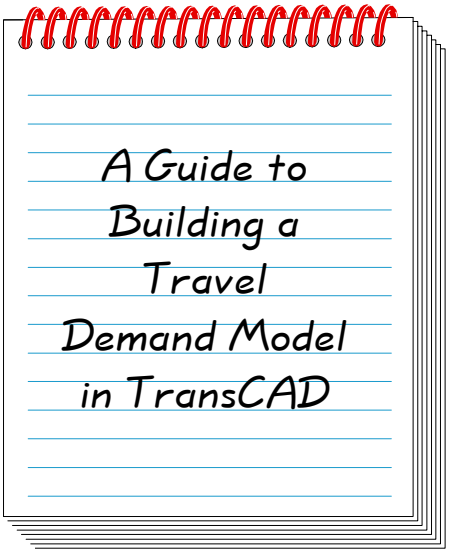
Modeling 101



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STATEWIDE PLANNING BRANCH

WHAT IS MODELING 101??

It is an attempt by the Model Development and Research Unit to create a step by step reference manual/class for users in the Statewide Planning Branch. The intent of the manual is to teach users the following things:

1) The process of how to build a Travel Demand Model in Transcad
2) Easy checks and tips on how to get the best results from your model while you are building
3) A guide to look back at when you need to refresh yourself on steps in the process
4) Brief discussions on the theory behind modeling

Tutorial files are included on the network drive as well as on CD for your use. The directory structure is setup to make sense in the modeling process. There is a folder for each step of the process and a few others that help keep files organized in the proper location. It is strongly encouraged that you follow this same structure to make it easier for you or others who may assist you along the way.

With all of these things combined into one manual it will allow you to become the State's best modeler in no time at all!!!!!

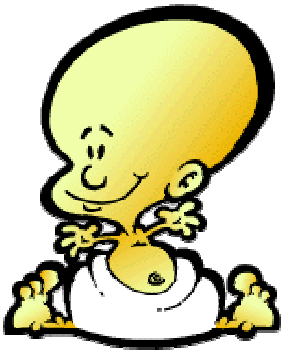
(Disclaimer: Results may vary and Not the Cindy crawford type model of Course!!)

Lets get started . . . . . .

. . . . .

Chapter 1

Before You Can Begin Building the Model



In order to build the actual travel demand model there are some things that you must understand and steps that must be completed before the actual modeling work can be done.

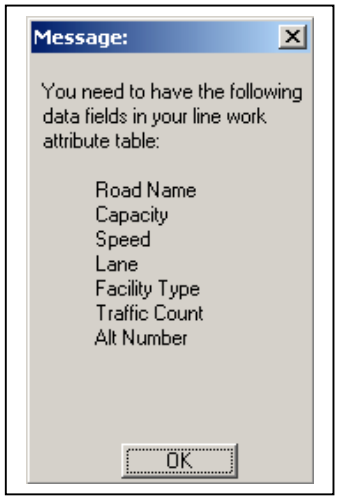
Just like you when you were a baby you couldn't walk before learning to crawl!

Below is a list of things that you need to have completed before beginning to build your model:

1) Be familiar with the basic commands in TransCAD –you should have completed the Intro to TransCad GIS notes before beginning this modeling portion of TransCad
   (ie….adding links, editing, layers, select by condition, etc!)

2) Clean Linework – this is a file that ONLY includes the roads you will be MODELING!(refer to the GIS notes section)

   *Links connected(using connectivity tool)
   *Node ID's changed to match your zones (***See addendum in back of notebook)***
   *Segments merged, dualized & simplified (***See addendum in back of notebook***)
   *at a minimum these attributes coded correctly in your data table:



Note: These fields are necessary to use the TransCad tools that SWP is or will be developing to make the process easier. **You MUST have a column for them in your data table even if you don't have information in the column**!!! It is important to note that you must spell the field names exactly the way they are shown in the dialog box above! The one capacity is automatically calculated for you so you just need the two way column in your layer. It will recognize one way links and calculate the capacity correctly.

3) Archive of your linework

Other Info You Might Want to Have

Zone Map
Background Roads Layer
Environmental Data
Aerial photos
Etc…….

Travel Time Calculation

It is important that you have already calculated travel time as part of your linework cleaning as mentioned in bullet two on this page. There is a tool that was developed to calculate the travel time on your network for you.

First you must install the program on your local drive (do it only once)

1. Go to **S:\TransCAD\GISDKtools\swpTools\r1** and double click on file ***swpToolsSetup.bat***

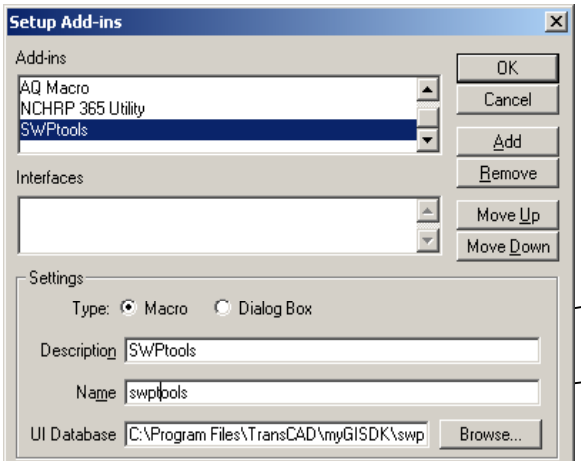
Or on the CD go to \GISDKTools\swptools\r1

This will install the program on your local drive at
C:\Program Files\TransCAD\myGISDK

Note: For future releases the r1 may change to r2, r3 etc…..

Then you must add the program in TransCAD (do it only once)

1. In TransCAD, go to ***Tools-Add Ins*** menu
2. In **Add-ins** dialog box, click button ***Setup…***
3. Click ***Add*** to display the **Setup Add-ins** dialog box
4. Fill out all the boxes to look like this(it is CASE SENSITIVE so make sure you type the values in correctly.)



SWP Tools(this can be whatever you want to name it)

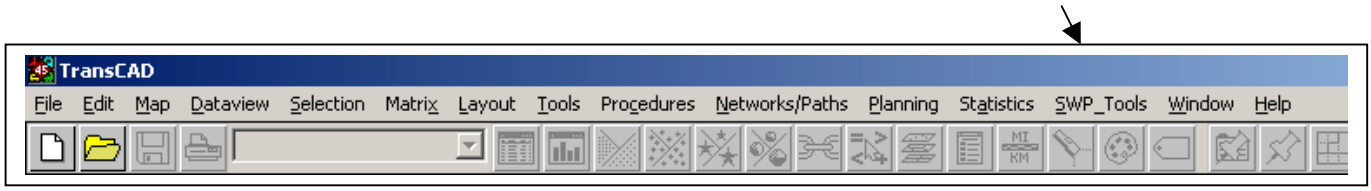
swptools

C:\Program Files\TransCAD\myGISDK\swptools.dbd

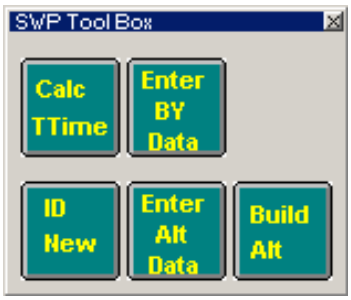
Now you can run the program in order to calculate your travel time (there are other tools that can be run using this toolbox as well)

1. In TransCAD, go to ***Tools-Add Ins*** menu
2. Double click on ***SWP Tools*** in the Add-ins list

You should now see a new menu called SWP-Tools appear on the menu bar :



and a new toolbox appear on screen similar to this:



Click on the Calc TTIME button and the travel time for your network will be added to your geographic file permanently!

If you change a speed limit then the travel time is automatically re-calculated.

If you add new links you must use the button again!

So now you're asking yourself, what is my travel time unit…….If you guessed MINUTES you are right!

Give yourself a high five and move on to Chapter 2!!

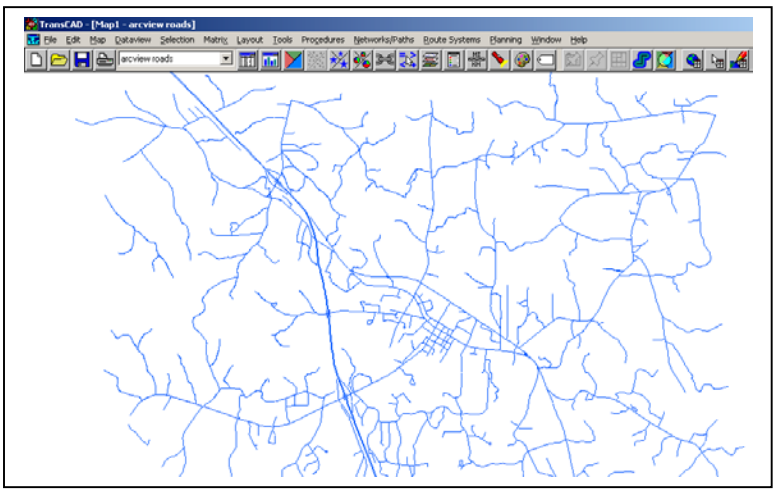
Chapter 2 - Building Your Network

Once you have clean linework you are now ready to create your network and begin the modeling process.

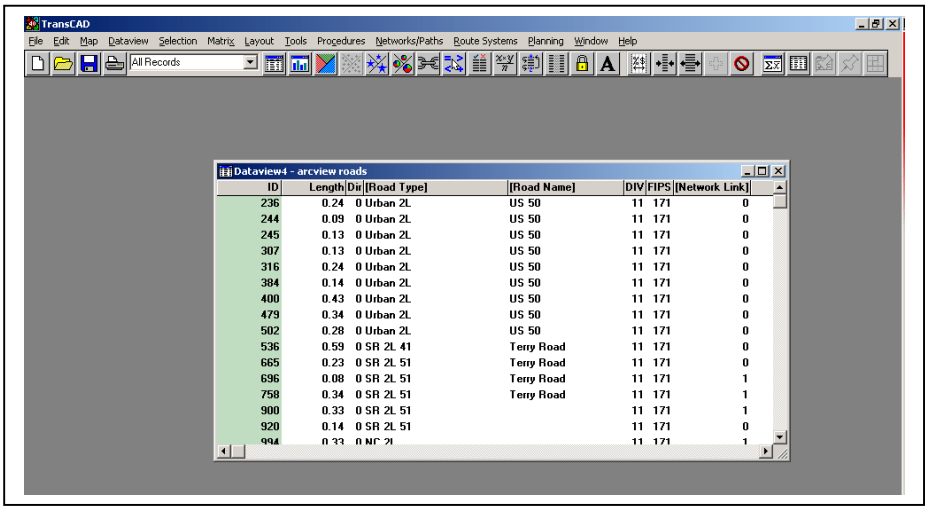
Before you attempt this step it is IMPORTANT for you to UNDERSTAND the difference between “linework” and “network”.

1)Open the map **Pilot Mtn Roads.map**
(located in the Base Year folder of the Pilot Mtn data)

Linework – This is all the roads you might have in your area that have attribute data associated with them. This attribute data in the linework may be just for reference or mapping or data you want to keep for future use. For example you might have columns in your data table like road names, # of lanes, functional class & type of future improvement. This layer might look like this:



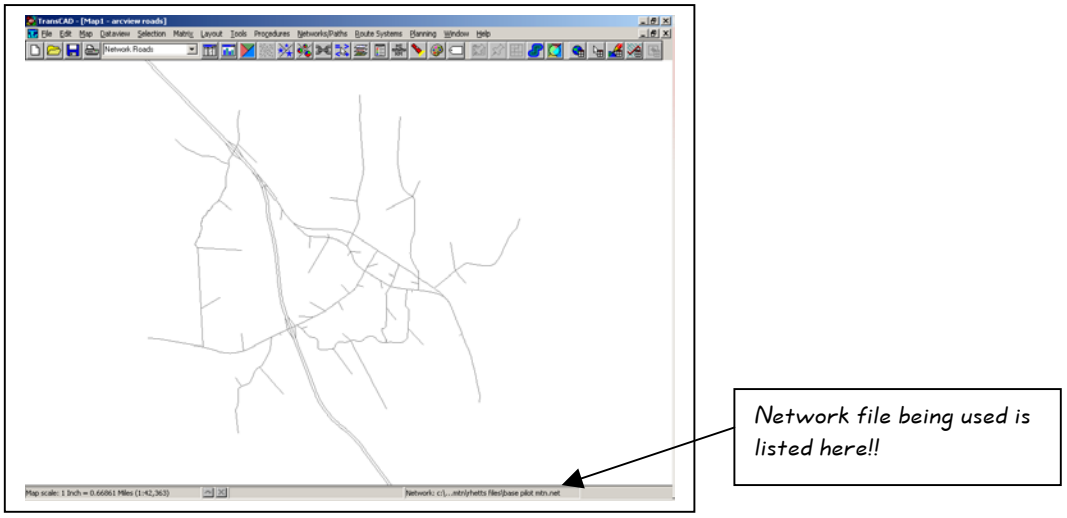
And your data table might look like this for the linework:



ID	Length	Dir	[Road Type]	[Road Name]	DIV	FIPS	[Network Link]
236	0.24	0	Urban 2L	US 50	11	171	0
244	0.09	0	Urban 2L	US 50	11	171	0
245	0.13	0	Urban 2L	US 50	11	171	0
307	0.13	0	Urban 2L	US 50	11	171	0
316	0.24	0	Urban 2L	US 50	11	171	0
384	0.14	0	Urban 2L	US 50	11	171	0
400	0.43	0	Urban 2L	US 50	11	171	0
479	0.34	0	Urban 2L	US 50	11	171	0
502	0.28	0	Urban 2L	US 50	11	171	0
536	0.59	0	SR 2L 41	Terry Road	11	171	0
665	0.23	0	SR 2L 51	Terry Road	11	171	0
696	0.08	0	SR 2L 51	Terry Road	11	171	1
758	0.34	0	SR 2L 51	Terry Road	11	171	1
900	0.33	0	SR 2L 51		11	171	1
920	0.14	0	SR 2L 51		11	171	0
994	0.33	0	NC 2L		11	171	1

Network:

The network is based on the linework but includes only the LINKS YOU WANT TO MODEL!!! The network is the links in which you want to use the travel demand model to predict volumes and to solve transportation problems. It is a scaled down set of roads that is based on a geographic linework layer. This layer would look like this:



Note: This is a geographic file displayed here but the "network" is actually just a reference file that is used in the model process. The name of the network being used in modeling is noted at the bottom of the TransCAD window.

The main concept to take away is that the network is used to analyze the roadways and the linework(geographic file) is used to display the results!!!

Well, now that you know the difference between linework and network let's make our network!!

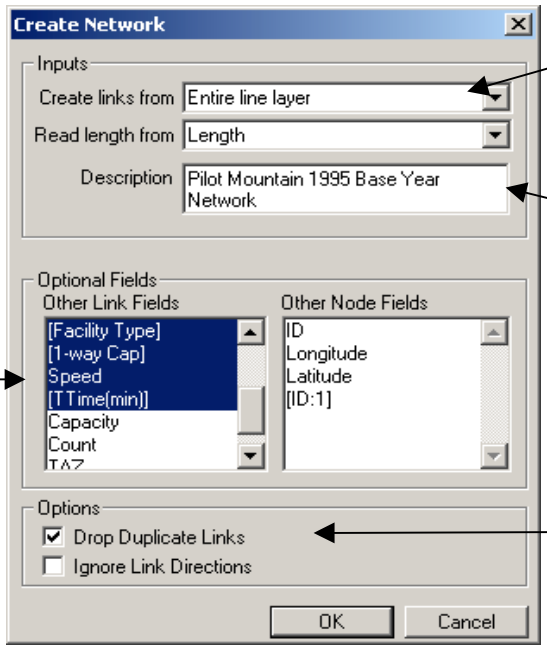
Close the map you currently have open

Step 1 – Open the geographic file that you want to base your model network on. This file can be a layer with only the network roads on it(which is recommended) or it can be the larger linework file that you can use the Select by Condition command on, to get the network roads. We will be doing the steps based on having a geographic line file that has just the network roads on it, similar to what was shown in the previous graphic above!

Open the file **pilot mtn base year linework.dbd**

Step 2- Go to the **Networks\Paths Menu** *(If you do not see this menu at the top of the screen then go to Procedures and click on Networks/Paths. The new menu should now appear)* and **Select CREATE**

You should now see this pop-up screen:



What part of the geographic file to use to create the NETWORK

Description of the network you are creating

Select the fields you want included in the network. These are the fields that will be used in your analyzing and loading of the network!

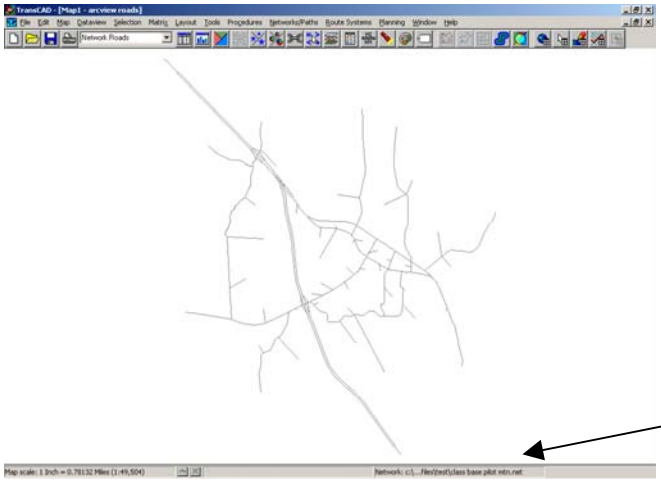
*See assignment type section below that discusses what fields are needed for modeling

Make sure this is checked

Gets rid of duplicate links still in file after cleaning it!

Click OK and Name the file MY Network
You have created your network!

Step 3 - Check to make sure you actually created the network and that it is referenced correctly by looking at your window and seeing what file is listed. As shown below:



Network file name should be listed here!

NOTE 1: The active network is kept in memory and used for all modeling analysis until you change it to another network. It is important that you check which network is being referenced before you perform any analysis!!! To close the network file Right Click over the file name and select Close All!

NOTE 2: a) To change networks go to the File-Open menu to display the dialog box

b) Select Network as file type and then choose the network file you want to use and click OK

c) The new network file should be displayed at the bottom of the screen.

Assignment Type Section – This is not intended to discuss in detail the type of assignment technique you should use but gives a starting point for the types of info that should/will be needed to perform various tasks associated with assignment of the trips onto the network.

At a minimum it is recommended that travel time and one way capacity should be included as data fields in your network.

Travel Time is a field that has to be calculated by you, the user. ***If ANY changes are made to your linework you must recalculate travel time and create a new network file in order for the changes to be used in the analysis***. If you do not re-specify your network then your model analysis will be incorrect. The steps should be performed as described previously! In the future this will be an automatic function that is performed by clicking a button, but for now you will have to use the fill command on your travel time column as mentioned in Chapter 1.

The capacities that are used in modeling for TransCAD MUST be ONE WAY! TransCAD recognizes, in its internal memory, each link as a one way link even though it does not show up on screen that way. Therefore if you do not use the right capacity then the traffic assignment could be incorrect on your model.

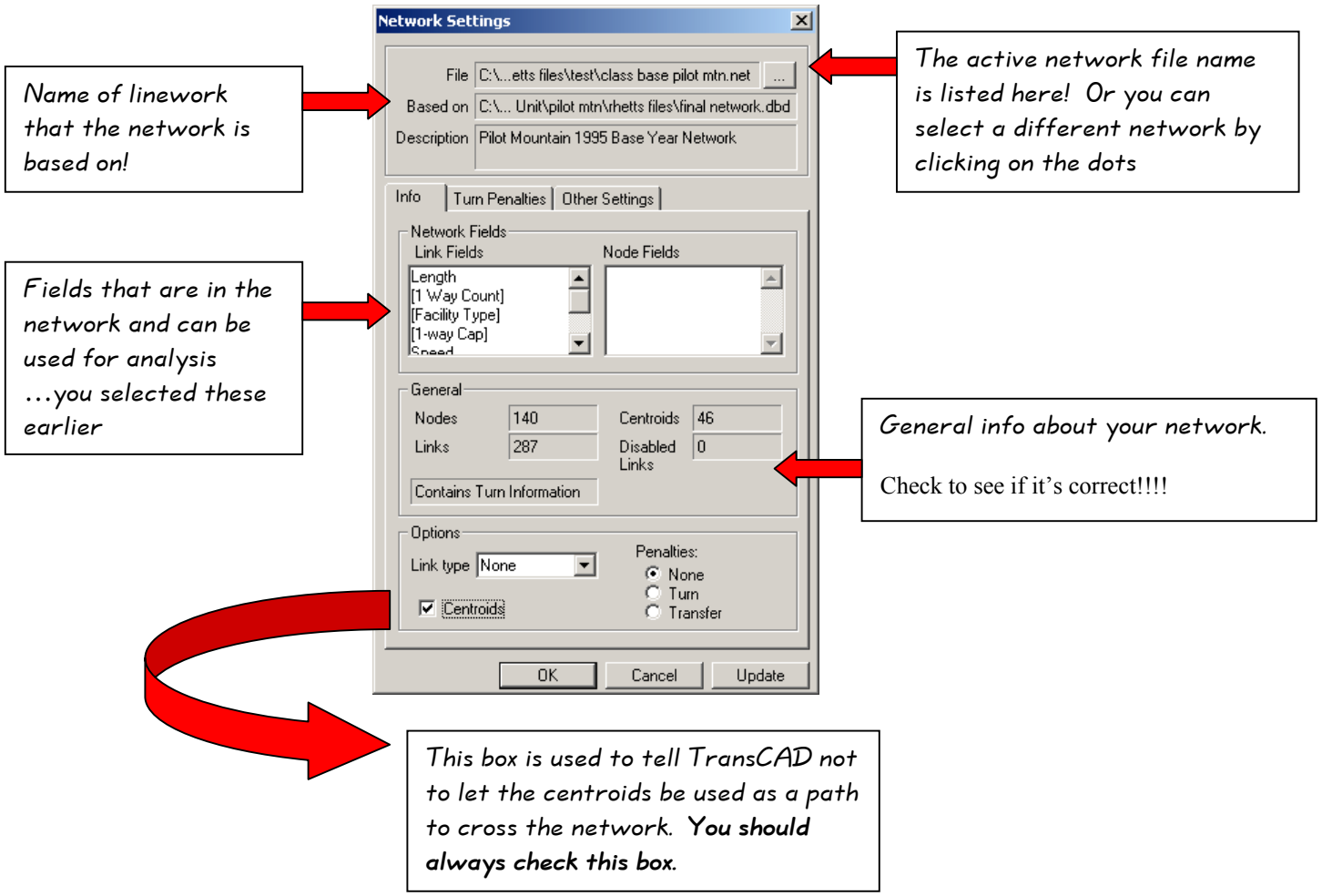
For most of our small urban models we use All-Or-Nothing assignment but we will be teaching you other techniques in the future. We encourage you to adopt as standard practice a technique that better represents reality, unlike the all-or-nothing technique, which is best for representing pure demand. For this reason it is good to be aware of the other techniques and the fields that are necessary. Here is the table for the data fields needed depending on the type of model loading technique you will be using. The loading technique will be discussed in more detail later.

	All-Or Nothing	Stochastic	Capacity Restraint	User Equilibrium & Stochastic User Equilibrium
Travel Time (Calculated using speed field)	✓	✓	✓	✓
Capacity (One Way)			✓	✓
Facility Type			✓	✓

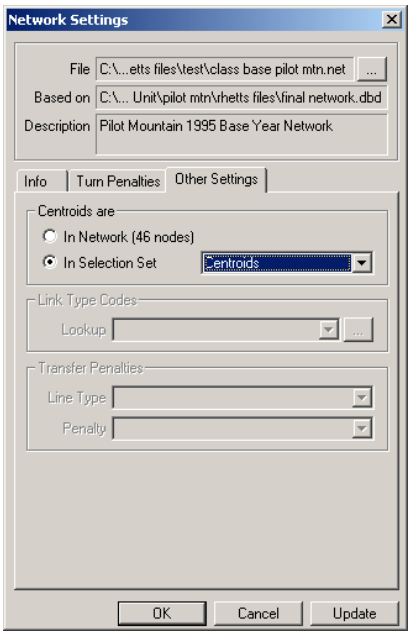
Now that we have created our network we need to review the settings on the network and do some logical error checking before we move on to building our minimum paths and trip generation.

So let's start with the settings menu which is located under
Networks/Paths → Settings

You should get this dialog box:



After you have checked through this screen, click on the Other Settings tab.



This is where we tell it how to determine what nodes are centroids! See the Selecting Centroids section below for the steps!

Selecting Centroids

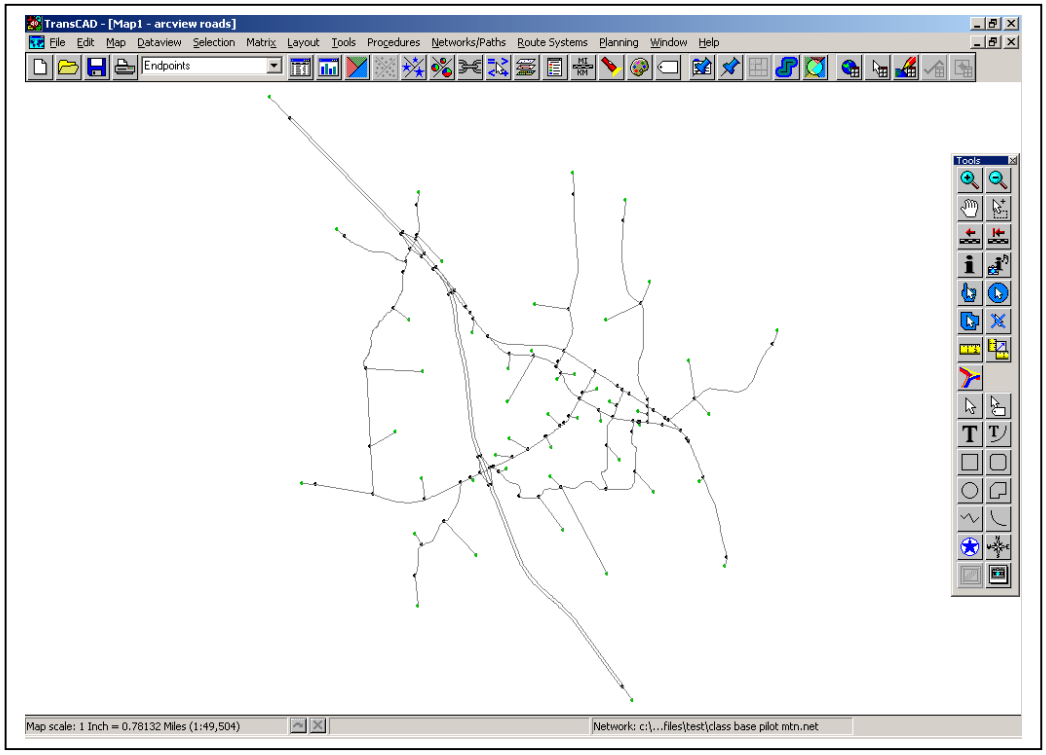
A centroid is a point in a Transportation Analysis Zone that represents the data in the zone. In order for TransCAD to know what the centroids in our network are we need to create a selection for the centroids only. As noted in the text box on the figure on the previous page we do not want our centroid links to be used as a "shortest path" when we build our travel time/skim matrix, so we must determine which nodes not to use. If we tell TransCAD that there are centroids and there is a selection set called that, it will recognize this fact when assigning trips. You also need to specify centroids for building the zone-to-zone travel time matrix. This is called multiple shortest paths and will be covered in future sessions.

Step 1 - It is important that you have changed your node ID's to represent the actual zone numbers for your area. (this is optional but encouraged)

This was covered previously and the notes are located on the Share drive in the TransCAD→User's Group Notes folder.

They are called: "*TransCAD Notes for nodes & centroids.pdf*"

Step 2 - We now need to show our nodes. Go under Map → Layers. The Layers dialog box will come up. Highlight Nodes and click on "Show Layer". Click Close. The network should redraw with the nodes highlighted.



Make sure that the Endpoints is the Working Layer at the top of the screen (as shown in the figure).

Step 3 - We now need to make a Centroid set.

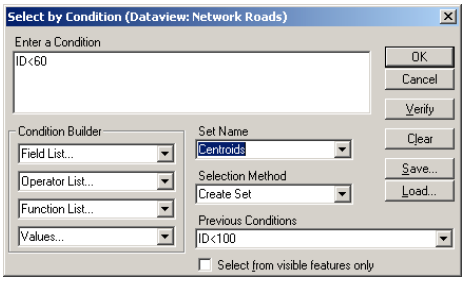
Choose Selection→ Select by Condition to display that dialog box.

We now need to build a formula for TransCAD to tell it which nodes are centriods. The first 60 nodes of this model are centroids or external stations, so any node number less than or equal to that number is a centroid. Just for ease of remembering I will use 60 as my reference number! ***You will have to know what your highest centroid number is (including your external stations) and that is the number you should use in the equation for the selection condition***.

You can either type the formula in the "Enter by Condition" box or use the Condition Builder to select your condition. Under "Field List" use the scroll down menu to find and click on ID. Under "Operator List" use the scroll down menu to find and click on <=. Now go into the "Enter By Condition" box and type in 60, so the formula should be ID <= 60.

*Or you may create a column in your data table that designates that link as a centroid. Place a 1 in that column where centroid links are located and then create a selection set based on that column.

We need to give this selection set a name. Under "Set Name" rename this box Centroids. Your screen should be similar to this:



Click OK. Your network should redraw, and the centroids will change color (in my case green). Our centroids are now identified.

Now we can go back to our Other Settings dialog box and tell TransCAD which nodes are centroids.

Step 4- Make sure you are still in the node working layer.

A) Choose Networks/Paths → Settings to display the Network Settings dialog box.

B) Click the box next to Centroids in the "Options" box.

C) Go to the Other Settings Tab

In this dialog box, there is a "Centroids are" box. Inside that, choose In Selection Set, and Centroids in the drop down menu. After you do this, you should see "In Network (46 Nodes)" pop up- or whatever your total number of centroids came out to be.

Click OK.

NOTE to SELF: You should not have created any "Dummy Zones" when you built your network. This will confuse TransCAD when it is building the matrices. You can add zones later if you need to so don't worry about it for now!!!

Final Checks on Your Network:

After doing the necessary steps to create your network it is important to do some error checking to ensure that this step of the travel demand model is as accurate as possible. By doing these checks now you will be able to better understand what you just completed and you will find it easier to remember the details of the network coding. The TransCAD GIS class sessions should give you the necessary background to create themed plots, selection sets, etc.

Here's a list of a few of things you should go through BEFORE moving on to minimum paths and trip generation!!!!

Highway Networks

- Centroid connectors should represent as closely as possible the local street system. Use GIS tools and local knowledge to locate centroid connectors.
- Size and density of the zones should correspond to the level of detail of the coded highway network. Major physical barriers should not split zones. Use GIS and local knowledge to check.
- Network review should include visual inspection in addition to range checking for capacities, speeds and distances.
- Use minimum path techniques to check for coding errors in the link attribute impedance factors.
- **Network attributes should be plotted and checked (distances, speed limit, facility classification, area type and number of lanes).**

Tutorial Assignment

A) ***Error-check the network for shortest paths.*** Use the shortest path tool to perform some logical error checks.

To use the shortest path tool go to the Networks/Paths Menu and select shortest path.

You should now have the toolbox that allows you to check the paths.

WHAT FIELD WOULD YOU USE TO CHECK THE SHORTEST PATHS BETWEEN AREAS????

CHECK THE PATHS FROM THESE ZONES:

40-44
6-41
13-41
41-46 (both directions)

Did you find an error? If so, what was it?

B) CREATE A THEMED PLOT OF SPEED LIMITS AND COMPARE THEM TO THE REAL WORLD SPEED LIMITS TO MAKE SURE THEY ARE RIGHT! (INSERT MAP OF CORRECT SPEEDS?)

Where are we and where are we going????

Up to now you have:

1) Created geographic linework that is cleaned and attributed with the appropriate data (including changing the node ID's to represent TAZ's & travel times)
2) Created your NETWORK to be used in the rest of the modeling process
3) Created a selection set of your centroids (which represent your TAZ's)
4) Error checked your network & geographic file for coding errors

Chapter 3-Building Minimum Paths

What is a minimum path you ask? It is the route or travel path on the transportation network that has the lowest "cost" for the traveler. The "cost" can be the travel time, distance or some monetary value. So basically if you choose to go from home to the mall would you go the shortest distance route regardless of time or would you take the quickest route based on time….what you choose is your minimum path based on some cost that is important to you!

Why do we need them? We don't need them, it's just a fun step to throw in just to use your brain a little more…ACTUALLY, we need them to use in two steps in the model…trip distribution and trip assignment. It helps determine where people will go in the model and how they get there. In modeling this minimum path value is stored in a matrix called the impedance matrix (Since we use travel time in our models, we call it the travel time matrix). This value is used in trip distribution to determine the zone-to-zone travel times. This minimum path value results from the "skim tree" that is developed. The skim tree is a table that shows all the possible combinations of links or paths that could be used to go from one zone to another. There is only one minimum path and that value is the one stored in the travel time matrix. During assignment the minimum path is used to assign trips on the links in the network. We will learn more about assignment in later chapters.

How do we create the minimum paths?

Step 1 – Open your geographic file and associated network

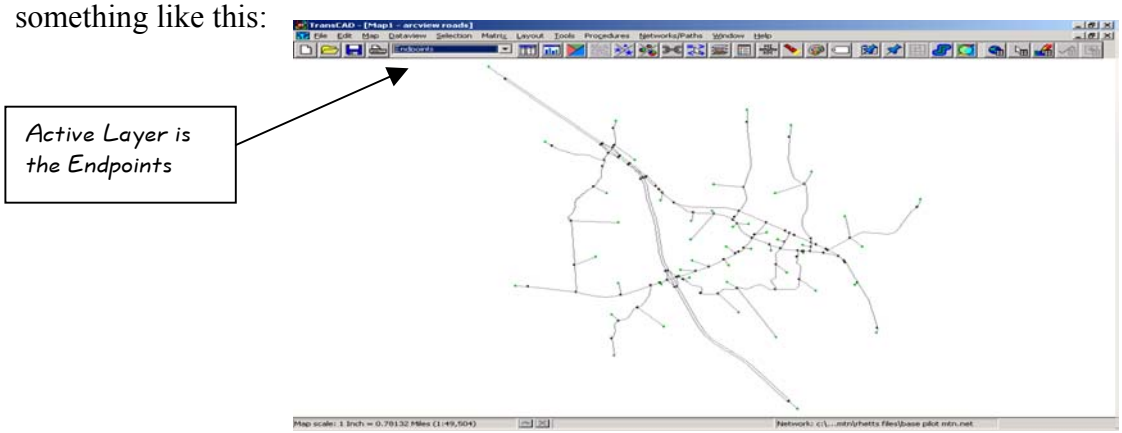
******Remember this is what Chapter 1 & 2 were all about!*

For the tutorial you should open :

a) the geographic file called: Pilot Mtn BY Final Network.dbd
b) The associated network file called: Pilot Mtn BY Network.net

Step 2 – **Unhide the nodes in your file and create a selection set of your centroids** by using the Select by Condition command under the selection menu as you did in the last section of Chapter 2. Call the selection set CENTROIDS.

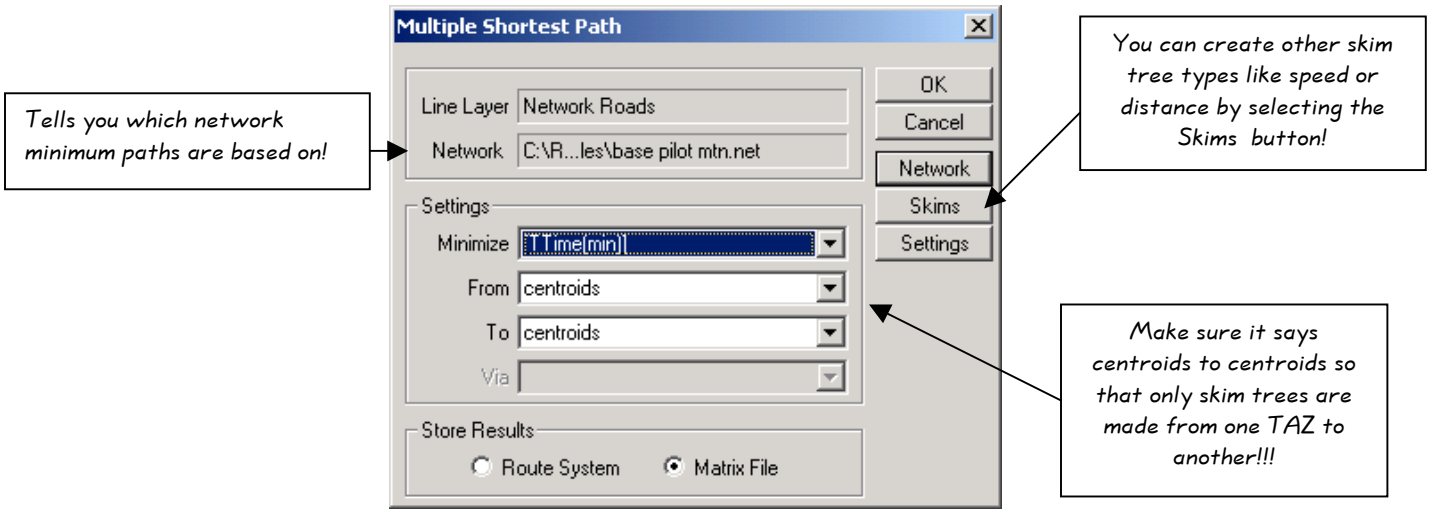
Step 3- **Make sure the nodes or endpoints layer is the active layer!** You should have something like this:



Step 4 – **Create the minimum paths for your interzonals** (these are the trips between zone A & zone B). This output file will be a matrix of minimum travel times for each zone to zone pair!

a) Choose Networks/Paths → Multiple Paths
You should get the Multiple Shortest Path dialog box.

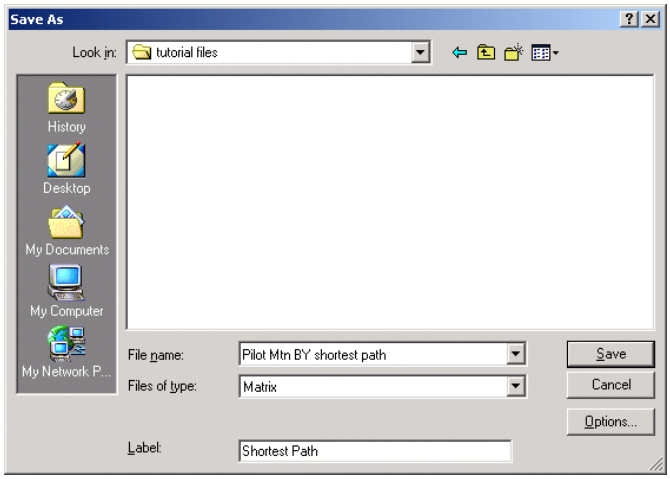
b) Under the Settings → Minimize section you should choose the column that represents travel time, in this case TTime[min]. TransCAD will minimize time in both directions from Centroids to Centroids.



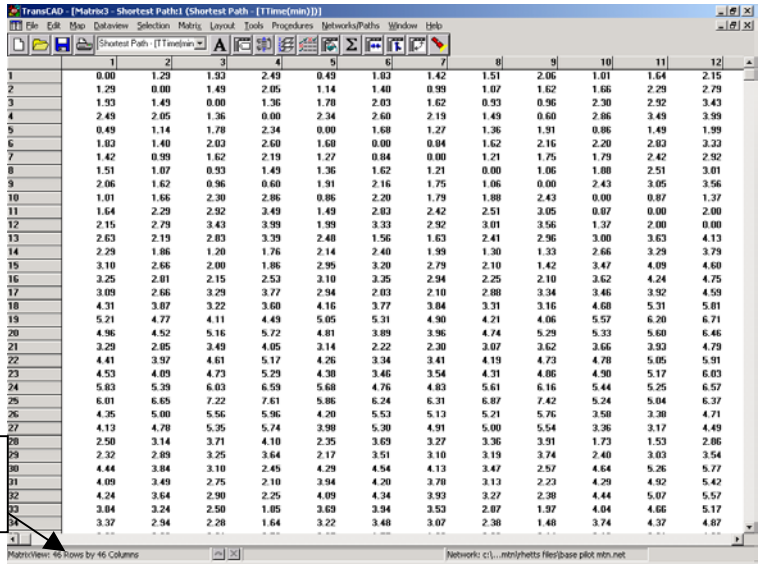
Note: You can create other matrices to do some checks on your network by clicking the skims button on the screen and selecting the skims you want to save. To see the actual minimum path you must use the minimum path tool located under the Networks/Paths menu.

c) Click OK

Next the Output File Setting dialog box will come up. Make sure the file will be saved in the proper directory. If not, go under Look In: and choose the proper directory to save the matrix. ***Name the matrix Pilot Mtn BY shortest path. Choose SAVE***



You should get some flashes….and then this screen showing your minimum path matrix:



This matrix is your interzonals only!!! You will see that from Zone 1 to Zone 1 you have 0.00 as the travel time and that is because the INTRAZONAL time has not been calculated yet! That is the next step but before we move on make sure you have the correct size matrix (it should be equal to 46 by 46 for Pilot Mountain)! Remember this number INCLUDES your externals!

Step 5 – Calculate the Intrazonal Travel Times.

The intrazonal travel time is found in the diagonal of the travel time matrix and represents the travel time for trips that are made within the zone. For example, if you left your house and drove up the street to the gas station a block away to get a drink…you stayed in the zone during your trip, so therefore it was an intrazonal trip. You don't want all of the trips in your zone to leave the centroid and get onto the network so you must calculate the time so that some of the short trips remain in the zone.

The intrazonal trips are important because they directly affect the volumes on the network:

- The higher the percentage of intrazonal trips the lower the volumes on the network.
- The lower the percentage of intrazonal trips the higher the volumes on the network.

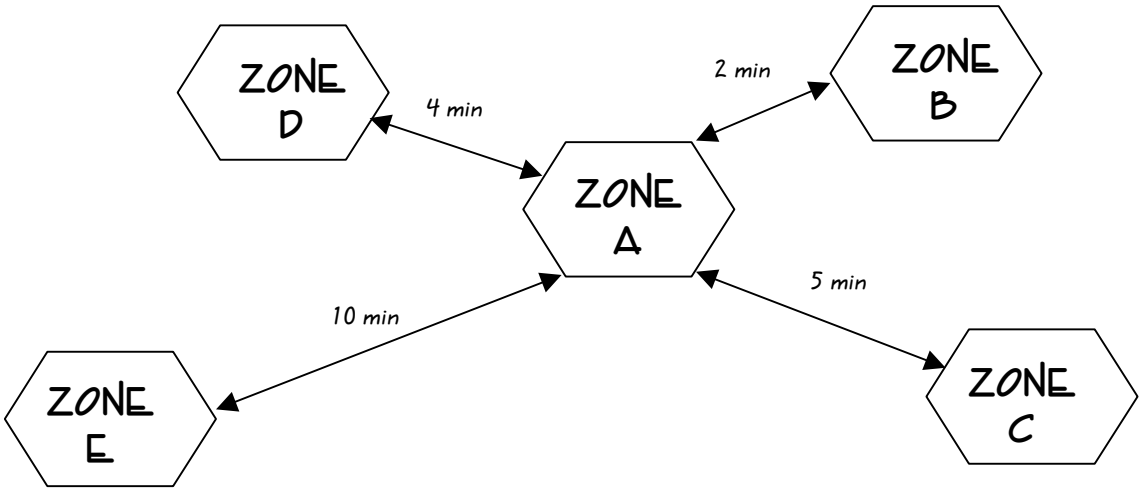
The number of intrazonal trips can be adjusted by adjusting the intrazonal travel times in the trip distribution process.

What are these numbers for and how are they calculated?

The way we typically calculate intrazonal times is to use the "nearest neighbor" technique. We are basically saying that the intrazonal time for Zone A is equal to half the average time it takes to get to the closest adjacent zones. We generally look at the three closest/adjacent zones in order to determine the travel time.

In the example below on how to calculate Zone A's intrazonal time, we would look at zones B, C, & D **not** E. The times from those zones would be averaged. The average time then gets reduced by 50% and the number that is produced is the intrazonal travel time for the zone you are looking at. Below is the sample calculation for Zone A.

Intrazonal Calculation Example



Average the travel times for the 3 closest zones:

$$\frac{(\text{Zone D} + \text{Zone B} + \text{Zone C})}{3} \rightarrow \frac{4+2+5}{3} = \frac{11}{3} = 3.7$$

Then reduce the travel time by 50% so:

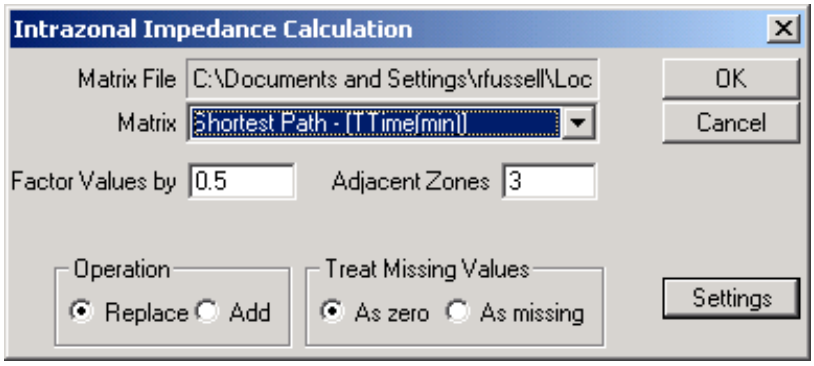
3.7*50% = 1.85 minutes

This is the intrazonal travel time for ZONE A!!!!

How do we calculate it in TransCAD:

Choose Planning→ Planning Utilities→ Intrazonal Travel Times

A dialog box will appear (like shown above)and you will need to fill in the values for "Factor Values By" and "Adjacent Zones".



These are described below.

Factor Values By – This is the factor that is applied to the average of the travel time values from a given zone to all of its adjacent zones (as specified by the user). The typical value for this factor is 0.5.

Adjacent Zone – This is the user-specified number of adjacent zones to be used in the calculation of the average travel time. The program determines which zones are the closest; the user is only required to input the number of zones to be considered. A typical value ranges from 3 to 5 zones.

The matrix you are trying to calculate the intrazonal impedance for is the shortest path - travel time matrix.

Once you have filled out the dialog box like on the previous page click OK and your travel times for your zones will show up in your matrix now!

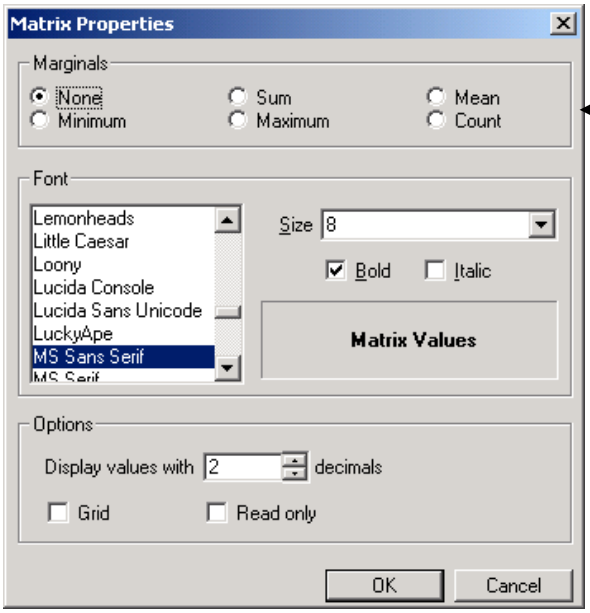
You now have your minimum path matrix for your network.

You should do some error checking to make sure your paths make sense!

If I go from Zone A to Zone B does it take me 10 minutes or 20 minutes and does the matrix compare to my experience in the field!

Check maximum & minimum times. Use the marginals tool in TransCAD to check the min & max for the matrix. HOW? Right click in the matrix and select properties.

You will get a new dialog box like this:



You can choose different things to look at for error checking!

You should look at these values so you will know what your maximum time is through your network. This is important to know because when you develop your friction factors later you will need to make sure they go out far enough to enable your trips to be distributed correctly!

IMPORTANT NOTE: If you edit your geographic file by adding new lines, editing existing lines, or changing a speed on a link you MUST RESPECIFY your network, calculate your travel times and redo your minimum path matrix!!!!!!

Tutorial assignment:

1) Recreate the minimum path steps and then answer these questions:

2) What is the maximum travel time for Pilot Mountain based on the minimum path matrix?

3) What is the minimum travel time for Pilot Mountain based on the minimum path matrix?

4) How did you get those values?

5) What is the travel time to go from Zone 40 to Zone 5?

6) What steps would I have to redo if I :

a) Added a new zone to my linework?
b) Changed the travel time/speed/capacity on a link?
c) Changed the name of a road in the dataview?

Chapter 4 - Trip Generation

What is Trip Generation???

Trip Generation is the first step in the actual 4 step modeling process. It is where we ***determine HOW MANY TRIPS will be made*** in each one of our zones (TAZ's). If you cannot accurately predict how many trips are being made in your area, then the rest of the process is not going to be accurate and it will be hard to get the travel demand model to perform at its highest level!

There are different ways to determine how the number of trips are calculated. The basic tools are:

Cross-Classification : Uses the population (and associated data) in an area to determine the trip making for each classification type (ie…one worker HH with 2 cars). A lookup table of values is created and used to estimate the trips for each TAZ.

Regression: The use of a standard regression equation is used to calculate either P's or A's for each TAZ. The equations are based on borrowed or estimated coefficients & input variables.

Discrete Choice: Using individual level data to estimate the probability of a household to make a trip.

All of these methods use land use data in some fashion to estimate the trips for each TAZ. Some use persons/household and auto ownership, while others just use more aggregate data like housing and employment totals broken into categories. Typically, in our estimation of trips for the model, the housing unit determines the number of trips produced (where the decision to make trips originated) and the employment determines how many trips are attracted (why you went to this destination).

FOR EXAMPLE: when you woke up this morning you had to decide to make a trip (or hit the snooze bar). You left your house and came to work. You produced a trip from your house and were attracted to work. This is the standard rationale of thinking for the trip generation step….trips are produced and attracted….so you must determine how many of both!!

Therefore, in order to complete the trip generation step of the modeling process there are 3 basic steps that must be accomplished:

1) Determine the number of trips produced by each zone
2) Determine the number of trips attracted by each zone
3) A balancing of the total attractions and productions

You know why we need #1 & #2 but why #3???????? Any ideas????

Ok times up….*similar in concept to what one of those scientists discovered a long time ago in the Law of the Conservation of Energy….you cannot create or destroy energy…you cannot have more productions than you do attractions*. They must be equal. We can't just get rid of the extra attractions or productions so our Trip Gen Program goes through and adjusts them by moving them around through a weighting process.

Once you complete those 3 steps you pass the test and can move onto Trip Distribution…the next step.

THE BASIC CONCEPT OF TRIP GENERATION IS TO TAKE LANDUSE DATA AND CONVERT IT INTO PRODUCTIONS/ATTRACTIONS.

It is important to understand the basic concepts of Trip Generation so that the steps of How to Do Trip Generation the SWP Way are easier to understand and perform. The rest of this section discusses step by step how we typically do Trip Generation in SWP. The data, variables needed, concepts behind our method, the accuracy checks and the programs you should use are all covered in here.

Section 1 – Data Needs

This is one of the important parts of trip generation because without data it is kind of hard to determine the trips in your area. Housing, employment and commercial vehicle data are the three basic data elements that are needed for your travel demand model (at least for a majority of the models we will build in SWP!)

Housing- Typically the housing data is broken down into the 5 housing rating classes that represent the trip making characteristics of the persons in the household. By placing all of your households into one of these categories you are determining the trip making ability of each household and in turn, the total number of trips produced in each zone! Our housing classification system is a surrogate for other trip making characteristics such as person/HH, income, and auto ownership. This classification process results in easier variables to collect and forecast than some of the other trip generation models. Here's an example of what it looks like:

Zone #	Excellent HH's	Above Ave HH's	Ave HH's	Below Ave HH's	Poor HH's
1	20	0	5	2	4
2	10	52	41	20	40

This data is entered into the SWP-Trip Gen software program on a zone by zone basis. The steps for using the program are discussed later in this section.

NOTE: Although we usually think of housing as the producing end of the trip, it also attracts trips as well. This is accounted for in the trip generation program we use.

Employment Employment is also a necessary data element and is classified by using SIC codes or Standard Industrial Classification Codes. There are five basic categories for employment:

Classification Group	Examples	SIC Code #'s included
Industry	Factories, Farms	1-49
Retail Employment	Target, Walmart, grocery store	50-54, 56,57,59
Highway Retail	Gas Station, Fast Food	55,58
Office	Lawyers, Real Estate, Insurance	60-67,91-97
Service	Doctors,Hotels, Automotive Repair	70-76,78-89,99

Each type of business attracts a different number of trips per employee because of the function it serves. For example:

Burger World has 25 Employees

Wilma's WebDesign has 25 Employees

Each business has the same amount of employees but they serve different functions and therefore attract a different amount of trips. Since Burger World is fast food, it is more likely people will stop by while out on the town because they are in a hurry, it attracts a lot of trips. The web design office attracts less trips because typically only the employees and a few customers may come to this location during a typical day. The web design office is not an attraction that will get drive by trips, quick stop ins, etc, therefore it generates less trips. Even though they have the same amount of employees…. Burger World would attract far more people on an average day!

The information for each business is entered into the SWP-Trip Gen program on a zone by zone basis and is used to calculate the number of attractions for each TAZ.

Commercial Vehicles – This is often a part of the trip generation process that does not get the correct attention to detail. Commercial vehicles are an important part of the trip productions in the model. The number of commercial vehicles has to be counted as part of field survey and input on a zonal basis. Single Unit trucks, cars, vans and pickup trucks are all considered commercial vehicles in this classification. Taxi's are a separate classification and should be accounted for since they generate on average 40 trips/day. Some areas do not have extensive taxi systems so this may not be an important part of your model.

Well we have all this data that is described above but where does it go?

Do we just wave our wand and out comes all the results of Trip Generation????

NO!!!!!

We Must use the SWP Trip Gen Program!!!!!

Now that you know some of the basic theory behind Trip Generation and you have collected your data for your area (ie…housing & employment), you have driven around and know approximately how long it takes to get to places in your area and what part of the town you have the most trips attracted to (the only grocery store or Walmart in a lot of cases!!!).

If you have all those details complete then you are ready to enter the information into the SWP-Trip Generation program. If you are just using this as part of the tutorial, then just pretend like you have done the data collection and know the time it takes to travel around Pilot Mtn!! Now let's get started……..

These things should not be out of your reach after you complete the entire section

-Understand different data types, production/attraction rates and other parameters entered into the SWP Trip Generation Program
-Calculate Non-Home Based Secondary Trips
-Perform reasonableness checks on the output from the SWP-Trip Generation Program
-Be confidant that your P's & A's make sense and can be used in Trip Distribution

What is SWP-TripGen ?

It is an easy to use computer application with a friendly user interface that will take the landuse data that you collect and convert it into balanced productions (P's) and attractions (A's)! Basically it tells you how many trips are being produced and attracted in each zone of your area! The program calculates, on a zonal level, your P's & A's for each trip purpose you define (HBW-home based work, HBO-Home Based Other, NHB-Non-Home Base, etc.). It balances the total trips attracted to the total trips produced, so that we don't have mystery trips with no where to go to!!! The program also saves the data into a format that is TransCAD ready and gives you the ability to check the output data by viewing the appropriate files. These files are very important for checking the reasonableness of your output. File names and how to use them will be covered later in the chapter.

What data do I need to be able to use SWP-TripGen?

Well there are two categories of data you need:

a) **Ones you collect** such as:
- # of dwelling units by classification
- # of employees by category (you know the 5 types discussed earlier in the chapter)
- # of taxis, trucks, commercial vehicles
- External productions/attractions at your external stations (ADT's minus your Thru trips)- this is your EI & IE trips!

b) **Ones you estimate** using your engineering judgement (this is not to be confused with a WAG!)
- Percent of HBW, HBO, NHB and the total internal trip percentage
- Occupancy rates for the DU's
- Generation rates for each DU classification
- Regression Equations for each trip purpose

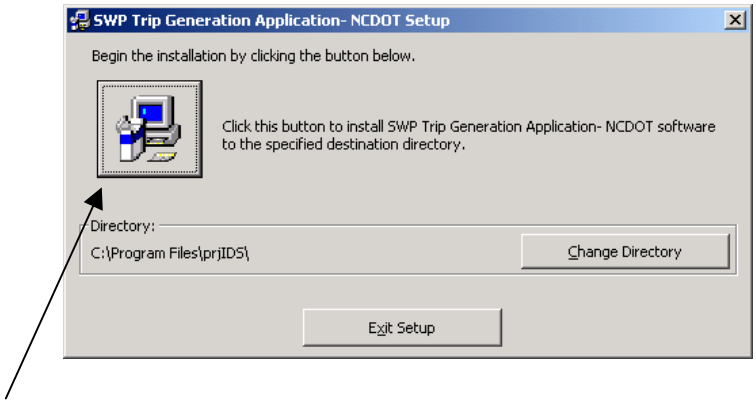
As we go through the program we will discuss the items in the estimated data category in order to help you make better decisions in the Trip Generation step, you know give you some rules of thumb.

The items in the collect category were discussed in the beginning of the chapter so you should know what they are and how to arrive at them.

Ok- if you think you have all the collected data then you can move on to using the program.

Quick Installation Step before we can use the program –You only have to do this one time, not every time you want to use the program!

1) Go to this directory: S:\TransCAD\Trip Generation Program\Package\
   or on the CD go to \Trip Generation Program\Package\
2) You should see a file called SETUP.exe (looks like a computer perhaps?)
3) Double click it to start the installation
4) Click OK on the initial pop-up screen
5) You should see this screen now!

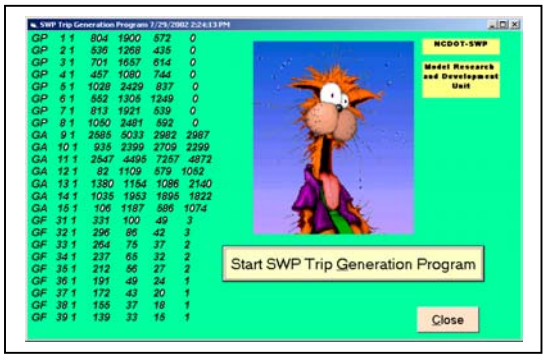


6) Click on the computer button and let it install in the default directory location.
7) Click Ok/Continue until the program has completed the installation

The program is now installed and ready for use!!!

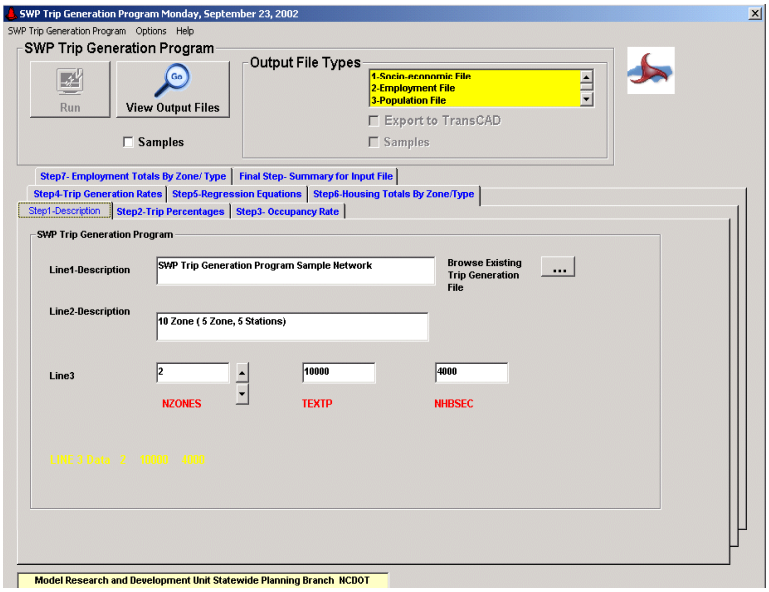
Let's Begin ……

Step 1- Open the SWP-TripGen program by going to the start menu and selecting it under the Programs menu or you can create a shortcut on your desktop. You should see the program screen pop-up. You should see this:



You can jam to the music for a while (by clicking on the cat a bunch of times) and prepare yourself for using the program or just hit START SWP Trip Generation Program.

Now you should see this screen:



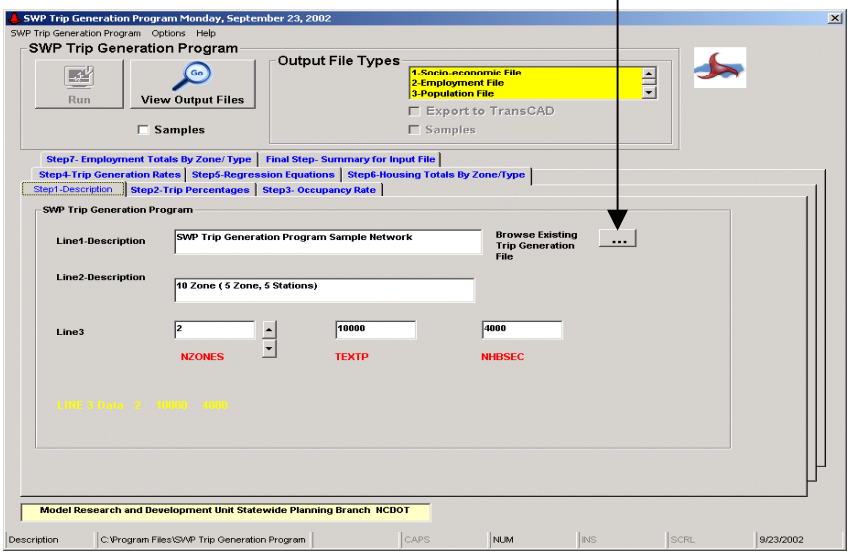
As you can see there are a bunch of TABS on this screen. Each one of them has information for you to enter or to review in order to complete the TripGen program. You do not have to enter your information in any particular order, just whatever method is easier for you. It is recommended to go in order of the tabs (numbered in the Application drop down menu) so that you know where you left off entering/editing your data.

IMPORTANT NOTE: If you already have an old "IDS" file that you would like to use in the new program instead of entering all the data again you can bring in an existing file that was in IDS format. Follow the few steps listed below.

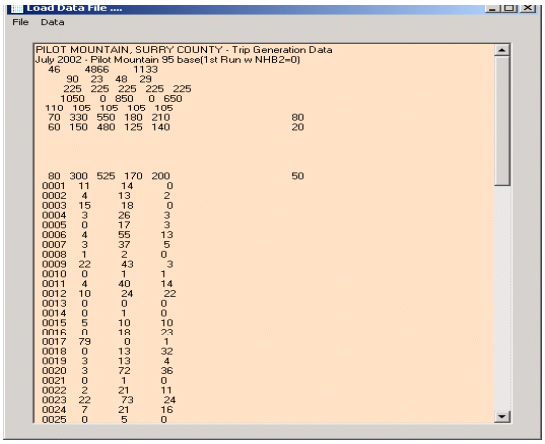
☆ **If you are beginning from scratch then do not worry about the step below, just skip to the TAB 1 section!** ☆

OPENING EXISTING IDS FILE

A) Click the Browse Existing IDS File button



B) Find the file you want to open and click OK. ***(In this case you open the file PMBYiter1.in)***
C) You should see your file open up with a tan colored background similar to this screen:



D) Press F6 or go to the Data menu and select Load Data. You should click OK and then a screen comes up telling you what data was used/imported (like # of zones & file name). Click OK on this screen and your background should change colors to yellow now. You can close the yellow box that shows the file you just imported by clicking the little X and now it has placed your existing data into the Trip Generation Program. You can now use it!!!!!

The next several sections go through each of the tabs in the program to explain in detail:

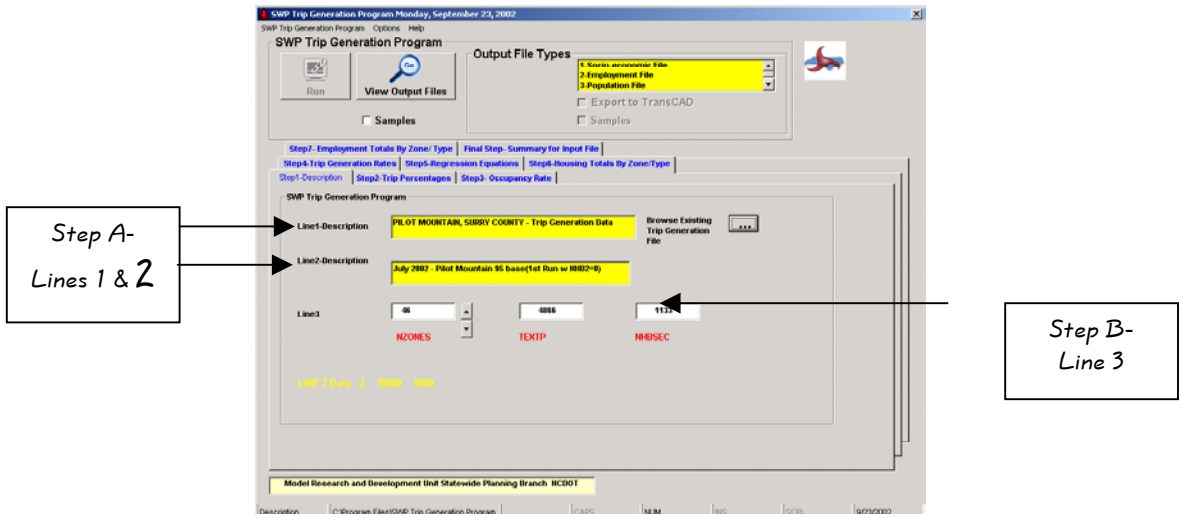
- what information goes in each box
- how to arrive at certain data
- the general theory behind the entire Trip Generation Program and variables associated with it

Using the Trip Generation Program – Step By Step *(All of the examples use the Pilot Mountain files for data)*

So let's start with the first tab, which by default shows up on screen when you begin the program.

STEP 1 -DESCRIPTION

This is generally the first screen you see when you open the program. It is information about your area!



STEP A – GO TO THE LINE 1 & LINE 2 BOXES

These boxes are for general information about your study area and this input file. Things such as the Name of the Area, the year of the data (95 Base or 25 future, etc.) , the engineer responsible for this work. You should enter whatever information helps you to identify this file and the data associated with it !!!!

Enter in your description info and then go to Step B

STEP B – GO TO LINE 3

Here you will see three different boxes:

The first box called NZONES is for you to enter in your total number of zones for your area. Enter in the total number of zones now! **(This INCLUDES your internal zones and external stations!!!)** For the tutorial we are using Pilot Mountain so what number do we use?

Internal zones are 1-36 External Stations are 37-46

So we have: 36 Zones + 10 External Stations = 46 ZONES

This is the number we enter in the NZONES box (see previous Figure).

Mental Note: Make sure that if for some reason you have created dummy nodes that you include this as part of your zone total number!!

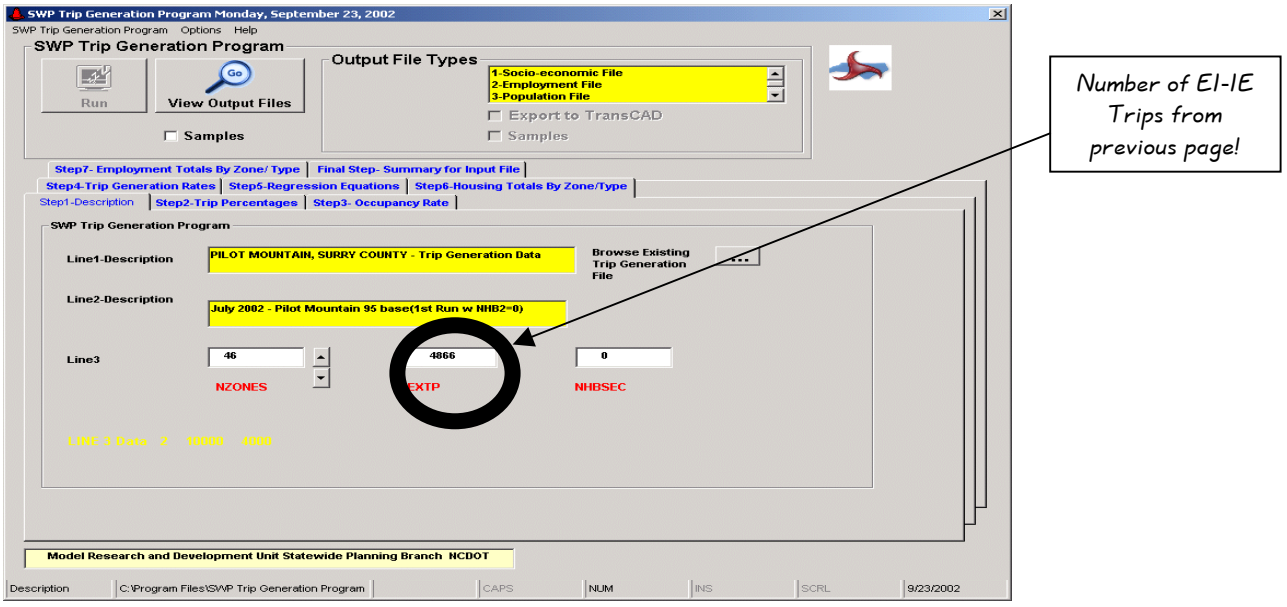
The second box is called TEXTP. This is the number of external station productions. The EI/IE productions, as we call them, are the number of trips that are coming from the people traveling on the facilities at your external station locations. These can be people living outside the area going to one of your internal zones or from an internal zone going outside the planning area to work, shop, etc. The way to get this number is to take each one of your external station ADT's and subtract the thru trips from them (using Synth output or whatever method you have chosen-See Chapter 5). The number you get is the total external productions. Once you have all the external productions calculated, then sum them together and this is the number that goes in the TEXTP box!! As a first run for Trip Generation it is recommended that you use the through percentages calculated by Synth (meaning, don't change them), and then adjust them accordingly before finalizing your P's & A's. See Chapter 5 to learn how to get the through percentage!

Here's the Example for Pilot Mountain(These are the adjusted SYNTH numbers):

Station #	ADT	Through Trip %	Through Trip Ends	EI & IE Trips
37	2000	75	1496	504
38	700	33	230	470
39	2500	75	1874	626
40	4100	90	3688	412
41	22200	98	21752	448
42	3700	81	3000	700
43	420	25	104	316
44	3200	90	2882	318
45	900	30	268	632
46	23670	98	23230	440
Totals=	**63390**		**58524**	**4866**

The number going in the TEXTP box is the TOTAL # of external productions for your area, in this case 4866.

Here's the result:



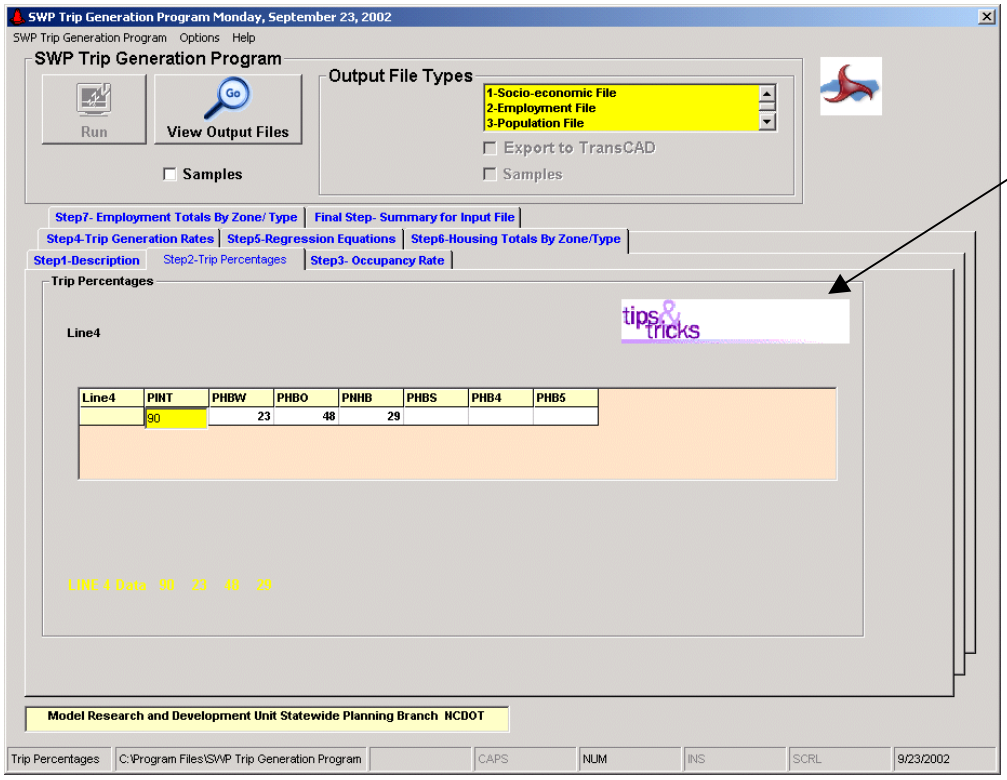
The third box called NHBSEC is the number of Non-home based trips made by people who do not live in the planning area (non-residents). Meaning, I live outside of the Pilot Mountain Planning Area. I drive through an external station to go to my job in downtown. While I am at work, I decide to go get something to eat for lunch and then back to work. The lunch trip is a Non-Home Based Secondary trip in this case.

Another description is people who are "garaged" outside the planning area but make NHB trips inside the planning area. There is an actual calculation to arrive at this number but because we are running Trip Generation for the first time we put a ZERO (0) in this box so that the program will calculate our internal trip numbers. The NHBS trips are based off of our total external productions and internal trip numbers and until we run through the program to get those numbers we cannot calculate a value for the NHBS trips. After you run the program and do the checks on the output you can calculate your NHBS trips and rerun the program to get your final output. ***The calculation of the NHBS trips and the performance checks on the data are covered later in this section, so until then just know why you are using Zero in this box!***

ON TO STEP 2 . . .

STEP 2 – TRIP PERCENTAGES

Here is the way the page looks in the SWP-Trip Generation program:



Clicking on the Tips & Tricks button will give you the description of each box on the Trip Percentages menu!

The trip percentages page helps to define the types of trips that are made in & out of your planning area. Choosing these percentages should be a carefully thought through process, based on the type of area that you are modeling. See the discussion that follows for the different trip types and how you should choose them for your area.

PINT BOX

Typical Range: 80-90

The first box on the menu is the PINT or the Percentage of Internal Trips. These trips are the trips that are produced by the people inside the planning area AND stay inside the planning area. Of all the trips produced by your housing units what is the percentage of those that will stay inside the planning area.

This number depends on the opportunity to make trips in the area based on the types of employment and housing. If you had an area that had a lot of housing but very little employment and most of the people traveled to other areas to work or shop or play(bedroom type community) then your percent internal would be lower. Or if most of the people who work at the big industries in town also live in the area, then they most likely make all their trips inside your planning area. You should know your area well enough to know the answer to these types of questions. You should also think in terms of all the trips people make on an average day…..work, school,shopping, etc. and then think about the businesses in your area….do they provide this type of trip opportunity???

We used 90% for Pilot Mountain.

PHBW Box

This box is for the percentage of Home Based Work trips for your area. It is simply the trip made by people living inside the planning area from home to work. Typically the percentage ranges from 18-25% depending upon the area type. If after collecting your data and calculating your employment to population ratio you got a value over .60, then you could justify raising the HBW percentage to the top of the range. The HBW purpose should typically be the lowest percentage of trips because people typically only make that work to home trip twice a day, whereas you might make several other trips to shop or eat from home on a daily basis. For Pilot Mountain, it is a blue collar area with most of the work trips in industry, so based on the total number of trips and the higher employment to population ratio we used 23% for HBW.

PHBO Box

This box is for the percentage of Home Based Other trips in your area. It is all of the trips that start from the home and end up as a shopping, play, entertainment, etc. type of trip. This is usually the HIGHEST percentage because people make so many other trips in a day and large portion of them are from the home to some other place besides work. Communities that have small distances/times for commuting from home to other types of places would have a higher percentage of HBO trips. If it takes someone only 10 minutes to get home from work then they may go home, change clothes then go to dinner, or to the store. If it took you 30 minutes to get home then you might not go home first before making another trip. The trip would then not be a HBO trip. These are the things you need to take into consideration when deciding on the percentage for HBO trips. The opportunity to make these other trips should aide you in your decision as to the percentage you should use for your area. If you only have one gas station and no Target or Walmart then there probably aren't a lot of these types of trips being made….you get the point? Pilot Mountain was 44%.

PNHB Box

This box is for the percentage of Non-Home Based trips in your area. These are trips that originate at some location other than the home. They are trips to the grocery store on your way home or a trip by the babysitters to get the kids. Generally these trips are about 1/3 of the total trips in the area. Pilot Mountain NHB percentage was 33%.

Note: *There are other boxes located on this screen and they can be used for OTHER TRIP PURPOSES if you need them. Shopping and School trip purposes are generally the other types that are used.*

Here is a table of values for you to use as a starting/comparison point for your study. Note that these are larger urban areas and your values would be different based on the population and type of area you are working with! However, studies have shown that no matter the size if the area the trip percentages seem to remain relatively stable and within the national average.

Purpose	Triangle Survey*	Triad Survey*	Charlotte Region*	National
HBW	22%	20%	19%	18 - 25%
HBO	46%	49%		47 - 58%
NHB	32%	31%		18 - 28%
Non-HBW			81%	

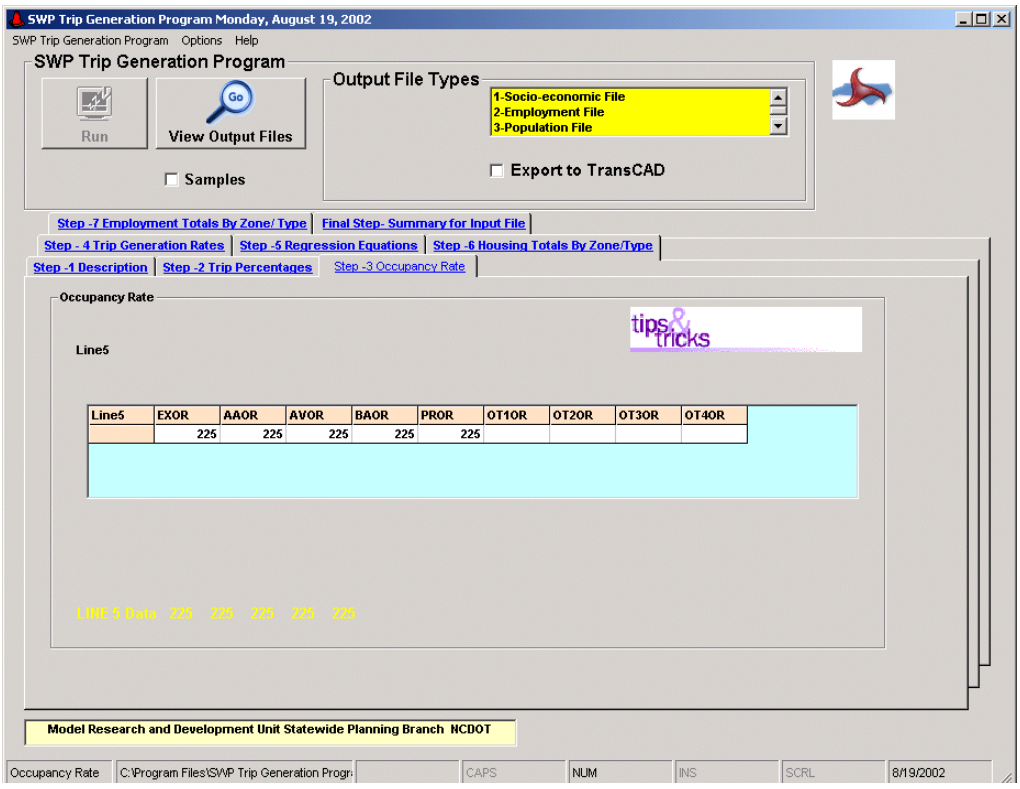
*Incorporates urban and non-urban households

**You are now finished with Step 2 -Trip Purposes….
only six more tabs until you are done!!!!!!!**

STEP 3 – OCCUPANCY RATES

Here's an interesting little tab! It is the occupancy rates for the housing in your area. Logically you would have a different occupancy rate for each type of house in your area because the characteristics for those houses differ. The occupancy would effect the number of trips made by the household if you were doing a cross-classification trip generation model. However, in our SWP Trip Generation program we set our generation rates manually and only have one value for each housing class (as you will see on Tab 4-the next section). Therefore, this occupancy rate is only used to determine the population in your area and then use that value to calculate your employment to population ratio. So what does that mean for you??? What do you need to worry about for this screen??? You just need the average occupancy rate for your area and enter it in all the boxes on this screen. You should know your population for your area and you also know the number of housing units in your area as well. Divide the population by the number of housing units and that is your occupancy rate! Or you may have gotten a occupancy rate for your area from some other source and you can use that here instead.

Here's the screen and the values for Pilot Mountain:



STEP 4-GENERATION RATES

Generation Rates are the average number of trips produced by each of the housing categories in your area. There are also rates for taxi's, trucks and commercial autos. The rates assume this is the total number of vehicle trips made in one day by all people in that dwelling unit. It is assumed that people who have more income (ie…better houses in this case) will make more trips.

The standard rates for Statewide Planning have typically been:

Excellent DU's (EXGR)	=	12 trips/DU
Above Average (AAGR)	=	10 trips/DU
Average (AVGR)	=	8 trips/DU
Below Average (BAGR)	=	6 trips/DU
Poor (PRGR)	=	4 trips/DU

The rates are multiplied by the number of dwelling units, by category, for every zone. The number is the total trips produced by that zone.

As an example, using the standard generation rates and for ZONE 1 you had the following:

Excellent Houses	10
Above Average	15
Average	7
Below Average	9
Poor	14

Then based on the following equation used for determining the productions in each zone:

Total Productions $Zone_i = (EXGR)X_{EX} + (AAGR)X_{AA} + (AVGR)X_{AV} + (BAGR)X_{BA} + (PRGR)X_{PR}$

Where X = number of DU's
i = Zone number

Total Productions $Zone_1 = 12*(10) + 10*(15) + 8*(7) + 6*(9) + 4*(14) = 436$

This calculation is performed for every zone using the designated generation rates.

You should determine your trip rates per dwelling unit based on the data that you collect in your area. You should know the opportunity to make trips in the area, look at the ADT's in the area to get a feel for the amount of traffic, and the classification of your dwelling unit data.

If you have a lot of average DU's and very little poor or excellent then you may need to raise the Average standard rate to a higher value. This is discussed in more detail in the error checking section of this chapter.

You can use the standard rates as a starting point and then adjust them after you complete the first run of trip generation. You can also borrow rates from another area if it is similar in characteristics such as housing distribution, employment type, etc.

Here is a table of values from local surveys. You can see are pretty similar in the trips that are made based on the housing classification:

Vehicle Trip Production Rates

Housing Classification	1995 Triangle Household Survey	Triad Survey	National Data *[FHWA]*
Excellent	9.4*	9.3	11.2
Above Average	9.4*	9.1	11.2
Average	8.3	7.7	8.3
Below Average	6.2*	6.3	5.4
Poor	6.2*	5.7	5.4
All Dwelling Units	7.8	7.4 - 8.0	7.8

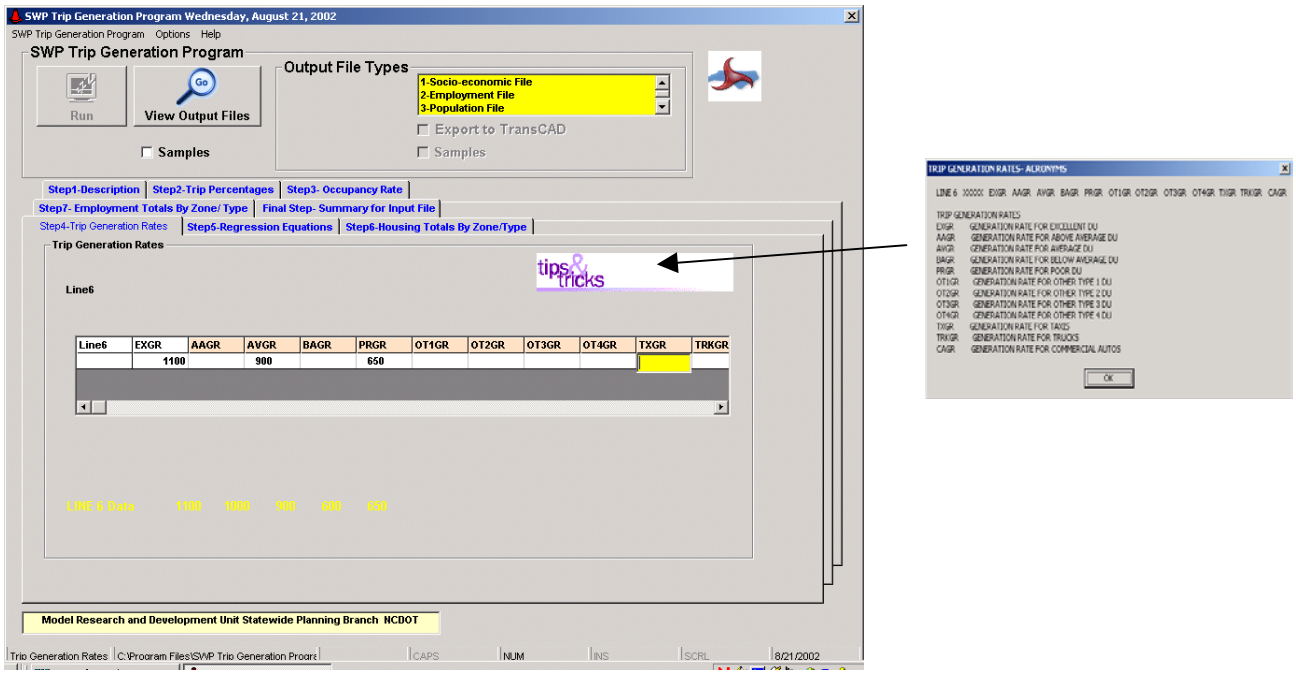
*Categories had to be combined to achieve a statistically significant sample

Taxi's and commercial vehicles(autos & trucks) can add extra trips to the network, especially in urban type areas. You should collect the data for both commercial vehicles and taxi's in your area because they will affect the total trips on your network. The typical rates are

Taxi = 40 Truck = 5.7 Commercial Auto = 4.9

The location of these rates is in the last few columns of the Trip Generation Rates Tab.

Below is the screen to enter in the Generation Rates for Pilot Mountain. There were only 3 housing classification types in this study, therefore only 3 rates are entered into the program. ***Note that you can click on the Tips/Tricks button to determine which column is for which rate!!***



TAB 5 – REGRESSION EQUATIONS

The regression equations are equations that describe the relative attractiveness of each type of employment. How many trips are attracted by each type of employment is key in determining how many trips each zone attracts and ultimately how they are distributed in the next step of the 4 step process. The equations are based on the number of employees for each employment type.

A typical equation may look like this:

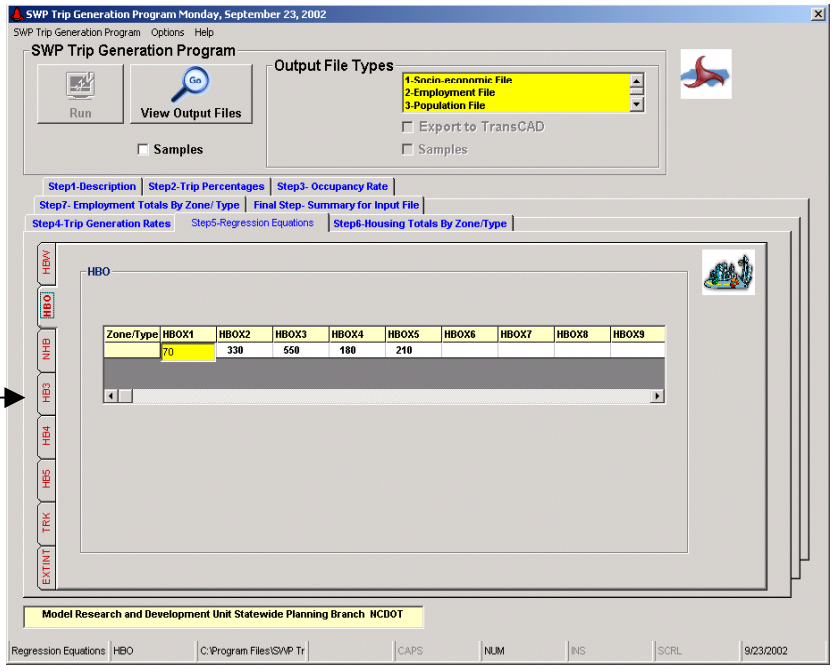
$$\text{HBO Attractions} = .6X_{Ind} + 2.50X_{Ret} + 6.36X_{Hwy} + 1.80_{Off} + 1.90X_{Ser} + .50DU$$

Where: X = Number of Employees & DU = number of dwelling units

It is important to understand that based on this equation, HBO trips would be attracted more to the Highway Retail category than the Industry because the factor for X_{Hwy} is a lot higher than the X_{Ind} factor. If you have things that need to be classified as a special generator (like universities, malls) you can enter in separate attraction equations for them as well.

These equations can be developed from travel survey data or borrowed from other studies. **It is important to understand** that when borrowing equations you should look at the type of city you are borrowing from to determine if the employment types are similar, bedroom community or not, importance of this area for retail (is it the only place to shop), population/employment ratio similar. You should use the borrowed equations as a STARTING POINT for your model development. After running the SWP Trip Gen program you will need to review the results to make sure your equations make sense (the error checking is discussed at the end of this chapter).

The SWP Trip Gen program has a tab(located on the left of the page) for each trip purpose. You must enter the attraction equation for each purpose.



Tab for each purpose. Each one needs its own equation!

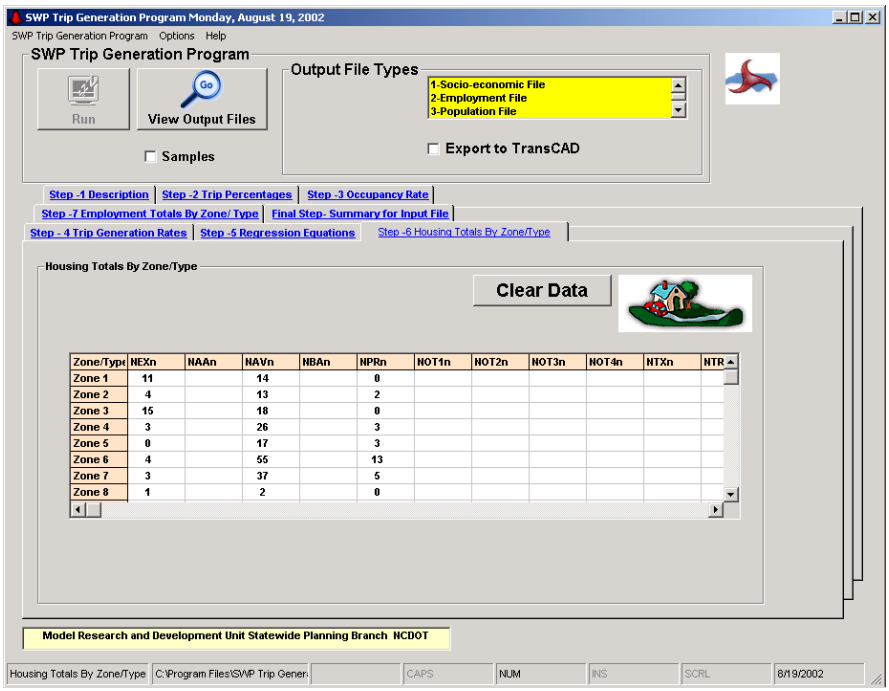
Don't forget to scroll over and enter the attraction for the DU's.

STEP 6 – HOUSING TOTALS

This tab is where all of your housing information is added. You should follow the column headings when entering the data to assure you have your data in the right columns. Here are the column headings and what they mean for the housing sheet.

ZONEn	***Zone number for which data applies***
NEXn	***Number of Excellent Dwelling units for ZONEn***
NAAn	***Number of Above Average Dwelling units for ZONEn***
NAVn	***Number of Average Dwelling units for ZONEn***
NBAn	***Number of Below Average Dwelling units for ZONEn***
NPRn	***Number of Poor Dwelling units for ZONEn***
NOT1n	***Number of Other 1 Dwelling units for ZONEn (ie. Dorm Rooms)***
NOT2n	***Number of Other 2 Dwelling units for ZONEn (ie. Motel Rooms)***
NOT3n	***Number of Other 3 Dwelling units for ZONEn***
NOT4n	***Number of Other 4 Dwelling units for ZONEn***
NTXn	***Number of Taxis for ZONEn***
NTRKn	***Number of Trucks for ZONEn***
NCAn	***Number of Commercial Autos for ZONEn***

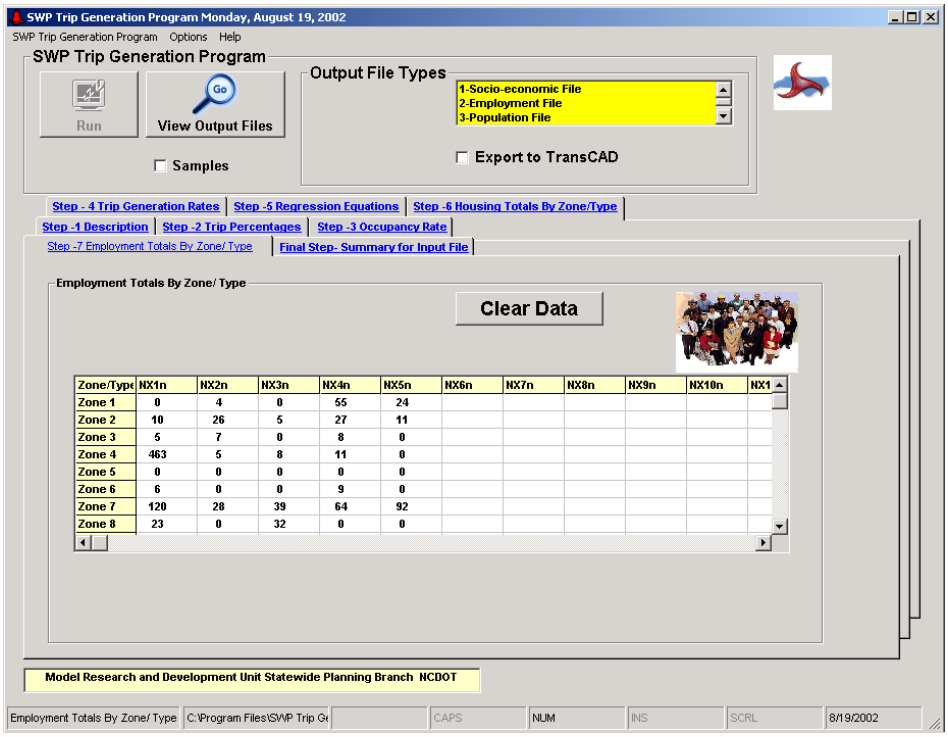
Here is the Pilot Mountain Housing Totals by Zone:



TAB 7 – EMPLOYMENT TOTALS

This tab is where all of your employment information is added. You should follow the column headings when entering the data to assure you have your data in the right columns. Here are the column headings and what they mean for the employment sheet.

ZONEn	***Zone number for which data applies***
NX1n	***Group 1 Employment (typically Industrial Employment)***
NX2n	***Group 2 Employment (typically Retail Employment)***
NX3n	***Group 3 Employment (typically Highway Retail Employment)***
NX4n	***Group 4 Employment (typically Office Employment)***
NX5n	***Group 5 Employment (typically Service Employment)***
NX6n	***Group 6 Employment (typically Other Employment)***
NX7n	***Group 7 Employment (typically Other Employment)***
NX8n	***Group 8 Employment (typically Other Employment)***
NX9n	***Group 9 Employment (typically Special, ie Shopping Center)***
NX10n	***Group 10 Employment (typically Special, ie Strong CBD)***
NX11n	***Group 11 Employment (typically Special)***
NEXTPn	***Total External Trip Productions (Station Counts minus Thrus)***



IMPORTANT NOTE: Don't forget to enter in your external station productions at the bottom of your employment. You should scroll down to the external station numbers and enter in the productions in the NEXTPn column

Here's the Example for Pilot Mountain for the external stations:

Station #	ADT	Through Trip %	Through Trip Ends	EI & IE Trips
37	2000	75	1496	504
38	700	33	230	470
39	2500	75	1874	626
40	4100	90	3688	412
41	22200	98	21752	448
42	3700	81	3000	700
43	420	25	104	316
44	3200	90	2882	318
45	900	30	268	632
46	23670	98	23230	440
Totals=	**63390**		**58524**	**4866**

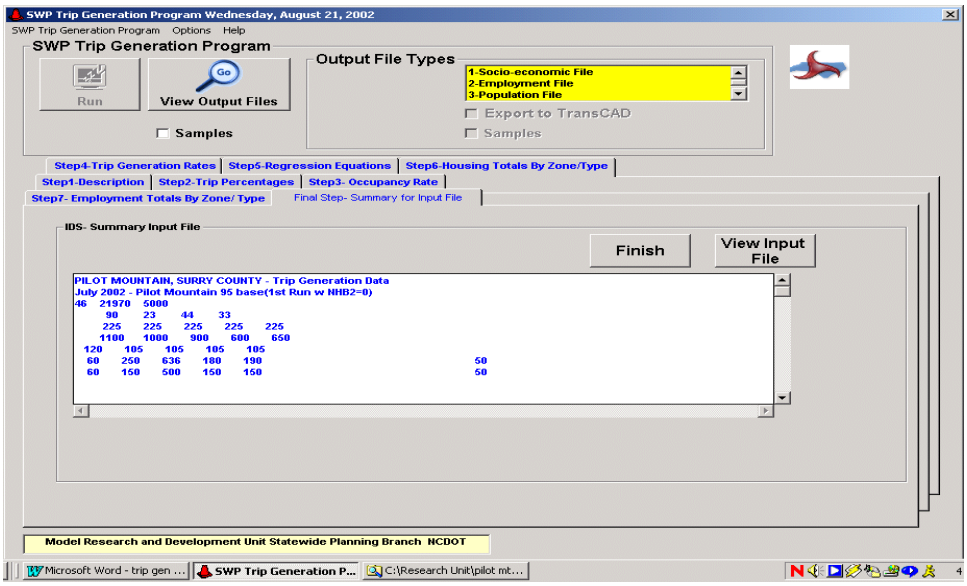
The last column of numbers (EI & IE trips) are the numbers you enter into the SWP trip generation sheet.

Zone/Type	NX3n	NX4n	NX5n	NX6n	NX7n	NX8n	NX9n	NX10n	NX11n	NEXTPn
Zone 37										504
Zone 38										470
Zone 39										626
Zone 40										412
Zone 41										448
Zone 42										700
Zone 43										316
Zone 44										318

You have now entered in all the data necessary to run the trip generation portion of the model for the first time. Congratulations!!

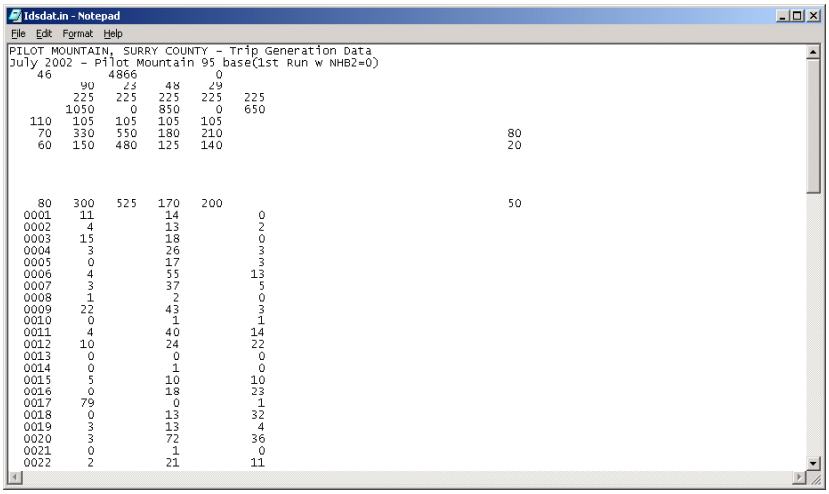
Note: If you have changed any of your through trip percents you have to rerun trip generation with the new productions from the SYNTH calculations!!!!!

All you have to do is go to the tab labeled FINAL STEP. It should look like this:



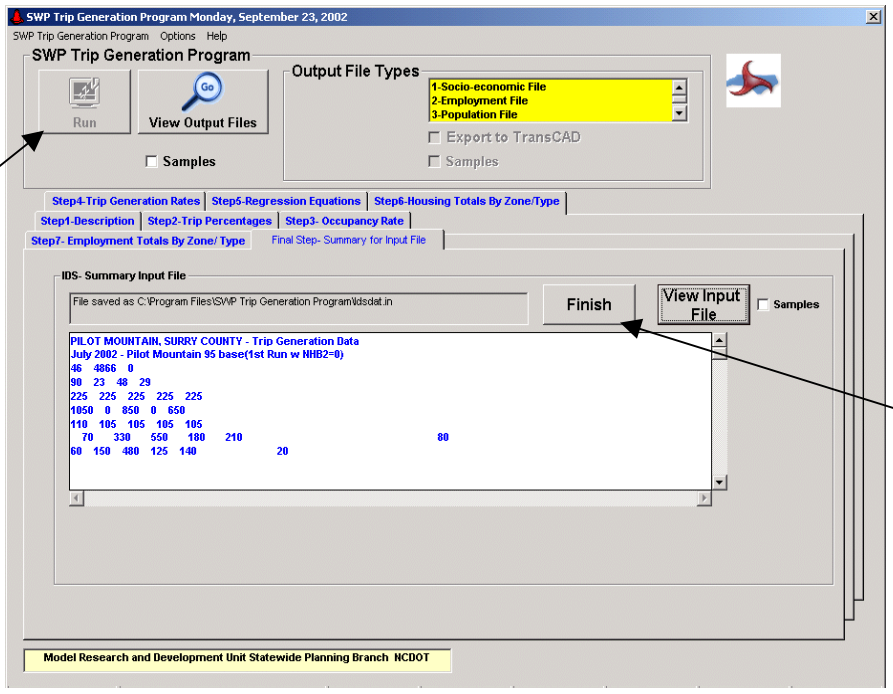
You can review your trip generation file by clicking on the View Input File **button. This will bring up your text file in notepad so that you can scan through it for possible errors.**

It will look similar to this:



When you are done reviewing the file you can close it by clicking the X in the corner.

In order to prepare your file for running in the trip generation program you must click on the Finish button. You should see the Run button become active at this point.

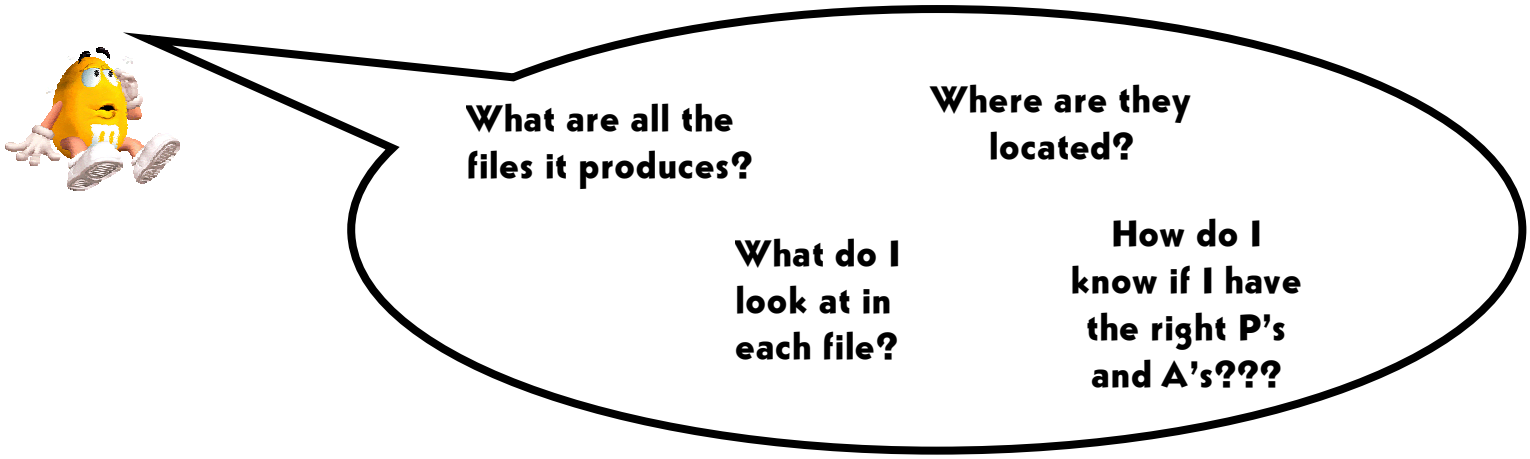


Click the RUN button and you will see the IDS screen flash briefly on your screen. ***You have now run the Trip Generation portion of the model***. However, you have done it with ZERO (0) NHB Secondary trips. We now can start the error/reasonableness checking to make sure we have the correct productions and attractions in each zone, that our regression equations are producing the correct results, and the percentages of trip types are accurate.

On to Reasonableness Checking.....

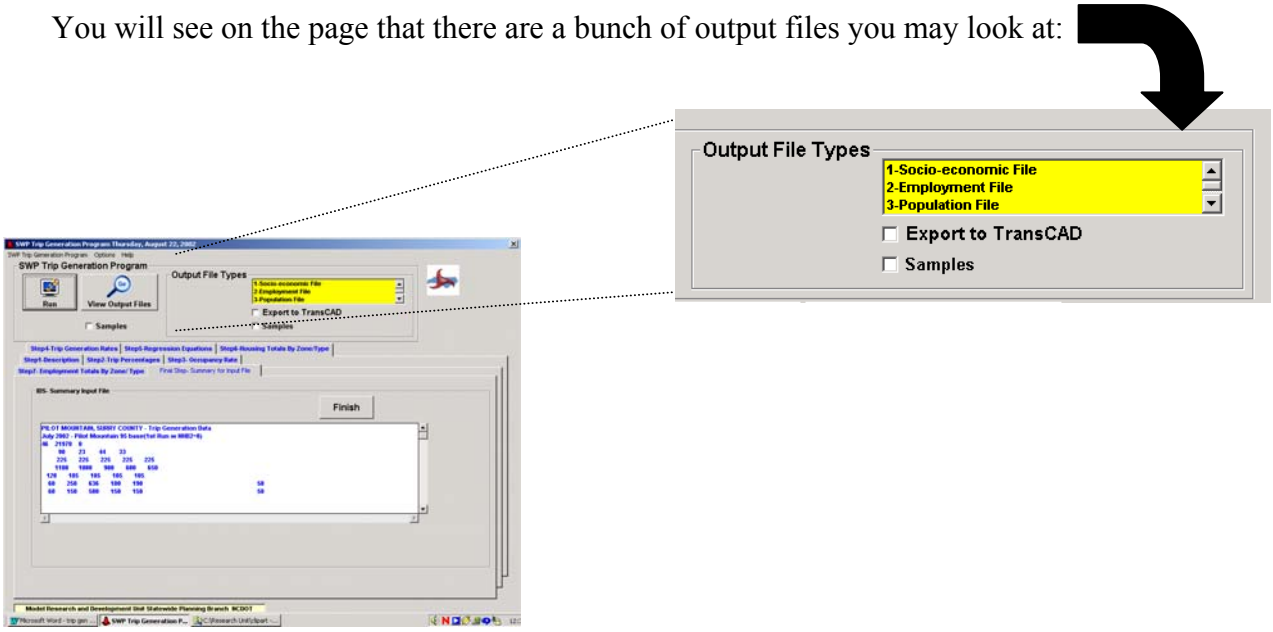
Trip Generation Reasonableness Checking

You are asking yourself.....



Let's start with the output files and what's in them

You will see on the page that there are a bunch of output files you may look at:



In order to view the files you must highlight the file you want to see and click View Output Files 

The output file will be opened as a text file for you to review the results.

Sorting Through the Files

Socio-economic File - This file displays the number of dwelling units by classification. You should check the totals for each one of your classifications and make sure they match the field collected data that you have!!! If you have commercial vehicle and taxi information it will be located in this file as well.

Employment File – This file displays the number of employees by type in your area. It should match the data from your field survey. You should review the totals for each type to assure that the data was entered properly.

Population File – This file shows the number of persons in each zone based on your dwelling unit inventory. It takes the occupancy rate you enter and uses it to calculate the total number of people in each housing classification for all of your zones. You should perhaps use another source of data to check against this population result to assure it is reasonable. The population total shown in the lower right of this file should closely match the total population you have determined for your study area.

Internal Trip File – This file displays the trips **produced internally** (you know by the houses!!) in your study area. You can look at each zone and see how many trips are being produced. It is a good way to see an error jump out at you…. like if one zone has 2000 trips being produced but there are only 25 dwelling units in it, then maybe there is an error in your data somewhere.

Calculations Trip File – This is the BANG for YOUR Bucks FILE!!!!!
This file gives the results of the unbalanced P's & A's, the checks on your rates & average trips, shows you the trips produced for each trip type and displays the totals for the balancing of the P's & A's. The real ERROR Checking for Trip Generation comes from an understanding and review of this file!

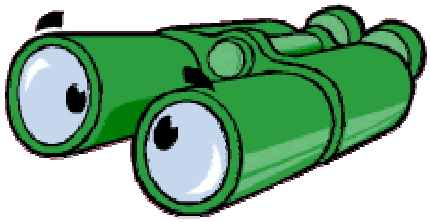
P-A's Trip File – This is the text file output of your balanced P's & A's from the Trip Generation Program. It has the attractions and productions for each type of housing, employment for each zone in the study area. This file is formatted and used in TransCAD to perform the final balance on your P's & A's.

This files are located in this directory:

C:\Program Files\SWP Trip Generation Program

If you would like to save your interations into another directory you can copy & paste them and rename them as you see appropriate.

Reminder: If you make changes to this file on screen then those saved changes are the IDSDAT.in file located in the directory above. You should change the name and save it in another location so that it doesn't get overwritten!!



REASONABLENESS CHECKING.....WHAT SHOULD I LOOK AT??

The calculations file is the starting point for your error checking. There are a lot of things to be checked in this file for reasonableness. You should print out the file and use it to perform your calculations either by hand or in a spreadsheet where you can keep track of the changes you made.(You can use the file called TGEN CHECKS.XLS located in the Trip Generation folder to calculate your PA ratios!)

Here's an example of a spreadsheet to track results. See the Next page for the actual calculation file that was used to fill out this spreadsheet.

MAKE SURE YOU KNOW WHERE THESE P'S & A'S COME FROM!!!

THEY ARE SHOWN ON THE NEXT PAGE WITH A STAR

Final Iteration - adjusted Ext prod to Synth fratared totals, include

Trips produced by housing units	10893
Internal of Total	90%
Internal Trips	9804
% HBW	23%
%HBO	48%
%NHB	29%
HBW Trips	2255
HBO Trips	4706
NHB Trips	2843
Total CV Trips	0
Internal CV Trips	0
External Station Productions	4866
Average Generation Rate	8.52
Employment/Population Ratio	0.77

Check Unbalanced Ps and As	Ps	As	P/A
HBW	2257	2374	0.95
HBO	4708	4937	0.95
NHB	2845	3084	0.92
IX	4866	4484	1.09
Total	**14676**	**14879**	**0.99**

```
         IDS CALCULATIONS for Pilot Mountain

PILOT MOUNTAIN, SURRY COUNTY - Trip Generation DataJuly 2002 - Pilot Mountain 95 base(1st Run w NHB2=0.July 2002 - Pilot
Mountain 95 base(1st Run w NHB2=0.
***WARNING*** Your average generation rate of  8.52 seems high.
    Average should be between  7-8. PLEASE CHECK.

*** WARNING ***  The Generation Rate for Above Average Households   0.00 is too high/low.  Normal Range is from 9 - 11.
*** WARNING ***  The Generation Rate for Below Average Households   0.00 is too high/low.  Normal Range is from 5 - 7.
*** WARNING ***  The Generation Rate for Poor Households   6.50 is too high/low.  Normal Range is from 3 - 5.
*** WARNING ***  The Generation Rate for Taxis   0.00 is too high/low.  Normal Range is from 30 - 50.
*** WARNING ***  The Generation Rate for Trucks   0.00 is too high/low.  Normal Range is from 6 - 9.
*** WARNING ***  The Generation Rate for Commercial Autos   0.00 is too high/low.  Normal Range is from 6 - 9.
***WARNING*** Your emp/pop ratio of   0.77 is out of range.  PLEASE CHECK.
     Allowable Ranges for Employee/Population Ratio
      EMP/POP         INT OF TOTAL
       40-50%           80-85%
       50-60%           85-90%

TRIP STATISTICS
-----------------------------------------------
TRIPS PRODUCED BY THE HOUSING UNITS =    10893

INTERNAL OF TOTAL  = 90.0%    INTERNAL TRIPS =     9804
HBW OF INTERNAL    = 23.0%    HBW TRIPS =     2255
HBO OF INTERNAL    = 48.0%    HBO TRIPS =     4706
NHB OF INTERNAL    = 29.0%    NHB TRIPS =     2843

COMM VEH TRIPS    =        0 INTERNAL =        0
         TRIPS PRODUCED BY EXTERNAL STATIONS =     4866
                       NHB SECONDARY TRIPS =        0

AVERAGE DU GENERATION RATE =   8.52 Trips/DU
     (Only include the 5 standard housing classes)

EMPLOYEE/POPULATION RATIO =   0.77
 (Total Employees in X1 - X8)

REGRESSION COEFFICIENTS
-------------------------------

            X1    X2    X3    X4    X5    X6    X7    X8    X9   X10   X11  DU S CONST
HBW       1.10  1.05  1.05  1.05  1.05  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
HBO       0.70  3.30  5.50  1.80  2.10  0.00  0.00  0.00  0.00  0.00  0.00  0.80  0.00
NHB       0.60  1.50  4.80  1.25  1.40  0.00  0.00  0.00  0.00  0.00  0.00  0.20  0.00
ENT-INT   1.00  1.50  5.10  1.60  1.50  0.00  0.00  0.00  0.00  0.00  0.00  0.25  0.00

CALCULATED ATTRACTION FACTORS
-----------------------------
   ZN      HBW      HBO      NHB    EX-IN
    1       87      182      113      136
    2       83      207      121      138
    3       21       67       30       36
    4      534      430      343      536
    5        0       16        4        5
    6       16       78       29       38
continues for every zone but not all zones displayed here……
   45        0        0        0        0
   46        0        0        0        0
      -------- -------- -------- --------
     2374     4937     3084     4484
```

THESE ARE THE UNBALANCED ATTRACTIONS THAT GO INTO YOUR SPREADSHEET!!!

```
-- Calculation of Productions and Attractions ------------------------------
  ZONE     TOTAL   INTERL      HBW      OHB       CV      NHB   NHBsec     TNHB      EXT      HBW      HBO      NHB    EX-INT
           TRIPS    TRIPS     PROD     PROD     PROD     PROD    TRIPS    PRODS    PRODS    ATTRA    ATTRA    ATTRA     ATTRA
    1       235      212       49      102        0      104        0      104        0       83      174      146       779
    2       166      149       34       72        0      112        0      112        0       79      197      156       790
    3       311      280       64      134        0       28        0       28        0       20       64       39       206
    4       273      246       57      118        0      316        0      316        0      508      410      443      3070
   Continues for every zone but not displayed here….
   46         0        0        0        0        0        0        0        0      440        0        0        0         0
       -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- ---------
        10893     9806     2257     4708        0     2845        0     2845     4866     2258     4707     2848      4864
```

PRODUCTIONS USED IN THE SPREADSHEET

FOR THE NHB PRODUCTIONS YOU MUST ADD THE COMMERCIAL VEHICLES AND NHB TOGETHER FOR THE TOTAL

Look at your calculation file and spreadsheet when going through these steps!

1. Check Average Rate per DU -

   Should be 7-8 trips per DU

   Yours is < 7 then increase your generation rates
   Yours is >8 then decrease OR know why you can justify it being higher!!!

2. Trips per capita (you know trips/population)

   Take the total trips produced by the housing units (shown in the calc file) and divide out your population (from your population file)

   It should be 3-4 trips/person……usually higher than 3.5….if not then raise or lower your rates accordingly. Or check your occupancy rate, you might have your population wrong!

3. Check % by purpose and % internal –
   Do they fall into a respectable range based on the conditions in my area? Compared to survey results?

4. **Check UNBALANCED P's & A's by purpose & for the region. VERY IMPORTANT!!!**

   Your P/A ratio for each purpose should be in the range of .9 - 1.1

   If ratio is off then check the attraction equations and make changes.

Here are the attraction rates for the Triangle Survey to use as a guide:

Vehicle Trip Attraction Rates*

Employment Type	HBW	HBO	NHB	IX
Industry	1.2	0.63	1.1	0.34
Retail	1.2	3.4	1.0	0.49
Highway Retail	1.2	4.2	4.0	0.28
Office	1.2	1.2	1.1	0.28
Service	1.2	2.0	1.9	0.28
Dwelling Units	0	0.9	0.13	0.33

*Rates obtained from 1995 Triangle Household Survey

5. Check for reasonableness of your External to Internal Trips!!!

   Do I have more externals than internals?-Should that be the case?

   What type of attraction is there in my area? Are people gonna come here just to get gas(ie..highway retail attraction factor)?

   Maybe my through trips are not correct?

These steps might take several iterations!! You should think about the numbers logically and make a decision that you can understand and rationalize. Don't try and change 3 or 4 factors at once (like attraction equations and generation rates simultaneously), because then you will not understand what is actually happening in the generation process.

Keep in mind that there is no "Cook Book" for what changes to make to your model but just some general guidance. Each area is so different that knowing your area and using your intuition after looking at the ranges discussed above, should get you in the right direction.

After you have made the changes you feel necessary and are comfortable with the results from your reasonableness checks then you can calculate the Non-Home Based Secondary trips(Use NHB2.xls to perform the calculation of these trips-the spreadsheet is displayed below), enter them into the trip generation program and finally get the final P's and A's from the SWP Trip Generation Program.

CALCULATION OF NON-HOME BASED SECONDARY TRIPS (NHB2) Pilot Mountain		
Trips produced by External Stations (E-I)	(Line 1)	4866
Trips produced by Housing Units (Ih-Ih and Ih-Eh)		10893
Internal Trips Produced By Housing Units (Ih-Ih)		9804
External Trips produced by Vehicles garaged within the P.A. (Ih-Eh)	(Line 2)	1089
Factor (ranges from 0.3 to 0.6, depending on opportunities to make extra trips)	(Line 3)	0.30
Trips within planning area that originated from outside the planning area (NHB2)		**1133**

The final calculation of the Non-Home Based Secondary Trips within the planning area is performed this way:

NHBS = (Total External Trips - Total EI Trips inside planning area)*Opportunity factor
OR
NHB Secondary = (Line 1 - Line 2)* (Line 3)

You must re-run the Trip Generation Program in order to get the correct P's & A's matrix that accounts for the NHBS trips!!

Keep in mind that the number of NHBS trips can heavily effect the other steps in the model development process and you should not overestimate them. NHBS trips are made in similar fashion to NHB trips by residents in the area…typically the percentages are close.

Chapter 5 - Through Trips

At the end of this chapter you should:

* understand what through trips are
* determine, by using SYNTH, your through (external-external) trips
* check to assure the through trips were balanced correctly

By now we understand that a through trip is someone living outside our planning area who travels on a series of roadways in our area but never makes a stop inside of our planning area. They travel from one side of the planning area to the other, thus making a trip through the area. Since external travel can have such an impact on the traffic characteristics in your area it is important to be able to accurately reflect this travel pattern.

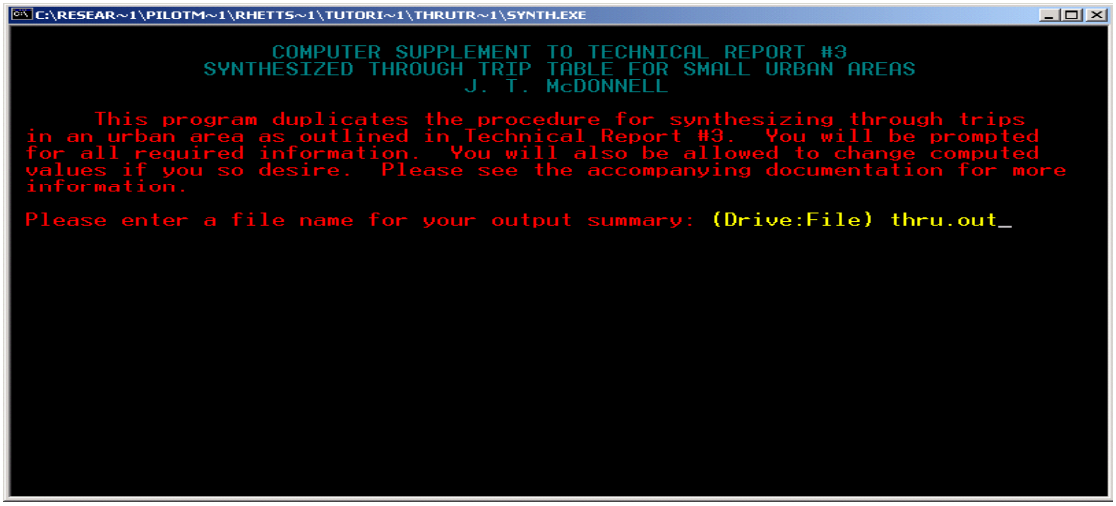
The best estimate of through trips is to use travel survey data to determine the through percentages on your routes. If travel survey data is not available then the use of SYNTH, a computer program, might be necessary. The SYNTH program uses regression equations to estimate the number of through trips at external stations and also to determine how those trips are distributed between all of the external stations.(For information on the equations and the research on external station development see Technical Report #3, Modlin or NCHRP829)

This method is only valid for small urban areas, ie…..population under 50,000. It should be noted that in areas where the population is less than 8-10,000, the estimated through trips may be incorrect due to the data that was used when the equations were developed. IN ANY CASE, IT IS IMPORTANT TO UNDERSTAND THAT THE THROUGH TRIP PERCENTAGES THAT ARE ESTIMATED FROM SYNTH SHOULD BE USED AS A STARTING POINT OF REFERENCE AND SHOULD BE ADJUSTED BASED ON YOUR KNOWLEDGE OF THE AREA.

How to use SYNTH since you don't have travel survey data!

Step 1: Copy the SYNTH directory from the N drive to your computer(or from the CD). The program will output files into the same directory in which the executable is located so you should place this directory in a location with the rest of your model files.

Step 2: Begin the program by double clicking on the SYNTH.EXE file. You should see something like this:

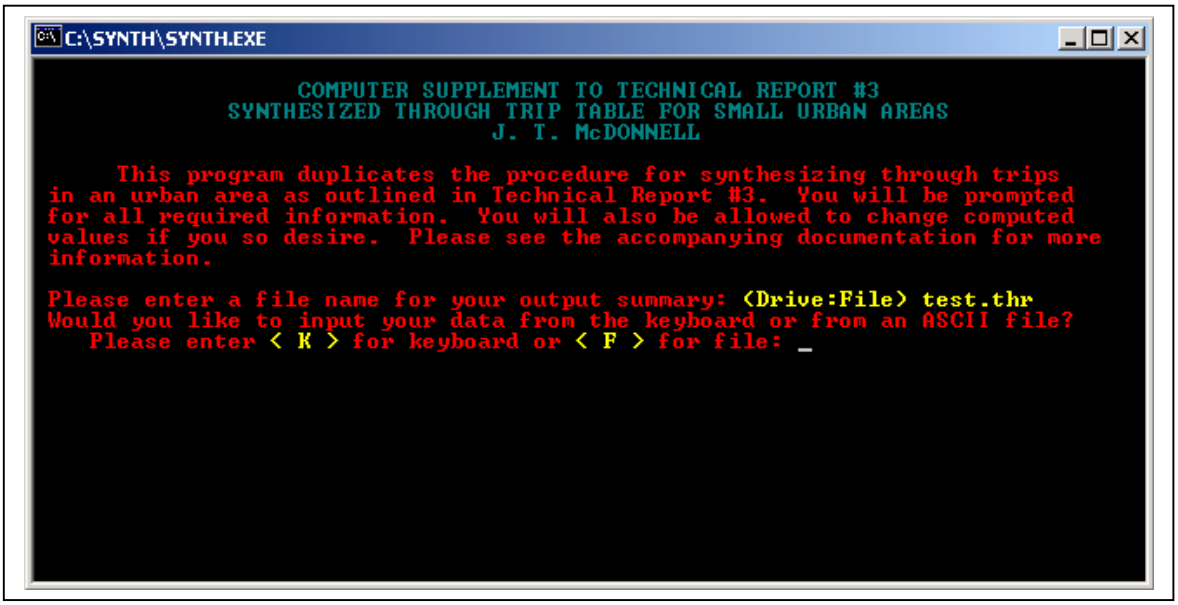


Once this screen is up you type in the name of your summary output file. Type the entire address for the location you want to save it. So for the example window on the previous page you would enter:

C:\RESEAR~1\PilotM~1\rhetts~1\tutori~1\thrutr~1\thru.out

Note: If you just type in c:\test.thr then it will place the output file in the directory that the SYNTH executable file is located.

And just to be safe turn on the caps lock button because the program only accepts capital letters as input for most of the questions it asks!!!!



Step 3: You can enter in your data from the keyboard directly or you can read a file into the program.

Entering the data by hand(using the keyboard) –Read this section but the tutorial uses a file already created!

If you choose to enter the data by the keyboard you will have to answer the following questions for each external station:

1 - Description of the Station
2 - Functional Classification of the Road (Comes from the classification maps)
3 - Average Daily Traffic (ADT) – (Comes from ADT book or from special traffic counts you have taken)
4 - Percentage of Trucks on the Facility (Enter the percent as a whole number,e.g. ten percent would be entered as 10) – can get from special counts or estimated from the general roadway characteristics for North Carolina

It will ask you if you want to save the file once you enter in all the information. You should save this file because if not then you will have to re-enter all of the information again, next time you use the program!!!!

USING A FILE TO READ THE STATION INFORMATION

You must create this file by hand using something like Excel, Wordpad, Notepad.
There are certain items that must be included in this file in order for it to be read into SYNTH.
Here is was the input file should look like:

```
Pop of Area , Number of External Stations
Station Description , ADT , % Trucks, Functional Classification
(Repeat Previous Line until Station information is entered)
.
.
.
From Route Station ID , To Route Station ID    (Note:  this is NOT your station number but the ID assigned
.                sequentially by the SYNTH program)
.
.
0,0              (This designates the end of the file!!)
```

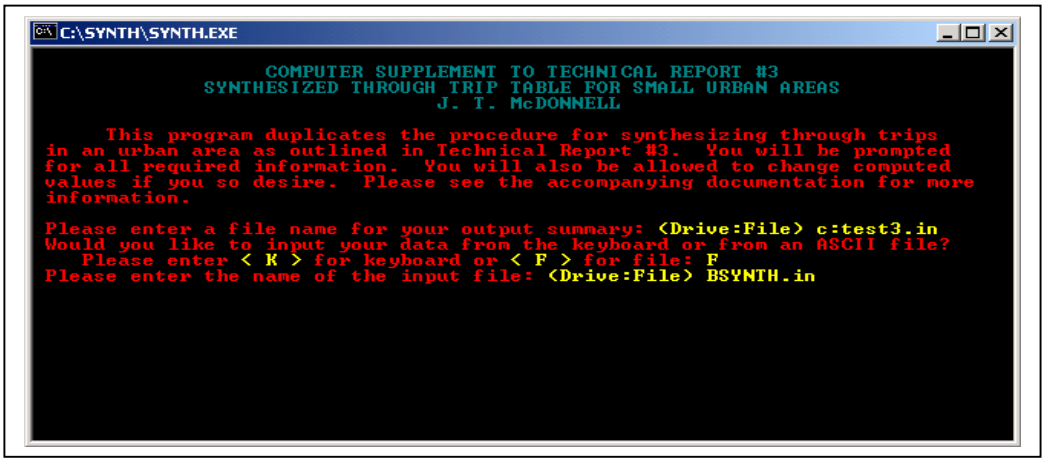
This is a comma delimited file, meaning there is a comma located between each piece of data. A finished file should look like this:

```
2752,10
37-SR 1901(KEY ST),2000,3,L
38-SR 2012(OLD52),700,3,L
39-SR 2048(SHOALS),2500,3,L
40-NC268 WEST ,4100,6,J
41-US 52 NORTH,22200,12,P
42-SR1809(WESTFLD),3700,3,L
43-SR 1837(CARSON),420,3,L
44-NC 268 EAST,3200,6,J
45-SR 1855(OLD52),900,3,L
46-US 52 SOUTH,23670,12,P
1,2
2,1
4,8
8,4
5,10
10,5
0,0
```

The functional classification code used in SYNTH corresponds to this classification chart:

I = Interstate
P = Principal Arterial
M = Minor Arterial
J = Major Collector
L = Minor Collector / Local Road

If you choose the file read option you will get this screen in which you enter the filename you want to load.



For this tutorial use the file PMSYNTH.in (located in the thru trip folder).

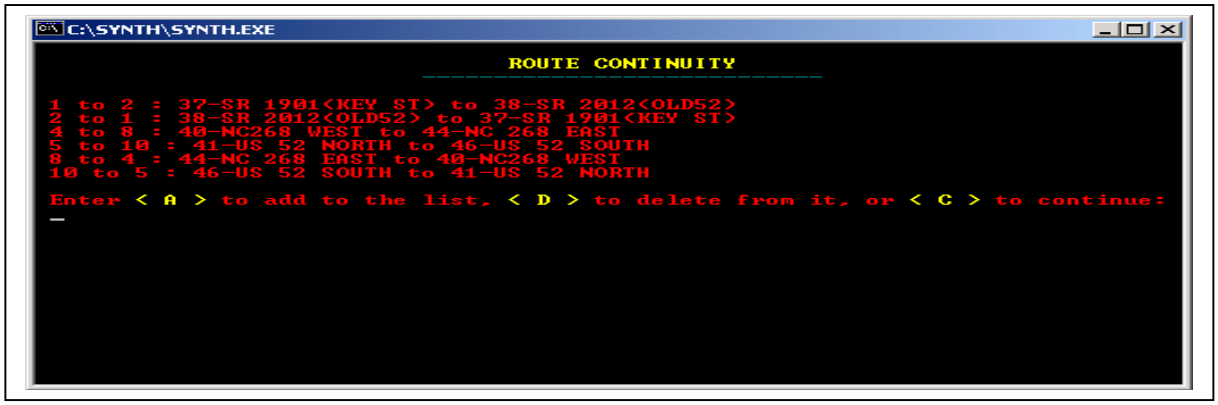
You can edit the basic input data on the screen if you see data that needs to be changed. Enter in the new data as directed by each of the questions (HIT enter if you don't need to change that piece of data) and then choose N after you are sure your data is entered correctly. You may have a lot of external stations that will cause you to use more lines on the screen in order to get the data into the DOS window. Unfortunately, DOS limits the number of lines displayed so you may not be able to see what is being estimated by the program for some of your earlier stations. It is recommended that you leave the percentages and run through the entire SYNTH program and printout your final report which shows the percentages. Then restart the program and adjust your through percentages after looking at the output from the first run.

Your through trips for each station are now estimated through the use of regression equations and displayed on screen. You may hand adjust the percentages by choosing Y when it asks if you would like to change the Through Trip Percentages (PTTDES). If your area is less than 10000 then chances are the through percentages on your major routes are being underestimated by the program due to the fact that the regression equations did not have any areas with less than 10,000 when they were developed. You should most likely increase your percentages in this case.

Note: If you change the through percentage it will not be saved in the text file so you will have to change it every time you rerun the program. Therefore keep the output files stored logically so that you know what you used for your variables.

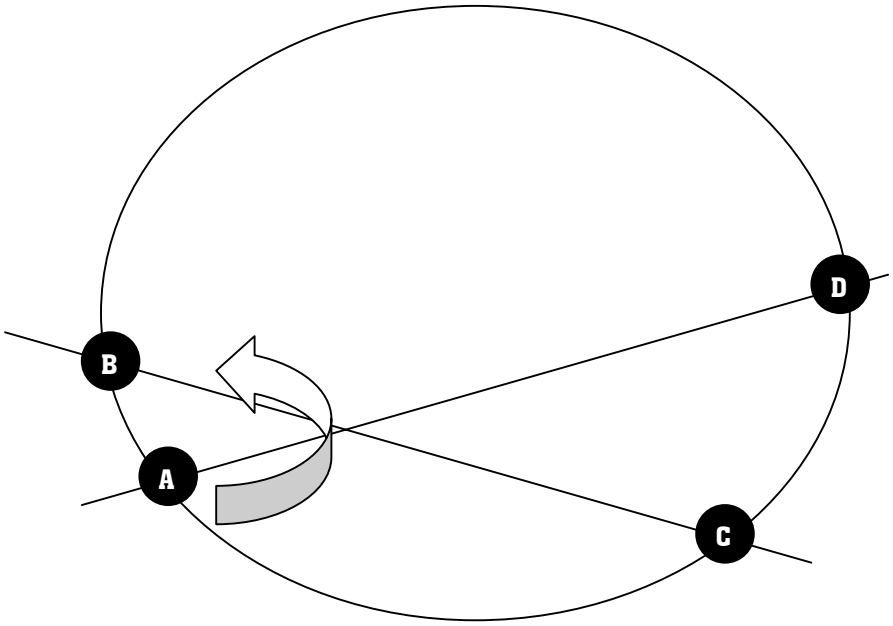
Once you are happy with the through trip percentages on each of your external stations you tell the program you do not want to change any of the percentages (answer "N").

Step 4 –Route Continuity
If you are reading from a file then the route continuity should come up on screen and be similar to this:



When entering in your route continuity you should think about which routes will serve the best continuous path for people to make their through trip. Your main routes are/should be entered in as continuous from both directions (usually the higher functionally classified routes). They do not have to be the same route to be considered continuous.

One thing that is important to consider for continuity purposes is the geographical location of all of your external stations. You may have a case where you have two major routes that are almost parallel or exist in such a way that people do not enter at point A and exit at point B (as shown below). In cases like this, it is important to make routes continuous to all the other higher functionally classified locations so that a large portion of the through trips are not assigned to the Road A to Road B combination!!!!



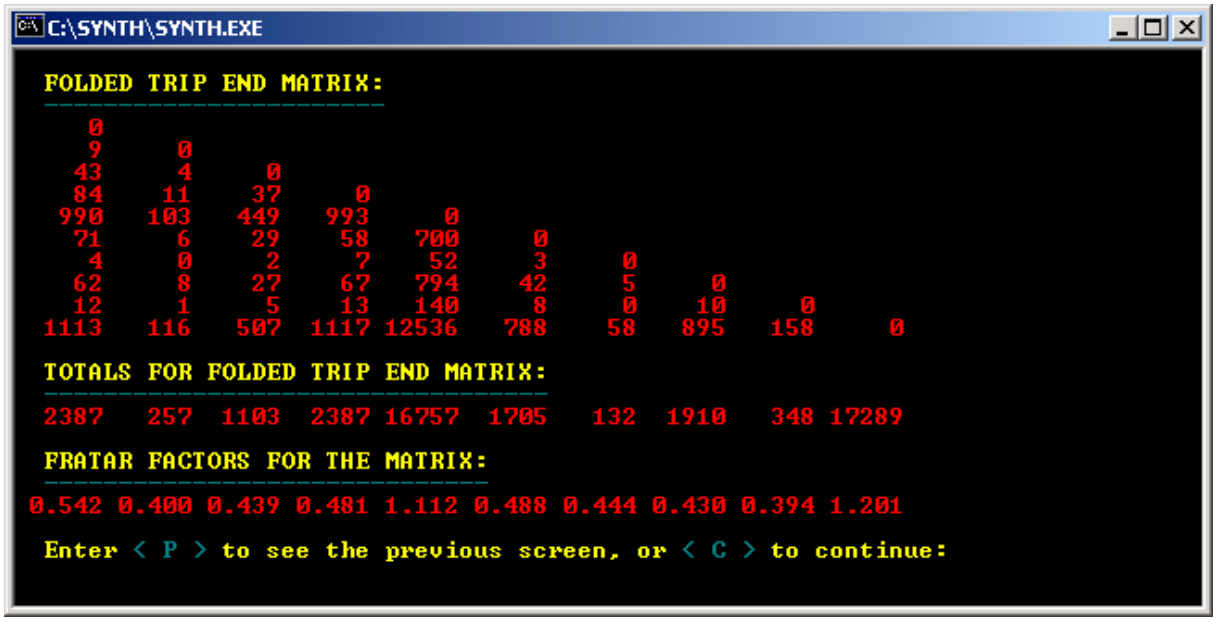
In this case you would want to make continuous routes from :

A to D
D to A
A to C
C to A
C to B
B to C
D to B
B to D

Basically you make your routes continuous from Point A to all other locations except for Point B so that less through trips are assigned to that route. You should only worry about this continuous routes issue on the routes that are NC routes and higher in most areas!!!

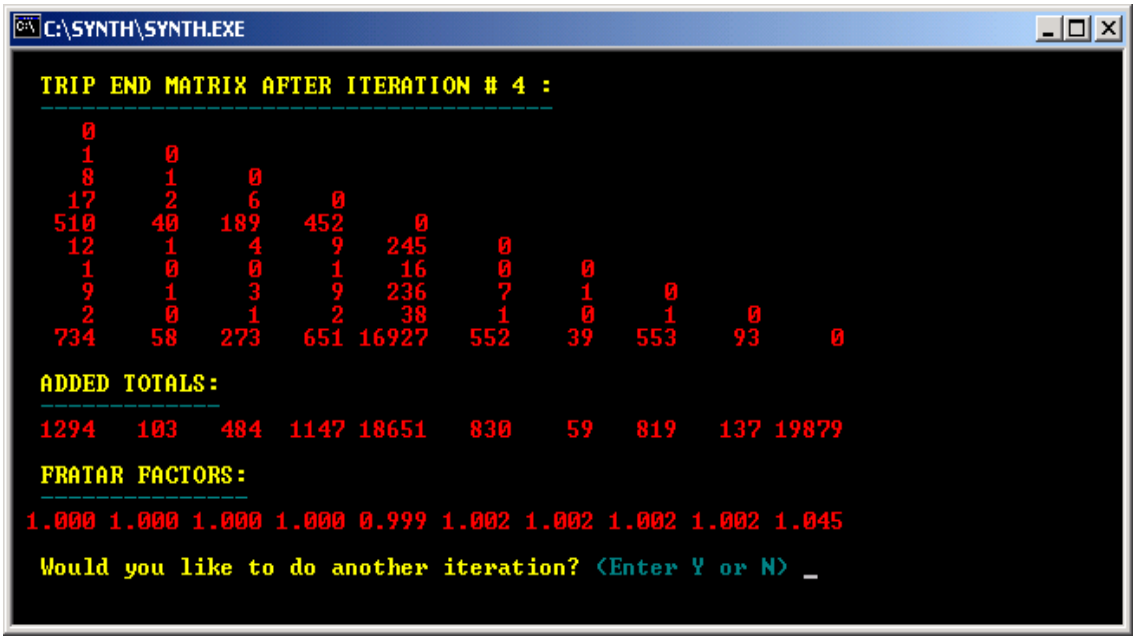
After you have your continuous route information entered you type in “C” and hit enter, then spacebar.

The next screen will show you the initial matrix for the through trips. You will see that the total for each station is given at the bottom of the file and a fratar factor (how much the difference in the matrix total is compared to the number of through desired at that location)



Choose "C" to continue the program and you will see the first iteration on the matrix appear. You should look at the factor number to see how close all of your stations are to the actual number of trips you desired. If the number is equal to or close to 1 then your matrix has estimated the distribution of the through trips at that station pretty accurately. You should continue to iterate (choosing "C") until you get most of the factors as close to 1 as possible. Once your factors converge then you can stop iterating and save the results. It is not recommended to iterate more than 5-6 times!!

Factors need to converge to 1.000



You need to save the file in a form that you can use in TransCAD so when it asks if you want a TRANPLAN matrix file choose yes and choose the name of the file. (For this case name it mythru.txt)

Finally you will be asked for your lowest external station number. Enter in that number so that your output file has the correct station to station matrix information. This is very important!!!!

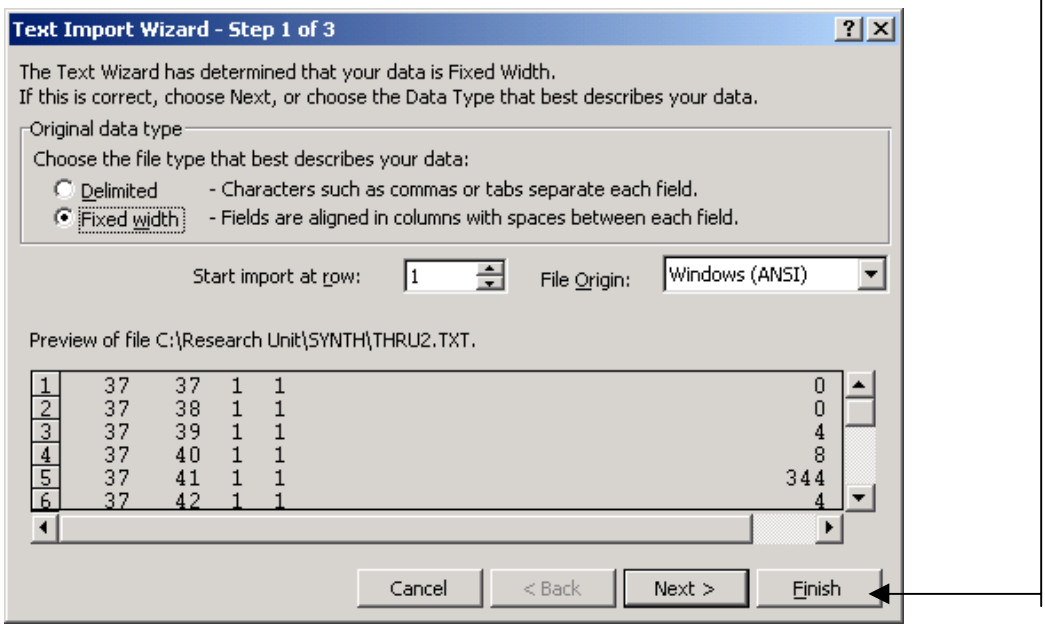
You should review the summary file that is output as a result of the program to see if your matrix makes sense. If you have gone back and redone your through trips after going through trip generation then you need to make the necessary changes to the trip generation file (you know the external production totals).

Once you have your output file from Synth you are ready to use it in TransCAD.

Creating the through trip matrix for use in TransCAD

Open up your newly created through trip text file (the one output for Tranplan format, in our case the Thru2.txt file is the right one-although you just created one called mythru.txt, use the thru2.txt file for consistency of the tutorial) using EXCEL.

Just click FINISH when the excel import wizard comes up!!!!



After Excel has imported the file DELETE the columns filled with ones (should be columns C & D).

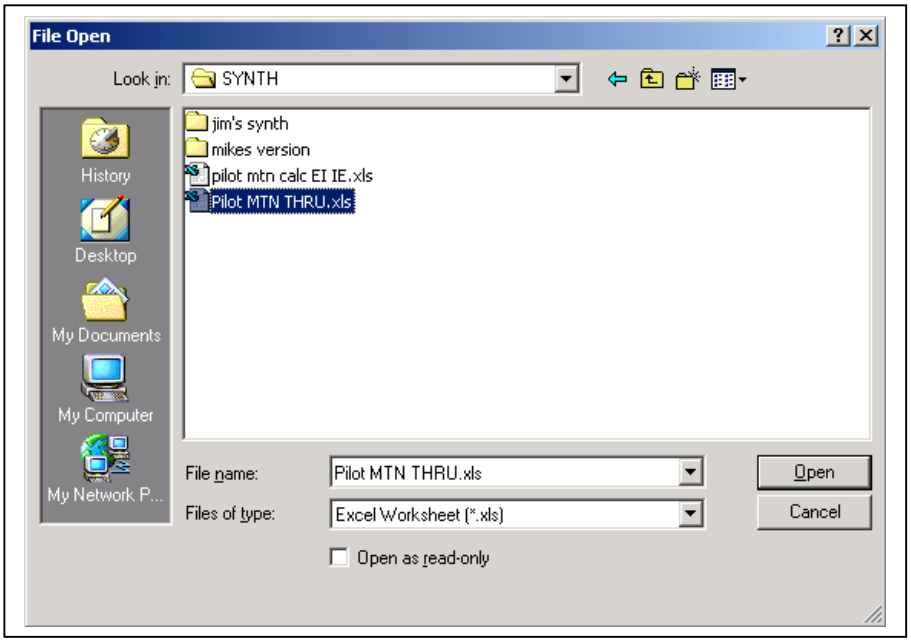
Rename each of the columns something logical like shown below:

	A	B	C	D	E
1	Orig Zone	Dest Zone	Thru Trips		
2	37	37	0		
3	37	38	0		
4	37	39	4		
5	37	40	8		
6	37	41	344		
7	37	42	4		
8	37	43	0		
9	37	44	3		
10	37	45	0		
11	37	46	385		
12	38	37	0		

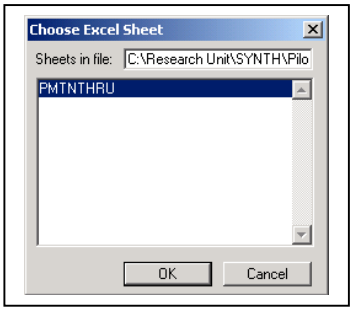
Now save the file as an Excel spreadsheet(Pilot Mtn Thru.xls) so that you can import it into TransCAD.

Importing the matrix into TransCAD

1) With TransCAD open on your desktop, go to File Open.
2) Select Excel Worksheet as the File Type
3) Find the file you saved your through trip file as and click Open

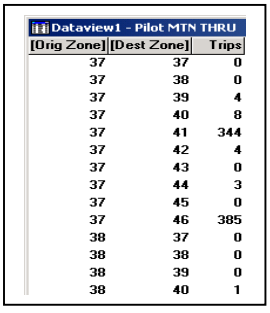


4) After clicking Open you may get a dialog box (like below) that asks you to select the excel sheet and most likely it will be the only one in your workbook, but select the right one and choose OK!



5) TransCAD wants to save this excel file as a BIN file so give it a name and click SAVE (pilot mtn thru.bin).

TransCAD will open the file in a dataview similar to this:

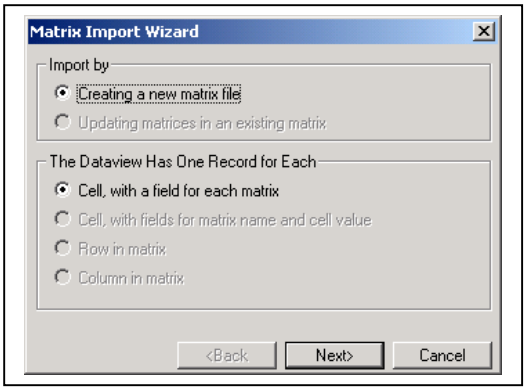


Dataview1 - Pilot MTN THRU

[Orig Zone]	[Dest Zone]	Trips
37	37	0
37	38	0
37	39	4
37	40	8
37	41	344
37	42	4
37	43	0
37	44	3
37	45	0
37	46	385
38	37	0
38	38	0
38	39	0
38	40	1

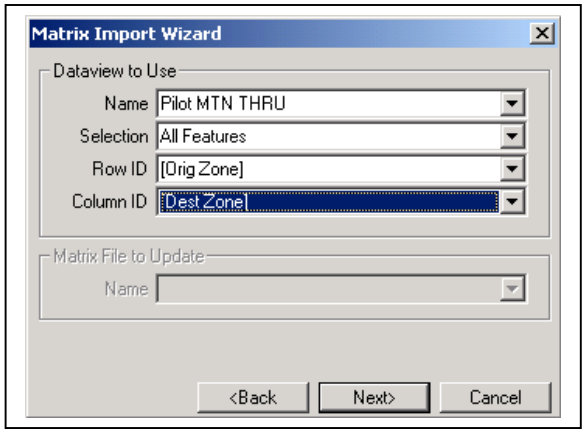
6) Once you have the dataview open go to the Matrix menu and choose Import

You should get a dialog box like this:

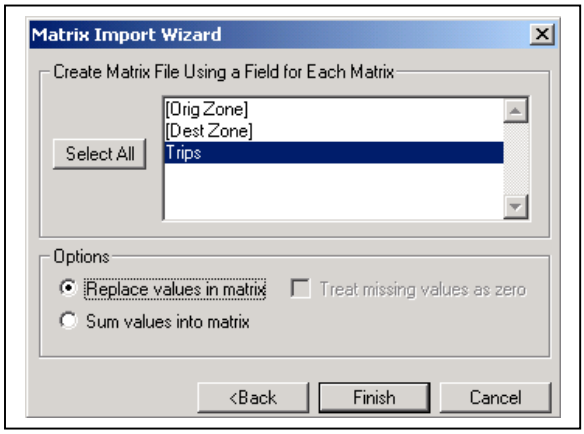


Choose Next

7) Specify the Row ID & Column ID's that will make up your matrix. You should have Origin Zone & Destination Zone specified. Click Next!



8) You now have the final dialog box and it asks you to specify what you want the matrix to represent. Since we need a through trip matrix we want trips from Zone A to Zone B to be the numbers in our matrix, so we select Trips as the field to fill the matrix with. CLICK FINISH!



9) Save the file as a matrix (which should automatically come up). Since it is your through trip matrix I recommend naming it something meaningful (Pilot Mtn Base Thru.mtx).

ERROR CHECK: You should check your marginals (the sum of each zone-done by right clicking and choosing properties) and compare it to what you got as your through trips for each of your stations, just to make sure you imported and are using the right matrix file!

You should also compare the fratared/balanced synth output totals for each zone to the original numbers you calculated for your through trips!!! When you enter you EI/IE trips into the Trip Gen program (Steps 3&7 from Chapter 4) you will have to use the BALANCED ones from synth.

For Example:

Use these numbers in the Trip Gen Program

STATION	ADT	PTTDES	Thru Trips	EI/IE	SYNTH output	THRU Adj. After SYNTH	EXT-INT Adj. After SYNTH
37-SR 1901(KEY ST)	2000	75	1500	500	748	1496	504
38-SR 2012(OLD52)	700	33	231	469	115	230	470
39-SR 2048(SHOALS)	2500	75	1875	625	937	1874	626
40-NC268 WEST	4100	90	3690	410	1844	3688	412
41-US 52 NORTH	22200	98	21756	444	10876	21752	448
42-SR1809(WESTFLD)	3700	81	2997	703	1500	3000	700
43-SR 1837(CARSON)	420	25	105	315	52	104	316
44-NC 268 EAST	3200	90	2880	320	1441	2882	318
45-SR 1855(OLD52)	900	30	270	630	134	268	632
46-US 52 SOUTH	23670	98	23196.6	473	11615	23230	440
	63390			4889	29262	58524	4866

This is the balanced matrix from SYNTH. The column totals are the SYNTH output totals in the chart above!

BALANCED THROUGH TRIP MATRIX:

0	0	4	8	344	4	0	3	0	385
0	0	0	1	53	1	0	1	0	59
4	0	0	12	430	7	0	5	0	479
8	1	12	0	852	12	0	11	1	947
344	53	430	852	0	655	18	536	46	7942
4	1	7	12	655	0	0	10	1	810
0	0	0	0	18	0	0	0	0	34
3	1	5	11	536	10	0	0	1	874
0	0	0	1	46	1	0	1	0	85
385	59	479	947	7942	810	34	874	85	0

COLUMN TOTALS:

748	115	937	1844	10876	1500	52	1441	134	11615

Important Notes:

Although this chapter comes after the Trip Generation section in the notebook you should be aware that you have to start determining your through trips before you run the trip generation program. It is recommended that you use the Synth program output data as your first run (no changes of the percent throughs, etc.) and input the external station data you get from it into the Trip generation program. After running the Trip Generation program and doing the error/reasonableness checks for your P's & A's for the external trips you should go through the through trip chapter to help you adjust and finalize your through trip percentages. This could be an iterative process.

You need to remember that if you change your through trip percentages that you will have to re-run Trip Generation with the new external production numbers.

Exercise-

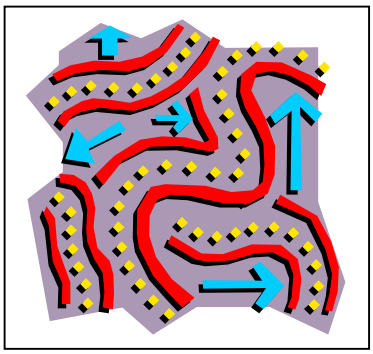
Use PMSYNTH.in file and change the percentages to what is listed on the previous page under the column PTTDES.

Iterate 5 times and save the file as mythru2.txt

Pull into Excel and create the matrix for use in TransCad.!

Note: When you perform the calculations in Trip Generation or in Assignment make sure you use the file THRU2.txt so that your results are the same as the ones shown in the tutorial.

Chapter 6 - Trip Distribution



Just to refresh ourselves, we have determined how many trips are going to be produced in our area, you know Chapter 4-Trip Generation. Do you recall how? We used the Trip Generation program!

We also determined what our through trips (the external to external trips) were going to be using the Synth program. So now what?

Trip Distribution is the next step we must perform on our way to building a successful travel demand model.

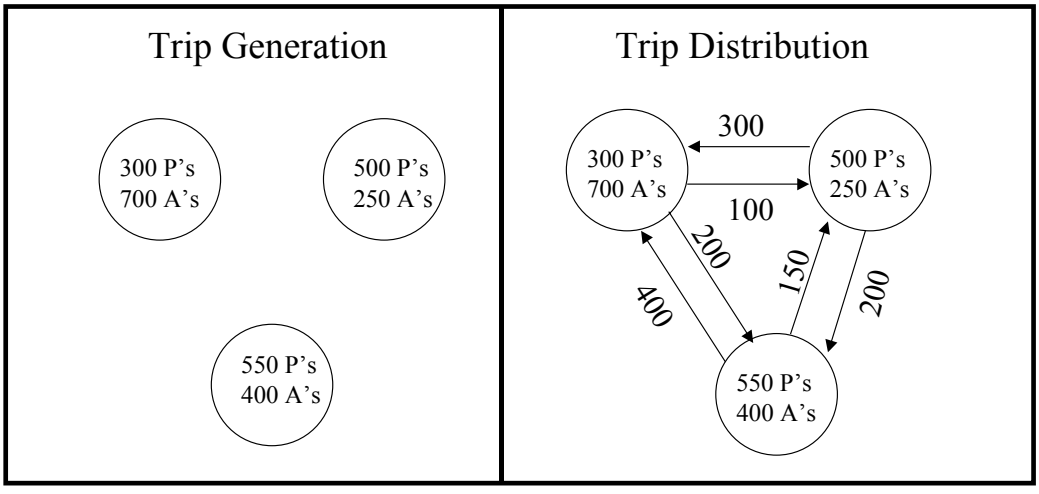
WHAT YOU SHOULD KNOW AFTER COMPLETING THIS CHAPTER:

What trip distribution is?
How to get/use/check friction factors
How to perform reasonableness checks on the Trip Distribution Data
How to convert your P's & A's to Origins & Destinations

What is Trip Distribution?

Trip Distribution is the step in the modeling process that determines the trip interchanges between all the zones! Huh?? Could you say that in more understandable terms…..well it basically takes the P's & A's from Trip Generation and determines how many trips from Zone A are attracted to Zone B and vice versa.

Or as Mr Roger's would say here's a picture of it:



Thanks to Sir Isaac Newton we use the concept of gravitational theory. The transportation derivation of this theory implies that the trips made between zones are directly proportional to the size of the productions and attractions for those zones and inversely proportional to the travel time for the zones. The actual theory uses size/mass of bodies to gets the attractions.

Here's the Gravity Model equation used in Trip Distribution:

$$T_{ij} = P_i * \frac{A_j F_{ij} K_{ij}}{\sum_{j=1}^{n} (A_j F_{ij} K_{ij})}$$

Where

T_{ij} = Number of trips from zone i to zone j
P_i = Number of trip productions in zone i
A_j = Number of trip attractions in zone j
F_{ij} = Friction factor (represents the spatial separation between zone i & zone j
K_{ij} = Optional adjustment factor (fudge factor)-not recommended

Zone	Productions	Attractions	Friction Factor between D & this zone
D	800	0	----
E	0	600	1000
F	0	200	500

Based on the above data the number of trips from zone D to E is:

$$T_{DtoE} = P_D * \frac{A_E F_{DE}}{\Sigma\ (A_E * F_{DE} + A_F * F_{DF})} = 800 * \frac{600*1000}{(600*1000 + 200*500)} = 685 \text{ trips}$$

Therefore there should be 115 Trips between zone D & F if you calculate using the gravity model!!!

Now you know what Trip Distribution is and how it is actually calculated in the modeling process. AND you are now thankful you don't have to perform these calculations by hand like when we didn't have computers!!!

How do you apply the trip distribution theory to the actual model building in TransCAD??????

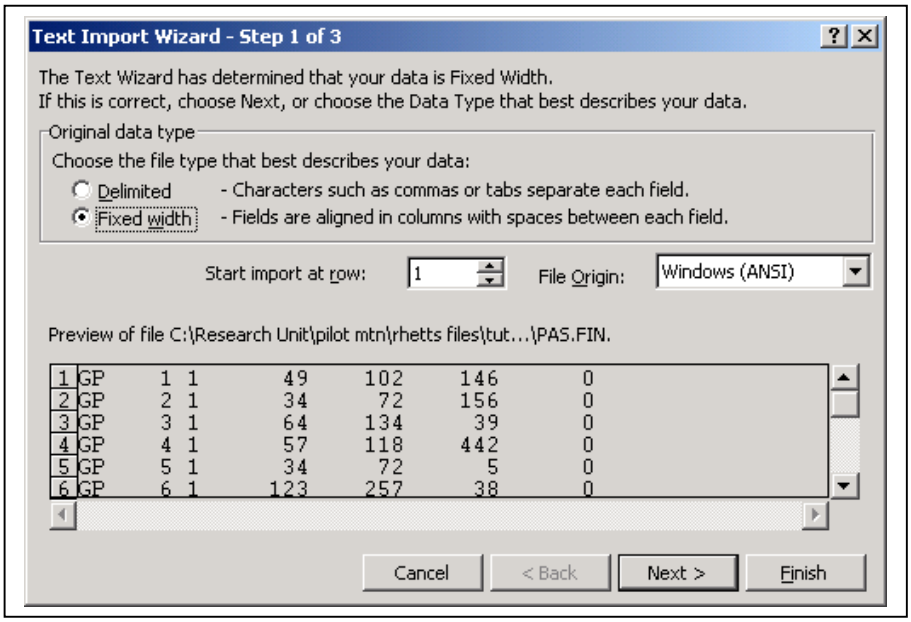
Preparing the productions, attractions, and friction factors

This step is simply taking the productions and attractions produced by the Trip Generation Program (Chapter 4) and the friction factors and preparing them to be used in TransCAD.

Let's start with our Productions and Attractions!

Open Microsoft Excel. Choose File → Open, and find the file folder with your P's & A's text file that was created from the Trip Generation Program in Chapter 4.

The Text Import Wizard will pop up.



Choose Finish and let Excel import all the data.

We now need to manipulate this data to a format suitable for TransCAD.

Delete Column A (with the GPs) and Column C (with the ones in it).

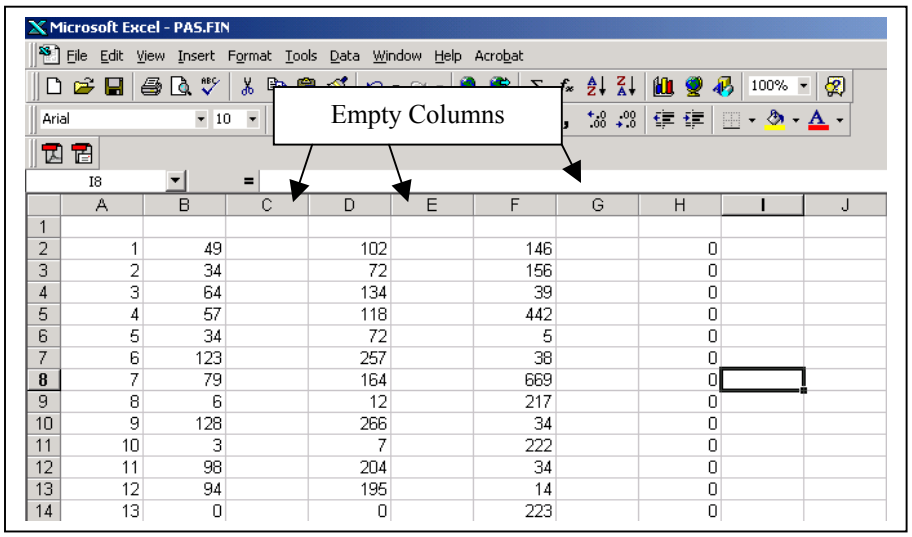
Choose Insert→Rows (The entire spreadsheet should shift down one row)

Highlight Column C and Choose Insert → Column

Highlight Column E and Choose Insert → Column

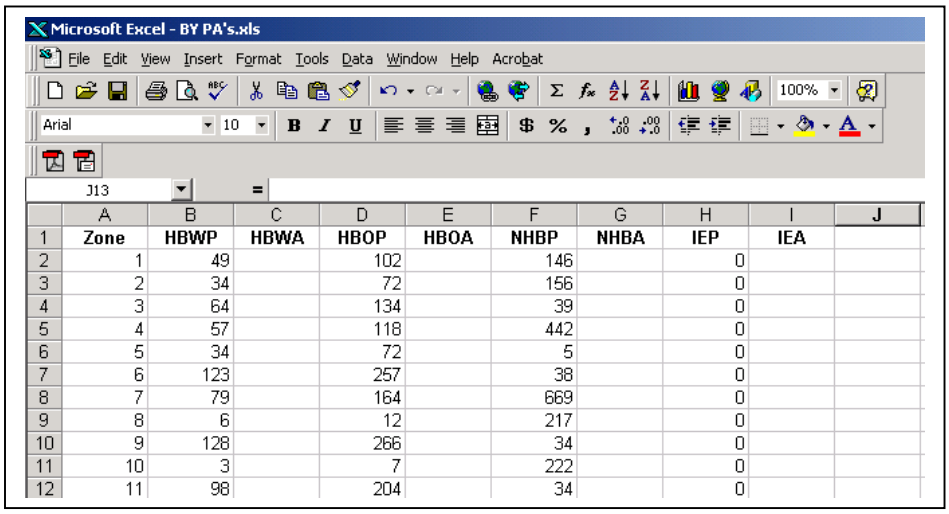
Highlight Column G and Choose Insert → Column

You should now have an empty column between each of the columns that contain your trip productions. Similar to this:



	A	B	C	D	E	F	G	H	I	J
1										
2	1	49		102		146		0		
3	2	34		72		156		0		
4	3	64		134		39		0		
5	4	57		118		442		0		
6	5	34		72		5		0		
7	6	123		257		38		0		
8	7	79		164		669		0		
9	8	6		12		217		0		
10	9	128		266		34		0		
11	10	3		7		222		0		
12	11	98		204		34		0		
13	12	94		195		14		0		
14	13	0		0		223		0		

Label your column titles with the Trip Purposes that you are using in your model. Your P's & A's for each purpose should be located next to each other as shown below:



	A	B	C	D	E	F	G	H	I	J
1	Zone	HBWP	HBWA	HBOP	HBOA	NHBP	NHBA	IEP	IEA	
2	1	49		102		146		0		
3	2	34		72		156		0		
4	3	64		134		39		0		
5	4	57		118		442		0		
6	5	34		72		5		0		
7	6	123		257		38		0		
8	7	79		164		669		0		
9	8	6		12		217		0		
10	9	128		266		34		0		
11	10	3		7		222		0		
12	11	98		204		34		0		

Now you need to cut & paste your attractions next to your productions, making sure you place them in the right column!!! The attractions are at the bottom of the productions and should be located where your zone numbers begin over again (ie at one probably).

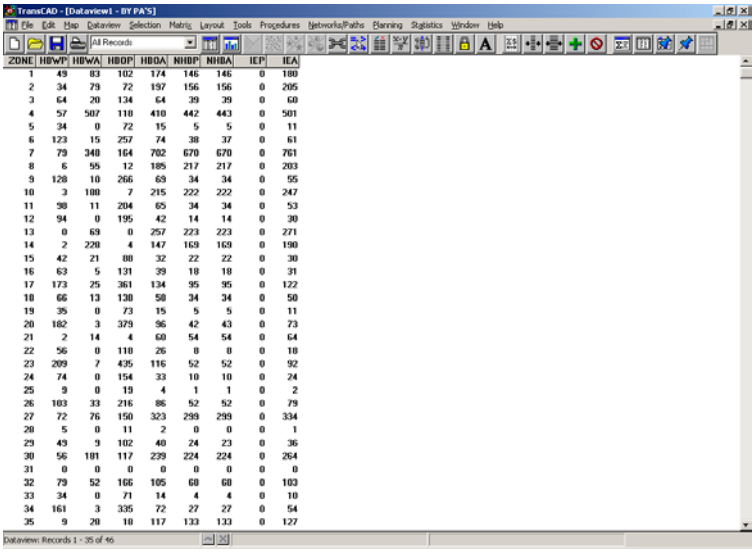
Attractions start here!

45	44	0	0	0	318
46	45	0	0	0	632
47	46	0	0	0	440
48	1	83	174	146	180
49	2	79	197	156	205
50	3	20	64	39	60
51	4	508	410	443	501
52	5	0	15	5	11
53	6	15	74	37	61

Once you have gotten all the data in the right columns choose File → Save As. Save this entire worksheet as a .DBF file. Use a name that makes sense to you and is easily understandable like **Base Year PA's.DBF**

In the future the Trip Generation Program, discussed in Chapter 4, will automatically set up this DBF file for you and import it into TransCAD so that you do not have to complete this step…..but for now you have to do it the long way!

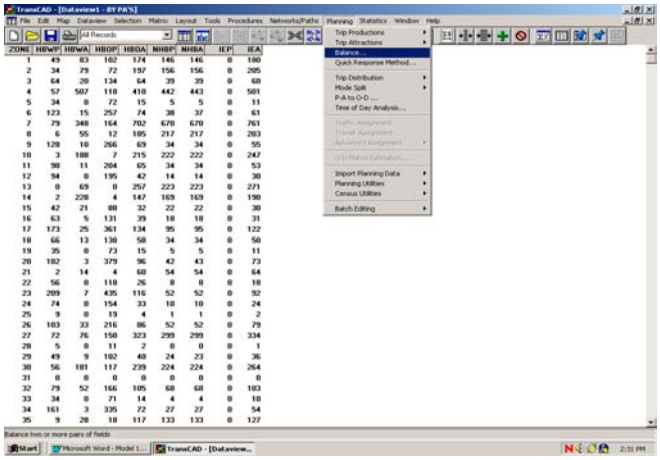
Once you have created this production/attraction PA file in dbf form open it in TransCad. You should have something like this:



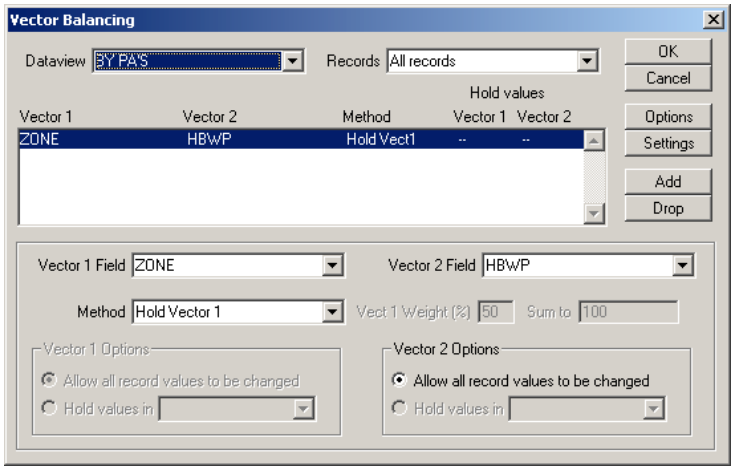
ZONE	HBWP	HBWA	HBOP	HBOA	NHBP	NHBA	IEP	IEA
1	49	83	102	174	146	146	0	180
2	34	79	72	197	156	156	0	205
3	64	20	134	64	39	39	0	60
4	57	507	118	410	442	443	0	501
5	34	0	72	15	5	5	0	11
6	123	15	257	74	38	37	0	61
7	79	348	164	702	670	670	0	761
8	6	55	12	185	217	217	0	203
9	128	10	266	69	34	34	0	55
10	3	188	7	215	222	222	0	247
11	98	11	204	65	34	34	0	53
12	94	0	195	42	14	14	0	30
13	0	69	0	257	223	223	0	271
14	2	220	4	147	169	169	0	190
15	42	21	88	32	22	22	0	30
16	63	5	131	39	18	18	0	31
17	173	25	361	134	95	95	0	122
18	66	13	138	58	34	34	0	50
19	35	0	73	15	5	5	0	11
20	182	3	379	96	42	43	0	73
21	2	14	4	60	54	54	0	64
22	56	0	118	26	8	8	0	18
23	209	7	435	116	52	52	0	92
24	74	0	154	33	10	10	0	24
25	9	0	19	4	1	1	0	2
26	103	33	216	86	52	52	0	79
27	72	76	150	323	299	299	0	334
28	5	0	11	2	0	0	0	1
29	49	9	102	40	24	23	0	36
30	56	181	117	239	224	224	0	264
31	0	0	0	0	0	0	0	0
32	79	52	166	105	68	68	0	103
33	34	0	71	14	4	4	0	10
34	161	3	335	72	27	27	0	54
35	9	28	18	117	133	133	0	127

Although the SWP trip generation program balances your P's & A's, when you bring it into TransCad it must be re-balanced. (TransCad uses real number where the Trip Gen program uses integers.) How do we do this?

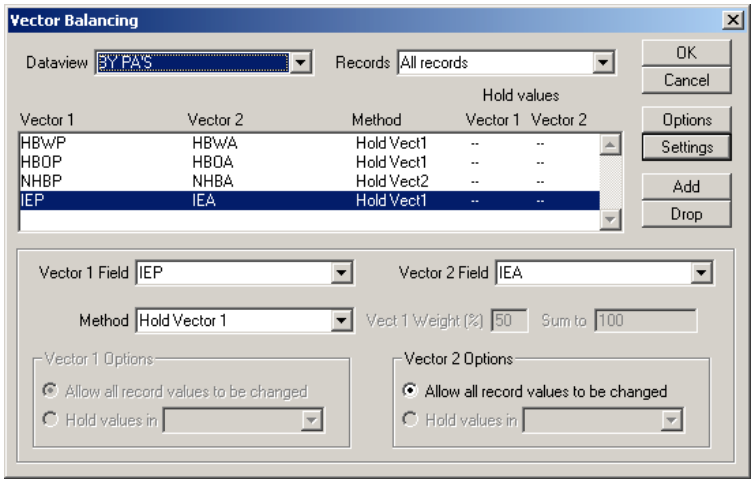
With the dbf file open, go to the planning menu and select balance:



You should now have the balance dialog box open:



You have to add each trip purpose by clicking the Add button, choosing each purpose in the Vector 1 field and choosing the type of "hold method". The hold method tells what we are keeping constant and balancing to. We usually balance to our productions with the exception of the NHB trip purpose. You should set up the balance dialog box to resemble the box below. You can also click on the settings button and select Balance BY PA's to automatically set it up for you (assuming you used the names that were suggested for files).



Click OK and the PA's will be balanced for you.

Now you can proceed with the other steps.

Setting up the Friction Factors

The friction factors must be setup in a similar fashion to the P's & A's, in order for TransCAD to read them properly. If you already have a text file that has your friction factors, then you can import it in a similar fashion as described previously. If you are starting a new study and must create your own friction factors or are borrowing them from another study, then you can just create a new table in Excel or in TransCAD directly. Regardless of where you create your table of friction factors you need to label the table appropriately. Here is the preferred look of the table:

Label the columns TIME, HBWFF, HBOFF, NHBFF, IEFF

TIME	HBWFF	HBOFF	NHBFF	IEFF
1	5800	5900	7800	10500
2	11600	12250	16750	13700
3	12200	15600	13850	14200
4	11000	11600	9500	13000
5	7750	6200	6750	5000
6	4500	3500	4200	2500
7	2500	2200	1900	1600
8	1500	1000	800	500
9	500	200	100	100
10	100	100	100	100

HBWFF - Home Based Work Friction Factors.
HBOFF - Home Base Other Friction Factor
NHBFF - Non Home Based Friction Factor
IEFF - Internal/External Friction Factor

Once you have setup the friction factor table you need to save it as a DBF file so that you can import it into TransCAD as part of Trip Distribution.

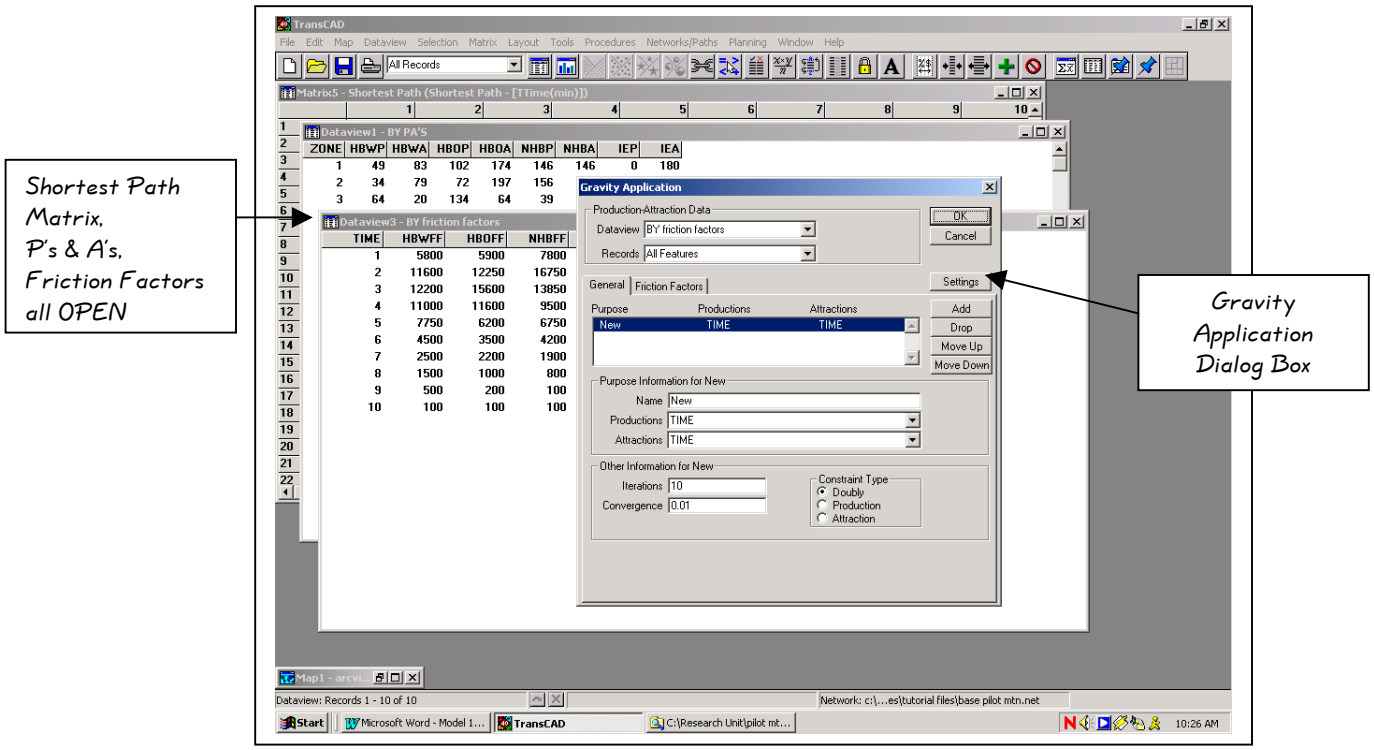
IMPORTANT NOTE: Developing & Determining Friction Factors is an addendum section located at the back of the manual so that you can understand the concept behind friction factors and how to use them.

Applying the Gravity Model

Since you understand the theory and concepts behind the Gravity Model (at least we hope so from earlier in this chapter), we now need to tell TransCAD on how to find these files and how to use them. We have the productions, attractions, and friction factors, and we need to apply the gravity model to generate the production-attraction matrix. The final output of the gravity model is a zone to zone trip matrix not a PA matrix.

Before starting this step make sure the two databases, the friction factors and the PA's, are open and on the screen (if you do not have these opened on screen these steps will not work correctly). You also will need the minimum path matrix you created using your network in Chapter 3. Which for Pilot Mountain was called ***shortest path BY.mtx.***

Step 1: Choose Planning → Trip Distribution → Gravity Application to get the Gravity Application Dialog box to come up.



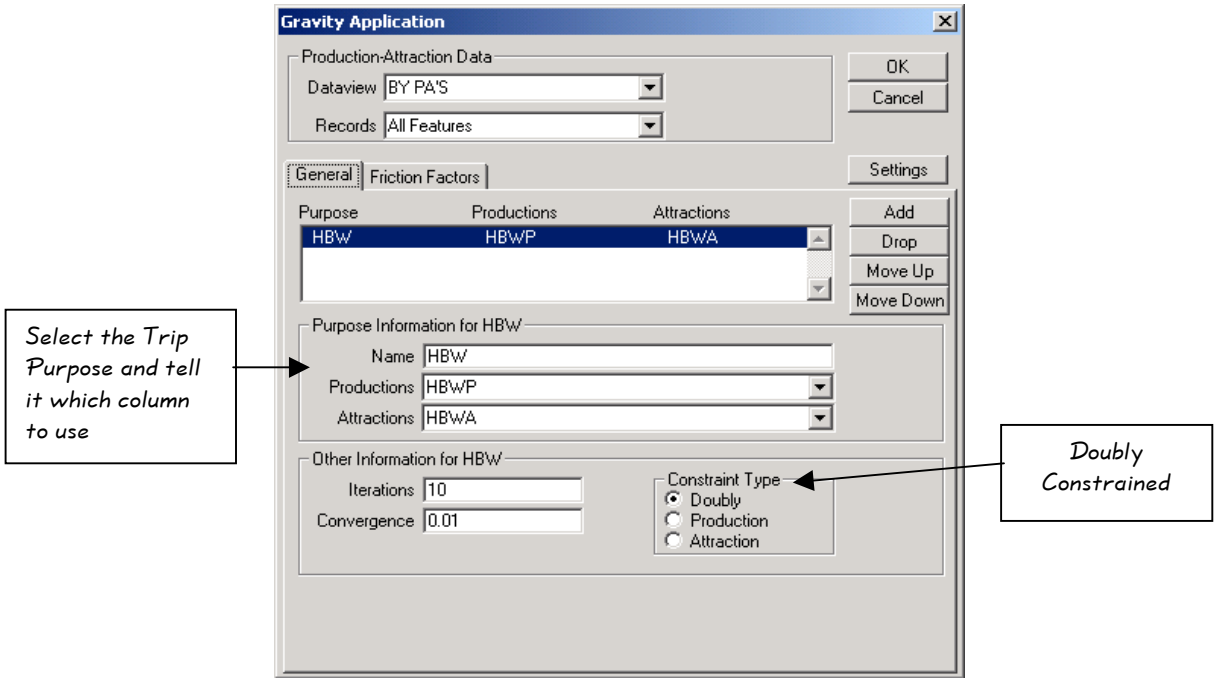
Filling Out the Gravity Application Dialog Box

Step 2: Under "Production-Attraction Data" use the drop down menu to choose your P's & A's file (BY PA's for Pilot Mountain) .

Step 3: Make sure the General Tab is selected. Under "Purpose Information for ", highlight the new and type in HBW (which is our first trip purpose Home Based Work). Then you must tell the program where to find your productions (it should automatically find the attractions that match it).

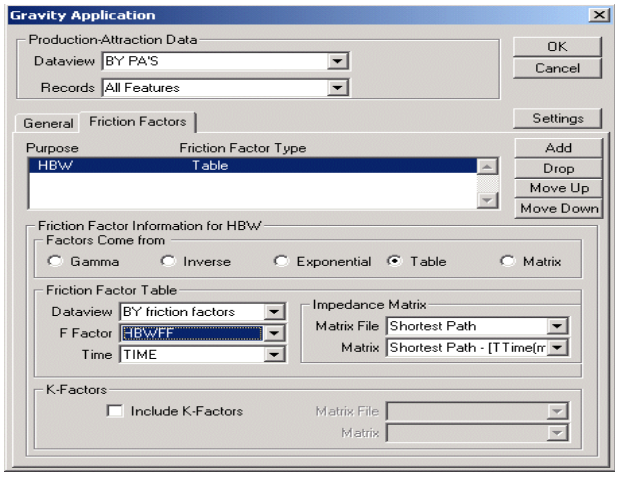
Step 4: ***Under constraint type, choose Doubly*** so that it performs a total balance between the P's & A's. (Remember our Trip Generation program already produces the P's & A's constrained to the productions so there is no need to do it again)

Your screen should look like the following figure.



Step 5: Now go to the Friction Factors Tab
Since we built our own friction factor table we will select that option. You could use other functions here to determine your factors (this will be discussed in the Developing Friction Factors Addendum mentioned previously).

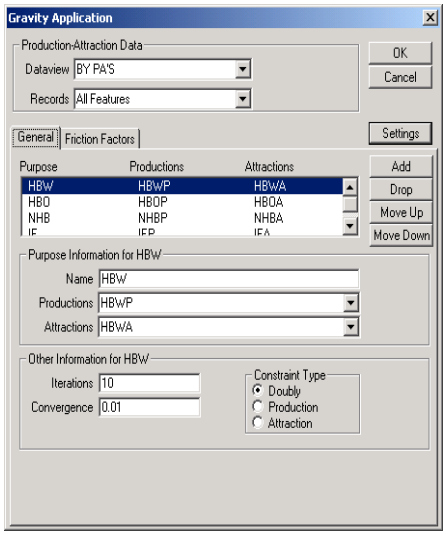
You will have to tell it where to find the friction factor table and impedance matrix that you created. (By default it should find it if you have it open!) Here's what it should look like:



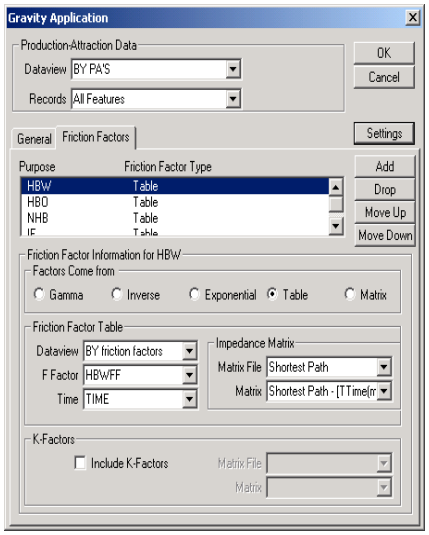
You will have to add ALL of your trip purposes to this dialog box and complete the information for each one of them.

After you get all the trip purposes in the Gravity Application dialog box your tabs should be similar to these:

General Tab



Friction Factors Tab



Just a little tidbit: Use the settings button to record your setup for this dialog box after you complete it one time!!! That way when you come back you don't have to change all the info in the dialog box again!!!!

Once you have all the purposes included in the dialog box click OK!!

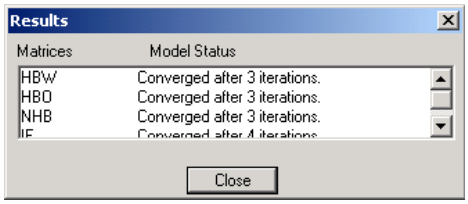
When the save as dialog box comes up please help yourself and others who might try to assist you by naming this matrix something logical. It is your PA Internal Trip Table that you are creating so that might be a good name for it(BY PA internal Trip Table). Use that name in the LABEL box as well. By putting the name in the label box, when you have this matrix open you will actually know what you are looking at!!!

See now you know what matrix you are looking at

Matrix7 - BY PA Internal Trip Table (HBW)

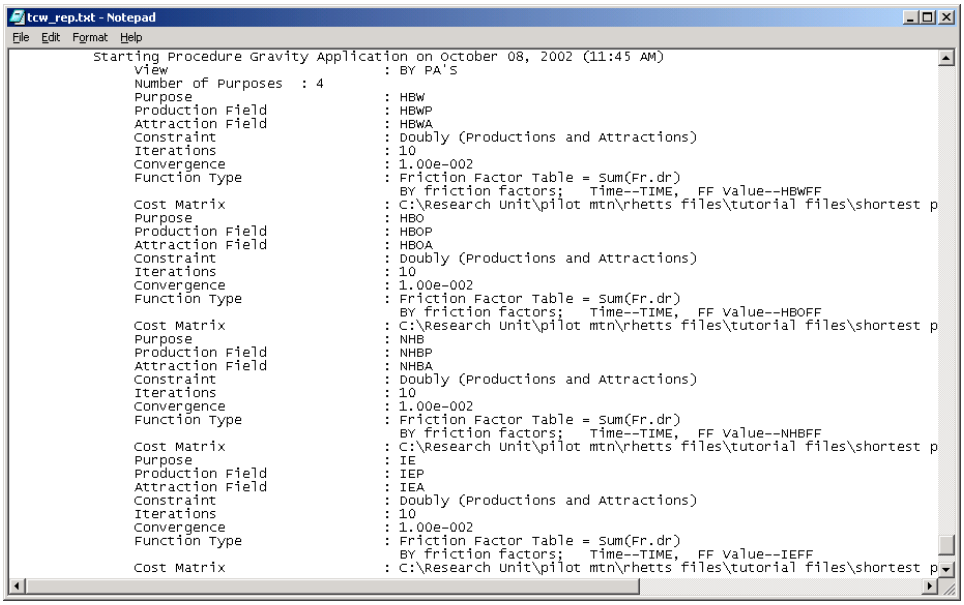
	1	2	3	4	5	6	7	8	9	
1	1.02	0.98	0.26	13.87	0.00	0.17	4.23	0.70	0.27	2.
2	0.77	0.74	0.20	10.54	0.00	0.13	3.21	0.54	0.10	1.
3	1.57	1.51	0.40	10.72	0.00	0.54	6.53	1.09	0.21	7.
4	2.46	2.37	0.32	8.41	0.00	0.42	10.25	0.85	0.17	5.
5	0.74	0.71	0.19	10.04	0.00	0.13	3.06	0.51	0.10	1.
6	2.62	2.53	1.35	35.84	0.00	0.45	10.92	1.82	0.71	11.
7	1.88	1.81	0.48	25.63	0.00	0.32	7.81	1.30	0.25	4.
8	0.16	0.16	0.04	1.11	0.00	0.03	0.67	0.11	0.02	0.
9	6.22	2.99	0.80	21.23	0.00	1.07	12.94	2.16	0.42	13.
10	0.06	0.06	0.03	0.84	0.00	0.02	0.25	0.04	0.02	0.
11	1.82	3.50	0.94	26.15	0.00	0.63	15.15	2.52	0.52	4.
12	3.46	3.33	0.94	24.84	0.00	0.63	14.39	2.52	0.49	3.
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.
14	0.10	0.05	0.01	0.33	0.00	0.02	0.20	0.03	0.01	0.
15	1.76	1.61	0.43	5.70	0.00	0.30	6.95	1.16	0.11	3.
16	2.45	2.24	0.60	15.88	0.00	0.42	9.68	1.61	0.31	5.
17	6.78	6.21	1.75	46.31	0.00	1.11	26.83	4.47	0.92	15.
18	2.24	2.39	0.64	16.99	0.00	0.43	10.35	1.72	0.34	5.
19	1.02	1.40	0.37	9.92	0.00	0.18	6.05	1.01	0.20	2.
20	8.05	7.75	1.46	38.71	0.00	1.54	37.14	5.58	0.77	12.
21	0.08	0.07	0.02	0.50	0.00	0.01	0.32	0.06	0.01	0.

You should make sure your matrices converged (this is the little dialog box that pops up on screen).



You should also look at the report to make sure you had all the information correct and that it ran like you thought. It also is a good way to check back and see what information you entered for the factors and when you last created this matrix. You have to scroll down to the bottom of the file to see the recent info.

Here's a sample of what it looks like:



Now you have created your internal trip matrices, one for each purpose.

Checks to Perform:

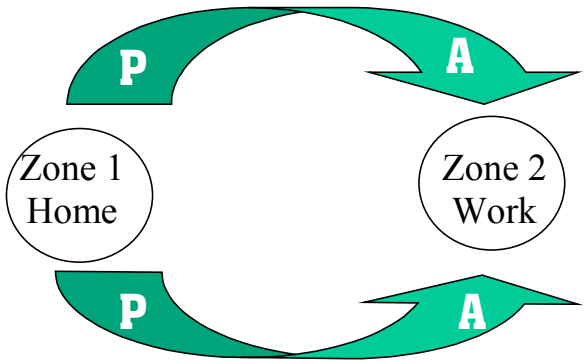
1) You should check the trips distributed for each purpose and make sure that the total matches the total that came out of Trip Generation. Use the marginals tool to perform this check!!
2) **Graph the trip distribution for each purpose to see the shape of the curve**. Does it make sense to you? Does it need to be shifted? Use the addendum in the back of the notebook to help you
3) Use the Rule of Thumb equations as a check

The next step is converting this PA matrix to an OD matrix!

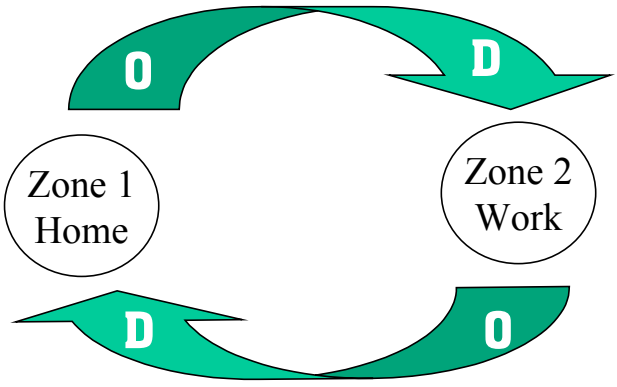
THINGS YOU SHOULD BE ABLE TO DO AFTER COMPLETING THIS SECTION:

Know how & why we convert P's & A's to O's & D's
How to get a total trip matrix!
Checks to perform to ensure that the trip distribution step is accurate

The conversion of productions and attractions to origins & destinations is a topic that often gets confusing when being discussed. We know from our previous knowledge (at least you should from chapter 4) that productions are the home end of the trip and the attraction end is work, school or shopping. Based on this concept the P's & A's for two zones would look like this:



If we tried to use the PA figure to travel on our network then people would leave home and never return in a sense! We know that in the "real traveling world" we actually start at home (our origin) and go to work in the morning (our destination) and in the afternoon we start at work (our origin) and go home(destination). That travel pattern looks like this:



Since we have built (earlier in this section) a matrix containing P's & A's, we know it functions like the first figure on this page. We need it to function like the second figure so that the actual directions of the travel patterns are realistic and represent what occurs on our roadways. This conversion is called???????? You guessed it….the PA to OD conversion!!!!

Mathematical Process behind the PA to OD conversion:

You don't have to be able to recite how this conversion occurs but it is important that you are at least exposed to the "how to" in case you are asked someday (hint hint!). In words, here's how the conversion occurs. The PA matrix is added to the transpose of the PA matrix (added to the transpose of itself) and then that resulting matrix is divided in half to produce the OD matrix! The transpose is basically a mirror image of the matrix (like if you saw it backwards) or if you flipped the matrix over by rotating it along the intrazonals!!!

Scratching your head??????????

Here's the visual of it!

Here's Our Original Matrix:

	Zone 1	**Zone 2**	**Zone 3**
Zone 1	11	12	13
Zone 2	21	22	23
Zone 3	31	32	33

The numbers inside the matrix represent the FROM/TO POSITION in that matrix…ie 12 is Zone 1 to Zone 2

Here's what our PA matrix with numbers would look like(for three zones in Pilot Mountain):

	Zone 1	**Zone 2**	**Zone 3**
Zone 1	1.02	.98	.26
Zone 2	.77	.74	.20
Zone 3	1.57	1.51	.40

Here's the concept behind the transpose of a matrix:

	Zone 1	**Zone 2**	**Zone 3**
Zone 1	11	*21	31
Zone 2	12	22	32
Zone 3	13	23	33

Basically we have reversed the order of the numbers in the matrix.
*What was from Zone1 to Zone2 now becomes from Zone2 to Zone1 in our matrix!

Here's the transpose of our Pilot Mountain PA matrix using the concept above:

	Zone 1	**Zone 2**	**Zone 3**
Zone 1	1.02	.77	**????**
Zone 2	.98	.74	1.51
Zone 3	.26	.20	.40

Once the matrix is transposed then you add the two matrices together

PA Matrix

	Zone 1	Zone 2	Zone 3
Zone 1	1.02	.98	.26
Zone 2	.77	.74	.20
Zone 3	1.57	1.51	.40

+

Transposed PA Matrix

	Zone 1	Zone 2	Zone 3
Zone 1	1.02	.77	1.57
Zone 2	.98	.74	1.51
Zone 3	.26	.20	.40

Added Trip Matrix

	Zone 1	Zone 2	Zone 3
Zone 1	**?????**	1.75	1.83
Zone 2	1.75	1.48	1.71
Zone 3	1.83	1.71	.80

Now you divide this matrix by 2 (because the matrix currently has twice the number of actual trips) and the result of this division is your final Origin/Destination Matrix!!

Final O/D Matrix

	Zone 1	Zone 2	Zone 3
Zone 1	1.02	.875	.915
Zone 2	.875	74	.855
Zone 3	.915	.855	.40

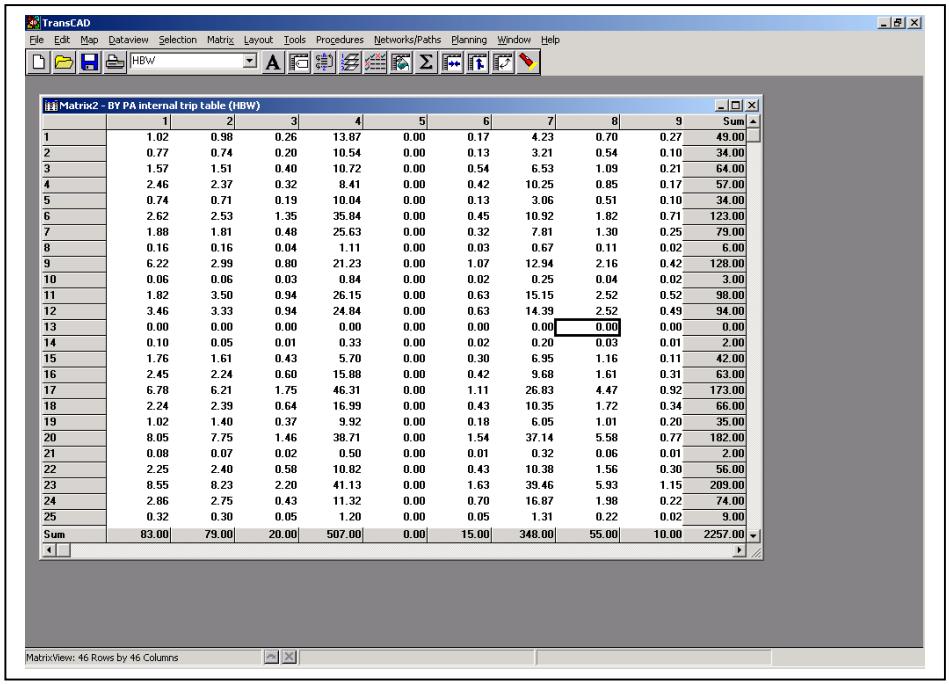
This series of calculations is performed for each trip purpose so that you can get an OD matrix for each purpose in your model!!!

Now you are thankful you don't have to do that by hand and that TransCAD does it for you!!!! So how do you do this in TransCAD?????????

Converting the Matrices in TransCAD

Step 1: Open your internal PA trip matrix (for Pilot Mountain it is: BY internal trip table.mtx)

It should look like this:

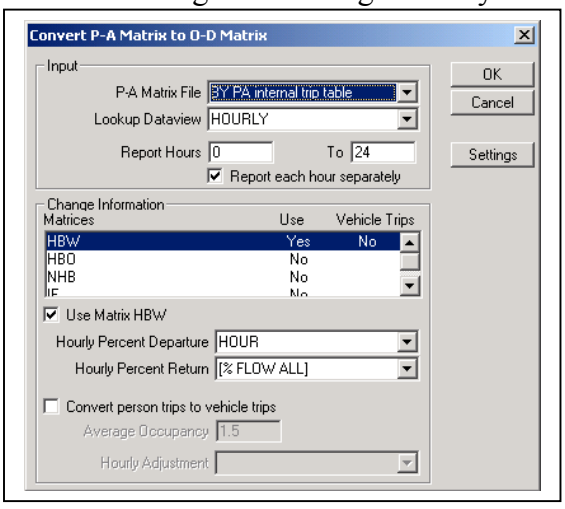


	1	2	3	4	5	6	7	8	9	Sum
1	1.02	0.98	0.26	13.87	0.00	0.17	4.23	0.70	0.27	49.00
2	0.77	0.74	0.20	10.54	0.00	0.13	3.21	0.54	0.10	34.00
3	1.57	1.51	0.40	10.72	0.00	0.54	6.53	1.09	0.21	64.00
4	2.46	2.37	0.32	8.41	0.00	0.42	10.25	0.85	0.17	57.00
5	0.74	0.71	0.19	10.04	0.00	0.13	3.06	0.51	0.10	34.00
6	2.62	2.53	1.35	35.84	0.00	0.45	10.92	1.82	0.71	123.00
7	1.88	1.81	0.48	25.63	0.00	0.32	7.81	1.30	0.25	79.00
8	0.16	0.16	0.04	1.11	0.00	0.03	0.67	0.11	0.02	6.00
9	6.22	2.99	0.80	21.23	0.00	1.07	12.94	2.16	0.42	128.00
10	0.06	0.06	0.03	0.84	0.00	0.02	0.25	0.04	0.02	3.00
11	1.82	3.50	0.94	26.15	0.00	0.63	15.15	2.52	0.52	98.00
12	3.46	3.33	0.94	24.84	0.00	0.63	14.39	2.52	0.49	94.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.10	0.05	0.01	0.33	0.00	0.02	0.20	0.03	0.01	2.00
15	1.76	1.61	0.43	5.70	0.00	0.30	6.95	1.16	0.11	42.00
16	2.45	2.24	0.60	15.88	0.00	0.42	9.68	1.61	0.31	63.00
17	6.78	6.21	1.75	46.31	0.00	1.11	26.83	4.47	0.92	173.00
18	2.24	2.39	0.64	16.99	0.00	0.43	10.35	1.72	0.34	66.00
19	1.02	1.40	0.37	9.92	0.00	0.18	6.05	1.01	0.20	35.00
20	8.05	7.75	1.46	38.71	0.00	1.54	37.14	5.58	0.77	182.00
21	0.08	0.07	0.02	0.50	0.00	0.01	0.32	0.06	0.01	2.00
22	2.25	2.40	0.58	10.82	0.00	0.43	10.38	1.56	0.30	56.00
23	8.55	8.23	2.20	41.13	0.00	1.63	39.46	5.93	1.15	209.00
24	2.86	2.75	0.43	11.32	0.00	0.70	16.87	1.98	0.22	74.00
25	0.32	0.30	0.05	1.20	0.00	0.05	1.31	0.22	0.02	9.00
Sum	83.00	79.00	20.00	507.00	0.00	15.00	348.00	55.00	10.00	2257.00

Step 2 : Open the convert PA to OD dialog box

Go to Planning Menu → select P-A to O-D

You should get this dialog box on your screen:

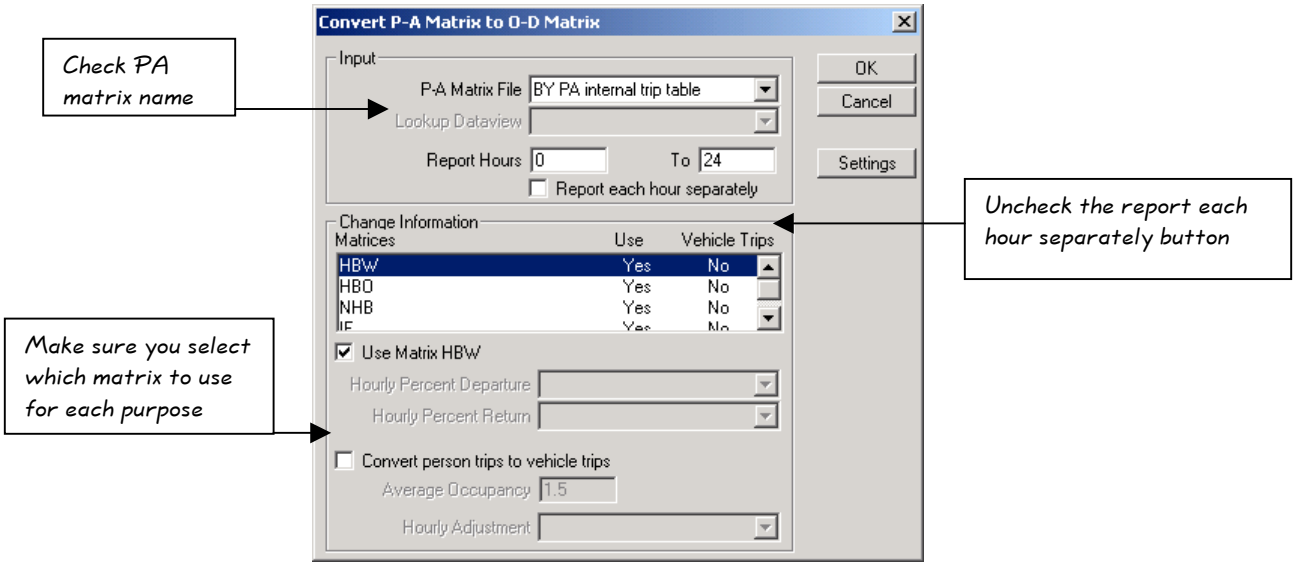


Step 3: Changing the options on the dialog box

*Make sure you are using the right P-A matrix file
*Uncheck the report each hour separately button.
*Then select, by checking, the Use Matrix HBW button

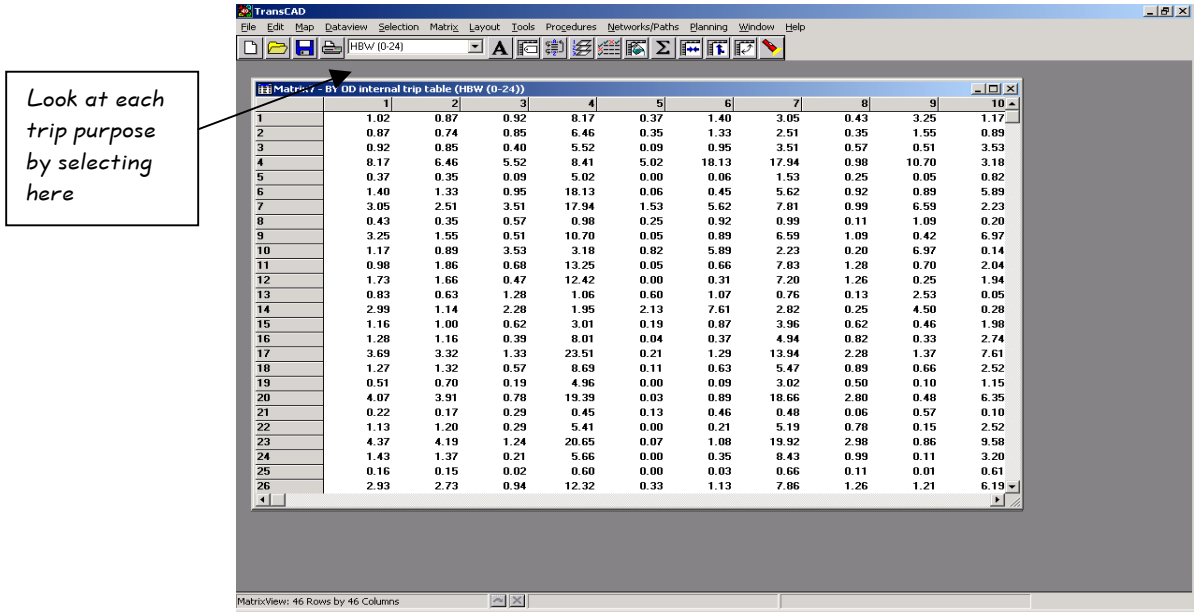
You will have to select the Use Matrix button for EACH PURPOSE

Your screen should look similar to this:



Step 4: When you have completed the changes in the dialog box click OK and save the file name as something logical: like → BY OD internal trip table

You should now get your Internal OD trip table, by purpose, on the screen.



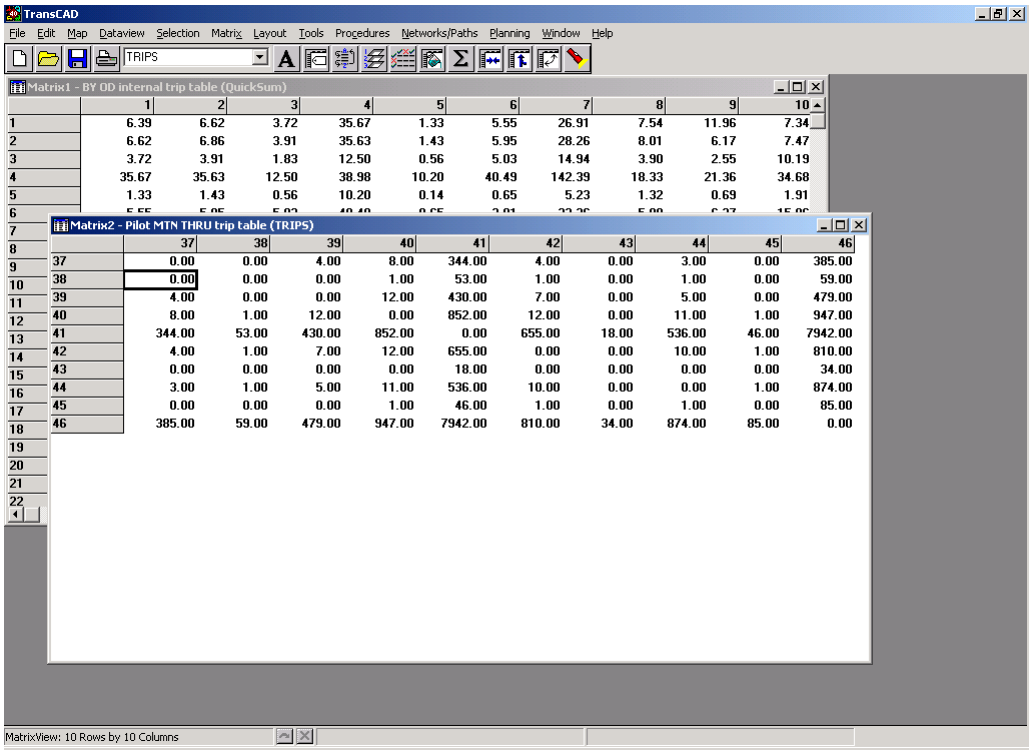
You should check your total trips for each matrix again to make sure you performed the right steps! Check using the marginals and compare it to your PA totals!

Is this the trip table you will use to assign the traffic onto your network???????????

NOPE!!!!!

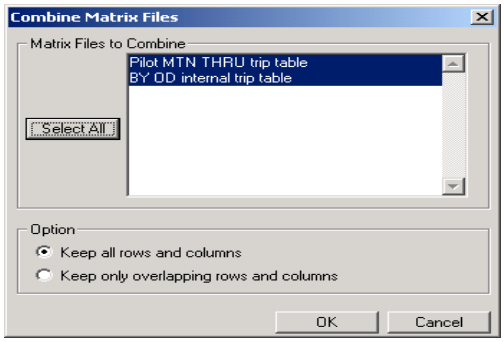
REMEMBER, THIS WAS OUR INTERNAL TRIPS SO WE MUST ADD THE EXTERNAL TRIPS (THROUGH) TO THIS TABLE TO GET OUR TOTAL TRIP TABLE!

In order to produce your Total Trip Table you should have your Internal OD table (the one you just created) and your through trip table open in TransCAD. (Use Pilot Mtn thru trip table.mtx)



Step 5: Combine the Matrices

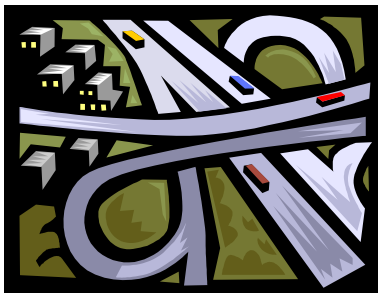
Go to Matrix → Combine, you should get this dialog box



You want to select both the Thru trip table and the internal OD table as the two matrices to combine. Keep all the rows and columns! Selecting keep only overlapping, will delete the OD pairs of the columns that are not the same zone numbers, so don't do that!

Give the file a name, like BY TOTAL TRIP TABLE and you have your trip table that you can load onto your network after you check it for reasonableness!

Chapter 7 - Trip Assignment



We have now decided the "trip interchanges" from each zone to all the other zones….ie distribution. What is left?
The path they will take on screen, loading them on the links of the network.

WHAT YOU SHOULD KNOW AFTER COMPLETING THIS CHAPTER:

What are the different methods of assigning traffic?
How to use TransCAD to perform assignment
Checks to do on assignment

Traffic Assignment Methods

Highway assignment models load the vehicle trips onto the highway network using a range of path-building algorithms, and typically iterate each assignment to account for congestion on the system.

There are two path-building algorithms in use: all-or-nothing (which is the foundation of several other methods) and stochastic. The all-or-nothing algorithm assigns all of the trips to the minimum path. The stochastic algorithm estimates a probability that a trip will take the minimum path or some other "efficient" path, and assigns proportions of the total trips to various paths based upon the estimated probabilities.

Below are the different assignment methods we would typically use in Statewide Planning:

All-or-nothing is the simplest form of assignment and is best used to determine minimum demand paths. It should only be used for small networks with no base year or future year congestion. This method assigns all vehicle trips between two zones in a trip table to the links in the highway network comprising a single minimum time path.

Capacity Restraint assignment changes the impedance of a link as traffic on that link increases. It attempts to represent the impact that congestion has on route choice and therefore traffic assignment. It is based on an iterative procedure.

Equilibrium assignment applies the theory of capacity restraint to trips on the network until no one can improve their trip impedance by changing paths.

Stochastic uses a user-defined probability that allows a trip to take either the minimum path or some other "efficient" path based on probability estimates.

These methods are discussed in more detail in following sections.

All or Nothing Assignment
All-or-nothing assignment assigns trips to the highway network using the minimum path between two zones. Assignment using this technique does not take into account delay caused by congestion, which reduces speed along the minimum path.

This type of loading is extremely sensitive to variation in speeds or other link impedances. This sensitivity to speed can be problematic when doing assignment in areas with competing corridors, with similar speeds, such as a central business district of a city.

Capacity Restraint Assignment
Capacity Restraint Assignment adjusts travel time based on congestion (the volume-to-capacity ratio) using an iterative procedure. The first iteration is an all-or-nothing assignment for which the analyst specifies the percentage of the trip table to be loaded. Using this initial assignment, link speeds are adjusted using a volume delay function. New minimum paths are then computed and another all-or-nothing assignment is completed for the next analyst specified percentage of the trip table. This process is repeated until 100 percent of the trip table has been assigned. With this procedure the final assignment will vary depending on the number of iterations completed (the number of subsets that the trip table is divided into.) Common break percentages are 70, 20 and 10 or 40, 30, 20, 10.

Equilibrium Assignment
Another variation on the all-or-nothing assignment is the equilibrium assignment. It is very difficult to obtain good estimates on congested networks with the standard all-or-nothing assignment. And while there is more control with the capacity restraint process that weighs results from iterations, both of these methods can be very sensitive to small changes in travel time making the process of arriving at just the right combination of speeds difficult.

An equilibrium assignment looks a several equally good paths through the network when assigning trips. This can buffer sensitivities by allowing the assignment to run through several iterations, thereby allowing a small change in speed to equal a small change in volume.

Stochastic Assignment
A stochastic assignment method uses a user specified probability estimate that a trip will take the minimum path or some other "efficient" path, and assigns proportions of the total trips to various paths based upon the estimated probabilities. This assignment captures travel behavior more effectively than using the all-or-nothing assignment technique alone.

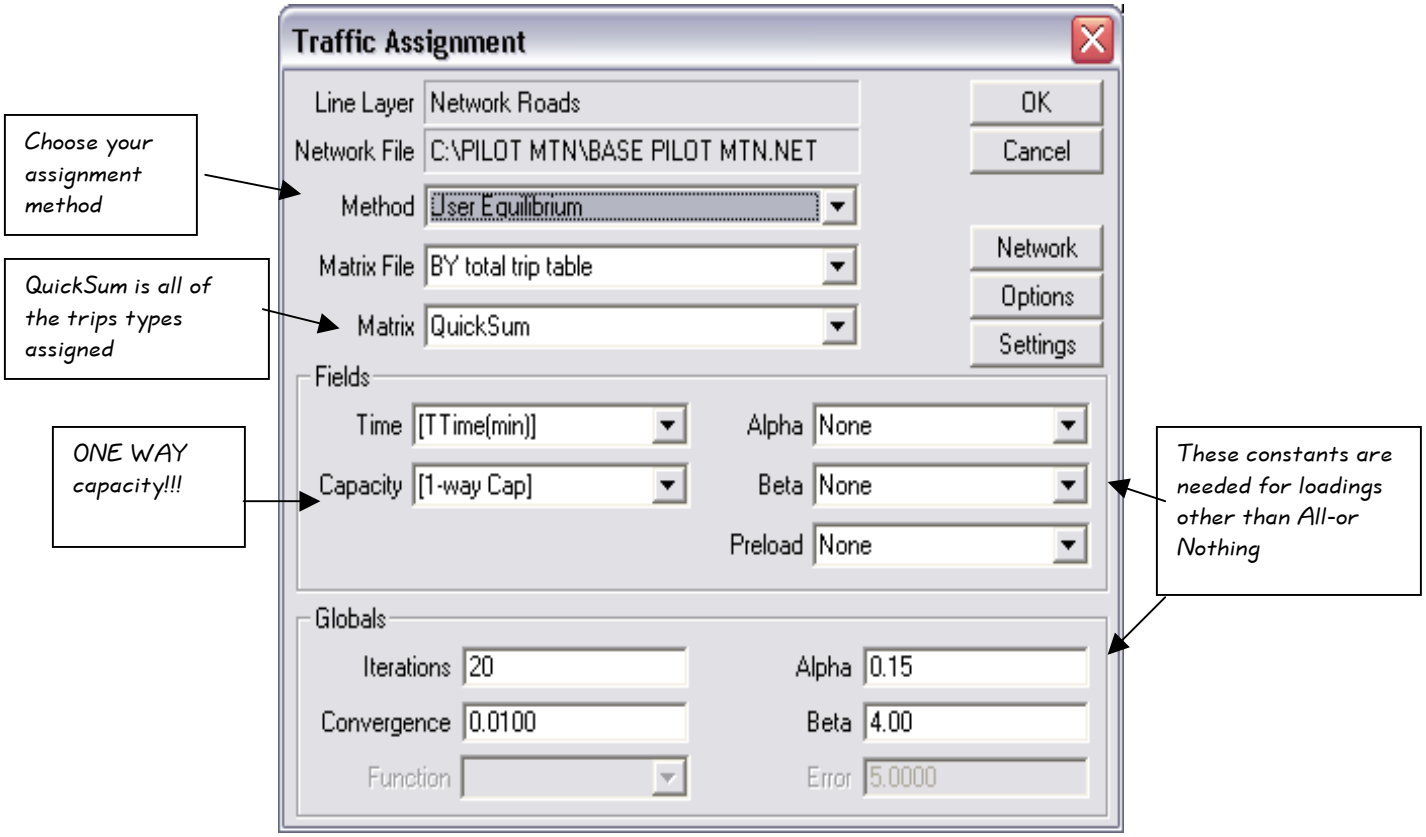
So How do I do it in TransCAD????????

To begin you MUST have these files open:

1) Your line layer with your modeled roads on it (Pilot Mtn BY Final Network.dbd)
2) The network you created from the linework (Base Pilot Mtn.net)
3) The FINAL OD MATRIX (BY Total Trip Table.mtx)

Make the line layer the working layer!!

1. Choose Planning→Traffic Assignment to display the Traffic Assignment dialog box.



2. Choose a traffic assignment method from the Method drop-down list.

3. Choose the travel demand matrix file(usually the Total trip tables) from the Matrix File drop-down list, and the demand matrix to be assigned from the Matrix drop-down list(the QuickSum because it is all of the purposes being loaded).

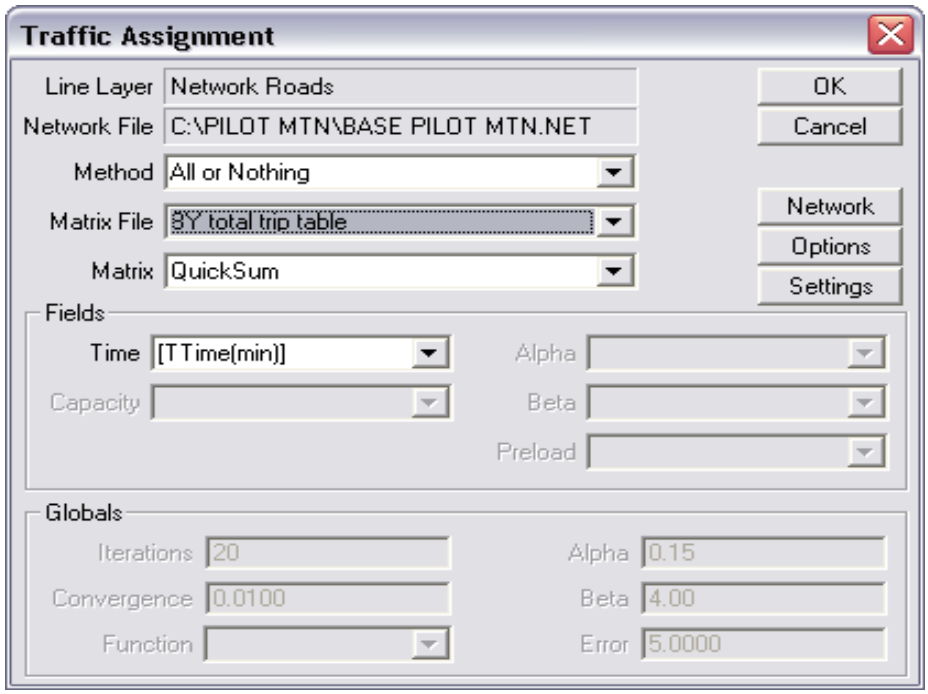
4. Depending on the method chosen, choose the network fields for time, capacity(should be one way), and/or preload(generally only for trucks/buses that do not change their paths).

5. To use link-specific values for alpha and beta, choose the corresponding network fields from the Alpha and Beta drop-down lists. (For now use the default values!)

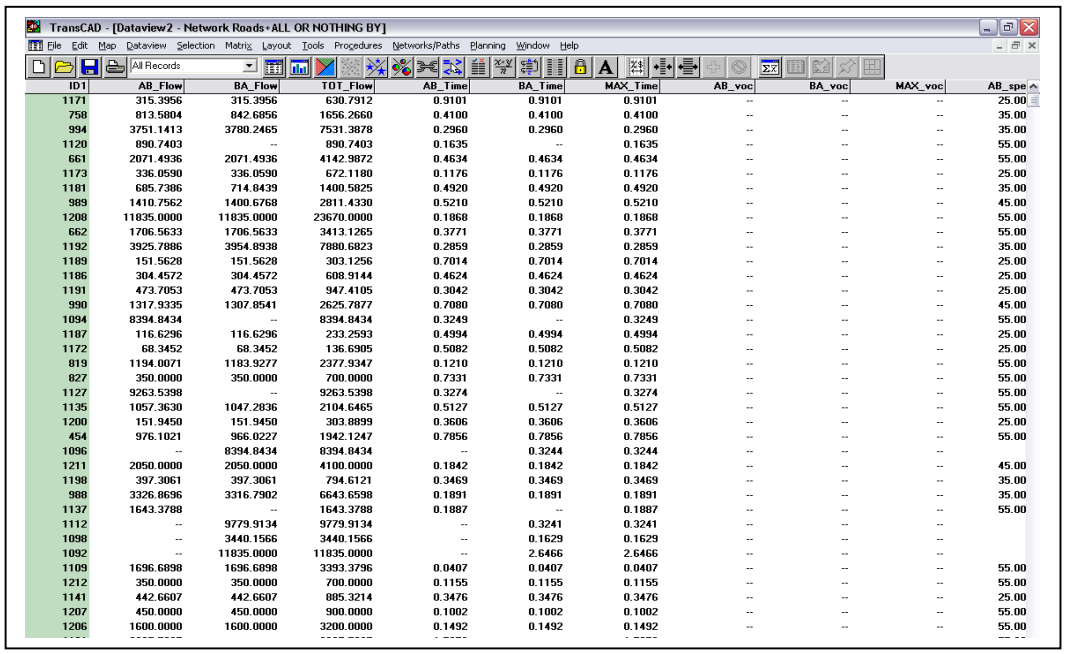
6. Depending on the method chosen, make global settings by typing values for iterations, convergence, alpha, beta, and/or error in the respective edit boxes, and choose a function from the Function drop-down list.

After you have chosen all the correct values click OK and give your assignment a meaningful name (ie….all or nothing BY assignment)

We are doing an All-or-Nothing assignment loading first!



After the fireworks you should now see a dataview on your screen that has joined the assigned volumes to your base year network data table!!!

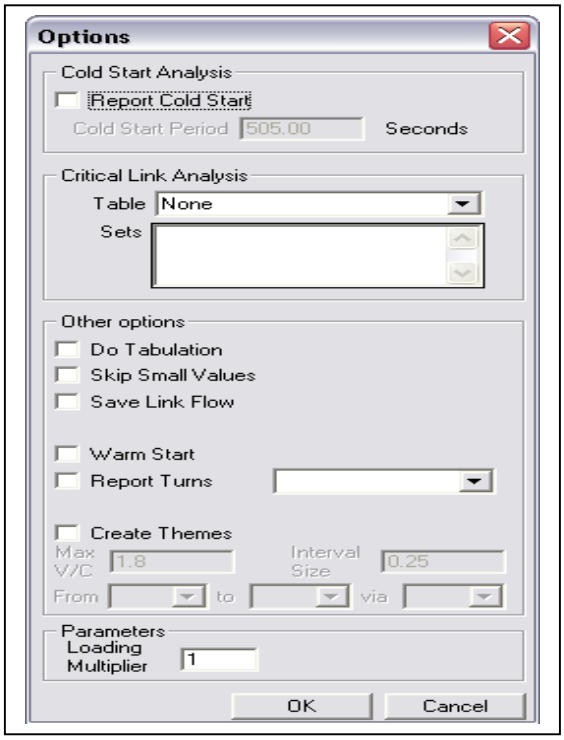


ID1	AB_Flow	BA_Flow	TOT_Flow	AB_Time	BA_Time	MAX_Time	AB_voc	BA_voc	MAX_voc	AB_spe
1171	315.3956	315.3956	630.7912	0.9101	0.9101	0.9101	--	--	--	25.00
758	813.5804	842.6856	1656.2660	0.4100	0.4100	0.4100	--	--	--	35.00
994	3751.1413	3780.2465	7531.3878	0.2960	0.2960	0.2960	--	--	--	35.00
1120	890.7403	--	890.7403	0.1635	--	0.1635	--	--	--	55.00
661	2071.4936	2071.4936	4142.9872	0.4634	0.4634	0.4634	--	--	--	55.00
1173	336.0590	336.0590	672.1180	0.1176	0.1176	0.1176	--	--	--	25.00
1181	685.7386	714.8439	1400.5825	0.4920	0.4920	0.4920	--	--	--	35.00
989	1410.7562	1400.6768	2811.4330	0.5210	0.5210	0.5210	--	--	--	45.00
1208	11835.0000	11835.0000	23670.0000	0.1868	0.1868	0.1868	--	--	--	55.00
662	1706.5633	1706.5633	3413.1265	0.3771	0.3771	0.3771	--	--	--	55.00
1192	3925.7886	3954.8938	7880.6823	0.2859	0.2859	0.2859	--	--	--	35.00
1189	151.5628	151.5628	303.1256	0.7014	0.7014	0.7014	--	--	--	25.00
1186	304.4572	304.4572	608.9144	0.4624	0.4624	0.4624	--	--	--	25.00
1191	473.7053	473.7053	947.4105	0.3042	0.3042	0.3042	--	--	--	25.00
990	1317.9335	1307.8541	2625.7877	0.7080	0.7080	0.7080	--	--	--	45.00
1094	8394.8434	--	8394.8434	0.3249	--	0.3249	--	--	--	55.00
1187	116.6296	116.6296	233.2593	0.4994	0.4994	0.4994	--	--	--	25.00
1172	68.3452	68.3452	136.6905	0.5082	0.5082	0.5082	--	--	--	25.00
819	1194.0071	1183.9277	2377.9347	0.1210	0.1210	0.1210	--	--	--	55.00
827	350.0000	350.0000	700.0000	0.7331	0.7331	0.7331	--	--	--	55.00
1127	9263.5398	--	9263.5398	0.3274	--	0.3274	--	--	--	55.00
1135	1057.3630	1047.2836	2104.6465	0.5127	0.5127	0.5127	--	--	--	55.00
1200	151.9450	151.9450	303.8899	0.3606	0.3606	0.3606	--	--	--	25.00
454	976.1021	966.0227	1942.1247	0.7856	0.7856	0.7856	--	--	--	55.00
1096	--	8394.8434	8394.8434	--	0.3244	0.3244	--	--	--	
1211	2050.0000	2050.0000	4100.0000	0.1842	0.1842	0.1842	--	--	--	45.00
1198	397.3061	397.3061	794.6121	0.3469	0.3469	0.3469	--	--	--	35.00
988	3326.8696	3316.7902	6643.6598	0.1891	0.1891	0.1891	--	--	--	35.00
1137	1643.3788	--	1643.3788	0.1887	--	0.1887	--	--	--	55.00
1112	--	9779.9134	9779.9134	--	0.3241	0.3241	--	--	--	
1098	--	3440.1566	3440.1566	--	0.1629	0.1629	--	--	--	
1092	--	11835.0000	11835.0000	--	2.6466	2.6466	--	--	--	
1109	1696.6898	1696.6898	3393.3796	0.0407	0.0407	0.0407	--	--	--	55.00
1212	350.0000	350.0000	700.0000	0.1155	0.1155	0.1155	--	--	--	55.00
1141	442.6607	442.6607	885.3214	0.3476	0.3476	0.3476	--	--	--	25.00
1207	450.0000	450.0000	900.0000	0.1002	0.1002	0.1002	--	--	--	55.00
1206	1600.0000	1600.0000	3200.0000	0.1492	0.1492	0.1492	--	--	--	55.00

(Here are some of the fields in the joined dataview table-just as an example of the data that exists!)

There are other options that exist in TransCAD that you may feel like using at some point in your analysis of the transportation system. Here's the descriptions of those options.

Click on the options button of the Traffic Assignment box to activate the Options Dialog Box!



Choose options as follows:

To do this...

Report cold start data -Check the Report Cold Start box and type a value for the cold start period (in seconds) in the edit box. Used for background info on air quality, recommended if you are comparing different options or base year to future.

Perform critical (select) link analysis- Choose a table from the Table drop-down list and choose sets from the scroll list. Sets that are not chosen will only output O-D matrices. Sets that are chosen will output O-D matrices and additional flow vectors.

Report tabulations of link flows and V/C ratios. Check the Do Tabulation box. This allows you to look at the link flows by category to do some reasonableness checks.

Skip small values in the assignment-Check the Skip Small Values box and type a minimum value in the edit box. If you want to not assign volumes under a certain threshold.

Save link flows in the network-Check the Save Link Flow box and choose a field in which to store the results from the drop-down list.

Report turning movements-Check the Report Turns checkbox and choose a selection set to report turning movements.

Specify flow values already present on the links-Check the Warm Start box and choose a network field that contains the flow values already present on the links.

Create V/C and flow themes of the results-Check the Create Themes box, type a maximum V/C value in the Max Vac edit box, type an interval value in the Interval Size edit box, and choose start, end, and intermediate colors from the drop-down lists.

Specify a preload PCE factor- Type a value in the Preload PCE edit box.(HCM 95 or 2000 values are recommended) –Used if you want to take your truck/bus loads and change them to vehicles to compare alternatives, etc.

Check your results…….

Using the screenline analysis tool you can check the results of your loadings!!

A screenline is an imaginary line on a map, which crosses one or more network links. To run screenline analysis, you need to specify each screenline that you want analyzed. Any number of screenlines can be analyzed at the same time.

How do you use the screenline tool in TransCAD??

You can draw and edit screenlines on the map using the tools in the Screenline Editor toolbox.

1. Choose Planning→Planning Utilities→Screenline Analysis to display the Screenline Dataview dialog box.

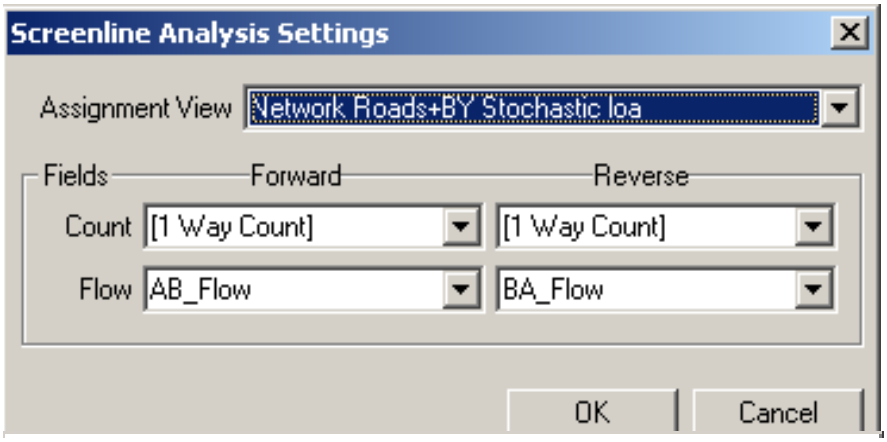
2. Choose the screenline definition table that you wish to use as follows:

   If you have NOT already created your screenline file then Click New Table and click OK to display the Store Table In dialog box. Type a file name and click Save.

   If you have created your screenlines already and want to edit them Click Open Table and click OK to display the Table Stored In dialog box. Choose the table and click Open.

   Or if you already have a dataview open Choose the dataview from the drop-down list and click OK.

TransCAD displays the Screenline Analysis Settings dialog box.



3. Make choices as follows.

A) Choose the dataview that contains the ground counts and assigned flows from the Line View drop-down list
B) Choose the fields from the Forward and Reverse Count drop-down lists
C) Choose the fields from the Forward and Reverse Flow drop-down lists

Click OK. TransCAD displays the Screenline Editor toolbox.

The screenlines are drawn as freehand lines on the map; they are not features in a map layer. The tools on the toolbox allow you to add, select, delete, and rename screenlines, and view the links that any screenline intersects.

Here's what the tools do:

To do this...	Do this...
Create a new screenline	Click the Add tool  to activate it, click on the starting point of the screenline, and click on additional points as needed. Press Esc if you want to cancel a partially-drawn screenline. While you are editing the screenline it will be shown as a thin, black dotted line. Press Enter or double-click at the endpoint to end the screenline. It will be shown as a thick, red dotted line.
Select an existing screenline	Click the Selection tool  to activate it and click on a screenline. TransCAD displays handles at the endpoints and shape points of the screenline.
Delete the selected screenline	Click  . TransCAD displays a Confirm dialog box. Click Yes to delete the selected screenline or No to keep it.
Rename the selected screenline	Click  . TransCAD displays the Rename Screenline dialog box. Type a new name and click OK.
Display a screenline link dataview	Click  . TransCAD displays a dataview that contains all the network links that are intersected by the selected screenline.
Change the settings	Click  . TransCAD displays the Screenline Analysis Settings dialog box. Make changes to the settings and click OK. TransCAD will use these settings for all future screenline analysis calculations until you change them or exit the Screenline Editor toolbox.
Perform screenline calculations	Click  . TransCAD displays the Store Summary In dialog box. Type a file name and click Save. TransCAD computes the flows, counts, and ratios over each screenline, writes the results to the file, and displays the results in a dataview.

Once you perform the screenline calculations you should get the results of your assignment in a dataview. There you can look at the ratio to see how your assignment looks!

Remember the Rule of Thumb- around 10%

If your screenlines are off then you will have to go through the validation/calibration steps in the final section of this class. This will be covered later.

Other TransCAD stuff for the screenlines

The specifications of screenlines are stored in a screenline definition table. This table contains all of the information needed to create screenlines on a map and to run screenline analysis. The screenline definition table is automatically updated when changes are made to the screenlines using the Screenline Editor.

The screenline definition table contains one or more records for each screenline. Each record includes the name of the screenline and a longitude and latitude of one of the points that defines the screenline. The fields are as follows:

Field	Contents
ID	A unique ID for each record
SCREENLINE	TransCAD internal ID for the screenline
NAME	Your name for the screenline
LONGITUDE	The longitude of a point that defines the screenline
LATITUDE	The latitude of a point that defines the screenline

The screenline definition table is automatically created, formatted, and updated as you modify screenlines using the Screenline Editor toolbox. In fact, you never have to directly look at or modify the screenline definition table to do screenline analysis, since everything is displayed as freehand lines and can be directly modified on the map using the Screenline Editor toolbox.

Note: you should not use the regular freehand tools for modifying screenlines. All manipulation of screenlines should be done from the Screenline Editor toolbox.

Once you have loaded the volumes on your network you should begin the validation/calibration process. Those steps are included as an addendum(slides) in the back of the notebook as well.