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Mathematics 235  
Examination 3  
May 2, 2011

Name \_\_\_\_\_

Please label your answers clearly, as I will not have time to perform extensive searches for answers. No credit will be given for answers without explanations.

Graphing calculators are not permitted on this examination.

Cheating will result in a failing grade.

The problems are not arranged in order of increasing difficulty, so you might want to read all of them before beginning.

1. (10 points) Suppose that  $f(x, y)$  is a function which has  $(2, 4)$  and  $(3, 5)$  as critical points. Suppose that we are also given the information in this table:

$x$	$y$	$f_{xx}(x, y)$	$f_{xy}(x, y)$	$f_{yy}(x, y)$
2	4	5	-3	1
3	5	2	-1	2

Use this information and the second derivative test to decide if each of the two critical pairs  $(2, 4)$  and  $(3, 5)$  is a local minimum, a local maxima, or a saddle point.

2. (15 points) Studies have shown that 10% of the American population suffers from a particular form of heart disease, and that 90% do not have this form. One method of diagnosing this type of heart disease is to administer a stress test. A person can have either a positive or a negative stress test. The probability of a positive stress test in a person with this form of disease is 0.96, and the probability of a negative stress test in a person without this form of disease is 0.97.

Suppose that a person is tested at random, and has a positive stress test. What is the probability that the person has this form of heart disease? Do all of your calculations to 4 decimal places.

3. (20 points) **KlipZ Ninety-Nine Cent Store** specializes in inexpensive office supplies. The demand for paper clips is constant throughout the year, and annual sales are 20,000 boxes of paper clips. Each time that KlipZ places an order for paper clips, there is a shipping and handling fee of \$7.50, and the cost of each box of clips is \$0.37. KlipZ is a small store, with limited storage space, and estimates that the annual cost of storing a box of paper clips in inventory is \$0.09.

What order size should KlipZ use to minimize total annual cost? Each order can be no smaller than 1 box, and no larger than 20,000 boxes. The order size does not need to be an integer.

4. (20 points) Find the maximum and minimum values of the function  $f(x, y) = 2x - 3y$  if  $x^2 + 2y^2 = 11$ . The values of  $x$  and  $y$  are not restricted, and can be positive and negative.

5. (20 points) **Stanley's Sub Shop** sells food from a truck during the summer. The truck is small, and has a limited amount of shelf space. Stanley knows that the sales of different items depends on the weather, which he classifies as mild ( $M$ ), hot ( $H$ ), and rainy ( $R$ ). Stanley can load his truck each day with one of assortments of food, which he called  $A$  and  $B$ . The payoff table depends on whether he chooses type  $A$  or type  $B$ , and also on the weather. His profits are:

Food assortment	<i>Weather</i>		
	$M$	$H$	$R$
$A$	83	71	52
$B$	89	46	58

- (a) If Stanley uses the optimistic approach, which food assortment should he use?  
 (b) If Stanley uses the conservative approach, which food assortment should he use?  
 (c) If Stanley uses the minimax regret approach, which food assortment should he use?  
 (d) Stanley calls the National Oceanographic and Atmospheric Administration, and determines that the probabilities for the 3 types of weather are:

$$P(M) = 0.35 \quad P(H) = 0.40 \quad P(R) = 0.25$$

If Stanley uses the Expected Value approach, which food assortment should he stock? What is the Expected Value of Perfect Information?

*(Problem continues on next page)*

6. (15 points) Stanley can look at his sales of iced coffee in the morning in an attempt to predict the weather later in the day. He either sells lots of iced coffee ( $I$ ) or not so much ( $N$ ). Here is a table of *joint probabilities*:

	$I$	$N$
$M$	0.05	0.30
$H$	0.30	0.10
$R$	0.05	0.20

- What is  $P(I)$ ? What is  $P(N)$ ?
- If Stanley sells lots of iced coffee in the morning ( $I$ ), should he load the truck with assortment  $A$  or assortment  $B$ ?
- If Stanley sells not so much iced coffee in the morning ( $N$ ), should he load the truck with assortment  $A$  or assortment  $B$ ?
- What is the Expected Value of Stanley's strategy? Draw a decision tree to explain your reasoning.
- What is the efficiency of this strategy?