Design and Development of Analysis Tools of Minglings

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ABSTRACT: In order to quickly and accurately calculate Minglings of each tree and the mean Minglings of stand, a tool was designed and developed with Excel VBA programming language. Firstly, the distances from four closest neighboring trees to reference tree were separately computed with the formula of the distance. Moreover, whether the reference tree and each closest neighboring tree shared a common species was determined with the function of tree species. Finally, Minglings of each reference tree and mean Minglings of stand were acquired based on main calculating modules with related formulas. Testing results show that the tool can precisely calculate Minglings.
KEYWORD: Minglings; Excel VBA; the formula of the distance

1 INTRODUCTION

The spatial structure, which is used to describe spatial distribution of all trees in stands or forests, determines competition degree among different trees and spatial niche of each tree, and can significantly affect stand growth, development and stability. Moreover, spatial structure is considered as an important factor influencing habitat and species diversity (Pretzsch 1999). Stand spatial structure indexes, such as competition index, spatial pattern index and other indexes, is used to describe spatial structure of a stand. Compared to interspecific competition, intraspecific competition almost always is more competitive (Jin 1993), and the effect is generally adverse. Therefore, more and more people have paid attention to the study on interspecific isolation among different tree species and more good methods have been presented. The mixed ratio only refers to proportion of a certain tree species in a stand, and it is not a spatial structure index, so it can't reflect the interspecific spatial isolation relation among different tree species. Diversity index proposed by Fisher (1943) normally compute the abundance of different trees species, but it can not reflect spatial distribution of different species. Finally, Minglings, which is a spatial structure index reflecting the degree of interspecific isolation, was proposed by Hui Gangying et al. (2007).

Generally, the data which were collected from field survey were stored in Excel workbooks. If Minglings is calculated by statistical analysis function in Excel, then the amount of computation is very big. VBA programming language embedded in Excel can manipulate directly and easily data in Microsoft Excel (Zhao et al. 2013). Therefore, it is feasible way to develop softwares with Excel VBA. VBA has been mostly preferred for systems development in recent years. Up to now, some DBMISs, GISs (Zhou & Li et al. 2006), DSSs (Zhao et al. 2011) and special software in regression analysis and charting (Tang et al. 2011; Zhao et al. 2011; Zhao et al. 2011; Wang 2009) have been developed.

The goal of this paper was to design and develop a tool that can calculate Minglings with VBA.

2 DESIGN OF ANALYSIS TOOLS OF MINGLINGS

2.1 Basic Idea

Four closest neighboring trees from a reference tree could be chosen in a stand. The ratio of the number of trees differing from the reference tree species to the number of the closest neighboring trees is called Minglings (M_i). M_i can be expressed by the follow formula(1):

$$M_i = \frac{1}{4} \sum_{j=1}^{4} v_{ij} \tag{1}$$

When the reference tree and the neighboring tree do not share a common tree species, v_{ij} equal 1, or v_{ij}

equal 0. When the number of closest neighboring trees is four, M_i may have five value (Figure 1).

Minglings of each reference tree can be calculated with formula (1). Accordingly, mean minglings of stand also can be computed by the follow formula (2):

$$\overline{M} = \frac{1}{n}\sum_{i=1}^{n} M_i \qquad (2)$$

Where $\overline{M}$ is mean minglings of stand, n is the number of all reference trees in a stand.

In order to develop a tool to calculate Minglings, two key points need be solved:

1. Four closest neighboring trees of a reference tree should be accquired. According to the formula of the distance, the distances between the reference tree and the neighboring trees in a stand were separately calculated. Four closest neighboring trees were chosen by utilizing the function of minimum value transmission;
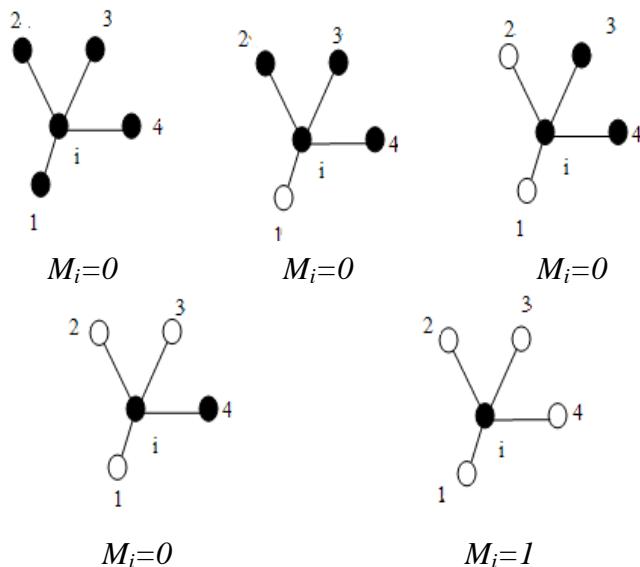

$M_i=0$ $M_i=0$ $M_i=0$

$M_i=0$ $M_i=1$

Figure 1. A set of values of Minglings

Where M_i =0, all closest neighboring trees and reference tree share a common tree species; M_i =0.25, a closest neighboring tree and reference tree only do not share a common tree species; M_i =0.5, two closest neighboring trees and reference tree do not share a common tree species; M_i =0.75, three closest neighboring trees and reference tree do not share a common tree species; M_i =1, all closest neighboring trees and reference tree do not share a common tree species.

2. The Minglings of each tree and mean minglings of stand was acquired. Firstly, when the reference tree and each closest neighboring tree did not share a common tree species, v_{ij} equal 1, or v_{ij} equal 0 according to the function of tree species. Moreover, Minglings of each reference tree can be acquired according to formula (1); Finally, mean minglings of stand was calculated by formula (2).

2.2 Operation flow of Analysis Tools of Minglings

At first, four closest distances from four closest neighboring trees to reference tree were chosen by utilizing the function of minimum value transmission (Figure 2a). Moreover, whether the reference tree and each closest neighboring tree shared a common species was determined with the function of tree species. Finally, Minglings of each reference tree and mean Minglings of stand were acquired based on main calculating modules with related formulas (Figure 2b).

2.3 Development of Analysis Tools of Minglings

Analysis Tools of Minglings contained two EXCEL sheet, two toolbars and abundant program codes embedded in Excel workbook. Toolbars in EXCEL was convenient for computing Minglings. Excel sheets were used as database, where data were processed and stored. Modules were mainly engaged to implement the all functions of the systems or tools

2.3.1 The design of sheets

Operating environment of the Analysis Tools of Minglings is EXCEL. There were two sheets: "Primitive data" and "Mean value of Minglings". The two sheets were used for storing initial data and processed data, respectively. The sheet of "Primitive data" insist of five fields: "Tree Number", "Tree species", "coordinate(x)", "coordinate(y)" and "Minglings". Data of the first three fields were collected by foresters, and the last one was computed by related modules of the tool. The sheet of "Mean value of Minglings" was used to store the mean value of Minglings of stand (Figure 4).
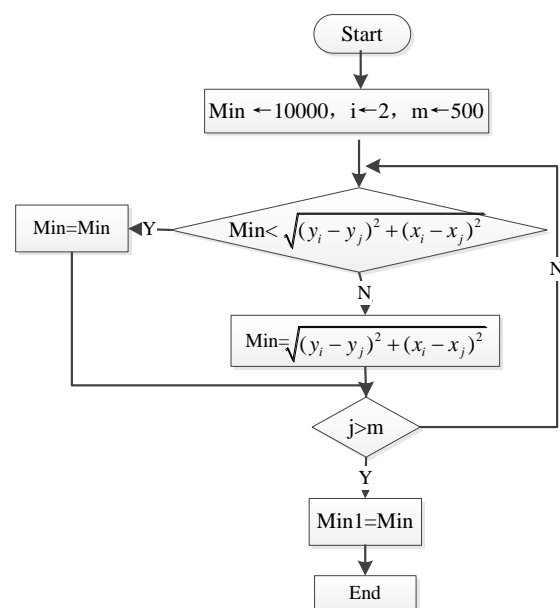

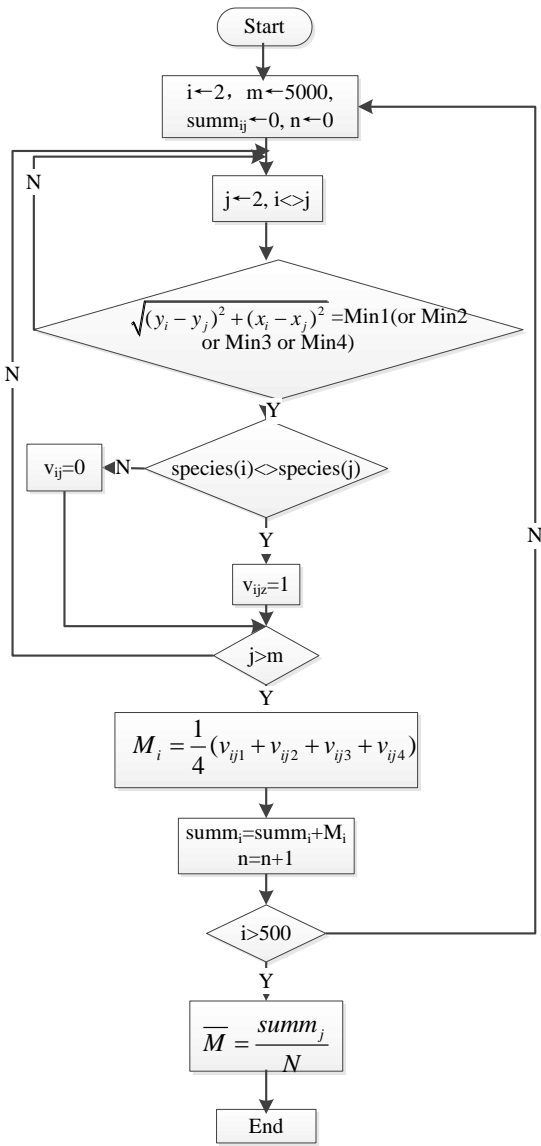Figure 2a. Flow chart of Analysis Tools of Minglings

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Figure 2b. Flow chart of Analysis Tools of Minglings

2.3.2 The design of user interface

Firstly, a commandbar was defined and established, then controls commandbarpopup were added with the method "add ( )". Finally, dropdown menus were acquired by applying "add ( )" method of controls commandbarpopup to msocontrolbutton. The system includes two dropdown menus: "Data management" and "Calculating Minglings" (Figure3).
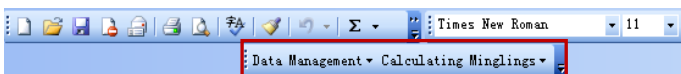

Figure3. User interface of Analysis Tools of Minglings

2.3.3 The design of main modules

The main modules were divided into there part: the module of computing four closest distances, the module of calculating Minglings of each reference tree and the module of calculating mean minglings of stand.

	A	B	C	D	E
1	Tree number	Tree species	X	Y	Minglings
2	1	korean pine	3.491892	10.746939	0.5
3	2	spruce	1.0557375	10.044671	0.5
4	3	spruce	10.150647	4.7333245	0.25
5	4	spruce	10.07492	2.1414904	0.25
6	5	korean pine	7.0465973	2.8470101	0.25
7	6	spruce	6.472136	4.702282	0.25
8	7	korean pine	1.790222	7.1801884	0.25
9	8	oka	-3.024761	6.2016789	0
10	9	korean pine	-5.79653	5.2192187	0
11	10	korean pine	-9.208988	3.3517974	0.5
12	11	korean pine	-6.122295	3.975865	0
13	12	spruce	1.8303149	4.1109546	0.25
14	13	spruce	5.4502172	1.9837168	0.5
15	14	spruce	6.4752655	0.5665123	1
16	15	oka	8.9328074	1.7363619	0.5
17	16	spruce	10.175153	-0.711516	0.75
18	17	spruce	10.368365	-2.203864	0.75
19	18	oka	6.8611605	-2.772089	0.5
20	19	oka	5.4791917	-1.571133	0.75
21	20	oka	3.0995279	0.0541025	0.25
22	21	spruce	0	2.7	0.25
23	22	spruce	-1.601998	3.7740699	0.25
24	23	korean pine	-4.09576	2.8678822	0
25	24	korean pine	-10.0812	3.2755801	0.75

primitive data / average Minglings of stand /

Figure4.The sheets of Analysis Tools of Minglings

The module of computing four closest distances was designed to compute the four closest distances from four closest neighboring trees to reference tree with the function of minimum value transmission.

The module of calculating Minglings involved three process: Firstly, determined whether each closest neighboring tree and its reference tree shared a common tree species; Secondly, Minglings of each reference tree were calculated based on the number of closest neighboring trees that did not share a common species with reference tree; Finally, mean minglings of stand was counted according to Minglings of each reference tree. The main codes were as follow:

```
Worksheets("Primitive data "). Activate
For yj = 2 To fRow + 1
        If ((Cells(xi, 3).Value - Cells(yj, 3).Value) ^ 2 +
(Cells(xi, 4).Value - Cells(yj, 4).Value) ^ 2) ^ 0.5 = t1 Then
            If Cells(xi, 2).Value =Cells(yj, 2).Value Then
              kij1 = 0
              Else
              kij1 = 1
              End If
        End If
        If ((Cells(xi, 3).Value - Cells(yj, 3).Value) ^ 2 +
(Cells(xi, 4).Value - Cells(yj, 4).Value) ^ 2) ^ 0.5 = t2 Then
            If Cells(xi, 2).Value = Cells(yj, 2).Value Then
              kij2 = 0
              Else
              kij2 = 1
              End If
        End If
        If ((Cells(xi, 3).Value -Cells(yj, 3).Value) ^ 2 +
(Cells(xi, 4).Value - Cells(yj, 4).Value) ^ 2) ^ 0.5 = t3 Then
            If Cells(xi, 2).Value = Cells(yj, 2).Value Then
              kij3 = 0
              Else
              kij3 = 1
              End If
        End If
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        If ((Cells(xi, 3).Value - Cells(yj, 3).Value) ^ 2 +
(Cells(xi, 4).Value - Cells(yj, 4).Value) ^ 2) ^ 0.5 = t4 Then
            If Cells(xi, 2).Value = Cells(yj, 2).Value Then
                kij4 = 0
                Else
                kij4 = 1
                End If
            End If
        Next yj
    ui = 1 / 4 * (kij1 + kij2 + kij3 + kij4)
    Cells(xi, 5).Value = ui
    SpeciesNumber
        For xi = 2 To fRow + 1
            alldaxiaobi(xi - 1) = Cells(xi, 5).Value
        Next xi
    ReDim shuzhongpingjundaxioabi(1 To wu)
    For yj = 1 To wu
    shuzhongdaxiaobi = 0
    speciesn = 0
        For xi = 2 To fRow + 1
            If ((Cells(xi, 3).Value) ^ 2 + (Cells(xi, 4).Value)
^ 2) ^ 0.5 <= 10.29 Then
                If Cells(xi, 2).Value = SingleSpe(yj) Then
                    shuzhongdaxiaobi = alldaxiaobi(xi - 1) +
shuzhongdaxiaobi
                    speciesn = speciesn + 1
                End If
            End If
        Next xi
        If speciesn = 0 Then
                speciesn = speciesn + 1
            End If
shuzhongpingjundaxioabi(yj) = shuzhongdaxiaobi / speciesn
        Next yj
        For xi = 2 To wu + 1
        Cells(xi, 1).Value = SingleSpe(xi - 1)
        Cells(xi, 2).Value = shuzhongpingjundaxioabi(xi - 1)
        Next xi
```

3 CONCLUSION

The Analysis Tools of Minglings was developed by utilizing Excel VBA programming language. As VBA can recall expediently and directly data in Excel without requirement of design of database module, the development of the analysis tool is very easily and the tool can deal with with powerful statistical analysis function embed in Excel.

4 ACKNOWLEDGEMENTS

REFERENCES

[1] Pretzsch H. 1999. Structural diversity as a result of silvicultural operations. In Olsthoorn A F M. Bartelink H H, Gardiner J J, Pretzsch H, Hekhuis H J, Frano A (ed), *Management of mixed species forest: silviculture and economics*:157   -174.Wageningen:Dlo   Institute   for Forestry and Nature Research (IBN-DLO) .

[2] Jin M.S. 1993. *Forest ecology.* Beijing: China Forestry Publishing.

[3] Fisher R.A., Corbet A.S., Williams C.B. 1943.The relation between the number of species and the number of individual in a random of ananimal population. *Ecology* 12:42-58.

[4] Hui G.Y., Klaus von Gadow, Hu Y.B. & Xu H. 2007. *Structure-based forest management.* Beijing: Forestry Publishing House.

[5] Zhao H.Y. & Kang X.G., Hua Y., *et al*. 2013. Design and Development of Sapling Growth Simulation System. *Journal of Converagence Information Technology* 5 (5):224-231.

[6] Zhou J.B. & Li X.H. 2006. GeoPlot: An Excel VBA program for geochemical data plotting *Computers & Geosciences* 32(4): 554-560.

[7] Zhao H.Y. & Lu Y.C., et al. 2011.Design and development of supporting tool for target-tree-operation management. In Proceeding(s) of *the 2011 International Conference on Computer and Communication Devices*, Li Yang, pp:Ⅵ40-Ⅵ43.

[8] Tang Y.,Zhao K. & Xu W.B. 2011. Development of VBA for pump performance experimental data based on Excel. *Paiguan Ji xie Xueba*o 29(2):123-126.

[9] Zhao H.Y. & Kang X.G., et al. 2011.A kind of algorithm estimating parameters of unitary non-linearity regression model. In Proceeding(s) of *the 2011 3rd International Conference on Machine Learning and Computing*, Dr.Steve Thatcher, pp: V317- V319.

[10] Zhao H.Y. & Kang X.G., et al. 2011.Design and development of a tool for fitting Weibull distribution function based on EXCEL VBA. In Proceeding(s) of *the 2011 International Conference on Information and Computer Applications*, Li Yuting, pp: 396-399.

[11] Wang Y.M. 2009.The calculation of urban gini coefficient in China by excel VBA. In Proceeding(s) of the 2009 ETP/IITA World Congress in Applied Computing, Computer Science, and Computer Engineering.