

22s:039 Probability and Statistics for Engineers
Exam 1A
Fall 2007

Thursday, September 27, 5:30 - 7pm

100 possible points

Student Name _____

Section [letter/#] _____

Section [day/time] _____

TA's name _____

Instructions:

- 1) Make sure you have the correct number of pages. There are 10 pages and 20 questions.
Each question is worth 5 points.
- 2) Please use a pencil.
- 3) Questions can be clarified, but no hints will be provided.
- 4) You have 1.5 hours to complete the exam.
- 5) Show your student ID to a TA when handing the exam in.
- 6) Please hand-in your formula sheet with your exam.
- 7) If not stated, round answers to three significant digits.
- 8) You may begin, good luck.

Questions 1-2.

A digital scale is used that provides weights to the nearest tenth of a pound.

1. Describe the sample space S . [5 pts]

2. Is the above sample space you described continuous or discrete? [5 pts]

Circle your answer:

a) continuous

b) discrete

Question 3.

3. How many unique arrangements of the letters in COLLOQUIUM are there? [5 pts]

Circle your answer:

a) 453,600

b) 907,200

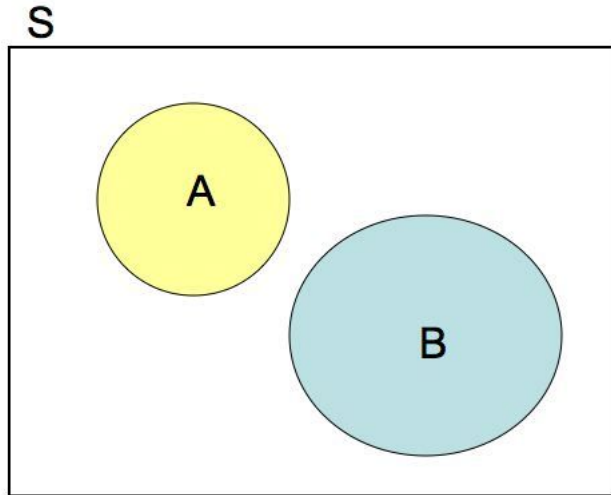
c) 3,628,800

d) 604,800

e) None of the answers is correct.

Question 4.

The following Venn diagram shows events A and B in the sample space S.



4. Circle ALL statements below that coincide with the diagram:[5 pts]

- a) A and B are independent
- b) A and B are mutually exclusive
- c) $P(A|B) = P(A)$
- d) None of the above statements are true.

Question 5.

A co-ed team of 14 soccer players is to be created by combining some of the players from the men's and women's soccer teams. The co-ed team must have an equal number of men and women. There are 15 women, and one of them is a goalie. There are 20 men, and one of them is a goalie. The co-ed team must have a male and female goalie.

5. How many different teams can be created? (assuming all non-goalies can play every position). [5 pts]

Circle your answer:

- a) 193,993,800
- b) 41,990
- c) 81,477,396
- d) 2,319,959,400
- e) None of the answers is correct.

Questions 6-7.

Consider the following probability mass function for the random variable X :

X	3	5	7
$f(x)$	0.65	0.25	0.10

6. Calculate $E(X)$. [5 pts]

7. Calculate $V(X)$. [5 pts]

Questions 8-9.

Customers are used to evaluate preliminary product design, but it is the market success that the company is most interested in. The customers review the preliminary products and label them as either good, or bad. In the past, the following probabilities were found:

- i) 55% of the products are successful.
- ii) 80% of the successful products received a good review.
- iii) 15% of the unsuccessful products received a good review.

8. Find the probability that a product will receive a good review.[5 pts]

Circle your answer rounded to the second significant digit:

- a) 0.95
 - b) 0.12
 - c) 0.44
 - d) 0.51
 - e) None of the answers is correct to the second significant digit.
9. Find the probability that a product will be successful given that it received a good review. [5 pts]

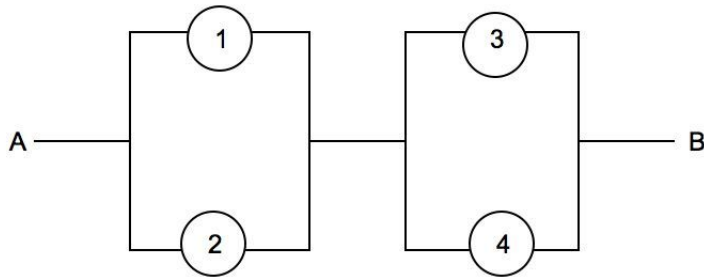
Circle your answer rounded to the third significant digit:

- a) 0.950
- b) 0.508
- c) 0.800
- d) 0.867
- e) None of the answers is correct to the third significant digit.

Question 10.

Relays used in the construction of electrical circuits function properly with a probability of 0.9. Four relays, labeled 1, 2, 3, and 4 are shown in the circuit below.

10. What is the probability that the circuit functions properly? (Current flows from point A to point B.) [5 pts]



Circle your answer:

- a) 0.9999
- b) 0.9801
- c) 0.9639
- d) 0.6561
- e) 0.0100
- f) 0.0199
- g) None of the answers is correct to the fourth decimal place.

Question 11.

From a group of 20 PhD engineers, ten are selected for employment. Because of a rush to employ, little is known about the background of the engineers before they're hired. In reality, 5 of them are considered 'top' engineers.

11. What is the probability that all 'top' engineers are chosen for employment? [5 pts]

Question 12.

A rock climber is attached to the top of a cliff with 4 independent ropes, Each rope has a 0.15 chance of breaking. If all the ropes break, the rock climber will fall, but if even one does not break, he'll be fine.

12. What is the probability that the rock climber does NOT fall? [5 pts]

Circle your answer:

a) $(0.15)^4$

b) $1 - (0.15)^4$

c) $(0.85)^4$

d) $1 - (0.85)^4$

e) None of the answers is correct.

Questions 13-14.

The cumulative distribution function is shown below for the random variable X.

$$F(x) = \begin{cases} 0 & x < 0 \\ 0.20 & 0 \leq x < 0.75 \\ 0.60 & 0.75 \leq x < 1 \\ 0.80 & 1 \leq x < 2 \\ 1 & x \geq 2 \end{cases}$$

13. What is the $P(X = 0)$? [X pts]

14. What is the $P(X \leq 1.5)$? [X pts]

Questions 15.

Let X be a hypergeometric random variable. X represents the number of defective items chosen from a pool of N=20 items, which has K=3 defects, and we are sampling $n = 5$ items.

15. What are the possible values for X? (i.e. which x-values have positive mass) [5 pts]
Circle your answer:

a) 0, 1, 2, ..., 20

b) 1, 2, ..., 20

c) 1, 2, 3

d) 0, 1, 2, 3

e) 0, 1, 2, 3, 4, 5

f) None of the answers is correct.

Questions 16-18.

The population of a small island consists of two ethnic groups. Each individual belongs to one of the four major blood groups. The 545 individuals are shown below in their respective 'ethnic group/blood type' category.

		Blood Group			
		O	A	B	AB
ETHNIC GROUP	1	103	97	13	7
	2	120	165	31	9

16. If a person is chosen at random from the island, what is the probability that they have blood type B? [5 pts]

17. If a person is chosen at random from the island, what is the probability that they have blood type A and are from ethnic group 2? [5 pts]

18. Given that a person has blood type A, what is the probability that they are from ethnic group 1? [5 pts]

Questions 19-20.

John is playing a dice game in which he will roll two dice. If one of the dice is a 5 or 6, John wins.

19. What is the probability that John wins a game? [5 pts]

20. If John plays the game 5 times, what is the probability that he wins exactly 3 times?
[5 pts]