A Statistical Analysis of Examination Performances: - A Case Study of Candidate Performance at the IESL Professional Review Examination

by

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Abstract

The analysis of the examination performance of candidates provides knowledge of insight in the areas which require improvement both in the candidate capability in the areas tested and the examination itself. The candidates appearing for the professional review of the Institution of Engineers Sri Lanka had often shown concern with respect to the poor performance at one particular section of the review. In order to investigate the performance of candidates, in this study, a statistical analysis of the professional review examination pertaining to four consecutive examinations held over two years was carried out. The study results clearly indicate the rather poor performance in this particular section of the professional review thus suggesting a through evaluation of both the candidates and the examination to achieve improvements. Among the other findings the study shows that on the average, the candidates from the civil engineering discipline had not fared in this particular section as well as the candidates from the other engineering disciplines.

1.0 Introduction

The Institution of Engineers Sri Lanka (IESL) is the umbrella organisation in Sri Lanka for all disciplines of engineering. At the professional review examination of the IESL each candidate is required to face an interview and appear for two written examinations namely the A-Paper and the B-Paper. The B-paper consists of two sections where section 1 consists of a question which is compulsory, and section 2 consists of a few questions which could be selectively answered. Candidates appearing for the PR had shown concern with respect to the poor performance in the B-paper attributing the poor performance to deficiencies in the question paper. In order to investigate this, an analysis of the results of the PR was carried out, This work presents a comparative analysis of student performance in four professional review examinations held in 1995 and 1996.

The main objective of this study is to identify the performance of the students at the professional review examination by studying the performance of the entire set of candidates at each section of the PR, analysing the performance of candidates from the three major disciplines of engineering namely Civil, Electrical and Mechanical, and studying the candidate performance in the B-paper comparing the results of each sub section.

2.0 Data and Methodology

Results of all candidates appeared for the four PR examinations in 1995 and 1996 available at the IESL head office were used for the study. The data consisted of the marks obtained by each candidate along with the engineering discipline in which a candidate has applied for the examination. The data indicated whether a candidate is appearing for the first time or otherwise. To ensure confidentiality, names were omitted and an identification number was incorporated when the data were released for this study.

In order to identify the performance at the examination, the results of the candidates appearing for the first time was considered. The examination results in the years 1995 and 1996 were separately analysed considering the performance of the candidates in the Civil, Mechanical and Electrical. engineering disciplines In the case of comparing the performance at viva, Section A and Section B examinations, results were summarised into two

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groups identified as a successful and an unsuccessful group. The marks obtained for each sub section in Section B examination were summarised to find the number of candidates who passed subsections 1 and subsection 2 in the B paper. A simple statistical computer software was used to scan the database to determine the distribution of 'percentage marks' obtained by candidates for each subsection of the B paper.

3.0 Results and Discussion

3.1 General

From the individual examination results (Figure 1) it can be observed that most of the candidates for the professional review are from civil engineering followed by electrical engineering. The number of candidates appearing at the professional review has shown a marked increase in the year 1996 (**Table 1**) It is observed that the latter part of the 1995 and the early 1996 had received the most number of candidates. In the period under study, the candidates from mechanical engineering were less than 10% of the candidates appearing from civil engineering (**Table 2**).

In general the candidate performance at any given examination in the civil and electrical engineering categories had been highest in the Viva; A-paper performance comes next; and performance in B-paper is the lowest The mechanical engineering category and the electrical engineering category at the August/September examinations in the years 1995

Table 1: Performance of Candidates (Numbers) in 1995 and 1996

Year	Appeared (First Time)	Passed (VAB)	Passed (VA)	Passed Viva	Passed A-Paper	Passed B-Paper
1995	100	29 (29%)	33 (33%)	77 (77%)	66 (66%)	43 (43%)
1996	152	47 (31%)	38 (25%)	102 (67%)	99 (65%)	73 (48%)
'95 +'96	252	76 (30%)	71 (28%)	179 (71%)	165 (65.5%)	116 (46%)

VAB - Viva, A-Paper and B-Paper
VA - Viva and A-Paper

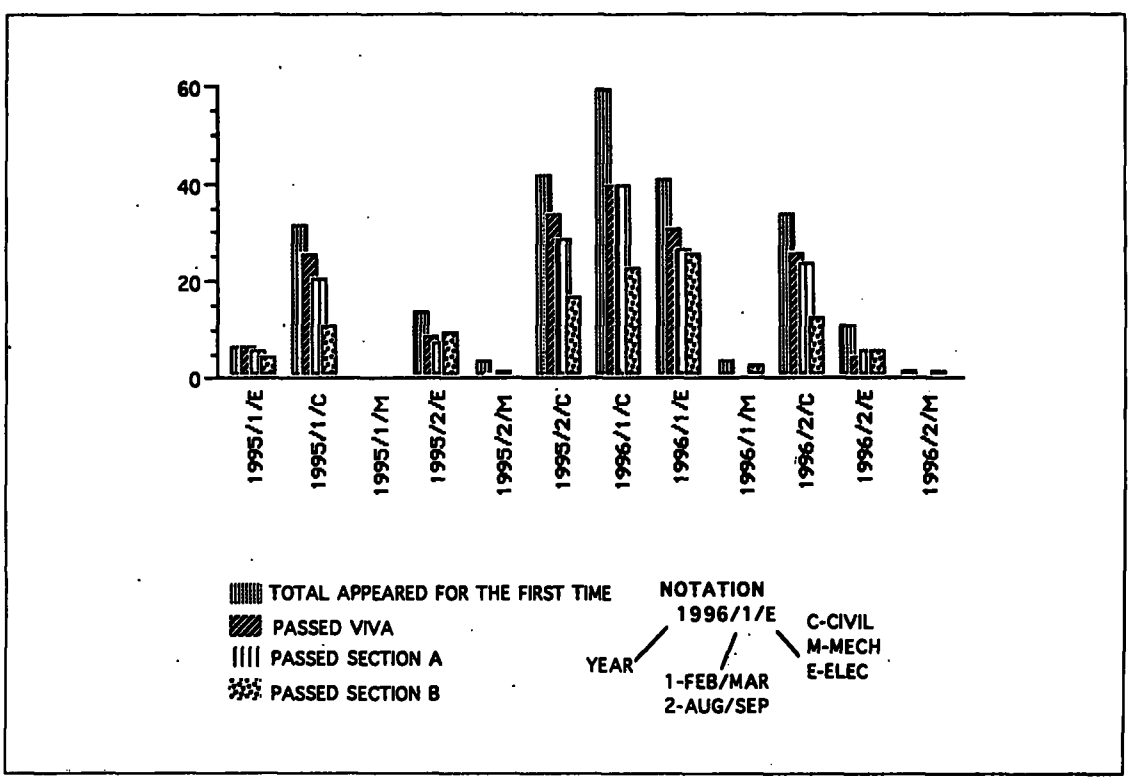


Fig 1: Performance of Candidaates (Number) in Each Section of the Professional Review: 1995, 1996

and 1996, had shown to behave differently indicating superior performance at the B-Paper of the professional review (**Figure 2**).

3.2 Performance at Each Section of the PR

Performance of the candidates who appeared for the PR from each engineering discipline during 1995 and 1996 is indicated in the **Table 1**. The Table shows the number and the percentage passed the PR in Viva, A-Paper and B-Paper. This Table also shows a comparison of the performance in the whole examination, and in the viva and Section A parts taken together.

Performance of the candidates appearing for the first time at each section of PR and from each engineering discipline, during each professional review held in 1995 and 1996 are graphically presented in Figure 1 and **Figure 2** comparing the numbers and the percentages in the respective figures.

Table 2: Performance of Candidates from Various Disciplines in 1995 and 1996

Category	Appeared (First Time)	Passed (VAB)	Passed (VA)	Passed Viva	Passed A-Paper	Passed B-Paper
Civil	168	44 (26.1%)	58 (34.5%)	126 (75%)	114 (67.9%)	64 (38.1%)
Electrical	73	32 (43.8%)	12 (16.4%)	52 (71.2%)	47 (64.4%)	47 (64.4%)
Mechanical	11	0 (0%)	1 (9.1%)	1 (9.1%)	4 (36.4%)	5 (45.5%)

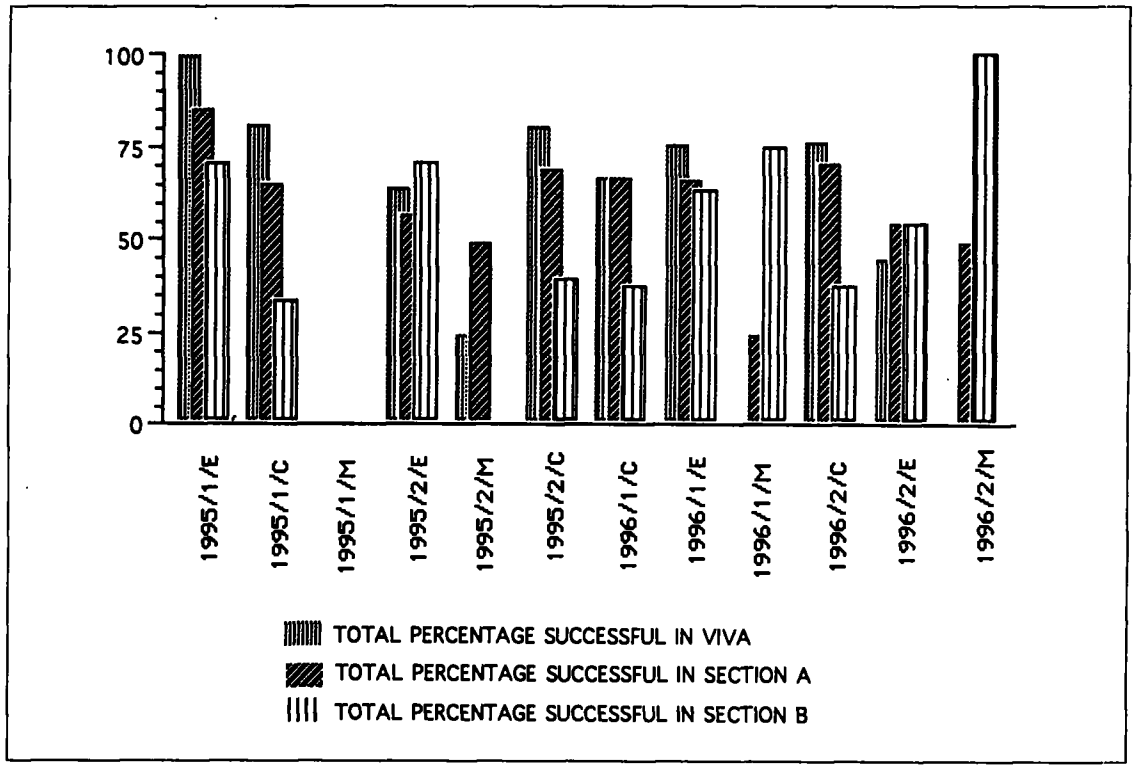


Fig: 2: Performance of Candidates (%) in Each Section of the Professional Review: 1995, 1996

Performance at each individual section of PR in the years 1995 and 1996 separately is shown in Figures 3. The aggregated performance at all four examinations used for the analysis is shown in Figure 4.

The aggregated results of the candidates on an yearly basis and also when taken as a whole shows that the average rates of passing the viva and the A-paper had been quite close to each other having approximate passing rates of 71% and 66% respectively. The passing rate at the B-paper had been fluctuating between 43% and 48% in 1995 and 1996. and this clearly indicates a significantly lower performance at the B-paper when compared with the performance at viva and the A-paper. It is felt that when considering the viva and the A-paper as independent examinations there is a satisfactory rate of passing which is above 65%..

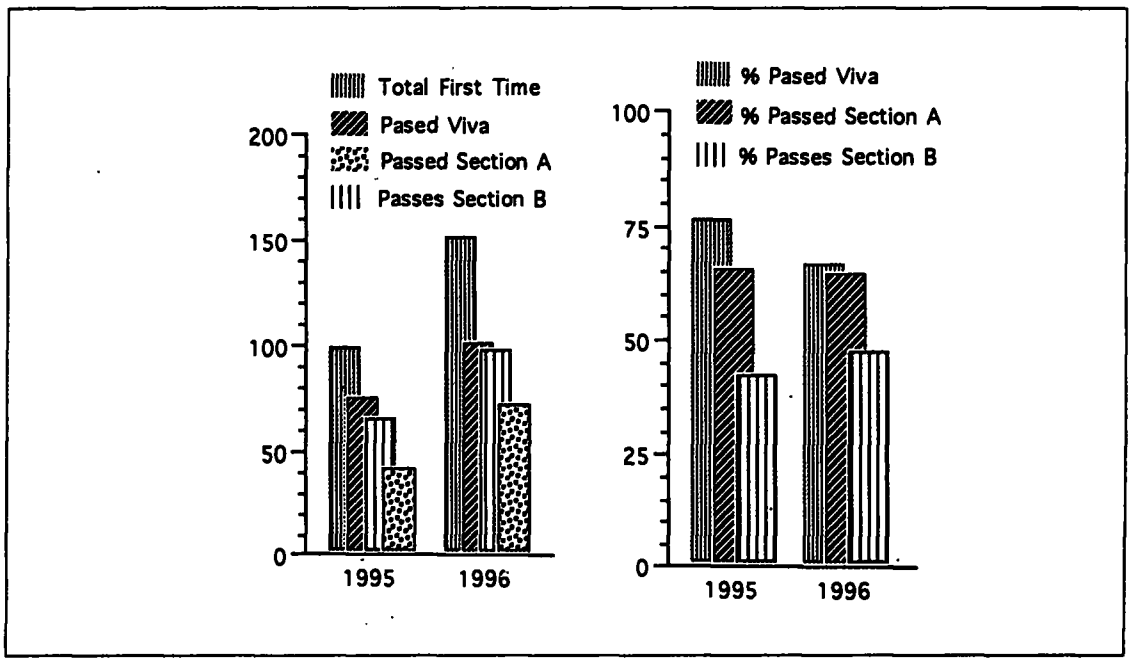


Fig: 3: Performance at Each Section (both Numbers and %) of the Professional Review on an Annual Basis

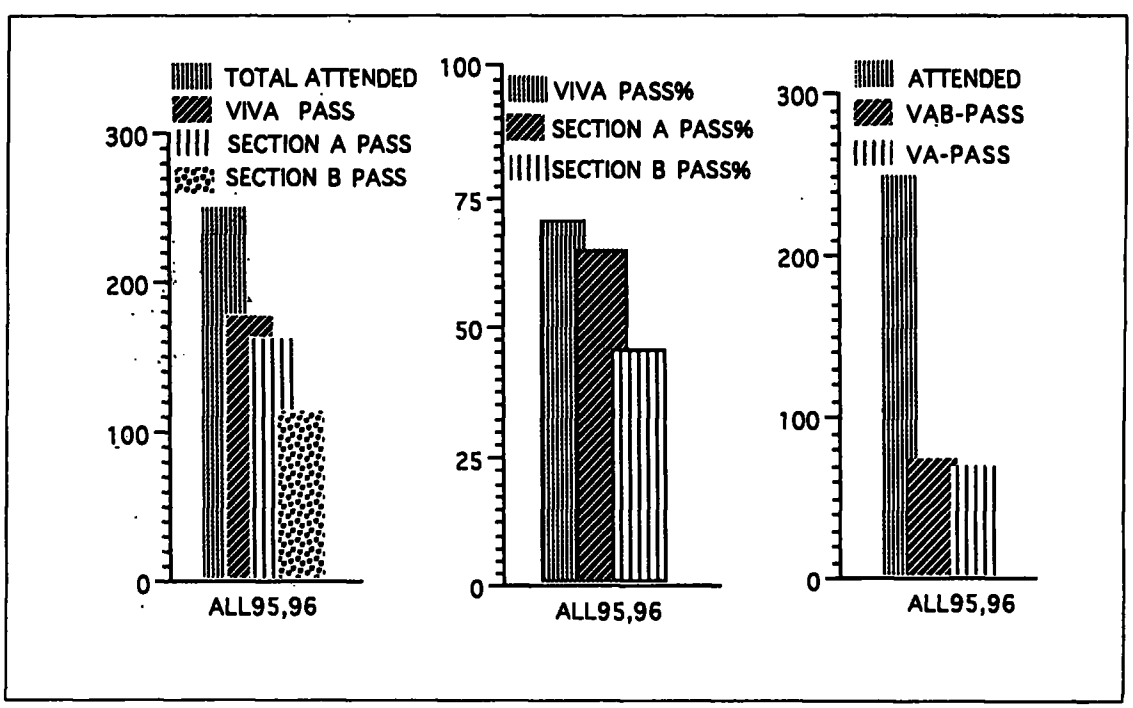


Fig: 4: Aggregated Performance of Candidates at Each Section of the Professional Review in 1995 and 1996

In the years under study, it is noted that out of the 11 candidates appeared from the mechanical engineering discipline, none had been successful in passing at the first attempt. Also the performance at the Viva from this category had been rather poor when compared with the results of the other two sections.

3.3 Aggregated Performance at Viva and Section A

In order to identify the impact on the final performance of the professional review due to the results of the B Paper, the numbers pertaining to (i) passing 'Viva, Section A, and Section B' and (ii) passing 'Viva and Section A Only' were computed. The values in each year are shown in Table 1. Graphical comparison of the same aggregated over 1995 and 1996 are also shown in **Figure 4.**

The percentage of candidates who passed all three sections of the professional review in their first attempt during the years 1995 and 1996 had been 29% and 31% respectively while the overall average shows to be 30%. The percentage who passed the viva and the A-paper added to 28% of the candidates when both years were aggregated. This value of 28% reflected the group of the candidates who fared well in the two of the three sections of the professional review examination. Hence this shows that the poor performance in the B-paper would have had adversely affected a maximum of 28% candidates from passing the professional review in their first attempt.

A similar comparison in the case of those candidates who had passed the viva and the B-paper was not carried out considering the vast difference in the passing rates at these sections when taken independently. The low numbers passing the entire examination and those who are most affected by the poor performance at the B-paper is well reflected in the **Figure 4.**

The failure percentage in the B-paper aggregated over the years 1995 and 1996 had been 46%. It can be observed that if a 50% improvement in the B-paper performance could be achieved, then the percentage of candidates passing the entire examination in their first attempt would increase to a value close to 50.

3.4 Performance by Engineering Discipline

Performance of candidates appeared for the first time from the Civil, Electrical and Mechanical engineering disciplines was carried out and the performances at each subsection of the examination are shown in **Figure 5** and in Table 2. The number of candidates and the percentages who passed the entire examination and who passed only the viva and section A only were plotted to reflect the distribution with respect to each engineering discipline (**Figure 6**).

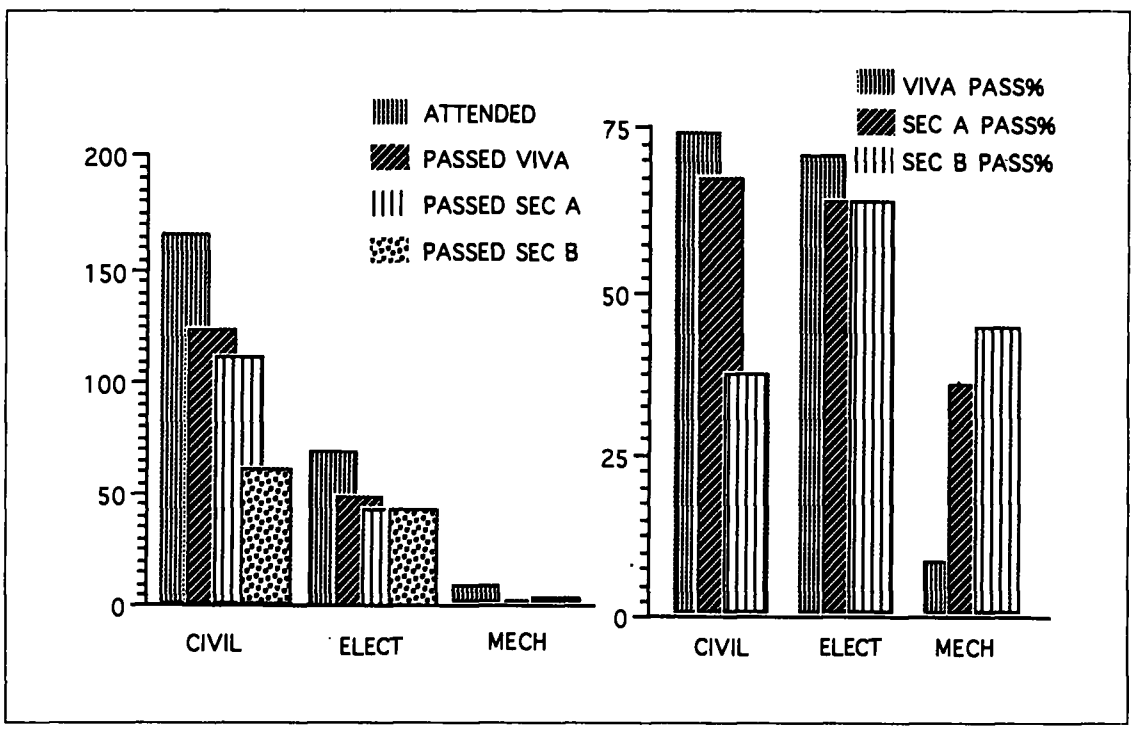


Fig: 5: Performance at Each Section of the Professional Review in 1995 and 1996 Corresponding to Each Enginering Descipline

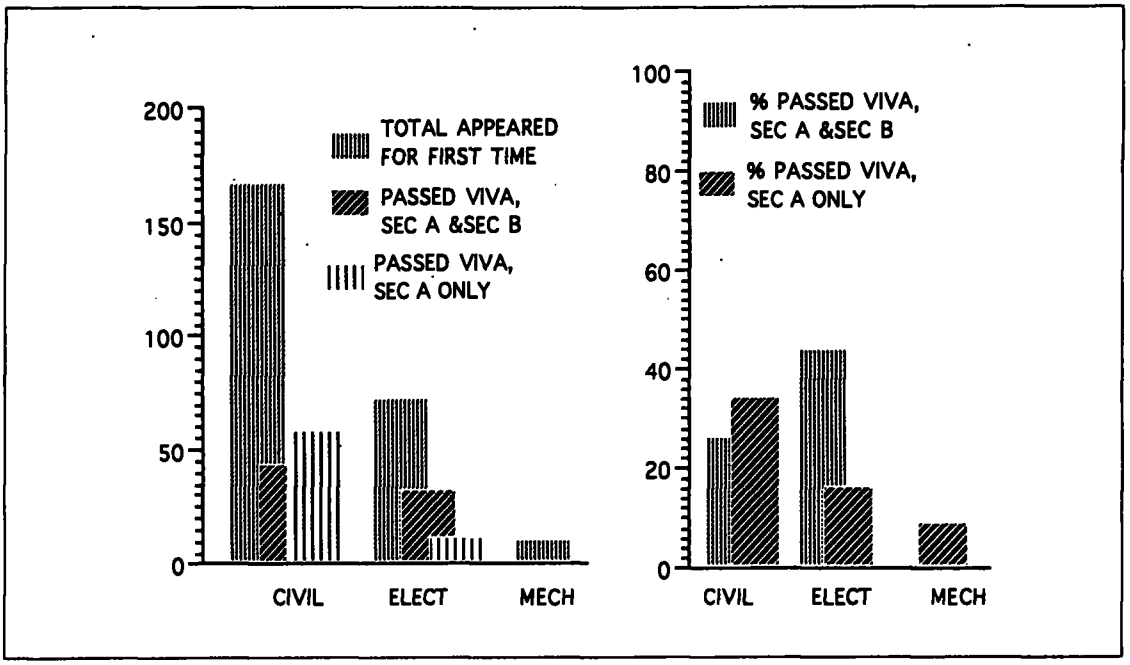


Fig: 6: Candidates from Each Engineering Descipline Successful in All Section of the Professional Review and Sucessful in Viva and Section A only

Aggregated performance of candidates in each engineering discipline shows that the highest rate of failures in the B-paper is in the civil engineering category. In the electrical engineering category the numbers passing in each section varies only between 64% and 71% and this could be treated as evenly balanced. In the civil engineering category the numbers passing the B-paper are only about 50% of those passing the other two sections. Mechanical engineering candidates are small in number and hence the percentages shown in Figure 5 need to be considered carefully.

Comparison of candidates passing all sections in their first attempt (Figure 6) shows that the passing rates in the civil, electrical and mechanical engineering candidates are 26%, 44% and 0% respectively. In the civil engineering discipline, the number of candidates who could not successfully complete the entire examination due to the poor performance in the B-paper far exceeds the number successfully completed the entire examination in the first attempt. This phenomena is reversed in the electrical section where the number passing the professional review in the first attempt is more than those who had passed only the viva and the A-paper. The aggregated results pertaining to the entire period under study shows that total number passing the examination in the first attempt and the total number failing the examination due to poor results in the B-paper are nearly equal (Table 1) and that the numbers pertaining to those are 76 and 71 respectively.

3.5 Professional Review B Paper-Sub Sections

The average marks received by candidates at each examination during 1995 and 1996 in different engineering disciplines are shown in the **Figure 7,** Maximum marks receivable for the sub section 1 and subsection 2 of B paper are 40 and 60 respectively. Level of performance at each section of B paper was calculated and the results in percentages are also shown in the Figure 7.

Average marks in percentages for each sub section 1 and sub section 2 of B paper received by the students in the civil, electrical and mechanical engineering streams in 1995 and 1996 were aggregated and the results are shown in Figure 8. Percentage marks received for sub sections 1 and 2 by candidates in 1995 and 1996 computed and are shown for comparison(Table 3, Figure 8).

The performance of a candidate in the B-paper is a combination of performance in its sub-sections 1 and 2. The average marks received by the candidates for each section are shown in the Figure 7a. As the marks allocated for sub-sections 1 and 2 are 40 and 60 respectively, the percentage marks received by candidates at each examination was computed for a comparative analysis of the candidate performance (Figure 7b). Figure 7b shows that the performance at both sections of the B-Paper is similar but only in one occasion in 1995, the performance has moved beyond the 50% level. The rest of the time level of performance had been below 50%. The analysis of marks received by the candidates in each discipline and in each year also show that in all three disciplines

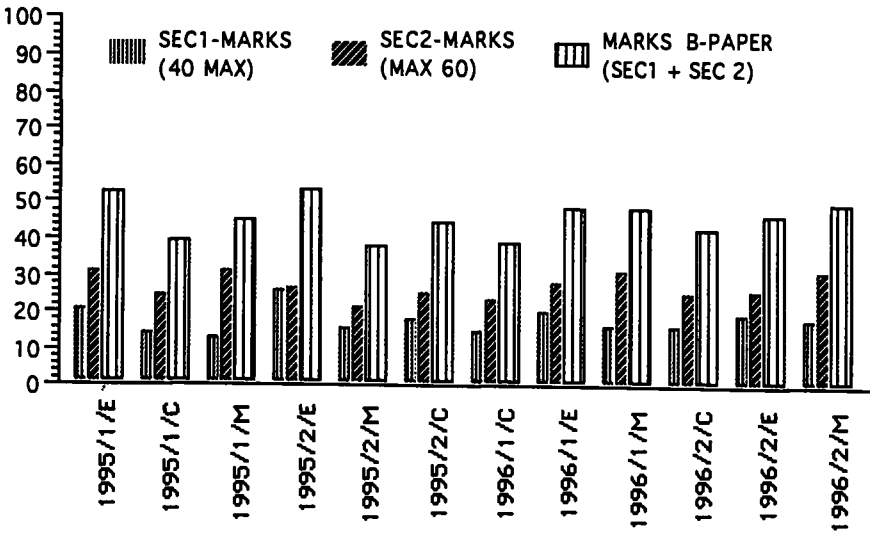


Fig: 7(a): Average Marks Received by Candidates at Each Professional Review During 1995 and 1996

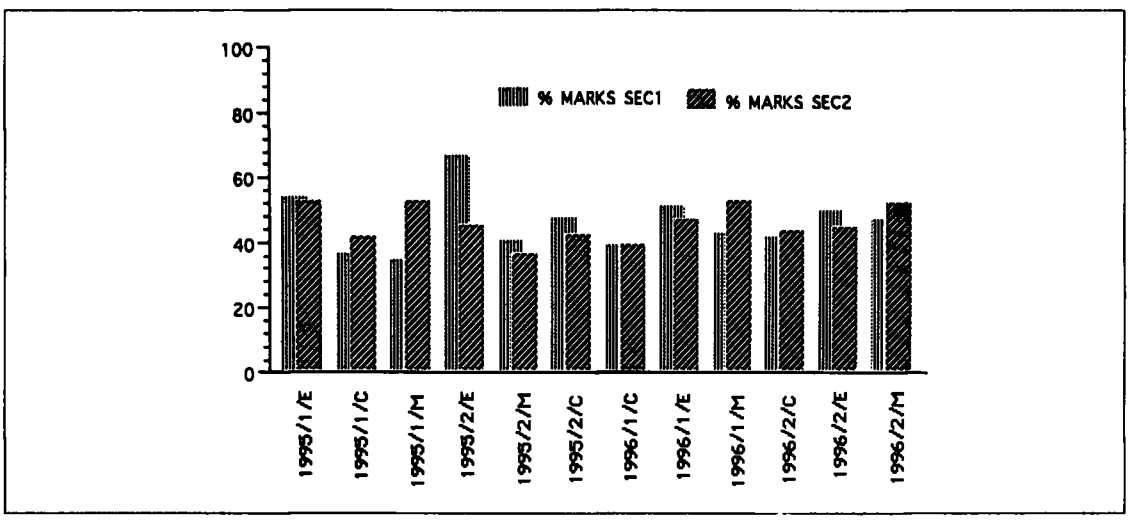


Fig: 7(b): Average Marks (%) Received by Candidates at Each Professional Review During 1995 and 1996

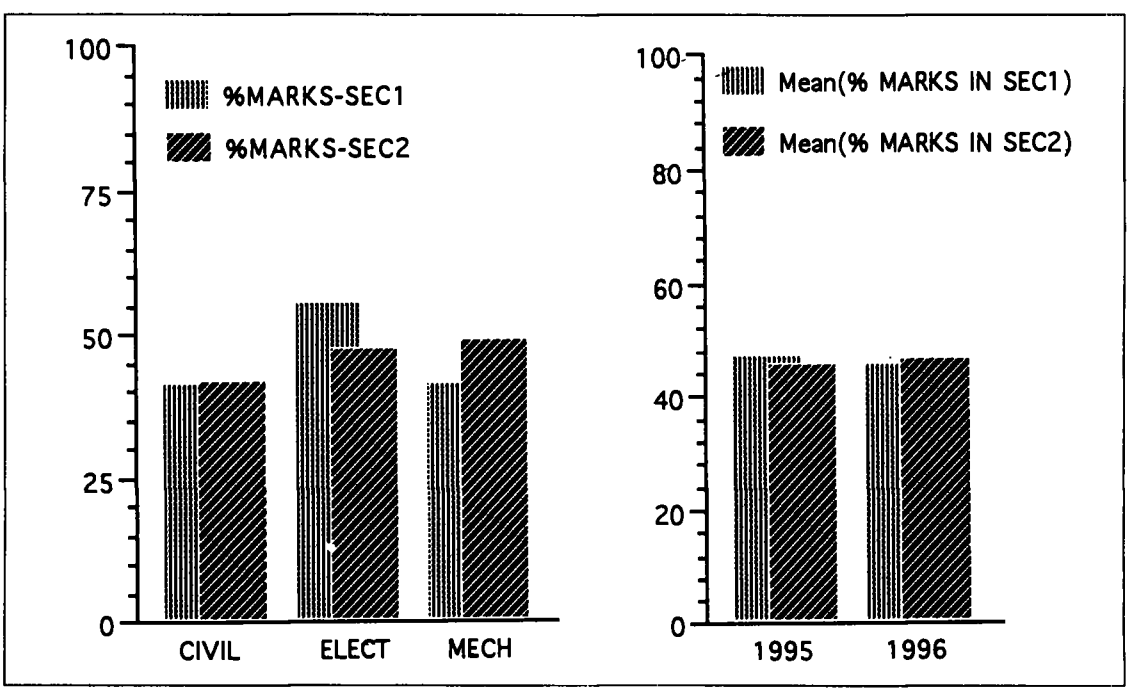


Fig: 8: Percentage Marks Received at Each Sub Section of the Professional Review B-Paper in 1995 and 1996

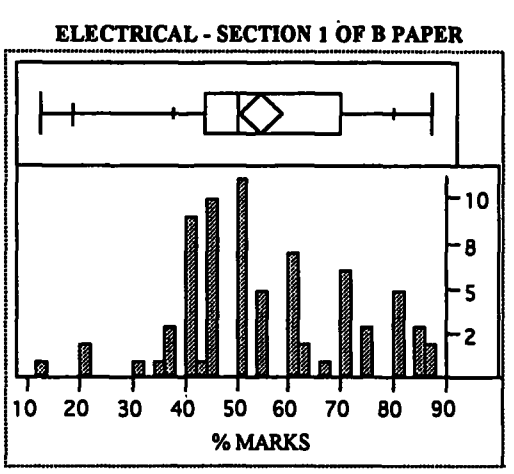
and in each year, the performance had been quite similar. The average value lies close to 50% but most of the time it does not exceed 50%(Figure 8). The exact values with respect to each section in each year are shown in the Table 3.

Table 3: Performance of Candidates in the Sub Sections of the Professional Review B Paper during 1995 and 1996

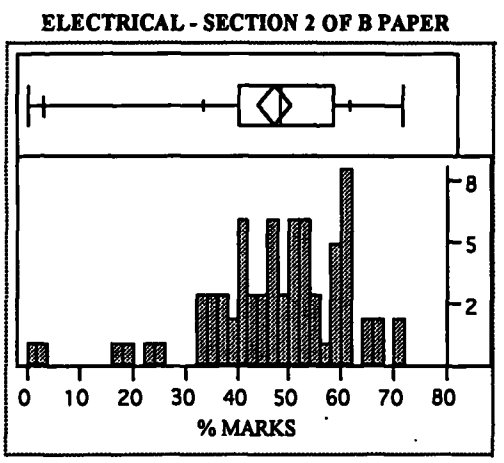
Year	Mean(& Section 1)	Mean(% Section 2)
1995	47.13%	45.71%
1996	45.78%	46.90%
Tatal 95 & 96	46.46%	46.31%

3.6 Professional Review B Paper Sub Sections-Distribution of Performance

Statistics pertaining to the distribution of performance by the number of candidates at each subsection of the B paper in years 1995 and 1996 were computed and are shown in Figures 9 and 10. These two figures correspond to the Civil and Electrical engineering disciplines, The Mechanical engineering distribution is not shown since the number of applicants were only in total which is considered as very small. Distribution of performance of the all the candidates who appeared for the first time was computed and shown in the Figure 11.



Quantiles		
maximum	100.0%	87.50
	99.5%	87.50
	97.5%	87.50
	90.0%	80.00
quartile	75.0%	70.00
median	50.0%	50.00
quartile	25.0%	43.75
	10.0%	37.50
	2.5%	18.87
	0.5%	12.50
minimum	0.0%	12.50
Moments		
Mean	54.72	
Std Dev	16.90	
Std Err Mean	1.97	
N	73.00	



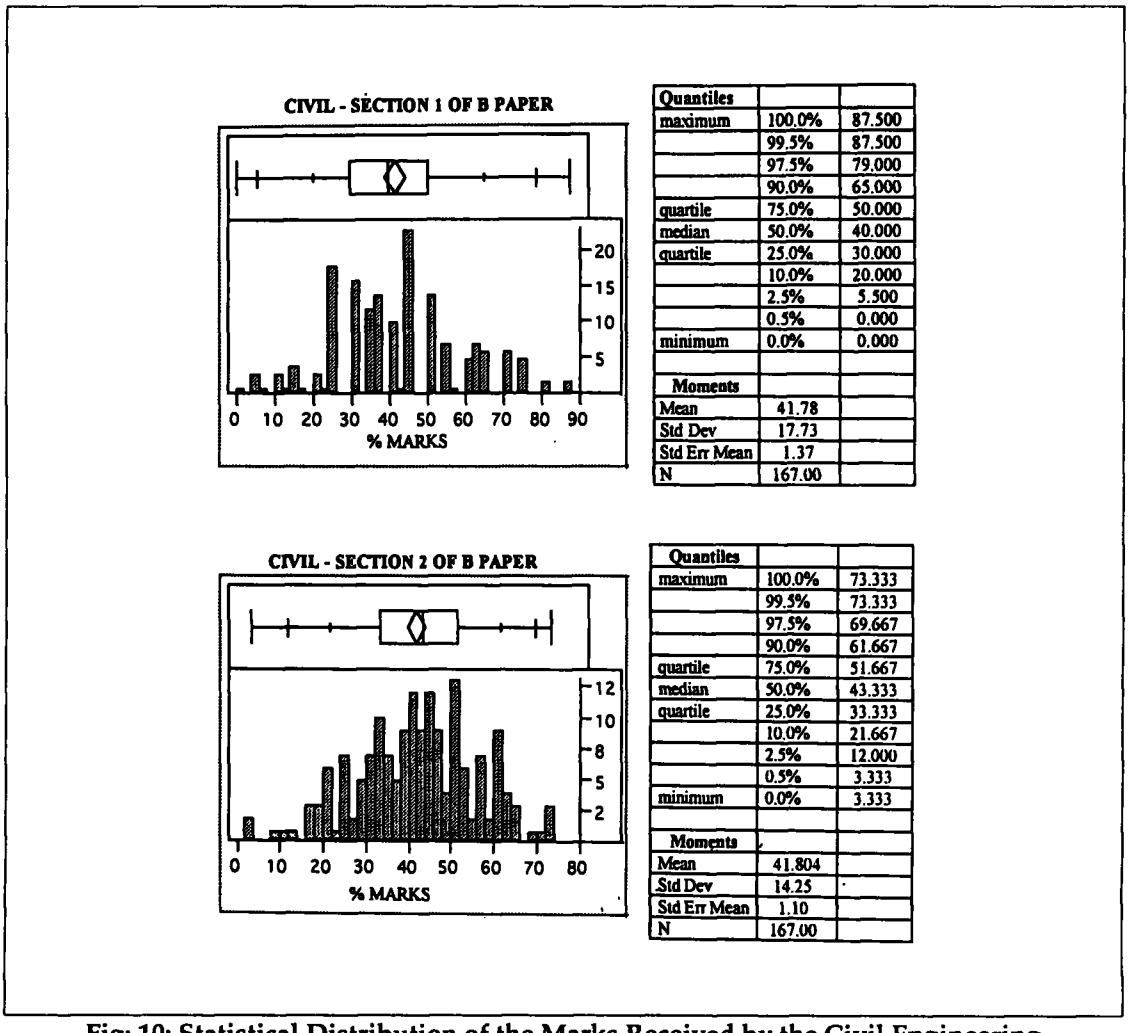
Quantiles		
maximum	100.0%	71.667
	99.5%	71.667
	97.5%	71.667
	90.0%	61.667
quartile	75.0%	58.333
median	50.0%	48.333
quartile	25.0%	40.000
	10.0%	33.333
	2.5%	2.833
	0.5%	0.000
minimum	0.0%	0.000
Moments		
Mean	47.19	
Std Dev	13.97	
Std Err Mean	1.63	
N	73.00	

Fig: 9: Statistical Distribution of the Marks Received by the Electrical Engineering Candidates at Each Sub Section of the Professional Review B-Paper

The distribution statistics show that the candidate performance in the subsection 1 is centered below the 50% level while the sub-section 2 marks are centered more close to the 50% marks. This is an indication that the candidates have fared a little better in the sub-section 2 when compared to the sub-section 1 of the B-paper. The distribution of candidate performance when the entire results of 1995 and 1996 were aggregated also show the same effect.

4.0 Summary of Results

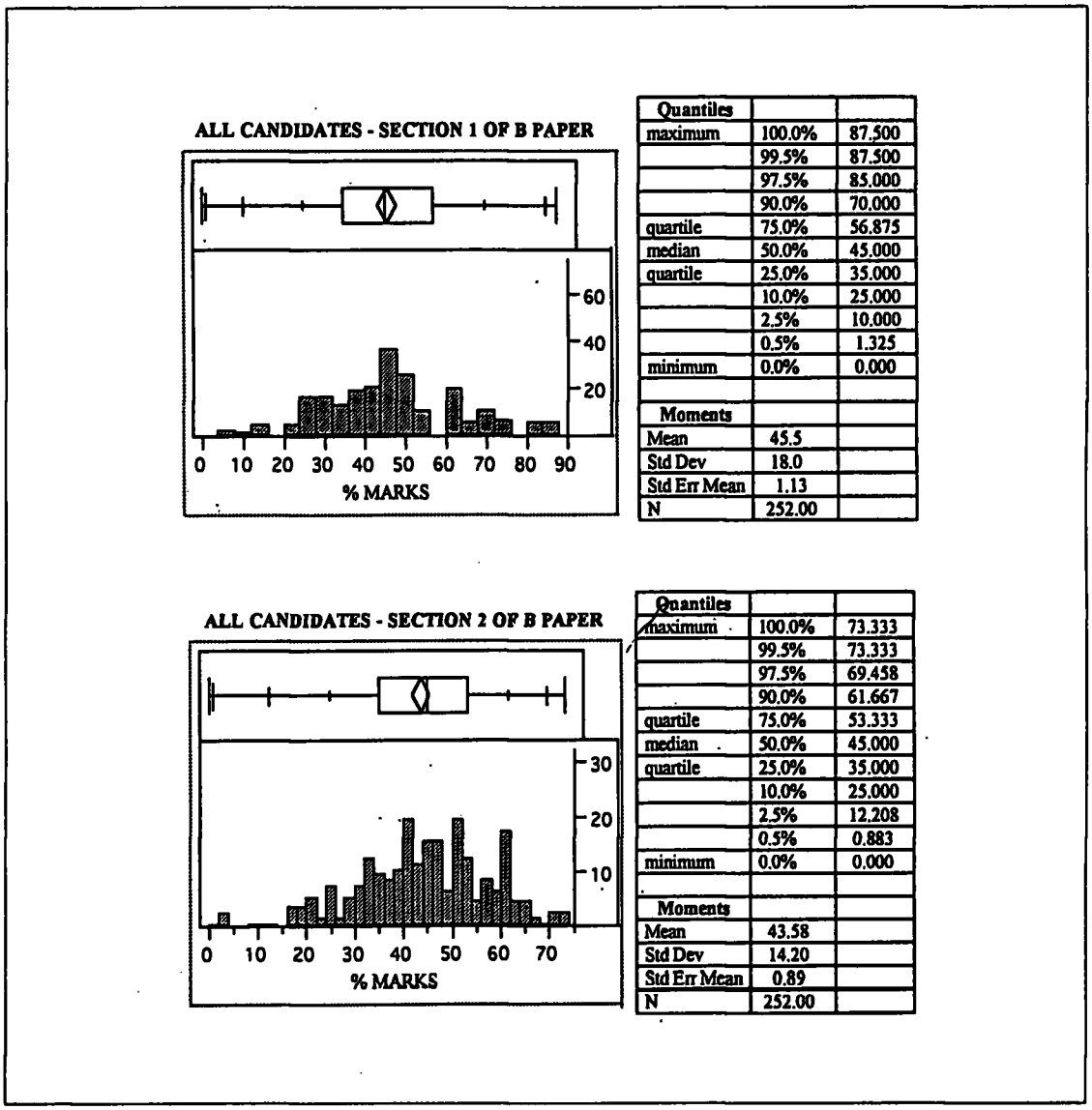
- Passing rate at the Viva and A-paper are above 65%, whereas in the B-Paper this rate is only about 46% which is below 50%.
- Only 30% of the professional review candidates appearing for the first time are successful in passing the entire professional review examination.
- A 28% of the professional review candidates who appear for the first time, do not pass the entire examination due to the poor performance in the B-Paper.
- The aggregated results show that the high rate of failures in the B-Paper is due to the high rate of failures in the B-Paper from the Civil Engineering candidates.
- The aggregated results pertaining to the entire period under study shows that the total number passing the examination in the first attempt and the total number failing the examination due to poor results in the B-paper are nearly equal.
- The average performance of candidates at the B-Paper falls below 50% level. The distribution statistics indicate that the candidates have fared better in the sub-section 2 when compared with the sub-section 1.
- The statistical distribution of the marks obtained by the number of candidates show that the performance of civil engineering candidate at the sub-sections of the B-Paper fall below the 50% level.



Quantiles		
maximum	100.0%	87.500
	99.5%	87.500
	97.5%	79.000
	90.0%	65.000
quartile	75.0%	50.000
median	50.0%	40.000
quartile	25.0%	30.000
	10.0%	20.000
	2.5%	5.500
	0.5%	0.000
minimum	0.0%	0.000
Moments		
Mean	41.78	
Std Dev	17.73	
Std Err Mean	1.37	
N	167.00	

Quantiles		
maximum	100.0%	73.333
	99.5%	73.333
	97.5%	69.667
	90.0%	61.667
quartile	75.0%	51.667
median	50.0%	43.333
quartile	25.0%	33.333
	10.0%	21.667
	2.5%	12.000
	0.5%	3.333
minimum	0.0%	3.333
Moments		
Mean	41.804	
Std Dev	14.25	
Std Err Mean	1.10	
N	167.00	

Fig: 10: Statistical Distribution of the Marks Received by the Civil Engineering Candidates at Each Sub Section of the Professional Review B-Paper



Quantiles		
maximum	100.0%	87.500
	99.5%	87.500
	97.5%	85.000
	90.0%	70.000
quartile	75.0%	56.875
median	50.0%	45.000
quartile	25.0%	35.000
	10.0%	25.000
	2.5%	10.000
	0.5%	1.325
minimum	0.0%	0.000
Moments		
Mean	45.5	
Std Dev	18.0	
Std Err Mean	1.13	
N	252.00	

Quantiles		
maximum	100.0%	73.333
	99.5%	73.333
	97.5%	69.458
	90.0%	61.667
quartile	75.0%	53.333
median	50.0%	45.000
quartile	25.0%	35.000
	10.0%	25.000
	2.5%	12.208
	0.5%	0.883
minimum	0.0%	0.000
Moments		
Mean	43.58	
Std Dev	14.20	
Std Err Mean	0.89	
N	252.00	

Fig: 11: Statistical Distribution of the Marks Received by All the Candidates at Each Sub Section of the Professional Review B-Paper

5.0 Conclusions

- The candidates have fared poorly in the B-paper of the professional review and this is clearly reflected in the success rates. This could be either due to a poor question paper or due to the poor standards of the candidates. The success rate of 46% in the B-paper which is rather low when compared with the other two sections of the examination suggests a through evaluation of both.
- The poor candidate performance in the B-Paper is clearly visible in the civil engineering discipline and hence a greater attention should be directed towards them in an attempt to improve the performance.
- The performance of the candidates at the sub-sections also lead to the conclusion supporting the need of a through evaluation of the design of the question paper and also the standards of the candidates and civil engineering candidates in particular.

6.0 Acknowledgments

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