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

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ABSTRACTS

The measured points of scores obtained from the computer process-ing data were as follows: for economics-major freshmen 160 points; for law-major freshmen 111 points. We took the 5-gradation evalua-tion, the mean values, the standard deviation, the regression coeffici-ent, the multiple-correlation coefficient 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 (63.42kg), girth of the chest (86.66cm) and grip strength (45.29kg), to be recorded higher than the nationwide average. While as for height (169.81cm), side step (44.15 points), vertical jump (59.97cm), back strength (131.43kg), trunk extension (56.93cm), stand-ing trunk flexion (9.71cm) and step test (61.85 points), OUEL students recorded lower than the nationwide mean value. (The Review of the Osaka University of Economics and Law, 51 (1993) p. 63–93)

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 271 freshmen students in all: 160 economics-majors and 111 law-major students. We gave then 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 coefficient, the multiple-correlation coefficient and the F-ratio of scattering analysis. In the 5-gradation evaluation, the data resulted in the distribution as follows: step E (10.15%), step D(13.75%), step C(47.00%), step B(19.10%) and step A(9.85%).

Consequently, the mean values of all OUEL students turned out to be higher in some items than the nationwide ones: weight (63.42kg), girth of the chest (86.66cm) and grip strength (45.29kg): while opposite lower in height (169.81cm), side step (44.15 points), vertical

jump (59.97cm), back strength (131.43kg), trunk extension (56.93cm),
standing trunk flexion (9.71cm) and step test (61.85 points). Further-
more, the mean values of economics-major freshmen are higher than
those of law-major freshmen in side step and step test, but they are
lower in all the other items.

Accordingly, we find the difference between the two major stu-
dents: economics-majors freshmen are greater in degree than ones
for physique test. In terms of standard deviation economics-major
freshmen stand higher in height and standing trunk flexion, but
quite opposite in the other items. The multiple-correlation coefficient
reads quite large in weight and girth of the chest: that is to say,
0.8752 in economics-majors and 0.8882 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
freshmen (age: 19, males and 160 students) and department of law
freshmen (age: 19, males and 111 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 higher. According to the *TABLE 1*, we then compared the data of economics-major (E) and law-major (L) freshmen[1].

According to *TABLE 1*, On Grade 1, (E) reads 0.6% and (L) reads 4.5%, which are both in smaller degrees. On Grade 2, (E) reads 3.7%, (L) reads 2.7%, and the mean value is 3.20%, which stand fairly low. On Grade 3, (E) reads 17.5%, (L) reads 29.7%, and the mean value is 23.60%. These are in the middle of this evaluation. On Grade 4, (E) reads 37.5%, (L) reads 39.6%, and the mean value reads 38.55%. On Grade 5 (E) reads 40.6%, (L) reads 23.4%,

INFORMATION PROCESSING OF SPORTS TEST DATA ON FRESHMEN IN OSAKA UNIVERSITY OF ECONOMICS AND LAW, 1989 (Sawa, Katsu, Walker)

TABLE 1 *Appraisement of the 5 Gradation Evaluation of OUEL Freshmen*

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	0.6	0.0	0.6	0.0	1.2	20.6	0.6	E	6.8
	2	3.7	1.8	13.1	3.1	8.1	36.2	30.0	D	13.1
	3	17.5	16.8	47.5	30.6	32.5	30.0	47.5	C	41.8
	4	37.5	36.2	33.1	55.0	51.2	11.2	13.1	B	25.6
	5	40.6	45.0	5.6	11.2	6.8	1.8	8.7	A	12.5
Law	1	4.5	0.0	0.0	0.0	0.0	17.1	0.0	E	13.5
	2	2.7	4.5	24.3	6.3	9.9	39.6	42.3	D	14.4
	3	29.7	21.6	51.3	41.4	32.4	37.8	43.2	C	52.2
	4	39.6	47.7	18.0	44.1	48.6	4.5	11.7	B	12.6
	5	23.4	26.1	6.3	8.1	9.0	0.9	2.7	A	7.2
Average	1	2.55	0.00	0.30	0.00	0.60	18.85	0.30	E	10.15
	2	3.20	3.15	18.70	4.70	9.00	37.90	36.15	D	13.75
	3	23.60	19.20	49.40	36.00	32.45	33.90	45.35	C	47.00
	4	38.55	41.95	25.55	49.55	49.90	7.85	12.40	B	19.10
	5	32.00	35.55	5.95	9.65	7.90	1.35	5.70	A	9.85

and the mean value reads 32.00%. 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) freshmen. On Grade 1, both (E) and (L) reads 0.0%. On Grade 2, (E) reads 1.8%, (L) read 4.5%, and the mean value reads 3.15%. On Grade 3, (E) reads 16.8%, (L) reads 21.6%, and the mean value reads 19.20%. These are in the middle of this evaluation. On Grade 4, (E) reads 36.2%, (L) reads 47.7%, and the mean value reads 41.95%. 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 45.0%, (L) reads 26.1%, and the mean value reads 35.55%. They stand lower in percentage than these on Grade 4. The difference between these two grades in percentage-distribution has a slightly different tendency from those of freshmen 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 eco-
nomics-major (E) and law-major (L) freshmen. On Grade 1, (E)
reads 0.6% and (L) reads 0.0%, which are both in small degrees.
On Grade 2, (E) reads 13.1%, (L) reads 24.3%, and the mean value
reads 18.70%. On Grade 3, (E) reads 47.5%, (L) reads 51.3%, and
the mean value reads 49.40%. 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 33.1%, (L) reads 18.0%, and
the mean value reads 25.55%. Put another way, a fourth part of the
enumerators are on this grade. Finally, on Grade 5, (E) reads 5.6%,
(L) reads 6.3%, and the mean value reads 5.95%. They stand be-
tween 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 eco-
nomics-major (E) and law-major (L) freshmen. On Grade 1, both
(E) and (L) reads 0.0%. On Grade 2, (E) reads 3.1%, (L) reads
6.3%, and the mean value reads 4.70%, which stand fairly low. On
Grade 3, (E) reads 30.6%, (L) reads 41.4%, and the mean value
reads 36.00%. These are in the middle of the evaluation. On Grade
4, (E) reads 55.0%, (L) reads 44.1%, and the mean value reads
49.55%. Almost half of the percentage of all the enumerators are
on this grade. On Grade 5, (E) reads 11.2%, (L) reads 8.1%, and

the mean value reads 9.65%. About 10% 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 heavier[1].

According to *TABLE 1*, we then compared the data between economics-major (E) and law-major (L) freshmen. On Grade 1, (E) reads 1.2%, (L) reads 0.0%, and the mean value reads 0.60%. On Grade 2, (E) reads 8.1%, (L) reads 9.9%, and the mean value reads 9.00%, about 10% of all the enumerators are on this grade. On Grade 3, (E) reads 32.5%, (L) reads 32.4%, and the mean value reads 32.45%. Put another way one third of the enumerators are on this grade. On Grade 4, (E) reads 51.2%, (L) reads 48.6%, and the mean value reads 49.90%. 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 6.8%, (L) reads 9.0%, and the mean value reads 7.90%, they stand between on Grade 1 and 2 in percentage.

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 eco-

nomics-major (E) and law-major (L) freshmen. On Grade 1, (E) reads 20.6%, (L) reads 17.1%, and the mean value reads 18.85%, these are in the middle of this evaluation. On Grade 2, (E) reads 36.2%, (L) reads 39.6%, and the mean value reads 37.90%, these indicate the highest degrees in the evaluation. On Grade 3, (E) reads 30.0%, (L) reads 37.8%, and the mean value reads 33.90%. Put another way, one third of the enumerators are on this grade. On Grade 4, (E) reads 11.2%, (L) reads 4.5%, and the mean value reads 7.85%, which is only less than 10%. On Grade 5, (E) reads 1.8%, (L) reads 0.9%, and the mean value reads 1.35%, 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) freshmen. On Grade 1, (E) reads 0.6%, (L) reads 0.0%, and the mean value reads 0.30%, which are both in small degrees. On Grade 2, (E) reads 30.0%, (L) reads 42.3%, and the mean value reads 36.15%. Put another way, one third of the enumerators are on this grade. On Grade 3, (E) reads 47.5%, (L) reads 43.2%, and the mean value reads 45.35%, 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 13.1%, (L) reads 11.7%, and the mean value reads 12.40%, about 10% of all

the enumerators are on this grade. On Grade 5, (E) reads 8.7%, (L) reads 2.7%, and the mean value reads 5.70%, they stand lower in percentage than those on Grade 4.

3.2 Results of the Mean Value[4-10]

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 Freshmen and the Nationwide Average

The sports test data of economics-major freshmen in OUEL students was compared with the nationwide average. As a result, the economics-major freshmen were recorded heavier than the nationwide mean value of college students as a whole in weight (gap: 1.13kg), vertical jump (gap: 0.54cm), grip strength (gap: 0.81kg) and step test (gap: 0.98 points), while as for height (gap: 0.92cm), girth of the chest (gap: 0.53cm), side step (gap: 2.50 points), back strength (gap: 1.01 kg), trunk extension (gap: 1.10cm) and standing trunk flexion (gap: 3.28cm). It was recorded lower than the nationwide average.

3.2.2 Comparing Law-major Freshmen and the Nationwide Average

The sports test data of law-major freshmen 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 (gap: 1.09cm), side step (gap: 4.84 points), vertical jump (gap: 2.95cm), back strength (gap: 12.03kg), grip strength (gap: 0.55kg), trunk extension (gap: 0.97cm), standing trunk flexion (gap: 3.79cm) and step test (gap: 2.03 points), while higher in weight (gap:

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

Name	MEAN S.D.	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 (E1)	MEAN	169.91	62.71	86.01	45.32	61.71	136.94	45.97	56.86	9.96	63.35
	S.D.	5.72	9.24	6.06	5.26	8.62	25.89	6.57	7.49	7.33	11.87
Law (L1)	MEAN	169.74	64.12	87.31	42.98	58.22	125.92	44.61	56.99	9.45	60.34
	S.D.	5.95	10.67	7.10	5.40	8.69	26.33	7.27	7.47	6.66	10.06
OUEL Mean (M.O)	MEAN	169.81	63.42	86.66	44.15	59.97	131.43	45.29	56.93	9.71	61.85
	S.D.	5.84	9.96	6.58	5.33	8.66	26.11	9.92	7.48	7.00	10.97
Nationwide (M.J)	MEAN	170.83	61.58	86.54	47.82	61.17	137.95	45.16	57.96	13.24	62.37
	S.D.	5.78	7.90	5.16	4.95	7.44	23.36	6.12	8.10	5.96	11.63
(E1) − (M.J)	MEAN	−0.92	1.13	−0.53	−2.50	0.54	−1.01	0.81	−1.10	−3.28	0.98
	S.D.	−0.06	1.34	0.90	0.31	1.18	2.53	0.45	−0.61	1.37	0.24
(L1) − (M.J)	MEAN	−1.09	2.54	0.77	−4.84	−2.95	−12.03	−0.55	−0.97	−3.79	−2.03
	S.D.	0.17	2.77	1.94	0.45	1.25	2.97	1.15	−0.63	0.70	−1.57
(M.O)−(M.J)	MEAN	−1.50	1.84	0.12	−3.67	−1.20	−6.52	0.13	−1.03	−3.53	−0.52
	S.D.	0.06	2.06	1.42	0.38	1.22	2.75	3.80	−0.62	1.04	−0.66
(E1) − (L1)	MEAN	0.17	−1.41	−1.30	2.34	3.49	11.02	1.36	−0.13	0.51	3.01
	S.D.	−0.23	−1.43	−1.04	−0.14	−0.07	−0.44	−0.70	0.02	0.67	1.81

2.54kg) and girth of chest (gap: 0.77cm).

3.2.3 Comparing OUEL Students and the Nationwide Average

The sports test data obtained compared the OUEL data with the nationwide mean value of the same college years. As a result, the comparison shows that the mean value of OUEL students, for height (gap: 1.50cm), side step (gap: 3.67 points), vertical jump (gap: 1.20 cm), back strength (gap: 6.52kg), trunk extension (gap: 1.03cm), standing trunk flexion (gap: 3.53cm) and step test (gap: 0.52 points) to be recorded lower than the nationwide average.

3.3 Results of the Standard Deviation[1-10]

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 freshmen OUEL students in the examination of physique and physical fitness test. Economics-major and law-major OUEL freshmen 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 (gap: 0.06cm), weight (gap: 2.06kg), girth of the chest (gap: 1.42cm), side step (gap: 0.38 points), vertical jump (gap: 1.22cm), back strength (gap: 2.75kg), grip strength (gap: 3.80 kg), and standing trunk flexion (gap: 1.04cm) was recorded higher than the nationwide average. While, as for trunk extension (gap: 0.62cm) and step test (gap: 0.66 points), it is lower than the average.
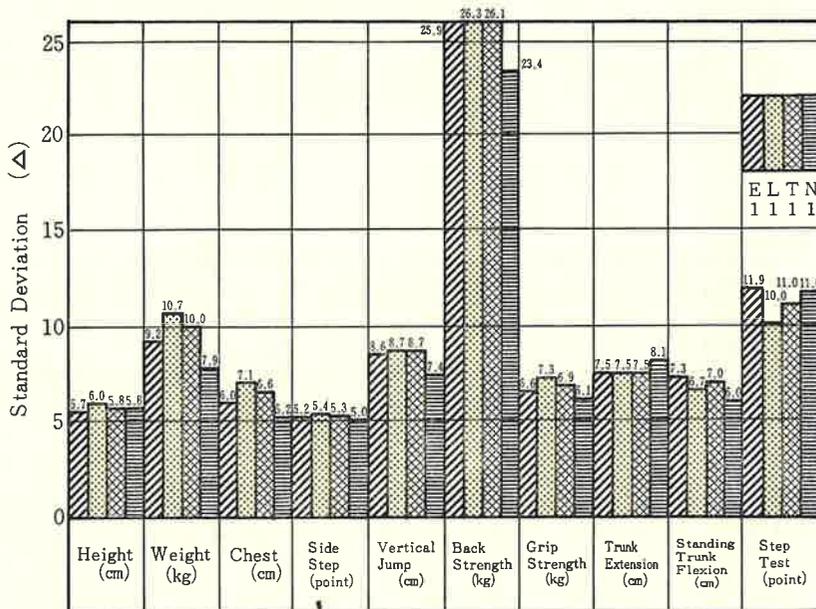
FIG. 1 *The Histogram of Standard Deviation on OUEL Freshmen*
where, E1 is Economics-major Freshmen, L1 is Law-major Freshmen,
T1 is OUEL Students and N1 is Nationwide Students

3.4 Regression Analysis[4-10]

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

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

TABLE 3 shows the upper coefficients (a) and the lower regression coefficient for freshmen 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

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		-57.917 / 0.710	34.594 / 0.303	41.338 / 0.023	-11.847 / 0.433	-24.772 / 0.952	-35.196 / 0.478		29.075 / -0.113	51.553 / 0.070
Weight	152.810 / 0.273		49.999 / 0.574	47.817 / -0.040		69.607 / 1.074	30.971 / 0.239	60.407 / -0.057	11.702 / -0.028	72.809 / -0.151
Chest	146.690 / 0.270	-52.029 / 1.334		1		-15.637 / 1.774	19.773 / 0.305	62.251 / -0.063	1.920 / 0.093	77.297 / -0.162
Side Step	168.650 / 0.028	68.277 / -0.123			31.797 / 0.660	66.033 / 1.565	31.067 / 0.329	46.635 / 0.226	-14.492 / 0.539	52.566 / 0.238
Vertical Jump	158.120 / 0.191			30.141 / 0.246		73.921 / 1.021	26.046 / 0.323	44.229 / 0.205	-3.755 / 0.222	58.827 / 0.073
Back Strength	163.530 / 0.047	43.980 / 0.137	72.686 / 0.097	36.469 / 0.065	46.207 / 0.113		25.911 / 0.146		-0.539 / 0.077	56.896 / 0.047
Grip Strength	153.200 / 0.363	40.933 / 0.474	74.069 / 0.260	35.610 / 0.211	36.128 / 0.557	32.244 / 2.278		50.905 / 0.130	-4.568 / 0.316	61.179 / 0.047
Trunk Extension		67.605 / -0.086	88.339 / -0.041	38.994 / 0.111	46.310 / 0.271	111.360 / 0.450	40.315 / 0.099		0.177 / 0.172	53.227 / 0.178
Standing Trunk Flexion	170.590 / -0.069	63.153 / -0.044	85.370 / 0.064	42.553 / 0.278	58.652 / 0.309	127.430 / 0.956	43.446 / 0.253	55.071 / 0.180		61.246 / 0.211
Step Test	168.880 / 0.016	68.508 / -0.091	88.688 / -0.042	42.355 / 0.047	59.260 / 0.039	0.1031 / 1.6975	45.053 / 0.014	52.361 / 0.071	4.846 / 0.081	

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. While, other sports tests are positive coefficient of the regression.

For freshmen economics-majors, the height on OUEL students was calculated from computer processing in the present study. The following regression as the relation between height (Yh) and sports tests (the data from examinations of physique and tests of physical fitness on OUEL students) has been determined by the experimental data:

$$Yh = 152.81 + 0.273 \text{ (weight)} \qquad (R = 0.446) \cdots\cdots (2)$$
$$Yh = 146.69 + 0.270 \text{ (chest)} \qquad (R = 0.296) \cdots\cdots (3)$$
$$Yh = 168.65 + 0.028 \text{ (side step)} \qquad (R = 0.066) \cdots\cdots (4)$$
$$Yh = 158.12 + 0.191 \text{ (vertical jump)} \qquad (R = 0.296) \cdots\cdots (5)$$
$$Yh = 163.53 + 0.047 \text{ (back strength)} \qquad (R = 0.221) \cdots\cdots (6)$$
$$Yh = 153.20 + 0.363 \text{ (grip strength)} \qquad (R = 0.422) \cdots\cdots (7)$$
$$Yh = 170.59 - 0.069 \text{ (standing trunk flexion)} \quad (R = 0.107) \cdots\cdots (8)$$
$$Yh = 168.88 + 0.016 \text{ (step test)} \qquad (R = 0.070) \cdots\cdots (9)$$

In this regression equation on height on freshmen of OUEL economics-major students, the multiple-correlation coefficient are noted in weight (R=0.446), grip strength (R=0.422), girth of the chest (R=0.296) and vertical jump (R=0.296) at above R=0.3. While the negative regression coefficient is standing trunk flexion. In the case of the multiple-correlation coefficient, side step and step test are R=0.066 and R=0.070, respectively.

The coefficients of the regression equation for freshmen in law-majors are shown in **TABLE 4**. The weight of OUEL students was

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		−32.965 / 0.572	72.021 / 0.090	0.476 / 0.250	−2.643 / 0.359	−51.404 / 1.045	−18.171 / 0.370	13.877 / 0.254	−28.029 / 0.221	44.492 / 0.093
Weight	158.310 / 0.178		49.433 / 0.591	47.069 / −0.064	64.533 / −0.099	63.582 / 0.972	29.160 / 0.241	49.421 / 0.118	2.086 / 0.115	71.781 / −0.178
Chest	164.200 / 0.063	−52.480 / 1.335		55.081 / −0.139	70.762 / −0.144	−2.757 / 1.474	13.062 / 0.361	46.240 / 0.123	−4.807 / 0.163	81.826 / −0.246
Side Step	156.620 / 0.305	74.832 / −0.249	97.615 / −0.240		30.042 / 0.655	44.346 / 1.898	22.573 / 0.513	53.241 / 0.087	−0.881 / 0.240	44.599 / 0.366
Vertical Jump	159.930 / 0.169	72.763 / −0.149	92.889 / −0.096	28.273 / 0.253		55.995 / 1.201	23.663 / 0.360	46.623 / 0.178	−4.208 / 0.235	
Back Strength	163.010 / 0.054	44.009 / 0.160	73.827 / 0.107	32.944 / 0.080	41.736 / 0.131		21.771 / 0.181		−1.054 / 0.083	57.325 / 0.024
Grip Strength	158.660 / 0.248	40.960 / 0.519	71.951 / 0.344	30.383 / 0.282	35.278 / 0.514	19.803 / 2.379		47.696 / 0.208	−39.780 / 0.301	
Trunk Extension	160.540 / 0.161	50.403 / 0.241	80.984 / 0.111	40.390 / 0.045	44.492 / 0.241	93.872 / 0.562	33.376 / 0.197		−9.532 / 0.333	67.754 / −0.130
Standing Trunk Flexion	168.070 / 0.177	61.328 / 0.295	85.557 / 0.186	41.490 / 0.158	54.437 / 0.400	113.590 / 1.305	41.219 / 0.359	53.023 / 0.420		
Step Test	167.760 / 0.033	76.239 / −0.201	94.706 / −0.123	36.618 / 0.105		116.010 / 0.164		61.326 / −0.072		

calculated from computer processing in the present study. The following regression equation as the relation between weight (Yw) and the sports tests is determined by a statistical analysis of sports test data:

$$Yw = -32.97 + 0.572 \text{ (height)} \qquad (R = 0.320) \cdots (10)$$

$$Yw = -52.48 + 1.335 \text{ (chest)} \qquad (R = 0.888) \cdots (11)$$

$$Yw = 74.83 - 0.249 \text{ (side step)} \qquad (R = 0.126) \cdots (12)$$

$$Yw = 72.76 - 0.149 \text{ (vertical jump)} \qquad (R = 0.121) \cdots (13)$$

$$Yw = 44.01 + 0.160 \text{ (back strength)} \qquad (R = 0.394) \cdots (14)$$

$$Yw = 40.96 + 0.519 \text{ (grip strength)} \qquad (R = 0.354) \cdots (15)$$

$$Yw = 50.40 + 0.241 \text{ (trunk extension)} \qquad (R = 0.169) \cdots (16)$$

$$Yw = 61.33 + 0.295 \text{ (standing trunk flexion)} \ (R = 0.184) \cdots (17)$$

$$Yw = 76.24 - 0.201 \text{ (step test)} \qquad (R = 0.189) \cdots (18)$$

In this regression equation of weight in freshmen OUEL law-major students, the maximum class multiple-correlation coefficient are girth of the chest (R=0.888), back strength (R=0.394), grip strength (R=0.354) and height (R=0.320) at above R=0.3. While, the negative regression coefficient are side step, vertical jump and step test. 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[4-10]

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 freshmen 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 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		0.4427 / 38.5100	0.2907 / 14.5830	0.0276 / 0.1206	0.2902 / 14.5310	0.2125 / 7.4733	0.4187 / 33.5780		0.0880 / 1.2332	0.0354 / 0.1978
Weight	0.4460 / 39.2410		0.8752 / 517.3100	0.0704 / 0.7867		0.3834 / 27.2220	0.3367 / 20.1960	0.0698 / 0.7742	0.0354 / 0.1982	0.1175 / 2.2127
Chest	0.2964 / 15.2140	0.8752 / 517.2600		1		0.4155 / 32.9730	0.2813 / 13.5740	0.0508 / 0.4088	0.0774 / 0.9522	0.0830 / 1.0948
Side Step	0.0664 / 0.7001	0.0700 / 0.7790	1		0.4029 / 30.6240	0.3181 / 17.7850	0.2636 / 11.7960	0.1585 / 4.0703	0.3872 / 27.8650	0.1056 / 1.7812
Vertical Jump	0.2960 / 15.1740			0.4030 / 30.6340		0.3401 / 20.6640	0.4239 / 34.6170	0.2355 / 9.2750	0.2613 / 11.5750	0.0534 / 0.4515
Back Strength	0.2206 / 8.0814	0.3853 / 27.2140	0.4156 / 32.9780	0.3181 / 17.7860	0.3400 / 20.6560		0.5776 / 79.1040	0.1305 / 2.7351	0.2707 / 12.4900	0.1029 / 1.6908
Grip Strength	0.4223 / 34.2860	0.3366 / 20.1930	0.2814 / 13.5830	0.2636 / 11.8000	0.4239 / 34.6140	0.5776 / 79.1100		0.1136 / 2.0658	0.2830 / 13.7520	0.0264 / 0.1100
Trunk Extension		0.0698 / 0.7745	0.0515 / 0.4205	0.1586 / 4.0784	0.2355 / 9.2741	0.1305 / 2.7351	0.1137 / 2.0693		0.1759 / 5.0416	0.1125 / 2.0257
Standing Trunk Flexion	0.1068 / 1.8238	0.0353 / 0.1970	0.0778 / 0.9631	0.3872 / 27.8720	0.2613 / 11.5730	0.2707 / 12.4960	0.2830 / 13.7540	0.1758 / 5.0400		0.1306 / 2.7421
Step Test	0.0704 / 0.7862	0.1175 / 2.2129	0.0834 / 1.1065	0.1058 / 1.7893	0.0533 / 0.4508	0.0123 / 0.2240	0.0268 / 0.1133	0.1125 / 2.0255	0.1307 / 2.7436	

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 recognized 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=0.875 and F=517). On the other hand, the multiple-correlation coefficient between R=0.4 and R=0.6 were the height-weight (R=0.446 and F=39), the height-grip strength (R=0.422 and F=34), the girth of the chest-back strength (R=0.416 and F=33), the side step-vertical jump (R=0.403 and F=31), the vertical jump-grip strength (R=0.424 and F=35) and the back strength-grip strength (R=0.578 and F=79), 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-corretion coefficient and the F-ratio of scattering analysis will remain consistent with the experimental data (1983–1988 years) with freshmen OUEL economics-majors.

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

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		0.3200 / 12.4360	0.0782 / 0.6701	0.2763 / 9.0087	0.2459 / 7.0152	0.2380 / 6.5427	0.3029 / 11.0140	0.2021 / 4.6409	0.1981 / 4.4515	0.0557 / 0.3393
Weight	0.3245 / 12.8250		0.8882 / 407.3700	0.1262 / 1.7642	0.1211 / 1.6213	0.3940 / 20.0350	0.3537 / 15.5870	0.1686 / 3.1896	0.1841 / 3.8249	0.1894 / 4.0543
Chest	0.0963 / 1.0200	0.8882 / 407.3700		0.1824 / 3.7503	0.1174 / 1.5243	0.3973 / 20.4260	0.3527 / 15.4900	0.1170 / 1.5127	0.1741 / 3.4077	0.1737 / 3.3920
Side Step	0.2816 / 9.3848	0.1262 / 1.7628	0.1824 / 3.7502		0.4070 / 21.6370	0.3890 / 19.4310	0.3806 / 18.4580	0.0632 / 0.4365	0.1949 / 4.3021	0.1966 / 4.3811
Vertical Jump	0.2519 / 7.3864	0.1211 / 1.6212	0.1175 / 1.5253	0.4070 / 21.6380		0.3965 / 20.3320	0.4302 / 24.7490	0.2071 / 4.8865	0.3063 / 11.2860	
Back Strength	0.2442 / 6.9130	0.3941 / 20.0360	0.3973 / 20.4280	0.3890 / 19.4340	0.3965 / 20.3340		0.6569 / 82.7290		0.3299 / 13.3150	0.0629 / 0.4331
Grip Strength	0.3077 / 11.3990	0.3537 / 15.5880	0.3528 / 15.4910	0.3806 / 18.4610	0.4302 / 24.7500	0.6569 / 82.7300		0.2027 / 4.6718	0.3288 / 13.2080	
Trunk Extension	0.2095 / 5.0045	0.1686 / 3.1894	0.1170 / 1.5139	0.0633 / 0.4379	0.2071 / 4.8864	0.1597 / 2.8530	0.2027 / 4.6716		0.3740 / 17.7220	0.0968 / 1.0309
Standing Trunk Flexion	0.2057 / 4.8160	0.1842 / 3.8262	0.1742 / 3.4097	0.1949 / 4.3050	0.3063 / 11.2880	0.3300 / 13.3160	0.3288 / 13.2090	0.3740 / 17.7250		
Step Test	0.0793 / 0.6894	0.1894 / 4.0543	0.1738 / 3.3930	0.1966 / 4.3826		0.0629 / 0.4333		0.0968 / 1.0310		

the F-ratio of scattering analysis, respectively.

In the sports test data, we obtained the multiple-correlation coeffi-
cient (R) and the F-ratio of scattering analysis (F) which was calcu-
lated using experimental data. The multiple-correlation coefficient
above R=0.8 is the relation of weight-girth of the chest (R=0.888
and F=407). On the other hand, the multiple-correlation coefficient
between R=0.4 and R=0.7 were the side step-vertical jump (R=0.407
and F=22), the vertical jump-back strength (R=0.400 and F=20), the
vertical jump-grip strength (R=0.430 and F=25) and the back strength-
grip strength (R=0.657 and F=83), 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-correla-
tion 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) freshmen OUEL law-majors.

4 DISCUSSION

4.1 Discussion of the 5-Gradation Evaluation[4-10]

FIG. 2 shows the experimental data derived from relation apprai-
sement of the 5-gradation evaluation and the physical fitness on the
students tested. In *FIG. 2*, the dotted line ($\times$----$\times$) and the solid
line (O----O) are plotted economics-major and law-major freshmen,
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).
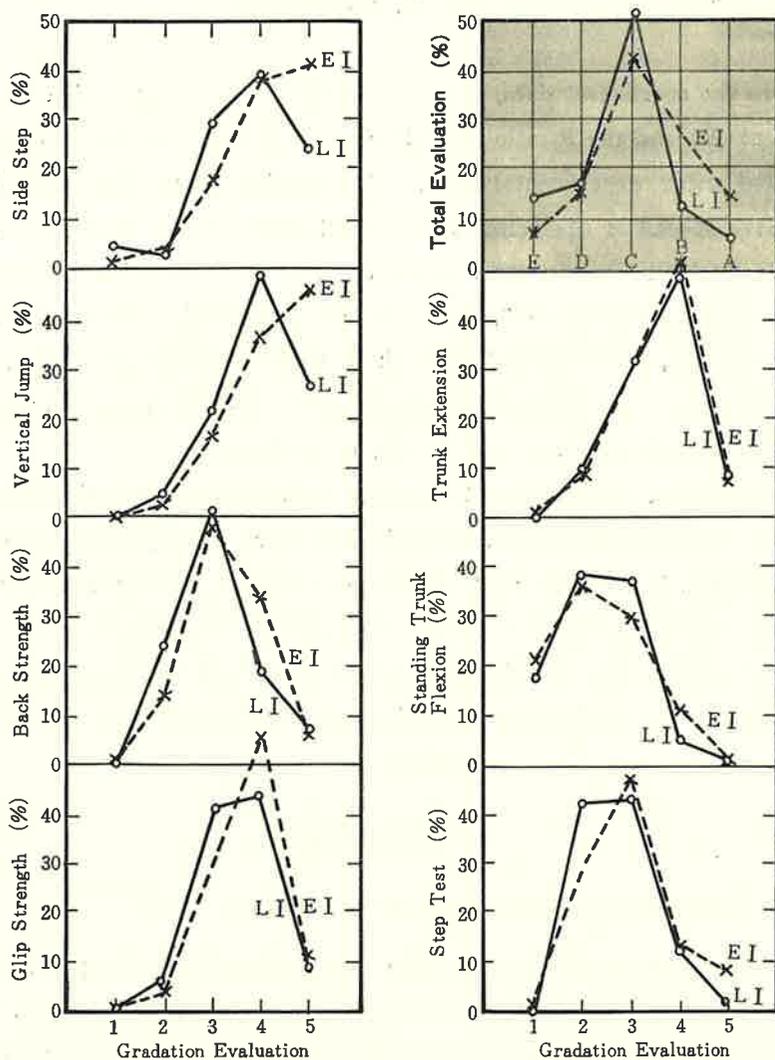
FIG. 2 *Relation Between Appraisement of the 5 Gradation Evaluation and Side Step, Vertical Jump, Back Strength, Grip Strength, Trunk Extension, Standing Trunk Flexion and Step Test in OUEL (Freshmen)*

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) and
trunk extension (E and L) agree very closely with the percentage
values determined by economics- and law-major freshmen, respectively.
The vertical jump agree very closely with the values determined by
(1983–1988) years[4–10].

4.2 Discussion of the Mean Values[4–10]

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 E1 is economics-major freshmen, the mean value of L1
is law-major freshmen, the mean value of T1 is OUEL students and
N1 is the nationwide mean values.

In height, we find the difference between the two categories of
students. That is to say, economics-major freshmen are greater (gap:
0.17cm) in degree than law-major ones. Accordingly, we find a diffe-
rence (gap: 1.50cm) 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 freshmen are lower than those of law-
major freshmen. 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 freshmen of the mean values are greater in degree than law-
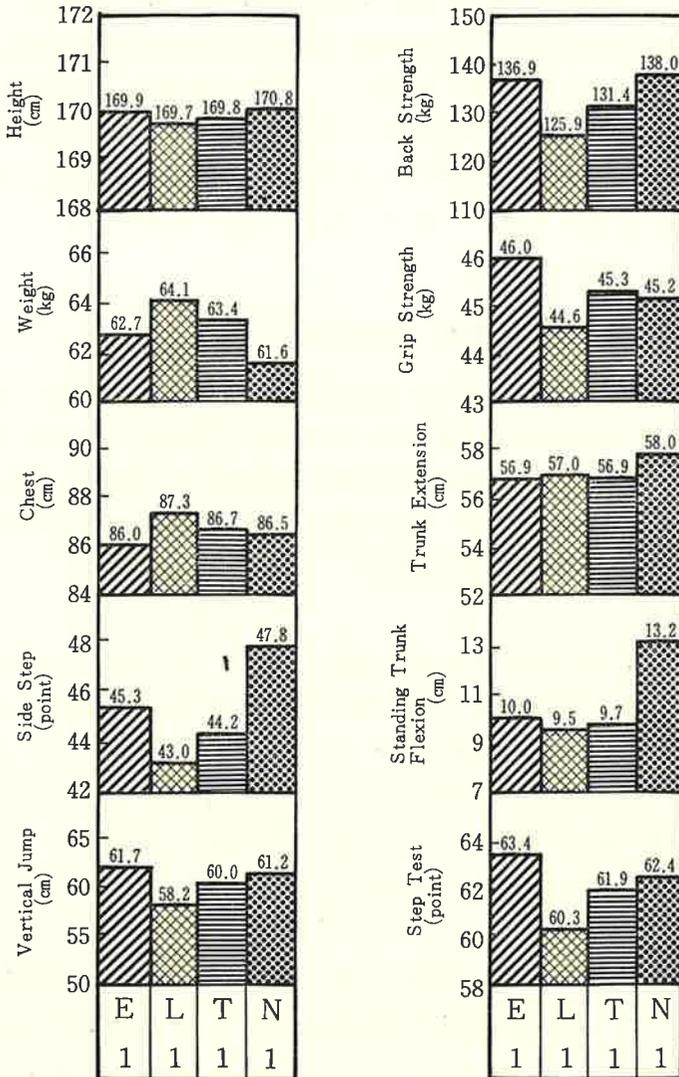
FIG. 3 *Histogram of the Sports Test Data in Relation between OUEL Students
and Nationwide students*
*where, E1 is Economics-major Freshmen, L1 is Law-major freshmen,
T1 is OUEL Students and N1 is Nationwide Students*

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

In grip strength, 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.

4.3 Discussion of Regression Analysis[4-10]

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 data of height in *FIG. 4* which charts the dotted line (✕———✕) and the solid line (○———○) showing economics-major freshmen and law-major freshmen OUEL students, respectively.

We can see that as the height item goes up, the higher sports data items grow: weight, vertical jump, back strength and grip strength on economics-major freshmen (E) and side step, vertical jump, back strength, grip strength and standing trunk flexion on law-major freshmen (L), respectively. It is noted that as the sports data increases, height data shows a smaller fluctuation; girth of the chest, side step, standing trunk flexion and step test on economics-major freshmen or girth of the chest and step test on law-major freshmen, respectively.

Therefore, a relation can be recognized in the sports test data and height data. That is, height depends on weight, vertical jump, back strength and grip strength. While oppositely independent of girth of the chest, standing trunk flexion and step test.
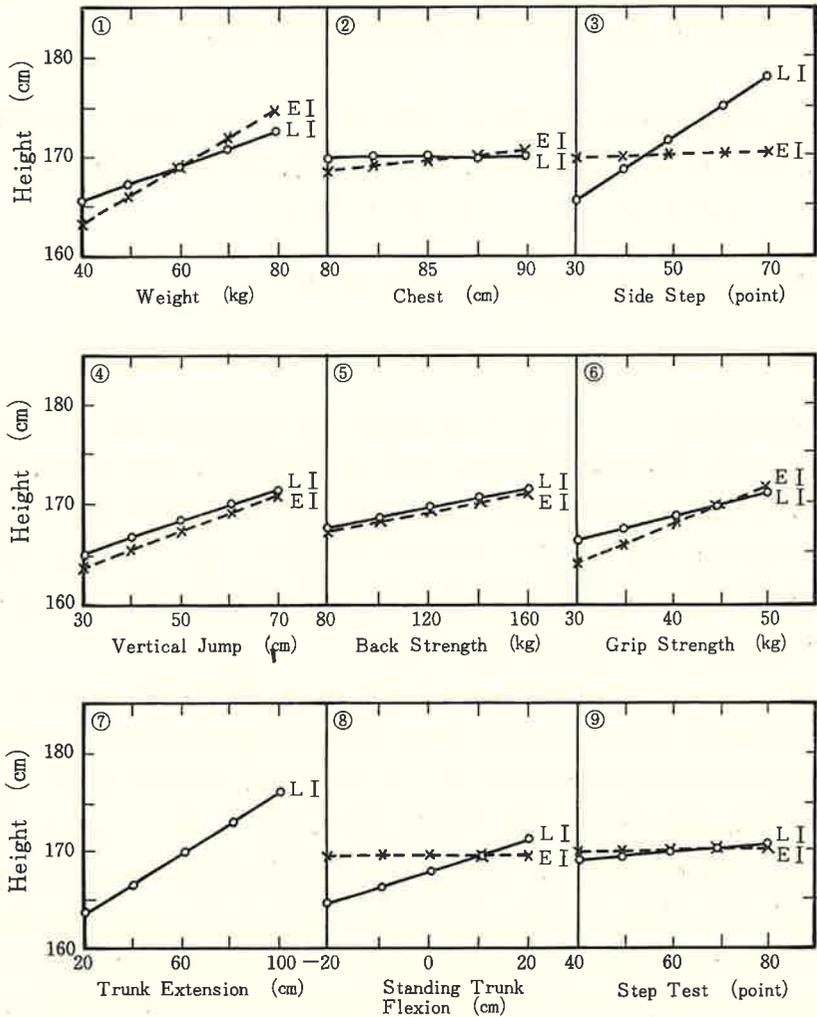
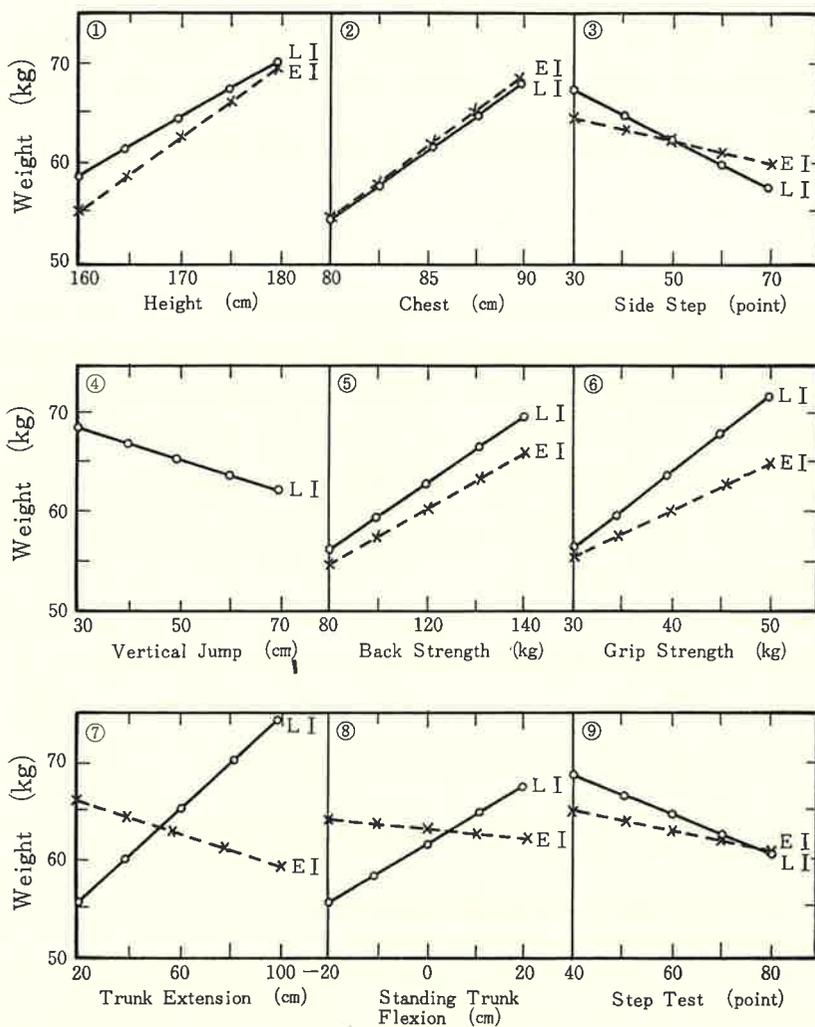**FIG. 4** *Regression Line of Height for Sports Test Data
where, EI(×————×) is Economics-major Freshmen and
L1(O———O) is Law-major Freshmen*

Accordingly, we find the difference between the two categories of students. The regression line values of law-major freshmen are greater in degree than economics-major ones: vertical jump and back strength.

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 dotted line ($\times---\times$) and the solid line (O——O) showing economics-major and law-major freshmen OUEL students, respectively. We can see that the heavier the weight item goes up, the heavier the sport data items are: height (E and L), girth of the chest (E and L), back strength (E and L), grip strength (E and L). While, oppositely lighter in side step (E and L), vertical jump (L), trunk extension (E), standing trunk flexion (E) and step test (E and L).

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

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 ($\times---\times$) and nationwide mean value (O——O).

Accordingly, we find a difference between OUEL students and nationwide mean value. The nationwide mean values are the greater

FIG. 5 *Regression Line of Weight for Sports Test Data*
where, EI(×——×) is Economics-major Freshmen and
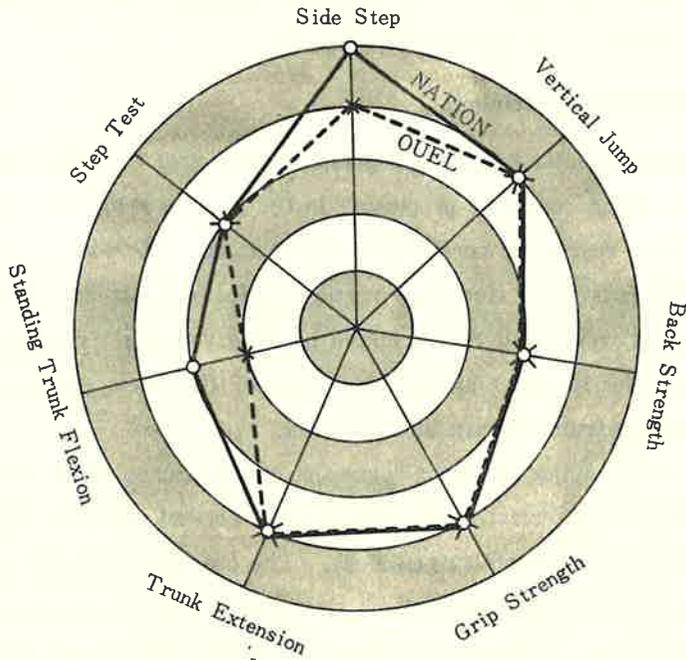*LI(O——O) is Law-major Freshmen*
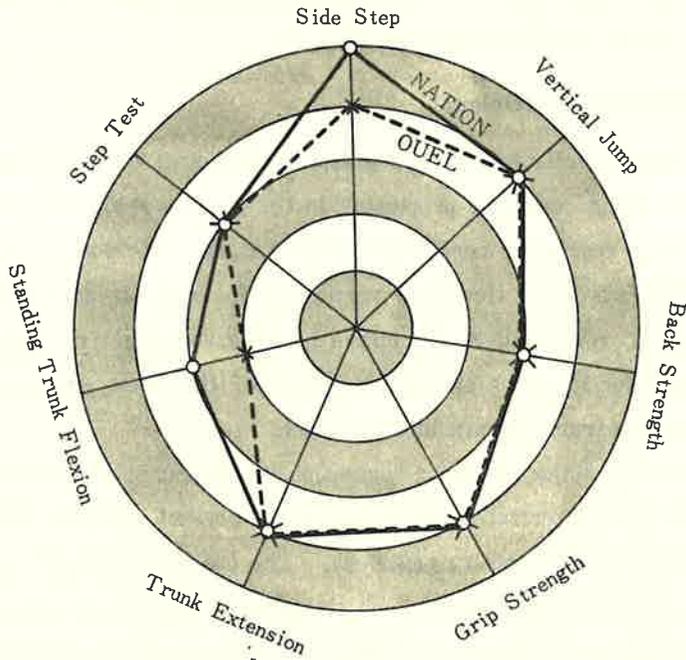
FIG. 6 *The 5 Gradation Evaluation of Physical Fitness Test in OUEL
Students Tested (×———×) and Nationwide Mean Value (O
——O) in the Year 1989*

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 freshmen are higher than those
of law-major freshmen in height (gap : 0.17cm), side step (gap: 2.34
points), vertical jump (gap: 3.49cm), back strength (gap : 11.02kg),
grip strength (gap: 1.36kg), standing trunk flexion (gap: 0.51cm) and
step test (gap: 3.01 points), but they are lower in all the other items.

Consequently, the mean values of all OUEL student turned out to be
higher in some items than the nationwide ones; weight (gap: 1.84kg),

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

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 freshmen are higher than those
of law-major freshmen in height (gap : 0.17cm), side step (gap: 2.34
points), vertical jump (gap: 3.49cm), back strength (gap : 11.02kg),
grip strength (gap: 1.36kg), standing trunk flexion (gap: 0.51cm) and
step test (gap: 3.01 points), but they are lower in all the other items.

Consequently, the mean values of all OUEL student turned out to be
higher in some items than the nationwide ones; weight (gap: 1.84kg),

girth of the chest (gap: 0.12cm) and grip strength (gap=0.13kg), but they are lower in all the other items.

5.3 Regression Coefficient

In economics-major freshmen, 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 vertical jump, 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, trunk extension, standing trunk flexion and step test.

Next, in law-major freshmen 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, 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, trunk extension and step test.

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