*Supplement File for Addressing Parameter Uncertainty in a Health Policy Simulation Model Using Monte Carlo Sensitivity Methods*

**Contents**

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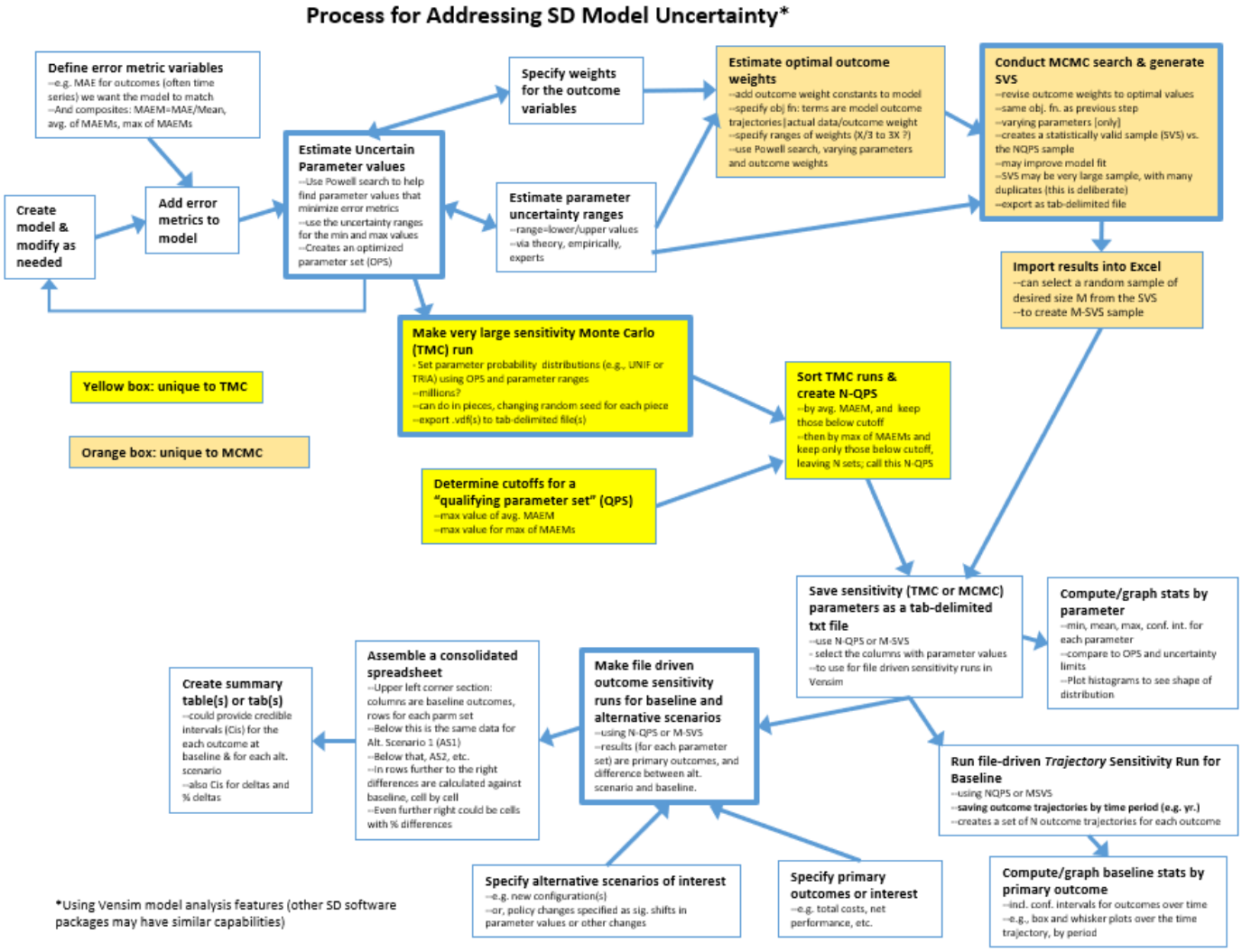
**Supplement Part S1:** Complete process for addressing simulation model uncertainty




**Supplement Part S2**: SSTATS Vensim Macro (Provided by John Sterman; developed by Tom Fiddaman)

```
:MACRO: SSTATS(historical,simulated:R2,MAE,MAE over Mean,MAPE,RMSE,MSE,Um,Us,Uc,Count\
             )
SSTATS = residuals
        ~       simulated
        ~       Note that first argument (historical) must be data;
                second argument (simulation) can be data or a simulation,
                but if it is data, it will not be checked for existence.
                This could easily by changed by modifying the code below.
                Arguments following the : are outputs. They generate model
                variables that are visible in the listing on the Variable
                tab of the control panel, and can be used in equations
                and custom graphs/tables/reports. However, they cannot be
                made visible on diagrams.
        |

R2 = r*r
        ~       Dimensionless
        ~       Correlation coefficient squared
        |

MAE=
        ZIDZ(sum ae,Count)
        ~       simulated
```

```
        ~       mean absolute error
        |

MAE over Mean=
        ZIDZ(MAE,meanx)
        ~       Dimensionless
        ~       Mean Absolute Error as a fraction of the mean of the data
        |

MAPE = ZIDZ(Sum APE,Count)
        ~       Dimensionless
        ~       Mean Absolute Percent Error is reported as fraction rather than
                percentage (x100) for consistency with other the other metrics
        |

RMSE = SQRT(MSE)
        ~       simulated
        ~       Root Mean Square Error
        |

MSE = dif mea + dif var + dif cov
        ~       simulated*simulated
        ~       Mean Square Error. The addition of the three components
        |

Um = ZIDZ(dif mea,MSE)
        ~       Dimensionless
        ~       Bias inequality proportion
        |

Us = ZIDZ(dif var,MSE)
        ~       Dimensionless
        ~       Variance inequality proportion
        |

Uc = ZIDZ(dif cov,MSE)
        ~       Dimensionless
        ~       Covariance inequality proportion
        |

Count = INTEG(pick/dt,0)
        ~       Dimensionless
        ~       Counter for # of points
        |

residuals=
        IF THEN ELSE(pick, Yi - Xi, :NA:)
        ~       simulated
        ~       Errors
        |

r = MIN(1,ZIDZ(Mxy-(meanx*MeanY),Sx*Sy))
        ~       Dimensionless
        ~       Correlation coefficient. Calculated through the 'hand computation' formula.
                   Sterman (1984) pg. 63
        |

sum ae= INTEG (
        ABS(Xi - Yi)/dt,
                0)
        ~       simulated
        ~       Sum of Absolute Errors
        |

meanx = ZIDZ(Sum Xi,Count)
        ~       simulated
        ~       Mean of x (sum x)/n
        |

Sum APE = INTEG(ABS(ZIDZ(Xi-Yi,Yi))/dt,0)
        ~       Dimensionless
        ~       Sum of Absolute Percent Errors is reported as fraction rather than
                percentage (x100) for consistency with other the other metrics
        |
```

```
dif mea = (meanx-MeanY)*(meanx-MeanY)
        ~       simulated*simulated
        ~       Difference of Means (bias)
        |

dif var = (Sx-Sy)*(Sx-Sy)
        ~       simulated*simulated
        ~       Difference of variances
        |

dif cov = 2*Sx*Sy*(1-r)
        ~       simulated*simulated
        ~       Difference of covariances
        |

pick= IF THEN ELSE(Y = :NA: :OR: X = :NA:, 0, 1)
        ~       Dimensionless
        ~       Takes a value of one for every data point available, assuming the data are \
                available at intervals of Interval between the Start Time and End Time.
        |

dt = TIME STEP$
        ~       Time$
        ~               |

Yi = pick*Y
        ~       simulated
        ~       Sampled simulated variable
        |

Xi = pick*X
        ~       simulated
        ~       The historic data series
        |

Mxy = ZIDZ(SumXY,Count)
        ~       simulated*simulated
        ~       Mean of x*y (sum x*y)/n
        |

MeanY = ZIDZ(Sum Yi,Count)
        ~       simulated
        ~       Mean of y (sum y)/n
        |

Sx = SQRT(MAX(0,MX2-(meanx*meanx)))
        ~       simulated
        ~       Standard Deviation of x. Calculated using the 'hand computation'
                formula to calculate the standard deviation without prior knowledge of
                the mean.  Sterman (1984), pg. 64  MAX prevents spurious numerical
                problems from roundoff
        |

Sy = SQRT(MAX(0,MY2-(MeanY*MeanY)))
        ~       simulated
        ~       Standard Deviation of y. Calculated using the 'hand computation'
                formula to calculate the standard deviation without prior knowledge of
                the mean.  Sterman (1984), pg. 64
        |

Sum Xi = INTEG(Xi/dt,0)
        ~       simulated
        ~       Sum of x's (simulated)
        |

Y = simulated
        ~       simulated
        ~       The simulated data series
        |

X :RAW: := historical
        ~       simulated
        ~       The historical data input
        |
```

```
SumXY = INTEG(Xi*Yi/dt,0)
        ~       simulated*simulated
        ~       Sum of x*y
        |

Sum Yi = INTEG(Yi/dt,0)
        ~       simulated
        ~       Sum of y
        |

MX2=
         ZIDZ(SumX2,Count)
        ~       simulated*simulated
        ~       Mean of x^2
        |

MY2 = ZIDZ(SumY2,Count)
        ~       simulated*simulated
        ~       Mean of y^2
        |

SumX2 = INTEG(Xi*Xi/dt,0)
        ~       simulated*simulated
        ~       Sum of x^2
        |

SumY2 = INTEG(Yi*Yi/dt,0)
        ~       simulated*simulated
        ~       Sum of y^2
        |

:END OF MACRO:
```

*Supplement File for Addressing Parameter Uncertainty in a Health Policy Simulation Model Using Monte Carlo Sensitivity Methods*

## **Supplement Part S3**: Vensim Code to Specify Error Variables

```
********************************************************
        .Stats
********************************************************~
                Summary Statistics
        |
Residuals addicted frac H users = SSTATS(Addicted frac of H users hist,Addicted frac of H users\
                :R2 Addicted frac H users,MAE Addicted frac H users,MAEM Addicted frac H users,MAPE Addicted frac H users\
                ,RMSE Addicted frac H users,MSE Addicted frac H users,Um Addicted frac H users,Us Addicted frac H users\
                ,Uc Addicted frac H users,Count Addicted frac H users)
        ~       dmnl
        ~               |
Residuals addicted frac PO abusers = SSTATS(Addicted frac of PO abusers hist,Addicted frac of PO abusers\
                :R2 Addicted frac PO abusers,MAE Addicted frac PO Abusers,MAEM Addicted frac PO Abusers\
                ,MAPE Addicted frac PO Abusers,RMSE Addicted frac PO Abusers,MSE Addicted frac PO Abusers\
                ,Um Addicted frac PO Abusers,Us Addicted frac PO Abusers,Uc Addicted frac PO Abusers\
                ,Count Addicted frac PO Abusers)
        ~       dmnl
        ~               |
Residuals addicted H users = SSTATS(Addicted H users hist,Addicted H users:R2 Addicted H users\
                ,MAE Addicted H users,MAEM Addicted H users,MAPE Addicted H users,RMSE Addicted H users\
                ,MSE Addicted H users,Um Addicted H users,Us Addicted H users,Uc Addicted H users,Count Addicted H users\
                )
        ~       popn
        ~               |
Residuals addicted PO abusers = SSTATS(Addicted PO abusers hist,Addicted PO abusers:R2 Addicted PO abusers\
                ,MAE Addicted PO Abusers,MAEM Addicted PO Abusers,MAPE Addicted PO Abusers,RMSE Addicted PO Abusers\
                ,MSE Addicted PO Abusers,Um Addicted PO Abusers,Us Addicted PO Abusers,Uc Addicted PO Abusers\
                ,Count Addicted PO Abusers)
        ~       popn
        ~               |
Residuals addicts treated = SSTATS(Opioid addicts treated hist,Opioid addicts treated\
                :       R2 addicts treated,MAE addicts treated,MAEM addicts treated,MAPE addicts treated\
                ,RMSE addicts treated,MSE addicts treated       ,Um addicts treated,Us addicts treated\
                ,Uc addicts treated,Count addicts treated)
        ~       popn/Year
        ~               |
Residuals frac H initiates also PO = SSTATS(Frac of H initiates started with PO abuse hist\
                ,Frac of H initiates started with PO abuse:R2 frac H initiates also PO,MAE frac H initiates also PO\
                ,MAEM frac H initiates also PO,MAPE frac H initiates also PO,RMSE frac H initiates also PO\
                ,MSE frac H initiates also PO,Um frac H initiates also PO,Us frac H initiates also PO\
                ,Uc frac H initiates also PO,Count frac H initiates also PO)
        ~       dmnl
        ~               |
Residuals frac H users also PO = SSTATS(Frac of H users also PO abusers hist     \
                ,Frac of H users also PO abusers:R2 frac H users also PO,MAE frac H users also PO,MAEM frac H users also PO\
                ,MAPE frac H users also PO,RMSE frac H users also PO     ,MSE frac H users also PO\
                ,Um frac H users also PO,Us frac H users also PO,Uc frac H users also PO,Count frac H users also PO\
                )
        ~       dmnl
        ~               |
Residuals H initiates = SSTATS(H initiates hist,H initiates:R2 H initiates,MAE H initiates\
                ,MAEM H initiates,MAPE H initiates,RMSE H initiates,MSE H initiates,Um H initiates,\
                Us H initiates,Uc H initiates,Count H initiates)
        ~       popn/Year
        ~               |
Residuals H users = SSTATS(H users hist,H users:R2 H users,MAE H users,MAEM H users,MAPE H users\
                ,RMSE H users,MSE H users,Um H users,Us H users,Uc H users,Count H users)
        ~       popn
        ~               |
```

```
Residuals OD deaths from illicits = SSTATS(Illicit opioid OD deaths hist,Illicit opioid OD deaths\
        :       R2 OD deaths from illicits,MAE OD deaths from illicits,MAEM OD deaths from illicits\
        ,MAPE OD deaths from illicits       ,RMSE OD deaths from illicits,MSE OD deaths from illicits\
        ,Um OD deaths from illicits,Us OD deaths from illicits,Uc OD deaths from illicits,Count OD deaths from illicits\
        )
    ~   popn/Year
    ~       |
Residuals OD deaths from PO = SSTATS(OD deaths from authentic PO hist,OD deaths from authentic PO\
        :       R2 OD deaths from PO,MAE OD deaths from PO,MAEM OD deaths from PO,MAPE OD deaths from PO\
            ,RMSE OD deaths from PO,MSE OD deaths from PO,Um OD deaths from PO,Us OD deaths from PO\
        ,Uc OD deaths from PO,Count OD deaths from PO)
    ~   popn/Year
    ~       |
Residuals OD deaths total = SSTATS(Total opioid OD deaths hist,Total opioid OD deaths\
        :       R2 OD deaths total,MAE OD deaths total,MAEM OD deaths total,MAPE OD deaths total\
            ,RMSE OD deaths total,MSE OD deaths total,Um OD deaths total,Us OD deaths total\
        ,Uc OD deaths total,Count OD deaths total)
    ~   popn/Year
    ~       |
Residuals PO abuse initiates = SSTATS(PO abuse initiates hist,PO abuse initiates:R2 PO abuse initiates\
        ,MAE PO abuse initiates,MAEM PO abuse initiates,MAPE PO abuse initiates,RMSE PO abuse initiates\
        ,MSE PO abuse initiates,Um PO abuse initiates,Us PO abuse initiates,Uc PO abuse initiates\
        ,Count PO abuse initiates)
    ~   popn/Year
    ~       |
Residuals PO abusers = SSTATS(PO abusers hist,PO abusers:R2 PO abusers,MAE PO Abusers\
        ,MAEM PO Abusers,MAPE PO Abusers,RMSE PO Abusers,MSE PO Abusers,Um PO Abusers,Us PO Abusers\
        ,Uc PO Abusers,Count PO Abusers)
    ~   popn
    ~       |
Residuals street price PO = SSTATS(Avg street price PO hist     ,Avg street price PO\
        :R2 street price PO,MAE street price PO,MAEM street price PO,MAPE street price PO      \
        ,RMSE street price PO,MSE street price PO       ,Um street price PO,Us street price PO\
        ,Uc street price PO,Count street price PO)
    ~   dollars/mgME
    ~       |
Simple avg of all MAEM = (MAEM Addicted frac H users + MAEM Addicted frac PO Abusers \
        + MAEM Addicted H users  + MAEM Addicted PO Abusers  + MAEM frac H initiates also PO\
        + MAEM frac H users also PO + MAEM H initiates + MAEM H users + MAEM OD deaths from illicits\
        + MAEM OD deaths from PO  + MAEM OD deaths total + MAEM PO abuse initiates + MAEM PO Abusers\
        + MAEM street price PO) / 14
    ~   dmnl
    ~       |
Total count across all data = Count Addicted frac H users + Count Addicted frac PO Abusers\
        + Count Addicted H users + Count Addicted PO Abusers  + Count frac H initiates also PO\
        + Count frac H users also PO + Count H initiates + Count H users + Count OD deaths from illicits\
        + Count OD deaths from PO + Count OD deaths total + Count PO abuse initiates + Count PO Abusers\
        + Count street price PO
    ~   dmnl
    ~       |
Weighted avg of all MAEM = ZIDZ( MAEM Addicted frac H users*Count Addicted frac H users\
        + MAEM Addicted frac PO Abusers*Count Addicted frac PO Abusers + MAEM Addicted H users\
        *Count Addicted H users + MAEM Addicted PO Abusers*Count Addicted PO Abusers      \
        + MAEM frac H initiates also PO*Count frac H initiates also PO + MAEM frac H users also PO\
        *Count frac H users also PO + MAEM H initiates*Count H initiates + MAEM H users*Count H users\
        + MAEM OD deaths from illicits*Count OD deaths from illicits+ MAEM OD deaths from PO\
        *Count OD deaths from PO + MAEM OD deaths total*Count OD deaths total + MAEM PO abuse initiates\
        *Count PO abuse initiates  + MAEM PO Abusers*Count PO Abusers+ MAEM street price PO\
        *Count street price PO, Total count across all data)
    ~   dmnl
    ~       |
```

**Supplement Part S4**: Sample .voc and .vpd files for the "Estimate Uncertain Parameters" Step

Opioid2u.voc

```
:OPTIMIZER=Powell
:SENSITIVITY=Off
:MULTIPLE_START=Off
:RANDOM_NUMBER=Default
:OUTPUT_LEVEL=On
:TRACE=Off
:MAX_ITERATIONS=1000
:RESTART_MAX=0
:PASS_LIMIT=2
:FRACTIONAL_TOLERANCE=0.0003
:TOLERANCE_MULTIPLIER=21
:ABSOLUTE_TOLERANCE=1
:SCALE_ABSOLUTE=1
:VECTOR_POINTS=25
:MCINITMETHOD=0
:MCPAYOFFTYPE=0
:MCRECORD=0
:MCSCHEDULE=0
:MCLIMIT=0
:MCBURNIN=0
:MCNCHAINS=2
:MCOUTLIER=0.05
:MCGAMMA=1
:MCEPSILON=0.01
:MCDELTA=0.0001
:MCJUMP=0.05
:MCUPDATEPAIRS=2
:MCXOVER=0.2
:MCTEMP=1
:MCFTEMP=1
:MCCOOLING=1000
.45<=Addicted frac of H users initial=0.65<=0.65
0.09<=Addicted frac of PONHA initial=0.123<=0.16
0.01<=Addicted H user OD death rate initial=0.01<=0.02
0.05<=Addicted H user quit rate initial=0.138<=0.15
0.02<=Addicted PONHA move to heroin rate initial=0.021<=0.035
0.003<=Addicted PONHA OD death rate initial=0.0059<=0.007
0.08<=Addicted PONHA quit rate initial=0.149<=0.15
1.2<=Avg street price initial=1.6<=1.6
0.04<=Casual H user become addicted rate=0.096<=0.1
0.002<=Casual H user OD death rate initial=0.0081<=0.01
0.15<=Casual H user quit rate=.192<=0.3
0.01<=Casual PONHA become addicted rate initial=0.02<=0.03
0.002<=Casual PONHA move to heroin rate initial=0.0038<=0.01
0.0004<=Casual PONHA OD death rate initial=0.0004<=0.001
0.1<=Casual PONHA quit rate initial=0.209<=0.3
2000<=Consumption mgs MME per addicted PO abuser per month initial=3200<=3200
200<=Consumption mgs MME per casual PO abuser per month=200<=400
0.3<=Diverted frac of script gms MME initial=0.576<=0.7
0.5<=Exponent for med user addiction rate from script strength=.655<=1.5
1.5<=Fent boost of H user OD deaths 2017=3<=3
0.05<=Frac reduction H price per doubling of supply experience=0.45<=0.8
0.65<=Frequency of use multiplier for treated PO addicts=0.65<=0.8
0.03<=H users attract initiates rate=0.062<=0.1
0.0007<=HNPOU frac of adult popn initial=0.0009<=0.0009
0.0004<=HPPOU frac of adult popn initial=0.0005<=0.0005
0.05<=HPPOU drop PO use rate=0.091<=0.15
5<=Inflow of disguised Fent pill apparent mgs per adult 2016=26.1<=60
0.1<=PO abuse initiate rate initial=0.142<=0.25
```

2<=Quit multiplier for treated PO addicts=2<=3.5
0.1<=Reltv noninjecting nonoral frac for casual PONHA vs addicted=0.19<=0.5
2<=Reltv PONHA OD risk from disguised Fent pills=5.19<=20
0<=Slope for addicted H user quits from overdoses=0<=0.2
0.1<=Slope for addicted PONHA move to heroin from street price=.92<=2
0.05<=Slope for addicted PONHA quits from OD deaths=.2<=1
-1<=Slope for addicted PONHA quits from street supply=-0.28<=-0.05
-2<=Slope for avg street price from street supply=-0.61<=-0.2
0<=Slope for casual H user quits from overdoses=0<=0.2
0.1<=Slope for casual PONHA move to heroin from street price=.78<=1.5
0.1<=Slope for casual PONHA quits from OD deaths=0.28<=1
-1<=Slope for casual PONHA quits from street supply=-0.3<=-0.05
-0.7<=Slope for diversion of scripts from street supply=-0.38<=-0.1
-0.4<=Slope for H direct initiation from overdoses=-0.2<=0
0.1<=Slope for PONHA addiction rate from street supply=0.53<=1
-0.9<=Slope for PONHA initiation from OD deaths=-0.69<=-0.1
1.5<=Slope for PONHA initiation from street supply=2.43<=4
.08<=Street supply coverage adequate=.13<=.18
0.15<=Street supply coverage initial=0.15<=0.35
0.25<=Time to perceive OD deaths=.25<=2.25

## Opioid2u.vpd

*C
PO abusers|PO abusers hist/2
*C
Addicted PO abusers|Addicted PO abusers hist/2
*C
H users|H users hist/10
*C
Addicted H users|Addicted H users hist/10
*C
PO abuse initiates|PO abuse initiates hist/10
*C
H initiates|H initiates hist/20
*C
Frac of H initiates started with PO abuse|Frac of H initiates started with PO abuse hist/10000000
*C
Avg street price PO|Avg street price PO hist/5000000
*C
Total opioid OD deaths|Total opioid OD deaths hist/1000
*C
OD deaths from authentic PO|OD deaths from authentic PO hist/1000
*C
Illicit opioid OD deaths|Illicit opioid OD deaths hist/1000
*C
Frac of H users also PO abusers|Frac of H users also PO abusers hist/20000000

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**Supplement Part S5**: Demo .vsc and .lst files for the Sensitivity MC run steps

## Opioid2U_MCrunTRI.vsc (for finding QPS candidates)

1000000,M,6592493,,0
Addicted frac of H users initial=RANDOM_TRIANGULAR(0.6,0.7,0.6,0.65,0.7)
Addicted frac of PONHA initial=RANDOM_TRIANGULAR(0.1,0.15,0.1,0.123,0.15)
Addicted H user OD death rate initial=RANDOM_TRIANGULAR(0.005,0.015,0.005,0.010,0.015)
Addicted H user quit rate initial=RANDOM_TRIANGULAR(0.07,0.21,0.07,0.138,0.21)
Addicted PONHA move to heroin rate initial=RANDOM_TRIANGULAR(0.01,0.03,0.01,0.21,0.03)
Addicted PONHA OD death rate initial=RANDOM_TRIANGULAR(0.004,0.007,0.004,0.0059,0.007)
Addicted PONHA quit rate initial=RANDOM_TRIANGULAR(0.08,0.22,0.08,0.149,0.22)
Avg street price initial=RANDOM_TRIANGULAR(1.4,1.8,1.4,1.6,1.8)
Casual H user become addicted rate=RANDOM_TRIANGULAR(0.05,0.15,0.05,0.096,0.15)
Casual H user OD death rate initial=RANDOM_TRIANGULAR(0.004,0.012,0.004,0.0081,0.012)
Casual H user quit rate initial=RANDOM_TRIANGULAR(0.13,0.25,0.13,0.192,0.25)
Casual PONHA become addicted rate initial=RANDOM_TRIANGULAR(0.01,0.03,0.01,0.02,0.03)
Casual PONHA move to heroin rate initial=RANDOM_TRIANGULAR(0.0025,0.005,0.0025,0.0038,0.005)
Casual PONHA OD death rate initial=RANDOM_TRIANGULAR(0.0002,0.0006,0.0002,0.0004,0.0006)
Casual PONHA quit rate initial=RANDOM_TRIANGULAR(0.1,0.3,0.1,0.209,0.3)
Consumption mgs ME per addicted PO abuser per month initial=RANDOM_TRIANGULAR(2000,5000,2000,3200,5000)
Consumption mgs ME per casual PO NMU per month=RANDOM_TRIANGULAR(100,300,100,200,300)
Diverted frac of script gms ME initial=RANDOM_TRIANGULAR(0.4,0.65,0.4,0.576,0.65)
Exponent for med user addiction rate from script strength=RANDOM_TRIANGULAR(0.3,0.9,0.3,0.655,0.9)
Fent boost of H user OD deaths 2017=RANDOM_TRIANGULAR(2,4,2,3.1,4)
Frequency of use multiplier for treated PO addicts=RANDOM_TRIANGULAR(0.55,0.85,0.55,0.65,0.85)
H users attract initiates rate initial=RANDOM_TRIANGULAR(0.04,0.1,0.04,0.073,0.1)
HNPOU frac of adult popn initial=RANDOM_TRIANGULAR(0.0007,0.0011,0.0007,0.0009,0.0011)
HPPOU drop PO use rate=RANDOM_TRIANGULAR(0.05,0.13,0.05,0.091,0.13)
HPPOU frac of adult popn initial=RANDOM_TRIANGULAR(0.0004,0.0006,0.0004,0.0005,0.0006)
Inflow of disguised Fent pill apparent mgs ME per adult 2016=RANDOM_TRIANGULAR(10,40,10,25,40)
PO abuse initiate rate initial=RANDOM_TRIANGULAR(0.05,0.25,0.05,0.142,0.25)
Quit multiplier for treated PO addicts=RANDOM_TRIANGULAR(1.5,3.5,1.5,2.0,3.5)
Reltv noninjecting nonoral frac for casual PONHA vs addicted=RANDOM_TRIANGULAR(0.1,0.3,0.1,0.19,0.3)
Reltv PONHA OD risk from disguised Fent pills=RANDOM_TRIANGULAR(3,7,3,5.19,7)
Slope for addicted H user quits from overdoses=RANDOM_TRIANGULAR(0,0.2,0,0,0.2)
Slope for addicted PONHA move to heroin from street price=RANDOM_TRIANGULAR(0.5,1.4,0.5,0.92,1.4)
Slope for addicted PONHA quits from overdoses=RANDOM_TRIANGULAR(0.1,0.4,0.1,0.25,0.4)
Slope for addicted PONHA quits from street supply=RANDOM_TRIANGULAR(-0.45,-0.15,-0.45,-0.28,-0.15)
Slope for avg street price from street supply=RANDOM_TRIANGULAR(-0.9,-0.3,-0.9,-0.61,-0.3)
Slope for casual H user quits from overdoses=RANDOM_TRIANGULAR(0,0.2,0,0,0.2)
Slope for casual PONHA move to heroin from street price=RANDOM_TRIANGULAR(0.4,1.2,0.4,0.78,1.2)
Slope for casual PONHA quits from overdoses=RANDOM_TRIANGULAR(0.1,0.6,0.1,0.35,0.6)
Slope for casual PONHA quits from street supply=RANDOM_TRIANGULAR(-0.45,-0.15,-0.45,-0.3,-0.15)
Slope for diversion of scripts from street supply=RANDOM_TRIANGULAR(-0.6,-0.2,-0.6,-0.38,-0.2)
Slope for H direct initiation from overdoses=RANDOM_TRIANGULAR(-0.4,0,-0.4,-0.2,0)
Slope for PONHA addiction rate from street supply=RANDOM_TRIANGULAR(0.25,0.8,0.25,0.53,0.8)
Slope for PONHA initiation from overdoses=RANDOM_TRIANGULAR(-1.2,-0.3,-1.2,-0.75,-0.3)
Slope for PONHA initiation from street supply=RANDOM_TRIANGULAR(1.2,3.6,1.2,2.43,3.6)
Street supply coverage adequate=RANDOM_TRIANGULAR(0.08,0.18,0.08,0.13,0.18)
Street supply coverage initial=RANDOM_TRIANGULAR(0.1,0.2,0.1,0.15,0.2)
Time to perceive overdoses=RANDOM_TRIANGULAR(0.125,1,0.125,0.25,1)

## Opioid2UwithMax.lst (for the sensitivity runs to find the QPS)

```
Addicted frac of H users initial
Addicted frac of PONHA initial
Addicted H user OD death rate initial
Addicted H user quit rate initial
Addicted PONHA move to heroin rate initial
Addicted PONHA OD death rate initial
Addicted PONHA quit rate initial
Avg street price initial
```

```
Casual H user become addicted rate
Casual H user OD death rate initial
Casual H user quit rate initial
Casual PONHA become addicted rate initial
Casual PONHA move to heroin rate initial
Casual PONHA OD death rate initial
Casual PONHA quit rate initial
Consumption mgs ME per addicted PO abuser per month initial
Consumption mgs ME per casual PO NMU per month
Diverted frac of script gms ME initial
Exponent for med user addiction rate from script strength
Fent boost of H user OD deaths 2017
Frequency of use multiplier for treated PO addicts
H users attract initiates rate initial
HNPOU frac of adult popn initial
HPPOU drop PO use rate
HPPOU frac of adult popn initial
Inflow of disguised Fent pill apparent mgs ME per adult 2016
MAEM Addicted H users
MAEM Addicted PO Abusers
MAEM frac H initiates also PO
MAEM frac H users also PO
MAEM H initiates
MAEM H users
MAEM OD deaths from illicits
MAEM OD deaths from PO
MAEM OD deaths total
MAEM PO abuse initiates
MAEM PO Abusers
MAEM street price PO
maxofMAEMs
PO abuse initiate rate initial
Quit multiplier for treated PO addicts
Reltv noninjecting nonoral frac for casual PONHA vs addicted
Reltv PONHA OD risk from disguised Fent pills
Simple avg of all MAEM
Slope for addicted H user quits from overdoses
Slope for addicted PONHA move to heroin from street price
Slope for addicted PONHA quits from overdoses
Slope for addicted PONHA quits from street supply
Slope for avg street price from street supply
Slope for casual H user quits from overdoses
Slope for casual PONHA move to heroin from street price
Slope for casual PONHA quits from overdoses
Slope for casual PONHA quits from street supply
Slope for diversion of scripts from street supply
Slope for H direct initiation from overdoses
Slope for PONHA addiction rate from street supply
Slope for PONHA initiation from overdoses
Slope for PONHA initiation from street supply
Street supply coverage adequate
Street supply coverage initial
Time to perceive overdoses
Weighted avg of all MAEM
```

runbyfile.vsc (for running file-driven sens runs, where the .txt file is the QPS file)

```
200,F,1234,2uQPS.txt,0
```

Opioid2Uforscenarios.lst (for running the baseline QPS trajectories and policy comparisons)

```
Opioid overdoses seen in ED
Total opioid addicts
Total opioid OD deaths
```