What Do I Need?

To create either filled or unfilled Theissen or Voronoi polygons use the **Fence** operation. To successfully execute the **Fence** operation you will need a map layer of sparse data. Each data point must have a unique value; if not, use the **Clump** operation to assign unique identifiers to each sparse point or cluster. Non-data cells should have the value “VOID”.

Example

**Create Filled Theissen/Voronoi Polygons to Define Catchment Areas**

A major convenience store chain wishes to perform a market analysis of existing convenience stores in the city of Shreveville. In market analysis the proximity of potential customers and competing establishments are commonly depicted on maps as “catchment areas” or Theissen or Voronoi polygons. These are regions (or tiles) of minimum proximity that surround each establishment.

To begin, the chain creates a map layer that depicts all the existing convenience stores in Shreveville. Each store is assigned a unique identification number. The map layer named **Stores** contains uniquely
numbered sparse point data that represents the location of the convenience stores in Shreveville:

The Fence operation is used to define equidistant boundaries between each point. The cells between each boundary are filled and assigned the value of the original data point at its centroid:

Note: If the values representing each store were not unique, it would not be possible to distinguish among the polygons.

If you were performing this operation from the Script window the statement would be:

```
MapLayer1 = Fence Stores;
```
The **Fence** operation generates a set of catchment polygons for the convenience stores:

![MapLayer1.mfm](image1)

The catchments are a useful tool for market analysis. They can be assigned values that reflect attributes of the regions they represent.

For the next step in their market analysis the chain needs to combine the population density with the catchment areas. It is simple to create a population density by catchment map layer using the **Score** operation. The chain creates a map layer depicting households in Shreveville which they name **Customers**:

![Customers.mfm](image2)
MapLayer1 and Customers can be used as input for the Score operation to determine the density of the potential customers in each of the catchment areas:

If you were performing this operation from the Script window the statement would be:

```
“Density Map” = Score MapLayer1
By Customers Density;
```

The output map layer, named Density Map, depicts the density of customers in each catchment area. This information is useful in determining where to locate a new store. The catchment areas with a high density of customers may be able to support more than one store:
**Example**  Create *Unfilled* Theissen/Voronoi polygons to define catchment areas

A major convenience store chain has created a customer-density-by-store-catchment-area map layer. They want to enhance the map layer by overlaying the existing store locations and drawing boundaries between the catchment polygons. As a first step, the **Fence** operation is used to generate the polygon frames:

If you were performing this operation from the **Script window** the statement would be:

```
Frames = Fence Stores FrameOnly;
```

This operation will create a map layer named **Frames** with the Theissen/Voronoi polygon boundaries outlined with cells that have the value “1”. The polygons have the value “VOID”. For the next step the value of the boundary cells is changed to “10 000” by clicking on the value “1” and entering “10000” in the **Change Value** dialog box so that it is not confused with the store that has the value “1”:
As a final step, the **Cover** operation will be used to assemble all the map layers that have been generated so far. The store locations and the frames will be overlaid onto the density by Theissen/Voronoï polygons map layer to better define the polygons. The original store locations are added to give context to the analysis:

If you were performing this operation from the **Script window** the statement would be:

```
"Final Map" = Cover "Density Map"
    With Frames
    With Stores;
```

In the map layer named **Final Map**, the original stores have been placed into their respective catchment areas. Each catchment area is enclosed by a frame and the value of each polygon represents the density of customers within the catchment area: