

Iterate Random Point Generation and Calculate Distance to a Base Station

These instructions enable you to generate replicates of random points within a study area polygon that can then be used to compare their distances to a base station with those of observed points within the same study area. Using ArcGIS 9.x software, you access a VBA macro (attached to a button on a toolbar when using the downloadable IterateRandomPts.mxd file – see page 4 if using version 9.0) to generate several iterations of random points within a selected polygon. After aggregating the random points and spatially joining to calculate distances, the output tables may be used for statistical tests of significance between the observed and random locations.

ORIGINAL DATA

Observations.shp	a point shapefile of individual animal locations recorded by telemetry or GPS collar
Base_Station.shp	a point shapefile of a given location(s) that you wish to measure distances to
Study_Area.shp	a polygon shapefile of the area of interest

CREATED DATA

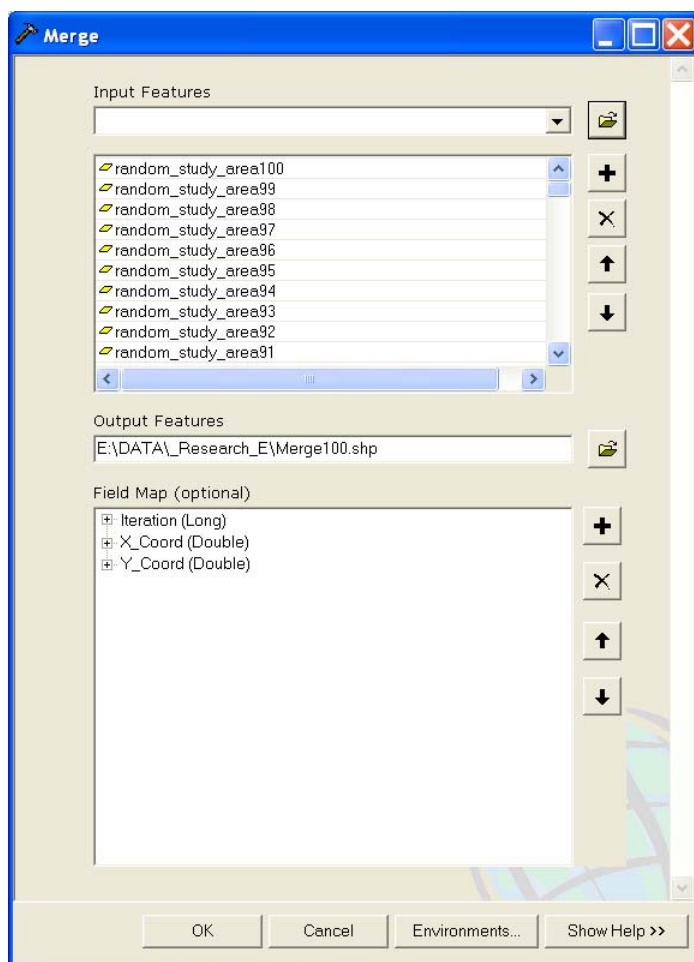
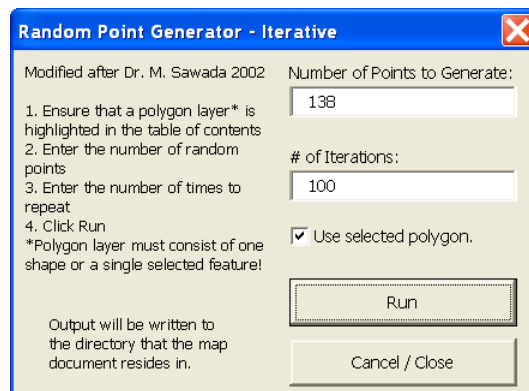
Random_Study_AreaN.shp	various point shapefiles resulting from the generation of random points within the Study_area.shp polygon
MergeN.shp	a point various shapefile resulting from the merging/appending of all random point iterations
Dist2Base.shp	a point shapefile that is a copy of MergeN, but with the Base_station.shp attributes spatially joined and a distance field
DistStatsXIteration.dbf	a dBase table that summarizes the statistics of the distance field of the Dist2Base.shp attribute table

Start the map document:

1. Download the IterateRandomPts.mxd and copy to your working directory – *all output files will be saved here, so it is a good idea to begin with a new empty folder if you plan to do a large number of iterations!*
2. Start **IterateRandomPts.mxd**
3. Click the ADD DATA button and add the following layers (substitute your actual filenames, of course): Base_Station.shp, Observations.shp, Study_Area.shp

Generate the random points:

4. In the table of contents, highlight the **Study_Area** layer
5. Locate the Random Toolbar (if it is not present, choose VIEW >>> TOOLBARS and click a check beside it)
6. Click the RANDOM button
7. Type the number of points for each replicate; e.g. **138**
8. Type the number of iterations (i.e. replicates); e.g. **100**
9. Click RUN



Aggregate the random points:

Combining all the points into one file makes for more automated processing. How this is done depends on your version of ArcGIS.

If using ArcGIS 9.1:

10. Locate the MERGE tool in ArcToolbox and open it
11. In the table of contents, highlight all the random points layers (hold the SHIFT key on the keyboard to select multiples)
12. Drag and drop the layers into the Input Features box
13. Specify the Output Features; e.g. Merge100.shp
14. Click OK

If using ArcGIS 9.0:

1. Make a copy of one of the point layers (right click on the first original random point layer in the table contents and choose DATA >>> EXPORT DATA to save as **Merge100.shp**)

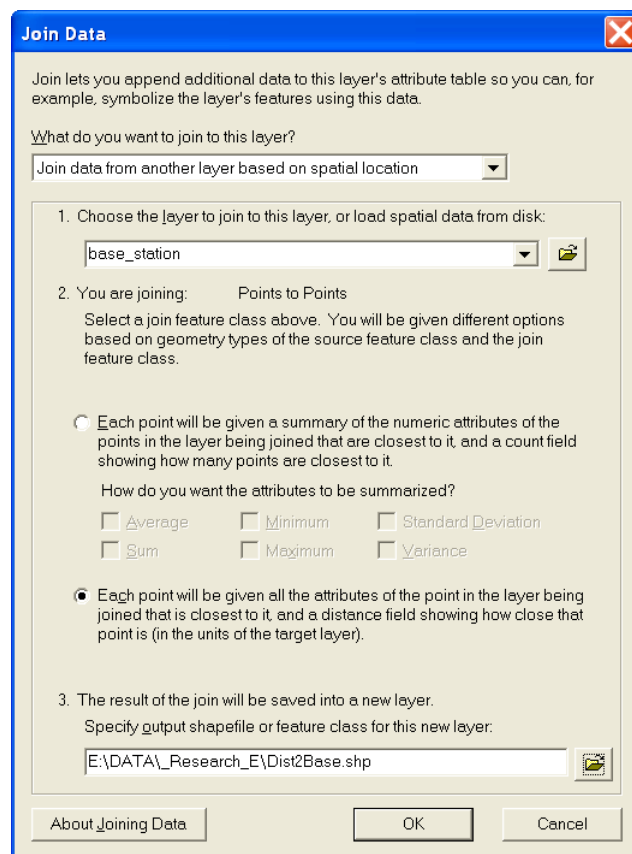
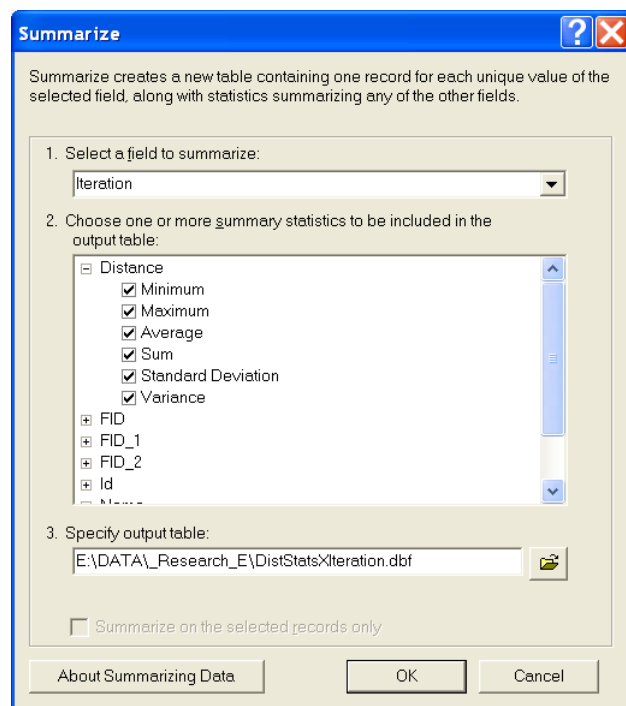
2. Locate the APPEND tool in ArcToolbox and open it
3. Select all other random point layers (skip the first original and Merge100.shp)
4. Drag and drop the layers into the Input Features box
5. Select Merge100.shp as the Output Features
6. Choose NO_TEST for the Schema Type and click OK

Calculate the distances to the base station:

15. In the table of contents, right click on **Merge100** and choose JOINS AND RELATES >>> JOIN
16. Select to “Join data from another layer based on spatial location”
17. Select **Base_Station** as the layer to join to
18. Choose the second option where “Each point will be given all the attributes of the point in the layer being joined... and a distance field...”
19. Enter an output shapefile name; e.g. **Dist2Base.shp**
20. Click OK
21. Repeat for the Observation points

Summarize the distance statistics:

22. In the table of contents, right click on **Dist2Base** and choose OPEN ATTRIBUTE TABLE



23. Right click on the ITERATION heading and choose SUMMARIZE
24. Select any of the summary statistics associated with the DISTANCE field
25. Specify an output table name; e.g. **DistStats\Iteration.dbf**
26. Click OK
27. Repeat for the Observation points spatial join output file from above

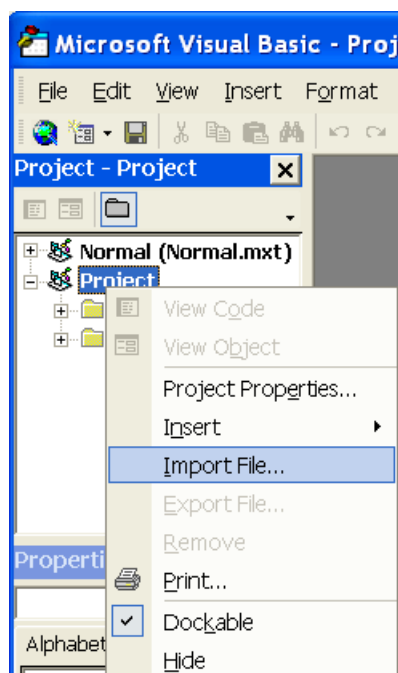
Compare using the statistical software package of your choice

OID	Iteration	Count	Iteration	Minimum Dist	Maximum Dist	Average Dist	Sum Dist	StdDev Dist	Variance Dist
0	1	138		42.727562	643.779113	284.9221	39319.246	159.5109	25443.7212
1	2	138		32.932598	645.060812	278.3853	38417.174	150.5366	22661.2821
2	3	138		31.639167	605.602783	256.4234	35386.434	148.1505	21948.572
3	4	138		22.933338	634.384509	263.5988	36376.628	163.752	26814.7334
4	5	138		15.480051	632.433124	284.7895	39300.949	160.0681	25621.7907
5	6	138		18.978130	617.502671	267.3019	36887.661	154.8016	23963.5393
6	7	138		26.141939	629.705076	250.7801	34607.66	155.1106	24059.2915
7	8	138		5.335353	590.858091	243.4425	33595.065	140.0976	19627.3265
8	9	138		12.858705	650.954986	275.4163	38007.454	143.2084	20508.6438
9	10	138		34.154756	622.914542	265.7749	36676.939	139.2517	19391.0347
10	11	138		10.273892	621.214233	273.4415	37734.927	148.2326	21972.8919
11	12	138		28.730571	625.937193	264.4626	36495.845	140.0861	19624.106
12	13	138		31.001360	649.802723	254.7585	35156.666	141.7706	20098.8911
13	14	138		29.977172	645.217579	283.1761	39078.305	157.1958	24710.5209
14	15	138		18.386481	626.025594	271.9438	37528.238	147.6924	21813.0522
15	16	138		18.075216	626.375728	270.095	37273.103	152.2128	23168.7515
16	17	138		33.895926	623.036442	282.5079	38986.084	158.5679	25143.7696
17	18	138		3.940310	634.095582	268.2201	37014.369	161.0574	25939.4752
18	19	138		24.535962	619.181179	291.1778	40182.534	163.7101	26801.0033
19	20	138		30.606165	612.154379	259.757	35846.467	153.2076	23472.5806
20	21	138		16.204841	606.910688	261.5817	36098.278	148.1893	21960.0671
21	22	138		47.299936	621.001393	301.5775	41617.696	151.5299	22961.3033
22	23	138		20.559288	642.439979	251.6926	34733.581	160.7879	25852.7561
23	24	138		25.376000	603.575082	293.8971	40557.801	150.8859	22766.5554
24	25	138		19.508836	609.198980	276.9707	38221.958	149.963	22488.8927
25	26	138		5.895760	609.607146	251.7900	34745.765	150.0348	22791.3176

Record: 1 Show: All Selected Records (0 out of 100 Selected.) Options

Final output table showing summary statistics for the distances to the base station for all iterations of random points.

VBA Macro Installation Instructions



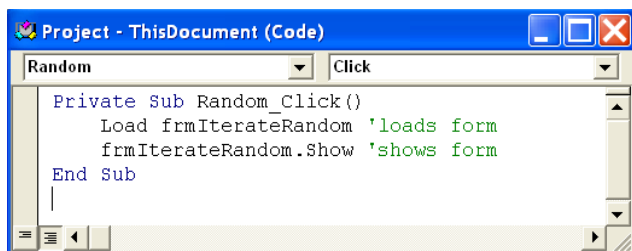
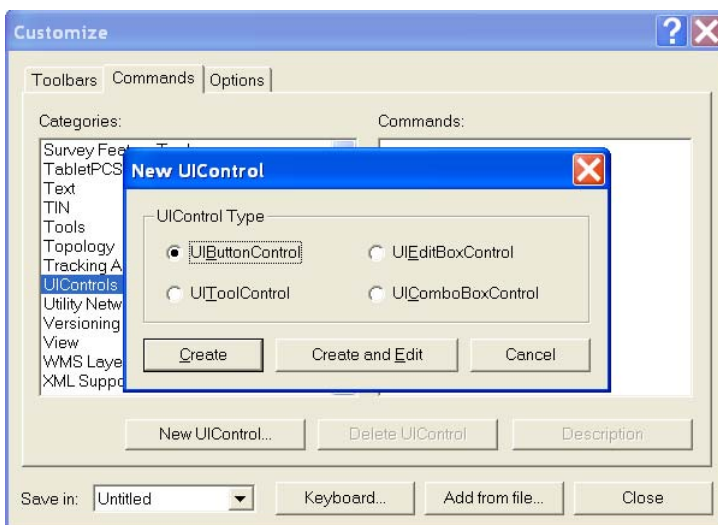
If you are using ArcGIS 9.0 (and not 9.1, which is the version that IterateRandomPts.mxd was created in), then you will need to download the IterateRandom.zip file, unzip it, and follow the import instructions to create your own VBA macro button.

Import the VBA macro:

1. Copy and unzip **IterateRandom.zip** to your local hard drive (e.g. create a new folder named C:\ArcGIS\VBA for permanent storage)
2. Start ArcMap with a new empty map document
3. Choose TOOLS >>> MACROS >>> VISUAL BASIC EDITOR
4. The Visual Basic Editor appears; locate the Project Explorer to the left
5. Right click on **Project** and choose IMPORT FILE
6. Navigate to find **frmIterateRandom.frm** file and click OPEN

Create a new button control in ArcMap:

7. Return to the ArcMap program and choose **TOOLS >>> CUSTOMIZE**
8. In the **COMMANDS** tab, select to Save in: Untitled
9. In the Categories window, scroll down to find the **UICONTROLS** category
10. Click on the **NEW UICONTROL** button
11. Click **CREATE**
12. In the Commands window, click once to highlight **Project.UIButtonControl1**; wait a second, then click again to access the text editing box so you can change its name
13. Making sure that all the text is selected, type **"Random"** as the new name and press **ENTER**



Associate the new button control with the macro:

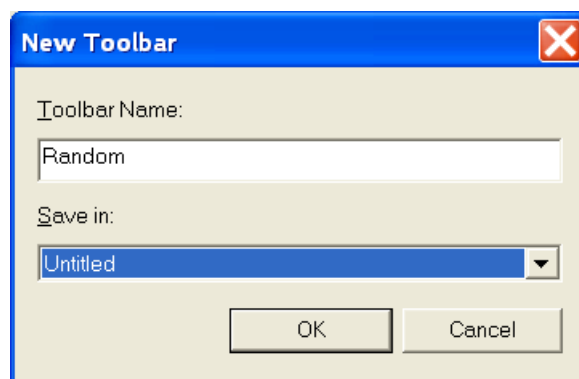
14. Double click on **Project.Random** to open up the Visual Basic Editor
15. Place the mouse cursor on the next line below "Private Sub Random_Click()"

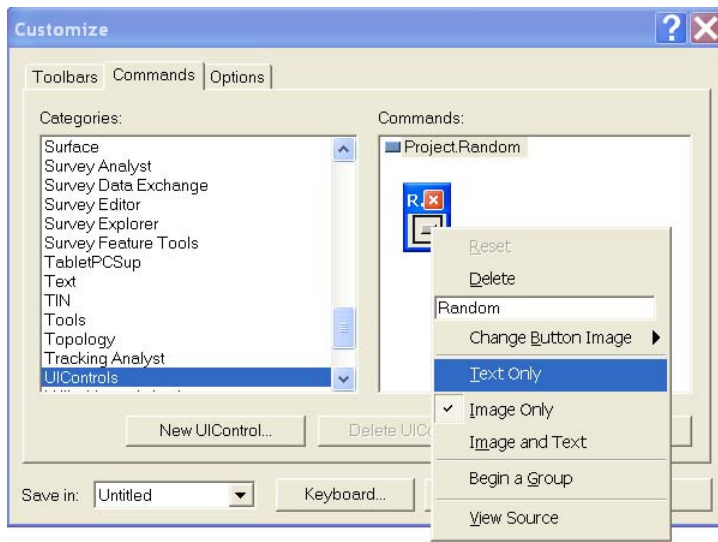
16. Type the following lines of code:

```
Load frmIterateRandom 'loads form
frmIterateRandom.Show 'shows form
```

Create a new toolbar with the custom button control:

17. Return to ArcMap
18. Choose **TOOLS >>> CUSTOMIZE**
19. In the **TOOLBARS** tab, click **NEW**
20. Type the name **"Random"** and choose to save in: Untitled
21. Click **OK**
22. In the **COMMANDS** tab, scroll to find the **UICONTROLS** category
23. Click and drag **Project.Random** to the new toolbar
24. On the new **RANDOM** toolbar, right click on the default button and choose **TEXT ONLY**





25. Click CLOSE on the CUSTOMIZE dialog
26. Finally, SAVE your Untitled map document to your working directory; e.g. **IterateRandomPts90.mxd**

Saving a VBA macro in the Normal.mxt:

If this is a macro tool that you wish to use all the time, then you may opt to save the VBA macro and new toolbar with custom button control into your Normal template (i.e. Normal.mxt). Make the following substitutions to the instructions that start on page 4:

- Step 5: Instead of Project, right click on Normal
- Step 8: Instead of Untitled, save in Normal
- Step 16: After typing in code, choose FILE >>> SAVE NORMAL.MXT
- Step 20: Instead of Untitled, save in Normal