

บรรณานุกรม

- ริชาร์ด ไอลีน และ ซี เอ เคิร์กพาทริก ๒๕๑๖. วิธีเชิงปริมาณสำหรับฝ่ายจัดการ
แปลจาก Quantitative Approaches to Management โดย เอกชัย
ชัยประเสริฐสิทธิ. พระนคร : ไทยวัฒนาพานิช
- Hamdy A. Taha. 1971. Operations Research An Introduction. New York :
Macmillan.
- Russel L. Ackoff and Maurice W. Sasieni. 1968. Fundamentals of Operations
Research. New York : John Wiley and Sons.
- Robert J. Thierauf and Richard A. Grosse. 1970. Decision Making through
Operations Research. New York : John Wiley and Sons.
- Robert B. Cooper. 1972. Introduction to Queueing Theory. New York :
Macmillan.
- Thomas L. Saaty. 1961. Elements of Queueing Theory. New York : McGraw Hill.
- D.R. Cox and Walter L. Smith. 1961 Queue. New York : John Wiley & Sons.
- G.F. Newell. 1971. Applications of Queue Theory. London. Chapman and
Hall LTD.
- A.Y. Khintchine. 1969. Mathematical Methods in the Theory of Queueing.
London : Griffin.
- Ronald L. Gue and Michael E. Thomas. 1968. Mathematical Methods in
Operations Research. New York: Macmillan.
- Thomas L. Saaty. 1959. Mathematical Methods of Operations Research.
New York : McGraw Hill:

L.S. Goddard. 1963. Mathematical Technique of Operational Research.

London : Pergaman Press.

James R. Emshoff and Roger L. Sisson. 1970. Design and Use of Computer
Simulation Models. New York : Macmillan.

G.M. Luck, J. Luckman, B.W. Smith and J. Stinger. 1971. Patients,
Hospitals and Operations Research. London : Tavistock Institute.

ภาคผนวก

ภาคผนวกที่ ๑


```
C*****PROGRAM SIMULATE QUEUE OF SIRIRAJ HOSP. BY WANCHAI
001   DIMENSION ATX(5),STX(5),WTX(5),TWTX(5),XIDT(5),TXIDT(5),TWLX(5),
      *SAX(5),SSX(5),SARV(5),EAXT(5),ESXT(5),EWTX(5),EWLX(5),EASX(5),
      *RS(10),RSPB(10),RA(10),RAPB(10),CSX(5),CXPB(5),NSX(5),X(5,10),
      *PBX(5,10),XARV(5)
002   ARV=0.
003   SUMATR=0.
004   WTR=0.
005   RIDT=0.
006   STR=0.
007   TWTR=0.
010   TRIDT=0.
011   ASTAR=0.
012   TWLR=0.
013   READ(2,5) STIME,NST,NRA,NRS
014   READ(2,15) (RA(I),I=1,NRA), (RAPB(J),J=1,NRA)
015   READ(2,15) (RS(I),I=1,NRS), (RSPB(J),J=1,NRS)
016   READ(2,15) (CSX(I),I=1,NST), (CXPB(J),J=1,NST)
017   READ(2,25) (NSX(I),I=1,NST)
020   DO 50 I=1,NST
021     N=NSX(I)
022     READ(2,15) (X(I,J),J=1,N)
023     50 READ(2,15) (PBX(I,J),J=1,N)
024     DO 6 I=1,NST
025       STX(I)=0.
026       ATX(I)=0.
027       WTX(I)=0.
030       XIDT(I)=0.
031       TWTX(I)=0.
032       TXIDT(I)=0.
033       XARV(I)=0.
034       TWLX(I)=0.
035       SAX(I)=0.
036       SSX(I)=0.
037     6 CONTINUE
040     SRS=0.
041     WRITE(3,10)
042     WRITE(3,20)
043     IN=1
044     27 CALL SRNDM1(IN,1,RN)
045     CALL FMONT(RA,RAPB,RN,ATR,NRA)
046     SUMATR=SUMATR+ATR
047     IF(SUMATR.GT.STIME) GO TO 7
050     AR=ATR
051     ATR=ATR-WTR
052     ARV=ARV+1.
053     IN=2
054     CALL SRNDM1(IN,1,RN)
055     CALL QUEUE(ATR,WTR,STR,TWTR,RIDT,TRIDT,TWLR)
056     CALL FMONT(RS,RSPB,RN,STR,NRS)
057     SRS=SRS+STR
060     ASTAR=ASTAR+STR+RIDT
061     CALL FMONT(CSX,CXPB,RN,XL,NST)
062     LX=XL
063     XARV(LX)=XARV(LX)+1.
064     ATX(LX)=ASTAR-ATX(LX)
065     SAX(LX)=SAX(LX)+ATX(LX)
066     AX=ATX(LX)
067     ATX(LX)=ATX(LX)-WTX(LX)
```

```

070      CALL QUEUE(ATX(LX),WTX(LX),STX(LX),TWTX(LX),XIDT(LX),TXIDT(LX),
      *TWLX(LX))
071      CALL SRNDM1(IN,1,RN)
072      NDUM=NSX(LX)
073      DO 16 I=1,NDUM
074      II=I
075      IF(RN.LE.PBX(LX,I)) GO TO 17
076      16 CONTINUE
077      17 STX(LX)=X(LX,II)
100      SSX(LX)=SSX(LX)+STX(LX)
101      WRITE(3,30)AR,SUMATR,STR,RIDT,WTR,LX,AX,STX(LX),XIDT(LX),WTX(LX)
102      GO TO 27
103      7 SUMATR=SUMATR-ATR
104      EAR=SUMATR/ARV
105      ESR=SRS/ARV
106      EWTR=TWTR/ARV
107      DO 26 I=1,NST
110      EAXT(I)=SAX(I)/XARV(I)
111      ESXT(I)=SSX(I)/XARV(I)
112      EWTX(I)=TWTX(I)/XARV(I)
113      26 CONTINUE
114      WRITE(3,35)EAR,ESR,EWTR,(I,EAXT(I),ESXT(I),EWTX(I),I=1,NST)
115      STOP
116      10 FORMAT(/,1H ,13H TIME BETWEEN,3X,7HARRIVAL,3X,12HREGISTRATION,
      *3X,12HREGISTRATION,3X,12HREGISTRATION,3X,5HX-RAY,2X,
      *12HTIME BETWEEN,5X,5HX-RAY,6X,5HX-RAY)
117      20 FORMAT(1H ,4X,7HARRIVAL,6X,4HTIME,5X,12HSERVICE TIME,4X,
      *9HIDLE TIME,5X,12HWAITING TIME,3X,4HUNIT,6X,7HARRIVAL,4X,
      *12HSERVICE TIME,2X,9HIDLE TIME,2X,12HWAITING TIME,/)
120      30 FORMAT(1H ,F8.2,4X,=7.2,6X,F7.2,8X,F7.2,9X,F7.2,5X,I3,7X,F7.2,
      *6X,F7.2,5X,F7.2,4X,=7.2)
121      5 FORMAT(F5.2,3I5)
122      15 FORMAT(20F4.3)
123      25 FORMAT(5I2)
124      35 FORMAT(///10X,39HEXPECTED ARRIVAL TIME OF REGISTRATION =,F10.2
      *///10X,39HEXPECTED SERVICE TIME OF REGISTRATION =,F10.2
      *///10X,39HEXPECTED WAITING TIME AT REGISTRATION =,F10.2
      */5(///5X,10HX-RAY UNIT,I3/10X,23HEXPECTED ARRIVAL TIME =,F10.2
      */10X,23HEXPECTED SERVICE TIME =,F10.2/10X,35HEXPECTED
      *WAITING TIME =,F10.2))
125      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE QUEUE(AT,WT,ST,TWT,IDT,TIDT,TWL)
002      REAL IDT
003      IF(ST-AT)11,9,6
004      11 WT=0.
005      IDT=AT-ST
006      TIDT=TIDT+IDT
007      GO TO 7
010      9 WT=0.
011      IDT=0.
012      GO TO 7
013      6 IDT=0.
014      WT=ST-AT
015      TWT=TWT+WT
016      TWL=TWL+1.
017      7 RETURN
020      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE SRNDM1(IND,N,RN1)
002      GO TO (100,200),IND
003      100 X=50249347.
004      200 A=23.
005      FM=1.E8+1.
006      DO 300IC=1,N
007      W=X*A
010      V=AMOD(W,FM)
011      RN1=V/FM
012      X=V
013      300 CONTINUE
014      RETURN
015      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE FMONT(X,FX,U,Y,N)
002      DIMENSION X(10),FX(10)
003      DO 6 I=1,N
004      IF(U.GT.FX(I)) GO TO 6
005      Y=X(I)
006      GO TO 7
007      6 CONTINUE
010      7 RETURN
011      END

```


ภาคผนวกที่ ๒


```

*****PROGRAM SIMULATE REGISTRATION UNIT BY WANCHAI RIVEPIBOON
*****EM=THE NUMBER OF UNITS TIME TO BE SIMULATED
*****N=THE NUMBER OF PARALLEL SERVICE STATIONS
*****AA=THE EXPECTED VALJE OF ARRIVAL TIME
*****AS=THE EXPECTED VALJE OF SERVICE TIME FOR EACH OF
  *THE SERVICE STATION

```

```

001     DIMENSION IDT(16),ST(16),WT(16),TT(16)
002     COMMON NEXT(200),VQ(200),RA(16),RAPB(16),
      *RS(16,16),RSPB(16,16)
003     REAL IDT
004     INTEGER RPQ,DPQ,STACK,Q,TNN,TQ
005     READ(2,1)STIME,N,NRA,NRS
006     READ(2,2)(RA(I),I=1,NRA),(RAPB(J),J=1,NRA)
007     DO 50 I=1,N
010     50 READ(2,2)(RS(I,J),J=1,NRS),(RSPB(I,J),J=1,NRS)
011     IND=1
012     TAT=0.0
013     TWT=0.0
014     TST=0.0
015     TQ=0
016     RPQ=0
017     STACK=1
020     DO10I=1,200
021     10 NEXT(I)=I+1
022     NEXT(200)=0
023     IDT(1)=0.0
024     J=1
025     CALL SER(1,ST(1),NRS,IND)
026     IND=2
027     TST=TST+ST(1)
030     WT(1)=0.0
031     TT(1) = ST(1)
032     Q=0
033     TNN=1
034     NN=1
035     TTS=ST(1)
036     CALL QUE(STACK,RPQ,TT(1),TAT,Q,NN,N)
037     WRITE(3,4)
040     WRITE(3,5) J,TAT,J,IDT(1),WT(1),ST(1),TT(1),ST(1),Q,NN
041     DO20J=2,N
042     CALL ARR(AT,NRA,IND)
043     TAT=TAT+AT
044     IDT(J)=TAT
045     CALL SER(J,ST(J),NRS,IND)
046     TST=TST+ST(J)
047     WT(J)=0.0
050     TT(J)=IDT(J)+ST(J)
051     TTS=TTS+ST(J)
052     CALL QUE(STACK,RPQ,TT(J),TAT,Q,NN,N)
053     TNN=TNN+NN
054     20 WRITE(3,5) J,TAT,J,IDT(J),WT(J),ST(J),TT(J),ST(J),Q,NN
055     I=N
056     200 SMIN=TT(1)
057     L=1
060     DO40J=2,N
061     IF(SMIN.LE.TT(J))GOTO40
062     SMIN=TT(J)
063     L=J
064     40 CONTINUE

```

```

065      I=I+1
066      CALLARR(AT,NRA,IND)
067      CALL SER(L,ST(L),NRS,IND)
070      TAT=TAT+AT
071      IF(TAT.GE.STIME) GO TO 100
072      DIF=TAT-TT(L)
073      NN = N
074      Q = 0
075      IF(DIF)41,42,43
076      41 WT(L)=-DIF
077         IDT(L)=0.0
100         TWT=TWT+WT(L)
101         GO TO 45
102      42 WT(L)=0.0
103         IDT(L)=0.0
104         GO TO 45
105      43 WT(L)=0.0
106         IDT(L)=DIF
107         TIDT=TIDT+IDT(L)
110      45 TST=TST+ST(L)
111         TS = WT(L) + ST(L)
112         TTS = TTS + TS
113         TT(L) = TAT + TS
114         CALL QUE(STACK,RPQ,TT(L),TAT,Q,NN,N)
115         TNN = TNN + NN
116         TQ = TQ + Q
117         WRITE(3,5) I,TAT,L,IDT(L),WT(L),ST(L),TT(L),TS,Q,NN
120         GO TO 200
121      100 WRITE(3,6) TIDT,TWT,TST,TTS,TQ,TNN
122         TIDT = TIDT/FLOAT(I)
123         TWT = TWT/FLOAT(I)
124         TST = TST/FLOAT(I)
125         TTS = TTS/FLOAT(I)
126         ANN = FLOAT(TNN)/FLOAT(I)
127         AQ = FLOAT(TQ)/FLOAT(I)
130         WRITE(3,7) TIDT,TWT,TST,TTS,AQ,ANN
131         STOP
132         1 FORMAT(F5.2,3I5)
133         2 FORMAT(20F4.3)
134         4 FORMAT(20X,90(1H:)/20X,19H:NUMBER: ARR TIME :,
          *44H:ST NO:IDLE TIME :WAIT TIME: SER TIME :DEP T,
          *25HIME :TIME SYS : QUE: SYS:/20X,90(1H:))
135         5 FORMAT(20X,1H:,16,1H:,F10.2,1H:,15,1H:,5(F10.2,
          *1H:),2(I4,1H:))
136         6 FORMAT(20X,90(1H:)/20X,1H:,6H TOTAL,1H:,10X,1H:,5X,1H:,
          *3(F10.2,1H:),10X,1H:,F10.2,1H:,2(I4,1H:)/20X,90(1H:))
137         7 FORMAT(45X,18HEXPECTED IDLE TIME,16X,1H=,F10.2//
          *45X,21HEXPECTED WAITING TIME,13X,1H=,F10.2//
          *45X,23HEXPECTED SERVICING TIME,11X,1H=,F10.2//
          *45X,35HEXPECTED TIME SPEND IN THE SYSTEM =,F10.2//
          *45X,21HEXPECTED QUEJE LENGTH,13X,1H=,F10.2//
          *45X,29HEXPECTED NUMBER IN THE SYSTEM,5X,1H=,F10.2/////
140      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE QUE(STACK,RPQ,V,TAT,Q,NN,N)
002      COMMON NEXT(200),VQ(200)
003      INTEGER RPQ,DPQ,STACK,Q
004      IF(STACK.EQ.0)GOTO44
005      IDPQ=STACK
006      STACK=NEXT(STACK)
007      VQ(IDPQ) = V
010      NEXT(IDPQ) = RPQ
011      RPQ=IDPQ
012      NN = 1
013      54 DPQ = NEXT(IDPQ)
014      IF(DPQ.EQ.0) GO TO 45
015      IF(TAT.LT.VQ(DPQ)) GO TO 53
016      NEXT(IDPQ) = NEXT(DPQ)
017      NEXT(DPQ) = STACK
020      STACK = DPQ
021      GO TO 54
022      53 NN = NN + 1
023      IDPQ = DPQ
024      GO TO 54
025      45 Q = NN - N
026      IF(Q.LT.0) Q = 0
027      RETURN
030      44 WRITE(3,8)
031      STOP
032      8  FORMAT(//20X,40HTHIS JOB IS FATAL BECAUSE NO EMPTY STACK)
033      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

PROG

```

001      SUBROUTINE SRNDM1(IND,N,RN1)
002      GOTO(100,200),IND
003      100 X=50249347.
004      200 A=23.
005      FM=1.E8+1.
006      D0300IC=1,N
007      W=X*A
010      V=AMOD(W,FM)
011      RN1=V/FM
012      X=V
013      300 CONTINUE
014      44 RETURN
015      END

```


FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE ARR(S,NS,IND)
002      COMMON NEXT(200),VQ(200),RA(16),RAPB(16),
      *RS(16,16),RSPB(16,16)
003      CALL SRNDM 1 (IND,1,R)
004      DO 6 I=1,NS
005      IF(R.GT.RAPB(I)) GO TO 6
006      S=RA(I)
007      RETURN
010      6 CONTINUE
011      END

```

FORTRAN 200 SOURCE LISTING AND DIAGNOSTICS

```

001      SUBROUTINE SER(N,S,NS,IND)
002      COMMON NEXT(200),VQ(200),RA(16),RAPB(16),
      *RS(16,16),RSPB(16,16)
003      CALL SRNDM 1 (IND,1,R)
004      DO 6 I=1,NS
005      IF(R.GT.RSPB(N,I)) GO TO 6
006      S=RS(N,I)
007      RETURN
010      6 CONTINUE
011      END

```


ประวัติการศึกษา

นายวันชัย รั้วไพบูลย์ จบปริญญาตรี ทางวิทยาศาสตร์ สาขาเทคนิคการแพทย์ (รังสีเทคนิค) จากคณะเทคนิคการแพทย์ มหาวิทยาลัยมหิดล พ.ศ. ๒๕๑๔ และประกาศนียบัตรชั้นสูง สาขาฟิสิกส์การแพทย์ บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล พ.ศ. ๒๕๑๕ ปัจจุบันรับราชการ ในตำแหน่งนักวิทยาศาสตร์ ในแผนกเวชศาสตร์นิวเคลียร์ ภาควิชารังสีวิทยา โรงพยาบาลศิริราช มหาวิทยาลัยมหิดล