14.1 Data analysis: spread, weighted averages and conditional probability

Name: _____ Class: _____ Date: _____

KEY WORDS weighted average • mutually exclusive

Objective

Distinguish mean, median, spread and a weighted average; Interpret distributions and overlapping or conditional event counts; Use the correct reference total in table-based inference.

Original public tasks and locally authored marking guidance. No official score is assigned.

1 Key knowledge and worked examples

weighted average : An average that accounts for each group's contribution or size.

mutually exclusive : Events that cannot occur together in the same outcome.

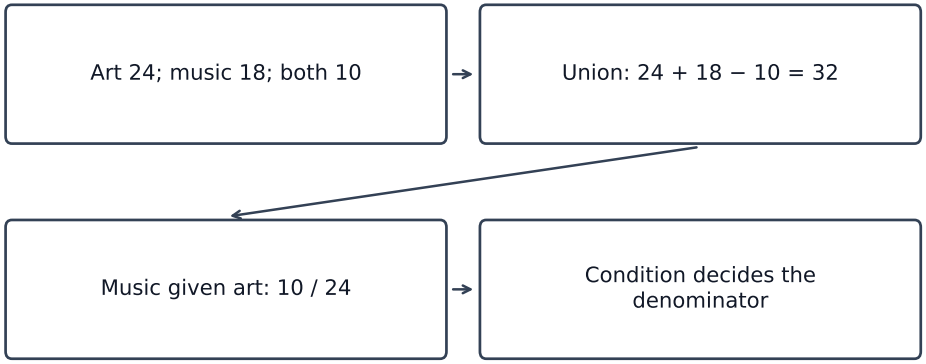
Mean is sum divided by count; median is the central ordered value or the mean of the middle two. Range is maximum minus minimum. An extreme value can alter mean and range without changing the median. Standard deviation measures spread about the mean; adding a constant changes the centre but not spread, while multiplying all values by c multiplies standard deviation by |c|.

Combine groups with their counts, not an unweighted mean of group means unless sizes are equal. A group of 10 with mean 6 contributes total 60; a group of 30 with mean 10 contributes total 300. The combined mean is (60+300)/40=9. A percentage of a subgroup uses that subgroup's denominator.

For equally likely discrete outcomes, probability is favourable count over total count. Conditional probability restricts the denominator to the given condition. Without replacement changes later counts. Overlapping events need subtraction of the overlap when counting a union. Independence must be given or justified; it is not the same as mutually exclusive.

Read displays for their axes, units and sample description before making inferences. A correlation does not isolate a cause. A convenience sample may not represent the target population. Basic counting can use ordered multiplication when roles differ, or divide duplicated arrangements when order does not matter. Keep the events and outcomes explicitly defined.

A bag holds four red counters, three marked, and six blue counters, one marked. There are four marked counters in total. P(red)=4/10, P(marked)=4/10, P(red given marked)=3/4. P(two red without replacement)=(4/10)(3/9)=2/15, not $(4/10)^2$. For data 1,2,3,4,20, mean=30/5=6 and median=3. Adding 5 to each shifts mean and median by 5 but leaves their pairwise deviations and standard deviation unchanged.



For music given art, divide by the 24 art students, not by the union of 32

2 Practice

2.1 Group A has 12 observations with mean 5; group B has eight with mean 10. Find the combined mean. For the data 1,2,3,4,20 find mean, median and range. Describe how adding 7 to every value changes the standard deviation.

3 Exam-style questions

3.1 Of 40 students, 24 study art, 18 study music and 10 study both. Find the probability of music given art and the probability of at least one subject. Are the events independent? Then explain what happens to standard deviation if all measurements are multiplied by -3.

Solutions

2.1 The combined total is $12(5) + 8(10) = 140$ across twenty observations, so mean is seven. An unweighted average of five and ten would incorrectly ignore group sizes. In the second data set, sum is thirty, mean six, median three and range nineteen. Adding seven shifts all values and their mean together; every deviation from the mean is unchanged, so standard deviation is unchanged.

3.1 Conditioning on art gives $P(M \mid A) = 10/24 = 5/12$. The union count is $24 + 18 - 10 = 32$, so union probability is $4/5$. Independence would require $P(A \cap M) = P(A)P(M)$, but $10/40 = 1/4$ differs from $(24/40)(18/40) = 27/100$. The events are not independent. Scaling every deviation by -3 scales its square by nine and the square root by three, so standard deviation triples. It cannot become negative.

Local review checklist: follow every response instruction; support the answer with the stated evidence; explain rejected alternatives or an opposing view; check scope, restrictions and clarity. For writing, this is a formative checklist, not an official rubric score.