

INFORMATION PROCESSING OF SPORTS TEST DATA ON SOPHOMORES IN OSAKA UNIVERSITY OF ECONOMICS AND LAW, 1989

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ABSTRACTS

The measured points of scores obtained from the computer processing data were as follows: for economics-major sophomores 132 points, for law-major sophomores 166 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 (63.48kg), girth of the chest(87.97cm) and trunk extension (58.41cm), to be recorded higher than the nationwide average. While as for height(171.01cm), side step(44.41 points), vertical jump(59.92cm), back strength(135.60kg), grip strength(44.63kg), standing trunk flexion (9.77cm) and step test (61.70 points), OUEL students recorded lower than the nationwide mean value.

(The Review of the Osaka University of Economics and Law, 52 (1993) p. 35-65)

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 298 sophomores students in all: 132 economics-majors and 166 law-major students. We gave them ten kinds of physical examinations and physical strength measurement, which we generally call a sports test. 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. In the 5-gradation evaluation, the data resulted in the distribution as follows: step E (8.50%), step D (15.05%), step C(43.75%), step B(27.75%) and step A(4.75%).

Consequently, the mean values of all OUEL students turned out to be higher in some items than the nationwide ones: weight (63.48kg), girth of the chest (87.97cm) and trunk extension (58.41cm): while

opposite lower in height (170.01cm), side step (44.41 points), vertical jump (59.92 cm), back strength (135.60kg), grip strength (44.63kg), standing trunk flexion (9.77cm) and step test (61.70 points). Furthermore, the mean values of economics-major sophomores are higher than those of law-major sophomores in side step and step test, but they are lower in all the other items.

Accordingly, we find the difference between the two major students: law-majors sophomores are greater in degree than economics-majors ones for physique test. In terms of standard deviation law-major sophomores stand higher back strength, 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, 0.8248 in economics-major and 0.8162 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: 20, males and 132 students) and department of law sophomores (age: 20, males and 166 students).

The measuring period was April 25 through May 10, 1989. 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. According to the *TABLE 1*, we then compared the data of economics-major(E) and law-major (L) sophomores⁽¹⁾.

According to *TABLE 1*, On Grade 1, (E) reads 0.7% and (L) reads 0.6%, which are both in smaller degrees. On Grade 2, (E) reads 3.0%, (L) reads 4.8%, and the mean value is 3.90%, which stand fairly low. On Grade 3, (E) reads 18.9%, (L) reads 25.9%, and the mean value is 22.40%. These are in the middle of this evaluation. On Grade 4, (E) reads 40.9%, (L) reads 37.9%, and the mean value reads 39.40%.

TABLE 1 Appraisalment of the 5 Gradation Evaluation of OUEL Sophomores

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	0.0	0.7	0.0	1.5	21.2	0.0	E 6.8
	2	3.0	2.2	17.4	4.5	3.7	43.1	28.7	D 15.1
	3	18.9	14.3	49.2	39.3	27.2	25.7	49.2	C 45.4
	4	40.9	53.0	28.0	50.7	56.8	9.0	18.9	B 27.2
	5	36.3	30.3	4.5	5.3	10.6	0.7	3.0	A 5.3
Law	1	0.6	0.0	0.0	0.6	0.6	21.0	0.6	E 10.2
	2	4.8	3.0	10.8	10.2	6.0	34.9	37.9	D 15.0
	3	25.9	21.6	48.7	33.1	30.7	30.7	48.1	C 42.1
	4	37.9	40.9	32.5	48.7	54.2	9.0	9.0	B 28.3
	5	30.7	34.3	7.8	7.2	8.4	4.2	4.2	A 4.2
Average	1	0.65	0.00	0.35	0.30	1.05	21.10	0.30	E 8.50
	2	3.90	2.60	14.10	7.35	4.85	39.00	33.30	D 15.05
	3	22.40	17.95	48.95	36.20	28.95	28.20	48.65	C 43.75
	4	39.40	46.95	30.25	49.70	55.50	9.00	13.95	B 27.75
	5	33.50	32.30	6.15	6.25	9.50	2.45	3.60	A 4.75

On Grade 5, (E) reads 36.3%, (L) reads 30.7%, and the mean value reads 33.50%. 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, both (E) and (L) reads 0%. On Grade 2, (E) reads 2.2%, (L) reads 3.0%, and the mean value reads 2.60%. On Grade 3, (E) reads 14.3%, (L) reads 21.6%, and the mean value reads 17.95%. These are in the middle of this evaluation. On Grade 4, (E) reads 53.0%, (L) reads 40.9%, and the mean value reads 46.95%. 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 30.3%, (L) reads 34.3%, and the mean value reads 32.30%. 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 1988.

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 0.7% and (L) reads 0.0%, which are both in small degrees. On Grade 2, (E) reads 17.4%, (L) reads 10.8%, and the mean value reads 14.10%. On Grade 3, (E) reads 49.2%, (L) reads 48.7%, and the mean value reads 48.95%. 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 28.0%, (L) reads 32.5%, and the mean value reads 30.25%. Put another way, a fourth part of the enumerators are on this grade. Finally, on Grade 5, (E) reads 4.5%, (L) reads 7.8%, and the mean value reads 6.15%. 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 0.0% and (L) reads 0.6%. On Grade 2, (E) reads 4.5%, (L) reads 10.2%, and the mean value reads 7.35%. On Grade 3, (E) reads 39.3%, (L) reads 33.1%, and the mean value reads 36.20%. On Grade 4, (E) reads 50.7%, (L) reads 48.7%, and the mean value reads 49.70%. Almost half of the percentage of all the enumerators are on this grade. On Grade 5, (E) reads 5.3%, (L) reads 7.2%, and the mean value

reads 6.25%. About 5-7% 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 1.5%, (L) reads 0.6%, and the mean value reads 1.05%. On Grade 2, (E) reads 3.7 %, (L) reads 6.0%, and the mean value reads 4.85%, about 5% of all the enumerators are on this grade. On Grade 3, (E) reads 27.2%, (L) reads 30.7%, and the mean value reads 28.95%. On Grade 4, (E) reads 56.8%, (L) reads 54.2%, and the mean value reads 55.50%. Almost half of the percentage of all the enumerators are on this grade. In addition, they stand highest in percentage. On Grade 5, (E) reads 10.6%, (L) reads 8.4%, and the mean value reads 9.50%, 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 econo-

mics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 21.2%, (L) reads 21.0%, and the mean value reads 21.10%, 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 43.1%, (L) reads 34.9%, and the mean value reads 39.00%, these indicate the highest degrees in the evaluation. On Grade 3, (E) reads 25.7%, (L) reads 30.7%, and the mean value reads 28.20%. On Grade 4, both (E) and (L) reads 9.0%, which is only less than 10%. On Grade 5, (E) reads 0.7%, (L) reads 4.2%, and the mean value reads 2.45%, 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 I**, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.0%, (L) reads 0.6%, and the mean value reads 0.30%, which are both in small degrees. On Grade 2, (E) reads 28.7%, (L) reads 37.9%, and the mean value reads 33.30%. On Grade 3, (E) reads 49.2%, (L) reads 48.1%, and the mean value reads 48.65%, 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 18.9%, (L) reads 9.0%, and the mean value reads 13.95%, about 14% 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 3.0%,

(L) reads 4.2%, and the mean value reads 3.60%, they stand lower in percentage than those on Grade 4.

3.2 Results of the Mean Value⁽⁴⁻¹¹⁾

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 weight (63.14kg), while as for height (170.82 cm), side step (44.86 points), vertical jump (60.16cm), back strength (133.83kg), grip strength (44.70kg), standing trunk flexion (9.14cm) and step test (62.96 points). 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 side step (43.96 points), vertical jump (59.68cm), back strength (137.37kg), grip strength (44.55kg), standing trunk flexion (10.39cm) and step test (60.43 points), while higher in height (171.20cm), weight (63.82 kg), girth of the chest (88.34 cm) and trunk extension (58.23cm).

TABLE 2 Statistical Analysis Value of Physique and Physical Fitness on OUEL Sophomores where, $M.O$ (OUEL students Mean), $M.J$ (nationwide Mean) $MEAN$ (Mean Values) and $S.D.$ (Standard Deviation)

Name	MEAN	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)
	S.D.										
Economics-major (E2)	MEAN	170.82	63.14	87.59	44.86	60.16	133.83	44.70	58.58	9.14	62.96
	S.D.	5.40	8.54	5.38	4.69	7.91	29.28	6.41	6.84	7.95	11.05
Law-major (L2)	MEAN	171.20	63.82	88.34	43.96	59.68	137.37	44.55	58.23	10.39	60.43
	S.D.	6.07	9.73	6.36	4.91	9.46	26.90	8.22	6.89	8.03	11.07
OUEL Mean (M.O)	MEAN	171.01	63.48	87.97	44.41	59.92	135.60	44.63	58.41	9.77	61.70
	S.D.	5.74	9.14	5.87	4.80	8.69	28.09	7.32	6.87	7.99	11.06
Nationwide (M.J)	MEAN	171.12	62.56	87.25	48.11	61.27	145.08	46.28	57.63	12.95	62.18
	S.D.	5.39	7.60	5.07	5.22	7.41	24.68	6.00	8.05	6.13	11.10
(E2) - (M.J)	MEAN	-0.30	0.58	0.34	-3.25	-1.11	-11.25	-1.58	0.95	-3.81	0.78
	S.D.	0.01	0.94	0.31	-0.53	0.50	4.60	0.41	-1.21	1.82	-0.05
(L2) - (M.J)	MEAN	0.08	1.26	1.09	-4.15	-1.59	-7.71	-1.73	0.60	-2.56	-1.75
	S.D.	0.68	2.13	1.29	-0.31	2.05	2.22	2.22	-1.16	1.90	-0.03
(M.O) - (M.J)	MEAN	-0.11	0.92	0.72	-3.70	-1.35	-9.48	-1.65	0.78	-3.18	-0.48
	S.D.	0.35	1.54	0.80	-0.42	1.28	3.41	1.32	-1.18	1.86	-0.04
(E2) - (L2)	MEAN	-0.38	-0.68	-0.75	0.90	0.48	-3.54	0.15	0.35	-1.25	2.53
	S.D.	-0.67	-1.19	-0.98	-0.22	-1.55	2.38	-1.81	-0.05	-0.08	-0.02

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 (171.01 cm), side step (44.41 points), vertical jump (59.92cm), back strength (135.60kg), standing trunk flexion (9.77 cm) and step test (61.70 points) to be recorded lower than the nationwide average.

3.3 Results of the Standard Deviation⁽⁴⁾⁻⁽¹¹⁾

In order to calculate the standard deviation in statistical analysis

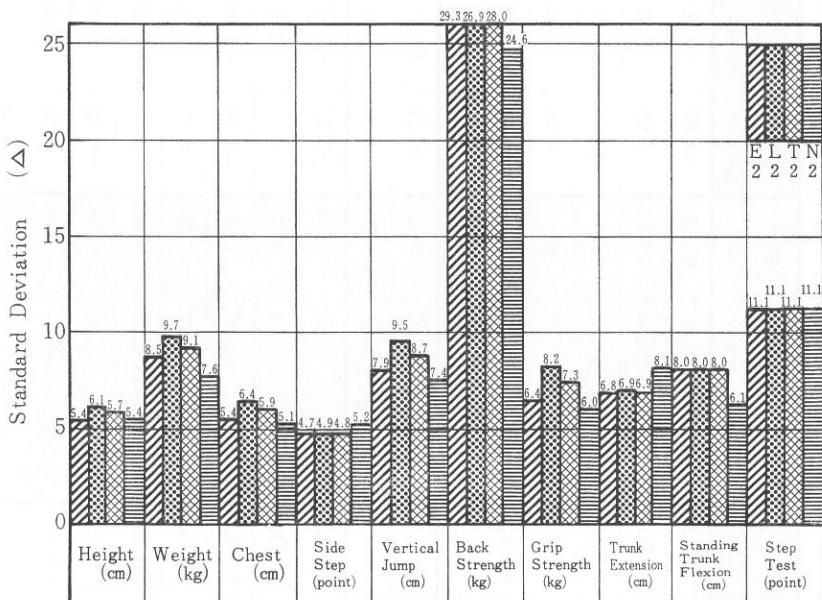


FIG. 1 The Histogram of Standard Deviation on OUEL Sophomores where, E2 is Economics-major Sophomores, L2 is Law-major Sophomores, T2 is OUEL Students and N2 is Nationwide Students

value of sports test data on OUEL students, the experimental results are shown **FIG. 1** which shows the relation between the standard deviation and sophomore OUEL students in the examination of physique and physical fitness test. Economics-major and law-major OUEL sophomores student, 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 side step, trunk extension and step test was recorded lower than the nationwide average. While, as for height, weight, girth of the chest, vertical jump, back strength, grip strength and standing trunk flexion, it is higher than the average.

3.4 Regression Analysis⁽⁴⁾⁻⁽¹¹⁾

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

$$Y = a + b (X) \dots\dots\dots(1)$$

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, trunk extension, standing trunk flexion and step test. It is found that a weight decrease results in an increase of side step, trunk extension, standing trunk flexion, and step test, respectively. While, other sports test data are positive coefficient of the regression.

For sophomores economics-majors, the girth of the chest on OUEL students was calculated from computer processing in the present study. The following regression as the relation between girth of the chest (Yc) and sports tests (the data from examinations of physique and

TABLE 3 Coefficients in Equation of Regression for OUEL Economics-majors where, in Equation, $Y = a + bX$, a is Upper Coefficient and b is Lower Coefficient

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		-37.185	64.968	34.664	37.182	82.326	3.217	15.765		
Weight	156.030		0.132	0.060	0.135	0.302	0.243	0.251		
Chest	0.234	159.160		43.390	74.320	96.851	33.991	53.173	5.807	79.330
Side Step	0.079	0.133	0.519		-0.224	0.586	0.170	0.086	0.053	-0.259
Vertical Jump	0.063	0.079	0.519	34.657	84.588	1.913	13.797	49.638	-13.185	85.344
Back Strength	0.010	0.079	0.519	0.116	-0.279	1.506	0.353	0.102	0.255	-0.256
Grip Strength	0.172	0.079	0.519	0.116	30.174	45.224	34.624	43.839	-13.527	
Trunk Extension	0.156	0.079	0.519	0.116	0.668	1.975	0.225	0.329	0.505	
Standing Trunk Flexion	0.156	0.079	0.519	0.116	64.635		30.402	48.724	-0.091	31.222
Step Test	0.156	0.079	0.519	0.116	1.150	1.150	0.238	0.164	0.304	0.528
	169.450	56.470	80.781	38.082	48.939		29.916		-1.958	52.839
	0.010	0.050	0.051	0.051	0.084		0.110		0.083	0.076
	163.140	49.691	76.487	39.494	44.020	30.913		53.453	-1.489	50.240
	0.172	0.301	0.248	0.120	0.361	2.303		0.115	0.238	0.285
	161.670	55.299	83.879	35.800	47.314	92.501	38.777		-9.167	50.116
	0.156	0.134	0.063	0.155	0.219	0.706	0.101		0.313	0.219
		62.584	86.518	43.249	57.410	123.540	43.281	56.470		60.737
		0.061	0.117	0.176	0.301	1.126	0.155	0.231		0.243
		72.900	91.401		43.154	100.390	38.660	53.301	1.217	
		-0.155	-0.061		0.270	0.531	0.096	0.084	0.126	

tests of physical fitness on OUEL students) has been determined by the experimental data:

- Y_c=64.968+0.132(height) (R=0.137).....(2)
- Y_c=54.791+0.519(weight) (R=0.825).....(3)
- Y_c=80.704+0.153(side step) (R=0.135).....(4)
- Y_c=95.358-0.129(vertical jump) (R=0.191).....(5)
- Y_c=80.781+0.051(back strength) (R=0.278).....(6)
- Y_c=76.487+0.248(grip strength) (R=0.296).....(7)
- Y_c=83.879+0.063(trunk extension) (R=0.082).....(8)
- Y_c=86.518+0.117(standing trunk flexion) (R=0.173).....(9)
- Y_c=91.401-0.061(step test) (R=0.126).....(10)

In this regression equation on girth of the chest on sophomores of OUEL economics-major students, the multiple-correlation coefficient are noted in weight (R=0.825), back strength (R=0.278) and grip strength (R=0.296) at above R=0.25. While the negative regression coefficient is vertical jump and step test. In the case the multiple-correlation coefficient, vertical jump and step test are R=0.191 and R=0.126, respectively.

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

- Y_s=20.348+0.138(height) (R=0.173).....(11)
- Y_s=45.033-0.017(weight) (R=0.033).....(12)

TABLE 4 Coefficients in Equation of Regression for OUEL Law-majors where, in Equation, $Y = a + bX$, a is Upper Coefficient and b is Lower Coefficient

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		-67.797	41.699	20.348	5.752	-15.557	-33.169	18.850	-12.771	43.742
Weight	152.080		54.290	45.033	0.315	0.893	0.454	0.230	0.135	0.098
Chest	0.300		0.534	-0.017	-0.060	1.118	0.334	0.090		-0.072
	149.240	-46.556		41.326	67.136	-43.470	-2.645	39.190	3.983	71.697
	0.249	1.250		0.030	-0.084	2.047	0.534	0.216	0.073	-0.128
Side Step	161.940	66.711	86.144		28.959	94.394	18.092	42.951	-3.466	49.413
	0.210	-0.066	0.050		0.699	0.978	0.602	0.348	0.315	0.251
Vertical Jump	163.460	67.638	90.612	32.717		85.718	32.842	51.064	1.712	56.098
	0.130	-0.064	-0.038	0.188		0.865	0.196	0.120	0.145	0.073
Back Strength	154.950	43.737	72.642	39.484	44.973		24.337		0.665	56.007
	0.045	0.146	0.114	0.033	0.107		0.147		0.071	0.032
Grip Strength	160.170	43.012	74.122	34.392	48.113	67.222		50.777	4.732	
	0.247	0.467	0.319	0.215	0.260	1.575		0.167	0.127	
Trunk Extension	160.780	53.336	77.647	33.659	46.482	90.061	30.657		-7.538	
	0.179	0.180	0.184	0.177	0.227	0.812	0.239		0.308	
Standing Trunk Flexion	170.390		87.867	42.736	57.583	129.100	43.162	55.874		60.060
	0.077		0.046	0.118	0.202	0.796	0.133	0.227		0.036
Step Test	169.420	67.202	90.883	40.977	56.473	125.860			9.248	
	0.029	-0.056	-0.042	0.049	0.053	0.190			0.019	

$$Y_s = 41.326 + 0.030(\text{chest}) \quad (R=0.039) \dots\dots\dots(13)$$

$$Y_s = 32.717 + 0.188(\text{vertical jump}) \quad (R=0.363) \dots\dots\dots(14)$$

$$Y_s = 39.484 + 0.033(\text{back strength}) \quad (R=0.179) \dots\dots\dots(15)$$

$$Y_s = 34.392 + 0.215(\text{grip strength}) \quad (R=0.360) \dots\dots\dots(16)$$

$$Y_s = 33.659 + 0.177(\text{trunk extension}) \quad (R=0.248) \dots\dots\dots(17)$$

$$Y_s = 42.736 + 0.118(\text{standing trunk flexion}) \quad (R=0.193) \dots\dots\dots(18)$$

$$Y_s = 40.977 + 0.049(\text{step test}) \quad (R=0.111) \dots\dots\dots(19)$$

In this regression equation of side step in sophomores OUEL law-major students, the maximum class multiple-correlation coefficient are vertical jump($R=0.363$), grip strength($R=0.360$) and trunk extension($R=0.248$) at above $R=0.2$. While, the negative regression coefficient is weight. In this case, the negative regression coefficient and the multiple-correlation coefficients are recognized as less reliable.

3.5 The Multiple-correlation Coefficient and F-ratio⁽⁴⁾⁻⁽¹¹⁾

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, repectively.

In the present experiments of the sports test data, it can be recognized that the effect of the multiple-correlation coefficients and the F-ratio of scattering analysis is evaluated by computer processing as

TABLE 5 *Multiple-Correlation Coefficient (Upper berth) and F-ratio of Scattering Analysis (Lower berth) for OUEL Economics-majors*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		0.3726	0.1373	0.0680	0.0931	0.0573	0.2041	0.1992		
Weight	0.3776		0.8249	0.0425	0.2425	0.1710	0.2259	0.1072	0.0569	0.2005
Chest	21.6170	276.7200		0.2355	8.1194	3.9156	6.9925	1.5123	0.4228	5.4445
Side Step	0.1514	0.8248	0.1345	0.1337	0.1900	0.2771	0.2960	0.0805	0.1727	0.1246
Vertical Jump	3.0511	276.6300	2.3965	2.3655	4.8679	10.8100	12.4850	0.8488	3.9944	2.0488
Back Strength	0.0948	0.0429	0.1906	0.3964	0.3162	0.3106	0.1642	0.2255	0.2981	
Grip Strength	1.1784	0.2394	2.3965	24.2310	14.4450	13.8760	3.6005	6.9637	12.6780	
Trunk Extension	0.1140	0.2425	0.1906	0.3964	0.3106	0.3106	0.2929	0.1896	0.3023	0.3775
Standing Trunk Flexion	1.7125	8.1229	4.8987	24.2300	13.8770	13.8760	12.2020	4.8492	13.0720	21.6040
Step Test	0.0875	0.1711	0.2775	0.3162	0.3106	0.5043	0.5043	0.1078	0.1920	0.1652
	1.0027	3.9194	10.8430	14.4450	13.8770	44.3370	44.3360	1.5296	4.9750	3.6490
	0.2141	0.2260	0.2964	0.1642	0.2929	0.5043		0.1078	0.1920	0.1652
	6.2452	6.9971	12.5190	3.6007	12.2030	44.3370		1.5296	4.9750	3.6490
	0.2095	0.1073	0.0819	0.2255	0.1896	0.1648	0.1078		0.2688	0.1357
	5.9673	1.5147	0.8778	6.9622	4.8481	3.6269	1.5280		10.1260	2.4385
		0.0572	0.1733	0.2981	0.3023	0.3056	0.1920	0.2688		0.1751
		0.4274	4.0262	12.6780	13.0730	13.3950	4.9755	10.1280		4.1102
		0.2006	0.1255		0.3775	0.2005	0.1653	0.1357	0.1751	
		5.4493	2.0803	21.6060	5.4443	3.6498	2.4404	4.1102		

follows: the multiple-correlation coefficient above $R=0.8$ is the relation of the weight-girth of the chest ($R=0.825$ and $F=277$). On the other hand, the multiple-correlation coefficient between $R=0.35$ and $R=0.55$ were the height-weight ($R=0.378$ and $F=22$), the side step-vertical jump ($R=0.396$ and $F=24$), the vertical jump-step test ($R=0.378$ and $F=22$) and the back strength-grip strength ($R=0.504$ and $F=44$), respectively.

The back 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 coefficient (R) and the F-ratio of scattering analysis (F) which was calculated using experimental data. The multiple-correlation coefficient above $R=0.8$ is the relation of weight-girth of the chest ($R=0.816$ and $F=327$). On the other hand, the multiple-correlation coefficient between $R=0.4$ and $R=0.7$ were the height-weight ($R=0.484$ and $F=50$), the back strength-weight ($R=0.405$ and $F=32$), the girth of the chest-back

TABLE 6 Multiple-Correlation Coefficient (Upper berth) and F-ratio of Scattering Analysis (Lower berth)
for OUEL Law-majors

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		0.4827 49.8300	0.2635 12.2330	0.1725 0.0503	0.2047 0.0717	0.2029 7.0376	0.3366 20.9480	0.2063 7.2883	0.1027 1.7467	0.0556 0.5091
Weight	0.4844 50.2860		0.8160 326.9700	0.0334 0.1830	0.0624 0.6405	0.4045 32.0900	0.3950 30.3090	0.1276 2.7145		0.0637 0.6687
Chest	0.2683 12.7240	0.8162 327.2900		0.0388 0.2470	0.0568 0.5316	0.4887 50.0950	0.4128 33.6910	0.1990 6.7589	0.0577 0.5471	0.0733 0.8865
Side Step	0.1786 5.4006	0.0340 0.1895	0.0301 0.1489		0.3629 24.8780	0.1786 5.4057	0.3596 24.3600	0.2480 10.7520	0.1930 6.3477	0.1114 2.0599
Vertical Jump	0.2097 7.5403	0.0626 0.6455	0.0512 0.4319	0.3629 24.8750		0.3045 16.7560	0.2258 8.8079	0.1651 4.5935	0.1715 4.9722	0.0622 0.6377
Back Strength	0.2079 7.4080	0.4046 32.0950	0.4832 49.9640	0.1786 0.0540	0.3045 16.7550		0.4814 49.4610		0.2374 9.7952	0.0784 1.0151
Grip Strength	0.3394 21.3490	0.3950 30.3150	0.4122 33.5700	0.3596 24.3560	0.2258 8.8064	0.4814 49.4600		0.1998 6.8209	0.1303 2.8319	
Trunk Extension	0.2112 7.6590	0.1277 2.7181	0.1975 6.6537	0.2480 10.7480	0.1650 0.4592	0.2081 7.4209	0.1998 6.8198		0.2642 12.3090	
Standing Trunk Flexion	0.1126 2.1058		0.0521 0.4464	0.1930 6.3453	0.1715 4.9717	0.2374 9.7953	0.1303 2.8320	0.2642 12.3100		0.0264 0.1143
Step Test	0.0725 0.8672	0.0640 0.6753	0.0691 0.7879	0.1114 2.0595	0.0623 0.6390	0.0785 1.0173			0.0266 0.1158	

strength ($R=0.483$ and $F=50$), the girth of the chest-grip strength ($R=0.412$ and $F=34$) and the back strength-grip strength ($R=0.481$ and $F=49$), respectively.

Therefore, the sports test items for back strength and grip strength with the multiple-correlation coefficient were a very large value. Although, in 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 (1983-1988 years) sophomores OUEL law-majors.

4 DISCUSSION

4.1 Discussion of the 5-Gradation Evaluation⁽⁴⁾⁻⁽¹¹⁾

FIG. 2 shows the experimental data derived from relation appraisal of the 5-gradation evaluation and the physical fitness on the students tested. In **FIG. 2**, the solid line ($\times\text{---}\times$) and the dotted line ($\circ\text{---}\text{---}\circ$) 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.

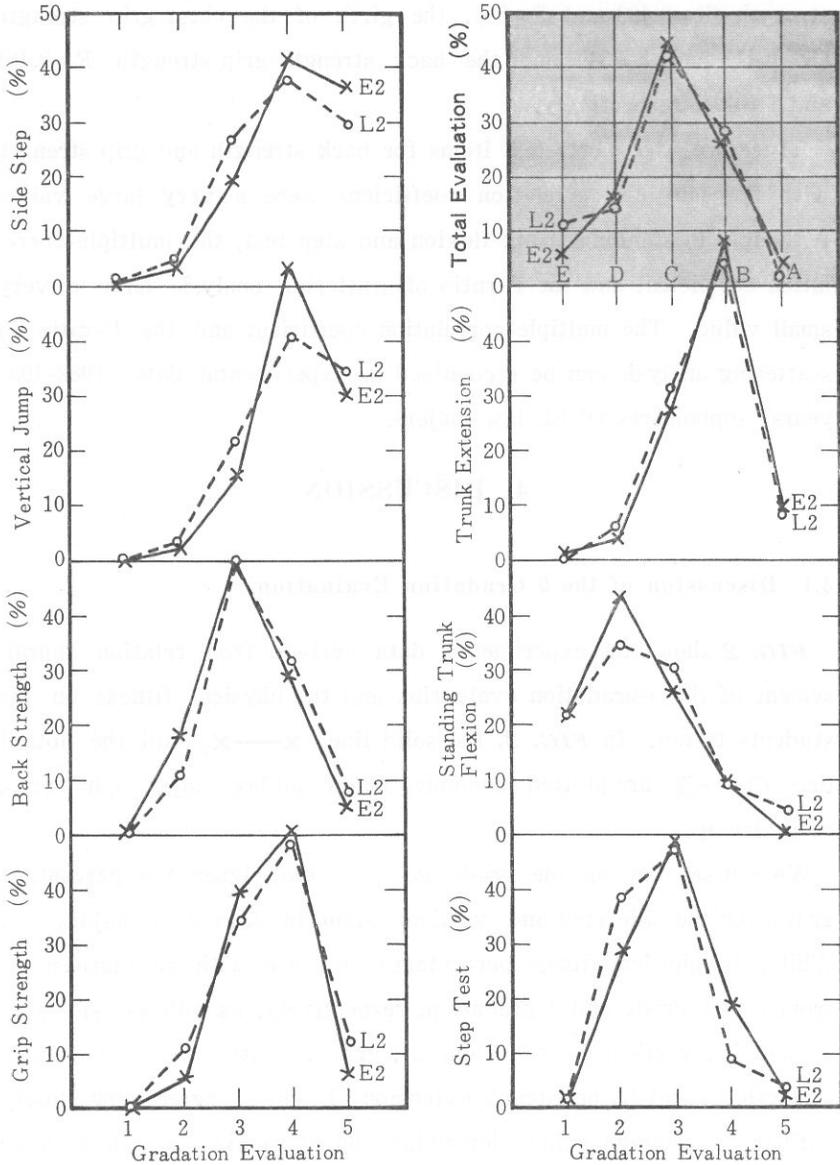


FIG. 2 Relation Between Appraisal of 5 Gradation Evaluation and Side Step, Vertical Jump, Back Strength, Grip Strength, Trunk Extension, Standing Trunk Flexion and Step Test in OUEL (Sophomores)

4.2 Discussion of the Mean Values

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: 0.38cm) 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 the chest are higher in degree than the nationwide ones.

In side step, vertical jump, grip strength and step test, economics-major sophomores of the mean values are greater in degree than law-major ones. While, the mean values of all OUEL students turned out to be lower in some items than the nationwide ones.

In trunk extension, the mean values of economics-major are greater in degree than law-major ones. Consequently, the mean values of all OUEL students are stronger than the nationwide ones. In back strength and standing trunk flexion, the mean values of economics-major are

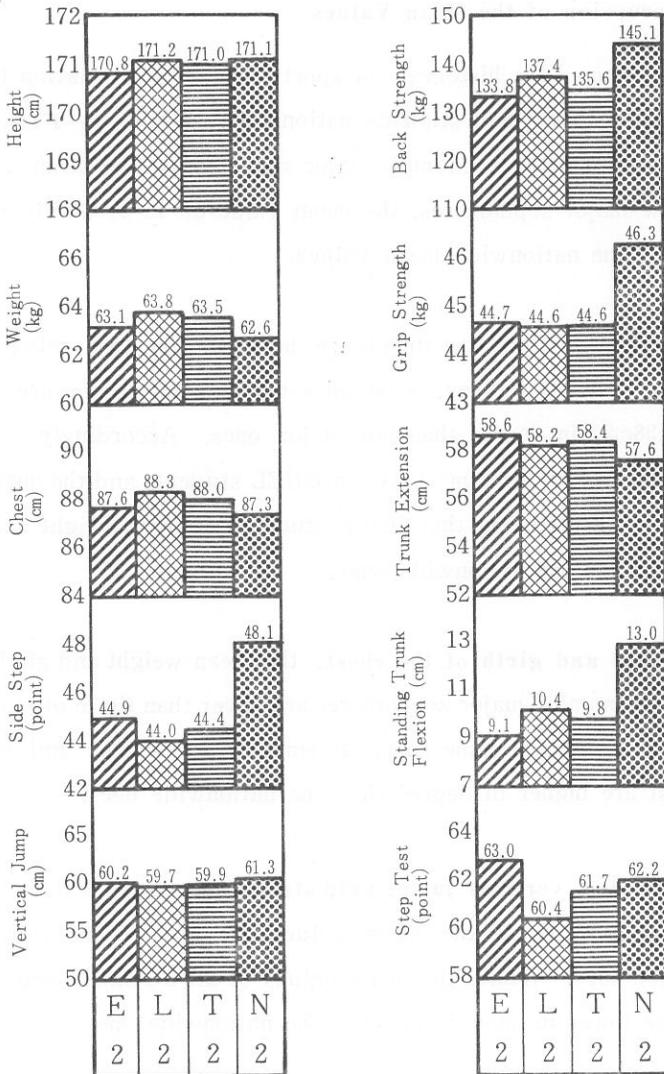


FIG. 3 The Histogram of the Sports Test Data in Relation between OUEL Students and Nationwide Students where, E2 is Economics-major Sophomores, L2 is Law-major Sophomores, T2 is OUEL Students and N2 is Nationwide Students

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

4.3 Discussion of Regression Analysis⁽⁴⁾⁻⁽¹¹⁾

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 (X—X) and the dotted line (O--O) 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, back strength, grip strength and trunk extension on economics-major sophomores (E) and weight, side step, vertical jump, back strength, 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, side step, vertical jump and back strength on economics-major sophomores or girth of the chest, 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.

Accordingly, we find the difference between the two categories of students. The regression line values of law-major sophomores are

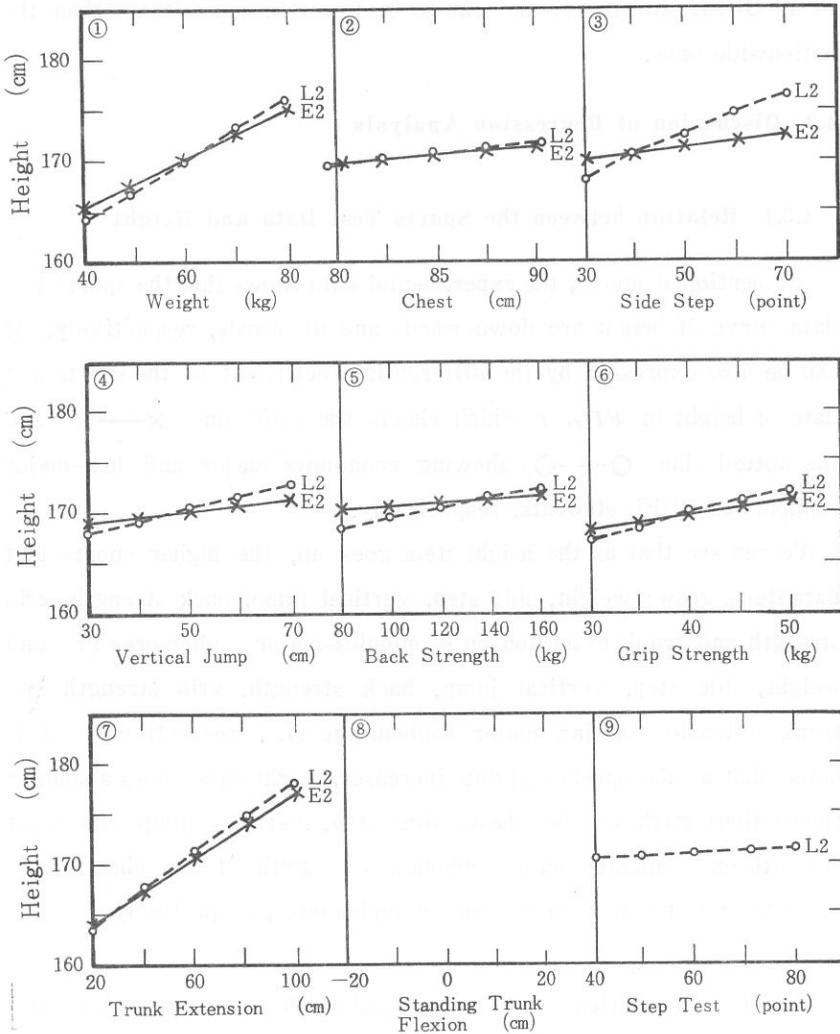


FIG. 4 Regression Line of Height for the Sports Test Data where, E2 (x---x) is Economics-major Sophomores and L2 (o---o) is Law-major Sophomores

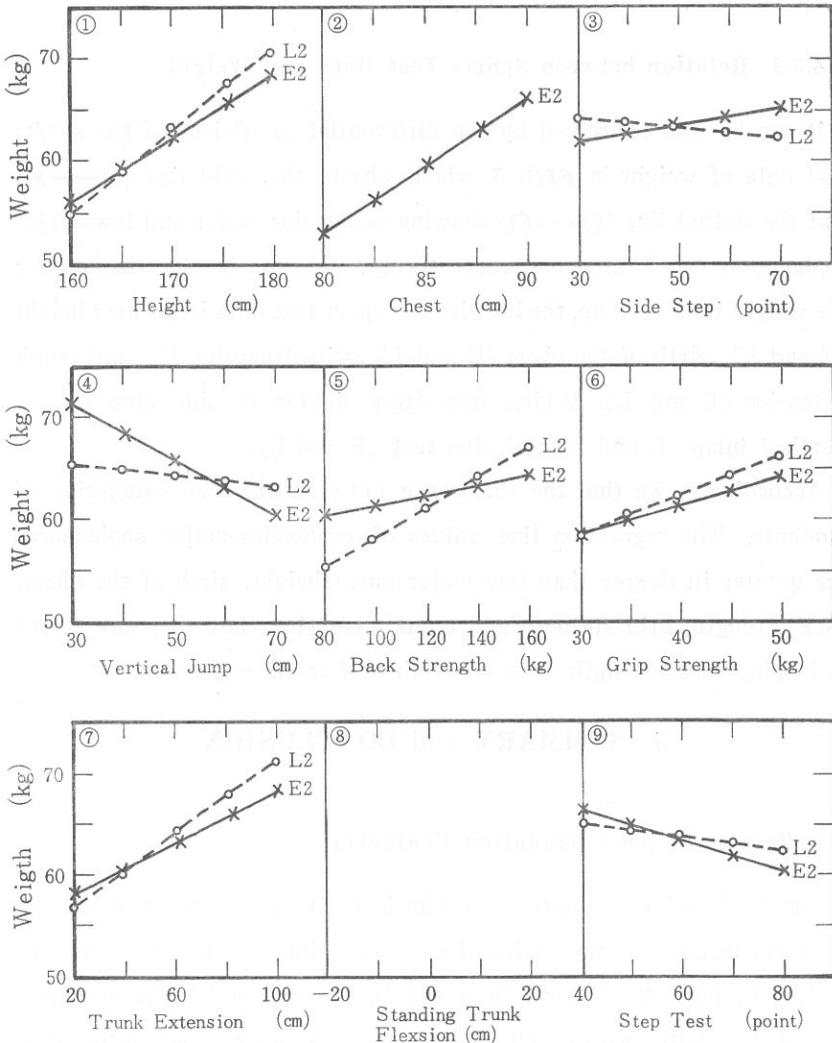


FIG. 5 Regression Line of Weight for the Sports Test Data
 where, E2(x—x) is Economics-major Sophomores and
 L2(O---O) is Law-major Sophomores

greater in degree than economics-major ones: side step, vertical jump, back strength, grip strength and trunk extension.

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), grip strength (E) and trunk extension (E and L). While, oppositely lighter in side step (L), vertical jump (E and L) and step test (E and L).

Accordingly, we find the difference between the two categories of students. The regression line values of economics-major sophomores are greater in degree than law-major ones: height, girth of the chest, back strength, grip strength and trunk extension, but they are lower in height, back strength, grip strength and trunk extension.

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 1989, are 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, back strength and

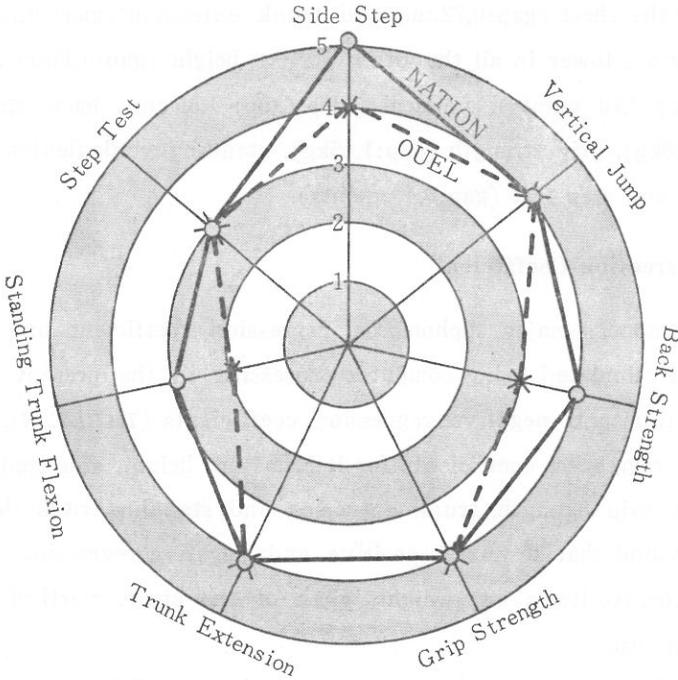


FIG. 6 The 5 Gradation Evaluation of Physical Fitness Test in OUEL Students Tested (x---x) and Nationwide Mean Value (O—O) in the Year 1989

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 in side step (gap:0.90 points), vertical jump (gap:0.48cm), grip strength (gap:0.15kg), trunk extension (gap:0.35cm) and step test (gap:2.53 points), but they are lower in all the other items; height (gap:0.38cm), back strength (gap:3.54kg) and stand trunk flexion (gap:1.25cm).

Consequently, the mean values of all OUEL student turned out to be higher in some items than the nationwide ones; weight (gap:0.92kg),

girth of the chest (gap:0.72cm) and trunk extension (gap: 0.78cm), but they are lower in all the other items; height (gap:0.11cm), side step (gap:3.70 points), vertical jump (gap: 1.35 cm), back strength (gap:9.48kg), grip strength (gap:1.65kg), standing trunk flexion (gap: 3.18cm) and step test (gap:0.48 points).

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, side step, back strength, grip strength, trunk extension and standing trunk flexion. It was found that a mixed positive and negative regression coefficients for its items are weight, girth of the chest, vertical jump 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, grip strength, trunk extension and standing trunk flexion. While it was found that mixed positive and negative regression coefficient are weight, girth of the chest, side step, vertical jump and step test.

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