**Name:** ______________________________ **MAT 121**

**Summer 2019** **Exam 3 Review**

**Problem 1:** The length of pregnancies are approximately normally distributed with mean of 268 days and standard deviation of 15 days.

(a) Find the probability that a pregnancy lasts 304 days or longer.

(b) If the wife of a service member last saw her husband about 306 days ago and just delivered their first child , what might this suggest?

(c) If a baby is considered to be delivered prematurely if the pregnancy is in the bottom 5% of pregnancy lengths, at most how long can a premature pregnancy last?

**Problem 2:** Assume that the probability that a pregnancy results in a girl is 0.50. Consider a group of 128 pregnancies.

(a) What is the probability that at least 60 of these babies will be male?

(b) What is the probability that at least 65 of these babies will be female?

(c) Use the continuity correction to improve your computation in (b).

(d) Use the continuity correction to find the probability that exactly 66 of these babies are female.

**Problem 3:** A paper in the journal, *Pediatrics*, describes a study of the possible cardiovascular benefits of active video games for healthy adults. A simple random sample of 80 adults was obtained, and heart rates were measured after 15 minutes of playing Wii Bowling. The resulting average heart rate was 100 beats per minute (bmp). Assume the population of heart rates after 15 minutes of Wii Bowling has a standard deviation of 16 bpm. Give a 97% confidence interval for the mean heart rate of healthy adults after 15 minutes of Wii Bowling.

**Problem 4:** In a recent election a survey indicated that of 856 people surveyed in a small county, 723 stated they voted. Voting records from the county indicate that only 79% of people in the county actually voted.

(a) Assuming that 79% of people actually voted in the election, what is the probability that among the 856 people surveyed, at least 723 voted.

(b) What can you most likely conclude from (a)?

**Problem 5:** A typical short flatbed truck is constructed in such a way that it can support various weights which are approximately normally distributed with mean 2,000 lb with standard deviation 30 lb.

(a) What percent of short flatbed trucks can support weights between 1,930 lb and 2,050 lb?

(b) If a short flatbed truck will only fail at a weights greater the upper 8% of elevator carrying capacities, what is the maximum weight this type of truck can safely carry?

**Problem 6:** The U.S. government is trying to determine amounts to dedicate to college financial aid in their new budget. It is necessary to estimate the percentage of full-time college students which will require aid and earn a degree in the traditional four years. The government will estimate this percentage by asking current and former college students. How large must the sample size be to estimate the percentage with a 0.01 margin of error, using a confidence interval of 95%?

**Problem 7:** The 2017 SAT scores were approximately normally distributed with mean 1060 and standard deviation 195.

(a) What percentage of test takers received a score of 850 or lower?

(b) What percentage of test takers received a score of 850 or higher?

(c) What percentage of test takers scored between 1000 and 800?

(d) What was the minimum score to place in the top 5% of test takers?

**Problem 8:** The outer shell of a car is manufactured from steel. Under extreme pressure, this steel can buckle. If the breaking point for this steel is normally distributed with standard deviation 60 MPa, how many steel pieces of this steel must be tested if a manufacturing company wants to estimate the breaking point for this steel within 5 MPa given that they want to construct a 95% confidence interval for the true mean breaking point of this steel?

**Problem 9:** The typical American quarter has a weight which is approximately normally distributed with mean 5.67 g and standard deviation 0.06 g. Some vending machines are designed to accept coin based currency based on weights. Assume a vending machine is designed in this way and that it assumes a quarter is valid if it weights between 5.0 g and 7.0 g.

(a) What percentage of valid quarters are rejected by this machine?

(b) What quarter weights should be accepted by the machine if it only wants to reject quarters in the top and bottom 1% of quarter weights?

(c) If 9 quarters are chosen at random, what is the probability that their mean weight is 5.62 g or less?

**Problem 10:** A study of 328,781 Americans found that 0.08% of individuals develop brain cancer.

(a) Construct a 85% confidence interval for the percentage of Americans that develop brain cancer.

(b) The rate of brain cancer in Americans is estimated to be 0.012%. Does this survey agree with this estimate? Explain.

**Problem 11:** Approximately 8% of individuals have hazel eyes. Assume 190 people are randomly surveyed and their eye color 'measured'.

(a) What is the probability that at least 16 of these people have hazel eyes?

(b) What is the probability that fewer than 15 people have hazel eyes?

(c) Use the continuity correction to improve your computation in (b).

**Problem 12:** To keep track of housing trends in the U.S., the Census Bureau records various characterizations of new houses built each year. Suppose a random sample of 70 new single-family houses completed last year has a mean size of 2,657 square feet. Assume the population distribution of sizes for houses built last year has standard deviation of 850 square feet. Give the 97% confidence interval for mean size of new houses built in 2014.

**Problem 13:** Mendel was trying to test his Theory of Genetics using pea plant colors. He grew 580 pea plants. Once grown, he counted that 427 of them were green and 153 of them were yellow.

(a) Find a 99% confidence interval to estimate the percentage of green pea plants.

(b) Based on this theory, Mendel expected 75% of the of pea plants would turn out to be green. Do Mendel's results contradict his theory?

**Problem 14:** Human beings have a body temperature with is approximately normally distributed with mean 98.2°F and standard deviation 0.62°F.

(a) Find the percentage of individuals that have an average body temperature less than $97.5\circ$F.

(b) Find the percentage of individuals that have an average body temperature of $99\circ$F or higher.

(c) Find the percentage of individuals that have an average body temperature between $98\circ$F and $99\circ$F.

(d) If 6 people are chosen at random, what is the probability that their average body temperature is 98.6 or higher.

**Problem 15:** IQ scores are approximately normally distributed with mean 100 and standard deviation 15. Suppose a survey wants to estimate the mean IQ of professors. Given that the directors of the study want to construct a 98% confidence interval for the true mean IQ of professors, find the sample size so that the sample mean is within 3 IQ points of the true population mean. Is this a practical sample size?

**Problem 16:** In a study of birth weights, an average birth weight of 7.1 lb among 165 participants was found. If birth rates are known to be approximately normally distributed with standard deviation 0.2 lb, find a 99% confidence interval for birth weights.

**Problem 17:** At a community college, there are 127 instructors. Of these instructors, 43 have a PhD. Assume that 80 instructors from the college are surveyed about their background.

(a) What is the probability that at least 27 of the instructors have a PhD?

(b) What is the probability that at fewer than 29 of the instructors have a PhD?

(c) Use the continuity correction to improve your computation in (a).

**Problem 18:** A sociologist wants to conduct a study about Americans belief in astrology. How many people must this sociologist survey if a 99% confidence interval and a margin of error of 3 percentage points is desired? What if previous studies indicated that 37% of Americans believe in astrology?

**Problem 19:** Assume the grades on a Statistics final exam were normally distributed with mean 79 and standard deviation 7.

(a) What percentage of students received an 85 or lower on the exam?

(b) What percentage of students received a 65 or higher on the exam?

(c) What is the minimum score a student would need to receive in order to place in the top 10% of students taking the exam?

(d) If the teacher curved the exam by adding 7 points to every students exam, what is the shape of the new exam distribution? What is the mean and standard deviation of the new exam?

**Problem 20:** A certain drug is developed to reduce the rate of blood clots. In a clinical trial, among 6,293 in a drug trial using this drug, 211 of the participants developed adverse reactions. Construct a 95% confidence interval for the proportion of individuals that experience adverse effects. If the drug is only approved if less than 1% of patients taking the drug experience adverse side effects, based on this study, will the drug be approved?

**Problem 21:** A study of mean body temperature of a certain species of amphibian is carried out on 87 randomly collected individuals. A 90% confidence interval for the mean body temperature is computed. If the standard deviation of the body temperature of this genus of amphibian is known to be 0.3°F, what is the margin of error for this study?

**Problem 22:** Men typically weight more than women. Hence when considering elevator carrying capacities, the maximum capacity in an elevator is computed by assuming all the passengers are male. The weights of men are normally distributed with mean 180 lb and standard deviation 40 lb.

(a) What percentage of men weight 200 lb or less?

(b) What does a man have to weigh to be in the top 5% of weights?

(c) If an elevator is designed with a weight capacity of 2,000 lb, assuming the carrying capacity of the elevator is computed assuming the occupants are male and in the lower 95% of weights, what is the carrying a capacity of the elevator?

(d) Considering the work above, why is it necessary to update every few years the maximum capacity of elevators?

**Problem 23:** IQs scores are normally distributed with mean 100 and standard deviation 15.

(a) What is the probability that a random individual has an IQ of 115 or more?

(b) What IQ marks $P_{50}$? What about $P_{75}$?

(c) Mensa is a group for high IQ individuals. Membership requirements stipulate that one need an IQ that places them in the top 2% of IQs. What is this minimum IQ required for membership?

(d) If 5 people are randomly selected, what is the probability that their average IQ is 120 or greater?

**Problem 24:** In a weight loss program, 30 adults used a drug to help increase weight loss. After 6 months, their average weight loss was found to be 2.1 lb. If the standard deviation for all patients taking the drug was known to be 4.3 lb, construct a 94% confidence interval for the weight loss of subjects taking the drug.