Midterm Exam 2: Review Sheet

Exam: Monday, April 17 (starts 9:05 sharp to 10:00).

Review Session: Wed evening in Science Center, time/room to be announced.

Office hours this week: Monday 2:00-3:00, Tuesday 3:00-4:00 Thursday 1:00-3:00 and, as always, by appointment. Unfortunately, I will be unavailible after 1:00 on Friday. CA's will have additional office hours to be announced.

Problem sessions: Will continue at the usual times unless you hear otherwise.

HW #19 Due Friday April 14: 14.2# 11. 14.3# 17, 20. Chapter 14 Review #5, 9.

HW #20 Due Monday April 17. Do any 10 of the review problems below. On problems where there are several identical sub-problems, you need do only one (this includes when I specify, for instance, #5(a-c) below). This HW will not be graded as usual, but you will simply receive 1 point for each problem turned in. The idea is that by choosing the problems yourself, you can concentrate on the areas that you don't fully understand.

Material Covered: The exam cover all of the multivariable calculus supplement. **Contary to previous comments, there will be no purely linear algebra questions on the exam.**

Review problems and course outline

- Functions of several variables: Supplement Ch. 11.
  - Functions of two variables: graphs, slices, level curves, contour diagrams.
  - Graphs, contour diagrams of linear functions.
  - Cobb-Douglas production functions.
  - Functions of 3-variables. Level surfaces.
  - Review Problems: 11.3: #17, 11.4: #34, 11.5: #17. Midterm problems: 7
- Derivatives of functions of several variables: Supplement Ch. 13.
  - Partial derivatives.
  - Local linearity (differentiability) of functions of 2 variables. Normals and tangent planes to a graph. Approximation by linear functions.
  - Directional derivatives.
  - The gradient.
  - Tangent lines/planes to implicitly defined curves and surfaces.
  - Chain rule.

  - Second order partial derivatives
  - Review problems: Section 13.3 #8 Section 13.4 #7 Section 13.5 #34, #36, Section 13.6 #4, 22. Section 13.7 #26. Chapter 13 Review problems: #41. Midterm problems 2, 3, 6(a-c). Final problems: 1

- Optimization problems
  - Local and global extrema, critical points, second derivative test.
  - Unconstrained optimization.
  - Constrained optimization: Lagrange multipliers.
  - Review problems: Section 14.2 #5. Chapter 14 Review #5,#7, #9. Midterm Problems: 5. Final Problems: 2, 3.

Selected problems from last semester's final

1. Consider the two surfaces in $\mathbb{R}^3$ defined by:

$$\begin{aligned} S_1: &\quad x^2+y^2+z^2=3 \\ S_2: &\quad 2x^2-8x+2y^2-8y+z^2-10z=-33. \end{aligned}$$

   The point $\mathbf{p}=(1,1,1)$ lies on S_1, and the point $\mathbf{q}=(1,1,3)$ lies on S_2.

   (a) Find the equation for the tangent plane P_1 to S_1 at $\mathbf{p}$. Find equation for the tangent plane P_2 to S_2 at $\mathbf{q}$.

   (b) The two planes you got in part (a) should be parallel. Why do the two equations define parallel planes?

   (c) Consider the line segment L joining the points $\mathbf{p}$ and $\mathbf{q}$. Is this the shortest line segment joining the planes P_1 and P_2?

2. Consider the function $f(x,y)=x^3+y^3+3xy+1/8$.

   (a) Determine all the local maxima, minima, and saddle points. Are the local extrema also global extrema?

3. Let $f(x,y)=x^2+xy$ and $g(x,y)=2x^2+2xy+y^2$. Find the global min and max of f subject to the constraint $g(x,y)\leq 2$.

Last Semester's Midterm 2