3. a) $z - z_0 = a((x-x_0)^2 + (y-y_0)^2)$

$$z = ax^2 - 2ax_0x + ax_0^2 + ay^2 - 2ay_0y + ay_0^2 + z_0$$

$$= a(x^2+y^2) \underbrace{-2ax_0x - 2ay_0y}_{-2a(x_0+y_0)} + ax_0^2 + ay_0^2 + z_0$$

$\Rightarrow$ $z = m_0(x^2+y^2) + m_1x + m_2y + m_3$

$$m_0 = a \quad m_1 = -2ax_0 \quad m_2 = -2ay_0 \quad m_3 = ax_0^2 + ay_0^2 + z$$

$$\underset{\underset{475\times1}{\swarrow}}{z} = \underset{\underset{475\times4}{\downarrow}}{A} \cdot \underset{\underset{4\times1}{\downarrow}}{m}$$

$z \to d$, then $m = (A^TN^{-1}A)^{-1}(A^TN^{-1}d)$

c) $y = \dfrac{x^2}{4f} = ax^2 \quad a = \dfrac{1}{4f}$

calculate error bar for f: $f = \dfrac{1}{4a}$

$$f(a+\delta a) = f(a) + f'(a)\delta a + O(\delta a^2) \Rightarrow \delta f = f(a+\delta a) - f(a) = f'(a)\delta a = -\frac{1}{4a^2}\delta a$$

$$|\delta f| = \left|\frac{\delta a}{4a^2}\right|$$