

1. Find the distance between objects 1 and 3 by using the formula provided on the slides. Notice that we have mixed type of attributes. (You can scan and submit your handwritten calculation) (25/20 points)

Object Identifier	test-1(nominal)	test-2 (ordinal)	test-3 (numeric)
1	A	excellent	45
2	B	fair	22
3	C	good	64
4	A	excellent	28

1.Nominal attribute (test-1):

Since the values for objects 1 and 3 are A and C, the distance $d_{13}^{(1)} = 1$.

2.Ordinal attribute (test-2):

The ranks assigned to 'excellent', 'good', and 'fair' are 3, 2, and 1, respectively.

For object 1 ('excellent'), $r_1 = 3$.

For object 3 ('good'), $r_3 = 2$.

$$Z_1 = \frac{3-1}{3-1} = 1 \quad Z_3 = \frac{2-1}{3-1} = 0.5.$$

The normalized rank distance = $|Z_1 - Z_3| = |1 - 0.5| = 0.5$.

3. Numeric attribute (test-3):

$$X_1 = 45, X_3 = 64$$

$$\text{the distance} = \left| \frac{45-64}{64-22} \right| = \frac{19}{42} \approx 0.452$$

$$d(1,3) = \frac{1(\text{nominal}) + 0.5(\text{ordinal}) + 0.452(\text{numeric})}{3} \approx 0.650$$

3. In the table below, determine whether passing a class has a dependency on attendance by using Chi-square test. Please refer to the formula in the slides. (25/20 points)
 (For the expected value for each cell, multiply the total counts in the rows and columns of the cell and divide by total count.
 For example: Expected value for Attended-Pass=33*31/54 = 18.94. You can scan and submit your handwritten calculation)

	Passed	Failed	Total
Attended	25	6	31
Skipped	8	15	23
Total	33	21	54

Expected for Attended and Passed: $31 \times 33 / 54 = 18.94$

Expected for Attended and Failed: $31 \times 21 / 54 = 12.06$

Expected for Skipped and Passed: $23 \times 33 / 54 = 14.06$

Expected for Skipped and Failed: $23 \times 21 / 54 = 8.94$

Chi-square Contributions for Each Cell:

Contribution for Attended and Passed: $(25 - 18.94)^2 / 18.94 \approx 1.94$

Contribution for Attended and Failed: $(6 - 12.06)^2 / 12.06 \approx 3.04$

Contribution for Skipped and Passed: $(8 - 14.06)^2 / 14.06 \approx 2.61$

Contribution for Skipped and Failed: $(15 - 8.94)^2 / 8.94 \approx 4.10$

Summing up all the contributions gives us the Chi-square Statistic:

$$\chi^2 \approx 1.94 + 3.04 + 2.61 + 4.10 = 11.69$$