EES 315: In-Class Exercise # 9

Date: 18 / 9 / 2020			
Name	ID (last 3 digits)		

Instructions

1. Work alone or in a group of no more than three students. For group work, **the group cannot be the same as any of your former groups in this class.**
2. **[ENRE] Explanation is not required for this exercise.**
3. Only one submission is needed for each group.
4. You have two choices for submission:
   (a) Online submission via Google Classroom
   - PDF only.
   - Only for those who can directly work on the posted files using devices with pen input.
   - Paper size should be the same as the posted file.
   - No scanned work, photos, or screen capture.
   - Your file name should start with the 10-digit student ID of one member. (You may add the IDs of other members, exercise #, or other information as well.)

   (b) Hardcopy submission
5. **Do not panic.**

Here, it is given that
$P(\{a\}) = 0.2,$
$P(\{b\}) = 0.3,$
$P(\{c\}) = 0.3,$
$P(\{d\}) = 0.2.$

1. Consider a random experiment whose sample space is $\{a,b,c,d\}$ with outcome probabilities 0.2, 0.3, 0.3, and 0.2, respectively. Let $A=\{a,b,c\}$, and $B=\{c,d\}$. Find the following probabilities.

$P(A\mid B)=\frac{P(A\cap B)}{P(B)}=\frac{P(\{c\})}{P(\{c,d\})}=\frac{0.3}{0.3+0.2}=0.6$	$A\cap B^c = A\backslash B = \{a,b\}$ $P(A\mid B^c)=\frac{P(A\cap B^c)}{P(B^c)}=\frac{P(\{a,b\})}{1-P(B)}=\frac{0.2+0.3}{1-0.5}=1$

2. Consider the following sequences of 1s and 0s which summarize the data obtained from 16 testees in a disease testing experiment.

D:	0	1	1	0	0	0	0	1	1	1	1	0	1	0	1	1
TP:	0	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1

The results in the *i*-th column are for the *i*-th testee. The `D` row indicates whether each of the testees actually has the disease under investigation. The `TP` row indicates whether each of the testees is tested positive for the disease. Numbers "1" and "0" correspond to "True" and "False", respectively.
Suppose we randomly pick a testee from this pool of 16 persons. Let D be the event that this selected person actually has the disease. Let T_P be the event that this selected person is tested positive for the disease.
Find the following probabilities.

There are 15 testees; so the sample space is finite. We "randomly" pick one testee; so it makes sense to assume that each testee has equal chance of being selected. Therefore, classical probability can be applied here.

$P(D)=\frac{9}{16}$ — Among the 16 testees, 9 have the disease.	$P(T_P)=\frac{7}{16}$ — Among the 16 testees, 7 test positive.
$P(T_P\cap D)=\frac{4}{16}=\frac{1}{4}$ — Among the 16 testees, 4 have the disease and test positive.	$P(T_P\cap D^c)=\frac{3}{16}$ — Among the 16 testees, 3 test positive but do not have the disease.

In each part below, additional information about the selected testee is available; this additional information is given in the condition part. With such information, find the corresponding conditional probability.

$P(T_P\mid D)=\frac{4}{9}$ — Among the 9 testees who have the disease, 4 test positive.	$P(T_P\mid D^c)=\frac{3}{7}$ — Among the $16-9=7$ testees who don't have the disease, 3 test positive.

Alternatively, $P(T_P|D)=\frac{P(T_P\cap D)}{P(D)}=\frac{\frac{1}{4}}{\frac{9}{16}}=\frac{4}{9}.$

$P(T_P|D^c)=\frac{P(T_P\cap D^c)}{P(D^c)}=\frac{\frac{3}{16}}{1-P(D)}=\frac{\frac{3}{16}}{1-\frac{9}{16}}=\frac{3}{7}.$