实用BASIC程序100例

（三）

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目　录（三册）

瑞典计算法（排队论）

这是一个古已有之的问题，你拥有X个保修工负责维修Y台机田。这些机田作性能统计时，随机采样的利率是相等的，其故障时间遵循指数规律，并以故障的平均间隔时间为特征，保修人员也是统计均等的，他们保修完成时间服从指数规律，并以期望值为特征，所有因素彼此无关，由于本程序可以提供资金流通分析，亦面提规定的保修工人工资额，机田加工收入和总的开销即可求得以及可行的机田与保修工的比例值，因此本程序是特别有用的。

如执行此程序，要录入机田号数，机田的平均故障问题时间，保修工人数以及维修机田平均时间，时间单元的选取，请君自便。机田会打印出各种系统特征。当你希望获得现金流通分析的结果时，则还得录入每个工人在单位时间内的工资，占用一台机田在单位时间内的费用，以及每台机田在单位时间内创造的价值，你采用哪种货币单位都成（几个便士，数十美元，几千美元，几个比索等）。

例：艾克·部德多曼特在城里共有50台机田在运转，这些机田的平均故障间隔时间为300小时，目前共有维修工3名，每个工人维修一台机田需24小时，任意时刻，可期望多少台机田在正常运转？多少台机田在待保修？多少田正等待维修？每台机田的平均行机时间是多少？多少工人处于空闲状态？每个工人

每小时费用为$5.25（包括附加费用等）。一台机器所有开销项目中包括，诸如土租或其盖费，保险费，按比例折标的管理费，磨损费等等。在此例中，一台机器每月总的开销为$36.00或每小时为$0.05，如果每台机器每小时收入为$0.271997，那么所有机器的现金流通率为多少呢？

答案：预期可有37台机器在任何时间都处于正常运转状态，3台处于维修状态，10台等待维修，每台机器平均打机时间大约为105小时，50台机器每小时所创造的平均收入价值为$0.271997。

SWEDISH MACHINE

INPUT THE NUMBER OF MACHINES ; COUNT MUST EXCEED ONE.

? 50

INPUT MEAN TIME-TO-FAILURE FOR A MACHINE ? 300

INPUT NUMBER OF REPAIRMEN ? 3

INPUT MEAN REPAIR TIME (PER MACHINE) FOR A REPAIRMAN?

? .24

THE SYSTEM IS SAID TO BE 'IN STATE OF G' IF G MACHINES AR IN A FAILED CONDITION, THE STATIONARY PROUABILITY DISTRIBUTION OVER THE POSSIBLE STATES, 0 THRU 50, AND OTHER CHARACTERISTISS OF INTEREST, FOLLOW.

STATE	PROBABILITY	NO. MACHINES ORERATING	NO. MACHINES WAITNG	NO. REPIR IDLE
0	.001966	50	0	3
2				

1	.007203	49	0	3
2	.01541	48	0	3
3	.019733	47	0	2
4	.024717	46	1	0
5	.030316	45	2	0
6	.036375	44	3	0
7	.042675	43	4	0
8	.048929	42	5	0
9	.054795	41	6	0
10	.059903	40	7	0
11	.063889	39	8	0
12	.066438	38	9	0
13	.067317	37	10	0
14	.063749	36	11	0
15	.059493	35	12	0
16	.059493	34	13	0
17	.053934	33	14	0
18	.047457	32	15	0
19	.040492	31	16	0
20	.03347	30	17	0
21	.026773	29	18	0
22	.020702	28	19	0
23	.015456	27	20	0
24	.011127	26	21	0
25	.007714	25	22	0
26	.005142	24	23	0
27	.003291	23	24	0
28	.002018	22	25	0
29	.001184	21	26	0

30	.000663	20	27	0
31	.000334	19	28	0
32	.000179	18	29	0
33	.000086	17	30	0
34	.000039	16	31	0
35	.000017	15	32	0
36	.000007	14	33	0
37	.000003	13	34	0
38	.000001	12	35	0
39	0	11	36	0
40	0	10	37	0
41	0	9	38	0
42	0	8	39	0
43	0	7	40	0
44	0	6	41	0
45	0	5	42	0
46	0	4	43	0
47	0	3	44	0
48	0	2	45	0
49	0	1	46	0
50	0	0	47	0

TO CONTINUE, PRESS 'RETURN'?

SYSTEM CHARACTERISTICS

NO. OF MACHINES = 50

MEAN TIME-TO-FAILURE PER MACHINE = 300 TIME UNITS

NO. OF REPAIRMEN = 3

MEAN REPAIR-TIME PER REPAIRMAN = 24 TIME UNITS

NUMBER OF MACHINES PER REPAIRMAN = 16.666667

PROB. (SERVICE SYSTEM IS EMPTY) = .001966

PROB. (NO, MACHINES ARE WAITING FOR SERVICE)=

EXP, NO. OF MACHINES OPERATING = 37.043994

EXP, NO. OF INACTIVE MACHINES = 12.956006

EXP, NO. OF MACH. IN WAITING LINE = 9.9968

EXP, NO, OF MACH. IN A NON-EMPTY 'WAITING LINE' =
10.467437

MEAN DOWN-TIME PER MACHINE = 104.923994 LIME UNITS

MEAN WAITING TIME PER MACHINE = 80.958873 TIME UNITS

EXP. NO, OF REPAIRMEN IDLE = .115163

TO CONTINUE, PRESS 'RETURN'?

'COEFFICIENT OF LOSS' FOR MACHINES = FRACTION OF TIME
A MACHINE IS 'DOWN' AS A CONSEQUENCE OF THE
SYSTEM CHARACTERISTICS = .199936

'COEFFICIENT OF LOSS' FOR REPAIRMEN = FRACTION OF
TIME A REPAORMAN IS IDLE AS A CONSEQUENCE OF
THE SYSTEM CHARACTERISTICS = .38388

TYPE 1 FOR CASH FLOW ANALYSIS
2 TO HALP

? 1

THIS ANALYSIS ASSUMES THAT REPAIRMEN ARE PAID 'A'
MONETARY UNITS PER UNIT TIME, THAT THE FIXEDCOST
OF POSSESSING EACH

MACHINE IS 'B' MONETART UNITS PER UNTI TIME AND
THAT A MACHINE,

WHEN OPERATING, IS CAPABLE OF PRODUCING 'C'
UNITS REVENUE

```
PER UNIT TIME.
INPUT THE REPAIRMAN-COST PER UNIT TIME,'A'? 5.25
INPUT THE FIXED COST PER UNIT TIME,'B' OF POSSESSING
A MACHINE ? .05
INPUT THE AMOONT OF REVENUE A WORKING MACHINE
     PRODUCES, PER UNIT OF (OPERATING) TIME?.5
THE AVERAGE CASH FLOW GENERATED BY THE COMBINATION
  OF 50 MACHINE(S) MAINTAINED BY 3REPAIRMEN IS
  .271997 MONETARY UNITS, PER UNIT TIME.
```

实际题例：

在上例中，假设艾克每台机由投资为$65.00，用于翻修它们的重型电机，从而将其平均故障间隔时间延至305小时，那么这些机由所产生的现金流通率为多少？艾克要多久才能回收他的$3,250.00投资额？

答案：一更新，这些机由每小时将创造$0.525136的平均收入。其投资额将在18个月内收回。

Program Listing

```
10  PRINT "SWEDISH MACHINE"
20  REM — CHANGE DIMENSION OF Q( ) TO MAXIMUM
    NUMBER OF MACHINES + 1
30  DIM Q(100)
40  PRINT
50  PRINT "INPUT THE NUMBER OF MACHINES; COUNT MUST
    6
```

```
    EXCEED ONE.
 60 INPUT N
 70 PRINT "INPUT MEAN TIME-TO-FAILURE FOR A MACHINE";
 80 INPUT F1
 90 F=1/F1
100 PRINT "INPUT NUMBER OF REPAIR TIME
110 INPUT M
120 PRINT "INPUT MEAN REPAIR TIME (PER MACHINE)
    FOR A REPAIRMAN";
130 INPUT R1
140 R=1/R1
150 PRINT
160 REM- INITIALIZE VARIABLES
170 FOR I=1 TO N+1
180 Q(I)=0
190 NEXT I
200 Q(1)=1
210 E1=0
220 E2=0
230 E3=0
240 P0=0
250 REM-LOOP TO CALCULATE PROBABILITIES FOR EACH
    MACHINE
```

```
260  S=Q(1)
270  FOR J=0 TO N-1
280  REM — K=MIN(J+1,M)
290  K=M
300  IF J+1>M THEN 320
310  K=J+1
320  Q(J+2)=(N-J)*F*Q(J+1)/K/R
330  S=S+Q(J+2)
340  NEXT J
350  IF Q(1)<>1 THEN 380
360  Q(1)=1/S
370  GOTO 260
380  PRINT
390  PRINT "THE SYSREM IS SAID TO BE 'IN STATE OF J
     J MACHINES ARE"
400  PRINT "IN A FAILED CONDITION, THE STATIONARY
     PROBABILITY DISTRI-"
410  PRINT "BUTION OVER THE POSSOBLE STATES, 0 THRU";
     N;",";" AND OTHER"
420  PRINT "CHARACTERISTICS OF INTEREST, FOLLOW."
430  PRINT
440  PRINT "STATE","PROBARILITY"
442  PRINT "NO, MACHINES","NO. MACHINES","NO,
       REPAIRMEN"
```

```
450   PRINT " "," "," OPERATING","WAITING","   IDLE "
460   FOR J=1 TO N+1
470   O=N-J+1
480   W=J-M-1
490   IF W>0 THEN 520
500   W=0
510   PO=PO+Q(J)
520   I=M-J+1
530   IF I>0 THEN 550
540   I=0
550   IF I<M THEN 570
560   I=M
570   PRINT " ";J-1,(J),O,W,I "
580   E1=E1+W*Q(J)
590   E2=E2+I*Q(J)
600   E3=E3+O*Q(L)
610   NEXT J
620   PRINT
630   PRINT "TO CONTINUE, PRESS 'RETURN'";
640   INPUT Z$
650   PRINT
660   PRINT TAB(15);"SYSTEN CHARACTISTICS"
```

```
670   PRINT TAB(15);"- - - - - - - - - - - - - - "
680   PRINT "NO. OF MACHINES =";N
690   PRINT "MEAN TIME-TO-FAILURE PER MACHINE =";
      F1;"TIME UNITS"
700   PRINT "NO. OF REPAIRMEN =";M
710   PRINT "MEAN REPAIR-TIME PER REPAIRMAN =";
      "TIME UNTIS"
720   PRINT "NUMBER OF MACHINES PER REPAIRMAN =";N/M
730   PRINT
740   PRINT "PROB.(SERVICE SYSTEM IS EMPTY) =";Q(1)
750   PRINT "PROB.(NO MACHINES ARE WAITING FOR SERVICE)
      =";P0
760   PRINT
770   PRINT "EXP. NO. OF MACHINES OPERATING =";E3
780   PRINT "EXP. NO. OF INACTIVE MACHINES =";N-E3
790   PRINT "EXP. NO. OF MACH. IN WAITING LANE =";E1
800   PRINT "EXP. NO. OF MACH. IN A NON-EMPTY 'WAITING
      LINE' =",E1/(1-P0)
810   PRINT "MEAN DOWN-TIME PER MACHINE =";(N-E3)*
      F1/E3;"TIME UNITS"
820   PRINT "MEAN WAITING TIME PER MACHINE =";
      E1*F1/E3;"TIME UNITS"
830   PRINT "EXP. NO. OF REPAIRMEN IDLE =";E2
840   PRINT
850   PRINT "TO CONTINUE, PRESS 'RETURN'";
```

```
660  INPUT Z#
670  PRINT "'COEFFICIENT OF LOSS' FOR MACHINES =
     FRACTION OF TIME A"
680  PRINT " MACHINE IS 'DOWN' AS A CONSEQUENCE OF
     THE SYSTEM"
890  PRINT "CHARACTERISTICS ="; E1/N
900  PRINT
910  PRINT "'COEFFICIENT OF LOSS' FOR REPAIRMEN =
     FRACTION OF TIME A"
920  PRINT " REPAIRMAN IS IDLE AS A CONSEQUENCE
     OF THE SYSTEM"
930  PRINT "CHARACTERISTICS ="; E2/M9
940  PRINT
950  PRINT "TYPE 1 FOR CASH FLOW ANALYSIS"
960  PRINT "     2 TO HALD"
970  INPUT Q1
980  IF Q1=2 THEN 1250
990  PRINT "THIS ANALYSIS ASSUMES THAT REPAIRMEN
     ARE PAID 'A' MONETARY"
1000 PRINT " UNITS PER UNIT TIME THAT THE FIXED COST
     OF POSSESSING"
1010 PRINT "EACH MACHINE IS 'B' MONETARY UNITS PER
     UNIT TIME, AND THAT"
1020 PRINT " A MACHINE, WHEN OPERATING, IS CAPABLE
     OF PRODUCING 'C'"
1030 PRINT "UNITS OF REVENUE PER UNIT TIME."
```

```
1040  PRINT
1050  PRINT "INPUT THE REPAIRAN-COST PER UNIT TIME,'A'";
1060  INPUT A
1070  PRINT
1080  PRINT "INPUT THE FIXED COST PER UNIT TIME 'B' OF
      PROCESSING"
1090  PRINT "A MACHINE";
1100  INPUT B
1110  PRINT
1120  PRINT "INPUT THE AMOUNT OF REVENUE A WORKING
      MACHINE PRODUCES,"
1130  PRINT "PER UNIT OF (OPERATING) TIME";
1140  INPUT C
1150  PRINT
1160  D=C*E3-A*M-B*N
1170  PRINT "THE AVERACE CASH FLOW GENERATED BY
      THE COMBINATION OF"; N
1180  PRINT "MACHINE(S) MAINTAINED BY"; M;"REPAIR";
1190  IF M ITHEN 1220
1200  PRINT "MAN";
1210  GOTO 1230
1220  PRINT "MEN";
1230  PRINT "IS"; D; "MONETARY"
```

```
1240  PRINT " UNITS, PER UNIT TIME."
1250  END
```

马尔可夫分析法

马科序关被现行运动的状态下所给定的变量计标将来的变化和动的时间。管理科学学者们采纳了这种分析法，主要是把它作为一种模拟手法用来分析市场的竞争情况，马尔可夫分析法尚有许多其它的应用，已为下例所示。

如运行此程序，首先应输入所考虑的自然状态数。第二种输入任意选择，你如想了从一个状态到下一个状态期间所出现的变化，则必须输入现时刻比例向量，如果你的兴趣仅限于运动中的稳态平衡状态，程序将从相等的概率来构你矢量，该矢量中包含的元素个数即等于自然状态数。

随后，程序要求你输入转移概率矩阵的每个单元（N X N，在这式N＝自然状态数），每个矢后阵单元，输入的转换概率范围是0 P 1。每行所输入的转移概率的和，其总数总是为1，当你输完整个矩阵式后，你即可有选择的考查任每个将来变化周期中计标机计标的平衡状态下的转换矩阵。当达到平衡状态时，程序显示出平衡矢量和每一自然状态首次通过次数，重复或无效变状态时，则不显示首次通过次数。

程序注释：

此程序允许自然状态数最多为12种，如要改变可以修改此

程序的行20实现。

用较大状态数（如15，20或25）置换1。

如果要输入一个大的矩阵，或者用基本多完全相同的数据重复执行此程序，可以"选择"部分所示修改程序，通过DATA语句输好数据。

例：加利西特公司想分析一下可盈利的总额以便从信贷客户估计本公司的现金流通率。该公司有三个分期划分：现期的45～89天，以及90天以上者为逾期账款，视为一种期内的客户最终将作为不可收帐目注销。

最近账分期付款分析表明，每一美元可收的未付费用的，现是其0.60，45～89天以内的为其0.30，90天或90天以后的为其0.7。更进一步的分析表明，流动中类的帐目金额下一个月内有可能付清总额的38%，整个往来帐户金额的45%依然通使用，17%将作为45～89天的旧帐。在45～89天分期级别内的金额将有60%作为延期付款，25%作为分期付款，5%即成90天以上的逾期帐，90天分期级别的帐款将付清25%，余下的75%即成坏帐。

这种支付和坏帐类别为"吸收"状态，在此状态下，假定支付待付项目的可能性为100%，坏帐同为此相同。由于二者现在均为未付帐额，故称其为吸收状态，但最终要付清或勾销的、可收金额为多少？勾销金额为多少？

在下面打印输出中，支付类和坏帐类吸收掉了整个未付债务，

加姆利指望他的帐目金额的91%能予支付，9%予以冲销。

```
MARK. V ANALYSIS
HOW MANY STATES OF NATURE? 5
IS THE POPULATION PROPORTION VECTOR KNOWN (Y/N)? Y
        ENTER VECTOR ELEMENT  1 ? 0
        ENTER VECTOR ELEMENT  2 ? .6
        ENTER VECTOR ELEMENT  3 ? .33
        ENTER VECTOR ELEMENT  4 ? .07
        ENTER VECTOR ELEMENT  5 ? 0

ENTER ELEMENT IN ROW 1 COLUMN 1 ? 1
ENTER ELEMENT IN ROW 1 COLUMN 2 ? 0
ENTER ELEMENT IN ROW 1 COLUMN 3 ? 0
ENTER ELEMENT IN ROW 1 COLUMN 4 ? 0
ENTER ELEMENT IN ROW 1 COLUMN 5 ? 0

ENTER ELEMENT IN ROW 2 COLUMN 1 ? .33
ENTER ELEMENT IN ROW 2 COLUMN 2 ? .45
ENTER ELEMENT IN ROW 2 COLUMN 3 ? .17
ENTER ELEMENT IN ROW 2 COLUMN 4 ? 0
ENTER ELEMENT IN ROW 2 COLUMN 5 ? 0

ENTER ELEMENT IN ROW 3 COLUMN 1 ? .65
ENTER ELEMENT IN ROW 3 COLUMN 2 ? .25
ENTER ELEMENT IN ROW 3 COLUMN 3 ? 0
ENTER ELEMENT IN ROW 3 COLUMN 4 ? .05
ENTER ELEMENT IN ROW 3 COLUMN 5 ? 0
--- PROBABILITIES DO NOT ADD UP TO 1.0 ---
    TRY ENTERING THE ROW AGAIN.
```