

*INFORMATION PROCESSING OF
SPORTS TEST DATA ON
SOPHOMORES IN OSAKA UNIVERSITY
OF ECONOMICS AND LAW, 1991*

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ABSTRACTS

The measured points of scores obtained from the computer processing data were as follows: for economics-major sophomores 429 points; for law-major sophomores 447 points. We took the 5-gradation evaluation, the mean values, the standard deviation, the regression coefficient, 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 height (171.53cm and gap=0.23cm), weight (63.99kg and gap=0.73kg), girth of the chest (88.24cm and gap=0.63cm), grip strength (45.16kg and gap=0.05 kg), trunk extension (57.90cm and gap=2.18cm) and step test (63.19 points and gap=1.18 points) to be recorded higher than the nationwide average. While as for side step (45.20 points and gap=-1.65 points), vertical jump (60.90cm and gap=-0.36cm), back strength (130.35kg and gap=-9.65 kg), and standing trunk flexion (9.39cm and gap=-1.96cm) OUEL students recorded lower than the nationwide mean value.

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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 1991 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 1991 from 876 sophomores students in all: 429 economics-majors and 447 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 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 (5.95%), step D (9.85%), step C (46.75%), step B (29.90%) and step A (7.30%).

Consequently, the mean values of all OUEL students turned out to be higher in some items than the nationwide ones: 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 height (171.53cm), weight

(63.99kg), girth of the chest (88.24cm), grip strength (45.16kg), trunk extension (57.90cm) and step test (63.19 points) to be recorded higher than the nationwide average. While as for side step (45.20 points), vertical jump (60.90cm), back strength (130.35kg) and standing trunk flexion (9.39cm) OUEL students recorded lower than the nationwide mean value.

Furthermore, the mean values of economics-major sophomores are higher than those of nationwide average in height, weight, girth of the chest, vertical jump, grip strength, trunk extension and step test, but they are lower in all the other items (side step, back strength and standing trunk flexion).

The mean values of law-major sophomores are higher than those of nationwide average in weight, girth of the chest, trunk extension and step test, but they are lower in all the other items (height, side step, vertical jump, back strength, grip strength, standing trunk flexion).

Accordingly, we find the difference between the two major students: economics-majors sophomores are greater in degree than ones for physique test (height, side step, vertical jump, back strength, grip strength, standing trunk flexion and step test). In terms of standard deviation, economics-major sophomores stand higher in vertical jump, back strength, grip strength, trunk extension and step test, 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, 0.7998 in economics-majors and 0.8134 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 faculty of economics sophomores (age: 19, males and 429 students) and faculty of law sophomores (age: 19, males and 447 students).

The measuring period was April 15 through May 15, 1991. 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 BASIC, STATISTICAL SYSTEM (BASIC), DRMLMN.N, KH0003 and FORTRAN.

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⁽¹⁾.

According to *TABLE 1*, we then compared the data of economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.6% and (L) reads 0.4% and the mean value reads 0.50%. On Grade 2, (E) reads 2.3%, (L) reads 4.6%, and the mean value reads 3.45%, which stand fairly low. On Grade 3, (E) reads 11.4%, (L) reads 19.0%, and the mean value reads 15.20%. These are in the middle of this evaluation. On Grade 4, (E) reads 35.8%, (L) reads 36.2%, and the mean value reads 36.00%. They stand higher in percentage than those on Grade 3. On Grade 5, (E) reads 49.6%, (L) reads 39.5%, and the mean value reads 44.55%. These Grade 5 values indicate the highest degrees in the evaluation. We can see that as the grade goes up, the higher the percentage grows. The difference between these two grades in percentage-distribution has a slightly different tendency from those of sophomores in years '84L2, '87L2, '88E2, '89L2 and '90E2.

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 0.2%, (L) reads 0.0%, and the mean value reads 0.10%, which are both in smaller degrees. On Grade 2, both (E) and (L) reads 1.1%, which are both in lower percentage. On Grade 3, (E) reads 11.8%, (L) reads 14.9%, and the mean value reads 13.35%. These are in the middle of this evaluation. On Grade 4, (E) reads 42.1%, (L) reads 48.0%, and the mean value reads 45.05%.

TABLE I The Results of the 5 Gradation Evaluation on Events Judgement for OUEL Sophomores in 1991 (%)

Faculty	Grada- tion	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 (E2)	1	0.6	0.2	0.9	0.4	0.6	14.4	0.2	E 3.9
	2	2.3	1.1	9.7	5.5	7.4	37.9	26.5	D 7.9
	3	11.4	11.8	56.8	32.8	34.0	37.0	45.4	C 46.8
	4	35.8	42.1	25.4	49.4	44.7	9.5	20.5	B 31.9
	5	49.6	44.5	6.9	11.6	13.0	0.9	7.2	A 9.3
Law (L2)	1	0.4	0.0	0.0	0.2	0.8	25.7	0.6	E 8.0
	2	4.6	1.1	20.3	5.8	5.3	34.0	37.1	D 11.8
	3	19.0	14.9	51.0	35.7	27.5	29.3	41.1	C 46.7
	4	36.2	48.0	24.6	47.8	55.2	9.3	16.3	B 27.9
	5	39.5	35.7	4.0	10.2	10.9	1.5	4.6	A 5.3
Average	1	0.50	0.10	0.45	0.30	0.70	20.05	0.40	E 5.95
	2	3.45	1.10	15.00	5.65	6.35	35.95	31.80	D 9.85
	3	15.20	13.35	53.90	34.25	30.75	33.15	43.25	C 46.75
	4	36.00	45.05	25.00	48.60	49.95	9.40	18.40	B 29.90
	5	44.55	40.10	5.45	10.90	11.95	1.20	5.90	A 7.30

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 44.5%, (L) reads 35.7%, and the mean value reads 40.10%. 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 sophomores in years '83-85 and '87-90.

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% and (L) reads 0.0%, and the mean value reads 0.45%, they stand lower in percentage. On Grade 2, (E) reads 9.7%, (L) reads 20.3%, and the mean value reads 15.00%, these are in the middle of this evaluation. On Grade 3, (E) reads 56.8%, (L) reads 51.0%, and the mean value reads 53.90%. 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 25.4%, (L) reads 24.6%, and the mean value reads 25.00%. Put another way, a fourth part of the enumerators are on this grade. Finally, on Grade 5, (E) reads 6.9%, (L) reads 4.0%, and the mean value reads 5.45%. They stand between on Grade 1 and 2 in percentage. The difference between these grades in percentage-distribution has a slightly similar tendency from those of OUEL students in years '83-85 and '87-90.

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 0.4% and (L) reads 0.2%, and the mean value reads 0.30%, which are both in very small degrees. On Grade 2, (E) reads 5.5%, (L) reads 5.8%, and the mean value reads 5.65%, which are both in lower in percentage. On Grade 3, (E) reads 32.8%, (L) reads 35.7%, and the mean value reads 34.25%. They stand between on Grade 4 and 5 in percentage. On Grade 4, (E) reads 49.4%, (L) reads 47.8%, and the mean value reads 48.6%. Almost half of the percentage of all the enumerators are on this grade. On Grade 5, (E) reads 11.6%, (L) reads 10.2%, and the mean value reads 10.90%. About 10% of all the enumerators are on this grade. These are in the middle of the evaluation between Grade 3 and 4. The difference between these grades in percentage-distribution has a similar tendency to those of OUEL students during years '83-90.

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 37-46 cm; 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) sophomores. On Grade 1, (E) reads 0.6%, (L)

reads 0.8%, and the mean value reads 0.70%. They stand lower in percentage. On Grade 2, (E) reads 7.4%, (L) reads 5.3%, and the mean value reads 6.35%. On Grade 3, (E) reads 34.0%, (L) reads 27.5%, and the mean value reads 30.75%. Put another way one third of the enumerators are on this grade. On Grade 4, (E) reads 44.7%, (L) reads 55.2%, and the mean value reads 49.95%. In addition, they stand highest in percentage. Almost half of the percentage of all the enumerators are on this grade. On Grade 5, (E) reads 13.0%, (L) reads 10.9%, and the mean value reads 11.95%, they stand between on Grade 2 and 3 in percentage. About 12% of all the enumerators are on this grade. The difference between these grades in percentage-distribution has a similar tendency to those of OUEL students during years 1983 through 1990.

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 5-11 cm; 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 14.4%, (L) reads 25.7%, and the mean value reads 20.05%. These are in the middle of this evaluation. They stand between on Grade 3 and 4. On Grade 2, (E) reads 37.9%, (L) reads 34.0%, and the mean value reads 35.95%. They Grade 2 values indicate the highest degrees in the evaluation. On Grade 3, (E) reads 37.0%, (L) reads 29.3%, and the mean value reads 33.15%. They stand between on Grade 1 and 2 in percentage. On Grade 4, (E) reads 9.5%, (L) reads 9.3%, and the mean value reads 9.4%, about 10% of all enumerators are on this grade. On Grade 5, (E) reads 0.9%, (L) reads 1.5%, and the

mean value reads 1.20%, they stand lower in percentage than those on Grade 1. The difference between these grades in percentage-distribution has a slightly different tendency to those of OUEL students during years '84, '87, '89 and '90.

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 0.2%, (L) reads 0.6%, and the mean value reads 0.4%, which are both in small degrees. On Grade 2, (E) reads 2.65%, (L) reads 37.1%, and the mean value reads 31.80%. On Grade 3, (E) reads 45.4%, (L) reads 41.1%, and the mean value reads 43.25%. In addition, they stand highest in percentage. On Grade 4, (E) reads 20.5%, (L) reads 16.3%, and the mean value reads 18.40%. These are in the middle of this evaluation. On Grade 5, (E) reads 7.2%, (L) reads 4.6%, and the mean value reads 5.90%, they stand lower in percentages. The difference between these grades in percentage-distribution has a slightly different tendency to those of OUEL students during years '84, '85, and '88.

3.2 Results of the Mean Value

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

TABLE 2 The Statistical Analysis Values of Physique and Physical Fitness on OUEL Sophomores in 1991
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 Exten- sion (cm)	Standing Trunk Flexion (cm)	Step Test (point)
Economics (E2)	MEAN	171.82	63.79	87.91	45.87	61.50	133.59	45.33	57.62	10.02	64.34
	S.D.	5.44	9.43	6.17	4.70	8.06	26.60	7.37	8.00	7.35	11.80
Law (L2)	MEAN	171.23	64.18	88.57	44.52	60.30	127.11	44.98	58.18	8.75	62.03
	S.D.	5.90	10.76	7.43	4.76	7.47	25.31	7.25	7.31	8.31	11.67
OUEL Mean (M.O)	MEAN	171.53	63.99	88.24	45.20	60.90	130.35	45.16	57.90	9.39	63.19
	S.D.	5.67	10.10	6.80	4.73	7.77	25.96	7.31	7.66	7.83	11.74
Nationwide (M.J)	MEAN	171.59	63.44	87.33	47.14	62.10	139.67	45.43	56.07	11.94	61.99
	S.D.	5.71	7.57	4.77	4.38	6.77	25.89	6.21	8.51	6.78	11.41
(E2) - (M.J)	MEAN	0.23	0.35	0.58	-1.27	-0.60	-6.08	-0.10	1.55	-1.92	2.35
	S.D.	-0.27	1.86	1.40	0.32	1.29	0.71	1.16	-0.51	0.57	0.39
(L2) - (M.J)	MEAN	-0.36	0.74	1.24	-2.62	-1.80	-12.58	-0.45	2.11	-3.19	0.04
	S.D.	0.19	3.19	2.66	0.38	0.70	-0.58	1.04	-1.20	1.53	0.26
(M.O) - (M.J)	MEAN	-0.06	0.55	0.91	-1.94	-1.20	-9.32	-0.27	1.83	-2.55	1.20
	S.D.	-0.04	2.53	2.03	0.35	1.00	0.07	1.10	-0.85	1.05	0.33
(E2) - (L2)	MEAN	0.59	-0.39	-0.66	1.35	1.20	6.48	0.35	-0.56	1.27	2.31
	S.D.	-0.46	-1.33	-1.26	-0.06	0.59	1.29	0.12	0.69	-0.96	0.13

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 (171.82cm, gap: 0.23cm), weight (63.79 kg, gap: 0.35kg), girth of the chest (87.91cm, gap: 0.58cm), trunk extension (57.62cm, gap: 1.55cm) and step test (64.34 point, gap: 2.35 points). While as for side step (45.87 points, gap: -1.27 points), vertical jump (61.50cm, gap: -0.60cm), back strength (135.59kg, gap: -6.08kg), grip strength (45.33kg, gap: -0.10kg), and standing trunk flexion (10.02cm, gap: -1.92 cm) were 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 OUEL students tested were recorded higher than the nationwide mean value of college students as a whole in weight (64.18kg, gap: 0.74kg), girth of the chest (88.57cm, gap: 1.24cm), trunk extension (55.18cm, gap: 2.11cm) and step test (62.03 points, gap: 0.04 points). While, lower in height (171.23cm, gap: -0.36cm), side step (44.52 points, gap: -2.62 points), vertical jump (60.30cm, gap: -1.80cm), back strength (127.11kg, gap: -12.58kg), grip strength (44.98kg, gap: -0.45kg) and standing trunk flexion (8.76cm, gap: -3.19cm).

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 weight (63.99kg, gap: 0.55kg), girth of the chest (88.24cm, gap: 0.91cm), trunk extension (57.90 cm, gap: 1.83cm), and step test (63.19 points, gap: 1.20 points) to be recorded higher than the nationwide average. While, lower in height (171.53

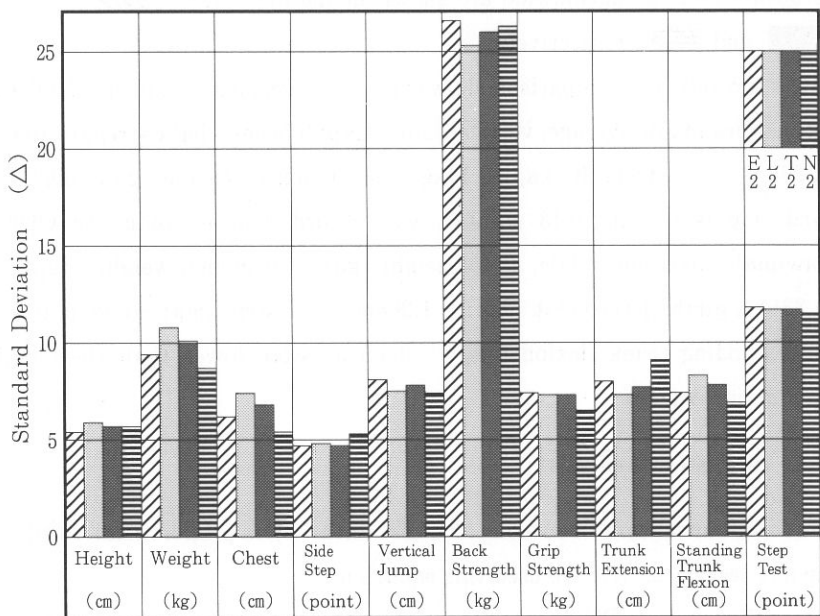






FIG. 1 The Histogram of Standard Deviation on Sophomores in 1991
 Where, E2: Economics-major, L2: Law-major,
 T2: OUEL Students and N2: Nationwide Students

cm, gap: -0.06cm), side step (45.20 points, gap: -1.94 points), vertical jump (60.90cm, gap: -1.20cm), back strength (130.35kg, gap: -9.32kg), grip strength (45.16kg, gap: -0.27kg), and standing trunk flexion (9.39cm, gap: -2.55cm), respectively.

3.3 Results of the Standard Deviation

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 economics-major average, vertical jump (gap: 0.59cm), back strength (gap: 1.29kg), grip strength (gap: 0.12kg), and trunk extension (gap: 0.69cm) and step test (gap: 0.13 points), was recorded lower than the OUEL law-major average. While, as for height (gap: -0.46cm), weight (gap: -1.33kg), girth of the chest (gap: -1.26cm), side step (gap: -0.06 points), and standing trunk flexion (gap: -0.96cm) were lower than the OUEL law-major average.

3.4 Regression Analysis

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 the coefficients and regression coefficients, respectively. The positive coefficient of the regression for grip strength are found in height, weight, girth of the chest, side step, vertical jump, back strength, trunk extension, standing trunk flexion and step test. It is found that grip strength increase results in an increase of height, weight, girth of the chest, side step, vertical jump, back strength, trunk extension, standing trunk flexion and step test, respectively.

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

TABLE 3 The Coefficients in Equation of Regression ($Y = a + bX$; a: Upper Berth and b: Lower Berth) for Economics-major Sophomores in 1991

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		-65.161	46.764	25.287	18.196	20.197	-19.542	48.714	29.365	44.356
Weight	155.760		54.555	47.758	65.751	63.522	22.775	0.052	-0.113	0.116
Chest	0.252		0.523	-0.030	-0.067	1.098	0.354		-0.049	75.463
Side Step	155.320	-43.668		47.565	67.540	-28.110	2.009	50.419	5.751	81.610
Vertical Jump	0.188	1.222		-0.019	-0.069	1.839	0.493	0.082	0.049	-0.197
Back Strength	164.400	69.252	89.429		32.640	79.566	28.017	42.896	-1.849	45.464
Grip Strength	0.162	-0.119	-0.033		0.629	1.178	0.377	0.321	0.259	0.411
Trunk Extension	164.710	69.393	90.378	31.737		86.704	27.834	51.364	1.921	60.296
Standing Trunk Flexion	0.116	-0.091	-0.040	0.214		0.762	0.285	0.102	0.132	0.661
Step Test	167.510	45.362	74.709	40.969	52.152		24.487		7.009	60.998
	0.032	0.138	0.099	0.037	0.070		0.156		0.023	0.025
	162.430	37.559	72.270	38.929	46.073	41.419		55.911	5.126	61.738
	0.270	0.579	0.345	0.153	0.340	0.203		0.038	0.108	0.057
	170.430	85.101	85.101	39.495	55.546	117.860	43.483		1.157	62.362
	0.024		0.049	0.111	0.103	0.273	0.032		0.154	0.034
	172.450	64.599	87.564	44.814	59.914	130.630	44.241	55.797		
	-0.062	-0.081	0.034	0.106	0.158	0.295	0.109	0.182		
	170.220	70.944	91.355	41.683	59.518	125.430	43.892	56.610		
	0.025	-0.111	-0.054	0.065	0.031	0.127	0.022	0.016		

$Y_g = -19.542 + 0.376$ (height)	(R=0.296)	(2)
$Y_g = 22.775 + 0.354$ (weight)	(R=0.452)	(3)
$Y_g = 2.009 + 0.493$ (girth of the chest)	(R=0.412)	(4)
$Y_g = 28.017 + 0.377$ (side step)	(R=0.241)	(5)
$Y_g = 27.834 + 0.285$ (vertical jump)	(R=0.311)	(6)
$Y_g = 24.487 + 0.156$ (back strength)	(R=0.563)	(7)
$Y_g = 43.483 + 0.032$ (trunk extension)	(R=0.035)	(8)
$Y_g = 44.241 + 0.109$ (standing trunk flexion)	(R=0.108)	(9)
$Y_g = 43.892 + 0.022$ (step test)	(R=0.036)	(10)

In this regression equation on grip strength on sophomores of OUEL economics-major students, the multiple-correlation coefficient is noted in weight (R=0.452), girth of the chest (R=0.412), vertical jump (R=0.311) and back strength (R=0.563) at above R=0.3. In the case of the multiple-correlation coefficient, height (R=0.296), side step (R=0.241) and standing trunk flexion (R=0.108) are between R=0.1 and R=0.3, respectively.

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 (Yt) and the sports tests is determined by a statistical analysis of sports test data:

$Y_t = 54.419 + 0.022$ (height)	(R=0.105)	(11)
$Y_t = 56.602 + 0.018$ (girth of the chest)	(R=0.018)	(12)
$Y_t = 52.232 + 0.134$ (side step)	(R=0.087)	(13)
$Y_t = 59.602 - 0.024$ (vertical jump)	(R=0.026)	(14)
$Y_t = 62.099 - 0.087$ (grip strength)	(R=0.087)	(15)
$Y_t = 56.883 + 0.148$ (standing trunk flexion)	(R=0.168)	(16)

TABLE 4 The Coefficients in Equation of Regression ($Y = a + bX$; a: Upper Berth and b: Lower Berth) for Law-major Sophomores in 1991

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		-82.711	26.114	34.365	23.066	-60.754	-26.320	54.419	32.935	33.701
Weight	154.500		0.365	0.059	0.218	0.110	0.416	0.022	-0.141	0.166
Chest	0.261	52.556		49.171	68.992	71.063	32.379		14.013	71.008
Side Step	150.620	-40.146	0.561	-0.072	-0.136	0.873	0.196		-0.082	-0.140
Vertical Jump	0.233	1.178	50.973	74.367	-0.459	1.440	19.811	56.602	14.540	71.991
Back Strength	167.130	80.649	96.458	-0.073	-0.159	1.440	0.284	0.018	-0.065	-0.113
Grip Strength	0.092	-0.370	-0.177	32.978	91.948	0.790	33.043	52.232	-7.387	55.811
Trunk Extension	162.960	81.103	98.021	0.614	0.790	80.154	0.268	0.134	0.363	0.140
Standing Trunk Flexion	0.137	-0.281	-0.157	29.521	80.154	0.779	24.312	59.602	-0.591	46.459
Step Test	163.570	44.112	72.804	0.249	0.779	0.779	0.343	-0.024	0.155	0.258
	0.060	0.158	0.124	40.972	51.662	0.068	26.294		5.529	51.576
	158.700	44.727	75.159	0.028	0.068	46.550	0.147		0.025	0.082
	0.279	0.432	0.298	39.326	43.912	1.791	62.099	62.099	5.574	50.869
	170.390	87.499	87.499	0.116	0.364	1.791	-0.087	-0.087	0.073	0.248
	0.014	0.018	0.018	41.230	61.736		49.978		-2.334	67.000
	171.860	65.379	89.023	0.057	-0.025		-0.086		0.191	-0.085
	-0.072	-0.138	-0.052	43.481	59.198	125.050	44.498	56.883		61.307
	168.580	71.557	91.393	0.119	0.126	0.236	0.056	0.148		0.083
	0.043	-0.119	-0.046	43.081	53.719	103.100	39.086	60.256		6.152
				0.023	0.106	0.387	0.096	-0.034		0.042

$$Y_t = 60.258 - 0.034 (\text{step test}) \quad (R=0.054) \quad \dots\dots (17)$$

In this regression equation of trunk extension on sophomores OUEL law-major students, the maximum class multiple-correlation coefficient are height ($R=0.105$) and standing trunk flexion ($R=0.168$) at above $R=0.1$. While, in this the multiple-correlation coefficients, girth of the chest ($R=0.018$), side step ($R=0.087$), vertical jump ($R=0.026$), grip strength ($R=0.087$) and step test ($R=0.054$) are between $R=0.01$ and $R=0.09$, respectively. In addition, the multiple-correlation coefficients between $R=0.01$ and $R=0.09$ stand lower reliability.

3.5 The Multiple-correlation Coefficient and F-ratio

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 on sophomores economics-majors. One of the important characteristics is that the multiple-correlation coefficient and the F-ratio of scattering analysis affects 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 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 ($R=0.7998$ and $F=758$). On the other hand, the multiple-correlation coefficient between $R=0.3$ and $R=0.7$ were the height-weight ($R=0.438$ and $F=101$), the weight-back strength ($R=0.389$ and $F=76$), the weight-grip strength ($R=0.452$ and $F=110$), the girth of the chest-back

TABLE 5 The Multiple-correlation Coefficient (Upper Berth) and the F-Ratio of Scattering Analysis (Lower Berth) for Economics-major Sophomores in 1991

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		0.4456	0.2322	0.1691	0.1951	0.1823	0.2961	0.0992	0.1246	0.1072
Weight	105.7700		0.7998	0.0586	0.0772	0.3892	41.0330	4.2462	6.7358	4.9611
Chest	0.4377	758.1900		1.4724	2.5625	76.2410	109.8300		0.0625	0.1389
Side Step	101.1700	0.7998	758.1900		0.0236	0.4263	0.4124	0.0630	0.0398	0.1022
Vertical Jump	0.2139	0.7998	758.1900	0.2384		94.8530	87.5050	1.6991	0.6787	4.5038
Back Strength	20.4640	758.1900	0.2384		0.3666	0.2081	0.2406	0.1886	0.1655	0.1638
Grip Strength	0.1425	0.0598	0.0263	66.2780		19.3190	26.2420	15.7400	12.0210	11.7740
Trunk Extension	8.8546	1.5347	0.2945	0.3666	0.2311	0.2311	0.3112	0.1029	0.1446	0.0457
Standing Trunk Flexion	0.1728	0.0781	0.0629	66.2750	24.0910		45.7930	4.5698	9.1162	0.8951
Step Test	13.1460	2.6191	1.1988	0.2080	0.2311		0.5633	0.0823	0.0818	0.0566
	0.1580	0.3894	0.4264	19.3080	24.0840		198.4300	2.9144	2.8745	1.3741
	10.9370	76.3020	94.9080	0.2406	0.3112	0.5633		0.0353	0.1084	0.0363
	0.2826	0.4524	0.4125	26.2360	45.7890	198.4300		0.5332	5.0798	0.5640
	37.0620	109.9000	87.5640	0.1884	0.1027		0.0348		0.1674	0.0234
	0.0367		0.0636	15.7170	4.5475		0.5173		12.3060	0.2331
	0.5771	1.7333	1.7333							
	0.0843	0.0633	0.0411	0.1654	0.1445	0.0818	0.1084	0.1675		
	3.0577	1.7203	0.7223	12.0080	9.1064	2.8729	5.0742	12.3180		
	0.0550	0.1392	0.1026	0.1637	0.0453	0.0564	0.0360	0.0237		
	1.2939	8.4397	4.5430	11.7570	0.8797	1.3650	0.5537	0.2390		

strength ($R=0.426$ and $F=95$), the girth of the chest-grip strength ($R=0.413$ and $F=88$), the side step-vertical jump ($R=0.367$ and $F=66$), the vertical jump-grip strength ($R=0.311$ and $F=46$) and the back strength-grip strength ($R=0.563$ and $F=198$), respectively.

The grip strength reveals a large confident coefficient for the sports test item data. Although height, standing trunk extension and the sports 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 (years 1983-1990) 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* which 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 *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 related to the weight-girth of the chest ($R=0.813$ and $F=870$). On the other hand, the multiple-correlation coefficient between $R=0.3$ and $R=0.7$ were the height-weight ($R=0.476$ and $F=131$), the height-girth of the chest ($R=0.294$ and $F=42$), the height-grip strength ($R=0.344$ and $F=60$), the weight-back strength ($R=0.372$ and $F=71$), the girth of the chest-back strength ($R=0.423$ and $F=97$), the side step-vertical jump ($R=0.391$ and $F=80$), the vertical jump-grip strength ($R=0.353$ and $F=64$) and the back strength-grip strength ($R=0.513$ and $F=159$), respectively.

TABLE 6 The Multiple-correlation Coefficient (Upper Berth) and the F-Ratio of Scattering Analysis (Lower Berth) for Law-major Sophomores in 1991

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height	0.4849 136.7700	0.3099 47.2600	0.1282 7.4329	0.2024 18.9990	0.2769 36.9580	0.3573 65.1250	0.1046 4.9225	0.1441 9.4324	0.1334 8.0632	
Weight	0.4763 130.5800	0.8134 869.9300	0.1635 12.2220	0.1947 17.5380	0.3714 71.2080	0.2914 41.3030	0.1060 5.0583	0.1287 7.4900		
Chest	0.2938 42.0430	0.8134 869.9400	0.1133 5.7860	0.1576 11.3360	0.4227 96.8070	0.2912 41.2150	0.0180 0.1434	0.0582 1.5149	0.0713 2.2733	
Side Step	0.0773 2.6771	0.1637 12.2600	0.1136 5.8160	0.3908 80.1910	0.1487 10.0670	0.1762 14.2500	0.0872 3.4112	0.2079 20.1020	0.0575 1.4752	
Vertical Jump	0.1754 14.1270	0.1950 17.5850	0.0249 11.3750	0.3908 80.2010	0.2302 24.8960	0.3535 63.5380	0.0257 0.2930	0.1397 8.8633	0.1657 12.5640	
Back Strength	0.2586 31.8840	0.3715 71.2430	0.4228 96.8380	0.1487 10.0600	0.2301 24.8800	0.5132 159.1300	0.0776 2.6939	0.1786 14.6570		
Grip Strength	0.3441 59.7460	0.2916 41.3390	0.2912 41.2440	0.1761 14.2470	0.3534 63.5220	0.5132 159.1300	0.0868 3.3758	0.0640 1.8303	0.1544 10.8640	
Trunk Extension	0.0198 0.1741	0.0186 0.1544	0.0870 3.3928	0.0244 0.2652	0.0866 3.3601	0.1678 12.8870	0.0536 1.2808	0.0591 1.5609		
Standing Trunk Flexion	0.1016 4.6428	0.1063 5.0819	0.0586 1.5341	0.2078 20.0880	0.0775 2.6870	0.0638 1.8206	0.1678 12.8940	0.0591 1.5609		
Step Test	0.0856 3.2850	0.1288 7.5119	0.0716 2.2904	0.0572 1.4954	0.1656 12.5410	0.1785 14.6480	0.0537 1.2848	0.0591 1.5586		

Therefore, the sports test items for the trunk extension-standing trunk flexion with the multiple-correlation coefficient were a large value. Although, in the trunk extension-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 (years 1983-1990) in sophomores.

4 DISCUSSION

4.1 Discussion of the 5-Gradation Evaluation ⁽⁴⁾⁻⁽¹⁵⁾

FIG. 2 show the experimental data derived from relation appraisalment of the 5-gradation evaluation and the physical fitness on the students tested. In *FIG. 2*, the dotted line (× - - ×) and the solid line (○ — ○) 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) and law major sophomores. 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 sophomores, respectively. The side step ('83E2, '84L2, '87L2, '88E2, '88L2 and '90E2), vertical jump ('83-85 and '87-90), back strength ('83-85 and '87-90), grip strength ('83-90), trunk extension ('83-90), standing trunk flexion ('84, '87, '89, '90) and step test ('84, '85, '88) agree very closely with the values determined by '91 sophomores in OUEL.

In the 5-gradation evaluation, the data resulted in the distribution as follows: step E (5.95%), step D (9.85%), step C (46.75%), step B (29.90%) and step A (7.30%), respectively.

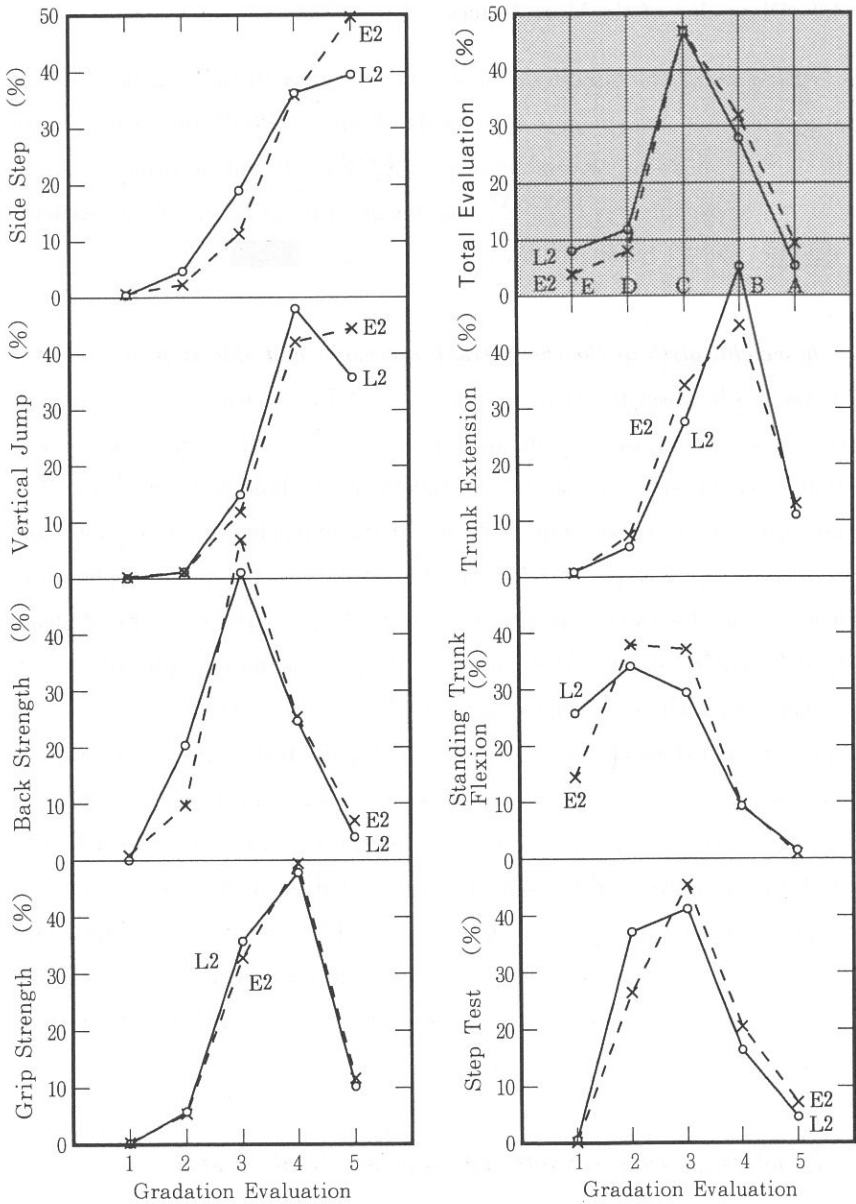


FIG. 2 Relation between Appraisement of the 5 Gradation Evaluation and Sports Test for OUEL Sophomores in 1991

4.2 Discussion of the Mean Values ⁽⁴⁾⁻⁽¹⁵⁾

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 sophomores (▨), the mean value of L1 is law-major sophomores (▤), the mean value of T1 is OUEL students (▧) and N1 is the nationwide mean values (■).

In weight, girth of the chest, trunk extension and side step, we find the difference between the two categories of OUEL students. That is to say, economics-major sophomores are greater in degree than law-major ones; that is wide mean value of college students as a whole in weight (gap: 0.35 kg), girth of the chest (gap: 0.58cm), trunk extension (gap: 1.55cm) and step test (gap: 2.35 points). The sports test data of law-major sophomores was compared with the nationwide average. As a result, the OUEL students tested were recorded higher than the nationwide mean value of college students as a whole in weight (gap: 0.74kg), girth of the chest (gap: 1.24 cm), trunk extension (gap: 2.11cm) and step test (gap: 0.04 points). Accordingly, we find a difference between OUEL students and the nationwide ones; that is, 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 weight (gap: 0.55kg), girth of the chest (gap: 0.91cm), trunk extension (gap: 1.83cm), and step test (gap: 1.20 points) to be recorded higher than the nationwide average.

In side step, back strength and standing trunk flexion, we find the difference between the two categories of OUEL students. That is to say, economics-major sophomores are lower in degree than nationwide average

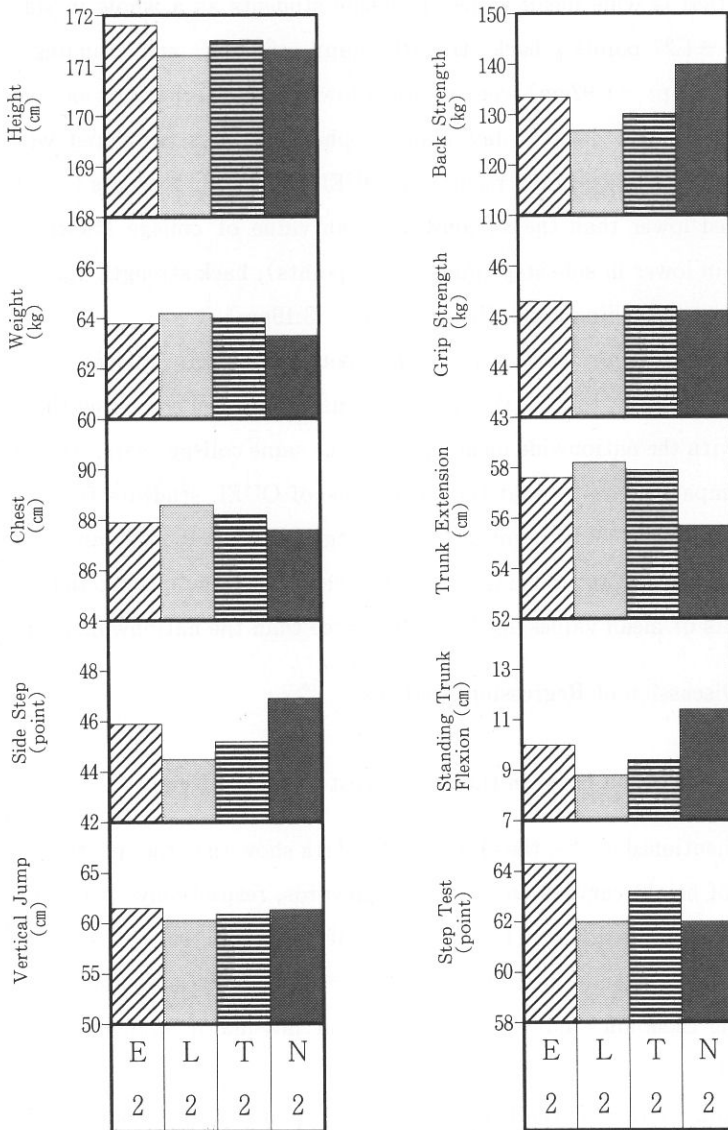


FIG. 3 The Histogram of Sports Test Data in Relation between Economics-major Sophomores (E₂), Law-major Sophomores (L₂), OUEL Sophomores (T₂) and Nationwide Sophomores (N₂) in 1991

ones; that is wide mean value of college students as a whole in side step (gap: -1.27 points), back strength (gap: -6.08kg) and standing trunk flexion (gap: -1.92cm) were recorded lower than the nationwide average. The sports test data of law-major sophomores was compared with the nationwide average. As a result, the OUEL law-major students tested were recorded lower than the nationwide mean value of college students as a whole in lower in side step (gap: -2.62 points), back strength (gap: -12.58kg), and standing trunk flexion (gap: -3.19cm).

Accordingly, we find a difference between OUEL students and the nationwide ones; that is, 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 lower in side step (gap: -1.94 points), back strength (gap: -9.32kg) and standing trunk flexion (gap: -2.55cm), respectively. The result being that OUEL students of mean values are lower in degree than the nationwide average.

4.3 Discussion of Regression Analysis⁽⁴⁾⁻⁽¹⁵⁾

4.3.1 Relation between the Sports Test Data and Height

As mentioned above, the experimental data show that the sports test data curve of height curve downwards and upwards, respectively. It can be also expressed by the differential coefficient of the sports test data of height in **FIG. 4** which charts the dotted line ($\times - - \times$) and the solid line ($\bigcirc - - \bigcirc$), showing economics-major sophomores and law-major sophomores OUEL students.

We can see that as the height item goes up, the higher sports test data items grow up (b:0.1 and over); weight (b:0.252), girth of the chest (b:188), side step (b:0.162), vertical jump (b:0.116) and grip strength (b:0.270) on economics-major sophomores (E), in **TABLE 3** and weight

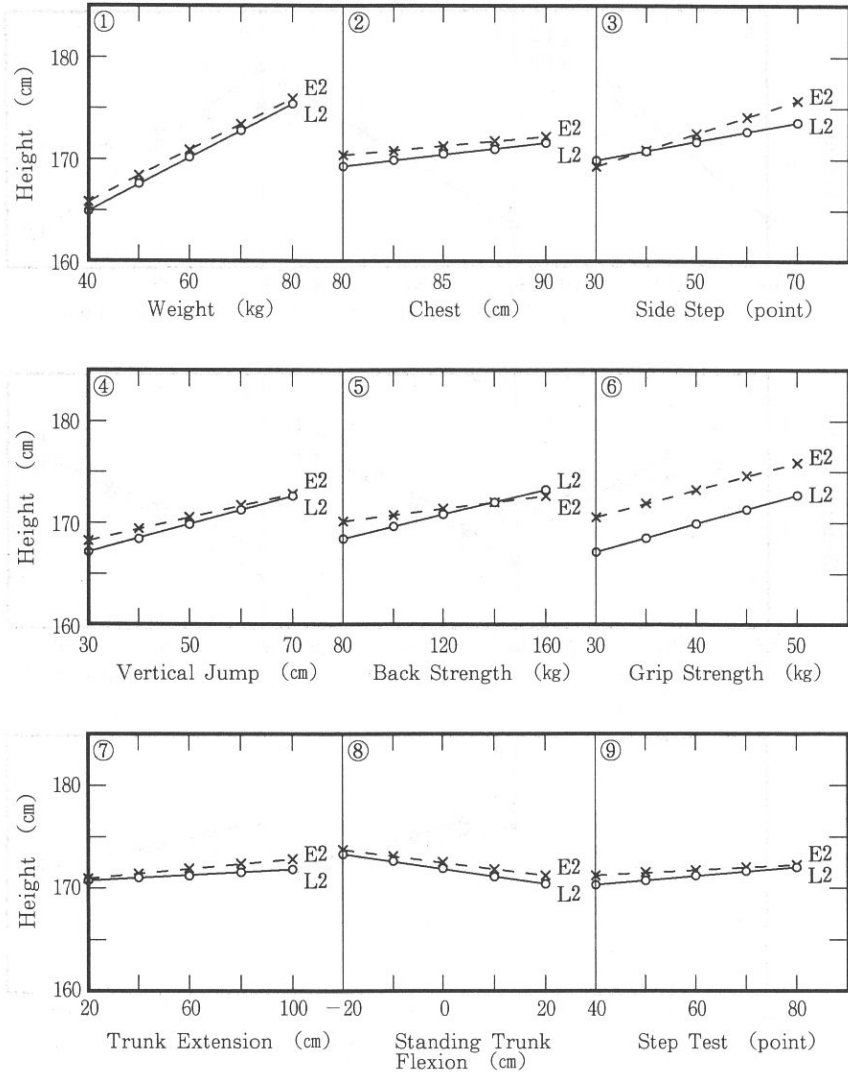


FIG. 4 The Regression Line of Height for Sports Test Data in Sophomores in 1991

Where, (x - - x) : E2 (Economics-major Sophomores) and
 (o — o) : L2 (Law-major Sophomores)

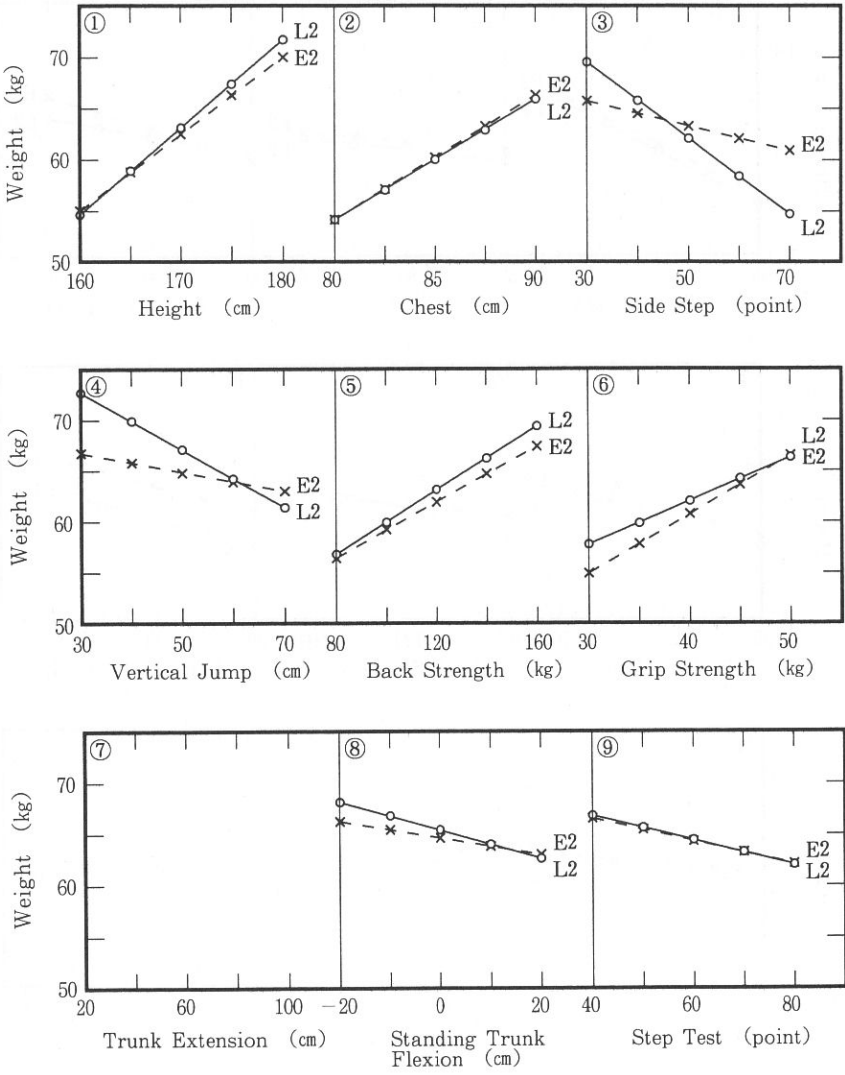


FIG. 5 The Regression Line of Weight for Sports Test Data in Sophomores in 1991

Where, (x - - x) : E2 (Economics-major Sophomores) and (o — o) : L2 (Law-major Sophomores)

(b:0.261), girth of the chest (b:0.233), vertical jump (b:0.137), grip strength (b:0.279) on law-major sophomores (L) in **TABLE 4**, respectively. It is noted that as the sports test data increases, height data shows a smaller fluctuation (b=0.1 and lower); back strength (b:0.032), trunk extension (b:0.024), standing trunk flexion (b: -0.062) and step test (b:0.025) on economics-major sophomores in **TABLE 3** and side step (b:0.092), back strength (b:0.060), trunk extension (b:0.014), standing trunk flexion (b: -0.072) and step test (b:0.043) on law-major sophomores in **TABLE 4**, respectively.

Therefore, a relation can be recognized in the sports test data and height data. That is, height depends on weight, girth of the chest and grip strength. While oppositely independent of back strength, trunk extension, standing trunk flexion 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 dotted line (× - - ×) and the solid line (○ — ○) showing economics-major and law-major sophomores OUEL students, respectively. We can see that the heavier the weight item goes up, the heavier the sport test data items (positive regression: b) are: height (b:0.751 in E and b:0.858 in L), girth of the chest (b:1.222 in E and b:1.178 in L), back strength (b:0.138 in E and b:0.158 in L) and grip strength (b:0.579 in E and b:0.432 in L). While, oppositely lighter (negative regression) in side step (b: -0.119 in E and b: -0.370 in L), vertical jump (b: -0.091 in E and b: -0.281 in L), standing trunk flexion (b: -0.081 in E and b: -0.138 in L) and step test (b: -0.111 in E and b: -0.119 in L).

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

strength, but they are lower in height. The negative regression line values of economics-major sophomores are greater in degree than law-major ones: the side step, vertical jump, standing trunk flexion and step test (*TABLE 3 and 4*).

5 SUMMARY and CONCLUSION

5.1 Results of the 5-Gradation Evaluation

In the 5-gradation evaluation, the data resulted in the distribution as follows: step E (5.95%), step D (9.85%), step C (46.75%), step B (29.90%) and step A (7.30%). While, the 1 gradation of minimum values are side step, vertical jump, back strength, grip strength, trunk extension and step test. Next, the 4 gradation of maximum are vertical jump, grip strength and trunk extension.

The 5-gradation evaluation on physical fitness sports test of the students tested and the nationwide mean values in the year 1991 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 ($\bigcirc - - \bigcirc$).

Accordingly, we find a difference between OUEL students and nationwide mean value. The nationwide mean values are the greater grade with side step in degree for OUEL students, 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 height (gap: 0.59cm), side step (gap: 1.35 points), vertical jump (gap: 1.20kg), back strength (gap: 6.48kg), grip strength (gap: 0.35kg), standing trunk flexion (gap: 1.27cm) and step test (gap: 2.31 point), but they are lower in all the other items; weight (gap: -0.39 kg), girth of the chest (gap: -0.66cm) and trunk extension (gap: -0.56

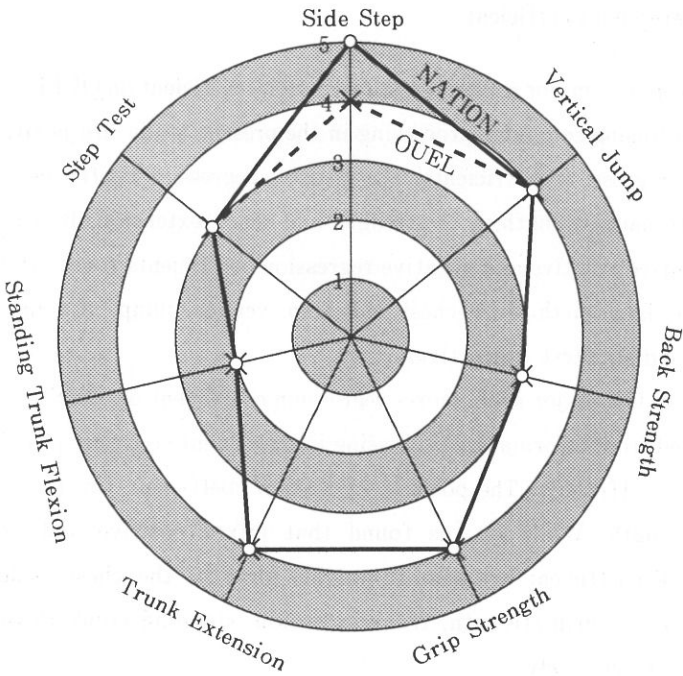


FIG. 6 The 5 Gradation Evaluation of Physical Fitness Test for OUEL Sophomores (x—x) and Nationwide Mean Values (o—o) in 1991

cm), respectively.

Consequently, the mean values of all OUEL student turned out to be higher in some items than the nationwide ones; weight (gap: 0.55kg), girth of the chest (gap: 0.91cm), trunk extension (gap: 1.83cm) and step test (gap: 1.20 point), but they are lower in all the other items; height (gap: -0.06cm), side step (gap: -1.94 point), vertical jump (gap: -1.20cm), back strength (gap: -9.32kg), grip strength (gap: -0.27kg) and standing trunk flexion (gap: -2.55cm), respectively.

5.3 Regression Coefficient

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

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

5.4 The Multiple-correlation Coefficient and F-ratio ⁽⁴⁾⁻⁽¹⁴⁾

To economics-major sophomores, the multiple-correlation coefficient above $R=0.8$ is the relation of the weight-girth of the chest. On the other hand, the multiple-correlation coefficient between $R=0.3$ and $R=0.7$ were the height-weight, the weight-back strength, the weight-grip strength, the girth of the chest-back strength, the girth of the chest-grip strength, the side step-vertical jump, the vertical jump-grip strength and the back strength-grip strength, respectively.

In the sports test data for law-major sophomores, the multiple-correlation coefficient above $R=0.8$ is relation the of weight-girth of the chest. On the other hand, the multiple-correlation coefficient between $R=0.3$ and $R=0.7$ were the height-weight, the height-girth of the chest, the

height-grip strength, the weight-back strength, the girth of the chest-back strength, the side step-vertical jump, the vertical jump-grip strength and the back strength-grip strength, respectively.

Therefore, the sports test items for the trunk extension-standing trunk flexion with the multiple-correlation coefficient were a large value. Although, in the trunk extension-step test, the multiple-correlation coefficient and the F-ratio of scattering analysis have a very small value.

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