Consider a family with a mother, father, and two children. Let A_1 = {mother has influenza}, A_2 = {father has influenza}, A_3 = {first child has influenza}, A_4 = {second child has influenza}, B = {at least one child has influenza}, C = {at least one parent has influenza}, and D = {at least one person in the family has influenza}.

(a) What does $A_1 \cup A_2$ mean?

- ○ No one in the family has influenza.
- ○ Both parents have influenza.
- ○ Neither parent has influenza.
- ◉ At least one parent has influenza.
- ○ At least one person in the family has influenza.

(b) What does $A_1 \cap A_2$ mean?

- ○ No one in the family has influenza.
- ◉ Both parents have influenza.
- ○ Neither parent has influenza.
- ○ At least one parent has influenza.
- ○ At least one person in the family has influenza.

(c) Are $A_3 \cap A_4$ mutually exclusive?

- ○ Yes
- ◉ No

(d) What does $A_3 \cup B$ mean?

- ○ No one in the family has influenza.
- ○ At least one person in the family has influenza.
- ● At least one child has influenza.
- ○ Both children have influenza.
- ○ Neither child has influenza.

(e) What does $A_3 \cap B$ mean?

- ○ The second child does not have influenza.
- ○ The second child has influenza.
- ● The first child has influenza.
- ○ The first child does not have influenza.
- ○ Either the first or the second child does not have influenza.

(f) Express C in terms of A_1, A_2, A_3, and A_4.

- ● $C = A_1 \cup A_2$
- ○ $C = A_3 \cap A_4$
- ○ $C = A_1 \cap A_2 \cap A_3 \cap A_4$
- ○ $C = A_1 \cap A_2$
- ○ $C = A_3 \cup A_4$

(g) Express D in terms of B and C.

- ○ $D = \overline{B} \cup C$
- ○ $D = B \cap \overline{C}$
- ○ $D = B \cap C$
- ○ $D = \overline{B} \cup \overline{C}$
- ◉ $D = B \cup C$

✓

(h) What does $\overline{A}_1$ mean?

- ○ The mother has influenza.
- ○ The father has influenza.
- ◉ The mother does not have influenza.
- ○ The father does not have influenza.
- ○ At least the first parent has influenza.

✓

(i) What does $\overline{A}_2$ mean?

- ○ The mother has influenza.
- ○ The father has influenza.
- ○ The mother does not have influenza.
- ◉ The father does not have influenza.
- ○ At least the first parent has influenza.

✓

(j) Represent C in terms of A_1, A_2, A_3, and A_4.

- $\overline{C} = \overline{A_1} \cup \overline{A_2}$
- $\overline{C} = \overline{A_3} \cap \overline{A_4}$
- $\overline{C} = \overline{A_1} \cap \overline{A_2} \cap \overline{A_3} \cap \overline{A_4}$
- $\overline{C} = \overline{A_1} \cap \overline{A_2}$
- $\overline{C} = \overline{A_3} \cup \overline{A_4}$

(k) Represent $\overline{D}$ in terms of B and C.

- $\overline{D} = \overline{B} \cup C$
- $\overline{D} = B \cap \overline{C}$
- $\overline{D} = \overline{B} \cap \overline{C}$
- $\overline{D} = B \cup C$
- $\overline{D} = \overline{B} \cup \overline{C}$

(l) Suppose an influenza epidemic strikes a city. In 10% of families the mother has influenza; in 10% of families the father has influenza; and in 4% of families both the mother and father have influenza.

Are the events A_1 = {mother has influenza} and A_2 = {father has influenza} independent?

- Yes
- No

(m) Suppose there is a 22% chance each child will get influenza, whereas in 14% of two-child families both children get the disease.

What is the probability that at least one child will get influenza?

0.3

(n) Based on the percentages given in subpart (l), what is the conditional probability that the father has influenza given that the mother has influenza?

0.4

(o) Based on the percentages given in subpart (l), what is the conditional probability that the father has influenza given that the mother does not have influenza? (Round your answer to four decimal places.)

0.0667

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2. [10/12 Points] DETAILS PREVIOUS ANSWERS

ROSBIOSTAT8 3.E.016-027.

MY NOTES ASK YOUR TEACHER

Mental Health

Estimates of the prevalence of Alzheimer's disease in a certain country are given in the following table.

Prevalence of Alzheimer's disease (cases per 100 population)

Age group	Men	Women
65–69	0.0	0.0
70–74	1.5	2.1
75–79	4.8	2.2
80–84	8.8	7.6
85+	35.2	28.0

Suppose an unrelated 77-year-old man, 76-year-old woman, and 82-year-old woman are selected from a community. (Round your answers to six decimal places.)

(a) What is the probability that all three of these individuals have Alzheimer's disease?

0.000080

(b) What is the probability that at least one of the women has Alzheimer's disease?

0.096328

(c) What is the probability that at least one of the three people has Alzheimer's disease?

0.139704

(d) What is the probability that exactly one of the three people has Alzheimer's disease?

0.133489

(e) Suppose we know exactly one of the three people has Alzheimer's disease, but we don't know which one. What is the conditional probability that the affected person is a woman?

0.675057

(f) Suppose we know exactly two of the three people have Alzheimer's disease. What is the conditional probability that they are both women?

0.259443

(g) Suppose we know exactly two of the three people have Alzheimer's disease. What is the conditional probability that they are both younger than 80 years of age?

0.159039

Suppose the probability that a married man and woman, each of whom is 75–79 years of age, will both have Alzheimer's disease is 0.0015. (Round your answers to six decimal places.)

(h) What is the conditional probability that the man will be affected given that the woman is affected?

0.068182

(i) What is the conditional probability that the woman will be affected given that the man is affected?

0.031250

(j) What is the probability that at least one member of the couple is affected?

0.068500

Suppose a study of Alzheimer's disease is proposed in a retirement community with people 65+ years of age, where the age-sex distribution is as shown in the given table.

Age-sex distribution of retirement community

Age group	Men (%)[a]	Women (%)[a]
65–69	6	11
70–74	8	16
75–79	12	19
80–84	7	11
85+	4	6

(k) What is the expected overall prevalence of Alzheimer's disease (as a percent) in the community if the prevalence estimates in the given table for specific age-sex groups hold? (Round your answer to two decimal places.)

%

(l) Assuming there are 1,000 people 65+ years of age in the community, what is the expected number of cases of Alzheimer's disease in the community? (Round your answer to the nearest integer.)

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3. [4/4 Points] DETAILS PREVIOUS ANSWERS

ROSBIOSTAT8 3.E.028-031.

MY NOTES ASK YOUR TEACHER

ملخص كامل

Infectious Disease

Commonly used vaccines for influenza are trivalent and contain only one type of influenza B virus. They may be ineffective against other types of influenza B virus. A randomized clinical trial was performed among children 3 to 8 years of age in 8 countries. Children received either a quadrivalent vaccine (QIV) that had more than one influenza B virus or a trivalent Hepatitis A vaccine (control). An attack rate (i.e.,% of children who developed influenza) starting 14 days after vaccination until the end of the study was computed for each vaccine group, stratified by age. The following data were reported.

age	QIV group	Control group
3–4	3.73	5.68
5–8	1.74	5.13

(a) Suppose 3 children in a village ages 3, 5, and 7 are vaccinated with the QIV vaccine. What is the probability that at least one child among the 3 will get influenza? (Round your answer to four decimal places.)

0.0705

(b) Suppose that 80% of 3–4-year-old children and 70% of 5–8-year-old children in a village are vaccinated with QIV vaccine. Also assume that children who are not vaccinated have twice the incidence of influenza as the control group in the table above. (Round your answers to two decimal places.)

(i) What percentage of 3–4-year-old children in the village will get influenza?

5.26 %

(ii) What percentage of 5–8-year-old children in the village will get influenza?

4.30 %

(c) Suppose we identify a 5–8-year-old child with influenza in the village but are uncertain whether the child was vaccinated. If we make the same assumptions that we made in part (b), then what is the probability that the child was vaccinated? (*Hint*: Use Bayes' rule here. Round your answer to four decimal places.)

0.2835

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3) [8/8 Points] DETAILS PREVIOUS ANSWERS

ROSBIOSTAT8 3.E.068-075.

MY NOTES ASK YOUR TEACHER

Pulmonary Disease

Research into cigarette-smoking habits, smoking prevention, and cessation programs necessitates accurate measurement of smoking behavior. However, decreasing social acceptability of smoking appears to cause significant underreporting. Chemical markers for cigarette use can provide objective indicators of smoking behavior. One widely used noninvasive marker is the level of saliva thiocyanate (SCN). In a certain school district, 1,332 students in eighth grade (ages 12–14) participated in a study whereby they acted as follows.

1. viewed a film illustrating how recent cigarette use could be readily detected from small samples of saliva
2. provided a personal sample of SCN
3. provided a self-report of the number of cigarettes smoked per week

The results are given in the following table.

Relationship between SCN levels and self-reported cigarettes smoked per week

Self-reported cigarettes smoked in past week	Number of students	Percent with SCN ≥ 100 μg/mL
None	1,163	3.5
1–4	70	4.5
5–14	30	6.6
15–24	27	29.5
25–44	19	36.9
45+	23	65

Suppose the self-reports are completely accurate and are representative of the number of eighth-grade students who smoke in the general community. We are considering using an SCN level ≥ 100 μg/mL as a test criterion for identifying cigarette smokers. Regard a student as positive if they smoke one or more cigarettes per week. (Round your answers to three decimal places.)

(a) What is the sensitivity of the test for light-smoking students (students who smoke ≤ 14 cigarettes per week)?

0.051 ✓

(b) What is the sensitivity of the test for moderate-smoking students (students who smoke 15–44 cigarettes per week)?

0.326 ✓

(c) What is the sensitivity of the test for heavy-smoking students (students who smoke ≥ 45 cigarettes per week)?

0.650 ✓

(d) What is the specificity of the test?

0.965 ✓

(e) What is the PV^+ of the test?

0.463 ✓

(f) What is the PV^- of the test?

0.893 ✓

Suppose we regard the self-reports of all students who report some cigarette consumption as valid but estimate that 20% of students who report no cigarette consumption actually smoke 1–4 cigarettes per week and an additional 10% smoke 5–14 cigarettes per week.

(g) Assuming the percentage of students with SCN ≥ 100 μg/mL in these two subgroups is the same as in those who truly report 1–4 and 5–14 cigarettes per week, compute the specificity under these assumptions.

0.972 ✓

(h) Compute the PV^- under these altered assumptions.

0.630 ✓

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