

HW 1

ECE341

Due date: June 21

- 1- Monitor three consecutive packets going through an Internet router. Based on the packet header, each packet can be classified as either video (v) if it was sent from a Youtube server or as ordinary data (d). Your observation is a sequence of three letters (each letter is either v or d). For example, two video packets followed by one data packet corresponds to vvd. Write the elements of the following sets:

A1 = second packet is video; B1 = second packet is data;

A2 = all packets are the same; B2 = video and data alternate;

A3 = one or more video packets; B3 = two or more data packets:

For each pair of events A1 and B1, A2 and B2, and so on, identify whether the pair of events is mutually exclusive or not.

- 2- A student's test score T is an integer between 0 and 100 corresponding to the experimental outcomes $s_0; s_1; \dots; s_{100}$. A score of 90 to 100 is an A, 80 to 89 is a B, 70 to 79 is a C, 60 to 69 is a D, and below 60 is a failing grade of F. If all scores between 51 and 100 are equally likely and a score of 50 or less never occurs, find the following probabilities:

(a) $P[s \leq 100]$

(b) $P[A]$

(c) $P[F]$

(d) $P[T < 90]$

(e) $P[\text{a C grade or better}]$

(f) $P[\text{student passes}]$

- 3- Monitor three consecutive packets going through an Internet router. Classify each one as either video (v) or data (d). Your observation is a sequence of three letters (each one is either v or d). For example, three video packets correspond to vvv. The outcomes vvv and ddd each have probability 0.2 whereas each of the other outcomes vvd, vdv, vdd, dvv, dvd, and ddd has probability 0.1. Count the number of video packets N_V in the three packets you have observed. Describe in words and also calculate the following probabilities:

(a) $P[N_V = 2]$

(b) $P[N_V \geq 1]$

(c) $P[\{vvd\} | N_V = 2]$

(d) $P[\{ddv\} | N_V = 2]$

(e) $P[N_V = 2 | N_V \geq 1]$

(f) $P[N_V \geq 1 | N_V = 2]$

4- Monitor customer behavior in the Phonesmart store. Classify the behavior as buying (B) if a customer purchases a smartphone. Otherwise the behavior is no purchase (N). Classify the time a customer is in the store as long (L) if the customer stays more than three minutes; otherwise classify the amount of time as rapid (R). Based on experience with many customers, we use the probability model $P[N] = 0.7$, $P[L] = 0.6$, $P[NL] = 0.35$. Find the following probabilities:

(a) $P[B \cup L]$

(b) $P[N \cup L]$

(c) $P[N \cup B]$

(d) $P[LR]$

5- We have 6 red balls and 6 blue balls. We store them in two urns: U1 and U2. U1 has 2 red balls and 4 blue balls. U2 has 2 blue balls and 4 red balls. Prior probabilities of urns are equal to each other: $P(U1) = P(U2) = 0.5$.

We pick a ball and it is red. Determine the probabilities $P(R | U1)$, $P(U1 | R)$ and $P(U2 | R)$.