SmoothPlans (version 4.0.5)

Revision History
7 January 2011 Created by Volpe Center

The SmoothPlans program applies moving average smoothing to travel plans by time of day. It can be used if a set of travel plans has a "lumpy" time of day distribution. For example, if the plans were derived directly from travel surveys, there might be a bias towards certain departure times, for example, 7:15, 7:20, 7:30, rather than 7:14, 7:18, 7:27.

In a trip-table based TRANSIMS implementation, an alternative to SmoothPlans is to use SmoothData on the diurnal distributions that are used to generate the initial TRANSIMS trips.

SmoothPlans is a console-based program that runs in a command window on either Windows or Linux. The command syntax is:

```
SmoothPlans [-flag] [control_file]
```

The control_file is the file name of an ASCII file that contains the control strings expected by the program. The control_file is optional. If a file name is not provided, the program will prompt the user to enter a file name. The flag parameters are also optional. Any combination of the following flag parameters can be included on the command line:

-Q[uiet] = execute without screen messages
-H[elp] = show program syntax and control keys
-K[eyCheck] = list unrecognized control file keys
-P[ause] = pause before exiting
-N[oPause] = never pause before exiting
-B[atch] = execute in batch processing mode

The program automatically creates a printout file based on the control_file name. If the file name includes an extension, the extension is removed and ".prn" is added. The printout file will be created in the current working directory and will overwrite an existing file with the same name.

Known Gaps in this Document

1. Treatment of input link_delay file
2. Link_List parameter
3. Usage of New_Link_Summary_File

Control File Examples

EXAMPLE 1 SMOOTH DEPARTURE TIME

```
PLAN_FILE               TimePlanARough
NEW_PLAN_FILE           TimePlanASmooth

MAXIMUM_TIME_SHIFT      15
TIME_INCREMENT          1

NUMBER_OF_ITERATIONS    10
```

```
SMOOTH_GROUP_SIZE              9
PERCENT_MOVED_FORWARD          20.0
PERCENT_MOVED_BACKWARD         20.0
SMOOTHPLANS_REPORT_1    TIME_CHANGE_SUMMARY
```

Control File Parameters

Control parameters are defined using a control key followed by a string or number. The control parameters can be specified in any order. If a given key is defined more than once, the last instance of the key is used. The default value for each key is 0 or "Null". Null parameters do not need to be included in the file. Note that comment lines or extraneous keys can be included in the file. They will be ignored by the program.

The keys recognized by the **SmoothPlans** program are listed below. These keys can be defined in a variety of different ways to perform different tasks. The first 2 keys specify the input and new plan files. They are required; other keys are optional.

Required Keys

PLAN_FILE

The plan file key is required. It specifies the name of the TRANSIMS plan file within the project directory. The full path and file name for the plan file is constructed by appending the value of this key to the value of the PROJECT_DIRECTORY key.

NEW_PLAN_FILE

The new plan file key is required. It specifies the name of the output TRANSIMS subarea plan file within the project directory. The full path and file name for the plan file is constructed by appending the value of this key to the value of the PROJECT_DIRECTORY key. If the partition number is '0', the '.tAA' extension is added. If the partition number is '1', the '.tAB' extension is added, etc. If the command line does not include a partition parameter and this key ends with '.t*' or '.*', all of the plan files in the file group are processed sequentially. If the plan files have a companion *.def file, the PLAN_FORMAT and NODE_LIST_PATHS keys are not required.

Optional Keys

TITLE

Any text string can be used on this line. This text is printed on the top of each output page.

REPORT_FILE

The report file name is optional. If a file name is not provided, the program automatically creates a report file name based on the input control file name plus the partition number. The report file will overwrite an existing file with the same name if the Report Flag key is False or not specified.

REPORT_FLAG

The report flag key is optional. If it is specified as Yes or True, the report file or default printout file will be opened in 'Append' mode rather than 'Create' mode. This permits the user to consolidate the output of several programs into a single report file.

PROJECT_DIRECTORY

The project directory key is optional. If it is specified, it is added to all non-network file names required by the program. If it is not specified, all non-network file names should fully specify the file path.

MAX_WARNING_MESSAGES

When the program generates a warning message, a counter is incremented and the total number of warning messages is reported and a warning return coded (2) is set at the end of the execution. By default the program prints up to 100,000 warning messages to the print-out file. If more than 100,000 warning messages are sent, the program stops printing additional messages to the file or terminates the program with an error message based on the setting of MAX_WARNING_EXIT_FLAG.

MAX_WARNING_EXIT_FLAG

If the maximum number of warning messages is exceeded, this flag directs the program in what to do. If the flag is TRUE (the default), the program is terminated with an error message about the warning messages. If the flag is FALSE, the program continues execution, but no additional warning messages are sent to the screen or written to the printout file. The warning message counter continues to count the messages and reports the total at the end of the execution.

TRAVELER_SCALING_FACTOR

The traveler scaling factor key enables the user to factor the input travelers by a scaling factor. The default value is 1.

NET_DIRECTORY

The network directory key is not required. If it is specified, it is added to all network table names. If it is not specified, the network table names should fully specify the file path.

NET_NODE_TABLE

The node table key specifies the name of the TRANSIMS node file within the network directory. The full path and file name for the node table is constructed by appending the value of this key to the value of the NET_DIRECTORY key.

NET_LINK_TABLE

The link table key specifies the name of the TRANSIMS link file within the network directory. The full path and file name for the link table is constructed by appending the value of this key to the value of the NET_DIRECTORY key.

NET_LANE_CONNECTIVITY_TABLE

The lane connectivity table key is optional. It specifies the name of the TRANSIMS lane connectivity file within the network directory. The full path and file name for the lane connectivity table is constructed by appending the value of this key to the value of the NET_DIRECTORY key.

NET_PARKING_TABLE

The network parking table key specifies the name of the TRANSIMS parking table file within the network directory. The full path and file name for the parking table is constructed by appending the value of this key to the value of the NET_DIRECTORY key.

NET_DEFAULT_FORMAT

Default format for network files. The default file format is set by DEFAULT_FILE_FORMAT. Other options include VERSION3, BINARY, FIXED_COLUMN, COMMA_DELIMITED, SPACE_DELIMITED, TAB_DELIMITED, CSV_DELIMITED, DBASE, LANL, and SQLITE3.

NET_*_FORMAT

The file format key enables the user to specify the input format for an input network file. Replace the * with any of the network file types: node, link, pocket_lane, etc. The default file format is set by NET_DEFAULT_FORMAT. Other options include VERSION3, BINARY, FIXED_COLUMN, COMMA_DELIMITED, SPACE_DELIMITED, TAB_DELIMITED, CSV_DELIMITED, DBASE, LANL.

LINK_DELAY_FILE

The link delay file key is optional. If the key is provided, the program uses the information in the link delay file to initialize the link volumes and travel times for each time period. The header record in the link delay file is used to determine the size of each time period. The time periods are typically 15 minutes long. If a link delay file is not provided (or the key is 'NULL'), free flow speeds are used for all times of day. Free flow speeds are also used for all links and time periods not included in the link delay file.

LINK_DELAY_FORMAT

The link delay format key enables the user to specify the input format for the link volume file. The default file format is set by DEMAND_FILE_FORMAT. The format options include VERSION3, BINARY, FIXED_COLUMN, COMMA_DELIMITED, SPACE_DELIMITED, TAB_DELIMITED, DBASE, and SQLITE3.

MAX_LINK_DELAY_ERRORS

The maximum number of link delay errors key is optional. It defaults to 100,000 errors. This parameter defines the number of link delay processing errors that are permitted before the program terminates execution. A processing error can occur if a Link-Node combination found in the link delay file is not included in the input Link file. This typically means that the input network is not fully compatible with the network used to create the link delay file. In most cases, a small number of differences are acceptable, but significant differences will invalidate the path building process. Considering that the link delay file typically includes records for each lane in each direction for each 15 minute time period, changing a single link in the network can easily result in 200 or more data processing errors.

PLAN_FORMAT

The plan format key is optional. If provided, it defines the file format of the plan file. The default plan file is in VERSION3 (unformatted text) format. This parameter enables the user to specify that the plan file is in BINARY format.

NODE_LIST_PATHS

The node list paths key is optional and when provided specifies the way the path is identified in the input plan file. The key is 'true' by default. This means that the input plans will include a list of the node ID numbers along the travel path. If the key is 'false', the program interprets the path as a list of link ID numbers. If the first character of the key is '0', 'N', 'n', 'F', or 'f', the key is interpreted as 'false'.

LINK_LIST

Undocumented.

RANDOM_NUMBER_SEED

This key specifies the random number seed used by the ActGen program. If the key is not provided or the key value is zero, the random number seed will be set by the computer clock.

TIME_OF_DAY_FORMAT

The time of day format defines how the activity start and end times are written to the activity file. The default format will display values in hours. The format options include HOURS, SECONDS, 24_HOUR_CLOCK, and 12_HOUR_CLOCK.

TIME_INCREMENT

The number of minutes that times will be shifted. The default is 15 minutes.

Figure 1 illustrates the effects of using different sets of parameters on the plan start times. The input plan (Rough) is a plan file with extremely lumpy start times, with large spikes at 8:00, 8:15 and 8:30. SmoothPlans was run twice, the first time with default parameters, and the second time with the chosen parameters shown below.

Parameter	*Default Value*	*Chosen Value*
`Time Increment`	15 minutes	1 minute
`Maximum Time Shift`	45 minutes	15 minutes
`Smooth Group Size`	3	9
`Percent Distributed Forward`	20%	20%
`Percent Distributed Backward`	20%	20%
`Number of Iterations`	3	10

The default value of 15 minutes for the time increment simply shifts the spikes by 15 minutes, not a desired result. The run of SmoothPlans with the chosen values produces a smoother, more desirable result (Figure 1).

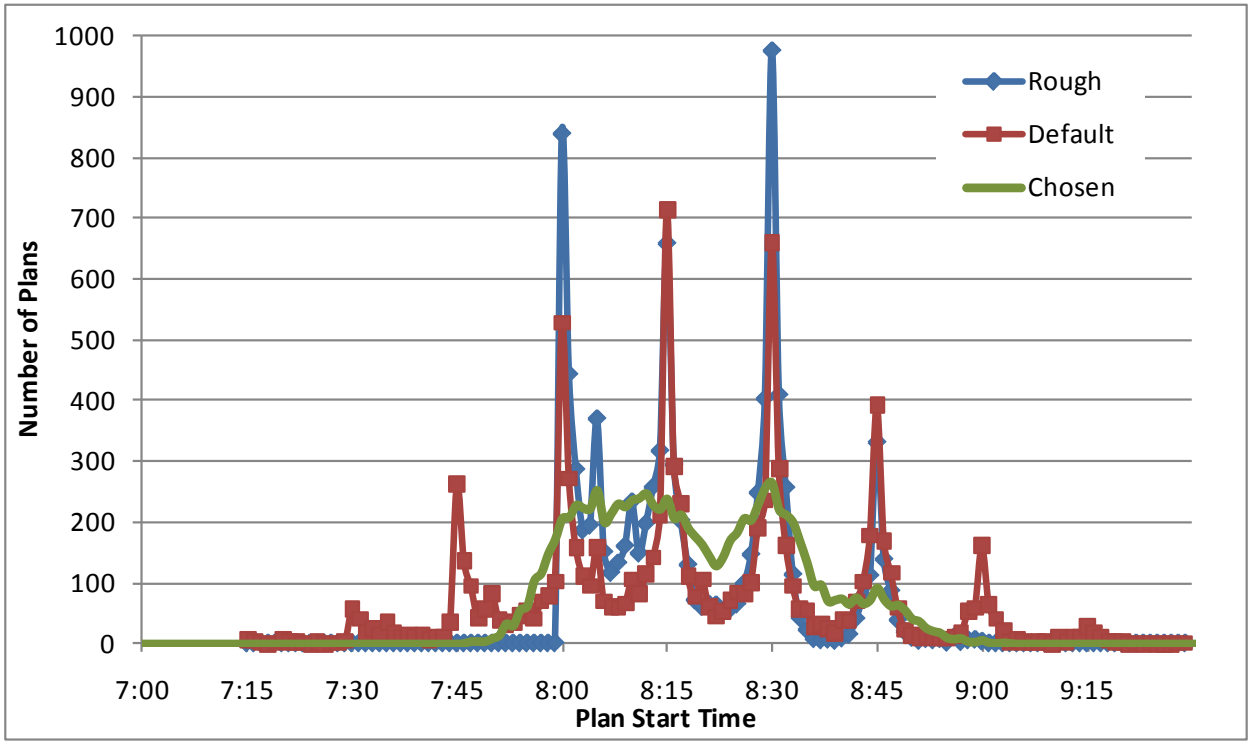

Figure 1 Plan Start Times

To generate the start times for Figure 1, the PlanSum program was run with the following control file:

```
TITLE         PlanSum: Create plan summary by time of day

PLAN_FORMAT       VERSION3
NODE_LIST_PATHS       false

# ---- Input Files ----

PLAN_FILE                     TimePlanASmooth
PLAN_FORMAT                     VERSION3

# ---- Output Files ----

NEW_TRIP_TIME_FILE            TripTimeSmooth.txt

# ---- Parameters ----

SUMMARY_TIME_PERIODS          7:00..10:00
SUMMARY_TIME_INCREMENT        1

PLANSUM_REPORT_1              TRIP_TIME_REPORT
```

MAXIMUM_TIME_SHIFT

The maximum amount of time that plans are shifted, in minutes. The default is 45 minutes.

SMOOTH_GROUP_SIZE

Smooth_Group_Size is the number of time periods included in a moving average smoothing process. The default is 3, which is normally used for 15 minute time periods (i.e., +1 and -1 period). Possible values are 3, 5, 7, 9. Higher values result in more smoothing.

PERCENT_MOVED_FORWARD

The Percent_Moved_Forward defines the percentage of the current period volume that is added to the next time period. It defaults to 20 percent. The range is 0..(100 – 50 / [smooth group size])

PERCENT_MOVED_BACKWARD

The Percent_Moved_Backward defines the percentage of the current period volume that is added to the previous time period. It defaults to 20 percent. The range is 0..(100 – 50 / [smooth group size])

NUMBER_OF_ITERATIONS

The Number_of_Iterations defines how many times the moving average process
is applied to the full set of time periods. The range is 1 to 25. If NUMBER_OF_ITERATIONS is not supplied, the default is 3. Typically, a value of 10 is used.

NEW_PLAN_FORMAT

The new plan format key is optional. If provided, it defines the file format for the output plan file. The default value is VERSION3 (unformatted text) format. This parameter enables the user to output the plan file in BINARY format.

NEW_LINK_SUMMARY_FILE

Undocumented.

SMOOTHPLANS_REPORT

The only option available is TIME_CHANGE_SUMMARY. It produces the following:

```
Time Change Summary Report

                ------ Trips -------      Average      Minimum      Maximum
          Hour   Original   Smoothed       Change       Change       Change

          3600          0          0          0.0            0            0
          7200          0          0          0.0            0            0
         10800          0          0          0.0            0            0
         14400          0          0          0.0            0            0
         18000          0          0          0.0            0            0
         21600          0          0          0.0            0            0
         25200          0          0          0.0            0            0
         28800       1781          0       -310.1         -900            0
```

```
32400      26359      28171         18.6       -900        900
36000         60         29        319.0          0        900
39600          0          0          0.0          0          0
43200          0          0          0.0          0          0
46800          0          0          0.0          0          0
50400          0          0          0.0          0          0
54000          0          0          0.0          0          0
57600          0          0          0.0          0          0
61200          0          0          0.0          0          0
64800          0          0          0.0          0          0
68400          0          0          0.0          0          0
72000          0          0          0.0          0          0
75600          0          0          0.0          0          0
79200          0          0          0.0          0          0
82800          0          0          0.0          0          0
```

Sample Printouts

A sample printout file generated by the **SmoothPlans** program is shown below. Each printout is an ASCII text file with a maximum of 95 characters per line and 65 lines per page. The file can be viewed or printed using a variety of text editors. For best results in a word processor, use a 10-point Courier font and 0.5 inch margins on all sides.

Example

```
*****************************************
|                                       |
|       SmoothPlans - Version 4.0.5     |
|   Copyright (c) 2009 by AECOM Consult |
|         Fri Jan 07 07:48:02 2011      |
|                                       |
*****************************************

Control File = SmoothPlans.ctl
Report_File  = SmoothPlans.prn (Create)

Smooth Plans by Time of Day

Plan File = TimePlanARough
Plan File contains Link List Paths

Plans will be Smoothed based on Start Time

Random Number Seed = 1294404482

Time of Day Format = SECONDS
Time Increment = 1 minute
Maximum Time Shift = 15 minutes
Smooth Group Size = 9
Percent Distributed Forward = 20.0 percent
Percent Distributed Backward = 20.0 percent
Number of Iterations = 10

New Plan File = TimePlanASmooth
```

```
Number of Plan Files = 1
Number of Input Plans = 28200
Number of Input Records = 188000
Number of Input Travelers = 9400
Number of Input Trips = 9400

Number of Plans using Count Links = 9400

Number of New Plan Files = 1
Number of Output Plans = 28200
Number of Output Records = 188000
Number of Output Travelers = 9400
Number of Output Trips = 9400

Number of Trips with New Times = 8449 (89.9)

Fri Jan 07 07:48:03 2011 -- Process Complete (0:00:01)
```