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'), r1 =3.

For object 3 ('good'), r3 =2.

Z1=$\frac{3-1}{3-1}$=1 Z3= $\frac{2-1}{3-1}$=0.5.

The normalized rank distance= | Z1 −Z3 | =|1−0.5|=0.5.

3. Numeric attribute (test-3):

X1=45, X3=64

the distance = | $\frac{45-64}{64-22}$ |=$\frac{19}{42}$ ≈0.452

$$d(1,3)=\frac{1(no\ \min al)+0.5(ordinal)+0.452(numeric)}{3}\approx 0.650$$

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*33/54= 18.94

Expected for Attended and Failed: 31*21/54=12.06

Expected for Skipped and Passed: 23*33/54=14.06

Expected for Skipped and Failed: 23*21/54=8.94

Chi-square Contributions for Each Cell:

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

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

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

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

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

x^2≈1.94+3.04+2.61+4.10=11.69

The critical value for 1 degree of freedom (df) at a 0.05 significance level is 3.84, according to the Chi-square distribution table. Since our Chi-square statistic of 11.69 is much higher than this critical value, it shows a statistically significant link between class attendance and passing. Simply put, the data suggests that attending class can significantly affect a student's chances of passing or failing.