Information Processing of Sports Test Data on Sophomores in Osaka University of Economics and Law, 1990

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ABSTRACTS

The measured points of scores obtained from the computer processing data were as follows: for economics-major sophomores 478 points, for law-major sophomores 352 points. We took the 5-gradation evaluation, the mean values, the standard deviation, the regression coefficients, the multiple-correlation coefficients and the F-ratio of scattering analysis.

The data obtained were compared with the nationwide mean value of the university students. As a result, the comparison shows that the mean value of OUEL(Osaka University of Economics and Law)students for weight (63.81kg), girth of the chest (88.33cm) and step test (60.56 points), to be recorded higher than the nationwide average. While as for height (171.38cm), side step (45.89 points), vertical jump (60.78cm), back strength (136.40kg), grip strength (44.32kg), trunk extension (56.45 cm), and standing trunk flexion (9.90cm), OUEL students recorded lower than the nationwide mean value.

(The Review of the Osaka University of Economics and Law, ***53*** *(1993) p. 35-66)*

1 PREFACE

The Japan Bureau of Physical Education in the Ministry of Education (JBPEME) has annually reported on the people's physique (height, weight and girth of the chest) and physical fitness since 1900 (the 33rd year of the Meiji Era)[1]. In Osaka University of Economics and Law, we have also collected and reported OUEL student's data on the same matters in each year's Review and Annals of the General Sciences Institute of Osaka University of Economics and Law since 1980. Moreover, we put the data obtained from 1983 to 1987 in computer-transaction for information processing. Meanwhile, some other research and reports on physical fitness measurement have been published by *S. AOYAMA* in University of Tokyo[2].

In this paper, we will report the data collected in 1989 from 830 sophomores students in all: 478 economics-majors and 352 law-major students. We gave them ten kinds of physical examinations and physical strength measurement, which we generally call a sports test. On the following stage, we put the data on these ten kinds in statistic processing such as the 5-gradation evaluation, the mean values, the standard deviation, the regression coefficients, the multiple-correlation coefficients and the F-ratio of scattering analysis. Int he 5-gradation evaluation, the data resulted in the distribution as follows: step E (6.45%), step D (20.65%), step C (47.40%), step B (18.00%) and step A (7.35%).

Consequently, the mean values of all OUEL students turned out to be higher in some items than the nationwide ones: weight (63.81kg), girth of the chest (88.33cm) and step test (60.56 points): while opposite lower in height (170.38cm), side step (45.89 points), vertical

jump (60.78cm), back strength (136.40kg), grip strength (44.32kg), trunk extension (56.45cm) and standing trunk flexion (9.90cm). Furthermore, the mean values of law-major sophomores are higher than those of economics-major sophomores in vertical jump, grip strength and step test, but they are lower in all the other items.

Accordingly, we find the difference between the two major students: economics-majors sophomores are greater in degree than law-majors ones for physique test. In terms of standard deviation economics-major sophomores stand higher vertical jump and standing trunk flexion, but quite opposite in the other items. The multiple-correlation coefficients reads quite large in weight and girth of the chest: that is to say, 0.8219 in economics-major and 0.7688 in law-majors, respectively. Therefore, the regression equation for these items is the most reliable of all in degree. At the same time, the reliability can be recognized in the multiple-correlation coefficient and the F-ratio of scattering analysis.

2 MEASURING METHOD

The measuring object and enumerators are department of economics sophomores (age: 19, males and 478 students) and department of law sophomores (age: 19, males and 352 students).

The measuring period was April 15 through May 15, 1990. In the measuring method and measurement members, we adopted the same measuring method as the one used for the physical fitness test used by the Ministry of Education. The measurement members are all instructors of physical education at Osaka University of Economics and Law.

In measurement items, we selected ten items referring to the above-

mentioned test by the Ministry of Education. These are the items of physical examination: height, weight and girth of the chest; and also the items of physical strength test: side step, vertical jump, back strength, grip strength, trunk extension, standing trunk flexion and step test.

In information processing for sports test data, we entered all the information on OUEL's sports test in optical character reader sheets, and put them in a computer. We used Hitachi's HITAC-IID. The language we used for the information processing was FORTRAN, BASIC, STATISTICAL SYSTEM (BASIS), DRMLMN. N, or KH0003.

3 MEASUREMENT RESULTS

3.1 The 5-Gradation Evaluation for Physical Fitness Test

3.1.1 The 5-Gradation Evaluation of Side Step

First of all, we made a classified JBPEME of the 5-gradation evaluation for side step: Grade 1 for 31 points and below, Grade 2 for 32-35 points, Grade 3 for 36-41 points, Grade 4 for 42-46 points, and Grade 5 for 47 points and over[1].

According to ***TABLE 1***, We then compared the data of economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.7% and (L) reads 0.3%, which are both in smaller degrees. On Grade 2, (E) reads 2.3%, (L) reads 1.3%, and the mean value is 1.65%, which stand fairly low. On Grade 3, (E) reads 14.3%, (L) reads 17.4%, and the mean value is 15.85%. These are in the middle of this evaluation. On Grade 4, (E) reads 32.4%, (L) reads 36.1%, and the mean value reads 34.25%. On Grade 5, (E) reads 50.1%, (L)

TABLE 1 *The Results of the 5 Gradation Evaluation on Events Judgement for OUEL Sophomores in 1990*

Faculty	Gradation	Side Step (point)	Vertical Jump (cm)	Back Strength (kg)	Grip Strength (kg)	Trunk Extension (cm)	Standing Trunk Flexion (cm)	Step Test (point)	Total Evaluation
Economics	1	0.7	0.9	0.9	1.1	1.6	18.1	0.7	E 5.4
	2	2.3	1.4	10.3	10.5	9.6	37.4	40.2	D 28.7
	3	14.3	16.2	46.5	39.5	34.1	30.8	44.0	C 45.4
	4	32.4	46.5	34.3	41.8	43.0	11.0	12.2	B 10.8
	5	50.1	34.8	7.7	6.8	11.5	2.5	2.8	A 9.6
Law	1	0.3	0.3	0.0	0.0	1.0	23.8	0.3	E 7.5
	2	1.3	0.6	9.5	5.1	9.5	34.1	39.2	D 12.6
	3	17.4	15.6	52.9	34.8	37.8	30.0	43.6	C 49.4
	4	36.1	43.6	30.7	50.1	43.3	10.2	14.6	B 25.2
	5	44.7	39.5	6.8	9.8	8.1	1.7	2.0	A 5.1
Average	1	0.50	0.60	0.45	0.55	1.30	20.95	0.50	E 6.45
	2	1.80	1.00	9.90	7.80	9.55	35.75	39.70	D 20.65
	3	15.85	15.90	49.70	37.15	35.95	30.40	43.80	C 47.40
	4	34.25	45.05	32.50	45.95	43.15	10.60	13.40	B 18.00
	5	47.40	37.15	7.25	8.30	9.80	1.85	2.40	A 7.35

reads 44.7%, and the mean value reads 47.40%. These Grade 4 values indicate the highest degrees in the evaluation. We can see that as the grade goes up, the higher the percentage grows.

3.1.2 The 5-Gradation Evaluation of Vertical Jump

First of all, we made a classified JBPEME of the 5-gradation evaluation for vertical jump: Grade 1 for 32cm and below, Grade 2 for 33-42cm, Grade 3 for 43-53cm, Grade 4 for 54-63cm, and Grade 5 for 64cm and higher[1].

According to ***TABLE 1***, we then compared the data of economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.9%, (L) reads 0.3% and the mean values reads 0.60%. On Grade 2, (E) reads 1.4%, (L) reads 0.6%. On Grade 3, (E) reads 16.2%, (L) reads 15.6%, and the mean value reads 15.90%. These are in the middle of this evaluation. On Grade 4, (E) reads 46.5%, (L) reads 43.6%, and the mean value reads 45.05%. Almost half of the percentage of all the enumerators are on this grade. Needless to say, they stand highest in percentage. On Grade 5, (E) reads 34.8%, (L) reads 39.5%, and the mean value reads 37.15%. They stand lower in percentage than those on Grade 4. The difference between these two grades in percentage-distribution has a slightly different tendency from those of sophomores in 1983-4.

3.1.3 The 5-Gradation Evaluation of Back Strength

First of all, we made a classified JBPEME of the 5-gradation evaluation for back strength: Grade 1 for 71kg and below, Grade 2 for 72-107kg, Grade 3 for 108-143kg, Grade 4 for 144-177kg, and Grade

5 for 178kg and heavier[1].

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.9%, (L) reads 0.0%, and the mean value reads 0.45%, which are both in small degrees. On Grade 2, (E) reads 10.3%, (L) reads 9.5%, and the mean value reads 9.90%. On Grade 3, (E) reads 46.5%, (L) reads 52.9%, and the mean value reads 49.70%. Almost half of the percentage of all the enumerators are on this grade. In addition, they stand highest in percentage. On Grade 4, (E) reads 34.3%, (L) reads 30.7%, and the mean value reads 32.50%. Put another way, a fourth part of the enumerators are on this grade. Finally, on Grade 5, (E) reads 7.7%, (L) reads 6.8%, and the mean value reads 7.25%. They stand between on Grade 1 and 2 in percentage.

3.1.4 The 5-Gradation Evaluation of Grip Strength

First of all, we made a classified JBPEME of the 5-gradation evaluation for grip strength: Grade 1 for 23kg and below, Grade 2 for 24-34kg, Grade 3 for 35-43kg, Grade 4 for 44-54kg, and Grade 5 for 55kg and stronger[1].

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 1.1%, (L) reads 0.0%, and the mean value reads 0.55%. On Grade 2, (E) reads 10.5%, (L) reads 5.1%, and the mean value reads 7.80%. On Grade 3, (E) reads 39.5%, (L) reads 34.8%, and the mean value reads 37.15%. On Grade 4, (E) reads 41.8%, (L) reads 50.1%, and the mean value reads 45.95%. Almost half of the percentage of all the enumerators are on this grade. On Grade 5, (E) reads 6.8%, (L)

reads 9.8%, and the mean value reads 8.30%. About 8% of all the enumerators are on this grade (2 and 5), respectively.

3.1.5 The 5-Gradation Evaluation of Trunk Extension

First of all, we made a classified JBPEME of the 5-gradation evaluation for trunk extension: Grade 1 for 36cm and below, Grade 2 for 37–46cm, Grade 3 for 47–56cm, Grade 4 for 57–66cm, and Grade 5 for 67cm and higher[1].

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 1.6%, (L) reads 1.0%, and the mean value reads 1.30%. On Grade 2, (E) reads 9.6%, (L) reads 9.5%, and the mean value reads 9.55%, about 10% of all the enumerators are on this grade. On Grade 3, (E) reads 34.1%, (L) reads 37.8%, and the mean value reads 35.95%. On Grade 4, (E) reads 43.0%, (L) reads 43.3%, and the mean value reads 43.15%. In addition, they stand highest in percentage. On Grade 5, (E) reads 11.5%, (L) reads 8.1%, and the mean value reads 9.80%, they stand between on Grade 2 and 3 in percentage. Put another way, one third of the enumerators are on this grade.

3.1.6 The 5-Gradation Evaluation of Standing Trunk Flexion

First of all, we made a classified JBPEME of the 5-gradation evaluation for standing trunk flexion: Grade 1 for 4cm and below, Grade 2 for 5–11cm, Grade 3 for 12–18cm, Grade 4 for 19–24cm, and Grade 5 for 25cm and higher[1].

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E)

reads 18.1%, (L) reads 23.8%, and the mean value reads 20.95%, these are in the middle of this evaluation. Put another way, one third of the enumerators are on this grade. On Grade 2, (E) reads 37.4%, (L) reads 34.1%, and the mean value reads 35.75%, these indicate the highest degrees in the evaluation. On Grade 3, (E) reads 30.8%, (L) reads 30.0%, and the mean value reads 30.40%. On Grade 4, (E) reads 11.0%, (L) reads 10.2% and the mean value reads 10.60%. On Grade 5, (E) reads 2.5%, (L) reads 1.7%, and the mean value reads 2.10%, they stand lower in percentage than those on Grade 4. In addition, they stand lower in percentage.

3.1.7 The 5-Gradation Evaluation of Step Test

First of all, we made a classified JBPEME of the 5-gradation evaluation for step test: Grade 1 for 41.8 points and below, Grade 2 for 41.9–56.5 points, Grade 3 for 56.6–71.3 points, Grade 4 for 71.4–85.9 points, and Grade 5 for 86.0 points and over[1].

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.7%, (L) reads 0.3%, and the mean value reads 0.50%, which are both in small degrees. On Grade 2, (E) reads 40.2%, (L) reads 39.2%, and the mean value reads 39.70%. On Grade 3, (E) reads 44.0%, (L) reads 43.6%, and the mean value reads 43.80%, almost half of the percentage of all the enumerators are on this grade. In addition, they stand highest in percentage. On Grade 4, (E) reads 12.2%, (L) reads 14.6%, and the mean value reads 13.40%, about 13% of all the enumerators are on this grade. Put another way, one third of the enumerators are on this grade. On Grade 5, (E) reads 2.8%, (L) reads 2.0%, and the mean value reads 2.40%, they stand lower in

percentage than those on Grade 4.

3.2 Results of the Mean Value[4-12]

In order to calculate the mean value in statistical analysis value of physique and physical fitness on OUEL students, the experimental results are shown in ***TABLE 2.***

3.2.1 Comparing Economics-major Sophomores and the Nationwide Average

The sports test data of economics-major sophomores in OUEL students was compared with the nationwide average. As a result, the economics-major sophomores were recorded heavier than the nationwide mean value of college students as a whole in height (171.55cm), weight (64.24kg), girth of the chest (88.66cm) and step test (60.52 points). While as for side step (46.29 points), vertical jump (60.33cm), back strength (136.86kg), grip strength (43.20kg), trunk extension (56.67cm) and standing trunk flexion (10.54cm). It was recorded lower than the nationwide average.

3.2.2 Comparing Law-major Sophomores and the Nationwide Average

The sports test data of law-major sophomores was compared with the nationwide average. As a result, the students tested were recorded lower than the nationwide mean value of college students as a whole in height (171.20cm), side step (45.49 points), vertical jump (61.22cm), back strength (135.93kg), grip strength (45.43kg), trunk extension (56.23cm) and standing trunk flexion (9.25cm), while higher in weight (63.37kg), girth of the chest (87.99cm) and step test (60.60 points).

TABLE 2 *The Statistical Analysis Values of Physique and Physical Fitness on OUEL Sophomores in 1990*

Name	MEAN S.E.	Height (cm)	Weight (kg)	Chest (cm)	Side Step (point)	Vertical Jump (cm)	Back Strength (kg)	Grip Strength (kg)	Trunk Extension (cm)	Standing Trunk Flexion (cm)	Step Test (point)
Economics -major (E2)	MEAN	171.55	64.24	88.66	46.29	60.33	136.86	43.20	56.67	10.54	60.52
	S.E.	5.74	9.73	6.84	5.29	7.75	26.92	7.78	8.10	7.46	10.45
Law-major (L2)	MEAN	171.20	63.37	87.99	45.49	61.22	135.93	45.43	56.23	9.25	60.60
	S.E.	5.51	9.39	6.83	4.68	8.10	26.23	7.13	7.42	7.88	10.13
OUEL Mean (M.O)	MEAN	171.38	63.81	88.33	45.89	60.78	136.40	44.32	56.45	9.90	60.56
	S.E.	5.63	9.56	6.84	4.99	7.93	26.58	7.46	7.76	7.67	10.29
Nationwide (M.J)	MEAN	171.49	62.77	86.57	46.73	61.35	138.42	45.66	57.50	12.15	58.99
	S.E.	5.64	7.60	5.35	4.70	7.24	23.98	6.92	8.28	6.58	10.40
(E2) – (M.J)	MEAN	0.06	1.47	2.09	−0.44	−1.02	−1.56	−2.46	−0.83	−1.61	1.53
	S.E.	0.10	2.13	1.49	0.59	0.51	2.94	0.86	−0.18	0.88	0.05
(L2) – (M.J)	MEAN	−0.29	1.40	1.42	−1.24	−0.13	−2.49	−0.23	−1.27	−2.90	1.61
	S.E.	−0.13	1.79	1.48	−0.02	0.86	2.25	0.21	−0.86	1.30	−0.27
(M.O)–(M.J)	MEAN	−0.11	1.04	1.76	−0.84	−0.57	−2.02	−1.34	−1.05	−2.25	1.57
	S.E.	−0.01	1.96	1.49	0.29	0.69	2.60	0.54	−0.52	1.09	−0.11
(E2) – (L2)	MEAN	0.35	0.87	0.67	0.80	−0.89	0.93	−2.23	0.44	1.29	−0.08
	S.E.	0.23	0.34	0.01	0.61	−0.35	0.69	0.65	0.68	−0.42	0.32

3.2.3 Comparing OUEL Students and the Nationwide Average

The sports test data obtained compared the OUEL data with nationwide mean value of the same college years. As a result, the comparison shows that the mean value of OUEL students, for height (171.38 cm), side step (45.89 points), vertical jump (60.78cm), back strength (136.40kg), grip strength (44.32kg), trunk extension (56.45cm) and standing trunk flexion (9.90cm) to be recorded lower than the nationwide average values.

3.3 Results of the Standard Deviation[4)-(12)]

In order to calculate the standard deviation in statistical analysis value of sports test data on OUEL students, the experimental results are shown ***FIG. 1*** which shows the relation between the standard deviation and sophomores OUEL students in the examination of physique and physical fitness test. Economics-major and law-major OUEL sophomores students, OUEL students and the nationwide are shown in the histograms ▨, ▩, ▩ and ▤, respectively.

As a result, the comparison shows that the standard deviation of OUEL students for height, side step, vertical jump, back strength, grip strength, trunk extension and standing trunk flexion was recorded lower than the nationwide average. While, as for weight, girth of the chest and step test, it is higher than the average.

3.4 Regression Analysis[4)-(12)]

It is assumed that one side sports test data (Y) is proportional to other sports test data (X). We used this equation

$$Y = a + b\,(X) \quad \cdots\cdots (1)$$

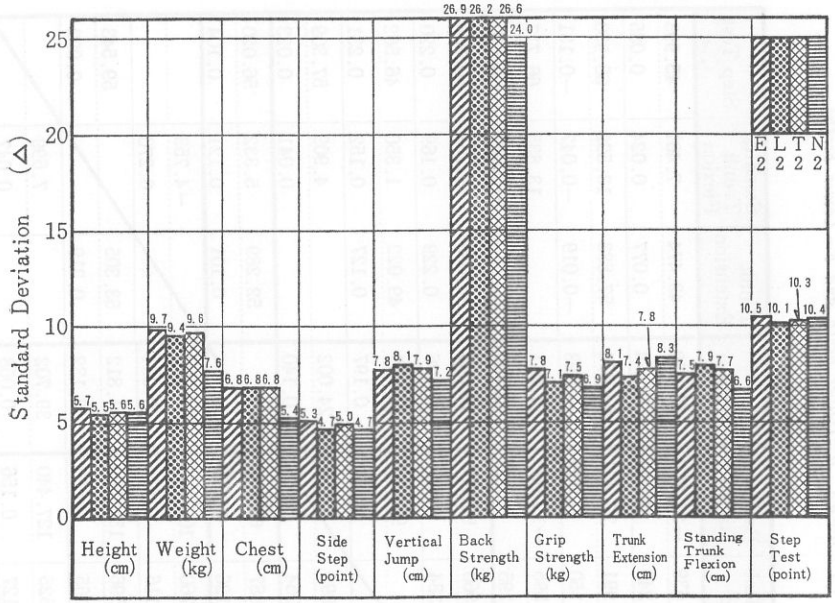

FIG. 1 *The Histogram of Standard Deviation on Sophomores in 1990*
Where, E2 : Economics-major, L2 : Law-major,
T2 : OUEL Students and N2 : Nationwide Students

TABLE 3 shows the upper coefficients (a) and the lower regression coefficient for sophomores economics-majors. In ***TABLE 3,*** the upper berth (a) and the lower berth (b) in the box are indicated as coefficients and regression coefficients, respectively. The negative coefficient of the regression for weight are found in side step, vertical jump, trunk extension, standing trunk flexion and step test. It is found that a weight decrease results in an increase of side step, vertical jump, trunk extension, standing trunk flexion and step test, respectively. While, other sports test data are positive coefficient of the regression. The negative coefficient of the regression for girth of the chest are found in vertical jump, standing trunk flexion and step test, respectively.

For sophomores economics-majors, the grip strength on OUEL

TABLE 3 *The Coefficients in Equation of Regression ($Y=a+bX$; a=Upper berth and b=Lower berth) for Economics-major Sophomores in 1990*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		−53.550	37.500	28.902	18.639	−24.200	−38.032	43.474	7.401	45.993
		0.687	0.298	0.101	0.243	0.939	0.474	0.077	0.024	0.085
Weight	156.120		51.560	49.223	69.991	77.462	24.034	57.883	13.592	68.950
	0.240		0.577	−0.046	−0.150	0.925	0.298	−0.019	−0.047	−0.131
Chest	152.840	−39.349		50.029	77.595	−19.000	7.011		13.835	66.717
	0.211	1.168		−0.042	−0.195	1.546	0.408		−0.037	−0.070
Side Step	166.000	71.384	91.920		42.560	92.703	35.044	46.055	2.731	50.336
	0.120	−0.154	−0.071		0.384	0.954	0.176	0.229	0.169	0.220
Vertical Jump	163.470	78.521	97.798	35.506		97.312	31.309	49.022	1.350	46.562
	0.134	−0.237	−0.152	0.179		0.656	0.197	0.127	0.152	0.231
Back Strength	165.680	47.722	75.008	41.252	52.895		24.002		4.909	57.309
	0.043	0.121	0.100	0.037	0.054		0.140		0.041	0.023
Grip Strength	160.370	44.112	75.046	42.776	51.887	64.356		52.289	5.332	56.020
	0.259	0.466	0.315	0.081	0.196	1.678		0.101	0.121	0.104
Trunk Extension	169.350	65.785		40.755	53.760	106.010	37.899		−4.753	
	0.039	−0.027		0.098	0.116	0.544	0.094		0.270	
Standing Trunk Flexion	171.420	65.093	88.988	45.395	58.596	131.200	41.812	53.305		59.543
	0.012	−0.081	−0.031	0.085	0.165	0.537	0.132	0.319		0.092
Step Test	169.990	71.129	90.472	42.879	52.625	127.440	39.702		7.699	
	0.026	−0.114	−0.030	0.056	0.127	0.156	0.058		0.047	

students was calculated from computer processing in the present study. The following regression as the relation between girp strength (Y_g) and sports tests (the data from examinations of physique and tests of physical fitness on OUEL students) has been determined by the experimental data:

$Y_g = -38.032 + 0.474$(height) (R=0.3534)·····(2)
$Y_g = 24.034 + 0.298$(weight) (R=0.3729)·····(3)
$Y_g = 7.011 + 0.408$(girth of the chest) (R=0.3588)·····(4)
$Y_g = 35.044 + 0.176$(side step) (R=0.1199)·····(5)
$Y_g = 31.309 + 0.197$(vertical jump) (R=0.1964)·····(6)
$Y_g = 24.002 + 0.140$(back strength) (R=0.4853)·····(7)
$Y_g = 37.899 + 0.094$(trunk extension) (R=0.0976)·····(8)
$Y_g = 41.812 + 0.132$(standing trunk flexion) (R=0.1261)·····(9)
$Y_g = 39.702 + 0.058$(step test) (R=0.0777)·····(10)

In this regression equation on grip strength on sophomores of OUEL economics-major students, the multiple-correlation coefficient are noted in height (R=0.3534 and F=60.3750), weight (R=0.3729 and F=68.3130), girth of the chest (R=0.3588 and F=62.4880) and back strength (R=0.4853 and F=130.2900) at above R=0.35.

The coefficients of the regression equation for sophomores in law-majors are shown in ***TABLE 4.*** The trunk extension of OUEL students was calculated from computer processing in the present study. The following regression equation as the relation between trunk extension (Y_t) and the sports tests is determined by a statistical analysis of sports test data:

TABLE 4 *The Coefficients in Equation of Regression ($Y=a+bX$; a=Upper berth and b=Lower berth) for Law-major Sophomores in 1990*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		−62.718	23.295	23.008	28.375	−115.850	−42.614	26.350		35.965
		0.736	0.378	0.131	0.192	1.471	0.514	0.175		0.144
Weight	155.120		52.524	49.845	69.737	72.880	27.750	54.909	10.462	66.565
	0.254		0.560	−0.069	−0.135	0.995	0.279	0.021	−0.019	−0.094
Chest	149.600	−29.505		49.535		14.670	11.039		1.184	63.934
	0.246	1.056		−0.046		1.378	0.391		0.092	−0.038
Side Step	162.930	75.933	92.450		26.015	74.404	27.004	42.756	−1.195	57.911
	0.182	−0.276	−0.098		0.774	1.353	0.405	0.296	0.230	0.059
Vertical Jump	165.770	74.427		29.663		82.906	31.541	53.214	1.572	59.097
	0.089	−0.181		0.259		0.866	0.227	0.049	0.125	0.025
Back Strength	162.380	46.044	75.270	39.635	49.991		24.527		3.608	58.033
	0.065	0.127	0.094	0.043	0.083		0.154		0.042	0.019
Grip Strength	157.270	41.416	71.687	37.566	47.928	41.471		53.008	2.375	56.501
	0.307	0.483	0.359	0.174	0.292	2.079		0.071	0.152	0.090
Trunk Extension	165.790	61.496		38.864	57.920	109.020	41.752		−0.392	64.560
	0.096	0.033		0.118	0.059	0.479	0.065		0.172	−0.070
Standing Trunk Flexion		63.617	87.354	44.742	59.990	131.680	44.286	54.819		59.861
		−0.027	0.069	0.081	0.133	0.460	0.124	0.152		0.080
Step Test	168.620	68.263	89.037	44.725	60.261	128.240	42.718	58.514	6.302	
	0.046	−0.081	−0.017	0.013	0.016	0.127	0.045	−0.038	0.049	

$Y_t = 26.350 + 0.175$(height) (R=0.1318)·····(11)

$Y_t = 54.909 + 0.021$(weight) (R=0.0272)·····(12)

$Y_t = 42.756 + 0.296$(side step) (R=0.1870)·····(13)

$Y_t = 53.214 + 0.049$(vertical jump) (R=0.0542)·····(14)

$Y_t = 53.008 + 0.071$(grip strength) (R=0.0685)·····(15)

$Y_t = 54.819 + 0.152$(standing trunk flexion) (R=0.1616)·····(16)

$Y_t = 58.514 - 0.038$(step test) (R=0.0521)·····(17)

In this regression equation of trunk extension in sophomores OUEL law-major students, the maximum class multiple-correlation coefficient and F-ratio of scattering analysis are height (R=0.1318 and F=5.1420), side step (R=0.1870 and F=10.5390) and standing trunk flexion (R=0.1616 and F=7.8071) at above R=0.1. While, the negative regression coefficient is weight. In this case, the negative regression coefficient and the multiple-correlation coefficients are recognized as less reliable for step test.

3.5 The Multiple-correlation Coefficient and F-ratio[4)-(12)]

This section presents the multiple-correlation coefficient and the F-ratio of scattering analysis relation based on the experimental data derived from the sports test data in sophomores economics-majors. One of the important characteristics is the multiple-correlation coefficient and the F-ratio of scattering analysis as it effects notably the coefficient of regression equation. ***TABLE 5*** shows the experimental data of the multiple-correlation coefficient and the F-ratio of scattering analysis. In the case of ***TABLE 5***, the upper berth and the lower berth are the multiple-correlation coefficient and the F-ratio of scattering analysis, respectively.

In the present experiments of the sports test data, it can be recog-

TABLE 5 *The Multiple-correlation Coefficient (Upper berth) and the F-Ratio of Scattering Analysis (Lower berth) for Economics-major Sophomores in 1990*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		**0.4091**	0.2535	0.1148	0.1829	0.2019	**0.3534**	0.0568	0.0166	0.0486
		84.9990	29.0430	5.6449	14.6310	17.9750	**60.3750**	1.3701	0.1169	1.0020
Weight	**0.4155**		**0.8220**	0.0842	0.1884	**0.3343**	**0.3729**	0.0225	0.0620	0.1221
	88.2530		**881.0600**	3.0209	15.5730	**53.2040**	**68.3130**	0.2143	1.1635	6.4076
Chest	0.2647	**0.8219**		0.0550	0.1715	**0.3928**	**0.3588**		0.0344	0.0460
	31.8750	**880.9100**		1.2818	12.8170	**77.1640**	**62.4880**		0.5021	0.8977
Side Step	0.1384	0.0825	0.0536		0.2600	0.1875	0.1199	0.1497	0.1199	0.1115
	8.2626	2.9012	1.2180		31.1680	15.4190	6.1659	9.6978	6.1705	5.3267
Vertical Jump	0.1984	0.1879	0.1713	0.2621		0.1888	0.1964	0.1213	0.1586	0.1717
	17.3350	15.4800	12.7810	31.1990		15.6420	16.9650	6.3166	10.9140	12.8540
Back Strength	0.2160	**0.3340**	**0.3927**	0.1877	0.1888		**0.4853**		0.1489	0.0607
	20.6920	**53.0940**	**77.1140**	15.4410	15.6350		**130.2900**		9.5850	1.5653
Grip Strength	**0.3609**	**0.3726**	**0.3586**	0.1201	0.1963	**0.4853**		0.0974	0.1262	0.0778
	63.3550	**68.1990**	**62.4350**	6.1851	16.9560	**130.2800**		4.0510	6.8401	2.5735
Trunk Extension	0.0967	0.0174		0.1500	0.1213	0.1640	0.0976		0.2935	
	3.9932	0.1274		9.7305	6.3206	11.6880	4.0640		39.8680	
Standing Trunk Flexion	0.0800	0.0602	0.0329	0.1201	0.1586	0.1488	0.1261	0.2934		0.0662
	2.7220	1.5379	0.4596	6.1931	10.9080	9.5835	6.8420	39.8560		1.8623
Step Test	0.0920	0.1212	0.0449	0.1117	0.1717	0.0607	0.0777		0.0662	
	3.6096	6.3062	0.8529	5.3459	12.8450	1.5634	2.5738		1.8596	

nized that the effect of the multiple-correlation coefficients and the F-ratio of scattering analysis is evaluated by computer processing as follows: the multiple-correlation coefficient above R=0.8 is the relation of the weight-girth of the chest (R=0.822 and F=881). On the other hand, the multiple-correlation coefficient between R=0.33 and R=0.50 were the height-weight (R=0.4155 and F=88.2530), the height-grip strength (R=0.3609 and F=63.3550), the weight-back strength (R=0.3340 and F=53.0940), the weight-grip strength (R=0.3726 and F=68.1990), the girth of the chest-back strength (R=0.3927 and F=77.1140), the girth of the chest-grip strength (R=0.3586 and F=62.4350) and the back strength-grip strength (R=0.4853 and F=130.2800), respectively.

The back strength and grip strength reveals a large confident coefficient for the sports test item data. Although the trunk extension, the standing trunk flexion and the step test are a small confidence coefficient. In this paper, it is shown that the multiple-correlation coefficient and the F-ratio of scattering analysis will remain consistent with the experimental data (1983-1988 years) with sophomores OUEL economics-majors.

The multiple-correlation coefficient and the F-ratio of scattering analysis in law-majors sophomores based on the experimental data in ***TABLE 6*** shows the experimental data of the multiple-coefficient and the F-ratio of scattering analysis for the relation between the sports test data items. In the case of ***TABLE 6***, the upper berth and the lower berth are the multiple-correlation coefficient and the F-ratio of scattering analysis, respectively.

In the sports test data, we obtained the multiple-correlation coeffi-

TABLE 6 *The Multiple-correlation Coefficient (Upper berth) and the F-Ratio of Scattering Analysis (Lower berth) for Law-major Sophomores in 1990*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		**0.4344**	**0.3069**	0.1572	0.1326	**0.3098**	**0.3991**	0.1318		0.0802
		67.6840	**30.2610**	7.3738	5.2053	**30.8830**	**55.1280**	5.1420		1.8812
Weight	**0.4351**		**0.7688**	0.1380	0.1560	**0.3563**	**0.3672**	0.0272	0.0233	0.0875
	67.9670		**420.4800**	5.6467	7.2552	**42.3090**	**45.3460**	0.2158	0.1587	2.2430
Chest	**0.3080**	**0.7688**		0.0674		**0.3593**	**0.3746**		0.0797	0.0264
	30.5020	**420.4500**		1.3260		**43.1270**	**47.5070**		1.8596	0.2036
Side Step	0.1597	0.1380	0.0677		**0.4474**	0.2415	0.2659	0.1870	0.1365	0.0282
	7.6100	5.6462	1.3408		**72.8060**	18.0240	22.1390	10.5390	5.5263	0.2320
Vertical Jump	0.1354	0.1559		**0.4473**		0.2675	0.2577	0.0542	0.1290	0.0208
	5.4346	7.2506		**72.7960**		22.4270	20.6970	0.8560	4.9255	0.1262
Back Strength	**0.3109**	**0.3563**	**0.3593**	0.2415	0.2675		**0.5655**		0.1383	0.0495
	31.1360	**42.3080**	**43.1420**	18.0210	22.4310		**136.8100**		5.6722	0.7147
Grip Strength	**0.3999**	**0.3672**	**0.3747**	0.2659	0.2577	**0.5655**		0.0685	0.1371	0.0640
	55.4020	**45.3480**	**47.5250**	22.1390	20.7030	**136.8200**		1.3710	5.5744	1.1963
Trunk Extension	0.1346	0.0269		0.1869	0.0541	0.1356	0.0683		0.1616	0.0520
	5.3705	0.2106		10.5330	0.8553	5.4473	1.3639		7.7983	0.7896
Standing Trunk Flexion		0.0236	0.0801	0.1366	0.1291	0.1383	0.1371	0.1616		0.0629
		0.1618	1.8766	5.5292	4.9331	5.6764	5.5758	7.8071		1.1553
Step Test	0.0848	0.0874	0.0271	0.0280	0.0292	0.0494	0.0639	0.0521	0.0627	
	2.1098	2.2402	0.2133	0.2284	0.1274	0.7117	1.1914	0.7921	1.1487	

cient (R) and the F-ratio of scattering analysis (F) which was calculated using experimental data. The multiple-correlation coefficient above R=0.75 is the relation of weight-girth of the chest (R=0.7688 and F=420.5). On the other hand, the multiple-correlation coefficient between R=0.4 and R=0.7 were the height-weight (R=0.4351 and F=67.9670), the height-grip strength (R=0.3999 and F=55.4020), the side step-vertical jump (R=0.4473 and F=72.7960) and the back strength-grip strength (R=0.5655 and F=136.8200). Where, the multiple-correlation coefficient between R=0.3 and R=0.4 were the height-girth of the chest (R=0.3080 and F=30.5020), the height-back strength (R=0.3109 and F=31.1360), the weight-back strength (R=0.3563 and F=42.3080), the weight-grip strength (R=0.3672 and F=45.3480), the girth of the chest-back strength (R=0.3593 and F=43.1420) and the girth of the chest-grip strength (R=0.3747 and F=47.5250), respectively.

Therefore, the sports test items for back strength and grip strength with the multiple-correlation coefficient were a very large value. Although, in trunk extension, standing trunk flexion and step test, the multiple-correlation coefficient and the F-ratio of scattering analysis have a very small value. The multiple-correlation coefficient and the F-ratio of scattering analysis can be recognized as experimental data (1983-1990 years) sophomores OUEL law-majors.

4 DISCUSSION

4.1 Discussion of the 5-Gradation Evaluation[4)-(12)]

FIG. 2 shows the experimental data derived from relation appraisement of the 5-gradation evaluation and the physical fitness on the students tested. In ***FIG. 2***, the solid line (×——×) and the dotted

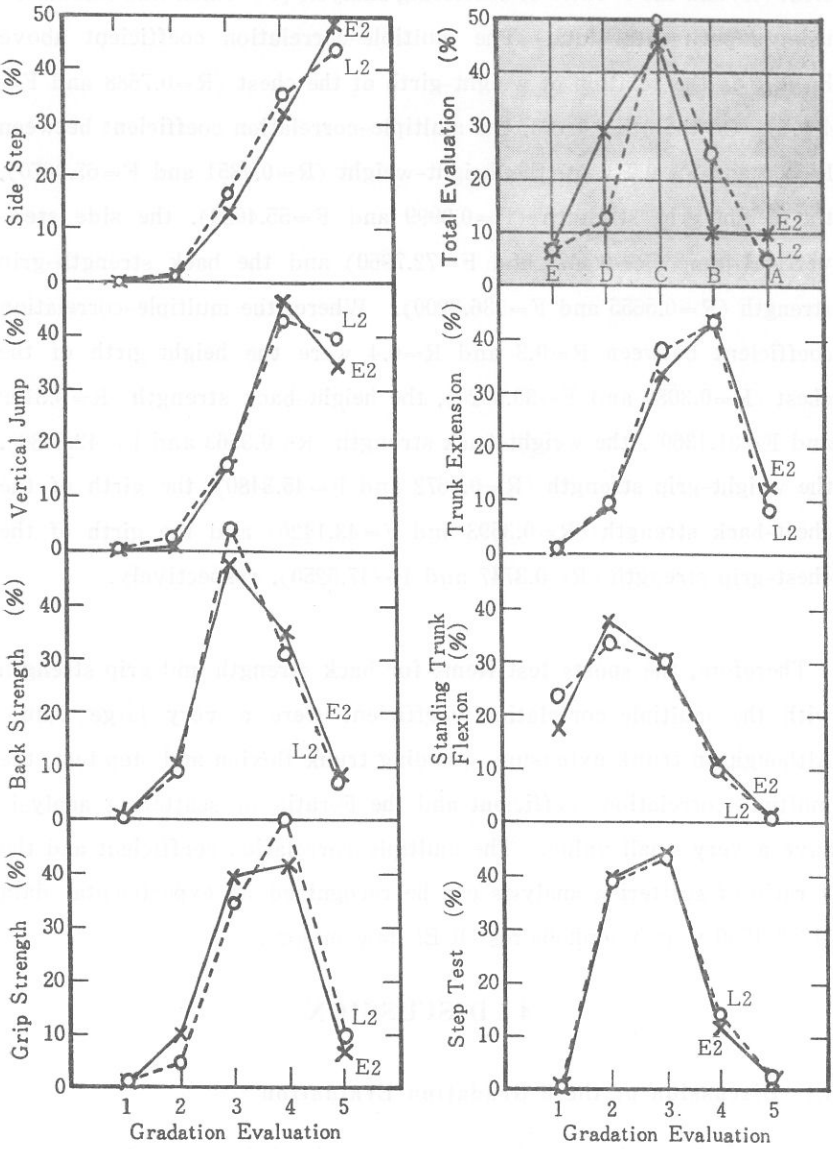

FIG. 2 *Relation between Appraisement of the 5 Gradation Evaluation and Side Step, Vertical Jump, Back Strength, Grip Strength, Trunk Extension, Standing Trunk Flexion and Step Test for Economics- and Law-major Sophomores in 1990*

line (O- - -O) are plotted economics-major and law-major sophomores, respectively.

We can see that as the grade goes up the higher the percentage grows for the side step and vertical jump in economics-majors (E). While, the physical fitness percentages decrease with an increase of from 1 to 3 grade and 4 gradation, respectively, as follows: side step (E and L), vertical jump (E and L), grip strength (E and L), back strength (E and L) and trunk extension (E and L) agree very closely with the percentage values determined by economics- and law-major sophomores, respectively. The vertical jump agree very closely with the values determined by (1983-1987) years.

4.2 Discussion of the Mean Values[4]-[12]

FIG. 3 shows the histogram of sports test data in relation between the students tested and students nationwide. While, in ***FIG. 3***, the mean value of E2 is economics-major sophomores, the mean value of L2 is law-major sophomores, the mean value of T2 is OUEL students and N2 is the nationwide mean values.

In height, we find the difference between the two categories of students. That is to say, economics-major sophomores are greater (gap: 0.35cm) in degree than law-major ones. Accordingly, we find a difference (gap: 0.11cm) between OUEL students and the nationwide ones. The result being that OUEL students of mean height are lower in degree than the nationwide ones.

In weight and girth of the chest, the mean weight and girth of the chest in economics-major sophomores are lower than those of law-major sophomores. At the same time, students in the weight and girth of

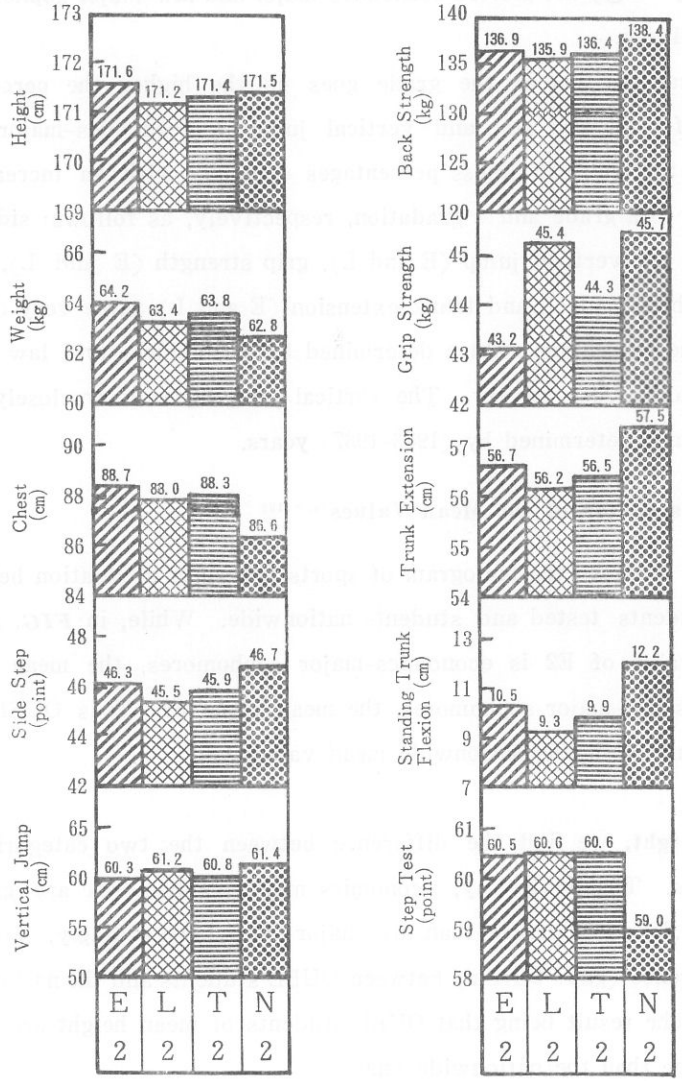

FIG. 3 *The Histogram of Sports Test Data in Relation between Economics-major Sophomores (E2), Law-major Sophomores (L2), OUEL Sophomores (T2) and Nationwide Sophomores (N2) in 1990*

the chest are higher in degree than the nationwide ones.

In side step, back strength, trunk extension and standing trunk flexion, economics-major sophomores of the mean values are greater in degree than law-major ones. While, the mean values of economics-major, law-major, and all OUEL students turned out to be lower in some items than the nationwide ones.

In vertical jump and grip strength, the mean values of law-major are greater in degree than economics-major ones. Consequently, the mean values of economics-major, law-major and all OUEL students are stronger than the nationwide ones.

In step test, the mean values of law-major are lower than those of economics-major sophomores. While, the mean values of law-major and all OUEL students turned out to be lower in some items than the nationwide ones.

4.3 Discussion of Regression Analysis[4)-(12)]

4.3.1 Relation between the Sports Test Data and Height

As mentioned above, the experimental data shows that the sports test data curve of height are down-wards and up-wards, respectively. It can be also expressed by the differential coefficient of the sports test data of height in ***FIG. 4*** which charts the solid line (×——×) and the dotted line (○- - -○) showing economics-major and law-major sophomores OUEL students, respectively.

We can see that as the height item goes up, the higher sports test data items grow: weight, side step, vertical jump and grip strength

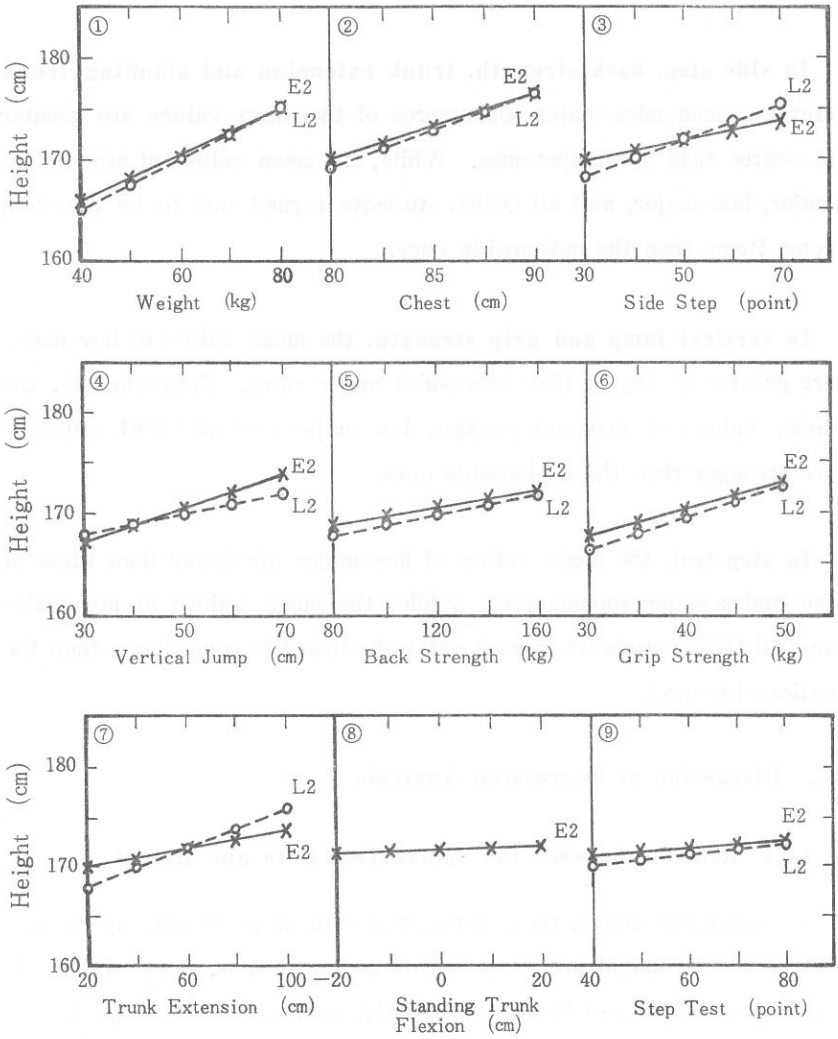

FIG. 4 *The Regression Line of Height for Sports Test Data in Sophomores in 1990*
Where, (×——×) : *E2 (Economics-major Sophomores)*
(○- - -○) : *L2 (Law-major Sophomores)*

on economics-major sophomores (E), or weight, side step, vertical jump, grip strength and trunk extension on law-major sophomores (L), respectively. It is noted that as the sports test data increases, height data shows a smaller fluctuation; girth of the chest, back strength, trunk extension, standing trunk flexion and step test on economics-major sophomores or girth of the chest, vertical jump, back strength and step test on law-major sophomores, respectively.

Therefore, a relation can be recognized in the sports test data and height data. That is, height depends on weight, vertical jump, grip strength and trunk extension. While oppositely independent of girth of the chest, standing trunk flexion and step test, respectively.

Accordingly, we find the difference between the two categories of students. The regression line values of law-major sophomores are greater in degree than economics-major ones: weight, girth of the chest, side step, back strength, grip strength and step test, respectively.

4.3.2 Relation between Sports Test Data and Weight

It can be also expressed by the differential coefficient of the sports test data of weight in ***FIG. 5*** which charts the solid line (×——×) and the dotted line (○- - -○) showing economics-major and law-major sophomores OUEL students, respectively.

We can be that the heavier the weight item goes up, the heavier the sport test data items are: height (E and L), girth of the chest (E and L), back strength (E and L), grip strength (E and L) and trunk extension (L) with positive regression. While, oppositely lighter in side step (E and L) and vertical jump (E and L), trunk extension (E), standing trunk flexion (E and L) and step test (E and L) with negative regression, respectively.

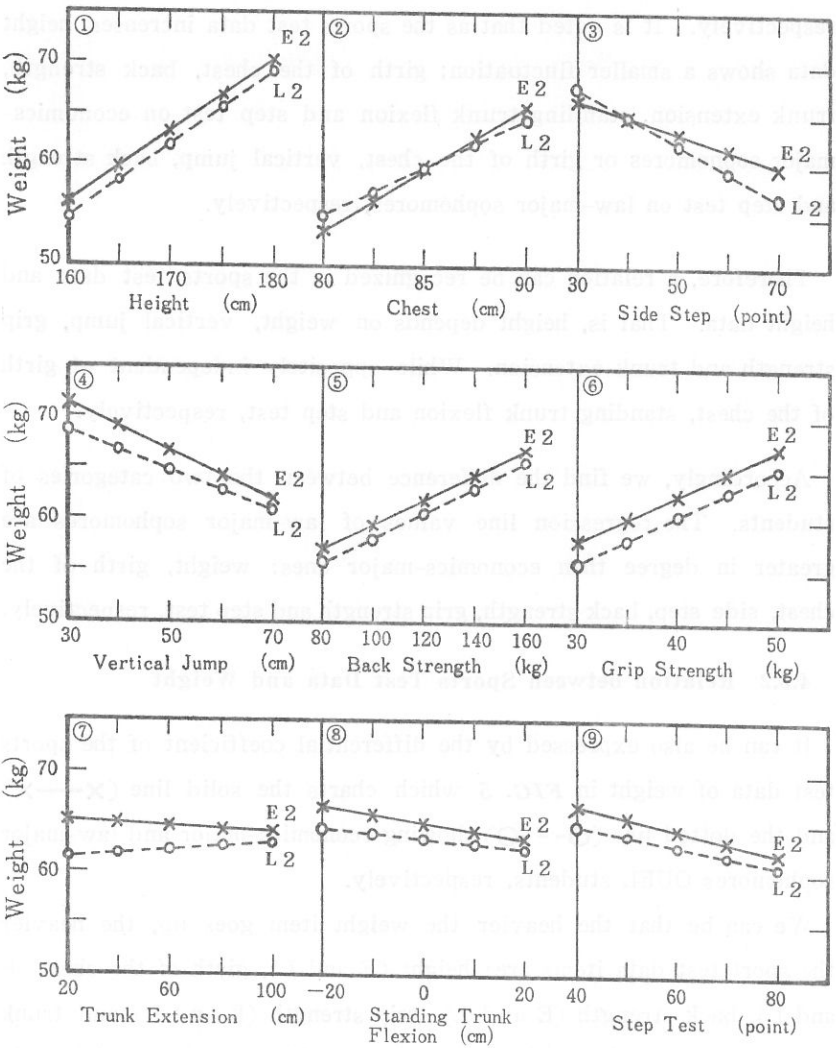

FIG. 5 *The Regression Line of Weight for Sports Test Data in Sophomores in 1990*

Where, (×——×) : *E2 (Economics-major Sophomores)*

(○- - -○) : *L2 (Law-major Sophomores)*

Accordingly, we find the difference between the two categories of students, the regression line values of law-major sophomores are greater in degree than economics-major ones: height, vertical jump, back strength, grip strength, trunk extension and step test, but they are lighter in weight, girth of the chest and side step, respectively.

5 SUMMARY and CONCLUSION

5.1 Results of the 5-Gradation Evaluation

The 5-gradation evaluation on physical fitness sports test of the students tested and the nationwide mean values in the year 1990, are

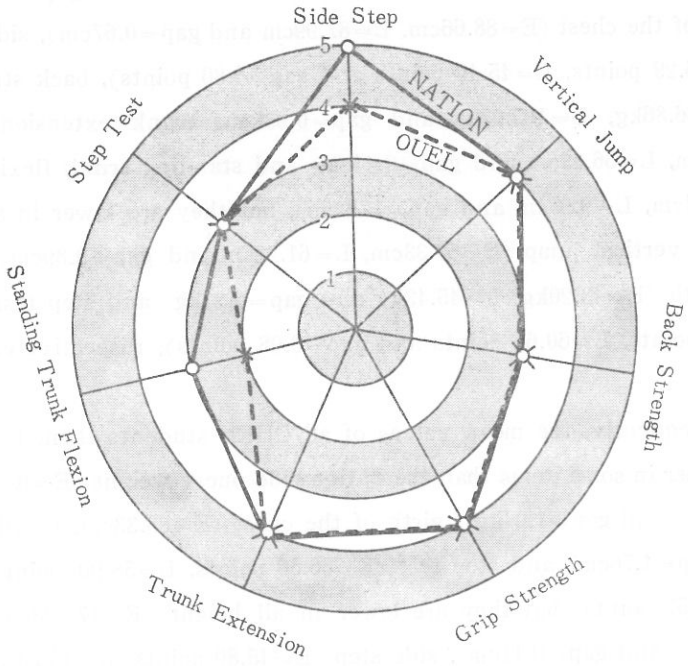

FIG. 6 *The 5 Gradation Evaluation of Physical Fitness Test for OUEL Sophomores (×---×) and Nationwide Mean Values (○—○) in 1990*

plotted in ***FIG. 6.*** Where, the points are considered to be arranged in a line in both cases of OUEL students (×---×) and nationwide mean value (○——○).

Accordingly, we find a difference between OUEL students and nationwide mean value. The nationwide mean values are the greater grade in degree for OUEL students: side step and standing trunk flexion, but other grades are at same level.

5.2 Results of the Mean Values

The mean values of economics-major sophomores are higher than those of law-major sophomores; height (E=171.55cm, L=171.20cm and gap=0.35cm), weight (E=64.24kg, L=63.37kg and gap=0.87kg), girth of the chest (E=88.66cm, L=87.99cm and gap=0.67cm), side step (E=46.29 points, L=45.49 points and gap=0.80 points), back strength (E=136.86kg, L=135.93kg and gap=0.93kg), trunk extension (E=56.67cm, L=56.23cm and gap=0.44cm) and standing trunk flexion (E=10.54cm, L=9.25cm and gap=1.29cm), but they are lower in all the items; vertical jump (E=60.33cm, L=61.22cm and gap=0.89cm), grip strength (E=43.20kg, L=45.43kg and gap=2.23kg) and step test (E=60.52 points, L=60.60 points and gap=0.08 points), respectively.

Consequently, the mean values of all OUEL students turned out to be higher in some items than the nationwide ones; weight (E=63.81cm, L=62.77 and gap=1.04kg), girth of the chest (E=88.33cm, L=86.57cm and gap=1.76cm) and step test (E=60.56 points, L=58.99 points and gap=1.57 points) but they are lower in all height (E=171.38cm, L=171.49cm and gap=0.11cm), side step (E=45.89 points, L=46.73 points and gap=0.84 points), vertical jump (E=60.78cm, L=61.35cm and gap=0.57cm), back strength (E=136.40kg, L=138.42kg and gap=2.02

kg), grip strength (E=44.32kg, L=45.66kg and gap=1.34kg), trunk extension (E=56.45cm, L=57.50kg and gap=1.05cm) and standing trunk flexion (E=9.90cm, L=12.15cm and gap=2.25cm), respectively.

5.3 Regression Coefficient

In economics-major sophomores, regression coefficient on OUEL students calculated using computer processing in the present study are positive and negative regression coefficients (***TABLE 3***). The positive regression coefficients for it items are height, back strength and grip strength. It was found that a mixed positive and negative regression coefficients for its items are weight, girth of the chest, side step, vertical jump, trunk extension, standing trunk flexion and step test.

Next, in law-major sophomores regression coefficient on OUEL students calculated from information processing in the present study are positive and negative coefficients (***TABLE 4***). The positive regression coefficient for its items are height, back strength and grip strength. While it was found that mixed positive and negative regression coefficient are weight, girth of the chest, side step, vertical jump, trunk extension, standing trunk flexion and step test.

Acknowledgements

The authors would like to thank Associate Professors H. KATSU, T. OMORI , Y. MORISHITA and H. TAKAGAKI for their valuable suggestions and helpful discussions. The authors also wish to acknowledge the interest and the helpful discussions of K. KAWAGUCHI, Dean of Koseikai and H. TSUKISHIRO of the Center of Information Science at OUEL for their support and cooperation.

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