An evaluation of hearing damage risk to attenders at discotheques : project report / Noise Advisory Council, Department of the Environment.

AN EVALUATION OF HEARING DAMAGE RISK TO ATTENDERS AT DISCOTHEQUES

NOISE ADVISORY COUNCIL
DEPARTMENT OF THE ENVIRONMENT
PROJECT REPORT

LEEDS POLYTECHNIC
SCHOOL OF CONSTRUCTIONAL STUDIES

MAY 1979

NAC(80)2

Please file in noise file.

NOISE ADVISORY COUNCIL

DISCOTHEQUE NOISE

1. Further to NAC(79)16 Members will wish to note that at their recent meeting the Working Group on Noise as a Hazard to Health gave further consideration to the recommendations in the research report on discotheque noise and have agreed that the report should be published and that its findings should be given due publicity. They have also agreed that Mr Bickerdike should be commissioned to undertake consultations with interested bodies for the preparation of a draft Code of Practice for the operation of discotheques, for consideration by the Council.

2. These actions are in hand and a copy of the report, published by Leeds Polytechnic is enclosed. A press announcement will shortly be made, which will also be copied to interested bodies to advise them of the report's findings and of the impending consultation on the draft Code. Members will receive a copy of the press announcement in the usual way.

J G THOMPSON
Secretary

March 1980

cc Assessors (without enclosure).

An Evaluation of Hearing Damage Risk to Attenders at Discotheques

by

J Bickerdike

and

A Gregory

Summary:
The report presents and discusses the results of a sound level survey in 49 discotheques and interviews with 4166 discotheque attenders and others. Existing Damage Risk Criteria (DRC) based on the Burns and Robinson NPL/MRC data was used to assess the risk of hearing damage. The sound level and attendance data show that, overall, the 50%, 10% and 5% NIL values for the survey are 85dB, 96dB and 97dB respectively but higher values are possible with correspondingly lower levels of probability. The results indicate that the risk of attenders achieving a 30dB ave. threshold shift at 1,2 & 3 kHz at the end of their attendance period is small and amounts to some 0.025% of an estimated 6 million regular attenders. These results apply to risk at discotheques only but in addition some 10 - 12% of attenders may have an added risk by noise exposure at work whilst 10% also attend pop concerts which is also likely to add to their risk. Comments are made on various classes of premises and possible variations in attendance patterns and future trends discussed. The report recommends the introduction of a Code of Practice and a schools educational programme.

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Department of the Environment Contract No. DGR 481/99

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Objective:- To Evaluate the Risk of Noise Induced Hearing Damage to Attenders at Discotheques; by

(a) Measurement of the sound levels experienced in discotheques, and

(b) An evaluation of the attendance patterns of patrons, and

(c) The use of established Damage Risk Criteria.

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1. Introduction

From time immemorial dancing to some kind of music has been an integral part of man's social behaviour, whether it be as unsophisticated as tribal percussion or as sophisticated as modern electronic technology can achieve.

The modern discotheque can be seen to have its more immediate origin from the dance hall era of the 1930s and 1940s which offered on stage dance band entertainment with little or no amplification. Subsequently the requirement for "live" entertainment has become less important with the advent of cheap and reasonable quality records and tapes. The present day disc jockey has taken the place of the latter day impressario.

Discotheques as such are a phenomenon of about the last 15 - 20 years. Many of them made the transition from dance hall to discotheque quite naturally as fashions changed, but some were purpose built to cater specifically for discotheque music only, with no provision for "live" performances. Today we are witness to a revival of interest in "disco" attednance, this being borne out by the rise of a star such as John Travolta and the prevalence in the record market of "disco sound" recordings. The current trend has firm support from many commercial interests such as record and tape recording companies, sound system manufacturers for both commercial and private use, radio, television, the entertainment companies who specialise in discotheques and of course the musicians and their sponsors.

The disco has developed from the one room affair to a very complex all round entertainment centre. In most discos today there are restaurant facilities, split level dance floor, bar areas, observation areas, revolving or adaptable stages so that both "live" and disco music tastes can be catered for and there are often smaller ancilliary discos within the premises for specialist tastes. Great care is taken over lighting, layout and decor and sums of £250,000 are not unusual for the establishment of a new disco. It has been estimated from a recent commercial survey (Osbourne Shircore 1977) that at least 80% of the population above the age of 15 years have attended a disco at some time in their life.

Another development has been that the number of musicians within performing bands has greatly decreased from about 20 to 3 to 6 and amplification systems have compensated for the lack of sound intensity produced. The type of music itself has radically altered and has brought with it a totally new style of dancing.

The greater sophistication of the type of equipment that both "live" performers and disco jockeys use seems to have gone hand in hand with an increase in the noise level that they have achieved and levels of up to 122 dB(A) have been reported. The demand for high sound levels appears to come from the public as well as from the musicians or DJs and seems to give physical and aural stimulation much along the lines of the tribal rhythms mentioned earlier. It is not the purpose of this study to investigate the psychological reasons why people attend discos, although

this could be an area of useful research in the future.

The high sound levels measured in discos and pop concerts have led to a number of investigations relating to the danger of hearing loss risk that regular attendance could incur. Opinion is very much divided as to whether or not attenders are at risk and this report attempts to cover two areas in which, according to Whittle and Robinson (1974) there is little information, namely

a) The actual sound levels which are experienced in discos and

b) The attendance patterns of patrons.

Literature Review

Hearing Loss and the Equal Energy Concept

There is a well established correlation between loud noise and permanent damage to hearing although the precise relationship is subject to some debtate. In the United Kingdom and Europe the 'Equal Energy Principle' is considered to form the basis of this relationship. That is to say; equal amounts of 'A' weighted sound energy will cause equal amounts of damage and that exposure time and sound level can be 'traded off' equally on a logrithmic basis. The validity of this concept was demonstrated by Burns and Robinson (1970) from a study of 759 screened subjects exposed to continuous steady state noise and an expression was derived relating the 'presumed noise induced hearing loss' (H) to the 'A' weighted 'noise immission level' (E_A) or NIL. This work also introduced the concept of 'noise dose' by deriving the 'Equivalent Continuous Noise Level' (ECNL); subsequently referred to as 'L_{eq}' which integrates the sound energy over the duration of exposure. These relationships are now well known and for the sake of brevity are not repeated here. The work of Atherley & Martin (1971) subsequently extended the equal energy principle to include impact nose.

A criticism of the Burns and Robinson study is that the noise induced hearing levels obtained are for an otologically normal population and therefore exclude hearing loss from causes other than noise. Clearly, in the context of their study this is commendable but when their relationship is used to predicting hearing levels in the population at large for any given NIl the estimates turn out to be rather conservative. ISO 1999, although subject to recent criticism and currently under revision, uses a less rigid otological criterion for selecting the population on which the recommendation is based and implies higher predicted hearing levels for the same NIL.

All these well established data have been obtained from studies of workers in industry and clearly the concern of early researchers was for those industries in which loss of hearing amongst workers was common. However, from the mid sixties attention was turned towards the high sound levels being experienced in the entertainment industry where the new fashion in the dance hall era was the discotheque. In these premises sound amplification systems were being used by live groups of 3 to 6 musicians or to reproduce recorded music. This concern culminated in the Leeds City Council (1973) introducing a licencing restriction to limit the peak sound levels in discotheques to 96dB(A). The subsequent storm of protest by the industry and attenders alike led to its withdrawal in 1974. The debate continued and the Department of the Environment asked the Acoustics Group of the National Physical Laboratory to review the subject with a view to drawing conclusions from existing data. This study was completed in March 1974 by Whittle & Robinson. We propose to summarise their findings as the basis of our review and to extend their data by the introduction of studies completed post 1973.

Whittle and Robinson reviewed some 38 papers directly relating to the subject together with some 11 other associated papers or reports dating from 1967 to 1973 and divided into two main groups.

(1) Studies on the sound levels experienced in discotheques from which, using established Damage Risk Criteria, predictions were made of hearing levels of attenders.

(2) Studies on the hearing levels of young people who were either recognised attenders or musicians or other groups in which the measured loss was associated with discotheques or pop concert attendance.

The remaining group consisted of laboratory studies of Temporary Threshold Shift (TTS) on volunteer population or animal studies of TTS or Permanent Threshold Shift (PTS) including histological examination.

The purpose of their report was defined as 'to review the various studies..... to collate the available information..... and to produce a best estimate of the probability and extent of damage to hearing using the latest (1973) methods of assessment (ISO 1971: Robinson and Shipton 1973)'

2.1 Sound Levels, Attendance Patterns and Predicted Hearing Loss

The parameters of the noise exposure contributing to noise induced hearing loss were examined and the results reported in group (1) above, summarised. Eleven sets of data involving live groups and two sets of data involving recorded music gave the results shown in Table 2.1

	Frequency Hz (SPL)									
	63	125	250	500	1K	2K	4K	8K	Lin	dB(A)
Live - Mean	97	103	103	101	98	95	89	80	109	104
- S.D.	5.2	5.7	6.9	5.9	6.0	7.3	9.3	8.0	6.0	6.2
Rec. - Mean	74	84	88	89	84	75	64	56	93	91
- S.D.	-	-	-	-	-	-	-	-	-	-

Table 2.1 Sound Levels from Live and Recorded Music from 13 investigations summaries by Whittle and Robinson (1973)

The general variability of the sound was considered and it was observed that the sound level varied some 5dB(A), RMS, 'Slow', 'when the music plays' (Fearn 1972) although it was thought likely that variations between items of music would exceed that value. Whittle and Robinson also expressed the view that intense impulses were hardly likely to occur due to the small margin between the mean level and the peak handling capacity of the equipment. This view is supported by Brüel (1976) who reported that 'Beat Music' and 'Modern Music' from a gramophone showed the least differences, 7 and 3dBs respectively,

between RMS "Fast" (125ms) and "Peak Hold" (30ms) from 37 sources analysed in a study to examine the relationship between short duration peaks and hearing damage.

Estimates of the Noise Exposure Time and the Intermittency and Variability were made and 5 combinations (cases) of sound level and duration of exposure were produced for 'Audience' and 'Musicians'; these are shown in Table 2.2

	Duration Assumed (hrs)	'Reported' Noise Level dB(A)	Estimated L_{eq}	Type of Programme	Case
Audience	4	104 (typical)	101	Live pop	1
"	4	110 (worst case)	107	" "	2
"	4	91 (typical)	88	Records	3
Musicians	10	111 (typical)	108	Live pop	4
"	10	117 (worst case)	114	" "	5

Table 2.2 5 cases of assumed exposure and L_{eq} (Whittle and Robinson 1973)

The Estimated L_{eq} was the 'Reported' noise level reduced by 3dB(A) for the intermittency and variability of the music and the 'worst case' was obtained by adding one standard deviation to the 'reported noise level'. Noise Immission Levels (NIL) were calculated, for all except case 3 which was omitted on the grounds of small predicted shifts, assuming 0.5, 1, 2, 4 and 8 years exposure. No indication was given on what basis these years of exposure had been derived but it is assumed that it was intended to show the rate of change of hearing level rather than any real estimate of the lifetime exposure. Predicted hearing levels at 0.5, 1, 2, 3, 4 and 6kHz were calculated from the Robinson and Shipton (1973) tables and, additionally, the 0.5, 1 and 2 kHz, and the 1, 2 & 3 kHz averages obtained. Comparisons were made with the AA00 (1964) and the equivalent 'low fence' values of 25dB and 34dB respectively.

It was concluded that 'In the group exposed to 104dB(A) typical for dancers the low fence is not reached even after 8 years of exposure, in 95% of the population. Increasing the level by one standard deviation (Worst case - case 2) gives the same values of impairment after two years of exposure and the 25dB or 34dB levels are exceeded (not quite) at 8 years. Some 5% of musicians, for whom the exposure of 111 dBA for 10 hours per week is taken (Case 4), will reach or exceed the low fence after only two years. Many more exceedences appear when the higher estimate of sound level (Case 5) is taken'.

The above predictions by the Robinson and Shipton tables are, as Whittle and Robinson point out, rather conservative as they are based on the

Burns and Robinson data and comparisons with ISO 1999 subsequently showed that for Case 1, exposure for 5 years would lead to expect 8% of noise exposed individuals to reach the low fence.

A further point recognised by Whittle and Robinson was that the overall probability of experiencing any given NIL and, hence, any stated percentile hearing level was much less than the $p < 0.05$, $p < 0.1$ and $p < 0.5$ (5%, 10% and 50%) values stated. This point is most important in estimating the total numbers of the population at risk.

Since the studies reported here, the more recently published literature reveals little by way of new evidence on sound levels or attendance patterns on which more reliable estimates of risk could be based. However, Rintelmann and Johnson (1975) reported the results of 220 measurements on 10 rock groups which showed levels ranging from 84dB(A) 111dB(A) with a mean of 104dB(A) at points 5-20 feet from the source. Their conclusions were that 'this data was in good agreement with their previous data (Rintelmann and Borus 1968) and demonstrates that rock music in the mid 1970s is being played at about the same sound pressure level as it was in the 1960s, an average of 100dB(A)....' Evidence from local authorities (GLC 1978), (Calderdale 1979) whose duty it is to enforce legislation controlling noise emissions from discotheques have reported levels ranging from 94dB(A) L_{eq} to 102dB(A) L_{eq} inside the building. However, there is no evidence to date of any large scale systematic series of measurement being undertaken either in this country or abroad.

2.2 Hearing Studies

Whittle and Robinson reported a number of studies concerned with retrospective or serial audiometry programmes on either attenders or musicians. Although the general difficulties of this approach were recognised, i.e. stringent audiometric techniques required, low statistical reliability because of small population and difficulty in obtaining well defined noise exposure case histories, it was also recognised that such studies can give a valuable indication of the trend in hearing levels.

For attenders the work of Fearn (1973a, 1973b) is most important in the U.K. The study reported was for groups of 102 attenders and 53 non-attenders with small but persistent differences in threshold levels ranging from 1.4 dB to 3.3 dB over the 1, 2, 3, 4 and 6 kHz frequencies. The maximum differences were reported at 2 and 3 kHz and were statistically significant at these frequencies. At 2kHz statistically significant differences were also obtained between the once-a-month attender and the once-a-week attender for subjects with a mean attendance duration of 2 years.

In screening tests Lipscomb (1969a, 1969b, 1970) demonstrated the incidence of 'high frequency hearing impairment' (HFI) in some 3000 school children and 3500 university freshmen. Percentages of the populations reaching an ISO hearing level of 15dB were reported as ranging from 3.8% to 12.6% for 12 year olds to 15 year olds

respectively and for the university freshmen 4.7% up to 58.2% over the frequency range 2, 3, 4 and 6 kHz with measurable deterioration between succeeding years of university intake. Flottorp (1973a & b) reports similar high frequency shifts in 20% of subjects examined over the period 1962 to 1971 and links this with pop music. In each of these studies the exposure to pop music is not well defined and little is known about other noise exposure but the suggestion is that these changes in hearing level are associated with the increasing occurrence of live and recorded pop music as a form of entertainment for young people.

For evidence of loss in musicians some 7 studies are reviewed. In three of these studies involving substantial numbers of subjects, Rintelmann and Borous (1968) gave little indication of permanent loss (about 5%). The others, Speaks et.al. (1970) and Redell and Lebo (1972) report in the region of 25% although the criteria on which these losses are based are not objectively defined.

Studies of Temporary Threshold Shift (TTS) are also reported. However, as our concern is with permanent damage we omit this data but for completeness we include the references at the end of this review. Similarly studies for TTS on musicians and laboratory experiments for TTS on volunteers and PTS and TTS on animals are not presented but we again include a list of references.

Since the Whittle and Robinson Review on hearing studies Rintelmann and Johnson (1975) have completed a follow up study of the 42 pop musicians studied by Rintelman and Borus (1968). In 1971 and 1974, 10 and 6 musicians respectively were still actively playing in rock groups. The mean threshold of these groups did not differ by more than 10dB over the period between the first and last test but some individual variation was observed and one 26 year old male experienced a 35dB shift at 3000 Hz. The number of subjects is small but lead to the conclusion that 'some individuals who are seemingly susceptible to noise induced hearing loss when exposed to levels of music commonly encountered today'.

Fearn and Hanson (1975) have also reported the audiometric finding of 29 controls and 50 attenders carefully selected from a population of 505 subjects. Results were reported over the range of audiometric frequencies 0.5, 1, 2, 3, 4, 6, 8 kHz and showed that for an average exposure of about 2 years the levels for both groups were within 5dB of the normal reference threshold. However, at each frequency the index group exhibited higher hearing levels than the control group. These differences are reported as statistically significant at 0.5, 1 & 4 kHz ($p < 0.01$) and highly significant at 3 kHz ($p < 0.001$). Higher hearing losses are also given at the 10% level with differences ranging from 0.5dB to 6.0dB. Beyond defining attenders as 'attending more than four times per year' and indicating an average exposure of 2 years, no details of the noise exposure are given. Subsequently this data base was expanded (Fearn 1976a) to include 124 attenders and 57 non-attenders. These results support the earlier findings with average differences ranging from 2.5dB (1kHz) to 4.0dB (6kHz) over the previously reported

frequency range. At each frequency the results were statistically significant at $p < 0.001$. At the 10% level the differences are between 0.3dB to 1.8dB higher than the average values. In a later report (Fearn 1976b) comparisons of hearing levels were made between four modes of attendance ranging from 1 per month to 2 per week shown in Table 2.3

	Frequency of Attendance			
	1/month	1/fortnight	1/week	2/week
Ave. length of attendance, years	3.5	2.9	2.8	4.2
Ave. number of attendances	42	75	146	432
Number of subjects	36	21	25	16
Ave. threshold (dB)	4	2.5	4	4
Hearing level exceed by 10% of group	9	8	9.5	11.5

Table 2.3 Hearing Levels averaged over frequency range ½ to 8kHz at different rates of attendance (Fearn 1976b)

Fearn reports that the levels show little difference for the different rates of attendance but goes on to examine the 16, 2/week attenders in detail against the whole group of 124 attenders. The observed differences are small and not systematic either on average or at the 10% level. This is interpreted as either; a tendency for the variations in noise level, attendance rate and length of attendance and different individual sensitivity, to camouflage the results or, that all attenders can be treated as one group with a different distribution of hearing loss (at least in the age groups reported).

Fearn's serial programme continues and in his latest report (Fearn 1978) the learning effect on audiometry is examined. It is reported that the learning effect between consecutive tests is more persistent than hitherto supposed and tends to camouflage any hearing loss experienced but the noise exposed group, on average, exhibit a smaller learning effect than the non-noise exposed group. This is interpreted as noise induced hearing deterioration counter influencing the learning effect.

In concluding their review Whittle and Robinson assert that:-

> 'there is as yet no convincing evidence that pop music need be treated in any other way than industrial noise of the kind upon which recent damage risk criteria have evolved'.

And go on to identify two areas of further study which would allow the uncertainty in the predictions of hearing loss to be considerably narrowed. They are:-

(a) a knowledge of the behaviour pattern of attenders at youth groups, commercial discotheques and places of public entertainment offering pop music,

and:-

(b) a systematic and suitably documented study on the actual acoustic exposure in terms of the 'A' weighted L_{eq}.

Whilst not excluding the value of audiometry they consider that the operational difficulties involved would preclude the possibilities of a decisive result.

2.3 REFERENCES

Abrol, B.M., Nath., L.M. and Sahai, A.N. 1970. Nose and acoustic trauma:

Noise levels in discotheques in Delhi
Ind. J. med. Res. 58, 1758-1763

American Academy of Ophthalmology and Otolaryngology 19464.
Guide for conservation of hearing in noise.

Atherley, G.R.C. and Martin, A.M. 1971 Equivalent Continuous Noise Level as a Measure of Injury from Impact and Impulse Noise. Ann. Occup. Hyg. 14; 11 - 2B

Barry, J.P. and Thomas, I.B. 1972. A clinical study to evaluate rock music, symphonic music and noise as sources of acoustic trauma. J. audio eng. Soc. 20, 271 - 274

Brüel, P.V., (1976). Do We Measure Damaging Noise Correctly, B & K Technical Review No.1 1976 p 3 - 32.

Burns, W. and Robinson, D.W. 1970. Hearing and Noise in Industry (London: HMSO).

Burns, W., Stead, J.C. and Penney, H.W. 1970. The relations between temporary threshold shift and occupational hearing loss. Appendix 13 in Burns and Robinson 1970.

Calderdale M.B.C. 1979 Environmental Health Department, Letter to Noise Advisory Council.

Central Statistical Office 1977 Annual Abstract of Statistics, HMSO

Cohen, A., Anticaglia, J. and Jones, H.H. 1970. 'Sociocusis' - Hearing loss from non-occupational noise exposure. Sound and Vibration, Nov. 1970. 12 - 24

Department of Employment, 1972. Code of practice for restricting the exposure of employed persons to noise (London: HMSO)

Department of Health and Social Security. 1973. Occupational Deafness. Cmnd 5461 (London: HMSO)

Dey, F.L. 1970. Auditory fatigue and predicted permanent hearing defects from rock-and-roll music. New England J.Med. 282, 467-470

Eldredge, D.H. 1973. Anatomical and physiological correlates of threshold shifts in the chinchilla after exposure to noise. In "Disorders of Auditory Function", ed. W.Taylor (London and New York, Academic Press).

Ewertsen, H.W. 1971. Beat musik og. høreskader. Nordisk Audiologi 20, 154 - 158.

Fearn, R.W. 1971. Risk of hearing damage from record players in clubs. Leeds Polytechnic Rpt. No. AS71/5

Fearn R.W. 1972a. Hearing damage risk in youth clubs. Leeds Polytechnic Report No. AS72/7.

Fearn R.W. 1972b. Noise levels in youth clubs. J.Sound Vib. 22, 127 - 131.

Fearn R.W. 1973a. Pop music and hearing damage. J.Sound Vib. 29, 396 - 397.

Fearn R.W. 1973b. Pop music and hearing damage. Leeds Polytechnic Report No. AS73/11.

Fearn R.W. and Hanson D.W. 1975. Hearing Acuity in Young People Exposed to Pop Music and Other Noise, Lancet, 2:1975 203-205

Fearn R.W. 1976a Hearing Loss Caused by Amplified Pop Music. J. Sound Vib., 46, 462 - 464

Fearn R.W. 1976b Hearing Loss Caused by Different Exposures to Amplified Pop Music, J. Sound Vib., 47, 454 - 456

Fearn R.W. 1978 Serial Audiometry in Young People Exposed to Loud Amplified Pop-Music. Leeds Polytechnic, Dept. of Architecture and Landscape; Report RWF/10.2.78/C/PD. Unpublished.

Flottorp, G. 1973a. Music - a noise hazard? Acta Otolaryng. 75, 345 - 347.

Flottorp, G. 1973b. Effects of noise upon the upper frequency limit of hearing. Acta Otolaryng. 75, 329 - 331.

Flugrath, J.M. 1968. Modern day rock-and-roll music and damage-risk criteria. J. acoust. Soc. Amer. 45, 704-711.

Flugrath, J.M. Irwin, J.A., Wolfe, B.N. and Krone, B. 1971. Temporary threshold shift and rock-and-roll music. J. aud. Res. 11, 291 - 293.

Fluur, E. 1967. Popmusiken som bullertrauma. Lakartidningen 64, 794 - 796.

Greater London Council. 1978. Scientific Branch of Director-General's Department - Private Correspondence.

Hickling, S. 1970. Noise-induced hearing loss and pop music. N.Z. med. J. 71, 94 - 96

International Organization for Standardization 1975. ISO 1999. Assessment of Occupational Noise Exposure for Hearing Conservation Purposes.

Jatho, K. and Hellmann, H. 1972. Zur Frage des "Larm und Klangtraumas des Orchestermusikers. HNO-Wegweiser 20, 21-29.

Jerger, J. and Jerger, S. 1970. Temporary threshold shift in rock-and-roll musicians. J. Speech Hear. Res. 13, 218-224.

Kowalczuk, H. 1967. Muzyka Big-Beatowa a urazy akustyczne. Otolaryngologia Polska, 21, 161-167.

Kryter, K.D., Ward, W.D., Miller, J.D. and Eldredge, D.H. 1966. Hazardous exposure to intermittent and steady state noise. J. acoust. Soc. Amer. 39, 451-464.

Lebo, C.P., Oliphant, K.S. and Garrett, J. 1967. Acoustic trauma from rock-and-roll music. 96th Annual Session of the California Medical Association, Los Angeles. Calif. Med. 107, 378-380.

Lebo, C.P. and Oliphant, K.S. 1969. Music as a source of acoustic trauma. J. audio eng. Soc. 17, 535-538.

Leeds City Council. 1973. Minutes of Licencing & Fire Brigade Committee; June.

Lipscomb, D.M. 1969a. Ear damage from exposure to rock-and-roll music. Arch. Otolaryng. 90, 29-39.

Lipscomb, D.M. 1969b. High intensity sounds in the recreational environment. Hazard to young ears. Clinical Pediatrics 8,63-68.

Lipscomb, D.M. 1970. Non-occupational noise: a growing problem. Nat. Hearing Aid J. 23, 30-32.

McKenzie, A. 1972. Recording sound techniques. Studio Sound, July, 35-36.

Miller, J.D., Rothenberg, S.J. and Eldredge, D.H. 1971. Preliminary observations on the effects of exposure to noise for 7 days on the hearing and inner ear of the chinchilla. J. acoust. Soc. Amer. 50, 1129-1203.

Office of Population Censuses and Surveys. 1976. Population Projections. 1974-2014.

Osbourne Shircore (Technical & Management Services) and Norman Miles Associates: Market Research Data. 1977.

Redell, R. and Lebo, C.P. 1972. Ototraumatic effects of Hard Rock Music. Calif. Med. 116, 1-4.

Rice, C.G. 1969. A pilot study on the effects of pop group music on hearing. Sound 3, 68-71.

Rintelmann, W.F. and Borus, J.F. 1968. Noise-induced hearing loss and rock-and-roll music. Arch. Otolaryng. 88, 57-65.

Rintelmann, W.F. and Johnson, W.M. 1975. Rock and Roll Music and the Effects on Human Hearing, Mitchigan State University, Unpublished Study.

Rintelmann, W.F. 1970. A review of research concerning rock-and-roll music and noise-induced hearing loss. Maico Audiol. Library, Ser. 8, Rpt No. 7, 24 - 27.

Rintelmann, W.F., Lindberg, R.F. and Smitley, E.K. 1971. Temporary threshold shift and recovery patterns from two types of rock-and-roll music presentation. J. acoust. Soc. Amer. 51, 1249-1255.

Robinson, D.W. and Shipton, M.S. 1973. Tables for the estimation of noise-induced hearing loss. (NPL Acoustic Report Ac 61).

Rupp, R.R. and Koch, L.J. 1969. Effects of too-loud music on human ears. Clinical Pediatrics 8, 60 - 62.

Smitley E K and Rintelmann W F 1971. Continuous versus intermittent exposure to rock-and-roll music. Effect upon temporary threshold shift. Arch. environ. Health 22, 413-420.

Speaks, C., Nelson, D. and Ward, W.D. 1970. Hearing loss in rock-and-roll musicians. J. occup. Med. 12, 216-219.

Spoendlin, H. and Brun, J.P. 1973. Relation of structural damage to exposure time and intensity in acoustic trauma. Acta Otolaryng. 75, 220 - 226.

Ward, W.D. 1969. Effect of noise on hearing thresholds. Proc. Conf. on Noise as a Public Health Hazard. ASHA Report No. 4, p.41.

Ward, W.D. and Nelson, D.A. 1968. TTS and PTS in chinchillas. J. acoust. Soc. Amer. 44, 352.

Ward, W.D., London, B. and Duvall, A.J. 1972. TTS, PTS and hair cell damage in the chinchilla. Audiology 11, Supplement, 47.

Weber, H.J., McGovern, F.F. and Zink, D. 1967. An evaluation of 1000 children with hearing loss. J. Speech Hearing Dis. 34, 3430353.

Whittle, L.S. and Robinson D.W. 1974. Discotheques and Pop Music as a Source of Noise Induced Hearing Loss - A Review and Bibliography. NPL Acoustics Report Ac. 66.

Wood, W.S. and Lipscomb, D.M. 1972. Maximum available sound pressure levels from stereo components. J. acoust. Soc. Amer. 52, 484 - 487.

3. Rationale for the Project

The equal energy principle is currently held to provide the best relationship between 'noise dose' and hearing loss. However, there is still sufficient uncertainty to cast doubt on the wide scale application of this principle to noises and exposures which fall outside the general data base from which this relationship was established. This area of uncertainty applies particularly to the possibility of noise induced threshold shift (NIPTS) associated with discotheque attendance. Although the reported physical characteristics are not sufficiently different from those of industrial noise as to warrant undue concern the characteristics of exposure to that sound are undoubtably so. Therefore, in order to establish a clear and decisive relationship between the exposure to sound levels in discotheques and any associated NIPTS it would be necessary to undertake a large scale prospective survey. The variables of interest for such a survey are well known and readily identifiable and include the characteristics of the sound, the variability of exposure and the hearing levels of exposed persons. These variables are relatively easy to quantify as well established techniques of enquiry or objective measurement are available in each case. However, in association with discotheque attendance they are compositely difficult to quantify without an inordinately complex system of controls being devised. The difficulty arises not from the nature of the techniques but from the nature of the activity and the attending population.

Discotheque attendance is clearly a leisure activity; not only is the individual free to attend or not but also free to exercise choice at which premises to attend and hence the variety of sound levels to which he or she may be exposed. Moreover, he or she may arrive and depart at will and is free to engage in a wide range of activities in the premises. Such problems, whilst difficult, are not unsurmountable but when the well recognised operational difficulties of audiometry are superimposed on a scale large enough to make the results conclusive it is easy to understand why a comprehensive, prospective survey is unrealistic.

Two alternative approaches to the problem remain, neither of which are wholly satisfactory but each will provide useful and valuable information. One approach is to measure the noise dose (NIL) of attenders by suitably measuring the sound levels to which they are exposed and determining the patterns of attendance. These results can be applied to established cause-effect relationships. This approach has few operational problems, allowing a large amount of data to be collected, thus improving the statistical reliability of the investigation. The second approach is to pursue a prospective audiometry programme during which the actual loss in hearing acuity can be determined together with information on the attendance patterns associated with that loss thus demonstrating an actual association. Both methods have major deficiencies. The former approach depends on the use of existing DRC which may not be appropriate to the sounds or exposure encountered, whereas the latter suffers from the problem of

low statistical reliability, at least at the extremes of the distribution of the results, because of the low numbers of subjects involved. Additionally the latter excludes any reliable knowledge of the sound levels associated with the measured loss.

The audiometric approach is being investigated by Fearn in his serial audiometry programme which is likely to be concluded in 1979. Our approach in the results presented here has been that of evaluating the NIL of attenders by investigating sound levels in discotheques and the attendance patterns of attenders and then applying established Damage Risk Criteria. In doing so we support the view of Whittle and Robinson reported earlier that nothing reported in earlier studies suggest that this approach would be unjustified. However we do so with caution and consider that the information on the sound levels and attendance patterns are important in their own right and would be equally valid if the existing damage models were changed. Moreover we believe that this approach will throw light on areas of the problem on which, hitherto, there has been much speculation but little by way of hard facts, in particular we refer to the number of people at risk. Additionally, we would hope that information in the attendance data would lead to a better understanding of the nature of discotheque attendance and that the sound level survey might indicate levels which are generally acceptable thereby leading to a reduction in some of the extreme levels experienced. Our choice of DRC has been to observe standard U.K. practice and to use the Burns and Robinson data as simplified by the Robinson and Shipton tables together with BS 5330: 1976 which sets the criterion based on the Burns and Robinson data, at which impairment begins.

The survey was planned in late 1976 after a small pilot study in 1974 and the subsequent introduction of more applicable measuring instruments made the project feasible. Early involvement and co-operation from the entertainment industry was essential and many discussions were held with management, ranging from the large scale national operators and local authority youth services to the small individual owner, the majority of which co-operated willingly. The main concern in discussion was not related to sound levels but with the confidentiality of information and the possible effect on attendance.

The project was approved by the Noise Advisory Council in November 1976 for a period of 2 years, subsequently extended by 3 months, commencing January 1977.

4. The Premises

The 40 premises in the survey varied considerably in size, interior fixtures and fittings and in mode of operation. They can be divided into two significantly different groups. Firstly, premises licenced for the sale of beer, wines and spirits which are all commercial premises and, secondly, unlicenced premises which consist largely of youth clubs and other youth service facilities. The distinction is an important one as it can be assumed that attendance at licenced premises will be restricted to persons above the minimum age of entry of eighteen years. Therefore noise dose and attendance are likely to be different from that experienced in unlicenced premises due to the different mode of operation. Realistically the division is somewhat blurred but our attendance data suggests that the overlap is small and our sound level survey indicates the differences are measurable.

4.1 Licenced Premises

The volume of the disco hall in the 22 licenced premises ranged from approx 330 m^3 to approx 11,700 m^3 with a mean value of around 2750 m^3. The internal surfaces were normally plastered brick or concrete which in the simplest premises with the lowest entry charge, such as Student Unions etc. were merely painted whereas in the more sophisticated and expensive premises were often decorated with wood and/or soft furnishings. The internal layout also varied considerably from a large open hall with a single dance floor surrounded by chairs and tables to 2, 3 or 4 separate dance floors often at different levels interspersed with chairs and tables. The bar facilities were normally placed around the edges of the room with seating areas separating them from the dance floor. Occasionally bars were in separate rooms entered off the dance hall. Again, the fixtures and fittings varied greatly in materials and design reflecting the general atmosphere intended, or tolerated, by the management ranging from the bare and spartan to the lush and intimate.

It would be difficult to generalise on the acoustic properties of the premises with such a wide variety of volumes and surface treatments and which are also clearly affected by the number attending the performance. However the acoustic properties of the hall do obviously influence the sound power required to produce satisfactory sound levels and hence the maximum levels which can be experienced by attenders. We have some comments to make on this point in the sound level survey.

Attempts were made to determine the sound power output of the amplifying equipment which appeared to range from about 300 W to about 5 kW. However, we can place no great significance on these figures as they were obtained by questioning musicians and disc jockeys rather than objective evaluation. Additionally, the use of various combinations of instruments, loudspeakers and different dance floors often involved use of separate amplifying equipment which varied significiantly in power output. The placing of loudspeakers,

however, could be determined with some accuracy. For live groups loud speakers and other equipment were invariably placed on the stage with the musicians with, in some instances, remote loudspeakers in other parts of the room. In the larger premises a distance of up to a few metres, either vertically or horizontally, separated the loudspeaker from the public. However in some premises the loudspeakers were on, or immediately adjacent to, the dance floor. For disc music similar arrangements were used in the less expensive and unsophisticated premises, other premises tended to use multiple loudspeaker systems normally dispersed over the dance floor occasionally employing speakers with directional characteristics to focus the sound onto the floor. The sound quality was normally good.

As may be expected in commercial premises entry into and exit from the building were strictly controlled normally through some entrance foyer which allowed accurate counts to be made of numbers attending and time of arrival. Opening hours range from 20.00 hours to 02.00 hours but typically 21.00 hours to 02.00 hours. Music was usually played non stop during these hours and on 5 occasions when measurements were obtained live music was played continuously, on a further 6 live and disc music played and in the remainder (20) disc only.

4.2 Unlicenced Premises

Of the 18 unlicenced premises only 1 was operated commercially and the remainder were run by local authority youth services. The volumes of the halls ranged from approx. 170 m^3 to approx 1600 m^3 with a mean of around 800m^3. The premises normally formed part of school buildings, such as assembly halls or gymnasiums, or were part of church or community buildings. The internal surfaces and fixtures and fittings were typical of quality and finish that can be expected of such premises and the halls could generally be classed as 'live' in terms of their acoustic characteristics. Few of the premises had more than a single dance floor, the area of the room, surrounded by chairs and occasionally tables. In some premises other activities, e.g. table tennis and other games, also took place in the same space. Refreshments were usually available, normally within the disco hall but occasionally in a separate room.

The sound amplifying equipment varied considerably in quality, although the power output rarely exceed a few hundred watts. Because of the multiple use of the space and the ad hoc nature of the event, loudspeakers were, in the majority of cases, placed at the edge of the stage or around the edge of the dance floor and almost always within touching distance of the attenders.

In contrast to the commercial premises entry into and exit from the premises was rarely strictly controlled, primarily because of access to other activities or services in other parts of the building. This made objective assessment of arrival and departure impracticable on

most occasions. However, as the premises normally opened at 19.30 hours and closed at 22.00 or 22.30 hours and attenders generally arrived within the first half hour and left at the end of the event this omission should not introduce any serious error into the assessment of duration of attendance. One other distinctive feature of operation of these unlicenced premises is in the numbers of attenders actually dancing. Whereas in the licenced commercial premises dancing is a major activity, in youth groups this is often not the case and the music appears to provide merely a background for the whole range of activities taking place rather than attenders being involved solely in dancing. We discuss these points further in results of the attendance survey.

5 The Sound Level Survey

In previously reported surveys the sound levels were obtained exclusively in terms of 'A' weighted or Octave Band SPL's by using sound level meters (SLM) set to either 'Fast' or 'Slow' time constants and observed for short periods of time 'while the music played'; usually at some representative position on the dance floor. The obvious disadvantage of such a method of measurement is, principally, that it neglects the variation of level with time and position which, from common experience, occur as the music changes during the performance and as the attenders engage in activities other than dancing. Whittle and Robinson (1974) in their review of earlier work allowed a corrections factor of 3dB for this observed variability. It appears likely that this correction will vary considerably from Disco to Disco and it is not clear whether any variation experienced is a function of personal behaviour or of the acoustic properties of the premises or if it exists at all. What is called for is a measure of the L_{eq} to which individual attenders are exposed and an evaluation of the variability between attenders. With the currently available integrating devices, and in particular, the personal dose meter this measurement is not difficult to obtain and the principal objective of the current survey is concerned with evaluating this quantity. However, the use of L_{eq} in the evaluation of hearing damage risk may be dependant on the spectral shape of the sound therefore this parameter must also be examined. Additionally, other parameters of the sound level may prove useful for comparative purposes and, possibly, as a means of establishing simple but representative methods of measurement. In order to satisfy the overall aims of the project, the sound level survey was designed to investigate; the personal L_{eq} experienced by attenders, some maximum L_{eq} to which attending populations could properly be exposed, statistical parameters of the sound levels occuring during the course of the event, the variation of L_{eq} with time over the duration of the event (both personal and maximum) and the frequency spectrum of the sound. Additionally, it was considered useful to obtain sound level measurement at various parts of the premises using a Sound Level Meter in order to compare measurements with Maximum and Personal L_{eq} values.

5.1 Personal L_{eq} of Attenders

For this purpose five battery operated personal dose meters were used; 3 CEL type 122 and 2 B & K 4424 each fitted with ½" condenser or electret microphones. They were initially calibrated and checked by the manufacturers and subsequently tested for 'A' weighting and L_{eq} response using calibrated tapes under free field or semi reverberant conditions. All instruments were found to be within the manufacturers specification and within ± 1.0dB of each other. Initially the microphones were worn at ear level but after complaints of discomfort and subsequent tests to determine any discrepancies in levels obtained, they were transferred to a position on the collar below the ear. Relative to the ear position the differences were non systematic and did not exceed ± 0.5dB(A) over the duration of any single performance

Each dose meter was acoustically calibrated before and after each performance. Apart from minor problems all instruments performed satisfactorily over the duration of the survey. Further details of the calibration and wearer position tests are given in Appendix 1.

The dose meters were worn by members of staff, students, friends and normal attenders. In each case the instrument was fitted by a technician and instruction given on how to operate and record values during the performance. Wearers were asked to record levels at approx ½ hour intervals and at the end of the evening. Results were examined collectively at the end of the performance and obvious errors corrected where appropriate, or results rejected. On occasions when all dose meters were not used as intended opportunity was taken to obtain information on levels experienced by disco personnel such as Disc Jockeys, barmaids etc. or placed at strategic points in the hall. These later results were analysed separately. All personnel were instructed to carry out their normal activities during the evening.

5.2 Maximum L_{eq}

As sound levels can be expected to vary considerably with space and time in any single hall the personal dose meter L_{eq} will reflect this variability as the individual moves about during his/her stay in the premises. Moreover, the L_{eq} value obtained will have some limiting higher value which will be determined by how near to loudspeakers members of the public are normally allowed to approach. It would therefore seem useful to obtain a measure of this limiting value as a means of determining some Maximum Practicable Exposure Level (MPEL). This can be defined as; 'the L_{eq} over the duration of the performance measured at the nearest point in the discotheques to a fully operational loudspeaker that the attending public are allowed to approach'. Additionally, it would appear advantageous to examine changes of L_{eq} with time over the duration of the event at this position as an indication of the sound power output into the premises and also, some measure of the total variability of the sound representative of the dynamic range.

Currently available Noise Analysers can be programmed to obtain most of these variables and the choice of variables was clearly influenced by the range of equipment on the market. The instrument used was a B & K Noise Analyser Type 4426 with ½" condenser microphone. The sampling rate was set at 0.5 sec and dynamic response to 'Fast'. The instrument was checked and calibrated in the same manner adopted for the personal close meters. Data was obtained automatically by using the associated printer Type 2312 with readings obtained at 10 min intervals. The parameters measured were cumulative percentile values, L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95}, L_{99}, L_{eq} and total distribution. The microphone was placed in the required position using a microphone stand with a boom arm. The position being first determined from general observation and knowledge of the sound system operating in the premises and checking initially and periodically with a sound

level meter. On occasions when the sound systems were changed during the performance, e.g. change from disc to live group, the microphone position was also changed. On 3 of the 49 occasions on which sound level data was obtained difficulties were encountered in obtaining a suitable position corresponding to MPEL. On these occasions differences were frequently monitored by making comparisons with the 4426 sound level output and a sound level meter at the maximum point; corrections were then made to the 4426 data at the end of the evening.

5.3 Sound Level Meter Measurements

Sound levels were monitored frequently throughout each performance using a B & K 2203 Precision Sound level meter fitted with a 1" condenser microphone. Measurements were obtained in what appears to be the three primary areas of activity within the premises, which are, the dance floor, the seating areas and the bars. The SLM was held at about ear level and readings obtained by averaging over a period of 15 sec to 30 sec with the dynamic response set to 'slow'. This procedure was repeated on two or three occasions during each performance.

5.4 Frequency Spectrum

Recordings of the music played during the performance were obtained on calibrated recordings obtained on either a Uher Report 4200 or a Nagra IV at 9.5cm sec via the AC output of the B & K 4426. The tapes were subsequently replayed through a measuring amplifier type 2606 and an octave band filter set type 1614 into the direct input of the 4426 from which two 10 min L_{eq} samples from each side of a 270m tape were obtaine d in each octave band from 63 Hz to 8kHz. These results were corrected for the 'A' weighting introduced on to the recording by the 4426 microphone preamp input. However, the values obtained in the lower frequencies must be interpreted with care as the severe recording pre-de-emphasis imposed by the 'A' weighting will lead to some uncertainty in the value of the correction to be applied.

5.5 Comparative Data

A criticism which could be levelled at the above measurements is that the presence of sound level measuring equipment in the disco could influence the level of sound recorded. In an attempt to measure this effect a simple check procedure was devised. Some 20 attendances were made to discos using dose meters only, when the management were not aware of our presence. These results were then compared with the main dose meter data. A similar criticism could be raised against our data in respect to differences between results around Leeds and other parts of the country. In this case data has been obtained from teams working in Carlisle and Newcastle. These teams were instructed in our general procedure but were not equipped to obtain dose meter measurements and results obtained were in terms of MPEL L_{eq} and percentile values only. Additional data was expected from other groups in the West and South but this has not been forthcoming.

6.0 The Attendance Survey

6.1 General Details

An accurate measure of the frequency and duration of individual attendances is necessary to combine with the sound level data if the Noise Immission Level (NIL) is to be evaluated. Hitherto references to attendance data have been couched in vague terms such as 'one or twice per week for two or three hours' which, between extremes, represents a 5dB change in NIL. This, coupled with a complete absence of any knowledge relating to the variation and duration of attendance over the lifetime of the individual reduces the estimation of risk, at best, to educated guesswork. Clearly, what is required is an objective evaluation of the variables. However, completely objective methods are not totally practicable in every case, particularly over a short time scale, and subjective methods must be resorted to in some cases.

It can be assumed that the individuals attendance at discotheques will vary over his or her lifetime and it is possible to propose a general model. Attendance is likely to commence at the age of about 10 or 11 at the school or youth club disco and continuing at a rate of about 1 or 2 times a week during the school terms until the age of 16 or 18. Between the age of 16 to 18 attendance may be influenced by leaving school to commence work or continuing to study for 'A' levels. The school leaver, with more money to spend, may wish to attend commercial disco but, particularly early in this period, may find this difficult as the majority of commercial discos are licenced premises and may therefore return to the Youth Group. On the other hand the 'A' level student is most likely to continue youth group attendance albeit at a somewhat reduced rate because of pressure of studies. From 18 years onwards commercial premises are open to both groups but the pattern of attendance may well again be influenced by continued education. Attendance beyond 18 years may additionally be influenced by a number of factors, in particular changes in music fashion and the ability to enter other licenced premises. This pattern of attendance is likely to continue into the early 20s until boys and girls pair off in some firm partnership which, if it continues, is likely to lead to a significant reduction in disco attendance. Formal courtship and marriage can be expected to reduce attendance still further but attendance may recommence to a small extent after some few years into marriage. Occasional attendance may well continue into middle age.

6.2 The Questionnaire

6.2.1 Sex and Age Groups

The Attendance Survey was designed to test the above model and to evaluate the various parameters; copies of the questionnaire are shown in Appendix 2. From previous discussions the major variables are sex and age and all data are divided into these two groups. Sex can be determined by observation but individuals were questioned on age. Specific age was asked, question 13, but, alternatively,

attenders were asked to indicate their age group. In commercial discotheques this was found to be the most satisfactory method as many attenders appeared sensitive to giving their specific age, particularly the higher age groups. The age groups are in three year intervals commencing at 11 years and proceeding to 49+ years, a total of 14 groups. The three year period was derived by the need to be discriminating over what could well have turned out to be a rather short time span in years and the need to allow attenders to maintain some element of privacy. A further point in group 3 (17 to 19), thus avoiding the attenders deliberately lying about their age in order to gain access to licenced premises.

Within each sex/age group the most important variables are number and length of attendances and the lifetime duration of attendance. The first decision was to determine the definition of attender. From previous data it was considered that attenders should be classified as those who attended 'once a month or more frequently than once a month'. On this basis the reduction in NIL would amount to about 17 dB, assuming a maximum monthly attendance duration of 6 hours and a lifetime attendance of 15 years, for the once per month attender. Question 2 determined this division. Whilst not important in estimating risk the definition helps to determine the casual from the hard-core attender.

6.2.2 Weekly Attendance Data

The weekly attendance data was obtained by question 3(A). It was considered that direct questioning on the number of attendances over the short time span of 7 days would produce reasonably accurate results, primarily for two reasons; firstly, the question relies on recall of material over a relatively short period and secondly, that attendance is likely to be cyclic on a weekly basis. Furthermore, there appeared to be no suitable alternative objective method as attendance data either by counting or from management figures will not distinguish between repeat attendances. A modifying question, question 3(b), which asked for monthly attendance was used to determine weekly attendance where no attendance had been made in the previous seven days. Whilst the replies are likely to be less accurate than weekly data, in practical terms this is not so important as this data will apply to the lower levels of attendance, i.e. 2 or 3 times per month.

The duration of each attendance was obtained by two methods. Firstly by questioning and secondly by objective methods. Questions 5 & 6, by subtraction, give the duration of attendance. Clearly, the questions are subject to some error as it is unlikely that attenders arrive and depart at exactly the same time on each occasion. The discrimination in terms of time, at hourly intervals, reflects this view. However, the error involved would not exceed half hour over the duration of the event as answers were adjusted between the two questions by recording to the hour below any fraction of an hour, in question 5 and adjusting the recording of question 6 accordingly to give the nearest answer to the stated duration, i.e 22.30 hours

was recorded as 2200 hours and a leaving time of 0130 hours recorded as 01.00 hours. Results were always over estimated rather than underestimated. The error in NIL with this level of discrimination is less than 1dB for a typical attendance which is small compared to the likely variation in actual attendance times on different attendances.

As direct questioning can lead to errors it was considered necessary to introduce an objective procedure. In addition to determining the duration of attendance more precisely it would also serve as a comparison for the direct questioning method. The procedure adopted was to count attenders arriving and departing over the duration of the event in $\frac{1}{4}$ hour intervals for both males and females. This was only practicable in commercial premises (licenced) where access control is necessary to ensure payment of entry fees. Even so, this was not always possible as not all commercial premises have entry foyers where counting can be done conveniently without hindering attenders or management. In non-commercial premises, i.e. Youth Clubs etc. the problems are much more difficult as control of movement into and out of the premises is subject to less control, therefore counting was severely restricted on these occasions. However, objective methods are less important in such premises because of the mode of operation and relatively short duration of the event.

6.2.3 Duration of Attendance in Years

The lifetime duration of attendance cannot be obtained by direct questioning as individual answers can only be retrospective. However, inferences can be drawn from such data from a wide range of age groups and question 4 relating to age of first attendance was an attempt to obtain information on this point. We do not place any great reliance on the results obtained and prefer to determine the duration of lifetime attendance on the basis of probabilities using the distribution of age groups in the attendance data for this purpose. Given the random nature of the sample for the attendance data the distribution of the age groups can be interpreted as a probability function so that the probability of an individual attending beyond a given age can be determined.

6.2.4 Activity Data

During attendance the individual will engage in a number of activities ranging from dancing, sitting around the dance floor, visiting the refereshment or eating areas and visiting other parts of the premises. These activities obviously influence the noise dose during attendance. Clearly, this variability is best measured by the dose meter but in an attempt to make some comparisons between measured and stated activity attenders were questioned about their activity and position in the premises, see questions 7 and 8, although it was not expected that any great measure of reliability could be put on the replies.

Objective methods were also attempted. Initially it was intended to obtain photographs of the dance floor at various times throughout the evening, however, this turned out to be a sensitive issue with the management of commercial premises and this method was discarded. As an alternative, head counts were made at various times and this proved reasonably satisfactory.

Additional information was sought on individual opinion of the loudness of the sound in the premises; question 14.

6.2.5 Personal data

In addition to age or age group, question 13, attenders were asked to state whether they were 'unattached', 'going steady','engaged' or 'married'. The intention being to determine whether any form of partnership between sexes effected attendance. It was expected that this might prove to be a sensitive question and interviewers were instructed to ask the question carefully and not to press the point if an answer was refused.

6.2.6 Additional Noise Exposure

As discotheque attendance is a leisure activity the exposure to loud music may be in addition to noise at work. It was, therefore, considered important to obtain details of such exposure if possible. Clearly, it would be impossible to quantify such exposure in any way without lengthy questioning which might prove counterproductive in the context of the questionnaire. Therefore, the standard qualitative test for noise in industry was used in question 11, asking 'whether the individual had to shout at work when they wished to speak to other workers'. Additionally the individuals occupation was obtained in question 10.

Information on attendance at other leisure activities associated with the disco scene was obtained in question 15 and this form of question was extended for use in the Educational Survey questionnaire to include information on frequency of attendance at such events.

6.2.7 The Premises, Administration and Processing

The survey was conducted in two classes of premises. In discotheques, both licenced and unlicenced, and in schools and colleges. The form of questionnaire was broadly the same but a small amount of additional information was obtained in the educational institutions where questionnaires could be completed in more leisurely circumstances.

In licenced discotheques interviewers were stationed near the entrance to the premises and questionnaire completed on the 'next in' basis after completing the subsequent interview. A small number of interviews were conducted in the hall on a random basis after the main body of attenders had arrived. In unlicenced premises, because of the restricted age range, it was considered satisfactory to complete

interviews around the premises on a random basis rather than at the entrance as entry to and from the premises is not strictly controlled. All interviewers were carefully instructed in the administration of the questionnaire and the need to avoid influencing the answers of attenders in any way.

The questionnaire results from both sources were punched on to cards, verified and fed into the Polytechnic's Honeywell Level 66 computer and all files stored on disc for processing.

Comparative data was obtained from sources in Newcastle, Carlisle and Bedford and also from Open University students.

7. Results of the Sound Level Survey

7.1 General Details

The results of the measurements previously described are presented below. In each case they are discussed in terms of implications they may have in estimating the L_{eq} of attenders to be used in conjunction with the attendance data to determine the NIL and of any interesting features relating to the general measurement of sound levels in discotheques. At the end of this section the sound level data to be used to determine NIL is summarised. The levels reported are given to the nearest dB as any greater precision is meaningless in the context of either the measurements or the evaluation of NIL with the exception that standard deviations are given to one decimal place. As a measure of central tendency the mean is used in preferance to the median.

The Comparative Data obtained from other sources is discussed in each part of the results appropriate to the measurements obtained.

7.2. Personal L_{eq} of Attenders

In all 154 dose meter measurements were obtained from attenders. Of these 98 were obtained in licenced discotheques and 56 in unlicenced discotheques. The distribution of the results for each of these two groups are shown in Figs 7.1 and 7.2. In licenced discotheques the mean value of L_{eq} is 96dB(A) and in unlicenced premises 97dB(A) with S.D. of 3.8dB(A) and 4.0dB(A) respectively. Although these values are covered by $\pm$ 3 s.e. they are sufficiently different in other respects that they are examined separately at this stage. Within each group the males and females are within $\pm$ 1 s.e. and are therefore considered together.

Tables 7.1 and 7.2 shows the comparison between the MPEL and the average Dose Meter L_{eq} obtained in the same premises. The difference, $\triangle$ MD, is on average, 6dB(A) and 4dB(A) in the licenced and unlicenced premises respectively which is clearly related to the activities, and hence position, of the attenders relative to MPEL position. The observed values show a range from -1dB to-13dB. A number of explanations are possible to account for this variation, which include difference in the volume and arrangement of the premises, placing of loudspeakers and also the possibility that attenders consciously or unconsciously reduce their dose as the level of sound within the premises increases. Two aspects were considered from the data available. Fig 7.3 shows the relationship between $\triangle$ MD and the volume of the associated premises and Fig. 7.4 the relationship between $\triangle$ MD and MPEL. In the former case the scatter shows little correlation between the two variables whilst in the latter, with simple least squares fit, the correlation is statistically significant with r = 0.78. Whilst recognising the possibility of other causes the association in Fig.7.4 may be interpreted as implying a general tendency by attenders to reduce their exposure in premises where the sound level is high. An examination of Fig. 7.4 suggests that the data can be divided into three groups. Group 1, below MPEL = 96 dB(A) where attenders feel the levels are low and tend to move towards the source, Group 2, 96dB(A) to

102 dB(A) where the scatter tends to suggest that the levels are generally acceptable and, Group 3, greater than 102dB(A) where attenders find the levels too high and increasing try to reduce their exposure. A measure of support for this interpretation is to be found in the Attendance Survey where in premises where the MPEL was above the mean level of 102dB(A),19% of attenders considered the levels 'too loud' whereas in premises with MPEL below the mean level the corresponding percentage was 4%. In the same premises the converse question of 'too quiet' gave percentages of 10% and 12% respectively. (Table 8.17)

Figures 7.5 and 7.6 show the change of dosemeter L_{eq} over the duration of the performance compared with the change in MPEL. In licenced discotheques the dose meter level increased by 5dB(A) compared with 8dB(A) in MPEL whilst in unlicenced discotheques these values are 6dB(A) and 3dB(A) respectively. These changes emphasise the difference in mode of operation in these premises. The licenced premises commence with few attenders and sound levels tend to be low but the early attenders congregate around the dance floor resulting in a higher initial dose. In unlicenced premises the majority of attenders arrive within the first half hour, hence the high initial value of MPEL, but often wander around the premises engaging in other activities before concentrating on the disco,therefore tending to lower their initial L_{eq}. The rate of increase of the dose meter L_{eq} broadly follows that of the MPEL which suggests this is associated with the increase in sound power input into the premises rather than any behavioural pattern of the attenders; however, we have more to say about this point in the next sections on MPEL.

A further implication of the change of L_{eq} with time is that the noise dose received in a single evening by attenders will depend on their time of arrival and departure. A significant change in L_{eq} over the duration of the event, coupled with exposure times less than the whole duration, could produce L_{eq}s which differ by a few dB independant of activity in the premises where attenders stay for a period less than the full duration of the performance.

As the dose meter L_{eq}s reported are cumulative over the whole performance the mean period L_{eq} over the last half will be, from the summing of partial exposure indices, approx 1dB higher than the mean value over the full duration. Therefore an attender in a licensed discotheque who arrives near the beginning of the event and leaves, say, at three quarter time will have an L_{eq} of 95dB(A) for a stay of $3\frac{1}{4}$ - $3\frac{1}{2}$ hours. Whereas, an attender arriving at half time and staying until the end will have an L_{eq} of 97dB(A) for a stay of approx $2\frac{1}{2}$ hours this discrepancy in level will decrease as duration of exposure increases and for attenders arriving earlier than $\frac{1}{3}$ into the performance this correction is insignificant. The Attendance Survey shows that in licenced discotheques attenders rarely stay for the full duration of an event and that such corrections are appropriate, particularly as the majority of attenders attend during the latter half of the performance. However, this is not the case in the unlicenced discotheques primarily because of the short duration of the performance where attenders arrive early and leave at the end.

Although it is considered that the differences between the two types of premises are measurable the above discussion suggests that there would be no serious error introduced into the calculation of NIL if a mean L_{eq} value of 97dB(A) is used for all attenders irrespective of whether they attend licenced or unlicenced discotheques.

Assuming a normal distribution ($\chi^2 = 2.8\ \nu = 3$) percentile values can be calculated and at the 10% and 5% level the respective L_{eq} value are 102dB(A) and 103dB(A).

The dose meter L_{eq}s obtained for comparative purposes by separate attendance at discotheques when the survey team were not in attendance showed a mean of 96.5dB(A) from 20 attendances; a difference of 0.5dB(A). This close proximity, to within 1 s.e. of the main L_{eq} data, demonstrates the overall integrity of the survey results.

7.3. Maximum Practicable Exposure Level and Percentile Levels

The MPEL was obtained over the duration of the performance in 30 licenced and 18 unlicenced discotheques. The results are shown, together with the percentile values from the B & K 4426 in Tables 7.3 and 7.4.

In the licenced premises the mean level of MPEL was 102dB(A) with a S.D. of 5.7dB(A) and in unlicenced premises these values are 100dB(A) and 5.8dB(A) respectively. In the licenced premises 11 results were obtained in discotheques where live music was played some or all of the time (marked L or M in Table 7.3) and although the level in one of these premises, Ref 23, achieved the highest level of the whole survey, 116dB(A), on average, over the duration of a performance, this group has the same L_{eq} of 102dB(A) as the remaining 19 premises. The live discos in the unlicenced premises, ref. 15 & 16 were significantly higher, 112dB(A), than the remaining disc playing premises. However, the sample is too small to draw any firm conclusions but some additional comments on these differences are made under the heading of frequency analysis.

In addition to the variation in level between premises there is also an observed variation in level between the same premises on different evenings. From Table 7.3 the following pairs of Ref Nos. represent the same premises on different occasions:-

(1,25) (3,12) (4,14) (5,15) (7,17) (10,27) (11,22).

The differences range from 1 to 8dB(A) with a mean value of 4dB(A), irrespective of sign, and a similar variation is to be observed in the appropriate dose meter values. The mean of the first and second series of measurements of MPEL is 102dB(A) in each case. This variability within premises reflects the various music programmes

played and numbers of attenders present in premises on different days of the week or between the same day in different weeks of the year. These observations support the view that even though attenders may regularly visit the same presmises the sound levels experienced, and hence noise dose, is not necessarily the same on each occasion. Moreover, coupled with the distinct possibility that the vast majority of attenders will attend other discotheques during their lifetime of attendance, this leads to the conclusion that the L_{eq} parameter of the NIL equation can be considered an independent variable for the purposes of this survey.

The variation of MPEL with time over the duration of the performance is shown in Figs. 7.5 and 7.6 and has briefly been discussed previously in connection with the dose meter L_{eq} s. The reason for the increase in MPEL is not clear. The lowest levels usually occur when the premises are relatively empty and, in the case of the licenced premises, increase sharply to the 50% time which corresponds to a period between 2300 hours and 2330 hours at a time when the majority of attenders are in the premises.

Because of the measuring position associated with MPEL, i.e near to speakers, the levels obtained are in some respects a measure of the sound power output into the premises and one interpretation of the increase is that it is an attempt by the D J or musicians to maintain constant sound levels, by increasing the sound power output, as the absorptive properties of the hall increase due to more attenders being present. In which case it might be expected that the dose meter levels would remain roughly constant throughout the duration of the event. However, as already shown in Fig. 7.5, this is not the case although the rise in dose meter L_{eq} is less than that of MPEL, at least in the licenced premises which are more important in this respect because of their longer duration. An alternative view might be that as the evening proceeds attenders experience a measure of Temporary Threshold Shift (TTS) and require additional sound power to maintain constant subjective loudness. We have no evidence to support this view from the survey data but TTS data (Dey 1970) suggests that with an exposure of one hour to a level of 95-97 dB(A) some 9dB of shift over the range 1kH to 8 kHz might be experienced in 50% of attenders. A more likely possibility relating to the latter point is that the increase is a requirement of the performers rather than attenders as they are more exposed to the higher levels and therefore more likely to suffer greater TTS. We have no evidence to indicate the levels experienced by performers in live groups but dose meter L_{eq} s from 14 D J s in licenced discotheques showed a mean of 98dB(A) over the duration of the performance, an increase of 2dB(A) over the attenders, indicating a greater risk of higher levels of TTS.

The percentile levels shown in Table 7.3 are of interest only in that they indicate the range of levels experienced at the MPEL point. Therefore they are more indicative of the variation in sound output into, rather than the variation within, the premises. The distribution is negatively skewed which is due primarily to the

wide range of levels and variety of conditions experience early in the performance. Whilst not representing the true dynamic range the mean $L_1 - L_{99}$ value of 29 dB(A) is an indication of peak music to background sound level but the $L_1 - L_{95}$ value of 21dB(A) is more typical of the peak to lowest music level over the performance. The highest L_1 recorded was 122dB(A), ref 23, for a live music performance and the peak r.m.s. 'fast' level recorded in the 4426 distribution channels was 128 dB(A) at the same premises. An examination of the distribution in each of the premises reveals that L_1 + 5dB(A) gives the r.m.s. 'fast' peak which puts the ave. peak for the licenced data at 114 dB(A) and for the unlicenced data at 112 dB(A); in each case some 12dB(A) above the MPEL. Additional measurements using the 'peak hold' facility on a B & K 2606 Measuring Amplifier from the tape recordings obtained during the performance showed a peak to L_{eq} of 17 dB(A) over 12 samples each of 5mins duration.

For comparative purposes MPEL values were obtained from two other groups working independently in Newcastle and Carlisle and the combined results of 9 measurements showed a mean of 99 dB(A) for licenced discotheques, some 3dB(A) below the equivalent value measured here. We can draw no firm conclusions from this comparison because of the small sample and the fact that the results were from the same region of the country but the two results are not so far apart as warrant concern.

7.4. Sound Level Meter Measurements

The measurements obtained are shown in Tables 7.5 and 7.6. In the licenced discotheques it was possible to obtain measurements in 3 areas, dance floor, bar and seating but in unlicenced discotheques only the dance floor and seating areas were possible. In both classes of premises the levels and differences are similar. Between MPEL and dance floor this is 3dB(A) for licenced and 2dB(A) for unlicenced premises and 6dB(A) in each case between the dance floor and the seating area; the bar area level being some 2dB(A) lower. The levels reflect the general arrangement of the premises with the seating areas usually situated between the dance floor and the bar.

The difference between the SLM measurements and the dose meter L_{eq}s are 3dB(A) for licenced and 2dB(A) for unlicenced premises and generally support Whittle and Robinson estimate of reduction in L_{eq} due to variability of position from the dance floor values. However, our dance floor measurements, although not directly comparable because of the mixing of live and recorded music, fall between the 104dB(A) for live and 92 dB(A) for recorded music summarised by them from data obtained by others.

7.5. Frequency Spectrum of Music

Tape recordings for frequency analysis were obtained on 10 occasions and divided into live and recorded music groups. The results are shown in Tables 7.7 and 7.8. For the live music the SPLs are within 6dB in the range 63 Hz to 1 kHz after which they fall sharply. For comparative purposes, this group are, on average, on the limits of the

spectra used by Burns and Robinson, all but one lying within band $S_1 6$ where S_1 spectra are defined by:

$$S_1 = \tfrac{1}{2}(L_{250} + L_{500}) - \tfrac{1}{2}(L_{2000} + L_{4000})$$

and band 6 lies between the values + 12.5 to 17. For recorded music the 63 Hz to 2kHz range is within 8dB, falling sharply beyond 4kHz and on average, this group lies in band $S_1 5$ with individual spectra ranging between bands $S_1 4$ and $S_1 6$.

In terms of linear or 'A' weighted SPL's there is a 6dB difference between the two groups which appears to contradict the earlier statement relating to the similarity of MPELs from premises playing live or recorded music. Clearly, this is because of the rather small sample and the inclusion in the live group of the two live music performances from the unlicenced premises, together with the fact that these represent 10 min samples from a whole evenings session.

It would appear that the spectra are, in general, within the range of acceptability for use with the Burns and Robinson Damage Risk Criteria although the live music data are at the limits of this range.

7.6. Summary of Sound Level Survey

(1) Although measurable differences do exist between licenced and unlicenced discotheques a mean L_{eq} value of 97dB(A) can be used in estimating NIL. The associated 10% and 5% values are 102dB(A) and 103dB(A) respectively.

(2) The MPEL values in licenced and unlicenced premises are 102dB(A) and 100dB(A) respectively.

(3) Differences between dose meter L_{eq}s and MPEL in the same premises tend to suggest that as MPEL increase attenders attempt to reduce their noise exposure.

(4) In the results reported in licenced premises there appears to be no significant difference in MPEL levels between live and recorded music over the duration of a performance.

(5) Differences in MPEL and dose meter L_{eq} levels occur between the same premises on different occasions and leads to the conclusion than the L_{eq} level can be treated as an independent variable in the determination of NIL.

(6) MPEL values increase over the duration of the performances but whether this is due to increased absorption with more attenders present or to TTS in attenders or performers is not clear.

(7) Percentile values show 'peak' levels of up to L_1 = 122dB(A) for the whole survey and up to 128dB(A) for individual distributions on r.m.s. 'fast' response.

(8) The frequency spectra for both live and recorded music are in general within the range of acceptability for use with the Burns and Robinson cause-effect relationship although the live music spectra are at the limits of this range.

(9) Comparative data from other sources shows reasonable agreement with the survey data.

8 Attendance Survey Results

In all 4166 valid interviews were conducted of which 1498 were obtained in discotheques and 2668 in educational premises. Of the 1498 discotheque interviews 289 were conducted in unlicenced premises and the remaining 1209 in licenced premises. In unlicenced premises of the 289 subjects there were 139 males and 150 females and in licenced premises this division was 513 and 696 respectively. The discotheque data was collected on 31 occasions from 20 separate premises at the same time as the sound level measurements were being obtained. Some 23 educational premises were visited on occasions to obtain the 2668 replies from 1387 males and 1281 females.

The data was coded on the questionnaire and transferred to punch cards, verified and stored on disc in a series of separate files. Initially, individual files were formed for males and females in licenced and unlicenced discotheques and educational premises. From inspection, the males and females were not sufficiently different as to warrant a separate study, therefore, these files were merged. However, comments are made, as and when appropriate, on any differences which are of interest and at the end of the assessment some comments are made on general differences between the sexes. Additionally, the licenced and unlicenced files were also combined as the classes of premises are divided only by age, i.e. eighteen years (age group 3). The combination of this group helps to balance the age distribution within the group which, in the case of unlicenced premises, is biased towards the 17 year olds and towards the 19 year olds in licenced premises.

For each individual the duration of attendance was calculated from questions 5 and 6 and this value multiplied by the number of attendances made during the previous week to give the total weekly hours. Each file was then analysed by sex and age group.

The primary data is that obtained directly from the discotheques and it is from this source that all attendance values are calculated. The educational data, because of its limited age range and spread of occupations, isused for comparison purposes and, together with the discotheque data, for estimating the numbers at risk.

The median is used as the measure of central tendency and the 10th and 5th percentiles calculated. In some age groups the numbers involved are such that little confidence can be placed on these upper values in which case some groups have been combined for certain purposes. The confidence limits which apply to the basic data are shown in Appendix 6.

The attendance data is presented and discussed first, following which the secondary variables of interest are considered. The attendance survey results are summarised at the end of this section.

8.1 The Sample Population

The distribution of the discotheque sample population is shown in Fig 8.1 and Table 8.1. The median age of the population is 21 years and the 10th and 5th percentiles 32 and 36 years respectively. For females the median age is slightly less, 20 years, but the female percentile values are slightly higher than the males, 33 and 37 years, as opposed to 30 and 35 years for the 10th and 5th percentiles respectively. In the lowest age group (11-13 years) there were surprisingly few young people present in the unlicenced discotheques visited although the educational data, Table ED.2, shows that 36% of that age group are regular attenders. In age group 2 (14 - 16 years) nearly all were attending unlicenced premises and in group 3 (17 - 19 years) some 13% of that group were still attending this class of discotheque. Almost all, more than 99.9%, of the remaining groups, 4 - 10+, attend licenced premises.

8.2 Attenders

The division of the sample population into Attenders and Non-Attenders is shown in Table 8.2. It would appear that 9.5% of all attenders do so on a casual basis; of the remainder, 14.8% attend less than once per week but more than once per month and 75.6% attend at least once per week. This element of casual attendance increases with age. In age group 2 the casual attender accounts for only 2% of all attenders whilst in groups 9+ this increases to 27%.

All casual non-attenders, amounting to 143 replies, were removed from the initial data base and the remaining 1355 used as the date base for all subsequent calculations. The removal of this data alters the age distribution of the group and the median age of Attenders is 20 years and the 10th and 5th percentiles are 30 and 35 years respectively. Additionally the reduced numbers in the upper age groups leads to lower statistical reliability therefore groups 7 and 8 and groups 9 through to 14 have been combined, where necessary, for the purposes of calculation but all tables show the full distribution.

8.3 Duration of each attendance

The distribution of duration of each attendance as determined from the questionnaires is shown in Table 8.3. Overall, the median value is 3.1 hours and the 10th and 5th percentiles 4.5 hours and 5.1 hours respectively. By age group, only groups 1 and 2 vary significantly from these values. In group 1 the median value is 2.3 hours and group 2, 2.1 hours. This is because these two groups almost exclusively attend unlicenced discotheques which have a much shorter overall duration.

The duration of each attendance was determined objectively by the procedure described earlier. The arrival and departure times of attenders were obtained on 21 occasions in licenced premises and 7 occasions in unlicenced premises. As arrival and departure are not independent events, the period from the time of arrival to the end

of the performance is used to determine the duration of stay. This will tend to over estimate the duration of attendance particularly for the higher percentile values as it might reasonably be expected that early arrivals were early leavers. Moreover, the mean time of departure is something less than the end of the event, again indicating a general over estimate of duration. However, in practical terms the differences are small when reduced to decibels and can be ignored without serious error.

Tables 8.4 & 8.5 show the time of arrival and duration of stay for males and females attending licenced discotheques. The percentile values indicated should be referred to as showing, for Time of Arrival, n% of the Attenders arrived after the stated time and, for Duration of Stay, n% of Attenders stayed longer than the stated number of hours/ mins. Mean percentile times of arrival are meaningless in this context as the events often started and ended at different times. It is clear that although there are differences in the duration of attendance between males and females these differences are small and can, for all practicable purposes be ignored. Therefore the results can be conveniently summarised as: 3, 4 and 4.3 hours for the 50th, 10th and 5th percentiles respectively.

For unlicenced premises the amount of data available is small, resulting from the difficulties, mentioned earlier, in counting Attenders in and out due to the method of operation of the premises. The data available supports the general observations that the majority of Attenders arrive early and leave at the end of the event. Tables 8.6 & 8.7 show that the differences between the 50% and 10% duration of stay and the maximum duration, i.e. the duration of the event, are small and can be ignored. Similarly, the differences between males and female, although systematic, are again insignificant. Therefore it is proposed that in the context of this procedure, for both the 50th and 10th percentile values, a duration of 2 hours 30 mins can be used for the duration of stay in unlicenced premises.

The most serious drawback to this data is that it cannot discriminate between the different durations of attendance which might exist between age groups. Therefore, the results reported refer to the percentile values of the whole age range of Attenders in the survey. Comparisons between the two sets of data for licenced premises, the questionnaire and objective method, show good agreement at the 50% level, 3.0 hours as against 3.3 hours (age groups 3 to 14 for licenced premises only). At the 10% level the discrepancy is rather more, 4.0 hours as opposed to 4.5 hours; similarly at the 5% level, 4.2 hours against 5.1 hours. In each case the questionnaire results tend to overestimate the duration of attendance and can be accounted for by the rather low level of discrimination offered in questions 5 and 6, i.e. to nearest hour and the tendency to over, rather than underestimate, and suggests that with a higher level of discrimination the result may have shown better agreement. In any event, this discrepancy is not serious in estimating NIL, as on a weekly basis, the error is about 1dB at the 10% and 5% level but it is proposed to make this correction in subsequent calculations of NIL. The similarity between the results leads to the

general conclusion that attenders are reasonably regular in their times of arrival and departure and hence, duration of stay.

The educational survey excluding Non-Attenders also shows reasonable agreement, with a median value of 3.0 hours, 4.4 hours at 10% and 5.1 hours at 5%. These are only marginally lower than the questionnaire values and can be accounted for by the bias in the educational data towards the lower age groups. (Table ED.3)

This agreement between the different sources is important, particularly between the objective data and the disco data, as the weekly hours of attendance can now be determined individually for each attender by multiplying hours of attendance by the number of weekly attendances. Had this not been the case it would have been necessary to estimate the weekly attendance on the basis of probabilities of various modes of attendance.

8.4 Weekly Attendance

Table 8.8 shows the number of attendances made each week by regular attenders. The median number of attendances is 1.5 with 3.7 and 4.4 times per week at the 10% and 5% levels respectively. In age groups 1 and 2 the number is slightly higher; the median is 2.5 and 2.2 respectively and at the 10% level, in group 2, 4.3 times per week. Attendance also falls slightly with age. Whilst accepting the higher values of attendance indicated, i.e. 5, 6 or 7 times per week, it is difficult to believe that this is likely to be sustained over any long period of time although from Table 8.9 which give details of the attendances in the past four weeks, these higher values also appear. On occasions it was found that some attenders accompany members of staff or musicians and it may well be that these high values are experience by this group; in any case the numbers involved are small.

The responses to question 3b, four weekly attendance, shown in Table 8.9 indicates that the weekly values are reasonably representative of a regular attendance pattern as the percentile values, 50% = 4.2, 10% = 13.2 and 5% = 16.4 times per month, are almost direct multiples of the weekly figures.

The educational data indicates in Table ED.4 that, excluding Non Attenders, the weekly attendance patterns are rather less than the disco data with 50% = 0.7 , 10% 2.5 and 5% = 3.4

8.5 Weekly Hours of Attendance

As indicated earlier the weekly hours of attendance have been calculated from individual responses and the distribution is shown in Table 8.10. For all age groups the median value is 4.4 hrs arising at the 10% level to 10.5 hrs and 15.1 hrs at 5%. In general the weekly hours at the 50% level decrease with age from a maximum of 5.7 hrs in group 1 to 3.7 hrs for groups 9 to 14. The 10% and 5% values peak in age group 5 at 12.2hrs and 19 hrs

respectively falling sharply on either side. Although the hours of attendance do differ between the age groups, particularly at the higher percentile values they are not sufficiently different as to warrant each individual age group being treated separately when calculating NIL. Various combinations of age groups were compared with the 'all age group' values of 50%; 10% and 5%. The mean difference between the individual age group values and the 'all age group' value of the stated percentiles, irrespective of sign, does not exceed 0.8 dB over the week when calculated by:-

$$\left|\triangle \text{ dB}\right| = 10 \log_{10} \frac{t_A}{40} \pm 10 \log_{10} \frac{t_{1-14}}{40} \quad \ldots\ldots(1)$$

where t_A = the 'all age group' value for a stated percentile,

t_{1-14} is the individual age group value for the same percentile

and 40 hrs is the normal working week. Other possible combinations yielded similar differences. Therefore it is proposed that the following weekly hours of attendance, to the nearest ½ hour, shall be used for the calculation of NIL.

Percentile	50%	10%	5%
Weekly hours	4.5	10.5	15.0

The educational data, although not directly comparable because of the age and occupation structure differences shows in Table ED 5 that, excluding non attenders, the percentile values are: 5% = 2.7 hrs, 10% = 8.4 hrs and 5% = 11.8 hrs.

8.6 Yearly attendance

The weekly data assumes that attendance is constant throughout the year; this is not the case. Attendance at youth groups is restricted to the school terms and commerical premises experience a reduced attendance during the summer months. The school term is approximately 39 weeks and a reduction in the order of approx 1 dB will apply to age groups 1 and 2. For commercial premises management indicate that attendance begins to fall off 'after Easter' and increases again' late September or early October'. The extent of the reduction depends on weather conditions in a 'good summer' this may be as much as 60% but in a 'bad summer' as little as 20% but 'on average' 30 - 40%. As the discotheque survey, for operational reasons, did not cover the summer months this reduction is not included in the data presented. Again, the error is not serious amounting to approx 1 dB in NIL, similar to the corrections for youth groups but it is appropriate to make these corrections in subsequent calculations.

8.7 Lifetime Attendance

The estimation of total life time attendance is a complex problem. It cannot properly be determined by asking attenders as answers can only be related to previous attendance and cannot be extrapolated into the future. What can be achieved with some accuracy from the data obtained is information on the limits of attendance, i.e. age of commencement and age of cessation of attendance. Between these extremes there are likely to be various sub groups whose lifetime attendance can only be estimated on the basis of probability rather than direct evidence; that is from this data at least. We start by considering the age at which attendance begins, then at which it ceases and then consider the likely modes of attendance.

8.7.1 Age at which Attendance begins

Table 8.11 is derived from question Q6 which asked about the age at which disco attendance commenced. The results show that, for all age groups, 50% of all Attenders commenced attendance before the age of 15.4 years, 10% before the 11.6 years and 5% before 10.8 years. Age of comment increases with age group; from, at the 50% level, 11 years in group 1, (mean age 12 years), giving an indicated duration of attendance from the mean age of the group of 1 year, to 22 years in group 8 + (mean age 42 years) with a duration of 20 years. In the latter case there is obviously some confusion between the disco and the dance hall as there were few discotheques, as such, 20 years ago. However, it serves as a guide to the general attendance patterns of this form of entertainment. Evidence from the Attenders in the educational data, Table ED.6 , shows reasonable agreement with the discotheque data over the same age range, i.e. groups 1 - 3.

There remains some uncertainty with this question; firstly, in the upper age groups it depends on long term memory which may lead to inaccuracies, secondly, in asking for first attendance there is no information on whether attendance has been continuous from that date, nor, thirdly, does it give any information concerning the variability of attendance during that period. However, it stands as a best estimate of the age at which disco attendance in regular attenders, began and is likely to indicate a maximum, rather than a minimum, duration of attendance for any particular age group.

8.7.2 Age at which Attendance Ceases

Whilst there may be no practicable upper limit to the age of attendance within the normal life span the sample population shows (Fig. 8.1) that discotheque attendance is, primarily, an activity for the young. Given the random nature of the sample, the population distribution can be interpreted as the probability of an individual attending beyond a given age. General examination of the data shows that the probability of attending increases with age group up to age group 3 (17 - 19) after which probability begins to decline. For the earlier age groups in the distribution, up to group 3, the increased probability of attendance is supported by the educational

data, Table ED.2 which shows that 56% of the population are Attenders in group 3 rising from 36% in group 1.

Using age group 3 as an Index Group the probability of continued attendance can be determined from the proportionate decrease in the population of Attenders in subsequent age groups. However, in order to do this a number of corrections must be made to the data. Firstly, whilst the combination of licenced and unlicenced premises is useful to obtain information on some aspects of the Survey in this case it is necessary to separate the two as the premises are almost mutually exclusive; few Attenders attend unlicenced premises after the age of 18 and under that age Attenders are excluded from licenced premises. Secondly, the proportions in each age group beyond group 3 need to be corrected for the age structure of the population at large as the number of Attenders in each age group will be related to the number of people available to attend. And thirdly, within the total number in each age group of Attenders there will be a number of New Attenders who have commenced their attendance in that age group thereby reducing the number of Attenders in that group who have attended from the previous age group.

Table 8.12 shows the effect of these corrections. Overall these corrections are not large and the corrections for population structure and new attenders tend to be opposite in effect. The data on New Attenders in each age group has been obtained from Table 8.11 and assumes that the previous experience of age at which attendance commenced applies to the current age group populations. To use the Table the values shown in the final row should be taken as the probability of attending into any given group from group 3; for example, an individual in group 3 has a 45% chance of attending into group 5 or 14% of attending into group 7. The corrected age distribution for the comparative data is also shown in Table 8.12.

The rate of change in the probability of continued attendance will be influenced by a number of factors not least of which will be marriage. Population statistics (OPCS 1976 and CSO 1977) show that in the population at large, in age group 20 - 24 (inc) 44% of the population are married. In the appropriate age group in the Attenders data only 15% were married (Table 8.2). As age increases the married population of the whole population increases and in the 25 to 34 (inc) age group the married proportion rose to 80% whilst in the Attenders this proportion amounts to 43%. This evidence supports the general, and fairly obvious, conclusion that marriage, and more particularly the age at which marriage occurs, influences the age at which attendance ceases and is a major factor in the fall off of attendance after age group 3. A further point of issues is whether the married Attenders are single Attenders continuing attendance into marriage or, a lapse period between single attendance and married attendance. Both these occurrences will tend to reduce the overall duration of exposure.

8.7.3 Modes of Attendance

Between the limits of attendance previously discussed many

modes of attendance are likely. That is, attenders can start and stop their attendance at any time between these limits and, moreover, may continue to do so between the age limits of the survey. What the survey data will do is to establish the limits of this attendance rather than estimate the variability within the attendance period which is likely to be considerable over the whole range of the attendance parameters. For the purpose of determining the maximum duration of attendance age group 3 (17 - 19) is used as this group represents the largest group in the survey for which the decline in subsequent attendance is known and where past attendance is well within the disco period. This group also contains the highest proportion of Attenders from the population at large as indicated by the education survey data.

The distribution of attendance for age group 3 is shown in Fig 8.2 which combines the data given in Tables 8.11 & 8.12 and represents the proportion of the group 3 population who have already attended and their likelihood of continued attendance. About group 3, 50% of the distribution is covered by a range of 7 years, 90% by 18 years and 95% by 24 years or, put another way, 50% of the group 3 population commenced attending after the age of 15 and stopped attending before the age of 23 years, 90% commenced after the age of 11 years and had stopped before the age of 29 and 95% commenced after the age of 11 years and stopped before the age of 35 years.

Other models of lifetime duration of attendance are possible from the data. For example, from Table 8.11 it can be seen that in group 8 + (but excluding group 14) with a mean age of 42 years, 11 individuals commenced attending at the age of 16 years or less giving a duration of 26 years with an associated probability of $p < 0.008$. The problem with this method is that the reliability of the result is small because of the low numbers in this group.

Clearly, other modes of attendance are possible but as a best estimate of maximum lifetime attendance for regular attenders at discotheques from this data we conclude that 50% of Attenders will attend for longer than 7 years, 10% for longer than 18 years and 5% for more than 24 years.

8.8 Activity Data

Tables 8.13, 18.14 & 8.15 give the response to questions 7 and 8 relating to activity and position during attendance. From table 8.13 it can be seen that few Attenders spend time out of the dance hall and those that do are concentrated in the earlier age groups and mainly attend unlicenced premises. For Licenced premises 95% of Attenders stay in the hall all the time, whereas for unlicenced premises this amounts to 61%. Again, this indicates the difference between the two types of premises and suggests that noise exposure may be rather less than that indicated in the Sound Level Survey for some unlicenced premises Attenders. However, the earlier age groups say they spend more time dancing than the later groups. For all Attenders their time in the premises appears to be divided between the dance floor and other areas although from objective methods (% dancing at a given time), it appears that only some 25% is spent dancing irrespective of type of premises. Comparisons with the sound level data for the dance floor

and the seating area in licenced premises show that for 50% of time spent at 99 dB(A) (ave. for dance floor) and 50% at 93 dB(A)(ave.for seating area) the resulting L_{eq} will be 97 dB(A) whereas for 25% of the time spent dancing the appropriate L_{eq} is 95.5 dB(A) which is very close to the calculated dose meter L_{eq} of 96 dB(A). In the context of this survey the implications of these results are not particularly important; however, they show that, in general, personal L_{eq}s can be calculated from stated or observed activity and sound level meter readings in the major activity areas without serious error.

In relation to position few Attenders appear to have any stated preference although 17% stated they preferred to be near to the loudspeakers and 10% preferred to be away from the loudspeakers. (Table 8.15).

When asked their opinion of the loudness of the sound in the discos, Table 8.16, 12% of the Attenders considered the music too loud which approximately corresponds to the 10% of Attenders who preferred to be away from the loudspeakers. This percentage increases with age to some 31% for groups 7 to 14 suggesting a reduced noise tolerance which may also contribute to fewer attendances and although 7% of all Attenders indicated that the levels were 'too quiet', less than 0.5% of these were in the 7 to 14 age groups. A general observation made by Attenders was that it was the 'live groups' which tended to be the loudest in premises where there were mixed sessions of live and recorded music. When considered by location, Table 8.17 against the appropriate MPEL, 19% of Attenders considered the sound levels were 'too loud' where the MPEL was above 102 dB(A) as opposed to 4% who considered the same premises 'too quiet'.

8.9 Additional Noise Exposure

The most significant additional exposure likely to be experienced by Attenders will be obtained during employment. Table 8.18 shows that 14.5% of all Attenders said they had to 'shout' to make themselves heard at work, implying that the noise levels were around the 90 dB(A) mark. From the replies relating to occupation some 14.5% of the 'Attenders' population are in occupation where there may well be some risk of high noise levels. These occupations are in Occupation Groups 1 to 22, but excluding groups 8, 14, 21, in Table 8.19 which represent the manufacturing and production industries in the Department of Employment Classification shown in Appendix 5. However, see section 10, page 49 for further comments on this point.

In addition to occupational exposure there may well be exposure to high sound levels in other forms of entertainment. Tables 8.20 and 8.21 show the responses to questions 15a and 15b which enquired of attendance at pop concerts and pubs and clubs where loud music was played. In these tables column 3 should be ignored as this question was not included in the earlier interviews. Of the remainder, 38% of Attenders also attend pop concerts and 75% attend pubs and clubs. These results should be interpreted with care as no information is available on the frequency and duration of this form of exposure.

However, from the educational data, Tables ED.7 and ED.8 which cover roughly the same age range as those in the Disco data where information is available, only some 10% regularly attend pop concerts (colums 2 and 3) and 75% regularly attend pubs and clubs. Probably the more reliable data is that concerning pop concert attendance as the replies to attendance at pubs and clubs may well include youth group disco attendance in the early age groups.

Overall there is sufficient evidence to suggest that a large proportion of Attenders will receive some additional noise exposure from entertainment which cannot properly be quantified but some 15% of Attenders may be subjected to significant risk during the course of their employment.

8.10 Personal Data

The major features of the personal data have been discussed elsewhere within the main survey results but it is appropriate to comment on two aspects which have not received specific attention. Firstly, in the data relating to marital status, Table 8.22, no comment has yet been made on variables 2 & 3 of that Table which consider relationships between the sexes other than marriage. And secondly, the distribution of occupations in Table 8.19 seems worthy of comment.

Columns 2 and 3 of Table 8.22 relate to 'going steady' and 'engaged' relationships respectively and overall amount to some 25% of the total Attenders. The 'engaged' proportion is small, some 7% and whilst no evidence is presented to support it, it is strongly suspected that this group could be added to the married proportion as an additional influence in determining the age at which attendance ceases.

From the occupational data the distribution of occupations broadly follows the national pattern (CSO 1977), within a small margin of error, reflecting both the diversity of occupations in the area in which the survey was conducted, and the ubiquitous attraction of the discotheque. A similar distribution is to be found in the comparative data.

8.11 Male/Female; Differences of Attendance

The difference between male and female attendance is small. Based on weekly percentile hours of attendance the differences are shown below

	differences dB		
	50%	10%	5%
Males	+ 0.3	+ 0.7	+ 1.2
Females	- 0.3	- 0.6	- 1.0

These higher values for males arise from more frequent attendance as females tend to stay rather longer than males at each attendance.

The Age at which attendance commences is the same for both males and females at all the percentile values reported but the peak age group in the age group distribution is in group 3 for females and group 4 for males although the median age is almost the same; late 21 years for females and early 22 years for males. Because of this difference in age distribution males have approximately an equal probability of attending from group 3 into group 4 whereas the probability for females is less (about 78%); this is most likely to be accounted for by the earlier age of marriage of females. Beyond group 3 the age distribution is approximately the same for both males and females and because of this, together with the similar age of commencement, the two groups will have similar overall lifetime attendances. Although at the 50% level, because of the shift in the peak age group from group 3 to group 4, the males are likely to experience 1 to 2 more years exposure amounting to an addition of just over 1dB to the male NIL. The reverse of this can be expected for females.

Overall the difference in NIL is in the order of + 2dB for males and - 2dB for females.

8.12 Comparative Data

The data from other centres have been combined into two files; Discotheques and Educational Institutes. No attempt has been made to compare centres as the individual centre results involve rather small amounts of data. In all 440 interviews were conducted in 11 discotheques and 490 in 13 educational institutes. The two files were processed in an identical manner to the main survey data and the results of the principal parameters are shown, together with the main appropriate main data results, in Table 8.23. The comparative data values show good agreement with the survey data in both discotheques and educational premises. The data from which the values given in Table 8.23 are obtained are presented in Appendices 3 and 4 but the age structure of the comparative disco population is also shown in Table 8.12.

8.13 Summary of Attendance Survey

(1) The attendance data suggests that approx 10% of all attenders do so on a casual basis, i.e. less than once per month. This element of casual attendance increases with age.

(2) The age distribution of regular attenders shows that the median age is 20 years and the 10th and 5th percentile are 30 and 35 years respectively.

(3) The questionnaire and objective data for determining the duration of each attendance are in reasonably good agreement and give median duration of approx. 3 hrs, a 10% value of approx. 4.5 hrs and 5% value of 5.1 hrs but a small correction, - 1dB, is appropriate to these higher values when calculating the NIL.

(4) The weekly hours of attendance, whilst varying with age group, show that percentile values of 50% = 4.5 hours, 10% = 10.5 hrs and 5% = 15.0 hrs over the whole age range of attendance can be used without introducing serious errors into the calculation of NIL.

(5) Variation of attendance over the year, i.e. Winter/Summer leads to a small correction,-1dB, in the calculated NIL.

(6) For all regular attenders, 50% commenced attendance before the age of 15 years and 5% before the age of 11 years although the age of first attendance increases with age group.

(7) The age distribution shows that attendance begins to decline after age group 3 (17-19) and that few attenders (5%) continue attendance beyond 35 years of age.

(8) Based on Group 3 (17-19 year olds), the 50% life time duration is 7 years; for 10%, 18 years and 5%, 24 years. Other probabilities can be worked out from the data but the stated values were obtained by using what is considered the most accurate method for the data and give the best estimate of maximum duration.

(9) Some 12% of all Attenders considered the music 'too loud' and 7% thought it 'too quiet'. Tolerance of high sound levels decreases with age. Sound levels were also considered 'too loud' by 19% of Attenders where the MPEL was above 102dB(A).

(10) In addition to exposure in Discotheques 14.5% of Attenders may have some additional noise exposure at work together with exposure at other forms of entertainment such as pop concerts.

(11) Marriage, and the age at which marriage occurs, appears to be a determining factor in the age at which attendance ceases as the percentage of married attenders in the earlier age groups, (approx. 15%) compared with the percentage in the population (approx. 44%) is significantly less.

(12) Differences between male and female attendance should not exceed $\pm$ 2dB in the calculation of NIL.

(13) The comparative data from other centres shows good agreement with the survey data.

9.0 Evaluation of NIL and Associated Hearing Damage Risk

The parameters of the exposure previously evaluated can now be combined to determine NIL by the relationship:

$$NIL = L_{eq} + 10 \log_{10} \frac{t}{40} + 10 \log_{10} \frac{T}{T_o} + k_1 + k_2 \quad ..(2)$$

where t = hours per week, T = duration of exposure in years, 40 and T_o are reference values of 40 hours per week and 1 year respectively, k_1 is the correction for length of each attendance (8.3) and k_2 is the correction for yearly attendance (8.6).

The values L_{eq}, t and T are shown in Table 9.1. These variables are independent of each other therefore the probability of any combination of the three required variables can be obtained by multiplying together the appropriate probability of each event. Overall 27 combinations are possible from the 9 values given leading to probabilities ranging from $p \leq 0.125$ to $p \leq 0.000125$ or 1 chance in 8 and 1 chance in 8000 of that particular combination.

The NILs for $p \leq 0.125$, $p \leq 0.001$ and $p \leq 0.000125$ are shown in Table 9.2. Using the Robinson and Shipton Tables the Estimated Noise Induced Loss can be calculated. This has been undertaken at three levels of susceptibility; 50%, 10% and 5%. By combing the associated probabilities of these events with the probability of achieving a given NIL the overall probability of L_{eq}, attendance data and hearing loss can be determined. Table 9.3 shows the Hearing Threshold Levels at the six frequencies, 0.5, 1, 2, 3, 4 and 6 kHz together with the average of the 0.5, 1 & 2 kHz and the 1, 2 & 3 kHz and also the probability of these percentile values being achieved.

The criteria by which hearing impairment is judged is based on the ability of the individual to understand normal speech in the absence of background noise. For this purpose various standards have been derived which are associated with the average hearing level over different combinations of audiometric frequencies and are quantified in terms of percentage handicap. Over the 0.5, 1 & 2 kHz frequencies handicap is just beginning at an average of 25dB (AA00 1970) and increases at a rate of 1.5% per dB. The equivalent UK value over the 1, 2 & 3 kHz frequencies is 34dB although BS5330: 1976 which is based on the Burns and Robinson data now sets the level at 30dB. From Table 9.3 the results, which include losses due to age, show that the 25dB level at 0.5, 1 & 2 kHz is exceeded where NIL = 111dB at both the 5% and 10% level of susceptibility and almost reached at 5% for NIL = 107dB. The 34dB and 30dB levels at 1, 2 & 3 kHz are exceeded, or almost, for the same levels of susceptibility and NIL. A feature of the results is the significant loss at high frequencies even at those level of susceptibility and NILs which do not show hearing levels sufficient to cause speech impairment. It may well be that such losses would interfere with spatial location of sound or the enjoyment of music.

The results in Table 9.3 show hearing levels at the end of discotheque attendance. Subsequently hearing will continue to deteriorate with age and Table 9.3 also shows the hearing levels at age 60 years, assuming no additional long term noise exposure. For the purposes of this exercise a median value of presbycutic data has been used although this ageing effect is known to have a distribution in the population. At this age, in addition to the three groups already identified, one additional group with NIL = 107dB at the 10% level of susceptibility also exceeds the 25dB, 30dB and 34dB levels.

The probabilities associated with the occurrence of a given hearing level are shown in the first column of Table 9.3 and shows that the risk of achieving the higher hearing levels is small. This is attributable to the independant nature of the parameters contributing to NIL and the varying suceptibility of the population to noise induced hearing loss.

An alternative method of estimating risk is to use the Robinson and Shipton, or BS 5330, data to determine the percentage of the population achieving a given threshold. Using BS 5330, which includes ageing effects, the percentage of the population reaching a threshold level of 30dB average over the 1, 2 & 3kHz range after their attendance has ceased and at age 60 will be;

NIL	% attaining or exceeding 30dB (ave. 1, 2 & 3 kHz)	
	End of Attendance	Age 60
95	0.0	2.5
107	7.0	19.5
111	15.5	31.5

Again it must be emphasised that, although the percentage of population at risk seems high, particularly at NIL = 111, the probability of achieving these higher values of NIL is low.

Many other possible combinations of L_{eq}, weekly attendance hours and lifetime durations can be obtained from the data. Three which are of interest are the median, 10% and 5% values of NIL for the combinations of three variables and from the data these turn out to be 85dB, 96dB and 97dB respectively. The associated risk is small but for completeness the expected average threshold levels at 1, 2 and 3 kHz and percentages reaching the 30dB average by BS 5330 at the end of their attendance period are shown in Table 9.4. Also shown is the expected variation in the normal population.

10. Estimation of Number of Attenders at Risk

10.1 Overall Risk

An estimate of the numbers at risk can be obtained from the survey data using:

(a) the educational survey data to determine the proportion of persons attending in the lower age groups from the population at large (Table ED.2),

(b) the age structure of Attenders in the licenced discotheques to determine the proportion and number attending in the upper age groups (Table 8.12) and,

(c) the probability data given in Table 9.3 to obtain the numbers at risk.

From the educational data Table ED 2, the proportion of Attenders (once per month or more) from the total population increases from 36% in group 1 to 56% in group 3 although the actual distribution of Attenders in groups 1 and 2 relative to group 3 (Table 8.1) is rather less than these percentages would lead to expect. The educational data is biased in terms of the occupations of the sample population towards full time students relative to the discotheque Attenders but the group 3 sample is less so than groups 1 and 2 (Table ED 9). If it can be assumed that this group is reasonably representative of the population at large then the number of Attenders in each age group, above and below group 3, can be obtained. It is clear that this can only be done with caution because of the discrepancy between the two populations but at 56% the error in the proportion of Attenders is unlikely to be more than $\pm$ 10 or 15% bearing in mind that a further 10% are casual attenders.

Using the group 3 percentage of 56% as the basis of the estimate, the educational data for the lower age groups and the proportion of Attenders shown in Table 8.12 for the upper age groups the total number of regular attenders at discotheques is put at around 6 million, or about 23% of the population over the age range 11 years to 49 years. The breakdown by age group is shown in Table 10.1.

From the NIL data, Table 9.2, and the above estimate of approx. 6 million Attenders it can be shown that 750,000 Attenders will have a NIL above 95dB. Of these 744,750 will have a NIL less than 107dB, 5,250 greater than NIL = 107dB but less than 111dB and 750 Attenders with a NIL greater than 111dB. Table 10.2 shows the number of Attenders at risk based on the data in Tables 9.2 and 9.3. The results shown should be interpreted with care and the values for each given NIL should be considered independently as the stated NILs apply to the same population and the lower NIL values and associated populations include the higher values. For example, some 750,000 Attenders will be exposed to a NIL greater than 95dB and therefore includes the higher NIL values of 107dB and 111dB so that the numbers at risk at a given level of susceptibility apply to the group as a whole. Similarly, taking NIL = 107dB as the starting point the population of Attenders in this group will include Attenders with NILs greater than 111dB.

Moreover, for NIL values below 95dB, which have a greater probability, some small percentage of the more susceptible Attenders will achieve threshold levels equal to, or higher than, NIL = 95dB estimates; for example 1% of the population exposed to a NIL of 85dB, which is approx. $p<0.5$, will experience approximately the same threshold shift as 6% of Attenders with an NIL of 95dB. It should also be borne in mind that in the otologically normal, non noise exposed population there is a variability of hearing levels which are included within the estimated thresholds and for the higher percentile values may amount to some 10dB over the range of frequencies over which impairment is calculated, therefore the actual noise induced shift is smaller than indicated. An example of this variability can be obtained from an examination of the Robinson and Shipton Tables which show that even at NIL = 111 some 5% of the population will have a threshold level of -5.3dB, that is 5.3dB better than the median value of the non noise exposed population.

The alternative approach adopted by BS5330 of estimating the numbers at risk of achieving the 30dB (ave). shift at 1, 2 and 3 kHz is shown in Table 10.3. This shows that 420 Attenders, or 7% of those exposed to NIL = 107, will achieve the 30dB level at the end of their attendance period. This percentage increases to 19.5% (1140 persons) at age 60 and although the percentages at risk increase when NIL = 111dB the numbers fall as the probability of experiencing that NIL is much less.

The attendance data indicates that some 14.5% of Attenders are at some additional risk of noise exposure at work. From this value it would appear that some 870,000 persons are at risk. Compared to the total estimate by the Health and Safety Executive of 0.7 and 1.0m workers at risk of experiencing levels above 90dB(A) this value would appear rather high. However, the noise levels to which these Attenders were exposed cannot be quantified in any way and levels around the 80 - 85dB(A) mark may well be included. Alternatively, it may indicate that the estimate of number of Attenders is too high or of some error in coding occupations. Analysis by occupation, Table 10.4, shows that 38% of the positive responses to the question of noise at work occur in the higher numbers of occupations, i.e. 24 and above, which are not normally considered noisy occupations. A search of the raw data indicates that some responses are from computer operators, office reprographic services and garage mechanics which are all included in these occupational groups. Nevertheless it would appear that there may be an overestimate of risk which can be attributed to the rather non-quantitative nature of the question and the non-specific coding of occupation. Reducing the estimate by what appears to be misinterpretation or error gives a proportion at risk of about 9% or some 540,000. From the rather uncertain nature of this data the numbers at risk of additional exposure at work might be put at between 10 - 12% and conclude that the noise levels referred to might be as low as 80 - 85dB(A).

The numbers at risk of additional exposure to pop music played at pop concerts and in pubs and clubs is large. The data shows that 75% of Attenders visit pubs and clubs whilst some 38% also attend pop concerts. The educational data also indicates that some 10% of Attenders are regular attenders at pop concerts but some 3.5% attend at least once per week. The degree of risk from these sources cannot be defined from the survey data but some additional evidence shows that pop concert attendance is potentially more likely to increase risk than attendance pubs and clubs.

Overall the risk of substantial hearing damage at the end of the attendance period is small and from the survey data and the Robinson and Shipton tables the NIL at which the 'low fence' threshold of 30dB is just beginning is 97dB. This NIL is experienced by 5% of Attenders. At this NIL, 0.5% of the exposed population are expected to reach the 30dB ave. From the population estimate the number likely to experience this level of impairment is approximately 1500 persons or 0.025% of all Attenders which would be expected to increase to 0.2% at age 60.

10.2 Variation in Numbers at Risk

The estimate of some 6 million Attenders refers to the total number attending at any one time during the autumn to spring months over which the survey was completed. However, attendance is likely to vary over the year, being lower in summer and higher in winter (see 8.6) and, although this variation applies primarily to the number of attendances by individual Attenders, is clear that some of the less requent attenders will become non-attenders (i e less than once per month) during the summer months whereas some of the non-attenders may well become regular attenders for short periods during the winter. Overall this should have little effect on the number involved nor significantly alter the exposure over the year.

Another important quantity to be determined is the number of Attenders commencing their attendance period. Once this cohort of Attenders enters the system they will experience the whole range of sound levels and attendance variables encountered in the survey, resulting in the associated risk previously discussed. Estimates of the yearly input of attenders can be obtained from Table 8.11 together with the census and attendance data shown in Table 10.1. Table 8.11 shows the age at which Attenders said they commenced regular attendance. Plotted cumulatively, curve (a) Fig 10.1, this data shows that 88% of Attenders commenced by the age of 18 and 95% by the age 25. The year-on-year increases over these periods are 11% and 1.5% respectively beyond which the rate falls to approx 0.25%. Applying these rates of commencement of attendance to the respective age groups then the numbers of New Attenders in any one year amounts to around 355,000.

An alternative estimate can be obtained from the distribution of age groups and the number of Attenders shown in Table 10.1. As the age group data represents a cross section in time of Attenders it can be assumed that the increasing proportion of Attenders, in age groups up to group 3, represents new Attenders over and above those continuing their attendance from previous years. In this part of the distribution the number of new attenders, by age, can be obtained from the year-on-year

percentage increase in the population. Beyond group 3, there is a net decrease in number of attenders and new attenders can only be estimated by extrapolation but, as the majority of attenders (90%) said they commenced attendance before age group 4 (Table 8.11) then, the error is unlikely to be a serious one. Fig 10.1 shows the proportion of Attenders in age groups, from Table 10.1, plotted cumulatively as a smooth curve (b). However, within each age group the real increase in New Attenders will be greater than the apparent increase represented by the curve by a factor of + k ($\sum_{x=0}^{n} x_i$) where x = age in years -11 and k $\triangleq$ 0.5% per year and where k is based on the rate at which the population in each age year declines, as a percentage of total number of Attenders, as some Attenders discontinue their attendance. Strictly, k is not constant, but varies with age group and is proportionate to the number of Attenders entering in any year. But k = 0.5% is a reasonable average for age groups 1 to 3 inc. in which the majority of Attenders commence attendance. Applying this correction the rate of increase of New Attenders is shown in curve (c) with extrapolation beyond group 3 shown as a dotted line. (The source of the data shown in Table 10.1 is the Educational Data Table ED2, which indicates regular attendance in the total population). Curve (c) shows 90% of Attenders commenced before the age of 20, a year on year increase of 9%, falling to 2% per year between 20 and 25 and to 0.1% per year beyond that. Applying these rates to the population figures in Table 10.1 puts the estimated number of New Attenders from this data at around 365,000 per year.

The estimates from the two sources are in reasonable agreement and amount to some 6% of the total number of regular attenders commencing attendance each year. As the data is more accurate in the earlier years and ignoring the later years, say beyond 23, then the rate of year on year increase is around 8% or 475,000 persons per year, which might might be regarded as an upper limit.

Applying the previously discussed risk data to incoming attenders the number reaching the 30dB threshold amounts to between 90 and 120 persons per year from the results of discotheque attendance.

11. Risk of Noise Induced Hearing Loss in Persons Employed in Discotheques

In addition to details of exposure experienced by Attenders some information was obtained on the exposure of employed persons. This group consisted of Disc Jockeys, Bar Staff etc., but not musicians, employed in and around the premises. The amount of data available, from both licenced and unlicenced premises, is small, amounting to 26 Dose Meter L_{eq}As and 23 interviews.

11.1 Dose Meter L_{eq}s

The mean Dose Meter L_{eq}A was 98 dB(A) with a standard deviation of 4.0 dB(A) only slightly above the attenders value of 96dB(A) and 97dB(A) in licenced and unlicenced premises respectively. However, one individual, a general stage hand to a group, reached a value of 118dB(A) (without overload); we found this value worthy of special note as this was, by some 9dB(A), the highest Dose Meter value recorded in the survey and 2dB(A) above the appropriate MPEL.

11.2 Attendance Data

The median length of each attendance was 4.8 hours and median number of attendances per week was 4.9 giving a median weekly attendance of 23.5 hours; an equivalent weekly L_{eq} of 96dB(A) to the nearest dB.

The median age of the group was 21 years, the same as the attenders, and the median age of commencing disco attendance was 16 years. However, this latter question on age of commencing attendance from the questionnaire is not appropriate to the employee as it is unlikely that the age at which attendance commenced would be the age at which he or she commenced employment in discotheques. Neither is it possible to obtain any firm indication of the upper age limit in order to estimate some lifetime duration of attendance other than to report that the upper age group was group 10 (38-40 years). It would seem most unlikely that the 24 years between these extremes would represent any real estimate of duration of employment as the conditions of employment, i.e. the unsocial hours of work, are hardly conducive to long term employment other than for higher management. What is clear is that for a number of employees, including some DJ's, this activity was a part-time job in addition to some full-time post elsewhere which further tends to suggest that the duration of employment may well be short term, say up to 10 years but more likely 2 or 3 years. These are no more than rough estimates and this is an area which needs further investigation.

The only direct comparison which can be made is with the 90dB(A)L_{eq} for a 40 hour week set out in the Department of Employment's 'Code of Practice for Reducing the Exposure of Employed Persons to Noise' (HMSO 1972) in which case the sound level of 98dB(A) L_{eq} would require an exposure of not more than around 6 hours per week if ear protection was not used.

2. Discussion

The accuracy and usefulness of the survey data is best demonstrated by comparing the results prediced with measured hearing losses associated with discotheque attendance. Such data are difficult to obtain as, to be directly comparable, other noise exposure must be excluded and the population must be otologically normal. The data of Fearn (1976a & b) most nearly fills these requirements. In these investigations rigid otological criteria have been applied in selecting the population but, whilst the principal exposure appears to have been in discotheques, other forms of pop music exposure are also included.

In Fearn's (1976a & b) data 10% of all 124 Attenders exceed an average threshold of 9.5dB over the 1, 2 & 3 kHz frequencies. Assuming the whole group had experienced the range of exposures determined in the survey, the median NIL would be 85dB over their 3 to 4 year duration of exposured. From the Robinson and Shipton tables 10% of that population would have reached an average of 9.3dB at 1, 2 & 3 kHz, quite close to the measured value. The survey data would also predict that one or two attenders from Fearns group would experience thresholds in this frequency range in excess of 14dB by exposure to higher NIL values (10% = 96dB; 5% = 97dB) although Fearn's data does not refer to such occurrences. Alternatively, using the data shown in Table 2.3 and the median combination of L_{eq} and duration of attendance (94dB(A) and 3.3 hrs), the predicted 10% levels at 1, 2 & 3 kHz turns out to be 11.6dB, 9.8dB, 9.3dB and 8.8dB for the 2/week, 1/week, 1/fortnight and 1/month attenders respectively, again quite close to the measured values. A 50% agreement is not quite so good. The survey predicts a shift of only 0.6dB over the three frequencies when NIL = 85dB whereas Fearn's data shows an average shift of 2.8dB. However, bearing in mind the small size of the sample and the possible range of exposures the overall agreement is close enough to suggest that existing damage risk criteria can be used without serious error.

Higher losses in the upper frequencies, greater than 2 kHz, have been reported by Lipscomb (1970) and Flottorp (1973b). Once again direct comparisons are difficult but from Lipscomb 1969 data from 734 freshmen students (age 18-19) some 14.8% had reported thresholds greater than 20dB at 2, 3, 4 and 6kHz. From the survey data, correcting for Non Attenders, less than 1% of Lipscomb's population would have reached the level of threshold shift as a result of discotheque attendance. The difference in these results is substantial and it is difficult to find a satisfactory explanation without further data, except that the population is unscreened and exposure unknown. Lipscomb's results are not supported by the data of Fearn with attenders who might be expected to have experienced longer exposure. Nevertheless, the high frequency losses predicted by the survey can be substantial (Table 9.3), but it has not been possible to obtain references to any investigations which indicate the degree of impairment which such losses might bring. Sound location and music appreciation may be affected and this would appear to be a suitable avenue for research.

The assumption within the survey data is that the model of attendance patterns and sound levels is a static one. This is clearly not the case, in reality the model is dynamic, particularly for the individual, in which

the changing patterns of exposure will be influenced by the prevailing fashion. The static model has attempted to define the general envelope of exposure and the values obtained are likely to give maximum exposures based on current experience. The dynamic nature of exposure is subject to certain constraints and it is possible to suggest limits.

Whilst the type of music played is important, the prime function of the discotheque is a meeting place for the sexes and it is difficult to contemplate this role being replaced by any other activity yet available on the entertainment scene. This observation is supported by the higher levels of attendance in the 17 to 24 age groups and the very large proportion of unmarried attenders in these groups. This activity sets the general age range. At the lower limit of the age range attendance will be subject to parental control whereas the upper limit is controlled primarily by marriage and it is more than likely that the limits of the age range have been encountered in the survey.

Currently, the maximum duration of attendance is controlled by commercial factors, in particular, the licencing laws although the actual attendance is considerably less than the actual opening hours except in unlicenced premises. A significant feature in licenced premises is the cost of drinks and most attenders arrive after the local public houses close. Therefore, unless prices become comparable or other features introduced to make premises more attractive then the duration of attendances is unlikely to change. For example, it is unlikely that the average duration of attendance would increase by 1 hour which even if this were to be the case, would only increase NIL by 1dB.

The most probable changes occur in weekly attendance brought about by changes in the pop scene and music fashion. Such changes can be expected to be short term, e.g. 3 - 6 months, and might be considered as a modulation about some mean value. Over these short term periods it is possible that attendance may double at the median level but is unlikely to affect the higher percentile values. A limiting factor will be cost. Overall, this variation could well be accounted for in the overestimation of the number of years of attendance, as individuals are more than likely to vary their attendance over their attendance period, particularly at the higher percentile values.

The variation in L_{eq} is inherent within the type of music played and will be affected by the changes in music fashion and in the choice of equipment used at each performance. The survey has shown that considerable variation occurs between premises and in the same premises on different occasions.

From the above discussion, although the dynamic nature of the exposure is recognised, the constraints acting on exposure are considered to limit the variation within the overall boundaries set by the survey; at least over the lifetime exposure period.

Future trends are more difficult to predict but some changes are possible. For the reasons given above and for sound commercial reasons

it is unlikely that the discotheque fashion will be totally replaced although undoubtedly the music will. It is in the structure and operation of the premises where the more significant changes are more probable. The larger operators are moving towards smaller, more intimate, dance floors with sound focusing systems with 'quiet' area for conversation and often separate restaurant facilities. 'Total Entertainment' schemes are being planned which include cinemas, bowling alleys, etc. the effect of such premises would be to reduce exposure. However, such developments apply only to the larger operators and the smaller commercial premises will retain their primary interest in dancing. In unlicenced premises, Youth Groups etc. few changes can be expected other than the introduction of more sophisticated equipment and the increasing hire of live groups.

The possible introduction of more live groups into the youth group or similar premises leads to some concern. Currently the operation of this form of disco leaves much room for improvement. The ad hoc nature of the event means that loudspeakers are often placed indiscriminately around the dance floor within touching distance of dancers and, on one occasion, a young attender was seen sitting within the horn of a loudspeaker. The possibility of live groups with more powerful equipment being introduced into these smaller, acoustically more 'live' premises suggests increased risk to the younger attenders. Any such development should be carefully monitored and controlled.

Trends in sound levels are likely to be influenced by the design of systems rather than any requirements of attenders. The survey presents evidence which suggest that sound levels are largely acceptable, around 102dB(A) MPEL and 97 L_{eq} (dose meter), although more attenders considered levels 'too loud' than 'too quiet'. This suggests that any increase in levels would tend to shift the distribution towards the 'too loud'. Additionally, the evidence concerning the relationship between MPEL and the dose meter L_{eq}s (Fig. 7.4) which indicates that attenders tend to reduce their exposure as the sound level increases, also supports the view that current levels in discotheques are about the maximum likely to be achieved or tolerated.

On the question of loudness, there remains one outstanding issue which has not been resolved by the survey. That is why are such levels as those experienced in the survey necessary? It is possible to suggest a purely physical reason. The background levels caused by conversation etc. in a crowded room, as indicated by the sound level survey, are high, typically of the order of 80-88dB(A) (Table 7.3) above which attenders would no doubt wish to listen to the music. Therefore, the difference between this background level and the attenders L_{eq} of 96-97dB(A) represent the sound intensity necessary to maintain audibility of the music. Beyond this, the only other explanation is a psychological one and it may well be there are opportunities for research in this field.

The survey has identified areas of additional risk. In particular, at work, from attendance at 'pop concerts' and at 'pubs and clubs'. In

the latter case although attendance is wide spread throughout the discotheque and educational data survey population this risk is probably the least serious as the nature of these premises is such that music at any level approaching that found in discotheques would not be tolerated by the patrons or management. The additional risk at work and at 'pop concerts' needs more serious consideration as, in the first instance, the duration of exposure is considerably longer than any other form of noise exposure activity and in the latter the levels experienced are likely to be considerably higher than those in discotheques. Beyond identifying the problem and the likely proportions of the population at risk, (38% pop concerts and 10-12% at work) it is only possible to speculate on the additional element of risk.

At work, assuming 90dB(A) L_{eq} for the working day and median dose meter L_{eq} and weekly attendance (97dB(A) and 4.5 hrs/week $p < 0.25$) then the resulting combined 8 hr L_{eq} would be 92dB(A) over the Attender's attendance period. For pop concert attendances the position is even more difficult but limits are possible. Concerts are less readily available than discotheques and the main promoters, at least in the survey area, are the Student Unions in the colleges and universities and events might average once per week during term time. Dose meter L_{eq} s from a small sample have reached 109dB(A) over a 2 hr concert which is equivalent to 96dB(A) over a working week; significantly higher than the weekly L_{eq} of the median discotheque attender of 83dB(A) (Weekly L_{eq} - $p < 0.5$). Fortunately, the educational data, Table ED7, indicates that only 3.5% of the population achieve this level of attendance. However, the number at risk, particularly in the student population, could be large. This is an area of the problem which would merit further investigation.

The comparative data obtained from other centres shows good agreement with the survey but may be somewhat restricted in the extent of its application to the country as a whole. In particular, almost all the data, both survey and comparative, has been obtained in urban areas and it may well be expected that rural area levels of attendance may be lower due to restricted availability of licenced discotheques. The attendance data also suggest that males may be slightly more at risk than females because of their rather more frequent attendance than females but the difference is small, in the order + 2dB on NIL, which may well be lost within the variation of attendance over the whole period of attendance.

Our estimateof 6 million Attenders (once a month or more) is based on a number of assumptions within the data which are not wholly justified but we expect the true value to be within $\pm$ 10 to 15% and more likely lower than higher. And, although the numbers exposed is large the number at risk of reaching 'low fence' impairment of hearing at the end of their attendance period is small; less than 1500. We would however point out that the criteria by which hearing impairment is judged refers only to the speech frequencies there may well be other, less serious, but nevertheless debilitating effects, which we have referred to earlier, caused by the rather higher losses at high frequencies predicted by damage risk criteria.

It may be instructive to compare the results reported here with the problem of noise induced hearing loss from occupational exposure. Although range of levels and number of persons exposed are not known with any certainty the Health and Safety Executive (private communication) indicate that there are between 1.5 and 2.5 million employees exposed to levels in excess of 85dB(A) and some 0.7 to 1.0 million to levels in excess of 90dB(A) over the working day. Ignoring higher levels which will be achieved by a smaller number of workers and assuming a 30 year occupational exposure then, from the Robinson and Shipton Tables (excluding presbycousis) around 50,000 will achieve the 30dB, or greater, average hearing level at 1, 2 & 3 kHz compared with the 1500 Attenders predicted by this survey. Moreover, the comparison is rather a generous one as, for occupational lifetime exposures, the 30dB level can be achieved with L_{eq}s in the order of 81-82 dB(A) thus increasing the numbers of employed persons exposed to that level and, hence, more persons at risk. However, on the basis of the evidence presented here it would appear that the number of persons likely to experience significant hearing losses through attendance at discotheques is at least 30 times less than through occupational exposure.

From a small sample of employees, but excluding musicians, the weekly L_{eq} is 96 dB(A), 6dB(A) higher than the Department of Employment's recommended level of 90dB(A), and it may well be that a number of employees have other day time occupations which may add to the risk of hearing damage. The problems come within the scope of the Health and Safety at Work Act in which provisions exist to control noise exposure and we would draw the industry's attention to the need to examine the matter more closely.

Throughout this investigation we have been conscious of the background to the problem, namely, the pressure from some quarters to introduce legislation in an attempt to control sound levels. At this stage we do not believe this is the right approach and we can suggest three sound reasons to support our view. Firstly, the problem is only part of a broader issue; that of hearing damage in recreational pursuits and to single out on particular areas before the whole subject is fully investigated would, in our view, only seek to alienate the industry particularly as the demonstrable risk is small. Secondly, legislation is only effective if it has the general support of all parties and it is clear from our discussions that neither the industry nor the majority of attenders would favour this form of control. However, it is recognised that much of this disfavour was based on the previous experience in Leeds and was clearly influenced by the choice of sound level specified on that occasion. And thirdly, in addition to support from the parties, legislation must be effectively enforced. The burden of enforcement would fall on local authorities adding yet another task to the already stretched environmental protection services. Moreover, recognisable monitoring on premises would not necessary be representative of unmonitored levels whereas unannounced monitoring may lead to legal difficulties. The development of low cost permanent monitoring and recording devices may well change this viewpoint but currently the introduction of legislation is not likely to contribute to an effective solution in those areas where control is necessary.

Two alternative approaches are possible; the introduction of a Code of Practice and an education programme to increase the awareness of attenders to the risks involved. We would recommend that a Code of Practice be introduced after discussions with all the parties concerned. Such a code should include reference to: the power amplification system, the type and placing of loudspeakers, the provision of 'quiet' areas and the general arrangement of premises, levels recommended for various parts of the premises and the use of indicating and/or recording instruments. The code might well also include reference to other operational characteristics of the premises, in particular, the use of stroboscopic lighting and lasers which have recently been introduced into some discotheques. We consider such a code is particularly important for discotheques in youth groups and other similar premises.

Increasing the awareness of the individual to the risks involved and putting these risks in perspective with risks from other sources is of major importance, particularly in the long term. The Noise Advisory Council's booklet 'Hearing Hazards and Recreation' goes some way towards this aim and should be essential reading for all attenders. However, we would suggest that the information contained in that booklet can now be revised in the light of evidence from this survey. It has also been suggested to us that warning notices should be posted in discotheques, similar to the government health warning on smoking, and that sound level indicating devices should be available on premises for inspection by attenders. Both these suggestions have some merit and might be considered for inclusion within a Code of Practice but we believe a more fundamental approach is necessary and we see the school curriculum, in which all aspects of leisure activities can be examined in the light of the risk they pose to the individual, as the only effective long term solution.

We would point out that our recommendations on this matter are not new, this advice has been given to local authorities and others from this Polytechnic much earlier in this debate. We would, however, hope that the evidence presented here would add weight to those views and that a general consensus can now be reached on the approach to the problem.

13 Conclusions

We conclude that:

(1) Although the range of possible exposures to sound levels in discotheques is large the risk of noise induced hearing loss sufficient to cause impairment in the understanding of speech is small. Out of an estimated 6 million regular attenders some 0.025% might be expected to reach the 'low fence' impairment level of 30dB ave. at 1, 2 & 3 kHz at the end of their attendance period.

(2) The survey data shows good agreement with data obtained from other parts of the country but this comparative date may be subject to some limitations.

(3) Comparisons of hearing loss data from audiometry on groups exposed to pop music with values predicted by the survey shows some agreement and indicates that existing damage risk criteria can be used to estimate risk with reasonable confidence although the number of suitable comparative studies is small.

(4) Although risk of 'low fence' impairment is small, high frequency losses can be high even at moderate levels of NIL experienced by attenders and it is considered that development of criteria to assess this form of impairment would be useful.

(5) The model of attendance proposed by the survey is a static one but, whilst the dynamic nature of the problem is recognised, it is considered that the constraints acting on the variables of L_{eq}, weekly and lifetime attendance are such that these variations lie within the limits set by the survey.

(6) The sound levels experienced at discotheques are considered satisfactory by the majority of attenders but no reasons, beyond a purely physical one, can be offered why this is so. It is considered this subject may be worthy of further investigation. However, evidence is presented which suggests that current levels are at or near the limit of acceptability at approximately MPEL = 102/104 dB(A).

(7) In addition to exposure in discotheques some 10-12% of regular attenders have noise exposure at work although the extent of that exposure is undefined. It is, however, probable that 1 in 4 of this group would add some 2dB to a weekly 8hr L_{eq} of 90dB(A) over their attendance period.

(8) Exposure at other forms of pop music entertainment is widespread. Some 75% of regular discotheque attenders attend pubs and clubs where music is played and 10% also attend pop concerts, at least once per month. The risk at pop concerts is estimated to be more serious than elsewhere and there is a need for further research into this area of exposure.

(9) From a small sample of employees it is estimated that the 40hr L_{eq} is 96dB(A) some 6dB(A) above the Department of Employments Code of Practice limit of 90(A).

(10) We would also recommend that:-

(a) a Code of Practice be produced by consultation between the interested parties in order to limit unnecessary exposure

and,

(b) further attention be directed towards informing attenders of the possible risks.

Definitions

Attenders	- persons who attend discotheques once per month or more than once per month.
dB(A)	- 'A' weighted sound pressure level
Educational Institutes	- Includes, schools, colleges and universities in which students are in full-time or part-time education and also includes youth employment offices.
H	- Age corrected hearing level relative to controls in the age group 18 to 25 and referred to as 'presumed noise induced hearing loss in appropriate cases.
H'	- A hearing level of a noise exposed group relative to non exposed controls in the age group 18 to 25.
L_{eq}	- The 'A' Weighted Equivalent Continuous Sound Level
Licenced Premises	- Discotheques which are licenced to sell beer, wine and spirits in which the minimum age of admission is 18 years of age.
MPEL	- The L_{eq} over the duration of a performance measured at the nearest point in the discotheque to a fully operational loud speaker that the attending public are allowed to approach.
Unlicenced Premises	- Discotheques which are not licenced for the sale of beer, wine and spirits (primarily Youth Groups, Church Institutes etc).

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Figures and Tables

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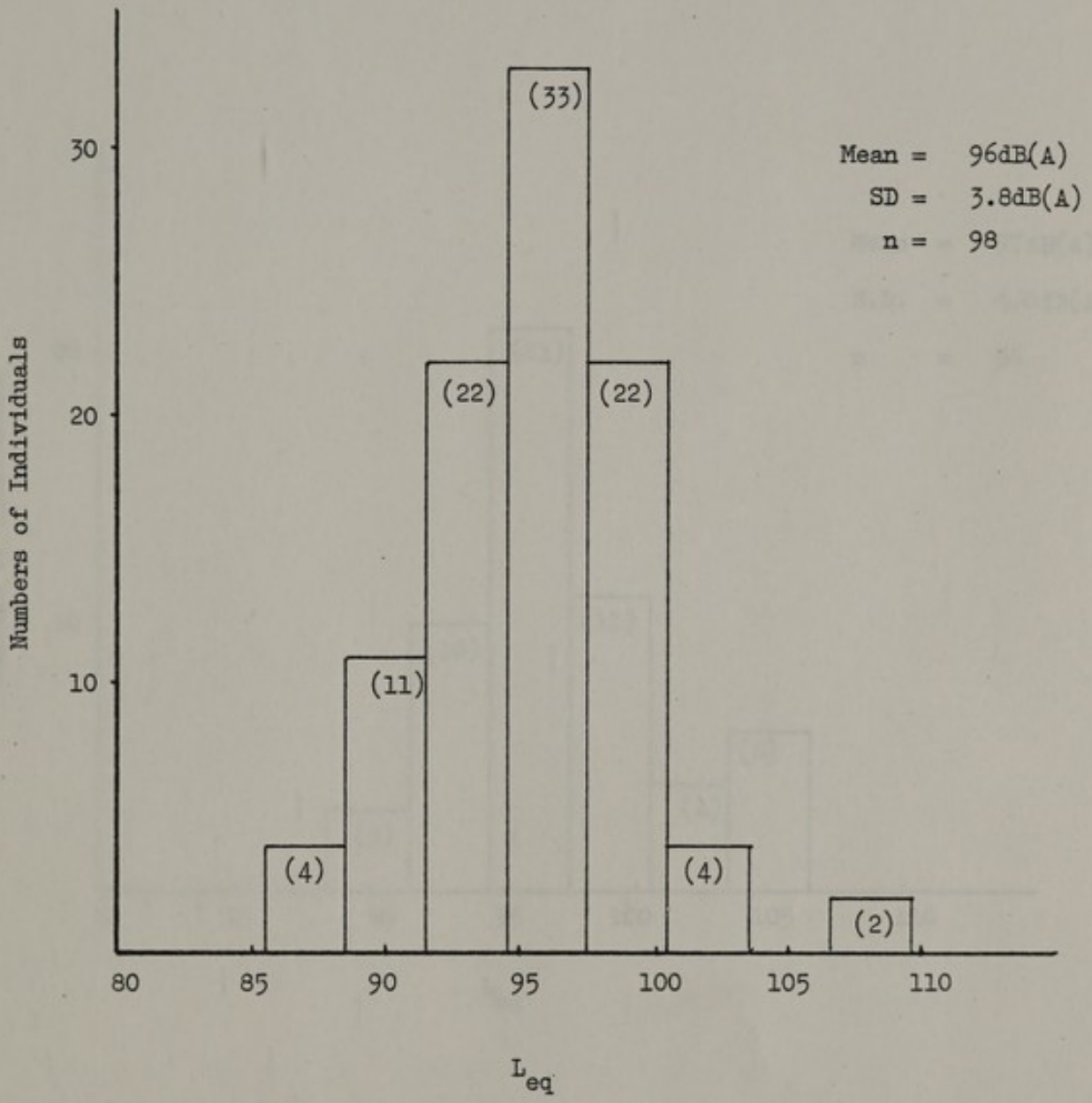
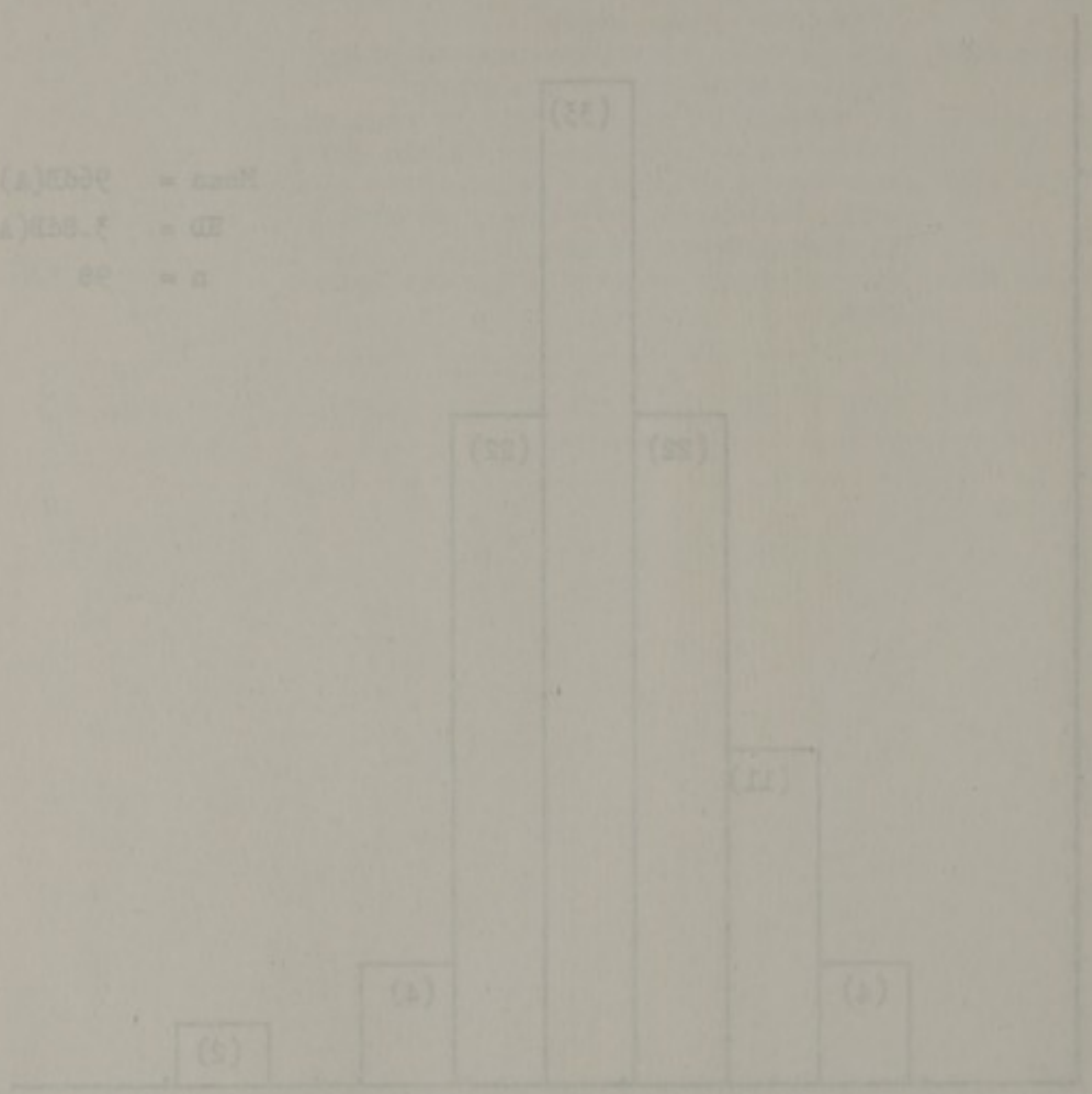


Fig 7.1 Distribution of Dose Meter L_{eq} s in Licenced Discotheques



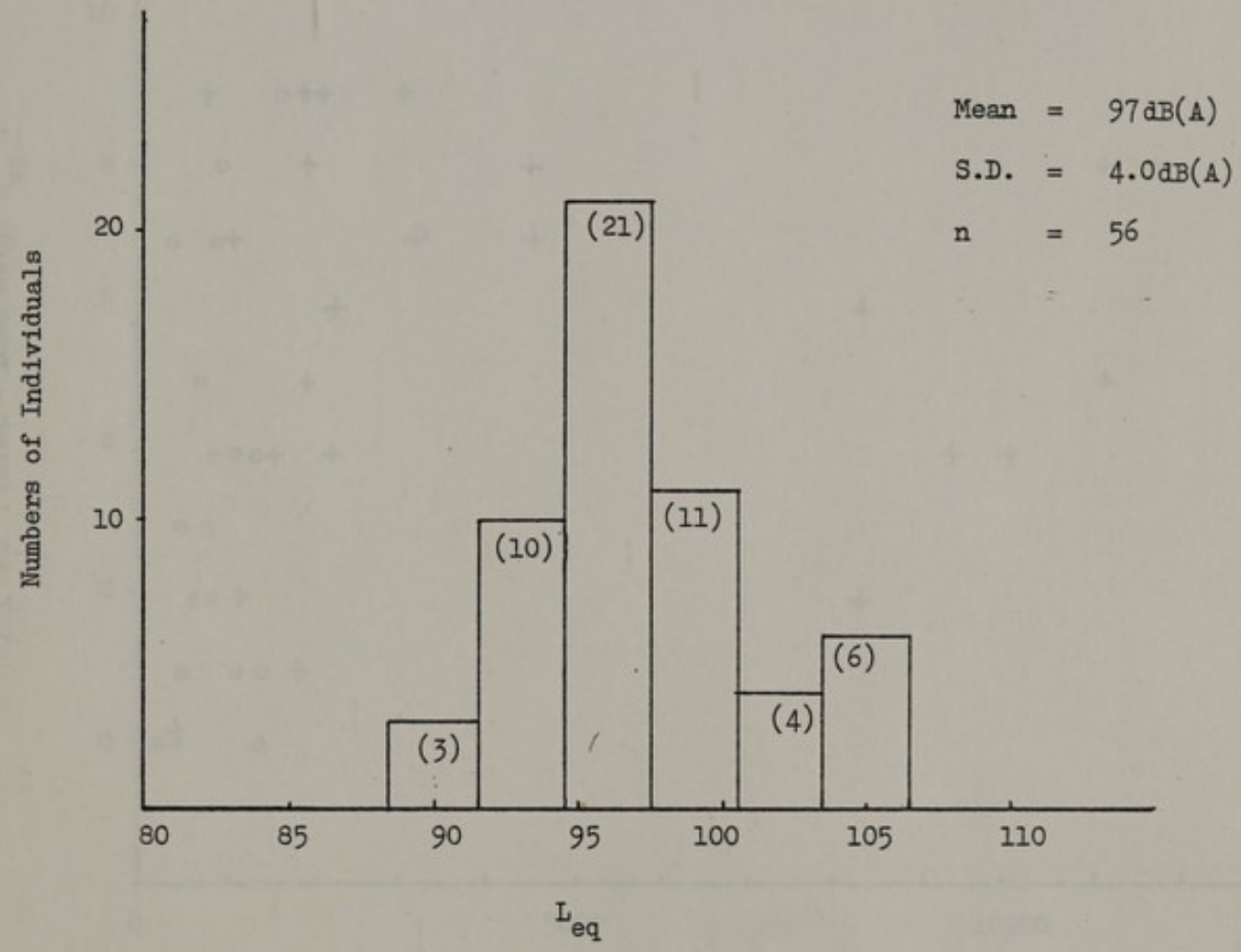


Fig 7.2 Distribution of Dose Meter L_{eq} s in Unlicenced Discotheques


(6)
(4)
(23)
(120)
(3)

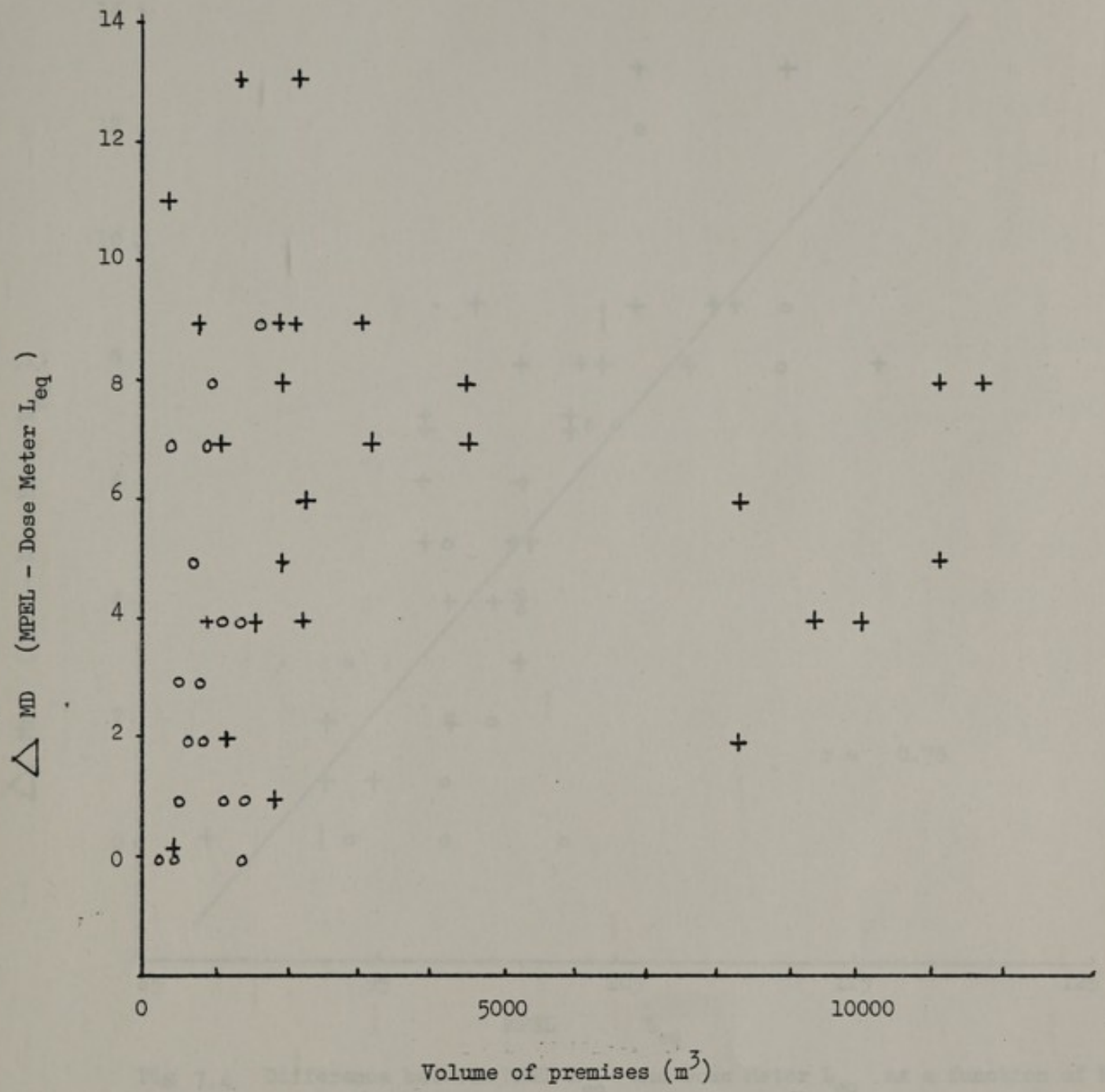
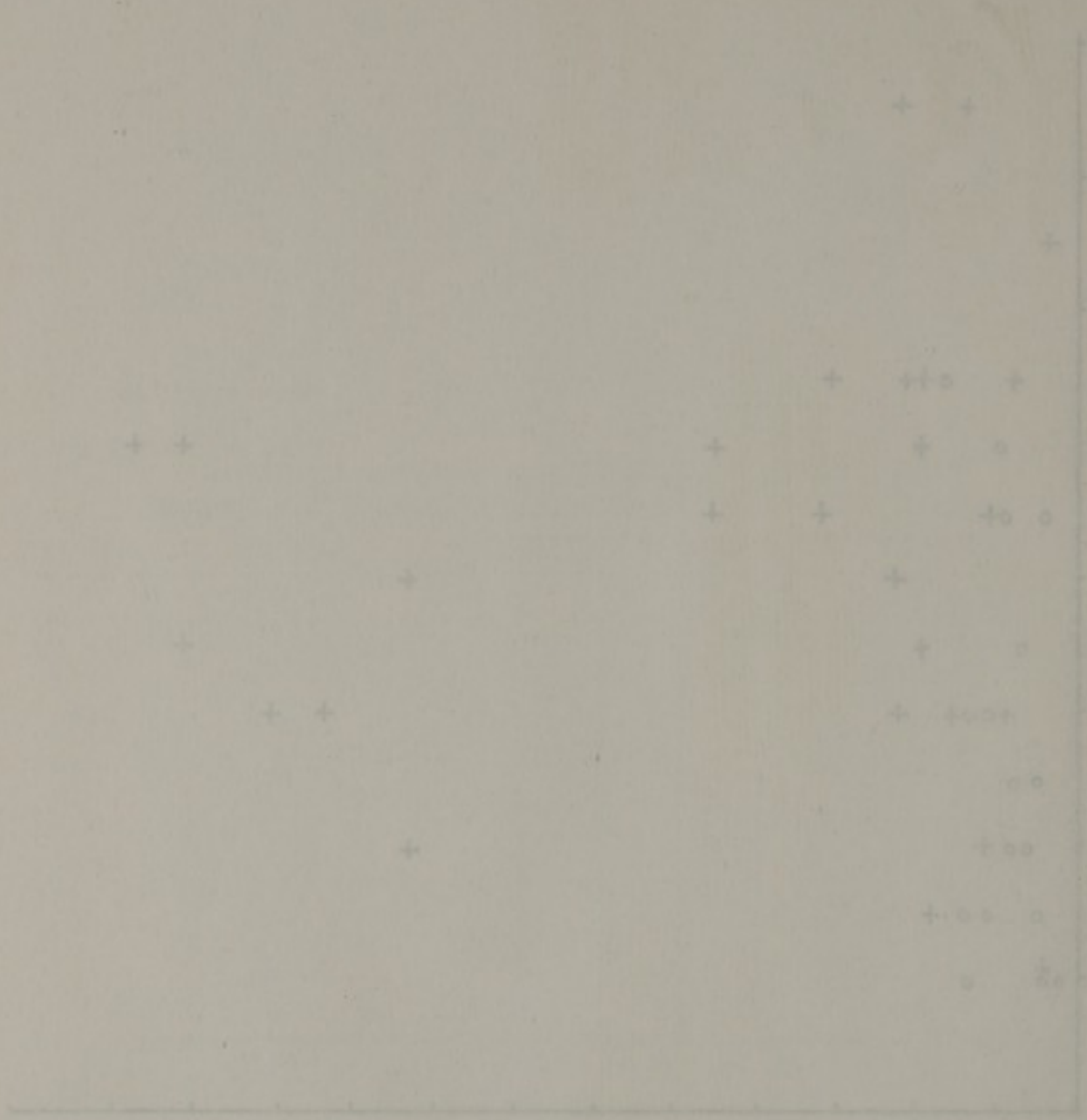


Fig 7.3 Difference between MPEL L_{eq} and Dose Meter L_{eq} and Volume of premises

\+ = Licenced premises

o = Unlicenced premises



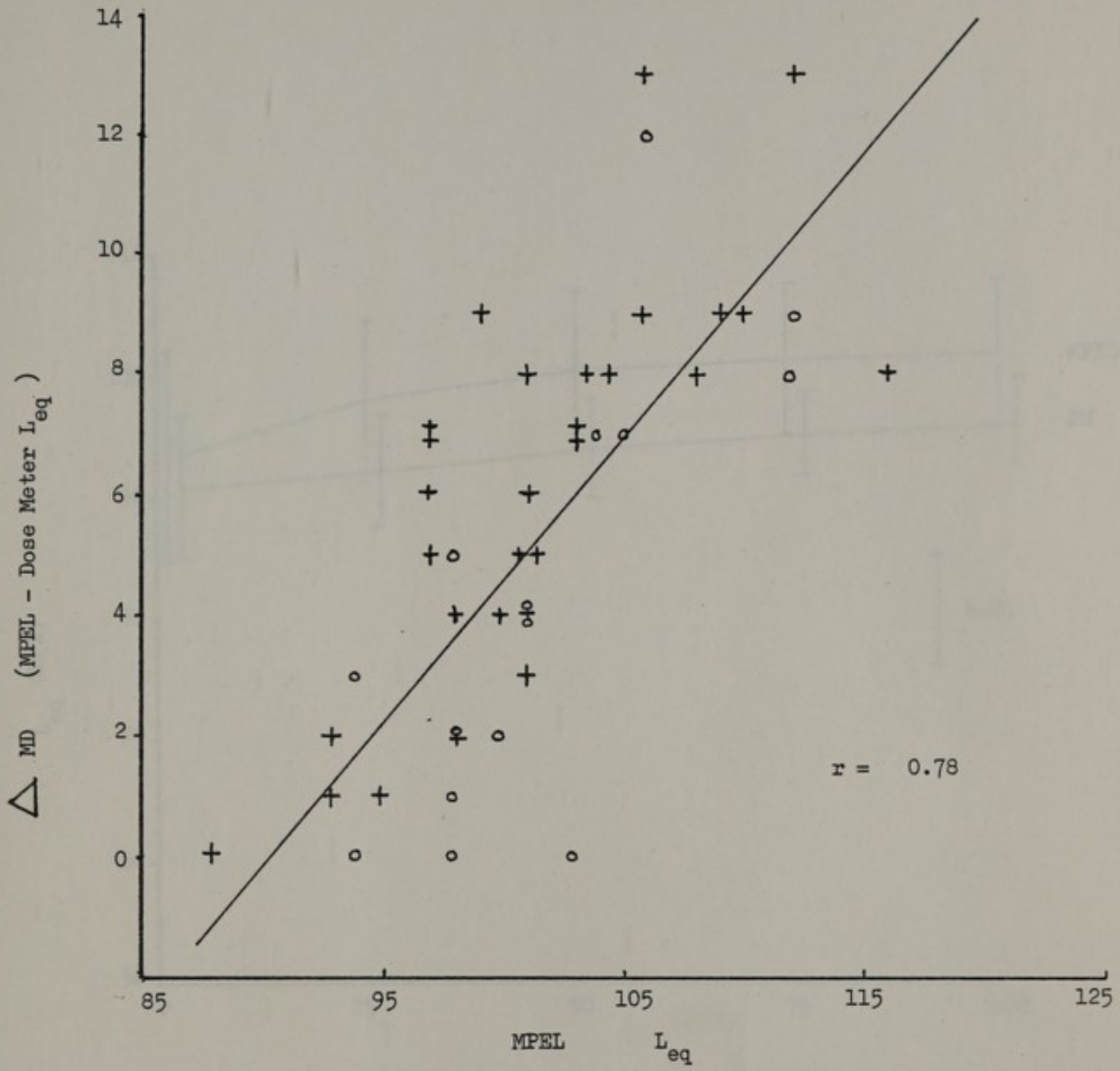
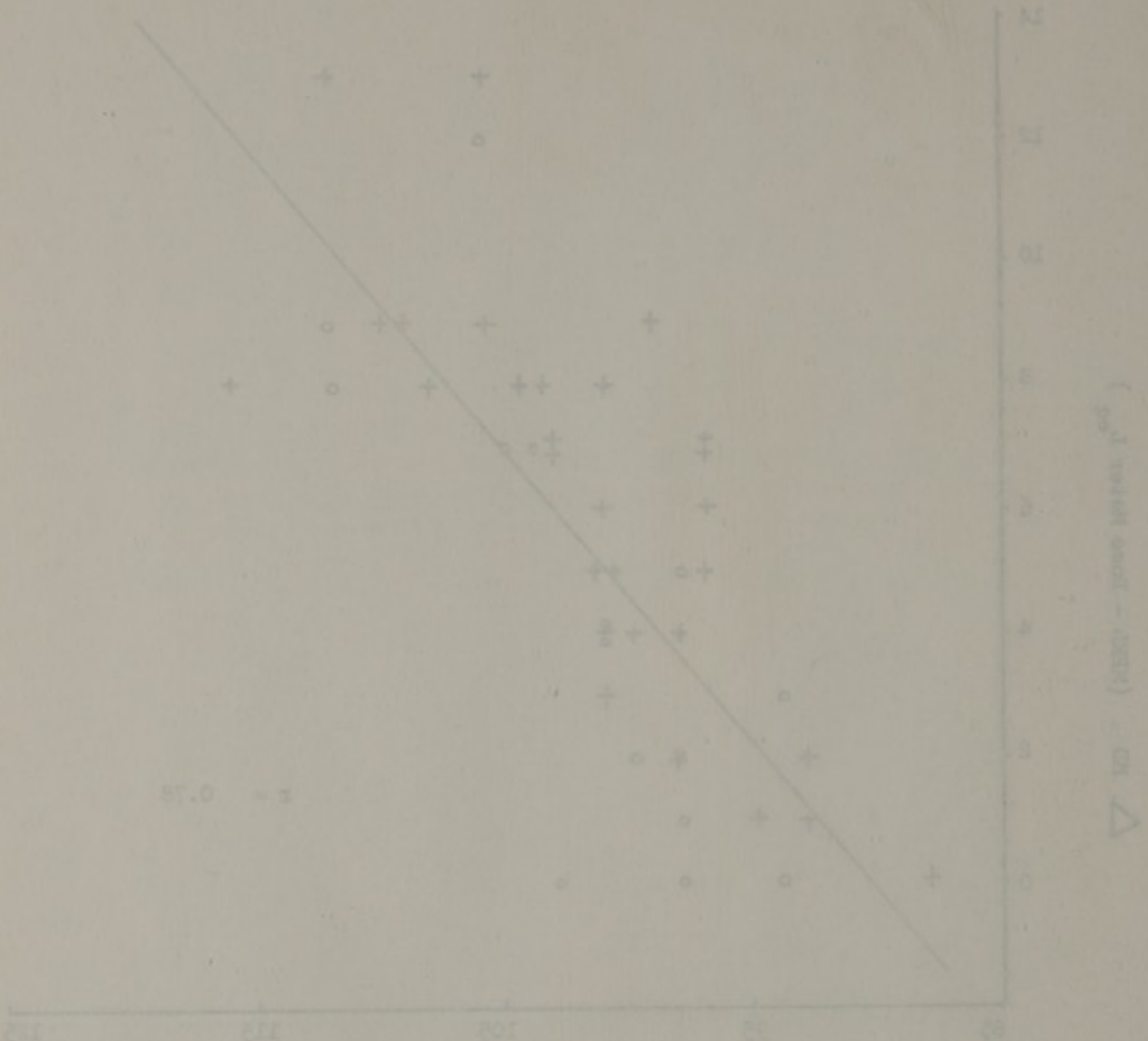


Fig 7.4 Difference between MPEL L_{eq} and Dose Meter L_{eq} as a function of MPEL

\+ = Licenced Premises.

0 = Unlicenced Premises.



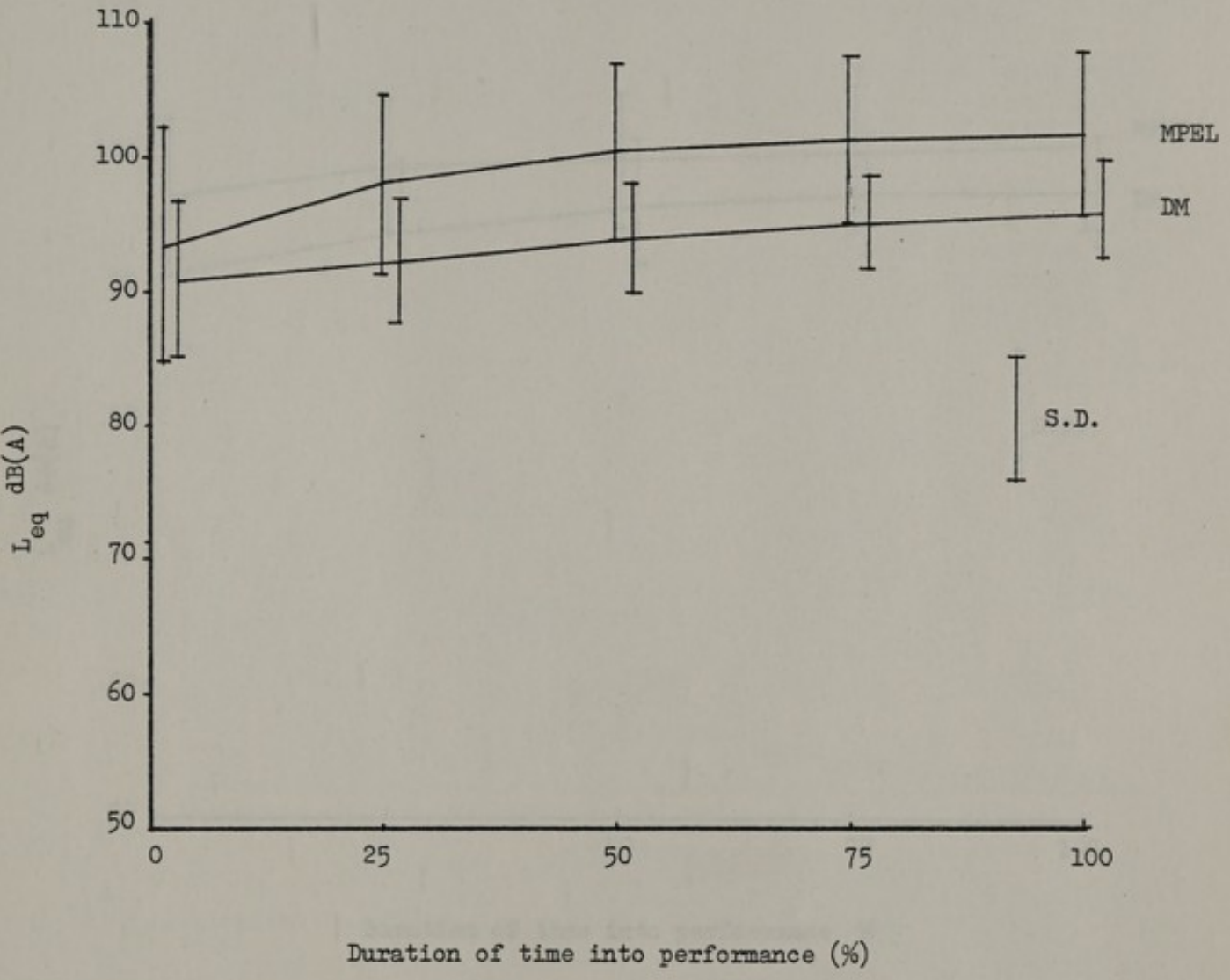
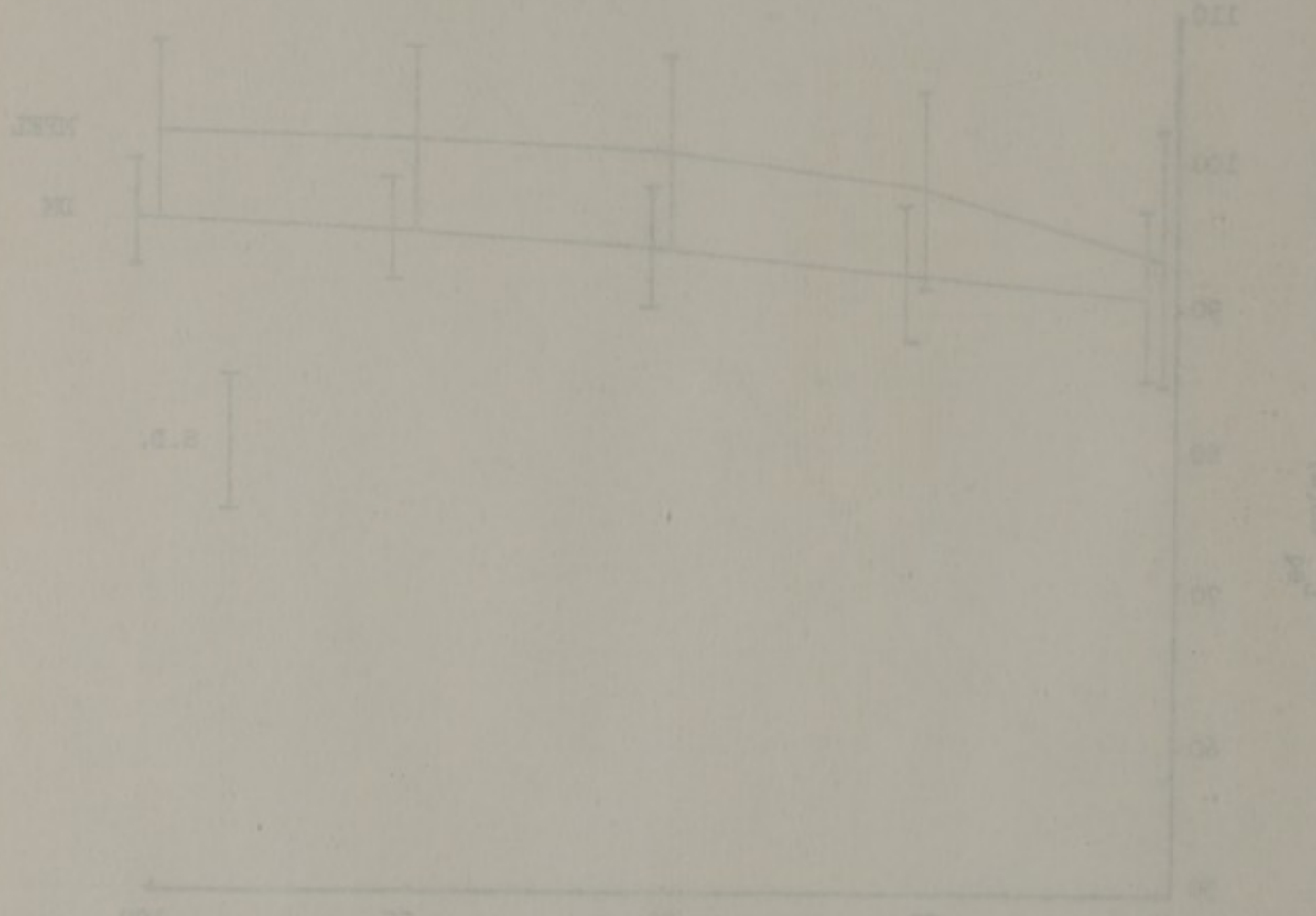


Fig 7.5 Variation of L_{eq} values with time in 30 Licenced Discotheques



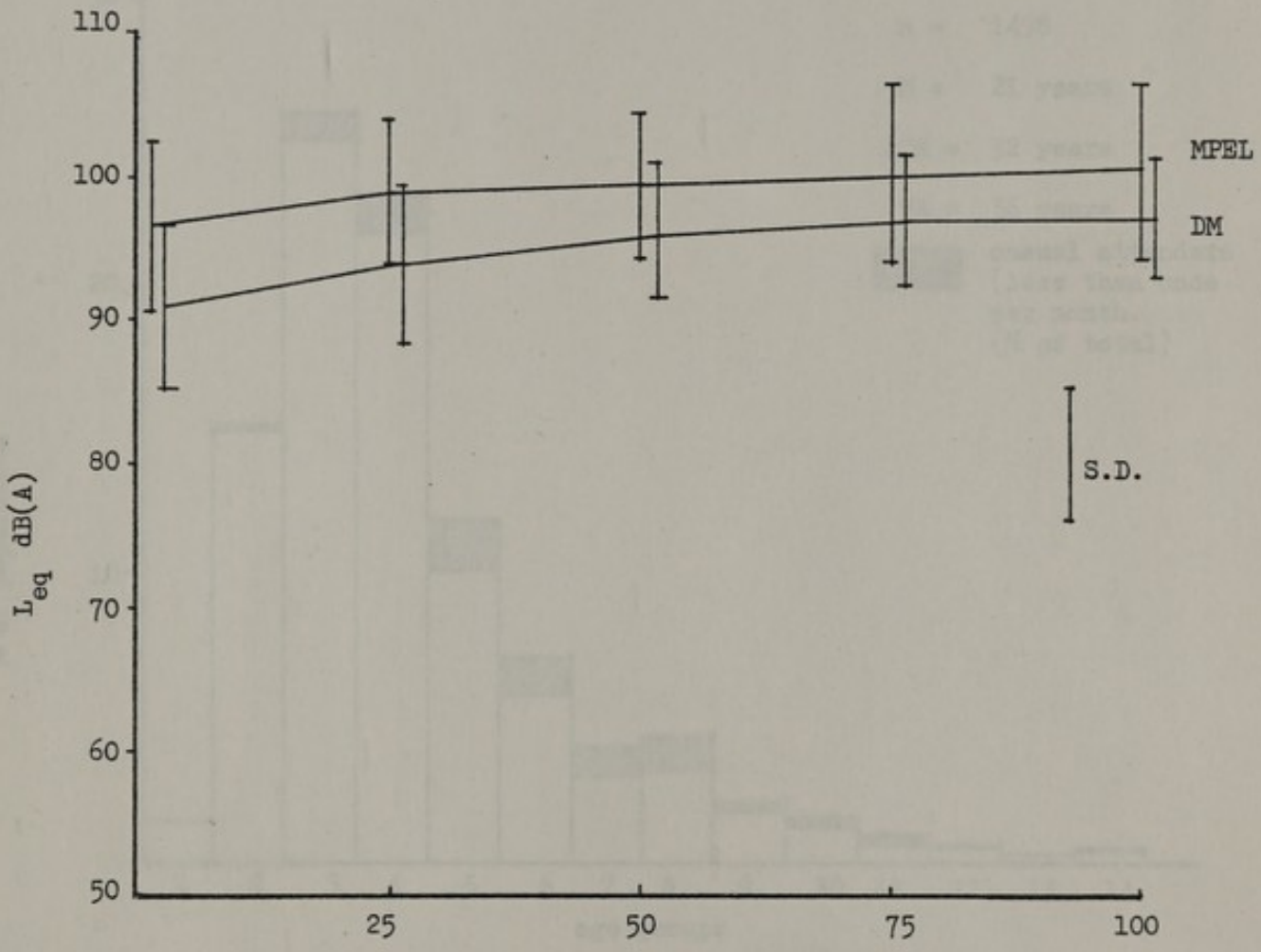
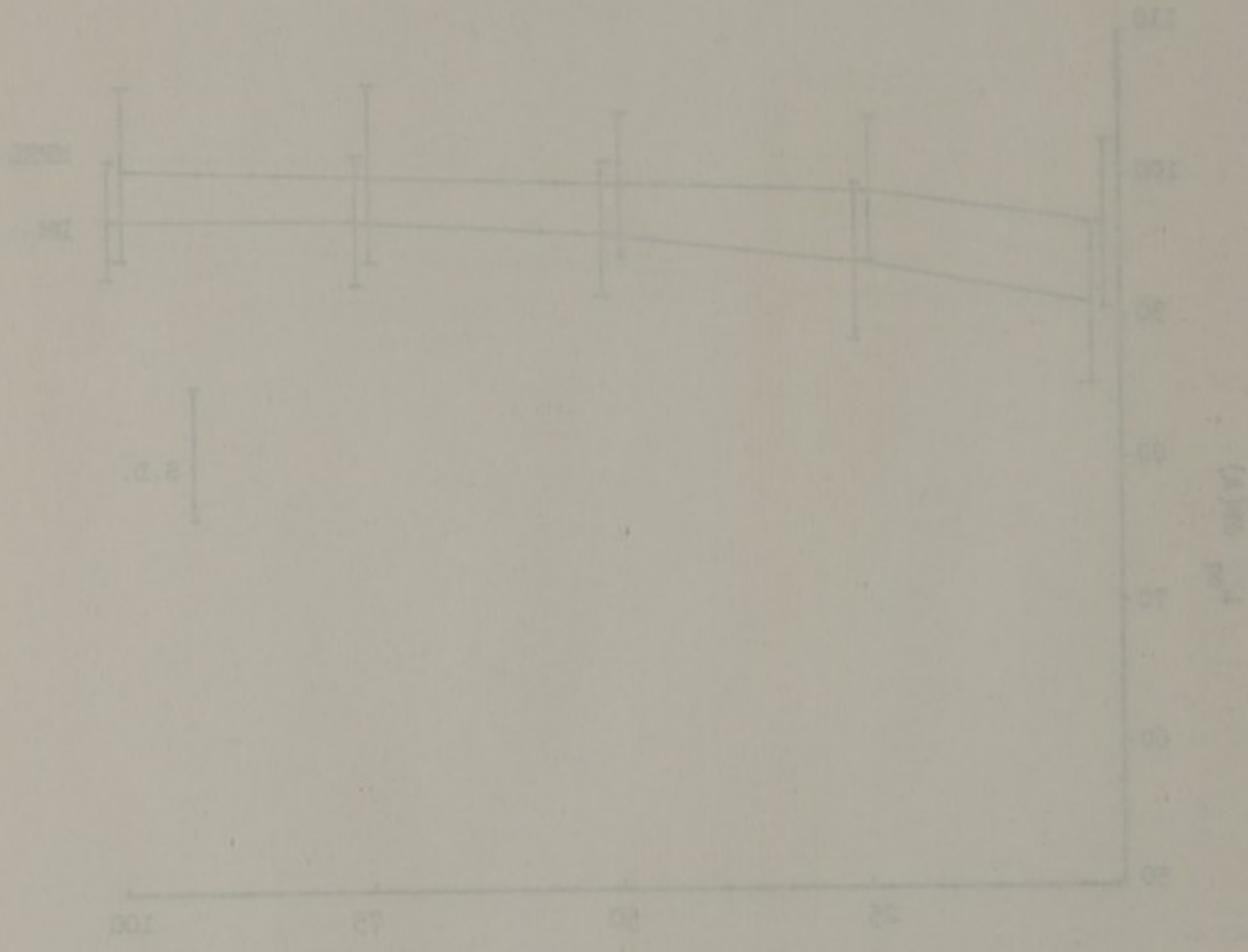


Fig 7.6 Variation of L_{eq} values with time in 18 Unlicenced Discotheques



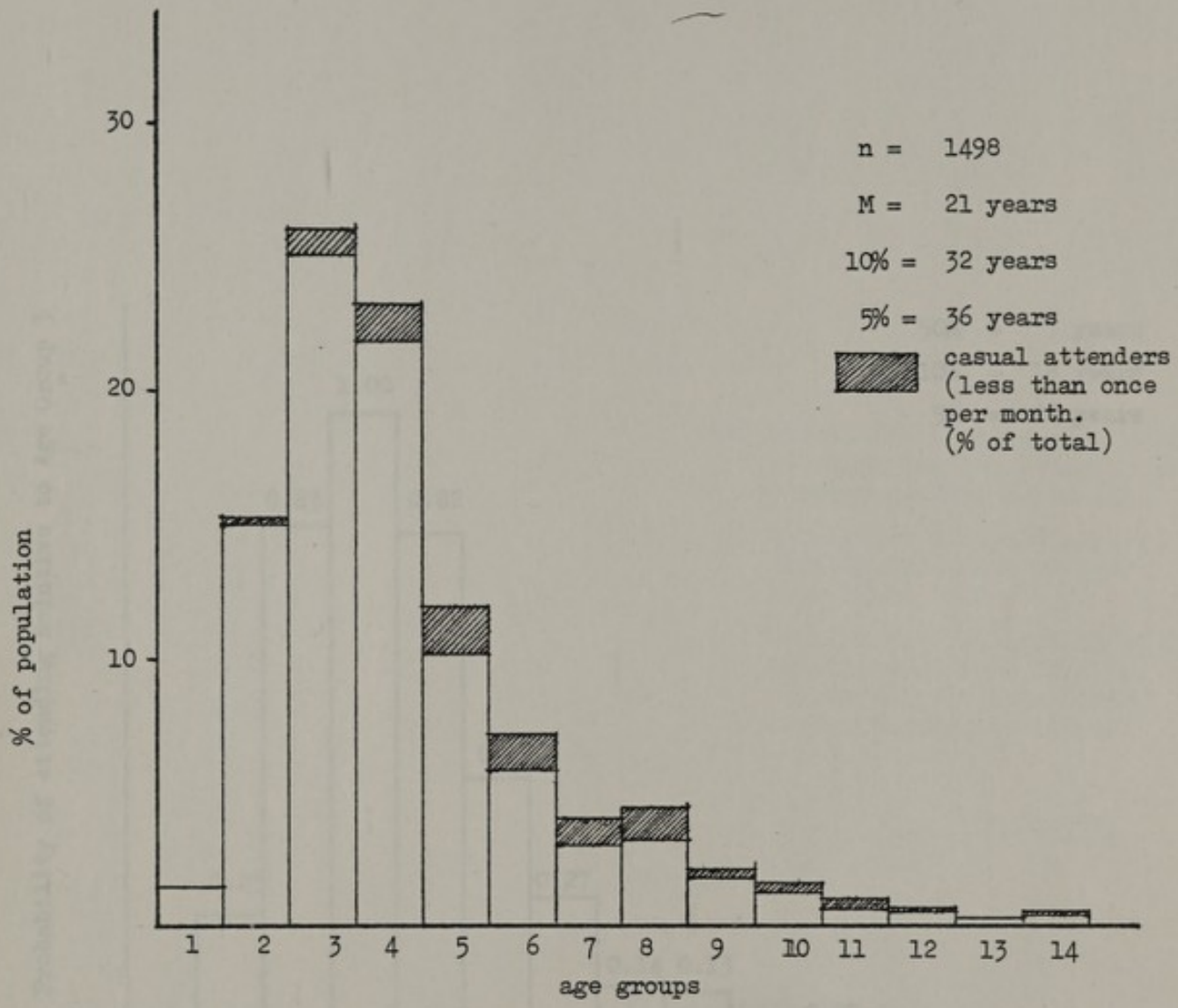
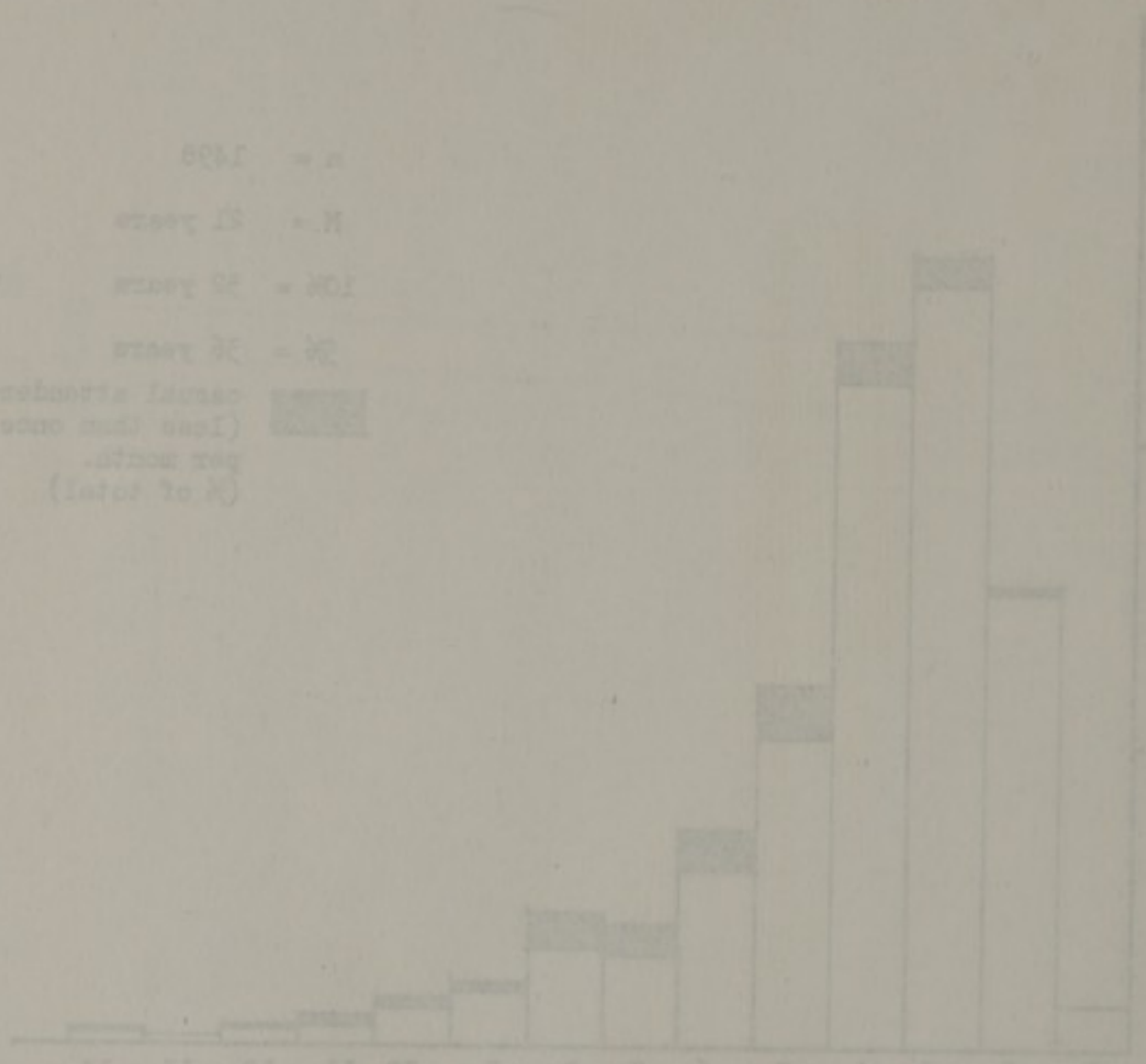


Fig 8.1 Distribution of age groups of Discotheque Attenders

Age groups					
	1 =	11 - 13	8 =	32 - 34
	2 =	14 - 16	9 =	35 - 37
	3 =	17 - 19	10 =	38 - 40
	4 =	20 - 22	11 =	41 - 43
	5 =	23 - 25	12 =	44 - 46
	6 =	26 - 28	13 =	47 - 49
	7 =	29 - 31	14 =	49 +



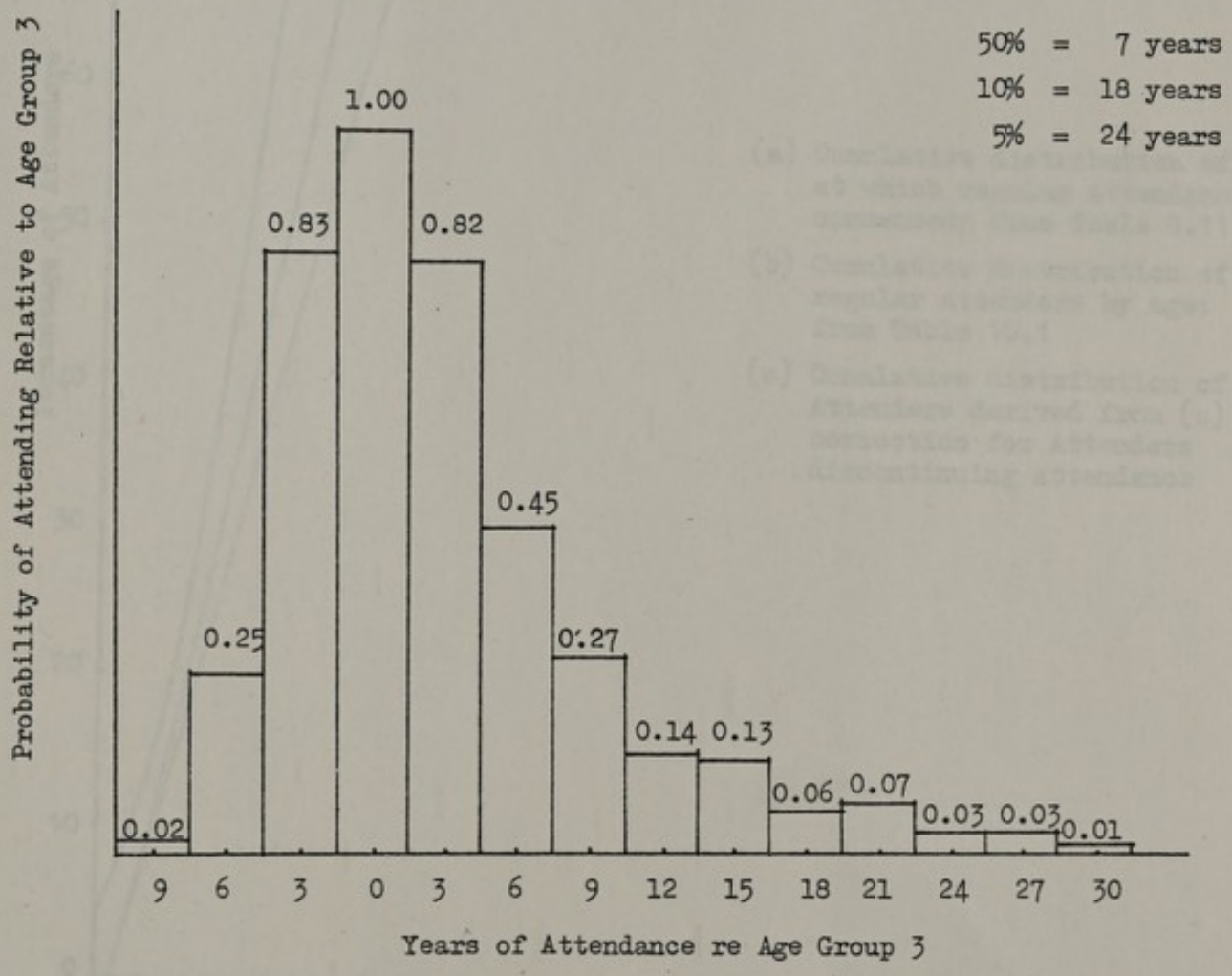


Fig 8.2 Probability of Past and Future Attendance for Regular Attenders in 17 to 19 year Age Group

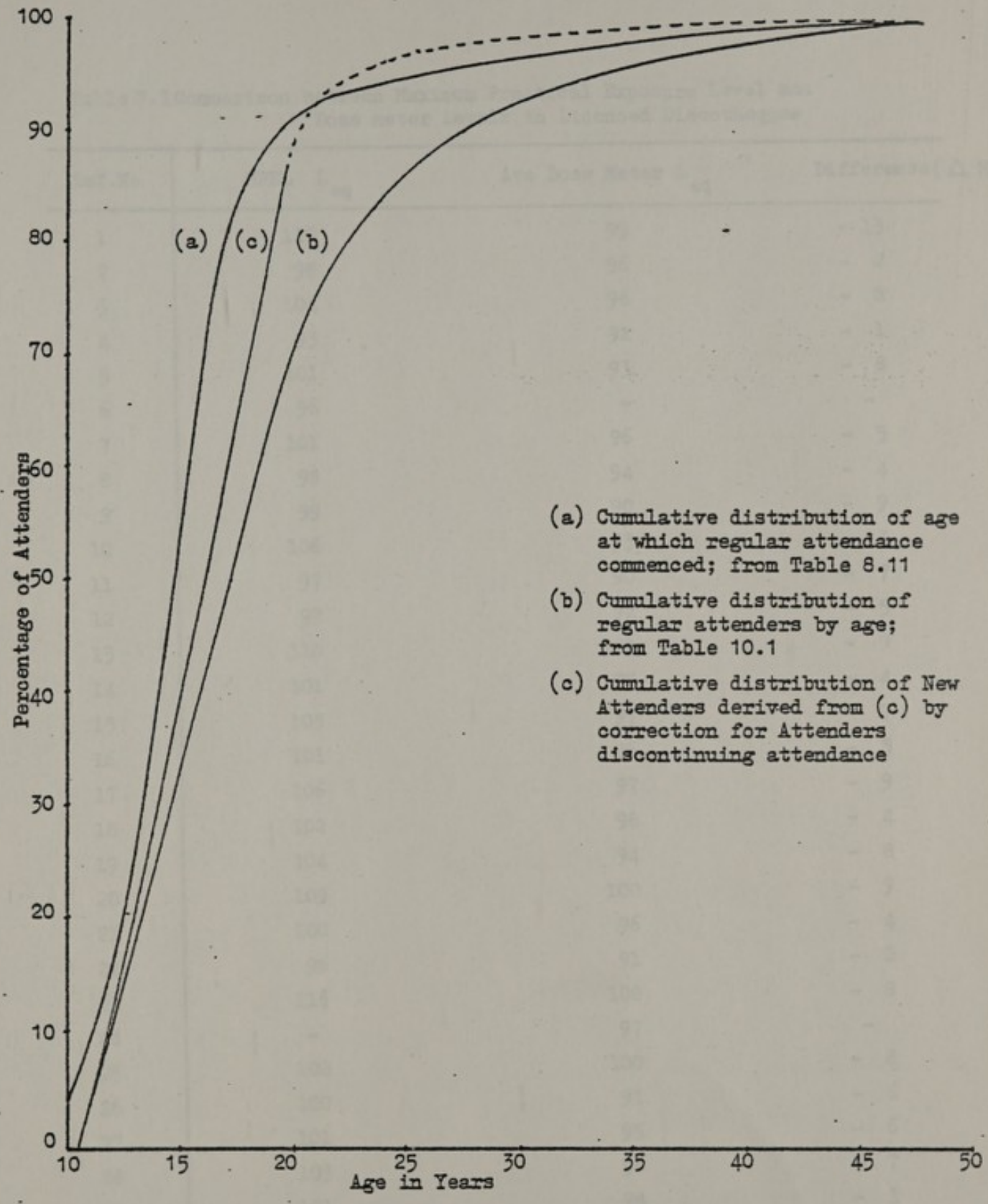


Fig. 10.1 Rate of Increase of New Attenders by Age

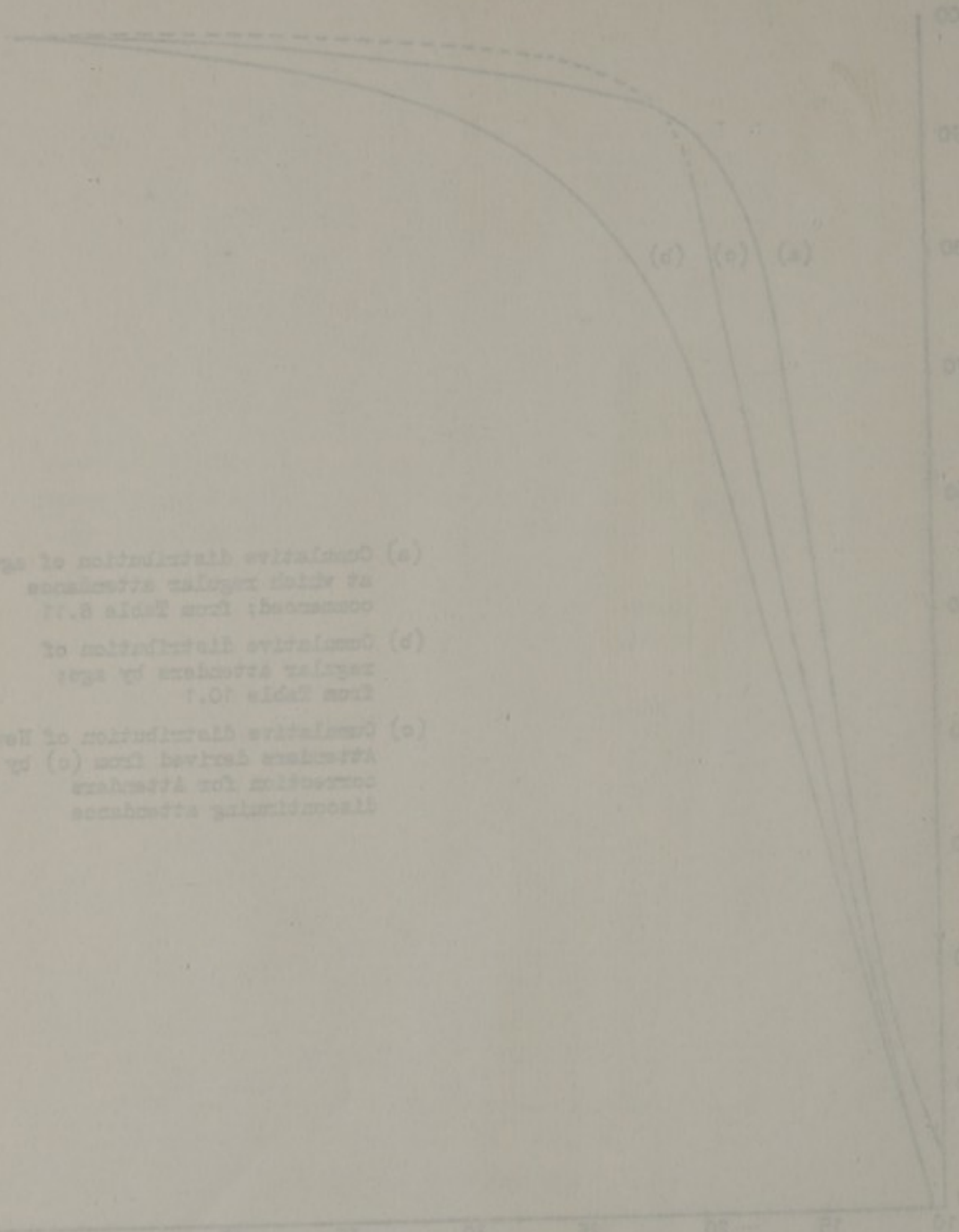

(a)
(c)
(b)

Table 7.1 Comparison between Maximum Practical Exposure Level and Dose meter Levels in Licenced Discotheques

Ref.No	MPEL L_{eq}	Ave Dose Meter L_{eq}	Difference (Δ MD)
1	112	99	- 13
2	98	96	- 2
3	104	96	- 8
4	93	92	- 1
5	101	93	- 8
6	96	-	-
7	101	96	- 5
8	98	94	- 4
9	99	90	- 9
10	106	93	- 13
11	97	90	- 7
12	97	92	- 5
13	110	101	- 9
14	101	97	- 4
15	103	97	- 7
16	101	96	- 5
17	106	97	- 9
18	102	98	- 4
19	104	94	- 8
20	109	100	- 9
21	100	96	- 4
22	96	91	- 2
23	116	108	- 8
24	-	97	-
25	108	100	- 8
26	100	91	- 6
27	101	95	- 6
28	103	96	- 7
29	101	98	- 3
30	111	101	- 10
31	98	88	- 3
$\bar{x}$	102.	96	- 6.0
s	5.7	4.0	3.0

Table 7.2 Comparison between Practical Maximum Exposure Level and Dose Meter Levels in Unlicenced Discotheques

Ref No	MPEL L_{eq}	Ave Dose Meter L_{eq}	Difference ($\triangle$ MD)
1	100	98	- 2
2	98	96	- 2
3	106	94	- 12
4	104	97	- 7
5	105	98	- 7
6	98	97	- 1
7	101	97	- 4
8	98	97	- 1
9	94	91	- 3
10	94	94	0
11	103	103	0
12	98	98	0
13	95	94	- 1
14		not available	
15	112	104	- 8
16	112	103	- 9
17	98	93	- 5
18	101	97	- 4
$\bar{x}$	101	97	4.0
s	5.5	3.6	3.6

Table 7.3 Percentile values and L_{eq} of Sound levels in 30 licenced Discotheques

Ref No	DLM	Percentile Values of dB(A)							L_{eq} MPEL
		L_1	L_5	L_{10}	L_{50}	L_{90}	L_{95}	L_{99}	
1	D	117	116	115	112	108	102	90	112
2	L	106	104	102	93	83	80	76	98
3	M	115	111	109	95	89	87	78	104
4	D	100	98	97	91	83	80	76	93
5	M	108	106	105	100	91	87	74	101
6	D	99	97	97	94	90	86	84	94
7	D	109	107	105	98	89	87	81	101
8	D	102	100	100	98	91	88	75	97
9	D	107	104	103	97	90	87	80	99
10	D	113	111	109	104	97	95	91	106
11	D	105	103	101	96	89	86	71	97
12	M	104	102	101	96	89	86	81	97
13	M	118	116	115	105	92	88	81	110
14	D	108	106	105	99	92	89	80	101
15	M	111	108	107	101	94	91	69	103
16	D	110	106	105	99	90	87	82	101
17	D	113	111	110	105	97	95	84	106
18	M	109	107	106	100	92	89	80	102
19	D	113	110	108	101	91	88	81	104
20	D	114	113	112	109	103	100	93	109
21	D	107	105	103	98	83	76	71	100
22	L	102	100	99	95	88	83	71	96
23	L	122	121	120	115	95	88	74	116
24	L	-	-	not	available	-	-	-	-
25	D	113	112	111	107	99	96	89	108
26	L	107	104	103	99	90	86	77	100
27	D	108	106	106	100	94	91	86	101
28	D	111	108	107	101	93	90	82	103
29	D	109	107	105	99	79	74	65	101
30	D	115	115	114	111	106	104	98	111
31	D	98	96	95	91	84	81	76	91
$\bar{x}$		109	107	106	100	92	88	80	102
s		5.7	5.9	5.8	6.0	6.5	6.8	7.5	5.7

Table 7.4 Percentile Values and L_{eq} of Sound Levels in 18 Unlicences Discotheques

Ref No	D L M	Percentile Values dB(A) L_1	L_5	L_{10}	L_{50}	L_{90}	L_{95}	L_{99}	Leq MPEL
1	D	104	103	102	100	94	93	89	100
2	D	104	102	102	98	92	89	82	98
3	D	113	111	110	104	95	92	78	106
4	D	110	108	107	103	98	96	88	104
5	D	111	109	108	104	98	96	91	105
6	D	105	102	101	96	90	88	56	98
7	D	107	105	104	100	93	88	66	100
8	D	104	102	101	97	92	91	87	98
9	D	101	100	98	93	85	82	75	94
10	D	101	99	98	93	87	86	80	94
11	D	109	107	106	102	96	93	83	103
12	D	102	101	100	98	95	92	77	98
13	D	102	100	99	94	81	78	72	95
14	D	not available							91
15	M	120	117	116	110	102	99	90	112
16	M	120	118	117	108	94	92	88	112
17	D	105	103	102	96	90	87	78	98
18	D	107	106	105	100	93	90	82	101
$\bar{x}$		107	105	104	100	93	90	80	100
s		5.9	5.7	5.7	4.9	5.1	5.2	9.3	5.8

Table 7.5 Sound Level Meter Measurements in Licenced Discotheques

Ref No	dB(A) Centre of Dance Floor	Bar Area	Seating Area
5	-	96	100
6	-	85	90
7	-	85	-
8	97 - 100	80	90 - 95
9	100	-	72 - 85
10	106	-	90 - 95
11	95 - 100	-	85
12	96 - 100	96 - 100	96 - 100
13	101	90	93
15	100 - 110	92	94
16	94	80	90 - 93
17		-	94
19	97	90	90 - 95
20	96 - 99	92 - 96	88 - 92
21	88 - 98	98 - 98	88 - 98
22	97	82 - 90	94 - 96
23	107 - 110	-	104 - 112
24	96	93	90
25	100 - 103	-	95 - 100
27	95 - 102	90 - 92	92 - 98
28	94 - 102	90 - 94	90 - 96
29	98 - 102	95 - 100	94 - 100
30	100 - 102	95 - 96	94 - 95
31	90	85 - 87	83 - 85
$\bar{x}$	99.	91	93.
s	4.3.	5.5.	5.8

Table 7.6 Sound Level Meter Measurements in Unlicenced Discotheques

Ref No	dB(A) Dance Floor	Seating Area
6	92 - 96	92 - 96
7	107	80 - 107
8	95 - 103	80 - 85
9	85 - 90	85 - 90
10	92 - 94	92 - 94
11	106	106
12	97 - 99	92 - 95
13	92 - 95	90 - 92
14	92 - 94	92
15	95 - 110	92 - 98
16	98 - 107	93 - 97
17	99 - 104	82 - 88
18	92 - 102	88 - 92
$\bar{x}$	98	92
s	5.6	5.7

Table 7.7 Octave band levels of Live Music

Ref No	Frequency Hz									
	63	125	250	500	1K	2K	4K	8K	lin	A
15 U/L	115	112	117	115	109	109	92	84	121	116
	114	112	117	115	108	109	92	83	121	116
16 U/L	105	109	114	116	113	111	94	79	120	116
	95	106	115	116	112	108	95	78	119	116
22 L	85	90	82	91	85	81	73	65	95	90
	95	100	95	91	85	81	73	65	103	92
23 L	110	120	121	121	114	102	94	83	126	119
	110	120	121	121	113	105	96	83	126	119
26 L	94	99	96	94	90	86	81	70	103	96
	90	95	89	89	81	78	72	64	98	89
$\bar{x}$	101	106	107	107	101	97	86	75	113	107
s	10.8	10.2	14.6	13.7	13.8	13.7	10.2	8.5	12.0	13.2

L = Licenced U/L = unlicenced

Table 7.8 Octave band Levels of Recorded Music

Ref No	Frequency Hz									
	63	125	250	500	1K	2k	4k	8k	lin	A
11 U/L	92	106	102	98	98	87	85	60	108	101
	92	108	102	102	102	95	93	65	110	105
18 L	100	104	105	101	98	95	86	77	110	103
	98	103	104	101	97	94	86	78	108	102
29 L	96	105	98	97	91	92	92	68	106	99
	99	108	99	98	93	95	92	70	109	101
30 L	99	96	112	112	107	106	101	80	117	113
	99	96	112	112	107	106	102	79	117	113
31 L	84	93	82	84	81	80	74	65	94	88
	81	93	89	85	76	79	72	64	95	87
$\bar{x}$	94	101	101	99	95	93	88	71	107	101
s	6.7	6.1	9.3	9.3	10.2	9.2	9.9	7.3	7.7	8.7

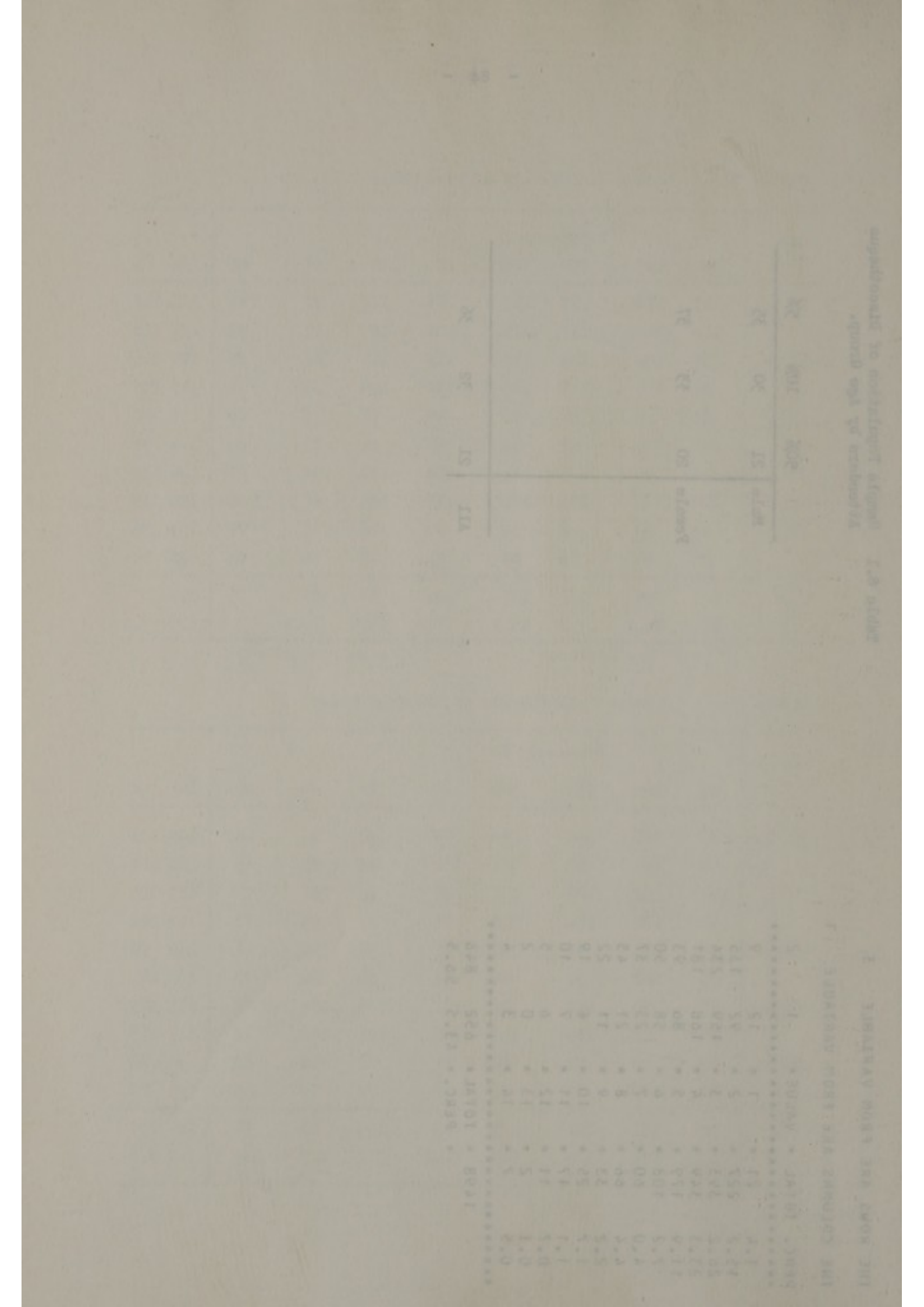
THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 1

PERC.	TOTAL	* VALUE *	1	2
1.4	21	* 1 *	12	9
15.2	227	* 2 *	92	135
26.2	393	* 3 *	159	234
23.3	349	* 4 *	168	181
11.9	179	* 5 *	86	93
7.2	108	* 6 *	58	50
4.0	60	* 7 *	23	37
4.4	66	* 8 *	21	45
2.2	33	* 9 *	11	22
1.7	25	* 10 *	6	19
1.1	17	* 11 *	7	10
0.7	11	* 12 *	6	5
0.1	2	* 13 *	0	2
0.5	7	* 14 *	3	4
	1498	* TOTAL *	652	846
		* PERC. *	43.5	56.5

Table 8.1 Sample Population of Discotheque Attenders by Age Group.

	50%	10%	5%
Male	21	30	35
Female	20	33	37
All	21	32	36



THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 7

PERC.	TOTAL	* VALUE *	1	2	3
1.4	21	* 1 *	0	1	20
15.2	227	* 2 *	5	12	210
26.2	393	* 3 *	14	53	326
23.3	349	* 4 *	22	68	259
11.9	179	* 5 *	25	24	130
7.2	108	* 6 *	21	22	65
4.0	60	* 7 *	15	15	30
4.4	66	* 8 *	19	13	34
2.2	33	* 9 *	5	4	24
1.7	25	* 10 *	6	5	14
1.1	17	* 11 *	7	2	8
0.7	11	* 12 *	2	2	7
0.1	2	* 13 *	0	0	2
0.5	7	* 14 *	2	1	4
	1498	* TOTAL *	143	222	1133
		* PERC. *	9.5	14.8	75.6

Table 8.2 Regular and Casual Attenders at Discotheques by Age Group

1. Less than once per month

2. More than once per month but less than once per week

3. Once a week or more

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 23

Table 8.3 Duration of each Attendance at Discotheques by Regular Attenders in Age Groups

PERC.	TOTAL	VALUE	1	2	3	4	5	6	7	50%	10%	5%
1.5	21	1	1	13	6	1	0	0	0	2.3	-	
16.4	222	2	4	172	36	6	2	1	1	2.1	3.2	3.5
28.0	379	3	3	60	152	115	41	7	1	3.4	4.7	5.2
24.1	327	4	4	37	172	82	24	8	0	3.2	4.5	5.1
11.4	154	5	0	20	82	35	14	2	1	3.2	4.6	5.2
6.4	87	6	1	11	35	27	9	4	0	3.4	4.9	-
3.3	45	7	0	8	19	16	2	0	0	3.3	4.3	-
3.5	47	8	0	8	16	15	7	1	0	3.5	4.9	-
2.1	28	9	0	3	15	10	0	0	0	3.2	-	-
1.4	19	10	0	5	9	3	1	1	0			
0.7	10	11	0	2	5	2	1	0	0			
0.7	9	12	0	0	4	3	2	0	0	3.3	4.7	-
0.1	2	13	0	0	1	1	0	0	0			
0.4	5	14	0	0	2	2	1	0	0			
	1355	TOTAL	13	339	554	318	104	24	3			
		PERC.	1.0	25.0	40.9	23.5	7.7	1.8	0.2	3.1	4.5	5.1

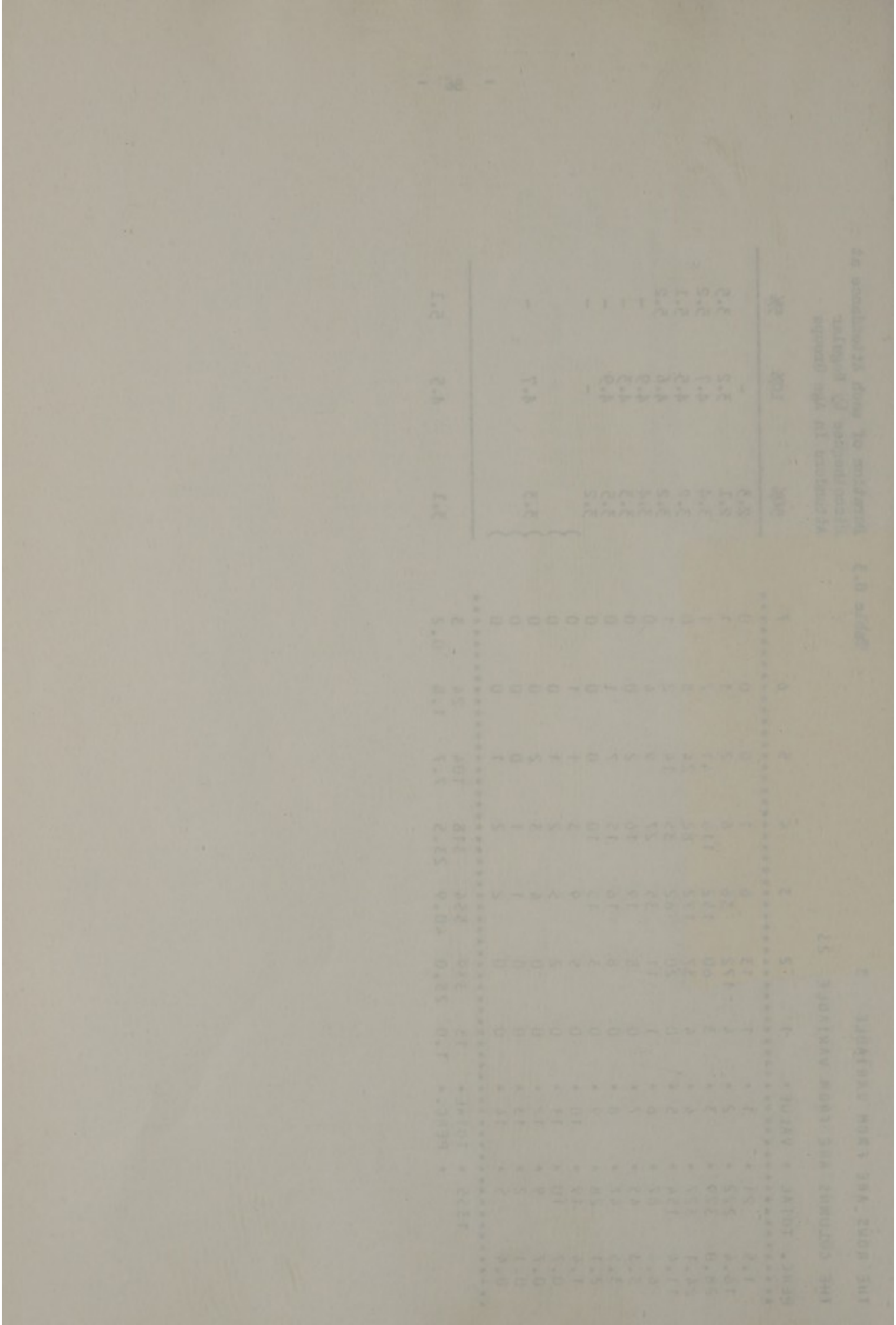


Table 8.4 Time of Arrival and Duration of Stay in Licenced Discotheques (Males)

Ref No	Time of Arrival (Time)			Duration of Stay (hrs min)			Max Poss Duration (hrs)
	50%	90%	95%	50%	10%	5%	
3	22.32	21.35	21.11	3.28	4.25	4.50	6
4	22.37	22.20	21.23	2.23	2.40	4.37	5
4	23.05	22.03	22.20	2.55	3.57	3.40	5
5	23.00	21.50	21.15	3.00	4.10	4.45	6
5	23.00	21.48	21.30	3.00	4.12	4:30	6
6	23.00	22.35	22.23	3.00	3.25	3.37	4
6	22.54	22.35	22.30	3.06	3.25	3.30	4
6	22.46	21.46	23.25	3.14	4.14	2.37	5
7	23.15	22.04	21.38	2.45	3.56	4.22	5
8	00.00	22.30	22.20	2.00	3.30	3.30	5
9	23.00	22.38	22.20	3.00	3.22	3.40	5
10	22.50	21.46	21.25	3.10	4.04	4.35	5
11	22.00	20.40	20.30	3.00	4.20	4.30	5
14	23.45	22.35	22.05	2.15	3.25	3.55	6
15	23.00	22.00	21.15	3.00	4.00	4.45	6
16	22.53	21.55	21.45	3.07	4.05	4.15	5
19	23.25	22.30	22.10	2.35	3.30	3.50	5
20	20.10	20.00	20.00	2.20	2.30	2.15	2½
22	23.00	21.10	20.45	3.00	4.50	5.15	6
27	22.05	21.10	21.00	3.55	4.50	5.00	5
30	23.05	22.50	-	2.55	3.10	-	4
$\bar{x}$				2.56	3.50	4.06	5.0
s				29 min	35 min	46 min	

Table 8.5 Time of Arrival and Duration of Stay in Licenced Discotheques (Females)

	Time of Arrival (Time)			Duration of Stay (hrs/min)			Max.Poss. Duration (hrs)
	50%	90%	95%	50%	10%	5%	
3	22.15	21.15	21.11	3.45	4.45	5.00	6
4	22.37	22.10	21.23	2.23	2.50	4.37	5
4	22.38	22.05	22.20	3.22	3.55	3.50	5
5	22.40	21.30	21.15	3.20	4.30	5.05	6
5	22.08	21.30	21.30	3.52	4.30	4.45	6
6	23.00	22.40	22.23	3.00	3.20	3.35	4
6	22.50	22.25	22.30	3.10	3.35	3.35	4
6	22.25	22.00	23.23	3.35	4.00	2.05	5
7	22.55	21.37	21.38	3.05	4.25	4.42	5
8	23.55	22.30	22.20	2.05	3.30	3.37	5
9	22.50	21.40	22.20	3.10	4.20	4.30	5
10	22.38	21.30	21.25	3.22	4.30	4.45	5
11	21.45	20.32	20.30	3.15	4.28	4.35	5
14	23.50	22.30	22.05	2.10	3.30	3.55	6
15	23.05	21.20	21.15	2.55	4.40	4.55	6
16	22.40	21.55	21.45	3.20	4.05	4.10	5
19	23.10	22.10	22.10	2.50	3.50	4.05	5
20	20.12	20.00	20.00	2.18	2.30	2.15	$2\frac{1}{2}$
22	22.15	21.00	20.45	3.45	5.00	5.15	6
27	21.55	21.10	21.00	4.05	4.50	5.00	5
30	23.10	22.50	-	2.50	3.10	-	4
$\bar{x}$				3.07	4.00	4.19	5.0
s				33 mins	41 mins	51 mins	

Table 8.6 Time of Arrival and Duration of Stay in Unlicenced Discotheques (Males)

Ref. No	Time of Arrival (Time)			Duration of Stay (hrs/min)			Max Duration hrs
	90%	50%	10%	90%	50%	10%	
9	19.30	19.40	19.50	2.10	2.20	2.30	$2\frac{1}{2}$
12	19.35	19.55	20.23	1.37	2.05	2.25	$2\frac{1}{2}$
13	19.00	19.10	19.35	1.55	2.20	2.30	$2\frac{1}{2}$
14	19.20	19.45	20.45	1.15	3.15	3.40	$3\frac{3}{4}$
15	20.00	20.10	20.25	2.05	2.20	2.30	$2\frac{1}{2}$
17	19.50	19.55	20.30	1.15	1.50	1.55	2
18	19.30	19.40	20.30	1.15	2.05	2.15	$2\frac{1}{4}$
$\bar{x}$	-	-	-	1.38	2.19	2.32	2.34

Table 8.7 Time of Arrival and Duration of Stay in Unlicenced Discotheques (Females)

Ref. No.	Time of Arrival (Time)			Duration of Stay (hrs/min)			Max Duration hrs
	90%	50%	10%	90%	50%	10%	
9	19.30	19.45	19.55	2.05	2.15	2.30	$2\frac{1}{2}$
12	19.37	19.57	20.25	1.35	2.03	2.23	$2\frac{1}{2}$
13	19.00	19.08	19.15	2.15	2.22	2.30	$2\frac{1}{2}$
14	19.20	19.38	21.45	1.15	3.22	3.40	$3\frac{3}{4}$
15	20.00	20.10	20.25	2.05	2.20	2.30	$2\frac{1}{2}$
17	19.45	20.00	20.15	1.30	1.45	2.00	2
18	19.30	19.40	21.25	1.20	2.05	2.15	$2\frac{1}{2}$
$\bar{x}$	-	-	-	1.44	2.27	2.35	2.34

Table 5.6 Time of Arrival and Duration of Stay in Baltimore
Bioscheduque (Below)

Bat. No	Time of Arrival (Time)			Duration of Stay (Days/min)		Max Duration
	90%	75%	50%	75%	100%	Days
9	19.30	19.40	19.50	2.10	2.50	2.50	4%
12	19.35	19.45	20.03	1.37	2.05	2.25	4%
13	19.00	19.10	19.35	1.25	2.20	2.30	4%
14	19.20	19.40	20.05	1.15	3.15	3.40	3%
15	20.00	20.10	20.25	2.05	2.20	2.30	4%
17	19.50	19.55	20.30	1.15	1.30	1.35	4
18	19.30	19.40	20.30	1.15	2.05	2.15	4%
X	-	-	-	1.30	2.19	2.32	0.34

Table 5.7 Time of Arrival and Duration of Stay in Baltimore
Bioscheduque (Below)

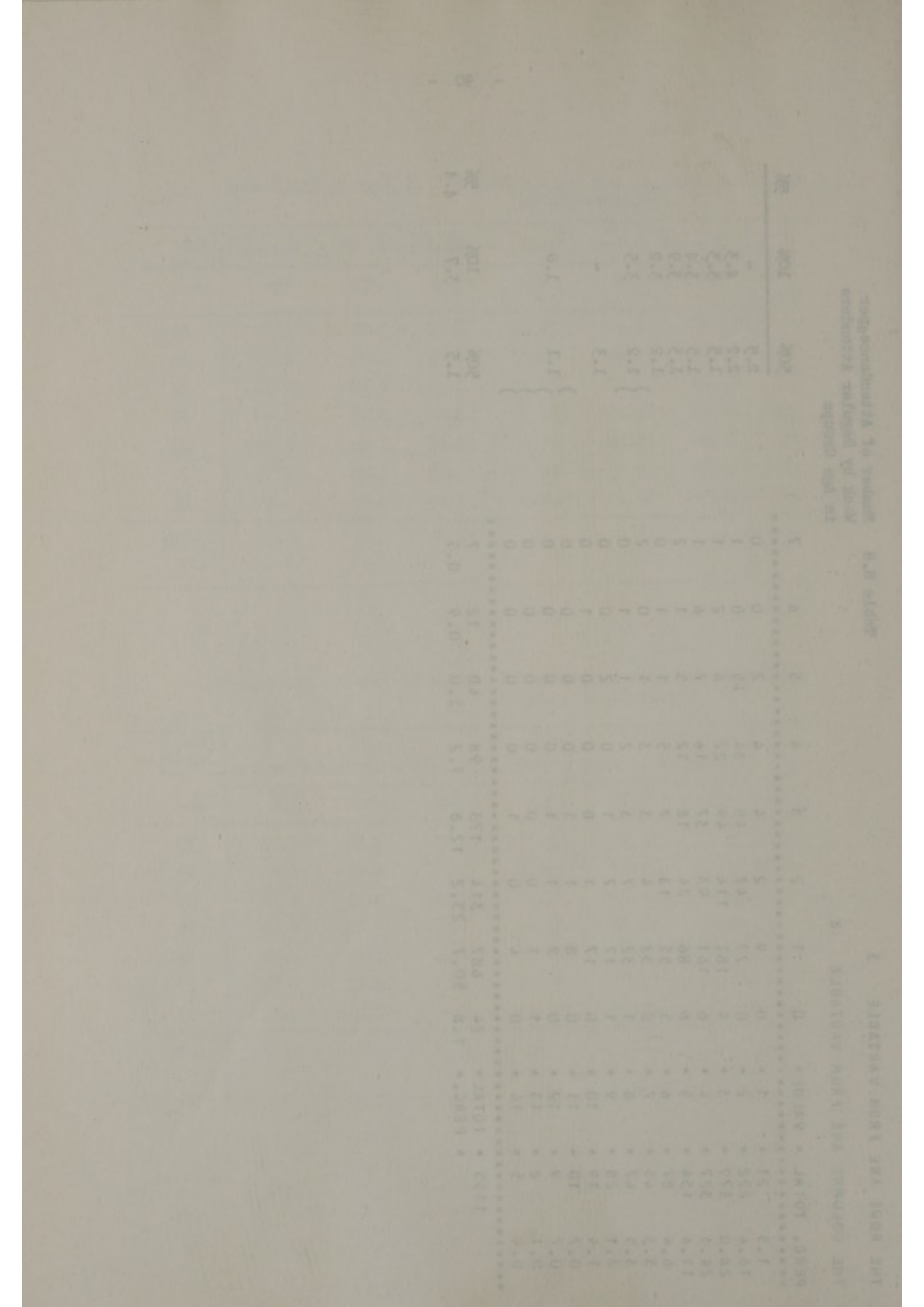
Bat. No.	Time of Arrival (Time)			Duration of Stay (Days/min		Max Duration
	90%	75%	50%	75%	100%	Days
9	19.30	19.45	19.55	2.05	2.15	2.30	4%
12	19.37	19.57	20.30	1.35	2.05	2.25	4%
13	19.00	19.00	19.15	2.15	2.25	2.30	4%
14	19.00	19.30	20.45	1.15	1.25	1.40	3%
15	20.00	20.10	20.25	2.05	2.20	2.30	4%
17	19.45	20.00	20.25	1.30	1.45	2.00	4
18	19.30	19.40	20.25	1.30	2.05	2.15	4%
X	-	-	-	1.44	2.27	2.35	0.34

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 8

Table 8.8 Number of Attendances per Week by Regular Attenders in Age Groups

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	7	50%	10%	5%
1.5	21	1	0	9	2	4	4	2	0	0	2.5	-	
16.4	222	2	0	77	47	48	34	15	0	1	2.2	4.3	
28.0	379	3	4	181	114	49	22	6	2	1	1.5	3.3	
24.1	327	4	6	161	93	37	16	7	6	1	1.5	3.4	
11.4	154	5	6	86	24	18	12	5	1	2	1.3	3.9	
6.4	87	6	5	55	13	7	5	1	1	0	1.2	3.2	
3.3	45	7	0	32	4	3	3	1	0	2	1.2	3.5	
3.5	47	8	1	32	7	3	2	1	1	0			
2.1	28	9	1	17	7	1	0	2	0	0	1.3	-	
1.4	19	10	0	17	1	0	0	0	1	0			
0.7	10	11	0	8	1	1	0	0	0	0	1.1	1.8	
0.7	9	12	0	7	1	1	0	0	0	0			
0.1	2	13	1	1	0	0	0	0	0	0			
0.4	5	14	0	4	0	1	0	0	0	0			
	1355	TOTAL	24	687	314	173	98	40	12	7	50%	10%	5%
		PERC.	1.8	50.7	23.2	12.8	7.2	3.0	0.9	0.5	1.5	3.7	4.4



THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 9

Table 8.9 Number of Attendances in 4 Weeks by Regular Attenders in Age Groups

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.5	21	1	0	3	0	2	4	0	0	0	2	1	2	0	3	0	0
16.4	222	2	1	4	13	26	27	14	17	9	19	2	12	4	31	1	3
28.0	379	3	33	27	51	23	69	24	20	9	43	3	8	1	34	0	6
24.1	327	4	62	34	26	13	57	14	13	12	40	3	4	1	25	1	1
11.4	154	5	39	12	6	12	25	6	5	2	15	1	2	0	10	3	0
6.4	87	6	19	9	12	4	17	3	4	1	5	0	1	0	3	1	1
3.3	45	7	10	6	3	3	9	1	0	0	4	0	1	0	2	0	0
3.5	47	8	13	5	1	3	16	0	0	0	3	0	1	0	3	0	0
2.1	28	9	3	1	5	2	9	0	1	0	4	1	0	0	0	0	0
1.4	19	10	2	4	3	0	7	1	0	0	1	0	0	0	0	0	0
0.7	10	11	0	1	3	0	3	2	0	0	0	0	1	0	0	0	0
0.7	9	12	1	2	1	1	2	0	0	0	2	0	0	0	0	0	0
0.1	2	13	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
0.4	5	14	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0
	1355	TOTAL	183	108	125	89	247	67	61	33	138	11	32	6	111	6	11
		PERC.	13.5	8.0	9.2	6.6	18.2	4.9	4.5	2.4	10.2	0.8	2.4	0.4	8.2	0.4	0.8

VALUE	15	16	17	18	19	20	21	22	24	25	26	28	30
1	0	2	0	0	0	2	0	0	0	0	0	0	0
2	11	15	3	0	1	9	0	0	0	0	0	0	0
3	5	11	0	2	1	7	0	0	1	0	0	1	0
4	2	6	0	0	0	6	2	1	0	1	1	1	1
5	4	5	0	1	0	4	0	0	1	0	0	1	0
6	0	3	0	1	0	2	0	0	1	0	0	0	0
7	2	1	0	0	0	1	0	0	0	0	0	2	0
8	0	0	0	0	0	1	1	0	0	0	0	0	0
9	0	0	0	0	0	2	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	25	43	3	4	2	34	3	1	4	1	1	5	1
PERC.	1.8	3.2	0.2	0.3	0.1	2.5	0.2	0.1	0.3	0.1	0.1	0.4	0.1

50%	10%	5%
4.2	13.2	16

THE ROWS ARE FROM VARIABLE 3

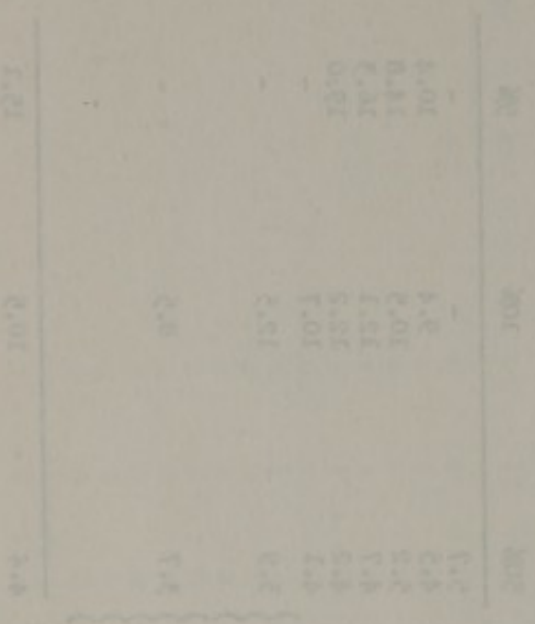
THE COLUMNS ARE FROM VARIABLE 24

Table 8.10 Weekly Hours of Attendance at Discotheques by Regular Attenders in Age Groups

PERC.	TOTAL	VALUE	1	2	3	4	5	6	8	9	10	12	14	15	16	18	20
1.5	21	1	1	4	4	1	0	3	4	1	2	1	0	0	0	0	0
16.4	222	2	1	57	16	40	2	49	29	7	11	3	1	2	0	0	2
28.0	379	3	2	25	75	78	18	61	41	22	17	17	1	8	5	1	4
24.1	327	4	2	21	92	47	13	55	31	21	6	11	0	6	7	6	5
11.4	154	5	0	9	50	26	10	16	9	12	1	9	0	2	2	0	2
6.4	87	6	0	7	22	26	8	8	3	3	0	5	0	0	1	2	1
3.3	45	7	0	4	15	11	2	3	3	0	0	3	2	1	1	0	0
3.5	47	8	0	7	12	10	3	5	4	0	0	1	0	2	0	0	2
2.1	28	9	0	1	10	7	0	4	3	1	2	0	0	0	0	0	0
1.4	19	10	0	4	9	4	1	0	0	0	0	0	0	0	0	0	0
0.7	10	11	0	1	4	2	1	2	0	0	0	0	0	0	0	0	0
0.7	9	12	0	0	3	3	1	0	0	1	1	0	0	0	0	0	0
0.1	2	13	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
0.4	5	14	0	0	1	2	1	0	0	1	0	0	0	0	0	0	0
	1355	TOTAL	6	140	314	257	61	206	127	69	40	50	4	21	16	9	16
		PERC.	0.4	10.3	23.2	19.0	4.5	15.2	9.4	5.1	3.0	3.7	0.3	1.5	1.2	0.7	1.2

VALUE	21	24	28	30	35	36	42
1	0	0	0	0	0	0	0
2	0	1	1	0	0	0	0
3	0	2	0	1	0	0	1
4	1	1	0	1	0	1	0
5	0	0	1	3	2	0	0
6	0	0	0	1	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	1	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
TOTAL	1	4	2	7	2	2	1
PERC.	0.1	0.3	0.1	0.5	0.1	0.1	0.1

50%	10%	5%
5.7	-	-
4.5	9.4	10.4
5.2	10.5	14.8
4.7	12.1	16.3
4.2	12.2	19.0
4.1	10.7	-
3.9	12.5	-
3.7	8.5	-
4.4	10.5	15.1



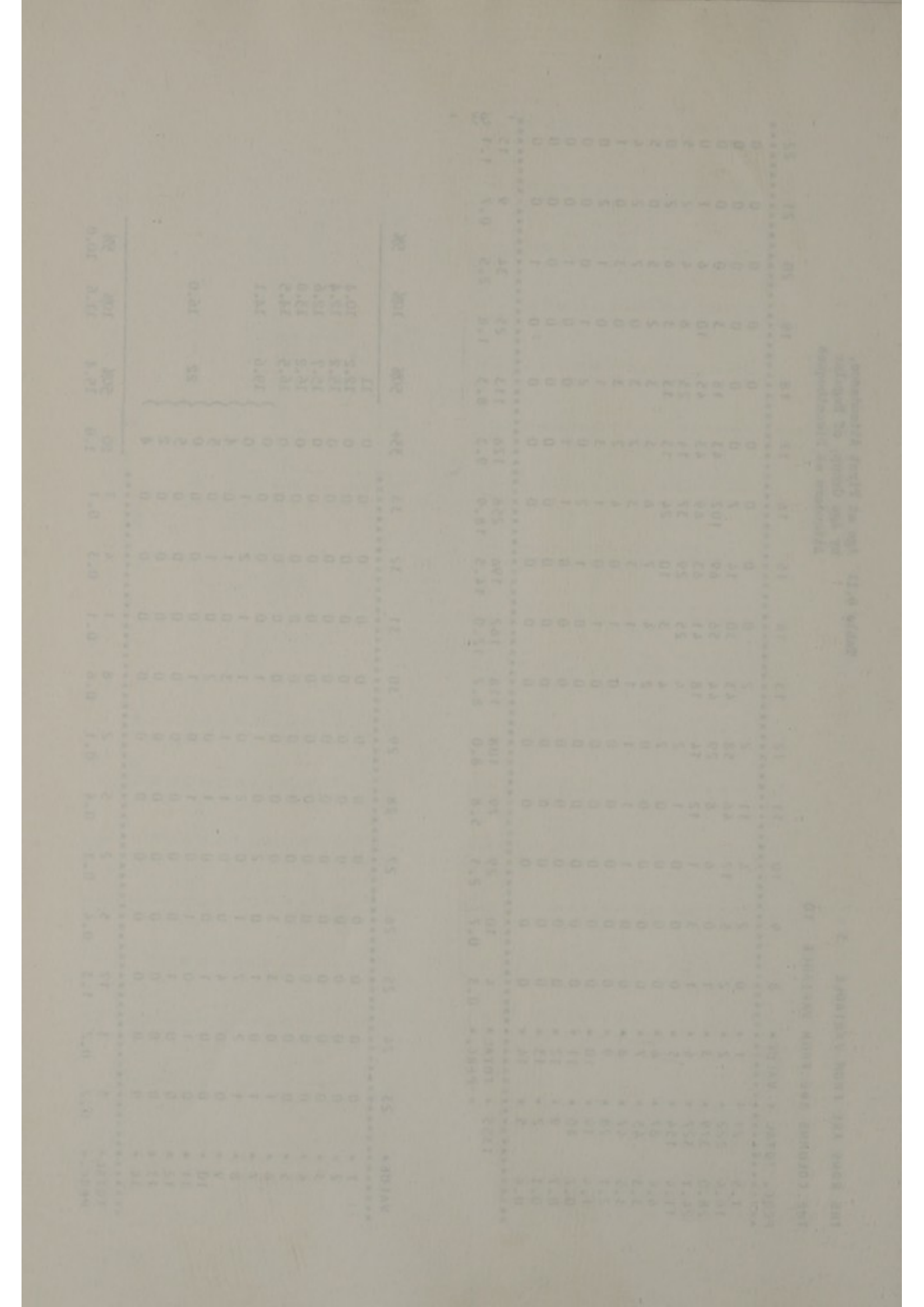
THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 10

Table 8.11 Age at First Attendance, by Age Group, of Regular Attenders at Discotheques

PERC.	TOTAL	VALUE	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.5	21	1	0	2	4	11	2	2	0	0	0	0	0	0	0	0	0
16.4	222	2	2	5	17	46	58	43	30	14	7	0	0	0	0	0	0
28.0	379	3	1	0	6	8	29	44	56	69	102	43	18	3	0	0	0
24.1	327	4	1	3	1	12	14	18	41	63	69	43	45	10	6	1	0
11.4	154	5	0	0	0	1	2	4	25	29	37	14	25	6	4	2	5
6.4	87	6	0	0	0	0	2	4	3	10	24	13	13	3	6	2	0
3.3	45	7	0	0	0	0	0	2	4	7	6	5	3	2	5	0	5
3.5	47	8	0	0	1	1	1	1	1	3	3	2	3	0	7	2	4
2.1	28	9	0	0	0	0	0	0	1	0	4	2	3	0	3	0	1
1.4	19	10	0	0	0	0	0	0	1	0	1	3	1	0	1	2	0
0.7	10	11	0	0	0	0	0	0	0	1	2	0	2	1	0	0	0
0.7	9	12	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
0.1	2	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.4	5	14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	1355	TOTAL	4	10	29	79	108	118	162	196	256	126	113	25	34	9	15
		PERC.	0.3	0.7	2.1	5.8	8.0	8.7	12.0	14.5	18.9	9.3	8.3	1.8	2.5	0.7	1.1

VALUE	23	24	25	26	27	28	29	30	31	32	33	33+	50%	10%	5%
1	0	0	0	0	0	0	0	0	0	0	0	0	11		
2	0	0	0	0	0	0	0	0	0	0	0	0	12.2	10.4	
3	0	0	0	0	0	0	0	0	0	0	0	0	15.2	12.4	
4	0	0	0	0	0	0	0	0	0	0	0	0	15.7	12.6	
5	0	0	0	0	0	0	0	0	0	0	0	0	16.2	13.8	
6	1	0	3	3	0	0	0	0	0	0	0	0	16.5	14.5	
7	1	0	1	0	2	0	1	1	0	0	0	0	19.6	14.1	
8	1	2	7	1	0	2	0	1	1	2	1	0			
9	0	0	4	0	0	1	1	3	0	1	0	4			
10	0	0	1	0	0	1	0	2	0	1	0	5			
11	0	1	0	1	0	1	0	1	0	0	0	0	22	16.0	
12	0	0	1	0	0	0	0	0	0	0	0	5			
13	0	0	0	0	0	0	0	0	0	0	0	2			
14	0	0	0	0	0	0	0	0	0	0	0	4			
TOTAL	3	3	17	5	2	5	2	8	1	4	1	20	50%	10%	5%
PERC.	0.2	0.2	1.3	0.4	0.1	0.4	0.1	0.6	0.1	0.3	0.1	1.8	15.4	11.6	10.8



Age Group	3	4	5	6	7	8	9	10	11	12	13
Age	17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47-49
Numbers in Age Group	333	321	154	87	53	45	28	19	10	9	2
Proportion re Age Group 3	1.0	0.96	0.46	0.26	0.16	0.14	0.08	0.06	0.03	0.03	0.01
New Attenders in Group	-	58	23	12	11	5	13	3	2	1	1
Previous Attenders in Group	-	253	131	75	42	40	15	16	8	8	1
Proportion re Age Group 3	1.0	0.76	0.39	0.23	0.13	0.12	0.05	0.05	0.02	0.02	0.00
Total Population (x 1000) * (Great Britain)	2318	2169	2026	2010	2175	2150	1866	1686	1697	1615	1690
Proportion re Age Group 3	1.0	0.93	0.87	0.86	0.93	0.92	0.80	0.72	0.73	0.69	0.72
Proportion of Attenders, ref Age Group 3, corrected for New Attenders and Total Population Age Structure	1.0	0.82	0.45	0.27	0.14	0.13	0.06	0.07	0.03	0.03	0.00
Comparative Data Pop (Corrected)	1.0	0.72	0.42	0.28	0.12	0.08	0.04	0.01	—	0.01	0.01

Table 8.12 Proportion of Licenced Discotheque Attenders by Age Group with correction for New Attenders and Total Population Structure

* From Office of Population Censuses and Surveys - Population Projections 1977

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 15

PERC.	TOTAL	VALUE	1	2	3	4	5
1.5	21	1	1	0	0	8	12
16.4	222	2	3	3	20	45	151
28.0	379	3	3	4	10	29	333
24.1	327	4	1	1	2	5	318
11.4	154	5	0	0	4	3	147
6.4	87	6	0	0	0	3	84
3.3	45	7	0	1	1	2	41
3.5	47	8	0	0	1	1	45
2.1	28	9	0	0	0	0	28
1.4	19	10	0	0	0	1	18
0.7	10	11	0	0	0	0	10
0.7	9	12	0	0	1	0	8
0.1	2	13	0	0	0	0	2
0.4	5	14	0	0	0	0	5
	1355	TOTAL	8	9	39	97	1202
		PERC.	0.6	0.7	2.9	7.2	88.7

Table 8.13 Proportion of Time Spent out of Dance Hall by Regular Attenders by Age Group

1 = All

2 = 75%

3 = 50%

4 = 25%

5 = Nil

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 13

PERC.	TOTAL	* VALUE *	1	2	3	4	5
1.5	21	* 1 *	0	6	3	2	10
16.4	222	* 2 *	9	24	54	52	83
28.0	379	* 3 *	30	87	125	93	44
24.1	327	* 4 *	24	83	105	86	29
11.4	154	* 5 *	8	46	42	41	17
6.4	87	* 6 *	9	24	20	28	6
3.3	45	* 7 *	6	12	12	9	6
3.5	47	* 8 *	6	13	15	9	4
2.1	28	* 9 *	4	7	9	5	3
1.4	19	* 10 *	4	7	4	2	2
0.7	10	* 11 *	2	1	5	2	0
0.7	9	* 12 *	1	4	2	1	1
0.1	2	* 13 *	0	1	1	0	0
0.4	5	* 14 *	0	2	1	2	0
	1355	* TOTAL *	103	317	398	332	205
		* PERC. *	7.6	23.4	29.4	24.5	15.1

Table 8.14 Proportion of Time Spent Dancing by Regular Attenders in Age Groups

1 = All

2 = 75%

3 = 50%

4 = 25%

5 = Nil

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 16

PERC.	TOTAL	VALUE	1	2	3
1.5	21	1	7	1	13
16.4	222	2	36	23	163
28.0	379	3	74	28	277
24.1	327	4	58	31	238
11.4	154	5	30	6	118
6.4	87	6	12	5	70
3.3	45	7	4	8	33
3.5	47	8	9	6	32
2.1	28	9	3	9	16
1.4	19	10	1	5	13
0.7	10	11	0	5	5
0.7	9	12	0	6	3
0.1	2	13	1	1	0
0.4	5	14	0	3	2
	1355	TOTAL	235	137	983
		PERC.	17.3	10.1	72.5

Table 8.15 Preference for Position in Discotheques by Regular Attenders in Age Groups

1 = Near to Loudspeakers

2 = Away from Loudspeakers

3 = No Preference

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 20

PERC.	TOTAL	VALUE	1	2	3
1.5	21	1	3	15	3
16.4	222	2	20	179	23
28.0	379	3	27	321	31
24.1	327	4	36	271	20
11.4	154	5	16	128	10
6.4	87	6	12	71	4
3.3	45	7	9	34	2
3.5	47	8	7	39	1
2.1	28	9	11	17	0
1.4	19	10	6	13	0
0.7	10	11	4	6	0
0.7	9	12	7	2	0
0.1	2	13	1	0	1
0.4	5	14	4	1	0
	1355	TOTAL	163	1097	95
		PERC.	12.0	81.0	7.0

Table 8.16 Opinion of Loudness of Music
by Regular Attenders in Age Group

1 = Too Loud
2 = Just Right
3 = Too Quiet

THE ROWS ARE FROM VARIABLE 4

THE COLUMNS ARE FROM VARIABLE 20

PERC.	TOTAL	VALUE	1	2	3	MPEL
13.5	183	1	18	161	4	106
17.7	240	2	57	178	5	104
12.6	171	3	8	153	10	93
6.7	91	4	7	76	8	-
12.8	173	5	9	148	16	96
4.1	55	6	16	37	2	103
4.9	66	7	10	52	4	112
4.3	58	8	8	41	9	-
2.7	36	9	2	32	2	99
5.0	68	11	4	53	11	100
3.1	42	12	6	32	4	98
0.5	7	13	1	6	0	98
1.2	16	14	2	13	1	106
2.1	29	15	1	24	4	104
2.7	36	16	4	28	4	105
2.0	27	17	2	23	2	101
1.6	22	20	2	17	3	95
1.7	23	21	3	18	2	94
0.9	12	31	3	5	4	112
	1355	TOTAL	163	1097	95	102 dB(A)
		PERC.	12.0	81.0	7.0	

Table 8.17

Opinion of Loudness of Music

by Regular Attenders by Location

1. Too Loud

2. Just Right

3. Too Quiet

(Note: Locations arenot cross referenced to Sound Level Survey)

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 18

PERC.	TOTAL	VALUE	0	1	2
1.5	21	1	0	0	21
16.4	222	2	0	6	216
28.0	379	3	0	59	320
24.1	327	4	1	61	265
11.4	154	5	0	24	130
6.4	87	6	0	12	75
3.3	45	7	0	11	34
3.5	47	8	0	9	38
2.1	28	9	1	7	20
1.4	19	10	0	3	16
0.7	10	11	0	1	9
0.7	9	12	0	4	5
0.1	2	13	0	0	2
0.4	5	14	0	0	5
	1355	TOTAL	2	197	1156
		PERC.	0.1	14.5	85.3

Table 8.18 Regular Attenders at Discotheques who may have Additional Noise Exposure at Work

0 = No Answer
1 = Possible Noise Exposure
2 = No Exposure

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 17

Table 8.19 Occupations of Regular Attenders at Discotheques (See Appendix 5 for Identification of Occupations)

PERC.	TOTAL	VALUE	0	1	2	3	5	6	7	8	9	11	12	13	14	15	16
1.5	21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.4	222	2	0	1	1	1	0	0	4	0	1	1	0	0	1	1	1
28.0	379	3	1	2	2	5	1	1	28	3	5	2	0	15	2	13	1
24.1	327	4	0	1	3	5	1	2	27	5	7	4	0	7	0	5	0
11.4	154	5	0	1	1	5	0	0	6	2	2	1	1	4	0	2	0
6.4	87	6	0	1	0	1	0	1	7	0	3	1	1	2	0	1	0
3.3	45	7	0	0	0	0	0	0	5	0	0	0	1	2	0	1	0
3.5	47	8	0	1	0	1	0	0	2	0	1	0	0	0	0	5	0
2.1	28	9	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0
1.4	19	10	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0
0.7	10	11	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
0.7	9	12	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0.1	2	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.4	5	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1355	TOTAL	1	7	7	18	2	5	85	10	21	9	3	30	3	31	2
		PERC.	0.1	0.5	0.5	1.3	0.1	0.4	6.3	0.7	1.5	0.7	0.2	2.2	0.2	2.3	0.1

VALUE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0
2	1	0	0	2	0	1	6	6	3	2	0	0	2	179	8
3	8	1	6	11	4	13	26	60	32	40	14	2	14	13	54
4	6	2	11	13	6	9	21	41	53	33	23	7	11	0	24
5	3	2	2	4	3	13	8	26	21	17	4	15	7	0	4
6	0	0	0	1	0	6	3	14	10	12	3	14	3	0	3
7	0	0	0	0	0	2	3	9	2	9	5	6	0	0	0
8	0	1	1	0	1	1	3	9	6	4	1	9	1	0	0
9	0	0	1	0	0	1	1	6	4	7	0	3	1	0	0
10	0	0	0	1	0	0	1	3	1	5	0	3	0	0	0
11	0	0	0	0	0	0	0	6	0	1	0	1	0	0	0
12	0	0	0	0	0	1	2	1	1	1	0	2	0	0	0
13	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
14	0	0	0	0	0	2	1	0	0	0	0	2	0	0	0
TOTAL	18	6	22	32	14	49	75	181	133	132	50	64	39	213	93
PERC.	1.3	0.4	1.6	2.4	1.0	3.6	5.5	13.4	9.8	9.7	3.7	4.7	2.9	15.7	6.9

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 21

PERC.	TOTAL	VALUE	1	2	3
1.5	21	1	0	21	0
16.4	222	2	61	152	9
28.0	379	3	73	92	214
24.1	327	4	46	34	247
11.4	154	5	18	16	120
6.4	87	6	3	5	79
3.3	45	7	2	7	36
3.5	47	8	1	3	43
2.1	28	9	0	2	26
1.4	19	10	0	0	19
0.7	10	11	0	2	8
0.7	9	12	0	0	9
0.1	2	13	0	0	2
0.4	5	14	0	2	3
	1355	TOTAL	204	336	815
		PERC.	15.1	24.8	60.1

Table 8.20 Regular Attenders at Discotheques who also attend Pop Concerts by Age Group

1 = Yes
2 = No
3 = No reply

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 22

PERC.	TOTAL	* VALUE *	1	2	3
1.5	21	* 1 *	11	10	0
16.4	222	* 2 *	150	63	9
28.0	379	* 3 *	133	32	214
24.1	327	* 4 *	62	17	248
11.4	154	* 5 *	31	3	120
6.4	87	* 6 *	6	2	79
3.3	45	* 7 *	6	3	36
3.5	47	* 8 *	3	1	43
2.1	28	* 9 *	2	0	26
1.4	19	* 10 *	0	0	19
0.7	10	* 11 *	2	0	8
0.7	9	* 12 *	0	0	9
0.1	2	* 13 *	0	0	2
0.4	5	* 14 *	1	1	3
	1355	* TOTAL *	407	132	816
		* PERC. *	30.0	9.7	60.2

Table 8.21 Regular Attenders at Discotheques who also attend Pubs and Clubs where Loud Music is Played by Age Group

1 = Yes
2 = No
3 = No reply

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 19

PERC.	TOTAL	* VALUE *	1	2	3	4
1.5	21	* 1 *	19	2	0	0
16.4	222	* 2 *	166	54	2	0
28.0	379	* 3 *	247	96	30	6
24.1	327	* 4 *	181	70	40	36
11.4	154	* 5 *	82	18	10	44
6.4	87	* 6 *	42	5	5	35
3.3	45	* 7 *	14	5	2	24
3.5	47	* 8 *	19	2	0	26
2.1	28	* 9 *	11	0	0	17
1.4	19	* 10 *	8	1	1	9
0.7	10	* 11 *	4	0	0	6
0.7	9	* 12 *	4	0	0	5
0.1	2	* 13 *	1	0	0	1
0.4	5	* 14 *	1	0	0	4
	1355	* TOTAL *	799	253	90	213
		* PERC. *	59.0	18.7	6.6	15.7

Table 8.22 Marital Status of Regular Attenders at Discotheques by Age Group

1 = Single
2 = 'Going Steady'
3 = Engaged
4 = Married

Table 8.23 Main Parameters of Survey Data and Comparative Data

Parameter	Main Survey Data				Comparative Data			
	%	50%	10%	5%	%	50%	10%	5%
Discotheque Data								
Age Structure		21yrs	32yrs	36yrs		21yrs	29yrs	32 yrs
Non Attenders	9.5				14.5			
Att. in Last 7 days		1.5	3.7	4.4		1.4	3.4	4.2
Length of each Att.		3.1	4.5	5.1		3.4	4.8	5.3
Weekly Hours		4.4	10.5	15.1		4.4	12.1	15.6
Years Duration		7	18	24		6	15	24
Noise at Work	14.5				16.8			
Age of Comm. Att.		15.4	11.6	10.8		15.7	13.1	12.4
Educational Data								
Age Structure		16	19	20		17	19	22
Non Attenders	51.2				40.4			
Att.in last 7 days		0.7	2.5	3.4		0.7	2.3	2.9
Length of each Att.		2.5				3.7		
Weekly Hours		2.7	8.4	11.8		3.2	8.8	10.9
Age of Comm. Att.		12.8	10.7	9.9		13.8	10.8	9.8

Source of Comparative Data in Appendices 3 & 4

Table 9.1 Percentile Values of L_{eq}, Weekly Hours and Year Duration used for Calculating NIL

	Percentile Values		
	50%	10%	5%
L_{eq}	97dB(A)	102dB(A)	103dB(A)
Weekly Hours (T)	4.5 hrs	10.5 hrs	15 hrs
Years Duration (T)	7 years	18 years	24 years

Table 9.2 Noise Immission Levels calculated from 50th, 10th and 5th Percentile Values of L_{eq}, Weekly Hours of Attendance and Years of Exposure. (Corrected for duration of attendance and yearly duration).

p <	L_{eq} db(A)	Weekly Attendance (hrs)	Years of Attendance (years)	Correction for duration of each Attendance (-1dB)	Correction for variation of Yearly Att. (-1dB)	NIL (dB)
0.125	97	4.5	7	-	-1	95
0.001	102	10.5	18	-1	-1	107
0.000125	103	15.0	24	-1	-1	111

Table 9.1 Percentile Values of L_{eq}, Yearly Dose and Dose Duration used for Calculating RIL

	Percentile Values		
	90%	10%	5%
L_{eq}	91dB(A)	102dB(A)	107dB(A)
Yearly Dose (Σ)	4.5 hrs	10.5 hrs	15 hrs
Years Duration (Σ)	7 years	14 years	24 years

Table 9.2 Noise Immission Levels calculated from 90%, 10% and 5% Percentile Values of L_{eq}, Yearly Doses of Attendance and Years of Exposure. (Corrected for duration of attendance not yearly duration).

L_{eq} dB(A)	Yearly Attendance (hrs)	Years of Attendance (years)	Correction for duration of each Attendance (-10Σ)	Correction for variation of Yearly Att. (-10Σ)	RIL (dB)
0.1Σ	37	4.5	7	-	-1	95
0.05Σ	102	10.5	14	-1	-1	107
0.025Σ	155	15.0	24	-2	-1	112

Table 9.3 Threshold Hearing Levels (H') for stated Percentiles of Discotheque Attenders and NIL with Probability of Occurrence at end of Estimated Lifetime Duration of Attendance and at 60 years of age.

p ≤	Age (yrs)	NIL (dB)	Frequency (kHz)						At age 60			
			0.5	1	2	3	4	6	Ave.of 0.5, 1 & 2	Ave.of 1,2 & 3	Ave. 0.5,1,2	Ave. 1,2,3
			5%									
0.0065	22	95	11.7	12.8	16.3	21.8	24.5	20.7	13.6	17.0	21.2	26.8
0.00005	28	107	18.3	22.1	32.1	42.2	46.0	40.8	24.1	32.1	31.4	41.5
0.0000063	34	111	22.1	28.5	40.3	50.2	54.0	50.0	30.7	39.7	37.2	48.1
			10%									
0.0125	22	95	9.1	9.9	12.7	17.1	19.4	16.2	10.6	13.2	18.2	23.0
0.0001	28	107	14.3	18.1	26.2	36.0	40.0	34.6	19.3	26.6	26.6	36.0
0.000013	34	111	18.6	23.0	34.1	44.5	48.6	44.2	25.3	33.9	31.8	42.3
			50%									
0.0625	22	95	0.5	0.8	1.9	3.8	4.9	3.5	1.1	2.2	8.7	12.0
0.0005	28	107	2.7	4.1	8.7	15.3	18.6	14.3	5.7	9.4	13.0	18.8
0.000063	34	111	4.9	7.2	14.0	23.0	27.5	23.0	8.8	14.8	15.3	23.2

Table 9.4 Threshold Hearing Levels (H') for stated Percentiles of Discotheque Attenders and 50%, 10% and 5% NIL values (NIL = 0 represents normal population)

NIL	Ave. Threshold Levels (H') at 1,2 and 3kHz (dB)			BS 5330 % at Risk of 30dB ave.
	50%	10%	5%	
50% = 85	0.6	9.3	12.0	-
10% = 96	2.5	13.9	17.8	-
5% = 97	2.8	14.6	18.7	-
0	0	7.7	9.9	-

Table 10.1 Estimate of Total Number of Regular Attenders at Discotheques in Total Population (Great Britain)

Age Group (Years)	Proportion of Attenders	Number in Age Group (Total Pop 1000)	Number of Attenders (x 1000)
11 - 13	0.36	2382	858
14 - 16	0.49	2461	1206
17 - 19	0.56	2318	1298
20 - 22	0.54	2169	1171
23 - 25	0.26	2026	526
26 - 28	0.15	2010	302
29 - 31	0.09	2175	196
32 - 34	0.08	2150	172
35 - 37	0.05	1866	93
38 - 40	0.03	1686	51
41 - 43	0.02	1697	34
44 - 46	0.02	1615	34
47 - 49	0.01	1690	17
	0.23	26,245	5,958

Table 10.2 Numbers of Attenders at Risk of Achieving a given Threshold Level (H) for stated NIL

NIL (Number of Attenders Exposed)	% of Exposed Pop.	Level exceed by population (H') (dB)		Number of Attenders at Risk of exceeding H'
		average 0.5, 1 & 2 kHz	average 1, 2 & 3 kHz	
111	5	30.7	39.7	38
(750)	10	25.3	33.9	75
	50	8.8	14.8	375
107	5	24.1	32.1	300
(6,000)	10	19.3	26.6	600
	50	5.7	9.4	3000
95	5	13.6	17.0	39,000
(750,000)	10	10.6	13.2	75,000
	50	1.1	2.2	375,000

Table 10.3 Numbers of Attenders at Risk of Achieving a 30dB (ave.) Threshold Level at 1,2 & 3 kHz for stated NIL. (BS5330: 1976)

NIL ($p <$)	Percentage of Attenders (Number of Attenders)	
	At end of Attedance	At age 60
95 (0.125)	0	2.5% (18,750)
107 (0.001)	7% (420)	19.5 (1140)
111 (0.000125)	15.5% (116)	31.5 (236)

THE ROWS ARE FROM VARIABLE 17

THE COLUMNS ARE FROM VARIABLE 18

PERC.	TOTAL	VALUE	0	1	2
0.1	1	0	0	0	1
0.5	7	1	0	1	6
0.5	7	2	0	3	4
1.3	18	3	0	10	8
0.1	2	5	0	0	2
0.4	5	6	0	2	3
6.3	85	7	0	32	53
0.7	10	8	0	6	4
1.5	21	9	0	3	18
0.7	9	11	0	5	4
0.2	3	12	0	1	2
2.2	30	13	0	12	18
0.2	3	14	0	0	3
2.3	31	15	1	15	15
0.1	2	16	0	1	1
1.3	18	17	0	2	16
0.4	6	18	0	0	6
1.6	22	19	0	9	13
2.4	32	20	0	4	28
1.0	14	21	0	0	14
3.6	49	22	0	7	42
5.5	75	23	0	8	67
13.4	181	24	0	20	161
9.8	133	25	0	19	114
9.7	132	26	1	15	116
3.7	50	27	0	10	40
4.7	64	28	0	4	60
2.9	39	29	0	3	36
15.7	213	30	0	1	212
6.9	93	31	0	4	89
	1355	TOTAL	2	197	1156
		PERC.	0.1	14.5	85.3

Table 10. 4

Regular Attenders at Discotheques who 'have to shout at work to make themselves heard' by Occupation

(See Appendix 5 for list of occupation)

1 = Possible noise exposure

2 = No noise exposure

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 1

PERC.	TOTAL	VALUE	1	2
8.5	228	1	127	101
62.1	1658	2	854	804
24.6	656	3	331	325
2.6	70	4	43	27
0.9	24	5	19	5
0.4	10	6	3	7
0.4	10	7	4	6
0.2	5	8	4	1
0.0	1	9	1	0
0.1	4	10	1	3
0.1	2	13	0	2
	2668	TOTAL	1387	1281
		PERC.	52.0	48.0

Table ED 1

Educational Survey Population

by Sex and Age Group

1 = Male

2 = Female

50%	10%	5%
16 yrs	19 yrs	20 yrs

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 12

PERC.	TOTAL	VALUE	1	2	3	
8.5	228	1	145	17	66	36%
62.1	1658	2	845	310	503	49%
24.6	656	3	290	213	153	56%
2.6	70	4	41	19	10	42%
0.9	24	5	17	4	3	÷
0.4	10	6	8	1	1	-
0.4	10	7	9	1	0	-
0.2	5	8	4	0	1	
0.0	1	9	0	1	0	
0.1	4	10	4	0	0	
0.1	2	13	2	0	0	
	2668	TOTAL	1365	566	737	
		PERC.	51.2	21.2	27.6	

Attenders

Table ED 2

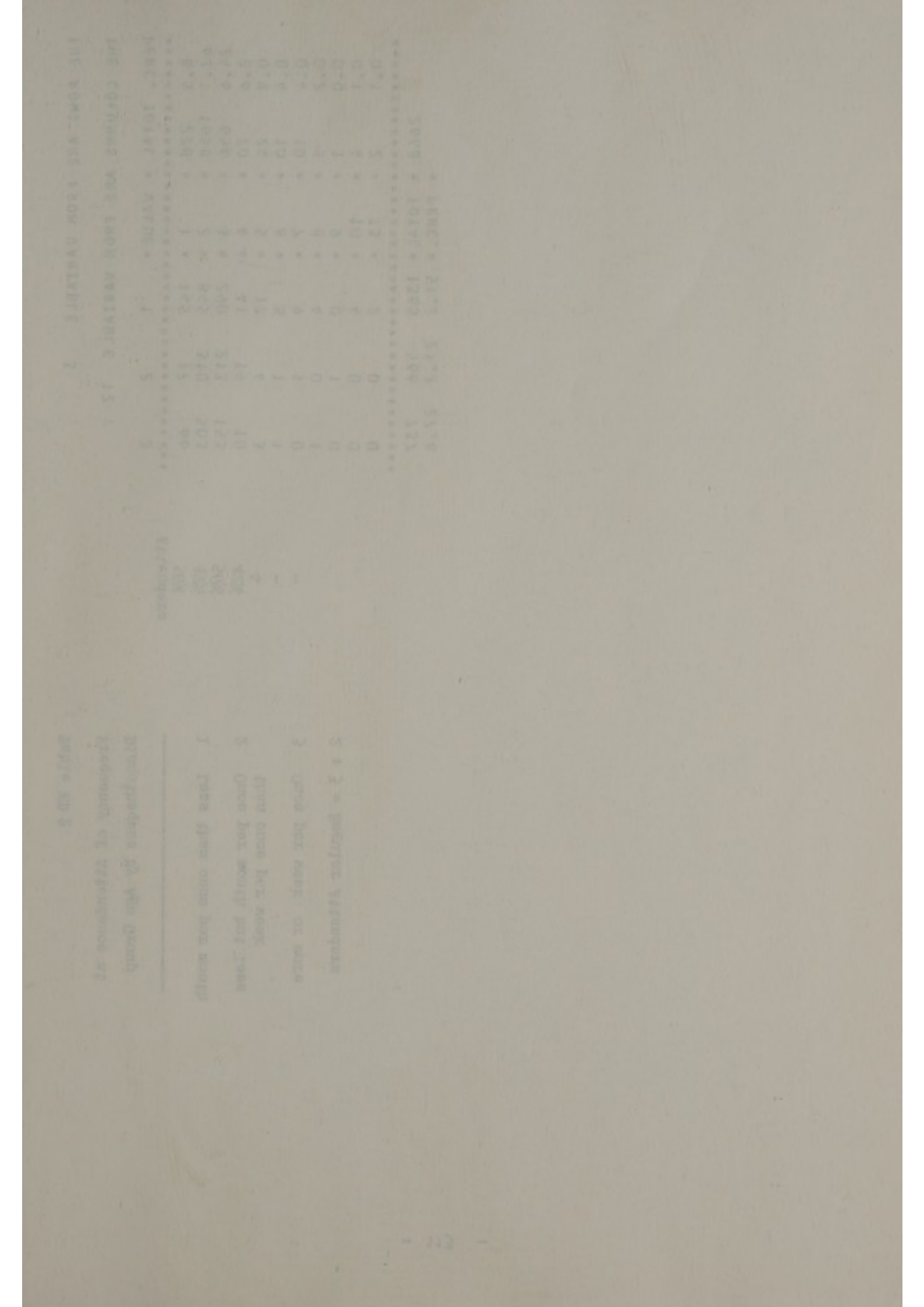
Frequency of Attendance at Discotheques by Age Group

1 Less than once per month

2 Once per month but less than once per week

3 Once per week or more

2 + 3 = Regular Attenders



THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 26

PERC.	TOTAL	* VALUE *	0	1	2	3	4	5	6	7
6.4	83	* 1 *	0	7	54	18	3	1	0	0
62.4	813	* 2 *	3	28	255	335	133	46	8	5
28.1	366	* 3 *	0	1	35	133	132	40	18	7
2.2	29	* 4 *	0	0	2	10	13	2	2	0
0.5	7	* 5 *	0	0	0	4	2	1	0	0
0.2	2	* 6 *	0	0	0	1	1	0	0	0
0.1	1	* 7 *	0	0	0	1	0	0	0	0
0.1	1	* 8 *	0	0	0	1	0	0	0	0
0.1	1	* 9 *	0	0	0	0	1	0	0	0
	1303	* TOTAL *	3	36	346	503	285	90	28	12
		* PERC. *	0.2	2.8	26.6	38.6	21.9	6.9	2.1	0.9

Table ED 3

Length of Each Attendance by Regular Attenders by Age Group

50%	10%	5%
3.0	4.4	5.1

THE ROWS ARE FROM VARIABLE 3

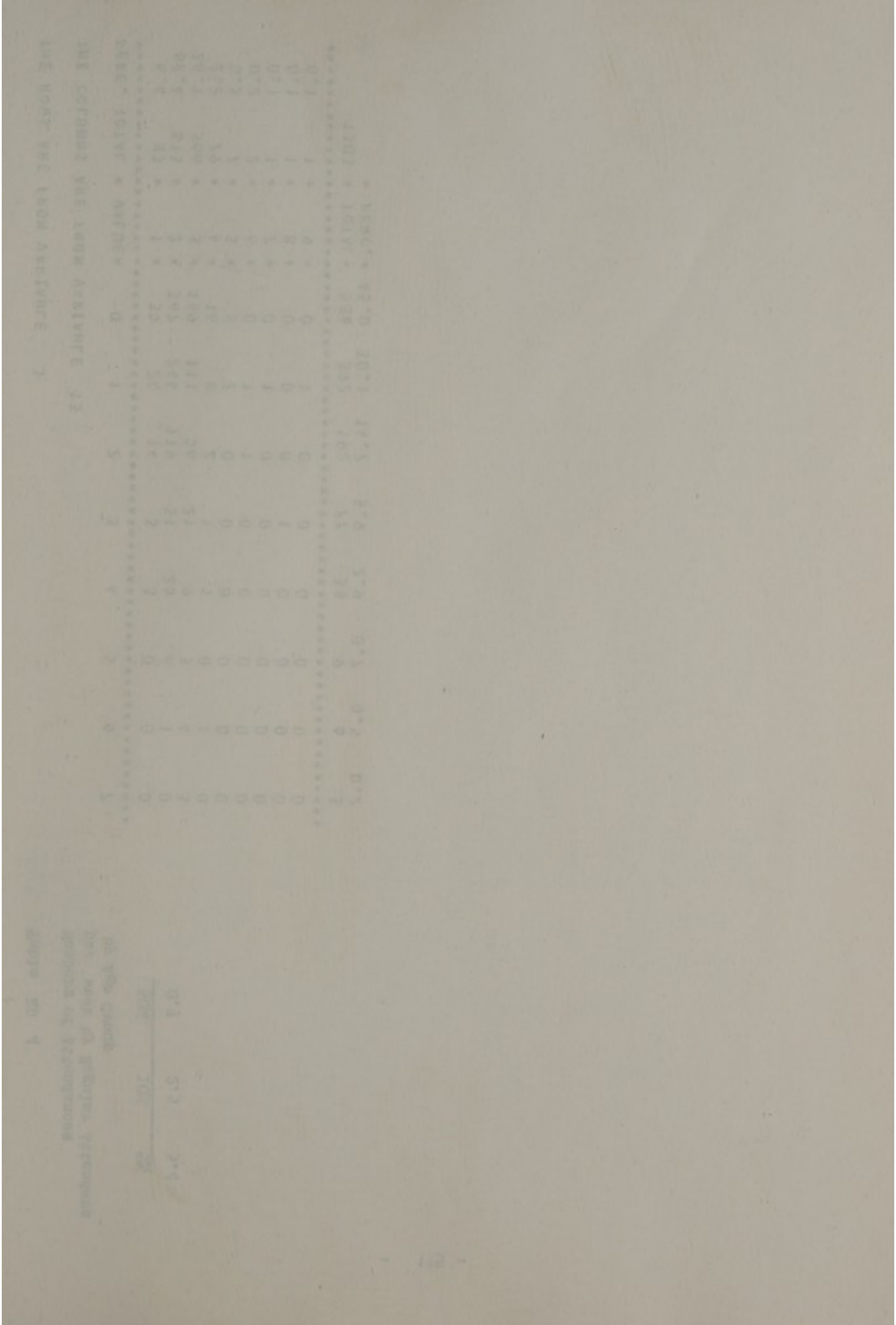
THE COLUMNS ARE FROM VARIABLE 13

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	7
6.4	83	1	39	24	14	3	3	0	0	0
62.4	813	2	367	244	119	51	25	6	1	0
28.1	366	3	159	111	56	21	9	3	4	3
2.2	29	4	16	8	2	1	1	0	1	0
0.5	7	5	5	2	0	0	0	0	0	0
0.2	2	6	0	1	1	0	0	0	0	0
0.1	1	7	0	1	0	0	0	0	0	0
0.1	1	8	0	0	0	1	0	0	0	0
0.1	1	9	0	1	0	0	0	0	0	0
	1303	TOTAL	586	392	192	77	38	9	6	3
		PERC.	45.0	30.1	14.7	5.9	2.9	0.7	0.5	0.2

Table ED 4

Numbers of Attendances per week by Regular Attenders by Age Group

50%	10%	5%
0.7	2.5	3.4



THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 27

Table ED 5

Weekly Hours of Attendance by

Regular Attenders by Age Group

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	7	8	9	10	12	14	15	16
6.4	83	1	12	17	23	7	12	1	6	0	2	2	0	1	0	0	0
62.4	813	2	145	137	122	112	106	26	72	2	27	19	9	20	0	4	4
28.1	366	3	49	50	45	60	53	15	24	1	16	11	12	8	1	2	5
2.2	29	4	7	3	5	1	5	2	1	0	1	0	1	2	0	0	0
0.5	7	5	1	1	2	1	1	1	0	0	0	0	0	0	0	0	0
0.2	2	6	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
0.1	1	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0.1	1	8	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0.1	1	9	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	1303	TOTAL	214	208	197	182	179	45	104	3	46	33	22	31	1	6	9
		PERC.	16.4	16.0	15.1	14.0	13.7	3.5	8.0	0.2	3.5	2.5	1.7	2.4	0.1	0.5	0.7

VALUE	18	20	21	24	25	28	36	42
1	0	0	0	0	0	0	0	0
2	2	3	1	0	1	1	0	0
3	4	0	1	2	1	3	0	3
4	0	0	0	0	0	0	1	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
TOTAL	6	3	2	2	2	4	1	3
PERC.	0.5	0.2	0.2	0.2	0.2	0.3	0.1	0.2

50%	10%	5%
2.7	8.4	11.8

Table ED. 6

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 15

Age at which Attendance Commenced
by Regular Attenders by Age Group

PERC.	TOTAL	VALUE	0	6	7	8	9	10	11	12	13	14	15	16	17	18	19
6.4	83	1	0	0	0	1	6	13	36	17	10	0	0	0	0	0	0
62.4	813	2	3	0	1	4	20	50	110	216	273	94	34	7	0	0	1
28.1	366	3	1	1	0	0	3	9	19	37	82	80	59	49	19	7	0
2.2	29	4	0	0	0	0	0	1	2	1	1	3	5	8	3	3	2
0.5	7	5	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
0.2	2	6	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
0.1	1	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0.1	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0.1	1	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	1303	TOTAL	4	1	1	5	29	73	167	271	367	178	101	66	24	11	5
		PERC.	0.3	0.1	0.1	0.4	2.2	5.6	12.8	20.8	28.2	13.7	7.8	5.1	1.8	0.8	0.4

50%	10%	5%
12.8yrs	10.7yrs	9.9yrs

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 10

PERC.	TOTAL	* VALUE *	0	1	2	3
6.4	83	* 1 *	0	80	2	1
62.4	813	* 2 *	1	758	38	16
28.1	366	* 3 *	0	295	46	25
2.2	29	* 4 *	0	24	3	2
0.5	7	* 5 *	0	6	0	1
0.2	2	* 6 *	0	2	0	0
0.1	1	* 7 *	0	1	0	0
0.1	1	* 8 *	0	1	0	0
0.1	1	* 9 *	0	1	0	0
	1303	* TOTAL *	1	1168	89	45
		* PERC. *	0.1	89.6	6.8	3.5

Table ED 7

Attendance at Pop Concerts by
Regular Attenders at Discotheques
by Age Group

1 Less than once per month
2 More than once per month
but less than once per week
3 Once per week or more

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 11

PERC.	TOTAL	* VALUE *	1	2	3
6.4	83	* 1 *	34	12	37
62.4	813	* 2 *	228	174	411
28.1	366	* 3 *	54	118	194
2.2	29	* 4 *	8	12	9
0.5	7	* 5 *	1	1	5
0.2	2	* 6 *	1	0	1
0.1	1	* 7 *	0	0	1
0.1	1	* 8 *	0	0	1
0.1	1	* 9 *	0	0	1
	1303	* TOTAL *	326	317	660
		* PERC. *	25.0	24.3	50.7

Table ED 8 Attendance at Pubs or Clubs where loud music is played, by Regular Attenders at Discotheques by Age Group.

1 = Less than once per month.

2 = Once per month but less than once per week.

3 = Once per week or more.

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 22

Table ED9 Occupation of Regular Attenders by Age Group

(see Appendix 5 for list of Occupations)

PERC.	TOTAL	VALUE	7	9	13	15	16	17	20	21	22	23	24	25	26	27	29
6.4	83	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.4	813	2	1	0	4	0	1	4	7	4	0	2	12	4	0	1	0
28.1	366	3	1	1	3	1	0	22	25	14	1	3	23	21	4	10	3
2.2	29	4	0	0	0	0	0	0	4	2	0	0	0	4	0	4	0
0.5	7	5	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
0.2	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
0.1	1	7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0.1	1	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
0.1	1	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	1303	TOTAL	2	1	7	1	1	26	37	21	1	5	36	30	4	18	3
		PERC.	0.2	0.1	0.5	0.1	0.1	2.0	2.8	1.6	0.1	0.4	2.8	2.3	0.3	1.4	0.2

VALUE	30	31	32
1	83	0	0
2	719	51	3
3	108	125	1
4	0	15	0
5	0	4	0
6	0	1	0
7	0	0	0
8	0	0	0
9	0	0	0
TOTAL	910	196	4
PERC.	69.8	15.0	0.3

Appendix 1

Calibration of Equipment

Appendix 1 Calibration of Equipment

A Weighting

B & K Noise Analysers 4426

The 'A' weighting response of the analysers was measured over a range of 7 SPL, in 10dB steps, from 60dB to 120dB. The results are shown below. Measurements were obtained via Direct Input of analyser.

Frequency Hz	'A' Weighting dB re 1 kHz	Tolerances dB BS4197	4426 $\bar{x}$	S.D.
31.5	- 39.4	± 3	-38.0	0.11
63	- 26.2	± 3	-25.5	0.09
125	- 16.1	± 1	-16.0	0.11
250	- 8.6	± 1	- 9.0	0.18
500	- 3.2	± 1	- 3.6	0.18
1K	0.0	± 1	0.0	
2K	1.2	± 1	1.3	0.00
4K	1.0	± 1	1.0	0.00
8K	- 1.1	+ 1-3	- 1.2	0.09
16K	- 6.6	+ 3-00	- 6.2	0.2

Table 1 'A' Weighting response of B & K Noise Analyser Type 4426

$\bar{x}$ = average of analyser response over dynamic range of instrument

Dose Meters B & K 4424 and CEL 122

Measurements obtained without microphone, input via an appropriate Capacitance.

Frequency Hz	Lower Limit	Upper Limit	Mean
31.5	- 41.8	- 37.3	- 39.6
63	- 28.6	- 24.1	- 26.4
125	- 18.4	- 13.9	- 16.2
250	- 11.3	- 6.7	- 9
500	- 4.0	- 2.3	- 3.2
1K	0	0	0
2K	+ 3.0	+ 1.3	+ 2.1
4K	0	+ 1.8	- 0.9
8K	- 2	- 0.3	- 1.2
16K	- 7.4	- 5.7	- 6.6

Table 2 'A' weighted response of Dose Meters.

L_{eq} Response

The relative L_{eq} response between the various instruments was determined using a 1 hour long calibrated tape of pop music played via amplifier and loudspeaker under free field conditions. The 4426 was used as the reference instrument against which each dose meter was compared. All microphones were suspended at 1m from the centre of the loudspeakers and orientated normal to the axis of the speaker. The calibration level measured by the 4426 was 93.8dBA and the mean of the five dose meters 93.6dBA and all were within $\pm$0.5 dBA of each other. A similar exercise was performed with white noise and the respective values were 95dBA and 95dBA with all instruments within $\pm$ 1.5 dBA of each other.

Position of Dose Meter Microphones

Early dose meter measurements were obtained with the microphone attached to an ear clip but following complaints of discomfort and difficulty in keeping the clips in place while dancing the position was changed to the collar below the ear.

On 9 occasions at discotheques dose meters were worn simultaneously at ear and collar position by individual attenders and in each case the L_{eq} did not differ by more than 0.5 dBA. These differences were not systematic and on 5 occasions measurements were identical.

Appendix 2

(i) Discotheque Survey Questionnaire

(ii) Discotheque Survey Instructions

(iii) Discotheque Tally Sheet

(iv) Educational Institutes Survey Questionnaire

(v) Educational Institutes Survey Instructions

(vi) Monitoring Procedure

LEEDS POLYTECHNIC

SCHOOL OF CONSTRUCTIONAL STUDIES

DISCOTHEQUE SURVEY

IS SUBJECT MALE OR FEMALE? a) MALE. b) FEMALE.

Q.1. HAVE YOU BEEN INTERVIEWED BEFORE IN CONNECTION WITH THIS SURVEY?

Q.2 HOW OFTEN DO YOU ATTEND DISCOS?
a) ONCE A WEEK OR MORE 3
b) ONCE A MONTH OR MORE 2
c) OTHER 1

Q.3 IF MORE THAN ONCE A MONTH, HOW MANY DISCOS HAVE YOU ATTENDED
a) IN THE LAST 7 DAYS
b) IN THE LAST 4 WEEKS

Q.4 AT WHAT AGE DID YOU BEGIN ATTENDING DISCOS ?

Q.5 ABOUT WHAT TIME DO YOU USUALLY ARRIVE?
8pm 08 9pm 09 10pm 10 11pm 11 12pm 12 1am 13

Q.6 ABOUT WHAT TIME DO YOU USUALLY LEAVE?
9pm 09 10pm 10 11pm 11 12pm 12 1am 13 2am 14 3am 15

Q.7 AT A DISCO WHAT PROPORTION OF YOUR TIME DO YOU SPEND

a)	DANCING	ALL 1	3/4 2	1/2 3	1/4 4	nil 5
b)	OUT OF THE DANCE HALL	ALL 1	3/4 2	1/2 3	1/4 4	nil 5
c)	OTHER	ALL 1	3/4 2	1/2 3	1/4 4	nil 5

Q.8 DO YOU PURPOSELY TRY TO BE
a) AS NEAR AS POSSIBLE TO GROUP OR LOUDSPEAKERS? 1
b) AS FAR " " FROM " " " 2
c) NO PREFERENCE 3

Q.10 WHAT IS YOUR OCCUPATION? .....

Q.11 IS YOUR PLACE OF WORK SO NOISY THAT YOU HAVE TO SHOUT TO SPEAK TO OTHER PEOPLE a) YES 1 b) NO 2

Q.12 DO YOU MIND SAYING WHETHER YOU ARE
a) UNATTACHED 1
b) GOING STEADY 2
c) ENGAGED 3
d) MARRIED 4

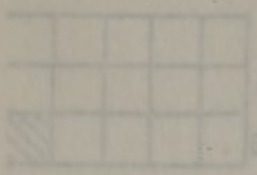
Q.13 WOULD YOU MIND SAYING WHAT AGE YOU ARE OR WHAT AGE GROUP YOU ARE IN .....

11-13 01, 14-16 02, 17-19 03, 20-22 04, 23-25 05, 26-28 06, 29-31 07
32-34 08, 35-37 09, 38-40 10, 41-43 11, 44-46 12, 47-49 13, 49+ 14

Q.14 DO YOU THINK THE MUSIC HERE IS
a) TOO LOUD 1, b) JUST RIGHT 2, c) TOO QUIET 3

Q.15 IN ADDITION TO DISCOS DO YOU EVER ATTEND
a) POP CONCERTS a) YES 1 b) NO 2
b) PUBS & CLUBS WHERE LOUD MUSIC IS PLAYED FOR DANCING a) YES 1 b) NO 2

1
7
13
18
25
30
31
33
36
39
43
48
49
50
52
54
57
59
61
63
64



Discotheque Survey Information for interviewers.

As can be seen, the form is constructed so that all the answers can be written in the boxes in the right-hand column of the sheet. The answers are usually one of numbered alternatives. The boxes are numbered 1, 7, 13.....64. Answers should be whole numbers, i.e. not ½, ¾ etc. or a, b, or c, and only one digit should be placed in each square. There should be no spaces except at Box 1.

If the subject has been interviewed before, pass on immediately to next person.

Box 1. Please leave all five spaces blank.

IS SUBJECT MALE OR FEMALE?

Box 7. First space indicates sex, i.e. '1' for male, '2' for female. The second and third spaces are for age in years, e.g. '09' or '22'. If actual age is withheld, the group age will suffice and '00' should be entered in second and third boxes. The fourth and fifth spaces are for group age, e.g. '01', '11' - see below.

Group Age

11 - 13 years old	= 01 age group
14 - 16	= 02
17 - 19	= 03
20 - 22	= 04
23 - 25	= 05
26 - 28	= 06
29 - 31	= 07
32 - 34	= 08
35 - 37	= 09
38 - 40	= 10
41 - 43	= 11
44 - 46	= 12
47 - 49	= 13
49 +	= 14

Box 13. Obtain location and interviewer number from co-ordinator. Each interviewer should use the same personal number on every occasion.

Box 18. Date of interview in six figures, day, month and year, e.g. 090477.

Box 25. Time of interview in four figures, hours and minutes, e.g. 0948
N.B. A twenty four hour clock running from 12 noon should be used i.e. 20.00 = 0800 in our time, 0200 = 1400 our time.

QUESTION 2.

Box 30. Choose one of the three options. Option b - an attendance of more than one per month, but less than once per week applies in this case. Option c - this applies to attendances of less than one disco per month.

QUESTION 3.

Boxes 31 and 33. If the answer to Box 30 is '1' then '0's should be entered in Boxes 31 up to and including 52. If the answer to Box 30 is '2' then a total should be entered at Box 31 and a total given in Box 33. If the answer to Box 33 is '3' then a total should be given in Boxes 31 and 33. Exclude in these totals the attendance at which the interview was obtained.

Questionnaire Survey Information for interviewers.

QUESTION 4.

Box 36. Insert age when attendance first began.

QUESTION 5.

Box 39. Choose usual time of arrival, e.g. '08', or '13' N.B. odd 24 hour clock! If interviewee usually arrives at 7 O'clock, then '08' should be entered and time of departure set at one hour later than usual.

QUESTION 6.

Box 43. Choose usual time of departure, e.g. '09' or '15'.

QUESTION 7.

Boxes 48-50. The total time spent at the disco should be divided into these three activities, so that the fractions of time chosen should add up to 1, e.g. '2', '4' and '5' = 1, if the fractions are totalled.

N.B. nil = '5', not '0'

QUESTION 8.

Box 52. Choose one of the options '1', '2', or '3'.

QUESTION 10.

Box 54. Write occupation on dotted line, then code up from Information Sheets, using the order numbers only.

QUESTION 11.

Box 57. Choose one of the two options. This refers obviously to people shouting over machinery noise, not over general office babble!

QUESTION 12.

Box 59. Choose one of the options. Refusal is '5'.

QUESTION 13. Write age in years on dotted line and circle age group.

QUESTION 14.

Box 61. Choose one of the three options. Don't know = '4' (interviewee may not have been to this disco before).

QUESTION 15.

Box 63. Choose one of the two options.

Box 64. Choose one of the two options.

Disco Survey Tally Sheet

Premises _____

Date _____

Time		In	Out
8.00 - 8.15			
8.15 - 8.30			
8.30 - 8.45			
8.45 - 9.00			
9.00 - 9.15			
9.15 - 9.30			
9.30 - 9.45			
9.45 - 10.00			
10.00 - 10.15			
10.15 - 10.30			
10.30 - 10.45			
10.45 - 11.00			

Time		In	Out
11.00 - 11.15			
11.15 - 11.30			
11.30 - 11.45			
11.45 - 12.00			
12.00 - 12.15			
12.15 - 12.30			
12.30 - 12.45			
12.45 - 1.00			
1.00 - 1.15			
1.15 - 1.30			
1.30 - 1.45			

LEEDS POLYTECHNIC

SCHOOL OF CONSTRUCTIONAL STUDIES

EDUCATIONAL INSTITUTES DISCO SURVEY

ARE YOU MALE OR FEMALE — 1. MALE 2. FEMALE

LOCATION & INTERVIEW

Q.1 HAVE YOU EVER ATTENDED
- a) DISCOTHEQUES — YES[1] NO[2]
- b) POP CONCERTS — YES[1] NO[2]
- c) CLUBS OR PUBS WHERE MUSIC IS PLAYED FOR DANCING — YES[1] NO[2]

I HAVE NEVER ATTENDED ANY OF ABOVE — NEVER[1] HAVE ATTENDED[2]

Q.2 HOW OFTEN DO YOU ATTEND POP CONCERTS
- a) LESS THAN ONCE PER MONTH[1]
- b) ONCE A MONTH[2]
- c) MORE THAN ONCE PER MONTH[3]

Q.3 HOW OFTEN DO YOU ATTEND CLUBS OR PUBS WHERE LOUD MUSIC IS PLAYED FOR DANCING?
- a) LESS THAN ONCE PER MONTH[1]
- b) ONCE A MONTH[2]
- c) MORE THAN ONCE PER MONTH[3]

Q.4 HOW OFTEN DO YOU ATTEND DISCOS
- a) LESS THAN ONCE PER MONTH[1]
- b) ONCE A MONTH[2]
- c) MORE THAN ONCE PER MONTH[3]

Q.5 IF ONCE PER MONTH OR MORE THAN ONCE A MONTH HOW MANY DISCOS HAVE YOU ATTENDED
- a) IN THE LAST 7 DAYS
- b) IN THE LAST 4 WEEKS

Q.6 AT WHAT AGE DID YOU BEGIN ATTENDING DISCOS REGULARLY?

Q.7 ABOUT WHAT TIME DO YOU USUALLY ARRIVE AT THE DISCOS? 8pm[08] 9pm[09] 10pm[10] 11pm[11] 12pm[12] 1am[13]

Q.8 ABOUT WHAT TIME DO YOU USUALLY LEAVE? 9pm[09] 10pm[10] 11pm[11] 12pm[12] 1am[13] 2am[14] 3am[15]

Q.9 AT THE DISCOS WHAT PROPORTION OF YOUR TIME DO YOU SPEND

	all[1]	¾[2]	½[3]	¼[4]	nil[5]
a) DANCING					
b) IN HALL NOT DANCING	all[1]	¾[2]	½[3]	¼[4]	nil[5]
c) OUT OF HALL FOR ANY REASON	all[1]	¾[2]	½[3]	¼[4]	nil[5]

Q.10 DO YOU PURPOSELY TRY TO BE
- a) AS NEAR AS POSSIBLE TO THE GROUP OR LOUDSPEAKERS[1]
- b) AS FAR " " FROM " " " " [2]
- c) ABOUT HALFWAY[3]
- d) HAVE NO PREFERENCE[4]

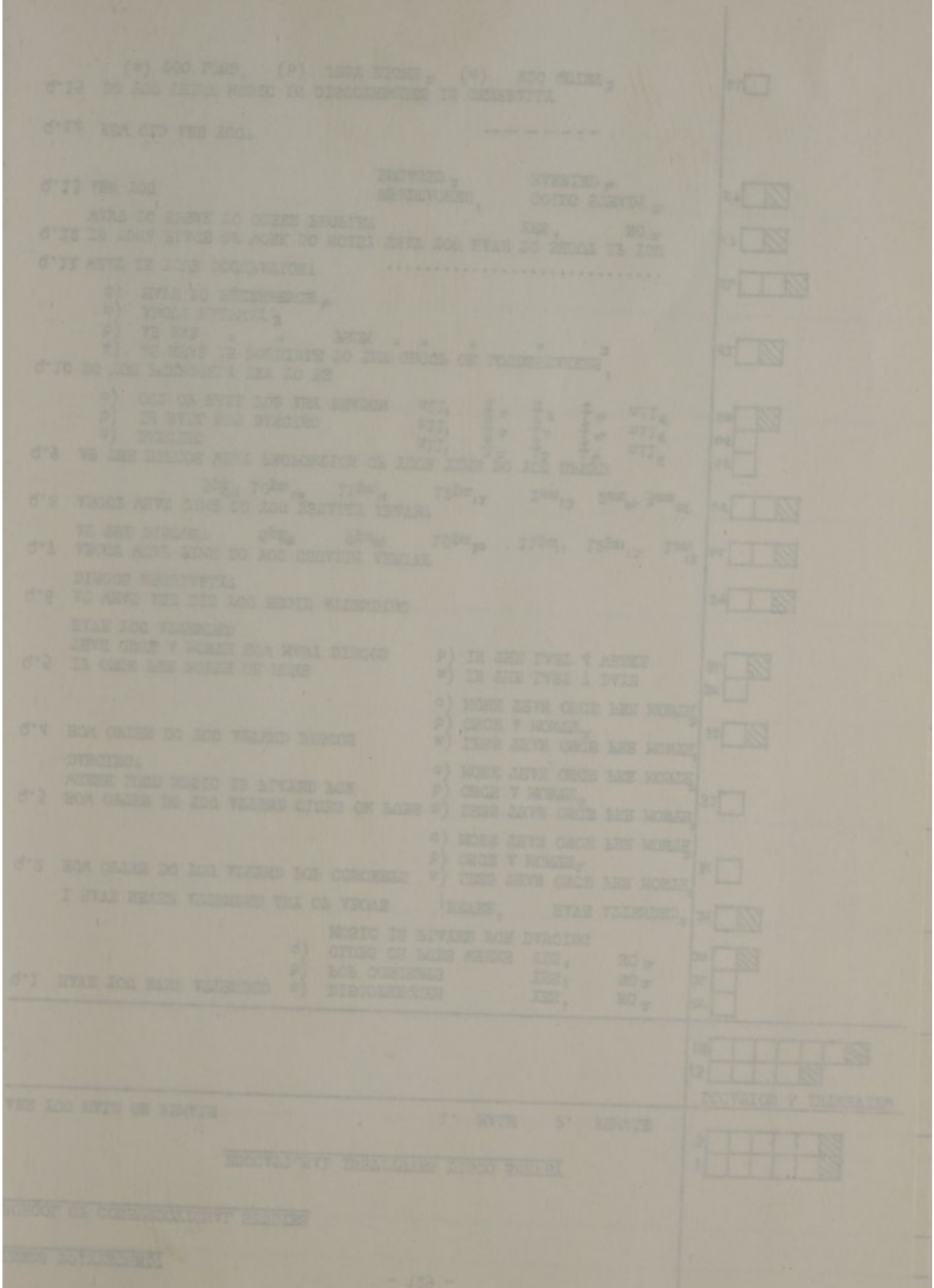
Q.11 WHAT IS YOUR OCCUPATION? .....

Q.12 IS YOUR PLACE OF WORK SO NOISY THAT YOU HAVE TO SHOUT IF YOU WANT TO SPEAK TO OTHER PEOPLE? YES[1] NO[2]

Q.13 ARE YOU UNATTACHED[1] GOING STEADY[2] ENGAGED[3] MARRIED[4]

Q.14 HOW OLD ARE YOU? ------

Q.15 DO YOU THINK MUSIC IN DISCOTHEQUES IS GENERALLY
(a) TOO LOUD[1] (b) JUST RIGHT[2] (c) TOO QUIET[3]



Educational Institutes Disco Survey

As can be seen, the form is constructed so that all the answers can be written in the boxes in the right hand column of the sheet. The answers are usually one of numbered alternatives. The boxes are numbered 1, 7, 13 ..... 61. Answers should be whole numbers i.e. not $\frac{1}{4}$, $\frac{3}{4}$ etc. or a, b or c, and only one digit should be placed in each square. There should be no spaces except at Box 1.

ARE YOU MALE OR FEMALE

Box 1. Please leave all five spaces blank.

Box 7. First space indicates sex, i.e. '1' for male, '2' for female. The second and third spaces are for age in years, e.g. '09' or '22'. If actual age is withheld, then group age will suffice and '00' should be entered in second and third boxes. The fourth and fifth spaces are for age group e.g. '01', '11' - see below.

Group Age

11-13 years old	=	01 age group.
14-16	=	02
17-19	=	03
20-22	=	04
23-25	=	05
26-28	=	06
29-31	=	07
32-34	=	08
35-37	=	09
38-40	=	10
41-43	=	11
44-46	=	12
47-49	=	13
49+	=	14

LOCATION AND INTERVIEW

Box 13. Insert in the four boxes.

Box 18. Date of interview in six figures, day, month and year, e.g. 090477.

QUESTION 1

Box 25. Choose one of the two options. This question applies to attendance at any time during the interviewee's life.

Box 26. Choose one of the two options. The criterion applying to Box 25 also applies here.

Box 27. Choose one of the two options, again applying the criterion above.

Box 29. If the answer to Q1 a, b and c, is NO in every case, then the answer here is '1'. If at least one answer to Q1 is YES, then the answer here is '2'.

QUESTION 2

Box 31. Choose one of the three options. If the interviewee has never been to Pop Concerts, or does not attend, then the answer is '1' not '0'. Option b - this applies to people who attend once per month or more, but less than once per week. Option c - applies to those who attend less than once per month.

QUESTION 3

Box 32. The criteria for Box 31 applies here.

QUESTION 4

Box 33. The criteria for Box 31 applies here.

QUESTION 5

Boxes 35 and 36. If the answer to Box 33 is '1' then '0's should be entered in Boxes 35 up to and including box 52. These are classed "non-attenders If the answer to Box 33 is '2' a total should be given in Boxes 35 & 36. If the answer to Box 33 is '3' then a total should be given in Boxes 35 and 36.

QUESTION 6.

Box 39. Insert age at first attendance. Non-attenders put '00'.

QUESTION 7

Box 42. Choose usual time of arrival, e.g. '08' or '13'. N.B. odd 24 hour clock!$ If interviewee usually arrives at 7 0'clock, then '08' should be entered and time of departure set at one hour later than usual. For non-attenders put '00'

QUESTION 8

Box 42. Choose usual time of departure, e.g. '09' or '15'.

QUESTION 9

Boxes 48-50. The total time spent at the disco should be divided into these three activities, so that the fraction of time chosen should add up to 1. e.g. '2', '4' and '5' = 1, if the fractions are totalled. N.B. nil = '5' not '0'. Non-attenders should put '0's here.

QUESTION 10.

Box 52. Choose one of the options '1', '2', '3' or '4'. Non-attenders should put '0'.

QUESTION 11

Box 54. School child should put '30' in these spaces - for other occupations refer to sheet.

QUESTION 12

Box 57. For schoolchildren the answer in all cases is NO i.e. '2'. This question attempts to discover if interviewee is in an environment where there is noisy machinery.

QUESTION 13

Box 59. Choose one of the options.

QUESTION 14 Write age in years on dotted line.

QUESTION 15

Box 61. Choose one of the three options. If interviewee is non-attender, he can still choose one of the options, if he has an opinion - he may not attend because he believes disco's are too noisy. If, however, he has no opinion, enter '0'. Disco attenders must choose an option, '0' is inadmissable for them.

LEEDS POLYTECHNIC

SCHOOL OF CONSTRUCTIONAL STUDIES

MODE OF PROCEDURE FOR MONITORING DISCOTHEQUES

1. Be at the selected premises 30 mins before opening time to set up the equipment and to be able to count people as they arrive.

2. Set up Noise Level Analyser so that its ½ inch microphone is at the loudest point of public access in the hall (this is usually in front of a loudspeaker, but not always - use Sound Level Meter to establish this position). The microphone should be at ear level.

3. Switch on N.L.A. as soon as the music begins and leave running until the end of the session.

4. Read the N.L.A. or set printer to print out every 20 mins. L_1, L_5, L_{10} L_{90} L_{95} L_{99} L_{eq}.

5. When the premises open to the public, one person should be sited near the outside entrance so that he can count people in and out. One Tally sheet should record male attendance, the other female attendance N.B. Fig. 1.

6. If there are insufficient personnel to spare one person by the outside door all the time, then a head count should be made inside the premises every 30 minutes and this should be noted on the Tally Sheet. N. B. Fig. 2.

7. The interviewer (s) should stand just inside the entrance doors. Up to 3 interviewers is acceptable to management, more means, the entrance becomes blocked. Interviewees are selected on a first come, first served basis i. e. after completing one interview, select the next person through the door for the next. Interviewing often becomes difficult after about 11.00 p.m. for obvious reasons.

8. If you have taken people with you to wear the dosemeters, they should switch them on at the beginning of the evening noting the time at which they do this. They should read the dosemeters every 30 mins. Fig. 3. If no one has volunteered to come with you, select some of the people you have interviewed (if they seem reliable) or the D.J. or wear them yourselves if no suitable alternative is available.

   Dose meter wearers should note their activity during the evening and complete interview form (mark with *).

9. Take spot Sound Level Meter readings at 20 min(corresponding with N.A. times) intervals at the extremities of the hall, midway, on the centre of the dance floor. Draw a plan of the hall to show positions of spot readings, speakers, stage, etc. If personnel is limited, then S.L.M. readings every hour will be sufficient.

Continued. . .

10. If personnel are limited, a minimum of 2 operators: one to look after the equipment and take spot readings, the other to do head count and interviewing. The most important operations in order are N.L.A., dosemeter, S.L.M. readings, counting and interviewing. If dosemeters are unavailable, the other functions are important in their own right. The ideal number of operators would be one for equipment minding and S.L.M. readings, one counting, two interviewing, x wearing dosemeters, if they are available, i.e. 4 + x.

11. Tabulate the results on the appended sheets.
There should be 6 results sheets: 1 for dosemeter readings (Fig. 4), 1 for distribution (Fig. 4), 1 for distribution (Fig. 5), 1 for N.L.A. readings (Fig. 6), 1 plan of room, 1 male attendance sheet (Fig. 1 or 2), 1 female attendance sheet. There should also be sheets for the individual dosemeters which need not be returned to us as long as Fig. 4 is completed.

Appendix 3

Comparative Data (Discotheques)

List of Tables

THE ROWS ARE FROM VARIABLE 3 (Comparative Data) Table 1

THE COLUMNS ARE FROM VARIABLE 1

Age Groups of Discotheque Survey Population

PERC.	TOTAL	VALUE	1	2
3.6	16	2	8	8
33.2	146	3	62	84
26.1	115	4	55	60
16.4	72	5	41	31
10.2	45	6	31	14
5.2	23	7	16	7
2.7	12	8	8	4
1.4	6	9	6	0
0.7	3	10	2	1
0.2	1	12	0	1
0.2	1	13	0	1
	440	TOTAL	229	211
		PERC.	52.0	48.0

50%	10%	5%
21	29	32

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 7

PERC.	TOTAL	VALUE	1	2	3
3.6	16	2	0	2	14
33.2	146	3	4	20	122
26.1	115	4	18	30	67
16.4	72	5	19	30	23
10.2	45	6	11	15	19
5.2	23	7	7	7	9
2.7	12	8	2	5	5
1.4	6	9	2	3	1
0.7	3	10	1	1	1
0.2	1	12	0	0	1
0.2	1	13	0	0	1
	440	TOTAL	64	113	263
		PERC.	14.5	25.7	59.8

(Comparative Data) Table 2

Frequency of Attendance at Discotheques in Age Groups

1. Less than 1 per month

2. More than 1 per month but less than 1 per week

3. 1 per week or more.

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 8

(Comparative Data) Table 3

Number of Attendances per Week by Regular Attenders

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	7
4.3	16	2	2	11	2	1	0	0	0	0
37.8	142	3	5	77	40	10	7	0	3	0
25.8	97	4	7	41	24	15	6	1	2	1
14.1	53	5	3	30	10	5	4	0	1	0
9.0	34	6	0	18	7	4	1	1	3	0
4.3	16	7	1	9	4	0	0	2	0	0
2.7	10	8	2	5	2	1	0	0	0	0
1.1	4	9	0	2	2	0	0	0	0	0
0.5	2	10	1	1	0	0	0	0	0	0
0.3	1	12	0	1	0	0	0	0	0	0
0.3	1	13	0	1	0	0	0	0	0	0
	376	TOTAL	21	196	91	36	18	4	9	1
		PERC.	5.6	52.1	24.2	9.6	4.8	1.1	2.4	0.3

50%	10%	5%
1.4	3.4	4.2

(Comparative Data) Table 4

Length of each Attendance in Hours
by Regular Attenders

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 23

PERC.	TOTAL	VALUE	1	2	3	4	5	6	7
4.3	16	2	0	4	6	4	1	1	0
37.8	142	3	0	4	57	52	24	5	0
25.8	97	4	0	8	46	36	5	1	1
14.1	53	5	1	8	26	12	5	0	1
9.0	34	6	1	4	15	8	3	2	1
4.3	16	7	0	3	9	3	1	0	0
2.7	10	8	0	2	7	1	0	0	0
1.1	4	9	0	2	1	1	0	0	0
0.5	2	10	0	1	1	0	0	0	0
0.3	1	12	0	0	1	0	0	0	0
0.3	1	13	0	0	0	1	0	0	0
	376	TOTAL	2	36	169	118	39	9	3
		PERC.	0.5	9.6	44.9	31.4	10.4	2.4	0.8

(Comparative Data) Table 5

THE ROWS ARE FROM VARIABLE 3

Weekly hours of Attendance by Regular Attenders

THE COLUMNS ARE FROM VARIABLE 24

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	8	9	10	12	14	15	16	18
4.3	16	2	2	0	1	6	3	1	1	1	0	0	1	0	0	0	0
37.8	142	3	1	1	6	35	27	10	17	16	3	9	6	0	4	2	0
25.8	97	4	3	4	2	24	14	3	10	12	8	0	8	1	2	3	1
14.1	53	5	2	2	4	13	9	3	10	2	1	1	3	0	0	0	1
9.0	34	6	0	1	3	7	6	2	3	3	3	0	1	0	2	0	0
4.3	16	7	1	0	1	5	4	0	3	0	0	0	0	0	1	0	0
2.7	10	8	1	1	1	3	1	0	2	0	1	0	0	0	0	0	0
1.1	4	9	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0
0.5	2	10	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
0.3	1	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0.3	1	13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	376	TOTAL	10	9	20	95	66	19	47	35	16	10	19	1	9	5	2
		PERC.	2.7	2.4	5.3	25.3	17.6	5.1	12.5	9.3	4.3	2.7	5.1	0.3	2.4	1.3	0.5

140

VALUE	20	24	25	28	36	42
2	0	0	0	0	0	0
3	0	4	0	0	1	0
4	1	0	0	1	0	0
5	1	0	0	1	0	0
6	0	0	0	0	2	1
7	0	0	1	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
TOTAL	2	4	1	2	3	1
PERC.	0.5	1.1	0.3	0.5	0.8	0.3

50%	10%	5%
4.4	12.1	15.6

(Comparative Data) Table 6

Percentage of Regular Attenders who may have Additional Noise Exposure at Work

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 18

PERC.	TOTAL	VALUE	1	2
4.3	16	2	0	16
37.8	142	3	22	120
25.8	97	4	18	79
14.1	53	5	7	46
9.0	34	6	10	24
4.3	16	7	3	13
2.7	10	8	2	8
1.1	4	9	0	4
0.5	2	10	0	2
0.3	1	12	0	1
0.3	1	13	1	0
	376	TOTAL	63	313
		PERC.	16.8	83.2

1. Possible noise exposure at work

2. No additional noise exposure

(Comparative Data) Table 7

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 10

Age at First Attendance by Age Group of Regular Attenders

PERC.	TOTAL	VALUE	0	10	11	12	13	14	15	16	17	18	19	20	21	23	25
4.3	16	2	0	0	2	5	3	5	1	0	0	0	0	0	0	0	0
37.8	142	3	0	1	2	7	9	23	39	27	25	9	0	0	0	0	0
25.8	97	4	1	0	0	4	10	11	13	29	12	10	5	1	1	0	0
14.1	53	5	1	0	0	0	5	5	10	7	10	7	3	1	1	0	3
9.0	34	6	0	0	0	0	0	3	6	9	8	3	2	2	0	0	1
4.3	16	7	0	0	1	0	0	1	4	2	1	2	0	2	0	1	1
2.7	10	8	0	0	0	0	0	0	0	1	1	1	0	0	0	0	4
1.1	4	9	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
0.5	2	10	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
0.3	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.3	1	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	376	TOTAL	4	1	5	16	27	48	73	76	58	32	10	7	2	1	10
		PERC.	1.1	0.3	1.3	4.3	7.2	12.8	19.4	20.2	15.4	8.5	2.7	1.9	0.5	0.3	2.7

VALUE	26	27	30	32	35
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	1	0	0	0	0
8	0	0	1	2	0
9	0	1	0	0	0
10	0	0	0	0	0
12	0	0	0	0	1
13	0	0	0	0	0
TOTAL	1	1	1	2	1
PERC.	0.3	0.3	0.3	0.5	0.3

50%	10%	5%
15.7	13.1	12.4

(Comparative Data) Table 8

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 17

Occupations of Regular Attenders at Discotheques

PERC.	TOTAL	VALUE	1	3	5	6	7	8	9	10	12	13	14	15	16	17	18
4.3	16	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
37.8	142	3	5	6	0	1	9	0	2	0	3	5	1	4	1	0	2
25.8	97	4	1	4	0	0	4	1	1	1	0	1	0	6	0	1	3
14.1	53	5	0	0	1	0	1	0	5	0	2	0	0	2	0	1	0
9.0	34	6	0	0	0	0	4	0	1	0	1	0	0	0	0	0	0
4.3	16	7	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
2.7	10	8	1	1	1	0	0	0	0	0	0	2	0	0	0	0	0
1.1	4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5	2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.3	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.3	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	376	TOTAL	7	11	2	1	18	1	9	1	7	9	1	13	1	2	5
		PERC.	1.9	2.9	0.5	0.3	4.8	0.3	2.4	0.3	1.9	2.4	0.3	3.5	0.3	0.5	1.3

VALUE	19	20	21	22	23	24	25	26	27	28	29	30	31	33
2	0	0	0	0	0	0	0	0	0	0	0	13	2	0
3	0	4	3	4	15	19	12	16	5	2	5	5	13	0
4	1	5	4	3	8	11	12	10	11	4	2	0	3	0
5	0	1	0	2	3	7	8	12	5	2	1	0	0	0
6	0	3	0	4	3	7	3	6	2	0	0	0	0	0
7	1	0	0	0	3	5	2	2	0	0	0	0	1	0
8	0	0	0	1	0	1	1	0	1	0	0	0	0	1
9	0	2	0	0	0	1	1	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0	0	0	0	1	0	0	0
12	0	0	0	0	0	0	0	0	0	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	1	0	0	0	0
TOTAL	2	15	7	14	32	52	39	46	24	10	9	18	19	1
PERC.	0.5	4.0	1.9	3.7	8.5	13.8	10.4	12.2	6.4	2.7	2.4	4.8	5.1	0.3

(See Appendix for List of Occupations

Appendix 4

Comparative Data (Educational)

List of Tables

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THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 1

PERC.	TOTAL	* VALUE *	0	1	2
2.0	10	* 1 *	0	6	4
35.3	173	* 2 *	1	50	122
54.5	267	* 3 *	1	68	198
4.1	20	* 4 *	0	13	7
1.0	5	* 5 *	0	3	2
0.4	2	* 6 *	0	1	1
0.4	2	* 7 *	0	1	1
0.6	3	* 8 *	0	0	3
0.4	2	* 9 *	0	0	2
0.2	1	* 10 *	0	0	1
0.2	1	* 11 *	0	0	1
0.6	3	* 12 *	0	0	3
0.2	1	* 13 *	0	0	1
	490	* TOTAL *	2	142	346
		* PERC. *	0.4	29.0	70.6

(Comparative data)

Table ED 1

Educational Survey Population by Sex and Age Group

1 = Male

2 = Female

(0 = no data)

50%	10%	5%
17yrs	19yrs	22yrs

HOW OFTE N AT TEND DIS COS

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 12

PERC.	TOTAL	* VALUE *	1	2	3	Attenders
2.0	10	* 1 *	5	3	2	-
35.3	173	* 2 *	65	46	62	37%
54.5	267	* 3 *	107	57	103	60%
4.1	20	* 4 *	7	3	10	
1.0	5	* 5 *	0	5	0	
0.4	2	* 6 *	1	0	1	
0.4	2	* 7 *	2	0	0	
0.6	3	* 8 *	3	0	0	
0.4	2	* 9 *	2	0	0	
0.2	1	* 10 *	1	0	0	
0.2	1	* 11 *	1	0	0	
0.6	3	* 12 *	3	0	0	
0.2	1	* 13 *	1	0	0	
	490	* TOTAL *	198	114	178	
		* PERC. *	40.4	23.3	36.3	

(Comparative Data) Table ED 2

Frequency of Attendance at Discotheques by Age Group.

1 Less than once per month

2 Once per month or more but less than once per week

3 Once per week or more

2 + 3 = Attenders

THE ROWS ARE FROM VARIABLE 3 (Comparative Data)

THE COLUMNS ARE FROM VARIABLE 26

Table ED 3

Length of Each Attendance by Regular Attenders by Age Group

PERC.	TOTAL	* VALUE *	1	2	3	4	5	6	7	9
1.7	5	* 1 *	0	0	2	3	0	0	0	0
37.0	108	* 2 *	0	8	42	38	13	5	1	1
54.8	160	* 3 *	2	10	57	54	31	6	0	0
4.5	13	* 4 *	0	0	5	4	4	0	0	0
1.7	5	* 5 *	0	1	1	1	1	1	0	0
0.3	1	* 6 *	0	0	0	1	0	0	0	0
	292	* TOTAL *	2	19	107	101	49	12	1	1
		* PERC. *	0.7	6.5	36.6	34.6	16.8	4.1	0.3	0.3

50%	10%	5%
3.7	5.2	5.5

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 13

PERC.	TOTAL	* VALUE *	0	1	2	3	4
1.7	5	* 1 *	3	2	0	0	0
37.0	108	* 2 *	49	43	13	3	0
54.8	160	* 3 *	68	54	19	16	3
4.5	13	* 4 *	7	5	1	0	0
1.7	5	* 5 *	3	2	0	0	0
0.3	1	* 6 *	0	0	1	0	0
	292	* TOTAL *	130	106	34	19	3
		* PERC. *	44.5	36.3	11.6	6.5	1.0

(Comparative Data) Table ED.4

Numbers of Attednances per Week by Regular Attenders

50%	10%	5%
0.7	2.3	2.9

THE ROWS ARE FROM VARIABLE 3 (Comparative Data) Table ED 5

THE COLUMNS ARE FROM VARIABLE 27

Weekly Hours of Attendance
by Regular Attenders by Age Group

PERC.	TOTAL	VALUE	0	1	2	3	4	5	6	8	9	10	12	14	15	16	18
1.7	5	1	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0
37.0	108	2	20	15	11	18	17	10	5	4	1	2	2	1	1	0	1
54.8	160	3	30	20	9	24	24	14	11	4	5	5	9	0	2	2	1
4.5	13	4	5	0	0	1	3	3	1	0	0	0	0	0	0	0	0
1.7	5	5	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0
0.3	1	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	292	TOTAL	58	36	20	46	46	27	18	9	6	7	11	1	3	2	2
		PERC.	19.9	12.3	6.8	15.8	15.8	9.2	6.2	3.1	2.1	2.4	3.8	0.3	1.0	0.7	0.7

50%	10%	5%
3.2	8.8	10.9

THE ROWS ARE FROM VARIABLE 3 (Comparative Data) Table ED.6

THE COLUMNS ARE FROM VARIABLE 15

Age at which Attendance Commenced by Regular Attenders Regular Attenders by Age Grou

PERC.	TOTAL	VALUE	0	8	9	10	11	12	13	14	15	16	17	18	19	20
1.7	5	1	0	0	0	0	4	1	0	0	0	0	0	0	0	0
37.0	108	2	3	1	3	7	19	17	21	22	8	6	0	1	0	0
54.8	160	3	5	0	0	2	4	20	21	37	31	23	14	2	1	0
4.5	13	4	0	0	0	0	0	1	0	3	0	2	1	1	3	2
1.7	5	5	0	0	0	0	0	0	0	0	0	2	1	0	1	1
0.3	1	6	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	292	TOTAL	8	1	3	9	27	39	42	62	40	33	16	4	5	3
		PERC.	2.7	0.3	1.0	3.1	9.2	13.4	14.4	21.2	13.7	11.3	5.5	1.4	1.7	1.0

50%	10%	5%
13.8	10.8	9.8

THE ROWS ARE FROM VARIABLE 3 (Comparative Data)

THE COLUMNS ARE FROM VARIABLE 10

PERC.	TOTAL	VALUE	0	1	2	3
1.7	5	1	0	5	0	0
37.0	108	2	7	94	3	4
54.8	160	3	9	124	21	6
4.5	13	4	3	9	0	1
1.7	5	5	0	2	3	0
0.3	1	6	0	1	0	0
	292	TOTAL	19	235	27	11
		PERC.	6.5	80.5	9.2	3.8

Table ED 7

Attendance at Pop Concerts by

Regular Attenders at Discotheques by Age Group

1 = Less than once per month

2 = More than once per month but less than once per week

3 = More than once per week

THE ROWS ARE FROM VARIABLE 3

THE COLUMNS ARE FROM VARIABLE 11

PERC.	TOTAL	* VALUE *	0	1	2	3
1.7	5	* 1 *	0	2	0	3
37.0	108	* 2 *	1	19	17	71
54.8	160	* 3 *	3	34	28	95
4.5	13	* 4 *	0	7	2	4
1.7	5	* 5 *	0	1	2	2
0.3	1	* 6 *	0	0	0	1
	292	* TOTAL *	4	63	49	176
		* PERC. *	1.4	21.6	16.8	60.3

(Comparative Data) Table ED 8

Attendance at Pubs or Clubs where loud music is played by Regular Attenders by Age Group

1 = Less than once per month

2 = Once per month or more but less than once per week

3 = Once per week or more

THE ROWS ARE FROM VARIABLE 3 (Comparative Data) Table ED 9

THE COLUMNS ARE FROM VARIABLE 22

Occupations of Regular Attenders
by Age Group (See Appendix 5 for list of Occupations)

PERC.	TOTAL	VALUE	0	7	23	24	25	27	30	31	32
1.7	5	1	0	0	0	0	0	0	5	0	0
37.0	108	2	1	0	0	0	0	0	47	59	1
54.8	160	3	3	0	0	0	6	0	40	111	0
4.5	13	4	0	1	1	0	1	0	0	10	0
1.7	5	5	0	0	0	1	0	0	0	4	0
0.3	1	6	0	0	0	0	0	1	0	0	0
	292	TOTAL	4	1	1	1	7	1	92	184	1
		PERC.	1.4	0.3	0.3	0.3	2.4	0.3	31.5	63.0	0.3

Appendix 5

List of Occupations

Appendix 5

List of Occupations used in Table 8.19

The list is derived from that prepared by the Central Statistical Office (CSO), for use in the Annual Abstract of Statistics. The CSO list is classified into 181 headings of occupations which are grouped into 27 Orders. For the purposes of the survey only the Order classification is used and the first 27 Occupations listed below correspond to the CSO Orders, additionally 6 further classifications are used, 28 - 33 mc, to cover other classes not included in the CSO list.

Occ. Group	Occupation
1	Agriculture, Forestry, Fishing
2	Mining and Quarrying
3	Food, Drink and Tobacco
4	Coal and Petroleum Products
5	Chemicals and Allied Industries
6	Metal Manufacture
7	Mechanical Engineering
8	Instrument Engineering
9	Electrical Engineering
10	Shipbuilding and Marine Engineering
11	Vehicles Manufacture
12	Metal Goods not Elsewhere Specified
13	Textiles Production
14	Leather, Leather Goods and Fur
15	Clothing and Footwear
16	Bricks, Pottery, Glass, Cement etc.
17	Timber, Furniture, etc.
18	Paper, Printing and Publishing
19	Other Manufacturing Industries
20	Construction
21	Gas, Electricity and Water
22	Transport and Communication
23	Distributive Trades
24	Insurance, Banking, Finance and Business Services

25	Professional and Scientific Services
26	Miscellaneous Services
27	Public Administration and Defence
28	Housewife
29	Unemployed
30	School Children
31	Student (full-time)
32	Student (part-time)
33	Retired

Appendix 6

Confidence Data for Attendance Survey

Appendix 6

Non Parametric Confidence Intervals of Discotheque and Educational Data.

The Confidence Intervals for the Percentile Values shown below are calculated from:-

$$\frac{r}{n} = p \pm 1.96 \sqrt{\frac{P\ (1 - p)}{n}}$$

Where r is the confidence interval about the p^{th} percentile, n is the number of values in sample and p is the percentile (expressed as proportion) of interest.

data	age group	95% confidence interval for percentile 50^{th}	10^{th}	5^{th}
Attendance data	1 (21)	± 5	-	-
	2 (222)	± 15	± 8	± 6
	3 (379)	± 19	± 11	± 8
	4 (327)	± 18	± 11	± 8
	5 (154)	± 12	± 7	± 5
	6 (87)	± 9	± 5	± 4
	7 & 8 (92)	± 9	± 6	± 4
	Total (1355)	± 36	± 22	± 16
Education data	1 (228)	± 15	± 8	± 6
	2 (1658)	± 40	± 24	± 17
	3 (656)	± 25	± 15	± 11
	4 (70)	± 8	± 5	± 4
	Total (2668)	± 50	± 30	± 22

The values of dispersion shown above should be read as indicating the range within which the true value of a given percentile lies for 95% of the time, e.g. in Table 8.8 the 50^{th} percentile value of number of attendances per week is 1.5. For 95% of the time the true value will lie within the range 1.44 and 1.59 attendances per week.