MATH 118
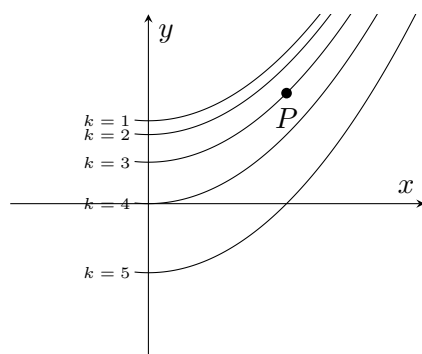Higher order derivatives and tangent planes

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1. Let $f(x, y) = x \cos(xy)$.

    (a) Find $\dfrac{\partial f}{\partial x}$ and $\dfrac{\partial f}{\partial y}$.

    (b) Find all of the second partial derivatives of $f(x, y)$.

    (c) What can you say about $\dfrac{\partial^2 f}{\partial x \partial y}$ and $\dfrac{\partial^2 f}{\partial y \partial x}$?

2. Use the contour plot for $f(x, y)$ below to find the sign of each of the indicated partial derivatives.

    (a) f_x

    (b) f_y

    (c) f_{xx}

    (d) f_{yy}

3. If $f(x, y)$ is as in question 1, use your answer to 1 to find ∇f and $\text{Hess}(f)$ when $x = 1$ and $y = 0$.

4. Find the equation of the plane tangent to $f(x, y) = x^2 y + e^{2x-y}$ at the point $(1, 2)$.

5. Find the point(s) at which the plane tangent to the surface $z = x^2 + y^2 + x^2 y + 4$.

6. The heat index (perceived temperature) I can be modelled as a function of the actual temperature T and the relative humidity H. When $T = 94°F$ and $H = 70\%$, I is measured to be $118°F$. Furthermore, $I_T(94, 70)$ is measured to be 3 and $I_H(94, 70)$ is measured to be 0.5. Estimate $I(95, 72)$.