Name: _____
MAT 222
Spring 2017
Exam 1 Review

Problem 1: Mark the following statements as true or false in the blank space provided. You should be able to explain why the statement is True/False.

(a) _____: A matched paired t procedure can only be used when the same individuals are tested in each group.

(b) _____: Given two samples from a distribution with unknown standard deviation, a two–sample t procedure must be used.

(c) _____: A simple random sample of n individuals from a normally distributed population is always normally distributed.

(d) _____: The core principle of hypothesis testing is to reject H_0 only when the observed sample is unlikely to have occurred when H_0 is true.

(e) _____: Inferences about population proportions are insensitive to false replies in the data.

(f) _____: Given a sample size of less than 15 people from a distribution with unknown standard deviation, the population distribution has to be normal or have no outliers/skewness to use one–sample t procedures.

(g) _____: As the number of observations in an experiment increases, the t–distribution 'looks' more like the normal distribution.

(h) _____: The power of a hypothesis test is the probability of not making a Type II error.

(i) _____: A z–statistic is used when making inferences about a population proportion.

(j) _____: A computer will always give the degrees of freedom for a t–distribution with sample size n as $n - 1$.

(k) _____: A pooled t procedure becomes more sensitive to violations of the necessary assumptions as the sample sizes vary in size.

(l) _____: All other things equal, choosing a smaller significance level, α, will increase the probability of making a Type II error.

(m) _____: Hypothesis testing can only be used when the mean of the population is known.

(n) _____: A two–sample t procedure can always be used if one of the samples has at least 40 people in it.

(o) _____: Changing the level of significance does not change the power of a hypothesis test.

(p) _____: A pooled t procedure can be used as long as the two samples are chosen so that the total number of people is at least 40.

(q) _____: If the null hypothesis is not rejected, there is strong evidence that the null hypothesis is true.

(r) _____: There is no way to improve inferences about a population proportion if the number of data values is less than 10.

(s) _____: The power of a test, β, is the probability of failing to reject the null hypothesis.

(t) _____: The standard error for a pooled t–procedure with two equal size samples is the same as the average of the standard deviations of the samples.

Problem 2: You are looking to replace your older vehicle which only gets 27 miles per gallon (mpg) with a newer model that gets over 32 mpg. After doing some research, you find a good match for a possible new car; SNW, a small four–door car company, claims their newest 2017 model car averages 32 miles per gallon. However after reading a few online reviews quoting varying mpg values, you begin to question this claim. You read a few reviews and find quoted mpg of 30, 27, 32, 27, 33, 25, 28, and 31 miles per gallon. Construct a 95% confidence interval for the mpg for SNW's latest vehicle. Based on this interval, should you purchase the car? Is the company's claim that the mpg of the vehicle being 32 mpg believable [at the 5% significance level]?

Problem 3: A common aliment among the elderly is arthritis—a painful, chronic inflammation of joints in the body. This inflammation is typically located in the extremities, such as the hands, but can also be found in joints such as the hip. Some doctors suggest taking a regular anti-inflammatory medication, such as ibuprofen, to help alleviate the symptoms. However, this medication can have adverse effects on the liver if taken in too large of a dose. Researchers test 384 nursing home patients and find that 17 of the patients taking the medication suffer these effects. Construct a 90% confidence interval for the average amount of patients that will suffer these side-effects. The company producing the drug gives data suggesting less than 3% of patients will suffer from these side-effects. Using a 10% confidence level, test the validity of the company's statements.

Problem 4: A night nurse with a statistics inclination ponders about the American obesity crisis. Although much of this has to do with diet and exercise, the nurse wonders whether it is the case that people are being 'born larger' from birth. From medical school, the nurse recalls that the typical infant weight is normally distributed with mean 7.5 lbs with 68% of infants born between 6.3 lbs and 8.7 lbs. In their spare time over the next few weeks, they examine the medical records at the hospital and finds that the average birth weight of 223 infants born at the hospital that year was 7.6 lbs. Based on the data discovered by the nurse, is there evidence (say at the 1% significance level) to suggest that babies are being 'born heavier'?

Problem 5: A statistician is reading the paper one day when he notices an article in the Food & Health portion written by a food critic. The critic discusses the difference between cheap 'fast food' and higher end restaurants. Among the reasons for spending the extra money for a higher end restaurant, the critic mentions that service is much better at a high-end dining establishment in comparison to a more family style eating establishment. The statistician pulls up some of the papers old restaurant reviews written by various critics and finds (on a 25 point scale), 7 high-end establishments received on average 20 stars with standard deviation 1.2 while 5 family style restaurants received on average 18 stars with standard deviation 0.8. Assuming both samples were normally distributed, discuss whether there is evidence to suggest that high-end restaurants deliver higher quality service at the 10% significance level.

Problem 6: The Inheritance Foundation has a group of data scientists that showing runners motivational posters of cats before a race will increase the speed at which they run. While firmly believing this to be true, a consultant to the firm suggests that they test the hypothesis before investing in the cutest cats they can find to produce a new line of motivational running posters. The company hires a group of runners and examines their times in a race on Monday. The next day, after having rested, the group is shown the cat posters while loud cat meows are blared through a loudspeaker system. They are then made to run the same distance as before. The results are summarized below. Assuming that running times for average runners is normally distributed, test

Runner	1	2	3	4	5	6	7	8
Pre–Time, s	15.9	17.4	11.0	16.3	16.0	13.2	14.8	10.1
Post–Time, s	12.2	14.3	14.4	12.9	16.5	15.5	13.8	14.7

whether the cat motivational posters have any effect on running times at the 5% significance level.

Problem 7: Anemia is a condition where hemoglobin fails to carry enough oxygen to the body for its needs or the body simply lacks sufficient red blood cells. In fact, anemia is the most common blood condition in the United Stated. The most common form of anemia is iron-deficiency anemia. In anemic children, where the anemia is not too severe, a vitamin supplement of 8–11 mg per day. These are often taken with ascorbic acid (Vitamin C) to help absorption. A drug company believes

Group	n	Mean (Days)	Standard Deviation (Days)
Group 1	24	176.3	16.7
Group 2	21	155.7	16.3

they have created a pill to help stimulate the production of iron when supplements are taken to reduce the length of time these patients need to be on the supplements. They test a placebo group (Group 1) and a supplement group (Group 2) for the possible efficacy of this new treatment. The

data is given above. Give a 95% confidence interval for the mean difference of the two treatment lengths. Test the hypothesis that their new 'iron boosting' drug is effective at decreasing treatment time at the 5% significance level.

Problem 8: A researcher investigating early childhood development looks at honesty among children ages 5 to 8. Both boys and girls in this age group were asked whether they would turn in a toy found at the school playground or keep it for themselves. Of the children asked, 23 of the 27 girls said yes while 19 of the 52 boys asked said yes. At the 5% significance level, test whether there is a difference between the boy/girl response to the question.

Problem 9: A student at Stanford University wonders whether there is a true difference between the intelligence of a student at the University in comparison to the average citizen. Having no basis to compare such a vague notion as 'intelligence' any other way, the student decides to compare Stanford student IQ to that of the traditional population. The typical American has IQ 98 with variance 101.3. Measuring the IQ of 37 Stanford students, the student measures an average IQ of 104. At the 5% significance level, is there enough evidence to suggest that a Stanford student is 'more intelligent' than the typical American?

Problem 10: A educational methodology researcher wants to compare a computer-based self-learning style for teaching 4^{th} grade students elementary chemistry topics compared to more physical hands-on approach to chemistry to see whether there is any difference in the two methods in producing learning results in any direction. To conduct the study, the researcher contacts a local school to gather participants for the study. The school and parents agree and 12 fourth grade students are selected. Students are broken into groups of equal learning abilities and one is given the computer approach and the other a hands-on approach. At the end of the week, the students are given an exam on the topics covered. The results are summarized below Assuming grades for any

Group	Computer	Hands–On
1	71	76
2	74	79
3	78	75
4	74	76
5	77	78
6	75	74

interactive learning method are typically normally distributed, test whether there is a difference in the two teaching methods at a 10% significance level.

Problem 11: A drug company produces a new hormone treatment to help those with particular mental illnesses. Due to differences in hormone levels in males and females, the company wants to see if the drug is more/less effective between the genders. Out of the estimated 237,345 individuals in the United States with the applicable mental illnesses, the company tests the treatment on 103 women and 196 men. The treatment was found to be effective for 53 of the females and 98 of the males. Construct a 90% confidence interval for the difference of effectiveness of the treatment between the genders. Using a significance level of 5%, is there evidence that the treatment is more/less effective for one gender?

Problem 12: A food processing company uses an automated system to package the various products produced at their larger warehouse. While the machines are very efficient, the company has been looking to increase packaging speeds to keep up with the growing demand for their products. Their current model packing machine is run for 12 trials and found to package a standard single crate shipment in the following amounts of time (in seconds): 8.214, 7.609, 7.972, 8.487, 7.904, 8.427, 5.056, 8.314, 8.097, 8.606, 6.693, and 7.034. The company examines a similar model packaging device from the same company. Before buying the device in bulk, they purchase one and test to see if the machine is faster. They find it packages the same loads in the following times: 7.832, 5.795, 7.756, 8.236, 8.157, 5.890, 7.731, 6.651, 5.367, 6.042, 6.148, and 7.050 seconds. Test at $\alpha = 0.10$ whether this alternate machine runs more efficiently than the current model.

Problem 13: A newly hired faculty at a teaching university wonders whether their teaching style for an introductory Statistics class has been effective in improving student understanding of essential statistics concepts. Out of the professors large lecture of 131 students, the professor gets 6 student volunteers taking an exam testing the basic concepts. The professor hopes that the class average will be at least a 70 on such an exam. The 6 students take the exam – none with particularly surprising/odd grades. The students obtained a score of 67, 89, 78, 72, 85, and 88. Construct a 99% confidence interval for the predicted student average on the exam. Should the professor be concerned? Test the hypothesis that the class average will be a 70 compared to the hypothesis that the students will be very proficient on the basic concepts exam at the 5% significance level.

Problem 14: Investigating the lifestyle differences between 'older generation' individuals and 'newer old' generation individuals, i.e. now aging millennials, a research group polls 1,729 adults on whether they regularly play a video game: computer, game console, smart phone, or otherwise. Of the 897 responders to the survey, the group finds that 422 of the responders regularly plays a video game of some sort. Construct a 90% confidence interval for the percentage of 'new adults' that play video games regularly. How many individuals would have to respond to the survey to guarantee an error of at most 0.5% in this estimate? Older surveys find that on average only 43% of adults play video games regularly, investigate whether the newer millennial generation adults play video games more than previous generations at a 1% significance level.

Problem 15: A university gives its students a college Mathematics preparedness exam to determine if the new incoming students are ready for their college mathematics classes. While the scores tend to be normally distributed, breaking students into groups, a mathematics professor observes there seems to be a discrepancy among the student outcomes. The instructor notices that their female students tend to be able to manage their mathematics classes better than the typical male student. Given this, the professor wonders if this can be predicted using the incoming exam scores. Examining 9 incoming female freshmen scores, the professor records a mean of 94.7 with standard deviation 2.8 while for 11 incoming male freshmen students the professor finds a mean of 87.3 with standard deviation 5.6. Using this data, construct a 90% confidence interval for the difference in female–male incoming freshman exam performance. Using a significance level of 5%, is there sufficient evidence based on this preparedness exam that a typical female students will outperform a typical male student in the early mathematics classes?