Appendix 3
Sample Sessions of NFXP programs

This appendix contains sample runs of the following programs:

1. STORDAT.GPR
2. SETUP.GPR
3. NFXP.GPR

RUN STORDAT.GPR;
STORDAT.GRF: creates bus data file BDT.DAT for use by NFXP.GPR
Version 7, November, 1995. By John Rust, University of Wisconsin
This program prepares bus data from the Madison Metro Bus Co
for estimation using the nested fixed point algorithm. The program
reads the raw bus data files (*FMT) producing an output file BDT.DAT
with fixed point dimension ‘n’ selected by the user. BDT.DAT consists
of either 3 or 4 columns of binary data, depending on the options
chosen below. The second column, dtx, is the state variable x(t)
which specifies a mileage range which contains the bus’s true odometer
reading during month t. The first column, dtc, is the dependent
variable i(t) which equals 1 if the bus engine was replaced in month t
when the bus’s state was x(t), and 0 otherwise. The third column, mil,
is the monthly mileage variable mil=[x(t)-x(t-1)] giving the change
in the bus odometer reading during month t. You also have the option
to include the lagged dependent variable i(t-1) in the data set. This
allows you to conduct a specification test of the assumption that un-
observed state variables are serially independent given {x(t)}.
pres any key to continue
Depending on how coarsely you discretize the state space (i.e.
how large the mileage ranges are), the maximum value of [x(t)-x(t-1)]
will take on values in the range 0,...,5. Let pi=Pr{x(t)=x(t-1)+i},
i=0,...,5, be the multinomial probabilities estimates of the discrete
mileage distribution. These values are automatically supplied to NFXP.
A maximum of 5 values are allowed. Note: the discretization procedure
produces a slight discrepancy between the continuous and discretized
mileage values. For example, even though the maximum monthly mileage
is less than 10,000, the discretized values may show a value of ‘2’
for a small percentage of cases. This is due to upward rounding needed
to convert the raw data to the discrete mileage ranges.
enter desired fixed point dimension ‘n’ (175 maximum) 90
If your computer has less than 330K of available memory, NFXP is likely
to run out of memory for large n. To avoid this, you can set the ‘low
memory flag’, lm=1 at the cost of longer computation time for the fixed
point. Enter lm=1 for ‘low memory option’, or lm=0 for ‘high speed option’.
Enter (1,0) 0
enter upper bound odometer value (recommend 450,000) 450000
implied size of discrete mileage range 5000
include lagged replacement choice i(t-1) in data set? (1=yes, 0=no) 1
specify drive to store output (with adjacent colon, e.g. C:; D:, etc): G:
enter bus groups to be included in BDT.DAT (1=include, 0=leave out)
Bus group 1: 1983 Grumman model 870 buses (15 buses total)
(1=include, 0=leave out) 1
minimum, maximum, mean monthly mileage 0 6780 4150
begin discretizing data ... minimum, maximum discretized mileage 0 2
current estimates of transition probabilities
p0  0.1972
p1  0.7889
p2  0.01389
p3  0

cumulative estimates of transition probabilities
p0  0.1972
p1  0.7889
p2  0.01389
p3  0

total rows written, cumulative, current  360  360

Bus group 2: 1981 Chance RT-50 buses (4 buses total)
(1=include, 0=leave out) 1
minimum, maximum, mean monthly mileage  600  7287  3106

begin discretizing data ...
minimum, maximum discretized mileage  0  2

current estimates of transition probabilities
p0  0.3906
p1  0.599
p2  0.01042
p3  0

cumulative estimates of transition probabilities
p0  0.2645
p1  0.7228
p2  0.01268
p3  0

total rows written, cumulative, current  552  192

Bus group 3: 1979 GMC model t6h203 buses (48 buses total)
(1=include, 0=leave out) 1
minimum, maximum, mean monthly mileage  0  10761  3506

begin discretizing data ...
minimum, maximum discretized mileage  0  2

current estimates of transition probabilities
p0  0.3071
p1  0.6827
p2  0.01027
p3  0

cumulative estimates of transition probabilities
p0  0.301
p1  0.6884
p2  0.01061
p3  0

total rows written, cumulative, current  3864  3312

Bus group 4: 1975 GMC model a5308 buses (37 buses total)
(1=include, 0=leave out) 1
minimum, maximum, mean monthly mileage  0  11625  3099

begin discretizing data ...
minimum, maximum discretized mileage  0  2

current estimates of transition probabilities
p0  0.3919
p1  0.5953
p2  0.01281
p3  0
cumulative estimates of transition probabilities

\[ \begin{array}{c}
p_0 & 0.3488 \\
p_1 & 0.6394 \\
p_2 & 0.01177 \\
p_3 & 0 \\
\end{array} \]

- total rows written, cumulative, current: 8156, 4292
- Bus group 5: 1972 GMC model a5308 buses (18 buses total)
- Bus group 6: 1972 GMC model a4523 buses (18 buses total)
- Bus group 7: 1974 GMC model a4523 buses (10 buses total)
- Bus group 8: 1974 GMC model a5308 buses (12 buses total)

- Maximum mileage value \([x(t) - x(t-1)]\) is: 2
- Estimated probabilities:
  - 0.3488
  - 0.6394
  - 0.01177

STORDAT.GPR successfully created data file g bd
t
- Ready to run SETUP.GPR to set parameters for NFXP algorithm

RUN SETUP.GPR;

SETUP.GPR: initialization routine for nested fixed point algorithm

- Version 7, November 1995. By John Rust, University of Wisconsin

Model selection:
- Fixed point dimension: 90
- Estimating partial likelihood function \( P(i|x) \)
- Maximum value of \([x(t) - x(t-1)]\) in BDT.DAT data set: 2
- Beta parameter fixed at \( \beta = 0.9999 \)
- Cost function \( c(x) = 0.01c1x \)

Objective function parameters are: \( \text{TR} \) \( c1 \)

- Total dimension of parameter vector \( q = 2 \)
- Are these the settings you want? (1 = yes, 0 = no) 0

Enter 1 if you wish to estimate partial likelihood \( P(i|x) \)
Enter 2 if you wish to estimate full likelihood \( P(i|x)p(x|x(-1),i(-1)) \)
- Do you want to estimate discount factor ‘\( \beta \)’? (1 = yes, 0 = no) 0

Beta fixed: Enter value 0 < \( \beta \) < 1 .9998

Enter desired number of parameters for cost function \( c(x) \): 1, 2, 3, 4: 1

Enter specification code for cost function or 0 to show menu 0
- Code 1: \( c(x) = c1x \)
- Code 2: \( c(x) = 0.01c1x \)
- Code 3: \( c(x) = c1x^{0.5} \)
- Code 4: \( c(x) = c1/(91-x) \)
- Code 5: \( c(x) = 0.01c1x^{0.5} \)

Enter desired code 2
- \( c(x) = 0.01c1x \)

Objective function parameters are: \( \text{TR} \) \( c1 \)

- Total dimension of parameter vector \( q = 2 \)

Tolerance settings for NFXP algorithm:
- Jacobian update factor \( d \), 0 < \( d \) < 1 for fixed point algorithm
- \( d = 1 \) corresponds to Newton-Kantorovich method
- \( d = 0 \) corresponds to Stirling’s method
- \( d = 0.5 \) corresponds to Werner’s method

Jacobian update factor \( d \), 0 < \( d \) < 1

\[ 0.5 \]
# rows of data set BDT.DAT read per pass 500
maximum number of 1f evaluations 200
maximum stepsize 20
maximum linesearch iterations 6
minimum linesearch iterations 0
maximum contraction iterations 100
minimum contraction iterations 2
maximum number of NK iterations 10
switch to step size 1 when grad*direc < 1E-12
lf ratio to terminate line search 0.999
initial stepsize 1
outer convergence tolerance 1E-12
inner convergence tolerance 1E-05
low memory option? (1=on, 0=off) 0
print value function? (1=yes, 0=no) 0
print hessian matrix? (1=yes, 0=no) 1
are these settings OK? (1=yes, 0=no) 1
enter 1 to input starting values for q or 0 to use current values
Parameter vector q (enter letter ’l’ to leave as is)
TR C1
11 3
are current values OK? (1=yes, 0=no) 1
absolute parameter bounds (enter ’l’ to leave as is)
TR C1
100 100
are these values OK? (1=yes, 0=no) 1
Set minimum contraction steps if q changes less than (’l’ to leave as is)
TR C1
0.1 0.1
are these values OK? (1=yes, 0=no) 1
Set maximum contraction steps if q changes by more than (’l’ to leave as is)
TR C1
1 1
are these values OK? (1=yes, 0=no) 1
parameter vector q
TR C1
11 3
absolute parameter bounds for parameter space
TR C1
100 100
set cstp=mincstp if all components of q are within
TR C1
0.1 0.1
set cstp=maxcstp if any component of q exceeds
TR C1
1 1
transition probability estimates 0.34882295 0.63940657
beta value 0<bet<1 : 0.9998
are these the values you want? (1=yes, 0=no) 1
SETUP complete: ready to run NFXP.GPR
To change future model settings without re-compiling NFXP procedures contained in SETUP.GPR, run CHGMOD.GPR instead of SETUP.GPR.
>RUN NFXP.GPR;
NFXP.GPR: nested fixed point maximum likelihood algorithm
Version 7, November, 1995. By John Rust, University of Wisconsin
enter run identification number
cost function c(x) = 0.001*c1*x
objective function parameters are: TR C1
total dimension of parameter vector q= 2
fixed point dimension n= 90
beta value, 0 < bet < 1 0.9998
transition probabilities 0.348823 0.639407 0.0117705
jacobian index, d (0 < d < 1) 0.5
maximum number of lf evaluations 200
maximum number of NK steps 10
maximum stepsize 20
maximum linesearch iterations 6
minimum linesearch iterations 0
maximum contraction iterations 100
minimum contraction iterations 2
switch to step size 1 when grad*direc< 1E-12
lf ratio to terminate line search 0.999
initial stepsize 1
outer convergence tolerance 1E-12
inner convergence tolerance 1E-05
low memory option, lm (l=on, 0=off) 0
print value function? (l=yes, 0=no) 0
print hessian matrix? (l=yes, 0=no) 1
are these settings OK? (l=yes, 0=no) 1
initial number of contraction steps 50
use last fixed point (0=no, 1=yes) 0
set cstp=macst when (q-q0) > : 1 1
set cstp=minst when (q-q0) < : 0.1 0.1
absolute parameter bounds 100 100
initial parameter estimates 11 3
TR C1
number of rows read per pass 500
number of rows of data 8156
begin contraction iterations
0.209747 0.98569 50
begin Newton-Kantorovich iterations at time 242
838.588 0.00733162
4.47739 0.000159361
0.0789791 8.64004E-08
6.55561E-05 2.44249E-14
Fixed point time 774
return to outer BHHH algorithm
Row 1
6.93089 -13.0676
Row 2
-13.0676 27.1761
Row 1
1.54485 0.74284
Row 2
0.74284 0.393992
Parameter estimates for cost function c(x) = 0.001*c1*x
Parameter Estimates direction gradient t-stat
begin contraction iterations

begin Newton-Kantorovich iterations at time 286

Fixed point time 692

return to outer BHHH algorithm

likelihood ss= 0

begin contraction iterations

begin Newton-Kantorovich iterations at time 330

Fixed point time 610

return to outer BHHH algorithm

likelihood ss= 0

begin contraction iterations

begin Newton-Kantorovich iterations at time 11

Fixed point time 164

return to outer BHHH algorithm

Row 1

7.02838  -13.2488

Row 2

-13.2488  27.5908

Parameter estimates for cost function c(x)=.001*c1*x

Parameter Estimates direction gradient t-stat

1  TR  9.750016  0.000000  0.000000  7.959857

2  C1  2.633410  0.000000 -0.000000  4.259643

log likelihood ss=0  -300.257 grad*direct 1.91134E-14

Iteration 13 evaluation number 26

Cpu time to cumulate moment matrix 555

NFXP converged: total execution time 21564

execution summary in matrix ‘qsav’: rename if you want it saved