

ESTIMATION OF STUDENTS' PERFORMANCE FROM CHARACTERISTICS OF SELF-EVALUATION –APPLYING T(TAGUCHI) METHOD TO UNIVERSITY STUDENTS –

Shinji YAMAGUCHI*
Kochi University of Technology*

ABSTRACT: This paper gives application of T (Taguchi) method to the relationship between students' performance and characteristics. So, I selected the characteristics data researched when students entered the university, and 2 kinds of performance data of 2nd grade each quarters, that is, numbers of acquired study-units and GPA value. The results show that good performance factors are serious, hard, dream. There is different results acquired units and GPA. GPA is appropriate indicator for evaluation.

KEYWORDS: T(1) method, unit norm(space), performance, total acquired study-units, GPA(Grade Point Average), student characteristics, MT system, MT distance

1. BACKGROUND AND OBJECTIVE

If students' performances can be estimated from their human characteristics of self-evaluation, we may find the difficult student quickly.

So, we choose the average performance students as unit norm (space), we can analyze the performance by T methods.

The students self-evaluation of characteristics may have intentional factors, but it will be converged to the average from many data. I guess this characteristics is not real characteristics, but their favorable word of characteristics.

This time I tried the students of management faculty.

2. METHODOLOGY

Taguchi's T(1) method is applied. This method is developed by Dr. Genichi Taguchi from late 1970. This method is applying to the wide areas, such as medical diagnosis, price of real estate and land, company management, process engineering etc. T method has 3 types, T(1), T(2), T(3). and MT system has MT, MTA, TS, and T methods. T(1) method's steps are as follows.

- (1) Definition of unit norm(space), and calculation of members average.
- (2) Definition of signal data

- (3) Normalization of signal data
- (4) Proportional constant β are calculated
- (5) Total estimation of each members output calculation
- (6) Total estimation of SN ratio
- (7) Evaluation of importance of items by using orthogonal array table (so called item selection)
- (8) Total estimate for unknown data calculation
- (9) Total estimate calculation

3. UNIT NORM(SPACE) AND SIGNAL DATA

The concept of unit norm and signal data is shown in Fig.3-1. Unit norm is not extraordinary data. So unit norm is thought as average data.

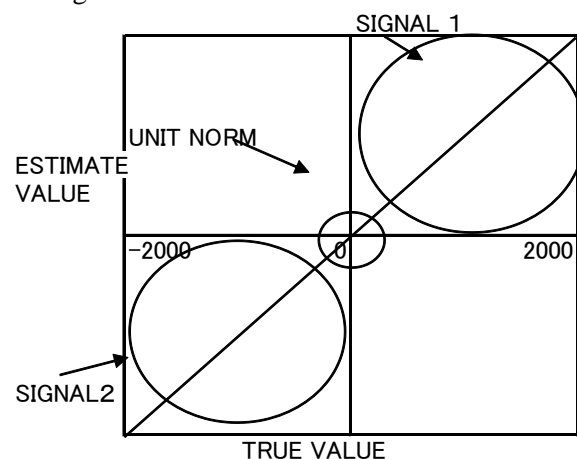


Fig.3-1 CONCEPT OF UNIT NORM AND SIGNAL

Objective total sample is 390 as quarter series data per student.

Unit norm is average of performance data 22.

4. STUDENTS AND CHARACTERISTICS WORDS

The performance data are from 1 to 2nd half grade, and characteristics data from 1st grade student self-evaluation. Human characteristics are 12 items. Each item are graded from 1 to 5.

- 1) Have will (volition)(aggressive , enthusiasm)
- 2) Have physical power
- 3) Have communication ability (can explain to others)
- 4) Have dream or target
- 5) Gentle & mild
- 6) Serious (grave & steady)

- 7) Gentle to others
- 8) Keep one's promise
- 9) Polite or courteous
- 10) Self-confidence
- 11) Cooperative (conciliatory)

And, 12 gender(male) ,13 grade(each quarter) are added.

The total sample no. is 390, as 6 quarter series data per student. Unit norm is average performance data 22.

5. EVALUATION OF TOTAL ACQUIRED STUDY-UNITS BY T METHOD

After normalization of unit norm ,and subtraction the unit norm ,data are recalculated as shown Table5-1. Total acquired study-units' factor-effect diagram and gain of SN ratio are shown in Fig.5-1, Table5-2.

Table 5-1. Input data of total acquired study-units,14 factors

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------

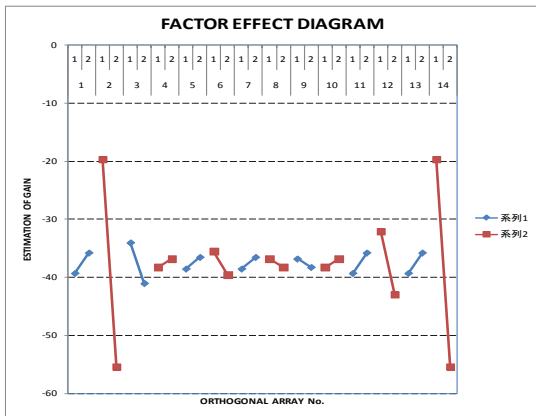


Fig.5-1 FACTOR EFFECT DAIGRAM

Table5-2 SN RATIO GAIN SEQUENCE OF TOTAL ACQUIRED UNITS

GAIN SEQUENCE	SORT RESULT	GAIN	FACTOR
1	2	35.67709	PHYSICAL POWER
2	14	35.67709	YEAR GRADE
3	12	10.85514	COOPERATIVE
4	3	7.015512	COMMUNICATION
5	6	4.047887	SERIOUS
6	9	1.461465	PROMISE
7	8	1.459946	GENTLE TO OTHERS
8	10	-1.45991	POLITE
9	4	-1.46148	DREAM
10	7	-1.9896	HARD
11	5	-1.98965	GENTLE & MILD
12	13	-3.51233	GENDER (MAEL)
13	1	-3.51233	WILL
14	11	-3.51532	SELF-CONFIDENT

The factors of plus gain is 2,14,12,3,6,9,8 ,and these are effective, and minus gain is 10,4,7,5,13,1,11,and those are not effective.

The estimation of true value is done by using 7 plus factors in Table 5-2. The results are shown as Fig.5-2.

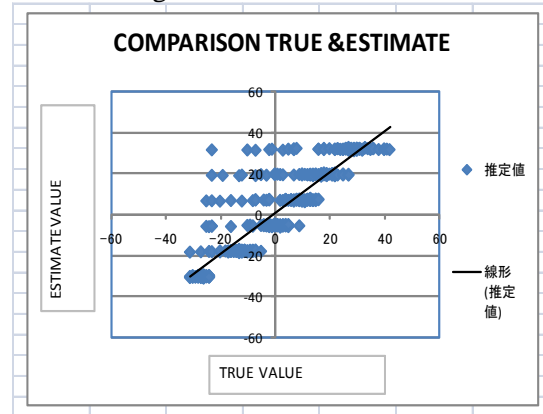


Fig.5-2 PERFORMANCE COMPARISON OF TRUE VALUE AND ESTIMATE

From factor item selection, performance equation is calculated, and the coefficient of equation and unit norm's constant are shown in Table 5-3.

Table5-3 CHARACTERISTICS FACTOR ,GAIN, AND ESTIMATION EQUATION'S COEFFICIENT AND CONSTANT

FACTOR	GAIN	COEFFICIENT	CONSTANT OF UNIT NORM
WILL	-3.51233	0	3.181818
PHYSICAL POWER	35.67709	-0.16075	2.590909
COMMUNICATION	7.015512	-0.26827	2.590909
DREAM	-1.46148	0	3.136364
GENTLE & MILD	-1.98965	0	3.454545
SERIOUS	4.047887	0.047097	3.272727
HARD	-1.9896	0	2.590909
GENTLE TO OTHERS	1.459946	0	3.409091
PROMISE	1.461465	0	3.363636
POLITE	-1.45991	0	3.409091
SELF-CONFIDENT	-3.51532	0	2.5
COOPERATIVE	10.85514	0	3.318182
GENDER(MALE)	-3.51233	0	0.727273
YEAR GRADE	35.67709	49.65684	0.852273
			32.18182

Table 6-1. INPUT DATA OF GPA,14 FACTORS

From these data, condition $S \beta - VE \geq 0$ applied, many factors are omitted.

The plus coefficient factor is 6 serious. The 2 physical power and 3 communication ability have reverse relation with total acquired units. Study-units are proportional with grade, and coefficient is 49.8 near 48 limit maximum attainable units per year grade.

Enterprises evaluate generally the communication ability at entrance examination. But communication ability is reciprocal with performance.

Enterprises look for the compatibility of the different characters of students.

6. EVALUATION OF GPA GRADE BY T METHOD

After normalization of unit norm, and subtraction the unit norm, data are recalculated as shown Table6-1. GPA factor-effect diagram and gain of SN ratio are shown in Fig.6-1, Table6-2.

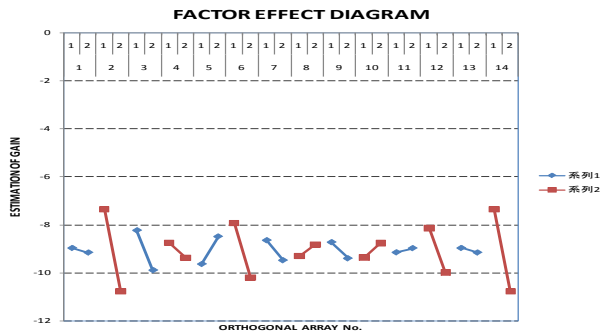


Fig.6-1 FACTOR EFFECT DAIGRAM OF GPA
Table6-2 SN RATIO GAIN SEQUENCE OF GPA

GAIN SEQUENCE	SORT RESULT	GAIN	FACTOR
1	2	3.391375	PHYSICAL POWER
2	14	3.391375	YEAR GRADE
3	6	2.261729	SERIOUS
4	12	1.835994	COOPERATIVE
5	3	1.64163	COMMUNICATION
6	7	0.825113	HARD
7	9	0.665717	PROMISE
8	4	0.61592	DREAM
9	13	0.187156	GENDER(MAEL)
10	1	0.187156	WILL
11	11	-0.17263	SELF-CONFIDENT
12	8	-0.48495	GENTLE TO OTHERS
13	10	-0.58922	POLITE
14	5	-1.13218	GENTLE &MILD

The factors of plus gain is 2,14,12,3,6,9,8 ,1,7,13,and these are effective and minus gain is 10,8,5, 11,and those are not effective. The estimation of true value is done by using 10 plus factors in Table 6-2. The results are shown as Fig.6-2.

Fig.6-2 PERFORMANCE COMPARISON OF TRUE VALUE AND ESTIMATE OF GPA

From factor item selection, performance equation is calculated, and the coefficient of equation and unit norm's constant are shown in Table 6-3.

Table6-3 CHARACTERISTICS FACTOR ,GAIN, AND ESTIMATION EQUATION'S COEFFICIENT AND CONSTANT OF GPA

FACTOR	GAIN	COEFFICIENT	CONSTANT OF UNIT NORM
WILL	0.187156	-0.54212	3.545455
PHYSICAL POWER	3.391375	-0.84372	3.045455
COMMUNICATION	1.64163	-0.87414	2.909091
DREAM	0.61592	0.346675	3.227273
GENTLE & MILD	-1.13218	0	3.045455
SERIOUS	2.261729	0.942631	3.318182
HARD	0.825113	0.519374	3.090909
GENTLE TO OTHERS	-0.48495	0	3.727273
PROMISE	0.665717	0	3.863636
POLITE	-0.58922	0	4.136364
SELF-CONFIDENT	-0.17263	0	2.136364
COOPERATIVE	1.835994	0	3.5
GENDER (MALE)	0.187156	-0.71479	0.636364
YEAR GRADE	3.391375	-1.8957	1.022727
			2.122727

From these data, condition $S\beta - VE \geq 0$ applied, some factors are omitted.

The plus coefficient factors are 6 serious, 7 hard, 4 dream. The 2 physical power, 3 communication ability and 1 will have reverse relation with GPA. GPA is reciprocal with grade.

Enterprises evaluate generally the communication ability at entrance examination. But communication ability is reciprocal with performance.

Enterprises look for the compatibility of the different characters of students.

7. RESULT OF PERFORMANCE AND CHARACTERISTICS

I got some knowledge between performance and characteristics by application of T method.

The conclusion and future issue are as follows.

- 1) In comparing total acquired study-units and GPA, GPA is good indicator related the characteristics, because acquired units are graduation condition, that is 124 units, are same case, but acquired level are different such as A, B, C, that is, different capability and different efforts.
- 2) The 4 dream, 6 serious, 7 hard, are plus factors for performance.
- 3) The 1 will, 2 physical power, 3 communication ability, are minus factors for performance.
- 4) The 5 gentle, 8 gentle to others, 9 promise, 10 polite, 11 self-confident, 12 cooperate do not affect to performance.
- 5) The 13 gender (male), 14 year grade are minus effect to GPA, but gender do not affect acquired study-units. The year grade affects plus to acquired study-units.

Future issues are as follows.

- 1) Data's variation is large from the personal self-evaluation, because students have 2 kinds tendency to seem high level person, and low level person. There are difference of standard of level.
- 2) The general relation is found from the estimate equation of T method. Future issues are applications to different faculties, and different year grade students.
- 3) The real problematic students' behavior are not coming to university, not deliver of home work. So, we can find these special students, but it is difficult to recover to study.

8. CONCLUSIONS AND SUMMARY

I understand dummy factors ,such as 1 or 0, are useful to analyze.

I thank to the cooperation of the students.

I would like to understand this method deeply. I would like to use this method as teaching tool of management education.

REFERENCES

- 1) Ohken: multi-dimensional information system data analysis software
- 2) SHINJI YAMAGUCHI, PRICING MANAGEMENT BETWEEN AIRCONDITIONER RETAIL PRICE AND SPECIFICATION FACTORS -APPLYING T(TAGUCHI)METHOD-,SSMS, 2009.3
- 3) 山口信次、“ロバストデザイン教育教材の開発検討(2), 2008年12月 高知工科大学紀要 第5巻第1号、p135-145
- 4) 山口信次、“ロバストデザイン教育教材の開発検討(3), 2009年6月 高知工科大学紀要 第6巻第1号、p173-182
- 5) 山口信次、“ロバストデザイン教育教材の開発検討(4), 2009年6月 高知工科大学紀要 第6巻第1号、p183-193