Formulas

1. The **linearization** for a function $f(x, y)$ of two variables at the point (a, b) is given by:

$$f(x, y) \approx f(a, b) + f_x(a, b)(x - a) + f_y(a, b)(y - b).$$

2. **D-Test** to find the relative maximum and minimum values of f:

   (1) Find f_x, f_y, f_{xx}, f_{yy} and f_{xy}.
   (2) Solve $f_x(x, y) = 0$ and $f_y(x, y) = 0$.
   (3) Evaluate $D = f_{xx}f_{yy} - [f_{xy}]^2$ at each point (a, b) found in Step 2.
      (a) If $D(a, b) > 0$ and $f_{xx}(a, b) < 0$, then f has a relative maximum at (a, b).
      (b) If $D(a, b) > 0$ and $f_{xx}(a, b) > 0$, then f has a relative minimum at (a, b).
      (c) If $D(a, b) < 0$, then f has a saddle point at (a, b).
      (a) If $D(a, b) = 0$, then the test is inconclusive. You will have to do something else to determine what is happening at that point.

3. **Method of Least Squares**.

   The line of least squares regression for the n points (c_1, d_1), (c_2, d_2),...,(c_n, d_n) is given by:

$$y - \bar{y} = m(x - \bar{x})$$

   where,

$$\bar{x} = \frac{\sum_{i=1}^{n} c_i}{n}, \qquad \bar{y} = \frac{\sum_{i=1}^{n} d_i}{n}, \qquad m = \frac{\sum_{i=1}^{n}(c_i - \bar{x})(d_i - \bar{y})}{\sum_{i=1}^{n}(c_i - \bar{x})^2}.$$