

## บรรณานุกรม

ภาษาไทยหนังสือ

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ภาคผนวก

TABLE 1 QUANTILES OF THE MANN-WHITNEY TEST STATISTIC\*

n	p	m=2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
2	.001	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
	.005	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	.01	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	
	.025	3	3	3	3	3	3	4	4	4	5	5	5	5	5	5	5	6	6	6	6	
	.05	3	3	3	4	4	4	5	5	5	5	6	6	7	7	7	7	7	8	8	8	
	.10	3	4	4	5	5	5	6	6	6	7	7	8	8	8	9	9	10	10	11	11	
	3	.001	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7	7	7	
		.005	6	6	6	6	6	6	6	7	7	7	8	8	8	9	9	9	9	10	10	
		.01	6	6	6	6	6	6	7	8	8	8	9	9	9	10	10	10	11	11	11	12
		.025	6	6	6	7	8	8	9	9	10	10	11	11	12	12	13	13	13	14	14	15
.05		6	7	7	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	17	18	
.10		7	8	8	9	10	10	11	12	12	13	14	15	16	17	18	19	20	21	22	22	
4		.001	10	10	10	10	10	10	10	10	11	11	11	12	12	12	13	13	14	14	14	
		.005	10	10	10	10	11	11	12	12	13	13	14	14	15	16	16	17	17	18	19	
		.01	10	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20	21	
		.025	10	10	11	12	13	14	15	15	16	17	18	19	20	21	22	22	23	24	25	
	.05	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29		
	.10	11	12	14	15	16	17	18	20	21	22	23	24	26	27	28	29	31	32	33		
	5	.001	15	15	15	15	15	15	16	17	17	18	18	19	19	20	21	21	22	23		
		.005	15	15	16	16	17	17	18	19	20	21	22	23	23	24	25	26	27	28		
		.01	15	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
		.025	15	16	17	18	19	21	22	23	24	25	27	28	29	30	31	33	34	35	36	
.05		16	17	18	20	21	22	24	25	27	28	29	31	32	34	35	36	38	39	41		
.10		17	18	20	21	23	24	26	28	29	31	33	34	36	38	39	41	43	44	46		



ตารางที่ 1 (ต่อ)

n	p	m=2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11	.001	66	66	67	69	71	73	75	77	79	82	84	87	89	91	94	96	99	101	104
	.005	66	67	69	72	74	77	80	83	85	88	91	94	97	100	103	106	109	112	115
	.01	66	68	71	74	76	79	82	85	89	92	95	98	101	104	108	111	114	117	120
	.025	67	70	73	76	80	83	86	90	93	97	100	104	107	111	114	118	122	125	129
	.05	68	72	75	79	83	86	90	94	98	101	105	109	113	117	121	124	128	132	136
	.10	70	74	78	82	86	90	94	98	103	107	111	115	119	124	128	132	136	140	145
	.001	78	78	79	81	83	86	88	91	93	96	98	102	104	106	110	113	116	118	121
	.005	78	80	82	85	88	91	94	97	100	103	106	110	113	116	120	123	126	130	133
	.01	78	81	84	87	90	93	96	100	103	107	110	114	117	121	125	128	132	135	139
	.025	80	83	86	90	93	97	101	105	108	112	116	120	124	128	132	136	140	144	148
.05	81	84	88	92	96	100	105	109	111	117	121	126	130	134	139	143	147	151	156	
.10	83	87	91	96	100	105	109	114	118	123	128	132	137	142	146	151	156	160	165	
12	.001	91	91	93	95	97	100	103	106	109	112	115	118	121	124	127	130	134	137	140
	.005	91	93	95	99	102	105	109	112	116	119	123	126	130	134	137	141	145	149	152
	.01	92	94	97	101	104	108	112	115	119	123	127	131	135	139	143	147	151	155	159
	.025	93	96	100	104	108	112	116	120	125	129	133	137	142	146	151	155	159	164	168
	.05	94	98	102	107	111	116	120	125	129	134	139	143	148	153	157	162	167	172	176
	.10	96	101	105	110	115	120	125	130	135	140	145	150	155	160	166	171	176	181	186
	.001	105	105	107	109	112	115	118	121	125	128	131	135	138	142	145	149	152	156	160
	.005	105	107	110	113	117	121	124	128	132	136	140	144	148	152	156	160	164	169	173
	.01	106	108	112	116	119	123	128	132	136	140	144	149	153	157	162	166	171	175	179
	.025	107	111	115	119	123	128	132	137	142	146	151	156	161	165	170	175	180	184	189
.05	109	113	117	122	127	132	137	142	147	152	157	162	167	172	177	183	188	193	198	
.10	110	116	121	126	131	137	142	147	153	158	164	169	175	180	186	191	197	203	208	
13	.001	91	91	93	95	97	100	103	106	109	112	115	118	121	124	127	130	134	137	140
	.005	91	93	95	99	102	105	109	112	116	119	123	126	130	134	137	141	145	149	152
	.01	92	94	97	101	104	108	112	115	119	123	127	131	135	139	143	147	151	155	159
	.025	93	96	100	104	108	112	116	120	125	129	133	137	142	146	151	155	159	164	168
	.05	94	98	102	107	111	116	120	125	129	134	139	143	148	153	157	162	167	172	176
	.10	96	101	105	110	115	120	125	130	135	140	145	150	155	160	166	171	176	181	186
	.001	105	105	107	109	112	115	118	121	125	128	131	135	138	142	145	149	152	156	160
	.005	105	107	110	113	117	121	124	128	132	136	140	144	148	152	156	160	164	169	173
	.01	106	108	112	116	119	123	128	132	136	140	144	149	153	157	162	166	171	175	179
	.025	107	111	115	119	123	128	132	137	142	146	151	156	161	165	170	175	180	184	189
.05	109	113	117	122	127	132	137	142	147	152	157	162	167	172	177	183	188	193	198	
.10	110	116	121	126	131	137	142	147	153	158	164	169	175	180	186	191	197	203	208	
14	.001	91	91	93	95	97	100	103	106	109	112	115	118	121	124	127	130	134	137	140
	.005	91	93	95	99	102	105	109	112	116	119	123	126	130	134	137	141	145	149	152
	.01	92	94	97	101	104	108	112	115	119	123	127	131	135	139	143	147	151	155	159
	.025	93	96	100	104	108	112	116	120	125	129	133	137	142	146	151	155	159	164	168
	.05	94	98	102	107	111	116	120	125	129	134	139	143	148	153	157	162	167	172	176
	.10	96	101	105	110	115	120	125	130	135	140	145	150	155	160	166	171	176	181	186
	.001	105	105	107	109	112	115	118	121	125	128	131	135	138	142	145	149	152	156	160
	.005	105	107	110	113	117	121	124	128	132	136	140	144	148	152	156	160	164	169	173
	.01	106	108	112	116	119	123	128	132	136	140	144	149	153	157	162	166	171	175	179
	.025	107	111	115	119	123	128	132	137	142	146	151	156	161	165	170	175	180	184	189
.05	109	113	117	122	127	132	137	142	147	152	157	162	167	172	177	183	188	193	198	
.10	110	116	121	126	131	137	142	147	153	158	164	169	175	180	186	191	197	203	208	

ตารางที่ 1 (ต่อ)

.001	120	120	122	125	128	133	135	138	142	145	149	153	157	161	164	168	172	176	180
.005	120	123	126	129	133	137	141	145	150	154	158	163	167	172	176	181	185	190	194
.01	121	124	128	132	136	140	145	149	154	158	163	168	172	177	182	187	191	196	201
.025	122	126	131	135	140	145	150	155	160	165	170	175	180	185	191	196	201	206	211
.05	124	128	133	139	144	149	154	160	165	171	176	182	187	193	198	204	209	215	221
.10	126	131	137	143	148	154	160	166	172	178	184	189	195	201	207	213	219	225	231
.001	136	136	139	142	145	148	152	156	160	164	168	172	176	180	185	189	193	197	202
.005	136	139	142	146	150	155	159	164	168	173	178	182	187	192	197	202	207	211	216
.01	137	140	144	149	153	158	163	168	173	178	183	188	193	198	203	208	213	219	224
.025	138	143	148	152	158	163	168	174	179	184	190	196	201	207	212	218	223	229	235
.05	140	145	151	156	162	167	173	179	185	191	197	202	208	214	220	226	232	238	244
.10	142	148	154	160	166	173	179	185	191	198	204	211	217	223	230	236	243	249	256
.001	153	154	156	159	163	167	171	175	179	183	188	192	197	201	206	211	215	220	224
.005	153	156	160	164	169	173	178	183	188	193	198	203	208	214	219	224	229	235	240
.01	154	158	162	167	172	177	182	187	192	198	203	209	214	220	225	231	236	242	247
.025	156	160	165	171	176	182	188	193	199	205	211	217	223	229	235	241	247	253	259
.05	157	163	169	174	180	187	193	199	205	211	218	224	231	237	243	250	256	263	269
.10	160	166	172	179	185	192	199	206	212	219	226	233	239	246	253	260	267	274	281
.001	171	172	175	178	182	186	190	195	199	204	209	214	218	223	228	233	238	243	248
.005	171	174	178	183	188	193	198	203	209	214	219	225	230	236	242	247	253	259	264
.01	172	176	181	186	191	196	202	208	213	219	225	231	237	242	248	254	260	266	272
.025	174	179	184	190	196	202	208	214	220	227	233	239	246	252	258	265	271	278	284
.05	176	181	188	194	200	207	213	220	227	233	240	247	254	260	267	274	281	288	295
.10	178	185	192	199	206	213	220	227	234	241	249	256	263	270	278	285	292	300	307
.001	190	191	194	198	202	206	211	216	220	225	231	236	241	246	251	257	262	268	273
.005	191	194	198	203	208	213	219	224	230	236	242	248	254	260	265	272	278	284	290
.01	192	195	200	206	211	217	223	229	235	241	247	254	260	266	273	279	285	292	298
.025	193	198	204	210	216	223	229	236	243	249	256	263	269	276	283	290	297	304	310
.05	195	201	208	214	221	228	235	242	249	256	263	271	278	285	292	300	307	314	321
.10	198	205	212	219	227	234	242	249	257	264	272	280	288	295	303	311	319	326	334

ตารางที่ 1 (ต่อ)

n	p	m=2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	.001	210	211	214	218	223	227	232	237	243	248	253	259	265	270	276	281	287	293	299
	.005	211	214	219	224	229	235	241	247	253	259	265	271	278	284	290	297	303	310	316
	.01	212	216	221	227	233	239	245	251	258	264	271	278	284	291	298	304	311	318	325
	.025	213	219	225	231	238	245	251	259	266	273	280	287	294	301	309	316	323	330	338
	.05	215	222	229	236	243	250	258	265	273	280	288	295	303	311	318	326	334	341	349
	.10	218	226	233	241	249	257	265	273	281	289	297	305	313	321	330	338	346	354	362

For  $n$  or  $m$  greater than 20, the  $p$ th quantile  $w_p$  of the Mann-Whitney test statistic may be approximated by

$$w_p = n(N+1)/2 + x_p \sqrt{nm(N+1)/12}$$

where  $x_p$  is the  $p$ th quantile of a standard normal random variable, obtained from Table A1, and where  $N = m + n$ .

<sup>a</sup> The entries in this table are quantiles  $w_p$  of the Mann-Whitney test statistic  $T$ , given by Equation 5.1.1, for selected values of  $p$ . Note that  $P(T < w_p) \leq p$ . Upper quantiles may be found from the equation

$$w_p = n(n+m+1) - w_{1-p}$$

Critical regions correspond to values of  $T$  less than (or greater than) but not equal to the appropriate quantile.

ตารางที่ 2 QUANTILES OF THE KRUSKAL-WALLIS TEST STATISTIC  
FOR SMALL SAMPLE SIZES\*

Sample Sizes	$W_{0.90}$	$W_{0.95}$	$W_{0.99}$
2, 2, 2	3.7143	4.5714	4.5714
3, 2, 1	3.8571	4.2857	4.2857
3, 2, 2	4.4643	4.5000	5.3571
3, 3, 1	4.0000	4.5714	5.1429
3, 3, 2	4.2500	5.1389	6.2500
3, 3, 3	4.6000	5.0667	6.4889
4, 2, 1	4.0179	4.8214	4.8214
4, 2, 2	4.1667	5.1250	6.0000
4, 3, 1	3.8889	5.0000	5.8333
4, 3, 2	4.4444	5.4000	6.3000
4, 3, 3	4.7000	5.7273	6.7091
4, 4, 1	4.0667	4.8667	6.1667
4, 4, 2	4.4455	5.2364	6.8727
4, 4, 3	4.773	5.5758	7.1364
4, 4, 4	4.5000	5.6538	7.5385
5, 2, 1	4.0500	4.4500	5.2500
5, 2, 2	4.2933	5.0400	6.1333
5, 3, 1	3.8400	4.8711	6.4000
5, 3, 2	4.4946	5.1055	6.8218
5, 3, 3	4.4121	5.5152	6.9818
5, 4, 1	3.9600	4.8600	6.8400
5, 4, 2	4.5182	5.2682	7.1182
5, 4, 3	4.5231	5.6308	7.3949
5, 4, 4	4.6187	5.6176	7.7440
5, 5, 1	4.0364	4.9091	6.8364
5, 5, 2	4.5077	5.2462	7.2692
5, 5, 3	4.5363	5.6264	7.5429
5, 5, 4	4.5200	5.6429	7.7914
5, 5, 5	4.5000	5.6600	7.9800

SOURCE. Adapted from Iman, Quade, and Alexander (1975), with permission from the American Mathematical Society.

\* The null hypothesis may be rejected at the level  $\alpha$  if the Kruskal-Wallis test statistic, given by Equation 5.2.5, exceeds the  $1 - \alpha$  quantile given in the table.



## ภาคผนวก ข

โปรแกรมสำหรับหาค่าผลการทดสอบที่ตรงกันระหว่างการทดสอบแบบที และแรงคัทรานส์ฟอร์มเมชัน

เมื่อประชากรมีการแจกแจงแบบปกติ

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C===== PROGRAM TO TEST THE DIFFERENCE MEAN OF TWO POPULATION =====C
C===== WHICH THE RANDOM SAMPLE HAS NORMAL DISTRIBUTION =====C
C== EY1 , EY2 ARE MEAN OF Y1 AND Y2. STD IS THE STANDARD DIVIATION ==C
C===== T01,T05,T10 ARE THE CRITICAL VALUE OF T-TEST =====C

C FILE TEST22
  DIMENSION Y(20),Y1(20),Y2(20),RY1(20),RY2(20),ZZ(40),R(40)
  INTEGER W01,W05,W10,W101,W105,W110
  COMMON IA
  IA = 65539
  2 READ(5,3) N,T01,T05,T10,W01,W05,W10,W101,W105,W110
  3 FORMAT(I2,3F5.3,6I3)
  WRITE(6,6) N,T01,T05,T10
  6 FORMAT(T5,'N = ',I2,3X,'T01 = ',F6.3,3X,'T05 = ',F6.3,3X,'T10 = ',
  *F5.3/)
  WRITE(6,7) W01,W05,W10,W101,W105,W110
  7 FORMAT(T5,'W01 = ',I3,3X,'W05 = ',I3,3X,'W10 = ',I3,3X,'W101 = ',
  *3,3X,'W105 = ',I3,3X,'W110 = ',I3/)
  15 READ(5,57) EY1,EY2
  WRITE(6,25) EY1,EY2
  25 FORMAT(T20,'EY1 = ',F8.5,T40,'EY2 = ',F8.5/)
  IF(EY1.EQ.999.99999) GO TO 9999

C
C ===== TEST END OF FILE=====C
  IF(EY1.EQ.0) GO TO 2

C
C =====TEST END OF GROUP OF DATA=====C
  57 FORMAT(2F8.5)
  AN001 = 0.
  ACC01 = 0.
  REJE01 = 0.
  AN005 = 0.
  ACC05 = 0.
  REJE05 = 0.
  AN010 = 0.
  ACC10 = 0.
  REJE10 = 0.

C
  N = 5
  K = 2
  AA = N/K
  STD = 10
  IT = N*K

C ===== TO GENERATE NORMAL DISTRIBUTION =====C
C ===== WHICH HAVE MEAN;EY1 AND EY2 =====C
C ===== THE STANDARD DIVIATION IS STD =====C
  SINT = 2.2160359
  A1=0.8840704
  A2=0.9733110
  A3=0.9587208
  A4=0.9113128
  DO 22 ISET = 1,500
  DO 11 I = 1,K
  DO 11 J = 1,N
  U = RANDOM(IA)

```

```

IF(U.LE.A1) THEN
GO TO 10
ELSE IF(U.GT.A2) THEN
GO TO 20
ELSE IF(U.GT.A3) THEN
GO TO 30
ELSE IF(U.LE.A4) THEN
GO TO 40
ELSE
GO TO 50
END IF

```

C  
C

```

50 V5 = RANDOM(IA)
W5 = RANDOM(IA)
CALL MXMN(V5,W5,RMAX,RMIN)
Z = V5 - W5
T5 = 0.4797274 - 0.5955071*RMIN
IF(RMAX.LE.0.8728350) THEN
GO TO 100
ELSE
RX = ABS(Z)*0.049264
END IF
CALL F(T5,SINT,FT)
IF(RX.LE.FT) THEN
GO TO 100
ELSE
GO TO 50
END IF

```

C  
C

```

40 V4 = RANDOM(IA)
W4 = RANDOM(IA)
CALL MXMN(V4,W4,RMAX,RMIN)
Z = V4 - W4
T4 = 0.4797274 - 0.5955071*RMIN
IF(RMAX.LE.0.8055779) THEN
GO TO 100
ELSE
RX = 0.0533755*ABS(Z)
END IF
CALL F(T4,SINT,FT)
IF(RX.LE.FT) THEN
GO TO 100
ELSE
GO TO 40
END IF
30 V3 = RANDOM(IA)
W3 = RANDOM(IA)
CALL MXMN(V3,W3,RMAX,RMIN)
Z = V3 - W3
T3 = SINT - 0.6308348*RMIN
IF(RMAX.LE.0.7555915) THEN
GO TO 100
ELSE

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```

      RX = ABS(Z)*0.0342405
      END IF
      CALL F(T3,SINT,FT)
      IF(RX.LE.FT) THEN
      GO TO 100
      ELSE
      GO TO 30
      END IF
20  V2 = RANDOM(IA)
      W2 = RANDOM(IA)
      HH = W2
      T = (SINT**2)/2 - ALOG(HH)
      C1 = (V2**2)*T
      C2 = (SINT**2)/2
      IF(C1.GT.C2) THEN
      GO TO 20
      ELSE IF(U.LE.0.9866555) THEN
      X = (2*T)**0.5
      ELSE
      X = -(2*T)**0.5
      END IF
      GO TO 200
100 IF(Z.LT.0) THEN
      X = T
      ELSE
      X = -T
      END IF
      GO TO 200
10  V1 = RANDOM(IA)
      X = SINT*(1.13113164*U+V1-1)
200 IF(I.EQ.1) THEN
      Y1(J) = EY1 + STD*X
      ELSE IF(I.EQ.2) THEN
      Y2(J) = EY2 + STD*X
      END IF
11 CONTINUE
C----- TO TEST ORIGIN DATA BY T-TEST -----C
C----- Y1,Y2 ARE ORIGINAL DATA WHICH HAVE NORMAL DISTRIBUTION -----C
      CALL TTEST(Y1,Y2,Y1BAR,Y2BAR,SPOOL,T,N)
C----- INTER, SORT AND SEARCH ARE SUBROUTINE TO RANK INPUT DATA -----C
C----- RY1,RY2 ARE THE RANK OF Y1 AND Y2 -----C
      CALL INTER(Y1,Y2,ZZ,N,II)
      CALL SORT(II,ZZ)
      CALL SEARCH(ZZ,Y1,Y2,RY1,RY2,N,II)
C----- TO COMPUTE T-TEST ON RANK OF DATA -----C
C----- WHICH TR IS THE TEST STATISTIC ON RANK -----C
      CALL TTEST(RY1,RY2,RY1BA,RY2BA,SPOOL,TR,N)
C----- TO CHECK THE ACCEPT AND REJECT WHICH TWO TEST MATCHED -----C
C----- WHICH THE LEVEL OF SIGNIFICANT 0.10,0.05 AND 0.10 -----C
      IF((T.GE.-T01).AND.(T.LE.T01)) THEN
      GO TO 211
      ELSE IF((TR.LT.-T01).OR.(TR.GT.T01)) THEN
      GO TO 212
      ELSE
      GO TO 213
      END IF

```



```

211 IF((TR.GE.T01).AND.(TR.LE.T01)) THEN
    GO TO 214
    ELSE
        GO TO 213
    END IF
C ===== COUNT THE NUMBER WHICH TWO TEST ARE REJECT =====C
212 REJE01 = REJE01+1
    GO TO 310
C ===== COUNT THE NUMBER WHICH TWO TEST ARE DIFFERENCE =====C
213 ANO01 = ANO01+1
    GO TO 310
C ===== COUNT THE NUMBER WHICH TWO TEST ARE ACCEPT =====C
214 ACC01 = ACC01+1
310 IF((T.GE.T05).AND.(T.LE.T05)) THEN
    GO TO 311
    ELSE IF((TR.LT.T05).OR.(TR.GT.T05)) THEN
        GO TO 312
    ELSE
        GO TO 313
    END IF
311 IF((TR.GE.T05).AND.(TR.LE.T05)) THEN
    GO TO 314
    ELSE
        GO TO 313
    END IF
312 REJE05 = REJE05+1
    GO TO 410
313 ANO05 = ANO05+1
    GO TO 410
314 ACC05 = ACC05+1
410 IF((T.GE.T10).AND.(T.LE.T10)) THEN
    GO TO 411
    ELSE IF((TR.LT.T10).OR.(TR.GT.T10)) THEN
        GO TO 412
    ELSE
        GO TO 413
    END IF
411 IF((TR.GE.T10).AND.(TR.LE.T10)) THEN
    GO TO 414
    ELSE
        GO TO 413
    END IF
412 REJE10 = REJE10+1
    GO TO 22
413 ANO10 = ANO10+1
    GO TO 22
414 ACC10 = ACC10+1
22 CONTINUE
WRITE(6,347)
347 FORMAT(10X,"COUNT THE NUMBER OF OUTPUT WHICH MATCH OF ACCEPT AND R
*EJECT)
WRITE(6,112)ACC01,REJE01,ANO01
112 FORMAT(10X,"ACC01 = ",F7.2,/,10X,"REJE01 = ",F7.2,/,10X,"ANO01 =
*",F7.2)
WRITE(6,114) ACC05,REJE05,ANO05

```

```

114 FORMAT(10X,"ACC05 = ",F7.2,/,10X,"REJE05 = ",F7.2,/,10X,"ANC05 =
*",F7.2)
WRITE(6,116)ACC10,REJE10,ANO10
116 FORMAT(10X,"ACC10 = ",F7.2,/,10X,"REJE10 = ",F7.2,/,10X,"ANC10 =
*",F7.2)
GO TO 15
9999 STOP
END

C
C----- MAIN PROGRAM FILE TEST THE DIFFERENCE OF MEAN OF TWO POPULATION
C----- GENERATE DISTRIBUTION FROM DOUBLE EXPONENTIAL; TWO POPULATION-----C
C-----
DIMENSION Y(20),Y1(20),Y2(20),RY1(20),RY2(20),ZZ(40),R(40)
C
COMMON IA
INTEGER W01,W05,W10,W101,W105,W110
IA = 65539
2 READ(5,3) N,T01,T05,T10,W01,W05,W10,W101,W105,W110
3 FORMAT(I2,3F5.3,6I3)
WRITE(6,6) N,T01,T05,T10
6 FORMAT(T5,'N = ',I2,3X,'T01 = ',F5.3,3X,'T05 = ',F5.3,3X,'T10 = ',
*F5.3/)
WRITE(6,7) W01,W05,W10,W101,W105,W110
7 FORMAT(T5,'W01 = ',I3,3X,'W05 = ',I3,3X,'W10 = ',I3,3X,'W101 = ',I
*3,3X,'W105 = ',I3,3X,'W110 = ',I3/)
15 READ(5,57) EY1,EY2
WRITE(6,25) EY1,EY2
25 FORMAT(T20,'EY1 = ',F8.5,T40,'EY2 = ',F8.5/)
IF(EY1.EQ.999.99999) GO TO 9999
IF(EY1.EQ.0) GO TO 2
57 FORMAT(2F8.5)
ALPHA1 = EY1
ALPHA2 = EY2
BELTA1 = 7.0710678
BELTA2 = 7.0710678
ANO01 = 0.
ACC01 = 0.
REJE01 = 0.
ANO05 = 0.
ACC05 = 0.
REJE05 = 0.
ANO10 = 0.
ACC10 = 0.
REJE10 = 0.
K = 2
AA = N/K
II = N*K
DO 22 ISET = 1,700
DO 10 J = 1,K
DO 10 I = 1,N
RN1 = RANDOM(IA)
RN2 = RANDOM(IA)
C
C ALPHA IS MEAN OF Y
C VARIANCE OF Y IS (1/3)*((22/7)**2)*BELTA
S = ALOG(RN1)-ALOG(RN2)
IF (J.EQ.1) THEN

```

```

      Y1(I) = ALPHA1 + S*BELTA1
      ELSE IF (J.EQ.2) THEN
        Y2(I) = ALPHA2 + S*BELTA2
      END IF
10  CONTINUE
      CALL INTER(Y1,Y2,ZZ,N,II)
      CALL SORT(II,ZZ)
      CALL SEARCH(ZZ,Y1,Y2,RY1,RY2,N,II)
      CALL TTEST(RY1,RY2,RY1BA,RY2BA,SPOOL,TR,N,TM)
      CALL MANN(RY1,RY2,N,U)
      IF((TR.GE.T01).AND.(TR.LE.T01)) THEN
        GO TO 211
      ELSE IF((TM.LT.W01).OR.(TM.GT.W101)) THEN
        GO TO 212
      ELSE
        GO TO 213
      END IF
211 IF((TM.GE.W01).AND.(TM.LE.W101)) THEN
      GO TO 214
      ELSE
        GO TO 213
      END IF
212 REJE01 = REJE01+1
      GO TO 310
213 AN001 = AN001+1
      GO TO 310
214 ACC01 = ACC01+1
310 IF((TR.GE.T05).AND.(TR.LE.T05)) THEN
      GO TO 311
      ELSE IF((TM.LT.W05).OR.(TM.GT.W105)) THEN
        GO TO 312
      ELSE
        GO TO 313
      END IF
311 IF((TM.GE.W05).AND.(TM.LE.W105)) THEN
      GO TO 314
      ELSE
        GO TO 313
      END IF
312 REJE05 = REJE05+1
      GO TO 410
313 AN005 = AN005+1
      GO TO 410
314 ACC05 = ACC05+1
410 IF((TR.GE.T10).AND.(TR.LE.T10)) THEN
      GO TO 411
      ELSE IF((TM.LT.W10).OR.(TM.GT.W110)) THEN
        GO TO 412
      ELSE
        GO TO 413
      END IF
411 IF((TM.GE.W10).AND.(TM.LE.W110)) THEN
      GO TO 414
      ELSE
        GO TO 413

```

```

      END IF
412 REJE10 = REJE10+1
      GO TO 22
413 ANO10 = ANO10+1
      GO TO 22
414 ACC10 = ACC10+1
      22 CONTINUE
      WRITE(6,112)ACC01,REJE01,ANO01
112 FORMAT(10X,"ACC01 = ",F7.2,/,10X,"REJE01 = ",F7.2,/,10X,"ANO01 =
      *",F7.2)
      WRITE(6,114) ACC05,REJE05,ANO05
114 FORMAT(10X,"ACC05 = ",F7.2,/,10X,"REJE05 = ",F7.2,/,10X,"ANO05 =
      *",F7.2)
      WRITE(6,116)ACC10,REJE10,ANO10
116 FORMAT(10X,"ACC10 = ",F7.2,/,10X,"REJE10 = ",F7.2,/,10X,"ANO10 =
      *",F7.2)
      GO TO 15
9999 STOP
      END
C----- PROGRAM TO GENERATE LOGISTIC DISTRIBUTION -----
C----- WHICH DEFINE MEAN AND STANDARD DIVIATION ;EX AND STD-----
C----- N IS A SAMPLE SIZE. K IS A NUMBER OF POPULATION.-----
C----- RANDOM(IA) IS A RANDOM FUNCTION IN COMPUTER SYSTEM HAS ORIGIN IA-----
C      MAIN PROGRAM FILE LOGTS4
      DIMENSION Y1(20),Y2(20),Y3(20),Y4(20),RY1(20),RY2(20),RY3(20),RY4(
      *20),ZZ(80),R(80)
      REAL MSTR,MSE
      2 READ(5,101)N,F01,F05,F10,X01,X05,X10
101 FORMAT(I2,6F6.4)
      WRITE(6,104)N,F01,F05,F10,X01,X05,X10
104 FORMAT(10X,"N =",I4,5X,"F01 =",F7.4,5X,"F05 =",F7.4,5X,"F10 =",F7.
      *4,5X,"X01 =",F7.4,5X,"X05 =",F7.4,5X,"X10 =",F7.4)
      15 READ(5,102)EY1,EY2,EY3,EY4
102 FORMAT(4F8.5)
      WRITE(6,105)EY1,EY2,EY3,EY4
105 FORMAT(10X,"EY1 =",F9.5,5X,"EY2 =",F9.5,5X,"EY3 =",F9.5,5X,"EY4 =
      *,F9.5)
      IF(EY1.EQ.999.99999) GO TO 9999
      IF(EY1.EQ.0) GO TO 2
C      COMMON IA
      IA = 65539
      ANO01 = 0.
      ACC01 = 0.
      REJE01 = 0.
      ANO05 = 0.
      ACC05 = 0.
      REJE05 = 0.
      ANO10 = 0.
      ACC10 = 0.
      REJE10 = 0.
      K = 4
      IT = N*K
      DO 22 ISET = 1,600
      DO 33 J = 1,K
      DO 44 I = 1,N
      RN = RANDOM(IA)

```

```

S = ALOG(RN) - ALOG(1.-RN)
IF(J.EQ.1) THEN
  Y1(I) = EY1 + STD*S
ELSE IF(J.EQ.2) THEN
  Y2(I) = EY2 + STD*S
ELSE IF(J.EQ.3) THEN
  Y3(I) = EY3 + STD*S
ELSE IF(J.EQ.4) THEN
  Y4(I) = EY4 + STD*S
C
C
  END IF
44 CONTINUE
33 CONTINUE
C
  DO 55 M = 1,N
C
  WRITE(6,12) Y1(M),Y2(M),Y3(M),Y4(M)
C 12 FORMAT(4(2X,F10.5))
C 55 CONTINUE
  CALL INTER(Y1,Y2,Y3,Y4,ZZ,N,II)
  CALL SORT(II,ZZ)
  CALL SEARCH(ZZ,Y1,Y2,Y3,Y4,RY1,RY2,RY3,RY4,N,II)
C
  WRITE(6,3)
C 3 FORMAT(5X,"***** RANK INPUT DATA*****")
C
  DO 77 I = 1,N
C 77 WRITE(6,78) RY1(I),RY2(I),RY3(I),RY4(I)
C 78 FORMAT(4(10X,F7.2))
  CALL FTEST(N,RY1,RY2,RY3,RY4,SSTR,SSE,SSTO,ASTR,ASE,FR,RY1BA,RY2BA
*,RY3BA,RY4BA,II,K)
C
  WRITE(6,79)
C 79 FORMAT("***** ANALYSIS OF VARIANCE ON RANK IN COMPLETELY R
C *RANDOMIZED DESIGN*****")
C
  WRITE(6,81) SSTR,SSE,SSTO,ASTR,ASE,FR
C 81 FORMAT(10X,"SUM SQUARE OF TREATMENT ON RANK =",F12.5,///,10X,"SUM
C *SQUARE OF ERROR ON RANK =",F12.5,///,10X,"SUM SQUARE OF TOTAL ON R
C *ANK =",F12.5,///,10X,"MEAN SQUARE OF TREATMENT ON RANK=",F12.5,///
C *,10X,"MEAN SQUARE OF ERROR ON RANK =",F12.5,///,30X,"FR =",F12.5)
  CALL KRUS(RY1,RY2,RY3,RY4,SS,H,N,II)
C
  WRITE(6,31) SS,H
C 31 FORMAT(///,10X,"MEAN SQUARE ERROR ON RANK ; SS = ",F12.5,///,10X,"T
C *EST STATISTIC OF KRUSKAL-WALLIS H =",F12.5)
  IF((FR.GE.F01).AND.(H.GE.X01)) THEN
    REJE01 = REJE01+1
    ELSE IF((FR.LT.F01).AND.(H.LT.X01)) THEN
      ACC01 = ACC01+1
      ELSE
        ANO01 = ANO01+1
  END IF
  IF((FR.GE.F05).AND.(H.GE.X05)) THEN
    REJE05 = REJE05+1
    ELSE IF((FR.LT.F05).AND.(H.LT.X05)) THEN
      ACC05 = ACC05+1
      ELSE
        ANO05 = ANO05+1
  END IF
  IF((FR.GE.F10).AND.(H.GE.X10)) THEN

```



```

REJE10 = REJE10+1
  ELSE IF((FR.LT.F10).AND.(H.LT.X10)) THEN
    ACC10 = ACC10+1
  ELSE
    ANO10 = ANO10+1
  END IF
22 CONTINUE
  WRITE(6,119)
119 FORMAT("===== OUTPUT OF TESTING POPULATION MEANS WHICH C.V =
*30,20,10 AND 5 ;N1=N2=20 ;SAMPLE SIZE=40; WHICH HAVE LOGIS DIST")
  WRITE(6,347)
347 FORMAT(10X,"COUNT THE NUMBER OF OUTPUT WHICH MATCH OF ACCEPT AND R
*EJECT;N1=N2=2,3,4,5,10,20 F01")
  WRITE(6,112)ACC01,REJE01,ANO01
112 FORMAT(10X,"ACC01 = ",F7.2,/,10X,"REJE01 = ",F7.2,/,10X,"ANCO1 =
*",F7.2)
  WRITE(6,113)
113 FORMAT(10X,"ACCEPTANT AND REJECTANT WHEN TEST POPULATION MEAN;C.V
* = 30; N1=N2=2,3,4,5,10,20, F05 ")
  WRITE(6,114) ACC05,REJE05,ANO05
114 FORMAT(10X,"ACC05 = ",F7.2,/,10X,"REJE05 = ",F7.2,/,10X,"ANCO5 =
*",F7.2)
  WRITE(6,115)
115 FORMAT(////,10X,"ACCEPTANT AND REJECTANT WHEN TEST POPULATION MEAN
*; C.V = 30; N1=N2=2,3,4,5,10,20, F10 ")
  WRITE(6,116)ACC10,REJE10,ANO10
116 FORMAT(10X,"ACC10 = ",F7.2,/,10X,"REJE10 = ",F7.2,/,10X,"ANCO10 =
*",F7.2)
  GO TO 15
9999 STOP
END

```

C  
C

```

SUBROUTINE MXMN(V,W,RMAX,RMIN)
IF(W.LE.V) THEN
  RMIN = W
  RMAX = V
ELSE
  RMIN = V
  RMAX = W
END IF
RETURN
END

```

C  
C

```

SUBROUTINE F(T,SINT,FT)
SINX = 0.39894290*EXP(-(T**2)/2.)
FT = SINX * 1.8002519*(SINT-ABS(T))
RETURN
END

```

สับโปรแกรมสำหรับหาค่าอันดับของข้อมูล

```

C
SUBROUTINE SORT(II,ZZ)
DIMENSION ZZ(II)
NL = II-1
DO 10 I = 1,NL
NF = I+1
DO 10 J = NF,II
IF(ZZ(I).LE.ZZ(J)) GO TO 10
STZ = ZZ(I)
ZZ(I) = ZZ(J)
ZZ(J) = STZ
10 CONTINUE
RETURN
END

C
C
SUBROUTINE SEARCH(ZZ,Y1,Y2,RY1,RY2,N,II)
DIMENSION ZZ(II),Y1(N),Y2(N),RY1(N),RY2(N)
CALL INTER(Y1,Y2,ZZ,N,II)
CALL SORT(II,ZZ)
C
DO 20 K = 1,N
C
RY2(K) = 0
C
RY1(K) = 0
C
20 CONTINUE
DO 10 I = 1,N
DO 10 J = 1,II
IF(Y1(I).EQ.ZZ(J)) RY1(I) = J
IF(Y2(I).EQ.ZZ(J)) RY2(I) = J
10 CONTINUE
RETURN
END

SUBROUTINE INTER(Y1,Y2,ZZ,N,II)
DIMENSION Y1(N),Y2(N),ZZ(II)
DO 10 I = 1,N
DO 10 J = N+1,II
ZZ(I) = Y1(I)
ZZ(I+N) = Y2(I)
10 CONTINUE
RETURN
END

```



สับโปรแกรมคำนวณค่าสถิติ และแมน-วิทนีย์

C  
C

```

SUBROUTINE TTEST(Y1,Y2,Y1BAR,Y2BAR,SPOOL,T,N,U)
DIMENSION Y1(N),Y2(N)
SUMY1 = 0
SUMY2 = 0
SSUMY1 = 0
SSUMY2 = 0
DO 15 I = 1,N
SUMY1 = SUMY1 + Y1(I)
SSUMY1 = SSUMY1 + Y1(I)**2
SUMY2 = SUMY2 + Y2(I)
SSUMY2 = SSUMY2 + Y2(I)**2
15 CONTINUE
AA = N*N + (N*(N+1))/2
UA = AA-SUMY1
UB = AA-SUMY2
IF(UA.LE.UB)THEN
  U = UA
ELSE
  U = UB
END IF
A = N
Y1BAR = SUMY1/A
Y2BAR = SUMY2/A
YY1BAR = Y1BAR**2
YY2BAR = Y2BAR**2
S1SQ = (SSUMY1-A*YY1BAR)/(A-1)
S2SQ = (SSUMY2-A*YY2BAR)/(A-1)
SPOOL = ((A-1)*(S1SQ+S2SQ))/(2*(A-1))
SUBT = 2*SPOOL/N
SSUB = SQRT(SUBT)
T = (Y1BAR-Y2BAR)/SSUB
RETURN
END

```

سابโปรแกรมคำนวณค่าเอฟ จากการวิเคราะห์ความแปรปรวน

```

SUBROUTINE FTEST(N,Y1,Y2,Y3,Y4,SSTR,SSE,SSTO,ASTR,ASE,FF,Y1BA,Y2BA
*,Y3BA,Y4BA,II,K)
DIMENSION Y1(N),Y2(N),Y3(N),Y4(N)
A1 = 0
A2 = 0
A3 = 0
A4 = 0
C
A11 = 0
A22 = 0
A33 = 0
A44 = 0
C
DO 90 L = 1,N
A1 = A1 + Y1(L)
A2 = A2 + Y2(L)
A3 = A3 + Y3(L)
A4 = A4 + Y4(L)
C
A11 = A11 + Y1(L)**2
A22 = A22 + Y2(L)**2
A33 = A33 + Y3(L)**2
A44 = A44 + Y4(L)**2
C
90 CONTINUE
A = N
Y1BA = A1/A
Y2BA = A2/A
Y3BA = A3/A
Y4BA = A4/A
C
TOTAL = A1 + A2 + A3 + A4
GMEAN = TOTAL/II
COR = (TOTAL**2)/FLOAT(II)
SSTO = A11+A22+A33+A44-COR
SSTR = (A1**2+A2**2+A3**2+A4**2)/N-COR
SSE = SSTO-SSTR
DFTR = K-1
DFTO = N*K-1
DFER = K*(N-1)
ASTR=SSTR/DFTR
ASE=SSE/DFER
FF=ASTR/ASE
RETURN
END

```

สับโปรแกรมคำนวณค่าสถิติครัสคัล-แวลลิส

```

C===== SUBROUTINE TO COMPUTE THE KRUSKAL-WALLIS TEST =====C
C
SUBROUTINE KRUS(RY1,RY2,RY3,RY4,SS,TKRUS,N,II)
DIMENSION RY1(N),RY2(N),RY3(N),RY4(N)
A1=0
A2=0
A3=0
A4=0
C
A11=0
A22=0
A33=0
A44=0
C
A=N
SI=II
DO 10 I = 1,N
A1=A1+RY1(I)
A2=A2+RY2(I)
A3=A3+RY3(I)
A4=A4+RY4(I)
C
A11=A11+RY1(I)**2
A22=A22+RY2(I)**2
A33=A33+RY3(I)**2
A44=A44+RY4(I)**2
C
10 CONTINUE
C===== COMPUTE TEST STATISTIC ; KRUSKAL-WALLIS =====C
B = SI*((SI+1)**2)/4
SS = ((A11+A22+A33+A44)-B)/(SI-1)
XT = (A1**2+A2**2+A3**2+A4**2)/N
TKRUS = (XT-B)/SS
RETURN
END

```

## ประวัติผู้เขียน

นายเจตพร ห้อยชะวณิช เกิดเมื่อวันที่ 7 มิถุนายน พ.ศ. 2503 จบชั้นมัธยมศึกษาจากโรงเรียนอานวยศิลป์ พระนคร สำเร็จปริญญาวิทยาศาสตรบัณฑิต (คณิตศาสตร์) จากมหาวิทยาลัยลงขลานครินทร์ วิทยาเขตหาดใหญ่ เมื่อปีการศึกษา 2524 และเข้าศึกษาต่อที่ภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย เมื่อปีการศึกษา 2525 ปัจจุบันรับราชการในตำแหน่งนักสถิติ แขวงการทางบุรีรัมย์ กรมทางหลวง กระทรวงคมนาคม

