the origin of the coordinate system is effectively moved to that first point. Consequently, the significant figure problem is avoided because coordinate <u>differences</u> are multiplied together rather than large coordinate values. The area equation is now rewritten as:

$$
\begin{aligned}
2A = {} & \cancelto{0}{(X_1-X_1)(Y_2-Y_1)} + (X_2-X_1)(Y_3-Y_1) \\
& + (X_3-X_1)(Y_4-Y_1) + \ldots \\
& (X_{n-1}-X_1)(Y_n-Y_1) + \cancelto{0}{(X_n-X_1)(Y_1-Y_1)} \\
& - \Big[\cancelto{0}{(Y_1-Y_1)(X_2-X_1)} + (Y_2-Y_1)(X_3-X_1) \\
& + (Y_3-Y_1)(X_4-X_1) + \ldots \\
& (Y_{n-1}-Y_1)(X_n-X_1) + \cancelto{0}{(Y_n-Y_1)(X_1-X_1)}\Big]
\end{aligned}
$$

The first and last product in each of the positive and negative sums above is zero because of subtracting a coordinate from itself. If the positive and negative terms containing the same subscripts are grouped together the area formula can be written as:

$$
\begin{aligned}
2A = {} & (X_2-X_1)(Y_3-Y_1) - (Y_2-Y_1)(X_3-X_1) \\
& + (X_3-X_1)(Y_4-Y_1) - (Y_3-Y_1)(X_4-X_1) \\
& + (X_4-X_1)(Y_5-Y_1) - (Y_4-Y_1)(X_5-X_1) \\
& + \ldots \text{ for any number of points.}
\end{aligned}
$$

Note that with the orderly progression of subscripts from line to line, a program need only be written for the first line and used repetitively until all points are used. A program written for the area formula above will utilize coordinate differences, will compute the double area after each point is entered, and requires minimal storage space.

The following flowchart admittedly is written for a Hewlett-Packard calculator, but it can be readily adapted to any other calculator or computer.

Area by Coordinates

<u>**Flowchart**</u>