

Hypothesis Testing

- 1) The Environmental Protection Agency releases figures on urban air soot in selected cities. For the city of Amritsar, the EPA claims that the average number of micrograms of suspended particles per cubic meter of air is 82. Suppose Amritsar officials have been working with businesses, commuters, and industries to reduce this figure. These city officials hire an environmental company to take random measures of air soot over a period of several weeks. The resulting data follow. Assume that the population standard deviation is 9.184. Use these data to determine whether the urban air soot in Amritsar is significantly lower than it was when the EPA conducted its measurements. Let $\alpha = .01$. If the null hypothesis is rejected, discuss the substantive hypothesis.

81.6	96.6	66.6	78.6	70.9	76.1	82.5
80.0	68.6	77.3	74.0	86.6	68.7	71.7
83.0	88.5	85.8	74.9	61.7	92.2	58.3
73.2	86.9	87.0	71.6	85.5	94.9	72.5
72.4	73.2	76.6	83.0			

- 2) According to the Bureau of Labor Statistics, the average weekly earnings of a production worker in manufacturing as of October 2018 was Rs.867.60. Suppose a labor analyst wants to test to determine whether this figure is still accurate today. The analyst randomly selects 54 production workers from across the country and obtains a representative earnings statement for one week from each worker. The resulting sample average is Rs. 886.30. Assuming a population standard deviation of Rs. 63.90 and a 5% level of significance, determine whether the mean weekly earnings of a production worker have changed.
- 3) According to a study several years ago by the Personal Communications Industry Association, the average cell phone user earns Rs. 62,600 per year. Suppose an analyst believes that the average annual earnings of a cell phone user are lower now, and he sets up a study in an attempt to prove his theory. He randomly samples 18 cell phone users and finds out that the average annual salary for this sample is Rs. 58,974, with a population standard deviation of Rs. 7,810. Use $\alpha = .01$ to test the analyst's theory. Assume wages of cell phone users are normally distributed in the population.
- 4) A manufacturing company produces valves in various sizes and shapes. One particular valve plate is supposed to have a tensile strength of 5 kg/mm. The company tests a random sample of 42 such valve plates from a lot of 650 valve plates. The sample mean is a tensile strength of 5.0611 kg/mm, and the population standard deviation is 0.2803 kg/mm. Use $\alpha = .10$ and test to determine whether the lot of valve plates has an average tensile strength of 5 kg/mm.
- 5) According to a report released by CIBC entitled "Women Entrepreneurs: Leading the Charge," the average age for businesswomen in 2008 was 41. In the report, there was some indication that analysts believed that this mean age will increase. Suppose now, a few years later, business analysts in want to test to determine if, indeed, the mean age of businesswomen has increased. The analysts randomly sample 97 businesswomen and ascertain that the sample mean age is 43.4. From past experience, it is known that the population standard deviation is 8.95. Using a 1% level of significance, test to

determine if the mean age of businesswomen has increased. What is the p -value for this test? What is the decision? If the null hypothesis is rejected, is the result substantive?

- 6) According to HowtoAdvice.com, the average price charged to a customer to have a 12' by 18' wall-to-wall carpet shampoo cleaned is about Rs.50. Suppose that a start-up carpet-cleaning company believes that in the region in which it operates, the average price for this service is higher. To test this hypothesis, the carpet-cleaning company randomly contacts 23 customers who have recently had a 12' by 18' wall-to-wall carpet shampoo cleaned and asks the customers how much they were charged for the job. Suppose the resulting data are given below and that the population standard deviation price is Rs.3.49. Use a 10% level of significance to test the hypothesis. Assume that such prices are normally distributed in the population. What is the observed value? What is the p -value? What is the decision? If the null hypothesis is rejected, is the result substantive?

52	52	56	50	50	51	49	49	54	51
51	48	56	52	52	53	56	52	52	56
57	48	53							

- 7) A hole-punch machine is set to punch a hole 1.84 cm in diameter in a strip of sheet metal in a manufacturing process. The strip of metal is then creased and sent on to the next phase of production, where a metal rod is slipped through the hole. It is important that the hole be punched to the specified diameter of 1.84 cm. To test punching accuracy, technicians have randomly sampled 12 punched holes and measured the diameters. The data (in cm) follow. Use an alpha of .10 to determine whether the holes are being punched an average of 1.84 cm. Assume the punched holes are normally distributed in the population.

1.81	1.89	1.86	1.83	1.85	1.82	1.87	1.85	1.84	1.86
1.88	1.85								

- 8) Suppose a study reports that the average price for a gallon of self-serve regular unleaded gasoline is \$2.76. You believe that the figure is higher in your area of the country. You decide to test this claim for your part of the United States by randomly calling gasoline stations. Your random survey of 25 stations produces the following prices. Assume gasoline prices for a region are normally distributed. Do the data you obtained provide enough evidence to reject the null hypothesis? Use a 1% level of significance.

2.87	2.89	2.76	2.80	2.97	2.80	2.83	2.79	2.80	2.84
2.76	2.67	2.87	2.69	2.95	2.75	2.83	2.74	2.65	2.95
2.81	2.74	2.74	2.67	2.70					

- 9) Suppose that in past years the average price per square foot for warehouses in the United States has been \$32.28. A national real-estate investor wants to determine whether that figure has changed now. The investor hires a business analyst who randomly samples 49 warehouses that are for sale across the United States and finds that the mean price per square foot is \$31.67, with a sample standard deviation of \$1.29. Assume that prices of warehouse footage are normally distributed in the population. If the analyst uses a

5% level of significance, what statistical conclusion can be reached? What are the hypotheses?

- 10) Independent Insurance Agents conducted a survey of insurance consumers and discovered that 48% of them always reread their insurance policies, 29% sometimes do, 16% rarely do, and 7% never do. Suppose a large insurance company invests considerable time and money in rewriting policies so that they will be more attractive and easy to read and understand. After using the new policies for a year, company managers want to determine whether rewriting the policies significantly changed the proportion of policyholders who always reread their insurance policy. They contact 380 of the company's insurance consumers who purchased a policy in the past year and ask them whether they always reread their insurance policies. One hundred and sixty-four respond that they do. Use a 1% level of significance to test the hypothesis.
- 11) A study by Haribhai Associates showed that 79% of companies offer employees flexible scheduling. Suppose a business analyst believes that in accounting firms this figure is lower. The analyst randomly selects 415 accounting firms and through interviews determines that 303 of these firms have flexible scheduling. With a 1% level of significance, does the test show enough evidence to conclude that a significantly lower proportion of accounting firms offer employees flexible scheduling?
- 12) A manufacturing company produces bearings. One line of bearings is specified to be 1.64 cm in diameter. A major customer requires that the variance of the bearings be no more than .001 cm². The producer is required to test the bearings before they are shipped, and so the diameters of 16 bearings are measured with a precise instrument, resulting in the following values. Assume bearing diameters are normally distributed. Use the data and $\alpha = .01$ to test to determine whether the population of these bearings is to be rejected because of too high a variance.

1.69	1.62	1.63	1.70	1.66	1.63	1.65	1.71	1.64	1.69
1.57	1.64	1.59	1.66	1.63	1.65				

- 13) A savings and loan averages about Rs.100,000 in deposits per week. However, because of the way pay periods fall, seasonality, and erratic fluctuations in the local economy, deposits are subject to a wide variability. In the past, the variance for weekly deposits has been about Rs.199,996,164. In terms that make more sense to managers, the standard deviation of weekly deposits has been Rs.14,142. Shown here are data from a random sample of 13 weekly deposits for a recent period. Assume weekly deposits are normally distributed. Use these data and $\alpha = .10$ to test to determine whether the variance for weekly deposits has changed.

93000	68000	128000	104000	87000	135000	112000	46000	104000	143000
131000	96000	71000							

- 14) The NSE recently reported that the average age of a female shareholder is 44 years. A broker in Amritsar wants to know whether this figure is accurate for the female shareholders in Amritsar. The broker secures a master list of shareholders in Amritsar and takes a random sample of 58 women. Suppose the average age for shareholders in the sample is 45.1 years, with a population standard deviation of 8.7 years. Test to determine whether the broker's sample data differ significantly enough from the 44-years figure released by the NSE to declare that Amritsar female shareholders are

different in age from female shareholders in general. Use $\alpha = .05$. If no significant difference is noted, what is the broker's probability of committing a Type II error if the average age of a female Amritsar shareholder is actually 45 years? 46 years? 47 years? 48 years?

- 15) A Harish poll was taken to determine which of 13 major industries are doing a good job of serving their customers. Among the industries rated most highly for serving their customers were computer hardware and software companies, car manufacturers, and airlines. The industries rated lowest on serving their customers were tobacco companies, managed care providers, and health insurance companies. Seventy-one percent of those polled responded that airlines are doing a good job serving their customers. Suppose due to rising ticket prices, a business analyst feels that this figure is now too high. He takes a poll of 463 respondents, and 324 say that the airlines are doing a good job of serving their customers. Does the survey show enough evidence to declare that the proportion of Indians saying that the airlines are doing a good job of serving their customers is significantly lower than stated in the Harish poll? Let alpha equal .10. If the analyst fails to reject the null hypothesis and if the figure is actually 69% now, what is the probability of committing a Type II error? What is the probability of committing a Type II error if the figure is really 66%? 60%?