21W-STATS100A-1 Midterm 1- Must submit before 7 PM on 1/31/2021

NICHOLAS DEAN

TOTAL POINTS

39.95 / 42

QUESTION 1

1 Front page with (ONLY) what is inside the box on page 1 of exam 3 / 3

✓ **- 0 pts** Correct

- 2 pts Hand-written signature required

- 1 pts Page where the signature can be found not indicated when exam submitted.

- 2 pts Statement incomplete. Had to submit the whole statement as given in front page of exam

QUESTION 2

2 Multiple choice questions 1-5 4 / 5

- 0 pts Correct

✓ **- 1 pts** MC1

- 1 pts MC2

- 1 pts MC3

- 1 pts MC4

- 1 pts MC5

- 1 pts Something other than answers to MC questions is on the page

- 1 pts Page not found when grading. Have to open whole exam to find answers. You had to indicate page where answers found

QUESTION 3

3 Multiple choice questions 6,7,8,10 (9 not graded) 4 / 4

✓ **- 0 pts** Correct

- 1 pts MC6

- 1 pts MC7

- 1 pts MC8

- 1 pts MC10

QUESTION 4

4 Multiple choice questions 11-15 5 / 5

✓ **- 0 pts** Correct

- 1 pts Q11

- 1 pts Q12

- 1 pts Q13

- 1 pts Q14

- 1 pts Q15

QUESTION 5

5 Multiple choice questions 16-20 5 / 5

✓ **- 0 pts** Correct

- 1 pts Q16

- 1 pts Q17

- 1 pts Q18

- 1 pts Q19

- 1 pts Q20

QUESTION 6

6 Work question 21 1.2 / 2

- 0 pts Correct

- 0.2 pts No, it is NOT a probability mass function

✓ **- 0.2 pts** $$0 \le P(Y = y)$$ is satisfied (or $$0 \le P(Y = y) \le 1$$ is not satisfied)

✓ **- 0.3 pts** Explain that $$0 \le P(Y = y)$$ is satisfied **because $$\theta>0$$** (or $$0 \le P(Y = y) \le 1$$ is not satisfied **for $$0<\theta<1$$**)

- 0.5 pts $$P(S) =1$$ is not satisfied

- 0.5 pts Correct work to show $$P(S)\ne 1$$

✓ **- 0.3 pts** Mention 3rd axiom (additivity) and show some work

QUESTION 7

7 Work question 22(a) 1 / 1

✓ **- 0 pts** Correct

- **0.2 pts** Label what you're calculating: P(error)
- **0.3 pts** Show some work
- **0.3 pts** Show correct work: $$P(B^c | A)P(A) + P(B | A^c)P(A^c) = 0.1(0.7) + 0.3(1 - 0.7)$$ or something similar
- **0.2 pts** Show correct answer: 0.16

QUESTION 8

8 Work question 22(b) 1 / 1

✓ **- 0 pts** Correct

- **0.2 pts** Label what you're calculating: $$P(A^c |B^c)$$
- **0.3 pts** Show some work
- **0.3 pts** Show correct work
- **0.2 pts** Correct answer is 0.75

QUESTION 9

9 Question 23 2 / 2

✓ **- 0 pts** Correct

- **0.2 pts** The sets do NOT form a partition.
- **0.2 pts** A = {EEU, EUE, UEE}
- **0.2 pts** B = {UUE, UEU, EUU, UUU}
- **0.2 pts** C = {EEE}
- **0.2 pts** D = {EEE, EEU, EUE, UEE}
- **0.3 pts** Discuss union condition
- **0.2 pts** Union condition is satisfied
- **0.3 pts** Discuss disjoint condition
- **0.2 pts** Disjoint condition not satisfied

QUESTION 10

10 Question 24(a) 1 / 1

✓ **- 0 pts** Correct

- **0.2 pts** M=15
- **0.2 pts** Label what we're calculating: P(A)
- **0.4 pts** Show work
- **0.2 pts** Answer is 0.095

QUESTION 11

11 Question 24(b) 1 / 1

✓ **- 0 pts** Correct

- **0.2 pts** Label what we're calculating: P(A)
- **0.6 pts** show work
- **0.2 pts** Answer is 0.11111

QUESTION 12

12 Question 24(c) 1 / 1

✓ **- 0 pts** Correct

- **1 pts** The product rule for independent events was used when we drew with replacement, part (b)

QUESTION 13

13 Question 25(a) 1 / 1

✓ **- 0 pts** Correct

- **1 pts** The sample space must be listed completely: S = {00; 01; 02; 10; 11; 12; 20; 21; 22}

QUESTION 14

14 Question 25(b) 2 / 2

✓ **- 0 pts** Correct

- **0.2 pts** Label event: A
- **0.8 pts** List event: A = {00; 01; 02}
- **0.2 pts** Label probability we're calculating: P(A)
- **0.6 pts** show work
- **0.2 pts** answer is 0.8

QUESTION 15

15 Questio 25(c) 3 / 3

✓ **- 0 pts** Correct

- **0.5 pts** Show $$y$$ column
- **0.5 pts** Show $$P(Y=y)$$ column
- **1 pts** List events
- **1 pts** Calculation of probabilities

QUESTION 16

16 Question 25(d) 2 / 2

✓ **- 0 pts** Correct

- **0.2 pts** Label expected value
- **0.6 pts** Show work for expected value
- **0.2 pts** Expected value is 0.5
- **0.2 pts** Label standard deviation
- **0.6 pts** Show work for standard deviation
- **0.2 pts** standard deviation is 0.73

QUESTION 17

17 Question 25(e) **1 / 1**

✓ **- 0 pts** Correct

- 0.2 pts NO

- 0.8 pts Justify your answer

QUESTION 18

18 Question 25(f) **1 / 1**

✓ **- 0 pts** Correct

- 0.2 pts show $$y$$ column

- 0.2 pts label each probability correctly: $$F(y)$$ or $$P(Y\le y)$$

- 0.6 pts show calculation

QUESTION 19

19 Question 25(g) **0.75 / 1**

- 0 pts Correct

- 0.5 pts Show PMF table

- 0.25 pts Show expected value: 7.5

✓ **- 0.25 pts show standard deviation: 11.01**

EVERYTHING IN THIS BOX MUST APPEAR ON A FRONT, PAGE 1, OF YOUR SUBMITTED EXAM. YOU MAY WRITE EVERYTHING BY HAND ON PAGE 1 OF YOUR EXAM. ONLY WHAT IS IN THIS BOX MUST BE ON YOUR PAGE 1 OF YOUR EXAM.

LAST NAME: -Dean-------- **FIRST NAME:** Nicholas----- **ID:** -705312823

Write a statement like this below and add your full signature (in English) below it. The statement must be exactly like this, with your name on it and signature. Do not cut the phrases or simplify.

I, --(your name here)- Nicholas Dean ---------sign to confirm that this exam reflects my work and only my work, that I have not consulted with anyone or anything except the class material posted in CCLE, the textbook, and Cognella active learning and that I have taken the time specified in the instructions or very close to that time to complete the exam from the moment that I first looked at it until it was in Gradescope. I also confirm that I have adhered to Section 102.01 or 102.02 of the UCLA Student Conduct Code and that I have and will not share this exam with anything or anyone.

YOUR SIGNATURE (in English):-- Nicholas Dean ----

INSTRUCTIONS

(points deducted for not following these instructions and those posted in the midterm folder)

(1) The exam must be submitted to Gradescope link for the exam **before 7 PM on 1/31/2021 Los Angeles Time.**
(2) **This is a three hour exam from the moment you click on the pdf file or the gradescope submission link for the first time, until it is showing submitted in gradescope. The time at which you access it will be logged in by CCLE. If you click, you must start and do the exam right away. "Accidental clicks" are clicks, and the clock starts for you with that click, if that happens to you.** The three hours includes the time it takes you to scan and submit the exam. You can choose any three hours between 5:30 PM on 1/29 and 7 PM on 1/31 to do your exam, but you must submit before the deadline. No excuses will be accepted because you wait until the last minute to look at, download and (or) submit your exam. Start early to prevent problems.
(3) You must work on your own. No group work allowed, no consulting with anyone or anything allowed. No sharing of information allowed. You may use all the material in our CCLE course web site and the required textbook, including Cognella active learning materials that come with the textbook.
(4) Do not contact the TA or anybody else regarding class material or anything regarding the exam and the course during the time window allowed for the exam. You may contact only me, Dr. Sanchez, within non-sleep time, but first check the Q& A file and the instructions given on these pages. If the answer to what you asked is there you will not receive an answer from Dr. Sanchez by email.
(5) There is a file called Q&A, where I will be posting anything worthwhile that may benefit the whole class, such as a typo found. You will look at that file before you email me (Dr. Sanchez). Read the instructions of the exam well to avoid wasting time asking questions that are answered in the instructions.
(6) The exam has two parts.

- Part I (20 points, 1 point for each question) is 20 multiple choice questions (pages 3-11). *Answer on the table given on page 3 or a table exactly like that written by hand. Required.* You must write the letter of the chosen answer or answers (A, B, C,...etc). Read MC instructions on page 3 to avoid losing points for just not reading the instructions.
- Part II (20 points) problems where you must show work. Work is 80% or more of your grade, as in homework. Make sure you read the instructions carefully.

1 Front page with (ONLY) what is inside the box on page 1 of exam **3 / 3**

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J. Sanchez
UCLA Department of Statistics

Part I. MULTIPLE CHOICE ANSWERS. WRITE YOUR ANSWER FOR QUESTIONS 1-20 ON A TABLE EXACTLY LIKE THE ONE GIVEN BELOW, WITH 4 COLUMNS AND 5 QUESTIONS PER COLUMN. YOU MAY WRITE A TABLE LIKE THIS BY HAND ON YOUR PAPER OR SUBMIT THIS PAGE. SHOWING WORK IS NOT REQUIRED FOR THE MULTIPLE CHOICE QUESTIONS.

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Q 3	c	Q 8	b	Q 13	c	Q 18	c
Q 4	c	Q 9	e	Q 14	c	Q 19	c
Q 5	b	Q 10	b	Q 15	b	Q 20	b

Table 1: There is a box for each question. Write your answer for each question inside the box where the question number is. The table you submit must be exactly like this, with 4 columns and 5 questions per column. Other formats will be deducted points. Only the table must be on this page.

PART I. Multiple choice questions. *Showing work is not required in the multiple choice questions. Write all your answers to the multiple choice questions in a table identical (4 columns) to the one on page 3.* **There is only one answer to each question.**

Question 1. What is the probability that if I roll a fair 12-sided die three times, the 3-tuple will contain the numbers 3, 6, 9.

$_{12}P_3 = 1320$

(a) 0.25

(b) 0.004545

$\frac{6}{1320} =$

(c) 0.003472222

(d) 0.08333

Question 2. If we roll two fair 4-sided die, and I have to bet on a sum of 4 or 5, which of the following is true?

4 | 5
22 | 32
31 | 23
13 | 41
 | 14

(a) 4 has higher chance of happening than 5.

(b) 5 has higher chance of happening than 4.

(c) 4 and 5 have equal chance of happening.

(d) None of the above.

Question 3. Consider a randomly chosen fringehead defending its cave. The probability that the fringehead succeeds in deterring a persistent intruder is 1/2. Consider two attempts to defend the cave. Which of the following is true if we assume independence?

LL WL LW WW

(a) The probability of 1 success in two attempts is 1/3

(b) The probability of 1 success in two attempts is 1/4

(c) The probability of 1 success in two attempts is 1/2

(d) None of the above

Question 4. A student has just transfered to a public university and requires the choice of both an applied course and a theoretical course. There are three departments on campus that the student likes, each offering 6 theoretical courses that the student could take and 3 applied courses that the student could take. The student has been told in orientation that it must select both the theoretical and the applied course from the same department. In how many ways can this be done?

$6 \times 3 = 18$

$18 \times 3 = 54$

(a) 20

(b) 24

(c) 54

(d) 121

(e) None of the above.

Question 5. Consider the roll of two fair six sided dice. Event A can be described as the event "the first roll is the number 3 or the number 5." Event B is the event "the sum of the two rolls is less than or equal to 7." Event C consists of the event "the largest of the two numbers obtained in the two rolls is 5." The probability of the event $\{A \cap B \cap C^c\} \cup (A \cap C \cap B^c)$ is

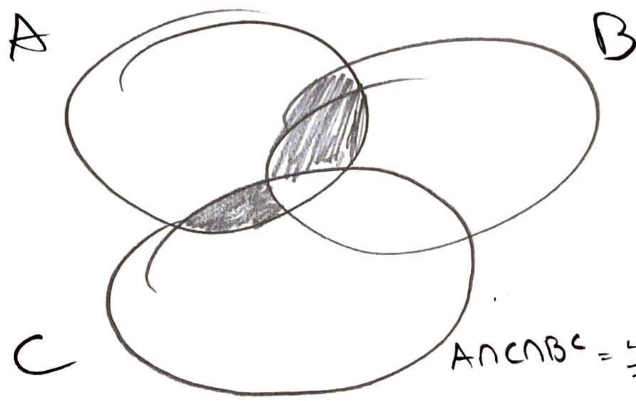
(a) 0.194444

(b) 0.2222222

(c) 0.25

(d) 0.3129

(e) None of the above



$A \cap B \cap C^c = \frac{4}{36}$ = 31 32 33 34

~~31~~ ~~61~~
~~32~~ ~~62~~
~~33~~ 63
~~34~~ 64
35 65
~~36~~ ~~66~~

$A \cap C \cap B^c = \frac{4}{36}$

Question 6. About 52% of the households of a country live in urban areas. The upper middle class accounts for just 14% of urban households, while the middle middle class accounts for almost 50%. About 56% of the urban upper middle class households buys electronics and household appliances, as compared to 36% of the middle middle class. Suppose there are 100000 households in this population. How many of the urban upper middle class households buy electronics and household appliances?

(a) Approximately 4077

(b) Approximately 3203

(c) Approximately 9360

(d) Approximately 1311

(e) None of the above

Question 7. Consider the network of highways shown below. Each line represents a highway and the lowercase letters represent locations. We are interested in going from location w to y. Highway A has probability 0.9 of being open to cars, highway B has probability 0.8 of being open, highway C has 0.9 probability of being open, highway D has 0.7 probability of being open and finally highway E has 0.9 probability of being open. Assuming that the highways have those probabilities of being open and that these events are independent, what is the probability that we will be able to go from location w to y?

2 Multiple choice questions 1-5 **4 / 5**

- **- 0 pts** Correct
- ✓ **- 1 pts** **MC1**
- **- 1 pts** MC2
- **- 1 pts** MC3
- **- 1 pts** MC4
- **- 1 pts** MC5
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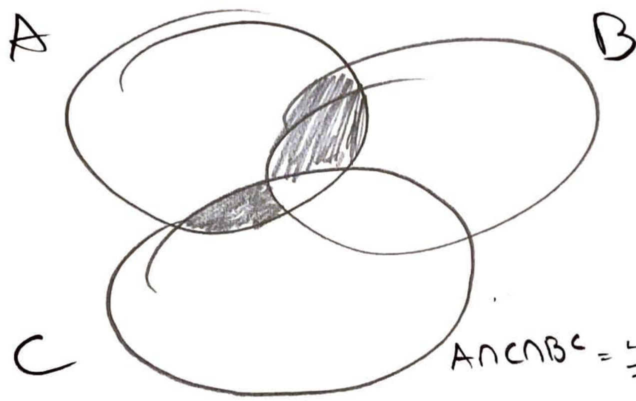

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~~31~~ ~~51~~
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35 55
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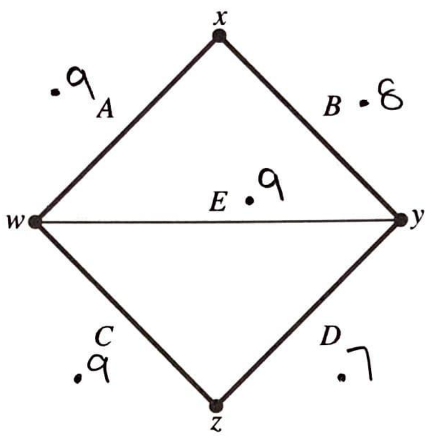


(a) 0.23146

(b) 0.0225

(c) 0.98964

(d) 0.5414

(e) None of the above

.72 .28
.9 .1
.63 .37

.98964

Question 8. Daily sales records for a car dealership show that it will sell 0, 1, 2, or 3 cars, with probabilities as listed

x= Number of sales	0	1	2	3
P(X=x)	0.5	0.3	0.15	0.05

How many cars does this dealership expect to sell tomorrow?

(a) 1.5

(b) 0.75

(c) 2

(d) 3

(e) None of the above

Question 9. The workers' union must select among two candidates A, B for the position of chief negotiator in the bargaining team. The voters are union members from three school systems : USC, UCLA and CS. The winner of this election must have won the majority of votes in 2 of the three school systems. Candidate A is equally likely to win in either district, but candidate B has probability 0.8 of winning in USC, probability 0.2 of winning in UCLA and probability 0.7 of winning in CS. Let W denote the event that A wins the election and let T be the event that both USC and UCLA vote for the same candidate. Calculate $P(W \cup T)$. You may assume that the school systems are independent.

W=

(a) 0.349037

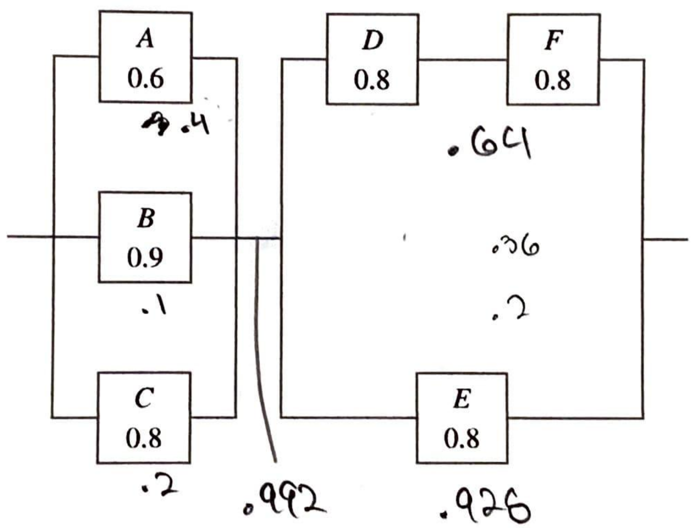
(b) 0.2801481

(c) 0.2259259

(d) 0.3912592

(e) None of the above

Question 10. Consider the circuit shown below showing the components and the probability that each of the components work. The components function independently. Calculate the reliability of the system.



(a) 0.27648

(b) 0.920576

(c) 0.875312

(d) 0.9921

(e) None of the above

Question 11. A robot is placed in front of a tourist store located in downtown S. Francisco, U.S., to welcome customers. The robot has been trained to give three different types of greetings. The training took place by telling the robot to associate conversations with the potential language of the visitors using supervised machine learning. The robot was trained to say:

- "Bienvenidos" for Spanish speaking people
- "Genki des ka?" for Japanese speaking people
- "Welcome" for English speaking people.

3 Multiple choice questions 6,7,8,10 (9 not graded) **4 / 4**

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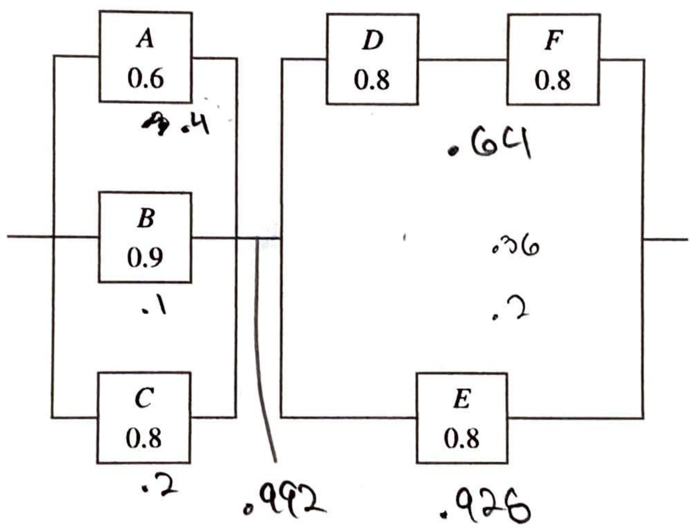

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- "Bienvenidos" for Spanish speaking people
- "Genki des ka?" for Japanese speaking people
- "Welcome" for English speaking people.

A random visitor to this store has probability 0.3 of being a Spanish speaking person, 0.5 of being an English speaking person and 0.2 of being a Japanese speaking person. In the training done, it was found that when the visitors are Spanish speaking the robot gives the correct greeting 70% of the time. When the visitors are English, the robot gives the correct greeting 85% of the time. And when the visitors are Japanese, the robot gives the correct greeting 60% of the time. The robot has all this information in its memory chip.

The robot is also trained to ask, after greeting the person: "Did I greet you properly"? If the person answers "yes", then the robot decides that it gave the right greeting, and uses the rules of probability to decide what language the person speaks and completes the sentence: " Wonderful. I love your.... " where the dots indicate the language (Spanish, Japanese, or English). Otherwise, the robot will not say anything else and just operates internally to update its algorithms in order to do better next time.

If a random person arrives, the robot greets the person, and the visitor tells the robot "Yes" (that it greeted properly), how will the robot complete the sentence? Use the rules of probability to make a decision, given the information available. Assume that the robot will conclude the sentence by choosing the language that is most probable given that it was told that it was right.

Spanish   English   Japanese
.21   .425   .12

(a) "Wonderful. I love your Spanish."

(b) "Wonderful. I love your Japanese."

(c) "Wonderful. I love your English."

(d) "Wonderful. I am indecisive, I can not tell which language you speak."

Question 12. In a survey of transgender individuals who were asked to name their favorite color, 18% said blue, 15% said red, 15% said yellow, 13% said black, and the rest named another color. If you pick a survey participant at random, what is the probability that this person named another color?

(a) 0.39

(b) 0.27

(c) 0.73

(d) 0.24

(e) None of the above

Question 13. Consider the experiment of screening people from a given population entering a mobile blood clinic until the first O blood person is found. Assume that the probability that a randomly chosen person in this population is O blood type is 0.4. People chosen at random means without replacement but the population is so large that you can assume independence as if it was with replacement. What is the probability that the first person with type O blood is the 5th person screened?

(a) 0.01024

$.6^4 \times .4$

(b) 0.4

(c) 0.05184

(d) None of the above

Question 14. In a certain population, 5% have a disease. A diagnostic test for the disease returns a positive result 90% of the time when it is used on a person who actually does have the disease. (The other 10% of the time the test fails to detect the disease. (The other 10% of the time the test fails to detect the disease.) However, when the test is used on a person who actually does not have the disease, the test returns a positive result 8% of the time.

What is the probability that a randomly chosen person actually has the disease and will test positive?

Calculate the variance of the outcome of the diagnostic test for those with the disease.

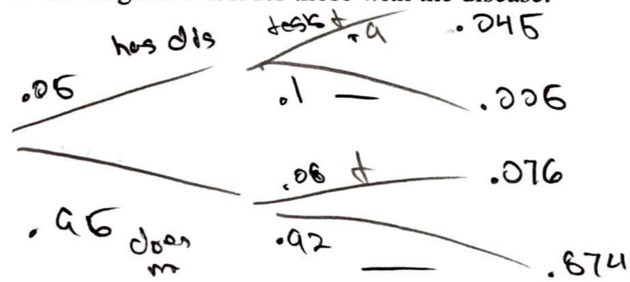
(a) 0.204

(b) 0.13

(c) 0.045

(d) 0.46

(e) None of the above



Question 15. You are asked to identify the source of a defective part. You know that the part came from one of three factories. Factory A produces 40% of the parts, factory B 40% and factory C 20% of the parts. It is known that 25% of the parts produced by factory A are defective, 35% of the parts produced by factory B are defective, and 25% of the parts produced by factory C are defective. Where did the defective part come from? Note: when making decisions under uncertainty, you let probability dictate your decision by choosing what is most probable given the available information.

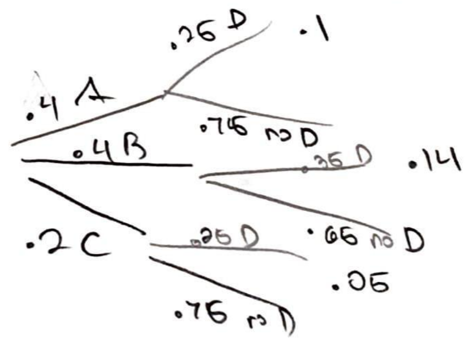
(a) It came from factory A

(b) It came from factory B

(c) It came from factory C

(d) It could have come from either factory

(e) None of the above.



Question 16. Proposition 134 is on the ballot for the next election. In a small town of 50 people, all eligible voters, 30 favor the proposition and 20 do not. A committee of 4 people is selected from this town. What is the probability that there will be at least one person in favor?

(a) 0.02103778

(b) 0.9789622

(c) 0.148502

(d) 0.843129

(e) None of the above.

1 − P(no in fava)

$$\frac{20}{50} \times \frac{19}{49} \times \frac{18}{46} \times \frac{17}{47}$$

4 Multiple choice questions 11-15 **5 / 5**

✓ **- 0 pts** **Correct**

- 1 pts Q11

- 1 pts Q12

- 1 pts Q13

- 1 pts Q14

- 1 pts Q15

J. Sanchez
UCLA Department of Statistics

Part I. MULTIPLE CHOICE ANSWERS. WRITE YOUR ANSWER FOR QUESTIONS 1-20 ON A TABLE EXACTLY LIKE THE ONE GIVEN BELOW, WITH 4 COLUMNS AND 5 QUESTIONS PER COLUMN. YOU MAY WRITE A TABLE LIKE THIS BY HAND ON YOUR PAPER OR SUBMIT THIS PAGE. SHOWING WORK IS NOT REQUIRED FOR THE MULTIPLE CHOICE QUESTIONS.

ONLY THIS TABLE MUST BE ON PAGE 2 OF YOUR EXAM

Question(Q)	Answer	Q	Answer	Q	Answer	Q	Answer
Q 1	b	Q 6	a	Q 11	c	Q 16	b
Q 2	b	Q 7	c	Q 12	a	Q 17	b
Q 3	c	Q 8	b	Q 13	c	Q 18	c
Q 4	c	Q 9	e	Q 14	c	Q 19	c
Q 5	b	Q 10	b	Q 15	b	Q 20	b

Table 1: There is a box for each question. Write your answer for each question inside the box where the question number is. The table you submit must be exactly like this, with 4 columns and 5 questions per column. Other formats will be deducted points. Only the table must be on this page.

(c) 0.05184

(d) None of the above

Question 14. In a certain population, 5% have a disease. A diagnostic test for the disease returns a positive result 90% of the time when it is used on a person who actually does have the disease. (The other 10% of the time the test fails to detect the disease. (The other 10% of the time the test fails to detect the disease.) However, when the test is used on a person who actually does not have the disease, the test returns a positive result 8% of the time.

What is the probability that a randomly chosen person actually has the disease and will test positive?

Calculate the variance of the outcome of the diagnostic test for those with the disease.

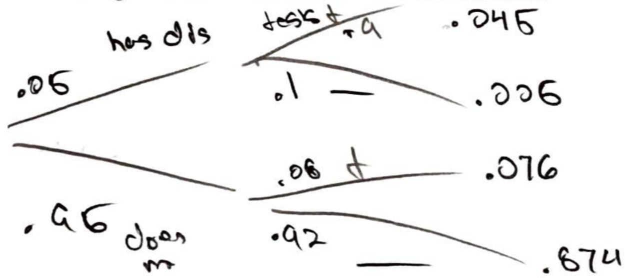
(a) 0.204

(b) 0.13

(c) 0.045

(d) 0.46

(e) None of the above



Question 15. You are asked to identify the source of a defective part. You know that the part came from one of three factories. Factory A produces 40% of the parts, factory B 40% and factory C 20% of the parts. It is known that 25% of the parts produced by factory A are defective, 35% of the parts produced by factory B are defective, and 25% of the parts produced by factory C are defective. Where did the defective part come from? Note: when making decisions under uncertainty, you let probability dictate your decision by choosing what is most probable given the available information.

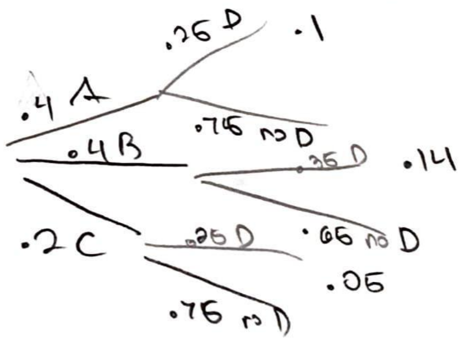
(a) It came from factory A

(b) It came from factory B

(c) It came from factory C

(d) It could have come from either factory

(e) None of the above.



Question 16. Proposition 134 is on the ballot for the next election. In a small town of 50 people, all eligible voters, 30 favor the proposition and 20 do not. A committee of 4 people is selected from this town. What is the probability that there will be at least one person in favor?

(a) 0.02103778

(b) 0.9789622

(c) 0.148502

(d) 0.843129

(e) None of the above.

1 - P(no in favor)

$$\frac{20}{50} \times \frac{19}{49} \times \frac{18}{46} \times \frac{17}{47}$$

Question 17. A student of introductory probability was given Table **??** of joint and total probabilities referring to events in a sample space.

	A	A^c	Total probability
B	.15		0.3
B^c			0.7
Total probability	0.6	0.4	1

Table 2: Table missing the joint probabilities

The table is missing a lot of the information. But it is known that $P(A \mid B) = 0.5$. What would you put in the cell corresponding to A and B?

(a) 0.5

(b) 0.15

(c) 0.3

(d) 0.4

(e) None of the above

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A|B) \times P(B) = P(A \cap B)$$

Question 18. Enquiries to an online computer system arrive on five communication lines. The percentage of messages received through each line are given in Table **??**.

Line	1	2	3	4	5
% received	20	30	10	15	25

Table 3: Percentage of messages received through each line

From past experience, it is known that the percentage of messages exceeding 100 characters on the different lines are as given in Table **??**.

Line	1	2	3	4	5
% exceeding 100 characters	40	60	20	80	90

Table 4: Percentage of messages in each line exceeding 100 characters

A message has arrived and it exceeds 100 lines. What is the probability that it came from line 3?

(a) 0.98

(b) 0.02

(c) 0.032

(d) 0.6

(e) None of the above

P(exceeds 100 chars) = .06 + .18 + .02 + .12 + .225
= .626

J. Sanchez
UCLA Department of Statistics

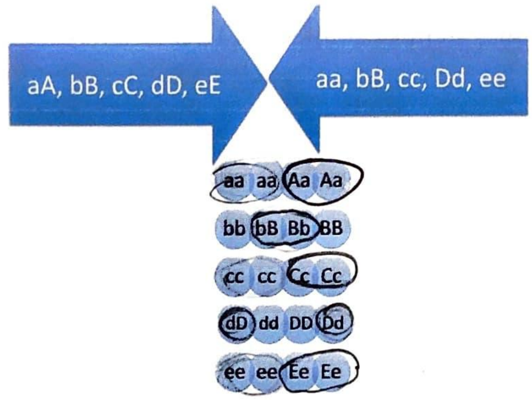


Figure 1: Mating between two organisms

Question 19. In a mating between the organism on the left and the one on the right in Figure ??, each of them contributes, at random, one of its gene pairs of each type. Independence is everywhere here. What is the probability that the progeny will have the same genetic composition as the parent on the right-hand-side or the parent on the left hand side?

(a) 0.0713

(b) 0.03125

(c) 0.06250

(d) 0.5130

(e) None of the above.

P(same as right) = ~~.0078125~~ .03125

P(same as left) =

Question 20. There are a large number of genetically based blood group systems that have been used for typing blood. Two of these are the Rh system (with blood types Rh+ and Rh-) and the Kell system (with blood types K+ and K-). It is found that any person's blood type in any one system is independent of the person's blood type in any other.

It is known that, for Europeans in New Zealand, about 81% are Rh+ and about 8% are K+. If a European New Zealander is chosen at random, what is the probability that this European is positive in both systems ?

(a) 0.1123

(b) 0.0648

(c) 0.2396

(d) 0.6714

(e) None of the above

GO TO NEXT PAGE FOR WORK QUESTIONS IN PART II

5 Multiple choice questions 16-20 **5 / 5**

- ✓ **- 0 pts** Correct
- **- 1 pts** Q16
- **- 1 pts** Q17
- **- 1 pts** Q18
- **- 1 pts** Q19
- **- 1 pts** Q20

J. Sanchez
UCLA Department of Statistics

PART II. SHOW WORK FOR THE FOLLOWING QUESTIONS

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Question 21. (2 points) A student of Probability proposed a discrete random variable Y which can take the possible values 1, 2, and 3. The student claims that the following function is a probability mass function for Y:

$$P(Y = y) = \frac{\theta^y}{\theta^2 + \theta^3 + \theta^4}, \qquad y = 1, 2, 3; \theta > 0$$

Is P(Y) a probability mass function? How many of Kolmogorov's axioms does it satisfy or does not satisfy?

P(Y) is not a probability mass function because the sum of the probabilities does not equal 1.

$P(Y=1) = \frac{\theta}{\theta^2+\theta^3+\theta^4}$ $\quad P(Y=2) = \frac{\theta^2}{\theta^2+\theta^3+\theta^4}$ $\quad P(Y=3) = \frac{\theta^3}{\theta^2+\theta^3+\theta^4}$

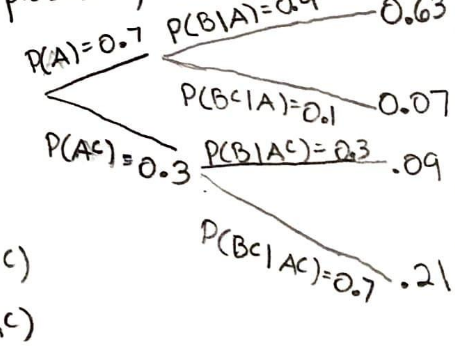
$P(Y=1) + P(Y=2) + P(Y=3) = \frac{\theta+\theta^2+\theta^3}{\theta^2+\theta^3+\theta^4}$ this does not equal 1!

this does not satisfy Axiom 1, (all outcomes of experiment add to 1), does not satisfy Axiom 2 if theta is small but it does satisfy Axiom 3.

Question 22. A noisy communication channel transmits a signal which consists of a binary code message; i.e., the signal is a sequence of 0's and 1's. Noise acts upon one transmitted symbol at a time. Let A be the event that a 1 is sent and B the event that a 1 is received at a certain time. The following is known:

$P(A) = 0.7, \quad P(B^c \mid A) = 0.1, \quad P(B \mid A^c) = 0.3$

probability tree:



(a) (1 point) Calculate the probability of error in this communication channel.

let's calculate $P(B^c \cap A)$

$P(B^c \mid A) = \frac{P(B^c \cap A)}{P(A)}$

$P(B^c \mid A) \cdot P(A) = P(B^c \cap A)$

$0.1 \times 0.7 = .07 = P(B^c \cap A)$

let's calculate $P(B \cap A^c)$

$P(B \mid A^c) = \frac{P(B \cap A^c)}{P(A^c)}$

$P(B \mid A^c) \cdot P(A^c) = P(B \cap A^c)$

$.3 \times .3 = .09 = P(B \cap A^c)$

these values represent the error but will also help us check work

$P(\text{"error"}) = P(B^c \cap A) + P(B \cap A^c)$

$P(\text{"error"}) = .07 + .09$

$\boxed{P(\text{"error"}) = 0.160}$

(b) (1 point) A 0 has arrived. Calculate the probability that a 0 was sent.

above wording implies what is the probability that a 0 was sent given a 0 has arrived, this can be represented as $P(A^c \mid B^c)$

refer to probability tree from part a) for calculations

$P(A^c \mid B^c) = \frac{P(A^c \cap B^c)}{P(B^c)} = \frac{0.21}{0.28} = \boxed{0.75}$

$P(B^c) = P(B^c \cap A) + P(B^c \cap A^c)$

$P(B^c) = P(B^c \mid A)P(A) + P(B^c \mid A^c)P(A^c) = .1 \times .7 + .7 \times .3 = 0.28$

6 Work question 21 **1.2 / 2**

- **- 0 pts** Correct
- **- 0.2 pts** No, it is NOT a probability mass function
- ✓ **- 0.2 pts** $$0 \le P(Y = y)$$ is satisfied (or $$0 \le P(Y = y) \le 1$$ is not satisfied)
- ✓ **- 0.3 pts** Explain that $$0 \le P(Y = y)$$ is satisfied **because $$\theta>0$$** (or $$0 \le P(Y = y) \le 1$$ is not satisfied **for $$0<\theta<1$$**)
- **- 0.5 pts** $$P(S) =1$$ is not satisfied
- **- 0.5 pts** Correct work to show $$P(S)\ne 1$$
- ✓ **- 0.3 pts** Mention 3rd axiom (additivity) and show some work

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P(Y) is not a probability mass function because the sum of the probabilities does not equal 1.

$P(Y=1) = \frac{\theta}{\theta^2+\theta^3+\theta^4}$ $P(Y=2) = \frac{\theta^2}{\theta^2+\theta^3+\theta^4}$ $P(Y=3) = \frac{\theta^3}{\theta^2+\theta^3+\theta^4}$

$P(Y=1) + P(Y=2) + P(Y=3) = \frac{\theta+\theta^2+\theta^3}{\theta^2+\theta^3+\theta^4}$ this does not equal 1!

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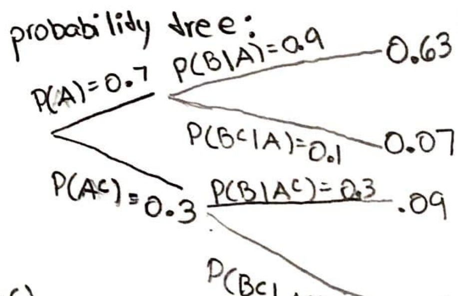

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let's calculate $P(B^c \cap A)$

$P(B^c \mid A) = \frac{P(B^c \cap A)}{P(A)}$

$P(B^c \mid A) \cdot P(A) = P(B^c \cap A)$

$0.1 \times 0.7 = .07 = P(B^c \cap A)$

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these values represent the error but will also help us check work

$P(\text{"error"}) = P(B^c \cap A) + P(B \cap A^c)$

$P(\text{"error"}) = .07 + .09$

$\boxed{P(\text{"error"}) = 0.160}$

(b) (1 point) A 0 has arrived. Calculate the probability that a 0 was sent.

above wording implies what is the probability that a 0 was sent given a 0 has arrived, this can be represented as $P(A^c \mid B^c)$

refer to probability tree from part a) for calculations $P(A^c \mid B^c) = \frac{P(A^c \cap B^c)}{P(B^c)}$

$= \frac{0.21}{0.28} = \boxed{0.75}$

$P(B^c) = P(B^c \cap A) + P(B^c \cap A^c)$

$P(B^c) = P(B^c \mid A)P(A) + P(B^c \mid A^c)P(A^c) = .1 \times .7 + .7 \times .3 = 0.28$

7 Work question 22(a) **1 / 1**

- ✓ **- 0 pts** **Correct**
- **- 0.2 pts** Label what you're calculating: P(error)
- **- 0.3 pts** Show some work
- **- 0.3 pts** Show correct work: $$P(B^c | A)P(A) + P(B | A^c)P(A^c) = 0.1(0.7) + 0.3(1 - 0.7)$$ or something similar
- **- 0.2 pts** Show correct answer: 0.16

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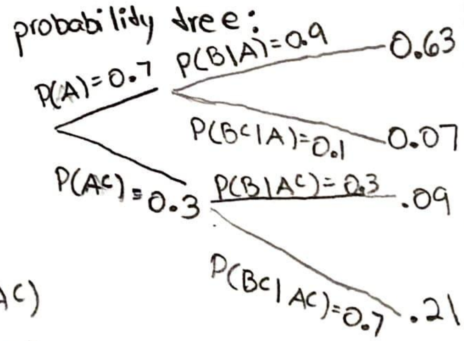

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8 Work question 22(b) **1 / 1**

✓ **- 0 pts** **Correct**

- 0.2 pts Label what you're calculating: $$P(A^c |B^c)$$

- 0.3 pts Show some work

- 0.3 pts Show correct work

- 0.2 pts Correct answer is 0.75

Question 23. (2 points) Let us consider the logical possibilities for the next three games in which England plays Russia in a FIFA World Cup. We can list the possibilities in terms of the winner of each game:

$$S = \{EEE, EEU, EUE, EUU, UEE, UEU, UUE, UUU\}$$

where E denotes England and U denotes Russia. The outcome or simple event EUU means that England wins the first game and Russia wins the next two games.

Consider the events:

A, which denotes the event that England wins two games
B, which denotes the event that Russia wins at least two games
C, which denotes the event that England wins three games
D, which denotes the event that Russia wins at most one game.

Do these events form a partition of S? Why? Why not? Note: work is incomplete if you do not check all conditions.

* this contradicts the definition of a partition, and this means the events A,B,C,D do not form a partition of S.

$A = \{EEU, EUE, UEE\}$

$B = \{EUU, UEU, UUE, UUU\}$

$C = \{EEE\}$

$D = \{EEU, EUE, UEE, EEE\}$

These events do not form a partition of S because a partition of S is a subdivision of the set into subsets that are disjoint and exhaustive, i.e. every element of S must belong to one and only one of the subsets. To check this, let's see if the union of the subsets is equal to S:

$A \cup B \cup C \cup D = \{EEE, EEU, EUE, EUU, UEE, UEU, UUE, UUU\} = S$

first condition is satisfied

Now, we check that every subset is disjoint from one another

$A \cap D = \{EEU, EUE, UEE\}$ because $A \cap D$ is not the empty set, * (above)

Question 24. There are two types of workers in an office: 10 administrative assistants and 5 fund managers. Two workers will be chosen randomly to represent the office on the board of directors and at the town's city hall, one worker to each place. Let A be the the event that two fund managers are chosen.

(a) (1 point) A random sample is a sample without replacement. So calculate the probability of A under this assumption. Indicate before you calculate the probability what the value of M (the population size) is in this problem.

M = total people in said office = 10 administrative assistants + 5 fund managers = 15

$$P(A) = \frac{\text{\# of fund managers}}{M} \times \frac{\text{\# of fund managers} - 1}{M-1} = \frac{5}{15} \times \frac{4}{14} = \boxed{0.09524 = P(A)}$$

(b) (1 point) Suppose now that we sample with replacement. Calculate the probability of A under this assumption.

$$P(A) = \frac{\text{\# of fund managers}}{M} \times \frac{\text{\# of fund managers}}{M} = \frac{5}{15} \times \frac{5}{15} = \boxed{0.1111 = P(A)}$$

9 Question 23 **2 / 2**

- ✓ **- 0 pts** Correct
- **- 0.2 pts** The sets do NOT form a partition.
- **- 0.2 pts** A = {EEU, EUE, UEE}
- **- 0.2 pts** B = {UUE, UEU, EUU, UUU}
- **- 0.2 pts** C = {EEE}
- **- 0.2 pts** D = {EEE, EEU, EUE, UEE}
- **- 0.3 pts** Discuss union condition
- **- 0.2 pts** Union condition is satisfied
- **- 0.3 pts** Discuss disjoint condition
- **- 0.2 pts** Disjoint condition not satisfied

Question 23. (2 points) Let us consider the logical possibilities for the next three games in which England plays Russia in a FIFA World Cup. We can list the possibilities in terms of the winner of each game:

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* this contradicts the definition of a partition, and this means the events A,B,C,D do not form a partition of S.

$A = \{EEU, EUE, UEE\}$

$B = \{EUU, UEU, UUE, UUU\}$

$C = \{EEE\}$

$D = \{EEU, EUE, UEE, EEE\}$

These events do not form a partition of S because a partition of S is a subdivision of the set into subsets that are disjoint and exhaustive, i.e. every element of S must belong to one and only one of the subsets. To check this, let's see if the union of the subsets is equal to S:

$A \cup B \cup C \cup D = \{EEE, EEU, EUE, EUU, UEE, UEU, UUE, UUU\} = S$

first condition is satisfied

Now, we check that every subset is disjoint from one another

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Question 24. There are two types of workers in an office: 10 administrative assistants and 5 fund managers. Two workers will be chosen randomly to represent the office on the board of directors and at the town's city hall, one worker to each place. Let A be the the event that two fund managers are chosen.

(a) (1 point) A random sample is a sample without replacement. So calculate the probability of A under this assumption. Indicate before you calculate the probability what the value of M (the population size) is in this problem.

M = total people in said office = 10 administrative assistants + 5 fund managers = 15

$$P(A) = \frac{\#\text{ of fund managers}}{M} \times \frac{\#\text{ of fund managers} - 1}{M-1} = \frac{5}{15} \times \frac{4}{14} = \boxed{0.09524 = P(A)}$$

(b) (1 point) Suppose now that we sample with replacement. Calculate the probability of A under this assumption.

$$P(A) = \frac{\#\text{ of fund managers}}{M} \times \frac{\#\text{ of fund managers}}{M} = \frac{5}{15} \times \frac{5}{15} = \boxed{0.1111 = P(A)}$$

10 Question 24(a) **1 / 1**

- ✓ **- 0 pts** Correct
- **- 0.2 pts** M=15
- **- 0.2 pts** Label what we're calculating: P(A)
- **- 0.4 pts** Show work
- **- 0.2 pts** Answer is 0.095

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D, which denotes the event that Russia wins at most one game.

Do these events form a partition of S? Why? Why not? Note: work is incomplete if you do not check all conditions.

* this contradicts the definition of a partition, and this means the events A,B,C,D do not form a partition of S.

A = {EEU, EUE, UEE}

B = {EUU, UEU, UUE, UUU}

C = {EEE}

D = {EEU, EUE, UEE, EEE}

These events do not form a partition of S because a partition of S is a subdivision of the set into subsets that are disjoint and exhaustive, i.e. every element of S must belong to one and only one of the subsets. To check this, let's see if the union of the subsets is equal to S:

$A \cup B \cup C \cup D = \{EEE, EEU, EUE, EUU, UEE, UEU, UUE, UUU\} = S$

first condition is satisfied

Now, we check that every subset is disjoint from one another

$A \cap D = \{EEU, EUE, UEE\}$ because $A \cap D$ is not the empty set, * (above)

Question 24. There are two types of workers in an office: 10 administrative assistants and 5 fund managers. Two workers will be chosen randomly to represent the office on the board of directors and at the town's city hall, one worker to each place. Let A be the the event that two fund managers are chosen.

(a) (1 point) A random sample is a sample without replacement. So calculate the probability of A under this assumption. Indicate before you calculate the probability what the value of M (the population size) is in this problem.

M = total people in said office = 10 administrative assistants + 5 fund managers = 15

$$P(A) = \frac{\#\text{ of fund managers}}{M} \times \frac{\#\text{ of fund managers} - 1}{M-1} = \frac{5}{15} \times \frac{4}{14} = \boxed{0.09524 = P(A)}$$

(b) (1 point) Suppose now that we sample with replacement. Calculate the probability of A under this assumption.

$$P(A) = \frac{\#\text{ of fund managers}}{M} \times \frac{\#\text{ of fund managers}}{M} = \frac{5}{15} \times \frac{5}{15} = \boxed{0.1111 = P(A)}$$

11 Question 24(b) **1 / 1**

✓ **- 0 pts** **Correct**

- **0.2 pts** Label what we're calculating: P(A)
- **0.6 pts** show work
- **0.2 pts** Answer is 0.11111

(c) (1 point) In which of the two parts above (a) or (b) was the product rule for independent events used? What allowed us to use that rule?

The product rule for independent events was used in part b). The fact that we sampled with replacement in part b) allowed us to use that rule because if we sample with replacement, each "pick" in the sample is independent from one another as the population is exactly the same at the time each worker is chosen.

Question 25. A biologist specializing in pigeons, typically observes the number of wounded pigeons per day in the natural habitat studied according to the probability mass function in Table ?? :

x	0	1	2
P(X=x)	0.8	0.15	0.05

Table 5: Probability mass function for random variable X="number of wounded pigeons observed per day."

The biologist is interested in reporting in a publication the results of observing the number of wounded pigeons in each of two randomly chosen days. The biologist asks for your help, knowing that you have studied probability.

(a) (1 pt) List the sample space of this experiment.

Let the event C denote the "number of wounded pigeons on day 1"

Let the event D denote the "number of wounded pigeons on day 2"

note: day 1 and day 2 are not necessarily consecutive, they simply represent two different randomly chosen days

$S = \{00, 01, 02, 10, 11, 12, 20, 21, 22\}$

the outcome (0,1) denotes that 0 wounded pigeons were observed on one day and 1 wounded pigeon was observed on the other day.

(b) (2pt) Consider event A that 0 wounded pigeons are observed in the first day. List the outcomes in the event A and calculate the probability of the event A.

$A = \{00, 01, 02\}$

$P(A) = P(\{00, 01, 02\}) = P(\{00\}) + P(\{01\}) + P(\{02\})$

The above probability can be broken up into a sum because the outcomes are mutually exclusive, so the probability that at least one of them happens is the sum of their probabilities.

$P(\{00\}) + P(\{01\}) + P(\{02\})$

$= 0.8 \times 0.8 + 0.8 \times 0.15 + 0.8 \times 0.05$

$\boxed{P(A) = 0.8}$

12 Question 24(c) 1 / 1

✓ **- 0 pts** Correct

- 1 pts The product rule for independent events was used when we drew with replacement, part (b)

(c) (1 point) In which of the two parts above (a) or (b) was the product rule for independent events used? What allowed us to use that rule?

The product rule for independent events was used in part b). The fact that we sampled with replacement in part b) allowed us to use that rule because if we sample with replacement, each "pick" in the sample is independent from one another as the population is exactly the same at the time each worker is chosen.

Question 25. A biologist specializing in pigeons, typically observes the number of wounded pigeons per day in the natural habitat studied according to the probability mass function in Table **??** :

x	0	1	2
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The biologist is interested in reporting in a publication the results of observing the number of wounded pigeons in each of two randomly chosen days. The biologist asks for your help, knowing that you have studied probability.

(a) (1 pt) List the sample space of this experiment.

Let the event C denote the "number of wounded pigeons on day 1"
Let the event D denote the "number of wounded pigeons on day 2"
note: day 1 and day 2 are not necessarily consecutive, they simply represent two different randomly chosen days

$S = \{00, 01, 02, 10, 11, 12, 20, 21, 22\}$

the outcome (0,1) denotes that 0 wounded pigeons were observed on one day and 1 wounded pigeon was observed on the other day.

(b) (2pt) Consider event A that 0 wounded pigeons are observed in the first day. List the outcomes in the event A and calculate the probability of the event A.

$A = \{00, 01, 02\}$

$P(A) = P(\{00, 01, 02\}) = P(\{00\}) + P(\{01\}) + P(\{02\})$

The above probability can be broken up into a sum because the outcomes are mutually exclusive, so the probability that at least one of them happens is the sum of their probabilities.

$P(\{00\}) + P(\{01\}) + P(\{02\})$

$= 0.8 \times 0.8 + 0.8 \times 0.15 + 0.8 \times 0.05$

$\boxed{P(A) = 0.8}$

13 Question 25(a) **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts The sample space must be listed completely: S = {00; 01; 02; 10; 11; 12; 20; 21; 22}

(c) (1 point) In which of the two parts above (a) or (b) was the product rule for independent events used? What allowed us to use that rule?

The product rule for independent events was used in part b). The fact that we sampled with replacement in part b) allowed us to use that rule because if we sample with replacement, each "pick" in the sample is independent from one another as the population is exactly the same at the time each worker is chosen.

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Table 5: Probability mass function for random variable X="number of wounded pigeons observed per day."

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(a) (1 pt) List the sample space of this experiment.

Let the event C denote the "number of wounded pigeons on day 1"
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(b) (2pt) Consider event A that 0 wounded pigeons are observed in the first day. List the outcomes in the event A and calculate the probability of the event A.

$A = \{00, 01, 02\}$

$P(A) = P(\{00, 01, 02\}) = P(\{00\}) + P(\{01\}) + P(\{02\})$

The above probability can be broken up into a sum because the outcomes are mutually exclusive, so the probability that at least one of them happens is the sum of their probabilities.

$P(\{00\}) + P(\{01\}) + P(\{02\})$

$= 0.8 \times 0.8 + 0.8 \times 0.15 + 0.8 \times 0.05$

$\boxed{P(A) = 0.8}$

14 Question 25(b) **2 / 2**

- ✓ **- 0 pts** **Correct**
- **- 0.2 pts** Label event: A
- **- 0.8 pts** List event: A = {00; 01; 02}
- **- 0.2 pts** Label probability we're calculating: P(A)
- **- 0.6 pts** show work
- **- 0.2 pts** answer is 0.8

(c) (3 pts) Consider the random variable Y denoting total number of wounded pigeons observed in the two randomly chosen days. Construct the probability mass function table of Y. Your table should have a column for the unique values of the random variable, a column for the probability of those unique values and then next to each row indicate the event corresponding to that value of the random variable and how you calculated the probability for that row.

(d) (2pts) Calculate the expected value and standard deviation of Y, simplifying as much as possible.

c)

y	P(Y=y)	Events in S	P(event) = P(Y=y)
0	0.640	{00}	$(0.8)^2$
1	0.240	{01,10}	$2(.8)(.15)$
2	0.1025	{11,02,20}	$(.15)^2 + 2(.8)(.05)$
3	0.015	{12,21}	$2(.15)(.05)$
4	0.0025	{22,22}	$(.05)^2$

d) $\mu_Y = E(Y) = 0(0.640) + 1(0.240) + 2(0.1025) + 3(0.015) + 4(0.0025)$

$\boxed{\mu_Y = E(Y) = 0.5}$

$\sigma_Y^2 = Var(Y) = (0-.5)^2(.640) + (1-.5)^2(.240) + (2-.5)^2(.1025) + (3-.5)^2(.015) + (4-.5)^2(.0025) = 0.575$

$\sigma_Y = SD(Y) = \sqrt{Var(Y)} = \sqrt{.575} = \boxed{0.7583 = SD(Y)}$

(e) (1 pts) Could your probability mass function for Y be simplified with the binomial probability formula or the hypergeometric formula studied in Chapter 4?

The probability mass function for Y could not be simplified with the binomial probability formula because the binomial probability formula requires that an experiment have only two outcomes, success or failure, and in our case, we have more than two outcomes. The hypergeometric formula cannot be used either because it says there can only be two outcomes which we know is false and it also requires that the probability of success changes after each trial which is not the case in our experiment as our population is large.

(f) (1 point) Provide in a table the cumulative probability mass function for Y.

Y	P(Y ≤ y)	Events in S	P(event) = P(Y ≤ y)
0	0.640	{00}	$(0.8)^2$
1	0.88	{00,01,10}	$P(Y \le 0) + 2(.8)(.15)$
2	0.9625	{00,01,10,11,02,20}	$P(Y \le 1) + (.15)^2 + 2(.8)(.05)$
3	0.9975	{00,01,10,11,02,20,12,21}	$P(Y \le 2) + 2(.15)(.05)$
4	1.000	{00,01,10,11,02,20,12,21,22}	$P(Y \le 3) + (.05)^2$

15 Questio 25(c) **3 / 3**

✓ **- 0 pts** **Correct**

- 0.5 pts Show $$y$$ column

- 0.5 pts Show $$P(Y=y)$$ column

- 1 pts List events

- 1 pts Calculation of probabilities

(c) (3 pts) Consider the random variable Y denoting total number of wounded pigeons observed in the two randomly chosen days. Construct the probability mass function table of Y. Your table should have a column for the unique values of the random variable, a column for the probability of those unique values and then next to each row indicate the event corresponding to that value of the random variable and how you calculated the probability for that row.

(d) (2pts) Calculate the expected value and standard deviation of Y, simplifying as much as possible.

c)

y	P(Y=y)	Events in S	P(event) = P(Y=y)
0	0.640	{00}	$(0.8)^2$
1	0.240	{01,10}	$2(.8)(.15)$
2	0.1025	{11,02,20}	$(.15)^2 + 2(.8)(.05)$
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2	0.9625	{00,01,10,11,02,20}	$P(Y \le 1) + (.15)^2 + 2(.8)(.05)$
3	0.9975	{00,01,10,11,02,20,12,21}	$P(Y \le 2) + 2(.15)(.05)$
4	1.000	{00,01,10,11,02,20,12,21,22}	$P(Y \le 3) + (.05)^2$

16 Question 25(d) **2 / 2**

- ✓ **- 0 pts** **Correct**
- **- 0.2 pts** Label expected value
- **- 0.6 pts** Show work for expected value
- **- 0.2 pts** Expected value is 0.5
- **- 0.2 pts** Label standard deviation
- **- 0.6 pts** Show work for standard deviation
- **- 0.2 pts** standard deviation is 0.73

(c) (3 pts) Consider the random variable Y denoting total number of wounded pigeons observed in the two randomly chosen days. Construct the probability mass function table of Y. Your table should have a column for the unique values of the random variable, a column for the probability of those unique values and then next to each row indicate the event corresponding to that value of the random variable and how you calculated the probability for that row.

(d) (2pts) Calculate the expected value and standard deviation of Y, simplifying as much as possible.

c)

y	$P(Y=y)$	Events in S	$P(\text{event}) = P(Y=y)$
0	0.640	{00}	$(0.8)^2$
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4	0.0025	{22,22}	$(.05)^2$

d) $\mu_Y = E(Y) = 0(0.640) + 1(0.240) + 2(0.1025) + 3(0.015) + 4(0.0025)$

$\boxed{\mu_Y = E(Y) = 0.5}$

$\sigma_Y^2 = Var(Y) = (0-.5)^2(.640) + (1-.5)^2(.240) + (2-.5)^2(.1025) + (3-.5)^2(.015) + (4-.5)^2(.0025) = 0.575$

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3	0.9975	{00,01,10,11,02,20,12,21}	$P(Y \le 2) + 2(.15)(.05)$
4	1.000	{00,01,10,11,02,20,12,21,22}	$P(Y \le 3) + (.05)^2$

17 Question 25(e) **1 / 1**

- ✓ **- 0 pts** Correct
- **- 0.2 pts** NO
- **- 0.8 pts** Justify your answer

(c) (3 pts) Consider the random variable Y denoting total number of wounded pigeons observed in the two randomly chosen days. Construct the probability mass function table of Y. Your table should have a column for the unique values of the random variable, a column for the probability of those unique values and then next to each row indicate the event corresponding to that value of the random variable and how you calculated the probability for that row.

(d) (2pts) Calculate the expected value and standard deviation of Y, simplifying as much as possible.

c)

y	P(Y=y)	Events in S	P(event) = P(Y=y)
0	0.640	{00}	$(0.8)^2$
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d) $\mu_Y = E(Y) = 0(0.640) + 1(0.240) + 2(0.1025) + 3(0.015) + 4(0.0025)$

$\boxed{\mu_Y = E(Y) = 0.5}$

$\sigma_Y^2 = Var(Y) = (0-.5)^2(.640) + (1-.5)^2(.240) + (2-.5)^2(.1025) + (3-.5)^2(.015) + (4-.5)^2(.0025) = 0.575$

$\sigma_Y = SD(Y) = \sqrt{Var(Y)} = \sqrt{.575} = \boxed{0.7583 = SD(Y)}$

(e) (1 pts) Could your probability mass function for Y be simplified with the binomial probability formula or the hypergeometric formula studied in Chapter 4?

The probability mass function for Y could not be simplified with the binomial probability formula because the binomial probability formula requires that an experiment have only two outcomes, success or failure, and in our case, we have more than two outcomes. the hypergeometric formula cannot be used either because it says there can only be two outcomes which we know is false and it also requires that the probability of success changes after each trial which is not the case in our experiment as our population is large.

(f) (1 point) Provide in a table the cumulative probability mass function for Y.

Y	P(Y ≤ y)	Events in S	P(event) = P(Y ≤ y)
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1	0.88	{00,01,10}	$P(Y \le 0) + 2(.8)(.15)$
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4	1.000	{00,01,10,11,02,20,12,21,22}	$P(Y \le 3) + (.05)^2$

18 Question 25(f) **1 / 1**

- ✓ **- 0 pts** Correct
- **- 0.2 pts** show $$y$$ column
- **- 0.2 pts** label each probability correctly: $$F(y)$$ or $$P(Y\le y)$$
- **- 0.6 pts** show calculation

gradescope

(g) (1 point) The biologist is publishing the results in order to ask for funding for a program that will prevent injury in pigeons. Given uncertainty, the biologist's only way of saying how much money will be needed is to tell the funding agency how much money it is expected to be needed in two randomly chosen days. If the biologist calculates that prevention costs 15 dollars per pigeon, calculate the probability mass function of the cost in two randomly chosen days, the expected value of the cost and the standard deviation of the cost.

Let the random variable Z represent the

Let Z represent the prevention costs needed for the pigeons.

Z is a function of Y.

$\boxed{Z = 15Y}$

Y	0	1	2	3	4
Z	\$ 10	\$ 15	\$ 30	\$ 45	\$ 60
P(Y=y)	.640	.240	.1025	.015	.0025

$E(Z) = 15 \times E(Y)$

$E(Z) = 15 \times 0.5$

$\boxed{E(Z) = \$7.5}$

$Var(Z) = (10-7.5)^2(.640) + (15-7.5)^2(.240) + (30-7.5)^2(.1025) + (45-7.5)^2(.015) + (60-7.5)^2(.0025)$

$Var(Z) = \$97.375$

$SD(Z) = \sqrt{Var(Z)} = \sqrt{97.375}$ $\boxed{= \$9.868 = SD(Z)}$

19 Question 25(g) 0.75 / 1

- **- 0 pts** Correct
- **- 0.5 pts** Show PMF table
- **- 0.25 pts** Show expected value: 7.5
- ✓ **- 0.25 pts show standard deviation: 11.01**