Instructions

1. **All electronic devices are to be turned off and put away.**
2. **This is a closed-book quiz.**
3. **Answer the questions in the spaces provided.**
4. **Final answers to written questions should be rounded to THREE DECIMAL PLACES, or left in fraction form.**
5. **Only question pages will be marked.**
6. **You may tear off the last page and use it for rough work. All pages will be collected at the end of the quiz.**
7. **Only a non-programmable, non-graphical calculator with a pink-tie or blue-goggle sticker will be allowed. No other aids are allowed.**
8. **DO NOT WRITE ON THIS COVER PAGE.**

Marking Scheme:

Questions	**Out of**
1 – 9	9
10	11
11	6
Total	26

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Part 1: Multiple Choice – Each question is worth 1 mark

Please CLEARLY CIRCLE your answer selection on this page. Do NOT simply write your choice next to the question. If you do, the question will not be graded. Each question has one correct answer. Choose the best answer.

1. Even though Carrie is not a Toronto Raptor (NBA basketball team) fan, she does follow the team's progress. She has spoken with a few friends who believe that the Raptors will definitely win another championship within the next three years. Carrie does not agree with her friends, but does believe that there is a 50% chance that the Raptors will win another championship within the next three years. The type of probability being used here is:

A) Classical probability
B) Subjective probability
C) Relative frequency probability

- **This probability is based on nothing more than an opinion.**

2. To determine whether the waiting time to be served is less than 10 minutes at a local pub, the waiting times of 250 customers were observed over a 4-hour period. It was found that 129 customers out of the 250 experienced a wait of less than 10 minutes. The owners of the local pub declare that the probability of waiting less than 10 minutes is 129/250 = 0.516. Which definition of probability best describes the above scenario?

A) Classical probability
B) Subjective probability
C) Relative frequency probability

- **The statement is based on a long series of repetitions of an experiment or process -- in this case, the observation of waiting times for a large number of customers. For this reason, the relative frequency definition is the best choice to describe the situation.**

3. A fair die is to be tossed two times. "Fair" implies that each face is equally likely to turn up. What is the probability that the same face will not appear on the two rolls?

A) 3/4 B) 5/36 C) 1/6 **D) 5/6** E) None of these

- **There are a total of 36 outcomes / points in this experiment.**
- **In this case:**
- **S = {(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (3,1), (3,2), (3,3), (3,4), (3,5), (3,6), (4,1), (4,2), (4,3), (4,4), (4,5), (4,6), (5,1), (5,2), (5,3), (5,4), (5,5), (5,6), (6,1), (6,2), (6,3), (6,4), (6,5), (6,6)}.**
- **Let B = same face appears both times.**
- **The outcomes "the same face appears both times" corresponds to**
- **B = {(1,1), (2,2), (3,3), (4,4), (5,5), (6,6)}. There are 6 outcomes that are equally likely**
- **Thus, the probability that the same face will not appear both times is**
- **P(B) = 1 – 6/36 = 30/36 = 5/6.**

4. A student and a professor each choose a number between 1 and 10 (1 and 10 are each possible choices). What is the probability that the two chose different numbers?

A) 9/10 B) 1/10 C) 9/100 D) 1/5 E) 2/5

- **If we let one person select a number. It doesn't matter what actual number is selected. Since there are 10 numbers to choose from, the probability that the second person doesn't pick the same number as the first person is simply 9/10.**

<u>Use the following information to answer the next TWO questions</u>:

A fair coin is to be flipped three times, with the outcome recorded after each flip.

5. How many outcomes are in the sample space for this experiment?

A) 4 B) 6 **C) 8** D) 9

- **In this case, S = {(H,H,H), (H,H,T), (H,T,H), (T,H,H), (T,T,H), (T,H,T), (H,T,T), (T,T,T)}**
- **So, there are a total of 8 outcomes (or points) in the sample space.**

6. What is the probability that at least two heads are flipped?

A) 0.125 B) 0.25 **C) 0.5** D) 0.625 E) None of these

- **As noted above, there are 8 outcomes (or points) in the sample space.**
- **Let A = at least two heads are flipped.**
- **A = {(H,H,T), (H,T,H), (T,H,H), (H,H,H)}**
- **So, the probability that at least two heads are flipped is 4/8 = 1/2.**

7. A fair die is to be rolled two times. What is the probability that the product of the two numbers is even?

A) 3/4 B) 1/6 C) 1/4 D) 1/2

- **We are rolling a fair die two times and will consider the product of the two numbers rolled. In this case, there are a total of 36 outcomes in the sample space.**
- **S = {(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), ……, (6,1), (6,2), (6.3), (6,4), (6,5), (6,6)}.**
- **If we express S in terms of the product of the two numbers, we get:**
- **S = {1, 2, 3, 4, 5, 6, 2, 4, 6, 8, 10, 12, 3, 6, 9, 12, 15, 18, 4, 8, 12, 16, 20, 24, 5, 10, 15, 20, 25, 30, 6, 12, 18, 24, 30, 36}.**
- **Let A = product is even.**
- **So, in this case, P(product is even) = P(A) = 27/36 = 3/4.**
- **Also, we can produce an even product as long as both values are not odd. If we let E represent the event that number rolled is even, and O represent the event that the number rolled is odd, then the possibilities are:**
- **S = {(E, E), (E, O), (O, E), (O, O)}.**
- **So, P(product is even) = P((E,E)) + P((E,0)) + P((O,E)) = 3/4 (as all outcomes are equally likely).**

8. Suppose that a card is drawn at random from a standard deck of 52 cards. What is the probability that the card does not belong to the set {2, 3, 4, 5}?

A) 9/52 B) 4/13 C) 9/22 **D) 9/13**

- **In this case, it doesn't matter what set of 4 face values the set contains. There are 13 different face values in the deck. So the probability of not selecting one of the 4 values in the set is simply 1 - 4/13 = 9/13**

9. Suppose that you were invited to play the following matching game on a game show: You are shown three prizes and then given three price tags. The object of this game is to put the correct price tag on each prize. If you do so, you will win the prize. You could end up winning 0 prizes, 1 of the prizes, or all 3 prizes. (It is not possible to win two prizes, because if you match two price tags, then the third one will have to match). Unfortunately, you have no knowledge of the price of any of the prizes, so you simply place the tags on the prizes randomly. What is the chance that you will win at least one prize?

A) 1/3 **B) 2/3** C) 1/2 D) 5/6

- **We can set up a table of possibilities here. Let's assume that a perfect match will occur when Prize A has a correct price tag A, Prize B has a correct price tag B, and Prize C has a correct price tag C (or sequence A, B, C). We know that there are 3! = 6 possible arrangements**

Sequence	# of Matches
A, B, C	3
A, C, B	1
B, A, C	1
B, C, A	0
C, A, B	0
C, B, A	1

- **From the table, we can see that P(at least one prize) = P(one prize) + P(three prizes) = 3/6 + 1/6 = 4/6 = 2/3**
- **Note: P(two prizes) = 0, as if two prizes have the correct price tag, the third will automatically have the correct price tag.**
- **OR, P(at least one prize) = 1 – P(no prizes) = 1 – 2/6 = 4/6 = 2/3**

Part 2: Written Answer / Short Answer Questions

Final answers can be left in fraction form OR rounded to THREE DECIMAL PLACES.

For full credit, you need to show all necessary work. Unjustified answers will not receive full credit.

10. A graduating statistics major has signed up for three job interviews. She intends to classify each one as either a "success" (S), or a "failure" (F) depending on whether it leads to a second interview.

a. Based on the above information, using S or F where appropriate, write out the sample space and determine how many outcomes are in the sample space. ***(3 marks)***

- **From the given information, we can write out the sample space as follows:**
- **S = {(S, S, S), (S, S, F), (S, F, S), (F, S, S), (F, F, S), (F, S, F), (S, F, F), (F, F, F)}.**
- **There are a total of 8 outcomes in the sample space.**

b. If we let event A = the first success occurs on the second interview, list the outcomes for the event A. ***(2 marks)***

- **Recall: S = {(S, S, S), (S, S, F), (S, F, S), (F, S, S), (F, F, S), (F, S, F), (S, F, F), (F, F, F)}.**
- **The outcomes corresponding to A = first success occurs on the second interview are A = {(F, S, F), (F, S, S)}.**

c. If we assume that all outcomes in the sample space are equally likely, what is P(A)?

(2 marks)

- **We know that there are 8 outcomes in the sample space.**
- **From part b., the outcomes corresponding to A = first success occurs on the second interview are A = {(F, S, F), (F, S, S)}.**
- **If all outcomes in S are equally likely, then P(A) = 2/8 = 1/4**

d. If we let event B = only one success occurs, list the outcomes for the event B.

(2 marks)

- **Recall: S = {(S, S, S), (S, S, F), (S, F, S), (F, S, S), (F, F, S), (F, S, F), (S, F, F), (F, F, F)}.**
- **The outcomes corresponding to B = only one success occurs are given by:**
- **B = {(S, F, F), (F, S, F), (F, F, S)}.**

e. If we assume that all outcomes in the sample space are equally likely, what is P(B)?

(2 marks)

- **From part d., the outcomes corresponding to B = only one success occurs are given by: B = {(S, F, F), (F, S, F), (F, F, S)}.**
- **If all outcomes in S are equally likely, then P(B) = 3/8 (= 0.375 to 3 d.p.)**

11. You are given information below regarding Undergraduate enrollment a small College for their 3-year programs

	Faculty		
	Math and Business	**Arts**	**Sociology**
Year 1	250	100	150
Year 2	195	90	140
Year 3	100	80	95

A student enrolled in a program at this College is randomly selected.

a. What is the probability that the student is in Year 3 of their program? ***(2 marks)***

- **From the given information, we see that there are a total of 1,200 students at the College.**
- **There are a total of 275 students in Year 3 of the programs.**
- **So, P(student is in Year 3 of their program) = 275/1,200 = 11/48 = 0.229 (to 3 d.p.)**

b. What is the probability that the student is in Math and Business? ***(2 marks)***

- **From the given information, we see that there are a total of 1,200 students at the College.**
- **There are a total of 545 students in Math and Business programs.**
- **So, P(student is in Math and Business) = 545/1,200 = 109/240 = 0.454 (to 3 d.p.)**

c. What is the probability that the student is not in Year 2 of an Arts program? ***(2 marks)***

- **From the given information, we see that there are a total of 1,200 students at the College.**
- **Of these 1,200 students, there are 90 students that are in Year 2 of an Arts program, so P(a student is in Year 2 of an Arts program) = 90/1,200.**
- **This means that P(a student is not in Year 2 of an Arts program) = 1 – 90/1,200 = 1,110/1,200 = 111/120 = 37/40 = 0.925 (to 3 d.p.)**