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MOVEMENT

ANIMAL MOVEMENT ANALYSIS ARCVIEW EXTENSION
USGS - BRD, Alaska Biological Science Center
Glacier Bay Field Station
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Introduction	Data Format	Views	Tables	Bibliography

Loading this Extension: Animal Movement is an ArcView program extension. 2 versions are currently available, one which requires the simultaneous use of Spatial Analyst. After downloading, unzip/extract the .avx file directly (or unzip to a temp directory, then copy) to the ArcView EXT32 folder. Start the ArcView program, click on "file" and go to "extensions". From the list of available extensions, select Spatial Movement Analysis (which requires Spatial Analyst to be selected first), or choose Animal Movement Analysis (which does not require Spatial Analyst), and click "ok". The collection of new functions will now be available through the menu choices, tools, and buttons described below.

Using this documentation: Click on the menu bar above to go to the major headings and then click on either the subheading list or the image map of menu choices or buttons. Click on the return button to get back to the subheading list.
Note: The images in this documentation are degraded compared to the screen and printer output in order to speed up loading.
Citation information
Please site the Animal Movement program if you use it in a publication.
P. N. Hooge and B. Eichenlaub. 1997. Animal movement extension to arcview. ver. 1.1. Alaska Biological Science Center, U.S. Geological Survey, Anchorage, AK, USA.
For any problems or questions regarding this documentation, contact: elizabeth_solomon@nps.gov

🌐 Introduction　　　　　　　　　　　　　⬆

The Movement extension is a collection of over 30 functions to aid in the analysis of animal movement data. The motivation for the creation of this program was the absence of a collection of tools with real integration into a GIS (Geographic Information System). In addition, several functions in this program had not been implemented before or were specifically developed to address author specific research problems. The ArcView software program was chosen for development because of high degree of integration of its GIS environment, the ability to work with a wide variety of spatial data formats, compatibility with many computer platforms, and the capability of its object oriented scripting language Avenue. The ability to cleanly load and unload code developed for specific functions (extensions) was an added benefit. The use of Avenue and ArcView has both costs and benefits. Implemented through a scripting language, several of the functions are significantly slower than compiled code would be. However most functions work as fast or faster than similarly compiled programs. On the benefit side the program has full integration with all other ArcView functions and extensions. The Movement extension works in multiple projection systems, uses the selected records (enabling complex queries or selections), inputs point and attribute data in many formats, and will integrate with many types of spatial data.

The Movement extension also has considerable utility for the analysis of other point phenomena and has functions which are

useful for many types of GIS uses.

Requirements: ArcView and Spatial Analyst (for full functionality). This program will work in versions of ArcView on PC , UNIX and Macintosh hardware. The random number generator on the UNIX platform, however is not truly random and caution should be used with the functions that use random numbers. On the PC platform it is recommended that a Pentium or Pentium Pro 200 or faster be used with this program and at least 32 megabytes of memory, especially when simultaneously running Spatial Analyst.

IMPORTANT NOTICE: We have done extensive testing on our data sets. However, due to the complexity and size of this application there will be bugs that we have missed or that only appear in some data sets. Be aware that there are substantial differences in the values calculated by many home range programs due to small differences in the way algorithms were implemented (see Worton 1989, White & Garrott 1990 for examples). Please send detailed descriptions of the problem and if possible data sets that they appeared with to Philip N. Hooge. We will try to fix them as time is available.

 Scripts being worked on for Version 2.0 (est. March 99)

-Compositional analysis of habitat use (Aebischer 1993)
-Habitat selection under changes in habitat availability (Arthur et al 1996)
-Subsetting data and batch processing
-Fourier nonparametric home range model (Anderson 1982)
-Easier to use dialog box query method for subsetting data
-Add a bivariate normal random function to the random point generator .
-Traveling harmonic mean graphics in movement path animation tool
-Additional habitat selection statistics
-MCP by cluster analysis
-T2/R2 bootstrap, even though I believe this has limited utility
-Better measure of meaningful autocorrelation
-Dynamic and static interaction of two or more location point files.
-Generation of correct circular plot random patterns (the random point generator does not work correctly for circles or ovals).
-Triangulation tools for location calculations.
-A Monte-Carlo method for using error polygons (from triangulation) and error circles (e.g. sonic tags) to generate confidence limits on home range and habitat selection methods.
-Bootstrapping of Kernel and MCP Home Ranges to get confidence limits on area measurements.
-Additional documentation on methodology
                                        What are your ideas?
Known Bugs in Version 1.1 as of November 11, 1998

-Constraining graphic in site-fidelity test does not work in a unprojected view
-Swedish Language option and the functions requiring spatial analyst are incompatible.
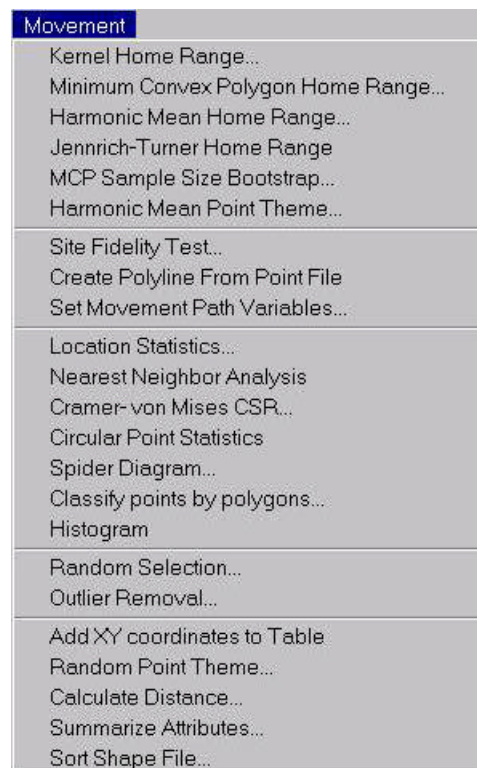-Dirichlet Tesselation will not work in a projected view.

| 🌐 **Data Format** | |

Most of the functions work on point themes, which can be created in any method that ArcView can use. Examples include making point event themes from database tables, ascii files or using point shape files, AutoCad point files, and point coverages from

ArcInfo. Data can have any number of attributes which can be used in several functions (as well as by the standard ArcView functions). The line coverages that are used for a few functions are best made with the point to polyline tool in the program. If there is a date field present it will be used automatically or if there are multiple date fields the program will query the user. The program can use multiple projections. The projection units and distance units are always the units set in the view. However some functions do not give meaningful measurements in some projections. For example area measurements in decimal degrees will have limited utility. The bulk of the testing was done using the UTM projection and this is the suggested projection because of this testing and the characteristics of the UTM projection for most study sites used in animal movement studies. Some studies however that have very large study sites may need to use other projections such as Albers. Even if all your work is in one projection system we suggest that you leave your vector data in decimal degrees to take advantage of the ability to reproject your data as needed to integrate your data with other spatial data sources. The Movement program expects the data to be sorted or functions that are outputting time depended data (e.g. speed, autocorrelation) will return nonsense. There is a function in the program which does a permanent sort of the data. If your data is not sorted it will be necessary to use this program as the Table Sort command only works on the Table document and does not extend to the virtual attribute table which is used by the rest of ArcView. If you wish to preserve the original ordering use the add record number function first and then resort latter based on this.

Views

Select a menu item.

| Movement |
| --- |
| Kernel Home Range... |
| Minimum Convex Polygon Home Range... |
| Harmonic Mean Home Range... |
| Jennrich-Turner Home Range |
| MCP Sample Size Bootstrap... |
| Harmonic Mean Point Theme... |
| Site Fidelity Test... |
| Create Polyline From Point File |
| Set Movement Path Variables... |
| Location Statistics... |
| Nearest Neighbor Analysis |
| Cramer-von Mises CSR... |
| Circular Point Statistics |
| Spider Diagram... |
| Classify points by polygons... |
| Histogram |
| Random Selection... |
| Outlier Removal... |
| Add XY coordinates to Table |
| Random Point Theme... |
| Calculate Distance... |
| Summarize Attributes... |
| Sort Shape File... |

View menu items added to v 1.1:

Delauney Triangulation

Dirichlet Tesselation

Select a button or tool.

Buttons

Tools

Tables

Select a menu item.

Movement
Field Properties
Selection to DBF...
Create Cumulative Field...
Histogram

VIEW MENU CHOICES

Kernel Home Range

Kernel Home Range calculates a fixed kernel home range utilization distribution (Worton1989) as a grid coverage using either ad hoc calculation of a smoothing parameter, least squares cross validation Silverman (1986), or a user input for the smoothing parameter (H). The bivariate normal density kernel is used as suggested by Worton (1989). The least squares cross validation (LSCV) in this version takes significant processing time despite using the golden minimizing routine. Most user will find that the adhoc calculations are very close to the LSCV for exploratory analysis (for most datasets Hopt is usually between 0 .7 and .9 of Href[Ad hoc] in this implementation). The adhoc calculation is based on Silverman (1986) rather than Worton(1989) or Seaman & Powel (1996). The problem of discretization errors (0 length distances caused from rounding location positions giving a minimized h of zero) are handled slightly different than Tufto (1996). Distance measures are uniform randomly placed between 0 and (href/100) when and only when the distance measurements are 0. This only adjust the locations when necessary and allows for different projection and distance systems. The kernel is based on the non-corrected data. The program queries the user if they would like to adjust the .LSCV or the Adhoc H. Worton (1994) suggests adjusting H by 0.8 for normal distributions and 0.5 for uniform. Work by Seaman & Powel (1996) suggest that this is not necessary with the LSCV. It is our experience that the original Adhoc and LSCV smoothing parameters provide a less biased estimator than a user selected or Worton's corrections.

Three things are output from this routine: A grid coverage with the Utilization Distribution (probabilities), a polygon shapefile containing individual polygons for each selected probability, an associated attribute table containing probability and area fields for each set of probability polygons, and a message box displaying the area calculations of each probability, Note that the default probabilities are 50 and 95, and that the view must be zoomed out sufficiently to encompass the larger probability areas to create the polygon shapefile (95%, etc.)
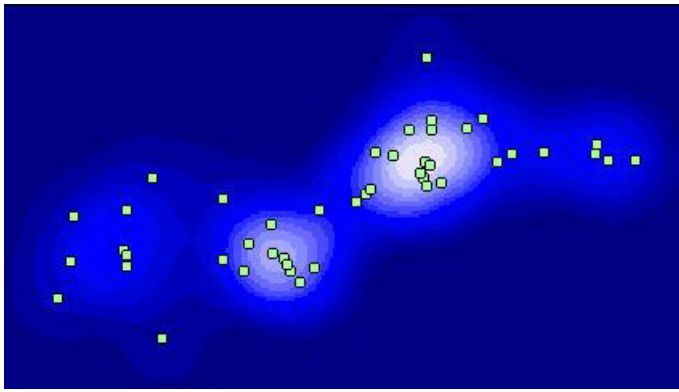
This figure shows the green dots (location points from which the kernel was created from using the LSCV) against the utilization distribution grid.
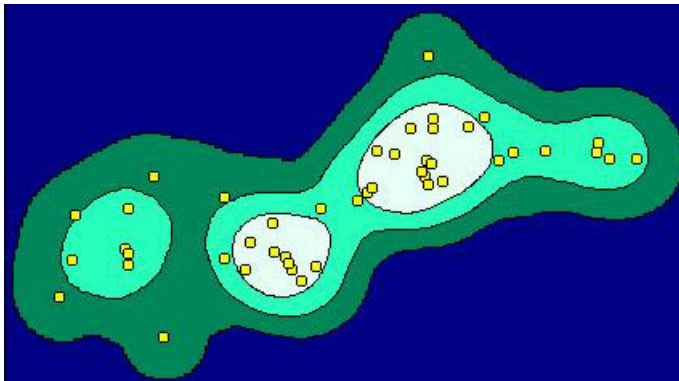
This figure is a display of the location points (shown in yellow) within the selected 50, 75, and 90% probability polygons.

This program calls four functions Fun.KernelHR, Fun.LSCV, Fun.Golden, Fun.Score. Fun.LSCV calls function Fun.Golden which in turn calls Fun.Score. These latter two functions are best used from Fun. LSCV rather than being called themselves. Fun.KernelHR and Fun.LSCV have the following structure which can be called from avenue:

Fun.LSCV 1.2 3/20/98

This implements Least Squares Cross Validation for the Normal Bivariate Kernel Smoothing Factor

NOTES: This LSCV is valid only for the bivariate normal kernel but while it is designed for the Fixed Kernel it will give accurate results for the adaptive kernel.

CALLS: Function Fun.Golden and Function Fun.Score

RETURNS: HList = {minH}
   H is the minimized smoothing parameter

INPUT:
 TheFTab = Self.Get(0) 'The Ftab of the location points
 TheSet = Self.Get(1) 'The Set of locations
 ThePrj = Self.Get(2) 'The projection of the location points
 Href   = Self.Get(3) 'The adhoc determined H value used to create the parameters for the search and shorten it.

.

Minimum Convex Polygon Home Range
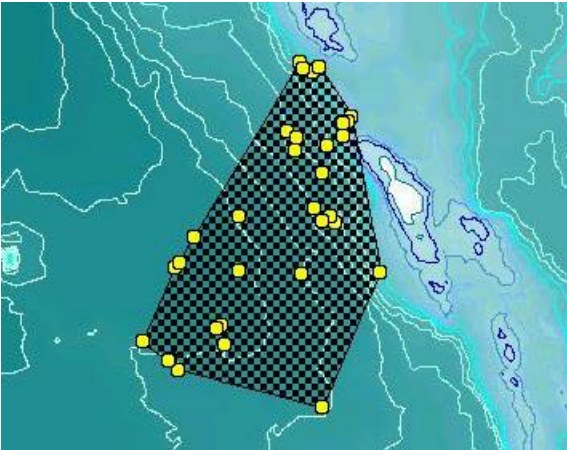
Calculates a minimum convex polygon home range based on either the selected records or if none are selected the entire data set. A polygon shape file theme is created. The location point statistics menu choice will output a MCP as a graphic object if this is desired rather than a shape file if (View Graphics must be selected). If only area is desired then location point statistics with nothing selected will output MCP area.

Yellow circles are locations and the checkered polygon is the MCP

The Fun.MCP which this program calls Minimum Convex Polygon Home Range has the following input and output structure:

RETURNS retList = {MCP, MCPArea, pList, cornerPts}
MCP is the polygon graphic object
MCPArea is the area measurement in view units
pList is the list of points
CornerPts are the points making up the corners
INPUT:
theView = SELF.Get(0) 'The view
theTheme = SELF.Get(1) 'The theme with the points
theFtab = SELF.Get(2) 'The Ftab with the points
theFBit = SELF.Get(3) 'The selected records
thePrj = SELF.Get(4)   'The view projection


Harmonic Mean Home Range
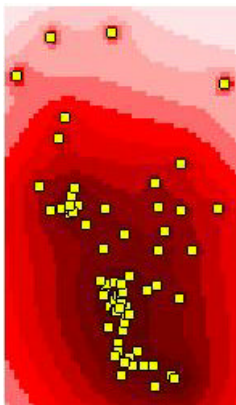
Creates a grid based on the Harmonic Mean method (Dixon & Chapman 1980). We do not encourage the use of this method for calculating home range areas and thus do not directly output a area measurement. It has many problems in home range calculation (Worton 1987 1989, White & Garrott 1990) these include dependencies on grid origin and spacing. This and the Harmonic Mean Point file are placed here mainly for the purpose of examining activity centers and for obtaining habitat relationships based on a gridded distance measurements.

Generates a harmonic mean home range from a gridded point theme of harmonic mean z values. This program generates a grid based on the harmonic mean z values. The attribute field VALUE is the z values, the attribute field PROPORTION is the proportional representation of those grid cells summed over the entire grid and equal to 1. PROPORTION_CUM is the cumulative total of PROPORTION. These can be used to generate a psuedo-utilization distribution as the harmonic mean method does not create a utilization distribution.

This menu choice used the Function Fun.HarmonicMean .

Jennrich-Turner Home Range
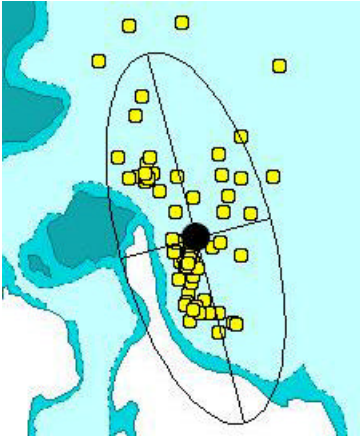
This implements the Jennrich-Turner (1969) Bivariate Normal Home Range. This method of home range calculation is seriously flawed in its dependence on a bivariate normal distribution of locations but is valuable due to its lack of sensitivity with sample size, simplicity of underlying probability theory, ability to get confidence limits on the estimates, and to derive the principle axis of the location coordinates. Other than the rare circumstances where the data is bivariately normal the main utility of this program lies in developing statistically simple home range-habitat models and in comparison with home range estimates using this method in other studies.

The program ask the user which probability ellipse to output (current choices are 95, 90, and 50). The program will then take the selected records (or if none are selected the entire dataset) and generate a bivariate normal probability ellipse including the major and minor axis and the arithmetic mean as a graphic object. This graphic object is ungrouped so individual items can be deleted. The graphics are not erased so multiple ellipses can be generated on one or many location files. The ellipse can be selected and copy and pasted into polygon coverage. A message box with the arithmetic mean X and Y, the area of the ellipse, the major axis length, the minor axis length and the angle of the major axis in reference to the X axis.

The Fun.Jennrich_Turner which this program calls Jennrich Turner Home Range has the following input and output structure:

RETURNS: JTList = {ArithmaticMean,Area, MajorAxisLength, MinorAxisLength, Angle, MajorAxis, MinorAxis, Ellipse}
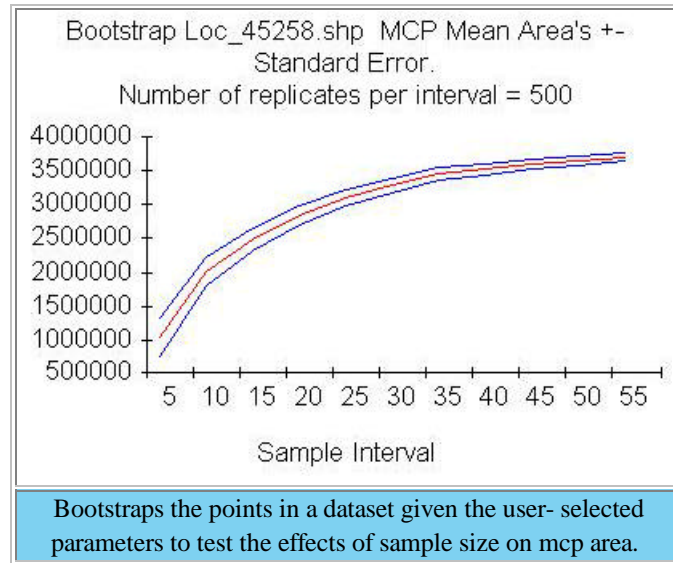
ARITHMATICMEAN is equal to the arithmetic mean point
AREA is equal to the area of the probability ellipse
MAJORAXISLENGTH is equal to the length of the major axis
MINOR AXISLENGTH is equal to the length of the minor axis
ANGLE is equal to the angle which the major axis is inclined from the X axis
MAJORAXIS is equal to a line representing the MajorAxis
MINORAXIS is equal to a line representing the MinorAxis
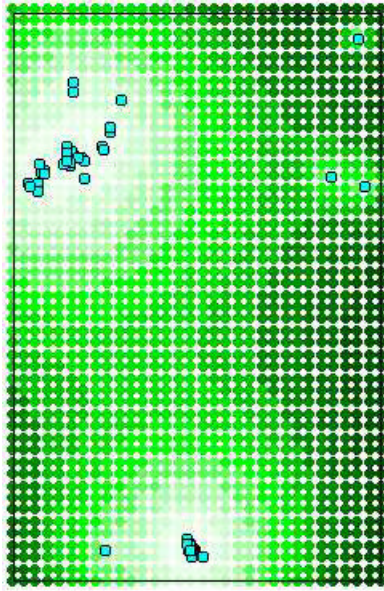ELLIPSE is equal to the probability ellipse

INPUT:
TheFTab = Self.Get(0) 'The Ftab of the location points
TheSet = Self.Get(1) 'The Set of locations
ThePrj = Self.Get(2) 'The projection of the location points
Probability = Self.Get(3) 'The probability ellipse 95%, 90%, or 50%

MCP Sample Size Bootstrap

Bootstrap Loc_45258.shp MCP Mean Area's +-
Standard Error.
Number of replicates per interval = 500

Bootstraps the points in a dataset given the user- selected
parameters to test the effects of sample size on mcp area.

Harmonic Mean Point Theme

Classify the legend using the z value.
This theme can be converted to a
probability grid with the cell size based on
point spacing

The fun.HarmonicMean which this program calls Harmonic Mean Point Theme has the following input and output structure:

RETURNS: Hmlist = {HarmonicMean, HMDict, zmin, zmax, MaxPoint, MinPoint,theInc,URPt} a list with the Harmonic Mean location (a point), the dictionary containing all the grid points and the z values (can be used to create a harmonic mean home range or to find multiple centers of activity, the minimum z value, the maximum z value, and the location of the Max z value (a record when the points themselves are used. MinPoint will equal HarmonicMean except for when the points are used. Then it will return the Record with the minimum value. theInc is the distance between points. URPt is the upper right corner pt these have been place in here to aid in the production of grid coverages from the data origin which is also useful can be obtained from the rect passed to this function.

NOTES: if both TheRect and TheXdiv are nil then the points themselves are used to generate the Harmonic Mean. This is useful for eliminating outliers from the data set in a meaningful way. In this case MinPoint & MaxPoint will be a record number. This is one of the methods used in outlier removal.
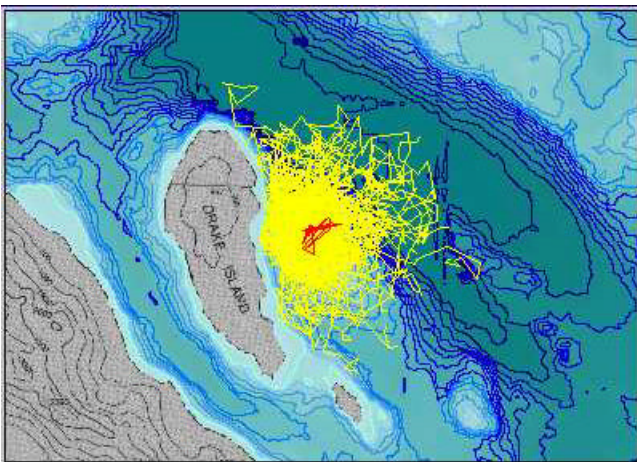

Site Fidelity Test

Creates random angles and uses distances between existing sequential points to determine walk points.
Requires an active point theme. Prompts the user to select one of the following starting points for the simulation: First Point, Last Point, Arithmatic Mean, and Harmonic Mean (Defaults to the First Point).
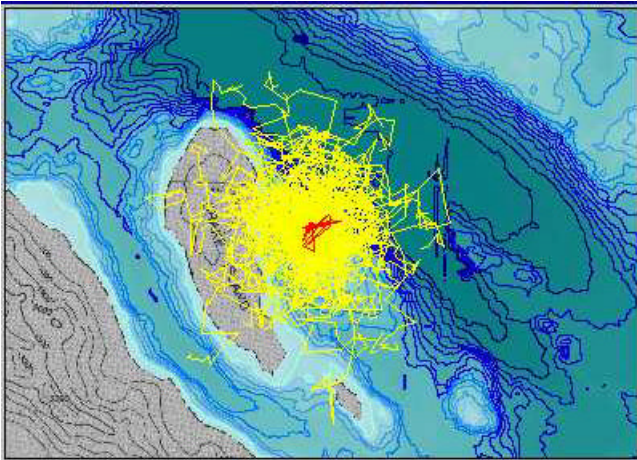
Site fidelity test without the use of a bounding graphic.
Red line represents the observed movement path and yellow lines
indicate 100 random replicates

Site fidelity test using a bounding graphic of 60 ft or deeper water.
Red line represents the observed movement path and yellow lines
indicate 100 random replicates

Replicate	R2	Linearity
0	67721.5567	0.008853
58	117275.1930	0.052104
11	122200.1468	0.068313
47	133993.3119	0.011660
5	145645.5608	0.084025
62	147605.9036	0.157427
16	155620.3911	0.097287
13	161644.0278	0.121089
88	171032.5876	0.098389
15	175830.9955	0.084604
45	179745.6939	0.084053
54	185171.1936	0.123097
1	188314.6728	0.062335
80	191732.8663	0.047216
3	198834.5327	0.025812
69	199047.7713	0.095383
6	203446.8386	0.012140
20	207437.1364	0.037535
95	208117.4301	0.101321

Table represents the number of replicates used in the analysis and the corresponding R2 and linearity values. Lower r2 value = higher site fidelity

The simulation compares the observed pattern with a user selectable number of random walks. This uses a Monte Carlo simulation and parameters from the original data to determine if the observed movement pattern has more site fidelity than should occur randomly, is a random pattern or is overly dispersed. It is suggested that a 100 simulations be run first and if the data is close to chosen probability level break point then run it with a 1000 simulations which will more accurately reflect the random walk distribution. Outputs a table with 3 fields, Replicate, R2 and Linearity. Outputs a polyline theme containing polylines of random walks. The polyline attribute table and the R2 table are linked by Replicate and LinkID. If replicates < 100, outputs a chart showing the r2 sorted in ascending order. To identify which r2 belongs with which polyline, select the record from the output table and view the selected polyline in the view. However, as the chart is dynamically linked to the table, selecting individual records will modify the charts color scheme. To save the original chart, add it to a static layout before viewing individual records in the r2 table. The O replicate in the output table and chart is the observed data the others are replicates from simulation runs. Works on selected point records or if none selected the entire table. A single selected polygon or polyline may be use to limit the extent of the random walks. Progress bar tells the progress through the simulation loop.

Create Polyline From Point File
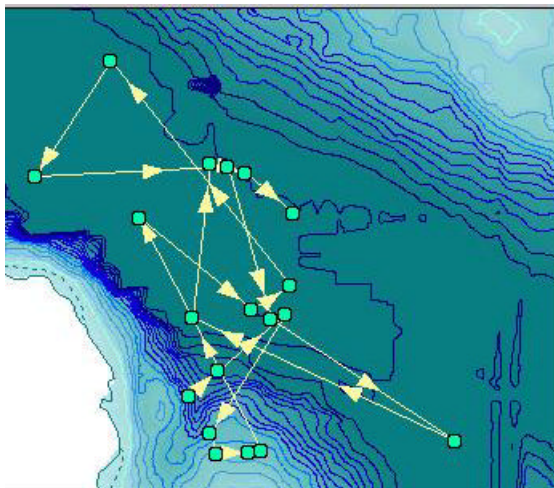
Creates a an ordered polyline theme from a point file

Point theme file must be pre-sorted.
Transfers all attributes of the point theme starting with
the second point record (= first line record).

You must classify the theme with the arrow line
symbol in order to see direction of travel.

Set Movement Path Variables

Sets the characteristics for the movement path function button.

Enter the following travel path graphic characteristics:
- **Line color**
- **Line width**
- **End point size**
- **End point color**
- **End point symbol**

Location Statistics

Calculates a series of descriptive statistics of the animal location point pattern and can output graphical representations of some statistics. Select a method for the output of location statistics. If nothing is selected then the routine will default to basic statistics and a screen report of the results. Multiple items from the list can be selected simultaneously. If any item is selected from the list and a screen report is desired then Screen Report must be selected. View Graphics will output the graphical results to the current view. Advanced Statistics contains those functions that require significant processing time namely the nearest neighbor analysis, Cramer-von mises, and the harmonic mean calculations. The harmonic mean calculation will query the user with the desired grid size which substantially effects the speed of the routine. The box showing the statistical boundaries is useful for evaluating the nearest neighbor analysis and Cramer-von mises both tests of complete spatial randomness. These boundaries can be adjusted in the individual menu choices for these functions.
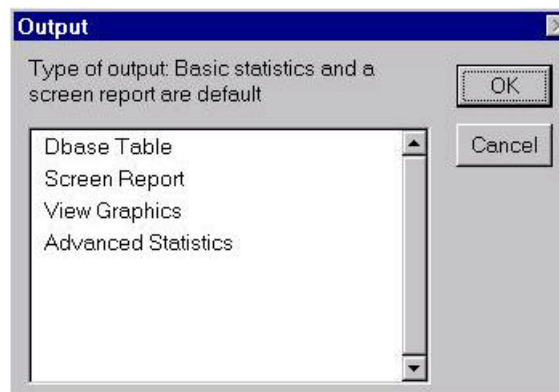
Minimum X	Minimum value of x coordinate (utmx - northing)
Minimum Y	Minimum value of y coordinate (utmy - easting)
Maximum X	Maximum value of x coordinate (utmx- northing)
Maximum Y	Maximum value of Y coordinate (utmy- easting)
Sample Size	Total number or records (observations) in the dataset
Mean of X	Mean value of x coordinate (utmx - northing)
Mean of Y	Mean value of y coordinate (utmy - easting)
X Variance	Variance of X coordinates (utmx - northing)
Y Variance	Variance of Y coordinates (utmy - easting)
XY Variance	The XY variance (not the covariance)
Minimum distance	Minimum distance (m) between observations
Maximum distance	Maximum distance (m) between observations
Total distance	Total distance (m) traveled per dataset
Mean distance	Mean distance (m) traveled per dataset
Number of bearings	Total number of bearings (angles) per dataset
Mean bearing	Mean bearing per dataset (azimuth)
R Concentration of angles	The concentration of angles 1-r is the "circular variance"
Angular deviation	The angular equivalent of linear standard deviation
Rayleigh's z for angles	The z value for Rayleigh's test for significant angles
Minimum date	Earliest observation date per dataset (yymmdd)
Maximum date	Latest observation date per dataset (yymmdd)
Duration of Study	Total number of days per dataset
Minimum speed (units/day)	Minimum number of meters traveled per day
Maximum speed (units/day)	Maximum number of meters traveled per day
Mean daily speed	Mean number of meters traveled per day; distance/number of days in dataset
Linearity	The distance between travel path endpoints and the total distance traveled
R2	A measure of dispersion of the data, mean squared distance (MSD) from the center of activity
T2/R2 ratio	Schoener's ratio for examining autocorrelation. R2/MSD between successive observations
Primary axis length	The major axis length (bivariate normal)
Secondary axis length	The minor axis length (bivariate normal)
Primary axis angle	The angle which the primary axis is offset from the X axis (90 to -90)
Eccentricity	The ratio between the minor and the major axis
Cramer-von Mises	Test statistic for Complete Spatial Randomness (CSR)(see Cramer-von Mises menu selection)
CM heterogeneity p.	The probability value for rejecting the null hypothesis of CSR using the Cramer-von Mises
MCP area	Minimum Convex Polygon area (m); calculates area between all points in dataset
95% Ellipse Area	The bivariate normal 95% ellipse
Harmonic mean X Value	The X coordinate position of the harmonic mean
Harmonic mean Y Value	The Y coordinate position of the harmonic mean
Nearest-Neighbor R	The nearest neighbor test statistic (see Nearest-Neighbor menu selection)
Nearest-Neighbor z	The z value of R
Nearest-Neighbor p	The probability value for rejecting the null hypothesis of CSR using Nearest-Neighbor R

View Graphics
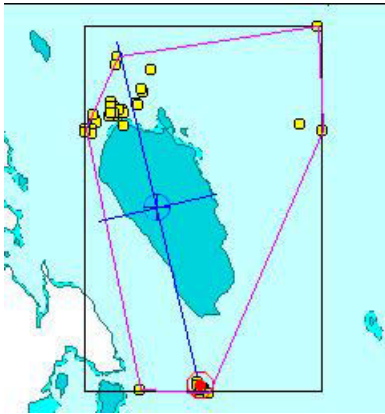
Advanced Statistics Graphic Output
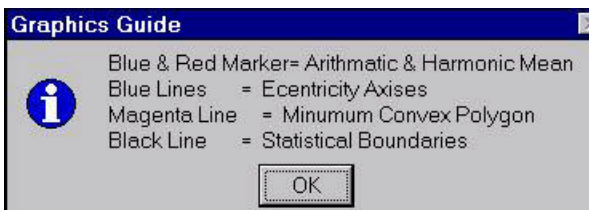
Nearest Neighbor Analysis Test For Complete Spatial Randomness

The Nearest Neighbor Analysis program tests for complete spatial randomness using a selected graphic or polygon feature from a polygon shapefile. Returns a message box displaying the area of the chosen study site and the z and r values.

This program references the FunNNDCSR, which implements the Clark and Evans (1954, Ecology 35. pp445-453) algorithm and allows for either points beyond the boundary to be used for correcting edge effects or uses the correction of Donnely (1978, Holder (eds) Simulation methods in archaeology. pp.91-95). This allows considerable flexibility. If the population has been completely sampled, e.g. animal locations from radio tracking or tag returns, then choose FALSE for correction and ignore the boundary boolean (i.e. set it to TRUE or FALSE as it won't matter). The program defaults to using the boundary correction for anlaysis. If you have not sampled the complete population then select either the edge correction or the boundary correction (if you have sample points beyond the boundary). It checks to see if the sample size is too small (from Donnely 1978) for the normal distribution.

The FunNNDCSR which this program calls Nearest Neighbor Analysis has the following input and output structure:

RETURNS: NNDCSR = {R, z, Significance}
        The R value, a z statistic, the probability level,

INPUT:

AFtab = Self.Get(0) 'The Ftab. A Ftab

ASet = Self.Get(1) 'The selected records. A bitmap

APrj = Self.Get(2) 'The projection or nil if it doesn't exist

ChosenShape = Self.Get(3) 'The shape where the points are

Correction = Self.Get(4) 'Do a edge correction? A boolean.

Boundary = Self.Get(5) 'Points outside the boundary to do an edge correction?

OutputSignificance = Self.Get(6) 'Output the significance? A boolean.

Cramer-Von Mises Test for Complete Spatial Randomness

Description: Works from a menu on either a selected point theme and a selected rectangle graphic or from a rectangle in a shape file. This function is only valid with a rectangular study plot. The wait cursor will appear and then a messagebox will tell you the W value and how many features were accounted for in the analysis. W values relate how clustered or dispersed points are within the graphic rectangle or rectangle theme you specified. A W value of greater than .3 indicates a tendency towards a clumped (clustered) pattern. A W value of 0.3-.06 indicates a random distribution. An R value of less than .06 indicates an organized (uniform) pattern. This statistical test
is insensitive to origin but highly sensitive to the upper right corner of the study plot. Its primary usefulness is in detecting heterogeneity that the nearest neighbor analysis (NNA) misses especially NNA base purely on distance measurements.
Zimmerman, D.L. 1993, A bivariate Cramer- von Mises type of test for spatial randomness, Appl. Statist. V. 42. pp. 43-54.

The funCramer which this program calls Cramer_von Mises has the following input and output structure:

RETURNS: cramer = {w,HeteroSign,OrderedSign}

W is the Cramer-von Mises statistic

HeteroSign is the significance of acceptance of the alternative hypothesis of heterogeneity.

OrderedSign is the significance of acceptance of the alternative hypothesis of ordering of the data.

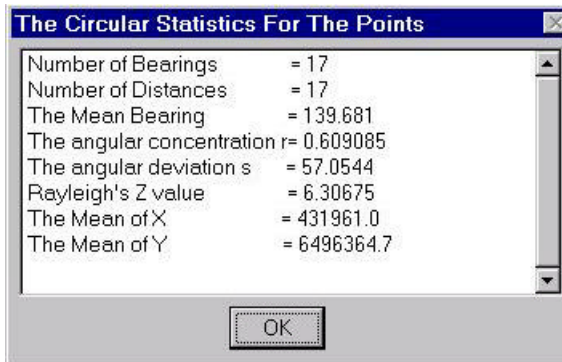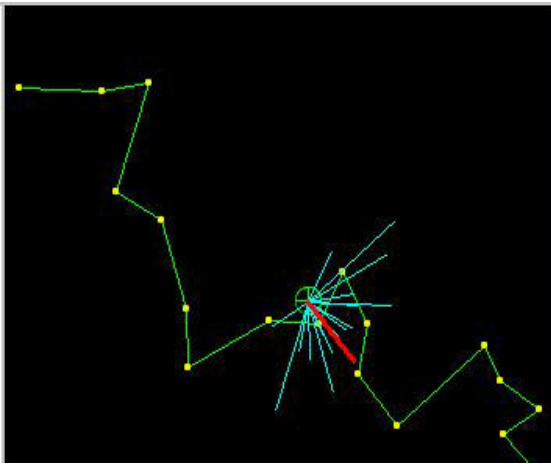INPUT:

AFtab = Self.Get(0) 'The table. A Ftab

ASet = Self.Get(1) 'The selected records. A bitmap.

APrj = Self.Get(2) 'The projection. The projection or nil if none.

ARect = Self.Get(3) 'The rectangle to do the statistics in. A rect

Circular Point Statistics

The Circular Statistics For The Points

Number of Bearings	= 17
Number of Distances	= 17
The Mean Bearing	= 139.681
The angular concentration r	= 0.609085
The angular deviation s	= 57.0544
Rayleigh's Z value	= 6.30675
The Mean of X	= 431961.0
The Mean of Y	= 6496364.7

OK

Conducts circular point statistics and outputs a graphic representation of the bearings. The red line = mean bearing, which is scaled proportionately to the r value of the angles; r value = 0 to 1, (1=all angles the same) multiplied by the longest line segment.

This implements circular statistics (Batschlet 1981) for the sequence of points in a point coverage. Useful for determining the travel directions from animal movement locations and the significance of direction of travel.. This function requires that the data be ordered in the sequence desired. The function works on the selected records (or all if none are selected) which is useful for examining parts of the movement path. The program will not tell the probability level of rejecting the null hypothesis of directed movement but will give the Z value and sample size which can be looked up in a Z table.

The fun.CircularPtStats which this program calls Circular Point Statistics has the following input and output structure:

RETURNS: CircleStatsList = TheNmbrBearings,Bearings,Distances,theMeanBearing, TheXMean, TheYMean,r,s,z}

The number of bearings, The List of Bearings, The List of Distances,
The Mean Bearing, The Arithmetic mean of X, the arithmetic mean of Y,
the angular intensity, The angular dispersion, and Rayleigh's Statistic

INPUT:

TheFTab = Self.Get(0) 'The Ftab of the location points
TheSet = Self.Get(1) 'The Selection BitMap of the locations
ThePrj = Self.Get(2) 'The projection of the location points

Does a series of circular spatial statistics on X,Y points representing animal locations or other travel path variables
Requires an active point theme.
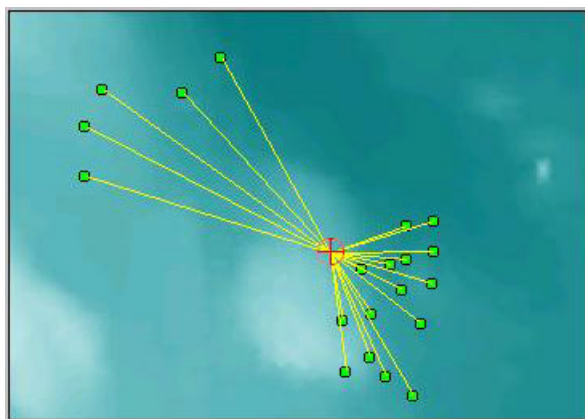Requires compiled script Fun.CircularPtStats

Outputs: Mean bearing, Number of Bearings with a length > 1,
   List of Bearings, List of Distances, s, z.

Spider Diagram

Creates a polyline file using either the arithmetic mean, harmonic mean, or another theme to calculate the centers. Use the area and perimeter update tool to add the length measurements to the attribute table in the view distance units. This program is useful for building distance relationships between either the arithmetic (A) or harmonic mean (B) or other point (C) or polygon themes (D). It builds the lines up to the the closest objects using the center of that object. This is useful for developing test of habitat relationships that are not as sensitive to locational error or polygon mismapping as are point on polygon methods.
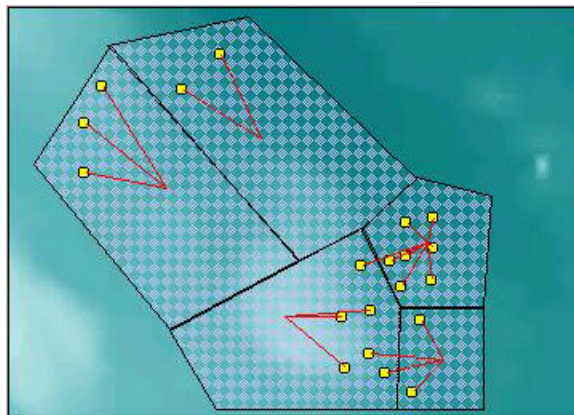
A) Calculated with the arithmetic mean   B) Calculated with the harmonic mean
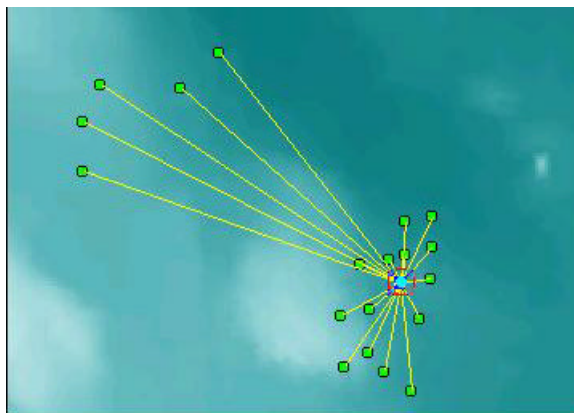
C) Calculated with a point theme   D) Calculated with a polygon theme
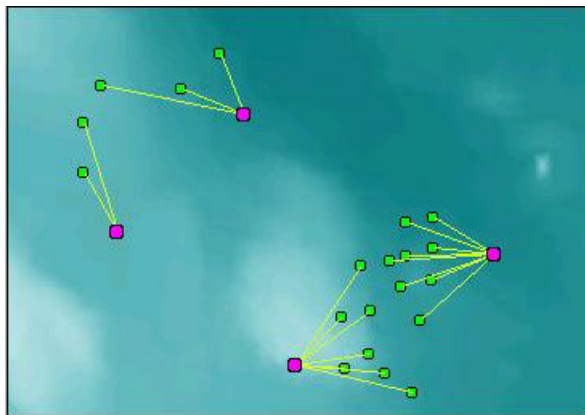
Description: The program first prompts for the type of centers to use. If the user selects themes the program creates spider diagrams based on the distances between the CLOSEST points (or center of shapes) contained in two themes. If the user selects Arithmetic or Harmonic Mean the program creates the spider diagram from just that one mean point. The Output is a new (spider) theme with distances stored in the FTAB.

Classify Point By Polygon

Takes the selected point theme and classifies it based on the selected field of a polygon theme. It adds a field to the point attribute table with the classification information. This works on the selected records or prompts the user if none are selected to use the entire point theme.

Histogram

Creates a histogram based on a selected field of a theme using its legend classification
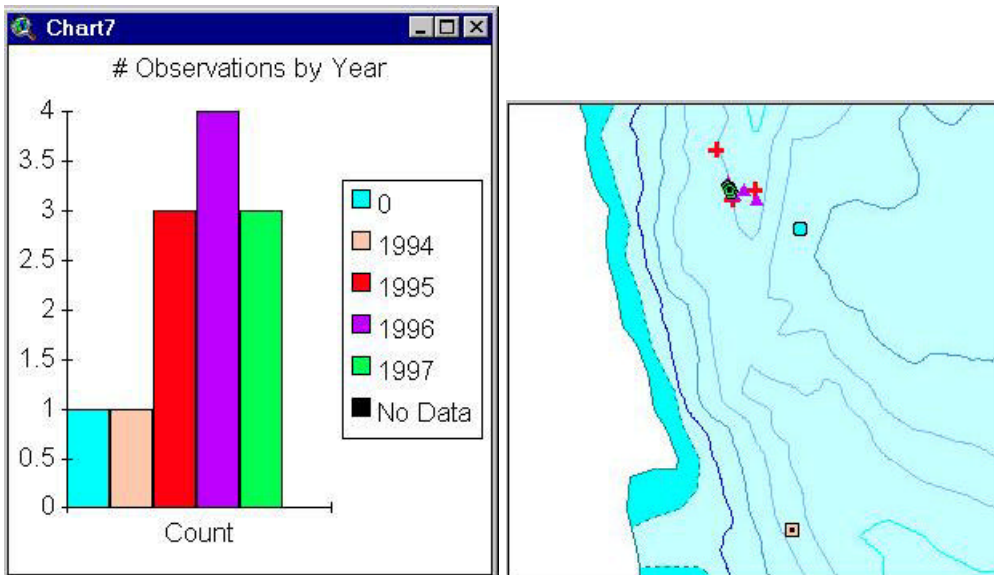
Random Selection

Enter the percentage of features to select.

Select with or without replacement.
Randomly selected features will appear
highlighted.

e.g. In this random selection process, 20 % of the
existing points (with replacement) have been
chosen, the results displayed in yellow.
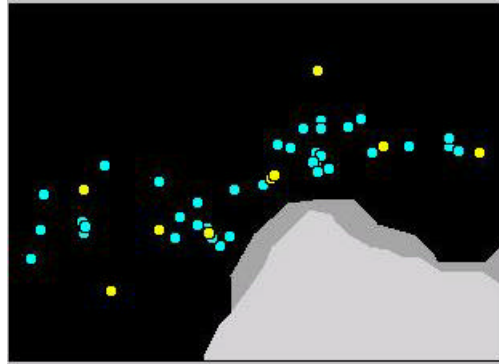
Outlier Removal

Enter the percentage of points to be removed.

Select the method of removal (only harmonic mean
in v. 1.0). The Harmonic mean method (Dixon &
Chapman 1980) removes points by their largest
harmonic mean value. The program recalculates
values after each removal as suggested by White &
Garrot (1990)

e.g. In this outlier removal process, 5% of the
outlying points were removed, and 95% (shown in
yellow) become selected for further analysis
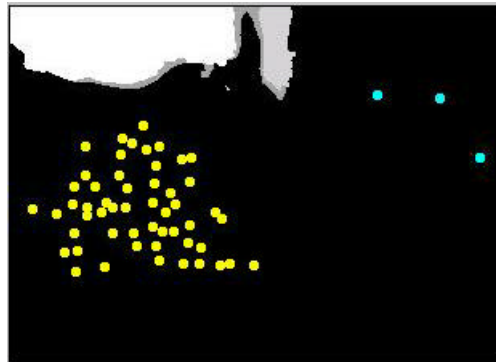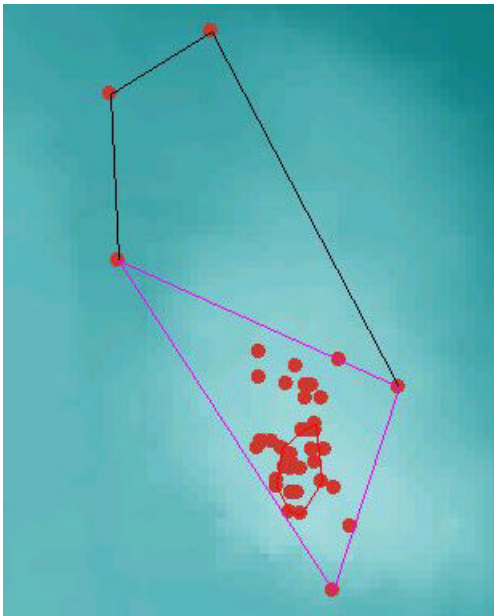
The outlier removal can be used to create MCPs containing different percentages of the total locations. In this example the 100% (black, partially covered by magenta), the 95% (magenta) and the 50% (red) are shown. These were built by sequentially unselecting a percentage of outliers using this menu choice and then building a polygon using the location statistics menu choice (view graphics option). After each selection all the points were reselected (or unselect all the points).

Inputs: A selected point theme, the percentage of points to remove and whether they should be removed with or without replacement.
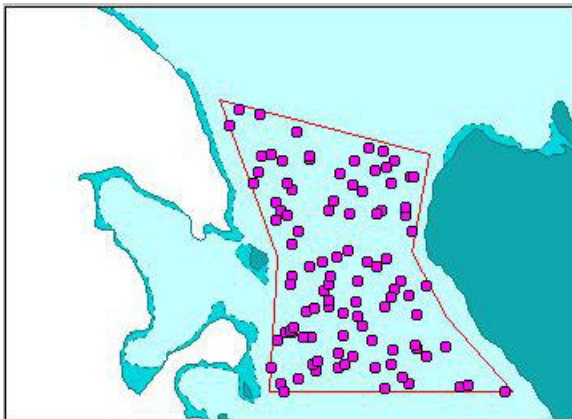
Outputs: A selection of points with the outliers removed

Add XY coordinates to Table

Adds geographical coordinates of a point or the centroid of a polygon to the theme's attribute table. Coordinate values are based on the current projection of the view.

Random Point Theme

Creates a random point theme using a selected record of a polygon theme or polygon graphic as the boundary. User selects the polygon record or graphic, then specifies number of points, distance from boundary, and distance from other points.

In this example, 100 points were chosen using 1 meter distances.

Calculate Distance

Calculates distance from selected items in one theme to items of another theme This script will prompt the user for two point themes in the active view: theFromTheme = the point theme containing the selected points that you wish to calculate the distance FROM. theToTheme = the point theme containing points that you wish to calculate the distance TO. The user will also be prompted for an identifying field in the FROM theme. The value of this field will be used to name to distance field in the TO theme. A distance field will be added to the TO theme for each point selected in the FROM theme. This distance field will be populated with the distance between the selected From point and the To point. If the view is projected, the distance will be returned in distance units.

Summarize Attributes

Summarizes the attributes of the selected theme based on a dialog input box.

Sort Shapefile

Sorts the attributes of the selected shapefile theme based on the chosen attribute. This script sorts a shapefile to ascending order using Avenue's dictionary data type to store original bitmap values indexed by sort field (unique) values. This does a permanent sort of the data. Sorting by date is required for several functions in movement. If you wish to keep the original sorting use the add.

Requires: A shapefile with attributes and an unique key.

VIEW BUTTONS
Displays the movement paths of an animal

First, set the graphic symbols, colors, sizes and attribute field to display by running the set movement path variables function from the menu.

Obsrv_date = Thu Jul 30 08:55:26 1992 Number of days from last sample= -5.000 Distance traveled from last sample= 89.8695

Description: Script runs from a tool and works on an active polyline theme. Script creates a sequential series of graphic lines which mimic underlying non-zero length polylines. Direction of travel is indicated by a graphic dot at the end of the most recently created graphic line. Complex polyline themes can be active but do not need to be visible. Useful for travel path analysis.

Left click to move forward, shift key down and left click to move backward. Select any non-zero length polyline to start or start at the beginning by not selecting any polyline. Reset tool and graphics by re-clicking on its tool button.

Record information is visible at the status line or via the identify dialog box.

## ▣ Recalculate area, length, and perimeter of selected items

This function will recalculate and update the area, length, and perimeter (if present) of selected items using the current projection and distance units of the view.

Description: Calculates area and perimeter for polygon themes and length for line themes. If the View has been projected the calculations are in projected meters. Otherwise the calculations are in 'native' map units. Modify the script to provide calculation in the current report units of
the View. The script processes the list of active themes to calculate area and perimeter, or length, depending on the theme type.

The script will add the fields: Area and Perimeter to polygon themes, Length to line themes if they do not exist. If the fields exist their values will be recalculated. Re-run the script if you change the projection of the view.

◯ Create a point buffer shapefile with specified buffer distance
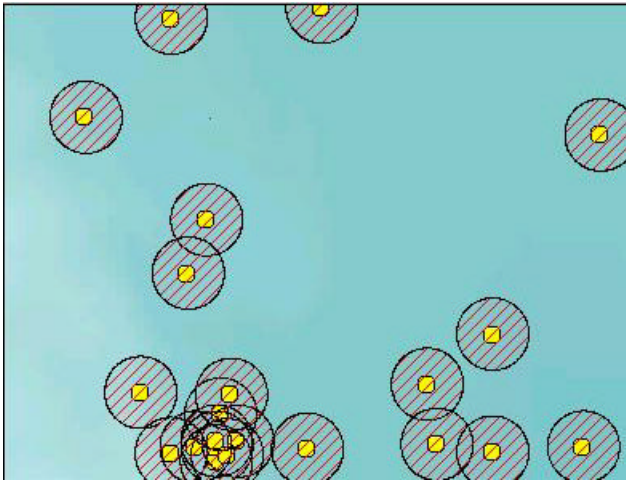
Creates a new polygon shapefile based on specified distance units from selected records in a point theme. The following example illustrates a 100 meter buffer around the selected points.

Creates a point buffer shape file. The user is asked to specify which, if any, of the point themes attributes will be associated

with the buffers. Like the 'Convert to Shapefile...' selection, this script will create buffer features for each point of the specified theme.

If no points have been selected, the new theme will contain a buffer feature corresponding to each point of the point theme. If a subset is selected, buffer features will be created only for the selected points. If the view has been projected, the user will be prompted for buffer units (m,ft,mi). Whether the view has been projected or not, the new theme will appear as circles around the points as expected. You will note that if the view was projected, and you unproject the view or add the theme to a new view, the buffers appear to be ovals. That is because of the difference in projection. It is, however, a geometrically correct buffer.

VIEW TOOLS

Nearest neighbor analysis

Degree of clustering or dispersion of points in a specified rectangle

Once you click on the button, you will be asked for the study area shapefile and the study points shapefile. The wait cursor will appear and then a messagebox will tell you the R value and how many features were accounted for in the analysis. R values relate how clustered or dispersed points are within the polygon theme you specified. An R value of less than 1 indicates a tendency towards a clumped (clustered) pattern. An R value of 1 indicates a random distribution. An R value of greater than 1 indicates an organized (uniform) pattern. This script also applies a simple test of significance for deviation from randomness, using the standard error of the expected difference. This script uses code from the FUN.NNDCSR.

Removes all screen graphics

VIEW TOOLS

Nearest neighbor analysis

Degree of clustering or dispersion of points in a specified rectangle

Once you click on the button, you will be asked for the study area shapefile and the study points shapefile. The wait cursor will appear and then a messagebox will tell you the R value and how many features were accounted for in the analysis. R values relate how clustered or dispersed points are within the polygon theme you specified. An R value of less than 1 indicates a tendency towards a clumped (clustered) pattern. An R value of 1 indicates a random distribution. An R value of greater than 1 indicates an organized (uniform) pattern. This script also applies a simple test of significance for deviation from randomness, using the standard error of the expected difference. This script uses code from the FUN.NNDCSR.

Removes all screen graphics

Removes ALL graphics from the view. This can be quite useful in this extension which can create a lot of graphic objects.

Display latitude/longitude and UTM coordinates

Select the XY button and click anywhere on the view.
Coordinate values in latitude/longitude (DD and DM) and UTM will be displayed at the bottom of the ArcView screen.
Hold down the Ctrl key and the XY button to copy the X coordinate values to the clipboard.
Hold the Alt key and the XY button to copy the Y coordinate values to the clipboard.

Lat/Long: 58.63769 / -136.07983 58 38.2614 / -136 4.78995 UTM Zone:8 Easting:437310.0 Northing:6500004.8
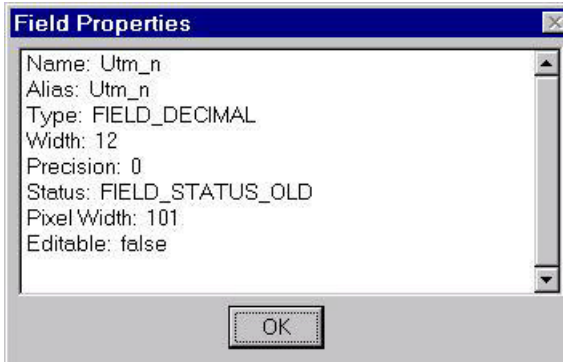
TABLE MENU CHOICES

Field Properties

Displays field type information about a selected field in a table
Select a field and choose Field Properties from the movement menu.

Field Properties

Name: Utm_n
Alias: Utm_n
Type: FIELD_DECIMAL
Width: 12
Precision: 0
Status: FIELD_STATUS_OLD
Pixel Width: 101
Editable: false

OK

Selection to DBF

Outputs selected records from an attribute table to a DBF table.

Create cumulative field

Creates a new field with the cumulative total from the selected field. Prompts the user to go either forward or backwards in tallying the cumulative field. If the field has already been cumulated then it will update the tally. This function is useful in travel path analysis.

Histogram

Creates a histogram based on a selected table field

Chart4

Histogram of Utm_easting

Count
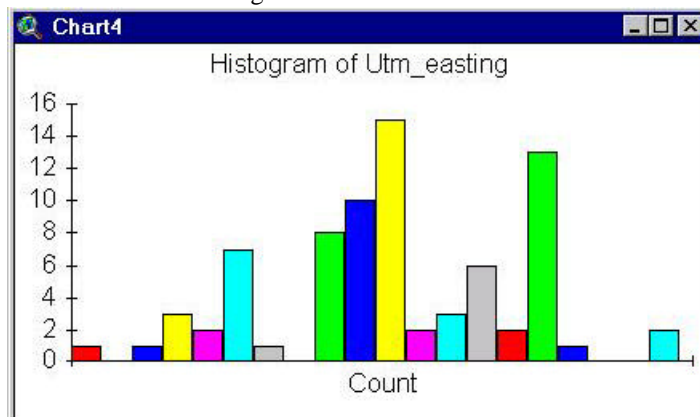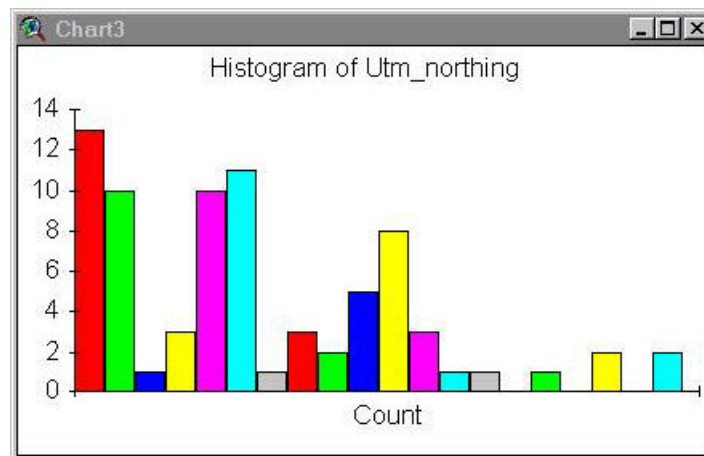
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Last Reviewed: