**Worksheet 10**

**Tangent Planes & Linear Approximation**                    MATH 2210, Fall 2018

1. Decide if each statement is true or false. Give an appropriate justification for your conclusion.

   (a) The tangent plane to the graph of $f(x, y) = e^{x+2y}$ at the point $(0, 0)$ is $x + 2y - z = -1$.

   (b) The planes tangent to the cylinder $x^2 + z^2 = 1$ in $\mathbb{R}^3$ all have the form $ax + bz + c = 0$.

   (c) The gradient $\nabla F(a, b, c)$ lies on the plane tangent to the surface $F(x, y, z) = 0$ at $(a, b, c)$.

2. Find an equation of the plane tangent to the surface $yze^{xz} - 8 = 0$ at the points $(0, 2, 4)$ and $(0, -8, -1)$.

3. Use an appropriate linear approximation of the function $f(x, y) = \ln(1 + x + y)$ to approximate the value of $f(0.1, -0.2)$.

4. The following questions involve an unknown function $f(x, y)$.

   (a) The space curves

   $$\mathbf{r}_1(t) = \langle 1, t, 7 - t^2 \rangle \quad \text{and} \quad \mathbf{r}_2(s) = \langle s, 2, 4 - s^2 \rangle$$

   lie on the surface $z = f(x, y)$ and intersect at $P_0(1, 2, 3)$. Find the equation of the tangent plane to the surface $z = f(x, y)$ at $P_0(1, 2, 3)$. Hint: we use a point and a normal vector to define a plane.

   (b) Use your answer from part (a) to find a linear approximation to the number $f(1.01, 1.98)$.