ECE 302: Probabilistic Methods in Electrical and Computer Engineering
Fall 2016
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PURDUE
U N I V E R S I T Y

Applications and their random experiments

Fall 2016
(August 23, 2016)

WHAT IS THE SAMPLE SPACE? WHAT IS THE EVENT OF INTEREST?

Problem 1. BOOK
Flip a coin 3 times. What is the probability you get the sequence Head,Tail,Head?

Problem 2. BOOK
Flip a coin times. What is the probability you get 2 heads and a tail?

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Problem 3. (From final exam Fall 2015)
Susie wants to take the 8:15 bus in the morning. Let X be the time she arrives at the bus-stop, which is a uniform random variable between 8:07 and 8:17. Let Y be the time the bus arrives at the bus-stop, which is a uniform random variable between 8:10 and 8:20. Assume that X and Y are independent.

Susie will miss the bus if it arrives before she does. What is the probability that Susie will miss the bus?
(Hint: It may be helpful to draw a diagram indicating the relationship between X, Y, and the event that Susie misses the bus.)

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Problem 4. BOOK
A block of information is transmitted repeatedly over a noisy channel until an error-free block arrives at the receiver. Each block is in error with probability 0.1. What is the probability that more than 4 retransmissions are required?

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Problem 5.
Temperature is measured in Indiana at noon in January. What is the probability the temperature is less than 10 degrees Farenheit?

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Problem 6.
A company has a machine that makes 1-kilo-ohm resistors. What is the probability the resistor's resistance is within $\pm 5\%$ of the desired value?

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Problem 7.
You ask for a glass of water at a restaurant. You measure the amount of water they bring you. You drink some water. You measure again.

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Problem 8. BOOK
You are designing a packet voice transmission system. A speech signal is segmented into 10 ms chunks, and sent in packets. However, to save bandwidth, the signal is only packetized when the speaker is NOT silent.
If you have a group of N speakers in *different* conversations, chances are not all of them will be speaking at once.
You design your system to handle up to 8 simultaneous speakers. How many calls can you admit into your system, and ensure that you exceed capacity no more than 1% of the time?

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Problem 9. Book

You are designing a system to go into space (or, into a hot humid environment, or a cold dry environment, ..). You want to model the lifetime of the system, using the lifetime of the components. What is the probability the system will function correctly for more than 1 year?

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Problem 10. (FROM SAMPLE EXAM 1 FALL 2015)
Zeros and ones are sent over a noisy communication channel, where the transmission of each bit can be considered to be independent sequential experiements. The probability that each 0 is correctly sent is 0.9, while the probability that each 1 is correctly sent is 0.85. The digit 0 is sent with probability 0.6.

(a) Find the probability that an error occurs, for each bit sent.

(b) Given that you detect a 1, what is the probability that a 1 had been sent.

(c) If the string 0010 is sent, what is the probability the string is correctly received.

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Problem 11. (Problem setup is from exam 2, fall 2015)
Five cars start out on a cross-country race. The probability that a car breaks down and drops out of the race is 0.2. Cars break down independently of each other.

(a) What is the probability that exactly two cars finish the race?

(b) What is the probability that at most two cars finish the race?

(c) What is the probability that at least three cars finish the race?

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Problem 12. FROM SAMPLE EXAM 2 FALL 2015

Suppose a basketball player shooting an uncontested 2-point shot will make the basket with probability 0.6. However, if you foul the shooter, the shot will be missed but two free throws will be awarded. Each free throw is an independent Bernoulli trial with success probability p. Based on the expected number of points the shooter will score, for what values of p may it be desirable to foul the shooter?

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Problem 13. FROM SAMPLE EXAM 2 FALL 2015
You are manager of a ticket agency that sells concert tickets. You assume that people will call three times in an attempt to buy tickets and then give up. You want to make sure that you are able to serve at least 95% of the people who want tickets. Let p be the probability that a caller gets through to your ticket agency. What is the minimum value of p to necessary to meet your goal?

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Problem 14. FROM QUIZ 1 SPRING 2016
Select a ball from a container that contains balls numbered from 1 to 10. Observe the number on the ball. You want to compute the probability that the observed number is even.
What is the sample space S? What is the event of interest?

WHAT IS THE SAMPLE SPACE? WHAT IS THE EVENT OF INTEREST?

Problem 15. (FROM EXAM 1 SPRING 2016)
Computers purchased from the surplus store will experience hard drive failures with probablitiy 0.4, memory failures with probability 0.2, and experience both types at the same time with probability 0.1.

What is the probability that there will be either a hard drive failure or a memory failure, but not both.

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Problem 16. (FROM FINAL SPRING 2016)
A super-computer has three cooling components that operate independently. Each fails with probability 1/10. The super-computer will overheat if any two (or three) cooling components fail. What is the probability the super-computer overheats?