

# Business Statistics

## Homework #4, Spring 2013

**Instructions: For all problems, use the 7 Steps in Hypothesis testing and round all z and t-values to 2 decimal places. Small samples are collected from normally distributed populations. Large sample samples are collected from populations with an unknown distribution.**

### Problem 1

intouch-quality.com—*The process for manufacturing a tennis ball has not changed in over 100 years, but the tennis ball inspection process continues to advance with modern technology. Tennis balls were historically manufactured in Europe and USA until recently when the need to have lower labor costs, and cheaper raw materials shifted manufacturing to the Far East.*



*A rebound test is also performed in the inspection process which did involve dropping a tennis ball vertically from the height of 100" and then measuring the rebound. The rebound range should be 55.5in. Equipment used in laboratories consist of a vacuum pipe that holds the tennis ball at the specified height. Then it is released onto a smooth, granite block. The tennis ball bounces and a camera records the height of the bounce. This video will then be analyzed to view the bounce in real time and then an accurate calculation of the height will be provided.*

Therefore, when ordering tennis balls for the US Open, a shipment of 2,600 tennis balls were shipped to USTA. A sample of 117 tennis balls was tested to see if they fulfilled the above rebound specifications. The average rebound was 54.82 inches with a standard deviation of 4.12 inches. Should the USTA keep the shipment or return the tennis balls to the manufacturer?

- Interpret your results with 90% confidence.
- Interpret your results with 95% confidence.

## Problem 2



theonlinemom.com—A new survey conducted for Verizon Wireless and Parenting.com has found that the average age for a first cell phone has fallen to 11.6-years-old. And it looks like this trend is set to continue: 10 percent of parents report that their children were between the ages of 7 and 9 when they received their first phone.

When asked about the reasons for providing their children with cell phones, over 95 percent of parents said it was for emergencies or for the parents' peace of mind, knowing that they can reach their children at all times. However, despite this concern for their children's physical safety and whereabouts, there is less emphasis on safe use of the phone itself: As many as one in five parents haven't set up any rules for how their children's phones should be used.

When asked how they think their children use their phones, the overwhelming majority said they use them for calling (51.4 percent) or texting (41.9 percent). Less than 7 percent think their children use their phones for online apps, social media, or taking photos and video.

Therefore, the average age that a child gets his or her first phone is 11.6 years old. Still, claims have been made that the age is lowering. A sample of 50 parents in Nebraska were asked what age their child received his or her first cell phone. The mean age was 11.3 years old with a standard deviation of 1.3 years.

- a) Using  $\alpha = .05$ , can you conclude that the average age a child gets his or her first cell phone is decreasing?
- b) Using  $\alpha = .05$ , can you conclude that the average age a child gets his or her first cell phone is increasing?

### Problem 3

Golfballs101—*In order for a golf ball manufacturing company to sell their golf balls to the public, each ball must pass the golf ball testing requirements provided by the United States Golf Association (USGA). Each ball is measured, weighed and examined in a number of different areas in order to make sure it is up to standard with the USGA golf ball standards. Here is a list some of the specifications which must be met before any golf ball becomes available for actual use:*



**Weight-** *Appendix III of the USGA golf ball testing requirements states that a ball must not weigh more than 1.620 ounces. There is no minimum weight requirement for a golf ball, therefore a ball can be as light as the manufacturers would like.*

**Size-** *The required size for a golf ball to pass this part of testing states the ball must have a diameter of at least 1.680 inches. There is no maximum size for a golf ball and as long as it does not exceed the weight requirements stated above, the golf ball will be conformed (legal to use).*

The golf manufacturing company, Titleist, takes a sample of its golf balls that are manufactured each day to make sure they meet testing requirements. Titleist took a sample of 27 golf balls. The average weight was 1.626 ounces with a standard deviation of .012 ounces; the average diameter was 1.691 inches with a standard deviation of .043 inches.

- a) Are Titleist's golf balls meeting the weight requirements? (Let  $\alpha = .01$ )
- b) What is the Type I error in this situation? What are the consequences of making this error?
- c) What is the Type II error in this situation? What are the consequences of making this error?
  
- d) Are Titleist's golf balls meeting the size requirements? (Let  $\alpha = .10$ )
- e) What is the Type I error in this situation? What are the consequences of making this error?
- f) What is the Type II error in this situation? What are the consequences of making this error?

#### Problem 4



msnbc.com—*In the proverbial battle of the sexes, women are better drivers than men. Or so says a new study by an online auto insurance group that hopes to dispel the long-standing notion that women are bad drivers.*

*Some 80 percent of all fatal and serious car crashes are caused by male drivers, the study says. It says women are 27 percent less likely than men to cause auto accidents. In 2007, statistics reveal men were involved in 6.1 million car accidents while women were involved in 4.4 million. Male drivers outnumber females 3 to 1 for DUI violations, according to the study.*

After analyzing data, researchers believe there is also a relation between auto insurance prices for men and women. A sample of 34 men resulted in a six-month insurance policy averaging \$765 with a standard deviation of \$161 while a sample of 40 women resulted in a six-month insurance policy averaging \$698 with a standard deviation of \$89. Test if men's six-month insurance policies cost more than women's six-month insurance policies. (Let  $\alpha = .02$ )



## Problem 5



Foxnews.com— *A sun shines on Dan Yu's back, alongside a swimming koi fish. A tree soon may grow on his arm. "Your body's an empty canvas, so you almost want to continue to add to it," said Yu, 28, as he showed off his tattoos.*

*A generation or two ago, Yu's tattoos — to say nothing of his pierced nose — probably would have placed him in a select company of soldiers, sailors, bikers and carnival workers. But no longer: The American University employee is among about 36 percent of Americans age 18 to 29 with at least one tattoo,*

*according to a survey.*

*The study, scheduled to appear Monday on the Web site of the Journal of the American Academy of Dermatology, provides perhaps the most in-depth look at tattoos since their popularity exploded in the early 1990s.*

*The results suggest that 24 percent of Americans between 18 and 50 are tattooed; that's almost one in four. Two surveys from 2003 suggested just 15 percent to 16 percent of U.S. adults had a tattoo.*

*"Really, nowadays, the people who don't have them are becoming the unique ones," said Chris Keaton, a tattoo artist and president of the Baltimore Tattoo Museum. For tattoos, 13 percent of respondents had problems with healing. Generally, the Food and Drug Administration receives few reports of complications from tattoos.*

Test the claims that more than 36% of Americans age 18 to 29 have at least one tattoo while over 24% Americans age 18 to 50 are tattooed.

- a) A survey of 49 individuals age 18 to 29 was taken to see if the claim holds true. Out of the 49 individuals sampled, 20 individuals had at least one tattoo. Using  $\alpha = .05$ , what conclusion can be made?
- b) Likewise a sample of 83 individuals ages 18 to 50 was taken. Out of the 83 individuals, 25 individuals were tattooed. With 90% confidence, what conclusion can be made?

## Problem 6

*huffingtonpost.com—The Lumina Foundation for Education's recent report, "A Stronger Nation Through Higher Education," stresses the importance of college degrees for American adults and calls for increased rates of educational attainment. Presently, 37.9 percent of Americans hold college degrees, and the foundation recommends that number increase to 60 percent by 2025. Currently, Americans holding a graduate or professional degree make up 10.70 percent.*



As stated above, 37.9% of Americans hold some form of college degree while 10.70% of Americans hold a graduate or professional degree. A survey of 113 Americans was taken to see if any difference occurred from given percentages. Out of the 113 Americans surveyed, 50 had some form of a college degree while only 9 had a graduate or professional degree.

- a) With 90% confidence, can you conclude that the proportion of Americans with a college degree has increased since the Lumina Foundation findings?
- b) The current Department of Education Chairman believes that the percent of Americans getting graduate degrees is decreasing. At a .20 level of significance, does the survey support the chairman's belief?

Problem 7

Huffingtonpost.com—Additionally, the percentage of adults (age 25-64) with at least an associate degree was found for each state by the Lumina Foundation for Education. Focusing on Nebraska, adults (ages 25-64) with at least an associate degree made up 41.99% of the population. Still, you decided to break it down to the county level believing that Buffalo County would have a higher percentage of adults with at least an associate college degree than Lincoln County.



A sample from each county was taken to see if your claim held true. Use the table below to determine if a higher percent of adults in Buffalo County have at least an associate degree than Lincoln County.

- Interpret your results with 80% confidence.
- Interpret your results with 90% confidence.

	Buffalo	Lincoln
<b>Number of adults sampled</b>	57	73
<b>Number of adults with at least an associate degree</b>	23	24



## Problem 8

U.S. Airlines vary in numerous ways. Researchers want to determine the factors which cause each airline to have different fleet sizes. In the Excel Spreadsheet Airlines, several U.S. Airlines are listed with the year they were founded and the number of destinations they fly to. Researchers believe that these two characteristics are what help determine the number of planes (fleet size) each airline owns.



- a) Using Excel, create a Scatter Graph for the “fleet sizes” by the “year founded” and a Scatter Graph for “fleet sizes” by the “number of destinations”.
- b) Use regression analysis to develop an estimated regression equation that could be used to estimate the airline's fleet size given the year in which it was founded. Write the regression equation. Use the 7 steps of hypothesis testing to see if the year in which the airline was founded is significant.
- c) Use regression analysis to develop an estimated regression equation that could be used to estimate the airline's fleet size given the number of airline destinations. Write the regression equation. Use the 7 steps of hypothesis testing to see if the number of airline destinations is significant.