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Question 1.

$\alpha = 0.05$

t-statistic.

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$\bar{X}_1 = 5.1$ kg (sample mean Program B)
$\bar{X}_2 = 4.3$ kg (sample mean Program A)
$\mu_1 - \mu_2 = 0$
s_1 = standart deviation Program B = 1.3 kg
s_2 = standart deviation Program A = 1.1 kg
$n_1 = 28$ (size program B)
$n_2 = 25$ (size program A)

$$t = \frac{(5.1 - 4.3) - 0}{\sqrt{0.060357 + 0.0484}}$$

$$t = \frac{0.8}{\sqrt{0.108757}}$$

$$t = \frac{0.8}{0.32978}$$

$$t = 2.426$$ #

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Degrees of freedom

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}}$$

$$\frac{s_1^2}{n_1} = \frac{1.3^2}{28} = \frac{1.69}{28} = 0.060357$$

$$\frac{s_2^2}{n_2} = \frac{1.1^2}{25} = \frac{1.21}{25} = 0.0484$$

$$\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2 = (0.060357 + 0.0484)^2$$
$$= (0.108757)^2$$
$$= 0.011828$$

$$\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1} = \frac{(0.060357)^2}{28-1} = \frac{0.003643}{27} = 0.0001349$$

$$\frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1} = \frac{(0.0484)^2}{25-1} = \frac{0.00234256}{24} = 0.0000976$$

$$0.0001349 + 0.0000976 = 0.0002325$$

$$df = \frac{0.011828}{0.0002325}$$
$$\approx 50.87$$
$$= 51$$

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Calculated t-value to critical value :

$2.4\cancel{26}5$

$df = 51$

critical t-value $= 1.675$

$t = \cancel{<} 2.426 > 1.675$

To conclude mean weight loss for Program B is significantly greater than Program A.

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Assignment 3

Machine A

-s1 = 2.1s_1 = 2.1, n1 = 21n_1 = 21

Machine B

-s2 = 1.5s_2 = 1.5, n2 = 16n_2 = 16

① • HOH_0 : σ12 = σ22\sigma_1^2 = \sigma_2^2 (no difference in variances)

• H1H_1 : σ12 ≠ σ22\sigma_1^2\ne \sigma_2^2 (variances are different)

② F = s12s22 = 2.12 1.52 = 4.41 2.25 ≈ 1.96F = \frac{s_1^2}{s_2^2} = \frac{2.1^2}{1.5^2} =

\frac{4.41}{2.25}\approx 1.96

③ df1 = n1 - 1 = 20df_1 = n_1 - 1 = 20

df2 = n2 - 1 = 15df_2 = n_2 - 1 = 15

④ Lower critical value = F0.025 (20,15) F_{0.025} (20,15)

Upper critical value = F0.975 (20,15) F_{0.975} (20,15)

= F0.025(20,15) ≈ 0.40F_{0.025} (20,15) \approx 0.40

F0.975 (20,15) ≈ 2.54F_{0.975} (20,15) \approx 2.54

⑤ Reject HOH_0 if F < 0.40F < 0.40 or F > 2.54F > 2.54

test statistic F = 1.96F = 1.96 lies within the interval

(0.40, 2.54) (0.40, 2.54)

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Question 3

a) Calculate D, D^2 and their sums.

Patient	Before	After	D (Before − After)	D^2
1	220	200	20	400
2	210	190	20	400
3	215	212	3	9
4	225	210	15	225
5	230	215	15	225
6	218	205	13	169
7	212	200	12	144
8	208	198	10	100
9	220	210	10	100
10	214	205	9	81

$\sum D = 127$ $\sum D^2 = 1853$

b) Calculate $\bar{D}$ and SD.

$$\bar{D} = \frac{\sum D}{n}$$

$$= \frac{127}{10} = 12.7$$

$$S_d = \sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{n}}{n-1}}$$

$$= \sqrt{\frac{1853 - \frac{127^2}{10}}{9}} = \sqrt{\frac{240.1}{9}}$$

$$= \sqrt{\frac{1853 - 1612.9}{9}} = \sqrt{26.68}$$

$$\approx 5.17$$

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c) Hypothesis Test

1. Hypotheses:

$H_0 : \mu D = 0$ (No effect)

$H_1 : \mu D > 0$ (Cholestrol Decreased)

2. Test Statistics:

$$t = \frac{\bar{D} - 0}{s_D / \sqrt{n}}$$

$$= \frac{12.70}{5.17/\sqrt{10}}$$

$$= \frac{12.70}{1.635}$$

$$= 7.77$$

3. Critical Value (Right - tailed test):

Degree of freedom (df) = n − 1 = 9.

$t_{0.05,9} = 1.833$

4. Decision:

Since $t_1 = 7.77 > t_{critical} = 1.833$, reject H_0.

5. Conclusion:

There is significant evidence at the 0.05 level to conclude that the diet plan reduces cholestrol levels.

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Assignment 3

Question 4.

a. Calculate the difference between the observed (o) and expected count (e) as in the table below.

Species	Observed count	e_i	$(o-e_i)^2/e$
Sparrows	42	40	$(42-40)^2/40 = 0.10$
Finches	33	30	$(33-30)^2/30 = 0.30$
Robins	15	20	$(15-20)^2/20 = 1.25$
Woodpeckers	10	10	$(10-10)^2/10 = 0$

b. Calculate the x^2 test

$$x^2 = \frac{(o-e)^2}{e} = 0.10 + 0.30 + 1.25 + 0 = 1.65 \#$$

c. At the 0.05 significance level, test wether the observed distribution matches the expected proportions.

From part (b), the calculated chi-square test statistic is: $x^2 = 1.65$

Degree of freedom (df), df = number of categories $-1 = 4 - 1 = 3$.

- The critical value is:

$$\alpha = 0.05, \quad df = 3$$

$$x^2 = 7.815$$

Since $1.65 < 7.815$ falls inside the acceptance region, we faild to reject the hypotesis.

Hence we assume that the observed data fits the proportions.

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Question 5

A researcher wants to determine whether preferred mode of transportation is associated with a person's type of employment. A random sample of 120 individuals is surveyed, and the results are recorded in the following table:

	Public Transport	Private Car	Bicycle	Total
Office Workers	20	30	10	60
Freelancers	15	20	5	40
Students	10	5	5	20
Total	45	55	20	120

At the 0.05 significance level, test whether type of employment and preferred mode of transportation are independent.

Step 1 : State the Hypotheses

- Null Hypothesis (H_0): Type of employment and preferred mode of transportation are independent.
- Alternative Hypothesis (H_1): Type of employment and preferred mode of transportation are associated.

Step 2: Calculate Expected Frequency.

$$E = \frac{(\text{Row Total}) \times (\text{Column Total})}{\text{Grand Total}}$$

	Public Transport	Private Car	Bicycle	Total
Office workers	$(60 \times 45)/120 = 22.5$	$(60 \times 55)/120 = 27.5$	$(60 \times 20)/120 = 10$	60
Freelancers	$(40 \times 45)/120 = 15$	$(40 \times 55)/120 = 18.33$	$(40 \times 20)/120 = 6.67$	40
Students	$(20 \times 45)/120 = 7.5$	$(20 \times 55)/120 = 9.17$	$(20 \times 20)/120 = 3.33$	20
Total	45	55	20	120

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Step 3 : Calculate Chi-Square Test Statistic

$$F = \quad \chi^2 = \sum \frac{(O-E)^2}{E}$$

- $(20 - 22.5)^2 / 22.5 = 0.278$
- $(30 - 27.5)^2 / 27.5 = 0.227$
- $(10 - 10)^2 / 10 = 0$
- $(15 - 15)^2 / 15 = 0$
- $(20 - 18.33)^2 / 18.33 = 0.153$
- $(5 - 6.67)^2 / 6.67 = 0.417$
- $(10 - 7.5)^2 / 7.5 = 0.833$
- $(5 - 9.17)^2 / 9.17 = 1.897$
- $(5 - 3.33)^2 / 3.33 = 0.833$

Total Chi Square

- $0.278 + 0.227 + 0 + 0 + 0.15 + 0.417 + 0.83 + 1.87 + 0.83 = 4.638$

Step 4 : Determine the critical Value

- Degrees of freedom : 4
- Significance level (α) : 0.05
- Chi-Square critical Value for df = 4 and (α) = 0.05 : 9.488

$4.638 < 9.488$ fail to reject H_0

= There is no significant association between type of employment and preferred mode of transportation at 0.05 significance level.