CHAPTER 9

Field selection Methodology for B.Sc and Model

Field selection should be done after the common first year examination using the following method. To the Average, add the marks of the two most significant subjects under each field (based on best subset for regression analysis). For the five fields each student will then have a set of five marks. List the index numbers under each field, in the merit order of the marks obtained for each field. Each field will have a specific number of vacancies depending on the resources available but these would add up to the total number of candidates. Starting from the top of each row from left to right and going down, allocate the places available. Afterwards, note down in a list of names with index numbers, each time an allocation is made and indicate the field given. In cases where the index number appear more than once as selected, check the preference and give the better preference. Also cut off these index numbers from the other selected lists and refill these vacancies from below. When this is done a selected index number may reappear as selected, if so change the preference if better and note down. Otherwise delete this number, which has reappeared, and refill. Proceed until all the vacancies are filled and thus complete matching the vacancies with the correct number of index numbers.

Aptitude may be defined as the capacity to develop the ability and is best measured by practical tests. However, by the above method since the students' abilities are used together with the preference, this combination would measure a certain knowledge component as a part of their aptitude. Practical tests in the different fields would be too tedious due to the large number of students involved and as such the next best option is considered.

Field Selection Model for B.Sc (Eng)

Fields and available vacancies in each						Personal Preferences				
CIVIL (4)	ELECT (3)	ELECTRO (2)	MECH (2)	TEXTILE (4)	INDEX NO	PREF 1	PREF 2	PREF 3	PREF 4	PREF 5
12	12	9	5	10	1	5	4	3	2	1
14	6	7	6	7	2	1	2	3	4	5
3	5	1	3	15	3	2	4	5	3	1
1	1	4	14	13	4	4	2	1	3	5
15	14	8	12	8	5	2	4	5	3	1
2	15	3	15	12	6	1	5	3	2	4
13	10	14	2	14	7	5	1	2	4	3
7	13	15	4	4	8	3	2	4	1	5
8	4	2	1	11	9	4	3	5	1	2
10	2	11	8	1	10	5	1	2	3	4
6	11	13	13	6	11	3	5	2	4	1
11	8	12	11	3	12	5	4	1	3	2
5	3	10	9	5	13	5	2	4	1	3
9	7	5	10	9	14	1	3	5	2	4
4	9	6	7	2	15	4	1	3	2	5

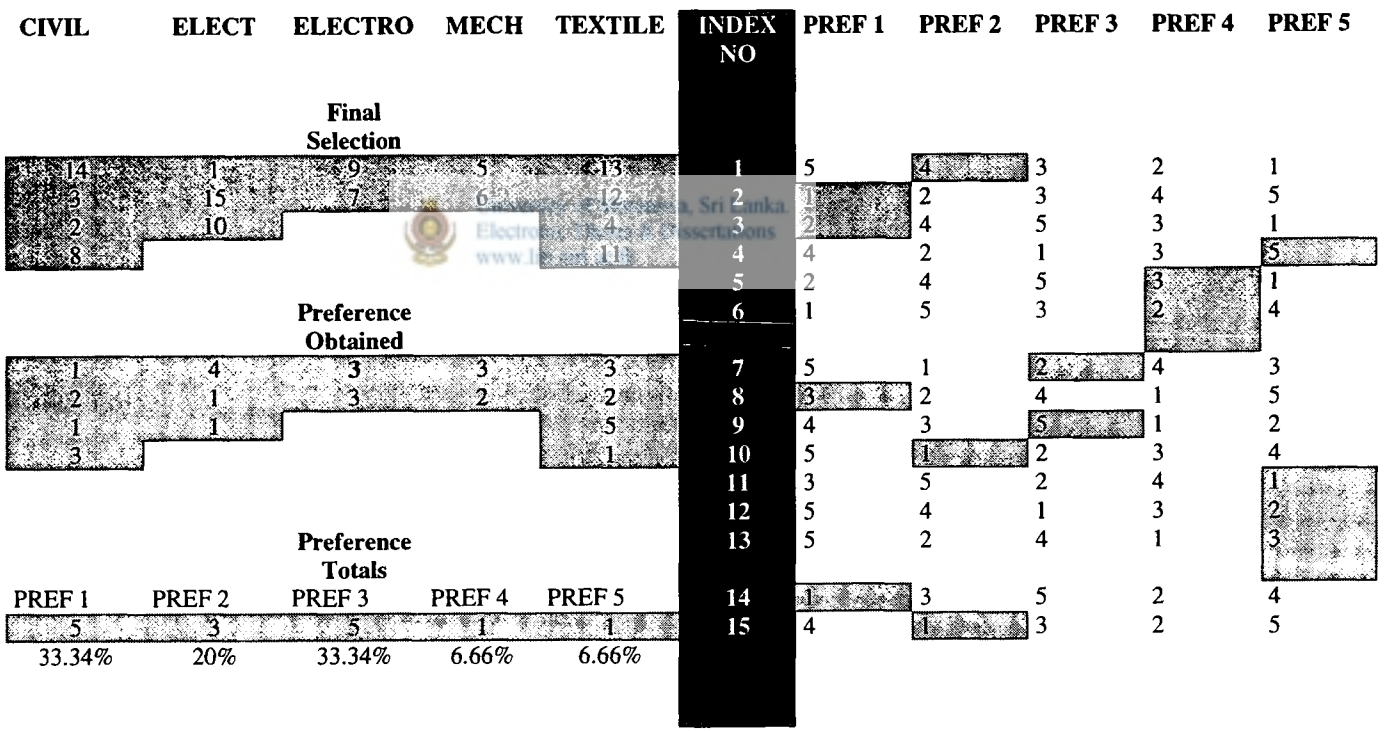
First stage of selection

CIVIL	ELECT	ELECTRO	MECH	TEXTILE	INDEX NO	PREF 1	PREF 2	PREF 3	PREF 4	PREF 5
	12	9	5	10	1	5	4	3	2	1
14		7	6		2	1	2	3	4	5
3		1	3	15	3	2	4	5	3	1
1	1	4	14	13	4	4	2	1	3	5
15	14	8	12	8	5	2	4	5	3	1
2	15	3	15	12	6	1	5	3	2	4
13	10	14	2	14	7	5	1	2	4	3
7	13	15	4	4	8	3	2	4	1	5
8	4	2	1	11	9	4	3	5	1	2
10	2	11	8	1	10	5	1	2	3	4
6	11	13	13	6	11	3	5	2	4	1
11	8	12	11	3	12	5	4	1	3	2
5	3	10	9	5	13	5	2	4	1	3
9	7	5	10	9	14	1	3	5	2	4
4	9	6	7	2	15	4	1	3	2	5

Second stage of selection

CIVIL	ELECT	ELECTRO	MECH	TEXTILE	INDEX NO	PREF 1	PREF 2	PREF 3	PREF 4	PREF 5
14	12	9	5	10	1	5	4	3	2	1
3	1	7	6	15	2	1	2	3	4	5
		1	3	13	3	2	4	5	3	1
15	15	4	14	8	4	4	2	1	3	5
2	10	8	12	12	5	2	4	5	3	1
13	13	3	15	14	6	1	5	3	2	4
7	4	14	2	4	7	5	1	2	4	3
8	2	15	4	11	8	3	2	4	1	5
10	11	2	1	1	9	4	3	5	1	2
6	8	11	8	6	10	5	1	2	3	4
11	3	13	13	3	11	3	5	2	4	1
5	7	12	11	5	12	5	4	1	3	2
9	9	10	9	9	13	5	2	4	1	3
4		5	10	2	14	1	3	5	2	4
		6	7		15	4	1	3	2	5

Final stage after repeating the procedure



Field selection Methodology for N.D.T. and Model

Let V and P represent the vacancy and preference while v and p their respective elements. The vacancies are indicated as n ,= 1,2, 3 etc. depending on the preference available in V, while the names (or index numbers) are listed according to their preferences in the order of aggregate marks in P. In order that V and P have the same form, their rows and columns are made equal by filling the empty spaces with 0.

If $v_{ab} = n$ while $p_{ab} \neq 0$ then p_{ab} is selected and removed from the next matrix

If $v_{ab} = 0$ while $p_{ab} \neq 0$ then p_{ab} is shifted to the next matrix

If $v_{ab} = n$ while $p_{ab} = 0$ then v_{ab} is shifted to the next matrix

If $v_{ab} = p_{ab} = 0$ then for all b, row a is deleted from both matrices

Starting from the 1st preference matrix and the corresponding vacancy matrix, this process is repeated with the matrices containing 2nd, 3rd, 4th preference etc., until all the vacancies are filled.

This system ensures that the best preference is given to each candidate depending on the performance at the required examination.

Field Selection Model for N.D.T.

Names (or Index numbers) say **A** to **R** are initially listed in descending order thus: **C,D,G,L,H,J,I,B,K,M,N,A,Q,R,P,F,E.** Vacancies are then matched with Preferences as shown below.

The 5 fields are 1.Civil 2.Electrical 3.Mechanical 4.Polymer 5.Textile
Vacancies are [2] [4] [4] [5] [2]

VACANCIES

1	2	3	4	5
1	1	1	1	1
1	1	1	1	1
0	1	1	1	0
0	1	1	1	0
0	0	0	1	0

PREFERENCES

1	2	3	4	5	
G	D	H	C	J	
L	B	M	K	I	
P	F	N	0	R	*1st pref*
0	0	A	0	E	
0	0	Q	0	0	

G,D,H,C,J,L,B,M,K,I,F,N & **A** get 1st preference but P,Q,R & E fail and go to next stage

0	2	0	2	0
0	0	0	2	0
0	0	0	2	0

0	P	R	Q	0	
0	0	0	E	0	2nd pref
0	0	0	0	0	

P,Q & **E** get 2nd preference but R fails and go to next stage

(0 0 0 3 0) (0 0 0 R 0) 3rd pref

R gets 3rd preference

References

1. Statistical Handbooks (1995 / 96 / 97)
   Division of Research & Statistics, U.G.C.

2. University Admissions 91/92, 92/93, 93/94
   U.G.C.

3. Education & Training in Sri Lanka
   EDCIL 1989 – Project Report by A.D.B

4. Education in Sri Lanka (1939 - 1968)
   J.E.Jayasuriya

5. Report of the Committee on Technical Education (1979)
   S.Gnanalingam and others

6. Taxonomy of Educational Objectives
   B.S.Bloom
   David Mckay Co. Inc. 1956

7. Constructing Achievement Tests
   Norman E. Gronland
   Prentice Hall 1968

8. Strategies to identify Education & Training at Advanced Middle Level
   G.T.F. de Silva, Director General (SLIATE) - 1998

9. Human Resourse Development Needs in Middle level
   Technical / Technological Education in Sri Lanka for 1998 – 2002

10. Student Perception of their Educational Needs
    S.Rupasinghe, Sri Lanka J.S.S. 1988 11 (1 & 2)

11. Advancing knowledge and skills for Development and Competitiveness –
    The Tertiary Education strategy
    Development Forum – Paris 2000

12. Neural Computing – an introduction
    R.Beale & T.Jackson, Bristol, Philadelphia 1992

Annexure

1. Paper on needs
2. Creative test sample
3. Cube test sample
4. Best subset and Regression sample

Annexure

1. Paper on needs
2. Creative test sample
3. Cube test sample
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Human Resource Development Needs in Middle Level Technological Education & Training in Sri Lanka for 1998 to 2002

[by D.S. Wijesekara, G.T.F. de Silva, S. C. Wickramasinghe, University of Moratuwa]

1. Background and Objectives

Non-availability of adequate databased information in respect of future demands, especially in middle level technical education, has made the planning process substantially difficult for educators of this level. Whenever a new course is proposed, comparisons are made with unemployment situation of University graduates, and the lack of clear proposals is seen as a sign of lethargy.

In this paper an attempt will be made to identify the intake needed for courses in this level, to meet the development needs of the Country, for the period mentioned. Areas of study will be grouped into the following three sectors, with possible subjects or groups indicated:—

(a) Agriculture & Food Science - Agriculture, Food Technology, Nutrition, Appropriate Technology, Environment Studies, Energy Studies, Computing, etc.

(b)Engineering & Technology - Civil, Electrical, Electronic ,Mechanical , Services, Energy Engineering, etc.

(c)Management & Accountancy- Accountancy, Commerce, Business Studies, Information Technology, Home Economics, Hospitality Studies, Psychology, etc.

2. Available Information

Very little numerical information is available for middle level manpower requirements in works of several authors in the field of Higher Education, (Karunatilake HNS, Indraratne AVdeS).

A Report of a Project sponsored by the ADB on Education and Training in Sri Lanka, (EdCIL 1989), places the annual market demand for qualified technicians in the Engineering sector as 5000. No figures are given for other sectors in this report.

3. Mid Level Requirement

Following Labour Force Projections are extracted from an unpublished report (Marga 1997):-

Table I Labour Force Projections (mid year) '000

Year	Total	Male	Female
1997	8403	5582	2821
1998	8568	5682	2886
1999	8736	5784	2952
2000	8908	5888	3020
2001	9040	5976	3064
2002	9174	6066	3108
2003	9309	6157	3152

Source: ATPI Abeykoon ,Demographic Proj ection for Sri Lanka 1996.

Following figures for percentages of Technicians & Associate Professionals, are taken from Labour Market Information Bulletin (TVEC 1998).

Table 2 Percentages of Mid Level Personnel in Labour Force

	1990	91	92	93	94	95	96
Technicians & Associate Professionals (%)	3.2	3.2	3.2	3.7	3.3	3.4	3.9

[Source :Quarterly Labour Force Survey, Dept. of Census & Statistics]

The above percentages for middle level personnel are projected using quadratic least squares curve fitting to give the following figures, for the period 1997 to 2003.

Table 3 Projected Percentages of Mid Level Personnel in Labour Force

	1997	98	99	2K	01	02	03
Middle level personnel (%)	4.0	4.2	4.4	4.7	5.0	5.4	5.7

For any year, the increased labour force number can be found from Table 1, by subtracting from the total labour force for that year the corresponding number of the previous year. This increased number multiplied by the percentage of the mid level personnel in Table 3, will give the increase in the number of mid level personnel required for a given year. Column 5 of Table 4 below gives the number of mid level personnel that has to be produced in a given year.

Table 4 .Annual Demand of Mid Level Personnel

(1) Year	(2) Labour Force ~000 (Table1)	(3) Increase in Labour Force ~000	(4) % Mid Level Personnel of Labour Force (Table 3)	(5) Demand of Mid Level Personnel (3) X (4)
1997	8403	----	4.0	-----
1998	8568	165	4.2	6900
1999	8736	171	4.4	7300
2000	8908	172	4.7	8100
2001	9040	132	5.0	6600
2002	9124	134	5.4	7200

4. Demand of Mid Level Personnel by Sector

Three sectors stated in section 1 have been identified for the development of middle level courses in Sri Lanka. It now remains to divide the total annual intake given in Column 5 of Table 4 among the three sectors.,

This division can be accomplished by distributing the intake in proportion to the generation of income in the Gross National Product (GNP), to the three sectors under consideration. The GNP is calculated under 11 items (Central Bank Report), which can be easily divided to the three sectors, as shown below:-

(a) Agriculture & Food Sciences

1. Agriculture, Forestry & Fisheries

(b) Engineering & Technology

2. Mining & Quarrying
3. Manufacturing
4. Construction
5. Electricity, Gas, Water & Sanitary Services
6. Transport, Storage & communication

(c) Management & Accountancy

7. Wholesale & Retail Trade
8. Banking, Insurance & Real Estate
9. Ownership of Dwellings
10. Public Administration & Defense
11. Services

Percentages to the GNP under the three sectors were calculated for the period 1990 to 1996. These figures were projected using least square method to give Table 5.

Table 5 Projected Percentages of Contribution to

	1998	1999	2000	2001	2002
(a) Agriculture	20.9	20.3	19.7	19.2	18.8
(b) **Engineering**	**37.9**	**38.3**	**38.8**	**39.1**	**32.4**
(c) Management	41.2	41.4	41.7	41.7	41.8

The intake figures of Table 4, Column 5, are distributed according to the percentages given in Table 5, to estimate the demand for the three sectors, as in Table 6.

Table 6 1998 Projected Intake to Three Sectors

	1998	1999	2000	2001	2002
(a) Agriculture	1442	1482	1595	1267	1354
(b) **Engineering**	**2615**	**2796**	**3143**	**2581**	**2836**
(c) Management	2843	3022	3362	2752	3010
Total	6900	7300	8100	6600	7200

It is now desirable to divide the numbers projected for the Engineering sector to seven fields of Chemical(CH), Civil(CV), Electrical(EL), Electronic(EN), Mechanical(ME), Polymer Engineering(PL) and Textiles & Clothing Technology(TX). These seven fields are those available for the National Diploma in Technology (NDT) course at the University of Moratuwa. Other organizations such as the Technical Training Institute (TTI) at Katunayaka and Advanced Technical Institutes (ATI) at Mattakuliya and Labuduwa conduct courses for Civil, Electrical and Mechanical Engineering only, but under different sub fields. Accordingly, only the numbers that could be projected for the seven fields mentioned above will be considered.

Based on figures of the Central Bank Reports for formation of the GNP, the earnings under Engineering & Technology are given under subheadings such as Mining & Quarrying, Manufacturing, etc., as stated earlier. It was attempted in

this work to calculate percentage contributions to Engineering & Technology earnings from different subdivisions. The results obtained are shown in Table 8.

Table 8 - Contributions in Rs. Million & (Percentage contributions) to GNP of Engineering & Technology from Sub fields

	1996	97	98	99
i. Mining & Quarrying	13.93(5.4)	14.46(5.3)	13.68(4.6)	14.24(5.0)
ii Manufacturing	112.72(20.0)	122.93(18.6)	130.70(19.6)	136.50(19.5)
iii Construction	48.23(23.2)	50.84(19.8)	54.46(18.3)	57.08(18.3)
iv Electricity, Gas Water & Sanitation	9.17(3.6)	9.92(3.2)	10.92(3.7)	11.96(3.8)
v Transport, Storage & Communication	73.78(28.6)	80.27(31.3)	86.44(29.2)	93.44(30.0)
Total for Engineering & Technology	257.83(100)	256.42(100)	296.24(100)	311.22(100)

The main thrust of this research is to divide the required middle level work force in Engineering & Technology into different fields according to the proportion that the fields contribute to the formation of the GNP. There are five sub sectors as given above contributing to the formation of GNP under Engineering & Technology, but there are seven fields for academic & professional training.

For our purposes, It can be safely assumed that practically all persons working in the construction sub sector are from the Civil Engineering field, at this professional level. However, there is considerable overlap in other sub sectors. or instance, for the fifth sub sector of transport, storage & communications, all the three academic fields of Civil Engineering, Mechanical Engineering and Electronic Engineering could contribute. Since there was no further detailed information on break down of the GNP contributions, a simple model was formulated for the purpose of this study, as described below; After careful analysis of GNP formation according with the scanty information available, it was decided to allocate academic fields to the sub sectors as given in the following table:-

Sub Sector of GNP	Fields contributing to Sub Sector
i. Mining & Quarrying	CH
ii. Manufacture	CH, EL,EN.ME,PL,TX
iii. Construction	CV
iv. Electricity, Gas, Water & Sanitation	CV,EL
v. Transport, Storage & Communication	CV,EN,ME

Again due to lack of information, it was decided to give equal weights to different fields competing in the same GNP sub sector. For instance, in the fifth sub sector of Transport, Storage & Communications, it is assumed that the fields of CV, EN and ME will be equally distributed. Along these lines percentage of middle level Engineering & Technology personal required for different fields for years under study were calculated and are shown in the following table.

Table 9 - Percentage of Mid Level Personal required For Fields of Study

		1996	97	98	99	Average
Chemical	CH	5.4	5.3	4.6	4.5	5.0
Civil	CV	20.0	18.6	19.6	19.5	19.4
Electrical	EL	1.3	1.2	1.2	2.0	1.4
Electronic	EN	27.0	27.2	27.2	27.3	27.2
Mechanical	ME	28.0	28.6	28.4	27.3	28.2
Polymer	PL	6.2	6.3	6.3	6.2	6.3
Textiles	TX	12.5	12.7	12.6	12.4	12.6

In Table 6, the estimates of mid level personal required for Engineering & Technology sector was given as follows :-

Year	1998	99	2000	01	02
Required Number	2615	2796	3143	2581	2836

It is generally accepted that this type of manpower requirement analysis should be short term, that is, covering at most for five years to the future. Since some planning could still be done for the year 2002, the numbers required for the country for 2002 in the seven fields could be estimated by dividing 2836, that is the total requirement proportion to the average percentages given in the last column of Table 9. Since the NDT course of the University of Moratuwa still remains to be the biggest supplier of middle level personal in the Engineering & Technology, it is worthwhile to estimate the numbers that could be admitted to Moratuwa for different fields, on the assumption that only 350 will be so admitted to that Institute in 2002. These figures are also given in Table 10.

Table 10 - Desired Enrolment for 1999 in Different Engineering Fields for output in 2002.

	CH	CV	EL	EN	ME	PL	TX	Total
Average percentage in sector(Table 9)	5.0	19.4	1.4	27.2	28.2	6.3	12.6	100
Requirement in the country	142	550	42	771	797	178	357	2836
Estimated Admission for NDT	18	68	**7**	**95**	95	21	44	350
Actual Admissions	25	80	**40**	**40**	90	25	50	350
First preference probability (%)	12	28	11	100	26	3	21	

5. Conclusions

It is well known that long term projections on manpower requirements are from realistic though short term ones are generally acceptable and are essential for the proper planning of human resources development programmes. However, it is this sort of study that are not generally found in Sri Lanka. This is mainly due to the fact that such research is extremely difficult and could be open to severe criticism. It ought to be stressed that the figures arrived at are more objective and meant to be taken as to point out to trends.

On the practical side it is seen that the highest numbers are required for Electronic Engineering, a fact that is reflected in the demand for students both at the middle and degree level at the University of Moratuwa. If the figures for Electronic and Electrical Engineering are combined, then it appears to agree much closely with the aspirations of the students. The popularity of Electrical appears to be on the decline in favour of Electronics. Civil, Mechanical and Textile are the next in line of popularity while Chemical and Polymer seem to be the least, based on probability calculations using the most recent data.

While further study is needed whether the figures reflect closely with the needs of the students which seems to be the case at a general level, the figures do not reflect what is provided by the University, or for that matter by other organizations.

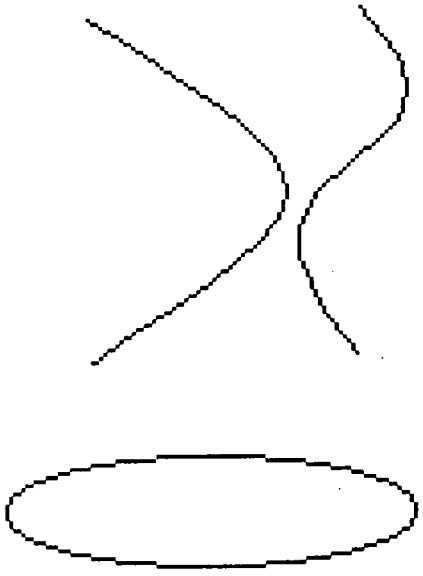
Accordingly the model to project numbers required for short term planning based on manpower projections and distributing to fields according to earnings generated by the fields for the GNP appear to reflect student aspirations.

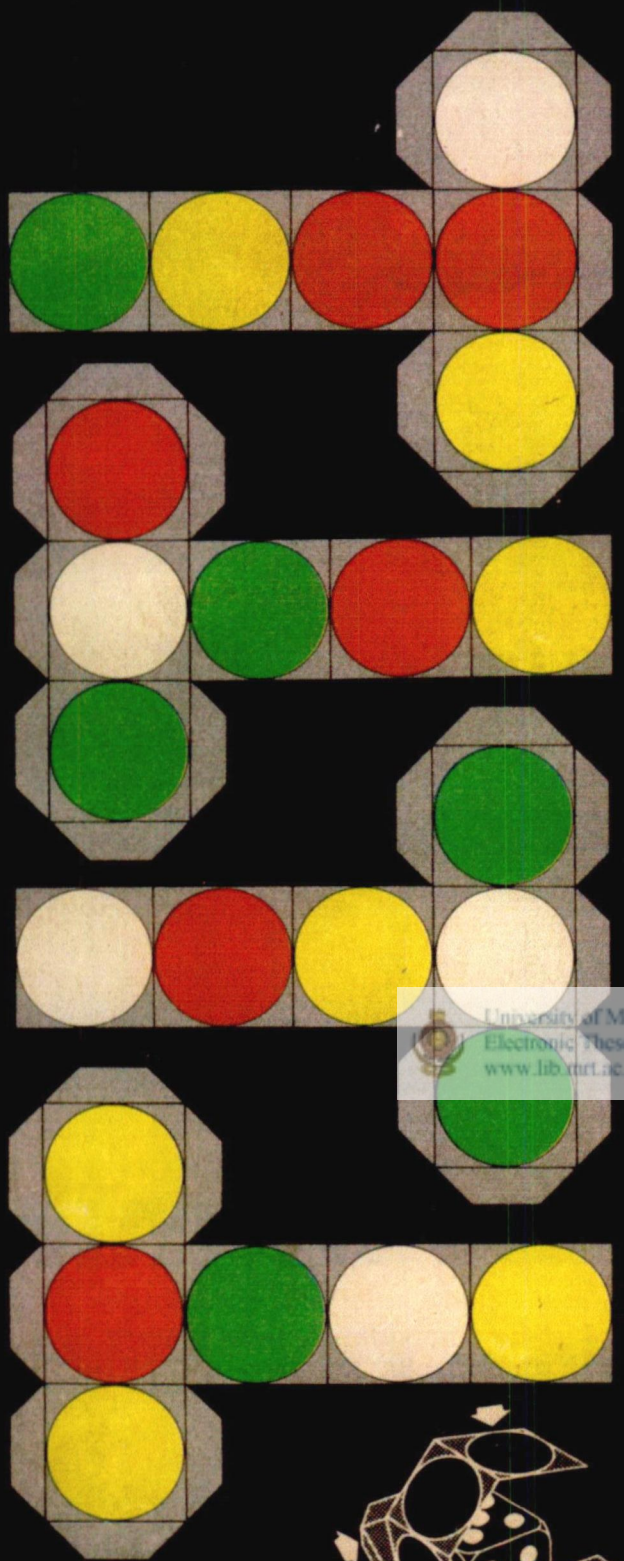
References

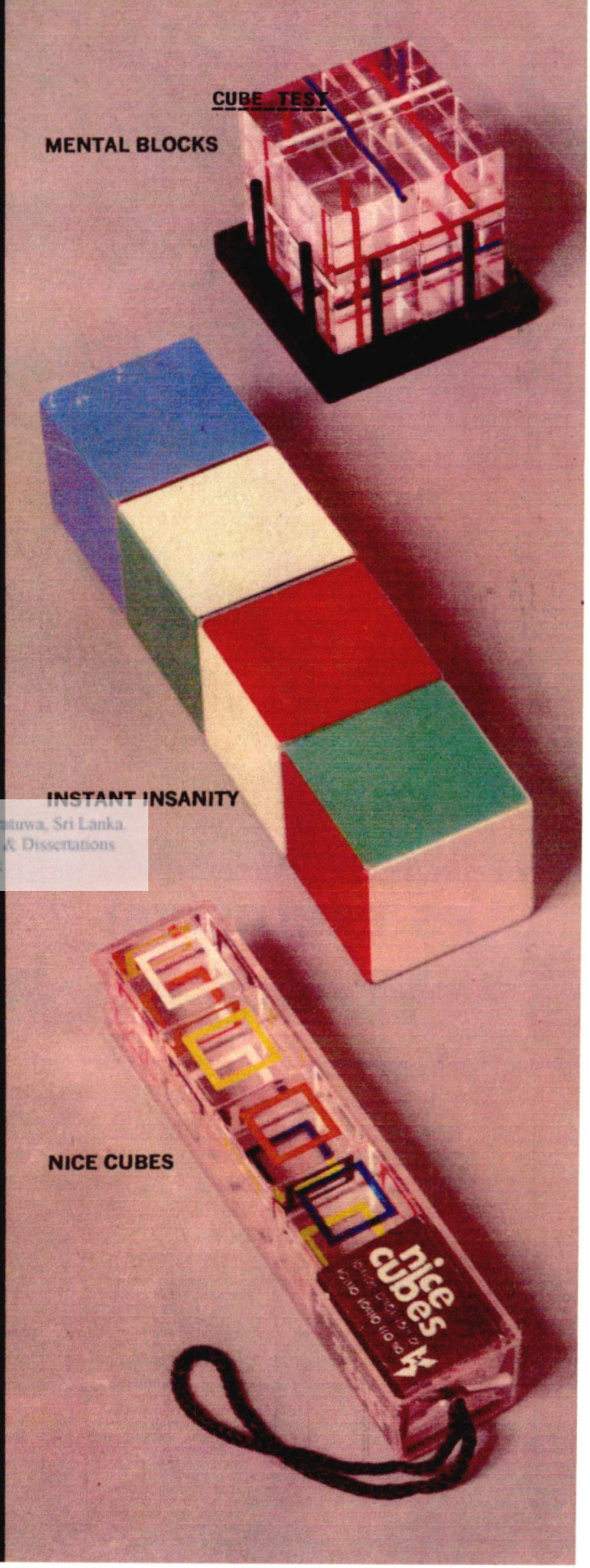
1. Karunatilake HNS, 1987, The Economy of Sri Lanka, Centre for Demographic and Socio—economic Studies, Colombo
2. Indraratne AVdeS, Economics of Higher Education
3. Educational Consultants India Ltd. (EdCIL), 1989, Education and Training in Sri Lanka
4. Marga Institute,Oct. 1997, Survey of Training Needs for Present Employment and New Employment for Women (unpublished)
5. TVEC, March 1998, Labour Market Information Bulletin
6. Central Bank Reports

Creative Test

Instructions : Create a picture using the lines given below.







Make your own cubes

Here's the PS version of the popular cube games, and you can make it yourself. Simply cut out the four forms containing the colored circles. Fold them to make cubes, using dice to support them and gluing tabs in place. If you prefer, you can eliminate dice: Paste forms to light cardboard or construction paper to stiffen them, fold into cubes, and glue.

Correlations (Pearson)

	AGGREGAT	FIRST MA	FINAL RE	Maths	Eng Dr	Phy	Chem
FIRST MA	0.543						
	0.000						
FINAL RE	0.436	0.608					
	0.008	0.000					
Maths	0.432	0.535	0.670				
	0.006	0.000	0.000				
Eng Dr	0.163	0.621	0.282	0.118			
	0.320	0.000	0.055	0.406			
Phy	0.270	0.601	0.281	0.236	0.384		
	0.096	0.000	0.055	0.092	0.005		
Chem	0.208	0.561	0.424	0.286	0.545	0.410	
	0.204	0.000	0.003	0.040	0.000	0.003	
W/T	0.349	0.634	0.309	0.187	0.448	0.365	0.217
	0.032	0.000	0.035	0.188	0.001	0.008	0.126

Cell Contents: Correlation
P-Value

Best Subsets Regression

Response is FINAL RE

35 cases used 18 cases contain missing values.

Vars	R-Sq	Adj. R-Sq	C-p	s	AGGREGAT	FIRST MA	Maths	Eng Dr	Phy	Chem	W/T
1	57.6	56.3	4.2	6.6423		X					
1	39.7	37.9	19.2	7.9254	X						
2	63.1	60.8	1.7	6.2925	X	X					
2	62.3	59.9	2.4	6.3652		X				X	
3	64.8	61.4	2.3	6.2500	X	X		X			
3	64.4	60.9	2.7	6.2865		X			X	X	
4	65.9	61.4	3.4	6.2494	X	X		X	X		
4	65.8	61.2	3.5	6.2589	X	X		X		X	
5	67.5	61.9	4.0	6.2050	X	X	X	X	X		
5	67.3	61.6	4.2	6.2264	X	X		X	X	X	
6	68.5	61.7	5.2	6.2188	X	X	X	X	X		X
6	68.1	61.2	5.6	6.2586	X	X	X	X	X	X	
7	68.7	60.6	7.0	6.3096	X	X	X	X	X	X	X
7	68.5	60.4	7.2	6.3285	X	X	X	X	X		X
8	68.7	59.1	9.0	6.4269	X	X	X	X	X	X	X

egression Analysis

e regression equation is

FINAL RESULT = 12.5 + 0.423 FIRST MARK + 6.40 Maths + 1.63 Chem - 2.96 Phy

cases used 8 cases contain missing values

redictor	Coef	StDev	T	P
Constant	12.492	7.194	1.74	0.090
RST MA	0.4235	0.1773	2.39	0.022
ths	6.403	1.648	3.89	0.000
Chem	1.630	1.423	1.15	0.259
hy	-2.963	2.368	-1.25	0.218

= 6.404 R-Sq = 56.6% R-Sq(adj) = 52.3%

alysis of Variance

Source	DF	SS	MS	F	P
egression	4	2142.64	535.66	13.06	0.000
sidual Error	40	1640.57	41.01		
tal	44	3783.21			

urce	DF	Seq SS
RST MA	1	1400.05
aths	1	629.69
Chem	1	48.68
y	1	64.21

Unusual Observations

bs	FIRST MA	FINAL RE	Fit	StDev Fit	Residual	St Resid
8	51.5	32.660	47.882	1.678	-15.222	-2.46R

R denotes an observation with a large standardized residual

egression Analysis

The regression equation is

INAL RESULT = 12.2 + 0.501 FIRST MARK + 6.52 Maths - 2.84 Phy

cases used 8 cases contain missing values

redictor	Coef	StDev	T	P
nstant	12.157	7.215	1.68	0.100
IRST MA	0.5014	0.1643	3.05	0.004
Maths	6.517	1.651	3.95	0.000
y	-2.841	2.375	-1.20	0.239

= 6.428 R-Sq = 55.2% R-Sq(adj) = 51.9%

nalysis of Variance

urce	DF	SS	MS	F	P
egression	3	2088.86	696.29	16.85	0.000
Residual Error	41	1694.35	41.33		
tal	44	3783.21			

Source	DF	Seq SS
IRST MA	1	1400.05
aths	1	629.69
hy	1	59.12

Unusual Observations

bs	FIRST MA	FINAL RE	Fit	StDev Fit	Residual	St Resid
6	42.7	53.660	48.260	3.393	5.400	0.99 X
48	51.5	32.660	49.011	1.362	-16.351	-2.60R

denotes an observation with a large standardized residual
denotes an observation whose X value gives it large influence.