

## APPENDIX B: FOUR-LEVEL POPULATION MODEL

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POP4
* FOUR-LEVEL POPULATION SECTOR WITH EXOGENOUS INPUTS
NOTE (THIS VERSION IS USED IN THE WORLD3 STANDARD MODEL)
NOTE
NOTE POPULATION LEVEL EQUATIONS
NOTE
1 A POP.K=P1.K+P2.K+P3.K+P4.K
2 L P1.K=P1.J*(DT) (G.JA-D1.JK-MAT1.JK)
3 C P1=P11
4 R P11=65E7
5 A D1.KL=P1.K*M1.K
6 T M1.K=TABUL(M1,LE,K,20,80,10)
7 R M1T=.0567/.0366/.0243/.0155/.0082/.0023/.001
8 L MAT1.KL=(P1.K) (1-M1.K)/15
9 C P2=P21
10 R P21=70E7
11 A D2.KL=P2.K*M2.K
12 T M2.K=TABUL(M2,LE,K,20,80,10)
13 R M2T=.0266/.0171/.0110/.0065/.0040/.0016/.0008
14 L MAT2.KL=(P2.K) (1-M2.K)/10
15 C P3=P31
16 R P31=19E7
17 A D3.KL=P3.K*M3.K
18 T M3.K=TABUL(M3,LE,K,20,80,10)
19 R M3T=.0567/.0373/.0252/.0171/.0118/.0083/.006
20 L MAT3.KL=(P3.K) (1-M3.K)/20
21 C P4=P41
22 R P41=4E7
23 A D4.KL=P4.K*M4.K
24 T M4.K=TABUL(M4,LE,K,20,80,10)
25 L MAT4.KL=(P4.K) (1-M4.K)/20
NOTE
NOTE DEATH RATE SUBSECTOR
NOTE
17 A D.K=D1.JK+D2.JK+D3.JK+D4.JK
18 S CDR.K=1000*D.K/POP.K
19 L LE.K=LEHIM*IMP.K*LMSIS.K*LMC.K
20 C LEH=28
21 A LMP.K=TABUL(LMP,IPC,K/SPPC,K,0,5,1)
22 T LMPH=0.1/2.1/3.1/5.1/4.4
23 A HSAPCT=0.20/50/50/140/175/200/220/230
24 T HSAPCT=0.20/50/50/140/175/200/220/230
25 C EHSPC.K=SMOOTH(HSAPCT,HSID)
26 A LMSIS.K=CLIP(LMSIS2,K,LMSIS1,K,TIME,K,IPHS)
27 T LMSIS1.K=TABUL(LMSIS1T,EHSPC,K,0,100,20)
28 C LMSIS2.K=TABUL(LMSIS2T,EHSPC,K,0,100,20)
29 A LMSIS2T=1/1.4/1.6/1.8/1.95/2.0
30 T FPU.K=TABUL(FPUT,POP,K,0,16E9,2E9)
31 C FPUT=0.2/4.5/.58/.65/.72/.78/.80
32 A CH1.K=TABUL(CH1T,IOPC,K,0,1600,200)
33 T CH1T=5/.05/-1/-1.58/-0.84/.05/1.1/1.5/2
34 A LMC.K=1-(CH1.K*FPU.K)
35 T LMP.K=TABUL(LMPT,PPOLX,K,0,100,10)
36 C LMPT=1.0/.99/.97/.95/.93/.91/.89/.87/.85/.83/.81/.79/.77/.75/.73/.71/.69/1
NOTE
NOTE BIRTH RATE SUBSECTOR
NOTE
30 B.KL=CLIP(D.K,(TF.K*P2.K*0.5/RLT),TIME,K,PE)
31 C RL=30
32 C FCT=4000
33 C CHR.K=1000*B.JK/POP.K
34 A TP.K=MIR(MF.K,(MF.K*(1-FCE.K)+DTF.K*FCE.K))
35 C MF.K=MFPU*FM.K
36 A FM.K=TABUL(FMT,LE,K,0,80,10)
37 T FMT=0.1/4.6/8.7/9.1/1.05/1.1
38 A UTR.K=CDCT*K*CMLE.K
39 C CMLE.K=TABUL(CMLET,PLE,K,0,80,10)
40 T CMLET=3/2.1/1.6/1.4/1.3/1.2/1.1/1.05/1

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37 A PLE.K=DLINF3(LE,K,LPD)
38 C LPD=20
39 A DCPS.K=CLIP(2.0,DCPSN*FRSN,K*SPSN,K,TIME,K,2POT)
40 C 2POT=4000
41 C DCPSN=4
42 A FSN.K=TABUL(FSNT,IOPC,K,0,800,200)
43 T FSNH=1.25/1.9/1.8/75
44 A DIOPC.K=DLINF3(IOPC,K,SAD)
45 C SAD=20
46 A FRSN.K=TABUL(FRSNT,FIS,K,-2,.2,.1)
47 T FRSNT=5/6/7/.85/1
48 H FRSN=.82
49 A FIS.K=(IOPC.K-AIOPC.K)/AIOPC.K
50 C AIOPC.K=SMOOTH(IOPC,K,IAT)
51 C IAT=7
52 A HFC.K=(HFP.K/DTF.K)-1
53 A FCE.K=CLIP(1.0,(TABUL(FCT,FCFPC,K,0,3,.5)),TIME,K,FCST)
54 C FCST=4000
55 T FCE=75/.85/.9/9.5/9.6/99/1
56 A FCPC.K=DLINF3(FCAPC,K,HSID)
57 A FCAPC.K=FSAPC.K*SPPC.K
58 A FSAPC.K=TABUL(FSAPCT,HFC,K,0,10,2)
59 T FSAPCT=0/.005/.015/.025/.03/.035
NOTE
NOTE EXOGENOUS INPUTS TO THE POPULATION SECTOR
NOTE
NOTE INDUSTRIAL OUTPUT
NOTE
A IO.K=CLIP(IO2.K,IO1.K,TIME,K,LT)
C LT=500
A IO1.K=CLIP(IO12.K,IO11.K,TIME,K,LT2)
C LT2=500
A IO11.K=.7E11*EXP(TIME,K*.037)
A IO12.K=POP.K*CIO
C CIO=100
A IO2.K=.7E11*EXP(LT*.037)
A IOPC.K=IO.K/POP.K
NOTE
NOTE INDEX OF PERSISTENT POLLUTION
NOTE
A PPOLX.K=1+RAMP(PG,PT)
C PG=8
C PT=10
NOTE
NOTE SERVICE OUTPUT
NOTE
A SO.K=CLIP(SO2.K,SO1.K,TIME,K,LT)
C SO1.K=CLIP(SO12.K,SO11.K,TIME,K,LT2)
A SO11.K=1.5E11*EXP(TIME,K*.030)
A SO12.K=POP.K*CSO
C CSO=150
A SO2.K=1.5E11*EXP(LT*.030)
A SOPC.K=SO.K/POP.K
NOTE
NOTE FOOD
NOTE
A F.K=CLIP(F2.K,F1.K,TIME,K,LT)
A F1.K=CLIP(F12.K,F11.K,TIME,K,LT2)
A F11.K=4E11*EXP(TIME,K*.020)
A F12.K=POP.K*CFOOD
C CFOOD=250
A F2.K=4E11*EXP(LT*.020)
A FPC.K=FT.K/POP.K
C SFFC=230
NOTE
NOTE CONTROL CARS
NOTE
C IPHS=40
C DT=1
C LENTH=200
C FLTPR=10
C FRTPR=0
A POP1.K=P1.K/POP.K
A POP2.K=P2.K/POP.K
A POP3.K=P3.K/POP.K
A POP4.K=P4.K/POP.K
PLOT SOPC=5,IOPC=1,FPC=F(0,1000)/POP*P(0,16E9)/
X CHR=B,CDR=D(0,50)/LE=L(0,80)/FPU=U(0,1)/FCE=C(.5,1)
RUN STANDARD

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