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section 1

Q1.) given,

500 ball bearings mean weight = 5.02 oz (μ)
and standard deviation = 0.3 oz (σ)

population size N_p = 500

sample size N_s = 100

for sampling distributions of mean,
population mean = sample mean = 5.02

but sample standard deviation is different and since population size is finite correction factor needs to be applied to calculate standard deviation

$$\bar{\sigma} = \frac{\sigma}{\sqrt{N_s}} \times \sqrt{\frac{N_p - N_s}{N_p - 1}} = \frac{\cancel{0.02}\ 0.3}{\sqrt{100}} \times \sqrt{\frac{500-100}{100-1}} = 0.027$$

a.) probability that sample of 100 ball bearings will have combined weight between 496 & 500 oz

$$P\left(\frac{\left(\frac{496}{100}\right) - 5.02}{0.027} < Z < \frac{\left(\frac{500}{100}\right) - 5.02}{0.027}\right) = 0.4868 - 0.2704$$
$$= 0.2164$$

b.) combined weight more than 510 oz

$$P\left(Z > \frac{\left(\frac{510}{100}\right) - 5.02}{0.027}\right) = 0.0015$$

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Q2.)

H_0: assuming 43.5 inches as population mean is reasonable

H_1: assuming 43.5 inches as population mean is not reasonable.

given, $n=16$, $\bar{x}=41.5$, $\mu=43.5$ & $\Sigma(x_i-\bar{x})^2 = 135$

t-test statistic $t = \dfrac{\bar{x}-\mu}{s/\sqrt{n}}$ where $\bar{x} = \frac{1}{n}\Sigma x_i$

$s^2 = \frac{1}{n-1}\Sigma(x_i-\bar{x})^2$

$s^2 = \frac{1}{16-1}\times 135 = \frac{135}{15} = 9 \Rightarrow s = \sqrt{9} = 3$

calculated t-value $= \dfrac{41.5-43.5}{3/\sqrt{16}} = \dfrac{-2\times4}{\cancel{3}} = \dfrac{-8}{3} = -2.666$

$|t| = 2.666$

at 95% confidence value from t-table $t_{0.05}$ & 15df = 2.131

at 99% " " " " $t_{0.01}$ " = 2.947

at 5% level of significance since calculated t-value 2.666 is greater than 2.131 we reject null hypothesis and conclude 43.5 inches is not reasonable.

95% confidence intervals

$\bar{x} \pm t_{0.05}\times\frac{s}{\sqrt{n}} = 41.5 \pm 2.131(0.75)$

$= 41.5 \pm 1.598$

$= [39.902, 43.098]$

99% confidence intervals

$\bar{x} \pm t_{0.01}\times\frac{s}{\sqrt{n}} = 41.5 \pm 2.947(0.75)$

$= 41.5 \pm 2.21$

$= [39.29, 43.71]$

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Q3.)

Researchers	Below average	Avg	Above Avg	genius	Total
A	40	33	25	2	100
B	86	60	44	10	200
total	126	93	69	12	300

$E_{1,1} = \frac{100 \times 126}{300} = 42$ $E_{1,2} = \frac{1}{3} \times 93 = 31$, $E_{1,3} = \frac{1}{3} \times 69 = 23$, $E_{1,4} = \frac{12}{3} = 4$

$E_{2,1} = \frac{200 \times 126}{300} = 84$, $E_{2,2} = \frac{2}{3} \times 93 = 62$, $E_{2,3} = \frac{2}{3} \times 69 = 46$, $E_{2,4} = \frac{2 \times 12}{3} = 8$

Expected values

Researchers	Below Avg	Avg	Above Avg	genius	Total
A	42	31	23	4	100
B	84	62	46	8	200
Total	126	93	69	12	300

since there is expected value < 5 must use Yate's correction

H_0: techniques adopted are significant

H_1: " " " not significant.

$$\chi^2_{yate} = \sum_{i=1}^{n} \frac{(|O_i - E_i| - 0.5)^2}{E_i} = \frac{(|40-42|-0.5)^2}{42} + \ldots\ldots + \frac{(|10-8|-0.5)^2}{8}$$

$$= 2.25\left(\frac{1}{42} + \frac{1}{31} + \frac{1}{23} + \frac{1}{4} + \frac{1}{84} + \frac{1}{62} + \frac{1}{46} + \frac{1}{8}\right)$$

$$= 2.25(0.5243) = 1.1796$$

$df = (2-1)(4-1) = 3$ & for 3df $P(\chi^2 \geq 1.1796) = 0.7579$

at 5% significance since p-value $0.7579 > \alpha(0.05)$ reject H_0 & accept H_1

conclusion: techniques not significant

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Q.4 Fill missing values in partially completed one-way ANOVA table.

source	Df	SS	MS = SS/df	F-statistic
Treatments	3	2.124	0.708	0.75
Error	20	18.88	0.944	
Total	23	21.004		

$$F\text{-statistic} = \frac{MS_T}{MS_E} \Rightarrow 0.75 = \frac{0.708}{MS_E} \Rightarrow MS_E = \frac{0.708}{0.75} = 0.944$$

$$SS_E = MS_E \times df_E = 0.944 \times 20 = 18.88$$

$$\text{Total } SS = SS_T + SS_E = 2.124 + 18.88 = 21.004$$

$$MS_T = \frac{SS_T}{df_T} \Rightarrow \frac{SS_T}{MS_T} = df_T \Rightarrow \frac{2.124}{0.708} = 3$$

$$\text{Total Df} = 3 + 20 = 23$$