1. A tourism and traveling agency claims that the average of a one-day travel expenses in Moscow exceed $500. If a random sample of 35 one-day travel expenses in Moscow has a mean of $538 and a standard deviation of $41, is the claim of the company true? Use the critical value approach and $\alpha = 10\%$.

The hypotheses are: H_0: $\mu \le 500$	H_A: $\mu > 500$ } 1 point
The assumption is:	Large Sample size, $n \ge 30$ } 1 point
The test statistic:	$n = 35$, $\bar{X} = 538$, $S = 41$ $Z_c = \dfrac{\bar{X} - \mu_0}{S/\sqrt{n}} = \dfrac{538 - 500}{41/\sqrt{35}} = 5.48$ } 2 points $\bar{x}_{\alpha U} = \mu_0 + Z_\alpha \dfrac{S}{\sqrt{n}} = 500 + (1.28)\dfrac{41}{\sqrt{35}} = \boxed{508.87}$
The critical value:	$\alpha = .10 \Rightarrow Z_\alpha = Z_{.10} = 1.28$ } 1 point
Decision Rule:	Reject Ho if $Z_c > Z_\alpha$ $\Rightarrow 5.48 > 1.28$ $\therefore$ Reject Ho } 2 points If $\bar{x} > \bar{x}_{\alpha U} \Rightarrow$ Reject H_0. So, Since $\bar{x} = 538 > 508.87 = \bar{x}_{\alpha U} \Rightarrow$ Rej. H_0
Conclusion:	A tourism and traveling agency claims based on the sample data is true, that means the average of a one-day travel expenses in Moscow exceeds $500. 1 point.

2. Assume that the UK insurance survey is based on 1,000 randomly selected United Kingdom households and that 640 of these households spent on life insurance in 1993. Using the p-value approach test the claim that no more than 60% of UK households spent on life insurance in 1993. Use 5% level of significance.

The hypotheses are: H_0: $p \leq 0.60$ H_A: $p > 0.60$ ① point

The assumptions are:

a. Large Sample Size

b. $np \geq 5$

c. $n(1-p) \geq 5$

② points

The test statistic value:

$$\bar{p} = \frac{x}{n} = \frac{640}{1000} = 0.64 \quad \text{① point}$$

$$Z_c = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{0.64 - 0.60}{\sqrt{\frac{(.6)(1-.6)}{1000}}} = 2.58 \quad \text{① point}$$

The p-value = $p(Z > Z_c)$

$= p(Z > 2.58)$

$= 0.5 - p(0 < Z < 2.58)$

$= 0.5 - .4951$

$= 0.0049$

② points

Decision Rule: Reject H_0 if p-value $< \alpha$

$\Rightarrow 0.0049 < .05$

$\therefore$ Reject H_0

②

Conclusion: Based on the sample data there are more than 60% of UK households spent on life insurance in 1993. ① point

3. Starting annual salaries for individuals with master's and bachelor's degrees were collected in two different samples. The data are given as follows

Master's Degree	**Bachelor's Degree**
$n_1 = 25$	$n_2 = 25$
$\bar{x}_1 = \$45{,}000$	$\bar{x}_2 = \$35{,}000$
$s_1 = \$4{,}000$	$s_2 = \$3500$

Do the data provide sufficient evidence to conclude that there is no difference between the average annual salaries of the two degrees? Use a significance level of 0.05.

The hypotheses are: H₀: $\mu_1 - \mu_2 = 0$ H$_A$: $\mu_1 - \mu_2 \neq 0$ 1

The assumptions are: a. Each pop. has a normal dist. b. σ_1^2, σ_2^2 are unknown but equal

2 points c. Samples are indep. d. Small samples size ($n_1 < 30$ or $n_2 < 30$)

The test statistic value:

$$t_c = \frac{\bar{x}_1 - \bar{x}_2 - 0}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \quad S_p = \sqrt{\frac{(25-1)(4000)^2 + (25-1)(3500)^2}{25+25-2}}$$

$$= 3758.32 \quad 1$$

$$\therefore t_c = \frac{45000 - 35000 - 0}{3758.32\sqrt{\frac{1}{25} + \frac{1}{25}}} = 9.407 \quad \Big\} \quad 1 \text{ point}$$

The critical value: $\alpha = .05 \Rightarrow t_{\alpha/2, n_1+n_2-2} = t_{.025, 48} \simeq 2.0086$ 1

with $df = 50$

Decision Rule: Reject H₀ if $|t_c| > t_{\alpha/2, n_1+n_2-2}$

$\Rightarrow 9.407 > 2.0086 \Longrightarrow$ Reject H₀ 1 point

Conclusion:

The data ~~provide~~ do not provide a sufficient evidence to conclude that there is no difference between the average annual salaries of the two degrees. 1 point

4. Figure perfect incorporation is a women's figure salon that specializes in weight reduction programs. Weights of a sample of 6 clients before and after a 6-week introductory program are shown below

Weight							
	Before	140	160	210	148	190	170
	After	132	158	195	152	180	164
	D_i	8	2	15	−4	10	6

Test to determine whether the introductory program provides a statistically significant weight loss at 1% significance level.

The hypotheses are: H_0: $\mu_d = \mu_1 - \mu_2 \leq 0$ H_A: $\mu_d = \mu_1 - \mu_2 > 0$ (1) point

The assumptions are: a. Samples are dependent b. Small Sample - pairs size (1) points

The test statistic value: μ_1: Before μ_2: After

$$t_c = \frac{\bar{d} - d_0}{S_d / \sqrt{n}}, \quad \bar{d} = \frac{\sum d_i}{n} = \frac{37}{6} = 6.167 \ \} \ (1) \text{ point}$$

$$S_d = \sqrt{\frac{\sum (d_i - \bar{d})^2}{n-1}} = 6.5853 \ \} \ (1) \text{ point}$$

$$t_c = \frac{6.167 - 0}{6.5853 / \sqrt{6}} = 2.293 \ \} \ (1)$$

The critical value: $\alpha = .01 \Rightarrow t_{\alpha, n-1} = t_{.01, 5} = 3.3649$ (1) point

The Decision Rule: Reject H_0 if $t_c > t_{\alpha, n-1}$

$\Rightarrow 2.293 \not> 3.3649$ $\therefore$ Do not reject H_0. } (1)

The Conclusion:

Based on the sample data, the introductory program does not provide a statistically significant weight loss. (1) point

5. Consider question 3 above, do you think that the standard deviations of the annual salaries of both the Bachelor's degree and the Master's degree should be equal at 10% significance level?

The hypotheses are: H_0: $\sigma_1^2 = \sigma_2^2$ H_A: $\sigma_1^2 \neq \sigma_2^2$ 1 point	
The assumption is: 1. populations are normally distributed 2. Sample variances are indep. 2 points	
The test statistic value: $F_c = \frac{S_1^2}{S_2^2} = \frac{(4000)^2}{(3500)^2} = 1.3061$ } 2 points	
The critical value: $F_{\alpha/2, n_1-1, n_2-1} = F_{.05, 24, 24} = 1.984$ 1 point	
The Decision Rule: Reject H_0 if $F_c > F_{\alpha/2, n_1-1, n_2-1}$ $\Rightarrow 1.3061 \not> 1.984 \Rightarrow$ Do not reject H_0. 1 points	
The Conclusion: Based on the sample data, the standard deviations of the annual salaries of both degrees are equal. 1 point	

6. The filling variance for boxes of cereal is designed to be no more than 0.02. A sample of ~~41~~ 31 boxes of cereal shows a standard deviation of 0.16 ounces. Determine whether the filling specifications were violated. Use $\alpha = 0.05$

The hypotheses are: H_0: $\sigma^2 \le .02$ H_A: $\sigma^2 > .02$	(1) point
The assumption is: Population is normally distributed.	(1) point
The test statistic value: $\chi_c^2 = \frac{(n-1)S^2}{\sigma_0^2} = \frac{(31-1)(.16)^2}{0.02} = 38.4$	(2) points
The critical value $\chi^2_{\alpha, n-1} = \chi^2_{.05, 30} = 43.7730 \rightarrow df = 30$	(1) point
The Decision Rule: Reject H_0 if $\chi_c^2 > \chi^2_{\alpha,n-1}$ $\Rightarrow 38.4 \not> 43.7730$ ∴ Do Not Reject ~~reject~~ H_0	(2) points
The Conclusion: Based on the sample data, The filling Variance for boxes is NO more than 0.02. NOT violated	(1) point

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