**Quantitative Methods Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Midterm Exam Spring 2014, Aaron Hill**

*Instructions: Answer the following questions thoroughly, and remember to describe and interpret your results. Include relevant information about your assumptions, methods or tests used, calculations, and interpretations. Remember to show all of your work; attach extra pages as needed. Some problems use fictitious data examples and do not represent actual research.*

**SECTION ONE***Computation and interpretation*

1. A company installs 5,000 light bulbs. The average bulb life is 500 hours, with a standard deviation of 100 hours and a distribution that is approximately normal.
   1. What is the probability that a bulb chosen at random will last more than 750 hours *(5 points)*
   2. How many of the bulbs will last at least 400 hours? *(5 points)*

*Show your work:*

1. The Norwegian University of Science and Technology in Trondheim, Norway conducted a study on high-intensity interval training, a type of workout that consists of very brief bouts of very strenuous exercise. Scientists divided 21 healthy subjects into two groups to complete either:
   1. 24 high-intensity training sessions throughout a time period of *eight* weeks (**moderate frequency**),

or,

* 1. 24 high-intensity training sessions throughout a time period of *three* weeks (**high frequency**)

The following table shows the differences in VO2max after each group completed 16 sessions. VO2max is defined as the maximum rate of oxygen consumption (VO2max levels are generally higher in those considered to be healthy and fit). At the start of the study, the average VO2max was the same between the two groups. After 16 sessions:

|  |  |  |
| --- | --- | --- |
| **VO2max** | **Moderate**  **Frequency**  **Group** | **High**  **Frequency**  **Group** |
| Average | 55.2 | 51.9 |
| Standard Deviation | 3.1 | 3.2 |
| Sample Size | 10 | 11 |

2.1. What type of statistical test should be used to test this hypothesis? *(4 points)*

1. a one-tail, one-sample test
2. a one-tail, two-sample test
3. a two-tail, one-sample test
4. a two-tail, two-sample test

2.2. State the null and research hypotheses. *(4 points)*

2.3. Which probability distribution should you use, and what is the critical value? *(5 points)*

**Given: Degrees of Freedom (df) = 19**

1. Z distribution, with a Z-critical of ±1.96
2. Z distribution, with a Z-critical of + *or* - 1.65
3. t distribution, with a t-critical of ±2.093
4. t distribution, with a t-critical of + *or* - 1.729

2.4. Compute the test statistic. *(3 points)*

**Given:**

2.5. How would you explain the results? *(3 points)*

1. reject the null hypothesis; the difference is statistically significant
2. accept the null hypothesis; the difference is statistically significant
3. reject the null hypothesis; the difference is not statistically significant
4. accept the null hypothesis; the difference is not statistically significant

2.6. If the standard deviation for each group was doubled, what would likely be different about the result in the test for statistical significance? *(3 points)*

1. the difference would become statistically significant
2. the difference would no longer be statistically significant
3. no change in the result

2.7. If the sample size for each group was greater than 100, what would likely be different about the result in the test for statistical significance? *(3 points)*

1. the difference would become statistically significant
2. the difference would no longer be statistically significant
3. no change in the result

2.8. Interpret the results and discuss the possible implications of these findings. *(5 points)*

1. A new national survey by the Pew Research Center was conducted February 14-23 among 1,821 adults. It found that 1,329 of the respondents said that immigrants currently living in the U.S. illegally should have a way to stay legally. At a 95% level of confidence, estimate the population proportion of those who believe that illegal immigrants should have a way to stay legally. Interpret the results. *(10 points)*

**SECTION TWO, ESSAY**: Researchers rarely have data on the full population that they are studying. In order to learn about their population, they draw a sample from it in order to infer meaning about the entire population. However, this inference is only permissible and/or credible under certain circumstances. What are these circumstances? What are the mechanisms by which these inferences are possible? What statistical principles and theories underlie these mechanisms? *In detail*, list, describe, define, and explain the process by which statistical inference is made. *(20 points)*

**SECTION THREE***Multiple choice.* Circle the *best* answer. (3 points each)

1. In a statewide database of social workers, we know that all social workers average 10.2 years of experience. In a random sample, 203 social workers in a specific city average only 8.7 years, with a standard deviation of 0.52. Are social workers in the city significantly *less* experienced than all workers in the state? To test this, you should use:
   1. a one-tail, one-sample hypothesis test
   2. a one-tail, two-sample hypothesis test
   3. a two-tail, one-sample hypothesis test
   4. a two-tail, two-sample hypothesis test
2. The standard deviation of [11, 33, 100] is:
   1. 37.85
   2. 46.36
   3. 48
   4. 2,149
3. What is the probability that you’d draw a Queen of Hearts from a full, shuffled deck of 52 cards?

* 1. 0.25
  2. 0.08
  3. 0.04
  4. 0.02

1. The interquartile range of [5, 6, 8, 11, 20, 23, 28, 29, 30, 30, 31, 33, 34, 35, 99, 100] is:

* 1. 11
  2. 22
  3. 33
  4. 95

1. In inferential statistics, which of the following sampling techniques is the *least* credible:
   1. simple random sample
   2. systematic sample
   3. cluster sample
   4. convenience sample
   5. stratified sample
2. The margin of error:
   1. defines the upper and lower bounds of a range that a population value likely falls within
   2. can be used as an alternative to confidence intervals to express estimated sampling error
   3. is used to compute confidence intervals
   4. all of the above
3. Sampling distributions are \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_ change shape:

* 1. actual, can
  2. actual, cannot
  3. theoretical, can
  4. theoretical, cannot

1. Which Z score would correspond with an alpha of 0.0001?:

* 1. 2.58
  2. 3.29
  3. 4.00
  4. some value greater than 4.00

1. If you say something is not statistically significant but there really is an effect in the population, you have committed which type of error?:
   1. Alpha / Type I error
   2. Alpha / Type II error
   3. Beta / Type I error
   4. Beta / Type II error
2. True / Fall *(1 point each)*
   1. TRUE / FALSE : Statistical significance *proves* that a phenomenon in a population is real.
   2. TRUE / FALSE : A normally distributed variable can be skewed, as long as the mean is 0 and the standard deviation is 1.
   3. TRUE / FALSE : the Sum of Squares, Variance, and Standard Deviation are all measures of variance.