PES University, Bangalore
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UE19CS203 – STATISTICS FOR DATA SCIENCE
Unit-4 - Hypothesis and Inference

QUESTION BANK

Drawing conclusions from the results of Hypothesis test:

Exercises for section 6.2: [Text Book Exercise 6.2– Pg. No. [411 – 413]]

1. For which P-value is the null hypothesis more plausible:
$$P = 0.5 \; or \; P = 0.05?$$

2. True or false:
i. If we reject H_0, then we conclude that H_0 is false.
ii. If we do not reject H_0, then we conclude that H_0 is true.
iii. If we reject H_0, then we conclude that H_1 is true.
iv. If we do not reject H_0, then we conclude that H_1 is false.

3. If $P = 0.01$, which is the best conclusion?
i. H_0 is definitely false.
ii. H_0 is definitely true.
iii. There is a 1% probability that H_0 is true.
iv. H_0might be true, but it's unlikely.
v. H_0 might be false, but it's unlikely.
vi. H_0 is plausible.

4. If $P = 0.50$, which is the best conclusion?
$i.$ H_0 is definitely false.
ii. H_0 is definitely true.
iii. There is a 50% probability that H_0 is true.
iv. H_0 is plausible, and H_1 is false.
v. Both H_0 and H_1 are plausible.

5. True or false: If $P = 0.02$, then

i. The result is statistically significant at the5%level.
ii. The result is statistically significant at the1%level.
iii. The null hypothesis is rejected at the 5% level.
iv. The null hypothesis is rejected at the 1% level.

6. George performed a hypothesis test. Luis checked George's work by redoing the calculations. Both George and Luis agree that the result was statistically significant the 5% level, but they got different *P*-values. George got a *P*-value of 0.20 and Luis got a *P*-value of 0.02.
a. Is it possible that George's work is correct? Explain.
b. Is it possible that Luis's work is correct? Explain.

7. The article "The Effect of Restricting Opening Hours on Alcohol-Related Violence" (S. Duailibi,W. Ponicki, et al., *American Journal of Public Health*, 2007:2276–2280) presented homicide rates for the years 1995–2005 for the town of Diadema, Brazil. In 2002, a law was passed requiring bars to close at 11 pm each night. After the law's passage, the homicide rate dropped by an average of 9 homicides per month, a statistically significant decrease. Which of the following is the best conclusion?

i. It is reasonable to conclude that the law is responsible for a reduction of 9 homicides per month.
ii. It is reasonable to conclude that the law is responsible for a reduction in homicides, but the actual amount might be somewhat more or less than 9 per month.
iii. It is reasonable to conclude that the homicide rate decreased, but the law may not have anything to do with the decrease.
iv. It is plausible that the homicide rate may not have decreased at all after the passage of the law.

8. Let μ be the radiation level to which a radiation worker is exposed during the course of a year. The Environmental Protection Agency has set the maximum safe level of exposure at 5 rem per year. If a hypothesis test is to be performed to determine whether a workplace is safe, which is the most appropriate null hypothesis:

$H_0 : \mu \leq 5, H_0 : \mu \geq 5, or\ H_0 : \mu = 5$? Explain.

9. In each of the following situations, state the most appropriate null hypothesis regarding the population mean μ.

a. A new type of battery will be installed in heart pacemakers if it can be shown to have a mean lifetime greater than eight years.
b. A new material for manufacturing tires will be used if it can be shown that the mean lifetime of tires will be more than 60,000 miles.
c. A quality control inspector will recalibrate a flowmeter if the mean flow rate differs from 10 mL/s.

10. The installation of a radon abatement device is recommended in any home where the mean radon concentration is 4.0 picocuries per liter (pCi/L) or more, because it is thought that long-term exposure to sufficiently high doses of radon can increase the risk of cancer. Seventy-five measurements are made in a particular home. The mean concentration was 3.72 pCi/L and the standard deviation was 1.93 pCi/L.

i. The home inspector who performed the test says that since the mean measurement is less than 4.0, radon abatement is not necessary. Explain why this reasoning is incorrect.
ii. Because of health concerns, radon abatement is recommended whenever it is plausible that the mean radon concentration may be 4.0 pCi/L or more. State the appropriate null and alternate hypotheses for determining whether radon abatement is appropriate.
iii. Compute the *P*-value. Would you recommend radon abatement? Explain.

11. It is desired to check the calibration of a scale by weighing a standard 10 g weight 100 times. Let μ be the population mean reading on the scale, so that the scale is in calibration if μ = 10. A test is made of the hypotheses $H_0 : \mu = 10\ versus\ H_1 : \mu \neq 10$. Consider three possible conclusions: (i) The scale is in calibration. (ii) The scale is out of calibration.
(iii) The scale might be in calibration.

i. Which of the three conclusions is best if H_0 is rejected?
ii. Which of the three conclusions is best if H_0 is not rejected?

iii. Is it possible to perform a hypothesis test in a way that makes it possible to demonstrate conclusively that the scale is in calibration? Explain.

12. A machine that fills cereal boxes is supposed to be calibrated so that the mean fill weight is 12 oz. Let μ denote the true mean fill weight. Assume that in a test of the hypotheses $H_0 : \mu = 12 \ versus \ H_1 : \mu \neq 12$, the *P*-value is 0.30.

i. Should H_0 be rejected on the basis of this test? Explain.

ii. Can you conclude that the machine is calibrated to provide a mean fill weight of 12 oz? Explain.

13. A method of applying zinc plating to steel is supposed to produce a coating whose mean thickness is no greater than 7 microns. A quality inspector measures the thickness of 36 coated specimens and tests $H_0 : \mu \leq 7 \ versus \ H_0 : \mu > 7$. She obtains a *P*-value of 0.40. Since *P* > 0.05, she concludes that the mean thickness is within the specification. Is this conclusion correct? Explain.

14. Fill in the blank: A 95% confidence interval for μ is *(*1.2*,* 2.0*)*. Based on the data from which the confidence interval was constructed, someone wants to test

$H_0 : \mu = 1.4 \ versus \ H_1 : \mu \neq 1.4$. The *P*-value will be

i. Greater than 0.05

ii. Less than 0.05

iii. Equal to 0.05

15. Refer to Problem 8. For which null hypothesis will *P* = 0.05?

i. $H_0 : \mu = 1.2$

ii. $H_0 : \mu \leq 1.2$

iii. $H_0 : \mu \geq 1.2$

16. A scientist computes a 90% confidence interval to be *(*4.38*,* 6.02*)*. Using the same data, she also computes a 95% confidence interval to be *(*4.22*,* 6.18*)*, and a 99% confidence interval to be *(*3.91*,* 6.49*)*. Now she wants to test $H_0 : \mu = 4 \ versus \ H_1 : \mu \neq 4$. Regarding the *P*-value, which one of the following statements is true?

$i. P > 0.10.$
$ii. 0.05 < P < 0.10.$
$iii. 0.01 < P < 0.05.$
$iv. P < 0.01.$

17. The strength of a certain type of rubber is tested by subjecting pieces of the rubber to an abrasion test. For the rubber to be acceptable, the mean weight loss μ must be less than 3.5 mg. A large number of pieces of rubber that were cured in a certain way were subject to the abrasion test. A 95% upper confidence bound for the mean weight loss was computed from these data to be 3.45 mg. Someone suggests using these data to test $H_0 : \mu \geq 3.5$ $versus$ $H_1 : \mu < 3.5$.

i. Is it possible to determine from the confidence bound whether $P < 0.05$? Explain.

ii. Is it possible to determine from the confidence bound whether $P < 0.01$? Explain.

18. A shipment of fibers is not acceptable if the mean breaking strength of the fibers is less than 50 N. A large sample of fibers from this shipment was tested, and a 98% lower confidence bound for the mean breaking strength was computed to be 50.1 N Someone suggests using these data to test the hypotheses

$$H_0 : \mu \leq 50 \; versus \; H_1 : \mu > 50.$$

i. Is it possible to determine from the confidence bound whether $P < 0.01$? Explain.

ii. Is it possible to determine from the confidence bound whether $P < 0.05$? Explain.

19. Refer to Problem 17. It is discovered that the mean of the sample used to compute the confidence bound is $X = 3.40$. Is it possible to determine whether $P < 0.01$? Explain.

20. Refer to Problem 18. It is discovered that the standard deviation of the sample used to compute the confidence interval is 5 N. Is it possible to determine whether $P < 0.01$? Explain.

21. The following MINITAB output (first shown in Exercise 14 in Section 6.1) presents the results of a hypothesis test for a population mean μ.

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One-Sample Z: X

Test of mu = 73.5 vs not = 73.5
The assumed standard deviation = 2.3634

Variable    N     Mean   StDev  SE Mean        95% CI               Z      P
X         145  73.2461  2.3634   0.1963  (72.8614, 73.6308)  -1.29  0.196
```

a. Can H_0 be rejected at the 5% level? How can you tell?

b. Someone asks you whether the null hypothesis $H_0: \mu = 73$ versus $H_1: \mu \neq 73$ can be rejected at the 5% level. Can you answer without doing any calculations? How?