1. Find the directions in which the function \( f(x,y) = x^2y + e^{xy}\sin y \) increases and decreases most rapidly at the point \((1,0)\).

\[
\nabla f = \langle 2xy + ye^{xy}\sin y, x^2 + xe^{xy}\sin y + e^{xy}\cos y \rangle
\]

\[
\nabla f(1,0) = \langle 0, 2 \rangle
\]

\( f \) increases most rapidly in the direction \( \langle 0, 2 \rangle \).

\( f \) decreases most rapidly in the direction \( \langle 0, -2 \rangle \).

2. Find equations of the tangent plane and the normal line at \((1, -1, 2)\) for the surface \( x^2 + 2xy - y^2 + z^2 = 2 \).

let \( F(x,y,z) = x^2 + 2xy - y^2 + z^2 \)

\[
\nabla F = \langle 2x + 2y, 2x - 2y, 2z \rangle
\]

\[
\nabla F(1, -1, 2) = \langle 0, 4, 4 \rangle
\]

Tangent plane \( 4(y+1) + 4(z-2) = 0 \)

or \( y + 2z = 1 \)

Normal line \( \begin{cases} 
  x = 1 \\
  y = -1 + 4t \\
  z = 2 + 4t
\end{cases} \)