Department of Mathematics
University of Notre Dame
Math 10260 – Bus. Calc. II
Fall 2009

Name:_____

Instructor:_____

Exam II

October 13 , 2009

This exam is in 2 parts on 11 pages and contains 15 problems worth a total of 100 points. You have 1 hour and 15 minutes to work on it. You may use a calculator, but no books, notes, or other aid is allowed. Be sure to write your name on this title page and put your initials at the top of every page in case pages become detached. Good luck!

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Place an × through your answer to each problem.

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Multiple Choice

1. (5 pts.) Compute the distance between the points $(-1, 3, 2)$ and $(2, -2, 3)$.

(a) 10 (b) $\sqrt{27}$ (c) 9 (d) $\sqrt{35}$ (e) $\sqrt{8}$

2. (5 pts.) Let $f(x, y) = ye^{x^2+y^2} + 3x^2$. Compute $\frac{\partial f}{\partial x}$.

(a) $2xye^{x^2+y^2} + 6x$

(b) $(2y^2 + 1)e^{x^2+y^2} + 6x$

(c) $(2y^2 + 1)e^{x^2+y^2}$

(d) $(2x + 2y)e^{x^2+y^2}$

(e) $e^{x^2+y^2} + 6x$

3. (5 pts.) A company produces two kinds of goods, X and Y. Suppose that x is the number of units of X being produced and that y is the number of units of Y being produced. The revenue function is given by

$$R(x, y) = 30x + 20y - \frac{1}{2}x^2 - \frac{1}{2}y^2.$$

Find the production levels that maximize revenue.

(a) $x = 20$, $y = 30$ (b) $x = 10$, $y = 30$

(c) $x = 20$, $y = 15$ (d) $x = 30$, $y = 30$

(e) $x = 30$, $y = 20$

4. (5 pts.) Find the equation of the plane passing through the points $(0, -1, 1)$, $(2, 0, 5)$ and $(0, 0, 3)$. Which of the following points also lies on the same plane?

(a) $(-3, 0, 3)$ (b) $(1, 1, 6)$ (c) $(1, -1, -2)$ (d) $(-1, -1, 1)$ (e) $(-2, 1, 2)$

5. (5 pts.) Find the minimum value of the function $f(x, y, z) = 2x^2 + 2y^2 + z^2$ subject to the constraint $x - 2y + 2z = 13$.

(a) 5 (b) 0 (c) 11 (d) 26 (e) 32

6. (5 pts.) Let $f(x, y) = x^3 + y^3 - 3xy$. This function has a critical point at (1,1). Use the second derivative test to determine what kind of critical point it is.

(a) Saddle point

(b) Local maximum

(c) Local minimum

(d) The second derivative test is inconclusive.

(e) Global maximum

7. (5 pts.) A company sells two items, X and Y. The marginal profit is profit of \$4 per unit for item X, and the marginal profit is \$10 per unit for item Y . When it sells only 40 units of X and 20 units of Y, then it makes \$350. Assuming the profit function is linear, compute the profit for selling 100 units of X and 50 units of Y.

(a) 890 (b) 960 (c) 1220 (d) 1010 (e) 200

8. (5 pts.) Acme juice company sells two kinds of juices, apple and grape. The profit in selling x bottles of apple juice and y bottles of grape juice is $P(x, y) = 15x + 25y - 0.25(x^2 + y^2)$. The company can only produce a total of 100 bottles of juice. Find how many bottles of each kind of juice the company should produce to maximize its profit. (Assume that any critical point will be a maximum.)

(a) $x = 20$ and $y = 80$

(b) $x = 60$ and $y = 40$

(c) $x = 50$ and $y = 50$

(d) $x = 40$ and $y = 60$

(e) none of the above

9. (5 pts.) Consider the initial value problem $\frac{dy}{dt} = t - 2y + 5, y(0) = 3$. Use Euler's method with two steps to estimate $y(1)$.

(a) 1.85 (b) 3.25 (c) 2.75 (d) 3.65 (e) 4.15

10. (5 pts.) Suppose the production function of a certain country is given by a Cobb-Douglas function of the form:

$$P(K, L) = 10K^{2/5}L^{3/5},$$

where P is the economy's output, K is the amount of capital (both in billions of dollars), and L is the quantity of labor (in hundreds of thousands of workers). Estimate MPK and MPL when $K = 32 = 2^5$ and $L = 243 = 3^5$.

(a) $MPK \approx \frac{32}{3};\ MPL \approx \frac{27}{5}$

(b) $MPK \approx \frac{2}{5};\ MPL \approx \frac{3}{5}$

(c) $MPK \approx \frac{5}{3};\ MPL \approx \frac{10}{3}$

(d) $MPK \approx \frac{9}{5};\ MPL \approx \frac{10}{27}$

(e) $MPK \approx \frac{27}{2};\ MPL \approx \frac{8}{3}$

Partial Credit

You must show your work on the partial credit problems to receive credit!

11. (10 pts.) (**Show your work!**) Let $f(x, y) = \sqrt{x + y}$.

(i) Find the equation to the tangent plane to f at the point $(1, 3)$.

(ii) Use linear approximation to estimate $f(1.2, 3.1)$.

12. (10 pts.) (**Show your work!**) Let $f(x, y) = x^2y + 4x - 4y - 1$.

(i) Find the critical point(s) of f.

(ii) Use the second derivative test to decide whether each critical point is a local minimum, a local maximum, or a saddle point.

13. (10 pts.) A mail order company sells bathrobes, either plain or monogrammed. It has determined that if it charges x dollars for the plain bathrobe, and y dollars for the monogrammed one, then it will sell $(2y - 3x + 50)$ plain and $(x - y + 6)$ monogrammed bathrobes per month.

(i) Write a formula for the monthly revenue as a function of x and y.

(ii) Find the x and y that maximize revenue. Show that your answer is a maximum, not a minimum or saddle point.

14. (10 pts.) A company's profit in millions of dollars for the first three years in business is given by

Year	1	2	3
Profit	0	2	3.5

(i) Find the least squares line that best fits this data. **Show all your work.**
(ii) Using the least squares line, predict the company's profit in its fourth year of business.

15. (10 pts.) The quantity Q of a product manufactured by a company is given by $Q(K, L) = 50K^{0.3}L^{0.7}$, where K is the quantity of capital and L is the quantity of labor used. Capital costs are \$60 per unit, labor costs are \$20 per unit, and the company wants to restrict the combined cost of capital and labor to $\$800,000$. Find the combination of capital and labor that maximize the quantity produced.

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