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

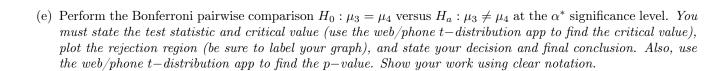
(a) Find the mean squares between groups, MS(Between). Show your work using clear notation.

(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 $H_a:$ 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.

2

(d) Find the p-value for the test in part (c). You will have to use the F-distribution web/phone applet to find



(f) Write out H_0 and H_a for the remaining 5 Bonferonni pairwise comparisons.