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 were from the computer processing data of 460 economics-major and 430 law-major sophomores. We adopted 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 concerning university students. As a result, the comparison shows that the mean value of OUEL (Osaka University of Economics and Law) students for weight (63.90kg and gap = 0.81kg), vertical jump (60.80cm and gap = 0.44cm), trunk extension (57.55cm and gap = 1.59cm) and step test (63.05 points and gap = 1.76 points) record higher than the nationwide average. On the other hand, as for height (171.43cm and gap = −0.19cm), girth of the chest (86.24cm and gap = −1.16cm), side step (45.10 points and gap = −1.58 points), back strength (128.85kg and gap = −12.26kg), grip strength (44.21kg and gap = −1.38kg), and standing trunk flexion (9.20cm and gap = −1.38cm), OUEL students are recorded lower than in the nationwide mean value.

(The Review of Osaka University of Economics and Law, ***57****(1994) p.107-143)*

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 (OUEL), 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 1992 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 1992 from 890 sophomores students in all: 460 economics-major and 430 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 (6.35%), step D (9.80%), step C (46.75%), step B (28.75%) and step A (8.35%).

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 students for weight, vertical jump, trunk extension and step test to be recorded higher

than the nationwide average. To the contrary, however, they are lower in height, girth of the chest, side step, back strength, grip strength and standing trunk flexion, 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, vertical jump, trunk extension and step test, but they are lower in all the other items (girth of the chest, side step, back strength, grip strength, and standing trunk flexion).

The mean values of law-major sophomores are higher than those of nationwide average in weight, back strength, trunk extension and step test, but they are lower in all the other items (height, girth of the chest, side step, vertical jump, grip strength and standing trunk flexion). Accordingly, we find the difference between the two major students: economics-major sophomores are greater in degree than ones for physique test (height, girth of the chest, side step, vertical jump, back strength, grip strength, standing trunk flexion and step test).

The multiple-correlation coefficient reads quite large in weight and girth of the chest: that is to say 0.9889 in economics-major and 0.7221 in law-major, 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 sophomores in the department of economics, 460 male students: age, 19; and sophomores in the department of law, 430 male students: age, 19.

The measuring period was April 20 through May 20, 1992. In respect of the measuring method and measurement members, we adopted the same

measuring method as the one used by the Ministry of Education. The measurement members are all instructors of physical education at Osaka University of Economics and Law.

In respect to measurement items, we selected ten items referring to the above-mentioned test by the Ministry of Education. These are the ones of physical examination: height, weight and girth of the chest; and also the ones of physical strength test: side step, vertical jump, back strength, grip strength, trunk extension, standing trunk flexion and step test.

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

3 MEASUREMENT RESULTS

3.1 The 5-Gradation Evaluation for Physical Fitness Test

3.1.1 The 5-Gradation Evaluation of Side Step

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

According to ***TABLE 1***, we then compared the data of economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 0.6%, (L) reads 0.4%, and the mean value reads 0.50%. They stand lower in percentage. On Grade 2, (E) reads 2.6%, (L) reads 4.4%, and the mean value reads 3.50%,

TABLE 1 The Results of the 5 Gradation Evaluation on Events Judgement for OUEL Sophomores in 1992 (%)

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 (460名)	1	0.6	0.3	0.8	0.0	6.5	14.2	0.2	E 3.8
	2	2.6	2.0	9.6	1.2	7.8	38.8	26.3	D 8.0
	3	12.0	12.6	**56.6**	17.8	26.0	36.9	**45.2**	C **46.6**
	4	35.0	**42.1**	26.2	**63.4**	**46.6**	9.1	20.3	B 30.9
	5	**49.8**	**44.0**	6.8	17.6	13.1	1.0	8.0	A 10.7
Law (430名)	1	0.4	0.0	0.0	0.0	0.7	25.6	0.5	E 8.9
	2	4.4	1.1	20.1	1.8	5.3	33.9	37.0	D 11.6
	3	19.4	14.0	**50.9**	19.7	27.4	29.1	**41.4**	C **46.9**
	4	37.6	**47.8**	24.0	**58.8**	**56.3**	10.1	16.3	B 26.6
	5	38.2	37.1	5.0	19.7	10.3	1.3	4.8	A 6.0
Average	1	0.50	0.15	0.40	0.00	3.60	19.90	0.35	E 6.35
	2	3.50	1.55	14.85	1.50	6.55	36.35	31.65	D 9.80
	3	15.70	13.30	**53.75**	18.75	26.70	33.00	**43.30**	C **46.75**
	4	36.30	**44.95**	25.10	**61.10**	**51.45**	9.60	18.30	B 28.75
	5	**44.00**	**40.55**	5.90	**18.65**	**11.70**	1.15	6.40	A 8.35

which stand fairly low. On Grade 3, (E) reads 12.0%, (L) reads 19.4%, and the mean value reads 15.70%. They stand between on Grade 2 and 4 in percentage. On Grade 4, (E) reads 35.0%, (L) reads 37.6%, and the mean value reads 36.30%. In another way, one third of the enumerators are in this grade. On Grade 5, (E) reads 49.8%, (L) reads 38.2%, and the mean value reads 44.00%. 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 slight change from those of the following OUEL students: '83 sophomores, '87 sophomores, '88 freshmen, '88 sophomores, '89 freshmen and '90 freshmen in the department of economics; and '83 sophomores, '87 sophomores and '88 sophomores in the department of law.

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 0.3%, (L) reads 0.0%, and the mean value reads 0.15%, which are both in smaller degrees. On Grade 2, (E) reads 2.0%, (L) reads 1.1%, and the mean value reads 1.55%, which are both in lower percentage. On Grade 3, (E) reads 12.6%, (L) reads 14.0%, and the mean value reads 13.30%. These are in the middle of this evaluation. On Grade 4, (E) reads 42.1%, (L) reads 47.8%, and the mean value reads 44.95%. 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 44.0%, (L) reads 37.1%, and the mean value reads 40.55%. 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 sophomores in the years 1983 through 1992.

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 0.8%, (L) reads 0.0%, and the mean value reads 0.40%, they stand lower in percentage. On Grade 2, (E) reads 9.6%, (L) reads 20.1%, and the mean value reads 14.85%, these are in the middle of this evaluation. On Grade 3, (E) reads 56.6%, (L) reads 50.9%, and the mean value reads 53.75%. 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 26.2%, (L) reads 24.0%, and the mean value reads 25.10%. In another way, one fourth of the enumerators are on this grade. Finally, on Grade 5, (E) reads 6.8%, (L) reads 5.0%, and the mean value reads 5.90%. They stand between on Grade 1 and 2 in percentage. The difference between these grades in percentage-distribution has a slightly similar tendency to those of OUEL students in the years 1983 through 1991.

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, both (E) and (L) reads 0.0%. On Grade 2, (E) reads 1.2%, (L) reads 1.8%, and the mean value reads 1.50%, which are both in lower in percentage. On Grade 3, (E) reads 17.8%, (L) reads 19.7%, and the mean value reads 18.75%, about 20% of all the enumerators are on grade. On Grade 4, (E) reads 63.4%, (L) reads 58.8%, and the mean value reads 61.10%. Needless to say, they stand highest in percentage and almost about 60 percentage than those on this grade. On Grade 5, (E) reads 17.6%, (L) reads 19.7%, and the mean value reads 18.65%. These are in the middle of the evaluation between Grade 2 and 3. They stand lower in percentage than those on Grade 3. The difference between these grades in percentage-distribution has similar tendency from those of OUEL students in the years 1983 through 1991.

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 6.5%, (L) reads 0.7%, and the mean value reads 3.60%. They stand lower in percentage. On Grade 2, (E) reads 7.8%, (L) reads 5.3%, and the mean value reads 6.55%. They stand between on Grade 1 and 5 in percentage. On Grade 3, (E) reads 26.0%, (L) reads 27.4%, and the mean value reads 26.70%. Put another way one third of the enumerators are on this grade. On Grade 4, (E) reads 46.6%, (L) reads 56.3%, and the mean value reads 51.45%. 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 13.1%, (L)

reads 10.3%, and the mean value reads 11.70%, they stand between on Grade 2 and 3 in percentage. The difference between these grades in percentage-distribution has a similar tendency from those of OUEL students in the years 1983 through 1991.

3.1.6 The 5-Gradation Evaluation of Standing Trunk Flexion

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

According to ***TABLE 1***, we then compared the data between economics-major (E) and law-major (L) sophomores. On Grade 1, (E) reads 14.2%, (L) reads 25.6%, and the mean value reads 19.90%. There are in the middle of this evaluation, and stand between on Grade 3 and 4 in percentage. On Grade 2, (E) reads 38.8%, (L) reads 33.9%, and the mean value reads 36.35%. Needless to say, they stand highest in percentage. On Grade 3, (E) reads 36.9%, (L) reads 29.1%, and the mean value reads 33.00%. They stand lower in percentage than those on Grade 3, and in another way one third of the enumerators are on this grade. On Grade 4, (E) reads 9.1%, (L) reads 10.1%, and the mean value reads 9.60%, about 10% of all the enumerators are on this grade. On Grade 5, (E) reads 1.0%, (L) reads 1.3%, and the mean value reads 1.15%. They stand lower in percentage than those on grade 4 which stand fairly low. The difference between these grades in percentage-distribution has a slightly transferring tendency in those of OUEL students during in the years 1983 through 1991.

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 0.5%, and the mean value reads 0.35%, which are both in small degrees. On Grade 2, (E) reads 2.63%, (L) reads 37.0%, and the mean value reads 31.65%. They stand between on Grade 3 and 4 in percentage. On Grade 3, (E) reads 45.2%, (L) reads 41.4%, and the mean value reads 43.30%. In addition, they stand highest in percentage. On Grade 4, (E) reads 20.3%, (L) reads 16.3%, and the mean value reads 18.30%. On Grade 5, (E) reads 8.0%, (L) reads 4.8%, and the mean value reads 6.40%, they stand lower in percentage. The difference between these grades in percentage-distribution has a slight change each in from those of the following OUEL students: '88 freshmen, '88 sophomores, and '89 freshmen in the department of economics and '83 freshmen, '83 sophomores, '84 freshmen, '85 freshmen, '85 sophomores and '87 sophomores in the department of law.

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***.

In comparing with the economics-major sophomores and the nationwide average, the sports test data of economics-major sophomores in OUEL were analyzed together with the nationwide average. As a result, the economics-major sophomores recorded higher than the nationwide mean value of college students as a whole in height (171.72cm, gap: 0.10cm), weight

TABLE 2 *The Statistical Analysis Values of Physique and Physical Fitness on OUEL Sophomores in 1992 MEAN (Mean Values) and S.D. (Standard Deviation)*

Name	MEAN S.E.	Height (cm)	Weight (kg)	Chest (cm)	Side Step (point)	Vertical Jump (cm)	Back Strength (kg)	Grip Strength (kg)	Trunk Extension (cm)	Standing Trunk Flexion (cm)	Step Test (point)
Economics-Najor (E2)	*MEAN*	171.72	63.70	86.91	45.77	61.40	132.59	44.33	57.00	9.99	64.10
	S.D.	5.34	9.40	5.17	4.60	8.00	25.60	7.27	7.90	7.15	11.30
Law-Major (L2)	*MEAN*	171.13	64.10	85.57	44.42	60.20	125.11	44.08	58.10	8.40	62.00
	S.D.	5.80	10.70	6.43	4.66	7.46	23.31	7.20	7.20	8.10	11.60
OUEL Mean (M.O)	*MEAN*	171.43	63.90	86.24	45.10	60.80	128.85	44.21	57.55	9.20	63.05
	S.D.	5.57	10.05	5.80	4.63	7.73	24.46	7.24	7.55	7.63	11.45
Nationwide (M.J)	*MEAN*	171.62	63.09	87.40	46.68	60.36	141.11	45.59	55.96	10.58	61.29
	S.D.	5.47	8.53	5.35	4.79	7.62	26.45	6.27	8.98	7.12	10.98
(E2) − (M.J)	*MEAN*	0.10	0.61	−0.49	−0.91	1.04	−8.52	−1.26	1.04	−0.59	2.81
	S.D.	−0.13	0.87	−0.18	−0.19	0.38	−0.85	1.00	−1.08	0.03	0.32
(L2) − (M.J)	*MEAN*	−0.49	1.01	−1.83	−2.26	−0.16	−16.00	−1.51	2.14	−2.18	0.71
	S.D.	0.33	2.17	1.08	−0.13	−0.16	−3.14	0.93	−1.78	0.98	0.62
(M.O) − (M.J)	*MEAN*	−0.19	0.81	−1.16	−1.58	0.44	−12.26	−1.38	1.59	−1.38	1.76
	S.D.	0.10	1.52	0.45	−0.16	0.11	−1.99	0.97	−1.43	0.51	0.47
(E2) − (L2)	*MEAN*	0.59	−0.40	1.34	1.35	1.20	7.48	0.25	−1.10	1.59	2.10
	S.D.	−0.46	−1.30	−1.26	−0.06	0.54	2.29	0.07	0.70	−0.95	−0.30

(63.70kg, gap: 0.61kg), vertical jump (61.40cm, gap: 1.04cm), trunk extension (57.00cm, gap: 1.04cm) and step test (64.10 points, gap: 2.81 points). However, while as for girth of the chest (86.91cm, gap: −0.49cm), side step (45.77 points, gap: −0.91 points), back strength (132.59kg, gap: −8.52kg), grip strength (44.33cm, gap: −1.26kg), and standing trunk flexion (9.99cm, gap: −0.59cm) were recorded lower than the nationwide average.

In comparing with the law-major sophomores and the nationwide average, the sports test data of law-major sophomores were analyzed together with the nationwide average. As a result, the tested OUEL students recorded higher than the nationwide mean value of college students as a whole in weight (64.10kg, gap: 1.01kg), back strength (125.11kg, gap: 16.00kg), trunk extension (58.10cm, gap: 2.14cm) and step test (62.00 points, gap: 0.71 points). On the other hand, they recorded lower in height (171.13cm, gap: −0.49cm), girth of the chest (85.57cm, gap: −1.83cm), side step (44.42 points, gap: −2.26 points), vertical jump (60.20cm, gap: −0.16cm), grip strength (44.08kg, gap: −1.51kg) and standing trunk flexion (8.40cm, gap: −2.18cm).

In comparing with the OUEL students and the nationwide average, the sports test data obtained were analyzed together with the nationwide mean value of the same college years. As a result, the comparison shows that the mean value of OUEL students, in weight (63.90kg, gap: 0.81kg), vertical jump (60.80cm, gap: 0.44cm), trunk extension (57.55cm, gap: 1.59cm), and step test (63.05 points, gap: 1.76 points) recorded higher than the nationwide average.

However, they recorded lower in height (171.43cm, gap: −0.19cm), girth of the chest (86.24cm, gap: −1.16cm), side step (45.10 points, gap: −1.58 points), back strength (128.85kg, gap: −12.26kg), grip strength (44.21kg,

gap: − 1.38kg), and standing trunk flexion (9.20cm, gap: − 1.38cm), respectively.

In comparing between the average of economics-major and law-major sophomores, the sports test data of economics-major sophomores in OUEL were analyzed by contrast compared with the law-major sophomores average. As a result, the economics-major sophomores recorded higher than law-major of mean value as a whole in height (171.72cm, gap: 0.59cm), girth of the chest (86.91cm, gap: 1.34cm), side step (45.77 points, gap: 1.35 points), vertical jump (61.40cm, gap: 1.20cm), back strength (132.59kg, gap: 7.48kg), grip strength (44.33kg, gap: 0.25kg), standing trunk flexion (9.99cm, gap: 1.59cm) and step test (64.10 points, gap: 2.10 points). On the other hand, as for weight (63.70kg, gap: − 0.40kg), and trunk extension (57.00cm, gap: − 1.10cm) they recorded lower than the law-major sophomores average.

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 in *FIG. 1*, which shows the relation between the standard deviation and OUEL sophomores in the examination of physique and physical fitness test. Economics-major and law-major sophomores, OUEL sophomores students and the nationwide students are respectively shown in the histograms.

In comparing between the average of economics-major sophomores and the nationwide average, the standard deviation of economics-major sophomores in OUEL students was analyzed by contrast with the nationwide average. As a result, the economics-major sophomores recorded higher than the nationwide average in weight (gap: 0.87kg), vertical jump (gap:

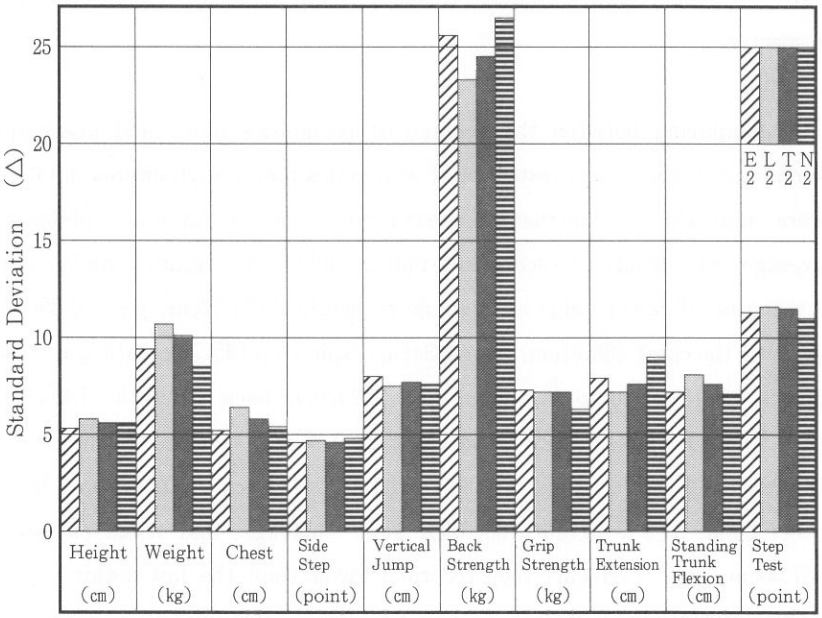

FIG. 1 The Histogram of Standard Deviation on Sophomores in 1992 Where, E2: Economics-Major, L2: Law-Major, T2: OUEL Students and N2: Nationwide Students

0.38cm), grip strength (gap: 1.00kg), standing trunk flexion (gap: 0.03cm) and step test (gap: 0.32 point).

As for height (gap: −0.13cm), girth of the chest (gap: −0.18cm), side step (gap: −0.19 point), back strength (gap: −0.85kg) and trunk extension (gap: −1.08cm), their average were lower than the nationwide average.

In comparing between the average of law-major sophomores and the nation average, the standard deviation of law-major sophomores in OUEL students was analyzed by contrast compared with the nationwide average. As a result, the economics-major sophomores recorded higher than the nationwide average in height (gap: 0.33cm), weight (gap: 2.17kg), girth of

the chest (gap: 1.08cm), grip strength (gap: 0.93kg), standing trunk flexion (gap: 0.98cm) and step test (gap: 0.62 point). As for side step (gap: −0.13 point), vertical jump (gap: −0.16cm), back strength (gap: − 3.14kg) and trunk extension (gap: − 1.78cm), their average were lower than the nationwide average.

In comparing between the average of OUEL sophomores and the nation average, the standard deviation of sophomores in OUEL was analyzed by contrast compared with the nationwide average. As a result, OUEL sophomores recorded higher than the nationwide average in height (gap: 0.10cm), weight (gap: 1.52kg), girth of the chest (gap: 0.45cm), vertical jump (gap: 0.11cm), grip strength (gap: 0.97kg), standing trunk flexion (gap: 0.51cm) and step test (gap: 0.47 point). As for side step (gap: −0.16 point), back strength (gap: −1.99kg) and trunk extension (gap: −1.43cm), their average were lower than the nationwide average.

In comparing between the average of economics-major and law-major sophomores, the standard deviation of economics-major sophomores in OUEL was analyzed by contrast with law-major sophomores average. As a result, the economics-major sophomores recorded higher than law-major sophomores average, in vertical jump (gap: 0.54cm), back strength (gap: 2.29kg), grip strength (gap: 0.07kg), and trunk extension (gap: 0.70cm). As for height (gap: −0.46cm), weight (gap: −1.30kg), girth of the chest (gap: −1.26cm), side step (gap: −0.06 point), standing trunk flexion (gap: −0.95cm) and step test (gap: −0.30 point), their average were lower than law-major sophomores 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

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

TABLE 3 shows the upper coefficients (a) and the lower regression coefficient for economics-major sophomores. In ***TABLE 3***, the upper berth (a) and the lower berth (b) in the box indicates coefficients and regression coefficients, respectively. The positive coefficients 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.

As economics-major sophomores, the height on OUEL students was calculated through 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) is determined by the experimental data:

$Yh = 155.660 + 0.242$ (weight) $(R = 0.547) \cdots\cdots (2)$
$Yh = 155.220 + 0.178$ (girth of the chest) $(R = 0.141) \cdots\cdots (3)$
$Yh = 164.300 + 0.152$ (side step) $(R = 0.147) \cdots\cdots (4)$
$Yh = 164.610 + 0.106$ (vertical jump) $(R = 0.162) \cdots\cdots (5)$
$Yh = 166.510 + 0.032$ (back strength) $(R = 0.151) \cdots\cdots (6)$
$Yh = 162.230 + 0.260$ (grip strength) $(R = 0.276) \cdots\cdots (7)$
$Yh = 170.230 + 0.014$ (trunk extension) $(R = 0.074) \cdots\cdots (8)$
$Yh = 171.450 - 0.052$ (standing trunk flexion) $(R = 0.074) \cdots\cdots (9)$
$Yh = 170.020 + 0.015$ (step test) $(R = 0.077) \cdots\cdots (10)$

In this regression equation on height in OUEL economics-major

TABLE 3 *The Coefficients in Equation of Regression ($Y = a+bX$; a: Upper Berth and b: Lower Berth) for Economics-major Sophomores in 1992*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		−65.101	46.704	25.177	18.096	20.097	−18.540	48.614	28.365	43.336
		0.721	0.209	0.110	0.252	0.666	0.376	0.042	−0.103	0.106
Weight	155.660		53.555	46.658	64.751	62.422	22.665		13.058	75.063
	0.242		0.423	−0.020	−0.057	1.077	0.334		−0.020	−6.066
Chest	155.220	−43.468		47.505	66.540	−28.010	2.004	50.319	5.650	80.400
	0.178	1.212		−0.018	−0.069	1.729	0.488	0.062	0.033	−0.177
Side Step	164.300	69.152	89.229		32.540	78.555	27.007	41.796	−1.663	45.263
	0.152	−0.109	−0.023		0.529	1.166	0.366	0.311	0.239	0.401
Vertical Jump	164.610	69.093	90.370	31.630		86.502	27.779	50.364	1.776	60.196
	0.106	−0.081	−0.030	0.210		0.742	0.265	0.102	0.130	0.551
Back Strength	166.510	44.362	74.509	40.888	52.052		24.287		7.003	59.877
	0.032	0.138	0.079	0.027	0.060		0.144		0.013	0.023
Grip Strength	162.230	37.339	71.270	38.729	45.003	40.419		54.811	5.111	60.138
	0.260	0.559	0.335	0.143	0.240	0.103		0.037	0.099	0.061
Trunk Extension	170.230		85.088	38.480	55.446	116.660	42.483		1.044	62.162
	0.014		0.038	0.101	0.101	0.260	0.031		0.144	0.024
Standing Trunk Flexion	171.450	64.499	86.464	44.614	59.814	129.620	44.041	54.797		
	−0.052	−0.071	0.033	0.096	0.128	0.288	0.108	0.162		
Step Test	170.020	70.744	91.322	41.583	58.418	124.320	42.692	56.055		
	0.015	−0.101	−0.044	0.055	0.022	0.117	0.011	0.010		

sophomores, the multiple-correlation coefficient is noted in weight (R = 0.547) and grip strength (R = 0.276) at above R = 0.25. The multiple-correlation coefficient in girth of the chest (R = 0.141), side step (R = 0.147), vertical jump (R = 0.162) and back strength (R = 0.151) is between R = 0.1 and R = 0.3, respectively. In addition it stands lower in reliability.

The coefficients of the regression equation of law-major sophomores are shown in ***TABLE 4***. The weight of OUEL students was 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:

$$Yw = -81.611 + 0.846 \text{ (height)} \quad (R = 0.463) \cdots\cdots (11)$$

$$Yw = -40.046 + 1.167 \text{ (girth of the chest)} \quad (R = 0.722) \cdots\cdots (12)$$

$$Yw = 80.529 - 0.360 \text{ (side step)} \quad (R = 0.153) \cdots\cdots (13)$$

$$Yw = 80.103 - 0.181 \text{ (vertical jump)} \quad (R = 0.175) \cdots\cdots (14)$$

$$Yw = 44.002 + 0.150 \text{ (back strength)} \quad (R = 0.272) \cdots\cdots (15)$$

$$Yw = 44.627 + 0.422 \text{ (grip strength)} \quad (R = 0.280) \cdots\cdots (16)$$

$$Yw = 64.279 + 0.118 \text{ (standing trunk flexion)} \quad (R = 0.101) \cdots\cdots (17)$$

$$Yw = 71.447 - 0.109 \text{ (step test)} \quad (R = 0.128) \cdots\cdots (18)$$

In this regression equation of trunk extension on law-major sophomores, the maximum class multiple-correlation coefficients for height (R = 0.463) and girth of the chest (R = 0.722) are at above R = 0.4. On the other hand, the multiple-correlation coefficients for side step (R = 0.153), vertical jump (R = 0.175), back strength (R = 0.272) and grip strength (R = 0.280) are between R = 0.25 and R = 0.45, respectively. In addition, the multiple-correlation coefficients between R = 0.01 and R = 0.09 stand higher in reliability.

TABLE 4 *The Coefficients in Equation of Regression ($Y = a+bX$; a: Upper Berth and b: Lower Berth) for Law-major Sophomores in 1992*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		−81.611	26.014	34.240	23.004	−60.544	−25.220	53.319	32.734	33.441
		0.846	0.355	0.048	0.118	0.100	0.316	0.011	−0.111	0.123
Weight	152.300		52.446	48.071	67.882	70.043	30.329		14.003	70.044
	0.241		0.461	−0.052	−0.126	0.663	0.186		−0.051	−0.120
Chest	150.620	−40.046		50.773	74.347	−0.349	18.711	56.502	14.340	70.881
	0.230	1.167		−0.043	−0.119	1.220	0.184	0.015	−0.044	−0.103
Side Step	166.130	80.529	95.448		32.908	91.846	33.003	52.132	−6.587	53.611
	0.082	−0.360	−0.166		0.514	0.770	0.243	0.114	0.353	0.120
Vertical Jump	161.860	80.103	98.011	29.420		80.050	23.302	58.501	−0.481	44.445
	0.127	−0.181	−0.147	0.229		0.669	0.223	−0.011	0.130	0.156
Back Strength	163.610	44.002	72.801	40.888	50.552		26.204		5.443	50.443
	0.061	0.150	0.114	0.014	0.048		0.137		0.015	0.041
Grip Strength	157.700	44.627	73.059	38.226	42.912	45.440		62.055	5.334	49.768
	0.266	0.422	0.277	0.106	0.264	1.681		−0.054	0.042	0.228
Trunk Extension	170.290		87.091	40.130	61.526		48.876		−2.114	66.559
	0.012		0.011	0.047	−0.015		−0.077		0.181	−0.064
Standing Trunk Flexion	171.660	64.279	88.013	42.281	59.098	124.040	44.336	56.773		60.206
	−0.062	−0.118	−0.042	0.108	0.026	0.136	0.044	0.137		0.062
Step Test	168.480	71.447	91.091	43.001	52.619	102.055	38.015	60.116	6.022	
	0.031	−0.109	−0.044	0.013	0.096	0.286	0.077	−0.031	0.032	

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 economics-major sophomores. One of the important characteristics is that the multiple-correlation coefficient and the F-ratio of scattering analysis notably affects 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 indicate 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 $R = 0.9$ is the relation of the weight-girth of the chest ($R = 0.9889$ and $F = 768$). On the other hand, the multiple-correlation coefficients between $R = 0.3$ and $R = 0.7$ are the height-weight ($R = 0.547$ and $F = 101$), the weight-back strength ($R = 0.399$ and $F = 77$), the weight-grip strength ($R = 0.464$ and $F = 109$), the girth of the chest-back strength ($R = 0.477$ and $F = 94$), the girth of the chest-grip strength ($R = 0.412$ and $F = 88$), the side step-vertical jump ($R = 0.379$ and $F = 67$), the vertical jump-grip strength ($R = 0.361$ and $F = 47$) and the back strength-grip strength ($R = 0.574$ and $F = 197$), respectively.

The grip strength reveals a large confident coefficient for the sports test item data, although trunk extension, standing trunk extension and step test have 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 of the years from 1983

TABLE 5 *The Multiple-correlation Coefficient (Upper Berth) and the F-Ratio of Scattering Analysis (Lower Berth) for Economics-major Sophomores in 1992*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		0.5566	0.1312	0.1581	0.1828	0.1813	0.2861	0.0882	0.1136	0.1044
		104.7711	24.1200	12.4740	15.1420	13.7700	39.0110	3.2452	5.0336	3.9610
Weight	0.5466		0.9889	0.0486	0.0771	0.3991	0.4743		0.0535	0.1219
	100.6600		768.1900	1.3627	2.6692	76.1410	108.7020		1.5113	7.2387
Chest	0.1412	0.9889		0.0286	0.0409	0.4784	0.4114	0.0430	0.0178	0.1001
	22.1610	768.1900		0.2494	1.0443	93.7630	88.5510	1.5410	0.5677	4.4010
Side Step	0.1471	0.0487	0.0286		0.3787	0.2181	0.2200	0.1661	0.1323	0.1438
	10.8470	1.4637	0.2595		67.2880	18.2190	24.1400	12.5150	11.0110	11.4410
Vertical Jump	0.1618	0.0781	0.0419	0.3787		0.2422	0.3613	0.1310	0.1224	0.0366
	13.1410	2.7791	1.0993	67.2890		25.0810	46.5990	4.7680	8.1088	0.8641
Back Strength	0.1510	0.3993	0.4774	0.2181	0.2422		0.5743		0.0718	0.0444
	10.7470	77.3110	93.8630	18.2091	25.0920		197.3300		2.7620	1.2641
Grip Strength	0.2761	0.4643	0.4115	0.2210	0.3612	0.5743		0.0252	0.1010	0.0330
	36.0410	108.8010	88.4450	24.1310	46.6890	197.3300		0.4322	6.0541	0.4337
Trunk Extension	0.0741		0.0522	0.1741	0.1300		0.0241		0.1443	0.0231
	0.5661		1.6431	13.6160	4.6670		0.4361		11.3070	0.2520
Standing Trunk Flexion	0.0741	0.0531	0.0211	0.1443	0.1225	0.0718	0.1010	0.1445		
	3.0446	1.6103	0.6687	11.7410	8.1044	2.7619	6.0440	11.3170		
Step Test	0.0767	0.1239	0.1011	0.1318	0.0326	0.0441	0.0220	0.0211		
	1.2819	7.3397	4.2011	11.2110	0.8741	1.2741	0.4437	0.2410		

through 1991 on OUEL economics-major sophomores.

The multiple-correlation coefficient and the F-ratio of scattering analysis in law-major sophomores based on the experimental data in ***TABLE 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 ***TABLE 6***, the upper berth and the lower berth have 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 by using experimental data. The multiple-correlation coefficient above R = 0.7 is related to the weight-girth of the chest (R = 0.722 and F = 859). On the other hand, the multiple-correlation coefficient between R = 0.3 and R = 0.6 are the height-weight (R = 0.446 and F = 130), the height-grip strength (R = 0.322 and F = 59), the girth of the chest-back strength (R = 0.412 and F = 96), the side step-vertical jump (R = 0.389 and F = 81), the vertical jump-grip strength (R = 0.364 and F = 62) and the back strength-grip strength (R = 0.503 and F = 158), respectively.

The grip strength reveals a large confident coefficient for the sports test item data. However, trunk extension, standing trunk extension and 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 of the years 1983-1991 with OUEL law-major sophomores. Accordingly, we find the difference between the two major students in the multiple-correlation coefficient and the F-ratio; economics-major sophomores are greater in degree than law-major ones.

TABLE 6 *The Multiple-correlation Coefficient (Upper Berth) and the F-Ratio of Scattering Analysis (Lower Berth) for Law-major Sophomores in 1992*

	Height	Weight	Chest	Side Step	Vertical Jump	Back Strength	Grip Strength	Trunk Extension	Standing Trunk Flexion	Step Test
Height		0.4629	0.2818	0.1172	0.1944	0.1786	0.3331	0.1016	0.1401	0.1134
		135.6600	46.2600	7.3319	18.7770	35.7580	64.2200	4.7225	9.2124	8.0122
Weight	0.4461		0.7221	0.1528	0.1747	0.2714	0.2810		0.1013	0.1278
	130.4400		858.9300	12.1400	16.4740	70.2080	40.2020		5.0041	7.2009
Chest	0.2718	0.7221		0.1112	0.1376	0.4117	0.2813	0.0176	0.0484	0.0813
	41.0230	858.9400		5.5160	10.3340	95.7080	40.1140	0.1424	1.4149	2.2733
Side Step	0.0663	0.1527	0.1114		0.3887	0.1387	0.1587	0.0772	0.2179	0.0475
	2.5661	12.1500	5.6160		81.1810	10.0067	14.1500	3.3111	19.2001	1.4554
Vertical Jump	0.1644	0.1750	0.0149	0.3887		0.2202	0.3636	0.0267	0.1296	0.1547
	14.0210	16.4750	10.3740	81.0810		25.8810	62.4380	0.2772	8.7631	12.5410
Back Strength	0.1576	0.2715	0.4118	0.1387	0.2201		0.5032		0.0746	0.1776
	30.8740	70.2380	95.7280	10.0060	25.7700		158.1200		2.5939	14.6670
Grip Strength	0.3221	0.2801	0.2813	0.1587	0.3637	0.5032		0.0767	0.0540	0.0426
	58.7200	40.2121	40.1440	14.1400	62.4280	158.1200		3.2747	1.8202	1.2718
Trunk Extension	0.0174		0.0170	0.0770	0.0257		0.0766		0.1778	0.0646
	0.1641		0.1434	3.2911	0.2552		3.2607		11.8871	1.2747
Standing Trunk Flexion	0.1006	0.1010	0.0486	0.2180	0.1295	0.0745	0.0538	0.1778		0.0681
	4.5317	5.0341	1.4341	19.1001	8.7521	2.5839	1.8101	11.8971		1.5509
Step Test	0.0746	0.1277	0.0816	0.0472	0.1546	0.1775	0.0416	0.0636	0.0681	
	3.1650	7.3119	2.2904	1.4754	12.4410	14.6570	1.2728	1.2847	1.5601	

4 DISCUSSION

4.1 Discussion of the 5-Gradation Evaluation[4)-(17)]

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

We can see that as the grade goes up the higher the percentage grows for the side step (E and L) and vertical jump (E) in economics-major (E) and law-major (L) sophomores. On the other hand, the physical fitness percentages decrease with an increase from Grade 1 to 3 and to Grade 4, respectively; the vertical jump (L), grip strength (E and L) and trunk extension (E and L) agree very closely to the percentage values determined by economics- and law-major sophomores, respectively. The side step on '83 sophomores, '87 sophomores, '88 freshmen, '88 sophomores, '89 freshmen and '90 freshmen in department of economics and '83 sophomores, '87 sophomores and '88 sophomores in department of law, vertical jump in the years from 1983 through 1991; back strength in the years from 1983 through 1991; grip strength in the years from 1983 through 1991; trunk extension in the years from 1983 through 1991; standing trunk flexion in the years from 1983 through 1991; and step test on the years '88 freshmen, '88 sophomores and '89 freshmen in department of economics and '83 freshmen, '83 sophomores, '84 freshmen, '85 freshmen, '85 sophomores and '87 sophomores in department of law agree very closely to the values determined by sophomores in OUEL.

As for the 5-gradation evaluation, the data resulted in the distribution as follows: step E (E = 3.8%, L = 8.9% and average = 6.35%), step D (E = 8.0%, L = 11.6% and average = 9.80%), step C (E = 46.6%, L = 46.9%

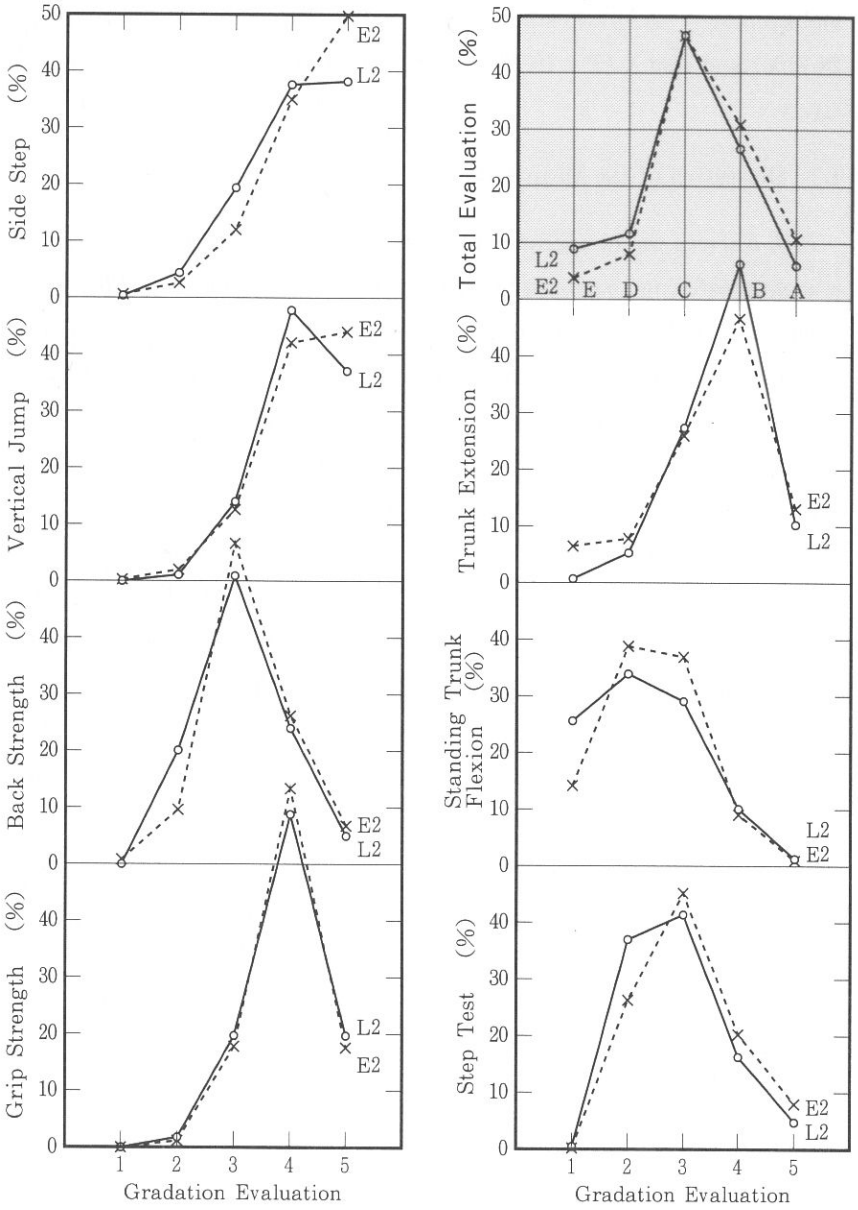

FIG. 2 *Relation between Appraisement of the 5 Gradation Evaluation and Sports Test for OUEL Sophomores in 1992*

and average = 46.75%), step B (E = 30.9%, L = 26.6% and average = 28.75%) and step A (E= 10.7%, L= 6.0% and average = 8.35%), respectively.

4.2 Discussion of the Mean Values[4)-17)]

FIG. 3 shows the histogram of sports test data in relation between the students tested and nationwide students. On the other hand, in ***FIG. 3***, the mean value of E1 shows economics-major sophomores; the mean value of L1, law-major sophomores; the mean value of T1, OUEL students; and N1, the nationwide mean values.

In weight, 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: 0.61kg), trunk extension (gap: 1.04cm) and step test (gap: 2.81 points). The sports test data of law-major sophomores were compared with the nationwide average. As a result, the OUEL students recorded higher than the nationwide mean value of college students as a whole in weight (gap: 1.01kg), trunk extension (gap: 2.14cm) and step test (gap: 0.71 points). Accordingly, we find a difference between OUEL students and the nationwide ones; that is, the sports test data obtained were 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: 0.81kg), trunk extension (gap: 1.59cm), and step test (gap: 1.76 points) record higher than the nationwide average.

In girth of the chest, side step, grip strength and standing trunk flexion, we find the difference between the two categories of OUEL students. That is

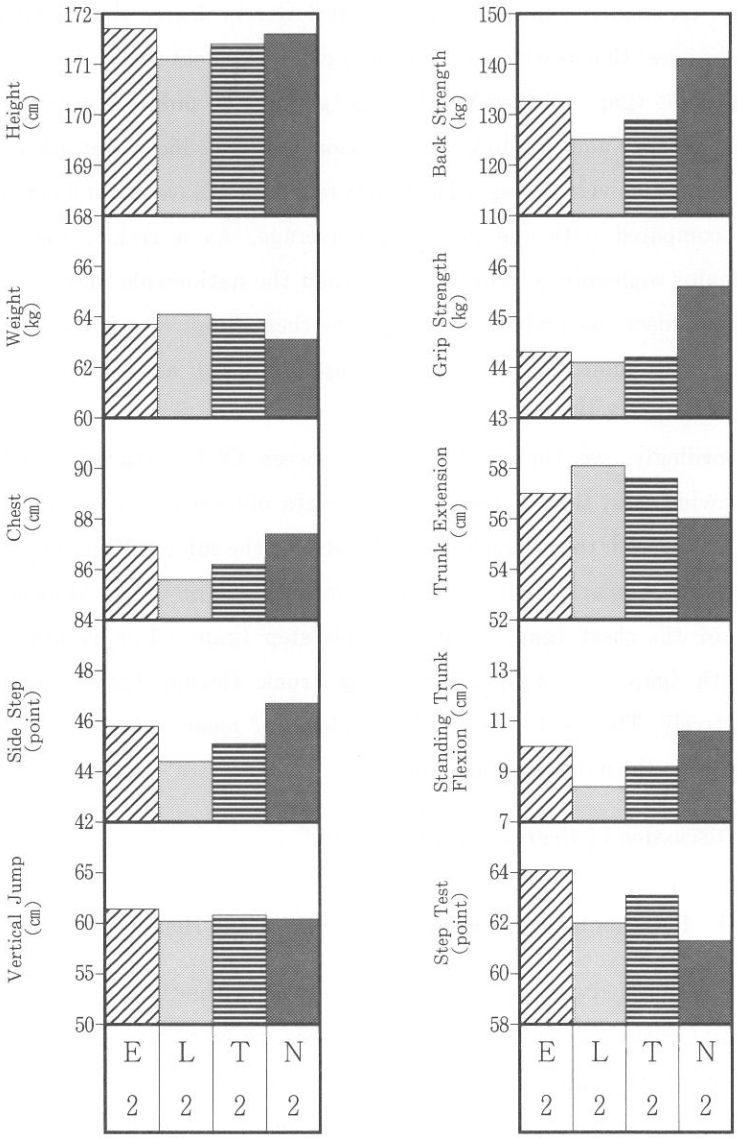

FIG. 3 *The Histogram of Sports Test Data in Relation between Economics-Major Sophomores (E2), Law-Major Sophomores (L2), OUEL Sophomores (T2) and Nationwide Sophomores (N2) in 1992*

to say, economics-major sophomores are lower in degree than nationwide average ones; that is wide mean value of college students as a whole in girth of the chest (gap: −0.49cm), side step (gap: −2.26 points), grip strength (gap: −1.51kg) and standing trunk flexion (gap: −2.16cm) recorded lower than the nationwide average. The sports test data of law-major sophomores were compared with the nationwide average. As a result, the OUEL law-major sophomores recorded lower than the nationwide mean value of college students as a whole in girth of the chest (gap: −1.83cm), side step (gap: −2.26 points), grip strength (gap: −1.51kg) and standing trunk flexion (gap: −2.18cm).

Accordingly, we find a difference between OUEL students and the nationwide ones; that is, the sports test data obtained were 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: in girth of the chest (gap: −1.16cm), side step (gap: −1.58 points), grip strength (gap: −1.38kg) and standing trunk flexion (gap: −1.38cm), respectively. The result that OUEL students of mean values are lower in degree than the nationwide average.

4.3 Discussion of Regression Analysis [4]-[17]

4.3.1 Relation between the Sports Test Data and Height

As mentioned above, the experimental data show that the sports test data of height curve are downwards and upwards, 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 and law-major sophomores.

We can see that up the height item goes up, the higher sports test data items grow up (b: 0.1 and over); weight (b: 0.242), girth of the chest (b:

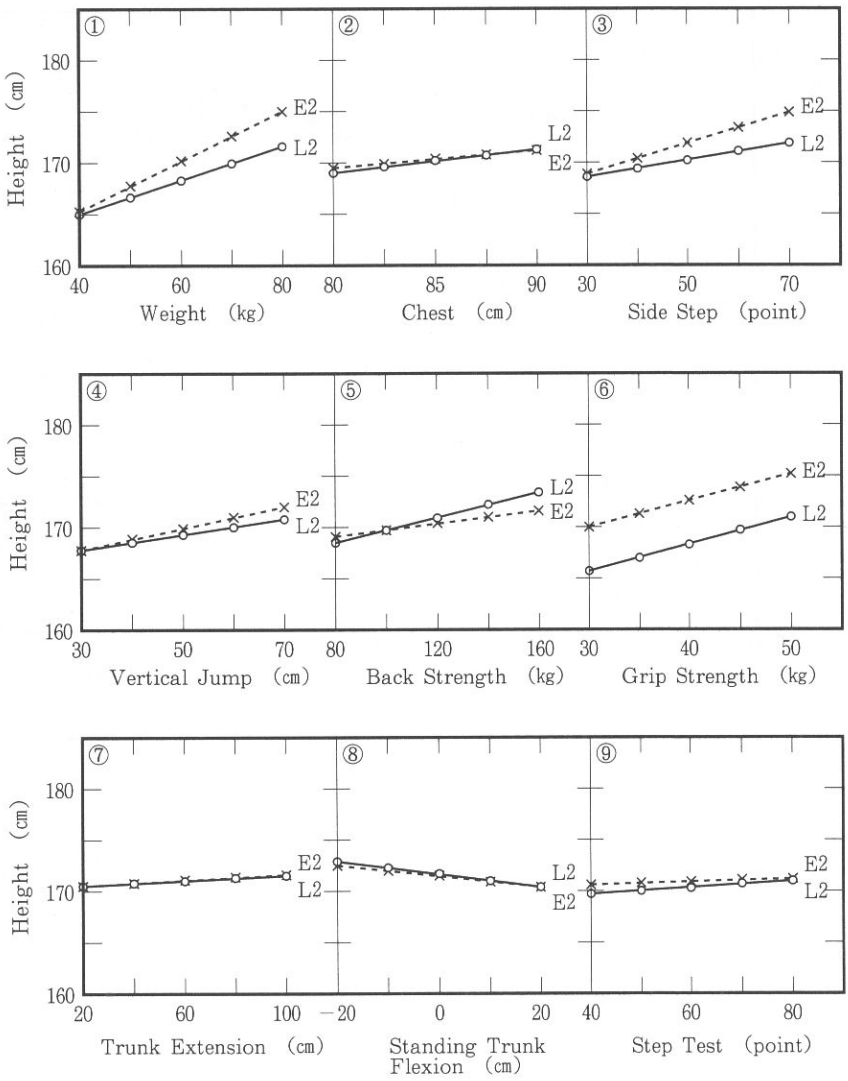

FIG. 4 *The Regression Line of Height for Sports Test Data in Sophomores in 1992*
Where, (× − − ×) : *E2* (*Economics-Major Sophomores*) *and*
(○ —— ○) : *L2* (*Law-Major Sophomores*)

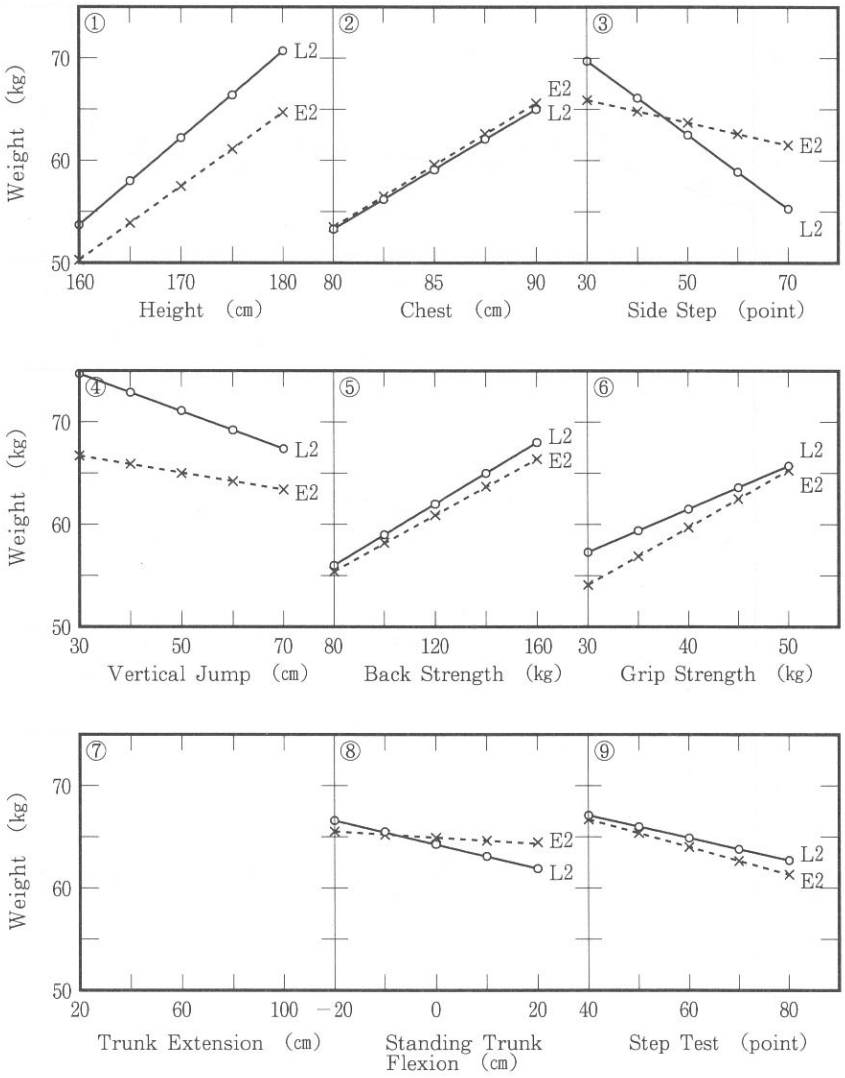

FIG. 5 *The Regression Line of Weight for Sports Test Data in Sophomores in 1992*
Where, (× − − ×) : *E2 (Economics-Major Sophomores) and*
(○ —— ○) : *L2 (Law-Major Sophomores)*

178), side step (b: 0.152), vertical jump (b: 0.106) and grip strength (b: 0.260) on economics-major sophomores (E), in ***TABLE 3*** and weight (b: 0.241), girth of the chest (b: 0.230), vertical jump (b: 0.127), grip strength (b: 0.266) on law-major sophomores (L) in ***TABLE 4***, respectively. It is noted that as the sports test data increase, height data show a smaller fluctuation (b = 0.1 and lower), back strength (b: 0.032), trunk extension (b: 0.014), standing trunk flexion (b: −0.052) and step test (b: 0.015) on economics-major sophomores in ***TABLE 3*** and side step (b: 0.082), back strength (b: 0.061), trunk extension (b: 0.012), standing trunk flexion (b: −0.062) and step test (b: 0.031) 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. On the other hand, back strength, trunk extension, standing trunk flexion and step test go independent respectively. We find the difference between the two categories of students. The regression line values of law-major sophomores are greater in degree than economics-major ones: weight, girth of the chest, vertical jump, back strength and step test. On the other hand, the regression line values of economics-major sophomores are oppositely greater in degree than law-major ones: side step, trunk extension and standing trunk flexion. Accordingly, we find the difference between both the economics- and law-major students.

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, respectively. We can see that the heavier the weight item goes up, the heavier the sports test data items (positive regression: b) are: height (b:

0.721 in E and b: 0.846 in L), girth of the chest (b: 1.212 in E and b: 1.167 in L), back strength (b: 0.138 in E and b: 0.150 in L) and grip strength (b: 0.559 in E and b: 0.422 in L), while oppositely it is lighter (negative regression) in side step (b: −0.109 in E and b: −0.360 in L), vertical jump (b: −0.081 in E and b: −0.181 in L), standing trunk flexion (b: −0.071 in E and b: −0.118 in L) and step test (b: −0.101 in E and b: −0.109 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 those of 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: side step, vertical jump, standing trunk flexion and step test (***TABLE 3 and 4***). Accordingly, we find the difference between both the economics- and law-major students.

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 (6.35%), step D (9.80%), step C (46.75%), step B (28.75%) and step A (8.35%). On the other hand, the 1 gradation of minimum values are in side step, vertical jump, back strength, grip strength, trunk extension and step test. Moreover, the 4 gradation of maximum are in 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 1992 are plotted in ***FIG. 6***. Here, the points are considered to be arranged in a line in both cases of OUEL students' average (× ···· ×) and nationwide mean value (○ —— ○). Accordingly, we find a difference between OUEL students and nationwide

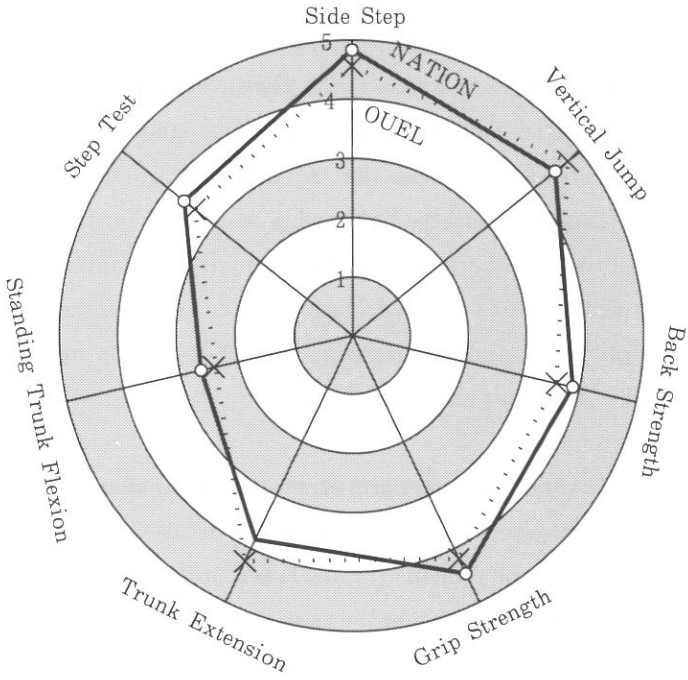

FIG. 6 *The 5 Gradation Evaluation of Physical Fitness Test for OUEL Sophomores (× - - ×) and Nationwide Mean Values (○—○) in 1992*

mean value. The nationwide mean values are graded greater in side step in degree for OUEL students, but the other grades are in the same level. Accordingly, we find the difference between both the economics- and law-major students.

5.2 Results of the Mean Values

In weight, 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 than law-major ones in degree; the difference is wide

in mean value of college students as a whole in weight, trunk extension and step test. The sports test data of law-major sophomores was compared with the nationwide average. As a result, the OUEL students tested recorded higher than the nationwide mean value of college students as a whole in weight, trunk extension and step test. Accordingly, we find a difference between OUEL students and the nationwide ones; that is, the sports test data obtained were 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, in weight, trunk extension and step test recorded higher than the nationwide average.

In girth of the chest, side step, grip 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 ones; the difference is wide in mean value of college students as a whole in girth of the chest, side step, grip strength and standing trunk flexion recorded lower than the nationwide average. The sports test data of law-major sophomores were compared with the nationwide average. As a result, the OUEL law-major students tested recorded lower than the nationwide mean value of college students as a whole and lower in girth of the chest, side step, grip strength and standing trunk flexion.

Accordingly, we find a difference between OUEL students and the nationwide ones; that is, the sports test data obtained were 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 is lower in girth of the chest, side step, grip strength and standing trunk flexion, respectively. The result is that mean values of OUEL students are lower than the nationwide average in degree.

The mean values of economics-major sophomores are higher than those of law-major sophomores in height, girth of the chest, side step, vertical jump, back strength, grip strength, standing trunk flexion and step test, but they are lower in all the other items; weight and trunk extension, respectively. Accordingly, we find the difference between the two major students; and economics-major sophomores are greater than law-major ones in degree. Consequently, the mean values of all OUEL student turned out to be higher in some items than the nationwide ones; weight, vertical jump, trunk extension and step test, but they are lower in all the other items; height, girth of the chest, side step, back strength, grip strength and standing trunk flexion, respectively.

5.3 Regression Coefficient

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

Furthermore, as to law-major sophomores regression coefficient on OUEL students calculated from information processing in the present study are positive and negative. The positive regression coefficients for items are in back strength. On the other hand, it was found that mixed positive and negative regression coefficients are in height, weight, girth of the chest, side step, vertical jump, grip strength, trunk extension, standing trunk flexion and step test, respectively. Accordingly, we find the difference between both the economics- and law-major students.

5.4 The Multiple-correlation Coefficient and F-ratio

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

In the sports test data for law-major sophomores. The multiple-correlation coefficient above R = 0.8 is related to weight-girth of the chest. On the other hand, the multiple-correlation coefficients between R = 0.3 and R = 0.7 are in height-weight, height-girth of the chest, height-grip strength, girth of the chest-back strength, side step-vertical jump, vertical jump-grip strength and back strength-grip strength, respectively.

Therefore, the sports test items for the trunk extension-standing trunk flexion with the multiple-correlation coefficient has a large value. Although, in the trunk extension-step test, the multiple-correlation coefficient and the F-ratio of scattering analysis has a very small value. Accordingly, we find the difference between both the economics- and law-major students.

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