บรรณานุกรม

ภาษาไทย

วิทยานิพนธ์

ปราณี รัตนัง "การประมาณสัมประสิทธิ์การถดถอยพหุ เมื่อความผิดพลาดมีการแจกแจงแบบเบ้และมีการแจกแจงแบบหางยาวกว่าการแจกแจงปกติ." วิทยานิพนธ์ ปริญญามหาบัณฑิต ภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย, 2531.

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ภาคผนวก


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C=====================================================================C
C     A COMPARISON ON THE POWER OF SOME STANDARD TEST STATISTICS      C
C                      FOR EXPONENTIAL DISTRIBUTION                   C
C     BY SA AAT NIWITPONG  ID CO23011                                 C
C=====================================================================C
C                                                                     C
C     MAIN PROGRAM TO COMPUTE TYPE 1 ERROR AND POWER OF TEST          C
C                                                                     C
C=====================================================================C
      DOUBLE PRECISION X,Y,S,D,MDP,MDN,T,BA2,BA3,AA,F,PP,GG,XX,SAVE,FF
     *,DD,DE,MD,AP,AF,NN,AMP,MP,MA,NP,NQ,IM,MG
      COMMON              IX,KK
      DIMENSION X(100),Y(100),AA(100),FF(100),PP(100),GG(100),XX(100)
     *,DD(100),AP(100),AF(100)
      INTEGER RA1,RA2,KL,KM,K
      REAL NORMAL
      ZA10=0.0
      ZA05=0.0
      F10=0.0
      F05=0.0
      D10=0.0
      D05=0.0
      D=0.0
      ZA=0.0
      N=100
      II=3
      DMEAN1=0.0
      SIGMA1=0.9
      NDF1=1.0
      ALPHA=3.0
      BETA=1.0
      IX=973253
```

```
      RA1=0
      RA2=0
      KK=0
C*************************************************************************
C========  CONSTANT VALUE FOR KOLMOGOROV-SMIRNOV TEST  ===============
C*************************************************************************
      DO 333 NOK=1,N
      NN = NOK
      AP(NOK)=NN/N
      AF(NOK) =(NN-1)/N
  333 CONTINUE
      DO 500 L=1,500
C*************************************************************************
C========   SELECT POPULATION FOR TEST STATISTICS  ===================
C*************************************************************************
      GOTO(20,40,60,80),11
C     II=1 IS LOGNORMAL DISTRIBUTION
C     II=2 IS WEIBUL DISTRIBUTION
C     II=3 IS GAMMA DISTRIBUTION
C     II=4 ID CHI-SQUARE DISTRIBUTION
   20 DO 30 J1=1,N
      X(J1)=EXP(NORMAL(DMEAN1,SIGMAL))
   30 CONTINUE
      GOTO  95
   40 DO 50 J2=1,N
      X(J2)=WEIBUL(ALPHA,BETA)
   50 CONTINUE
      GOTO 95
   60 DO 70 J3=1.N
      X(J3)=GAMMA1(ALPHA.BETA)
   70 CONTINUE
      GOTO 95
```

```
 80 DO 90 I=1,N
    8(I)=CSD(NDF1,DMEAN1,SIGMA1)
 90 CONTINUE
    GOTO 95
 95 CALL RANK(N,X)
C*************************************************************************
C=========    REGRESSION TEST(Z)    ==================================
C*************************************************************************
     MA=N-RA1-RA2
     MB=MA-1
     AA(1)=1-(MA/2)
     DO 115 I1=2,N
     NP=I1
     NQ=MA
     AA(I1)=(NP)-(NQ/2)
     NM=(N-11+1)
     IM=II-1
     CALL RANK(N,X)
     Y(I1)=(NM)*(X(NP)-X(IM))
 115 CONTINUE
     BA2=0.0
     BA3=0.0
     TA=MA-2
     BAI=SQRT(12/TA)
     MB=MA-1
  DO 120 I=1,MB
     BA2=BA2+Y(RA1+I+1)
     BA3=BA3+AA(I)*y(RA1+I+1)
 120 CONTINUE
     ZA=(BA1*BA3)/BA2
     IF(ABS(ZA).GT.1.65)ZA10+1
     IF(ABS(ZA).GT.1.96)ZA05=ZA05+1
```

```
C*************************************************************************
C============  GNEDENGO F TEST (F)=====================================
C*************************************************************************
 240 M=N-RA1-RA2
     M1=M-1
     K=M1/2
     KL=K+1
     C1=0.0
     DO 245 I=2,KL
     C1=C1+Y(RAI+1)
 245 CONTINUE
     S1=C1/K
     KM=K+2
     C2=0.0
     DO 246  J=KM,M
     C2=C2+Y(RA1+J)
 246 CONTINUE
     S2=C2/(M-1-K)
     F=S1/S2
     IF(1.0/F.GT.1.482.OR.F.GT.1.441)F10=F10+1
     IF(1.0/F.GT.1.484.OR.F.ST.1.484)F05=F05+1
C*************************************************************************
C==================   KOLMOGOROV SMIRNOV TEST(D)   ====================
C*************************************************************************
     SUM=0.0
 360 DO 365 I=1,N
     SUM=SUM+X(I)
 365 CONTINUE
     XBAR=SUM/N
     XBAR1=1.0/XBAR
     SAVE=0.0
     DO 370 I=1,N
```

```
      XX(I)=((-X(I))*XBAR1)
      SAVE=XX(1)
      FF(I)=1-DEXP(SAVE)
      PP(I)=AP(I) - FF(I)
  370 CONTINUE
      NAM = 10
      I=1
      MG=PP(I)
      DO 100 I=2.N
      IF(MG.LT.PP(I)MG=PP(I)
  100 CONTINUE
      J=1
      MP=GG(J)
      DO 101 I=2,N
      IF(MP.LT.GG(I)MP=GG(I)
  101 CONTINUE
      IF(MP-MG)400,400,410
  400 D=MG
      GOTO 420
  410 D=MP
  420 IF(D.GT.0.1075)D10=D10+1
      IF(D.GT.0.1149)D05=D05+1
  500 CONTINUE
C*************************************************************************
C===============  COMPUTE TYPE 1 ERROR OR POWER OF TEST   ============
C*************************************************************************
      PZA10=ZA10/500.
      PZA05=ZA05/500.
      PD10=D10/500.
      PD05=D05/500.
      PF10=F10/500.
      PF05=F05/500.
```

```
      PF05=F05/500.
  510 WRITE(6,520) PZA10,PZA05,PD10,PD05,PF10,PF05
  520 FORMAT('0','REGRESSION TEST',5X,'ZA10 = ',F10.5,5X.'ZA05=.'
     *F10.5/,'0','KOMOGOROV-SEMIRNOV TEST',
     *5X,'D10 = ',F10.5,5X.'D05 = '.F10.5/.
     *'0','GNEDENKO F TEST ',5X,'F10 = ',F10.5'5X.'F05 = '.F10.5)
     *'0','GNEDENKO F TEST ',5X,'F10 = ',F10.5,5X,'F05 = ',F10.5)
      STOP
      END
```



```
C*************************************************************************
C==================    SUBROUTINE RANDOM VARIABLE  ==================
C*************************************************************************
      SUBROUTINE RAND(IX,IY,YFL)
      IY  = IX * 65539
      IF  (IT) 5,6,6
    5 IY   = IY + 21+7483647 + 1
    6 YFL  = YFL / 2147483647
      IX  = IY
      RETURN
      END
C*************************************************************************
C=============  FUNCTION NORMAL (DMEAN,SIGMA) DISTRIBUTION ==========
C*************************************************************************
      FUNCTION NORMAL(DMEAN,SIGMA)
      REAL NORMAL
      COMMON IX
      COMMON KK
      PI = 3.1415926
      IF   (KK.EQ.1) GOTO 10
           CALL  RAND(IX.IY.YFL)
           RONE = YFL
```

```
      CALL  RAND(IX,IY,YFL)
            RTWO = YFL
      ZONE = SQRT(-2*ALOG(RONE))*COS(2*PI*RTWO)
      NORMAL = ZONE*SIGMA+DMEAN
      KK = 1
      RETURN
   10       NORMAL = ZTWO*SIGMA+DMEAN
      KK = 0
      RETURN
      END
C*************************************************************************
C=================== FUNTION WEIBULL DISTRIBUTION   ==================
C*************************************************************************
      FUNCTION WEIBUL(ALPHA1,BETA1)
      COMMON IX
      COMMON K1
      CALL      RAND(1X,IY,YFL)
      WEIBUL = BETA1*(-ALOG(1.0-YFL))88(1.0/ALPHA1)
      RETURN
      END
C*************************************************************************
C===================   FUNTION GAMMA DISTRIBUTION   ==================
C*************************************************************************
      FUNCTION GAMMA1(ALPHA1,BETA1)
      COMMON IX
      COMMON T1
      ALPHA = ALPHA1
      U     = 0.0
    5 CALL  RAND(IX,IY,YFL)
      V     = -ALOG(YFL)
      U     = 0 + V
      IF (ALPHA.EQ.1.0) GOTO 10
```

```
      ALPHA = ALPHA - 1.0
      GOTO 5
   10 GAMMA1 = BETA1*0
      RETURN
      END
C*************************************************************************
C==============  SUBROUTINE FOR RANKING OBSERVATION  ==================
C*************************************************************************
      SOUBROUTINE RANK(N,X)
      DOUBLE PRECISION X,T
      DIMENSION X(100)
      N1      = N - 1
      DO 10 I = I,N1
      II      = I+I
      DO 10 K = II,N
      IF ( X(I) .LE. X(K) ) GOTO 10
         T    = X(1)
         X(I) = X(K)
         X(K) = T
   10 CONTINUE
      RETURN
      END
C*************************************************************************
C==============  FUNCTION CHI-SQUARE DISTRIBUTION  ====================
C*************************************************************************
      FUNCTION CSD(NDF,DMEAN,SIGMA)
      REAL NORMAL
         CSD=0.0
             DO 10 I=1,NDF
   10           CSD=CSD+(NORMAL(DMEAN,SIGMA)**2)
      RETURN
      END
```

ตาราง ก CUMULATIVE NORMAL DISTRIBUTION

$$F(z) = \int_{\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-t^2/2} dt$$

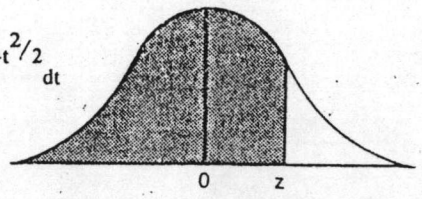

Table entries are cumulative probabilities represented in the shaded area above.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

z	1.282	1.645	1.960	2.326	2.575	3.090	3.291	3.981	4.417
F(z)	.90	.95	.975	.99	.995	.999	.9995	.99995	.999995

Adopted by permission from A. M. Mood, INTRODUCTION TO THE THEORY OF STATISTICS. Table II, New York: McGraw-Hill Book Company, 1950.

ตาราง ข. VALUE OF F

Den. df	A	Numerator df 1	2	3	4	5	6	7	8	9
1	.50	1.00	1.50	1.71	1.82	1.89	1.94	1.98	2.00	2.03
	.90	39.9	49.5	53.6	55.8	57.2	58.2	58.9	59.4	59.9
	.95	161	200	216	225	230	234	237	239	241
	.975	648	800	864	900	922	937	948	957	963
	.99	4,052	5,000	5,403	5,625	5,764	5,859	5,928	5,981	6,022
	.995	16,211	20,000	21,615	22,500	23,056	23,437	23,715	23,925	24,091
	.999	405,280	500,000	540,380	562,500	576,400	585,940	592,870	598,140	602,280
2	.50	0.667	1.00	1.13	1.21	1.25	1.28	1.30	1.32	1.33
	.90	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38
	.95	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4
	.975	38.5	39.0	39.2	39.2	39.3	39.3	39.4	39.4	39.4
	.99	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4
	.995	199	199	199	199	199	199	199	199	199
	.999	998.5	999.0	999.2	999.2	999.3	999.3	999.4	999.4	999.4
3	.50	0.585	0.881	1.00	1.06	1.10	1.13	1.15	1.16	1.17
	.90	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24
	.95	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
	.975	17.4	16.0	15.4	15.1	14.9	14.7	14.6	14.5	14.5
	.99	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3
	.995	55.6	49.8	47.5	46.2	45.4	44.8	44.4	44.1	43.9
	.999	167.0	148.5	141.1	137.1	134.6	132.8	131.6	130.6	129.9
4	.50	0.549	0.828	0.941	1.00	1.04	1.06	1.08	1.09	1.10
	.90	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94
	.95	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
	.975	12.2	10.6	9.98	9.60	9.36	9.20	9.07	8.98	8.90
	.99	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7
	.995	31.3	26.3	24.3	23.2	22.5	22.0	21.6	21.4	21.1
	.999	74.1	61.2	56.2	53.4	51.7	50.5	49.7	49.0	48.5
5	.50	0.528	0.799	0.907	0.965	1.00	1.02	1.04	1.05	1.06
	.90	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3,32
	.95	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
	.975	10.0	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68
	.99	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2
	.995	22.8	18.3	16.5	15.6	14.9	14.5	14.2	14.0	13.8
	.999	47.2	37.1	33.2	31.1	29.8	28.8	28.2	27.6	27.2
6	.50	0.515	0.780	0.886	0.942	0.977	1.00	1.02	1.03	1.04
	.90	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96
	.95	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
	.975	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52
	.99	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98
	.995	18.6	14.5	12.9	12.0	11.5	11.1	10.8	10.6	10.4
	.999	35.5	27.0	23.7	21.9	20.8	20.0	19.5	19.0	18.7
7	.50	0.506	0.767	0.871	0.926	0.960	0.983	1.00	1.01	1.02
	.90	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72
	.95	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
	.975	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82
	.99	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
	.995	16.2	12.4	10.9	10.1	9.52	9.16	8.89	8.68	8.51
	.999	29.2	21.7	18.8	17.2	16.2	15.5	15.0	14.6	14.3

ตาราง ข (ต่อ) VALUE OF F

Den. df	A	Numerator df								
		10	12	15	20	24	30	60	120	∞
1	.50	2.04	2.07	2.09	2.12	2.13	2.15	2.17	2.18	2.20
	.90	60.2	60.7	61.2	61.7	62.0	62.3	62.8	63.1	63.3
	.95	242	244	246	248	249	250	252	253	254
	.975	969	977	985	993	997	1,001	1,010	1,014	1,018
	.99	6,056	6,106	6,157	6,209	6,235	6,261	6,313	6,339	6,366
	.995	24,224	24,426	24,630	24,836	24,940	25,044	25,253	25,359	25,464
	.999	605,620	610,670	615,760	620,910	623,500	626,100	631,340	633,970	636,620
2	.50	1.34	1.36	1.38	1.39	1.40	1.41	1.43	1.43	1.44
	.90	9.39	9.41	9.42	9.44	9.45	9.46	9.47	9.48	9.49
	.95	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5
	.975	39.4	39.4	39.4	39.4	39.5	39.5	39.5	39.5	39.5
	.99	99.4	99.4	99.4	99.4	99.5	99.5	99.5	99.5	99.5
	.995	199	199	199	199	199	199	199	199	200
	.999	999.4	999.4	999.4	999.4	999.5	999.5	999.5	999.5	999.5
3	.50	1.18	1.20	1.21	1.23	1.23	1.24	1.25	1.26	1.27
	.90	5.23	5.22	5.20	5.18	5.18	5.17	5.15	5.14	5.13
	.95	8.79	8.74	8.70	8.66	8.64	8.62	8.57	8.55	8.53
	.975	14.4	14.3	14.3	14.2	14.1	14.1	14.0	13.9	13.9
	.99	27.2	27.1	26.9	26.7	26.6	26.5	26.3	26.2	26.1
	.995	43.7	43.4	43.1	42.8	42.6	42.5	42.1	42.0	41.8
	.999	129.2	128.3	127.4	126.4	125.9	125.4	124.5	124.0	123.5
4	.50	1.11	1.13	1.14	1.15	1.16	1.16	1.18	1.18	1.19
	.90	3.92	3.90	3.87	3.84	3.83	3.82	3.79	3.78	3.76
	.95	5.96	5.91	5.86	5.80	5.77	5.75	5.69	5.66	5.63
	.975	8.84	8.75	8.66	8.56	8.51	8.46	8.36	8.31	8.26
	.99	14.5	14.4	14.2	14.0	13.9	13.8	13.7	13.6	13.5
	.995	21.0	20.7	20.4	20.2	20.0	19.9	19.6	19.5	19.3
	.999	48.1	47.4	46.8	46.1	45.8	45.4	44.7	44.4	44.1
5	.50	1.07	1.09	1.10	1.11	1.12	1.12	1.14	1.14	1.15
	.90	3.30	3.27	3.24	3.21	3.19	3.17	3.14	3.12	3.11
	.95	4.74	4.68	4.62	4.56	4.53	4.50	4.43	4.40	4.37
	.975	6.62	6.52	6.43	6.33	6.28	6.23	6.12	6.07	6.02
	.99	10.1	9.89	9.72	9.55	9.47	9.38	9.20	9.11	9.02
	.995	13.6	13.4	13.1	12.9	12.8	12.7	12.4	12.3	12.1
	.999	26.9	26.4	25.9	25.4	25.1	24.9	24.3	24.1	23.8
6	.50	1.05	1.06	1.07	1.08	1.09	1.10	1.11	1.12	1.12
	.90	2.94	2.90	2.87	2.84	2.82	2.80	2.76	2.74	2.72
	.95	4.06	4.00	3.94	3.87	3.84	3.81	3.74	3.70	3.67
	.975	5.46	5.37	5.27	5.17	5.12	5.07	4.96	4.90	4.85
	.99	7.87	7.72	7.56	7.40	7.31	7.23	7.06	6.97	6.88
	.995	10.2	10.0	9.81	9.59	9.47	9.36	9.12	9.00	8.88
	.999	18.4	18.0	17.6	17.1	16.9	16.7	16.2	16.0	15.7
7	.50	1.03	1.04	1.05	1.07	1.07	1.08	1.09	1.10	1.10
	.90	2.70	2.67	2.63	2.59	2.58	2.56	2.51	2.49	2.47
	.95	3.64	3.57	3.51	3.44	3.41	3.38	3.30	3.27	3.23
	.975	4.76	4.67	4.57	4.47	4.42	4.36	4.25	4.20	4.14
	.99	6.62	6.47	6.31	6.16	6.07	5.99	5.82	5.74	5.65
	.995	8.38	8.18	7.97	7.75	7.65	7.53	7.31	7.19	7.08
	.999	14.1	13.7	13.3	12.9	12.7	12.5	12.1	11.9	11.7

ตาราง ข (ต่อ) VALUE OF F

Den. df	A	Numerator df 1	2	3	4	5	6	7	8	9
8	.50	0.499	0.757	0.860	0.915	0.948	0.971	0.988	1.00	1.01
	.90	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56
	.95	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
	.975	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.43	4.36
	.99	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
	.995	14.7	11.0	9.60	8.81	8.30	7.95	7.69	7.50	7.34
	.999	25.4	18.5	15.8	14.4	13.5	12.9	12.4	12.0	11.8
9	.50	0.494	0.749	0.852	0.906	0.939	0.962	0.978	0.990	1.00
	.90	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44
	.95	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
	.975	7.21	5.71	5.08	4.72	4.48	4.32	4.20	4.10	4.03
	.99	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
	.995	13.6	10.1	8.72	7.96	7.47	7.13	6.88	6.69	6.54
	.999	22.9	16.4	13.9	12.6	11.7	11.1	10.7	10.4	10.1
10	.50	0.490	0.743	0.845	0.899	0.932	0.954	0.971	0.983	0.992
	.90	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35
	.95	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
	.975	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.85	3.78
	.99	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
	.995	12.8	9.43	8.08	7.34	6.87	6.54	6.30	6.12	5.97
	.999	21.0	14.9	12.6	11.3	10.5	9.93	9.52	9.20	8.96
12	.50	0.484	0.735	0.835	0.888	0.921	0.943	0.959	0.972	0.981
	.90	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21
	.95	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
	.975	6.55	5.10	4.47	4.12	3.89	3.73	3.61	3.51	3.44
	.99	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
	.995	11.8	8.51	7.23	6.52	6.07	5.76	5.52	5.35	5.20
	.999	18.6	13.0	10.8	9.63	8.89	8.38	8.00	7.71	7.48
15	.50	0.478	0.726	0.826	0.878	0.911	0.933	0.949	0.960	0.970
	.90	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09
	.95	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
	.975	6.20	4.77	4.15	3.80	3.58	3.41	3.29	3.20	3.12
	.99	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
	.995	10.8	7.70	6.48	5.80	5.37	5.07	4.85	4.67	4.54
	.999	16.6	11.3	9.34	8.25	7.57	7.09	6.74	6.47	6.26
20	.50	0.472	0.718	0.816	0.868	0.900	0.922	0.938	0.950	0.959
	.90	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96
	.95	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
	.975	5.87	4.46	3.86	3.51	3.29	3.13	3.01	2.91	2.84
	.99	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
	.995	9.94	6.99	5.82	5.17	4.76	4.47	4.26	4.09	3.96
	.999	14.8	9.95	8.10	7.10	6.46	6.02	5.69	5.44	5.24
24	.50	0.469	0.714	0.812	0.863	0.895	0.917	0.932	0.944	0.953
	.90	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91
	.95	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
	.975	5.72	4.32	3.72	3.38	3.15	2.99	2.87	2.78	2.70
	.99	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
	.995	9.55	6.66	5.52	4.89	4.49	4.20	3.99	3.83	3.69
	.999	14.0	9.34	7.55	6.59	5.98	5.55	5.23	4.99	4.80

ตาราง ข (ต่อ) VALUE OF F

Den. df	A	Numerator df								
		10	12	15	20	24	30	60	120	∞
8	.50	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.08	1.09
	.90	2.54	2.50	2.46	2.42	2.40	2.38	2.34	2.32	2.29
	.95	3.35	3.28	3.22	3.15	3.12	3.08	3.01	2.97	2.93
	.975	4.30	4.20	4.10	4.00	3.95	3.89	3.78	3.73	3.67
	.99	5.81	5.67	5.52	5.36	5.28	5.20	5.03	4.95	4.86
	.995	7.21	7.01	6.81	6.61	6.50	6.40	6.18	6.06	5.95
	.999	11.5	11.2	10.8	10.5	10.3	10.1	9.73	9.53	9.33
9	.50	1.01	1.02	1.03	1.04	1.05	1.05	1.07	1.07	1.08
	.90	2.42	2.38	2.34	2.30	2.28	2.25	2.21	2.18	2.16
	.95	3.14	3.07	3.01	2.94	2.90	2.86	2.79	2.75	2.71
	.975	3.96	3.87	3.77	3.67	3.61	3.56	3.45	3.39	3.33
	.99	5.26	5.11	4.96	4.81	4.73	4.65	4.48	4.40	4.31
	.995	6.42	6.23	6.03	5.83	5.73	5.62	5.41	5.30	5.19
	.999	9.89	9.57	9.24	8.90	8.72	8.55	8.19	8.00	7.81
10	.50	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.06	1.07
	.90	2.32	2.28	2.24	2.20	2.18	2.16	2.11	2.08	2.06
	.95	2.98	2.91	2.84	2.77	2.74	2.70	2.62	2.58	2.54
	.975	3.72	3.62	3.52	3.42	3.37	3.31	3.20	3.14	3.08
	.99	4.85	4.71	4.56	4.41	4.33	4.25	4.08	4.00	3.91
	.995	5.85	5.66	5.47	5.27	5.17	5.07	4.86	4.75	4.64
	.999	8.75	8.45	8.13	7.80	7.64	7.47	7.12	6.94	6.76
12	.50	0.989	1.00	1.01	1.02	1.03	1.03	1.05	1.05	1.06
	.90	2.19	2.15	2.10	2.06	2.04	2.01	1.96	1.93	1.90
	.95	2.75	2.69	2.62	2.54	2.51	2.47	2.38	2.34	2.30
	.975	3.37	3.28	3.18	3.07	3.02	2.96	2.85	2.79	2.72
	.99	4.30	4.16	4.01	3.86	3.78	3.70	3.54	3.45	3.36
	.995	5.09	4.91	4.72	4.53	4.43	4.33	4.12	4.01	3.90
	.999	7.29	7.00	6.71	6.40	6.25	6.09	5.76	5.59	5.42
15	.50	0.977	0.989	1.00	1.01	1.02	1.02	1.03	1.04	1.05
	.90	2.06	2.02	1.97	1.92	1.90	1.87	1.82	1.79	1.76
	.95	2.54	2.48	2.40	2.33	2.29	2.25	2.16	2.11	2.07
	.975	3.06	2.96	2.86	2.76	2.70	2.64	2.52	2.46	2.40
	.99	3.80	3.67	3.52	3.37	3.29	3.21	3.05	2.96	2.87
	.995	4.42	4.25	4.07	3.88	3.79	3.69	3.48	3.37	3.26
	.999	6.08	5.81	5.54	5.25	5.10	4.95	4.64	4.48	4.31
20	.50	0.966	0.977	0.989	1.00	1.01	1.01	1.02	1.03	1.03
	.90	1.94	1.89	1.84	1.79	1.77	1.74	1.68	1.64	1.61
	.95	2.35	2.28	2.20	2.12	2.08	2.04	1.95	1.90	1.84
	.975	2.77	2.68	2.57	2.46	2.41	2.35	2.22	2.16	2.09
	.99	3.37	3.23	3.09	2.94	2.86	2.78	2.61	2.52	2.42
	.995	3.85	3.68	3.50	3.32	3.22	3.12	2.92	2.81	2.69
	.999	5.08	4.82	4.56	4.29	4.15	4.00	3.70	3.54	3.38
24	.50	0.961	0.972	0.983	0.994	1.00	1.01	1.02	1.02	1.03
	.90	1.88	1.83	1.78	1.73	1.70	1.67	1.61	1.57	1.53
	.95	2.25	2.18	2.11	2.03	1.98	1.94	1.84	1.79	1.73
	.975	2.64	2.54	2.44	2.33	2.27	2.21	2.08	2.01	1.94
	.99	3.17	3.03	2.89	2.74	2.66	2.58	2.40	2.31	2.21
	.995	3.59	3.42	3.25	3.06	2.97	2.87	2.66	2.55	2.43
	.999	4.64	4.39	4.14	3.87	3.74	3.59	3.29	3.14	2.97

ตาราง ข (ต่อ) VALUE OF F

Den. df	A	Numerator df 1	2	3	4	5	6	7	8	9
30	.50	0.466	0.709	0.807	0.858	0.890	0.912	0.927	0.939	0.948
	.90	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85
	.95	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
	.975	5.57	4.18	3.59	3.25	3.03	2.87	2.75	2.65	2.57
	.99	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
	.995	9.18	6.35	5.24	4.62	4.23	3.95	3.74	3.58	3.45
	.999	13.3	8.77	7.05	6.12	5.53	5.12	4.82	4.58	4.39
60	.50	0.461	0.701	0.798	0.849	0.880	0.901	0.917	0.928	0.937
	.90	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74
	.95	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
	.975	5.29	3.93	3.34	3.01	2.79	2.63	2.51	2.41	2.33
	.99	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72
	.995	8.49	5.80	4.73	4.14	3.76	3.49	3.29	3.13	3.01
	.999	12.0	7.77	6.17	5.31	4.76	4.37	4.09	3.86	3.69
120	.50	0.458	0.697	0.793	0.844	0.875	0.896	0.912	0.923	0.932
	.90	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68
	.95	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96
	.975	5.15	3.80	3.23	2.89	2.67	2.52	2.39	2.30	2.22
	.99	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56
	.995	8.18	5.54	4.50	3.92	3.55	3.28	3.09	2.93	2.81
	.999	11.4	7.32	5.78	4.95	4.42	4.04	3.77	3.55	3.38
∞	.50	0.455	0.693	0.789	0.839	0.870	0.891	0.907	0.918	0.927
	.90	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63
	.95	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88
	.975	5.02	3.69	3.12	2.79	2.57	2.41	2.29	2.19	2.11
	.99	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41
	.995	7.88	5.30	4.28	3.72	3.35	3.09	2.90	2.74	2.62
	.999	10.8	6.91	5.42	4.62	4.10	3.74	3.47	3.27	3.10

ตาราง ข (ต่อ) VALUE OF F

Den. df	A	Numerator df 10	12	15	20	24	30	60	120	∞
30	.50	0.955	0.966	0.978	0.989	0.994	1.00	1.01	1.02	1.02
	.90	1.82	1.77	1.72	1.67	1.64	1.61	1.54	1.50	1.46
	.95	2.16	2.09	2.01	1.93	1.89	1.84	1.74	1.68	1.62
	.975	2.51	2.41	2.31	2.20	2.14	2.07	1.94	1.87	1.79
	.99	2.98	2.84	2.70	2.55	2.47	2.39	2.21	2.11	2.01
	.995	3.34	3.18	3.01	2.82	2.73	2.63	2.42	2.30	2.18
	.999	4.24	4.00	3.75	3.49	3.36	3.22	2.92	2.76	2.59
60	.50	0.945	0.956	0.967	0.978	0.983	0.989	1.00	1.01	1.01
	.90	1.71	1.66	1.60	1.54	1.51	1.48	1.40	1.35	1.29
	.95	1.99	1.92	1.84	1.75	1.70	1.65	1.53	1.47	1.39
	.975	2.27	2.17	2.06	1.94	1.88	1.82	1.67	1.58	1.48
	.99	2.63	2.50	2.35	2.20	2.12	2.03	1.84	1.73	1.60
	.995	2.90	2.74	2.57	2.39	2.29	2.19	1.96	1.83	1.69
	.999	3.54	3.32	3.08	2.83	2.69	2.55	2.25	2.08	1.89
120	.50	0.939	0.950	0.961	0.972	0.978	0.983	0.994	1.00	1.01
	.90	1.65	1.60	1.55	1.48	1.45	1.41	1.32	1.26	1.19
	.95	1.91	1.83	1.75	1.66	1.61	1.55	1.43	1.35	1.25
	.975	2.16	2.05	1.95	1.82	1.76	1.69	1.53	1.43	1.31
	.99	2.47	2.34	2.19	2.03	1.95	1.86	1.66	1.53	1.38
	.995	2.71	2.54	2.37	2.19	2.09	1.98	1.75	1.61	1.43
	.999	3.24	3.02	2.78	2.53	2.40	2.26	1.95	1.77	1.54
∞	.50	0.934	0.945	0.956	0.967	0.972	0.978	0.989	0.994	1.00
	.90	1.60	1.55	1.49	1.42	1.38	1.34	1.24	1.17	1.00
	.95	1.83	1.75	1.67	1.57	1.52	1.46	1.32	1.22	1.00
	.975	2.05	1.94	1.83	1.71	1.64	1.57	1.39	1.27	1.00
	.99	2.32	2.18	2.04	1.88	1.79	1.70	1.47	1.32	1.00
	.995	2.52	2.36	2.19	2.00	1.90	1.79	1.53	1.36	1.00
	.999	2.96	2.74	2.51	2.27	2.13	1.99	1.66	1.45	1.00

Source: Reprinted from Table 5 of Pearson and Hartley, *Biometrika Tables for Statisticians*, Volume 2, 1972, published by the Cambridge University Press, on behalf of The Biometrika Society, by permission of the authors and publishers.

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n	p=.05	0.1000	0.2000	0.3000	0.5000	0.7000	0.8000	0.9000	0.9500	0.9900	0.9990
1.0000	0.3127	0.3200	0.3337	0.3617	0.4337	0.5034	0.5507	0.5934	0.6133	0.6284	0.6317
3.0000	0.2299	0.2544	0.2899	0.3166	0.3645	0.4122	0.4508	0.5111	0.5508	0.6003	0.6296
4.0000	0.2072	0.2281	0.2545	0.2766	0.3163	0.3685	0.4007	0.4442	0.4844	0.5574	0.6215
5.0000	0.1884	0.2052	0.2290	0.2483	0.2877	0.3317	0.3603	0.4045	0.4420	0.5127	0.5814
6.0000	0.1726	0.1882	0.2102	0.2290	0.2645	0.3045	0.3320	0.3732	0.4085	0.4748	0.5497
7.0000	0.1604	0.1750	0.1961	0.2136	0.2458	0.2838	0.3098	0.3481	0.3811	0.4459	0.5181
8.0000	0.1506	0.1646	0.1845	0.2006	0.2309	0.2671	0.2914	0.3274	0.3590	0.4208	0.4913
9.0000	0.1426	0.1561	0.1746	0.1897	0.2186	0.2529	0.2758	0.3101	0.3404	0.3995	0.4679
10.0000	0.1359	0.1486	0.1661	0.1805	0.2082	0.2407	0.2626	0.2955	0.3244	0.3813	0.4473
12.0000	0.1249	0.1364	0.1524	0.1657	0.1912	0.2209	0.2411	0.2714	0.2981	0.3511	0.4132
14.0000	0.1162	0.1268	0.1418	0.1542	0.1778	0.2054	0.2242	0.2525	0.2774	0.3272	0.3858
16.0000	0.1091	0.1191	0.1332	0.1448	0.1669	0.1929	0.2105	0.2371	0.2606	0.3076	0.3632
18.0000	0.1032	0.1127	0.1260	0.1369	0.1578	0.1824	0.1990	0.2242	0.2465	0.2911	0.3441
20.0000	0.0982	0.1073	0.1199	0.1303	0.1501	0.1735	0.1893	0.2132	0.2345	0.2771	0.3277
22.0000	0.0939	0.1025	0.1146	0.1245	0.1434	0.1657	0.1809	0.2038	0.2241	0.2649	0.3135
24.0000	0.0901	0.0984	0.1099	0.1195	0.1376	0.1590	0.1735	0.1954	0.2150	0.2542	0.3010
26.0000	0.0868	0.0947	0.1058	0.1150	0.1324	0.1530	0.1670	0.1881	0.2069	0.2447	0.2899
28.0000	0.0838	0.0914	0.1021	0.1110	0.1278	0.1477	0.1611	0.1815	0.1997	0.2362	0.2799
30.0000	0.0811	0.0885	0.0988	0.1074	0.1236	0.1428	0.1559	0.1756	0.1932	0.2286	0.2709
35.0000	0.0754	0.0822	0.0918	0.0997	0.1148	0.1326	0.1447	0.1630	0.1793	0.2123	0.2517
40.0000	0.0707	0.0771	0.0861	0.0935	0.1077	0.1243	0.1356	0.1528	0.1681	0.1990	0.2361
45.0000	0.0668	0.0729	0.0814	0.0884	0.1017	0.1174	0.1281	0.1443	0.1588	0.1880	0.2231
50.0000	0.0636	0.0693	0.0774	0.0840	0.0966	0.1116	0.1217	0.1371	0.1509	0.1787	0.2121
60.0000	0.0582	0.0635	0.0708	0.0769	0.0885	0.1021	0.1114	0.1255	0.1381	0.1635	0.1943
70.0000	0.0541	0.0589	0.0658	0.0714	0.0821	0.0946	0.1033	0.1164	0.1281	0.1517	-
80.0000	0.0507	0.0553	0.0616	0.0669	0.0769	0.0887	0.0968	0.1090	0.1200	0.1421	-
90.0000	0.0479	0.0522	0.0582	0.0632	0.0726	0.0838	0.0914	0.1029	0.1132	0.1341	-
100.0000	0.0455	0.0496	0.0553	0.0600	0.0690	0.0796	0.0868	0.0977	0.1075	0.1274	-
n>100	.4550/$\sqrt{n}$	.4959/$\sqrt{n}$	.5530/$\sqrt{n}$	.6/$\sqrt{n}$	.6898/$\sqrt{n}$	.7957/$\sqrt{n}$	.8678/$\sqrt{n}$	.9773/$\sqrt{n}$	1.0753/$\sqrt{n}$	1.2743/$\sqrt{n}$	-

ประวัติผู้เขียน

นายสอาด นิวิศพงศ์ เกิดวันที่ 13 มกราคม พ.ศ. 2504 จังหวัดลำปาง ได้รับปริญญาการศึกษาบัณฑิต สาขาคณิตศาสตร์ จากมหาวิทยาลัยศรีนครินทรวิโรฒ พิษณุโลก ปีการศึกษา 2527 ได้เข้าศึกษาในภาควิชาสถิติ คณะพาณิชยศาสตร์และการบัญชี จุฬาลงการณ์มหาวิทยาลัย เมื่อปีการศึกษา 2530 ปัจจุบันรับราชการตำแหน่งอาจารย์ 1 ระดับ 3 โรงเรียนเชียงม่วนวิทยาคม จังหวัดพะเยา