

## Math 53 Discussion Problems Oct 15

1. Find  $\frac{\partial w}{\partial v}$  when  $u = 0, v = 0$ , if  $w = x^2 + \frac{y}{x}, x = u - 2v + 1, y = 2u + v - 2$
2. Find  $\frac{\partial w}{\partial u}$  when  $u = \frac{1}{2}, v = 1$ , if  $w = xy + yz + xz, x = u + v, y = u - v, z = uv$
3. Find  $\frac{\partial w}{\partial r}$  when  $r = 1, s = -1$ , if  $w = (x + y + z)^2, x = r - s, y = \cos(r + s), z = \sin(r + s)$
4. Suppose that the equation  $F(x, y, z) = 0$  implicitly defines each of the three variables  $x, y$  and  $z$  as functions of the other two. If  $F$  is differentiable and  $F_x, F_y$  and  $F_z$  are all nonzero, show that

$$\frac{\partial z}{\partial x} \frac{\partial x}{\partial y} \frac{\partial y}{\partial z} = -1$$

5. Find the derivative of  $f(x, y, z) = xy + yz + xz$  at the point  $(1, -1, 2)$  in the direction of  $\langle 3, 6, -2 \rangle$ .
6. Find the derivative of  $f(x, y, z) = 3e^x \cos(yz)$  at the point  $(0, 0, 0)$  in the direction of  $\langle 2, 1, -2 \rangle$ .
7. Find the directions in which  $f(x, y, z) = \frac{x}{y} - yz$  increases and decreases most rapidly at the point  $(4, 1, 1)$ . Then find the derivative of the function in these directions.