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Grey Relational Analysis for Scholarship Grants

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Abstract

The grey relational analysis system is constructed to simplify user complex calculations during grey relational analyses, and to eliminate unneeded time allowing users to easily perform grey relational analysis. Grey relational analysis is that which under partly known message status process and solves system problems. Besides systematizing various uncertain factors, grey relational analysis also provides users with the best strategy within the shortest time. This study uses the scholarship grant of the college of management, Tunghai University as example to demonstrate the grey relational analysis system which provides users with a simpler, easier and more convenient interface tool.

Keywords: Grey Relational Analysis, Grey Relation Grade, Grey System, Degree of Relation.

1. Introduction

This study employs the grey relational analysis method to prevent inefficiency that often occurs with manual operations. Grey relational analysis is one of two main pillars of grey theory system. The grey relational analysis system replaces manual processes with computerized processes, providing a complete and whole analysis method [1]. Furthermore, the grey

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relational analysis system is primarily constructed to estimate calculations between dispersed arrays. Mathematical methods are employed to correct the degree of traditional grey relation and to convert the degree of traditional grey relation from qualitative analysis to quantitative analysis [2]. Grey relational analysis performs comparisons and calculations on the situation of different behavior factors of the system; the requisite data is few, primarily the dynamic course of the system [4-5]. The system is written in Visual Basic 6.0. Its main object is to provide users with a convenient interface by eliminating complex manual calculations of the past and providing a new user interface that is easy to use, simple to learn and performs data analysis easily [3]. The example below uses the scholarship grant of the college of management, Tunghai University to demonstrate the grey relational system.

2. Functions

(1) Collection and processing of data in advance:

The scholarship grant of the college of management, Tunghai University is used as example to demonstrate the grey relational analysis system (as Table 1).

《Table 1》 The course comparison standard for the scholarship grant

Subjects	Standard
Accounting	1st rank as per department
Economics	1st rank as per department
Statistics	1st rank as per department
English	1st rank as per department
Computer	1st rank as per department

First, only the top five students of each department may apply for the scholarship (as Table 3). Selection is based on comparison of common courses. Scholarship is granted to the holder of 1st rank of all departments. The results of the 1st rankers are taken as the basis of comparison; then the degree of similarity is determined by comparing the results of students ranking

from 2nd to 5th to that of their respective 1st ranker; after obtaining the degree of similarity of all 2nd to 5th rankers, their ranking in the college of management is determined. The student whose degree of similarity is the closest to "1" is the ranks 2nd in the college of management; the next is 3rd rank, ranking continues until the 8th rank is reached (as Table 2). The above method of determining ranking takes into consideration the different standards of grading of different teachers, thus it is a more fair method of analysis.

《Table 2》 Allotment of scholarship fund

Rank	Total NT200,000
1st of per department	NT20,000 per person (total NT120,000)
2nd of the college of management	NT18,000
3rd of the college of management	NT16,000
4th of the college of management	NT14,000
5th of the college of management	NT12,000
6th of the college of management	NT10,000
7th of the college of management	NT 7,000
8th of the college of management	NT 3,000

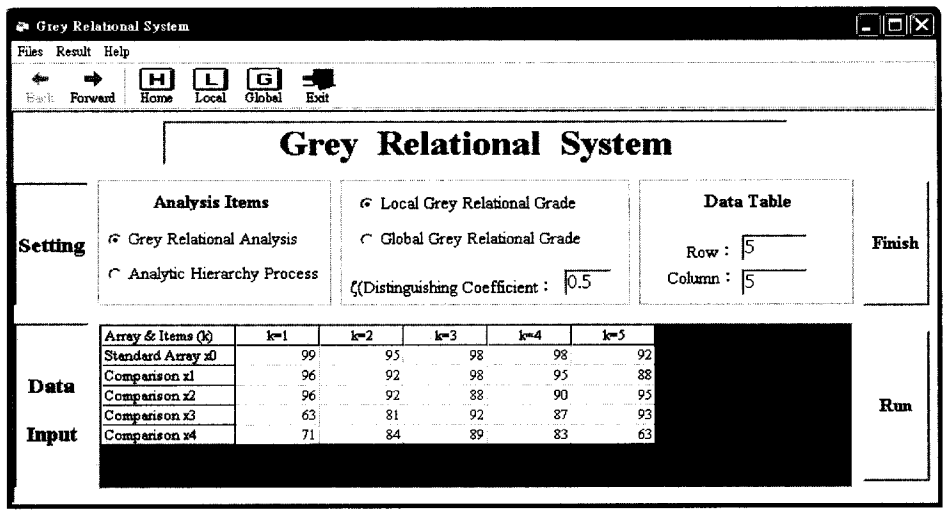
(2) Enter the data into the system:

First, select a method of analysis. This study opts for grey relational analysis (as Figure1). Next, select localized analysis or whole analysis. Since the 1st ranks of each department are used as the basis of comparison to compare the degree of similarity from 2nd ranks to 5th ranks, therefore the degree of localized grey relation is chosen. Next, we see the distinguishing coefficient (ζ), the function of ζ is mainly to perform comparison between background value and the awaiting-test items; the size of the value can be adjusted to the needs in reality. Generally, the value of ζ is set at 0.5; a change in value of ζ changes only the size of its relative value, but not the order of the degree of grey relation. Finally, enter the array and factor that are to be analyzed and click on the "Run" button to produce the required blank columns; enter the data to perform analysis operation.

《Table 3》Students of various departments applicable to scholarship

Department	Student ID	Accounting	Economics	Statistics	English	Computer	Total	Rank
Business Administration	s914121	97	99	89	89	99	473	1
	s914440	97	91	93	97	90	468	2
	s914109	93	95	87	89	97	461	3
	s914402	85	91	87	92	93	448	4
	s914105	84	83	80	86	91	424	5
International Trade	s914507	98	96	99	96	94	483	1
	s914218	90	99	96	95	90	470	2
	s914243	90	88	96	95	90	459	3
	s914530	80	95	88	90	85	438	4
	s914217	81	74	75	89	77	396	5
Accounting	s914325	90	88	90	88	92	448	1
	s914307	85	87	82	80	85	419	2
	s914636	80	82	78	75	85	400	3
	s914613	82	78	70	85	80	395	4
	s914648	70	80	86	82	76	394	5
Statistics	s914836	95	92	98	92	96	473	1
	s914850	90	96	92	99	90	467	2
	s914734	98	95	90	90	90	463	3
	s914707	90	87	88	92	96	453	4
	s914732	90	92	80	95	90	447	5
Finance	s914012	96	85	88	99	95	463	1
	s914026	99	90	90	98	85	462	2
	s914034	95	96	88	92	90	461	3
	s914044	88	88	98	90	90	454	4
	s914014	63	82	86	88	80	399	5
Information Management	s914907	99	95	98	98	92	482	1
	s914909	96	92	98	95	88	469	2
	s914916	96	92	88	90	95	461	3
	s914910	63	81	92	87	93	416	4
	s914901	71	84	89	83	63	390	5

《Figure 1》 The original data of the top five students of the Information Management Department



(3) The data processing steps:

Step1: Construct standard array and comparison array

Explain the calculations of grey relation using the results of the top five Information Management students as example.

a. Standard array x0 = {99, 95, 98, 98, 92}, the top student of each department is set as the standard array.

b. Comparison array

x1 = {96, 92, 98, 95, 88}

x2 = {96, 92, 88, 90, 95}

x3 = {63, 81, 92, 87, 93}

x4 = {71, 84, 89, 83, 63}

Step2: Construct difference array △0i

Determine the size of the difference array if

$\triangle 0i = | x0(k) - xi(k) |$

△01 = {3, 3, 0, 3, 4}

△02 = {3, 3, 10, 8, 3}

△03 = {36, 14, 6, 11, 1}
△04 = {28, 11, 9, 15, 29}

At this time, the largest value of the difference array is Max = 36, the smallest Min = 0, let ζ = 0.5 (ζ distinguishing coefficient: ζϵ [0, 1], generally ζ = 0.5).

Step3: Calculate the grey relational coefficient r0i = r(x0(k), xi(k))

$$r(x_0(k), x_i(k)) = \frac{\Delta\min + \xi\,\Delta\max}{\Delta_{ij}(k) + \xi\,\Delta\max}$$

$x1$: $r(x_0(1), x_1(1)) = 0.8571$ $r(x_0(2), x_1(2)) = 0.8571$ $r(x_0(3), x_1(3)) = 1$
$r(x_0(4), x_1(4)) = 0.8571$ $r(x_0(5), x_1(5)) = 0.8182$

$x2$: $r(x_0(1), x_2(1)) = 0.8571$ $r(x_0(2), x_2(2)) = 0.8571$ $r(x_0(3), x_2(3)) = 0.6429$
$r(x_0(4), x_2(4)) = 0.6913$ $r(x_0(5), x_2(5)) = 0.8571$

$x3$: $r(x_0(1), x_3(1)) = 0.3333$ $r(x_0(2), x_3(2)) = 0.5625$ $r(x_0(3), x_3(3)) = 0.75$
$r(x_0(4), x_3(4)) = 0.6207$ $r(x_0(5), x_3(5)) = 0.9474$

$x4$: $r(x_0(1), x_4(1)) = 0.3913$ $r(x_0(2), x_4(2)) = 0.6207$ $r(x_0(3), x_4(3)) = 0.6667$
$r(x_0(4), x_4(4)) = 0.5454$ $r(x_0(5), x_4(5)) = 0.383$

Step4: Determine the value of the grey relation (subjects as equal rights)

$$r(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} r(x_0(k), x_i(k))$$

r(x0, x0) = (1/5)(1 + 1 + 1 + 1 + 1) = 1
r(x0, x1) = (1/5)(0.8571 + 0.8571 + 1 + 0.8571 + 0.8182) = 0.8779
r(x0, x2) = (1/5)(0.8571 + 0.8571 + 0.6421 + 0.6913 + 0.8571) = 0.78094
r(x0, x3) = (1/5)(0.3333 + 0.5625 + 0.75 + 0.6207 + 0.9474) = 0.64278
r(x0, x4) = (1/5)(0.3913 + 0.6207 + 0.6667 + 0.5454 + 0.383) = 0.52142

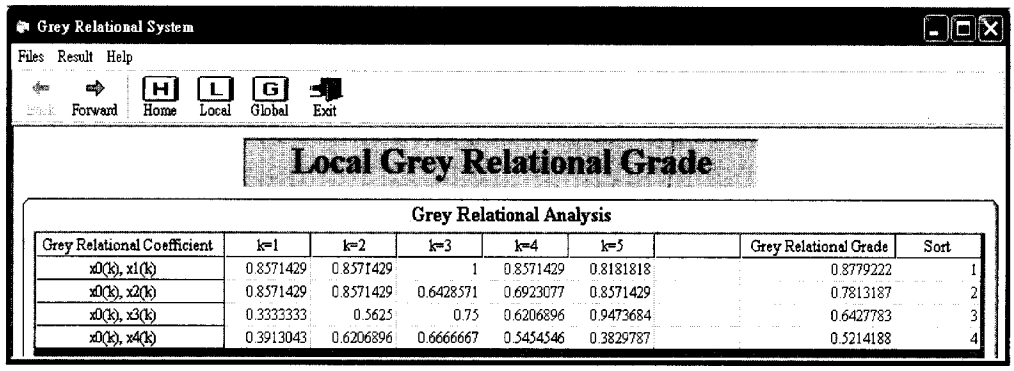
Step5: Based on the obtained values, sort results in descending order

0.8779 > 0.78094 > 0.64278 > 0.52142

r(x0, x1) > r(x0, x2) > r(x0, x3) > r(x0, x4)

In the figure of the grey relational analysis system below (as Figure 2), we can clearly see that the results of the degree of localized grey relation and the results of our calculations are the same. We can also see that the system provides users with an interface tool that is convenient to calculate values. Thus, complex calculations can be eliminated.

《Figure2》 The local grey relational grade of grey relation between the top five Information Management students



Grey Relational Coefficient	k=1	k=2	k=3	k=4	k=5	Grey Relational Grade	Sort
x0(k), x1(k)	0.8571429	0.8571429	1	0.8571429	0.8181818	0.8779222	1
x0(k), x2(k)	0.8571429	0.8571429	0.6428571	0.6923077	0.8571429	0.7813187	2
x0(k), x3(k)	0.3333333	0.5625	0.75	0.6206896	0.9473684	0.6427783	3
x0(k), x4(k)	0.3913043	0.6206896	0.6666667	0.5454546	0.3829787	0.5214188	4

From the above, we can see that the closer the degree of relation is to 1, the higher is the degree of grey relation, and the more similar is the result of the student to the 1st ranker; it is also closer to the top. In this manner, determine the degree of grey relation of students of all departments and sort them in descending order to determine the rank of each student. The rankings and scholarship grant are as shown in the table below(as Table 4).

3. Conclusion

The grey relational analysis system not only provides users with a more convenient user interface, it also eliminates unneeded complex calculations. The advantages of the grey relational analysis are: simple model, less data, less computations, and it does not require extensive knowledge of statistics; it only requires that data is appropriately processed. The system's strength lies in its

《Table 4》 The scholarship grants is as follows

Department	Student ID	Grey relation	Rank	Scholarship grant
Business Administration	s914121	1	1	NT20,000
International Trade	s914507	1	1	NT20,000
Accounting	s914325	1	1	NT20,000
Statistics	s914836	1	1	NT20,000
Finance	s914012	1	1	NT20,000
Information Management	s914907	1	1	NT20,000
International Trade	s914218	0.9052	2	NT18,000
Finance	s914026	0.8932	3	NT16,000
Finance	s914034	0.8828	4	NT14,000
Information Management	s914909	0.8779	5	NT12,000
International Trade	s914243	0.87628	6	NT10,000
Statistics	s914707	0.8416	7	NT7,000
Finance	s914044	0.8286	8	NT3,000
Accounting	s914307	0.8236	9	--
Statistics	s914734	0.8113	10	--
Business Administration	s914109	0.78668	11	--
Information Management	s914916	0.78094	12	--
International Trade	s914530	0.78008	13	--
Statistics	s914732	0.778	14	--
Statistics	s914850	0.7642	15	--
Finance	s914014	0.7594	16	--
Accounting	s914636	0.7156	17	--
Accounting	s914613	0.7089	18	--
Accounting	s914648	0.7082	19	--
Information Management	s914910	0.64278	20	--
Business Administration	s914440	0.62746	21	--
International Trade	s914217	0.61808	22	--
Business Administration	s914402	0.59974	23	--
Information Management	s914901	0.52142	24	--
Business Management	s914105	0.48244	25	--

ability to work in an environment of incomplete information or insufficient data. Moreover, the grey relational analysis system can not only be applied to scholarship grants analysis, it can also applicable to various grey relational analysis related work. Thus, grey relational analysis system can be said to be a must-have user interface for users in different domains.

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