

## **AGA KHAN UNIVERSITY EXAMINATION BOARD**

### Notes from E-Marking Centre HSSC-II Business Statistics Annual Examinations 2023

#### **Introduction**

This document has been prepared for the teachers and candidates of Higher Secondary School Certificate (HSSC) Part II (Class XII) Business Statistics. It contains comments on candidates' responses to the 2023 HSSC-II Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

#### **E-Marking Notes**

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that requires candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the SLOs which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used.

#### **General Observations**

Candidates performed really well in some concepts, such as, price index and median of the group data. However, candidates who did not score well mostly failed to understand the demands of the questions, often misinterpreting the command words and the stimuli. Furthermore, interpretation of graphs and scientific reasoning were also weak.

Mentioned below are few concepts that teachers need to focus so that the candidates may perform better.

- Pie Chart and its sector distribution
- Properties of the Central Tendencies and Quartiles
- Counting Techniques and Probability

**Note: Candidates' responses shown in this report have not been corrected for grammar, spelling, format, or information.**

**DETAILED COMMENTS**  
**Constructed Response Questions (CRQs)**

**Question No. 1**

**Question Text** The given table provides information about the likes of different sports by students in a school. Draw a pie chart by completing the given table.

Sports	Likes (%)	Angle of Sector
Cricket	35	
Football	25	
Hockey	20	
Table Tennis	10	
Badminton	10	

**SLO No.** 10.1.6

**SLO Text** Draw a pie chart and extract information from it.

**Max Marks** 3

**Cognitive Level** A\*

**Checking Hints** 1 mark for calculating the angles of the sectors (Award 1 mark if any three values are CORRECT)  
2 marks for appropriate distribution of sectors in the pie chart (Award 1 mark if any three values are CORRECT)

**Overall Performance** The question was related to a pie chart. The candidates were required to extract three main information - the angle of a specific sector, the distribution of the sector in the pie chart, and the appropriate angle representation in the chart. Most candidates demonstrated proficiency in identifying at least two relevant components: the angle of a specific sector and its distribution in the pie chart.

**Description of Better Responses** In better responses, candidates adeptly identified all the required elements in the question, including the angle of the sector, the distribution of the angle in the pie chart, and the accurate representation of the angle within the chart. Their ability to grasp these concepts indicated a solid understanding of pie charts and reflected their clarity of thought.

**Image of Better Response**

Cricket	35	126°
Football	25	90°
Hockey	20	72°
Table Tennis	10	36°
Badminton	10	36°

①  $\frac{35}{100} \times 360 = 126^\circ$     ②  $\frac{25}{100} \times 360 = 90^\circ$     ③  $\frac{20}{100} \times 360 = 72^\circ$     ④  $\frac{10}{100} \times 360 = 36^\circ$   
 ⑤  $\frac{10}{100} \times 360 = 36^\circ$

Space for Pie Chart

The pie chart is divided into five sectors. Starting from the top and moving clockwise, the sectors are: Cricket (126°), Football (90°), Hockey (72°), Table Tennis (36°), and Badminton (36°). Each sector is labeled with the sport name and its corresponding angle.

**Description of Weaker Responses**

In weaker responses, candidates struggled to identify the angle of the sector, the distribution of angles in the pie chart, and faced challenges in creating an appropriate graphical representation.

**Images of Weaker Responses**

**Image (i)**

Sports	Likes (%)	Angle of Sector
Cricket	35	120°
Football	25	60°
Hockey	20	40°
Table Tennis	10	20°
Badminton	10	20°

There is different ways to make the angle sector according to the pie chart.

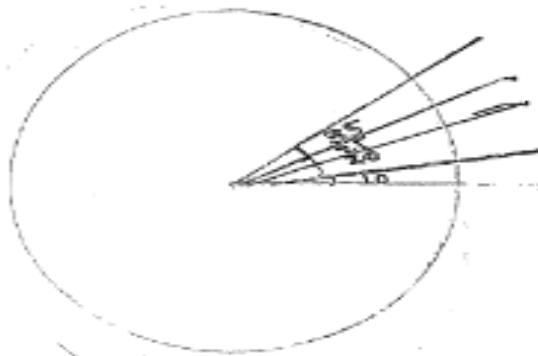
Space for Pie Chart




**Image (ii)**

Cricket	35	<del>35</del> Sector 0.35
Football	25	0.25
Hockey	20	0.20
Table Tennis	10	0.10
Badminton	10	0.10

Space for Pie Chart



## Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy** Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>• Understand the expectations of the command words</li> <li>• Look at the cognitive level</li> <li>• Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>• Go through the past paper questions on that particular concept</li> <li>• Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>• Story Board</li> <li>• Cause and Effect</li> <li>• Fish and Bone</li> <li>• Concept Mapping</li> <li>• Audio Visual resources</li> <li>• Think, Pair and Share</li> <li>• Questioning Technique (Socratic approach)</li> <li>• Practical Demonstration</li> </ul> <p>** For description of each pedagogy, refer to Annexure A</p>	<ul style="list-style-type: none"> <li>• Past paper questions</li> <li>• Discussion on E-Marking Notes</li> <li>• AKU-EB Digital Learning Solution powered by Knowledge Platform <a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></li> </ul> 

### Any Additional Suggestion:

By implementing these teaching methodologies and strategies, teachers can create an engaging and effective learning environment that promotes a thorough understanding of pie charts.

Utilise visualisation tools or software that allow students to create pie charts easily. Interactive platforms can help students understand the relationship between data values and sector angles.

Provide real-world data sets and ask students to create pie charts from them. This encourages the application of pie chart skills to practical scenarios.

Teach students how to label sectors with category names and percentage values. Discuss the importance of clear labelling for data representation.

Introduce comparative pie charts that show changes over time or between different groups. Teach students how to create and analyse such charts.

Organise hands-on activities where students collect data and create their own pie charts. This provides practical experience in data representation.

Review common errors made in pie chart creation and interpretation. Discuss strategies to avoid these errors. Showcase how pie charts are used in various fields, such as business, statistics, and marketing, to emphasise their real-life significance.

\*K = Knowledge U = Understanding A = Application and other higher-order cognitive skills

### Question No. 2a

Candidates were given the choice to attempt any ONE out of the two questions: 2a and 2b.

**Question Text** A college physical training instructor noted the time of 60 students in a race and recorded the information in the given table.

Time (seconds)	Number of Students	Cumulative Frequency
50 - 54	6	
55 - 59	20	
60 - 64	18	
65 - 69	16	

Calculate median time of the students by completing the given table.

**SLO No.** 11.2.2

**SLO Text** Calculate median for ungrouped and grouped data.

**Max Marks** 3

**Cognitive Level** A

**Checking Hints**  
 1 mark for calculating cumulative frequencies.  
 1 mark Identifying  $l$ ,  $h$ , and  $c$  for the data.  
 1 mark for calculating the median of the data.

**Overall Performance** Most of the candidates attempted this part and some of the candidates attempted it successfully. In this question candidates were required to determine the median of a given dataset by identifying the median class, cumulative frequency, class boundaries of the median class, and the class interval.

**Description of Better Responses** In better responses, candidates exhibited a strong grasp of finding the median of grouped data by effectively determining the central value. Such responses demonstrated a clear understanding of finding the median, showcasing their familiarity with the elements such as the median class, cumulative frequency, class boundaries of the median class, and the width of the median class. Candidates' proficient application of these concepts facilitated accurate calculations.

**Image of Better Response**

Time (seconds)	Number of Students	Cumulative Frequency
50 - 54	6	6
55 - 59	20	26
60 - 64	18	44
65 - 69	16	60

Calculate median time of the students by completing the given table.

b. A random sample of 15 employees at an organisation were asked about the screen time during their working hours. The data obtained is

3, 4, 6, 7, 2, 3, 5, 4, 6, 7, 5, 8, 8, 10, 5

Find the first and the third quartiles of the data.

$$a. \text{median} = L + h \left( \frac{\frac{N}{2} - c.f}{f} \right)$$

$$60 : 30$$

2

$$59.5 + \frac{5}{18} (30 - 26)$$

$$\text{median} = 60.61$$


**Description of Weaker Responses** In weaker responses, candidates struggled in identifying the median class on the basis of cumulative frequency. While some candidates demonstrated the knowledge of calculating the width of the class interval and recognizing the class boundaries, they struggled to accurately apply these values in the provided formula of median.

**Image of weaker Response**

Part a

Time (seconds)	Number of clubs	Cumulative Frequency
50 - 54	6	$\frac{49.5 + 54.5}{2} = 52$
55 - 59	20	$\frac{54.5 + 59.5}{2} = 57$
60 - 64	18	$\frac{59.5 + 64.5}{2} = 62$
65 - 69	16	$\frac{64.5 + 69.5}{2} = 67$

**Suggestions for Improvement (Highlighted part)**

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform <a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></li> </ul> 

**Any Additional Suggestion:**

Following are some teaching strategies that teachers can use to teach this concept.

Use interactive software or drawing tools to create histograms for grouped data. Show students how to locate the median visually by identifying the class interval that contains it.

Utilise online tools i.e., atozmath and easycalculation that allow students to input grouped data and automatically calculate the median. Encourage them to experiment with different data sets.

Connect grouped data and the calculation of the median to real-world scenarios, such as analysing census data, income distribution, or class sizes.

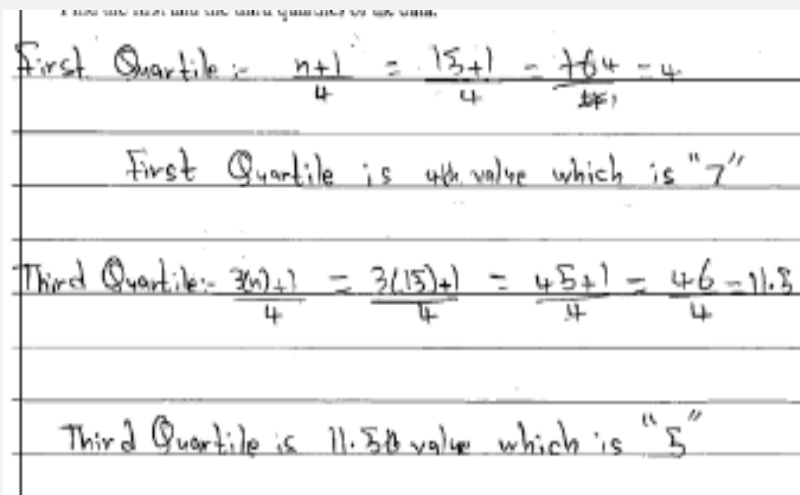
### Question No. 2b

Candidates were given the choice to attempt any ONE out of the two questions: 2a and 2b.

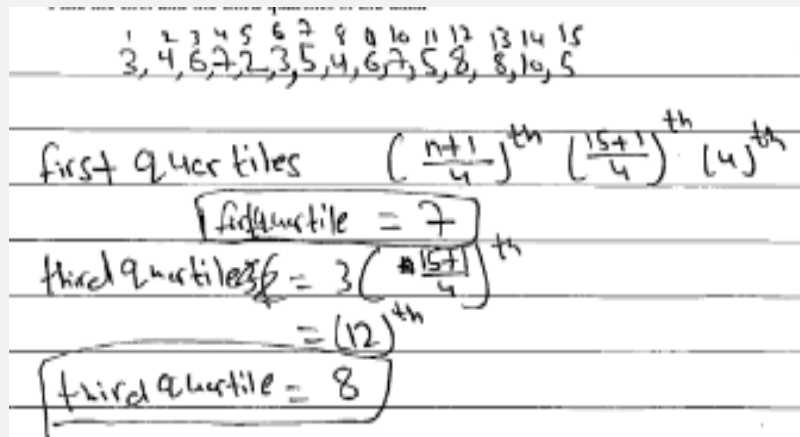
<b>Question Text</b>	A random sample of 15 employees at an organisation were asked about the screen time during their working hours. The data obtained is  3, 4, 6, 7, 2, 3, 5, 4, 6, 7, 5, 8, 8, 10, 5  Find the first and the third quartiles of the data.
<b>SLO No.</b>	11.3.2
<b>SLO Text</b>	Calculate quartiles for ungrouped and grouped data.
<b>Max Marks</b>	3
<b>Cognitive Level</b>	A
<b>Checking Hints</b>	1 mark for writing the data in ascending or descending order 1 mark for calculating $Q_1$ 1 mark for calculating $Q_3$
<b>Overall Performance</b>	This question specifically tested the candidates' ability to solve quartile-based problems, requiring a basic knowledge of ascending and descending order. Overall, most of the candidates demonstrated competence in finding the correct answers for this question, reflecting their proficiency in understanding about quartiles of ungrouped data. However, few students encountered difficulties while attempting to solve this particular problem.
<b>Description of Better Responses</b>	In better responses, candidates correctly sorted the given data in either ascending or descending order. They accurately calculated the number of terms and successfully found the first and third quartiles. By organizing the data correctly and using appropriate methods, these candidates were able to determine the quartile values accurately.
<b>Image of Better Response</b>	<p>b) Working for 1<sup>st</sup> quartile :- <math display="block">\left(\frac{n+1}{4}\right)^{th} = \frac{15+1}{4} = \frac{16}{4} = 4^{th} \text{ value}</math><math display="block">= \boxed{4 \text{ ans.}}</math> • Working for 3<sup>rd</sup> quartile :- <math display="block">3 \left(\frac{n+1}{4}\right)^{th} \text{ value} = 3 \left(\frac{15+1}{4}\right) = 3 \left(\frac{16}{4}\right)</math><math display="block">= 3(4)^{th} \text{ value}</math><math display="block">= 12^{th} \text{ value}</math><math display="block">= \boxed{7 \text{ ans.}}</math> 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8, 10</p>
<b>Description of Weaker Responses</b>	In weaker responses, students struggled in arranging the data in ascending or descending order. Due to this, they were not able to calculate correctly the number of terms given in the question. Such responses also showed that candidates were not aware of the formula that they should apply for the quartile.

**Images of Weaker Responses**


**Image (i)**



**Image (ii)**



Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform</li> </ul> <p><a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></p> 



**Any Additional Suggestion:**

Following are some teaching strategies related to misconceptions and common errors which candidates exhibited.

Provide students with datasets to order and encourage them to practice ordering data regularly. Ensure they understand the importance of data arrangement in quartile calculations

Ensure students thoroughly understand quartile formulas. Teach them how to calculate quartiles step by step, including finding positions and values.

Provide a step-by-step problem-solving framework for quartile-based questions. Highlight the importance of a systematic approach. Use interactive tools or software to visually demonstrate how data arrangement affects quartile positions. Encourage hands-on exploration.

**Question No. 3**

<b>Question Text</b>	The standard deviation of a variable $X$ is 6. Using the property of standard deviation and variance find the value of the  i. standard deviation of $2X + 5$ ii. variance of $X + 5$ iii. variance of $3X - 5$ .
<b>SLO No.</b>	12.1.6
<b>SLO Text</b>	Apply the above-mentioned properties to solve related problems.
<b>Max Marks</b>	3
<b>Cognitive Level</b>	A
<b>Checking Hints</b>	i. 1 mark for finding the value of the standard deviation of $2X + 5$ ii. 1 mark for finding the value of the variance of $X + 5$ iii. 1 mark for finding the value of the variance of $3X - 5$
<b>Overall Performance</b>	The question assesses the properties of standard deviation and variance. Some of the candidates performed good in this question while most of the candidates were not able to perform well in this question.
<b>Description of Better Responses</b>	In better responses, students exhibited their knowledge of standard deviation, variance and their properties. They were also able to identify which property should be applied on each part.

**Image of Better Response**

i.	standard deviation of $2X+5$	(1 Mar)
	$Var(X) = 6^2 \Rightarrow 36$	
	$Var(2X) = 2^2 \times 36 \Rightarrow 144$ , Standard deviation = $\sqrt{144} \Rightarrow 12$ .	
ii.	variance of $X+5$	(1 Mar)
	$Var(X) = 6^2$	
	$Var(1X) = 36$	
iii.	variance of $3X-5$ .	(1 Mar)
	$Var(X) = 36$	
	$Var(3X) = 3^2 \times 36 \Rightarrow 324$	

**Description of Weaker Responses**

Weaker responses showed that candidates were not able to understand the demand of the question. They used formulae of finding standard deviation and variance which were not required. In cases where they were able to understand that the question requires the application of properties of standard deviation and variance, these properties were not applied correctly resulting in loss of marks.

**Images of Weaker Responses**

**Image (i)**

i.	standard deviation of $2X+5$	(1 Mark)
	$2 \times 6 + 5$ $6 + 5$	
	$= 17$ $= 11$	
ii.	variance of $X+5$	(1 Mark)
	$6 + 5$	
	$= 11$	
iii.	variance of $3X-5$ .	(1 Mark)
	$6 - 5$	
	$= 1$	

**Image (ii)**

standard deviation of  $2X+5$  (1 Mar)

$$sd = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} = \frac{sd \sqrt{(2+5)^2}}{5} = \frac{sd \sqrt{(7)^2}}{5} = \frac{2.8 \cdot 5}{5} = 2.8$$


variance of  $X+5$  (1 Mar)

$$\frac{\sum (x - \bar{x})^2}{n} = \frac{\sum (x+5 - \bar{x})^2}{5} = \frac{5+5}{5} = \frac{10 \times 2}{5} = \frac{20}{5} = 4$$

variance of  $3X-5$  (1 Mar)

$$\frac{\sum (x - \bar{x})^2}{n} = \frac{\sum (3x-5)^2}{5} = \frac{-2^2}{5} = \frac{-4}{5} = -0.8$$

**Suggestions for Improvement (Highlighted part)**

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform <a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></li> </ul> 

**Any Additional Suggestion:**

Following are some effective methodologies that teachers may use to teach the properties of standard deviation and variance.

**Comparative Analysis:** Teach students to compare standard deviation and variance values across different datasets. Show how these measures can help identify differences in data variability.

**Formulas and Calculations:** Provide step-by-step explanations of the formulas for standard deviation and variance. Break down the calculations into smaller, manageable parts, and have students practice them.

**Graphical Representations:** Create graphs that illustrate the impact of changing data values on standard deviation and variance. For example, show how outliers affect these measures.

Offer a variety of practice problems with increasing levels of complexity. Gradually introduce more challenging datasets and problems as students become more proficient.

### Question No. 4

**Question Text** Calculate Paasche's index number for the given data, taking 2010 as the base year.

Commodity	Price		Quantity		$\sum P_o Q_n$	$P_n Q_n$
	2010	2011	2010	2011		
A	6.60	7.10	240	330		
B	4.15	4.90	185	210		
C	1.25	2.00	315	345		
D	0.65	1.30	260	115		

**SLO No.** 13.3.1

**SLO Text** Calculate weighted price index by Laspeyeres, Paasche's and Fisher's indices.

**Max Marks** 4

**Cognitive Level** A

**Checking Hints**  
 1 mark for completing the column  $P_o Q_n$   
 1 mark for completing the column  $P_n Q_n$   
 1 mark for taking the sum of the two columns  
 1 mark for calculating Paasche's index number

**Overall Performance** Most of the candidates exhibited correct multiplication of  $P_o Q_o$  and  $P_n Q_n$  followed by correct summation. In few of the cases candidate were unable to differentiate between the values of  $P$  and  $Q$ .

**Description of Better Responses** In better responses, candidates correctly identified the information given in the question, linked it correctly with base year and thus performed the appropriate multiplications to obtain the required result.

**Image of Better Response**

Commodity	Price		Quantity		$\sum P_o Q_n$	$P_n Q_n$
	2010	2011	2010	2011		
A	6.60	7.10	240	330	2178	2343
B	4.15	4.90	185	210	871.5	1029
C	1.25	2.00	315	345	431.25	690
D	0.65	1.30	260	115	74.75	149.5
					$\Sigma = 3555.5$	$\Sigma P_n Q_n = 4211.5$

$$\text{Paasche's index number} = \frac{\sum P_n \cdot Q_n}{\sum P_o \cdot Q_n}$$

$$= \frac{4211.5}{3555.5}$$


$$\text{Paasche index number} = 1.18$$

**Description of Weaker Responses** In weaker responses, candidates struggled to distinguish the symbol used for base year and made mistakes in arithmetic operations in their responses. In addition to this, such candidates also left the solution incomplete without using any formula for finding the final answer.

Image of Weaker Response

Commodity	Price		Quantity		$\sum P_0 Q_n$	$P_n Q_n$
	2010	2011	2010	2011		
A	6.60	7.10	240	330	86.427	759
B	4.15	4.90	185	210	97.175	262.75
C	1.25	2.00	315	345	94.554	373.75
D	0.65	1.30	260	115	228.036	19.5
					506.222	1,415

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform</li> </ul> <p><a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></p> 

**Any Additional Suggestion:**

Following are some interactive teaching strategies, you can help students to understand how to calculate weighted price indices also appreciate the significance and practical applications of these indices in economics and data analysis.

Use spreadsheet software (e.g., Excel or Google Sheets) to demonstrate how to calculate the indices in real-time. Provide students with sample datasets and guide them through the calculations.

Give each student or group a different market basket (a set of goods and their quantities) and price data for multiple time periods. Let them calculate the Laspeyres, Paasche's, and Fisher's indices and compare results.

Create a virtual shopping game where students can choose items and quantities to purchase over different time periods. Then, ask them to calculate the indices based on their purchases.

Provide students with real price data for a selection of goods and services (e.g., inflation data). Ask them to calculate price indices using the three methods and interpret the results in terms of inflation rates.

### Question No. 5a

Candidates were given the choice to attempt any ONE out of the two questions: 5a and 5b.

**Question Text** How many 6 digits' odd numbers are possible using digits 1, 2, 3, 4, 6, 7 and 9 if digits can be repeated but all the numbers start with digit 2?  
Use the given table to find the possible answer.

Placement of Digits at Different Place Values						Possible Odd Numbers
Lac	Ten Thousand	Thousand	Hundred	Ten	Unit	

**SLO No.** 14.2.3

**SLO Text** Solve problems related to permutation with and without restrictions.

**Max Marks** 4

**Cognitive Level** A

**Checking Hints**  
1 mark for deciding the possibilities for unit place value  
1 mark for deciding the possibility at lac place value  
1 mark for deciding the possibility at the remaining place values  
1 mark for calculating correctly the possible numbers

**Overall Performance** This question offered choice between part 'a' and part 'b'. Part 'a' involves a basic counting technique. It required candidates to construct a six-digit odd number starting from 2, with repetition allowed.

**Description of Better Responses** In better responses, the majority of candidates understood the question and accurately applied the concept of counting technique. They correctly placed the number 2 at the first position, and the digits 1, 3, 7, and 9 for the last position. Between these two positions, they repeatedly used all the numbers given in the question.

**Image of Better Response**

Placement of Digits at Different Place Values						Possible Odd Numbers
Lac	Ten Thousand	Thousand	Hundred	Ten	Unit	
2	7	7	7	7	4	9604

$$\begin{array}{c}
 \underline{2 \quad 7 \quad 7 \quad 7 \quad 7 \quad 4} \\
 1 \times 7 \times 7 \times 7 \times 7 \times 4 \\
 = 9604
 \end{array}$$

**Description of Weaker Responses** In weaker responses, students demonstrated difficulty comprehending the question. They attempted to solve the problem using incorrect methods such as combination and permutation. Consequently, they were unable to grasp the concept of the repeated number technique, leading to inaccuracies in finding the six-digit numbers.

**Images of Weaker Responses**


**Image (i)**

						NUMBERS
Lac	Ten Thousand	Thousand	Hundred	Ten	Unit	
2	8	7	6	4	3	4900 <del>4900</del>

Image (ii)

Placement of Digits at Different Place Values						Possible Odd Numbers
Lac	Ten Thousand	Thousand	Hundred	Ten	Unit	2, 4, 6
2264264	26,246	2,466	224	22	2	

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform <a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></li> </ul> 

**Any Additional Suggestion:**

By using these teaching methodologies, teachers can help students grasp the distinctions between permutations and combinations, apply the correct concept in problem-solving, and avoid common errors in their responses.

**Hands-On Activities:** Engage students in tangible activities using objects like coins, cards, or building blocks. let them physically arrange these objects to understand permutations. For example, ask them to arrange five colored balls in different orders.

**Interactive Simulations:** Use online tools and simulations that allow students to experiment with permutations. There are various permutation calculators and apps available that can help students practice and visualise permutations.

**Combinations vs. Permutations:** Clearly differentiate between permutations and combinations. Use examples to show when each concept is appropriate. This distinction is essential to prevent confusion.

**Scaffolding:** Break down complex permutation problems into smaller, manageable steps. This helps students understand the sequential nature of permutations and how to approach problems systematically.

**Real-World Applications:** Illustrate how permutations are used in real-life situations, such as password combinations, seating arrangements, and lock combinations. Show the practical significance of permutations.

**Error Analysis:** Encourage students to analyse their mistakes when solving permutation problems. Understanding common errors can help them improve their problem-solving skills.

### Question No. 5b

<b>Question Text</b>	In an experiment, two fair dice are rolled and a balanced coin is tossed simultaneously. i. Find the possible numbers of outcomes of the experiment. ii. List the possible outcomes if both the dice show the same number. iii. Find the probability of the event that both dice show the same number and coin shows the tail.
<b>SLO No.</b>	14.4.12
<b>SLO Text</b>	Apply the laws mentioned in SLOs 14.4.5, 14.4.7 and 14.4.10 to solve related problems.
<b>Max Marks</b>	4
<b>Cognitive Level</b>	A
<b>Checking Hints</b>	1 mark for finding the number of outcomes 1 mark for listing the any six outcomes correctly (12 required) 1 mark for calculating the required probability
<b>Overall Performance</b>	The question involved finding the probability using two fair dice and a balanced coin. There was a total of 36 outcomes from the fair dice, and when combined with the balanced coin, it resulted in 72 possibilities (36 samples with heads and 36 samples with tails). While a few candidates performed well in this question, the majority encountered difficulties while attempting to solve it.
<b>Description of Better Responses</b>	In better responses, candidates exhibited a precise understanding of the question. Such responses correctly established connection between the two fair dice and the balanced coin and they accurately determined the total sample space (using two sample spaces). By appropriately combining these spaces, they arrived at the correct probability for part (ii) and part (iii).
<b>Image of Better Response</b>	<p>             b) i) <math>6^2 = 36</math> <math>2^1 = 2</math> , <math>36 \times 2 = 72</math> total outcomes              ii) (1,1,H) (1,1,T) (2,2,H) (2,2,T) (3,3,H) (3,3,T) (4,4,H) (4,4,T) (5,5,H) (5,5,T) (6,6,H) (6,6,T)              Possible outcomes if both dice show same number = 12.              iii) Probability = <math>\frac{6}{72} = \frac{1}{12} = 0.0833</math> </p>
<b>Description of Weaker Responses</b>	In weaker responses, candidates struggled to understand the events that were given in the question, failing to comprehend the relation between the sample space of the two dices and the fair coin. This led to incorrect probability outcomes in part (ii) and part (iii).



**Images of Weaker Responses**

**Image (i)**

(i) formulae  $n \times n = 12 \times 2 = 24$  possible outcome

(ii)  $n_C = \binom{12}{2} = 66$  outcomes.

(iii) Dice =  $\frac{2}{12} + \frac{1}{2} = 0.17 + 0.5 = 0.67$  probability


**Image (ii)**

b(i)  $x = \frac{12}{2} = 6$  possible numbers of outcomes

b(ii) dice one = 6 sides, dice two = 6 sides.  
=  $6 \times 6 = 36$  possible outcomes.

c(iii) =  $0 = \phi$

**Suggestions for Improvement (Highlighted part)**

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>Understand the expectations of the command words</li> <li>Look at the cognitive level</li> <li>Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>Go through the past paper questions on that particular concept</li> <li>Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>Story Board</li> <li>Cause and Effect</li> <li>Fish and Bone</li> <li>Concept Mapping</li> <li>Audio Visual resources</li> <li>Think, Pair and Share</li> <li>Questioning Technique (Socratic approach)</li> <li>Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Past paper questions</li> <li>Discussion on E-Marking Notes</li> <li>AKU-EB Digital Learning Solution powered by Knowledge Platform</li> </ul> <p><a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></p> 

**Any Additional Suggestion:**

By using these teaching methodologies, teachers can help students grasp the concept of probability.

**Hands-on Experiments:** Conduct hands-on experiments with simple events like coin tossing, drawing cards from a deck, or rolling dice. Encourage students to record results and calculate probabilities based on their experiments.

**Real-world Applications:** Show how probability is used in real-life situations, such as weather forecasting, sports betting, and risk assessment in insurance. Relate probability to practical scenarios to make it more relevant.

**Visual Representation:** Use visual aids, such as diagrams or tables, to represent the sample space when two dice are rolled. This can help students visualise all possible outcomes more easily.

**Step-by-Step Approach:** Encourage students to take a step-by-step approach to solving the problem. First, have them calculate the sample space for rolling two dice. Then, extend this to include the coin toss.

**Understand the Problem Statement:** Ensure that students fully understand the problem statement and what is being asked. In this case, they should recognise that there are two separate sets of outcomes: one for heads and one for tails.

**Challenge Variations:** Introduce more challenging variations of the problem to challenge advanced students and promote critical thinking.

**Question No. 6****Question Text**

Complete the given table to find the coefficient of correlation.

S. No.	$X$	$Y$	$X^2$	$Y^2$	$XY$
1	5	7	25		
2	6	9	36		
3	8	15	64		
4	10	20	100		
5	12	10	144		
<b>Total</b>	41	61	369		

**SLO No.**

15.2.3

**SLO Text**

Calculate the coefficient of correlation by using the formula.

**Max Marks**

3

**Cognitive Level**

A

**Checking Hints**

1 mark for completing the column of  $Y^2$   
 1 mark for completing the column of  $XY$   
 1 mark for calculating the value of  $r$

**Overall Performance**

The candidates demonstrated proficiency in completing the  $Y^2$  column and calculating the coefficient of correlation. However, some of the candidates encountered challenges in filling out the table provided, consequently affecting their ability to arrive at the accurate solution.

**Description of Better Responses**

In better responses, the candidates proficiently executed the requirement of the question. They completed the table, calculated  $Y^2$  and  $XY$  accurately, and then substituted the values into the formula to obtain the correct correlation coefficient ( $r$ ).

**Image of Better Response**

S. No.	X	Y	$X^2$	$Y^2$	XY
1	5	7	25	49	35
2	6	9	36	81	54
3	8	15	64	225	120
4	10	20	100	400	200
5	12	10	144	100	120
<b>Total</b>	41	61	369	855	529

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

$$r = \frac{5(529) - (41)(61)}{\sqrt{[5(369) - (41)^2][5(855) - (61)^2]}}$$

$$r = \frac{2645 - 2501}{\sqrt{(164)(554)}}$$

$$r = 0.478$$

$$r = \frac{144}{301.42}$$

**Description of Weaker Responses**

In weaker responses, candidates managed to complete the chart with some error, however, they faced difficulties in identifying the correct formula for finding correlation coefficient.

Images of Weaker Responses

Image (i)

S. No.	X	Y	X <sup>2</sup>	Y <sup>2</sup>	XY
1	5	7	25	49	35
2	6	9	36	81	54
3	8	15	64	225	120
4	10	20	100	<del>400</del> 10000	200
5	12	10	144	10	120
Total	41	61	369	<del>822</del> 765	<del>529</del>

coefficient of correlation Y on X

$$Y = a + bX$$

$$a = \bar{Y} + b\bar{X}, \quad b = \frac{\sum YX^2 - (\sum X)(\sum Y)}{\sum X^2 - (\sum X)^2}$$

$$\frac{(529)^2 - (41)(61)}{(369)^2 - (41)^2}$$

$$\frac{279841 - 2501}{136161 - 1681}$$

$$= \frac{279590}{134480}$$

$$r = 0.568$$

∴ positive moderate relation

Image (ii)

S. No.	X	Y	X <sup>2</sup>	Y <sup>2</sup>	XY
1	5	7	25	49	71.48
2	6	9	36	81	66.68
3	8	15	64	225	53.3
4	10	7	100	400	50
5	12	9	144	100	120
Total	41	61	369	855	361.3

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$


$$= r = \frac{5 + 361.3 - (41)(61)}{\sqrt{[5 + 369 - (41)^2][5 + 855 - (61)^2]}}$$

$$= r = \frac{366.3 - 20}{\sqrt{[374 - 1681][860 - 3721]}}$$

$$r = \frac{346.3}{\sqrt{[1307][2861]}}$$

$$r = \frac{346.3}{\sqrt{1554}} = 8.777090007$$

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
<ul style="list-style-type: none"> <li>• Understand the expectations of the command words</li> <li>• Look at the cognitive level</li> <li>• Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating)</li> <li>• Go through the past paper questions on that particular concept</li> <li>• Refer to the resource guide for extra resources</li> </ul>	<ul style="list-style-type: none"> <li>• Story Board</li> <li>• Cause and Effect</li> <li>• Fish and Bone</li> <li>• Concept Mapping</li> <li>• Audio Visual resources</li> <li>• Think, Pair and Share</li> <li>• Questioning Technique (Socratic approach)</li> <li>• Practical Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• Past paper questions</li> <li>• Discussion on E-Marking Notes</li> <li>• AKU-EB Digital Learning Solution powered by Knowledge Platform</li> </ul> <p><a href="https://akueb.knowledgeplatform.com/login">https://akueb.knowledgeplatform.com/login</a></p> 

**Any Additional Suggestion:**

Following are some interactive teaching strategies for regression and coefficients of correlation. Begin with real-world datasets that are relevant to the students' interests or experiences. Show how regression analysis and correlation coefficients can be used to find relationships in data. Utilise statistical software or online tools like Excel, to perform regression analysis and calculate correlation coefficients in real-time. Demonstrate how to input data, run analyses, and interpret results. Create scatter plots of data and visually demonstrate how to fit regression lines or curves to the data points. Use colors and labels to make the visualisation informative. Engage students in a discussion about the difference between correlation and causation. Use real-life examples to illustrate the concept that correlation does not imply causation.

## Annexure A: Pedagogies Used for Teaching the SLOs

### Pedagogy: Storyboard

**Description:** A visual pedagogy that uses a series of illustrated panels to present a narrative, encouraging creativity and critical thinking. It helps learners organise ideas, sequence events, and comprehend complex concepts through storytelling.

**Example:** In a Literature class, students are tasked with creating storyboards to visually retell a novel. They draw key scenes, write captions, and present their stories to the class, enhancing their reading comprehension and fostering their imagination.

### Pedagogy: Cause and Effect

**Description:** This pedagogy explores the relationships between actions and consequences. By analysing cause-and-effect relationships, learners develop a deeper understanding of how events are interconnected and how one action can lead to various outcomes.

**Example:** In a History class, students study the causes and effects of the Industrial Revolution. They research and discuss how technological advancements in manufacturing led to significant societal changes, such as urbanisation and labour reform movements.

### Pedagogy: Fish and Bone

**Description:** A method that breaks down complex topics into main ideas (the fish) and supporting details (the bones). This visual approach enhances comprehension by highlighting essential concepts and their relevant explanations.

**Example:** During a Biology class on human anatomy, the teacher uses the fish and bone technique to teach about the human skeletal system. Teacher presents the main components of the human skeleton (fish) and elaborates on each bone's structure and function (bones).

### Pedagogy: Concept Mapping

**Description:** An effective way to visually represent relationships between ideas. Learners create diagrams connecting key concepts, aiding in understanding the overall structure of a subject and fostering retention.

**Example:** In a Psychology assignment, students use concept mapping to explore the various theories of personality. They interlink different theories, such as Freud's psychoanalysis, Jung's analytical psychology, and Bandura's social-cognitive theory, to see how they relate to each other.

### Pedagogy: Audio Visual Resources

**Description:** Incorporating multimedia elements like videos, images, and audio into lessons. This approach caters to different learning styles, making educational content more engaging and memorable.

**Example:** In a General Science class, the teacher uses a documentary-style video to teach about the solar system. The video includes stunning visual animations of the planets, interviews with astronomers, and background music, enhancing students' interest and understanding of space.

### Pedagogy: Think, Pair, and Share

**Description:** A collaborative learning technique where students ponder a question or problem individually, then discuss their thoughts in pairs or small groups before sharing with the entire class. It fosters active participation, communication skills, and diverse perspectives.

**Example:** In a Literature in English class, the teacher poses a thought-provoking question about a novel's moral dilemma. Students first reflect individually, then pair up to exchange

their opinions, and finally participate in a lively class discussion to explore different viewpoints.

**Pedagogy: Questioning Technique (Socratic Approach)**

**Description:** Based on Socratic dialogue, this method stimulates critical thinking by posing thought-provoking questions. It encourages learners to explore ideas, justify their reasoning, and discover knowledge through a process of inquiry.

**Example:** In an Ethics class, the instructor uses the Socratic approach to lead a discussion on the meaning of justice. By asking a series of probing questions, the students engage in a deeper exploration of ethical principles and societal values.

**Pedagogy: Practical Demonstration**

**Description:** A hands-on approach where learners observe real-life applications of theories or skills. Practical demonstrations enhance comprehension, skill acquisition, and problem-solving abilities by bridging theoretical concepts with real-world scenarios.

**Example:** In a Food and Nutrition class, the instructor demonstrates the proper technique for filleting a fish. Students observe and then practice the skill themselves, learning the practical application of knife skills and culinary precision.

(**Note:** The examples provided in this annexure serve as illustrations of various pedagogies. It is important to understand that these pedagogies are versatile and can be applied across subjects in numerous ways. Feel free to adapt and explore these techniques creatively to enhance learning outcomes in your specific context.)



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