

AD-A144 997

NORMAL APPROXIMATION FOR RESPONSE TIME IN A
PROCESSOR-SHARED COMPUTER SYSTEM MODEL(U) NAVAL
POSTGRADUATE SCHOOL MONTEREY CA 5 PORNURIYA MAR 84

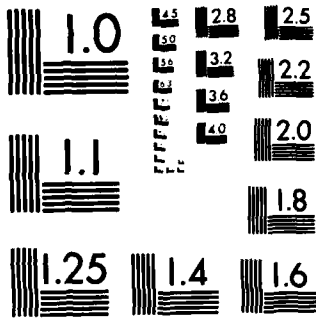
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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101 CONTINUE
102 DO 103 J=1,N
    PI(I,(J+1))=GAMMA((FLOAT(N+1)))/GAMMA((FLOAT(N-J+1)))
    PI(I,(J+1))=PI(I,(J+1))*((LAM2/MU2)**J)
103 CONTINUE
    DO 104 I=1,M
        PI((I+1),1)=GAMMA((FLOAT(N+1)))/GAMMA((FLOAT(N-I+1)))
        PI((I+1),1)=PI((I+1),1)*((LAM1/MU1)**I)
104 CONTINUE
        PI(1,1)=0.
        DO 120 I=1,M1
            DO 110 J=1,N1
                PI(1,1)=PI(1,1)+PI(I,J)
110 CONTINUE
120 CONTINUE
        PI(1,1)=1./((PI(1,1)+1.))
        DO 140 I=1,M1
            DO 130 J=1,N1
                IF ((I.EQ.1) .AND. (J.EQ.1)) GO TO 130
                PI(I,J)=PI(1,1)*PI(I,J)
130 CONTINUE
140 CONTINUE
        DO 180 I=1,M1
            DO 170 J=1,N1
                TUI(I,J)=PI(I,J)*LAM1*(M1-I)
170 CONTINUE
180 CONTINUE
        Q1=0.
        DO 200 I=1,M1
            DO 190 J=1,N1
                Q1=Q1+TUI(I,J)
190 CONTINUE
200 CONTINUE
        Q1=1./Q1
        DO 220 I=1,M1
            DO 210 J=1,N1
                TUI(I,J)=TUI(I,J)*Q1
210 CONTINUE
220 CONTINUE
        DO 225 J=1,N1
            NUI(1,J)=0.
225 CONTINUE
        DO 232 I=2,M1
            DO 231 J=1,N1
                NUI(I,J)=TUI((I-1),J)
231 CONTINUE
232 CONTINUE
  
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235 CONTINUE
RETURN
END
C ***** SIMULATE RESPONSE TIME AND COMPARISON TO CLT *****
C SUBROUTINE SIMRT(M,N,I,LAM1,LAM2,MU1,MU2,X1,A1,B1,C1 *****
C ***** RESPONSE TIME AND COMPARISON TO CLT *****
C ***** RESPONSE TIME AND COMPARISON TO CLT *****
SUBROUTINE SIMRT(M,N,I,LAM1,LAM2,MU1,MU2,X1,A1,B1,C1
*PRI,VARP,PHI,VPH,HTXB,HTSD,QH)
*REAL*4 W0,CO,T,LA,M1,LAM2,MU1,XP(6),XJ,XL,XM,BRI(5,6),CRI(5,6)
*LJ1(6),LJ2(6),MJ1(6),MJ2(6),XP4,X1(6,6),A1(6,6),C1(6,6)
*EXPI,EXP2,EXP3,EXP4,PK1(7),PK3(7),PRI(7),PHI(7),VARP(7),DNY(7),HTSD
*VPH(7),CI(7),DNV(7),NU1(6,6),XBLT,SDLT,HTXB,HTSD
INTEGER IX1,IX2,M,N,M1,N1,KT,K1(7),K3(7)
IX1 = 3766
IX2 = 344921
M1 = M+1
N1 = N+1
KT = 300
DO 10 I=1,M1
LJI(I) = (M1-I)*LAM1
MJI(I) = MU1*(I-1)
10 CONTINUE
DO 10 J=1,N1
LJ2(J) = (N1-J)*LAM2
MJ2(J) = MU2*(J-1)
10 CONTINUE
C CALL SUBROUTINE TO COMPUTE STEADY-STATE DISTRIBUTION
C CALL SST(M,N,LAM1,LAM2,MU1,MU2,NU1)
C STD. NORMAL QUANTILES (.10,.25,.50,.75,.90,.95,.99)
QU(1) = -1.2816
QU(2) = -0.6745
QU(3) = 0.6745
QU(4) = 1.2816
QU(5) = 1.6449
QU(6) = 2.3263
QU(7) = 3.0907
C CALL SUBROUTINE TO READ CLT MEAN AND VARIANCE
C CALL APPROX(XBLT,SDLT)
XBLT = XBLT*I
SDLT = SQRT(SDLT*I)
C SUBROUTINE TO COMPUTE HEAVY TRAFFIC MEAN AND VARIANCE
C CALL HTA2(T,M,HTSD)
HTSD = SQRT(HTSD)
DO 13 I=1,7
QI(I) = XBLT+SOLT*QU(I)
PRI(I) = 0.
  
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VARP(I) = 0.
 QH(I) = HTXB+HTSD*QU(I)
 PHI(I) = 0.
 VPH(I) = 0.

13 CONTINUE

C CONDITIONAL RESPONSE TIME

DO 25 NI=1,M
 DO 24 NJ=1,N1
 RI(NI,NJ) = 0.
 BR(NI,NJ) = 0.
 CR(NI,NJ) = 0.

24 CONTINUE

DO 250 I=1,M
 DO 240 J=1,N1
 DO 230 K=1,K1
 W0 = T
 C0 = 0.
 I0 = I
 J0 = J

C GENERATE EXPONENTIAL ARRIVAL AND DEPARTURE TIME

30 CALL LEXPN(IXI,EXP,6,1,0)

C IF (I0 .NE. M) GO TO 50

EXP1 = 9999.99

IF (I0 .NE. 1) GO TO 38

EXP3 = 9999.99

GO TO 39

EXP3 = EXP(3)/(MU1*(I0-1))

IF (J0 .NE. 1) GO TO 40

EXP2 = EXP(2)/(LJ2(J0)*(I0+J0-1))

XL = EXP(5)/(LJ1(I0+1)+LJ2(J0))*(I0+J0-1))

EXP4 = EXP(6)

XM = EXP3

GO TO 110

IF (J0 .NE. N1) GO TO 41

EXP2 = 9999.99

XL = EXP1

EXP4 = EXP(4)/(MU2*(J0-1))

XM = EXP(6)/(MU1*(I0-1)+MU2*(J0-1))

GO TO 110

EXP2 = EXP(5)/(LJ2(J0)*(I0+J0-1))

XL = EXP(5)/(LJ1(I0+1)+LJ2(J0))*(I0+J0-1))

EXP4 = EXP(4)/(MU2*(J0-1))

XM = EXP(6)/(MU1*(I0-1)+MU2*(J0-1))

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50  GO TO 110
    IF ( IO .NE. 1 ) GO TO 55
    EXP1 = EXP(1)/(LJ1(10+1))*(10+J0-1)
    EXP3 = 9999.99
    GO TO 39
55  EXP1 = EXP(1)/(LJ1(10+1))*(10+J0-1)
    EXP3 = EXP(3)/(MJ1*(10-1))
    GO TO 35
110  XJ = AMIN1(XL, XM)
    IF ( XJ .LT. W0 ) GO TO 120
    RI(I, J) = RI(I, J) + (CO+W0*(10+J0-1))/(FLOAT(KT))
    XR(K) = CO+W0*(10+J0-1)
    GC TO 220
120  CO = CO+XJ*(10+J0-1)
    W0 = W0-XJ
    IF ( XJ .NE. XL ) GO TO 140
    IF ( EXP1 .GT. EXP2 ) GO TO 130
    IF ( IO .EQ. M ) GO TO 160
    IO = IO+1
    GO TO 160
130  IF ( JO .EQ. N1 ) GO TO 160
    JO = JO+1
    GO TO 160
140  IF ( EXP3 .GT. EXP4 ) GO TO 150
    IF ( IO .EQ. 1 ) GO TO 160
    IO = IO-1
    GO TO 160
150  IF ( JO .EQ. 1 ) GO TO 160
    JO = JO-1
    IX1 = IX1+1
    GO TO 30
220  CONTINUE
230  CONTINUE
    DO 231 LI=1, 7
    K1(LI) = 0
    K2(LI) = 0
    K3(LI) = 0
231  CONTINUE
    DO 232 LI=1, 7
    AR1(I, J) = AR1(I, J) + (XR(K) - RI(I, J))**2 / (FLOAT(KT))
    BR1(I, J) = BR1(I, J) + (XR(K) - RI(I, J))**3 / (FLOAT(KT))
    CR1(I, J) = CR1(I, J) + (XR(K) - RI(I, J))**4 / (FLOAT(KT))
    IF ( XR(K) .GT. QI(1) ) GO TO 355
    DO 350 LI=1, 7
    KI(LI) = KI(LI)+1
    CCNTINUE
    GO TO 400
350  CONTINUE
355  IF ( XR(K) .GT. QI(2) ) GO TO 360
    DC 357 LI=2, 7
  
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357 K1(LI) = K1(LI)+1
 CCNTINUE
 GO TO 400
 360 IF (XR(K) .GT. QI(3)) GO TO 365
 DC 363 LI=3,7
 K1(LI) = K1(LI)+1
 363 CCNTINUE
 GO TO 400
 365 IF (XR(K) .GT. QI(4)) GO TO 370
 DC 367 IL=4,7
 K1(IL) = K1(IL)+1
 367 CCNTINUE
 GO TO 400
 370 IF (XR(K) .GT. QI(5)) GO TO 375
 DC 372 KI=5,7
 K1(KI) = K1(KI)+1
 372 CCNTINUE
 GO TO 400
 375 IF (XR(K) .GT. QI(6)) GO TO 380
 DC 377 LK=6,7
 K1(LK) = K1(LK)+1
 377 CCNTINUE
 GO TO 400
 380 IF (XR(K) .GT. QI(7)) GO TO 400
 K1(7) = K1(7)+1
 400 CCNTINUE
 235 DO 800 MI=1,KT
 IF (XR(MI) .GT. QH(1)) GO TO 710
 GO 705 MK=1,7
 K3(MK) = K3(MK)+1
 705 CCNTINUE
 GO TO 780
 710 IF (XR(MI) .GT. QH(2)) GO TO 720
 DC 715 MKK=2,7
 K3(MKK) = K3(MKK)+1
 715 CCNTINUE
 GO TO 780
 720 IF (XR(MI) .GT. QH(3)) GO TO 730
 DC 725 MKI=3,7
 K3(MKI) = K3(MKI)+1
 725 CCNTINUE
 GO TO 780
 730 IF (XR(MI) .GT. QH(4)) GO TO 740
 DC 735 MKJ=4,7
 K3(MKJ) = K3(MKJ)+1
 735 CCNTINUE
 GO TO 780

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74C IF ( XR(MI) .GT. QH(5) ) GO TO 750
    CO 745 MKL=5;7
    K3(MKL) = K3(MKL)+1
    CONTINUE
    GC TO 780
745 IF ( XR(MI) .GT. QH(6) ) GO TO 760
    DO 755 MKM=6;7
    K3(MKM) = K3(MKM)+1
    CCNTINUE
    GC TO 780
760 IF ( XR(MI) .GT. QH(7) ) GO TO 780
    K3(7) = K3(7)+1
    CONTINUE
800 CONTINUE
    DO 410 KK=1,7
    PK1(KK) = FLOAT(K1(KK))/FLOAT(KT)
    PK3(KK) = FLOAT(K3(KK))/FLOAT(KT)
    CONTINUE
410 DO 420 LM=1,7
    PRI(LM) = PRI(LM)+PK1(LM)*NUI(I+1,J)
    PHI(LM) = PHI(LM)+PK3(LM)*NUI(I+1,J)
    CONTINUE
240 CONTINUE
250 DO 425 LL=1,7
    IF (PRI(LL) .GT. 1.0) GO TO 200
    GO TO 201
    PRI(LL) = 1.0
    IF (PHI(LL) .GT. 1.0) PHI(LL) = 1.0
    DO 423 JJ=1,N1
    DMY(LL) = PRI(LL)*(1-PRI(LL))*NUI((II+1),JJ)**2/FLOAT(KT)
    VARP(LL) = VARP(LL)+DMY(LL)
    DNY(LL) = PHI(LL)*(1-PHI(LL))*NUI((II+1),JJ)**2/FLOAT(KT)
    VPH(LL) = VPH(LL)+DNY(LL)
    CONTINUE
423 CONTINUE
424 CONTINUE
425 CONTINUE
490 DO 310 JJJ=1,N1
    XI(1,JJJ) = 0.
    AI(1,JJJ) = 0.
    BI(1,JJJ) = 0.
    CI(1,JJJ) = 0.
    CONTINUE
310 CONTINUE
    DO 320 IK=1,M
    DO 315 JK=1,N1
    XI((K+1),JK) = RI(IK,JK)
  
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    AI((IK+1),JK) = ARI(IK,JK)
    BI((IK+1),JK) = BRI(IK,JK)
    CJ((IK+1),JK) = CRI(IK,JK)
319 CONTINUE
320 RETURN
    END

C*****
C SUBROUTINE TO READ CLT, MEAN AND VARIANCE
C*****
SUBROUTINE APPROX(XBLT,SDLT)
  REAL XBLT,SDLT
  C READ RESULTS FROM APL PROGRAM GIVEN M,N,LAM1,LAM2,MU1,MU2
  XBLT = 7.170168127
  SDLT = C.05611889739
  RETURN
  END

C*****
C SUBROUTINE TO COMPUTE HEAVY TRAFFIC MEAN AND VARIANCE
C*****
SUBROUTINE HTA2(T,M,N,LAM1,LAM2,MU1,MU2,HTXB,HTSD)
  REAL T,LAM1,LAM2,MU1,MU2,HTXB,HTSD,XL1,XL2,XC,AA,BB,CC
  *XM1,XM2,AS1,AS2,BS1,BS2,SM1,SM2,S0,S1,B11,B12,B21,B22
  *K11,K12,K21,K22,G31,G32,B31,B32,K31,K32,Y10,Y20,V12
  *Z11,Z12,DZ1,DZ2,DZ3,DT1,DT2,DT3,DS1,DS2,DS3,D10,D20
  INTEGER M,N
  XL1 = LAM1*M
  XL2 = LAM2*N
  XC = FLCAT(N)/FLOAT(M)
  AA = XL1*(MU1*XL2-MU2*XL1)
  BB = MU2*(MU1-XL1)-XL2*(MU1*XL2-MU2*XL1)+XC*XL2*XL1*MU1
  CC = XL1*MU2*(MU1-XL1)
  IF (MU1*XL2-MU2*XL1) .GT. 100,100,100
    XM1 = (SQRT(BB**2-4*AA*CC)-BB)/(2*AA)
    GO TO 200
  100 XM1 = -CC/BB
  200 XM2 = XM1*MU1/(XL1*(1-XM1))-XM1
  C COMPUTE THE MEAN
  HTXB = M*(XM1+XM2)*T
  C
  AS2 = -XL1*(1-XM1)
  BS1 = -XL2*(XC-XM2)
  BS2 = XL1*(XM1+XM2)+MU1+AS2
  SM1 = SQRT(XM1*MU1-AS2*(XM1+XM2))
  SM2 = SQRT(XM2*MU2-BB*(XM1+XM2))

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SO = ( SCRI((BS2+AS1)**2-4*(AS1*BS2-AS2*BS1))-BS2-AS1)/2.
SI = -(BS2*AS1+SOI
B11 = (SO+BS2)/(SO-S1)
B12 = BS2/(S1-SO)
B21 = (SO+AS1)/(SO-S1)
B22 = (S1+AS2)/(S1-SO)
K11 = (S1+BS2)/(S1-SO)
K12 = (S1+AS1)/(S1-SO)
K21 = (AS1-BS1)/(SO*S1)
G31 = (G31*S1+1)/(SO-S1)
B31 = (G32*S1+1)/(S1-SO)
K31 = (G32*SO+1)/(S1-SO)
SM1 = (SM1**2*(B11**2/(2*SO)+2*B11*K11/(SO+S1)+K11**2/(2*S1))
Y10 = (Y10-SM2**2*(B12**2/(2*SO)+2*B12*K12/(SO+S1)+K12**2/(2*S1))
Y20 = (Y20-SM1**2*(B21**2/(2*SO)+2*B21*K21/(SO+S1)+K21**2/(2*S1))
D10 = (B11*SM2)/(2*SO)+(K11*B22)/(SO+S1)+K11*K22/(2*S1)
D20 = (B12*SM1)/(2*SO)+(K12*B21)/(SO+S1)+K12*K22/(2*S1)
DS1 = (DS1**2*(EXP(2*SO*T)-1)/(2*SO)+K31**2*(EXP(2*S1*T)-1)/(2*S1)
DS2 = (DS2**2*(EXP(SO*T)-1)/(SO+2*G31*K31*(EXP(S1*T)-1)/S1
DS3 = (G31**2*(1+2*G31*K31*(EXP((SO+S1)*T)-1)/(SO+S1)
DT1 = (DT1**2*(EXP(2*SO*T)-1)/(2*SO)+K32**2*(EXP(2*S1*T)-1)/(2*S1)
DT2 = (DT2**2*(EXP(SO*T)-1)/(SO+2*G32*K32*(EXP(S1*T)-1)/S1
DT3 = (G32**2*(1+2*G32*K32*(EXP((SO+S1)*T)-1)/(SO+S1)
ZT1 = (ZT1+DT2+DT3
DZ1 = (G31+BS1)*EXP(SO*T)+K31*(S1*T)**2**Y10
DZ2 = (G32+BS2)*EXP(SO*T)+K32*(S1*T)**2**Y20
DZ3 = (G32+BS2)*EXP(SO*T)+K32*(S1*T)**2**Y12
DZ3 = 2*SQR(DZ1/Y10)*SQR(DZ2/Y20)*Y12
C COMPUTE THE VARIANCE
HTSD = (DZ1+DZ2+DZ3+ZT1*SM1**2+ZT2*SM2**2)*M
C
RETURN
END
  
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LIST OF REFERENCES

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