Estimate Function of Career Plan: An Application of Multivariate Analysis in Educational Research

職業計劃之估量復變量分析法在教育研究上之應用實例

doi:10.29811/PE.197012.0006

心理與教育, (4), 1970

Psychology and Education, (4), 1970

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頁數/Page： 65-70

出版日期/Publication Date：1970/12

ESTIMATE FUNCTION OF CAREER PLAN: AN APPLICATION OF MULTIVARIATE ANALYSIS IN EDUCATIONAL RESEARCH[1]

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PROBLEN

Since the rise of vocational guidance, vocational choice has become an important and popular topic in this area. Many educational researchers have paid their attention to the personal abilities and interest which are related to decision-making. As we know, personal abilities and interest are always influential factors of career plan. Yet the influential weight of each factor might be different. A study on the function which could be used to estimate career choice might have some practical value. Thus this study was designated to employ multivariate statistical technique find, first, the relation of personal abilities and interest to career plan in a selected sample and, furthermore, to describe the nature of that relationship.

METHOD

The subjects used in the study were 120 students selected at random from the high schools located in western New York Rochester area. All of the subjects had taken Kuder Scientific Interest Test, Holzinger-Crowder Scales, and provided information about their career plans. The Kuder Scientific Interest Test was used to measure the student's interest in science. The Holzinger-Crowder Scales which include four subscales were employed to measure the subject's verbal, spacial, numerial, and reasoning abilities. The information about the student's career plan was obtained from student questionnaire filled out by the student. For the study, career plan was summarized into three categories, house wife, science, and the other.

Three analyses were employed in the study. To test the homogeneity of disperson and the equality of the mean vectors in the three groups, multivariate analysis of variance was used. Discriminant analysis was employed to construct discriminant function and to estimate the membership of the group. A maxinum likelihood method of classification procedure was applied to assign the individual to the highest relative group.

RESULTS

The summary of multivariate analysis of variance, wich is presented in Table 1, reveals that the significantly differential dispersions of the three groups were not existence, but the significant difference among the mean vectors of the three groups

1 This is one of the author's papers for Advanced Educational Statistics. The author wishes to express his gratitude to Dr. S. David Farr for his guidance and comments on the paper.

did exist. Accordingly, the five variables were correlated with the three career plans. The Eta square shows that therir relation is high, $\eta^2=0.5399$.

Table 1. Summary of Multivariate ANOVA.

$H_1 = M = 33.459$	$F_{30, 30097} = 1.042$	$P > .10$.
$H_2 = \Lambda = .4601$	$F_{10, 226} = 10.72$	$P < .001$.

Since the null hypothesis H_1 indicating the homogeneity of dispersion is not rejected the total dispersion matrix is presented in Table 2. In addition, H_2 of equality of group means is rejected. The estimated group means of the five variables are presented in Table 3.

Table 2. Dispersion Matrix of the Total Group.

	1	2	3	4	5
1. Kud Sci	94.44				
2. HC Ver	7.19	157.75			
3. HC Spa	34.08	49.18	395.22		
4. HC Num	10.79	60.86	65.95	260.94	
5. HC Res	7.92	42.89	86.79	99.99	123.89

Table 3. G.roup Means and SD's for the Five Variables.

	HW n=57		SCI n=37		OTH n=30		TOT N=120	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1.	21.02	8.37	42.30	10.42	33.03	10.99	30.58	9.72
2.	69.68	11.80	63.84	12.10	61.67	14.32	65.87	12.56
3.	88.19	19.94	94.62	19.08	85.27	20.72	89.44	19.88
4.	85.88	15.01	90.54	15.57	91.93	18.64	88.78	16.15
5.	83.43	11.04	72.76	12.00	72.23	10.13	72.92	11.13

A comparison of the three group means on each variable; science group has higher scores on scientific interest and space; house wife group higher on verbal. These could be explained that the student who has greater interest in science tends to choose science related career; house wife group has higher scroe on verbal ability since girl students are often superior on verbal behavior.

Univariate and step down analyses of variances are summarized in Table 4. It can be seen in the table that significant differences among the three group means only exist in scientific interest and verbal, meanwhile only these two variables affect career plan indepently from other variables.

In discriminant analysis, two discriminant functions were attempted to use in the study. In fact, the Bartlett's Chi-square test for significance of canonical cerrelation,

Table 4. Summary of Univariate and Step Down ANOVA.

Variable	MS		F	P<	F	P<
	Between	Within	Univariate		Step Down	
1.	5052.74	94.44	53.50	0.0001	53.50	0.0001
2.	725.94	157.75	4.60	0.012	4.00	0.0208
3.	799.45	395.22	2.02	0.1369	0.76	0.4700
4.	446.01	260.94	1.70	0.1855	2.31	0.1038
5.	14.56	123.89	0.12	0.8892	0.41	0.6649
	df = 2	117				

which is presented in Table 5, shows that Function II is not significant and possesses only 5.64% of variates so that it can not be used to estimate an individual membership of the group from his test scores. In this case Function I is useful equation of the discriminant analysis. The functions could be constructed by means of the coefficients shown in Table 6. The function is used to transform the student's test scores to a discriminant score, which is applied to estimate his position in the group. Besides, the weight of the coefficient also indicates the contribution of its corresponding variable to the group separation. As we can see in Table 6, scientific interest is the largest contributor in the first function, followed by verbal ability. These correspond with those univariate and step down ANOVA mentioned above. Because of the coefficient of scientific interest is negative, the higher the score on scientific interest the lower the discriminant score from Function I. Thus science group with highest score on scientific interest has the lowest

Table 5. Bartlett's X^2 Test for Significance of Discriminant Functions.

Function	Variate	% of Vari.	df	X^2	P<
I	1.0457	94.36	10	89.28	0.0001
II	0.0625	5.64	4	6.98	0.1372

Table 6. Coefficients of the Discriminant Functions.

Variable	Row Coef.		Standardized	
	I	II	I	II
1.	− 0.0970	− 0.0214	− 0.9430	− 0.2082
2.	0.0258	− 0.0508	0.3246	− 0.6382
3.	− 0.0004	− 0.0281	− 0.0083	− 0.5588
4.	− 0.0162	0.0422	− 0.2622	0.6831
5.	0.0136	− 0.0059	0.1517	− 0.0666

discriminant score on Function I. In the second function, which is not useful function in this study, the greatest contributor of the function is numerial variable. Therefore the other group has the highest discriminant score since its numerial score is the highest one. These can also be found evidently in group centroids and discriminant space shown in Table 7 and Figure 1.

Table 7. Group Centroids

Group	Function	
	I	II
1.	1.4880	− 0.4995
2.	− 0.8170	− 0.6338
3.	0.0000	0.0000

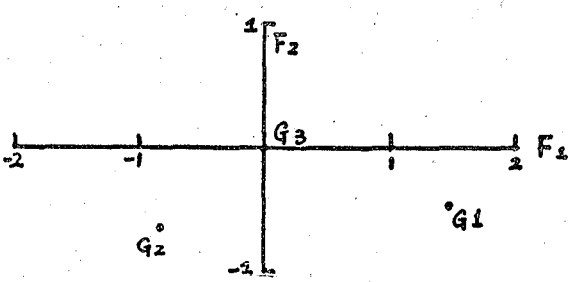

Figure 1. Group Centroids in Discri Space.

Instead of X^2 quata method, the probability approach is used in the classification analysis in the study. Three classification functions for the three groups are presented in Table 8. After evaluating the three probabilities of an individual computed from the three functions, the individual was assigned to the group with the highest probability. The classification matrix is shown in Table 9.

Table 8. Classification Functions for the Three Groups.

Eunction Coefficient	I	II	III
1.	0.1302	0.3567	0.2639
2.	0.2749	0.2222	0.2111
3.	0.0843	0.0891	0.0709
4.	0.1058	0.1375	0.1511
5.	0.3448	0.3141	0.3215
Constant	− 31.8590	− 36.5020	− 32.4434

Table 9. Classification Matrix.

Group Assigned	Group Entered							
	1. HW		2. Sci.		3. Oth.		Sum	
	N	%	N	%	N	%	N	%
1. HW	44	83.02	3	5.66	6	11.32	53	44.17
2. Sci.	3	8.11	25	67.57	9	24.32	37	30.83
3. Oth.	6	20.00	11	36.66	13	43.34	30	25.00
Sum	53	44.17	39	32.5	28	23.33	120	100.00

$X^2 = 67.09$ df = 4 $P < 0.001$. Hits = 68.33%

Significant X^2 indicates that group assigned is related to group entered. The percentage of hits manifests that 68.33% of the studnts were correctly classified. The proportion of correct blassification for house wife group is the greatest, for other group is the smallest. In addition, the proportion of misclassifications could also be examined in the matrix.

SUMMARY

The main purpose of the present study is to apply the three multivariate procedures to analyze the relation of personal abilities and interest to career plan and the nature of the relationship in a selected sample. At the first stage, multivariate ANOVA was used to find the existence of the relationship. The analysis indicates that the relationship did exist. Univariate and step-down ANOVA reveal that scientific interest and verbal ability were effective independent variables. At the second stage, discriminant analysis was employed to estimate the individual membership of the group. Meainwhile, the coefficient weights of the discriminant function indicate that scientific interest is the largest contributor to the group separation. Finally, a maximum likelihood method of classification procedure was applied to assign the individual to the relative group. The proportion of "hits" show that about two-third of the subjects were correctly classified.

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職業計劃之估量複變量分析法在教育研究上之應用實例

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複變量分析（Multivariate Analysis）爲教育統計學上近年來之一重要發展，亦爲教育研究上不可或缺之工具。本文爲運用“複變量離中分析”（Multivariate Analysis of Variance）.“區別分析”（Discriminant Analysis）與“分類程序”（Classification Procedure）等法以處理分析學生興趣能力與其職業選擇之關係之一實例。茲將三法之應用分爲三步驟簡敍如下：

一、以“複變量離中分析法”探究學生之科學興趣，語文，空間，數字，推理等能力是否與其職業選擇有關。結果顯示有相關，且其相關亦高。因此進而以“單一變量離中分析”（Univariate Analysis of Variance）與“逐步離中分析”（Step Down ANOVA）發現何種變量（分數）影響力最大。本資料中科學興趣最具影響力，語言能力居其次。

二、以“區別分析法”計算各種變量（分數）在職業“區別方程式”（Discriminant Funcfion）上所佔之份量。藉以推算學生所屬之職業類別。（本文中將職業歸爲科學類主婦類，及其他等三類）。本資料中科學興趣之比重最高。

三、以“分類程序法”將學生實得各項分數代入三“分類方程式”（Classification Function），然後將學生歸入或然率最高之職業類別，如此以便觀察幾人應屬何類職業，幾人分類錯誤。本資料中68.33%分類正確；反言之，31.67%分類錯誤。

簡言之，此一序列分析首在發現興趣能力與職業選擇間之關係是否存在。倘其關係存在，則進而探究其相關之性質，即各變量（分數）於職業區分中所佔之份量如何？如何推測個人職業分類之地位，及分類適妥與否等問題。