```
%MACRO MSLT(DATA=,S=,VAR=,NS=,COV=,NC=,STRATA=,PSU=,WGT=,LOI=,BEG=,END=,SIMSIZE=);
 %DO MA=1 %TO &NC;
   %LET COV&MA=%SCAN(&COV,&MA,' ');

   PROC SORT DATA=&DATA;
     BY &&COV&MA;
   RUN;

   DATA TEMP&MA(KEEP=ID &&COV&MA);
     SET &DATA;
     BY &&COV&MA;
     IF FIRST.&&COV&MA;
   RUN;

   DATA _NULL_;
     SET TEMP&MA END=FINAL;
     N+1;
     IF FINAL THEN CALL SYMPUT("LC&MA", N);  *** LC: LEVEL OF COVARIATES 1,2,... ***;
   RUN;
 %END;

  PROC SORT DATA=&DATA;
    BY ID AGE;
  RUN;

  DATA SEM;
    SET &DATA;
    BY ID AGE;
    IF FIRST.ID THEN DO;
      PREVAGE=.;
      PREVST=.;
      PREVWGT=.;
    END;
    OUTPUT;
    PREVAGE=AGE;
    PREVST=&VAR;
    PREVWGT=&WGT;
    RETAIN PREVAGE PREVST PREVWGT;
  RUN;

  DATA SEM1(DROP=MIDAGE AGE &VAR &WGT J PREVAGE PREVST PREVWGT RENAME=(NAGE=AGE HS=&VAR NWGT=&WG
    SET SEM;
    BY ID;
    IF FIRST.ID THEN DO;
      HS=&VAR;
      NAGE=AGE;
      NWGT=&WGT;
      OUTPUT;
    END;
    ELSE DO;
      IF &VAR NE &NS THEN DO;
        *IF MOD(GAP,2)=1 THEN MIDAGE=PREVAGE+FLOOR(GAP/2);
        *ELSE MIDAGE=PREVAGE+CEIL(GAP*RANUNI(ROUND(DATETIME())))-1;
```

```
      MIDAGE=PREVAGE+CEIL((AGE-PREVAGE)*RANUNI(ROUND(DATETIME())))-1;

      DO J=PREVAGE+1 TO AGE;
        IF J<=MIDAGE THEN DO;
          HS=PREVST;
          NWGT=PREVWGT+ROUND((&WGT-PREVWGT)/(AGE-PREVAGE));
        END;
        ELSE DO;
          HS=&VAR;
          NWGT=&WGT;
        END;
        NAGE=J;
        PREVWGT=NWGT;
        OUTPUT;
      END;
    END;
    ELSE DO;
      IF PREVAGE+1<AGE THEN DO;
        DO J=PREVAGE+1 TO AGE;
          IF J NE AGE THEN DO;
            HS=PREVST;
            NWGT=PREVWGT+ROUND((&WGT-PREVWGT)/(AGE-PREVAGE));
          END;
          ELSE DO;
            HS=&VAR;
            NWGT=&WGT;
          END;
          NAGE=J;
          PREVWGT=NWGT;
          OUTPUT;
        END;
      END;
      ELSE IF PREVAGE+1=AGE THEN DO;
        HS=&VAR;
        NAGE=AGE;
        NWGT=&WGT;
        OUTPUT;
      END;
    END;
  END;
RUN;
```

This and the above blocks convert the input data set, which lists one interview observation per line of record, into the interval or person-year format. For surveys with interview gaps wider than 1 year, this section also randomly assigns the occurrence of event, if there is one, to any of intermittent years. For example, if there are 4 years between the 1996 and 2000 interviews, then the event is assumed to occur in 1997, 1998 or 1999, each with a probability of 1/3.

```
DATA PRSNYR(RENAME=(&VAR=ENDST));
  SET SEM1;
  BY ID;

  AGE=LAG(AGE);
  BEGST=LAG(&VAR);
  &WGT=LAG(&WGT);
  IF FIRST.ID THEN DO;
    AGE=0;
    BEGST=0;
    DELETE;
```

```
  END;
RUN;

DATA SEM2;
  SET SEM1;
  BY ID;
  IF FIRST.ID;
RUN;

PROC FREQ DATA=SEM2 NOPRINT;
  TABLE AGE*&VAR/OUT=HSPREV OUTPCT;
  WEIGHT &WGT;
  WHERE 65<=AGE<=85;
RUN;

DATA HSPREV2;
  SET HSPREV;
  PCT=PCT_ROW/100;
  KEEP AGE &VAR PCT;
RUN;

PROC SORT;
  BY AGE &VAR;
RUN;

DATA HP;
  DO AGE=65 TO 85;
    DO &VAR=1 TO &NS-1;
      PCT=0;
      OUTPUT;
    END;
  END;
RUN;

PROC SORT;
  BY AGE &VAR;
RUN;

DATA HSPREV3;
  UPDATE HP HSPREV2;
  BY AGE &VAR;
RUN;

DATA _NULL_;
  IF &NC>1 THEN CALL SYMPUT("CP",TRANSLATE("&COV",'*',' '));
RUN;

DATA COVPREV;
  SET SEM2;
  BY ID;
  IF 65<=AGE<=74 THEN AGE=65;
  ELSE IF 75<=AGE<=84 THEN AGE=75;
  ELSE IF AGE>=85 THEN AGE=85;
```

```
RUN;

PROC SORT;
  BY AGE &VAR;
RUN;

PROC FREQ DATA=COVPREV NOPRINT;
  BY AGE &VAR;
  %IF &NC>1 %THEN %DO;
    TABLE &CP / OUT=PREVEST OUTPCT;
  %END;
  %ELSE %DO;
    TABLE &COV / OUT=PREVEST OUTPCT;
  %END;
  WEIGHT &WGT;
RUN;

DATA PREVEST2;
  SET PREVEST;
  PCT=PERCENT/100;
  KEEP AGE &VAR &COV PCT;
RUN;

%MACRO MODEL_logit;
  DATA SEST;
    %DO MA=1 %TO &NC;
      DO &&COV&MA=1 TO &&LC&MA;
    %END;
        DO BEGST=1 TO &NS-1;
          DO AGE=&BEG TO &END;
            CONTROL=1;
            OUTPUT;
          END;
        END;
    %DO MA=1 %TO &NC;
      END;
    %END;
  RUN;

  DATA MODEL;
    SET SEST PRSNYR;
    IF CONTROL=. THEN CONTROL=0;
    KEEP ID &COV AGE BEGST ENDST &WGT CONTROL;
  RUN;

  PROC SORT;
    BY BEGST;
  RUN;

  PROC LOGISTIC DATA=MODEL DESCENDING NOPRINT;
    BY BEGST;
    CLASS &COV;
    MODEL ENDST=AGE &COV / L=GLOGIT;
```

```
    WEIGHT &WGT;
    OUTPUT OUT=PROBS PREDPROBS=I;
  RUN;

  DATA TRANPR;
    SET PROBS(WHERE=(CONTROL=1));
    %DO U=1 %TO &NS;
      P&U=IP_&U;
    %END;
    KEEP &COV AGE BEGST P1-P&NS;
  RUN;

  PROC SORT;
    BY &COV AGE BEGST;
  RUN;
%MEND;

%MODEL_logit;

DATA BSLE;
  STATE=.;
RUN;

DATA PLY4;
  COL1=.;
RUN;

%DO A=65 %TO 85 %BY 10;
  DATA PLY3;
    COL1=.;
  RUN;

  DATA TRANPR2;
    SET TRANPR(WHERE=(AGE>=&A)) END=FINAL;
    N+1;
    IF FINAL THEN CALL SYMPUT('NT', N);
  RUN;

  %DO B=1 %TO &NS-1;
    DATA PREVEST3;
      SET PREVEST2(WHERE=(AGE=&A & &VAR=&B)) END=FINAL;
      N+1;
      IF FINAL THEN CALL SYMPUT('NR', N);
    RUN;

    PROC IML;
      USE HSPREV3;
      READ ALL VAR {PCT} INTO HSPREV WHERE (AGE=&A);
      TIMES=ROUND(&SIMSIZE*HSPREV[&B,]);
      PLY=J(TIMES,100,0);        *** RECORD HEALTH AT EACH AGE FOR EACH PERSON ***;

      *** PREVALENCE OF COVARIATES BY AGE & HEALTH STATES ***;
      USE PREVEST3;
```

```
    READ ALL VAR {&COV PCT} INTO PCNT;  *** &NR ROWS AND &NC+1 COLUMNS ***;

    *** IF USE %MODEL_LOGIT TO GET THE TRANSITION PROBABILITIES ***;
    USE TRANPR2;
    READ ALL VAR {&COV %DO U=1 %TO &NS; P&U %END;} INTO SRVP;  *** &NT ROWS AND &NS COLUMNS

    *** SIMULATION ***;
    DO T=1 TO TIMES;
      PLY[T,1]=100000000*&A+10000000*&B+T;
      PLY[T,2]=&A;

      ***S: RANDONLY SELECTED COVARIATE SET ***;
      S=PCNT[RANTBL(ROUND(DATETIME())%DO W=1 %TO &NR; ,PCNT[&W,&NC+1] %END;),1:&NC];
      PLY[T,3:3+&NC-1]=S;

      *** FIND THE CORRESPONDING TRANSITION MATRIX FOR THIS PERSON ***;
      %DO J=1 %TO &NT;
        IF SRVP[&J,1:&NC]=S THEN SRVP2=SRVP2//SRVP[&J,&NC+1:NCOL(SRVP)];
      %END;

      IHS=&B;
      PLY[T,3+&NC]=IHS;

      DO K=1 TO NROW(SRVP2)/(&NS-1);
        %DO U=1 %TO &NS;
          P&U=SRVP2[(&NS-1)*(K-1)+IHS,&U];
        %END;
        HS=RANTBL(ROUND(DATETIME())%DO Z=1 %TO &NS;,P&Z %END;);
        IF 3+&NC+K<=100 THEN PLY[T,3+&NC+K]=HS;

        IHS=HS;

        IF HS=&NS | (&NS-1)*K=NROW(SRVP2) THEN DO;
          PLY[T,3+&NC+K]=&NS;
          GOTO ENDA;
        END;
      END;

      ENDA:
      FREE SRVP2;
    END;

    CREATE PLY2 FROM PLY;
    APPEND FROM PLY;
    CLOSE PLY2;
  QUIT;

  DATA PLY3;
    SET PLY3 PLY2;
    IF COL1 NE .;
  RUN;
%END;
```

```
  DATA PLY4;
    SET PLY4 PLY3;
    IF COL1 NE .;
  RUN;
%END;

DATA PHSB(KEEP=ID &COV IAGE AGE &VAR);
  SET PLY4;
  LENGTH &COV AGE &VAR 3;
  ARRAY COL{100};
  ID=COL1;
  IAGE=COL2;
  %DO MA=1 %TO &NC;
    %LET COV&MA=%SCAN(&COV,&MA,' ');
    &&COV&MA=COL%EVAL(2+&MA);
  %END;
  DO I=&NC+3 TO 100;
    AGE=IAGE+(I-&NC-3);
    &VAR=COL{I};
    IF &VAR NE 0 THEN OUTPUT;
  END;
RUN;

PROC SORT DATA=PHSB OUT=COMAREC;
  BY IAGE ID AGE;
RUN;

DATA MSP&VAR.2;
  SET COMAREC;
  BY IAGE ID;
  RENAME &VAR=ENDST;
  BEGST=LAG(&VAR);
  BAGE=LAG(AGE);
  IF FIRST.ID THEN DO;
    BEGST=0;
    BAGE=0;
    DELETE;
  END;
RUN;

DATA PHSC(KEEP=ID IAGE BH DAGE);
  SET MSP&VAR.2;
  BY IAGE ID;

  RETAIN BH;
  IF FIRST.ID THEN BH=BEGST;

  IF LAST.ID THEN DO;
    DAGE=AGE;
    OUTPUT;
  END;
RUN;
```

```
DATA MSP&VAR.3;
  MERGE MSP&VAR.2(RENAME=(AGE=EAGE)) PHSC;
  BY IAGE ID;

  IF FIRST.ID THEN DO;
    YRLVED=0;
    YRINAH=0;
    YRINAD=0;
  END;

  IF BEGST=1 THEN DO;
    IF ENDST IN (1,&NS) THEN AH=1;
    ELSE IF ENDST=2 THEN DO;
      AH=0.5;
      AD=0.5;
    END;
  END;
  ELSE IF BEGST=2 THEN DO;
    IF ENDST IN (2,&NS) THEN AD=1;
    ELSE IF ENDST=1 THEN DO;
      AH=0.5;
      AD=0.5;
    END;
  END;

  YRLVED+1;
  YRINAH+AH;
  YRINAD+AD;

  IF LAST.ID THEN OUTPUT;
RUN;

PROC MEANS DATA=MSP&VAR.3 MEAN P25 P50 P75 NOPRINT;
  CLASS IAGE &COV BH;
  VAR YRLVED YRINAH YRINAD;
  OUTPUT OUT=MEDLE MEAN=TLE ALE DLE
                   P25=TLY25 ALY25 DLY25
                   P50=TLY50 ALY50 DLY50
                   P75=TLY75 ALY75 DLY75;
RUN;

DATA MEDLE2;
  SET MEDLE;
  IF BH=. THEN BH=0;
  RENAME BH=STATE;
  FORMAT TLE ALE DLE 5.1;
  DROP _TYPE_;
RUN;

DATA S.BSLE&S;
  SET BSLE MEDLE2;
  IF STATE NE .;
RUN;
```

```
  PROC SORT;
    BY &COV IAGE STATE;
  RUN;
%MEND;
```