1. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.010.ALT.**

MY NOTES ASK YOUR TEACHER

DATAfile: CodeChurn

Code Churn is a common metric used to measure the efficiency and productivity of software engineers and computer programmers. It's usually measured as the percentage of a programmer's code that must be edited over a short period of time. Programmers with higher rates of code churn must rewrite code more often because of errors and inefficient programming techniques. The following table displays sample information for 10 computer programmers. (Round your numeric answers to four decimal places.)

Programmer	Total Lines of Code Written	Number of Lines of Code Requiring Edits
Liwei	23,789	4,589
Andrew	17,962	2,780
Jaime	31,025	12,080
Sherae	26,050	3,780
Binny	19,586	1,890
Roger	24,786	4,005
Dong-Gil	24,030	5,785
Alex	14,780	1,052
Jay	30,875	3,872
Vivek	21,546	4,125

(a) Use the data in the table above and the relative frequency method to determine probabilities that a randomly selected line of code will need to be edited for each programmer.

Programmer	Probability
Liwei	0.1929 ✓
Andrew	0.1548 ✓
Jaime	0.3894 ✓

Sherae	0.1451 ✓
Binny	0.0965 ✓
Roger	0.1616 ✓
Dong-Gil	0.2407 ✓
Alex	0.0712 ✓
Jay	0.1254 ✓
Vivek	0.1915 ✓

(b) If you randomly select a line of code from Liwei, what is the probability that the line of code will require editing?

0.1929 ✓

(c) If you randomly select a line of code from Sherae, what is the probability that the line of code will *not* require editing?

0.8549 ✓

(d) Which programmer has the lowest probability of a randomly selected line of code requiring editing?

The lowest probability is Alex ✓ at 0.0712 ✓ .

Which programmer has the highest probability of a randomly selected line of code requiring editing?

The highest probability is Jaime ✓ at 0.3894 ✓ .

Need Help? Read It

2. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.029.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

High school seniors with strong academic records apply to the nation's most selective colleges in greater numbers each year. Because the number of slots remains relatively stable, some colleges reject more early applicants. Suppose that for a recent admissions class, an Ivy League college received 2,848 applications for early admission. Of this group, it admitted 1,034 students early, rejected 852 outright, and deferred 962 to the regular admission pool for further consideration. In the past, this school has admitted 18% of the deferred early admission applicants during the regular admission process. Counting the students admitted early and the students admitted during the regular admission process, the total class size was 2,378. Let E, R, and D represent the events that a student who applies for early admission is admitted early, rejected outright, or deferred to the regular admissions pool.

(a) Use the data to estimate $P(E)$, $P(R)$, and $P(D)$. (Round your answers to four decimal places.)

$P(E)$ = 0.3631 ✓

$P(R)$ = 0.2992 ✓

$P(D)$ = 0.3378 ✓

(b) Are events E and D mutually exclusive?

They are ✓ mutually exclusive.

Find $P(E \cap D)$.

$P(E \cap D)$ = 0 ✓

(c) For the 2,378 students who were admitted, what is the probability that a randomly selected student was accepted during early admission? (Round your answer to four decimal places.)

0.4348 ✓

(d) Suppose a student applies for early admission. What is the probability that the student will be admitted for early admission or be deferred and later admitted during the regular admission process? (Round your answer to four decimal places.)

0.4239 ✓

Need Help? Read It

3. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.032.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

Consider the following hypothetical survey results of 18- to 34-year-olds in a certain country, in response to the question "Are you currently living with your family?"

	Yes	**No**	**Totals**
Women	94	155	249
Men	107	144	251
Totals	201	299	500

(a) Develop the joint probability table for these data and use it to answer the following questions.

	Yes	**No**	**Totals**
Women	0.188 ✓	0.31 ✓	0.498 ✓
Men	0.214 ✓	0.288 ✓	0.502 ✓
Totals	0.402 ✓	0.598 ✓	1 ✓

(b) What are the marginal probabilities?

P(18- to 34-year-old woman) = 0.498 ✓

P(18- to 34-year-old man) = 0.502 ✓

P(responded yes) = 0.402 ✓

P(responded no) = 0.598 ✓

(c) What is the probability of living with family given you are an 18- to 34-year-old woman in this country? (Round your answer to four decimal places.)

0.3775 ✓

(d) What is the probability of living with family given you are an 18- to 34-year-old man in this country? (Round your answer to four decimal places.)

0.4263 ✓

(e) What is the probability of an 18- to 34-year-old in this country living with family?

0.402 ✓

(f) If, in this country, 50.4% of 18- to 34-year-olds are male, do you consider this a good representative sample? Why?

Since P(18- to 34-year-old man) = 0.502 ✓ in this sample, this seems ✓ like a good representative sample based on gender.

Need Help? Read It Watch It

4. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.040.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

The prior probabilities for events A_1, A_2, and A_3 are $P(A_1) = 0.20$, $P(A_2) = 0.50$, and $P(A_3) = 0.30$. The conditional probabilities of event B given A_1, A_2, and A_3 are $P(B \mid A_1) = 0.30$, $P(B \mid A_2) = 0.20$, and $P(B \mid A_3) = 0.40$. (Assume that A_1, A_2, and A_3 are mutually exclusive events whose union is the entire sample space.)

(a) Compute $P(B \cap A_1)$, $P(B \cap A_2)$, and $P(B \cap A_3)$.

$P(B \cap A_1)$ = 0.06 ✓

$P(B \cap A_2)$ = 0.1 ✓

$P(B \cap A_3)$ = 0.12 ✓

(b) Apply Bayes' theorem, $P(A_i \mid B) = \dfrac{P(A_i)P(B \mid A_i)}{P(A_1)P(B \mid A_1) + P(A_2)P(B \mid A_2) + \cdots + P(A_n)P(B \mid A_n)}$, to compute the posterior probability $P(A_2 \mid B)$. (Round your answer to two decimal places.)

0.36 ✓

(c) Use the tabular approach to applying Bayes' theorem to compute $P(A_1 \mid B)$, $P(A_2 \mid B)$, and $P(A_3 \mid B)$. (Round your answers to two decimal places.)

Events	$P(A_i)$	$P(B \mid A_i)$	$P(A_i \cap B)$	$P(A_i \mid B)$
A_1	0.20	0.30	0.06 ✓	0.2143 ✓
A_2	0.50	0.20	0.1 ✓	0.3571 ✓
A_3	0.30	0.40	0.12 ✓	0.4286 ✓
	1.00		0.28 ✓	1.00

Need Help? Read It

5. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.043.MI.SA.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

This question has several parts that must be completed sequentially. If you skip a part of the question, you will not receive any points for the skipped part, and you will not be able to come back to the skipped part.

Tutorial Exercise

According to a 2018 article in Esquire magazine, approximately 70% of males over age 70 will develop cancerous cells in their prostate. Prostate cancer is second only to skin cancer as the most common form of cancer for males in the United States. One of the most common tests for the detection of prostate cancer is the prostate-specific antigen (PSA) test. However, this test is known to have a high false-positive rate (tests that come back positive for cancer when no cancer is present). Suppose there is a 0.01 probability that a male patient has prostate cancer before testing. The probability of a false-positive test is 0.75, and the probability of a false-negative (no indication of cancer when cancer is actually present) is 0.3.

(a) What is the probability that the male patient has prostate cancer if the PSA test comes back positive?

(b) What is the probability that the male patient has prostate cancer if the PSA test comes back negative?

(c) For older men, the prior probability of having cancer increases. Suppose that the prior probability of the male patient is 0.4 rather than 0.01. What is the probability that the male patient has prostate cancer if the PSA test comes back positive?

What is the probability that the male patient has prostate cancer if the PSA test comes back negative?

(d) What can you infer about the PSA test from the results of parts (a), (b), and (c)?

Step 1

(a) What is the probability that the male patient has prostate cancer if the PSA test comes back positive?

Let C be the event that a male patient has prostate cancer, Y be the event the PSA test is positive for prostate cancer, and N be the event the PSA test is negative for prostate cancer. Of interest is the probability that a male patient with a positive PSA test has prostate cancer. That is, we wish to determine $P(C|Y)$. This can be found as follows using Bayes' Theorem.

$$P(C|Y) = \frac{P(C)P(y|C)}{P(C)P(y|C) + P(C^C)P(y|C^C)}$$

It is given that there is a 0.01 probability that a male patient has prostate cancer, so we have $P(C) =$ 0.01 ✓ 0.01 .

Recall the complement of an event is made up of the sample points that are not contained in that event. Thus, C^C is the event that a patient does not have prostate cancer. An event and its complement are mutually exclusive, and together they represent the entire sample space. That is, $P(C) + P(C^C) = 1$.

Thus, the probability of the event that a patient does not have prostate cancer, $P(C^C)$, is as follows.

$P(C^C) = 1 - P(C)$
$= \boxed{0.99}$ ✓ 🔑 0.99

Step 2

Let C be the event that a male patient has prostate cancer, Y be the event the PSA test is positive for prostate cancer, and N be the event the PSA test is negative for prostate cancer.

The probability of a false-positive is given to be 0.75. A false-positive occurs when a patient gets a positive PSA test result even though he does not have prostate cancer. That is, given that a patient does not have cancer, the probability of a positive PSA test is 0.75. Thus, we have the following conditional probability.

- ○ $P(C^C|Y) = 0.75$
- ○ $P(C|Y) = 0.75$
- ● 🔑 $P(y|C^C) = 0.75$
- ○ $P(y|C) = 0.75$

✓

The probability of a false-negative is given to be 0.3. A false-negative occurs when a patient gets a negative PSA test result, but he does have prostate cancer. That is, given that a patient does have prostate cancer, the probability of a negative PSA test is 0.3. Thus, we have the following conditional probability.

- ● 🔑 $P(N|C) = 0.3$
- ○ $P(C|N) = 0.3$
- ○ $P(N|C^C) = 0.3$
- ○ $P(C^C|N) = 0.3$

✓

Step 3

Let C be the event that a male patient has prostate cancer, Y be the event the PSA test is positive for prostate cancer, and N be the event the PSA test is negative for prostate cancer.

A false-negative occurs when a patient who does have prostate cancer gets a negative PSA test result. The probability of this event is $P(N|C)$.

Recall that an event and its complement are mutually exclusive, and their union is the entire sample space. The complement of a false-negative is then a patient who does have cancer gets a positive PSA test result. The probability of this is $P(y|C)$.

Therefore, $P(y|C) + P(N|C) = 1$.

We found $P(N|C) = 0.3$, so $P(y|C)$ can be found as follows.

$$\begin{aligned} P(y|C) &= 1 - P(N|C) \\ &= 1 - 0.3 \\ &= \boxed{0.7} \checkmark \quad \boxed{\text{🔑} \quad 0.7} \end{aligned}$$

Step 4

All the necessary probabilities to use Bayes' Theorem have been found. Substitute the values $P(C) = 0.01$, $P(y|C) = 0.7$, $P(C^C) = 0.99$, and $P(y|C^C) = 0.75$ into the formula, rounding the result to four decimal places.

$$\begin{aligned} P(C|Y) &= \frac{P(C)P(y|C)}{P(C)P(y|C) + P(C^C)P(y|C^C)} \\ &= \frac{0.01\left(\boxed{0.7} \checkmark \quad \boxed{\text{🔑} \quad 0.7}\right)}{0.01(0.7) + 0.99(0.75)} \\ &= \boxed{0.0093} \checkmark \quad \boxed{\text{🔑} \quad 0.0093} \end{aligned}$$

Thus, the probability that a male patient has prostate cancer if the PSA test comes back positive, rounded to four decimal places, is $\boxed{0.0093}$ ✓ $\boxed{\text{🔑} \quad 0.0093}$.

Step 5

(b) What is the probability that the male patient has prostate cancer if the PSA test comes back negative?

Let C be the event that a male patient has prostate cancer, Y be the event the PSA test is positive for prostate cancer, and N be the event the PSA test is negative for prostate cancer. Of interest is the probability that a male patient has prostate cancer given a negative PSA test result. That is, we wish to determine $P(C|N)$, which can be found using Bayes' Theorem as follows.

$$P(C|N) = \frac{P(C)P(N|C)}{P(C)P(N|C) + P(C^C)P(N|C^C)}$$

We previously determined the probability a male patient has prostate cancer is given by $P(C) = 0.01$, the probability a male patient does not have prostate cancer is given by $P(C^C) = 0.99$, the probability of a false-positive is $P(y|C^C) = 0.75$, and the probability of a false-negative is $P(N|C) = 0.3$. To apply Bayes' Theorem, we must determine $P(N|C^C)$.

A false-positive occurs when a patient who does not have prostate cancer gets a positive PSA test result. The complement of this event is then a patient who does not have cancer gets a negative PSA test result, with probability $P(N|C^C)$.

Therefore, $P(y|C^C) + P(N|C^C) = 1$.

We determined $P(y|C^C) = 0.75$, so $P(N|C^C)$ can be found as follows.

$$\begin{aligned} P(N|C^C) &= 1 - P(y|C^C) \\ &= 1 - \boxed{0.75} \checkmark \quad \boxed{\text{🔑} \quad 0.75} \\ &= \boxed{0.25} \checkmark \quad \boxed{\text{🔑} \quad 0.25} \end{aligned}$$

Step 6

All the necessary probabilities to use Bayes' Theorem have been found. Substitute the values $P(C) = 0.01$, $P(N|C) = 0.3$, $P(C^C) = 0.99$, and $P(N|C^C) = 0.25$ into the formula, rounding the result to four decimal places.

$$P(C|N) = \frac{P(C)P(N|C)}{P(C)P(N|C) + P(C^C)P(N|C^C)}$$

$$= \frac{0.01\left(\boxed{0.3}\ \checkmark\ \boxed{\text{🔑}\ 0.3}\right)}{0.01(0.3) + 0.99(0.25)}$$

$$= \boxed{0.0120}\ \checkmark\ \boxed{\text{🔑}\ 0.0120}$$

Thus, the probability that a male patient has prostate cancer if the PSA test comes back negative, rounded to four decimal places, is $\boxed{0.0120}$ ✓ $\boxed{\text{🔑}\ 0.0120}$.

Step 7

(c) For older men, the prior probability of having cancer increases. Suppose that the prior probability of the male patient is 0.4 rather than 0.01. What is the probability that the male patient has prostate cancer if the PSA test comes back positive? What is the probability that the male patient has prostate cancer if the PSA test comes back negative?

Let C be the event that a male patient has prostate cancer, Y be the event the PSA test is positive for prostate cancer, and N be the event the PSA test is negative for prostate cancer. Of interest is the probability that a male patient has prostate cancer given he got a positive PSA test result. That is, we wish to determine $P(C|Y)$.

For older men, it is given that there is a 0.4 probability that a male patient has prostate cancer, so we have $P(C) = \boxed{0.4}$ ✓ $\boxed{\text{🔑}\ 0.4}$.

Recall the complement of an event is made up of all the sample points that are not contained in that event. Thus, C^C is the event that a patient does not have prostate cancer and $P(C^C) = 1 - P(C) = \boxed{0.6}$ ✓ $\boxed{\text{🔑}\ 0.6}$.

Step 8

We determined the probability an older man has prostate cancer is $P(C) = 0.4$, and the probability an older man does not have prostate cancer is $P(C^C) = 0.6$. Since the accuracy of the PSA test does not change, the previously found probabilities of a false-positive, false-negative, and their complements will not change. Thus, we have the probability of a false-positive to be $P(y|C^C) = 0.75$, and the probability of its complement to be $P(N|C^C) = 0.25$.

The probability of a false-negative is $P(N|C) = 0.3$, and the probability of its complement is $P(y|C) = 0.7$.

The probability that a male patient with a positive PSA test has prostate cancer is $P(C|Y)$, which can be found as follows using Bayes' Theorem as follows.

$$P(C|Y) = \frac{P(C)P(y|C)}{P(C)P(y|C) + P(C^C)P(y|C^C)}$$

Substitute the probabilities into the above formula, rounding the result to four decimal places.

$$\begin{aligned} P(C|Y) &= \frac{P(C)P(y|C)}{P(C)P(y|C) + P(C^C)P(y|C^C)} \\ &= \frac{0.4\left(\boxed{0.7}\ \checkmark\ \boxed{\text{🔑}\ 0.7}\right)}{0.4(0.7) + 0.6(0.75)} \\ &= \boxed{0.3836}\ \checkmark\ \boxed{\text{🔑}\ 0.3836} \end{aligned}$$

Thus, the probability that a male patient has prostate cancer if the PSA test comes back positive, rounded to four decimal places, is 0.3836 ✓ 🔑 0.3836 .

Step 9

We determined the probability an older man has prostate cancer is $P(C) = 0.4$, and the probability an older man does not have prostate cancer is $P(C^C) = 0.6$.

Since the accuracy of the PSA test does not change, the previously found probabilities of a false-positive, false-negative, and their complements will not change. Thus, we have the probability of a false-positive to be $P(y|C^C) = 0.75$, and the probability of its complement to be $P(N|C^C) = 0.25$. The probability of a false-negative is $P(N|C) = 0.3$, and the probability of its complement is $P(y|C) = 0.7$.

The probability that a male patient with a negative PSA test has prostate cancer is $P(C|N)$, which can be found as follows using Bayes' Theorem as follows.

$$P(C|N) = \frac{P(C)P(N|C)}{P(C)P(N|C) + P(C^C)P(N|C^C)}$$

Substitute the probabilities into the above formula, rounding the result to four decimal places.

$$\begin{aligned} P(C|N) &= \frac{P(C)P(N|C)}{P(C)P(N|C) + P(C^C)P(N|C^C)} \\ &= \frac{0.4\left(\boxed{0.3}\ \checkmark\ \boxed{\text{🔑}\ 0.3}\right)}{0.4(0.3) + 0.6(0.25)} \\ &= \boxed{0.4444}\ \checkmark\ \boxed{\text{🔑}\ 0.4444} \end{aligned}$$

Thus, the probability that a male patient has prostate cancer if the PSA test comes back negative, rounded to four decimal places, is 0.4444 ✓ 🔑 0.4444 .

Step 10

(d) What can you infer about the PSA test from the results of parts (a), (b), and (c)?

When the probability a male has prostate cancer is 0.01, the probability he actually has cancer if the PSA test comes back positive is 0.0093. This is low, indicating a positive result on the PSA test is not ✓ 🔑 is not very accurate at determining if a patient actually has prostate cancer. The probability he actually has cancer if the PSA test comes back negative is 0.0120. This is low, so it is likely that the patient does not ✓ 🔑 does not have prostate cancer.

However, for older men when the probability of having prostate cancer increases to 0.4, the probability of actually having cancer if the PSA test comes back positive increases to 0.3836 and to 0.4444 if the test comes back negative. These probabilities are fairly close to one another, indicating the PSA test is not ✓ 🔑 is not very accurate at determining whether or not a patient actually has prostate cancer.

You have now completed the Master It.

Need Help? Read It

6. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.053.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

A survey asked students of different age groups whether or not they had applied to more than one school. After gathering the data, the following joint probability table was produced.

		Applied to More Than One School		
		Yes	**No**	**Total**
Age Group	**23 and under**	0.1035	0.1000	0.2035
	24−26	0.1469	0.1878	0.3347
	27−30	0.0902	0.1326	0.2228
	31−35	0.0320	0.0966	0.1286
	36 and over	0.0261	0.0843	0.1104
	Total	0.3987	0.6013	1.0000

(a) Given that a person applied to more than one school, what is the probability that the person is 24−26 years old? (Round your answer to four decimal places.)

0.3684 ✓

(b) Given that a person is in the 36-and-over age group, what is the probability that the person applied to more than one school? (Round your answer to four decimal places.)

0.2364 ✓

(c) What is the probability that a person is 24−26 years old or applied to more than one school? (Round your answer to four decimal places.)

0.5865 ✓

(d) Suppose a person is known to have applied to only one school. What is the probability that the person is 31 or more years old? (Round your answer to four decimal places.)

0.3008 ✓

(e) Is the number of schools applied to independent of age? Explain.

- ○ Yes, because $P(24 \text{ to } 26 \mid \text{Yes}) = P(\text{Yes} \mid 24 \text{ to } 26)$.
- ○ Yes, because $P(31 \text{ to } 35 \cap \text{No}) = 0$.
- ○ No, because the two events aren't mutually exclusive.
- ● No, because $P(24 \text{ to } 26 \mid \text{Yes}) \neq P(24 \text{ to } 26)$.

✓

Need Help? Read It

7\. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.054.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

A survey was conducted that included several questions about how internet users feel about search engines and other websites collecting information about them and using this information either to shape search results or target advertising to them. In one question, participants were asked, "If a search engine kept track of what you search for, and then used that information to personalize your future search results, how would you feel about that?" Respondents could indicate either "Would *not* be okay with it because you feel it is an invasion of your privacy" or "Would be *okay* with it, even if it means they are gathering information about you." Frequencies of responses by age group are summarized in the following table.

Age	Not Okay	Okay
18–29	0.1486	0.0603
30–49	0.2274	0.0906
50+	0.4009	0.0722

(a) What is the probability a survey respondent will say she or he is *not okay* with this practice?

0.7769 ✓

(b) Given a respondent is 30–49 years old, what is the probability the respondent will say she or he is *okay* with this practice? (Round your answer to four decimal places.)

0.2849 ✓

(c) Given a respondent says she or he is *not okay* with this practice, what is the probability the respondent is 50+ years old? (Round your answer to four decimal places.)

0.5160 ✓

(d) Is the attitude about this practice independent of the age of the respondent? Why or why not?

○ Yes, because $P(\text{okay} \mid 30\text{-}49) = P(30\text{-}49 \mid \text{okay})$.

● No, because $P(\text{okay} \mid 30\text{-}49) \neq P(\text{okay})$.

○ Yes, because $P(\text{okay} \cap 18\text{-}29) = 0$.

○ No, because these events aren't mutually exclusive.

✓

(e) Do attitudes toward this practice for respondents who are 18–29 years old and respondents who are 50+ years old differ?

The attitudes differ ✓ . Compared to respondents in the 18-29 age category, respondents in the 50+ age category are more likely ✓ to say this practice is not okay.

Need Help? Read It

8. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.056.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

A real estate company recently became interested in determining the likelihood of one of their listings being sold within a certain number of days. An analysis of company sales of 800 homes in previous years produced the following data.

		Days Listed Until Sold			**Total**
		Under 30	**31–90**	**Over 90**	
Initial Asking Price	**Under $150,000**	10	40	50	100
	$150,000–$199,999	20	150	80	250
	$200,000–$250,000	280	20	100	400
	Over $250,000	30	10	10	50
Total		340	220	240	800

(a) If A is defined as the event that a home is listed for more than 90 days before being sold, estimate the probability of A.

0.3 ✓

(b) If B is defined as the event that the initial asking price is under $150,000, estimate the probability of B.

0.125 ✓

(c) What is the probability of $A \cap B$?

0.0625 ✓

(d) Assuming that a contract was just signed to list a home with an initial asking price of less than $150,000, what is the probability that the home will take the company more than 90 days to sell?

0.5 ✓

(e) Are events A and B independent?

○ No, because A and B aren't mutually exclusive.

○ Yes, because $P(A \cap B) = 0$.

● No, because $P(A \mid B) \neq P(A)$.

○ Yes, because $P(A \mid B) < P(A)$.

✓

Need Help? Read It

9. **[10/10 Points]** DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.059.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

An oil company purchased an option on land in Alaska. Preliminary geologic studies assigned the following prior probabilities.

$P(\text{high-quality oil}) = 0.50$
$P(\text{medium-quality oil}) = 0.30$
$P(\text{no oil}) = 0.20$

(a) What is the probability of finding oil?

0.8 ✓

(b) After 200 feet of drilling on the first well, a soil test is taken. The probabilities of finding the particular type of soil identified by the test follow.

$P(\text{soil} \mid \text{high-quality oil}) = 0.20$
$P(\text{soil} \mid \text{medium-quality oil}) = 0.80$
$P(\text{soil} \mid \text{no oil}) = 0.20$

How should the firm interpret the soil test? Calculate the revised probabilities by completing the table below. (Round your answers to two decimal places.)

Events	$P(A_i)$	$P(S \mid A_i)$	$P(A_i \cap S)$	$P(A_i \mid S)$
High Quality (A_1)	0.50	0.20	0.1 ✓	0.26 ✓
Medium Quality (A_2)	0.30	0.80	0.24 ✓	0.63 ✓
No Oil (A_3)	0.20	0.20	0.04 ✓	0.11 ✓
Total	1.00		$P(S) =$ 0.38 ✓	1.00

What is the new probability for finding oil after finding this particular type of soil? (Round your answer to two decimal places.)

$P(\text{oil} \mid S) =$ 0.89 ✓

Is the company more likely or less likely to find oil after the results of the test?

● more likely
○ less likely
✓

Do the new probabilities favor medium or high quality oil?

● medium quality oil

○ high quality oil

✓

Need Help? Read It

10. [10/10 Points] DETAILS PREVIOUS ANSWERS **ASWSBE14 4.E.060.**

MY NOTES ASK YOUR TEACHER PRACTICE ANOTHER

Suppose the five most common words appearing in spam emails are *shipping*!, *today*!, *here*!, *available*, and *fingertips*! Many spam filters separate spam from ham (email not considered to be spam) through application of Bayes' theorem. Suppose that for one email account, 1 in every 10 messages is spam and the proportions of spam messages that have the five most common words in spam email are given below.

shipping!	0.050
today!	0.043
here!	0.035
available	0.015
fingertips!	0.014

Also suppose that the proportions of ham messages that have these words are the following.

shipping!	0.0015
today!	0.0021
here!	0.0024
available	0.0040
fingertips!	0.0009

(a) If a message includes the word *shipping*!, what is the probability the message is spam? (Round your answer to three decimal places.)

0.7874 ✓

If a message includes the word *shipping*!, what is the probability the message is ham? (Round your answer to three decimal places.)

0.2126 ✓

Should messages that include the word *shipping*! be flagged as spam?

They should ✓ be flagged as spam because the probability that a message is spam if it includes the word *shipping*! is high ✓ .

(b) If a message includes the word *today*!, what is the probability the message is spam? (Round your answer to three decimal places.)

0.6947 ✓

If a message includes the word *here*!, what is the probability the message is spam? (Round your answer to three decimal places.)

0.6184 ✓

Which of these two words is a stronger indicator that a message is spam? Why?

A message that includes the word today! ✓ is more likely to be spam because *P*(spam | *today*!) is larger ✓ than *P*(spam | *here*!).

(c) If a message includes the word *available*, what is the probability the message is spam? (Round your answer to three decimal places.)

0.2941 ✓

If a message includes the word *fingertips*!, what is the probability the message is spam? (Round your answer to three decimal places.)

0.6335 ✓

Which of these two words is a stronger indicator that a message is spam? Why?

A message that includes the word fingertips! ✓ is more likely to be spam because *P*(spam | *available*) is smaller ✓ than *P*(spam | *fingertips*!).

(d) What insights do the results of parts (b) and (c) yield about what enables a spam filter that uses Bayes' theorem to work effectively?

A message containing a word is more ✓ likely to be spam when that word occurs more often in unwanted messages (spam) and less often in legitimate messages (ham).

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