THE STATISTICAL AND SOCIAL INQUIRY SOCIETY OF IRELAND.

STATISTICS OF EXAMINATIONS.

Intermediate Certificate Examination, 1928.

Synopsis of Paper read before the Society by Mr. John Hooper, B.A., on May 30th, 1929.

The paper contained a great mass of statistical information of importance to educationists. As the paper has already been published in full in an Appendix to the Report of the Department of Education for the year 1927–28 it is considered that it will be sufficient to publish a summary in this Journal. The principal object for which the paper was written was to interest educationists in this country in the theory of statistics, in the hope that they will give the subject its proper place in their educational courses.

SECTION I.

In the first of the three sections of the paper the characteristics of the distribution of marks in each subject were shown by tables and diagrams which indicated that the distribution was very different for different subjects. The following table shows for boys the lower quartile, the median, the upper quartile and the 95th percentile mark (that is the mark of the boy quarter-way, half-way, three-quarters-way and ninety-five hundredths way up the list of merit) in each subject, the maximum for each being taken as 100.

			Gr.	Dr.	Sc.	Ir.	Maths.	Lat.	Eng.	Fr.	H. &G.
Lower Quartile	..	..	33.2	41.6	33.3	36.6	28.1	25.2	32.7	26.3	26.2
Median	..	..	50.7	54.6	45.2	51.2	39.3	36.6	40.7	35.6	32.9
Upper Quartile	..	..	65.1	70.3	62.3	66.1	51.0	51.0	50.0	45.4	40.2
95th Percentile	..	..	87.4	87.2	84.2	84.0	70.7	69.0	61.2	58.5	50.2

The table shows that the boy nineteen-twentieths way up the list of merit in History and Geography scored only 50.2 marks in that subject as compared with 87.4 marks scored in Greek by the boy nineteen-twentieths up the list of merit in Greek.

Statistics of Examinations.

The percentage of boys who passed with honours in each subject was :

Dr.	Ir.	Gr.	Sc.	Lat.	Maths.	Eng.	Fr.	H. & G.
59.5	53.2	52.7	43.8	27.9	26.6	25.1	17.0	7.4

The writer suggested that the examiners' results should be used only for placing the candidates in order of merit in each subject, that each rank (e.g., the candidate quarter way up the list of merit) should be given a mark to be decided on general principles and that the same rank in each subject should be given the same percentage mark. In other words that the lower quartile mark should be the same for every subject, the median the same, the upper quartile the same, etc. This would, of course, also mean that the percentage of passes would be the same for each subject and the percentage of honours the same.

It was also suggested in the paper that the present system is unfair to boys and girls who excel in such subjects as History and Geography, French and English as even very high candidates (e.g., those at the 95th percentile) obtain, under the present system, comparatively low marks in these subjects. The system is more unfair to girls than to boys as few candidates score high marks in the subjects in which the girls excel whereas large numbers score high marks in the subjects in which boys excel.

The following were the standard deviations and the quartile deviations for boys, the maximum in each subject being taken as 100 :—

INTERMEDIATE CERTIFICATE EXAMINATION, 1928.

BOYS.

	Gr.	Ir.	Sc.	Dr.	Lat.	Maths.	Fr.	Eng.	H.&G.
Standard Deviation ..	21.6	20.2	19.3	18.5	17.3	16.7	13.2	11.7	10.3
Quartile Deviation ..	15.9	14.7	14.5	14.3	12.9	11.4	9.6	8.6	7 0

The above table shows that the marks cluster closely round the average in History and Geography, English and French—candidates show little variability, in these subjects—and that the marks are well dispersed between 0 to 100 in Greek, Irish and Science. A comparison of these measures of dispersion with the corresponding figures for girls shows that in general boys were more variable than girls in the examination.

In the first section of the paper many references were made to corresponding results for England and Wales published in " Secondary School Examination Statistics " (Longman, Green and Co., Ltd., 1928).

SECTION II.

The second section dealt with the correlation between the marks in each pair of examination subjects. The theory of the coefficient of correlation was explained in a simple manner through tables and a chart which showed that as the mark in each subject increased the associated mark in every other subject also increased. The following were the coefficients of correlation for boys. (The coefficient must lie between $+1$ and -1; the larger the coefficient, the stronger the association between the subjects.)

COEFFICIENTS OF CORRELATION (BOYS).

	I.	E.	Gr.	L.	F.	H.	M.	S.	D.	All
I.	—	.37	.53	.53	.39	.40	.44	.45	.08	.73
E.	.37	—	.44	.51	.39	.55	.40	.46	.32	.69
Gr.	.53	.44	—	.77	*	.39	.55	.34	*	.86
L.	.53	.51	.77	—	.59	.46	.54	.43	.31	.81
F.	.39	.39	*	.59	—	.36	.36	.41	*	.67
H.	.40	.55	.39	.46	.36	—	.46	.49	.34	.66
M.	.44	.49	.55	.54	.36	.46	—	.71	.27	.83
S.	.45	.46	.34	.43	.41	.49	.71	—	.21	.78
D.	.08	.32	*	.31	*	.34	.27	.21	—	.40
ALL	.73	.69	.86	.81	.67	.66	.83	.78	.40	—

* Only 20 boys took Gr., F.; only 24 took Gr., D.; only 47 took Fr., D. The next smallest groups were Gr., S., 89; F., S., 169; L., F., 252; I., F., 264; F., H., 292.

The strongest correlation, in the case of boys, was between Greek and Latin .77, the next strongest that between Mathematics and Science .71. Latin had a coefficient of over .5 with *five* subjects; Greek with *three*; Mathematics with *three*.

The corresponding coefficients for girls were :—

COEFFICIENTS OF CORRELATION (GIRLS)*.

	I.	E.	F.	H. & G.	M.	D.Sc.	D.	All
I.	—	.24	.49	.44	.42	.25	—.04	.69
E.	.24	—	.51	.53	.42	.32	.31	.66
F.	.49	.51	—	.51	.51	.27	.17	.75
H. & G.	.44	.53	.51	—	.53	.45	.26	.76
M.	.42	.42	.51	.53	—	.39	.29	.82
D.S.	.25	.32	.27	.45	.39	—	.03	.57
D.	—.04	.31	.17	.26	.29	.03	—	.39
ALL	.69	.66	.75	.76	.82	.57	.39	—

* The smallest numbers of girls in the groups were: D.Sc., D., 168; M., D.Sc., 283; F., D., 301.

Again all the coefficients were positive, except the negligible coefficient between Irish and Drawing. The highest coefficient was .53 between History and Geography and English.

It was suggested that it would be useful to calculate the coefficients between different types of questions in different subjects in order to ascertain the common and different faculties developed. In this connection reference was made to results of this type published in Biometrika Vol. VII., pp. 352–367.

Tables were given for writing down the equations of the lines of regression of the marks in each pair of subjects. Thus, if a boy's mark in English was X the corresponding *normal* mark in Irish is obtained from the equation

$$Y = 51.2 + .64 (X - 41.7)$$

Section III.

The results of candidates classified by age were compared for each subject in detail ; the general results were given for a broader age classification and sub-classification by type of school.

The general results were :—

Age			Number of Candidates				Average marks in all subjects	
			Actual Numbers		Percentages			
			Boys	Girls	Boys	Girls	Boys	Girls
Under 16	..	..	500	192	25.7	15.2	43.9	40.9
16 to 17	..	..	851	585	43.8	46.4	43.9	40.7
17 and over	..	..	594	485	30.5	38.4	38.4	40.4
TOTAL	..		1,945	1,262	100.0	100.0	—	—

Seventeen years was the limit of age for scholarships. Boys under 17 got much better results than those 17 or over, girls under 17 were slightly better than those 17 or over. Few girls under 16 competed—only 15.2%.

The following table shows the general results according to a more detailed age classification.

AVERAGE MARKS IN ALL SUBJECTS.

Age	Average marks		Age	Average marks	
	Boys	Girls		Boys	Girls
—15	49.1	45.0			
15 —	43.7	42.9	17 —	37.6	39.4
15¼—	43.5	42.6	17¼—	40.4	40.3
15½—	42.7	37.9	17½—	39.4	42.3
15¾—	44.3	40.9	17¾—	40.8	41.6
16 —	42.9	40.4	18 —	38.5	39.0
16¼—	44.1	39.8	18¼—	36.7	39.2
16½—	44.4	41.0	18½—	35.0	37.3
16¾—	44.2	41.3	18¾—	31.0	41.5
			19 —	37.9	42.2

In each of the nine age groups under 17, boys got higher marks than girls, in each of the remaining nine groups (with the exception of $17\frac{1}{4}$—$17\frac{1}{2}$) girls got higher marks than boys ; the boys under 17 were a very different class to those 17 or over.

Boys and girls under 15 got the best average results ; this was due to the regulation permitting candidates of this age to be examined only after recommendation by official inspectors. There was little difference between the results of the eight other groups of boys under 17 ; this shows that the younger the group of boys the better their average natural ability. Accordingly those who obtained scholarships may not have been the most suitable candidates and it was suggested that it might be wise to lower the limit of age for scholarships from 17 to 16 years.

The results of candidates classified according to their possible total marks were also compared. (The possible total allowed for scholarship purposes was 2,200.)

Possible total marks in hundreds	Under 20	20	21	22	23	24	25	26	27	28	Over 28
Number of Candidates: Boys ..	37	121	246	339	123	418	276	195	78	77	35
Girls ..	205	293	54	194	290	43	49	82	32	20	
Average marks : Boys ..	34.2	37.3	38.1	45.7	41.7	41.8	44.2	44.9	43.1	38.6	43.9
Girls ..	39.7	39.0	39.3	44.4	40.5	41.7	39.1	41.0	43.4	38.0	

39.5% of the girls took subjects totalling less than 2,100 marks as compared with only 8.1% of the boys. The classification by possible total marks appeared to classify the candidates roughly by natural ability, the weakest candidates taking subjects totalling less than 2,200. One boy who got a scholarship had a possible total of 3,000 marks (eight subjects), another 2,900, a third 2,800, seven had 2,700, twelve had 2,600, sixteen had 2,500, twenty-three had 2,400, one had 2,300 and only nine had 2,200—71 boys in all.

The paper concluded with a short account of the normal curve, giving formulæ for the standard deviations of statistical constants with a summary table for calculating the probable errors ; illustrations were given for thus calculating the stability of the results given in the paper.