Started on	Saturday, 1 October 2022, 12:30 PM
State	Finished
Completed on	Saturday, 1 October 2022, 1:35 PM
Time taken	1 hour 5 mins
Grade	**8.60** out of 11.00 (**78.18**%)

Question **1**

Complete

Mark 3.00 out of 3.00

The following is question 9 in the miniquiz of Chapter 2, Section 2.8 of the textbook. We will solve that question first.

Question 9, Miniquiz Chapter 2.

A certain type of rocket is known to fail for one or two reasons: (1) failure of the rocket engine because the fuel does not burn evenly or (2) failure of the guidance system. Let *the experiment* consist of the firing of a rocket of this type. We let A be the event that the rocket fails because of engine malfunction and B the event the rocket fails because of guidance failure. The event F of a failure of the rocket is thus given by: $F = A \cup B.$ A and B are not mutually exclusive and they are not empty events. Consider the following three events:

W={ "engine fails"} or {"engine operates and guidance fails"}

T={"guidance fails"} or {"guidance operates and engine fails"}

R={"engine operates and guidance fails"}, or {"both fail"}, or {"engine fails and guidance operates"}

Each of the events W, T, and R are (choose all that apply)

Solution to question 9 of miniquiz chapter 2: The events W, T, and R are each of them equal to F. Also, each of the events W,T, and R are obtained by using some of the elements of the partition of F.

<u>Question for you.</u>

(a) Write the events W, T, and R symbolically in terms of the A and B events and using the symbols of the algebra of sets, such as intersection symbol, union symbol, etc. At the end of this problem, you will find instructions for how to insert the symbols used in the algebra of sets. Unlike in the review exercises, we will not accept writing of the answer without algebra of sets symbols for intersection, complement, unions..

(b) If you have watched the lectures on partitions posted for this week 1, you should be able to justify, showing work, the second part of the solution, namely, justify that

"each of the events W,T, and R are obtained by using some of the elements of the partition of F."

Again, you must justify your answer using the algebra of sets symbols and the events as you expressed them in part (a).

<u>Technical information for those who did not try to find how to do symbols in the review exercises (I posted a short video illustrating the following in my office hours module in BL).</u>

A quick way to enter the symbols of the algebra of sets is to write them as follow within your text.

For intersection: ∩

For union: ∪ although union can be represented by an inverted U.

They will be read properly by the quiz, even though you will not see their typesetting. There is a way to see it and to enter these codes differently. You can see how in a video I posted in my office hours module (Dr. Sanchez's office hours).

For complement, e.g. for complement of event O: O^c. But you could alternatively use the superscript. Expand the editor menu by clicking on the down arrow above and you will see it.

a)

W = A ∪ (A^c ∩ B)

T = B ∪ (A ∩ B^c)

R = W ∪ T = (A^c ∩ B) ∪ (A ∩ B) ∪ (A ∩ B^c) = A ∪ B

b)

Consider event F, which is the failure of the rocket, as the sample space, F = A∪B. This sample space can be divided into several different parts, (A^c ∩ B) ∪ (A ∩ B) ∪ (A ∩ B^c), which include all of the event W, T and R. Also defined them as a partition of the sample space F.

(a)

$W = A \cup (A^c \cap B)$; ok if also written as $W = A \cup (A^c B)$

$T = B \cup (A \cap B^c)$; ok if also written as $T = B \cup (A \cap B^c)$

$R = (A^c \cap B) \cup (A \cap B) \cup (A \cup B^c)$; ok if also written as $R = (A^c B) \cup (AB) \cup (AB^c)$

(b)

$F = (A \cup B)$

A partition of F is, as indicated in the partitions lectures of week 1, the following events: (AB^c), (AB) and $(A^c B)$.

In W, we use the element $(A^c B)$ of the partition of F

In T, we use the element (AB^c) of the partition of F

In R, we all the elements of the partition of F

Comment:

Question **2**

Correct

Mark 1.00 out of 1.00

In the context of rolling 3 fair six-sided dice, what is the most important factor contributing to obtaining the correct answer to the probability of the sum being 14, for example, without having to do long observations (i.e., without having to roll the dice endless number of times)?

Select one:

- a. counting not only the favorable partitions but also the number of permutations of each partition. ✔
- b. using the law of large numbers
- c. Taking into account that the number of possible outcomes is: any of the numbers from 3 to 18, that is, there are 16 outcomes. One of those outcomes is favorable, 14. So the probability 1/16 will be the correct probability.
- d. use your subjective opinion

Your answer is correct.

See Section 1.3 in the textbook and watch *Lecture 1.*

Think how many partitions give a sum of 14:(6,6,2), (5,3,6), (4,4,6),(5,5,4).

The gamblers of the 17th century would have said that there are only 4 favorable outcomes. But they were not counting the permutations. The way they put together their sample spaces did not write the permutations like we did in the lecture and the textbook.

The number of permutations of (6,6,2) is 3; the number of permutations of (4,4,6) is 3; the number of permutations of (5,5,4) is 3; and the number of permutations of (5,3,6) is 6. There are therefore 15 possible outcomes where the sum is 14.

P("sum is 14") =15/216

The correct answer is:
counting not only the favorable partitions but also the number of permutations of each partition.

Question 3
Correct
Mark 1.00 out of 1.00

Chapter 2, section 2.1.1, Exercise 1.

Consider the experiment of monitoring the credit card activity of an individual to detect whether fraud is committed. Let 1 denote that there is fraud and 0 that there is no fraud. The sample space of this experiment is

- a. S= {1, 01, 001, 0001, 00001, 000001, ..., 00000000001, ...}
- b. S={10, 01}
- c. S={1,0}
- d. S={111,110,101,100, 011,010,001,000}

Your answer is correct.

The correct answer is:
S={1,0}

Question **4**

Correct

Mark 1.00 out of 1.00

The classical definition of probability has some limitations. Which of the following are some limitations?

Select one or more:

- [x] a. It cannot be used when the outcomes are not equally likely. ✔
- [ ] b. It does not satisfy Kolmogorov's axioms.
- [ ] c. We could not double-check it with long observations.
- [x] d. It can only be used when there are finite or infinite countable outcomes. ✔

Your answer is correct.

Section 1.3 in the textbook talks about the classical definition of probability and its assumptions.

The material in this question refers to what was discussed in *Lecture 1. Origins of the mathematical theory of probability.* You may watch the video posted in Week 1's module.

The correct answers are:
It cannot be used when the outcomes are not equally likely.,
It can only be used when there are finite or infinite countable outcomes.

Question 5
Complete
Not graded

Section 1.7 of the textbook, Chapter 1, talks about R code for simulating rolls of dice with R. During the TA discussion session of week 1, the TA introduced R and illustrated how to do such simulations. If you missed it, there is a video posted in the TA Discussion session page of Module 1. The question is about the code.

Question

You want to roll three fair 10 sided dice and see what the sum of the dice is to determine whether it is more likely to get a sum of 15 or a sum of 14. Below are some options for how to run this simulation. Which code will best provide you with the correct answer?

- a. This choice was deleted after the attempt was started.
- b. This choice was deleted after the attempt was started.
- c. This choice was deleted after the attempt was started.
- d. This choice was deleted after the attempt was started.

Your answer is incorrect.

The correct answer is:

```
n=10000
sum.rolls <- numeric(0)

for (i in 1:n) {
  rolls = sample(1:10, 3, prob=c(rep(1/10, 10), replace=TRUE)
  sum.rolls[i]= sum(rolls)
}
sum(sum.rolls==14)
sum(sum.rolls==15)
```

Question **6**

Complete

Mark 2.60 out of 3.00

a)

i) bought = A, not bought = B

S = {AAA, AAB, ABA, BAA, BBA, BAB, ABB, BBB}

ii)Germinate = A, not Germinate = B

S = {AAA, AAB, ABA, BAA, BBA, BAB, ABB, BBB}

iii) head = A, tail = B

S = {AAA, AAB, ABA, BAA, BBA, BAB, ABB, BBB}

These experiments all have a similar sample space, same number of outcomes

b)

A∪B = {AAA, AAB, ABA, BAA, BBA, BAB, ABB}

A∩B = ø (empty)

Comment:
Need to write out the A and B (-0.4)

Question **7**

Incorrect

Mark 0.00 out of 1.00

Chapter 2, exercise 11, Section 2.10 contains a version of the following question, and we slightly modify it.

(This problem is from Goldberg, pages 22–23.) Persons are classified according to blood type and Rh quality by testing a blood sample for the presence of three antigens: A, B, and Rh. Blood is of type AB if it contains both antigens A and B, of type A if it contains A but not B, of type B if it contains B but not A, and of type O if it contains neither A nor B. In addition, blood is classified as Rh+ if the Rh antigen is present, and Rh- otherwise. If we let A, B, and Rh denote the sets of people whose blood contains the A, B, and Rh antigens respectively, then all people can be classified into one of the eight categories indicated using a Venn diagram with three events that intersect inside a box representing.

(i) Draw A Venn diagram as indicated. Make it big enough so that the different classes mentioned above are clearly put into one part of the diagram. For example, the area corresponding to A- should be clear in your Venn diagram.

(ii) A laboratory technician reports the following proportions for blood samples of 1000 people:

50% contain antigen A

52% contain antigen B

40% contain antigen Rh

20% contain both A and B

13% contain both A and Rh

15% contain both B and Rh

5% contain all three antigens

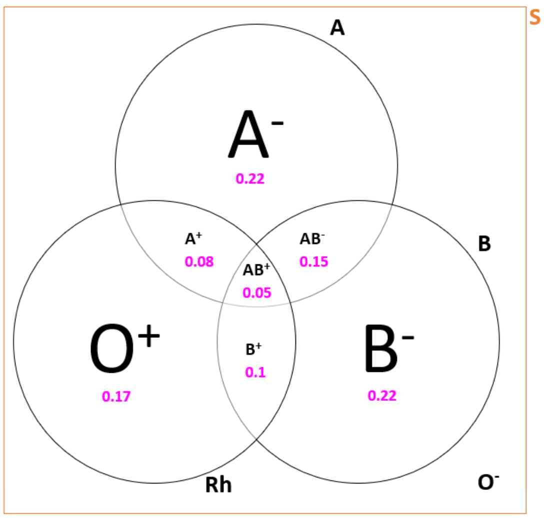
(ii.1) What is the proportion of type A- persons?

(ii.2) What is the proportion of O- persons?

(ii.3) What is the proportion of B+ persons?

Solution

We help ourselves by drawing a Venn diagram embedded in a sample space, since we must have a universal set S to account for all events.



(ii.1) We partition the Sample space into 8 sets. The black lines delimit all these sets. Inside each delimited set, we mark that blood type (in black color) and the proportion of people with that blood type.

(ii.2) There are 22% type A^-. There are (1-0.22-0.15-0.08-0.05-0.1-0.22-0.17)=0.01 or 1% persons that are O^-

(ii.3) There are 10% B^+ persons

A question for you

How many of the 1000 people are in the event $A \cap B \cap Rh^c$?

a. 200

b. 600

c. 590 ✖

d. 150

Your answer is incorrect.

The correct answer is:
150

Question **8**

Incorrect

Mark 0.00 out of 1.00

Consider an experiment that consists of observing three characteristics of a randomly chosen individual: whether they are tall (event E), whether they like tea (event F) and something else not relevant to this question. The event

$(E \cup F) \cap (E^c \cup F) \cap (E \cup F^c)$

equals the event

(choose all that applies)

- [ ] a. This choice was deleted after the attempt was started.
- [x] b. This choice was deleted after the attempt was started. ✖
- [ ] c. This choice was deleted after the attempt was started.
- [ ] d. This choice was deleted after the attempt was started.

Your answer is incorrect.

The correct answers are:
tall person that likes tea,

\(E \cap F \)