Bunker Hill Community College
imagine the possibilities

Math 181 First Exam Practice C

Spring 2019

Name: ______________________________

- Write your **full name** on the line above.
- Show your work. Incorrect answers with work can receive partial credit.
- Attempt every question; showing you understand the question earns some credit.
- If you run out of room for an answer, continue on the back of the page. Before doing so, write "see back" with a circle around it.
- You can use 1 page (front and back) of notes.
- You can use (and probably need) a calculator.
- You can use the Geogebra Scientific Calculator instead of a calculator. You need to put your phone on **airplane mode** and then within the application, start **exam mode**; you should see a green bar with a timer counting up.
- If a question is confusing or ambiguous, please ask for clarification; however, you will not be told how to answer the question.
- **Box your final answer**.
- A formula sheet is attached to this test.

Do not write in this grade table.

Question:	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	Total
Points:	10	10	5	5	10	10	10	10	70
Score:									

Sample statistics:

n = sample size
x_i = the ith value in a sample
$\bar{x}$ = sample mean
s = sample standard deviation

Q_1 = first quartile
m = median
Q_3 = third quartile
IQR = inter-quartile range = $Q3 - Q1$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

Population parameters:

μ = population mean
σ = population standard deviation

Probability:

Ω = set of all possible equally likely outcomes
A = event A, a set of outcomes
A^c = The complement of A
B = event B, another set of outcomes
$|A|$ = size of set, number of outcomes in A
$P(A)$ = probability of A
$P(A \text{ AND } B)$ = probability of both A and B
$P(A \text{ OR } B)$ = probability of either A or B (or both)
$P(A|B)$ = probability of A given B

$$P(A) = \frac{|A|}{|\Omega|}$$

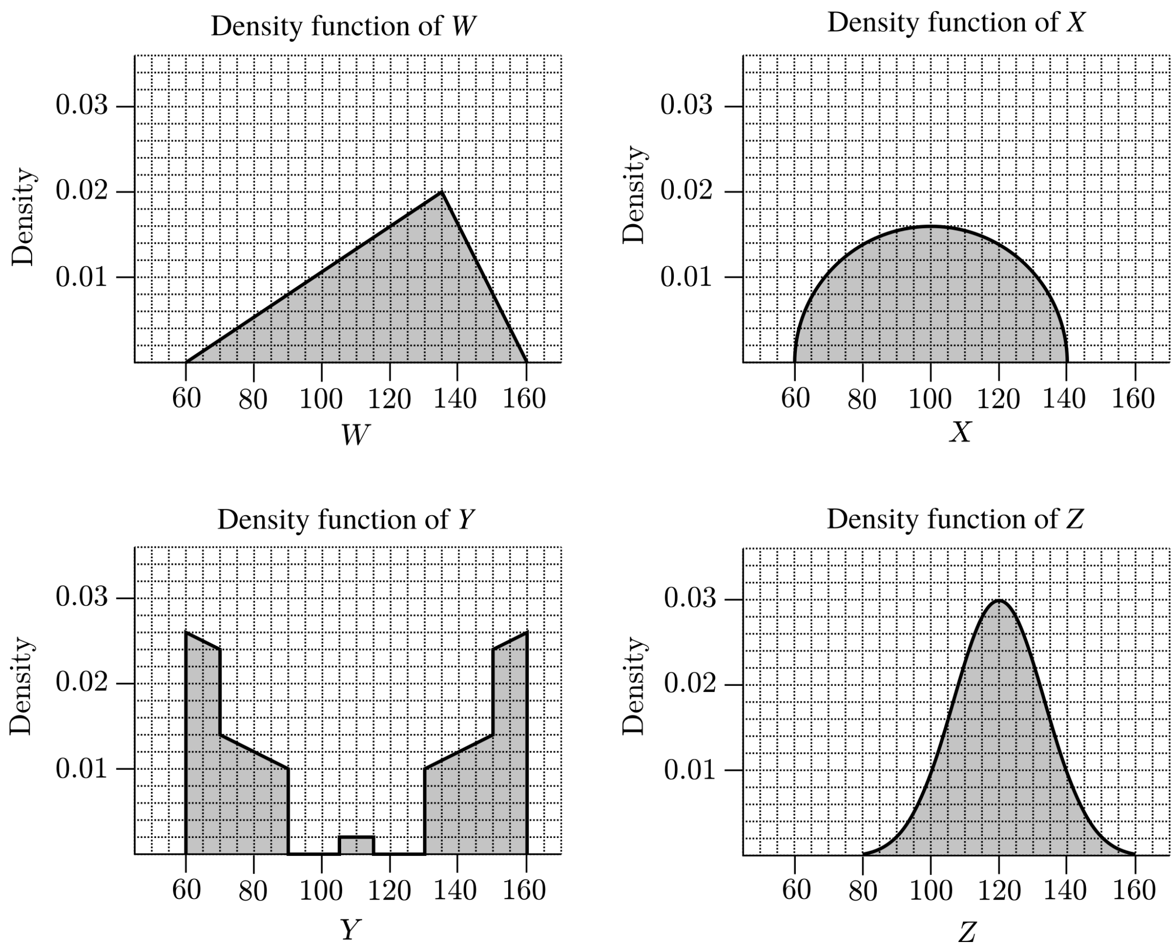
$0 \leq P(A) \leq 1$
$P(A \text{ AND } B) = P(A) \cdot P(B|A)$
$P(A \text{ OR } B) = P(A) + P(B) - P(A \text{ AND } B)$
$P(A^c) = 1 - P(A)$

A, B are disjoint (mutually exclusive) $\iff$ $P(A \text{ AND } B) = 0$
A, B are non-disjoint $\iff$ $P(A \text{ AND } B) > 0$
A, B are exhaustive $\iff$ $P(A \text{ OR } B) = 1$
A, B are complements $\iff$ A, B are disjoint and exhaustive $\iff$ $B = A^c$
A, B are independent $\iff$ $P(A \text{ AND } B) = P(A) \times P(B)$ $\iff$ $P(A|B) = P(A)$

Random variables and distributions:

X = random variable
x_i = the ith possible value of X. (Notice different meaning here vs. sample statistics.)
k = number of possible values of X.
$E(X) = \mu$ = expected value of X
σ = standard deviation of X
$\mu = \sum_{i=1}^{k} x_i \cdot P(X = x_i)$
$\sigma = \sqrt{\sum_{i=1}^{k}(x_i - \mu)^2 \cdot P(X = x_i)}$

Q1. (10 points) Four random variables (W, X, Y, and Z) are continuously distributed, and their density functions are shown below. Notice that each density function has an area of 100 percentile squares.



(a) Which variable is most likely to fall below 100? ○ W ○ X ○ Y ○ Z

(b) Which distribution has the highest Q_3? ○ W ○ X ○ Y ○ Z

(c) Which variable is least likely to fall between 80 and 90? ○ W ○ X ○ Y ○ Z

(d) Which distribution has a mean not equal to its median? ○ W ○ X ○ Y ○ Z

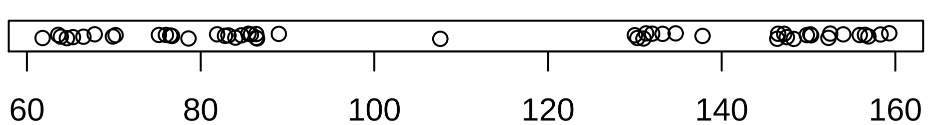
(e) Which distribution has the smallest standard deviation? ○ W ○ X ○ Y ○ Z

(f) Which distribution has the largest standard deviation? ○ W ○ X ○ Y ○ Z

(g) Which variable is most likely to fall above 150? ○ W ○ X ○ Y ○ Z

(h) Which has a 8% chance of falling between 95 and 100? ○ W ○ X ○ Y ○ Z

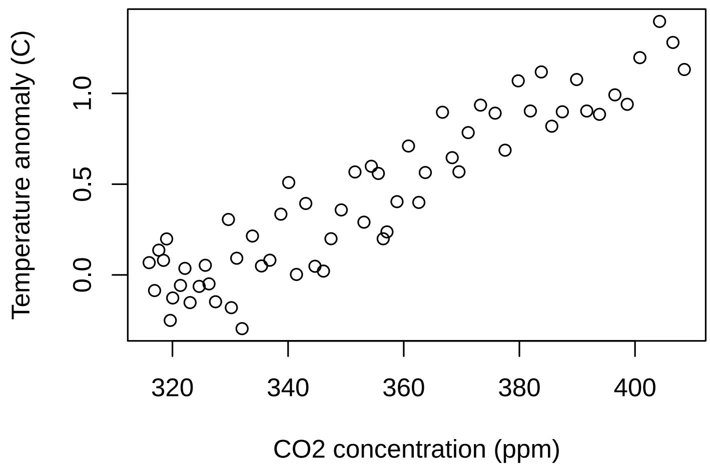
(i) Using 50 draws from one of the above distributions, the following dot plot was made:



Which distribution was drawn from? ○ W ○ X ○ Y ○ Z

(j) $P(W = 120) \;=\; ?$ ○ 0 ○ 0.016 ○ 0.5 ○ 1

Q2. (10 points) A study was done to investigate the relationship between CO_2 and average temperature. The Mauna Lau observatory has continuously measured the concentration of CO_2 over the last hundred years. Many other observatories have continuously measured temperature. Below we plot the two variables, where temperature is represented as degrees Celsius above expected (temperature anomaly).



(a) What kind of study was this (observational or experimental)?

(b) What is the implied explanatory variable?

(c) What is the implied response variable?

(d) What association is there between the two variables (positive, negative, or none)?

(e) Based on this study, should we conclude there is a causal relationship between the variables?

(f) Suggest another possible hypothesis than "more CO_2 causes higher temperature anomalies". For example, provide a possible confounding variable.

Q3. (5 points) Complete the contingency table below by assuming A and B are **independent** events.

	A	A^c	total
B	0.1		
B^c			
total		0.6	1

Q4. (5 points) A random sample of the bikes on Craiglist (near Boston in February) provided the following prices (in USD):

145 175 240 160 175 222 75 500 299 1300

Make a box plot summarizing these data.

Q5. (10 points) About 2.2% of Boston commuters use bicycles. If a Boston commuter uses a bicycle, there is an 80% chance their jacket is muddy. If a Boston commuter uses a nonbicycle, there is a 10% chance their jacket is muddy. You see a Boston commuter with a muddy jacket and wonder if they commute via bicycle.

(a) Draw a tree diagram.

(b) Make a contingency table.

(c) Determine the probability the person commutes via bicycle given their jacket is muddy.

Q6. (10 points) An urn contains marbles. Each marble has a color and a pattern. The frequencies are shown in the contingency table.

	red	green	blue	total
dotted	18	24	15	57
striped	32	16	23	71
checkered	27	19	30	76
filled	15	22	16	53
total	92	81	84	257

(a) What is the probability that a random marble is red?

(b) What is the probability that a random marble is checkered?

(c) What is the probability that a random marble is blue and striped?

(d) What is the probability that a random marble is blue or striped?

(e) What is the probability that a random marble is striped given it is blue?

(f) What is the probability that a random marble is blue given it is striped?

Q7. (10 points) The random variable X follows the probability distribution below.

x_i	$P(X = x_i)$
1	0.50
10	0.30
100	0.15
1000	0.05

(a) Evaluate $P(X = 100)$.

(b) Evaluate $P(10 \le X \le 100)$.

(c) Evaluate the mean of the probability distribution.

(d) Evaluate the standard deviation of the probability distribution.

(e) Assume multiple draws are independent, where X_i is the result of the ith draw. Evaluate the probability $P(X_1 = 10 \text{ AND } X_2 = 100)$. In other words, what is the chance of drawing a 10 and then a 100?

(f) Evaluate $P(X_1 \neq 1000 \text{ AND } X_2 \neq 1000 \text{ AND } X_3 \neq 1000)$. In other words, what is the chance of drawing thrice and getting no 1000s?

(g) Evaluate $P(X_1 = 1000 \text{ OR } X_2 = 1000 \text{ OR } X_3 = 1000)$. In other words, what is the chance of drawing thrice and getting at least one 1000?

Q8. (10 points) A random sample was taken from a population. Each individual was measured, and those measurements are shown below.

62 48 55 24 51 60

(a) Determine the sample mean.

(b) Determine the sample standard deviation.