MA331   Midterm Exam   4/23/20

I pledge my honor that i have abided by the stevens
Honor System

1. Organic   sample size: 20 undergraduates
                  μ : 5.58
                  std dev: 0.59
    control   sample size: 20 undergraduates
                  mean : 8.08
                  std dev. : .62
    comfort   sample size: 22 undergraduate
                  mean : 4.89
                  std. dev. : 0.57

2. $H_0 : \theta_1 = \theta_2$
    $H_A : \theta_1 \neq \theta_2$ $F = \dfrac{larger^2}{smaller^2} = \dfrac{0.59356^2}{0.57291^2} = 1.0734$

    d.o.f. = $F(20-1, 22-1) = F(19, 21)$
    I used table E to check the degrees of freedom
    and see the p value : 0.8698, which is very large.
    We fail to reject the H_0 and accept they have
    normal population variance.

3. $H_0 : \mu_1 = \mu_2$
    $H_A : \mu_1 \neq \mu_2$ $t = \dfrac{\bar{z}_1 - \bar{z}_2}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}} = \dfrac{(5.5835 - 4.88727)}{\sqrt{\dfrac{(0.59356)^2}{10} + \dfrac{0.57241^2}{22}}} = 3.8599$

    d.o.f : min (20-1, 22-1) = 19
    μ_1 = organic
    μ_2 = comfort $P(|T| > |3.85991|) = 4.11 \times 10^{-4} < 0.05$

    the pvalue is small so we would reject the H_0
    and recognize there is a difference between
    organic and comfort anocrlity.

4. i) $\bar{z} = \dfrac{[n_1 \bar{x}_1 + n_2 \bar{x}_2 + n_3 \bar{x}_3]}{n_1 + n_2 + n_3} = \dfrac{20(5.58) + 20(5.08) + 22(4.18)}{20+20+22} = 5.1748$

ii) $SSB = \sum\limits_{i=1}^{3} n_i (\bar{x}_i - \bar{z})^2 = 5.3299$

$SSE = \sum\limits_{i=1}^{3} (n_i - 1) s_i^2 = 20.9675$

$SST = SSB + SSE = 26.2574$

iii) ANOVA TABLE

source	degrees of freedom	SS	MS	F
group	2	5.299	2.66495	F = 7.51
Error	59		0.3547	
Total	61			

ANOVA Table

source	d.o.f.	SS	MS	F
group	2	5.3299	2.66495	F = 7.51
Error	59	20.9275	0.35	
total	61	26.2574		

iv) Based on the F statistic and table E

pvalue: $P(F > 7.51) = 1 - pf(7.51, 2, 59)$

The pvalue is so small so we reject the H_0 and conclude that there could be potential link between organic foods and morality.

v) $t_{oc} = \dfrac{\bar{x}_1 - \bar{x}_2}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \dfrac{5.5835 - 4.889}{S_p \sqrt{\frac{1}{20} + \frac{1}{20}}} = 75.24$

$H_0 : \mu_1 = \mu_2$ $\mu_1 -$ organic

$H_A : \mu_1 \ne \mu_2$ $\mu_2 -$ comfort

$S_p = \dfrac{S_1 + S_n}{n_1 + n_2} = 0.02916$ $s_p^2 = MSE = .3547$ d.o.f. $n - k = 59$

$P(|T| > 75.24) = 2(1 - pt(75), 38)$

if the pvalue is too small we reject the H_0.