CENG 222

Statistical Methods for Computer Engineering

Spring '2016-2017

Assignment 4

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Answer 9.8

a.

Let μ denote the mean installation time in minutes. What we want is a 95% confidence interval for μ. The 95% confidence means that $1 - \alpha = 0.95$. $n = 64$, $X = 42$ min, and $\sigma = 5$. Since σ is known, we can calculate our Z interval:

$$X \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} = 42 \pm (1.96) \frac{5}{\sqrt{64}} = 42 \pm 1.225 = [40.775, 43.225]$$

where $Z_{0.025} = 1.96$ is obtained from the normal table (Table A4). The mean installation time is between 40.8 and 43.2 min, with 95% confidence.

b.

We first get the Z score for the two values. As $Z = (x - \mu)\frac{\sqrt{n}}{\sigma}$ then;

$$x1 = lowerbound = 40.775$$
$$x2 = upperbound = 43.225$$
$$\mu = mean = 40$$

Thus, the two Z scores are

$$z1 = lowerzscore = (40.775 - 40)\frac{\sqrt{64}}{5} = 1.240$$
$$z2 = upperzscore = (43.225 - 40)\frac{\sqrt{64}}{5} = 5.160$$

Using table, the left tailed ares between theze Z scores are:

$$P(Z < z1) = 0.892$$
$$P(Z < z2) = 0.999$$

Thus the are between them, by subtracting these areas is;

$$P(z1 < Z < z2) = 0.107$$

Answer 9.16

Let n_1 =250, $n_2 = 300$, $p_1 = \frac{10}{250} = 0.04$, and $p_2 = \frac{18}{300} = 0.06$.

a.

A 98% confidence interval for $P_1 - P_2$is

$$\begin{aligned}
&= (p_1 - p_2) \pm z_{\frac{0.02}{2}}\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}} \\
&= (0.04 - 0.06) \pm z_{0.01}\sqrt{\frac{(0.04)(0.96)}{250} + \frac{(0.06)(0.94)}{300}} \\
&= (0.04 - 0.06) \pm 2.33\sqrt{\frac{(0.04)(0.96)}{250} + \frac{(0.06)(0.94)}{300}} \\
&= (-0.0631, 0.0231)
\end{aligned}$$

b.

From confidence interval, one can conclude that there is no significant difference between the quality of two sets.

Answer 10.3

Let's first calculate our array.

$$(< -2.0) --> 4$$
$$(-2.0, -1.5) --> 4$$
$$(-1.5, -1.0) --> 15$$
$$(-1.0, -0.5) --> 9$$
$$(-0.5, 0.0) --> 22$$
$$(0.0, 0.5) --> 15$$
$$(0.5, 1.0) --> 12$$
$$(1.0, 1.5) --> 11$$
$$(1.5, 2.0) --> 7$$
$$(> 2.0) --> 1$$

a.

The corresponding standard normal probabilities and the expected number of observations with $n = 100$ are the following:

Array	Normal Prob.	Expected Counts	Observed- Expected	Chi Value
(Less than -2.0)	0.023	2.3	1.7	1,12
(-2.0,-1.5)	0.044	4.4	-0.4	-0,19
(-1.5,-1.0)	0.092	9.2	5.8	1,91
(-1.0,-0.5)	0.150	15.0	-6.0	-1,54
(-0.5,0.0)	0.191	19.1	2.9	0,66
(0.0,0.5)	0.191	19.1	-4.1	-0,93
(0.5,1.0)	0.150	15.0	-3.0	0,77
(1.0,1.5)	0.092	9.2	1.8	0,59
(1.5,2.0)	0.044	4.4	2.6	1,24
(More than 2.0)	0.023	2.3	-1.3	-0,85

The chi-square statistic is the sum of the squares of the values in the last column, and is equal to 12,76.
Data are divided into 10 bins and we estimated 2 parameters, we have 7 degrees of freedom. Since 12,76 is less than 14,1 we do not reject the null hypothesis that the data are normally distributed.

b.

If the distribution is uniform, then we have;

Array	Normal Prob.	Expected Counts	Observed- Expected
(Less than -2.0)	0.166	16.6	-12.2
(-2.0,-1.5)	0.083	8.3	-4.3
(-1.5,-1.0)	0.083	8.3	6.7
(-1.0,-0.5)	0.083	8.3	0.7
(-0.5,0.0)	0.083	8.3	13.7
(0.0,0.5)	0.083	8.3	6.7
(0.5,1.0)	0.083	8.3	3.7
(1.0,1.5)	0.083	8.3	2.7
(1.5,2.0)	0.083	8.3	-1.3
(More than 2.0)	0.166	16.6	-15.6

Without calculating the rest of the table and chi square we can conclude that this sample does not come from Uniform$(-3, 3)$ distribution. Thus we reject the null hypothesis.

c.

No. If these numbers come from both distribution, then there will be contradiction about this distribution's definition.