Name: ________________________________

I.D. Number: ______________

1	/3
2	/7.5
3	/7.5
4	/8
5	/1.5
6	/0.5
7	/2

ECON 222
2. MIDTERM EXAMINATION
April 18, 2013

- This is a closed book exam.
- You are not allowed to exchange calculators during the exam.
- You must show your computations to receive any credit.
- In each hypothesis testing problem state the null and alternative hypothesis explicitly. Define the test statistic and name its distribution. State the decision rule and your conclusions to get full credit.

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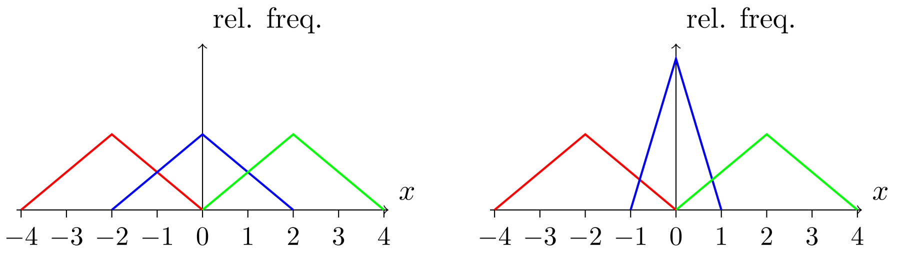
1) In order to test if there is a difference between the distributions of three populations, we take random samples of equal size from each population. Each graph below shows a possible frequency polygons for the three samples. Graph i, $i = 1, 2$, shows the result of experiment i.



Frequency polygons for experiment 1. Frequency polygons for experiment 2.

(a) Let MSW_i denote the mean sum of squares within groups for experiment i, $i = 1, 2$. Write the relation (i.e., being greater than, less than, or equal) between MSW_1 and MSW_2 (explain).

(b) Let MSG_i denote the mean sum of squares between groups for experiment i, $i = 1, 2$. Write the relation (i.e., being greater than, less than, or equal) between MSG_1 and MSG_2 (explain).

2) We test $H_1 : \mu > 4$ against $H_0 : \mu \leq 4$ at a significance level of 0.04. To test these hypotheses we take a random sample of size 36 from the population. It is known that the population standard deviation is equal to 12.

(a) If the sample mean is 7 what is the corresponding p-value?

(b) If $\mu = 3$ what is the probability of a Type I Error?

3) In order to test $H_1 : \sigma^2 < 16$ against $H_0 : \sigma^2 \geq 16$ we take a sample of size 9. It is known that the population is normally distributed. The significance level of the test is 0.01.

(a) What can you say about the p-value corresponding to $s^2 = 3$?

(b) If $\sigma^2 = 8$ what can you say about the probability of making a type II error?

4) We would like to test if the degree of professorship has any effect on the amount of time spent on teaching responsibilities. To test this independent random samples of 4 assistant professors, 3 associate professors, and 4 full professors were asked to report the amount of time they spent on teaching responsibilities. There answers are shown below:

	Assistant Prof.	Associate Prof.	Full Prof.
	12	13	10
	9	11	6
	11	6	4
	12		8
mean	11	10	7
variance	2	13	6.67

(a) State the response variable, factor(s),and factor levels for this test.

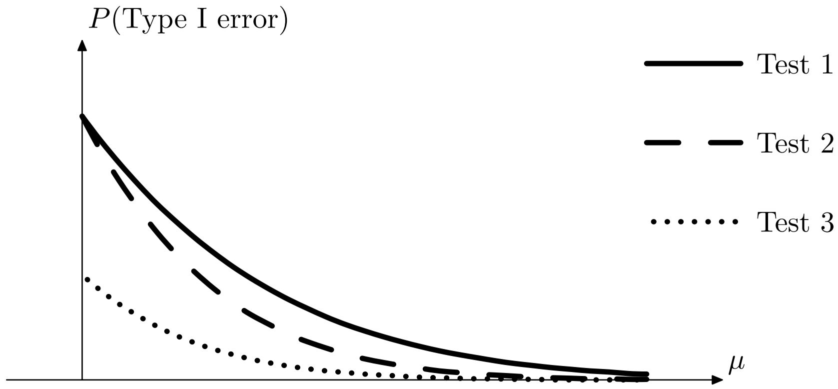
(b) Fill in the underlined cells in the following ANOVA table:

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	34.18	______	______	2.63	XXXX	______
Within Groups	______	______	______			

(c) Test if the degree of professorship has any effect on the time spent on teaching responsibilities (let $\alpha = 0.05$).

(d) What is the corresponding p-value?

5) We test $H_0 : \mu \geq 0$ against $H_1 : \mu < 0$. We use $\bar{x}/(\sigma/\sqrt{n})$ as our test statistic. The following are graphs of probabilities of type I errors for three different tests (with possibly different significance levels and/or sample sizes).



Let α_1, α_2, and α_3 be the significance levels for test 1, test 2, and test 3 respectively. What is the relation (i.e., being greater than, less than, or equal) between the significance levels of the tests (explain)?

6) Let $H_0 : \sigma_1^2 \geq 2\sigma_2^2$ and $H_1 : \sigma_1^2 < 2\sigma_2^2$. We take a sample of size 5 from population 1 and a sample of size 8 from population 2 and use the test statistic $s_1^2/(2s_2^2)$. If we reject H_0 at a significance level of 0.05 but fail to reject at a significance level of 0.01 what can you say about the p-value?

7) We test $H_1 : \sigma^2 > 0$ against $H_0 : \sigma^2 = 0$ at a significance level of 0.05. We take a sample of size 4 and use s^2 as our test statistic. What is the probability of a Type I Error?

$$\text{MSG} = \frac{\text{SSG}}{k-1}, \quad \text{SSG} = \sum_{i=1}^{k} n_i(\bar{x}_i - \bar{x})^2,$$

$$\text{MSW} = \frac{\text{SSW}}{n-k}, \quad \text{SSW} = \sum_{i=1}^{k}\sum_{j=1}^{n_i}(x_{i,j} - \bar{x}_i)^2 = \sum_{i=1}^{k}(n_i - 1)s_i^2,$$

$$F_{n_1,n_2,a} = \frac{1}{F_{n_2,n_1,1-a}}$$

Type I error: Rejecting H_0 when H_0 is true.

Type II error: Failing to reject H_0 when H_0 is false.