NAME ____________________________

MATH 201 Binomial Distribution Project Test, Spring 2020

Directions:

- This mini-test is worth 50% of your project's grade.
- You may refer to your notes or project, and use a stand-alone calculator. But electronic communication is prohibited, and you must work alone.
- To receive full credit, you must show all relevant work to justify your answer on the test paper. Write down your calculator commands for statistical calculations.
- Clearly identify your final answer, correct to at least 3 significant digits.

Honor Pledge: I pledge that I will neither give nor receive unauthorized help on this test from any person, technology, or other resource, and that I will abide by the honor code of Carson-Newman University.

Signed: ____________________________________

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1. A rogue nation has launched an intercontinental ballistic missile (ICBM) at your territory. You immediately launch 6 anti-missle interceptors, each with a 38% chance of hitting its target. Two hits are guaranteed to destroy the incoming ICBM.

   (a) Finish the formula to find the probability that exactly two of the six interceptors hit the target. (use Pascal's triangle for the first box)

   $$\boxed{}\left(\boxed{.38}\right)^{\boxed{}}\left(\boxed{}\right)^{\boxed{}} = \boxed{}$$

   Answer: $15(.38)^2(.62)^4 = .320$

   (b) Now write down the calculator command that finds that same answer.
   Answer: $bipdf(6, .38, 2)$

   (c) Find the probability that the ICBM is hit fewer than two times.
   Answer: $bicdf(6, .38, 1) = .266$

2. In a carnival game, a contestant has a 60% chance of success on each attempt. Assuming independence, find the probability that she is successful on a majority of 15 attempts.
   Answer: $1 - bicdf(15, .6, 7) = .787$

3. A factory worker is provided enough raw materials to construct 125 widgets in a day. Suppose each widget independently has a 16% chance of failing inspection. The worker's daily quota is 100 widgets that pass inspection. Let X be the number of widgets that **pass** inspection. Here is part of the distribution's table:

102	0.0709	0.2653
103	0.0831	0.3484
104	0.0923	0.4407
105	0.0969	0.5376
106	0.0960	0.6336
107	0.0895	0.7231
108	0.0783	0.8014
109	0.0641	0.8655
110	0.0490	0.9145
111	0.0347	0.9492
112	0.0228	0.9720
113	0.0138	0.9858
114	0.0076	0.9934
115	0.0038	0.9972
116	0.0017	0.9990
117	0.0007	0.9996
118	0.0002	0.9999
119	0.0001	1.0000
120	0.0000	1.0000

(a) Find the expected value of X.
Answer: $\mu = (125)(.84) = 105$

(b) Find the third quartile.
Answer: 75th percentile is $x = 108$

(c) Find the standard deviation.
Answer: $\sigma = \sqrt{(125)(.84)(.16)} = 4.1$

(d) Find the probability that exactly 100 widgets pass inspection.
Answer: $\mathit{bipdf}(125, .84, 100) = .0442$

(e) Find the probability that the worker fails to meet her quota, i.e. $P(X < 100)$.
Answer: $\mathit{bicdf}(125, .84, 99) = .0928$

4. The local hospital serves 5,000 elderly people in the area. Suppose each one has a 1.5% chance of needing the ICU due to the COVID-19 virus. Let X be the number of locals that need the ICU. Is $X \sim BI(5000, 0.015)$ an appropriate model for X ? Explain your answer with a short paragraph.
Answer: The binomial is not appropriate if the events are not independent. A contagious virus is likely to spread, and could hit the area much harder than the BI would suggest.