MTH 498
Exam 2
Spring 2014

1. The random variable X has moment generating function $(1-2t)^{-6}$, and Y has moment generating function $(1-2t)^{-8}$. Assume X and Y are independent. Determine the distribution of the random variable $W = \dfrac{4X}{3Y}$.

2. Let the distribution of W be $F(4, 10)$. Find the following:

(a) $F_{0.05}(4, 10)$

(b) $F_{0.95}(4, 10)$

(c) $P(0.1131 \leq W \leq 5.99)$

3. A machine is used to fill plastic bottles with bleach. A sample of 18 bottles had a mean fill volume of 2.007 L and a standard deviation of 0.010 L. The machine is then moved to another location. A sample of 10 bottles filled at the new location had a mean fill volume of 2.001 L and a standard deviation of 0.012 L. It is believed that moving the machine may have changed the mean fill volume, but it is unlikely to have changed the standard deviation. Assume that both samples come from approximately normal populations. Find a 99% confidence interval for the difference between the mean fill volumes at the two locations.

4. A random sample of $n = 9$ wheels of cheese yielded the following weights in pounds, assumed to be $N(\mu, \sigma^2)$.

21.50 18.95 18.55 19.40 19.15 22.35 22.90 22.20 23.10

Find a 90% confidence interval for σ.

5. A group of five individuals with high blood pressure were given a new drug that was designed to lower blood pressure. Systolic blood pressure was measured before and after treatment for each individual, with the following results.

Subject	A	B	C	D	E
Before	170	164	168	158	183
After	145	132	129	135	145

Find a 95% confidence interval for the mean reduction in systolic blood pressure.

6. Two identical jars, jar A and jar B, contain 10 marbles each. Jar A contains 8 white and 2 red marbles, while jar B contains 4 white and 6 red marbles. A statistician is asked to select one of the jars and then to determine the contents of the jar by drawing 4 marbles with replacement from the selected jar. The statistician decides to call the jar A unless 3 or 4 selected marbles are red, in which case the jar will be called jar B.

(a) In terms of p, the proportion of red marbles in the jar, what would be the null and alternate hypotheses for the test?

(b) What is α, the size of the Type I error?

(c) What is β, the size of the Type II error?

7. Industrial firms often employ methods of "risk transfer," such as insurance or indemnity clauses in contracts, as a technique of risk management. The article "Survey of Risk Management in Major U.K. Companies" (S. Baker, K. Ponniah, and S. Smith, *Journal of Professional Issues in Engineering Education and Practice*, 1999:94–102) reports the results of a survey in which managers were asked which methods played a major role in the risk management strategy of their firms. In a sample of 43 oil companies, 22 indicated that risk transfer played a major role, while in a sample of 93 construction companies, 55 reported that risk transfer played a major role. Can we conclude that the proportion of oil companies that employ the method of risk transfer is less than the proportion of construction companies that do? With $\alpha = 0.05$, test $H_0 : p_1 - p_2 = 0$ against $H_1 : p_1 - p_2 < 0$.

1. Hypotheses

H_0 :

H_1 :

2. Test Statistic

etc.

8. In a series of experiments to determine the absorption rate of certain pesticides into skin, measured amounts of two pesticides were applied to several skin specimens. After a time, the amounts absorbed (in μg) were measured. For pesticide A, the variance of the amounts absorbed in 6 specimens was 2.3, while for pesticide B, the variance of the amounts absorbed in 10 specimens was 0.6. Assume that for each pesticide, the amounts absorbed are a simple random sample from a normal population. Can we conclude that pesticide A and pesticide B have different variances with respect to the amount absorbed? Test using $\alpha = 0.05$.

1. Hypotheses

H_0 :

H_1 :

2. Test Statistic

etc.

9. The article "Inconsistent Health Perceptions for US Women and Men with Diabetes" (M. McCollum, L. Hansen, et al., *Journal for Women's Health*, 2007:1421–1428) presents results of a survey of adults with diabetes. Each respondent was categorized by gender and income level. The numbers in each category are presented in the following table.

	Men	Women
Poor	156	348
Near Poor	77	152
Low Income	253	433
Middle Income	513	592
High Income	604	511

Use $\alpha = 0.05$ to test whether gender and income level are independent.

1. Hypotheses

H_0 :

H_1 :

2. Test Statistic

etc.