QUESTION 1

Call the first digit of a number D. Benford's law is a probability function that predicts that $P(D = d) = log_{10}\left(1 + \dfrac{1}{d}\right)$. The base of the log is dependent on the base that is used for the number, so Benford's law in base 16 would be $P(D = d) = log_{16}\left(1 + \dfrac{1}{d}\right)$. Additionally, d must be within the bound [1, base). Let:

A = the expected value of the first digit of a base ten number, to the nearest hundredth.
B = the standard deviation of the first digit of a base ten number, to the nearest hundredth.
C = the z-score if a base sixteen number has a first digit of 7, to the nearest hundredth
D = the probability that the first digit of a hexadecimal is E, to the nearest hundredth.

Compute $A + B - C + D$.

QUESTION 2

Ananya flips a fair coin 9 times. Tanmay flips a fair coin 10 times. Let:

$$A = \text{the probability that Ananya flips more heads than tails, to the nearest thousandth.}$$
$$B = \text{the probability that Tanmay flips more tails than heads, to the nearest thousandth.}$$
$$C = \text{the probability that Ananya flips more heads than Tanmay, to the nearest thousandth.}$$
$$D = \text{the sum of the standard deviations of the number of heads flipped by Tanmay and Ananya, to the nearest thousandth.}$$

Compute $A - B + C + D$.

QUESTION 3

Shreyas wants to find the line of best fit between how many hours he plays video games (independent variable) in a given week and his average in Physics (dependent variable). All he knows is that the more video games he plays, the worse his grades get. The coefficient of determination of the two values is 0.729. For the hours on video games, the mean is 10.482 and the standard deviation is 4.227. For his average grade in Physics, the mean is 92.258 and the standard deviation is 6.102. The most hours Shreyas has ever spent gaming in one week was 20 hours. Let:

$A =$ The residual of the point (11, 99.2), expressed to the nearest thousandth.
$B =$ The x-intercept of the line of best fit, expressed to the nearest thousandth.
$C =$ The correlation, expressed to the nearest thousandth.
It would be called _____ if we tried to accurately estimate Shreyas's grade if he spends 70 hours playing video games in one week. Let D be the number of permutations in the 13-letter word that fills in the blank.

Find $A + B + C + D$.

QUESTION 4

All IB seniors at Rickards. 34 take IB Physics, 31 take IB Biology, and 26 take IB Chemistry. 15 take IB Physics and IB Biology. 12 take IB Chemistry and IB Biology. 13 take IB Chemistry and IB Physics. 9 take all three classes. Let:

A = The probability a randomly selected IB Senior takes all 3 subjects given they take IB Chemistry
B = The probability a randomly selected IB Senior takes Biology given that they take all 3 subjects
C = The probability a randomly selected IB Senior takes IB Physics given they take IB Chemistry
D = The probability a randomly selected IB Senior takes IB Biology given they take IB Physics

Find $A + B + C + D$, expressed as an improper fraction.

QUESTION 5

Karthik and Tanmay play a game involving drawing beetles. The way that the game works is that a beetle is drawn with 6 legs, numbered 1 through 6. Karthik and Tanmay go back and forth and roll dice. If the number on top of the die is a number that has not yet shown up, the beetle leg with that number is marked off. When all 6 numbers have been rolled, the game ends and the last person to have marked off a leg is declared the winner. Karthik rolls the dice first. Let:

$A =$ the probability Karthik wins the game if he is about to roll when there are only 2 legs left
$B =$ the standard deviation of the number of times the dice is rolled after the 5th leg is marked off.
$C =$ the probability that it takes 4 rolls after the 3rd leg is marked off for the 4th leg to be marked off.
$D =$ the standard deviation of the number of dice rolls needed for the first leg to be marked off.

Express $A + B + C + D$ as a decimal rounded to the nearest thousandth.

QUESTION 6

Nitish is watching "Minions: The Rise of Gru" and realizes that the heights of the minions are normally distributed with a mean of 2 feet, 6 inches and a variance of 1 foot, 4 inches. Using the empirical rule, let:

$$A = \text{the event that a given minion is shorter than 1 foot, 6 inches.}$$
$$B = \text{the event that a given minion is shorter than 2 feet, 10 inches.}$$

Find $1000000 \cdot P(A) \cdot P(B) \cdot P(A|B) \cdot P(B|A)$.

QUESTION 7

The variable X has mean 23 and standard deviation 4. The variable Y has mean 51 and variation 9. They have a correlation of 0.9. Let:

$$A = \mathrm{E}(X + Y)$$
$$B = \mathrm{Var}(X + Y)$$
$$C = \mathrm{E}(5X - 9Y)$$
$$D = \mathrm{Var}(20Y)$$

Find $A + B + C + D$.

QUESTION 8

Add up the values of the following statements that are false:

(5) Changes in the scale or units of the measurements used for x-values or y-values change the coefficient of determination.
(9) The standard deviation and the standard error of a mean are the same things.
(-3) A type 1 error is when the null hypothesis is false but its not rejected.
(-6) A type 2 error is when the null hypothesis is false but its not rejected.
(7) A test for homogeneity is used to see how well a sample data fits a hypothesized distribution.
(1) The sum of squares of residuals is always equal to 0.

What is the final value?

QUESTION 9

Amogh and Shravan are trying to find the relationship between the number of waffles one eats in week to the probability they will get diabetes (in percent).

Number of Waffles	12	15	18	21	24	27
Probability of Diabetes	5	20	21	35	57	62

$A =$ the slope of the line of best fit
$B =$ the square root of the coefficient of determination
$C =$ the sum of the squares of the residuals
$D =$ the product of the residuals at $x = 15$ and 27

Find $\lceil A + B + CD \rceil$.

QUESTION 10

This table shows the number of people in different age groups and their favorite flavor of ice cream

	Vanilla	Chocolate	Matcha	Strawberry	Cookies n Cream	Pistachio
$5-15$	20	27	42	12	16	41
$16-25$	52	32	11	56	7	19
$26-35$	21	8	34	46	10	37
$36-45$	64	25	9	17	28	67

Find the product of the X^2 value and the degrees of freedom to the nearest hundredth.

QUESTION 11

A new virus is going around Tallahasse, affectionately deemed the TallaNasty. So far, it has infected 4% of the population. Schmidt Sciences has created a test that is 99% accurate. Let:

$$A = \text{the probability that someone who tested positive has TallaNasty}$$
$$B = \text{the probability that someone who tested positive does not have TallaNasty}$$
$$C = \text{the probability that someone has the disease given they tested negative}$$

Find $3A + 2B + 4C$ to the nearest thousandth.

QUESTION 12

Find the number of ways you can arrange the letters in the following types of random samples based on their description.

A = dividing the population into heterogeneous groups and then picking everyone in a random selection of one or more of the groups

B = dividing the population into homogeneous groups and then picking everyone in a random selection of one or more of the groups

C = dividing large populations into smaller and smaller samples

D = listing the population in some order, choosing a random point to start, and then picking every nth person from the list

Find $A + \dfrac{C^2}{B \cdot D}$.

QUESTION 13

Mozzie is taking a 30-question test where the answers are only true or false. He is a good guesser, having a 68% chance of getting a question correct. Let:

$$A = \text{the probability he gets at least 17 questions correct}$$
$$B = \text{the probability he gets more than 22 questions correct}$$
$$C = \text{the expected number of correct answers}$$
$$D = \text{the standard deviation of this situation}$$

Multiply the final answer by 2 if the shape of the distribution is symmetric, 3 if the shape of the distribution is right-skewed, or 4 if the shape of the distribution is left-skewed.

Find $A + B + C + D$ to the nearest thousandth.

QUESTION 14

There are two correlated random variables F and G. F has a mean of 250 and a variance of 49 and G has a mean of 180 and a standard deviation of 36. The coefficient of determination between the two variables is 0.64. Let:

$$A = \text{the standard deviation of } 5F - 3G$$
$$B = \text{the mean of } 4F^2$$
$$C = \text{the variance of } 2F + G$$
$$D = \text{the standard deviation of } 7G - 7$$

Find $A + \dfrac{B}{250} + C + \sqrt{D}$ rounded to the nearest whole number.