

**HOMEWORK 14 (ONE-WAY ANOVA)**  
**PROB. AND STAT. FOR ENG. (STAT:2020; BOGNAR)**

NAME: \_\_\_\_\_

*Do not turn-in. This material is on final exam, however.*

1. A watch maker wanted to compare four robotic milling machines for cut roughness. The roughness is measured in microns (1/1000 of a mm). Assume the roughness for Machine  $i$  follows a  $N(\mu_i, \sigma_i^2)$  distribution,  $i = 1, 2, 3, 4$ , and assume that  $\sigma_1 = \sigma_2 = \sigma_3 = \sigma_4$ . After milling a number of parts on each machine, he summarized the data in the following table.

Mach 1	Mach 2	Mach 3	Mach 4
$n_1 = 5$	$n_2 = 5$	$n_3 = 6$	$n_4 = 6$
$\bar{x}_1 = 11.5$	$\bar{x}_2 = 8.9$	$\bar{x}_3 = 9.3$	$\bar{x}_4 = 12.2$
$s_1 = 1.3$	$s_2 = 1.5$	$s_3 = 1.0$	$s_4 = 1.1$

- (a) Find the mean squares between groups,  $MS(Between)$ . *Show your work using clear notation.*
- (b) Find the mean squares within groups,  $MS(Within)$ . *Show your work using clear notation.*
- (c) Test  $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$  vs  $H_a : \text{not } H_0$  at the  $\alpha = 0.05$  significance level using a 3-step one-way ANOVA test. *Find the test statistic and critical value (use Matt's super sweet F-distribution web/phone app to find the critical value), plot the rejection region (be sure to label the distribution), and state your decision and final conclusion. Show your work using clear notation.*

- (d) Find the  $p$ -value for the test in part (c). You will have to use the  $F$ -distribution web/phone applet to find the  $p$ -value. *Show your work using clear notation.*

- (e) Perform the Bonferroni pairwise comparison  $H_0 : \mu_3 = \mu_4$  versus  $H_a : \mu_3 \neq \mu_4$  at the  $\alpha^*$  significance level. *You must state the test statistic and critical value (use the web/phone  $t$ -distribution app to find the critical value), plot the rejection region (be sure to label your graph), and state your decision and final conclusion. Also, use the web/phone  $t$ -distribution app to find the  $p$ -value. Show your work using clear notation.*

- (f) Write out  $H_0$  and  $H_a$  for the remaining 5 Bonferroni pairwise comparisons.