STAT/MA 41600
Midterm Exam #1: October 5, 2018

Name _____

Purdue student ID (10 digits) _____

1. The testing booklet contains 5 questions. Dr. Ward will grade them all, but will only use the highest 4 scores. These highest 4 scores will all be weighted evenly (i.e., each question is worth 1/4 of the midterm exam grade).

2. Permitted Texas Instruments calculators:
   BA-35
   BA II Plus*
   BA II Plus Professional Edition*
   TI-30XS MultiView*
   TI-30Xa
   TI-30XIIS*
   TI-30XIIB*
   TI-30XB MultiView*
   *The memory of the calculator should be cleared at the start of the exam.

3. **Circle your final answer in your booklet**; otherwise, no credit may be given.

4. There is no penalty for guessing or partial work.

5. Show all your work in the exam booklet. If the majority of questions are answered correctly, but insufficient work is given, the exam could be considered for academic misconduct.

6. Extra sheets of paper are available from the proctor.

1. A family with three daughters and three sons needs to go to the grocery store. Besides the father, who is driving the car, exactly three of the children can come along to the grocery store with him. Suppose that the three children to join the father are chosen randomly, and all such choices are equally likely.

Let X denote the number of daughters who accompany the father to the grocery.

1a. Find $\mathbb{E}(X)$.

1b. Find $\mathrm{Var}(X)$.

2. Roll a 6 sided die until you have seen all of the sides as a result. Let X denote the number of rolls required. Find $\mathbb{E}(X)$.

Hint: Let X_i denote the number of additional rolls needed until the ith new result appears. So $X = X_1 + \cdots + X_6$. Caution: the X_i's are different from each other; they do not behave the same way.

3. Consider a collection of 3 million jelly beans. Suppose that each jelly bean has a 1 in a million chance of having a defect, and suppose that the potential for defects is independent, from jelly bean to jelly bean.

3a. Write an exact expression for the probability that there are 4 or fewer defects in the collection.

3b. Approximate the probability that there are 4 or fewer defects in the collection, and find the value of the probability, using this approximation.

4. Let X, Y, and Z be independent Geometric random variables that each have expected value $5/3$.

4a. Find $P(X > 10)$.

4b. Find $P(X + Y + Z > 10)$.

5. Bob rolls a 6-sided die until the first value of "2" appears for the first time, and then he stops afterwards. Suppose that it takes him n rolls.

Based on that number n, Bob's friend Alice flips a coin exactly n times. What is the probability that Alice gets no heads at all, during her n flips?

[Please give your solution in closed form, i.e., please compute the probability.]