Detailed Solutions

Q.1 (a) If the price of an item decreases from 500 PKR to 400 PKR, calculate the percentage decrease.

Solution:
Absolute decrease = Original price - New price = 500 - 400 = 100 PKR.
Percentage decrease = (Absolute decrease / Original price) × 100% = (100 / 500) × 100% = 0.2 × 100% = 20%.
Therefore, the price decreased by 20%.

Q.1 (b) Theme park choices: 5 roller coasters, 8 water rides, and 3 shows. You want to experience at least one roller coaster and one water ride. How many different combinations of rides can you choose for your day at the theme park?

Interpretation and Solution:
We interpret the question as selecting any subset of roller coasters (possibly more than one) and any subset of water rides, and optionally selecting any subset of shows. The only requirement is: at least one roller coaster and at least one water ride must be chosen.

Number of possible subsets of the 5 roller coasters = 2^5 = 32. But we must exclude the empty subset (choosing none), so valid roller-coaster choices = 2^5 − 1 = 31.
Number of possible subsets of the 8 water rides = 2^8 = 256. Excluding the empty subset gives 2^8 − 1 = 255.
Number of possible subsets of the 3 shows = 2^3 = 8. We allow choosing zero or more shows, so all 8 subsets are allowed.

Total number of combinations = 31 × 255 × 8.
Compute: 31 × 255 = 7905. Then 7905 × 8 = 63,240.
Therefore, there are 63,240 different combinations satisfying the condition.

Q.2 (a) What are the advantages of creating various types of graphs (bar graphs, line graphs, histograms, etc.) to visually represent different types of data and relationships within the dataset?

Solutions / Advantages:
1. Visual clarity: Graphs convert numerical data into visual form, making

patterns and trends easier and faster to understand.
2. Comparison: Bar graphs and grouped charts make it easy to compare different categories side by side.
3. Trend detection: Line graphs are ideal for showing changes over time and revealing upward/downward trends.
4. Distribution insight: Histograms and boxplots show the distribution of data, highlighting spread, central tendency, skewness, and outliers.
5. Proportional understanding: Pie charts show proportions or percentage shares of a whole, useful for composition analysis.
6. Relationship analysis: Scatter plots reveal relationships or correlations between two numeric variables.
7. Communication: Visuals are more effective for communicating results to non-technical audiences.
8. Data reduction: Graphs summarize large datasets into digestible visuals, helping decision-making.
9. Detect anomalies: Outliers and unexpected values are easier to spot in graphical representations.
10. Accessibility: Well-designed graphs assist memory retention and quicker comprehension.

Each graph type fits particular data and purpose; choosing the correct type improves clarity and insight.

Q.2 (b) Find the mean deviation of the following data set: 3, 6, 6, 7, 8, 11, 16, 15.

Solution:
Data: [3, 6, 6, 7, 8, 11, 16, 15]
Number of observations, n = 8.
Mean = (Sum of observations) / n = 72 / 8 = 9.00.
Absolute deviations from mean:
|3 − 9.00| = 6.00, |6 − 9.00| = 3.00, |6 − 9.00| = 3.00, |7 − 9.00| = 2.00, |8 − 9.00| = 1.00, |11 − 9.00| = 2.00, |16 − 9.00| = 7.00, |15 − 9.00| = 6.00.
Sum of absolute deviations = 30.00.
Mean deviation = (Sum of absolute deviations) / n = 30.00 / 8 = 3.75.
Therefore, the mean deviation is 3.75.

Q.3 (a) A scientist measures the length of a table as 120.5 cm. The actual length is 121.0 cm. (i) Calculate the absolute error. (ii) Calculate the relative error as a percentage.

Solution:
(i) Absolute error = |Measured value − True value| = |120.5 − 121.0| = 0.50

cm.
(ii) Relative error = (Absolute error / True value) × 100% = (0.50 / 121.0) × 100% = 0.4132% ≈ 0.413%.
So, absolute error = 0.50 cm, and relative error ≈ 0.413%.

Q.3 (b) You are considering investing in a stock. Historically, there is a 60% chance the stock will increase in value over the next year. Past performance does not guarantee future results. How would you assess the risk of investing in this stock? Explain how you would use probability to assess the risk, considering both historical performance and uncertainty of future outcomes.

Solution / Discussion:
1. Interpret probability: A historical 60% chance means that, based on past data or models, in similar past situations the stock rose 60% of the time. It is a measure of relative frequency, not a guarantee.
2. Consider uncertainty: Future behavior can be affected by new information (earnings, macro events), so combine the historical probability with qualitative information (company health, sector trends, macroeconomy).
3. Use expected value approach: If you can estimate likely percentage gains when it rises and likely losses when it falls, compute expected return = P(rise)×AvgGain + P(fall)×AvgLoss.
4. Scenario analysis: Construct scenarios (best, base, worst) with assigned probabilities; compute outcomes and risk metrics (e.g., expected return, variance).
5. Measure risk with variance / standard deviation: Use historical return series to compute standard deviation — higher standard deviation means greater risk (more uncertainty around expected return).
6. Consider downside risk measures: Value at Risk (VaR) or Conditional VaR show potential losses at a given confidence level.
7. Diversification: Assess how this stock's returns correlate with your portfolio; low correlation reduces overall portfolio risk.
8. Risk tolerance and time horizon: Match the probabilistic assessment to your personal investment horizon and risk tolerance.

In summary, use the 60% information as one input, combine it with estimates of magnitude of gains/losses, compute expected return and volatility, run scenario or sensitivity analysis, and place the stock in the context of a diversified portfolio to make a reasoned decision.

Q.4 (a) What are the various ways of organizing the data systematically and presenting it clearly and concisely?

Solutions / Methods for organizing and presenting data:
1. Tables: Raw data tables, frequency distribution tables, cross-tabulations.
2. Frequency distributions: Class intervals, frequencies; cumulative frequency.
3. Graphs and charts: Bar charts, histograms, pie charts, line graphs, scatter plots, box plots.
4. Descriptive summaries: Mean, median, mode, range, variance, standard deviation.
5. Stem-and-leaf displays: Show raw data shape while preserving individual values.
6. Sorted lists and ranked data: Useful for median, percentiles, and order statistics.
7. Pivot tables: For summarising multi-dimensional categorical data.
8. Ogives and cumulative frequency curves: For percentiles and median from grouped data.
9. Infographics and dashboards: Combine charts and key figures for quick decisions.
10. Documentation: Clear titles, axis labels, legends, sources, and notes on methods.

Good practice: choose the format that matches the data type and the message; label axes, include units, and avoid misleading scales.

Q.4 (b) You are planning a dinner party menu with appetizers, main courses, and desserts. You have 5 appetizer options, 7 main course options, and 4 dessert options. How many different dinner menus can you create?

Solution:
If a dinner menu consists of choosing one appetizer, one main course, and one dessert, then by the fundamental counting principle:
Number of menus = (number of appetizer options) × (number of main course options) × (number of dessert options) = 5 × 7 × 4 = 140.
Therefore, you can create 140 different dinner menus.

Q.5 (a) A woman bought a horse for Rs. 50,000 and then sold it for Rs. 60,000. She bought it back for

Rs. 70,000 and then sold it again for Rs. 80,000. How much did she gain or lose on these transactions?

Solution:
First transaction: Bought for 50,000 and sold for 60,000 → Profit = 60,000 − 50,000 = Rs. 10000.
Second transaction: Bought for 70,000 and sold for 80,000 → Profit = 80,000 − 70,000 = Rs. 10000.
Net profit = 10000 + 10000 = Rs. 20000.
Therefore, she made a total gain of Rs. 20000.

Q.5 (b) Using permutations, determine how many distinct 5-letter codes can be formed from the letters of the word 'ALGEBRA' if no letter repeats. Validate your answer using factorial notation.

Solution:
The word 'ALGEBRA' has letters A, L, G, E, B, R, A. The distinct letters available are: A, L, G, E, B, R → total 6 distinct letters.
We want 5-letter codes with no repeated letters. First choose which 5 distinct letters to use: C(6,5) choices. For each selection of 5 different letters, we can arrange them in 5! ways.
Hence total codes = C(6,5) × 5! = 6 × 120 = 720.
Using factorial notation: C(6,5) = 6! / (5! × 1!) = 6. So total = 6 × 5! = 6 × 120 = 720 distinct codes.