

บรรณานุกรม



ภาษาไทย

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การศึกษาคณะศึกษาศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ ประสานมิตร, 2532.
- ณัฐภา สรรพศรี. การแจกแจงของค่าดัชนีประสิทธิผลการจัดการเรียนการสอน. วิทยานิพนธ์
การศึกษาคณะศึกษาศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ ประสานมิตร, 2531.
- ทองดี แยมสรवल. การศึกษาลักษณะการแจกแจงการควบคุมความคลาดเคลื่อนประเภทที่ 1 และ
อำนาจของสถิติทดสอบสำหรับค่าสัมประสิทธิ์สหสัมพันธ์แบบสเปียร์แมน เคสคลทเท และ
เคลมเมอร์วี. วิทยานิพนธ์ครุศาสตร์มหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2530.
- ศิริจันทร์ ทองประเสริฐ. การจำลองแบบกักตุน. วิทยานิพนธ์จุฬาลงกรณ์มหาวิทยาลัย, 2535
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ข้อกระทง. วิทยานิพนธ์ครุศาสตร์มหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2534.
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ที่ภาควิชาวิจัยการศึกษา คณะครุศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

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ภาคผนวก

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ภาคผนวก ก ตารางค่าแลมดาของแรมเบิร์ตสำหรับปรับโค้งให้เข้าตามต้องการ

ภาคผนวก ข ค่าความยากของเครื่องมือวัด การตรวจสอบเลขคู่ และตัวอย่าง

ต่างๆ ประกอบการอภิปราย

ภาคผนวก ค ตัวอย่างโปรแกรมที่ใช้ในการวิจัย



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ภาคผนวก ก ตารางค่าแลมดาของสมรรถเบิร์กสำหรับปรับโค้งให้เข้าตามต้องการ



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ตาราง 1ก ค่าแลมดาสำหรับความหน้ (α_3) และความโค้ง (α_4) ต่างๆ เมื่อ $\mu=0$ และ $\sigma=1$

$\alpha_3 = 0.0$					$\alpha_3 = 0.05$					$\alpha_3 = 0.10$				
α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4
1.8	.0	-.5774	1.0000	1.0000	1.8	-1.703	-.2861	.0000	.9502*	1.8	-1.678	-.2835	.0000*	.9071*
2.0	.0	-.4952	.5843	.5843	2.0	-1.229	-.3122	.0505	.7603	2.0	-1.271	-.3028	.0412	.7373
2.2	.0	-.4197	.4092	.4092	2.2	-.802	-.3314	.1128	.5802	2.2	-.872	-.3177	.0941	.5700
2.4	.0	-.3533	.3032	.3032	2.4	-.375	-.3328	.1876	.3941	2.4	-.515	-.3164	.1477	.4116
2.6	.0	-.2949	.2303	.2303	2.6	-.143	-.2924	.1973	.2605	2.6	-.269	-.2863	.1678	.2831
2.8	.0	-.2433	.1765	.1765	2.8	-.083	-.2429	.1625	.1903	2.8	-.164	-.2417	.1486	.2033
3.0	.0	-.1974	.1349	.1349	3.0	-.059	-.1975	.1276	.1425	3.0	-.117	-.1977	.1205	.1503
3.2	.0	-.1563	.1016	.1016	3.2	-.046	-.1565	.0974	.1061	3.2	-.092	-.1572	.0936	.1111
3.4	.0	-.1191	.0742	.0742	3.4	-.038	-.1194	.0718	.0770	3.4	-.076	-.1203	.0698	.0803
3.6	.0	-.0852	.0512	.0512	3.6	-.033	-.0856	.0499	.0530	3.6	-.065	-.0866	.0490	.0552
3.8	.0	-.0545	.0317	.0317	3.8	-.027	-.0548	.0311	.0327	3.8	-.057	-.0558	.0308	.0342
4.0	.0	-.0262	.0148	.0148	4.0	-.026	-.0264	.0146	.0153	4.0	-.049	-.0276	.0149	.0163
4.1	.0	-.0128	.0140*	.0140*	4.1	-.024	.0132	.0184*	.0150*	4.1	-.048	.0142	.0142	.0163
4.2	.0	-.0659*	-.0363*	-.0363*	4.2	-.024	.0704*	-.0380*	-.0397*	4.2	-.046	.0140*	.0140*	.0163
4.3	.0	-.0123	-.0130	-.0130	4.3	-.022	-.0120	-.0386*	-.0397*	4.3	-.044	-.0109	-.0109	.0163
4.4	.0	-.0241	-.0246	-.0246	4.4	-.022	-.0238	-.0126	-.0131	4.4	-.041	-.0227	-.0227	.0163
4.6	.0	-.0466	-.0246	-.0246	4.6	-.018	-.0462	-.0240	-.0248	4.6	-.037	-.0452	-.0452	.0163
4.8	.0	-.0676	-.0350	-.0350	4.8	-.019	-.0671	-.0342	-.0354	4.8	-.036	-.0661	-.0661	.0163
5.0	.0	-.0870	-.0443	-.0443	5.0	-.016	-.0867	-.0435	-.0448	5.0	-.033	-.0857	-.0857	.0163
5.2	.0	-.1053	-.0528	-.0528	5.2	-.016	-.1050	-.0519	-.0534	5.2	-.032	-.1040	-.1040	.0163
5.4	.0	-.1227	-.0606	-.0606	5.4	-.015	-.1222	-.0596	-.0612	5.4	-.030	-.1213	-.1213	.0163
5.6	.0	-.1389	-.0677	-.0677	5.6	-.014	-.1386	-.0667	-.0684	5.6	-.028	-.1375	-.1375	.0163
5.8	.0	-.1541	-.0742	-.0742	5.8	-.014	-.1538	-.0731	-.0750	5.8	-.027	-.1520	-.1520	.0163
6.0	.0	-.1686	-.0802	-.0802	6.0	-.013	-.1682	-.0791	-.0810	6.0	-.027	-.1674	-.1674	.0163
6.2	.0	-.1823	-.0858	-.0858	6.2	-.012	-.1820	-.0847	-.0866	6.2	-.025	-.1811	-.1811	.0163
6.4	.0	-.1954	-.0910	-.0910	6.4	-.012	-.1950	-.0899	-.0918	6.4	-.024	-.1903	-.1903	.0163
6.6	.0	-.2077	-.0958	-.0958	6.6	-.012	-.2074	-.0947	-.0967	6.6	-.023	-.2066	-.2066	.0163
6.8	.0	-.2194	-.1003	-.1003	6.8	-.011	-.2192	-.0992	-.1012	6.8	-.023	-.2184	-.2184	.0163
7.0	.0	-.2306	-.1045	-.1045	7.0	-.011	-.2303	-.1034	-.1054	7.0	-.022	-.2297	-.2297	.0163
7.2	.0	-.2414	-.1085	-.1085	7.2	-.010	-.2411	-.1074	-.1094	7.2	-.021	-.2405	-.2405	.0163
7.4	.0	-.2518	-.1123	-.1123	7.4	-.010	-.2515	-.1112	-.1132	7.4	-.020	-.2507	-.2507	.0163
7.6	.0	-.2615	-.1158	-.1158	7.6	-.009	-.2613	-.1147	-.1167	7.6	-.020	-.2606	-.2606	.0163
7.8	.0	-.2709	-.1191	-.1191	7.8	-.009	-.2707	-.1180	-.1201	7.8	-.020	-.2699	-.2699	.0163
8.0	.0	-.2800	-.1223	-.1223	8.0	-.008	-.2800	-.1212	-.1232	8.0	-.019	-.2791	-.2791	.0163
8.2	.0	-.2887	-.1253	-.1253	8.2	-.008	-.2884	-.1242	-.1262	8.2	-.019	-.2878	-.2878	.0163
8.4	.0	-.2969	-.1281	-.1281	8.4	-.008	-.2969	-.1270	-.1291	8.4	-.018	-.2961	-.2961	.0163
8.6	.0	-.3050	-.1308	-.1308	8.6	-.008	-.3050	-.1297	-.1318	8.6	-.017	-.3041	-.3041	.0163
8.8	.0	-.3128	-.1334	-.1334	8.8	-.008	-.3128	-.1323	-.1343	8.8	-.017	-.3119	-.3119	.0163
9.0	.0	-.3203	-.1359	-.1359	9.0	-.008	-.3203	-.1348	-.1368	9.0	-.017	-.3193	-.3193	.0163
$\alpha_3 = 0.15$					$\alpha_3 = 0.20$					$\alpha_3 = 0.25$				
α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4
1.8	-1.655	-.2811	.0000*	.8700*	2.0	-1.387	-.2881	.0212	.7090	2.0	-1.465	-.2748	.0105	.7034
2.0	-1.323	-.2934	.0314	.7204	2.2	-1.011	-.2947	.0638	.5571	2.2	-1.084	-.2847	.0506	.5588
2.2	-.940	-.3056	.0782	.5623	2.4	-.706	-.2919	.1013	.4246	2.4	-.790	-.2820	.0843	.4294
2.4	-.617	-.3031	.1215	.4194	2.6	-.471	-.2718	.1233	.3120	2.6	-.558	-.2650	.1062	.3226
2.6	-.376	-.2791	.1435	.2994	2.8	-.322	-.2374	.1221	.2273	2.8	-.398	-.2349	.1099	.2385
2.8	-.244	-.2397	.1135	.1586	3.0	-.237	-.1983	.1065	.1672	3.0	-.298	-.1987	.0996	.1763
3.0	-.177	-.1980	.0901	.1167	3.2	-.187	-.1599	.0866	.1200	3.2	-.237	-.1619	.0831	.1300
3.2	-.138	-.1594	.0682	.0843	3.4	-.154	-.1240	.0647	.0809	3.4	-.196	-.1266	.0653	.0942
3.4	-.114	-.1219	.0485	.0581	3.6	-.132	-.0908	.0482	.0615	3.6	-.167	-.0937	.0481	.0656
3.6	-.098	-.0884	.0310	.0363	3.8	-.116	-.0601	.0314	.0399	3.8	-.147	-.0632	.0321	.0421
3.8	-.086	-.0577	.0155	.0178	4.0	-.103	-.0318	.0164	.0198	4.0	-.131	-.0351	.0176	.0224
4.0	-.076	-.0294	.0037*	.0064*	4.1	-.097	.0185	.0467*	.0113	4.1	-.126	.0217	.0108	.0136
4.1	-.073	.0160	.0378*	.0378*	4.2	-.093	.0570*	.0294*	.0329*	4.2	-.118	.0889*	.0408*	.0467*
4.2	-.069	.0317*	.0667*	.0667*	4.3	-.089	.0664*	.0342*	.0329*	4.3	-.113	.0347*	.0173*	.0210*
4.3	-.066	-.0113*	-.0107	-.0120	4.4	-.085	-.0185	-.0216	-.0106	4.4	-.108	-.0154	-.0104	-.0125
4.4	-.063	-.0210	-.0218	-.0242	4.6	-.079	-.0410	-.0202	-.0233	4.6	-.099	-.0380	-.0184	-.0220
4.6	-.056	-.0435	-.0318	-.0351	4.8	-.074	-.0622	-.0302	-.0345	4.8	-.094	-.0591	-.0282	-.0334
4.8	-.055	-.0644	-.0410	-.0449	5.0	-.069	-.0818	-.0392	-.0444	5.0	-.087	-.0790	-.0373	-.0436
5.0	-.051	-.0842	-.0493	-.0537	5.2	-.065	-.1003	-.0475	-.0534	5.2	-.082	-.0974	-.0455	-.0527
5.2	-.048	-.1025	-.0569	-.0617	5.4	-.061	-.1176	-.0551	-.0615	5.4	-.077	-.1149	-.0531	-.0610
5.4	-.045	-.1199	-.0639	-.0690	5.6	-.058	-.1339	-.0621	-.0689	5.6	-.073	-.1312	-.0601	-.0685
5.6	-.043	-.1361	-.0703	-.0757	5.8	-.055	-.1494	-.0686	-.0757	5.8	-.070	-.1467	-.0665	-.0754
5.8	-.042	-.1514	-.0763	-.0819	6.0	-.053	-.1639	-.0745	-.0819	6.0	-.067	-.1613	-.0725	-.0817
6.0	-.040	-.1660	-.0819	-.0876	6.2	-.051	-.1778	-.0801	-.0877	6.2	-.064	-.1753	-.0781	-.0876
6.2	-.038	-.1798	-.0870	-.0929	6.4	-.049	-.1909	-.0853	-.0930	6.4	-.062	-.1885	-.0833	-.0930
6.4	-.037	-.1928	-.0919	-.0978	6.6	-.047	-.2034	-.0901	-.0980	6.6	-.059	-.2010	-.0882	-.0980
6.6	-.035	-.2053	-.0964	-.1024	6.8	-.045	-.2153	-.0947	-.1026	6.8	-.058	-.2129	-.0927	-.1027
6.8	-.034	-.2172	-.1006	-.1067	7.0	-.044	-.2265	-.0989	-.1069	7.0	-.055	-.2242	-.0970	-.1070
7.0	-.033	-.2284	-.1046	-.1107	7.2	-.043	-.2374	-.1029	-.1110	7.2	-.054	-.2350	-.1010	-.1111
7.2	-.032	-.2392	-.1084	-.1145	7.4	-.041	-.2477	-.1067	-.1148	7.4	-.052	-.2455	-.1048	-.1150
7.4	-.031	-.2496	-.1119	-.1180	7.6	-.040	-.2577	-.1103	-.1184	7.6	-.051	-.2554	-.1084	-.1186
7.6	-.030	-.2593	-.1153	-.1214	7.8	-.039	-.2671	-.1136	-.1218	7.8	-.049	-.2649	-.1118	-.1220
7.8	-.029	-.2688	-.1185	-.1246	8.0	-.038	-.2762	-.1168	-.1250	8.0	-.048	-.2742	-.1151	-.1252
8.0	-.028	-.2780	-.1215	-.1276	8.2	-.037	-.2850	-.1199	-.1280	8.2	-.047	-.2829	-.1181	-.1283
8.2	-.028	-.2866	-.1243	-.1304	8.4	-.036	-.2935	-.1228	-.1309	8.4	-.046	-.2914	-.1210	-.1312
8.4	-.027	-.2948	-.1271	-.1332	8.6	-.035	-.3014	-.1255	-.1336	8.6	-.044	-.2995	-.1238	-.1339
8.6	-.027	-.3031	-.1297	-.1357	8.8	-.034	-.3092	-.1281	-.1362	8.8	-.044	-.3072	-.1264	-.1365
8.8	-.026	-.3108	-.1322	-.1382	9.0	-.034	-.3168	-.1306	-.1387	9.0	-.043	-.3147	-.1289	-.1390
9.0	-.025	-.3183	-.1347	-.1407	9.2	-.034	-.3241	-.1330	-.1411	9.2	-.042	-.3220	-.1313	-.1414

ตาราง 1ก (ต่อ)

$\alpha_3 = 0.30$					$\alpha_3 = 0.35$					$\alpha_3 = 0.40$				
α_4	LAN 1	LAN 2	LAN 3	LAN 4	α_4	LAN 1	LAN 2	LAN 3	LAN 4	α_4	LAN 1	LAN 2	LAN 3	LAN 4
2.0	-1.550	.2660	.0000	.7020	2.0	-1.539	.2639	.0000	.6836	2.2	-1.354	.2582	.0129	.5683
2.2	-1.164	.2755	.0380	.5556	2.2	-1.252	.2668	.0256	.5599	2.4	-1.043	.2580	.0430	.4500
2.4	-.871	.2733	.0695	.4348	2.4	-.955	.2653	.0559	.4415	2.6	-.808	.2473	.0648	.3527
2.6	-.642	.2586	.0911	.3324	2.6	-.724	.2528	.0775	.3423	2.8	-.627	.2273	.0767	.2720
2.8	-.474	.2323	.0983	.2495	2.8	-.550	.2298	.0873	.2606	3.0	-.494	.2000	.0782	.2069
3.0	-.362	.1991	.0925	.1859	3.0	-.427	.1996	.0854	.1961	3.2	-.400	.1690	.0718	.1555
3.2	-.288	.1641	.0796	.1377	3.2	-.343	.1665	.0758	.1462	3.4	-.333	.1371	.0609	.1149
3.4	-.239	.1298	.0640	.1003	3.4	-.285	.1333	.0625	.1072	3.6	-.284	.1060	.0482	.0824
3.6	-.204	.0973	.0481	.0704	3.6	-.243	.1014	.0482	.0760	3.8	-.248	.0764	.0351	.0558
3.8	-.179	.0671	.0330	.0460	3.8	-.213	.0714	.0340	.0505	4.0	-.222	.0485	.0223	.0337
4.0	-.160	.0389	.0190	.0255	4.0	-.191	.0434	.0206	.0293	4.2	-.200	.0224	.0103	.0189
4.2	-.144	.0127	.0175	.0035	4.2	-.172	.0173	.0158	.0112	4.3	-.190	.0100	.0057	.0121
4.3	-.138	.0789	.0380	.0489	4.3	-.163	.0870	.0293	.0209	4.4	-.182	-.0397	.0182	.0254
4.4	-.131	-.0116	-.0554	-.0707	4.4	-.156	-.0710	-.0332	-.0431	4.5	-.174	-.0136	-.0204	-.0533
4.5	-.129	-.0231	-.0110	-.0139	4.5	-.151	-.0187	-.0723	-.0115	4.6	-.166	-.0248	-.0113	-.0153
4.6	-.121	-.0343	-.0163	-.0203	4.6	-.142	-.0298	-.0139	-.0180	4.8	-.155	-.0462	-.0209	-.0277
4.8	-.113	-.0554	-.0260	-.0319	4.8	-.132	-.0511	-.0236	-.0300	5.0	-.146	-.0662	-.0297	-.0387
5.0	-.105	-.0752	-.0350	-.0423	5.0	-.124	-.0710	-.0325	-.0407	5.2	-.136	-.0850	-.0379	-.0485
5.2	-.100	-.0939	-.0432	-.0517	5.2	-.117	-.0898	-.0407	-.0503	5.4	-.129	-.1027	-.0455	-.0574
5.4	-.094	-.1114	-.0508	-.0601	5.4	-.110	-.1074	-.0483	-.0589	5.6	-.122	-.1194	-.0525	-.0654
5.6	-.089	-.1279	-.0578	-.0678	5.6	-.105	-.1240	-.0553	-.0668	5.8	-.115	-.1352	-.0591	-.0727
5.8	-.085	-.1435	-.0643	-.0748	5.8	-.100	-.1396	-.0618	-.0739	6.0	-.111	-.1501	-.0651	-.0794
6.0	-.081	-.1582	-.0703	-.0812	6.0	-.096	-.1545	-.0678	-.0805	6.2	-.106	-.1643	-.0708	-.0856
6.2	-.078	-.1722	-.0759	-.0872	6.2	-.091	-.1685	-.0735	-.0865	6.4	-.102	-.1778	-.0761	-.0913
6.4	-.075	-.1854	-.0811	-.0927	6.4	-.088	-.1818	-.0787	-.0921	6.6	-.098	-.1906	-.0811	-.0966
6.6	-.072	-.1979	-.0860	-.0977	6.6	-.085	-.1945	-.0836	-.0973	6.8	-.094	-.2026	-.0857	-.1014
6.8	-.069	-.2100	-.0906	-.1025	6.8	-.082	-.2067	-.0883	-.1021	7.0	-.091	-.2142	-.0901	-.1060
7.0	-.067	-.2214	-.0949	-.1069	7.0	-.079	-.2181	-.0926	-.1066	7.2	-.089	-.2253	-.0942	-.1103
7.2	-.065	-.2325	-.0990	-.1111	7.2	-.077	-.2291	-.0967	-.1108	7.4	-.086	-.2359	-.0981	-.1143
7.4	-.063	-.2427	-.1028	-.1149	7.4	-.074	-.2396	-.1006	-.1147	7.6	-.083	-.2459	-.1018	-.1180
7.6	-.061	-.2528	-.1064	-.1186	7.6	-.072	-.2496	-.1042	-.1184	7.8	-.081	-.2558	-.1053	-.1216
7.8	-.060	-.2623	-.1098	-.1220	7.8	-.070	-.2593	-.1077	-.1219	8.0	-.079	-.2650	-.1086	-.1249
8.0	-.058	-.2716	-.1131	-.1253	8.0	-.068	-.2685	-.1109	-.1252	8.2	-.077	-.2741	-.1118	-.1281
8.2	-.056	-.2805	-.1162	-.1284	8.2	-.066	-.2775	-.1141	-.1283	8.4	-.075	-.2827	-.1148	-.1311
8.4	-.055	-.2889	-.1191	-.1313	8.4	-.065	-.2860	-.1170	-.1313	8.6	-.075	-.2908	-.1176	-.1339
8.6	-.054	-.2971	-.1219	-.1341	8.6	-.064	-.2942	-.1198	-.1341	8.8	-.072	-.2988	-.1203	-.1366
8.8	-.053	-.3050	-.1246	-.1367	8.8	-.062	-.3020	-.1225	-.1367	9.0	-.070	-.3064	-.1229	-.1391
9.0	-.052	-.3125	-.1271	-.1392	9.0	-.060	-.3096	-.1251	-.1392	9.2	-.069	-.3139	-.1254	-.1416
9.2	-.051	-.3197	-.1295	-.1416	9.2	-.059	-.3172	-.1276	-.1417	9.4	-.067	-.3210	-.1278	-.1439

$\alpha_3 = 0.45$					$\alpha_3 = 0.50$					$\alpha_3 = 0.55$				
α_4	LAN 1	LAN 2	LAN 3	LAN 4	α_4	LAN 1	LAN 2	LAN 3	LAN 4	α_4	LAN 1	LAN 2	LAN 3	LAN 4
2.2	-1.471	.2500	.0000	.5812	2.4	-1.245	.2445	.0178	.4748	2.4	-1.370	.2379	.4463	.4931
2.4	-1.138	.2511	.0305	.4608	2.6	-.987	.2376	.0410	.3770	2.6	-1.087	.2331	.0292	.3920
2.6	-.894	.2424	.0528	.3641	2.8	-.790	.2225	.0561	.2969	2.8	-.879	.2202	.0859	.3109
2.8	-.707	.2248	.0663	.2840	3.0	-.635	.2006	.0630	.2307	3.0	-.716	.2009	.0551	.2440
3.0	-.565	.2003	.0707	.2184	3.2	-.525	.1742	.0625	.1768	3.2	-.593	.1767	.0572	.1889
3.2	-.460	.1716	.0674	.1657	3.4	-.440	.1454	.0566	.1332	3.4	-.499	.1497	.0538	.1438
3.4	-.384	.1412	.0590	.1236	3.6	-.376	.1163	.0472	.0979	3.6	-.422	.1217	.0467	.1070
3.6	-.329	.1110	.0480	.0897	3.8	-.329	.0877	.0369	.0689	3.8	-.372	.0990	.0376	.0767
3.8	-.287	.0818	.0361	.0619	4.0	-.290	.0604	.0259	.0447	4.0	-.330	.0670	.0275	.0514
4.0	-.255	.0542	.0241	.0388	4.2	-.262	.0345	.0149	.0243	4.2	-.298	.0413	.0172	.0301
4.2	-.230	.0202	-.0126	-.0191	4.3	-.246	.0221	-.0582	.0152	4.4	-.265	.0170	-.0749	.0118
4.3	-.221	.0158	-.0745	-.0106	4.4	-.238	.0101	-.0383	.0815	4.5	-.257	.0355	-.0258	.0364
4.4	-.206	.0102	-.1833	-.0291	4.5	-.228	-.0122	-.0700	-.1066	4.6	-.247	-.0594	-.0251	-.0397
4.5	-.200	-.0761	-.3505	-.0665	4.6	-.219	-.0128	-.0570	-.0834	4.7	-.237	-.0169	-.0760	-.0111
4.6	-.192	-.0191	-.0511	-.0249	4.8	-.202	-.0344	-.0149	-.0216	4.8	-.227	-.0276	-.0177	-.0178
4.8	-.178	-.0406	-.0180	-.0249	5.0	-.188	-.0546	-.0236	-.0333	5.0	-.213	-.0480	-.0203	-.0300
5.0	-.165	-.0607	-.0268	-.0362	5.2	-.177	-.0737	-.0317	-.0438	5.2	-.200	-.0671	-.0283	-.0408
5.2	-.157	-.0796	-.0349	-.0464	5.4	-.167	-.0917	-.0393	-.0532	5.4	-.187	-.0852	-.0359	-.0505
5.4	-.147	-.0975	-.0425	-.0555	5.6	-.157	-.1087	-.0464	-.0617	5.6	-.177	-.1024	-.0430	-.0593
5.6	-.140	-.1142	-.0495	-.0637	5.8	-.150	-.1246	-.0529	-.0694	5.8	-.165	-.1184	-.0495	-.0672
5.8	-.132	-.1302	-.0561	-.0712	6.0	-.142	-.1398	-.0591	-.0764	6.0	-.161	-.1338	-.0557	-.0745
6.0	-.127	-.1453	-.0622	-.0781	6.2	-.137	-.1542	-.0648	-.0829	6.2	-.153	-.1483	-.0615	-.0811
6.2	-.121	-.1595	-.0679	-.0844	6.4	-.131	-.1679	-.0702	-.0889	6.4	-.147	-.1620	-.0669	-.0872
6.4	-.116	-.1731	-.0733	-.0902	6.6	-.126	-.1809	-.0753	-.0944	6.6	-.141	-.1753	-.0721	-.0929
6.6	-.112	-.1860	-.0783	-.0956	6.8	-.122	-.1933	-.0800	-.0995	6.8	-.136	-.1878	-.0769	-.0981
6.8	-.108	-.1983	-.0830	-.1006	7.0	-.117	-.2050	-.0845	-.1042	7.0	-.131	-.1997	-.0814	-.1030
7.0	-.104	-.2098	-.0874	-.1052	7.2	-.114	-.2163	-.0887	-.1087	7.2	-.127	-.2111	-.0857	-.1075
7.2	-.101	-.2211	-.0916	-.1096	7.4	-.110	-.2270	-.0927	-.1128	7.4	-.123	-.2218	-.0897	-.1117
7.4	-.097	-.2316	-.0955	-.1136	7.6	-.107	-.2374	-.0965	-.1167	7.6	-.119	-.2322	-.0935	-.1157
7.6	-.095	-.2419	-.0992	-.1175	7.8	-.104	-.2473	-.1001	-.1204	7.8	-.115	-.2422	-.0972	-.1194
7.8	-.092	-.2518	-.1028	-.1211	8.0	-.101	-.2567	-.1035	-.1238	8.0	-.113	-.2519	-.1006	-.1230
8.0	-.090	-.2611	-.1061	-.1245	8.2	-.098	-.2659	-.1067	-.1271	8.2	-.110	-.2610	-.1039	-.1263
8.2	-.088	-.2702	-.1093	-.1277	8.4	-.095	-.2745	-.1098	-.1301	8.4	-.107	-.2698	-.1070	-.1294
8.4	-.085	-.2789	-.1124	-.1307	8.6	-.094	-.2830	-.1127	-.1331	8.6	-.104	-.2784	-.1100	-.1324
8.6	-.084	-.2871	-.1152	-.1336	8.8	-.091	-.2910	-.1155	-.1358	8.8	-.102	-.2864	-.1128	-.1352
8.8	-.081	-.2952	-.1180	-.1363	9.0	-.089	-.2986	-.1181	-.1384	9.0	-.100	-.2943	-.1155	-.1379
9.0	-.080	-.3029	-.1206	-.1389	9.2	-.088	-.3064	-.1207	-.1410	9.2	-.097	-.3019	-.1181	-.1404
9.2	-.078	-.3102	-.1231	-.1413	9.4	-.086	-.3134	-.1231	-.1433	9.4	-.095	-.3092	-.1206	-.1428
9.4	-.076	-.3176	-.1256	-.1437	9.6	-.084	-.3206	-.1255	-.1456	9.6	-.094	-.3164	-.1230	-.1452

ตาราง 1ก (ต่อ)

$\alpha_3 = 0.90$					$\alpha_3 = 1.00$					$\alpha_3 = 1.10$				
α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4
3.2	-1.277	.1880	.0000	-.3160	3.4	-1.253	.1772	-.0000*	-.2858*	3.8	-1.215	.1582	.0000*	-.2379
3.4	-1.085	.1751	.0133	-.2548	3.6	-1.169	.1664	-.4828*	-.2490	4.0	-1.108	.1459	.6035*	-.2013
3.6	-.933	.1586	.0218	-.2039	3.8	-1.010	.1509	-.0141	-.1996	4.2	-.974	.1294	.0125	-.1607
3.8	-.814	.1397	.0260	-.1615	4.0	-.886	.1333	-.0193	-.1588	4.4	-.869	.1177	.0157	-.1267
4.0	-.717	.1193	.0269	-.1258	4.2	-.787	.1142	-.0212	-.1244	4.6	-.781	.0932	.0165	-.0977
4.2	-.635	.0979	.0251	-.0953	4.4	-.706	.0943	-.0206	-.0950	4.8	-.708	.0743	.0154	-.0727
4.4	-.575	.0762	.0214	-.0693	4.6	-.638	.0741	-.0182	-.0697	5.0	-.647	.0552	.0128	-.0508
4.6	-.522	.0547	.0161	-.0468	4.8	-.581	.0539	-.0144	-.0477	5.2	-.596	.0365	.0168*	-.0318
4.8	-.478	.0337	.0100	-.0273	5.0	-.533	.0340	-.0695*	-.0285	5.4	-.552	.0181	.4839*	-.0150
5.0	-.439	.0132	.432*	-.0102	5.2	-.492	.0146	-.4383*	-.0117	5.5	-.532	.9038*	.2484*	-.7342*
5.1	-.422	.3339*	.1111*	-.2526*	5.3	-.474	.5192*	.1584*	-.4061*	5.6	-.517	.0997*	.0279*	-.0795*
5.2	-.407	-.6388*	-.2154*	-.4735*	5.4	-.445	-.0317*	-.0101*	-.0242*	5.7	-.497	-.8629*	-.2479*	-.6726*
5.3	-.394	-.0159	-.5426*	-.0116	5.5	-.442	-.0132	-.4176*	-.9946*	5.8	-.481	-.0173	-.5066*	-.0132
5.4	-.375	-.0252	-.8694*	-.0180	5.6	-.429	-.0222	-.7097*	-.0164	6.0	-.451	-.0340	-.0103	-.0251
5.6	-.353	-.0432	-.0152	-.0298*	5.8	-.403	-.0395	-.0129	-.0282*	6.2	-.427	-.0501	-.0155	-.0358
5.8	-.334	-.0605	-.0215	-.0405	6.0	-.379	-.0562	-.0187	-.0388	6.4	-.403	-.0656	-.0208	-.0455
6.0	-.317	-.0768	-.0275	-.0500	6.2	-.358	-.0721	-.0244	-.0484	6.6	-.384	-.0805	-.0259	-.0544
6.2	-.301	-.0924	-.0334	-.0587	6.4	-.341	-.0873	-.0299	-.0571	6.8	-.366	-.0947	-.0309	-.0624
6.4	-.287	-.1073	-.0390	-.0666	6.6	-.325	-.1019	-.0352	-.0651	7.0	-.350	-.1084	-.0358	-.0698
6.6	-.273	-.1215	-.0444	-.0738	6.8	-.309	-.1158	-.0404	-.0723	7.2	-.335	-.1214	-.0405	-.0766
6.8	-.262	-.1352	-.0495	-.0805	7.0	-.297	-.1291	-.0453	-.0790	7.4	-.322	-.1341	-.0451	-.0829
7.0	-.252	-.1481	-.0544	-.0866	7.2	-.285	-.1419	-.0500	-.0852	7.6	-.311	-.1460	-.0494	-.0887
7.2	-.242	-.1606	-.0591	-.0923	7.4	-.275	-.1540	-.0545	-.0909	7.8	-.299	-.1577	-.0537	-.0941
7.4	-.233	-.1723	-.0635	-.0975	7.6	-.265	-.1658	-.0589	-.0962	8.0	-.289	-.1687	-.0577	-.0991
7.6	-.225	-.1838	-.0678	-.1024	7.8	-.256	-.1769	-.0630	-.1011	8.2	-.280	-.1794	-.0616	-.1038
7.8	-.218	-.1947	-.0718	-.1070	8.0	-.248	-.1878	-.0670	-.1058	8.4	-.271	-.1896	-.0653	-.1082
8.0	-.212	-.2051	-.0756	-.1113	8.2	-.241	-.1980	-.0707	-.1101	8.6	-.263	-.1994	-.0689	-.1123
8.2	-.205	-.2151	-.0793	-.1153	8.4	-.233	-.2079	-.0744	-.1141	8.8	-.256	-.2090	-.0724	-.1162
8.4	-.199	-.2246	-.0828	-.1190	8.6	-.227	-.2174	-.0778	-.1179	9.0	-.249	-.2180	-.0757	-.1198
8.6	-.194	-.2340	-.0862	-.1226	8.8	-.220	-.2267	-.0812	-.1215	9.2	-.242	-.2267	-.0788	-.1232
8.8	-.189	-.2428	-.0894	-.1259	9.0	-.215	-.2356	-.0844	-.1249	9.4	-.236	-.2353	-.0819	-.1265
9.0	-.185	-.2514	-.0924	-.1291	9.2	-.210	-.2440	-.0874	-.1281	9.6	-.231	-.2435	-.0848	-.1296
9.2	-.180	-.2597	-.0954	-.1321	9.4	-.204	-.2522	-.0904	-.1311	9.8	-.226	-.2513	-.0876	-.1325
9.4	-.176	-.2676	-.0982	-.1349	9.6	-.200	-.2602	-.0932	-.1340	10.0	-.221	-.2590	-.0903	-.1353
9.6	-.172	-.2753	-.1009	-.1376	9.8	-.195	-.2678	-.0959	-.1367	10.2	-.216	-.2664	-.0930	-.1379
9.8	-.168	-.2827	-.1035	-.1402	10.0	-.191	-.2752	-.0985	-.1393	10.4	-.211	-.2735	-.0955	-.1404
10.0	-.165	-.2900	-.1060	-.1427	10.2	-.187	-.2824	-.1010	-.1418	10.6	-.207	-.2804	-.0979	-.1423
10.2	-.162	-.2969	-.1084	-.1450	10.4	-.184	-.2893	-.1034	-.1442	10.8	-.203	-.2870	-.1002	-.1441
10.4	-.159	-.3035	-.1107	-.1472	10.6	-.180	-.2959	-.1057	-.1464	11.0	-.199	-.2936	-.1025	-.1473
$\alpha_3 = 1.20$					$\alpha_3 = 1.30$					$\alpha_3 = 1.40$				
α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4	α_4	LAM 1	LAM 2	LAM 3	LAM 4
4.2	-1.183	.1407	.0000*	-.1997	4.6	-1.156	.1244	-.0000*	-.1679	5.0	-1.132	.1092	.0000*	-.1411
4.4	-1.082	.1278	.5096*	-.1675	4.8	-1.084	.1129	-.3174*	-.1435	5.2	-1.106	.1011	.0787*	-.1268
4.6	-.965	.1113	.9967*	-.1329	5.0	-.975	.0968	-.7225*	-.1130	5.4	-1.001	.0855	.4546*	-.0991
4.8	-.870	.0941	.0122	-.1036	5.2	-.886	.0802	-.9035*	-.0870	5.6	-.916	.0697	.6296*	-.0754
5.0	-.792	.0764	.0124	-.0784	5.4	-.812	.0634	-.9148*	-.0645	5.8	-.844	.0538	.6530*	-.0547
5.2	-.723	.0586	.0112	-.0565	5.6	-.749	.0466	-.7959*	-.0447	6.0	-.782	.0379	.5603*	-.0365
5.4	-.668	.0408	.8705*	-.0372	5.8	-.695*	.0300	-.5783*	-.0273	6.2	-.729	.0222	.3785*	-.0204
5.6	-.615	.0233	.5411*	-.0202	6.0	-.604	.0286*	-.6619*	-.0239*	6.3	-.706	.0145	.2611*	-.0130
5.7	-.597	.0146	.3525*	-.0124	6.1	-.617	.0446*	-.0100*	-.0375*	6.4	-.683	.6822*	.1292*	-.5987*
5.8	-.577	.6088*	.1515*	-.5050*	6.2	-.616	-.0526*	-.0118*	-.0442*	6.5	-.660	-.1226*	-.0244*	-.1052*
5.9	-.558	-.2319*	-.0594*	-.1884*	6.3	-.585	-.0104*	-.2450*	-.8504*	6.6	-.643	-.8266*	-.1702*	-.6968*
6.0	-.542	-.0962*	-.0245*	-.0784*	6.4	-.572	-.0182*	-.3293*	-.0746*	6.8	-.607	-.3230*	-.5060*	-.0187*
6.2	-.506	-.0268	-.7343*	-.0206	6.6	-.539	-.0333*	-.8469*	-.0258*	7.0	-.575	-.0373*	-.8670*	-.0293*
6.4	-.481	-.0424	-.0120	-.0315	6.8	-.510	-.0480*	-.0127	-.0340*	7.2	-.547	-.0510*	-.0124*	-.0389*
6.6	-.454	-.0575	-.0168	-.0414	7.0	-.485	-.0622*	-.0170*	-.0453*	7.4	-.521	-.0645*	-.0163*	-.0478*
6.8	-.432	-.0719	-.0215	-.0504	7.2	-.463	-.0758*	-.0213*	-.0538*	7.6	-.498	-.0775*	-.0202*	-.0559*
7.0	-.412	-.0860	-.0262	-.0587	7.4	-.442	-.0890*	-.0256*	-.0616*	7.8	-.475	-.0900*	-.0242*	-.0633*
7.2	-.394	-.0993	-.0308	-.0662	7.6	-.424	-.1017*	-.0298*	-.0688*	8.0	-.456	-.1020*	-.0280*	-.0702*
7.4	-.378	-.1123	-.0353	-.0732	7.8	-.407	-.1140*	-.0340*	-.0754*	8.2	-.440	-.1137*	-.0319*	-.0766*
7.6	-.362	-.1247	-.0397	-.0796	8.0	-.392	-.1258*	-.0380*	-.0816*	8.4	-.423	-.1250*	-.0357*	-.0825*
7.8	-.349	-.1366	-.0439	-.0856	8.2	-.378	-.1372*	-.0420*	-.0873*	8.6	-.410	-.1358*	-.0393*	-.0881*
8.0	-.337	-.1480	-.0480	-.0911	8.4	-.365	-.1480*	-.0458*	-.0926*	8.8	-.395	-.1463*	-.0430*	-.0932*
8.2	-.325	-.1589	-.0519	-.0962	8.6	-.353	-.1584*	-.0495*	-.0975*	9.0	-.382	-.1564*	-.0465*	-.0980*
8.4	-.314	-.1695	-.0558	-.1010	8.8	-.342	-.1687*	-.0531*	-.1022*	9.2	-.372	-.1662*	-.0499*	-.1026*
8.6	-.305	-.1796	-.0594	-.1055	9.0	-.332	-.1784*	-.0566*	-.1065*	9.4	-.361	-.1756*	-.0532*	-.1068*
8.8	-.296	-.1896	-.0630	-.1098	9.2	-.322	-.1878*	-.0600*	-.1106*	9.6	-.351	-.1844*	-.0564*	-.1108*
9.0	-.287	-.1990	-.0664	-.1137	9.4	-.314	-.1969*	-.0632*	-.1145*	9.8	-.342	-.1935*	-.0595*	-.1144*
9.2	-.280	-.2082	-.0697	-.1175	9.6	-.305	-.2057*	-.0664*	-.1181*	10.0	-.333	-.2018*	-.0625*	-.1181*
9.4	-.273	-.2168	-.0728	-.1210	9.8	-.296	-.2141*	-.0694*	-.1215*	10.2	-.325	-.2102*	-.0655*	-.1215*
9.6	-.265	-.2253	-.0759	-.1243	10.0	-.291	-.2223*	-.0723*	-.1248*	10.4	-.317	-.2181*	-.0683*	-.1247*
9.8	-.259	-.2335	-.0788	-.1275	10.2	-.284	-.2304*	-.0752*	-.1279*	10.6	-.310	-.2257*	-.0710*	-.1277*
10.0	-.254	-.2414	-.0816	-.1305	10.4	-.277	-.2379*	-.0779*	-.1308*	10.8	-.303	-.2332*	-.0737*	-.1306*
10.2	-.248	-.2490	-.0843	-.1333	10.6	-.272	-.2453*	-.0805*	-.1336*	11.0	-.297	-.2405*	-.0762*	-.1334*
10.4	-.242	-.2564	-.0870	-.1360	10.8	-.266	-.2525*	-.0831*	-.1362*	11.2	-.291	-.2475*	-.0787*	-.1360*
10.6	-.237	-.2636	-.0895	-.1386	11.0	-.261	-.2595*	-.0855*	-.1388*	11.4	-.285	-.2542*	-.0811*	-.1385*
10.8	-.233	-.2704	-.0919	-.1410	11.2	-.256	-.2662*	-.0879*	-.1412*	11.6	-.279	-.2609*	-.0835*	-.1409*
11.0	-.228	-.2772	-.0943	-.1434	11.4	-.251	-.2728*	-.0902*	-.1435*	11.8	-.274	-.2671*	-.0857*	-.1431*
11.2	-.224	-.2837	-.0966	-.1456	11.6	-.246	-.2792*	-.0925*	-.1457*	12.0	-.269	-.2734*	-.0879*	-.1453*
11.4	-.220	-.2901	-.0988	-.1478	11.8	-.242	-.2852*	-.0946*	-.1478*	12.2	-.265	-.2794*	-.0900*	-.1474*

ตาราง 1ก (ต่อ)

Q3 = 1.50					Q3 = 1.60					Q3 = 1.70				
Q4	LAN 1	LAN 2	LAN 3	LAN 4	Q4	LAN 1	LAN 2	LAN 3	LAN 4	Q4	LAN 1	LAN 2	LAN 3	LAN 4
5.4	-1.112	-.0951	.0000*	-.1182	6.0	-1.086	-.0757	.0000*	-.0896	6.6	-1.064	-.0580	.0000*	-.0657
5.6	-1.103	.0886	.0000*	.1083	6.2	-1.078	-.0698	.0000	-.0814	6.8	-1.057	-.0525	.0000	-.0588
5.8	-1.042	-.0773	-.1949*	-.0899	6.4	-1.011	-.0573	-.1699*	-.0634	7.0	-1.001	-.0412	-.1027*	-.0441
6.0	-.957	-.0622	-.3907*	-.0677	6.6	-.937	-.0430	-.2684*	-.0449	7.2	-.935	-.0275	-.1513*	-.0280
6.2	-.885	-.0471	-.4441*	-.0483	6.8	-.875	-.0287	-.2597*	-.0285	7.4	-.875	-.0142	-.1142*	-.0138
6.4	-.824	-.0321	-.3885*	-.0313	7.0	-.744	-.0422*	-.6356*	-.0378*	7.5	-.85	-.0754*	-.0696*	-.7179*
6.6	-.688	-.0566*	-.0104*	-.0494*	7.1	-.796	-.7773*	-.0969*	-.7177*	7.6	-.825	-.0250*	-.2601*	-.0232*
6.7	-.747	-.9962*	-.1538*	-.9059*	7.2	-.771	-.0341*	-.4634*	-.0309*	7.7	-.806	-.5469*	-.0619*	-.5000*
6.8	-.714	-.0290*	-.4897*	-.0256*	7.3	-.751	-.5924*	-.0858*	-.5279*	7.8	-.784	-.0119	-.1463*	-.0107
6.9	-.704	-.4446*	-.0768*	-.3882*	7.4	-.731	-.0127	-.1942*	-.0111	8.0	-.745	-.0125	-.3423*	-.0212
7.0	-.684	-.0115	-.2088*	-.9875*	7.6	-.693	-.0258	-.4383*	-.0218	8.2	-.709	-.0367	-.5705*	-.0308
7.2	-.647	-.0254	-.4989*	-.0210	7.8	-.659	-.0386	-.7111*	-.0316	8.4	-.678	-.0487	-.8225*	-.0397
7.4	-.615	-.0390	-.8156*	-.0312	8.0	-.630	-.0511	-.0100	-.0406	8.6	-.650	-.0603	-.0109	-.0478
7.6	-.585	-.0520	-.0115	-.0404	8.2	-.602	-.0633	-.0131	-.0489	8.8	-.622	-.0717	-.0138	-.0553*
7.8	-.558	-.0648	-.0150	-.0489	8.4	-.577	-.0752	-.0163	-.0566*	9.0	-.598	-.0827	-.0167	-.0623*
8.0	-.536	-.0767	-.0184	-.0565	8.6	-.553	-.0866	-.0196	-.0636	9.2	-.578	-.0933	-.0196	-.0688
8.2	-.514	-.0891	-.0221	-.0640	8.8	-.534	-.0972	-.0227	-.0699	9.4	-.557	-.1036	-.0226	-.0748
8.4	-.494	-.1007	-.0257	-.0707	9.0	-.515	-.1084	-.0261	-.0763	9.6	-.538	-.1136	-.0256	-.0804
8.6	-.476	-.1118	-.0292	-.0769	9.2	-.496	-.1187	-.0294	-.0819	9.8	-.521	-.1233	-.0286	-.0857
8.8	-.459	-.1225	-.0327	-.0826	9.4	-.480	-.1288	-.0326	-.0872	10.0	-.505	-.1329	-.0316	-.0907
9.0	-.443	-.1330	-.0362	-.0880	9.6	-.465	-.1385	-.0358	-.0922	10.2	-.485	-.1420	-.0346	-.0953
9.2	-.429	-.1431	-.0396	-.0931	9.8	-.452	-.1480	-.0389	-.0969	10.4	-.476	-.1509	-.0375	-.0997
9.4	-.416	-.1528	-.0429	-.0978	10.0	-.436	-.1572	-.0420	-.1013	10.6	-.463	-.1594	-.0403	-.1038
9.6	-.404	-.1622	-.0461	-.1022	10.2	-.426	-.1659	-.0450	-.1054	10.8	-.451	-.1677	-.0431	-.1077
9.8	-.392	-.1713	-.0493	-.1064	10.4	-.415	-.1745	-.0479	-.1093	11.0	-.440	-.1758	-.0458	-.1114
10.0	-.382	-.1803	-.0524	-.1104	10.6	-.404	-.1828	-.0508	-.1130	11.2	-.429	-.1837	-.0485	-.1149
10.2	-.372	-.1887	-.0553	-.1141	10.8	-.394	-.1908	-.0536	-.1165	11.4	-.419	-.1913	-.0511	-.1182
10.4	-.363	-.1969	-.0582	-.1176	11.0	-.385	-.1986	-.0563	-.1198	11.6	-.410	-.1988	-.0537	-.1214
10.6	-.354	-.2049	-.0611	-.1209	11.2	-.377	-.2062	-.0589	-.1230	11.8	-.401	-.2059	-.0562	-.1244
10.8	-.346	-.2127	-.0638	-.1241	11.4	-.368	-.2135	-.0615	-.1260	12.0	-.392	-.2128	-.0586	-.1272
11.0	-.338	-.2202	-.0665	-.1271	1.6	-.360	-.2206	-.0640	-.1288	12.2	-.384	-.2195	-.0610	-.1299
11.2	-.331	-.2273	-.0690	-.1299	1.8	-.352	-.2275	-.0665	-.1315	12.4	-.377	-.2261	-.0633	-.1325
11.4	-.325	-.2339	-.0713	-.1325	2.0	-.346	-.2341	-.0688	-.1341	12.6	-.369	-.2326	-.0656	-.1350
11.6	-.317	-.2414	-.0740	-.1350	2.2	-.339	-.2407	-.0711	-.1366	12.8	-.362	-.2388	-.0678	-.1374
11.8	-.311	-.2478	-.0763	-.1377	2.4	-.333	-.2471	-.0734	-.1390	13.0	-.356	-.2450	-.0700	-.1397
12.0	-.305	-.2544	-.0786	-.1401	2.6	-.328	-.2527	-.0753	-.1411	13.2	-.350	-.2508	-.0720	-.1419
12.2	-.300	-.2607	-.0808	-.1424	2.8	-.322	-.2592	-.0777	-.1434	13.4	-.344	-.2566	-.0741	-.1440
12.4	-.295	-.2662	-.0827	-.1444	3.0	-.316	-.2650	-.0797	-.1455	13.6	-.338	-.2622	-.0761	-.1460
12.6	-.289	-.2726	-.0851	-.1466	3.2	-.311	-.2706	-.0817	-.1475	13.8	-.333	-.2675	-.0780	-.1479*
Q3 = 1.80					Q3 = 1.90					Q3 = 2.00				
Q4	LAN 1	LAN 2	LAN 3	LAN 4	Q4	LAN 1	LAN 2	LAN 3	LAN 4	Q4	LAN 1	LAN 2	LAN 3	LAN 4
7.2	-1.045	.0417	.0000*	-.0456	8.0	-1.023	-.0220	.0000*	-.0230	8.6	-1.009	-.8397*	.0000*	-.8541*
7.4	-1.039	.0367	.0000*	-.0396	8.2	-1.018	-.0175	.0000	-.0181	8.8	-1.004	-.4147*	.0000*	-.4182*
7.6	-1.007	-.0284	-.0378*	-.0298	8.4	-.968	-.6447*	-.0150*	-.6431*	8.9	-1.002	-.2061*	.0001*	-.2070*
7.8	-.945	-.0155	-.0646*	-.0155	8.5	-.946	-.1239*	-.4120*	-.1215*	9.0	-.993	-.1081*	-.0407*	-.1076*
7.9	-.918	-.9177*	-.0496*	-.9006*	8.6	-.917	-.5444*	-.0257*	-.5220*	9.1	-.974	-.5675*	-.0705*	-.5567*
8.0	-.892	-.2914*	-.0193*	-.2801*	8.7	-.892	-.0113	-.0657*	-.0106	9.2	-.950	-.0113	-.0272*	-.0109
8.1	-.868	-.3291*	-.0254*	-.3102*	8.8	-.871	-.0171	-.1167*	-.0158	9.4	-.905	-.0222	-.1012*	-.0207
8.2	-.846	-.9427*	-.0826*	-.8721*	9.0	-.831	-.0284	-.2475*	-.0254	9.6	-.865	-.0331	-.2125*	-.0298
8.4	-.804	-.0215	-.2289*	-.0192	9.2	-.794	-.0395	-.4100*	-.0343	9.8	-.828	-.0435	-.3537*	-.0381
8.6	-.787	-.0323	-.4103*	-.0288	9.4	-.761	-.0503	-.5975*	-.0424	10.0	-.796	-.0538	-.5187*	-.0453
8.8	-.733	-.0448	-.6190*	-.0376	9.6	-.731	-.0609	-.8046*	-.0500	10.2	-.766	-.0637	-.7027*	-.0529
9.0	-.702	-.0559	-.8404*	-.0456	9.8	-.703	-.0712	-.0103	-.0570	10.4	-.738	-.0738	-.9016*	-.0595
9.2	-.675	-.0668	-.0109	-.0531	10.0	-.679	-.0811	-.0126	-.0635	10.6	-.713	-.0829	-.0111	-.0657
9.4	-.649	-.0774	-.0135	-.0601	10.2	-.656	-.0907	-.0150	-.0695	10.8	-.690	-.0920	-.0133	-.0714
9.6	-.625	-.0877	-.0162	-.0665	10.4	-.634	-.1002	-.0175	-.0752	11.0	-.670	-.1005	-.0154	-.0766
9.8	-.604	-.0978	-.0189	-.0726	10.6	-.614	-.1093	-.0200	-.0805	11.2	-.647	-.1097	-.0179	-.0819
10.0	-.583	-.1075	-.0217	-.0782	10.8	-.595	-.1183	-.0226	-.0855	11.4	-.629	-.1181	-.0202	-.0867
10.2	-.565	-.1169	-.0244	-.0835	11.0	-.578	-.1269	-.0251	-.0902	11.6	-.611	-.1264	-.0226	-.0912
10.4	-.548	-.1260	-.0272	-.0884	11.2	-.562	-.1355	-.0277	-.0947	11.8	-.595	-.1345	-.0249	-.0955
10.6	-.532	-.1349	-.0299	-.0931	11.4	-.547	-.1437	-.0302	-.0989	12.0	-.579	-.1423	-.0273	-.0995
10.8	-.517	-.1436	-.0327	-.0975	11.6	-.533	-.1515	-.0327	-.1028	12.2	-.565	-.1498	-.0296	-.1033
11.0	-.503	-.1520	-.0354	-.1016	11.8	-.520	-.1594	-.0352	-.1066	12.4	-.557	-.1555	-.0312	-.1062
11.2	-.490	-.1600	-.0380	-.1055	12.0	-.508	-.1665	-.0375	-.1100	12.6	-.539	-.1644	-.0342	-.1104
11.4	-.478	-.1679	-.0406	-.1092	12.2	-.495	-.1742	-.0401	-.1135	12.8	-.527	-.1715	-.0365	-.1137
11.6	-.467	-.1757	-.0432	-.1128	12.4	-.485	-.1811	-.0423	-.1166	13.0	-.515	-.1784	-.0388	-.1168
11.8	-.456	-.1831	-.0457	-.1161	12.6	-.474	-.1883	-.0448	-.1198	13.2	-.504	-.1851	-.0410	-.1198
12.0	-.445	-.1904	-.0482	-.1193	12.8	-.464	-.1950	-.0471	-.1227	13.4	-.495	-.1914	-.0431	-.1226
12.2	-.436	-.1974	-.0506	-.1223	13.0	-.455	-.2015	-.0493	-.1255	13.6	-.485	-.1979	-.0453	-.1254
12.4	-.427	-.2043	-.0530	-.1252	13.2	-.446	-.2080	-.0515	-.1282	13.8	-.475	-.2041	-.0474	-.1280
12.6	-.418	-.2109	-.0553	-.1279	13.4	-.437	-.2142	-.0537	-.1307	14.0	-.466	-.2101	-.0495	-.1305
12.8	-.410	-.2175	-.0576	-.1306	13.6	-.429	-.2203	-.0558	-.1332	14.2	-.458	-.2160	-.0515	-.1329
13.0	-.402	-.2238	-.0598	-.1331	13.8	-.421	-.2262	-.0579	-.1355	14.4	-.450	-.2216	-.0535	-.1351*
13.2	-.395	-.2299	-.0619	-.1355	14.0	-.414	-.2320	-.0599	-.1378	14.6	-.443	-.2271	-.0554	-.1373
13.4	-.388	-.2359	-.0640	-.1378	14.2	-.407	-.2376	-.0619	-.1399	14.8	-.436	-.2321	-.0571	-.1393
13.6	-.381	-.2417	-.0661	-.1400	14.4	-.400	-.2431	-.0638	-.1420	15.0	-.428	-.2380	-.0582	-.1415
13.8	-.374	-.2473	-.0681	-.1421	14.6	-.394	-.2485	-.0657	-.1440	15.2	-.422	-.2432	-.0610	-.1435*
14.0	-.366	-.2530	-.0701	-.1442	14.8	-.388	-.2537	-.0676	-.1459	15.4	-.415	-.2481	-.0628	-.1453*
14.2	-.362	-.2583	-.0720	-.1461	15.0	-.382	-.2589	-.0694	-.1478	15.6	-.409	-.2532	-.0646	-.1472
14.4	-.357	-.2632	-.0737	-.1479	15.2	-.376	-.2636	-.0711	-.1495	15.8	-.403	-.2580	-.0663	-.1489*

ภาคผนวก ข ค่าความยากของเครื่องมือวัด การตรวจสอบเลขสัมพันธ์ และตัวอย่าง
ต่างๆประกอบการอภิปรายผล

- ตารางที่ 1ข ค่าความยาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 30 ข้อ
- ตารางที่ 2ข ค่าความยาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 60 ข้อ
- ตารางที่ 3ข ค่าความยาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 120 ข้อ
- ตารางที่ 4ข ผลการทดสอบความเป็นเลขสัมพันธ์มาเสมอ
- ตารางที่ 5ข ค่าความเที่ยงของวิธีวัดการเปลี่ยนแปลงการเรียนรู้ต่างๆ ของแบบ
วิจัย S .8 50 30 100 รอบ
- ตารางที่ 6ข ค่าความคลาดเคลื่อนมาตรฐานในการวัดของวิธีวัดต่างๆ ของแบบ
วิจัย S .8 50 30 100 รอบ
- ตัวอย่างการประมาณค่าความเที่ยง

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ตาราง 1ข ค่าความชาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 30 ข้อ

ข้อที่	ค่าความชาก (b)	ข้อที่	ค่าความชาก (b)
1	-3.0	16	0.2
2	-2.8	17	0.4
3	-2.3	18	0.6
4	-2.4	19	0.8
5	-2.2	20	1.0
6	-2.0	21	1.2
7	-1.8	22	1.4
8	-1.6	23	1.6
9	-1.4	24	1.8
10	-1.2	25	2.0
11	-1.0	26	2.2
12	-0.8	27	2.4
13	-0.6	28	2.6
14	-0.4	29	2.8
15	-0.2	30	3.0

$$\bar{X} = 0.00 \quad SD = 1.849$$

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ตาราง 2ข ค่าความยาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 60 ข้อ

ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)
1	-2.5	21	-0.5	41	0.6
2	-2.4	22	-0.4	42	0.7
3	-2.3	23	-0.4	43	0.8
4	-2.2	24	-0.3	44	0.9
5	-2.1	25	-0.3	45	1.0
6	-2.0	26	-0.2	46	1.1
7	-1.9	27	-0.2	47	1.2
8	-1.8	28	-0.1	48	1.3
9	-1.7	29	-0.1	49	1.4
10	-1.6	30	0.0	50	1.5
11	-1.5	31	0.1	51	1.6
12	-1.4	32	0.1	52	1.7
13	-1.3	33	0.2	53	1.8
14	-1.2	34	0.2	54	1.9
15	-1.1	35	0.3	55	2.0
16	-1.0	36	0.3	56	2.1
17	-0.9	37	0.4	57	2.2
18	-0.8	38	0.4	58	2.3
19	-0.7	39	0.5	59	2.4
20	-0.6	40	0.5	60	2.5

$$\bar{X} = 0.008 \quad SD = 1.373$$

ตาราง 3๗ ค่าความยาก (b) ของข้อสอบสำหรับแบบสอบที่มีข้อสอบ 120 ข้อ

ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)
1	-2.50	21	-1.60	41	-0.80
2	-2.45	22	-1.56	42	-0.76
3	-2.40	23	-1.52	43	-0.72
4	-2.35	24	-1.48	44	-0.68
5	-2.30	25	-1.44	45	-0.64
6	-2.25	26	-1.40	46	-0.60
7	-2.20	27	-1.36	47	-0.56
8	-2.15	28	-1.32	48	-0.52
9	-2.10	29	-1.28	49	-0.48
10	-2.05	30	-1.24	50	-0.44
11	-2.00	31	-1.20	51	-0.40
12	-1.96	32	-1.16	52	-0.36
13	-1.92	33	-1.12	53	-0.32
14	-1.88	34	-1.08	54	-0.28
15	-1.84	35	-1.04	55	-0.24
16	-1.80	36	-1.00	56	-0.20
17	-1.76	37	-0.96	57	-0.16
18	-1.72	38	-0.92	58	-0.12
19	-1.68	39	-0.88	59	-0.08
20	-1.64	40	-0.84	60	-0.04

ตาราง 3๗ (ต่อ)

ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)	ข้อที่	ความยาก (b)
61	0.00	81	0.80	101	1.60
62	0.04	82	0.84	102	1.64
63	0.08	83	0.88	103	1.68
64	0.12	84	0.92	104	1.72
65	0.16	85	0.96	105	1.76
66	0.20	86	1.00	106	1.80
67	0.24	87	1.04	107	1.85
68	0.28	88	1.08	108	1.90
69	0.32	89	1.12	109	1.95
70	0.36	90	1.16	110	2.00
71	0.40	91	1.20	111	2.05
72	0.44	92	1.24	112	2.10
73	0.48	93	1.28	113	2.15
74	0.52	94	1.32	114	2.20
75	0.56	95	1.36	115	2.25
76	0.60	96	1.40	116	2.30
77	0.64	97	1.44	117	2.35
78	0.68	98	1.48	118	2.40
79	0.72	99	1.52	119	2.45
80	0.76	100	1.56	120	2.50

$$\bar{X} = -0.015 \quad SD = 1.413$$

ตาราง 4๗ ผลการทดสอบความเป็นเลขสุ่มสม่ำเสมอ

INTERVAL	OBS. FREQ.	EXP. FREQ.	Chi-Sqr
0.0 - 0.1	2055	2000	1.51250
0.1 - 0.2	1973	2000	.36450
0.2 - 0.3	2073	2000	2.66450
0.3 - 0.4	2007	2000	.02450
0.4 - 0.5	1982	2000	.16200
0.5 - 0.6	1942	2000	1.68200
0.6 - 0.7	2052	2000	1.35200
0.7 - 0.8	1956	2000	.96800
0.8 - 0.9	1967	2000	.54450
0.9 - 1.0	1993	2000	.02450
TOTAL	20000	20000	9.29900

9.30 < 16.92 NOT REJECT THESE RANDOM NUMBERS

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ตาราง 5x ค่าความเที่ยงของวิธีวัดการเปลี่ยนแปลงการเรียนรู้ต่างๆ ของแบบวิจัย
S .8 50 30 100 รอบ

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
.4540	.4540	.5353	.5354	.6289	.6289	.4883	.4792	.4347	.4321
.4644	.4635	.5786	.5786	.6629	.6628	.5094	.5186	.4448	.3421
.4944	.4842	.6368	.6350	.6681	.6681	.5727	.5436	.5612	.5701
.5591	.5603	.6301	.6308	.6684	.6689	.5774	.5859	.5643	.5677
.6526	.6553	.6949	.6935	.6963	.7001	.6798	.7334	.6145	.6145
.4639	.4442	.5658	.5616	.6176	.6209	.5545	.5480	.5096	.5207
.4668	.4662	.5418	.5439	.6627	.6635	.4707	.4775	.4579	.4540
.4562	.4400	.4943	.4882	.5060	.5015	.5044	.4807	.4874	.4830
.7245	.7213	.7690	.7686	.7516	.7496	.7306	.7338	.7224	.7241
.7596	.7582	.7884	.7917	.7889	.7872	.7635	.8258	.6901	.6896
.5334	.5645	.6750	.6849	.6649	.6774	.5348	.5569	.5357	.4886
.4566	.4597	.5739	.5747	.5875	.5877	.4837	.4808	.4268	.3982
.5385	.5305	.6040	.6048	.6633	.6589	.5496	.6193	.4214	.4280
.5676	.5771	.6682	.6727	.6864	.6880	.5826	.6365	.5347	.5186
.7306	.7257	.7497	.7502	.7822	.7807	.7180	.7739	.6425	.6538
.5685	.5686	.6660	.6661	.6893	.6891	.6004	.6322	.5371	.5368
.6744	.6783	.7395	.7408	.7411	.7416	.6524	.6148	.6510	.6387
.4435	.4413	.5663	.5659	.6219	.6222	.5029	.5155	.5002	.5022
.4865	.4897	.5285	.5285	.5862	.5886	.5129	.5218	.4102	.4066
.7567	.7605	.8136	.8145	.8025	.8041	.7707	.7701	.7019	.6784
.6487	.6499	.6869	.6875	.7171	.7169	.6531	.6476	.6389	.6358
.5904	.5862	.6492	.6486	.6894	.6874	.6323	.6963	.4640	.4932
.3334	.2991	.4158	.4218	.4603	.4612	.3850	.3761	.3650	.3782
.4817	.4850	.6148	.6156	.5245	.5246	.5040	.5280	.4847	.4761
.3123	.3150	.4167	.4184	.5292	.5285	.3309	.3325	.3222	.3214

ตาราง 5๗ (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
.4374	.4208	.5967	.5942	.6689	.6688	.5591	.521	.5980	.6149
.7702	.7576	.8110	.8120	.8074	.7986	.7169	.7065	.6730	.6940
.6657	.6458	.7051	.6994	.7164	.7145	.6981	.6643	.6946	.7069
.5218	.5392	.5897	.5845	.6188	.6362	.5178	.5474	.5523	.5116
.7468	.7277	.7283	.7144	.8037	.7954	.7505	.7785	.5756	.6127
.6408	.6327	.7024	.7057	.7447	.7333	.6011	.6168	.5714	.5756
.5183	.5339	.6267	.6253	.6230	.6302	.5650	.6075	.5237	.4858
.5077	.4648	.5423	.5454	.4922	.4931	.5274	.4120	.5551	.5462
.3190	.3201	.3941	.3948	.4111	.4114	.3715	.4296	.2476	.0502
.6495	.6497	.7266	.7267	.7385	.7377	.6313	.6643	.6073	.6065
.3911	.3817	.4835	.4789	.5856	.5838	.3767	.4245	.2424	.2472
.6783	.6792	.7279	.7275	.7339	.7342	.6684	.6911	.6539	.6511
.5601	.5604	.6172	.6183	.6731	.6727	.5780	.5885	.5078	.5032
.6277	.6281	.6716	.6720	.7135	.7130	.6189	.6589	.5503	.5356
.3568	.3131	.4226	.4114	.5701	.5716	.4948	.4500	.4953	.5384
.6388	.6368	.6895	.6877	.6721	.6724	.6403	.6350	.6356	.6367
.8269	.8156	.8265	.8313	.8490	.8423	.7989	.8499	.7295	.7504
.6180	.6223	.7352	.7345	.7166	.7179	.6114	.6622	.5536	.5374
.6305	.6184	.6860	.6865	.7268	.7260	.6000	.6126	.5263	.5422
.4734	.4698	.5617	.5615	.6026	.6002	.4850	.4700	.3688	.3750
.7877	.7757	.7804	.7868	.8294	.8252	.7341	.7478	.6844	.7050
.7757	.7765	.7920	.7933	.8175	.8175	.6773	.7379	.7312	.7182
.1982	.1176	.1984	.1858	.2639	.2618	.2809	.1726	.2373	.2617
.5271	.5474	.6107	.6100	.6122	.6071	.5528	.5634	.5791	.5357
.3451	.3470	.4514	.4537	.5256	.5316	.3811	.4156	.3464	.3365
.5383	.5381	.6032	.6030	.6699	.6699	.5525	.5767	.5212	.5177

ตาราง 5๗ (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
.4944	.48-2	.6368	.6350	.6681	.6681	.5727	.5436	.5612	.5701
.5591	.5603	.6301	.6308	.6684	.6689	.5774	.5859	.5643	.5677
.6526	.6553	.6949	.6935	.6963	.7001	.6798	.7334	.6145	.6145
.4639	.4442	.5658	.5616	.6176	.6209	.5545	.5480	.5096	.5207
.4668	.4662	.5418	.5439	.6627	.6635	.4707	.4775	.4579	.4540
.4562	.4400	.4943	.4882	.5060	.5015	.5044	.4807	.4874	.4830
.7245	.7213	.7690	.7686	.7516	.7496	.7306	.7338	.7224	.7241
.7596	.7582	.7884	.7917	.7889	.7872	.7635	.8258	.6901	.6896
.5334	.5645	.6750	.6849	.6649	.6774	.5348	.5569	.5357	.4886
.4566	.4597	.5739	.5747	.5875	.5877	.4837	.4808	.4268	.3982
.5385	.5205	.6040	.6048	.6633	.6589	.5496	.6193	.4214	.4280
.5676	.5771	.6682	.6727	.6864	.6880	.5826	.6365	.5347	.5186
.7306	.7257	.7497	.7502	.7822	.7807	.7180	.7739	.6425	.6538
.5685	.5686	.6660	.6661	.6893	.6891	.6004	.6322	.5371	.5368
.6744	.6783	.7395	.7408	.7411	.7416	.6524	.6148	.6510	.6387
.4435	.4413	.5663	.5659	.6219	.6222	.5029	.5155	.5002	.5022
.4865	.4897	.5285	.5285	.5862	.5886	.5129	.5218	.4102	.4066
.7567	.7605	.8136	.8145	.8025	.8041	.7707	.7701	.7019	.6784
.6487	.6499	.6869	.6875	.7171	.7169	.6531	.6476	.6389	.6358
.5904	.5862	.6492	.6486	.6894	.6874	.6323	.6963	.4640	.4932
.3334	.2991	.4158	.4218	.4603	.4612	.3850	.3761	.3650	.3782
.4817	.4850	.6148	.6156	.5245	.5246	.5040	.5280	.4847	.4761
.3123	.3150	.4167	.4184	.5292	.5285	.3309	.3325	.3222	.3214
.4374	.4208	.5967	.5942	.6689	.6688	.5591	.5214	.5980	.6149
.7702	.7576	.8110	.8120	.8074	.7986	.7169	.7065	.6730	.6940
.6657	.6458	.7051	.6994	.7164	.7145	.6981	.6643	.6946	.7069

ตาราง 5๕ (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
.5218	.5892	.5897	.5845	.6188	.6362	.5178	.5474	.5523	.5116
.7468	.7277	.7283	.7144	.8037	.7954	.7505	.7785	.5756	.6127
.6408	.6327	.7024	.7057	.7447	.7333	.6011	.6168	.5714	.5756
.5183	.5339	.6267	.6253	.6230	.6302	.5650	.6075	.5237	.4858
.5077	.4648	.5423	.5454	.4922	.4931	.5274	.4120	.5551	.5462
.3190	.3201	.3941	.3948	.4111	.4114	.3715	.4296	.2476	.0502
.6495	.6497	.7266	.7267	.7385	.7377	.6313	.6643	.6073	.6065
.3911	.3817	.4835	.4789	.5856	.5838	.3767	.4245	.2424	.2472
.6783	.6792	.7279	.7275	.7339	.7342	.6684	.6911	.6539	.6511
.5601	.5604	.6172	.6183	.6731	.6727	.5780	.5885	.5078	.5032
.6277	.6231	.6716	.6720	.7135	.7130	.6189	.6589	.5503	.5356
.3568	.3131	.4226	.4114	.5701	.5716	.4948	.4500	.4953	.5384
.6338	.6368	.6895	.6877	.6721	.6724	.6403	.6350	.6356	.6367
.8269	.8156	.8265	.8313	.8490	.8423	.7989	.8499	.7295	.7504
.6180	.6223	.7352	.7345	.7166	.7179	.6114	.6622	.5536	.5374
.6305	.6184	.6860	.6865	.7268	.7260	.6000	.6126	.5263	.5422
.4734	.4698	.5617	.5615	.6026	.6002	.4850	.4700	.3688	.3750
.7877	.7757	.7804	.7868	.8294	.8252	.7341	.7478	.6844	.7050
.7757	.7765	.7920	.7933	.8175	.8175	.6773	.7379	.7312	.7182
.1982	.1176	.1984	.1858	.2639	.2618	.2809	.1726	.2373	.2617
.5271	.5474	.6107	.6100	.6122	.6071	.5528	.5634	.5791	.5357
.3451	.3470	.4514	.4537	.5256	.5316	.3811	.4156	.3464	.3365
.5383	.5381	.6032	.6030	.6699	.6699	.5525	.5767	.5212	.5177

ตาราง 6๗ ค่าความคลาดเคลื่อนมาตรฐานในการวัดของวิธีวัดต่างๆ ของแบบวิจัย S .8 50 30
100 รอบ

C1A	C1B	C2A	C2B	วิธีวัด				D	L
				C3A	C3B	C4A	C4B		
2.519	3.167	2.4239	3.046	5.406	6.795	2.072	2.735	2.616	1.121
2.696	3.328	2.4816	3.060	6.322	7.795	2.079	2.944	2.256	.887
3.021	3.634	2.6219	3.153	4.556	5.465	2.307	2.997	2.575	1.620
2.081	2.525	1.9646	2.376	4.353	5.267	1.784	2.255	2.137	.988
3.186	3.870	3.0588	3.761	4.263	5.192	2.367	2.895	2.527	1.821
2.982	3.995	2.7690	3.715	4.784	6.359	2.089	2.868	2.648	1.367
2.092	2.492	1.9904	2.330	5.573	6.534	1.945	2.399	2.274	.860
2.400	3.158	2.0965	2.952	5.532	7.782	2.079	2.744	2.676	1.302
2.300	2.745	2.1645	2.593	3.535	4.245	1.752	2.124	1.984	1.333
2.891	3.435	2.8432	3.320	3.761	4.447	2.068	2.550	2.376	1.579
3.064	3.478	2.7275	3.111	4.517	5.133	2.222	2.729	2.471	1.542
3.381	4.487	3.1601	4.196	5.401	7.176	2.176	3.305	2.797	1.419
3.231	4.036	3.1845	3.915	5.538	6.860	2.355	3.133	2.920	1.481
3.257	3.808	3.0185	3.507	4.862	5.673	2.378	2.981	2.786	1.730
2.561	3.000	2.5738	2.979	3.968	4.614	2.019	2.411	2.179	1.308
2.767	3.313	2.5467	3.046	4.606	5.513	2.160	2.637	2.554	1.478
2.615	3.188	2.4629	3.003	3.811	4.655	1.926	2.692	2.190	1.285
3.275	4.416	3.0170	4.067	4.610	6.209	2.228	3.295	2.820	1.492
3.165	4.447	3.1726	4.482	5.775	8.132	2.191	3.524	2.764	1.152
3.560	3.945	3.2142	3.577	4.617	5.129	2.604	3.299	2.646	2.081
2.450	3.028	2.4102	2.975	3.439	4.252	1.771	2.265	2.089	1.293
3.208	4.023	3.1155	3.885	5.125	6.406	2.257	2.964	2.873	1.559
2.365	3.362	2.1895	3.208	6.479	9.523	1.954	2.736	2.483	.892
2.956	4.160	2.5523	3.682	4.752	6.848	2.158	3.102	2.921	1.615
2.346	3.168	2.2652	3.012	6.000	7.996	1.983	2.879	2.671	.959

ตาราง 6ข (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
3.135	4.172	2.6812	3.559	3.735	4.937	2.039	2.788	2.482	1.467
3.127	3.651	2.9528	3.326	4.026	4.655	2.365	2.996	2.692	1.911
2.507	3.027	2.3257	2.828	4.080	4.928	2.032	2.526	2.286	1.520
2.462	2.962	2.0743	2.719	4.369	5.554	2.227	2.601	2.564	1.622
3.538	4.152	3.6634	4.248	5.634	6.547	2.683	3.848	2.860	1.757
2.357	2.931	2.2525	2.709	3.575	4.423	1.912	2.366	2.421	1.362
2.619	3.327	2.2414	2.981	4.440	5.830	2.153	2.785	2.752	1.610
2.626	4.031	2.3145	3.754	4.326	6.930	1.963	3.310	2.629	1.532
2.416	3.442	2.4271	3.457	12.976	18.511	1.720	2.775	2.286	.438
3.194	3.830	2.9511	3.534	4.617	5.540	2.355	2.788	2.769	1.732
2.535	3.591	2.4896	3.508	8.732	12.324	1.788	2.706	2.414	.585
2.472	2.916	2.3127	2.739	3.652	4.319	1.960	2.258	2.301	1.579
2.882	3.531	2.8378	3.463	4.836	5.914	2.119	2.788	2.588	1.401
3.534	4.232	3.4407	4.118	4.950	5.934	2.497	3.113	2.769	1.836
2.861	3.758	2.6497	3.515	4.708	6.170	2.164	2.894	2.616	1.418
3.043	3.875	2.8569	3.683	4.334	5.558	2.242	2.977	2.664	1.735
2.804	3.238	2.9191	3.211	3.662	4.173	2.138	2.572	2.304	1.568
2.928	3.344	2.5782	2.942	4.595	5.227	2.206	2.678	2.482	1.547
2.396	2.858	2.3507	2.733	4.432	5.166	1.895	2.300	2.311	1.162
3.160	4.157	3.0530	3.991	5.437	7.129	2.214	3.357	2.862	1.423
2.690	3.081	2.8686	3.136	3.880	4.358	2.173	2.541	2.344	1.497
2.430	2.775	2.4291	2.766	3.572	4.082	2.157	2.425	1.946	1.307
1.938	3.081	1.8171	3.124	23.253	38.740	1.607	2.627	2.370	.537
2.093	2.465	1.6748	2.160	4.353	5.659	1.902	2.217	2.210	1.260
2.522	3.418	2.3428	3.282	5.918	8.253	2.042	2.816	2.617	1.072
2.545	3.157	2.4887	3.087	4.777	5.926	1.991	2.615	2.365	1.103

ตาราง 6ข (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
3.021	3.634	2.6219	3.153	4.556	5.465	2.307	2.997	2.575	1.620
2.081	2.525	1.9646	2.376	4.353	5.267	1.784	2.255	2.137	.988
3.186	3.870	3.0588	3.761	4.263	5.192	2.367	2.895	2.527	1.821
2.982	3.995	2.7690	3.715	4.784	6.359	2.089	2.868	2.648	1.367
2.092	2.492	1.9904	2.330	5.573	6.534	1.945	2.399	2.274	.860
2.400	3.158	2.0965	2.952	5.532	7.782	2.079	2.744	2.676	1.302
2.300	2.745	2.1645	2.593	3.535	4.245	1.752	2.124	1.984	1.333
2.891	3.435	2.8432	3.320	3.761	4.447	2.068	2.550	2.376	1.579
3.064	3.478	2.7275	3.111	4.517	5.133	2.222	2.729	2.471	1.542
3.381	4.487	3.1601	4.196	5.401	7.176	2.176	3.305	2.797	1.419
3.231	4.026	3.1845	3.915	5.538	6.990	2.355	3.133	2.920	1.481
3.257	3.808	3.0185	3.507	4.862	5.673	2.378	2.981	2.786	1.730
2.561	3.000	2.5738	2.979	3.968	4.614	2.019	2.411	2.179	1.308
2.767	3.313	2.5467	3.046	4.606	5.513	2.160	2.637	2.554	1.478
2.615	3.188	2.4629	3.003	3.811	4.655	1.926	2.692	2.190	1.285
3.275	4.416	3.0170	4.067	4.610	6.209	2.228	3.295	2.820	1.492
3.165	4.447	3.1726	4.482	5.775	8.132	2.191	3.524	2.764	1.152
3.560	3.945	3.2142	3.577	4.617	5.129	2.604	3.299	2.646	2.081
2.450	3.028	2.4102	2.975	3.439	4.252	1.771	2.265	2.089	1.293
3.208	4.023	3.1155	3.885	5.125	6.406	2.257	2.964	2.873	1.559
2.365	3.362	2.1895	3.208	6.479	9.523	1.954	2.736	2.483	.892
2.956	4.160	2.5523	3.682	4.752	6.848	2.158	3.102	2.921	1.615
2.346	3.168	2.2652	3.012	6.000	7.996	1.983	2.879	2.671	.959
3.135	4.172	2.6812	3.559	3.735	4.937	2.039	2.788	2.482	1.467
3.127	3.651	2.9528	3.326	4.026	4.655	2.365	2.996	2.692	1.911
2.507	3.027	2.3257	2.828	4.080	4.928	2.032	2.526	2.286	1.520

ตาราง 6ข (ต่อ)

วิธีวัด									
C1A	C1B	C2A	C2B	C3A	C3B	C4A	C4B	D	L
2.462	2.962	2.0743	2.719	4.369	5.554	2.227	2.601	2.564	1.622
3.538	4.152	3.6634	4.248	5.634	6.547	2.683	3.848	2.860	1.757
2.357	2.931	2.2525	2.709	3.575	4.423	1.912	2.366	2.421	1.362
2.619	3.327	2.2414	2.981	4.440	5.830	2.153	2.785	2.752	1.610
2.626	4.031	2.3145	3.754	4.326	6.930	1.963	3.310	2.629	1.532
2.416	3.442	2.4271	3.457	12.976	18.511	1.720	2.775	2.286	.438
3.194	3.830	2.9511	3.534	4.617	5.540	2.355	2.788	2.769	1.732
2.535	3.591	2.4896	3.508	8.732	12.324	1.788	2.706	2.414	.585
2.472	2.916	2.3127	2.739	3.652	4.319	1.960	2.258	2.301	1.579
2.882	3.531	2.8378	3.463	4.836	5.914	2.119	2.788	2.588	1.401
3.534	4.232	3.4407	4.118	4.950	5.934	2.437	3.113	2.769	1.838
2.861	3.758	2.8497	3.515	4.708	6.170	2.164	2.894	2.616	1.418
3.043	3.875	2.8569	3.683	4.334	5.553	2.242	2.977	2.664	1.735
2.804	3.238	2.9191	3.211	3.662	4.173	2.138	2.572	2.304	1.568
2.928	3.344	2.5782	2.942	4.595	5.227	2.206	2.678	2.482	1.547
2.396	2.858	2.3507	2.733	4.432	5.166	1.895	2.300	2.311	1.162
3.160	4.157	3.0530	3.991	5.437	7.129	2.214	3.357	2.862	1.423
2.690	3.081	2.8686	3.136	3.880	4.358	2.173	2.541	2.344	1.497
2.430	2.775	2.4291	2.766	3.572	4.082	2.157	2.425	1.946	1.307
1.938	3.081	1.8171	3.124	23.253	38.740	1.607	2.627	2.370	.537
2.093	2.465	1.6748	2.160	4.353	5.659	1.902	2.217	2.210	1.260
2.522	3.418	2.3428	3.282	5.918	8.253	2.042	2.815	2.617	1.072
2.545	3.157	2.4887	3.087	4.777	5.926	1.991	2.615	2.365	1.103

ตาราง 7๗ แสดงค่าความเที่ยงในการวัดก่อนเรียนและหลังเรียน ค่าความสัมพันธ์ระหว่างคะแนน ความแตกต่างระหว่างคะแนนดิบ และคะแนนก่อนเรียนค่าความเบี่ยงเบนมาตรฐาน ในการวัดก่อนเรียน และ หลังเรียน 100 รอบ สำหรับแบบวิจัย S. 8 50 30

R_{xx}	R_{yy}	R_{dx}	SD_x	SD_y	R_{dd}
.81567	.81172	-.15985	3.6565	4.3589	.4347
.79400	.79547	-.48676	4.2490	3.9711	.4448
.86113	.83638	-.48259	4.3442	4.2058	.5612
.81745	.82473	-.49579	4.1345	3.7819	.5643
.88254	.81872	-.39326	3.5014	4.1981	.6145
.81683	.75482	-.46778	3.9844	4.0102	.5096
.82331	.84688	-.47574	4.4462	4.0303	.4579
.82362	.72608	-.61701	4.5923	3.7256	.4874
.88154	.83987	-.43704	4.0074	4.1299	.7224
.73507	.84402	-.38799	3.5193	4.3532	.6901
.73620	.85340	-.43843	3.5377	3.7977	.5357
.72790	.75075	-.36491	3.3301	3.9699	.4268
.73235	.80515	-.36192	3.7449	4.2849	.4214
.77634	.84832	-.43993	4.0765	4.3191	.5347
.81110	.85691	-.22896	3.5715	4.4809	.6425
.83020	.83521	-.43171	4.1817	4.2455	.5371
.78483	.81513	-.38325	3.6064	4.0630	.6510
.74970	.74252	-.52524	3.8514	3.8221	.5002
.76015	.71245	-.27358	3.3106	4.1708	.4102
.85238	.89268	-.21307	4.0360	5.6075	.7019
.79938	.80850	-.46952	3.3579	3.5216	.6389
.78545	.80103	-.32138	3.6976	4.4444	.4640
.83157	.69704	-.47214	3.8066	3.6058	.3650
.76665	.69512	-.61460	3.9930	3.5398	.4847
.71767	.74745	-.59505	3.8427	3.2336	.3222

ตาราง 7ข (ต่อ)

R_{XX}	R_{YY}	R_{DX}	SD_X	SD_Y	R_{DD}
.78836	.75710	-.59393	3.8410	3.4961	.5980
.80170	.88067	-.39817	4.0164	4.8210	.6730
.90405	.83789	-.51190	4.8687	4.4944	.6946
.86622	.77719	-.61811	4.5967	3.7470	.5523
.71342	.86185	.00346	3.4272	5.5794	.5756
.76495	.82186	-.55041	3.9210	3.6180	.5714
.81149	.75784	-.61803	4.4399	3.7054	.5237
.83410	.62401	-.64386	4.0052	3.3541	.5551
.69257	.70029	-.25395	2.9299	3.4073	.2476
.82326	.83366	-.40244	4.4213	4.8322	.6073
.66259	.70660	-.25763	2.8496	3.4263	.2424
.85235	.84536	-.53273	4.1220	3.8879	.6539
.79702	.81603	-.38431	3.8751	4.1998	.5078
.81876	.83365	-.24609	3.5341	4.7290	.5503
.83633	.76792	-.57750	4.1886	3.6455	.4953
.83460	.78089	-.53252	4.2298	4.1823	.6356
.72670	.88448	-.24563	3.4423	4.8985	.7295
.79254	.86793	-.34240	3.7895	4.3035	.5536
.79142	.85011	-.35325	3.8166	4.0973	.5263
.73252	.76262	-.39737	3.3743	3.8348	.3688
.77709	.88834	-.26677	3.9154	4.9013	.6844
.84710	.87181	-.21365	3.7129	4.6826	.7312
.76271	.60843	-.53452	3.4871	3.0675	.2373
.86541	.78676	-.60373	4.4722	3.6346	.5791
.81257	.72344	-.48301	3.7977	3.6094	.3464
.80846	.80647	-.38790	3.9570	4.1051	.5212
.86113	.83638	-.48259	4.3442	4.2058	.5612

ตาราง 7ข (ต่อ)

R_{xx}	R_{yy}	R_{dx}	SD_x	SD_y	R_{DD}
.81745	.82473	-.49579	4.1345	3.7819	.5643
.88254	.81872	-.39326	3.5014	4.1981	.6115
.81683	.75482	-.46778	3.9844	4.0102	.5006
.82331	.84688	-.47574	4.4462	4.0303	.4579
.82362	.72608	-.61701	4.5923	3.7256	.4874
.88154	.83987	-.43704	4.0074	4.1299	.7224
.73507	.84402	-.38799	3.5193	4.3532	.6901
.73620	.85340	-.43843	3.5377	3.7977	.5357
.72790	.75075	-.36491	3.3301	3.9699	.4268
.73235	.80515	-.36192	3.7449	4.2849	.4214
.77634	.84832	-.43993	4.0765	4.3191	.5347
.81140	.85691	-.22396	3.5715	4.4809	.6425
.83020	.83521	-.43111	4.1817	4.2455	.5371
.78483	.81513	-.38325	3.6064	4.0630	.6510
.74970	.74252	-.52524	3.8514	3.8221	.5002
.76015	.71245	-.27358	3.3106	4.1708	.4102
.85238	.89268	-.21307	4.0360	5.6075	.7019
.79938	.80850	-.46952	3.3579	3.5216	.6389
.78545	.80103	-.32138	3.6976	4.4444	.4640
.83157	.69704	-.47214	3.8066	3.6058	.3650
.76665	.69512	-.61460	3.9930	3.5398	.4847
.71767	.74745	-.59505	3.8427	3.2336	.3222
.78836	.75710	-.59393	3.8410	3.4961	.5980
.80170	.88067	-.39817	4.0164	4.8210	.6730
.90405	.83789	-.51190	4.8687	4.4944	.6946
.86622	.77719	-.61811	4.5967	3.7470	.6730
.71342	.86185	.00346	3.4272	5.5794	.6946

ตาราง 7B (ต่อ)

R_{XX}	R_{YY}	R_{DX}	SD_x	SD_y	R_{DD}
.76495	.82186	-.55041	3.9210	3.6180	.5523
.81149	.75784	-.61803	4.4399	3.7054	.5756
.83410	.62401	-.64386	4.0052	3.3541	.5714
.69257	.70029	-.25395	2.9299	3.4073	.5237
.82326	.83366	-.40244	4.4213	4.8322	.5551
.66259	.70660	-.25763	2.8496	3.4263	.2476
.85235	.84536	-.53273	4.1226	3.8879	.6073
.79702	.81603	-.38431	3.8751	4.1998	.2424
.81876	.83365	-.24609	3.5341	4.7290	.6539
.83633	.76792	-.57750	4.1886	3.6455	.5078
.83460	.78089	-.53252	4.2298	4.1823	.5503
.72670	.88448	-.24562	3.4423	4.8985	.4953
.79254	.86793	-.34240	3.7895	4.3035	.6356
.79142	.85011	-.35325	3.8166	4.0973	.7295
.73252	.76262	-.39737	3.3743	3.8348	.5536
.77709	.88834	-.26677	3.9154	4.9013	.5263
.84710	.87181	-.21365	3.7129	4.6826	.3686
.76271	.60843	-.53452	3.4871	3.0675	.6844
.86541	.78676	-.60373	4.4722	3.6346	.7312
.81257	.72344	-.48301	3.7977	3.6094	.2373
.80846	.80647	-.38790	3.9570	4.1051	.5791

ตัวอย่างการประมาณค่าความเที่ยง

ตัวอย่างที่ 1

แบบวิจัย S .8 50 60 คือแบบวิจัยในสถานการณ์การเรียนแบบกึ่งรอบรู้ที่ความสัมพันธ์ระหว่างความสามารถ สูงขนาด 0.8 กลุ่มตัวอย่างขนาดปานกลาง คือ 50 คน และใช้แบบสอบที่มีข้อคำถามขนาด 60 ข้อ

$$R_{xx'} = .8770 \quad R_{yy'} = .9249 \quad R_{C4B, C4B'} = .7086 \quad R_{DD'} = .6647$$

$$S_x^2 = 55.012 \quad S_y^2 = 56.325 \quad R_{xy} = .6526 \quad R_{EX, EY} = -.2179$$

เมื่อคำนวณ โดยคำนึงข้อตกลงเบื้องต้นอย่างเคร่งครัด

$$R_{DD'} = \frac{S_x^2 R_{xx'} + S_y^2 R_{yy'} - 2R_{xy} S_x S_y}{S_x^2 + S_y^2 - 2R_{xy} S_x S_y}$$

แทนค่าจะได้

$$R_{DD'} = \frac{55.012 \times .877 + 56.325 \times .9249 - 2 \times .6526 \times 7.417 \times 7.505}{55.012 + 56.325 - 2 \times .6526 \times 7.417 \times 7.505}$$

$$R_{DD'} = .7157$$

เมื่อคำนวณ โดยยอมให้ความสัมพันธ์ระหว่างความคลาดเคลื่อนในการวัด

$$R_{DD'} = \frac{S_x^2 R_{xx'} + S_y^2 R_{yy'} - 2R_{xy} S_x S_y + 2R_{EX, EY} S_x S_y (1 - R_{xx'}) (1 - R_{yy'})}{S_x^2 + S_y^2 - 2R_{xy} S_x S_y}$$

แทนค่าจะได้ (ใช้ทศนิยม 2 ตำแหน่งในเศษเพื่อให้พอหนึ่งบรรทัด)

$$R_{DD'} = \frac{55.01 \times .88 + 56.33 \times .93 - 2 \times .65 \times 7.42 \times 7.51 + 2 \times (-.22) \times 7.42 \times 7.51 \times (1 - .88) (1 - .93)}{55.012 + 56.325 - 2 \times .6526 \times 7.417 \times 7.505}$$

$$R_{DD} = .6555$$

จะเห็นว่าค่าที่คำนวณโดยยอมให้มีความสัมพันธ์ระหว่างความคลาดเคลื่อนในการวัด ซึ่งมีความสัมพันธ์ระหว่างความคลาดเคลื่อนในการวัดเป็นลบ จะได้ค่าความเที่ยงต่ำกว่าเดิมเล็กน้อย

ตัวอย่างที่ 2

แบบวิจัย M .6 30 30 คือแบบวิจัยในสถานการณ์การเรียนรู้แบบรอบรู้ที่ความสัมพันธ์ระหว่างความสามารถก่อนข้างสูงขนาด 0.6 กลุ่มตัวอย่างขนาดเล็ก ขนาด 30 คน และใช้เครื่องมือที่มีข้อคำถามน้อยขนาด 30 ข้อ

$$R_{XX} = .7623 \quad R_{YY} = .8547 \quad R_{C4B,C4E} = .8422 \quad R_{DD} = .7320$$

$$S_x^2 = 13.8622 \quad S_y^2 = 24.1789 \quad R_{XY} = .5519 \quad R_{EX,EY} = .3010$$

เมื่อคำนวณโดยคำนึงข้อตกลงเบื้องต้นอย่างเคร่งครัด

$$R_{DD} = \frac{S_x^2 R_{XX} + S_y^2 R_{YY} - 2R_{XY} S_x S_y}{S_x^2 + S_y^2 - 2R_{XY} S_x S_y}$$

แทนค่าจะได้

$$R_{DD} = \frac{13.8622 \times .7623 + 24.1789 \times .8547 - 2 \times .5519 \times 3.7232 \times 4.9172}{13.8622 + 24.1789 - 2 \times .5519 \times 3.7232 \times 4.9172}$$

$$R_{DD} = .6182$$

เมื่อคำนวณโดยยอมให้มีความสัมพันธ์ระหว่างความคลาดเคลื่อนในการวัด

$$R_{DD} = \frac{S_x^2 R_{XX} + S_y^2 R_{YY} - 2R_{XY} S_x S_y + 2R_{EX,EY} S_x S_y (1 - R_{XX})(1 - R_{YY})}{S_x^2 + S_y^2 - 2R_{XY} S_x S_y}$$

แทนค่าจะได้ (ใช้ทศนิยม 2 ตำแหน่งในเศษเพื่อให้ออกหนึ่งบรรทัด)

$$R_{DD} = \frac{13.86 \times .76 + 24.18 \times .85 - 2 \times .55 \times 3.72 \times 4.92 + 2 \times .30 \times 3.72 \times 4.92 \times (1-.76)(1-.85)}{13.8622 + 24.1789 - 2 \times .5519 \times 3.7232 \times 4.9172}$$

$$R_{DD} = .7331$$

จะเห็นว่าค่าที่คำนวณโดยยอมให้มีความสัมพันธ์ระหว่างความคลาดเคลื่อนในการวัด จะได้ค่าสูงกว่าเล็กน้อย แต่ก็ยังไม่สูงกว่าความเที่ยงของการวัดก่อนเรียนหรือหลังเรียน และค่าที่สูงขึ้นนี้ไม่มีนัยสำคัญทางสถิติ



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ภาคผนวก ค โปรแกรมที่ใช้ในการวิจัย

- โปรแกรม A : โปรแกรมตรวจสอบความเป็นเลขคู่สมมาตรด้วยโคสแควร์ (UNIFORM.FOR)
- โปรแกรม B : ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับการเรียนแบบรอบรู้ (MAS4.FOR)
- โปรแกรม C : ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับการเรียนแบบปกติ (NOR6.FOR)
- โปรแกรม D : ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับการเรียนแบบกึ่งรอบรู้ (SEMI8.FOR)
- โปรแกรม E : ตัวอย่างโปรแกรมจำลองข้อมูล และคำนวณการเปลี่ยนแปลงการเรียนรู้ สำหรับการเรียนแบบรอบรู้ (MAS.FOR)
- โปรแกรม F : โปรแกรมสำหรับเรียกใช้โปรแกรมสำเร็จรูป SPSSPC หาค่าสถิติพื้นฐาน คะแนนก่อนเรียนและหลังเรียน (SIMCT1)
- โปรแกรม G : โปรแกรมสำหรับเรียกใช้โปรแกรมสำเร็จรูป SPSSPC หาค่าสถิติพื้นฐาน คะแนนการวัดการเปลี่ยนแปลงการเรียนรู้ (SIMCT2)
- โปรแกรม H : ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างสหสัมพันธ์เป็นรายคู่ (THC.FOR)
- โปรแกรม I : ตัวอย่างโปรแกรมหาสหสัมพันธ์แบบอันดับ (TR.FOR)
- โปรแกรม J : ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างสหสัมพันธ์ ที่อิสระจากกัน (ทดสอบความแตกต่างระหว่างค่าความถี่) (INCOR.FOR)
- โปรแกรม K : ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างความคลาดเคลื่อนมาตรฐานในการวัด (F.FOR)
- โปรแกรม L : ตัวอย่างโปรแกรมกับความถี่ของคะแนน (FREQ.FOR)

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โปรแกรม A: โปรแกรมตรวจสอบความเป็นเลขสุ่มสม่ำเสมอ ด้วยไดสแควร์ (UNIFORM.FOR)

* PROGRAM TEST FOR UNIFORM DISTRIBUTION *

* BETWEEN ZERO AND 1 *

INTEGER OF(10),EXP,TOF,TEXP

DIMENSION CHI(10),Y(20000)

CHARACTER*9 INV(10)

*INITIALIZE VARIABLE

X=65539

TABLE=16.919

EXP=2000

DO 8 I=1,10

OF(I)=0

8 CHI(I)=0

INV(1)='0.0 - 0.1'

INV(2)='0.1 - 0.2'

INV(3)='0.2 - 0.3'

INV(4)='0.3 - 0.4'

INV(5)='0.4 - 0.5'

INV(6)='0.5 - 0.6'

INV(7)='0.6 - 0.7'

INV(8)='0.7 - 0.8'

INV(9)='0.8 - 0.9'

INV(10)='0.9 - 1.0'

TCHI=0

TOF=0

TEXP=0

*****COUNT OBSERVE FREQUENCY

DO 30 I=1,20000

CALL GENRAN (X,RN)

```

Y(I)=RN
IF (Y(I) .GE. 0.0 .AND. Y(I) .LE. 0.1) THEN
    OF(1)=OF(1)+1
ELSEIF (Y(I) .GT. 0.1 .AND. Y(I) .LE. 0.2) THEN
    OF(2)=OF(2)+1
ELSEIF (Y(I) .GT. 0.2 .AND. Y(I) .LE. 0.3) THEN
    OF(3)=OF(3)+1
ELSEIF (Y(I) .GT. 0.3 .AND. Y(I) .LE. 0.4) THEN
    OF(4)=OF(4)+1
ELSEIF (Y(I) .GT. 0.4 .AND. Y(I) .LE. 0.5) THEN
    OF(5)=OF(5)+1
ELSEIF (Y(I) .GT. 0.5 .AND. Y(I) .LE. 0.6) THEN
    OF(6)=OF(6)+1
ELSEIF (Y(I) .GT. 0.6 .AND. Y(I) .LE. 0.7) THEN
    OF(7)=OF(7)+1
ELSEIF (Y(I) .GT. 0.7 .AND. Y(I) .LE. 0.8) THEN
    OF(8)=OF(8)+1
ELSEIF (Y(I) .GT. 0.8 .AND. Y(I) .LE. 0.9) THEN
    OF(9)=OF(9)+1
ELSEIF (Y(I) .GT. 0.9 .AND. Y(I) .LE. 1.0) THEN
    OF(10)=OF(10)+1
ENDIF
30 CONTINUE
*****Chi-Square Test
DO 20 I=1,10
    CHI(I)=(OF(I)-2000.)*2/2000.
    TCHI=TCHI+CHI(I)
20 CONTINUE
*****PRINT RANDOM NUMBERS
OPEN(6,FILE='UNI',STATUS='NEW')
*   WRITE (6,100)

```

```

* 100 FORMAT (30X, 'RANDOM NUMBERS')
*      WRITE (6,110)
* 110 FORMAT (30X, (14('=')))
*      WRITE(6,120) (Y(I),I=1,20000)
* 120 FORMAT (10F7.5)
**** PRIINT FREQUENCY TABLE
      WRITE (6,130)
130 FORMAT (////,28X, 'FREQUENCY TABLE'//)
      WRITE (6,140)
140 FORMAT (10X, 'INTERVAL ',5X, 'OBS. FREQ. ',5X, 'EXP. FREQ. ',5X,
* 'Chi-Sqr')
      WRITE (6,150)
150 FORMAT (9X, (52('-')))
      DO 300 I=1,10
          WRITE (6,160) INV(I),OF(I),EXP,CHI(I)
160      FORMAT (9X,A9,7X,I4,9X,I4,10X,F9.5)
          TOF=TOF + OF(I)
          TEXP=TEXP+EXP
300 CONTINUE
      WRITE(6,180)
180 FORMAT (9X, (52('-')))
          WRITE (6,170) TOF,TEXP,TCHI
170 FORMAT (10X, 'TOTAL ',9X,I5,9X,I5,9X,F9.5)
          IF (TCHI .LT. TABLE) THEN
              WRITE (6,190) TCHI, TABLE
190      FORMAT (////,20X,F5.2, ' < ',F5.2,
*      ' NOT REJECT THESE RANDOM NUMBERS')
          ELSE
              WRITE (6,200) TCHI, TABLE
200      FORMAT (////,20X,F5.2, ' > ',F5.2,
*      ' REJECT THESE RANDOM NUMBERS')

```

```
ENDIF
STOP
END
```

```
*****
* SUBROUTINE GENERATE RANDOM NUMBER *
*****
```

```
SUBROUTINE GENRAN (X,RN)
```

```
T=7
```

```
K=8*T+3
```

```
X=X*K
```

```
IF (X) 5,5,6
```

```
5 X=X+2**20
```

```
6 KEEP=X/(2**20)
```

```
X=X-(KEEP*(2**20))
```

```
RN=X/(2**20)
```

```
RETURN
```

```
END
```

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โปรแกรม B ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับการเรียนแบบรอบรู้ (MAS4.FOR)

*PROGRAM TO SIMULATE MASTERY LEARNING XETA FOR .4 CORRELATION

DIMENSION XETAX(20000),XETAY(20000)

X =65539.

EX =0.

STD=1.

RXY=.4

NO=20000

AM1 = -2.1400

AM2= -.1341

AM3= -.0520

AM4= -.0820

AM'1= 3.7880

AM21= -.1230

AM31= -.0831

AM41=-.0260

OPEN(6,FILE='ABC',STATUS='NEW')

DO 5 I=1,NO

CALL NORMALP(X,EX,STD,Z1,Z2)

R1=AM3*ALOG(Z1)

R2=AM4*ALOG(1.-Z1)

RX1=EXP(R1)

RX2=EXP(R2)

XETAX(I)=AM1+(RX1-RX2)/AM2

R3=AM31*ALOG(Z2)

R4=AM41*ALOG(1.-Z2)

RY1=EXP(R3)

RY2=EXP(R4)

XEY=AM11+(RY1-RY2)/AM21

XETAY(I)=XETAX(I)*RXY+XEY*SQRT(1.-RXY**2)

5 CONTINUE

CALL CORR (NO,XETAX,XETAY,RXY)

CALL SKEW(XETAX,NO,XME,SDX,SKX)

CALL SKEW(XETAY,NO,YME,SDY,SKY)

CALL KURTO(XETAX,NO,XME,SDX,ZKURX)

CALL KURTO(XETAY,NO,YME,SDY,ZKURY)

WRITE (6,10) XME,SDX,SKX,ZKURX,YME,SDY,SKY,ZKURY,RXY

10 FORMAT(8F7.4,F5.4)

STOP

END

 * SUBROUTINE TO FIND PAIRED NORMAL RANDOM NUMBER**

SUBROUTINE NORMALP(X,EX,STD,Z1,Z2)

2 CALL GENRAN(X,RN)

R1=2.*RN-1.

CALL GENRAN(X,RN)

R2=2.*RN-1.

RR=R1*R1+R2*R2

IF (RR .GE. 1.) GO TO 2

RR1=R1*SQRT((-2.*ALOG(RR))/RR)

RR2=R2*SQRT((-2.*ALOG(RR))/RR)

Z1=EX+RR1*STD

Z2=EX+RR2*STD

IF (Z1 .GE. 1. .OR. Z1 .LE. 0.) GO TO 2

IF (Z2 .GE. 1..OR. Z2 .LE. 0.) GO TO 2

RETURN

END

```
*****
*   SUBROUTINE TO FIND NORMAL RANDOM NUMBER   *
*****
```

```
      SUBROUTINE NORMAL(X, EX, STD, Z)
```

```
      A=0.0
```

```
      DO 7 I=1,12
```

```
      CALL GENRAN(X, RN)
```

```
7 A=A+RN
```

```
      Z=EX+STD*(A-6.)
```

```
      RETURN
```

```
      END
```

```
*****
*   SUBROUTINE GENERATE RANDOM NUMBER         *
*****
```

```
      SUBROUTINE GENRAN(X, RN)
```

```
      T=7
```

```
      K=8*T+3
```

```
      X=X*K
```

```
      IF (X) 5,6,6
```

```
5 X=X+2**20
```

```
6 KEEP=X/(2**20)
```

```
      X=X-(KEEP*(2**20))
```

```
      RN=X/(2**20)
```

```
      RETURN
```

```
      END
```

```
*****
*   SUBROUTINE TO FIND CORRELATION*
*****
```

```
      SUBROUTINE CORR(NO, TOR1, TOR2, R)
```

```
      DIMENSION TOR1(NO), TOR2(NO)
```

```
      SX=0.
```

```

SY=0.
DO 57 I=1,NO
    SX=SX+TOR1(I)
57 SY=SY+TOR2(I)
    XBAR=SX/NO
    YBAR=SY/NO
    SX=0.
    SXY=0.
    SY=0.
DO 58 I=1,NO
    SXY=SXY+(TOR1(I)-XBAR)*(TOR2(I)-YBAR)
    SX=SX+(TOR1(I)-XBAR)**2
58 SY=SY+(TOR2(I)-YBAR)**2
    R=SXY/SQRT(SX*SY)
    RETURN
END

```

```
*****
```

```
* SUBROUTINE SKEWNESS *
```

```
*****
```

```

SUBROUTINE SKEW(Y,N,BA,SD,SK)
DIMENSION Y(*)
SY=0
SYY=0
DO 55 I=1,N
    SY=SY+Y(I)
55 SSY=SSY+Y(I)*Y(I)
    BA.=SY/N
    SD=SQRT(SSY/N-BA**2)
    S=0
DO 1 I=1,N
1 S=S+(Y(I)-BA)**3

```

SK=S/(N*SD**3)

RETURN

END

* SUBROUTINE KURTOSIS *

SUBROUTINE KURTC(Y,N,BA,SD,ZKUR)

DIMENSION Y(*)

S=0

SY=0

SYY=0

DO 55 I=1,N

SY=SY+Y(I)

55 SYY= SYY+Y(I)*Y(I)

BA =SY/N

SD=SQRT(SYY/N-BA**2)

DO 1 I=1,N

1 S=S+(Y(I)-BA)**4

ZKUR=S/(N*SD**4)

RETURN

END

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โปรแกรม C ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับลักษณะการเรียนรู้แบบทั่วไป
(REG6.FOR)

```
*****
*PROGRAM TO SIMULATE NORMAL LEARNING XETA FOR .6 CORRELATION
*****
```

```

DIMENSION XETAX(20000),XETAY(20000)
REAL LAM1,LAM11,LAM2,LAM3,LAM4,LAM21,LAM31,LAM41
X =65539.
EX =0.
STD=1.
RXY=.6
NO=20000
LAM1 = -1.8113
LAM2= .1974
LAM3= .1489
LAM4= .1349
LAM11= 4.1490
LAM21= .1974
LAM31= .1349
LAM41= .1339
OPEN(6.FILE='ABC',STATUS='NEW')
DO 5 I=1,NO
CALL NORMALP(X,EX,STD,Z1,Z2)
R1=LAM3*ALOG(Z1)
R2=LAM4*ALOG(1.-Z1)
RX1=EXP(R1)
RX2=EXP(R2)
XETAX(I)=LAM1+(RX1-RX2)/LAM2
R3=LAM31*ALOG(Z2)
R4=LAM41*ALOG(1.-Z2)
RY1=EXP(R3)

```

```

RY2=EXP(R4)
KEY=LAM11+(RY1-RY2)/LAM21
XETAY(I)=XETAX(I)*RXY+KEY*SQRT(1.-RXY**2)

```

```
5 CONTINUE
```

```

CALL CORR (NO, XETAX, XETAY, RXY)
CALL SKEW(XETAX, NO, XME, SDX, SKX)
CALL SKEW(XETAY, NO, YME, SDY, SKY)
CALL KURTO(XETAX, NO, XME, SDX, ZKURX)
CALL KURTO(XETAY, NO, YME, SDY, ZKURY)
WRITE (6, 10) XME, SDX, SKX, ZKURX, YME, SDY, SKY, ZKURY, RXY

```

```
10 FORMAT(8F7.4, F5.4)
```

```
STOP
```

```
END
```

```
*****
```

```
* SUBROUTINE TO FIND PAIRED NORMAL RANDOM NUMBER**
```

```
*****
```

```
SUBROUTINE NORMALP(X, EX, STD, Z1, Z2)
```

```
2 CALL GENRAN(X, RN)
```

```
R1=2.*RN-1.
```

```
CALL GENRAN(X, RN)
```

```
R2=2.*RN-1.
```

```
RR=R1*R1+R2*R2
```

```
IF (RR .GE. 1.) GO TO 2
```

```
RR1=R1*SQRT((-2.*ALOG(RR))/RR)
```

```
RR2=R2*SQRT((-2.*ALOG(RR))/RR)
```

```
Z1=EX+RR1*STD
```

```
Z2=EX+RR2*STD
```

```
IF (Z1 .GE. 1. .OR. Z1 .LE. 0.) GO TO 2
```

```
IF (Z2 .GE. 1..OR. Z2 .LE. 0.) GO TO 2
```

```
RETURN
```

```
END
```

```
*****
*   SUBROUTINE TO FIND NORMAL RANDOM NUMBER   *
*****
```

```
      SUBROUTINE NORMAL(X, EX, STD, Z)
```

```
      A=0.0
```

```
      DO 7 I=1,12
```

```
      CALL GENRAN(X, RN)
```

```
7  A=A+RN
```

```
      Z=EX+STD*(A-6.)
```

```
      RETURN
```

```
      END
```

```
*****
*   SUBROUTINE GENERATE RANDOM NUMBER         *
*****
```

```
      SUBROUTINE GENRAN(X, RN)
```

```
      T=7
```

```
      K=8*T+3
```

```
      X=X*K
```

```
      IF (X) 5,6,6
```

```
5  X=X+2**20
```

```
6  KEEP=X/(2**20)
```

```
      X=X-(KEEP*(2**20))
```

```
      RN=X/(2**20)
```

```
      RETURN
```

```
      END
```

```
*****
*   SUBROUTINE TO FIND CORRELATION*
*****
```

```
      SUBROUTINE CORR(NO, TOR1, TOR2, R)
```

```
      DIMENSION TOR1(NO), TOR2(NO)
```

```
      SX=0.
```

```

SY=0.
DO 57 I=1,NO
    SX=SX+TOR1(I)
57 SY=SY+TOR2(I)
    XBAR=SX/NO
    YBAR=SY/NO,
    SX=0.
    SXY=0.
    SY=0.
DO 58 I=1,NO
    SXY=SXY+(TOR1(I)-XBAR)*(TOR2(I)-YBAR)
    SX=SX+(TOR1(I)-XBAR)**2
58 SY=SY+(TOR2(I)-YBAR)**2
    R=SXY/SQRT(SX*SY)
RETURN
END

```

```

*****
*   SUBROUTINE KURTOSIS   *
*****

```

```

SUBROUTINE KURTO(Y,N,BA,SD,ZKUR)
DIMENSION Y(*)
S=0
SY=0
SYY=0
DO 55 I=1,N
    SY=SY+Y(I)
55 SYY= SYY+Y(I)*Y(I)
    BA =SY/N
    SD=SQRT(SYY/N-BA**2)
DO 1 I=1,N
1 S=S+(Y(I)-BA)**4

```

```
ZKUR=S/(N*SD**4)
```

```
RETURN
```

```
END
```

```
*****
```

```
* SUBROUTINE SKEWNESS *
```

```
*****
```

```
SUBROUTINE SKEW(Y,N,BA,SD,SK)
```

```
DIMENSION Y(*)
```

```
SY=0
```

```
SYI=0
```

```
DO 55 I=1,N
```

```
SY=SY+Y(I)
```

```
55 SSI= SSI+Y(I)*Y(I)
```

```
BA =SY/N
```

```
SD=SQRT(SSY/N-BA**2)
```

```
S=0
```

```
DO 1 I=1,N
```

```
1 S=S+(Y(I)-BA)**3
```

```
SK=S/(N*SD**3)
```

```
RETURN
```

```
END
```

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โปรแกรม D ตัวอย่างโปรแกรมตรวจสอบลักษณะประชากรสำหรับการเรียนแบบกึ่งรอบรู้
(SEMI8.FOR)

*PROGRAM TO SIMULATE SEMI - MASTERY LEARNING XETA FOR .8 CORRELATION

```

DIMENSION XETAX(20000),XETAY(20000)
REAL LAM1,LAM11,LAM2,LAM3,LAM4,LAM21,LAM31,LAM41
X =65539.
EX =0.
STD=1.
RXY=.8
NO=20000
LAM1 = -1.878
LAM2= .1974
LAM3= .1349
LAM4= .1349
LAM11= 6.6602
LAM21= -.1291
LAM31= -.0860
LAM41= -.0256
OPEN(6,FILE='ABC',STATUS='NEW')
DO 5 I=1,NO
CALL NORMALP(X,EX,STD,Z1,Z2)
R1=LAM3*ALOG(Z1)
R2=LAM4*ALOG(1.-Z1)
RX1=EXP(R1)
RX2=EXP(R2)
XETAX(I)=LAM1+(RX1-RX2)/LAM2
R3=LAM31*ALOG(Z2)
R4=LAM41*ALOG(1.-Z2)
RY1=EXP(R3)

```

RY2=EXP(R4)

XEY=LAM11+(RY1-RY2)/LAM21

XETAY(I)=XETAX(I)*RXY+XEY*SQRT(1.-RXY**2)

5 CONTINUE

CALL CORR (NO, XETAX, XETAY, RXY)

CALL SKEW(XETAX, NO, XME, SDX, SKX)

CALL SKEW(XETAY, NO, YME, SDY, SKY)

CALL KURTO(XETAX, NO, XME, SDX, ZKURX)

CALL KURTO(XETAY, NO, YME, SDY, ZKURY)

WRITE (6, 10) XME, SDX, SKX, ZKURX, YME, SDY, SKY, ZKURY, RXY

10 FORMAT(8F7.4, F5.4)

STOP

END

* SUBROUTINE TO FIND PAIRED NORMAL RANDOM NUMBER**

SUBROUTINE NORMALP(X, EX, STD, Z1, Z2)

2 CALL GENRAN(X, RN)

R1=2.*RN-1.

CALL GENRAN(X, RN)

R2=2.*RN-1.

RR=R1*R1+R2*R2

IF (RR .GE. 1.) GO TO 2

RR1=R1*SQRT((-2.*ALOG(RR))/RR)

RR2=R2*SQRT((-2.*ALOG(RR))/RR)

Z1=EX+RR1*STD

Z2=EX+RR2*STD

IF (Z1 .GE. 1. .OR. Z1 .LE. 0.) GO TO 2

IF (Z2 .GE. 1..OR. Z2 .LE. 0.) GO TO 2

RETURN

END

```
*****
```

```
* SUBROUTINE TO FIND NORMAL RANDOM NUMBER *
```

```
*****
```

```
  SUBROUTINE NORMAL (X, EX, STD, Z)
```

```
  A=0.0
```

```
  DO 7 I=1,12
```

```
  CALL GENRAN(X,RN)
```

```
7 A=A+RN
```

```
  Z=EX+STD*(A-6.)
```

```
  RETURN
```

```
  END
```

```
*****
```

```
* SUBROUTINE GENERATE RANDOM NUMBER *
```

```
*****
```

```
  SUBROUTINE GENRAN (X, RN)
```

```
  T=7
```

```
  K=8*T+3
```

```
  X=X*K
```

```
  IF (X) 5,6,6
```

```
5 X=X+2**20
```

```
6 KEEP=X/(2**20)
```

```
  X=X-(KEEP*(2**20))
```

```
  RN=X/(2**20)
```

```
  RETURN
```

```
  END
```

```
*****
```

```
* SUBROUTINE TO FIND CORRELATION*
```

```
*****
```

```
  SUBROUTINE CORR(NO, TOR1, TOR2, R)
```

```
  DIMENSION TOR1(NO), TOR2(NO)
```

```
  SX=0.
```

```

SY=0.
DO 57 I=1,NO
    SX=SX+TOR1(I)
57 SY=SY+TOR2(I)
XBAR=SX/NO
YBAR=SY/NO
SX=0.
SKY=0.
SY=0.
DO 58 I=1,NO
    SKY=SKY+(TOR1(I)-XBAR)*(TOR2(I)-YBAR)
    SX=SX+(TOR1(I)-XBAR)**2
58 SY=SY+(TOR2(I)-YBAR)**2
R=SKY/SQRT(SX*SY)
RETURN
END

```

```

*****

```

```

*   SUBROUTINE SKEWNESS   *

```

```

*****

```

```

SUBROUTINE SKEW(Y,N,BA,SD,SK)
DIMENSION Y(*)
SY=0
SYY=0
DO 55 I=1,N
    SY=SY+Y(I)
55 SSY= SSY+Y(I)*Y(I)
BA =SY/N
SD=SQRT(SSY/N-BA**2)
S=0
DO 1 I=1,N
1 S=S+(Y(I)-BA)**3

```

SK=S/(N*SD**3)

RETURN

END

* SUBROUTINE SKEWNESS *

SUBROUTINE SKEW(Y,N,BA,SD,SK)

DIMENSION Y(*)

SY=0

SSY=0

DO 55 I=1,N

SY=SY+Y(I)

55 SSY= SSY+Y(I)*Y(I)

BA =SY/N

SD=SQRT(SSY/N-BA**2)

S=0

DO 1 I=1,N

1 S=S+(Y(I)-BA)**3

SK=S/(N*SD**3)

RETURN

END

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

โปรแกรม E : ตัวอย่างโปรแกรมจำลองข้อมูล และคำนวณการเปลี่ยนแปลงการเรียนรู้
สำหรับการเรียนแบบรอบรู้ (MAS.FOR)

```
*****
*** PROGRAM : SIMULATION TO FIND LEARNING CHANGED SCORE ***
*** MASTERY LEARNING RXETA .6 ***
*** SAMPLES 30, ITEMS 60 ***
*****
```

*INITIALIZE VARIABLE

```
REAL L(30),K1,LT(30),LBAR
DIMENSION IUX(30,60),IUY(30,60),XETAX(30),XETAY(30),
*TORX(30),TORY(30),TOTX(30),TOTY(30),TX(30),TY(30),
*B(60),ERX(30),ERY(30),ESTX(30),ESTY(30),D(30),DT(30),
*DXETA(30),C1A(30),C1B(30),C2A(30),C2B(30),C3A(30),
*C3B(30),C4A(30),C4B(30),C1AT(30),C1BT(30),C2AT(30),
*C2BT(30),C3AT(30),C3BT(30),C4AT(30),C4BT(30),SX(30),
*SY(30)

COMMON MO,NO,D,DT,L,DXETA,C1A,C1B,C2A,C2B,C3A,C3B,C4A,C4B
DATA B/-2.5,-2.4,-2.3,-2.2,-2.1,-2.0,-1.9,-1.8,-1.7,-1.6,-1.5,
*-1.4,-1.3,-1.2,-1.1,-1.0,-0.9,-0.8,-0.7,-0.6,-0.5,-0.4,-0.4,
*-0.3,-0.3,-0.2,-0.2,-0.1,-0.1,0.0,0.1,0.1,0.2,0.2,0.3,0.3,0.4,
*0.4,0.5,0.5,0.6,0.7,0.8,0.9,1.0,1.1,1.2,1.3,1.4,1.5,1.6,1.7,
*1.8,1.9,2.0,2.1,2.2,2.3,2.4,2.5/

DATA SX,SY/30*0,30*0/
X=65539.
EX=0.
STD=1.0
NO=30
MO=60
RXETA=0.6
AM1 = -2.1471
AM2= -.1212
```

AM3= -.0470
 AM4= -.0760
 AM11= 4.7559
 AM21= -.1291
 AM31= -.0940
 AM41=-.0220

***CALL XETA TO FIND SAMPLES

DO 5 I=1,NO
 CALL NORMALP(X,EX,STD,Z1,Z2)
 R1=AM3*ALOG(Z1)
 R2=AM4*ALOG(1.-Z1)
 RX1=EXP(R1)
 RX2=EXP(R2)
 XETAX(I)=AM1+(RX1-RX2)/AM2
 R3=AM31*ALOG(Z2)
 R4=AM41*ALOG(1.-Z2)
 RY1=EXP(R3)
 RY2=EXP(R4)
 XEY=AM11+(RY1-RY2)/AM21
 XETAY(I)=XETAX(I)*RXETA+XEY*SQRT(1.-RXETA**2)

5 CONTINUE

OPEN(4,FILE='FFFF',STATUS='NEW')
 OPEN(5,FILE='ffff',STATUS='NEW')
 OPEN(6,FILE='ffffff',STATUS='NEW')
 OPEN(7,FILE='fffffff',STATUS='NEW')

*****TAKING PRETEST AND POSTTEST

CALL RESP(XETAX,B,IUX,X,EX,STD,NO,MO)
 CALL RESP(XETAY,B,IUY,X,EX,STD,NO,MO)

*****TO FIND RAW SCORE

DO 35 I=1,NO

```

TORX(I)=0.
TORY(I)=0.
35 CONTINUE
DO 80 I=1 ,NO
    DO 81 J=1,MO
        TORX(I)=TORX(I)+IUX(I,J)
        TORY(I)=TORY(I)+IUY(I,J)
81 CONTINUE
    IF (TORX(I).EQ. 0.) THEN
        TORX(I) =1.
    END IF
    IF (TORY(I).EQ.0.) THEN
        TORY(I) =1.
    END IF
80 CONTINUE
DO 21 I=1,NO
    SX(I)=0.
    SY(I)=0.
21 CONTINUE
*****ANSWER THE TEST SEVERAL TIMES
DO 200 M=1,100
    WRITE(*,*) 'PLEASE WAIT... ',M
    CALL RESP(XETAX,B,IUX,X,EX,STD,NO,MO)
    CALL RESP(XETAY,B,IUY,X,EX,STD,NO,MO)
DO 11 I=1,NO
    TOTX(I)=0.
    TOTY(I)=0.
11 CONTINUE
DO 22 I=1,NO
    DO 13 J=1,MO
        TOTX(I)=TOTX(I)+IUX(I,J)

```

```

          TOTY(I)=TOTY(I)+IUY(I,J)
13      CONTINUE
22      CONTINUE
        DO 7 I=1,NO
          SX(I) =SX(I)+TOTX(I)
        7 SY(I) =SY(I)+TOTY(I)
200    CONTINUE
***** TO FIND TRUE SCORE**
        DO 9 I =1,NO
          TX(I)=SX(I)/100.
        9 TY(I)=SY(I)/100.
        NO=30
        MO=30
        CALL MSD(NO,TORX,XBAR,SDX)
        CALL MSD(NO,TORY,YBAR,SDY)
        CALL MSD(NO,TX, TXPA,SDTX)
        CALL MSD(NO,TY, TYBA,SDTY)
***** TO FIND ERROR SCORE**
        CALL ERR(NO,TORX,TX,ERX)
        CALL ERR(NO,TORY,TY,ERY)
***** TO FIND RELIABILITY
        CALL CORR(NO,TORX,TX,RXTX)
        RELIX=RXTX**2
        CALL CORR(NO,TORY,TY,RYTY)
        RELIY=RYTY**2
***** TO FIND ESTIMATE TRUE SCORE
        CALL ESTM(NO,RELIX,TORX,XBAR,ESTX)
        CALL ESTM(NO,RELIY,TORY,YBAR,ESTY)
        CALL CORR(NO,TORX,TORY,RAXY)
        WX=(SDY*RAXY*(1-RELIY)-SDX*(RELIX-RAXY**2))/(SDX*(1-RAXY**2))
        WY=(SDY*(RELIY-RAXY**2)-SDX*RAXY*(1-RELIX))/(SDY*(1-RAXY**2))

```



K1=YBAR-XBAR-WX*XBAR-WY*YBAR

DO 85 I=1 ,NO

D(I) = TORY(I) - TORX(I)

DT(I) = TY(I) - TX(I)

LT(I) = DT(I)

DXETA(I)= XETAY(I) - XETAX(I)

85 L(I) = WX*TORX(I)+WY*TORY(I)+K1

CALL MSD(NO,D,DBAR,SDD)

CALL CORR(NO,D,TORY,RDY)

W2=(-RDY/RELIY)*(SDD/SDY)

CALL CORR(NO,D,TORX,RDX)

W3=(-RDX/RELIX)*(SDD/SDX)

CALL MSD(NO,DT,DTBAR,SDDT)

CALL MSD(NO,TY,TYBAR,SDTY)

CALL CORR(NO,DT,TY,RDITY)

W2T=(-RDITY)*SDDT/SDTY

CALL MSD(NO,TX,TXBAR,SDTX)

CALL CORR(NO,DT,TX,RDTTX)

W3T=(-RDTTX)*SDDT/SDTX

CALL CORR(NO,D,DT,RDDT)

CALL CORR(NO,L,LT,RLLT)

ROD=RDDT**2

ROL=RLLT**2

CALL MSD(NO,L,LBAR,SDL)

SED=SDD*SQRT(1-ROD)

VED=SED**2

SEL=SDL*SQRT(1-ROL)

VEL=SEL**2

W21=(SQRT(RELIY*SDY**2+RELIX*SDX**2-2*RAXY*SDX*SDY)*

*(RDX*RAXY-RELIX*RDY))/(SDY*RDDT*(RELIX*RELIY-RAXY**2))

```

CALL CORR(NO,DT,TY,RDITY)
CALL CORR(NO,TX,TY,RTXTY)
W21T=SDDT/SDTY*(RDITX*RTXTY-RDITY)/(1-RTXTY**2)
F=MO
DO 86 I=1 ,NO
  C1A(I) = (1-W2)*ESTY(I)-ESTX(I)
  C1AT(I) = (1-W2T)*TY(I)-TX(I)
  C1B(I) = (1-W2)*TORY(I)-TORX(I)
  C1BT(I) = C1AT(I)
  C2A(I) = (1-W2)*ESTY(I)-(1-W3)*ESTX(I)
  C2AT(I) = (1-W2T)*TY(I)-(1-W3T)*TX(I)
  C2B(I) = (1-W2)*TORY(I)-(1-W3)*TORX(I)
  C2BT(I) = C2AT(I)
  C3A(I) = (1-W21)*ESTY(I)-ESTX(I)
  C3AT(I) = (1-W21T)*TY(I)-TX(I)
  C3B(I) = (1-W21)*TORY(I)-TORX(I)
  C3BT(I) = C3AT(I)
  C4A(I) = (1-W2/ESTX(I))*ESTY(I)
  * -ESTX(I)+W2*F/ESTX(I)
  C4AT(I) = (1-W2T/TX(I))*TY(I)-TX(I)+W2T*F/TX(I)
  C4B(I) = (1-W2/TORX(I))*TORY(I)
  * -TORX(I)+W2*F/TORX(I)
  C4BT(I) = C4AT(I)
86 CONTINUE
CALL CORR(NO,C1A,C1AT,RC1A)
ROC1A =RC1A**2
CALL MSD(NO,C1A,C1AB,SC1A)
SEC1A=SC1A*SQRT(1-ROC1A)
VEC1A=SEC1A**2
CALL CORR(NO,C1B,C1BT,RC1B)
ROC1B =RC1B**2

```

```
CALL MSD(NO, C1B, C1BB, SC1B)
SEC1B=SC1B*SQRT(1-ROC1B)
VEC1B=SEC1B**2
CALL CORR(NO, C2A, C2AT, RC2A)
ROC2A =RC2A**2
CALL MSD(NO, C2A, C2AB, SC2A)
SEC2A=SC2A*SQRT(1-ROC2A)
VEC2A=SEC2A**2
CALL CORR(NO, C2B, C2BT, RC2B)
ROC2B =RC2B**2
CALL MSD(NO, C2B, C2BB, SC2B)
SEC2B=SC2B*SQRT(1-ROC2B)
VEC2B=SEC2B**2
CALL CORR(NO, C3A, C3AT, RC3A)
ROC3A=RC3A**2
CALL MSD(NO, C3A, C3AB, SC3A)
SEC3A=SC3A*SQRT(1-ROC3A)
VEC3A=SEC3A**2
CALL CORR(NO, C3B, C3BT, RC3B)
ROC3B =RC3B**2
CALL MSD(NO, C3B, C3BB, SC3B)
SEC3B=SC3B*SQRT(1-ROC3B)
VEC3B=SEC3B**2
CALL CORR(NO, C4A, C4AT, RC4A)
ROC4A =RC4A**2
CALL MSD(NO, C4A, C4AB, SC4A)
SEC4A=SC4A*SQRT(1-ROC4A)
VEC4A=SEC4A**2
CALL CORR(NO, C4B, C4BT, RC4B)
ROC4B =RC4B**2
CALL MSD(NO, C4B, C4BB, SC4B)
```

```

SEC4B=SC4B*SQRT(1-ROC4B)
VEC4B=SEC4B**2
*****WRITE OUTPUT
write (*,*) 'w2 =', w2
write (*,*) 'w3 =', w3
write (*,*) 'w21 =', w21
write (*,*) 'wX =', wX
write (*,*) 'wY =', wY
write (*,*) 'K =', K1
write (*,*) 'W2T =', W2T
write (*,*) 'W3T =', W3T
write (*,*) 'W21T =', W21T
DO 2 I =1,NO
2 WRITE(5,38) XETAX(I),TORX(I),ERX(I),TX(I),ESTX(I),
*XETAY(I),TORY(I),FRY(I),TY(I),ESTY(I)
38 FORMAT (2(F7.3,3F4.0,F9.3))
DO 4 I=1,NO
4 WRITE(6,40) I,DT(I),D(I),DXETA(I),L(I),
* C1A(I),C1B(I),C2A(I),C2B(I),C3A(I),C3B(I),C4A(I),C4B(I)
40 FORMAT (I2,2F4.0,F5.3,9f7.3)
WRITE(7,45) ROC1A,ROC1B,ROC2A,ROC2B,ROC3A,ROC3B,ROC4A,ROC4B,ROD,
*ROL
WRITE(7,45)RC1A,RC1B,RC2A,RC2B,RC3A,RC3B,RC4A,RC4B,RDDT,RLLT
WRITE(7,46) SEC1A,SEC1B,SEC2A,SEC2B,SEC3A,SEC3B,SEC4A,SEC4B,SED,
*SEL
WRITE(7,46) VEC1A,VEC1B,VEC2A,VEC2B,VEC3A,VEC3B,VEC4A,VEC4B,VED,
*VEL
45 FORMAT(10F5.4)
46 FORMAT(10F8.4)
WRITE(4,49)RELIX,RELIY
49 FORMAT('RELIABILITY X ,Y =', 2f6.5)

```

STOP

END

* SUBROUTINE TO FIND NORMAL RANDOM NUMBER *

SUBROUTINE NORMAL(X, EX, STD, Z)

A=0.0

DO 7 I=1,12

CALL GENRAN(X, RN)

7 A=A+RN

Z=EX+STD*(A-6.)

RETURN

END

* SUBROUTINE GENERATE RANDOM NUMBER *

SUBROUTINE GENRAN(X, RN)

T=7

K=8*T+3

X=X*K

IF (X) 5,6,6

5 X=X+2**20

6 KEEP=X/(2**20)

X=X-(KEEP*(2**20))

RN=X/(2**20)

RETURN

END

* SUBROUTINE TO FIND PAIRED NORMAL RANDOM NUMBER**

SUBROUTINE NORMALP(X, EX, STD, Z1, Z2)

```

2 CALL GENRAN(X,RN)
  R1=2.*RN-1.
  CALL GENRAN(X,RN)
  R2=2.*RN-1.
  RR=R1*R1+R2*R2
  IF (RR .GE. 1.) GO TO 2
  RR1=R1*SQRT((-2.*ALOG(RR))/RR)
  RR2=R2*SQRT((-2.*ALOG(RR))/RR)
  Z1=EX+RR1*STD
  Z2=EX+RR2*STD
  IF (Z1 .GE. 1. .OR. Z1 .LE. 0.) GO TO 2
  IF (Z2 .GE. 1..OR. Z2 .LE. 0.) GO TO 2
  RETURN
END

```

```

*****
* SUBROUTINE TO FIND PROBABILITY OF RESPONSE *
*****

```

```

SUBROUTINE POBA(AXETA,AB,APOB)
C=EXP(AXETA-AB)
APOB=C/(1+C)
RETURN
END

```

```

*****
* SUBROUTINE TO FIND Z-SCORES *
*****

```

```

SUBROUTINE NORTR1(P,Y,D,IE)
IE=0.
Y=0.99999E+20
D=Y
IF (P) 2,3,5
2 IE=-1

```

```

GO TO 14
5 IF (P-1.0) 4,7,2
3 Y=-0.999999E+20
7 D=0.0
GO TO14
4 D=P
IF(D-0.5)9,9,8
8 D=1.0-D
9 T2=ALOG(1.0/(D*D))
T= SQRT(T2)
Y=T-(2.1515517+0.802853*T+0.010328*T2)/(1.0+1.432788*T+0.189269
**T2+0.001308*T*T2)
IF (P-0.5) 10,10,11
10 Y=-Y
11 D=0.03989423*EXP(-Y*Y/2.0)
14 RETURN
END

```

```
*****
```

```
* SUBROUTINE TO FIND PROBABILITY OF RESPONSE*
```

```
*****
```

```
SUBROUTINE FESP(XETA,B,IUU,X,EX,STD,NO,MO)
```

```
DIMENSION IUU(30,60),XETA(NO),B(MO),PO(30,60)
```

```
DO 50 N=1,NO
```

```
DO 40 J=1,MO
```

```
AXETA=XETA(N)
```

```
AB=B(J)
```

```
C4LL POBA(AXETA,AB,APOB)
```

```
PO(N,J)=APOB
```

```
40 CONTINUE
```

```
50 CONTINUE
```

```
DO 72 N=1,NO
```

```

DO 71 J=1,MO
  P=PO(N,J)
  CALL NORTR1(P,Y,D,IE)
  AY=Y
  CALL NORMAL(X,EX,STD,Z)
  IF (Z .GE. AY) GO TO 27
  IUU(N,J)=1
  GO TO 71
27  IUU(N,J)=0
71  CONTINUE
72 CONTINUE
  RETURN
  END

```

```

*****
*   SUBROUTINE TO FIND ERROR SCORE *
*****

```

```

SUBROUTINE ERR(NO,TOR,T,E)
  DIMENSION TOR(NO),T(NO),E(NO)
  DO 60 I =1,NO
    E(I)=TOR(I)-T(I)
60 CONTINUE
  RETURN
  END

```

```

*****
*   SUBROUTINE TO FIND ESTIMATE T *
*****
SUBROUTINE ESTM(NO,RE,TOR,BAR,EST)
  DIMENSION TOR(NO),EST(NO)
  DO 60 I =1,NO
    EST(I)=BAR+RE*(TOR(I)-BAR)
    IF (EST(I) .NE. 0.) GO TO 60

```

EST(I) =.001

.60 CONTINUE

RETURN

END

 * SUBROUTINE TO FIND MEAN AND STANDARD DEVIATION *

SUBROUTINE MSD(NO, TOR, XBAR, SD)

DIMENSION TOR(NO)

SX=0.

SXX=0.

DO 55 I=1,NO

SX=SX+TOR(I)

55 SXX=SXX+TOR(I)*TOR(I)

XBAR=SX/NO

SD=SQRT(SXX/NO-XBAR**2)

RETURN

END

 * SUBROUTINE TO FIND CORRELATION*

SUBROUTINE CORR(NO, TOR1, TOR2, R)

DIMENSION TOR1(NO), TOR2(NO)

SX=0.

SY=0.

DO 57 I=1,NO

SX=SX+TOR1(I)

57 SY=SY+TOR2(I)

XBAR=SX/NO

YBAR=SY/NO

SX=0.

```
SXY=0.  
SY=0.  
DO 58 I=1,NO  
SXY=SXY+(TOR1(I)-XBAR)*(TOR2(I)-YBAR)  
SX=SX+(TOR1(I)-XBAR)**2  
58 SY=SY+(TOR2(I)-YBAR)**2  
R=SXY/SQRT(SX*SY)  
RETURN  
END
```



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

โปรแกรม F: โปรแกรมสำหรับเรียกใช้โปรแกรมสำเร็จรูป SPSSPC หาค่าสถิติพื้นฐาน คะแนน
ก่อนเรียนและหลังเรียน (SIMCT1)

TITLE RESEARCH.

DATA LIST FILE= c:\fortran\FFFFF'

/XETAX 1-7(3) X 8-10 ERX 12-14 TX 16-18 ESTX 20-28(3)

XETAY 29-35(3) Y 36-38 ERY 40-42 TY 44-46 ESTY 48-56(3).

FREQU VARIABLES= ALL/FORMAT=NOTABLES/STAT=MEAN STDDEV SKEW KURTO
MIN MAX RANGE MEDIAN MODE.

corr vari= all/option=3/stat=1.

fin.

โปรแกรม G: โปรแกรมสำหรับเรียกใช้โปรแกรมสำเร็จรูป SPSSPC หาค่าสถิติพื้นฐาน คะแนน
การเปลี่ยนแปลงการเรียนรู้อ (SIMCT2)

TITLE RESEARCH.

DATA LIST FILE='c:\fortran\FFFFFF'

/DT 3-6 D 7-10 DXETA 11-15(3) L 16-22(3) C1A 23-29(3) C1B 30-36(3)

C2A 37-43(3) C2B 44-50(3) C3A 51-57(3) C3B 58-64(3) C4A 65-71(3)

C4B 72-78(3).

FREQU VARIABLES= ALL/FORMAT=NOTABLES/STAT=MEAN STDDEV SKEW KURTO
MIN MAX RANGE MEDIAN MODE.

corr vari= all/option=3/stat=1.

fin.

โปรแกรม H: ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างสหสัมพันธ์เป็นรายคู่ (THO.FOR)

** PROGRAM TO TEST CO-CORREATION**

```

      OPEN(3,FILE='DAXS')
      OPEN(6,FILE='THC',STATUS='NEW')
      WRITE(6,20)
20  FORMAT(/11X,'N1',4X,'R12',4X,'R13',4X,'R23',6X,'T',8X,'DXS')
      5  READ(3,10)N,R12,R13,R23
10  FORMAT(I3,3F5.4)
      IF(N .EQ. 0) GO TO 40
      A=0.
      B=0.
      A=2*(1-(R23**2)-(R12**2)-(R13**2)+(2*R12*R13*R23))
      IF (A .GE. 0.)GO TO 25
      WRITE(6,31) N,R12,R13,R23
      GO TO 5
25  B=B+(N-3)*(1+R23)
      T=(R12-R13)*SQRT(B/A)
      WRITE(6,30) N,R12,R13,R23,T
      GO TO 5
30  FORMAT(10X,I3,3F7.4,2X,F8.4)
31  FORMAT(10X,I3,3F7.4,3X,'UNSOLVED')
40  STOP
      END

```

โปรแกรม I ตัวอย่างโปรแกรมหาสหสัมพันธ์แบบอันดับ (TR.FOR)

PROGRAM : SIMULATION SPEARMAN ' RANK CORRELATION

*INITIALIZE VARIABLE

REAL L(100)

DIMENSION DXETA(100),D(100),DT(100),

*C1A(100),C1B(100),C2A(100),C2B(100),

*C3A(100),C3B(100),C4A(100),C4B(100)

OPEN(5,FILE='B:M433.F6')

OPEN(6,FILE='F',STATUS='NEW')

WRITE(6,5)

5 FORMAT(5X,'ST433')

NO=30

DO 20 I=1,NO

READ(5,10) DT(I),D(I)

20 CONTINUE

10 FORMAT (2X,2F4.0)

CALL SPM(NO,DT,D,P1,V1)

REWIND 5

DO 21 I=1,NO

READ(5,34) DT(I),DXETA(I)

21 CONTINUE

34 FORMAT (2X,F4.0,4X,F5.3)

CALL SPM(NO,DT,DXETA,P2,V2)

REWIND 5

DO 22 I=1,NO

READ(5,35) DT(I),L(I)

22 CONTINUE

35 FORMAT (2X,F4.0,9X,F7.3)

```
CALL SPM(NO,DT,L,P3,V3)
REWIND 5
DO 23 I=1,NO
READ(5,36) DT(I),C1A(I)
23 CONTINUE
36 FORMAT (2X,F4.0,16X,F7.3)
CALL SPM(NO,DT,C1A,P4,V4)
REWIND 5
DO 24 I=1,NO
READ(5,37) DT(I),C1B(I)
24 CONTINUE
37 FORMAT (2X,F4.0,23X,F7.3)
CALL SPM(NO,DT,C1B,P5,V5)
REWIND 5
DO 25 I=1,NO
READ(5,38) DT(I),C2A(I)
25 CONTINUE
38 FORMAT (2X,F4.0,30X,F7.3)
CALL SPM(NO,DT,C2A,P6,V6)
REWIND 5
DO 26 I=1,NO
READ(5,39) DT(I),C2B(I)
26 CONTINUE
39 FORMAT (2X,F4.0,37X,F7.3)
CALL SPM(NO,DT,C2B,P7,V7)
REWIND 5
DO 27 I=1,NO
READ(5,40) DT(I),C3A(I)
27 CONTINUE
40 FORMAT (2X,F4.0,44X,F7.3)
CALL SPM(NO,DT,C3A,P8,V8)
```

```

REWIND 5
DO 28 I=1,NO
  READ(5,41) DT(I),C3B(I)
28 CONTINUE
41 FORMAT (2X,F4.0,51X,F7.3)
  CALL SPM(NO,DT,C3B,P9,V9)
  REWIND 5
  DO 29 I=1,NO
    READ(5,42) DT(I),C4A(I)
29 CONTINUE
42 FORMAT (2X,F4.0,58X,F7.3)
  CALL SPM(NO,DT,C4A,P10,V10)
  REWIND 5
  DO 30 I=1,NO
    READ(5,43) DT(I),C4B(I)
30 CONTINUE
43 FORMAT (2X,F4.0,65X,F7.3)
  CALL SPM(NO,DT,C4B,P11,V11)
*****WRITE OUTPUT
  WRITE(6,*) 'C1A C1B C2A C2B C3A C3B C4A C4B D L DXE'
  WRITE(6,50) P4,P5,P6,P7,P8,P9,P10,P11,P1,P3,P2
  WRITE(6,51) V4,V5,V6,V7,V8,V9,V10,V11,V1,V3,V2
50 FORMAT(11F6.4)
51 FORMAT(11F6.2)
  STOP
  END

*****
* SUBROUTINE TO FIND Spearman ' Rank Correlation*
*****
SUBROUTINE SPM(NO,X,Y,P,V)
DIMENSION X(100),Y(100),A(100),B(100),RX(100),RY(100)

```

```

SX=0.
SY=0.
SXX=0.
SYY=0.
SXY=0.
DO 10 I=1,NO
  A(I)=X(I)
10 B(I)=Y(I)
  5 S=0.
    DO 12 I=1,NO-1
      IF (X(I).LE.X(I+1)) GO TO 12
      T=X(I)
      *   U=Y(I)
      X(I)=X(I+1)
      *   Y(I)=Y(I+1)
      X(I+1)=T
      *   Y(I+1)=U
      S=1.
12 CONTINUE
    IF (S.EQ.1) GO TO 5
    DO 11 I=1,NO
      R=0.
      C=0.
      DO 13 J=1,NO
        IF (A(I).EQ.X(J)) THEN
          C=C+1
          R=R+J
        END IF
13 CONTINUE
      RX(I)=R/C
11 CONTINUE

```

```

7 S=0.
  DO 14 I=1,NO-1
    IF (B(I).LE.B(I+1)) GO TO 14
    T=B(I)
    B(I)=B(I+1)
    B(I+1)=T
    S=1.
14 CONTINUE
  IF (S.EQ.1) GO TO 7
  DO 16 I=1,NO
    R=0.
    C=0.
    DO 15 J=1,NO
      IF (Y(I).EQ.B(J)) THEN
        C=C+1
        R=R+J
      END IF
15 CONTINUE
    RY(I)=R/C
16 CONTINUE
    SDD=0.
    DO 20 I=1,NO
      * WRITE(*,*) RX(I),RY(I)
      D=RX(I)-RY(I)
      DD=D*D
      SDD=SDD+DD
20 CONTINUE
    P=1-((6*SDD)/(NO*(NO*NO-1)))
    V=(P*P)*100
  RETURN
  END

```

โปรแกรม J ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างสหสัมพันธ์ ที่อิสระจากกัน
(ทดสอบความแตกต่างระหว่างค่าความเที่ยง) (INCOR.FOR)

```
*****
***PROGRAM TO TEST INDEPENDENT-CORRELATION***
*****
```

```
REAL L
OPEN (3,FILE='B:N856.F7')
N=50
OPEN(6,FILE='IND',STATUS='NEW')
WRITE (6,100)
100 FORMAT(5X,'RELIABILITY TEST OF N856.F7')
WRITE(6,101)
101 FORMAT(/,6X,'N',5X,'R1',5X,'R2',8X,'Z')
READ(3,1)C1A,C1B
1 FORMAT(F5.4,F5.4)
CALL ZCOR(N,C1A,C1B)
REWIND 3
READ(3,2)C1A,C2A
2 FORMAT(F5.4,5X,F5.4)
CALL ZCOR(N,C1A,C2A)
REWIND 3
READ(3,3)C1A,C2B
3 FORMAT(F5.4,10X,F5.4)
CALL ZCOR(N,C1A,C2B)
REWIND 3
READ(3,4)C1A,C3A
4 FORMAT(F5.4,15X,F5.4)
CALL ZCOR(N,C1A,C3A)
REWIND 3
READ(3,5)C1A,C3B
5 FORMAT(F5.4,20X,F5.4)
```

```
CALL ZCOR(N,C1A,C3B)
REWIND 3
READ(3,6)C1A,C4A
6 FORMAT(F5.4,25X,F5.4)
CALL ZCOR(N,C1A,C4A)
REWIND 3
READ(3,7)C1A,C4B
7 FORMAT(F5.4,30X,F5.4)
CALL ZCOR(N,C1A,C4B)
REWIND 3
READ(3,8)C1A,D
8 FORMAT(F5.4,35X,F5.4)
CALL ZCOR(N,C1A,D)
REWIND 3
READ(3,9)C1A,L
9 FORMAT(F5.4,40X,F5.4)
CALL ZCOR(N,C1A,L)
REWIND 3
READ(3,10)C1B,C2A
10 FORMAT(5X,F5.4,F5.4)
CALL ZCOR(N,C1B,C2A)
REWIND 3
READ(3,11)C1B,C2B
11 FORMAT(5X,F5.4,5X,F5.4)
CALL ZCOR(N,C1B,C2B)
REWIND 3
READ(3,12)C1B,C3A
12 FORMAT(5X,F5.4,10X,F5.4)
CALL ZCOR(N,C1B,C3A)
REWIND 3
READ(3,13)C1B,C3B
```

```
13  FORMAT(5X,F5.4,15X,F5.4)
      CALL ZCOR(N,C1B,C3B)
      REWIND 3
      READ(3,14)C1B,C4A
14  FORMAT(5X,F5.4,20X,F5.4)
      CALL ZCOR(N,C1B,C4A)
      REWIND 3
      READ(3,15)C1B,C4B
15  FORMAT(5X,F5.4,25X,F5.4)
      CALL ZCOR(N,C1B,C4B)
      REWIND 3
      READ(3,16)C1B,D
16  FORMAT(5X,F5.4,30X,F5.4)
      CALL ZCOR(N,C1B,D)
      REWIND 3
      READ(3,17)C1B,L
17  FORMAT(5X,F5.4,35X,F5.4)
      CALL ZCOR(N,C1B,L)
      REWIND 3
      READ(3,18)C2A,C2B
18  FORMAT(10X,F5.4,F5.4)
      CALL ZCOR(N,C2A,C2B)
      REWIND 3
      READ(3,19)C2A,C3A
19  FORMAT(10X,F5.4,5X,F5.4)
      CALL ZCOR(N,C2A,C3A)
      REWIND 3
      READ(3,20)C2A,C3B
20  FORMAT(10X,F5.4,10X,F5.4)
      CALL ZCOR(N,C2A,C3B)
      REWIND 3
```

```
READ(3,21)C2A,C4A
21 FORMAT(10X,F5.4,15X,F5.4)
CALL ZCOR(N,C2A,C4A)
REWIND 3
READ(3,22)C2A,C4B
22 FORMAT(10X,F5.4,20X,F5.4)
CALL ZCOR(N,C2A,C4B)
REWIND 3
READ(3,23)C2A,D
23 FORMAT(10X,F5.4,25X,F5.4)
CALL ZCOR(N,C2A,D)
REWIND 3
READ(3,24)C2A,L
24 FORMAT(10X,F5.4,30X,F5.4)
CALL ZCOR(N,C2A,L)
REWIND 3
READ(3,25)C2B,C3A
25 FORMAT(15X,F5.4,F5.4)
CALL ZCOR(N,C2B,C3A)
REWIND 3
READ(3,26)C2B,C3B
26 FORMAT(15X,F5.4,5X,F5.4)
CALL ZCOR(N,C2B,C3B)
REWIND 3
READ(3,27)C2B,C4A
27 FORMAT(15X,F5.4,10X,F5.4)
CALL ZCOR(N,C2B,C4A)
REWIND 3
READ(3,28)C2B,C4B
28 FORMAT(15X,F5.4,15X,F5.4)
CALL ZCOR(N,C2B,C4B)
```

```
REWIND 3
READ(3, 29)C2B, D
29 FORMAT(15X, F5.4, 20X, F5.4)
CALL ZCOR(N, C2B, D)
REWIND 3
READ(3, 30)C2B, L
30 FORMAT(15X, F5.4, 25X, F5.4)
CALL ZCOR(N, C2B, L)
REWIND 3
READ(3, 31)C3A, C3B
31 FORMAT(20X, F5.4, F5.4)
CALL ZCOR(N, C3A, C3B)
REWIND 3
READ(3, 32)C3A, C4A
32 FORMAT(20X, F5.4, 5X, F5.4)
CALL ZCOR(N, C3A, C4A)
REWIND 3
READ(3, 33)C3A, C4B
33 FORMAT(20X, F5.4, 10X, F5.4)
CALL ZCOR(N, C3A, C4B)
REWIND 3
READ(3, 34)C3A, D
34 FORMAT(20X, F5.4, 15X, F5.4)
CALL ZCOR(N, C3A, D)
REWIND 3
READ(3, 35)C3A, L
35 FORMAT(20X, F5.4, 20X, F5.4)
CALL ZCOR(N, C3A, L)
REWIND 3
READ(3, 36)C3B, C4A
36 FORMAT(25X, F5.4, F5.4)
```

```
CALL ZCOR(N,C3B,C4A)
REWIND 3
READ(3,37)C3B,C4B
37 FORMAT(25X,F5.4,5X,F5.4)
CALL ZCOR(N,C3B,C4B)
REWIND 3
READ(3,38)C3B,D
38 FORMAT(25X,F5.4,10X,F5.4)
CALL ZCOR(N,C3B,D)
REWIND 3
READ(3,39)C3B,L
39 FORMAT(25X,F5.4,15X,F5.4)
CALL ZCOR(N,C3B,L)
REWIND 3
READ(3,40)C4A,C4B
40 FORMAT(30X,F5.4,F5.4)
CALL ZCOR(N,C4A,C4B)
REWIND 3
READ(3,41)C4A,D
41 FORMAT(30X,F5.4,5X,F5.4)
CALL ZCOR(N,C4A,D)
REWIND 3
READ(3,42)C4A,L
42 FORMAT(30X,F5.4,10X,F5.4)
CALL ZCOR(N,C4A,L)
REWIND 3
READ(3,43)C4B,D
43 FORMAT(35X,F5.4,F5.4)
CALL ZCOR(N,C4B,D)
REWIND 3
READ(3,44)C4B,L
```

```
44 FORMAT(35X,F5.4,5X,F5.4)
```

```
CALL ZCOR(N,C4B,L)
```

```
REWIND 3
```

```
READ(3,45)D,L
```

```
45 FORMAT(40X,F5.4,F5.4)
```

```
CALL ZCOR(N,D,L)
```

```
STOP
```

```
END
```

```
*****
```

```
***SUBROUTINE Z-CORRELATION ***
```

```
*****
```

```
  SUBROUTINE ZCOR(N,R1,R2)
```

```
  Z1=0.
```

```
  Z2=0.
```

```
  COR1=SQRT(R1)
```

```
  COR2=SQRT(R2)
```

```
  Z1=Z1+0.5*(ALOG((1.+COR1)/(1-COR1)))
```

```
  Z2=Z2+0.5*(ALOG((1.+COR2)/(1-COR2)))
```

```
  C=1./(N-3)
```

```
  D=SQRT(C+C)
```

```
  Z=(Z1-Z2)/D
```

```
  WRITE(6,30)N,R1,R2,Z
```

```
30 FORMAT(5X,I3,2X,F5.4,2X,F5.4,F10.4)
```

```
  RETURN
```

```
  END
```

โปรแกรม K: ตัวอย่างโปรแกรมทดสอบความแตกต่างระหว่างความคลาดเคลื่อนมาตรฐานในการวัด
(F.FOR)

```
*****
***PROGRAM TO TEST STANDARD ERROR OF MEASUREMENT***
*****
```

```
REAL L
OPEN (3,FILE='SES8512')
OPEN(6,FILE='F',STATUS='NEW')
WRITE (6,100)
100 FORMAT(5X,'STANDARD ERROR OF MEASUREMENT TEST FOR SES8512')
WRITE(6,101)
101 FORMAT(/,21X,'SE1',5X,'SE2',5X,'VER1',5X,'VER2',5X,'F')
READ(3,1)C1A,C1B
1 FORMAT(F7.4,F7.4)
CALL FTEST(C1A,C1B)
REWIND 3
READ(3,2)C1A,C2A
2 FORMAT(F7.4,7X,F7.4)
CALL FTEST(C1A,C2A)
REWIND 3
READ(3,3)C1A,C2B
3 FORMAT(F7.4,14X,F7.4)
CALL FTEST(C1A,C2B)
REWIND 3
READ(3,4)C1A,C3A
4 FORMAT(F7.4,21X,F7.4)
CALL FTEST(C1A,C3A)
REWIND 3
READ(3,5)C1A,C3B
5 FORMAT(F7.4,28X,F7.4)
CALL FTEST(C1A,C3B)
```

```
REWIND 3
READ(3,6)C1A,C4A
6 FORMAT(F7.4,35X,F7.4)
CALL FTEST(C1A,C4A)
REWIND 3
READ(3,7)C1A,C4B
7 FORMAT(F7.4,42X,F7.4)
CALL FTEST(C1A,C4B)
REWIND 3
READ(3,8)C1A,D
8 FORMAT(F7.4,49X,F7.4)
CALL FTEST(C1A,D)
REWIND 3
READ(3,9)C1A,L
9 FORMAT(F7.4,56X,F7.4)
CALL FTEST(C1A,L)
REWIND 3
READ(3,10)C1B,C2A
10 FORMAT(7X,F7.4,F7.4)
CALL FTEST(C1B,C2A)
REWIND 3
READ(3,11)C1B,C2B
11 FORMAT(7X,F7.4,7X,F7.4)
CALL FTEST(C1B,C2B)
REWIND 3
READ(3,12)C1B,C3A
12 FORMAT(7X,F7.4,14X,F7.4)
CALL FTEST(C1B,C3A)
REWIND 3
READ(3,13)C1B,C3B
13 FORMAT(7X,F7.4,21X,F7.4)
```

```
CALL FTEST(C1B,C3B)
REWIND 3
READ(3,14)C1B,C4A
14 FORMAT(7X,F7.4,28X,F7.4)
CALL FTEST(C1B,C4A)
REWIND 3
READ(3,15)C1B,C4B
15 FORMAT(7X,F7.4,35X,F7.4)
CALL FTEST(C1B,C4B)
REWIND 3
READ(3,16)C1B,D
16 FORMAT(7X,F7.4,42X,F7.4)
CALL FTEST(C1B,D)
REWIND 3
READ(3,17)C1B,L
17 FORMAT(7X,F7.4,49X,F7.4)
CALL FTEST(C1B,L)
REWIND 3
READ(3,18)C2A,C2B
18 FORMAT(14X,F7.4,F7.4)
CALL FTEST(C2A,C2B)
REWIND 3
READ(3,19)C2A,C3A
19 FORMAT(14X,F7.4,7X,F7.4)
CALL FTEST(C2A,C3A)
REWIND 3
READ(3,20)C2A,C3B
20 FORMAT(14X,F7.4,14X,F7.4)
CALL FTEST(C2A,C3B)
REWIND 3
READ(3,21)C2A,C4A
```



ประวัติผู้เขียน

นางอรุณี อ่อนสวัสดิ์ เกิดเมื่อวันที่ 28 กรกฎาคม พ.ศ. 2494 ที่อำเภอบางปะกง จังหวัดฉะเชิงเทรา สำเร็จการศึกษาระดับปริญญาการศึกษามัธยมศึกษา เอกเคมี จากวิทยาลัย วิชาการศึกษาสงขลา เมื่อปีการศึกษา 2515 เคยทำการสอนทางวิชาวิทยาศาสตร์และเคมี ที่ โรงเรียนวิสุทธิกษัตริย์จังหวัดสมุทรปราการ ปีการศึกษา 2521 เข้าศึกษาระดับปริญญาการศึกษามหาบัณฑิต วิชาเอกการวัดผลการศึกษา ที่มหาวิทยาลัยศรีนครินทรวิโรฒ ประสานมิตร เมื่อปีการศึกษา 2523 เข้ารับราชการที่ มหาวิทยาลัยศรีนครินทรวิโรฒ นิษณุโลก ปีการศึกษา 2532 เข้าศึกษาต่อหลักสูตรดุษฎีบัณฑิต สาขาวิชาการวัดและประเมินผลการศึกษา คณะครุศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ปัจจุบันเป็น ผู้ช่วยศาสตราจารย์ประจำภาควิชาพื้นฐานการศึกษา คณะศึกษาศาสตร์ มหาวิทยาลัยนเรศวร จังหวัดพิษณุโลก

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

```
21  FORMAT(14X,F7.4,21X,F7.4)
      CALL FTEST(C2A,C4A)
      REWIND 3
      READ(3,22)C2A,C4B
22  FORMAT(14X,F7.4,28X,F7.4)
      CALL FTEST(C2A,C4B)
      REWIND 3
      READ(3,23)C2A,D
23  FORMAT(14X,F7.4,35X,F7.4)
      CALL FTEST(C2A,D)
      REWIND 3
      READ(3,24)C2A,L
24  FORMAT(14X,F7.4,42X,F7.4)
      CALL FTEST(C2A,L)
      REWIND 3
      READ(3,25)C2B,C3A
25  FORMAT(21X,F7.4,F7.4)
      CALL FTEST(C2B,C3A)
      REWIND 3
      READ(3,26)C2B,C3B
26  FORMAT(21X,F7.4,7X,F7.4)
      CALL FTEST(C2B,C3B)
      REWIND 3
      READ(3,27)C2B,C4A
27  FORMAT(21X,F7.4,14X,F7.4)
      CALL FTEST(C2B,C4A)
      REWIND 3
      READ(3,28)C2B,C4B
28  FORMAT(21X,F7.4,21X,F7.4)
      CALL FTEST(C2B,C4B)
      REWIND 3
```

```
    READ(3,29)C2B,D
29  FORMAT(21X,F7.4,28X,F7.4)
    CALL FTEST(C2B,D)
    REWIND 3
    READ(3,30)C2B,L
30  FORMAT(21X,F7.4,35X,F7.4)
    CALL FTEST(C2B,L)
    REWIND 3
    READ(3,31)C3A,C3B
31  FORMAT(28X,F7.4,F7.4)
    CALL FTEST(C3A,C3B)
    REWIND 3
    READ(3,32)C3A,C4A
32  FORMAT(28X,F7.4,7X,F7.4)
    CALL FTEST(C3A,C4A)
    REWIND 3
    READ(3,33)C3A,C4B
33  FORMAT(28X,F7.4,14X,F7.4)
    CALL FTEST(C3A,C4B)
    REWIND 3
    READ(3,34)C3A,D
34  FORMAT(28X,F7.4,21X,F7.4)
    CALL FTEST(C3A,D)
    REWIND 3
    READ(3,35)C3A,L
35  FORMAT(28X,F7.4,28X,F7.4)
    CALL FTEST(C3A,L)
    REWIND 3
    READ(3,36)C3B,C4A
36  FORMAT(35X,F7.4,F7.4)
    CALL FTEST(C3B,C4A)
```

```
REWIND 3
READ(3,37)C3B,C4B
37 FORMAT(35X,F7.4,7X,F7.4)
CALL FTEST(C3B,C4B)
REWIND 3
READ(3,38)C3B,D
38 FORMAT(35X,F7.4,14X,F7.4)
CALL FTEST(C3B,D)
REWIND 3
READ(3,39)C3B,L
39 FORMAT(35X,F7.4,21X,F7.4)
CALL FTEST(C3B,L)
REWIND 3
READ(3,40)C4A,C4B
40 FORMAT(42X,F7.4,F7.4)
CALL FTEST(C4A,C4B)
REWIND 3
READ(3,41)C4A,D
41 FORMAT(42X,F7.4,7X,F7.4)
CALL FTEST(C4A,D)
REWIND 3
READ(3,42)C4A,L
42 FORMAT(42X,F7.4,14X,F7.4)
CALL FTEST(C4A,L)
REWIND 3
READ(3,43)C4B,D
43 FORMAT(49X,F7.4,F7.4)
CALL FTEST(C4B,D)
REWIND 3
READ(3,44)C4B,L
44 FORMAT(49X,F7.4,7X,F7.4)
```

```
CALL FTEST(C4B,L)
REWIND 3
READ(3,45)D,L
45 FORMAT(56X,F7.4,F7.4)
CALL FTEST(D,L)
STOP
END

*****
***SUBROUTINE Z-CORRELATION ***
*****
SUBROUTINE FTEST(SE1,SE2)
VER1=SE1**2
VER2=SE2**2
IF (VER1 .GT. VER2) THEN
F=VER1/VER2
ELSE
F=VER2/VER1
END IF
WRITE(6,30)SE1,SE2,VER1,VER2,F
30 FORMAT(15X,5F9.4)
RETURN
END
```

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โปรแกรม L: ตัวอย่างโปรแกรมนับความถี่ของคะแนน (FREQ.FOR)

** PROGRAM TO COUNT FREQUENCY OF VARIOUS CHANGE SCORES **

** FOR 100 PERSONS **

REAL L(100)

DIMENSION D(100),DT(100),DXETA(100),

* C1A(100),C1B(100),C2A(100),C2B(100),C3A(100),C3B(100),

*C4A(100),C4B(100),NDTF(7),NDF(7),NDXETAF(7),NLF(7),

* NC1AF(7),NC1BF(7),NC2AF(7),NC2BF(7),NC3AF(7),NC3BF(7),

*NC4AF(7),NC4BF(7)

*****READ INPUT FILE

OPEN(5,FILE='B:N6106.F6')

OPEN(6,FILE='C:\FORTRAN\N6106F', STATUS='NEW')

NO=100

DO 4 I=1,NO

+ READ(5,40) DT(I),D(I),DXETA(I),L(I),

* C1A(I),C1B(I),C2A(I),C2B(I),C3A(I),C3B(I),C4A(I),C4B(I)

40 FORMAT (2X,2F4.0,F5.3,9f7.3)

CALL PVAL(NO,DT,NDTF)

CALL PVAL(NO,D,NDF)

CALL PVAL(NO,DXETA,NDXETAF)

CALL PVAL(NO,L,NLF)

CALL PVAL(NO,C1A,NC1AF)

CALL PVAL(NO,C1B,NC1BF)

CALL PVAL(NO,C2A,NC2AF)

CALL PVAL(NO,C2B,NC2BF)

CALL PVAL(NO,C3A,NC3AF)

CALL PVAL(NO,C3B,NC3BF)

CALL PVAL(NO,C4A,NC4AF)

CALL PVAL(NO,C4B,NC4BF)

```

WRITE(6,*) 'N6106F'
DO 20 I=1,7
20 WRITE(6,50) I,NDTF(I),NDF(I),NDXETAF(I),NLF(I),
  *NC1AF(I),NC1BF(I),NC2AF(I),NC2BF(I),NC3AF(I),NC3BF(I),
  *NC4AF(I),NC4BF(I)
50 FORMAT(I2,3X,12I5)
STOP
END
*****
*      SUBROUTINE PVAL
*****
SUBROUTINE PVAL(NO,X,NY)
DIMENSION X(NO),NY(7)
DO 1 I=1,7
1 NY(I) =0
2 S=0.
DO 12 I=1,NO-1
IF (X(I).LE.X(I+1)) GO TO 12
T=X(I)
X(I)=X(I+1)
X(I+1)=T
S=1.
12 CONTINUE
IF (S.EQ.1) GO TO 3
RI=(X(NO)-X(1))/7.
DO 5 I=1,NO
IF (X(I).LE.(X(1)+RI)) THEN
NY(1)=NY(1)+1
ELSE IF (X(I).LE.(X(1)+2*RI)) THEN
NY(2)=NY(2)+1
ELSE IF (X(I).LE.(X(1)+3*RI)) THEN

```

```
NY(3)=NY(3)+1  
ELSE IF (X(I).LE.(X(1)+4*RI)) THEN  
  NY(4)=NY(4)+1  
ELSE IF (X(I).LE.(X(1)+5*RI)) THEN  
  NY(5)=NY(5)+1  
ELSE IF (X(I).LE.(X(1)+6*RI)) THEN  
  NY(6)=NY(6)+1  
ELSE  
  NY(7)=NY(7)+1  
END IF  
5 CONTINUE  
RETURN  
END
```



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