Build Balanced Zones (Spatial Statistics)

ArcGIS Pro 3.5|Other versions|[Help archive](https://pro.arcgis.com/en/pro-app/latest/get-started/archived-arcgis-pro-help.htm)

Summary

Creates spatially contiguous zones in a study area using a genetic growth algorithm based on specified criteria.

You can create zones that contain an equal number of features, zones that are similar based on a set of attribute values, or both. You can also select zones with approximately equal areas, that are as compact as possible, and that maintain consistent summary statistics of other variables.

[Learn more about how Build Balanced Zones works](https://pro.arcgis.com/en/pro-app/3.5/tool-reference/spatial-statistics/learnmore-buildbalancedzones.htm)

Usage

* To create zones, choose **Attribute target**, **Number of zones and attribute target**, or **Defined number of zones** for the **Zone Creation Method** parameter. When you choose **Attribute target**, the tool will create zones based on the target values of one or more specified variables. The **Number of zones and attribute target** option balances the attributes over the specified number of zones. The **Defined number of zones** option creates zones based on feature counts.
* This tool can take input points or polygons.
* If multiple variables are specified for the **Zone Building Criteria** parameter, you can provide weights for each criteria. Weights are applied proportionally to the value specified in the weights field.
* This tool supports parallel processing to create generations for the algorithm and uses 50 percent of available processors by default. The number of processors can be increased or decreased using the [Parallel Processing Factor](https://pro.arcgis.com/en/pro-app/3.5/tool-reference/environment-settings/parallel-processing-factor.htm) environment.

Parameters

DialogPython

arcpy.stats.BuildBalancedZones(in\_features, output\_features, zone\_creation\_method, {number\_of\_zones}, {zone\_building\_criteria\_target}, {zone\_building\_criteria}, {spatial\_constraints}, {weights\_matrix\_file}, {zone\_characteristics}, {attribute\_to\_consider}, {distance\_to\_consider}, {categorial\_variable}, {proportion\_method}, {population\_size}, {number\_generations}, {mutation\_factor}, {output\_convergence\_table})

| Name | Explanation | Data Type |
| --- | --- | --- |
| in\_features | The feature class or feature layer that will be aggregated into zones. | Feature Layer |
| output\_features | The output feature class indicating which features are aggregated into each zone. The feature class will be symbolized by the ZONE\_ID field and will contain fields displaying the values of each criteria that you specify. | Feature Class |
| zone\_creation\_method | Specifies the method that will be used to create each zone. Zones grow until all specified criteria are satisfied.   * ATTRIBUTE\_TARGET—Zones will be created based on target values of one or multiple variables. The sum of each attribute must be specified in the **Zone Building Criteria With Target** parameter, and each zone will grow until the sum of the attributes exceeds these values. For example, you can use this option to create zones that each have at least 100,000 residents and 20,000 family homes. * NUMBER\_ZONES\_AND\_ATTRIBUTE—A specified number of zones will be created while keeping the sum of an attribute approximately equal within each zone. The number of zones must be specified in the **Target Number of Zones** parameter. The attribute sum within each zone is equal to the sum of the total attribute divided by the number of zones. * NUMBER\_OF\_ZONES—A specified number of zones will be created that are each composed of approximately the same number of input features. The number of zones must be specified in the **Target Number of Zones** parameter. | String |
| number\_of\_zones  (Optional) | The number of zones that will be created. | Long |
| zone\_building\_criteria\_target  [[variable, sum, weight],...]  (Optional) | Specifies the variables that will be considered, as well as their target values and optional weights. The default weight is 1, and each variable contributes equally unless they are changed. | Value Table |
| zone\_building\_criteria  [[variable, weight],...]  (Optional) | Specifies the variables that will be considered and, optionally, their weights. The default weight is 1, and each variable contributes equally unless changed. | Value Table |
| spatial\_constraints  (Optional) | Specifies how neighbors will be defined while the zones grow. Zones can only grow into new features that are neighbors of at least one of the features already in the zone. If the input features are polygons, the default spatial constraint is **Contiguity edges corners**. If the input features are points, the default spatial constraint is **Trimmed Delaunay triangulation**.   * CONTIGUITY\_EDGES\_ONLY—For zones containing contiguous polygon features, only polygons that share an edge will be part of the same zone. * CONTIGUITY\_EDGES\_CORNERS— For zones containing contiguous polygon features, only polygons that share an edge or a vertex will be part of the same zone. * TRIMMED\_DELAUNAY\_TRIANGULATION— Features in the same zone will have at least one natural neighbor in common with another feature in the zone. Natural neighbor relationships are based on a trimmed Delaunay Triangulation. Conceptually, Delaunay Triangulation creates a nonoverlapping mesh of triangles from feature centroids. Each feature is a triangle node, and nodes that share edges are considered neighbors. These triangles are then clipped to a convex hull to ensure that features cannot be neighbors with any features outside of the convex hull. This is the default. * GET\_SPATIAL\_WEIGHTS\_FROM\_FILE— Spatial, and, optionally, temporal relationships will be defined by a specified spatial weights file (.swm). Create the spatial weights matrix using the Generate Spatial Weights Matrix tool or the Generate Network Spatial Weights tool. The path to the spatial weights file is specified by the **Spatial Weights Matrix File** parameter. | String |
| weights\_matrix\_file  (Optional) | The path to a file containing spatial weights that define spatial and, optionally, temporal relationships among features. | File |
| zone\_characteristics  [zone\_characteristics,...]  (Optional) | Specifies the characteristics of the zones that will be created.   * EQUAL\_AREA— Zones with total area as similar as possible will be created. * COMPACTNESS—Zones with more closely-packed (compact) features will be created. * EQUAL\_NUMBER\_OF\_FEATURES—Zones with an equal number of features will be created. | String |
| attribute\_to\_consider  [[variable, function],...]  (Optional) | Specifies attributes and statistics to consider in the selection of final zones. You can homogenize attributes based on their sum, average, median, or variance. For example, if you are creating zones based on home values and want to balance the average total income within each zone, the solution with the most equal average income across zones will be preferred. | Value Table |
| distance\_to\_consider  [distance\_to\_consider,...]  (Optional) | The feature class that will be used to homogenize the total distance per zone. The distance is calculated from each of the input features to the closest feature provided in this parameter. This distance is then used as an additional attribute constraint when selecting the final zone solution. For example, you can create police patrol districts that are each approximately the same distance from the closest police station. | Feature Layer |
| categorial\_variable  (Optional) | The categorical variable to be considered for zone proportions. | Field |
| proportion\_method  (Optional) | Specifies the type of proportion that will be maintained based on the chosen categorical variable.   * MAINTAIN\_WITHIN\_PROPORTION—Each zone will maintain the same proportions as the overall study area for the given categorical variable. For example, given a categorical variable that is 60% Type A and 40% Type B, this method will prefer zones that are composed of approximately 60% Type A features and 40% Type B features. * MAINTAIN\_OVERALL\_PROPORTION—Zones will be created so that the overall proportions of category predominance by zone matches the proportions of the given categorical variable for the entire dataset. For example, given a categorical variable that is 60% Type A and 40% Type B, this method will prefer solutions where 60% of the zones are predominantly Type A features and 40% of the zones are predominantly Type B features. | String |
| population\_size  (Optional) | The number of randomly generated initial seeds. For larger datasets, increasing this number will increase the search space and the probability of finding a better solution. The default is 100. | Long |
| number\_generations  (Optional) | The number of times the zone search process will be repeated. For larger datasets, increasing the number is recommended to find an optimal solution. The default is 50 generations. | Long |
| mutation\_factor  (Optional) | The probability that an individual's seed values will be mutated to a new set of seeds. Mutation increases the search space by introducing variability of the possible solutions in every generation and allows for faster convergence to an optimal solution. The default is 0.1. | Double |
| output\_convergence\_table  (Optional) | The table containing the total fitness score for the best solution found in every generation as well as the fitness score for the individual zone constraints. | Table |

Code sample

BuildBalancedZones example 1 (Python window)

The following Python window script demonstrates how to use the BuildBalancedZones function.

import arcpy

arcpy.env.workspace = r"c:\data\project\_data.gdb"

arcpy.stats.BuildBalancedZones("US\_Counties", "out\_features",

"NUMBER\_OF\_ZONES", 5, None, None, "TRIMMED\_DELAUNAY\_TRIANGULATION",

None, None, None, None, None, '', 100, 50, 0.1)

BuildBalancedZones example 2 (stand-alone script)

The following stand-alone Python script demonstrates how to use the BuildBalancedZones function.

# Aggregate states into zones that have a target population of approximately

# 250,000 people. Make the zones of equal area and compact.

import arcpy

# Set the current workspace (to avoid having to specify the full path to

# the feature classes each time)

arcpy.env.workspace = r"c:\data\project\_data.gdb"

arcpy.stats.BuildBalancedZones("states", "out\_zones", "ATTRIBUTE\_TARGET",

None, "POPULATION 250000 1", None, "TRIMMED\_DELAUNAY\_TRIANGULATION",

None, "EQUAL\_AREA;COMPACTNESS", None, None, None, '', 100, 50, 0.1)