

Shortest Path, Least Cost Path, or Cost Path Functions

These instructions enable you to calculate the cost path distances between a set of points (e.g. survey points) to the closest set of polygons (e.g. natural areas) in ArcGIS 9.x software. The GUI in the Spatial Analyst toolbar and the corresponding ArcToolbox tools makes shortest path easy for the beginner user; however, learning the syntax of raster functions allows you to automate batch processing with no programming required!

If you don't know what cost path is about or if it's the right analyses for your data, more info can be found here:

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Least_cost_path_and_least_cost_corridor

Spatial Analyst's function information can be searched for in the ArcGIS help documentation on Map Algebra:

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=What_is_Map_Algebra?

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=An_overview_of_Spatial_Analyst_Toolsets_and_Tools

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Cost_Path (scroll down to the Map Algebra section)

ORIGINAL DATA

survey.shp	a shapefile of survey points
nareas.shp	a polygon shapefile of natural areas
FRICITION	a raster grid representing friction/impedance/resistance values

CREATED DATA

NAREAS	a raster grid converted from the natural area polygons
POINT_ID	a raster grid converted from the survey points
COSTDISTN	a cost distance raster created from the cost distance function on the NAREAS
BACKLINKN	a cost direction raster created from the cost distance function on the NAREAS
CostPath_n.shp	various shapefiles resulting from converting Cost Path raster outputs

The following instructions assume familiarity with using ArcMap, ArcToolbox, and various conversion and table tools.

Start a new empty ArcMap document

1. ADD DATA: your survey points, natural area polygons, and friction raster (i.e. your cost surface of impedance values)

Make sure all your layers are in the same projected coordinate system!

IMPORTANT!!! Set the analysis options in Spatial Analyst.

2. In Spatial Analyst toolbar >>> Options
 - GENERAL tab: Set Working directory same folder as your FRICTION raster
 - EXTENT tab: Set same as FRICTION raster
 - CELL SIZE tab: Set same as FRICTION

Convert Features to Raster

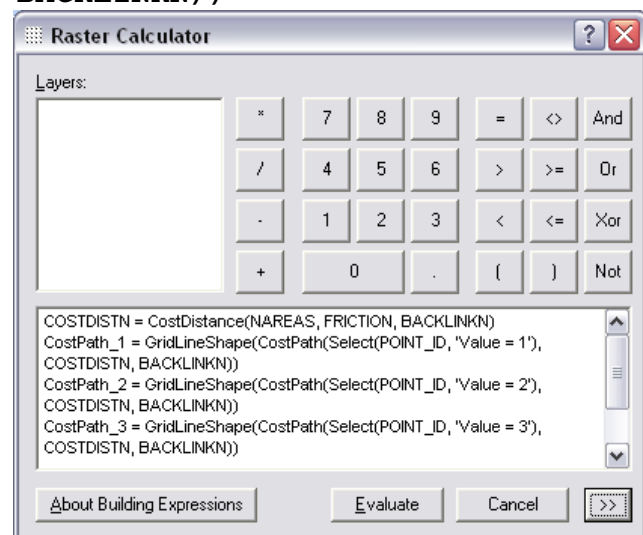
3. Convert natural areas to raster on just about any field >>> e.g. output raster name = NAREAS
4. Add new field to survey points: short integer named UID*
5. Calculate as [FID]+1
6. Convert features to raster using Spatial Analyst toolbar on the UID field >>> e.g. output raster name = POINT_ID

**Note: UID field is not necessary if you already have a unique integer field; e.g. site ID*

Cost Distance and Shortest Path layers

7. Choose SPATIAL ANALYST >>> RASTER CALCULATOR
8. Enter the following in to the expression window and click EVALUATE:
`COSTDISTN = CostDistance(NAREAS, FRICTION, BACKLINKN)`
`CostPath_1 = GridLineShape(CostPath(Select(POINT_ID, 'Value = 1'), COSTDISTN, BACKLINKN))`
`CostPath_2 = GridLineShape(CostPath(Select(POINT_ID, 'Value = 2'), COSTDISTN, BACKLINKN))`
`CostPath_3 = GridLineShape(CostPath(Select(POINT_ID, 'Value = 3'), COSTDISTN, BACKLINKN))`
`CostPath_188 = GridLineShape(CostPath(Select(POINT_ID, 'Value = 188'), COSTDISTN, BACKLINKN))`

Note: Type out each CostDistance expression ONCE for each point ID; type out all possible CostPath expressions; copy and paste into raster calculator and run everything together; be wary of syntax and file names (calculation will fail if you try to use the same names - even if accidental). In case you are wondering, the "N" in the raster file names indicates 'natural area' - my old instructions that I am rewriting to suit your needs were based on calculating shortest paths between all possible pair wise distances between origins and destinations!



To make the expression creation less tedious, examine the concatenated functions in the companion MS Excel file!!! Simply substitute your exact path and file names.

Combine paths into one file for analysis

9. Add new field to EACH cost path shapefile: short integer named PATH
10. Calculate as the original point ID as indicated in the shapefile name; e.g. 1, then 2, then 3, then,... 188

Yes, very repetitive, but here may be a helpful alternative:

<http://arcscripts.esri.com/details.asp?dbid=16093> *(my very similar tool isn't ready yet)*

11. ArcToolbox >>> Data management Tools >>> General >>> MERGE all together
12. ArcToolbox >>> Data management Tools >>> Generalization >>> DISSOLVE based on PATH (or Merge_Src field)
13. ADD LENGTH to table (e.g. using Hawth's Tools or adding a new double field and calculate geometry) - this gives you total path length

Optional, calculate proportions of habitat along each path - if you have a polygon layer with a CLASS field (substitute your names)

14. INTERSECT the merged paths with your landcover/habitat polygon layer (if one exists)
15. Add new text field (length 15) and concatenate the field representing the point ID value and the habitat class fields; e.g. P_CLASS = [PATH] & " - " & [CLASS]
16. ADD NEW LENGTH field and calculate - this gives you length of each segment through a habitat polygon
17. SUMMARIZE by P_CLASS field and sum of NEW LENGTH field
18. If you divide the sum of NEW LENGTH field by total length of path, you can get proportions (will require table joining)