2. The Colorado Rocky Mountain Rescue Service wishes to study the behavior of lost hikers. If more were known about the direction in which lost hikers tend to walk, then more effective search strategies could be devised. Two hundred hikers selected at random from those applying for hiking permits are asked whether they would head uphill, downhill, or remain in the same place if they became lost while hiking. Each hiker in the sample was also classified according to whether he or she was an experienced or novice hiker. The resulting data are summarized in the following table.

	Direction		
	Uphill	Downhill	Remain in Same Place
Novice	20	50	50
Experienced	10	30	40

Do these data provide convincing evidence of an association between the level of hiking expertise and the direction the hiker would head if lost?

Give appropriate statistical evidence to support your conclusion.

3. The dentists in a dental clinic would like to determine if there is a difference between the number of new cavities in people who eat an apple a day and in people who eat less than one apple a week. They are going to conduct a study with 50 people in each group.

Fifty clinic patients who report that they routinely eat an apple a day and 50 clinic patients who report that they eat less than one apple a week will be identified. The dentists will examine the patients and their records to determine the number of new cavities the patients have had over the past two years. They will then compare the number of new cavities in the two groups.

a. Why is this an observational study and not an experiment?

b. Explain the concept of confounding in the context of this study. Include an example of a possible confounding variable.

c. If the mean number of new cavities for those who ate an apple a day was statistically significantly smaller than the mean number of new cavities for those who ate less than one apple a week, could one conclude that the lower number of new cavities can be attributed to eating an apple a day? Explain.

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Question 2

Solution:

H_o: There is no association between level of hiking experience and direction

H_a: There is an association between level of hiking experience and direction

or

H_o: Level of hiking experience and direction are independent

H_a: Level of hiking experience and direction are not independent

Chi-Square test for independence

$$\chi^2 = \sum \frac{(Obs - Exp)^2}{Exp}$$

Requirements: Need to check expected counts using some accepted rule (textbooks differ).
Table of Observed and (Expected Counts):

20 (18)	50 (48)	50 (54)
10 (12)	30 (32)	40 (36)

Requirements Check: All expected counts are greater than or equal to 5. So the Chi-Square test of independence is appropriate.

$$x^2 = \frac{(20 - 18)^2}{18} + \frac{(50 - 48)^2}{48} + \frac{(50 - 54)^2}{54} + \frac{(10 - 12)^2}{12} + \frac{(30 - 32)^2}{32} + \frac{(40 - 36)^2}{36} = 1.5046$$

df = 2, P-value = 0.471 **OR** (using tables) P-value > 0.25
Since the P-value is large for any reasonable level of significance, we fail to reject H_o. (A picture showing an appropriate rejection region and the test statistic value is acceptable). There is not convincing evidence that an association exists between level of hiking expertise and direction.

Note:
For rejection region approach, rejection regions are
$x^2 > 9.21$ or significance level 0.01,
$x^2 > 5.99$ for significance level 0.05,
$x^2 > 4.61$ for significance level 0.10

Question 2 (cont.)

A complete response constitutes

a. Stating a correct set of hypotheses,
b. Identifying appropriate test & checking appropriate assumptions,
c. Providing correct mechanics, and
d. Stating correct conclusion in the context of the problem using results of the statistical test.

Part (a) Stating a correct set of hypotheses,

- States null and alternative hypothesis correctly defining any notations used.
- Both hypotheses are stated in the context of problem.

Note: If a student switches the null and alternative hypotheses, then no credit will be given for part (a).

Part (b) Identifying appropriate test & checking appropriate requirements,

- Gives some indication of using a correct statistical test by naming the test, by giving correct symbol or formula for the test statistic.
- Checks requirements. In this case, expected counts are greater than or equal to 5. Some indication of use of expected counts in checking requirements is needed.

Note: If a wrong statistical test is performed, then no credit is given for section (b).

Part (c) Providing correct mechanics,

- Gives the computed test statistic value correctly.
- Gives the associated P-value correctly (the rejection region approach is acceptable)

Note: One minor computational error will not necessarily drop the score to a 3.

Part (d) Stating correct conclusion in the context of the problem using results of the statistical test.

- Uses test results correctly to arrive at the conclusion (either p-value approach or the rejection region approach). Linkage between the conclusion and the test result must be stated clearly. Correct interpretation of a P-value is acceptable as a statistical linkage.
- Writes conclusion in the context of the problem consistent with the defined hypotheses.

Note: If a student applies rejection rule incorrectly, then no credit will be given for part (d).

Question 2 (cont.)

Points:

4 Complete Response

Essentially correct responses on all 4 parts.

3 Substantial Response

Essentially correct responses on any 3 of the 4 parts.

OR

Essentially correct responses on any 2 of the 4 parts and partially correct responses on the remaining 2 parts.

2 Developing Response

Essentially correct responses on any 2 of the 4 parts.

OR

Essentially correct response on any 1 of the 4 parts and partially correct responses on any 2 of the remaining 3 responses.

OR

Partially correct responses on all 4 parts.

1 Minimal Response

Essentially correct response on 1 of the 4 parts.

OR

Partially correct responses on 2 or 3 of the 4 parts.

Notes:

1. Maximum score of 2 if the student does a Chi-square on the proportions rather than the counts.
2. Some students may attempt to do the problem using two-proportion tests. Bring these solutions to the table leaders.
3. Score is 0 if there is no statistical test used (e.g. conclusion based on the comparison of proportions only).