.
Discuss:	To give a critical account of the points involved in the topic.
Distinguish:	To identify those characteristics which always or sometimes distinguish between two categories.
Explain:	To give reason or use some reference to theory, depending on the context.
Illustrate:	To give clear examples to state, clarify or synthesize a point of view.
Interpret:	To translate information from observation, charts, tables, graphs, and written material in a supportable manner.

Application

Apply:	To use the available information in different contexts to relate and draw conclusions.
Calculate:	Is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
Draw:	To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
Estimate:	To calculate approximately (the amount, extent, magnitude, position, or value of something).
Find:	Is a general term that may variously be interpreted as calculate, measure, determine, etc. In other contexts, describe and give an account of should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organization of the material to be included in the answer. Describe and explain may be coupled in a similar way to state and explain.
Solve:	To work out systematically the answer of a given problem.
Use:	To deploy the required attribute in a constructed response.

Annex

HSSC Scheme of Studies[3]

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. The marks allocated to subjects in the revised National Scheme of Studies have been followed.

HSSC I-II (Classes XI-XII) subjects on offer for examination

HSSC Part-I (Class XI) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Biology-I	85	15	100	English
Total:	**455**	**45**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Biology-II	85	15	100	English
Total:	**555**	**45**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

[3] Government of Pakistan September 2007. *Scheme of Studies for SSC and HSSC (Classes IX-XII).* Islamabad: Ministry of Education, Curriculum Wing.

HSSC Part-I (Class XI) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Mathematics-I	100	-	100	English
Total:	**470**	**30**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Mathematics –II	100	-	100	English
Total:	**570**	**30**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I Pakistan Culture-I [a]	100	-	100	Urdu English
Any one subject combinations of the following:				
Physics-I Mathematics-I *Statistics-I	85 100 85	15 - 15	300	English English English
Economics-I Mathematics-I *Statistics-I	100 100 85	- - 15	300	English / Urdu English English
Economics-I Mathematics-I Computer Science-I	100 100 75	- - 25	300	English / Urdu English English
Physics-I Mathematics-I Computer Science-I	85 100 75	15 - 25	300	English English English
Mathematics-I *Statistics-I Computer Science-I	100 85 75	- 15 25	300	English English English
Total:			**500**	

HSSC Part-II (Class XII) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Any one subject combinations of the following:				
Physics-II Mathematics-II *Statistics-II	85 100 85	15 - 15	300	English English English
Economics-II Mathematics-II *Statistics-II	100 100 85	- - 15	300	English / Urdu English English
Economics-II Mathematics-II Computer Science-II	100 100 75	- - 25	300	English / Urdu English English
Physics-II Mathematics-II Computer Science-II	85 100 75	15 - 25	300	English English English
Mathematics-II *Statistics-II Computer Science-II	100 85 75	- 15 25	300	English English English
Total:			**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.

b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subject is offered ONLY in the May examination.**

HSSC Part-I (Class XI) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Principles of Accounting-I	100	-	100	English
Principles of Economics	75	-	75	English
Principles of Commerce	75	-	75	English
Business Mathematics	50	-	50	English
Total:	**500**	**-**	**500**	

HSSC Part-II (Class XII) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Principles of Accounting-II	100	-	100	English
Commercial Geography	75		75	English
*Computer Studies **OR** Banking	60 **OR** 75	15 -	75	English
Business Statistics	50	-	50	English
Total:	**600**		**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***This subjects are offered ONLY in the May examination.**

HSSC Part-I (Class XI) Humanities Group

Subjects	Marks	Medium
English Compulsory-I	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	Urdu English
Any three of the following Elective Subjects	300	
1. Civics-I	(100	English / Urdu
2. Computer Science-I (75+25 practical)	each)	English
3. Economics-I		English / Urdu
4. *Education-I		English / Urdu
5. *Geography-I (85+15 practical)		English / Urdu
6. *Islamic Studies-I		English / Urdu
7. *Islamic History-I		English / Urdu
8. Literature in English-I		English
9. Mathematics-I		English
10. *Psychology-I (85+15 practical)		English / Urdu
11. *Statistics-I (85+15 practical)		English
12. *Sociology-I		English / Urdu
13. Urdu Literature-I		Urdu
14. *Fine Arts-I		English
Total:	**500**	

HSSC Part-II (Class XII) Humanities Group

Subjects	Marks	Medium
English Compulsory-II	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	Urdu English
Islamiyat **OR** Ethics [b]	50	English / Urdu
Pakistan Studies	50	English / Urdu
Any three of the following Elective Subjects	300	
1. Civics-II	(100	English / Urdu
2. Computer Science-II (75+25 practical)	each)	English
3. Economics-II		English / Urdu
4. *Education-II		English / Urdu
5. *Geography-II (85+15 practical)		English / Urdu
6. *Islamic Studies-II		English / Urdu
7. *Islamic History-II		English / Urdu
8. Literature in English-II		English
9. Mathematics-II		English
10. *Psychology-II (85+15 practical)		English / Urdu
11. *Statistics-II (85+15 practical)		English
12. *Sociology-II		English / Urdu
13. Urdu Literature-II		Urdu
14. *Fine Arts-II		English
Total:	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subjects are offered <u>ONLY</u> in the May examination.**