Name:

1. **Problem**

   An experiment has $n_1 = 8$ plants in the treatment group and $n_2 = 8$ plants in the control group. After some time, the plants' heights (in cm) are measured, resulting in the following data:

	value1	value2	value3	value4	value5	value6	value7	value8
sample 1:	12.1	12.5	10	10.8	7.4	11.2	8.2	12.1
sample 2:	10.9	14.2	10.8	12.6	8.7	13.7	16.2	13.8

   (a) Determine degrees of freedom.

   (b) Determine t^* for a 95% confidence interval.

   (c) Determine SE.

   (d) Determine a lower bound of the 95% confidence interval of $\mu_2 - \mu_1$.

   (e) Determine an upper bound of the 95% confidence interval of $\mu_2 - \mu_1$.

   (f) Determine $|t_{obs}|$ under the null hypothesis $\mu_2 - \mu_1 = 0$.

   (g) Determine a lower bound of the two-tail p-value.

   (h) Determine an upper bound of two-tail p-value.

   (i) Do you reject the null hypothesis with a two-tail test using a significance level $\alpha = 0.05$? (yes or no)

1. (a) | | | | | | 7 | . | 0 | 0 | 0 |

   (b) | | | | | | 2 | . | 3 | 6 | 0 |

   (c) | | | | | | 1 | . | 0 | 7 | 2 |

   (d) | | | | | - | 0 | . | 4 | 3 | 0 |

   (e) | | | | | | 4 | . | 6 | 3 | 0 |

   (f) | | | | | | 1 | . | 9 | 5 | 8 |

   (g) | | | | | | 0 | . | 0 | 5 | 0 |

   (h) | | | | | | 0 | . | 1 | 0 | 0 |

   (i) **no**

1. **Solution**
   These data are unpaired. We might as well find the sample means and sample standard deviations (use a calculator's built-in function for standard deviation).

$$\overline{x_1} = 10.5$$

$$\overline{x_2} = 12.6$$

$$s_1 = 1.88$$

$$s_2 = 2.38$$

We make a conservative estimate of the degrees of freedom using the appropriate formula.

$$df = \min(n_1, n_2) - 1 = \min(8, 8) - 1 = 7$$

We use the t table to find $t^\star$ such that $P(|T| < t^\star) = 0.95$

$$t^\star = 2.36$$

We use the SE formula for unpaired data.

$$SE = \sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}} = \sqrt{\frac{(1.88)^2}{8} + \frac{(2.38)^2}{8}} = 1.072$$

We find the bounds of the confidence interval.

$$CI = (\overline{x_2} - \overline{x_1}) \pm t^\star SE$$

$$CI = (-0.43, 4.63)$$

We find t_{obs}.

$$t_{obs} = \frac{(\overline{x_2} - \overline{x_1}) - (\mu_2 - \mu_1)_0}{SE} = \frac{(12.6 - 10.5) - 0}{1.072} = 1.96$$

We find $|t_{obs}|$.

$$|t_{obs}| = 1.96$$

We use the table to determine bounds on p-value. Remember, $df = 7$ and p-value $= P(|T| > |t_{obs}|)$.

$$0.05 < p\text{-value} < 0.1$$

We should consider both comparisons to make our decision.

$$|t_{obs}| < t^\star$$

$$p\text{-value} > \alpha$$

Thus, we retain the null hypothesis. Also notice the confidence interval does contain 0.

   (a) 7
   (b) 2.36
   (c) 1.072
   (d) -0.43
   (e) 4.63
   (f) 1.958
   (g) 0.05
   (h) 0.1
   (i) no