QUESTION 1

Prabhas is thinking of designing an experiment that tests how a new pill, MAOdryl, impacts the rate of making questions for Rickards Invitational tests. To perform this experiment, Prabhas plans to randomly assign people to 3 different groups, each with the same amount of people in each group. Each group either took a sugar pill, no pill, or 0.5g of MAOdryl. Prabhas plans to divide the participants in each treatment group into three age groups: 18-30, 31-53, and 54+, with the same amount of people in each age group found within a single treatment group.

A = the number of treatments (inert and active) in this experiment.

B = the number of blocking factors in this experiment.

C = the exact probability of a random person being in the 54+ age group and getting a sugar pill. Assume that the random person selected will be between 18-89 years old, and there is an equal chance of being any age, and getting any treatment.

D = Let's say that trends were found within each separate age group between taking MAOdryl and the increase in the number of test questions created, but the trend disappeared when all age groups were put together. What phenomenon is this? Your answer will be the number of distinct letters in the entire name.

Evaluate $A + \frac{1}{C} - B + D$

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Evaluate $A + \frac{1}{C} - B + D$

QUESTION 2

The 15 players with the most home runs on a certain baseball team had the following home run totals:

$$\{24, 27, 9, 29, 31, 38, 12, 21, 11, 11, 16, 2, 11, 3, 5\}$$

A = the mean of this dataset, rounded to the nearest tenth

B = the standard deviation of this dataset, rounded to the nearest tenth

C = the minimum value of a single additional data point needed to make the distribution of this dataset likely right-skewed (if the distribution is already likely right-skewed, the value is 0), rounded to the nearest hundredth.

D = the number of the following statistics of this dataset that would be a biased estimator of the total population of players' home runs (mean, median, standard deviation, range).

Using the rounded values, evaluate $ABCD$ to the nearest hundredth.

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QUESTION 3

Suppose there exist two independent, random variables, X and Y. Given that μ_X=9, σ_X^2=16, μ_Y=7, σ_Y^2=25:

A = the standard deviation of $2X - 3Y$

B = the variance of $X + Y - 7$

C = the mean of $X^2 + Y^2$

D = the mean of $X^2 + Y^2 + 2XY$

E = the absolute difference of the mean and the standard deviation of $X + Y$, if X and Y are now not independent and have a correlation coefficient of 0.54, rounded to the nearest hundredth.

Using the rounded values, evaluate $A + B - (C + D - E)$.

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QUESTION 4

A research group creates a 99% confidence interval, (9%, 11%), for the percentage of the active ingredient in a certain medication. Determine which of the following interpretations of this interval are correct, and multiply the number(s) in parentheses at the end of each correct interpretation to reach the answer (or state the one number if only one is true).

- There is a 99% chance that the mean percentage of active ingredient is within this interval (2)
- 99% of doses of the new medication contains between 9% and 11% active ingredient (5)
- In 1000 doses of the medication, 990 are expected to contain between 9% and 11% active ingredient (7)
- In 1000 doses of the medication, there are 990 doses which have between 9% and 11% active ingredient (9)
- In 1000 doses of the medication, 10 doses must have an incorrect percentage of active ingredient (11)

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QUESTION 5

Jeromy is making questions for 4 different team tests, each with 10 questions. Help Jeromy find the probability of each of the scenarios given below given a single question either having an independent 65% chance of making it on the team test or having a 35% it doesn't, rounding each answer to the nearest thousandth:

A = the probability of finishing the team test given Jeromy writing 15 questions.

B = the probability of Jeromy finding a single question to put on this team test after going through 5 questions, given Jeromy keeps writing questions until he finds a question to put on the test.

C = the probability of finishing the last question on this team test after writing 13 questions.

D = Jeromy has already finished writing this team test, but now is experimenting with changing the order of the questions. How many ways are there to order the questions on this team test, given that none of the questions are in their original order?

Using the rounded values, evaluate $(A + B + C) \times D$.

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QUESTION 6

A statistics teacher gives his class of 29 students a test in which the grades can only be one of the first 6 triangular numbers, starting with 1. The results are shown in this cumulative distribution table:

Note: Let T_n represent the nth smallest triangular number.

Triangular Number	T_1	T_2	T_3	T_4	T_5	T_6
Distribution	0.2414	0.3793	0.4483	0.8276	0.8621	1.000

Rounding each answer to the nearest hundredth:

$$\begin{aligned} A &= \text{the number of students who scored a 12.} \\ B &= \text{the arithmetic mean score of the class.} \\ C &= \text{the interquartile range of the scores.} \\ D &= \text{the variance of this distribution.} \end{aligned}$$

Using the rounded values, evaluate $A + 2B + 3C + 4D$.

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QUESTION 7

Max Scherzer is a Major League Baseball pitcher, and quite a good one at that. His pitch type usage (per 1000 pitches) for the 2014 season (his last on the Detroit Tigers) and for the 2015 season (his first on the Washington Nationals) are as follows, with the speed of the pitch (in mph) in parentheses.

Year	Team	Fastball	Slider	Curveball	Changeup
2014	Tigers	551(93)	136(85)	103(77)	210(84)
2015	Nationals	594(94)	188(86)	81(80)	132(85)

Perform a χ^2-goodness of fit test on both the pitch type and pitch speed data (using the 2014 data for the expected values and the 2015 data for the observed values), then find the product of the χ^2 values, rounded to 4 decimal places.

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QUESTION 8

A fisherman catches fish then posts pictures of them on social media. He tallies the length of each fish and then records how many likes each post gets, because he's like that.

Length(in.)	4.2	5.0	8.3	8.6	11.6	14.9	26.1
Likes	30	48	59	68	267	430	1200

Rounding each answer to the nearest thousandth (when applicable):

A = the slope of the least-squares regression line for this data.

B = the correlation between the length of the fish and amount of likes.

C = the sum of the residuals.

D = If you graph this data, you can see that this data doesn't look that linear. Which model best fits this data? The answer to this part is the number of letters in the model's name.

Using the rounded values, evaluate $D + B + (\frac{C}{A})$.

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Using the rounded values, evaluate $D + B + (\frac{C}{A})$.

QUESTION 9

A Statistics individual test (with a maximum score of 120) is given and the scores are normally distributed with a mean of 65 and a standard deviation of 15. Rounding each answer to the nearest hundredth (when applicable):

A = the proportion of scores from 0 to 35.

B = the proportion of scores from 100 to 120.

C = the z-score of a score of -22.

D = the number of students who score at least a 90, if 200 students take the test, rounded to the nearest whole number.

Using the rounded values, evaluate $AC + BD$.

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Using the rounded values, evaluate $AC + BD$.

QUESTION 10

The probability density function of a continuous random variable X is defined by the equation $y = 2x$ on the interval $[0, A]$. Rounding each answer to the nearest thousandth:

A = the upper bound on the interval where the pdf is defined on.

B = $P(X = 0) + P(X = 0.5)$

C = the x-value of the median, or where the area of the pdf on the left side of the value is equal to the area of the pdf on the right side of the value.

D = $P(X > 0.75 \mid X < 0.99) * P(X < 0.88 \mid X > 0.3)$

Using the rounded values, evaluate $A^{(B+C)} \times D$ to the nearest thousandth.

QUESTION 10

The probability density function of a continuous random variable X is defined by the equation $y = 2x$ on the interval $[0, A]$. Rounding each answer to the nearest thousandth:

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B = $P(X = 0) + P(X = 0.5)$

C = the x-value of the median, or where the area of the pdf on the left side of the value is equal to the area of the pdf on the right side of the value.

D = $P(X > 0.75 \mid X < 0.99) * P(X < 0.88 \mid X > 0.3)$

Using the rounded values, evaluate $A^{(B+C)} \times D$ to the nearest thousandth.

QUESTION 11

At Rickards High School, a total of 112 students make up the senior class. Out of these students, 72 students take exactly one of either Calculus, Statistics, or Physics. 40 students take Calculus, 57 take Physics, and 53 take Statistics. Additionally, 15 people take Calculus and Statistics only, and the number of people who take Physics and Calculus only is double the number of people who take Physics and Statistics only. Finally, amidst these students are 8 geniuses (nerds) that take all three classes at the same time. Rounding each answer to the nearest hundredth (when applicable):

$$
\begin{aligned}
A &= \text{the number of students who take Calculus only.} \\
B &= \text{the number of people who don't take any of these classes.} \\
C &= P(\text{3 classes} \mid \text{takes Calculus}) \\
D &= P((\text{takes Calculus} \cup \text{takes Physics and Statistics only}) \mid \text{2 classes})
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Using the rounded values, evaluate $A + B + C + D$.

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\end{aligned}
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Using the rounded values, evaluate $A + B + C + D$.

QUESTION 12

A study using a simple random sample is performed to test the effectiveness of a heart rate medication. The 50-subject study finds that it lowers heart rate by a mean value of 5.44 bpm (beats per minute) with a standard deviation of 2.27 bpm. Rounding each answer to the nearest hundredth (when applicable):

A = the width of a 95% confidence interval for the mean lowering of the heart rate.

B = the width of a 99.9% confidence interval for the mean lowering of the heart rate.

C = the percentage certainty with which we can assert that the new medication lowers the heart rate by a mean of 5.44 bpm $\pm$ 0.4 bpm (Treat this as a non-percentage number).

D = the whole-number sample size needed to assert that the medication lowers heart rate by a mean of 5.44 bpm $\pm$ 0.2 bpm with 95% certainty, using the given mean and standard deviation.

Using the rounded values, evaluate $A + B + C + D$.

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Using the rounded values, evaluate $A + B + C + D$.

QUESTION 13

The one and only Stat Team, composed of Akash, Jeromy, Vamsi, and Vishal, are solving a truly perplexing statistical riddle. The probability that Akash will solve this riddle is $\frac{7}{9}$. The probability that Jeromy will not solve this riddle is $\frac{1}{5}$. The probability that Vamsi will solve the riddle is $\frac{7}{10}$, and the probability that Vishal will not solve the riddle is $\frac{4}{15}$. Assume that all four students are working on the riddle separately and independently.

A = the probability that Vamsi is the only one who solves the riddle, rounded to the nearest thousandth.

B = the probability that all 4 students solve the riddle, rounded to the nearest thousandth.

C = the probability that only Jeromy and Vishal solve the riddle, rounded to the nearest thousandth.

D = the probability that any 3 of the 4 students solve the riddle, rounded to the nearest thousandth.

Using the rounded values, evaluate $\frac{AB}{CD}$.

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Using the rounded values, evaluate $\frac{AB}{CD}$.

QUESTION 14

Consider the following statements and identify each as being true or false:

A: Bernoulli trials for random experiments have variable probabilities of success for each trial.

B: Bayes' theorem states that $P(A|B) = \frac{P(B|A) \times P(B)}{P(A)}$, giving us the probability of event A occurring, given that B occurs.

C: It is impossible to eradicate bias in an experiment through the utilization of various probability techniques and statistical tests.

D: The standard deviation, median, interquartile range, upper quartile are all measures of spread.

Let the number of assumptions/conditions of a Bernoulli trial equal n. Starting with this value, divide n by 2 for every true statement, and square n for every false statement. Start from statement A and continue through statement D. Assume that the value of n carries over to each of the following statements. For example, if a statement were true, you would divide n by 2, and use that value as your new n in the next statement.

Find the final value of n, rounded to the nearest thousandth.

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Find the final value of n, rounded to the nearest thousandth.

QUESTION 15

Two students are drawing cards from a standard deck, without replacement.

A = the exact probability that both students draw a Clubs card.
B = the exact probability that student A draws a face card, then student B draws a non-face card.
C = the exact probability that both students draw a King of Hearts.
D = the exact probability that student A draws a black card, then student B draws a red 7.

Evaluate the exact value of $A \times B \times (\frac{1}{D}) + C$

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