Tutorial for MCTABLE

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Purpose: MCTABLE simultes the life course of an individual in a multistate setting. The intensities of state transitions can be duration-specific. An age-specific (positive or negative) cost can be attached to each state. Thus, we have a multistate cost functional life table, or MCTABLE. For example, the program can be used to describe the net contributions of an individual who sometimes works and pays taxes, can be unemployed and receives compensation, or is outside the labor force and receives legislated benefits. A more detailed description of MCTABLE one can find in **MCTABLE-Program Description**.

This is a "toy" illustration of how to run the program, in practice. The values used are not to be taken as examples for other uses.

Note: Below, we have enclosed in bracets "**[**" and "**]**" instructions that are not relevant for the concrete example we use in the illustration, but they may come up in other settings.

1. Installation

MCTABLE is a C++ program and runs under Windows. It takes about 1.6 MB of disk space.

Step 1.1. Copy the files *mctable.exe, bds52f.dll, cw3230.dll* and *owl52f.dll* into the directory of your choice, for example *c:\mctable*. These files take up about 1.4 MB. *mctable.exe* makes simulations and the dll-files are needed to run.

Step 1.2. Copy the file *params.dat* into the same directory. This is not necessary in general, but we assume it has been done to facilitate going through the tutorial. It is a text file like the other input files, which contains all necessary settings for a program run. For an example, see **File 1** of **Appendix 1**.

2. Setting up the Point Forecast Files

Step 2.1. Copy the files *tr1.dat*, *tr2.dat* and *tr3.dat* into *c:\mctable* (they should be in the same directory *mctable.exe* and *params.dat* are). They contain duration dependent transition intensities for a "**General model"** of relative risk between states by age.

In this tutorial it is assumed that **"Number of states"** is equal to 3, the "**Lowest age"** is 17 and the "**Highest age"** is 20. For an example, see **Files 2, 3** and **4** of **Appendix 1**.

[For an example of files containing duration-independent transition intensities, and transition intensities for the "**Proportional hazards model"** of duration dependence, see **Files 7**, **8** and **9** of **Appendix 2**.**]**

Step 2.2. Copy the file *mor.dat* into *c:\mctable*. It contains the mortality rates by age. In this tutorial it is assumed that all the states have the same mortality rates. For an example, see **File 5** of **Appendix 1**. This can be circumvented as explained in **MCTABLE-Program**

Description.

(Files containing the mortality rates have the same structure in duration-dependent and independent cases).

[3. Setting up the Betas and R:S

In this tutorial "**General model"** of duration dependence is used, so "**Betas"** and "**R:S"** are not relevant.

Step 3.1. This step is used, if "**Proportional hazard model"** of duration dependence and then "**Cox model"** are chosen. For an example of input file structure, see $\beta - file$ **structure** in **Appendix 2**.

Step 3.2. This step is used, if the "**Proportional hazard model"** of duration dependence and then "**General proportional hazards model"** are chosen. For an example of input file, see $rs - file$ **structure** in **Appendix 2**.]

4. Setting up the Cost Functionals

Copy the file *cost.dat* into *c:\mctable*. It contains cost values by age, state and simulation round ("**Random cost functionals"**). **"Number of simulation rounds"** is equal to 1000 in this example. For an example, see **File 6** of **Appendix 1**.

(For example of file containting fixed cost values for all simulation rounds ("**Fixed cost functionals"**) see **File 10** of **Appendix 2**).

It is not necessary to set the "**Cost Functionals"** if cost information is not desired.

5. Running MCTABLE

Step 5.1. Start MCTABLE by clicking on the MCTABLE icon. The program is menu driven. To exit the program click on "**Exit"**.

Step 5.2. Click on "**Optional parameters"**. Choose the "**Specification file"**, by first writing the file name *params.dat* into the space provided on the right of the text "**Read the parameter values and file names from specification file"** (see **File 1**), and then click on the check box. If desired, values used by MCTABLE can be saved in the same menu.

Now, the program is ready to run. If you do not use a specification file, you may enter the necessary input values by going through the following steps. Similarly, you may edit any values obtained from the specification file.

Step 5.3. Click on "**Parameters and point forecasts"**. Go through all submenu items.

Step 5.4. Click on "**Duration Parameters"**. Click on "**Total/state duration"**. We use "**Total**

duration in state" in this tutorial. Click on "**Form of duration dependence"** and check that "**General model"** is choosen.

Step 5.5. Click on "**Cost Functionals/Cost Parameters"** and check that "**Random age-specific costs"** is chosen.

Step 5.6. Click again "**Optional parameters"** and then on "**Seed"**. We use 1 in this tutorial, but you can set any other positive value you like.

Step 5.7. Click on "**Results/Duration dependent results"**. You will see a dialog window with self-explanatory options to obtain output.

If "**Starting age**" is higher than the "**Lowest age"** and "**General model"** is chosen, then the user should specify the starting durations that will be used in simulation. By default MCTABLE assumes that this is a vector of zeros, but other values can be loaded from the a file. For an example, see **File 11** of **Appendix 2**.

If "**Condition on a person being in a particular state**" is chosen and the age and the state are different from the starting age and state, then only simulation rounds, in which an individual's path goes via this particular state in the given age, are used in simulation.

6. Output Data

There are tree types of output files: (1) distribution of time spent in a state, (2) cost values for all states and rounds, (3) log-file with the parameters, the settings, the input data file names of the current run and the names of output files. (For more details about log-file see **MCTABLE – Program Description**) .

Output data with distribution of time spent in a state. This file for the age 20 and the state 1 looks like this:

```
3.000
3.000
...
2.313
```

Here the number of rows is equal to the number of simulation rounds, in which an individual's path goes via the particular state in the fixed age given as a condition (equal to 902 in this example), and the values are the times spent in the selected state and age range.

Output data with cost values for all states and rounds. This file looks like this:

```
-0.693  0.000  0.000
-0.668  0.000  0.000
...
-0.588  0.698  0.000
```

Here the number of rows is equal to the number of simulation rounds, in which an individual's path goes via the particular state in the fixed age given as a condition (equal to 902 in this example), the number of columns is equal to the "**Number of states**" (is equal to 3 in this

example), and the values are the total costs by age, in each state.

One can use these data to obtain statistical descriptions such as expectation and variance. See **Appendix** in **MCTABLE – Program Description**.

Appendix 1.

The following parameters and settings are used in this tutorial:

- Number of simulation rounds: 1000
- Number of states: 3
- Lowest age: 17
- Highest age: 20
- Names for states:
    - 1 – state1
    - 2 – state2
    - 3 – state3
- Total duration in state
- General model of duration dependence
- Random age-specific cost
- Sratring age: 18
- Starting state: state1
- Starting durations are read from file: start_duration.dat (see **File 11** in **Appendix 2**)
- Condition on person being
    - in state1
    - in age 19

File 1. params.dat
This file contains settings, which are needed to run MCTABLE program. The values in the file will be as follows:

Row number	Values
1	`1000 3 17 20`
2	`1 2 2 2`
3	`mor.dat`
4	`tr1.dat`
5	`mor.dat`
6	`tr2.dat`
7	`mor.dat`
8	`tr3.dat`
9	`-`
10	`-`
11	`cost.dat`
12	`state1`
13	`state2`
14	`state3`

The meaning of the parameters on each line is as follows:

Line 1. The values in the 1st row are used for "**Parameters and point forecast/Parameters"**:
- The first value is "**Number of simulation rounds"**,
- The second value is "**Number of states"**,
- The third value is "**Lowest age"**,

- The fourth value is "**Highest age".**

Line 2. The values in the 2nd row:

- The first value defines "**Duration Parameters/Total/state duration"**:
  - 1 means "**Total duration in state"**,
  - 2 means "**Duration in current state"**.
- The second value defines "**Duration Parameters/Form of duration dependence"**:
  - 1 means **"Proportional hazard"**,
  - 2 means "**General model"**.
- The third value defines "**Cost Functionals/Coast parameters"**:
  - 1 means "**Fixed age-specific costs"**,
  - 2 means "**Random age-specific costs"**.
- The last value defines "**Results"**:
  - 1 means "**Duration-independent results",**
  - 2 means "**Duration-dependent results".**

Lines 3 – 8. The names of the input data files given in "P**arameters and point forecast/Point forecasts**" follow. The odd rows refer to "**Mortality**" and the even rows refer to "**Transition"**. In general there are *(number of states)*2* rows.

Line 9. The 9th row has the name of the input data file given in "P**arameters and point forecast/Betas and r:s/Betas**". It is used if "**Duration Parameters/Form of duration dependence/Proportional hazard**" is choosen, otherwise, like in this example, the line is equal to "-".

Line 10. The 10th row has the name of the input data file given in "P**arameters and point forecast/Betas and r:s/R:S**". It is used if "**Duration Parameters/Form of duration dependence/Proportional hazard**" is chosen, otherwise, like in this example, the line is equal to "-".

Line 11. The 11th row has the name of the input data file given in "P**arameters and point forecast/Cost Functionals/Cost**". It is used if the calculation of costs has been requested, otherwise the line is equal to "-".

Lines 12 – 14. The next 3 rows give the names of the states from "P**arameters and point forecast/Names of states**".

It is not necessary to use the file *params.dat*. All parameters can be given interactively by going through the menus. However, we recommend that you use the specification file, in order to minimize the possibility of typos, and then go through the menus to check that everything is as intended.

File 2. tr1.dat

```
( 17.0) F 0.1 0 0 0
( 17.5) F 0.1 0 0 0
( 18.0) F 0.1 0.1 0 0
( 18.5) F 0.1 0.1 0 0
( 19.0) F 0.1 0.1 0.1 0
( 19.5) F 0.1 0.1 0.1 0
( 20.0) F 0.1 0.1 0.1 0.1
( 17.0) F 0 0 0 0
( 17.5) F 0 0 0 0
( 18.0) F 0 0 0 0
( 18.5) F 0 0 0 0
( 19.0) F 0 0 0 0
( 19.5) F 0 0 0 0
( 20.0) F 0 0 0 0
```

The file must begin with "("; then comes age from the lowest to the highest in 0.5 year steps, here from 17.0 to 20.0; then comes ")"; then letter F and values of transition intensity corresponding to duration spent in the state 1. The third column in the file corresponds to the duration < 1 year, the fourth column in the file corresponds to the duration in $[1,2)$, and so on. Values in lines 1-7 are transition intensities from state 1 to state 2, and values in lines 8-14 are the transition intensities from state 1 to state 3.

File 3. tr2.dat

```
( 17.0) F 0.05 0 0 0
( 17.5) F 0.05 0 0 0
( 18.0) F 0.05 0.05 0 0
( 18.5) F 0.05 0.05 0 0
( 19.0) F 0.05 0.05 0.05 0
( 19.5) F 0.05 0.05 0.05 0
( 20.0) F 0.05 0.05 0.05 0.05
( 17.0) F 0.1 0 0 0
( 17.5) F 0.1 0 0 0
( 18.0) F 0.1 0.1 0 0
( 18.5) F 0.1 0.1 0 0
( 19.0) F 0.1 0.1 0.1 0
( 19.5) F 0.1 0.1 0.1 0
( 20.0) F 0.1 0.1 0.1 0.1
```

The file has the same structure as *tr1.dat*, but applies to state 2.

File 4. tr3.dat

```
( 17.0) F 0.05 0 0 0
( 17.5) F 0.05 0 0 0
( 18.0) F 0.05 0.05 0 0
( 18.5) F 0.05 0.05 0 0
( 19.0) F 0.05 0.05 0.05 0
( 19.5) F 0.05 0.05 0.05 0
( 20.0) F 0.05 0.05 0.05 0.05
( 17.0) F 0.1 0 0 0
( 17.5) F 0.1 0 0 0
( 18.0) F 0.1 0.1 0 0
( 18.5) F 0.1 0.1 0 0
( 19.0) F 0.1 0.1 0.1 0
( 19.5) F 0.1 0.1 0.1 0
( 20.0) F 0.1 0.1 0.1 0.1
```

The file has the same structure as *tr1.dat*, but applies to state 3.

File 5. mor.dat

```
( 17.0)  F  0
( 17.5)  F  0
( 18.0)  F  0
( 18.5)  F  0
( 19.0)  F  0
( 19.5)  F  0
( 20.0)  F  0
```

Note: In other applications mortality probabilities don't have to be 0!

File 6. cost.dat

```
(17)  F  -0.221    1.000    0.525
(18)  F  -0.251    1.000    0.493
(19)  F  -0.284    1.000    0.422
(17)  F  -0.239    1.000    0.497
(18)  F  -0.190    1.000    0.487
(19)  F  -0.248    0.964    0.521
......
(17)  F  -0.264    1.023    0.531
(18)  F  -0.192    1.016    0.546
(19)  F  -0.271    0.951    0.477
```

The file must begin with "("; then comes age from the lowest to the (highest – 1) in 1.0 year steps, here from 17.0 to 19.0; then comes ")"; then letter F and values of cost functional by each state. The number of rows is equal to (*highest age – lowest age*)*(*simulation rounds*). So there is possibility to have different cost values for the same ages during different simulation rounds. Values for the first state are in the third column in the file, values for the second state are in the fourth column in the file, and so on.

Appendix 2.

File 7. tri1.dat

```
( 17.0) F 0.1 0
( 17.5) F 0.1 0
( 18.0) F 0.1 0
( 18.5) F 0.1 0
( 19.0) F 0.1 0
( 19.5) F 0.1 0
( 20.0) F 0.1 0
```

The file must begin with "("; then comes age from the lowest to the highest in 0.5 year steps, here from 17.0 to 20.0; then comes ")"; then letter F and the first value after latter F is the transition intensity from state 1 to state 2, and the second – from state 1 to state 3 and so on.

File 8. tri2.dat

```
( 17.0) F 0.05 0.1
( 17.5) F 0.05 0.1
( 18.0) F 0.05 0.1
( 18.5) F 0.05 0.1
( 19.0) F 0.05 0.1
( 19.5) F 0.05 0.1
( 20.0) F 0.05 0.1
```

The file has the same structure as *tri1.dat*, but applies to state 2.

File 9. tri3.dat

```
( 17.0) F 0.05 0.1
( 17.5) F 0.05 0.1
( 18.0) F 0.05 0.1
( 18.5) F 0.05 0.1
( 19.0) F 0.05 0.1
( 19.5) F 0.05 0.1
( 20.0) F 0.05 0.1
```

The file has the same structure as *tri1.dat*, but applies to state 3.

File 10. fixedCost.dat

```
(17) F -0.25 1 -0.5
(18) F -0.25 1 -0.5
(19) F -0.25 1 -0.5
```

File 11. start_duration.dat

```
() D 1 0 0
```

The file must begin with "()" and letter D, then come positive values of starting durations, the first value for the starting duration in the first state, the second value for the starting duration in the second state, and so on.

β – *file* structure

File consists of *J* blocks:

- leftmost corresponds to starting state 1
- the next corresponds to state 2

  ...
- last block corresponds to state *J*.

Within each block there are *J* columns:

- leftmost corresponds to receiving state 1
- the next corresponds to receiving state 2

  ...
- last corresponds to receiving state *J*.

In each column there are *J* rows:

- first gives β for duration in state 1
- the next gives β for duration in state 2

  ...
- last gives β for duration in state *J*.

rs – *file* structure

File consists of *J* blocks:

- leftmost corresponds to starting state 1
- the next corresponds to state 2

  ...
- last block corresponds to state *J*.

Within each block there are *J* columns:

- leftmost corresponds to state 1
- the next corresponds to state 2

  ...
- last corresponds to state *J*.

In each column there are (*Highest age* - *Lowest age*) rows:

- first gives values for general proportional hazards model in *Lowest age*
- the next gives values for general proportional hazards model in *Lowest age* + 1

  ...
- last gives values for general proportional hazards model in *Highest age*.

Instruction for copying a section of a pdf-file into a text file

When a *pdf-file* is open, choose the **Text Select Tool** by clicking on the icon that looks something like this (depending on the version of Acrobat Reader you are using):  ; paint the text to be selected (e.g., the 8 values for males in **File 1**); go to **Edit/Copy**. Switch to text file (e.g., *params.dat*); press CTRL+V or go to **Edit/Paste**.