Development of the Franklin Travel Demand Model

Hampton Roads Planning District Commission

December 2008

T08-09

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PLANNING DISTRICT COMMISSION

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ABSTRACT
In Fiscal Year 2007, the Virginia Department of Transportation instituted a new program aimed at creating Rural Long Range Transportation Plans (RLRP) in rural areas across Virginia to complement planning efforts in the metropolitan areas of the state. A component of the RLRP includes analyzing both current and future traffic forecasts. To accomplish this task, the Hampton Roads Planning District Commission developed a small urban travel demand model for the City of Franklin. This document explains how this model was developed and validated.

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INTRODUCTION

BACKGROUND

In Fiscal Year 2007, the Virginia Department of Transportation (VDOT) instituted a new program, the Rural Long Range Transportation Plan (RLRP), aimed at creating regional transportation plans in rural areas across Virginia to complement planning efforts in the metropolitan areas of the state.

These RLRP's will be used as a foundation for identifying transportation priorities for the Six-Year Improvement Program as well as in the statewide transportation planning process. Through the development of the RLRP, the Hampton Roads Planning District Commission (HRPDC) will evaluate the transportation system with respect to existing and projected population and employment and recommend a range of transportation improvements that could best satisfy existing and future transportation needs.

PURPOSE OF MODEL DEVELOPMENT

HRPDC staff developed a travel demand model for the City of Franklin to forecast future traffic congestion and to test candidate projects for the RLRP.

Objectives of the RLRP include:

- Identifying and measuring the potential impact of high growth areas (residential, retail, and distribution centers)
- Identifying critical freight infrastructure and improvements
- Identifying operational improvements (intersection improvements, access management strategies, etc.)
- Identifying facilities that should be targeted for bicycle and pedestrian improvements
- Identifying highway needs based on minimum standards
- Recognizing corridors to preserve right of way for future transportation improvements
- Identifying areas of need for on-demand transit services
- Providing increased opportunity for local/regional input on interstate and primary recommendations in the State Highway Plan
- Ensuring consistency of secondary recommendations with interstate and primary recommendations

APPLICATION OF MODEL

The Franklin travel demand model will produce estimates of typical weekday traffic volumes. It will be used as a tool to produce travel forecasts, identify deficiencies, and evaluate alternatives for the RLRP.

CITY OF FRANKLIN

BACKGROUND

The City of Franklin is located in the Hampton Roads region of southeastern Virginia, situated between Southampton and Isle of Wight Counties, forty miles west of Norfolk and nine miles north of the North Carolina border. Franklin is both a retail and service center for the city and surrounding counties.

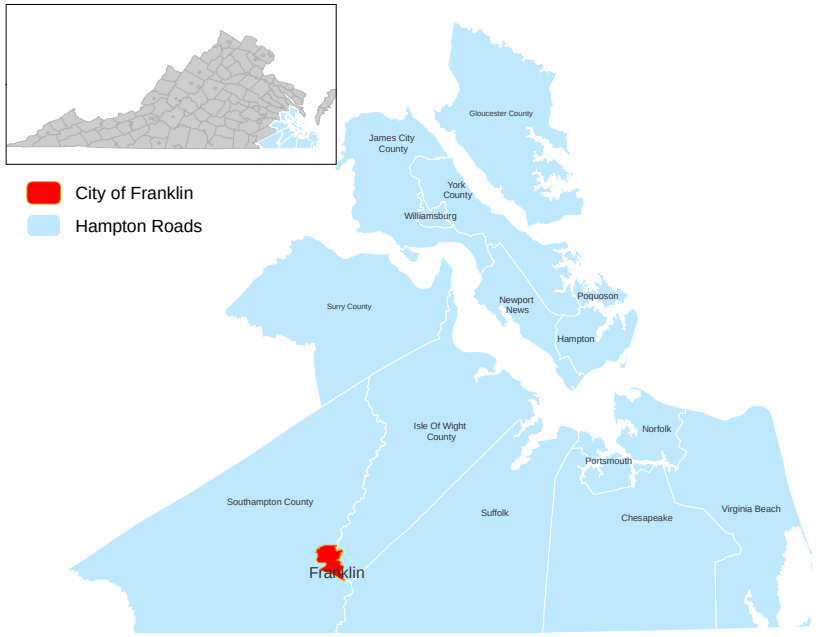
Franklin is approximately 8.4 square miles with its greatest dimensions being about 5 miles long and 5 miles wide.

SOCIOECONOMIC PROFILE

In 2000, the City of Franklin had a population of approximately 8,400 residents living in about 3,400 Households. The total for registered vehicles was approximately 5,800. Employment was just over 5,500 – of which 1,400 was listed as retail employment.

According to the City's Comprehensive Plan, *Franklin 2010*, approximately half of Franklin's employed citizens worked in management and professional or sales and office jobs. Industries employing the greatest number of Franklin residents include Manufacturing (24%) and Educational, Health, and Social Services (26%). Most of the residents with manufacturing jobs work in the surrounding counties, such as International Paper in Isle of Wight County or Hercules in Southampton County. Likewise, about 1,200 Southampton County workers travel into the city for employment[1].

Map 1: Hampton Roads



[1] *Franklin 2010, The City of Franklin, Virginia Comprehensive Plan* Hampton Roads Planning District Commission, November 2005, and 2000 Census Transportation Planning Package.

Table 1: Socioeconomic Data

City of Franklin – Year 2000	
Population	8,346
Households	3,384
Vehicles	5,775
Total Employment	5,560
Retail Employment	1,400
Non-Retail Employment	4,160

Data Source: Hampton Roads Planning District Commission

SOCIOECONOMIC FORECAST

According to the 2035 Socioeconomic Forecast from the Hampton Roads Phase I RLRP report, population in Franklin is projected to grow by 0.9% annually and employment by 0.4% annually. It is expected that Franklin's importance as an economic center for the southwest section of Hampton Roads will continue.

Table 2: Socioeconomic Forecast for 2035

City of Franklin – Year 2035					
	2000	2035	Change	AGR (Annual Growth Rate)	Hampton Roads AGR (2034 Forecast)
Population	8,346	11,300	+2,954	0.9%	0.8%
Employment	5,560	6,400	+840	0.4%	0.7%

Data Source: Hampton Roads Planning District Commission

LAND USE AND HIGH GROWTH AREAS

The City of Franklin has a broad range of existing land uses including single and multi-family residential, agricultural and forested areas, industrial, as well as big box and strip commercial development. Franklin also has a central business district located in its historic downtown area.

The majority of the commercial and industrial areas are in and around the downtown area, along the Armory Drive corridor, and in the southern tip of the City. Most of the remaining land area is zoned for various types of residential uses. Small areas of land zoned for Neighborhood Commercial are intermingled within residential areas.

Approximately half of the land within Franklin is currently in agricultural, forested and open space uses. Some of these areas may be rezoned in order to accommodate development as population increases. City staff is currently reviewing several proposed residential development areas along North High Street, Hunterdale Road, Clay Street, South Street and College Drive. The City expects to add approximately one thousand new single family dwellings along these roadways.

TRANSPORTATION SYSTEM

Franklin is served by US Highway 58 (Bypass), a mostly four-lane highway connecting the city to the metropolitan area of Hampton Roads to the East and Interstates 95, 85, and 77 to the West. The following three US Highway 58 interchanges serve the City: Pretlow Street, South Street, and Armory Drive (See Map 2).

The roadway system consists of almost 60 centerline miles of publicly maintained roads made up of a network of streets divided into four functional classifications:

- Principal Arterial
- Minor Arterial
- Urban Collector
- Local Roads

The most prevalent form of transportation in the City of Franklin is the use of the private automobile. According to the 2000 Census, 76% of Franklin workers drove alone to work and 17% carpooled.

Picture 1: Second Avenue in Downtown Franklin

Picture 2: Main Street in Downtown Franklin

DEVELOPMENT OF MODEL

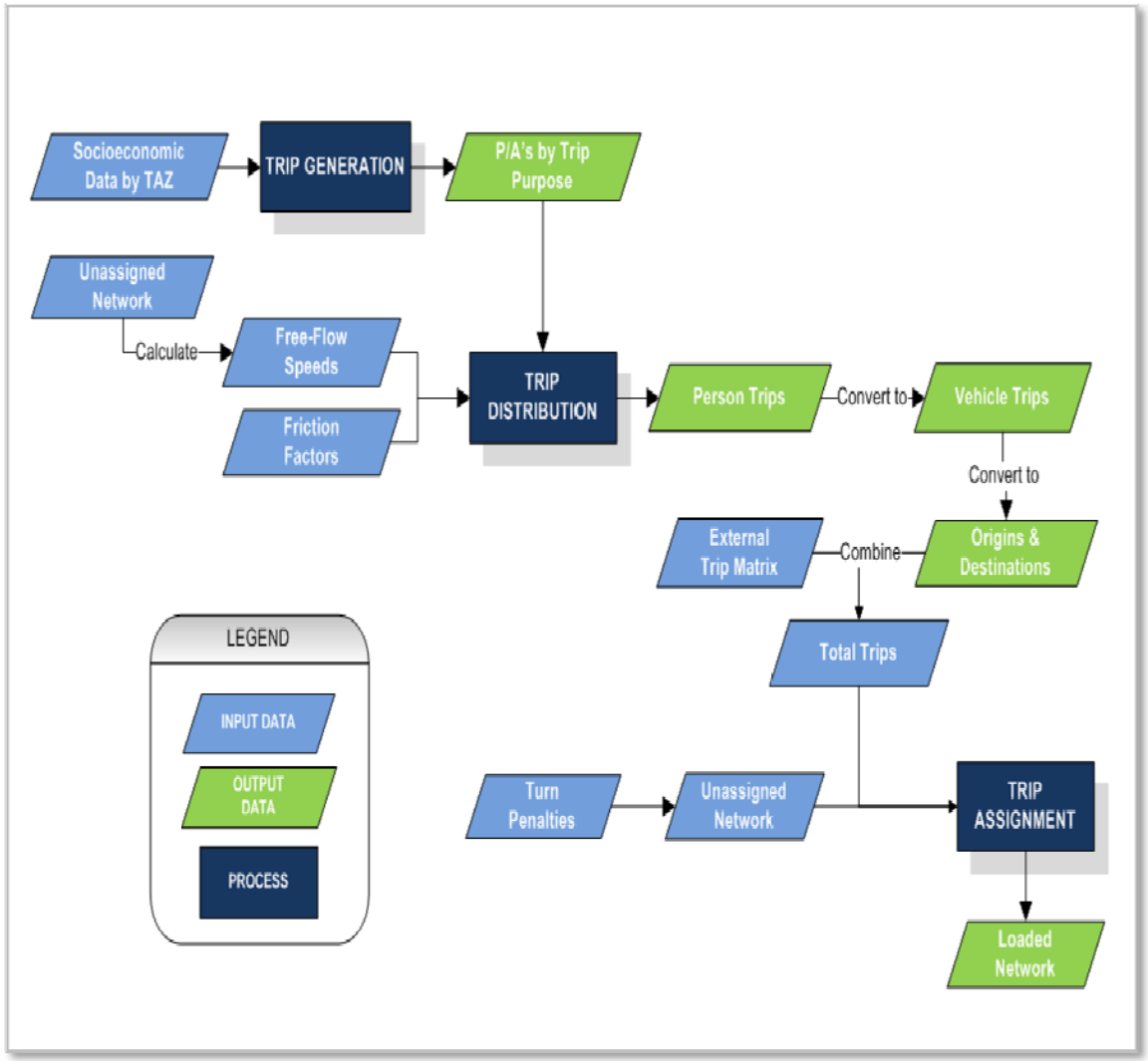
MODEL STRUCTURE

Traditional travel demand models use a four-step process – Trip Generation, Trip Distribution, Mode Choice, and Trip Assignment. Trip Generation produces estimates of trip productions and trip attractions for each Transportation Analysis Zone (TAZ) in the model area in terms of trip purposes. Trip Distribution determines where the trips are traveling from and to. Mode Choice splits the trip by available transportation modes. Finally, Trip Assignment determines what route the vehicle trips will take on the network.

For the Franklin model, since the private automobile is the most prevalent form of transportation in the City of Franklin, a basic three-step approach was chosen for the Franklin model structure (Trip Generation, Trip Distribution, and Trip Assignment).

The Hampton Roads travel demand model was used as a starting point for the development of the Franklin model.

Figure 1: Franklin Model Flowchart



INPUT DATA

Application of the model begins with the development of key sets of input:

- Socioeconomic Data
- Transportation Network
- Transportation Analysis Zones
- External Trip Table

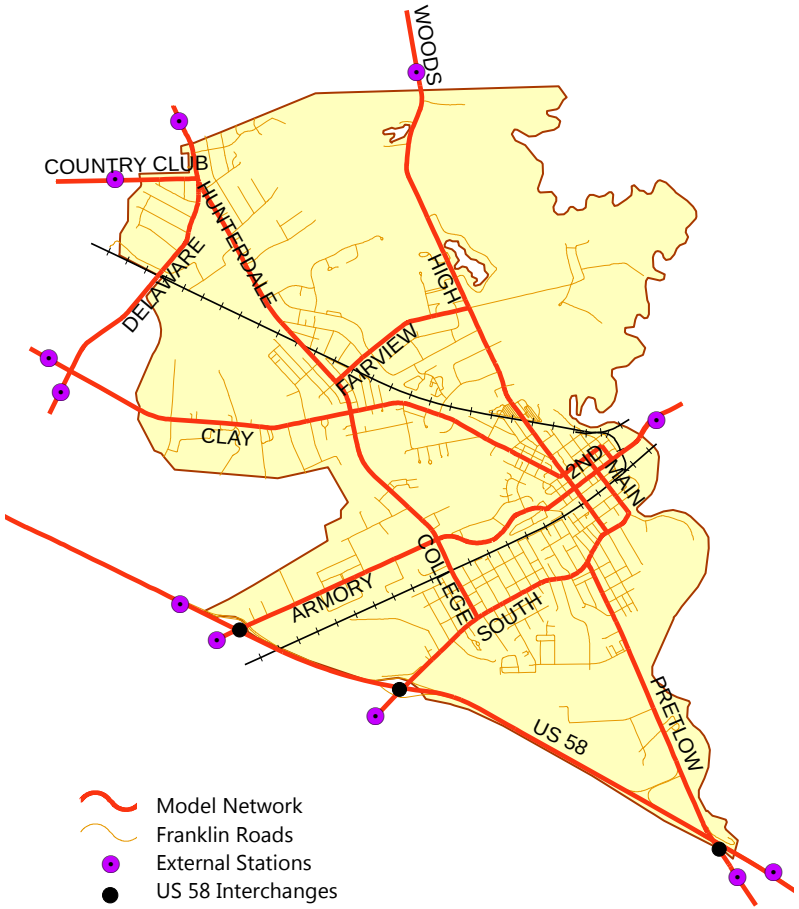
Socioeconomic Data Development

Socioeconomic data in the form of demographic and land use data are essential inputs to the travel demand modeling process because many travel decisions are based on these variables. For example, household characteristics such as the number of people living in household, number of vehicles in household, etc. are fundamental in the travel decision process. Also, land use information regarding activity type (employment, retail, industrial, etc.) has a direct impact on not only the type of trip made but the quantity of these trips as well.

Network Development

An abstract representation of the highway network was created using the centerlines from the City of Franklin based on the road inventory as it existed in 2000 (base year for model). Basic information such as miles of roadway, number of lanes, functional class, capacity, and traffic counts were stored as attributes in the network.[2]

Map 2: Model Network



[2] 1999 Traffic counts were used to validate model due to flooding from Hurricane Floyd in late 1999 which greatly altered traffic patterns in the City of Franklin for most of 2000.

The model uses attributes from the network to estimate impedance (travel cost or resistance to travel between TAZs). The highway network is made up of links, nodes, centroids, centroid connectors, and external stations.

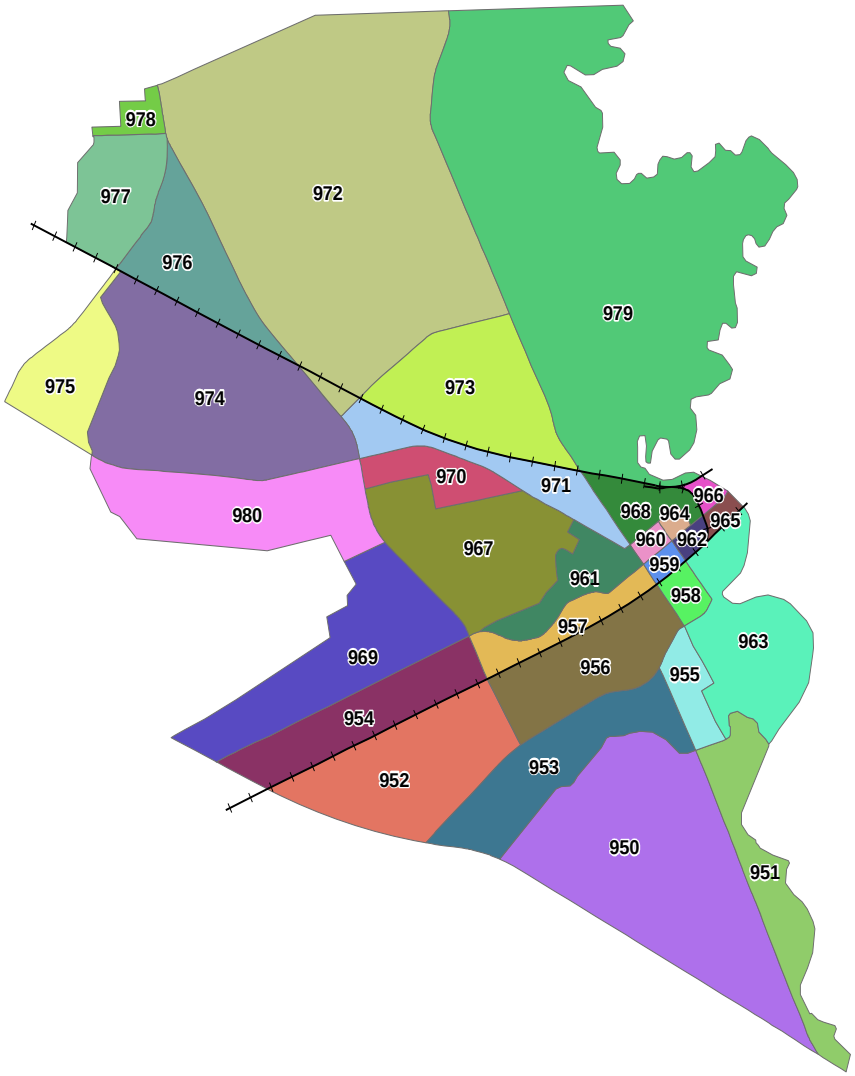
- Links represent individual roadway segments.
- Nodes generally represent the intersection of roadway segments but are also used to maintain a truer representation of the highway system.
- Centroids represent the center of activity in each TAZ and the point at which trips are loaded onto the highway network via a Centroid Connector.
- External stations are centroids which represent the points at which external trips enter or leave the study area.

Transportation Analysis Zone (TAZ) Development

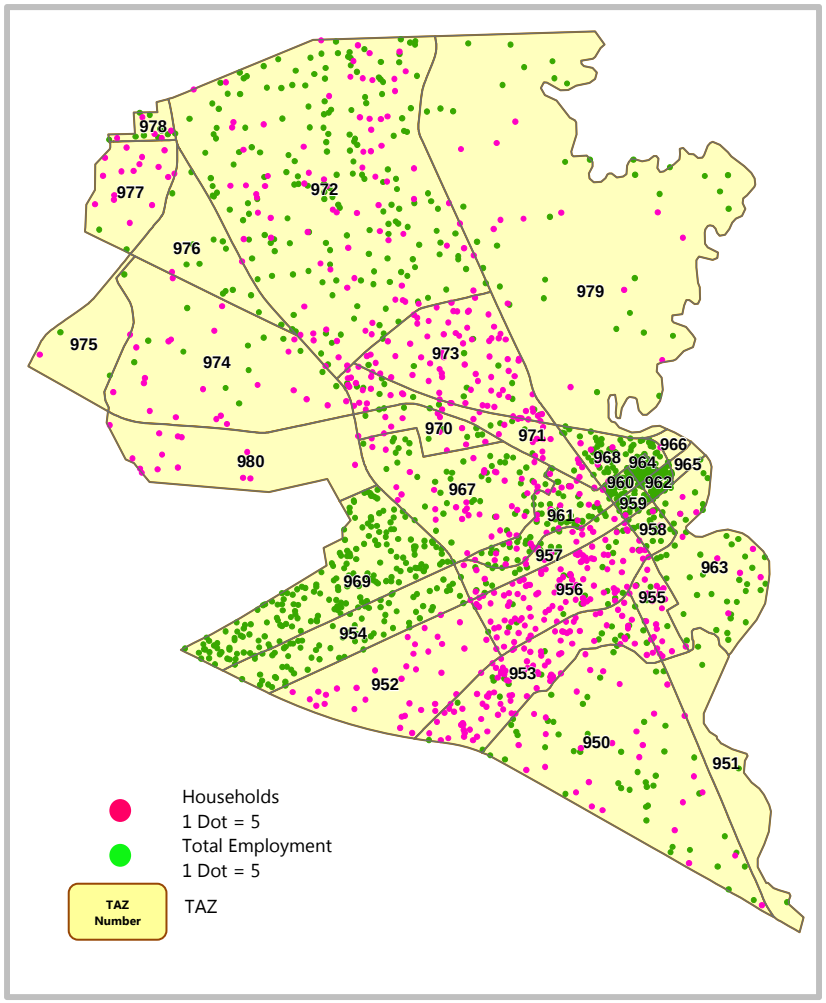
The road network is an essential component of the travel demand model as are the Transportation Analysis Zones (TAZs). TAZs are the basic unit of geography used in transportation models.

Using census blocks as a basis, thirty-one TAZs were established for Franklin. Using GIS software to spatially reference socioeconomic data obtained from the US Census and the Virginia Employment Commission, approximately 3,400 Households, 5,800 Vehicles and 5,600 jobs were allocated to these TAZs. Maps 4 and 5 on the following pages depict Households, Total Employment and Retail Employment by TAZ. Socioeconomic data by TAZ can be found in Appendix B.

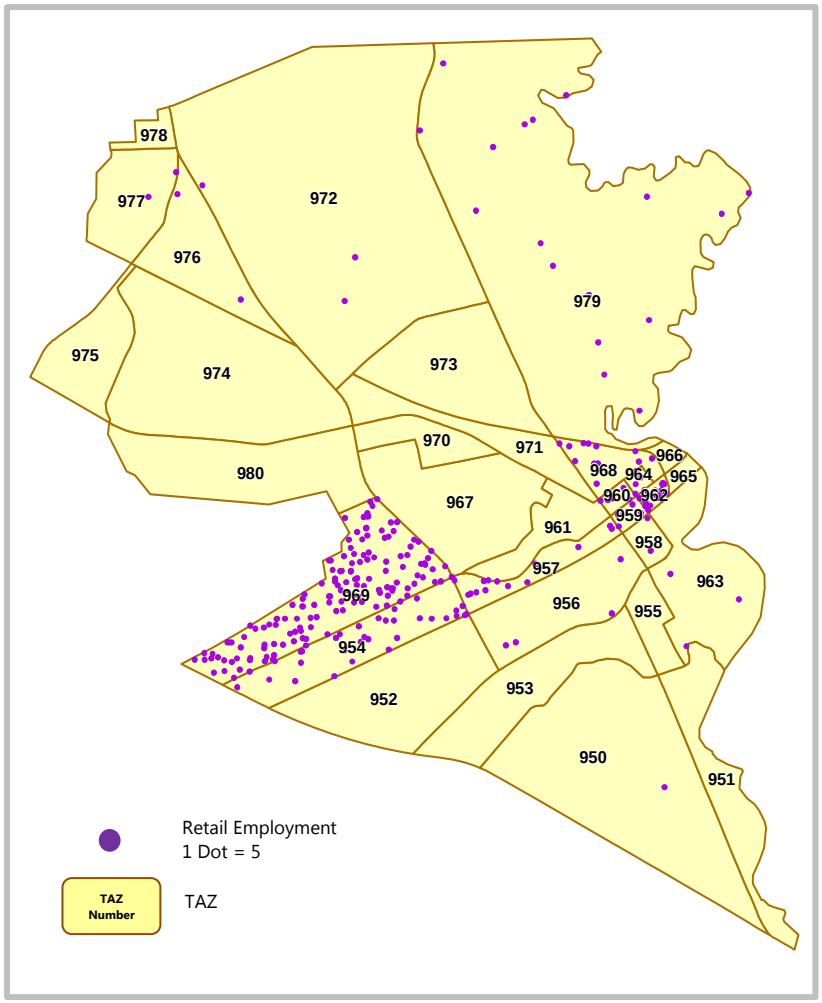
Map 3: Franklin Transportation Analysis Zones



Map 4: 2000 Households and Total Employment by TAZ



Map 5: 2000 Retail Employment by TAZ



External Trip Table Development

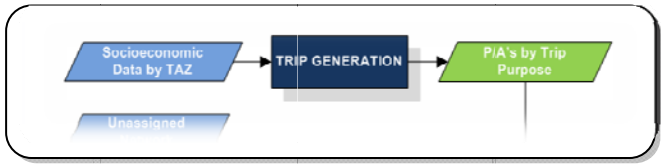
External stations represent trips entering and leaving the model area and are an important piece of the modeling process. The Franklin model has eleven external stations.

Inputs to calculating external trips include the ADT traffic counts at the external stations, socioeconomic data, and the connectivity between each external station pair. Outputs include a trip matrix incorporating through or External-External (E-E) trips as well as Internal-External (I-E) and External-Internal trips (E-I).

Estimation of external trips required the following steps:

- Estimation of the percent of E-E and IE-EI trips at each external station
- Calculation and balancing of the E-E, I-E, and E-I trip tables
- Distribution of IE-EI trips between internal zones and external stations

TRIP GENERATION



Trip Generation uses socioeconomic input factors of household, vehicle ownership, retail employment, non-retail employment and total employment to describe land use. Outputs from this step are trip productions and attractions by trip purpose.

Trip Purposes

Productions and Attractions generated by the model are categorized by trip purpose. Three trip purposes were used for the Franklin model - Home Based Work (HBW), Home Based Other (HBO), and Non-Home Based (NHB). HBW trips are those trips originating at the home and go directly to work. HBO trips are those trips that originate at home with a destination other than work (i.e. daycare, store, etc.). NHB trips are those trips that do not originate at home (i.e. work lunch trip). The following equations were used for configuring trip productions and attractions:

PRODUCTION EQUATIONS

- HBW (0.31*HH)+(0.93*VEH)+(0.58*RETAIL)
- HBO 1.70*VEH
- NHB 1.5*((0.73*HH)+(0.20*RETAIL)+(0.15*NONRETAIL))

ATTRACTION EQUATIONS

- HBW (0.24*HH)+(0.90*TOT_EMP)+(0.44*RETAIL)
- HBO 1.6*((1.04*HH)+(1.51*RETAIL))
- NHB (1.15*HH)+(0.32*TOT_EMP)

Where:

- HH = Households
- VEH = Vehicles
- RETAIL = Retail Employment
- NONRETAIL = Non-Retail Employment
- TOT_EMP = Total Employment

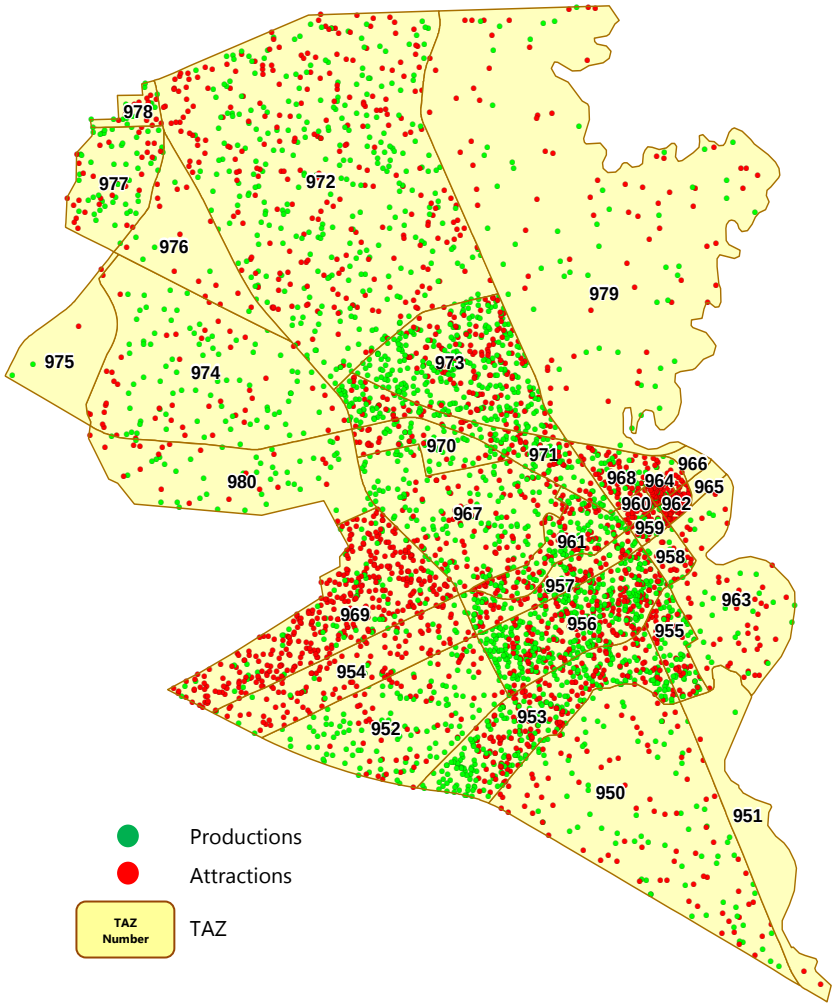
Trip Generation Calibration

Each step of the model was checked and calibrated based on guidelines from VDOT's *Virginia Travel Demand Modeling Policies and Procedures Manual*. The table below defines the guidelines as well as the model results for Trip Generation:

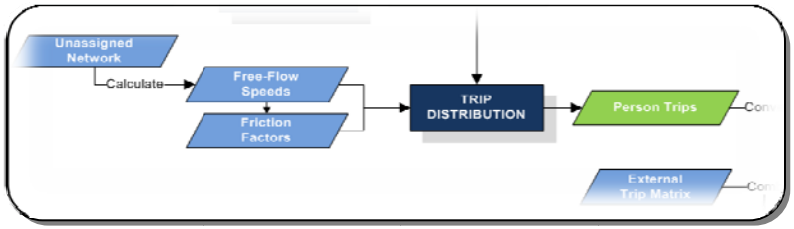
Table 3: Trip Generation Calibration Procedural Check for Small Regions

	Guideline	Franklin Model	
Person Trips/TAZ	< 10,000		734
Unbalanced P/A Ratio	0.90 – 1.10	Total P/A Ratio	1.04
		P/A Ratio HBW	1.12
		P/A Ratio HBO	1.09
		P/A Ratio NHB	0.89

Map 6: Productions and Attractions by TAZ



TRIP DISTRIBUTION



Trip Distribution is the method used to link pairs of trip productions to trip attractions. VDOT guidelines call for the use of the standard gravity model as the method for trip distribution.

The gravity model is a spatial allocation model, allocating trips between zones based on the attractiveness of each zone and some measure of impedance or separation between zones. Inputs to this step are the balanced production and attraction matrix, the free-flow times between each TAZ pair, and friction factors (used to limit the average trip length as well as help distribute trip lengths) obtained from the Hampton Roads travel demand model. A table of the friction factors used for the model can be found in Appendix B.

Trips are then converted from person trips to vehicle trips. Next, the production-attraction matrix is then converted into an origin-destination trip matrix. Finally, the external trip matrix is also combined with the internal trip matrix. Once this is completed, the vehicle trips are ready to be loaded onto the network.

Free-flow Speed and Travel Impedance

Free-flow speed based on link classification was used to determine the travel impedance between zones in the Franklin model.

Every link in the network was coded into one of five link classifications. The free-flow speeds of all categories are listed in the table below:

Table 4: Free-Flow Speed Lookup Table

Link Type	Classification	Free-flow Speed
0	Centroid Connector	25
1	Freeway	50-58
3	Principal Arterial	26-51
4	Minor Arterial	28-47
5	Collector	25-36

Intrazonal Travel Time

The average travel time within each TAZ is referred to as the internal travel time. The Franklin model assumes that the intrazonal travel time of a TAZ is equal to one-half the travel time to the nearest zone.

Trip Distribution Calibration

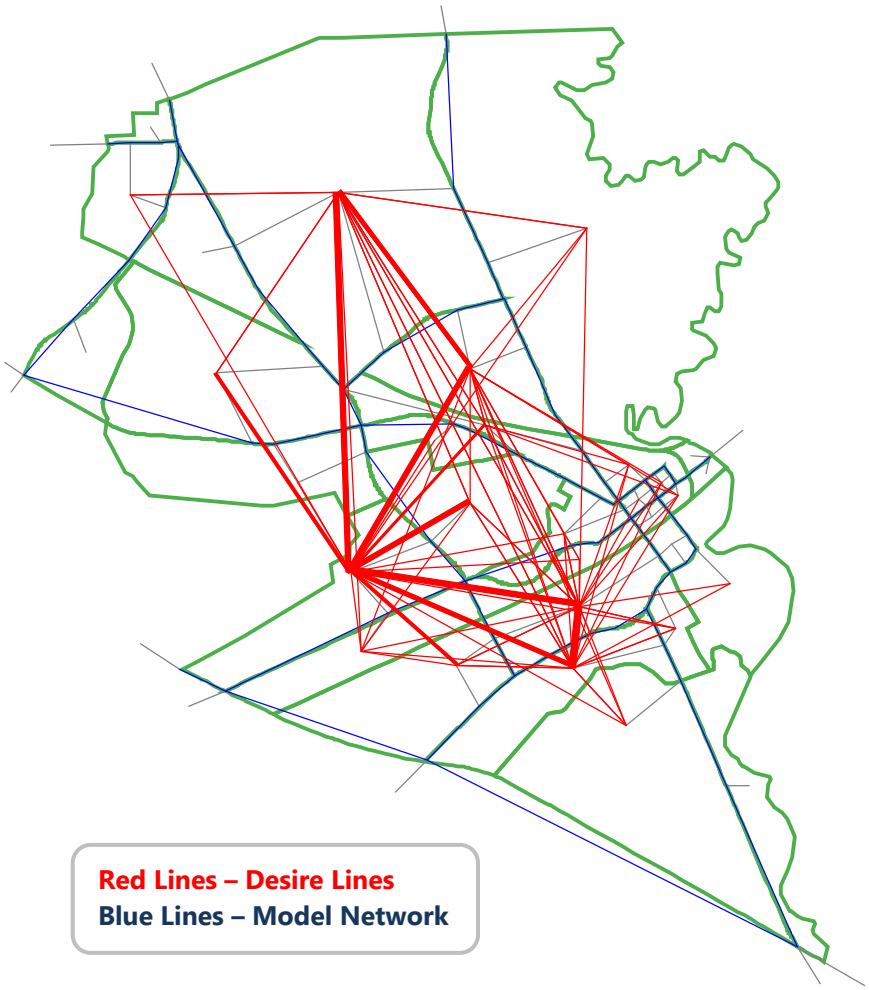
Guidelines for Trip Distribution include minimizing the number of intrazonal trips to ensure enough traffic is routed onto the highway network. For a model of this size, it is recommended that the percentage of intrazonal trips be less than 8% for each TAZ. TAZs with a high percentage of intrazonal trips could be considered for zone splitting in future model modifications.

Table 5: Trip Distribution Calibration Procedural Check for Small Regions

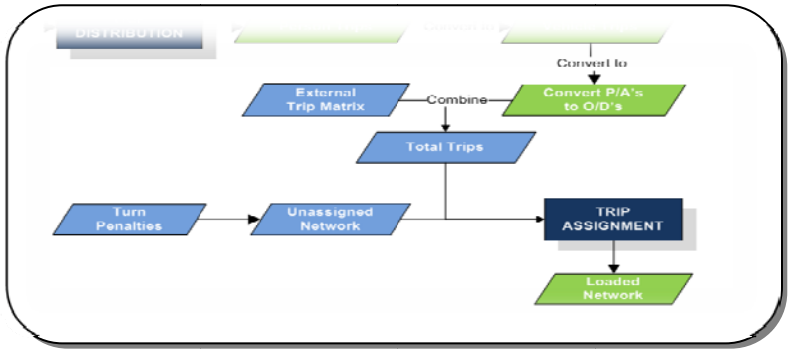
TAZ	Intrazonal Trips	% or TAZ Trips (Guideline <8%)
950	164	14%
951	1	3%
952	123	10%
953	474	16%
954	57	6%
955	62	8%
956	589	16%
957	93	9%
958	5	2%
959	2	1%
960	4	1%
961	134	10%
962	17	2%
963	43	7%
964	9	2%
965	0	0%

TAZ	Intrazonal Trips	% of TAZ Trips (Guideline <8%)
966	0	0%
967	213	13%
968	27	4%
969	323	10%
970	33	6%
971	140	9%
972	1,010	24%
973	479	16%
974	96	10%
975	1	3%
976	6	3%
977	85	15%
978	16	7%
979	109	11%
980	25	5%

Map 7: Desire Lines (Desired Travel between TAZs)



TRIP ASSIGNMENT



The primary inputs for trip assignment are the origin-destination (O-D) matrix from Trip Distribution, a turn penalty file (defines turn penalties to prohibit traffic flow on certain links) and the highway network. Flows for each O-D pair are assigned onto the network using time as a cost function.

The model uses a Capacity Lookup Table in assigning trips to the network:

Table 6: Capacity Lookup Table

Link Type	Classification	Capacity Values
0	Centroid Connector	9,999
1	Freeway	1,820-1,950
3	Principal Arterial	780-890
4	Minor Arterial	650-765
5	Collector	480-720

Trip Assignment Calibration

Below are the recommended guidelines as well as model results for Assigned vs. Observed traffic volumes as well as percent difference targets for Vehicle Miles Traveled (VMT):

Table 7: Percent Difference for Traffic Volumes by Facility Type

Facility Type	Acceptable Practice	Recommended Practice	Franklin Model
Interstate & Freeway	± 7%	± 6%	-6.1%
Major Arterial/Highway	± 10%	± 7%	N/A
Minor Arterial	± 15%	± 10%	-7.63%
Collector & Local	± 25%	± 20%	+25.6%
All Roads	± 10%	± 5%	-4.4%

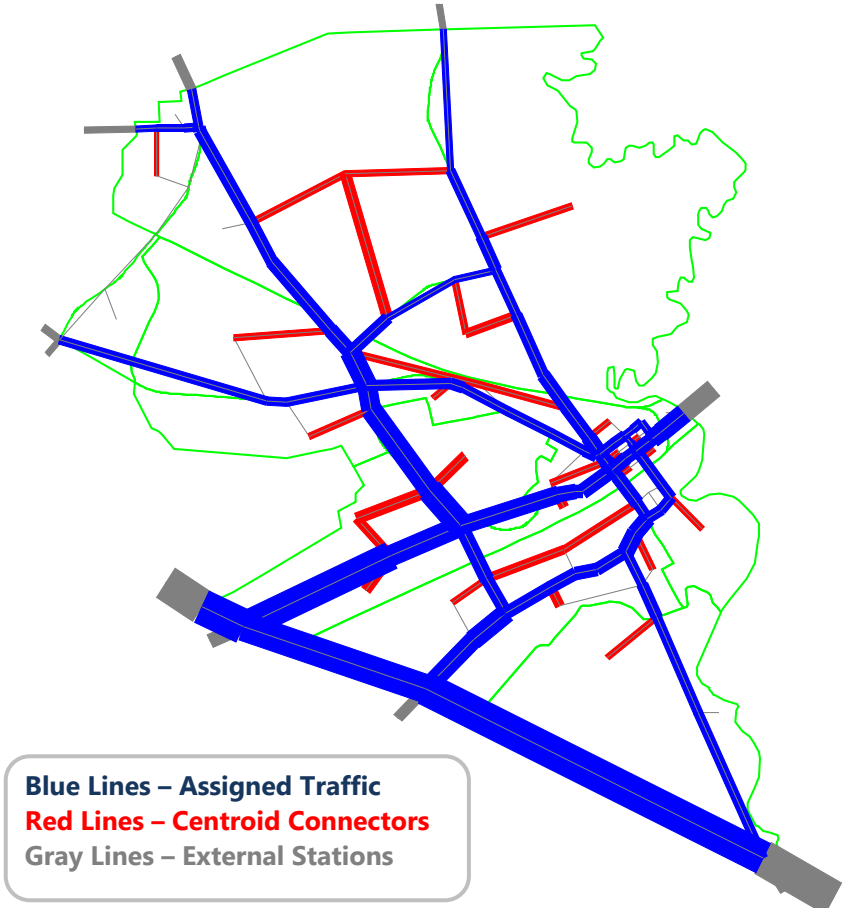
Table 8: Percent Difference Targets for Total VMT by Facility Type

Facility Type	Acceptable Practice	Recommended Practice	Franklin Model
Interstate & Freeway	± 10%	± 5%	-6.1%
Major Arterial/Highway	± 15%	± 10%	N/A
Minor Arterial	± 20%	± 15%	-4.4%
Collector & Local	± 25%	± 20%	+17.1%
All Roads	± 10%	± 5%	-3.3%

BANDWITH OF ASSIGNED TRAFFIC VOLUMES

The following is a map depicting assigned traffic volumes from the 2000 base year model:

Map 8: Bandwidth of Assigned Traffic Volumes



MODEL OUTPUTS

The following table is a summary of person trips, vehicle trips, total vehicle trips including those entering and leaving the model area, as well as total Vehicle Miles Travel (VMT) produced by the model:

Table 9: Model Outputs for Person Trips, Vehicle Trips, Total Trips and VMT

Franklin Model	
Person Trips (Internal)	**22,744**
Home Based Work	7,237
Home Based Other	9,829
Non-Home Based	5,678
Vehicle Trips (Internal)	**17,141**
Home Based Work	6,641
Home Based Other	6,384
Non-Home Based	4,116
Total Vehicle Trips (Including Externals)	**76,274**
Vehicle Miles Travel (VMT)	**178,565**
Average Trip Length	2.3 miles

MODEL VALIDATION

Model Validation is the final step in model development and is an indication of how well the model is replicating existing travel patterns by comparing model outputs to known (base year) travel data.

Using the guidelines from VDOT's *Virginia Travel Demand Modeling Policies and Procedures Manual*, the following tables and graphs summarize how well the model is replicating known travel behavior in Franklin.

ASSIGNED VS OBSERVED VOLUMES

This scatterplot depicts the assigned traffic volumes produced by the model against known traffic counts for 1999. Traffic counts from 1999 instead of 2000 were used due to the catastrophic flooding in the downtown area of Franklin from Hurricane Floyd in late 1999 which affected travel patterns for some time afterwards.

Figure 2: Scattergram

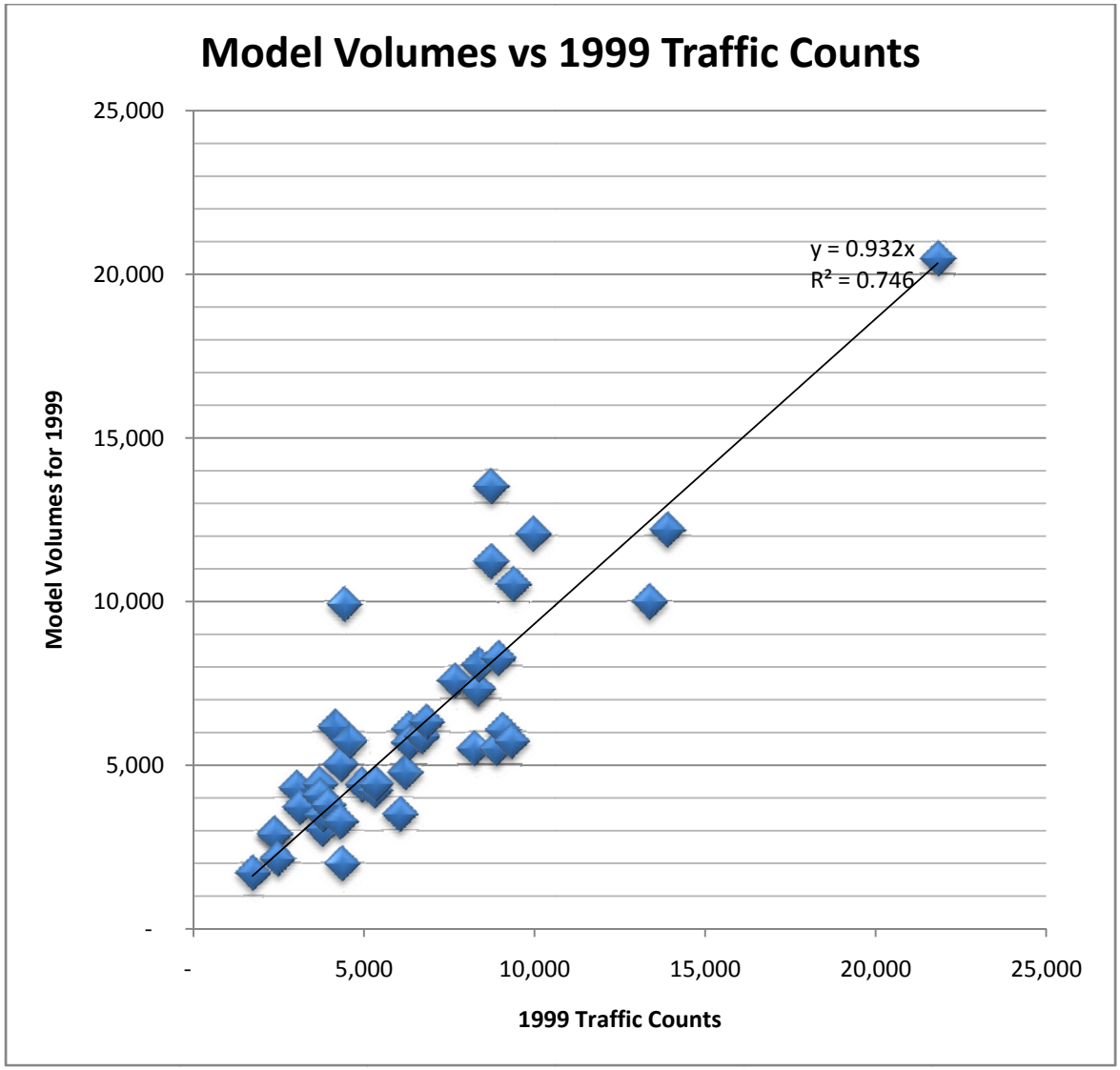


Table 10: Model Validation of Trips Produced by Model

	Guidelines[3]	Franklin Model
Person Trips per Household	9.2	(22,744/3,387) 6.7
Vehicle Trips per Household[4]	8.1	(17,142/3,387) 5.1
Percentage of Average Daily Trips by Purpose (Vehicle Trips)[5]	HBW = 20%	39%
	HBO = 57%	37%
	NHB = 23%	24%

Table 11: Model Validation of Assigned Traffic Volumes

	Guideline	Franklin Model
R^2 for Model Region	> 0.92	0.75
Percent RMSE for Model Region	< 30%	29%
Assigned vs. Observed Traffic Assignment	Scattergram compared to a 45° line	See Chart on Page 14

[3] Guidelines are for an urban area with a population size ranging from 50,000 to 200,000.

[4] 17,142 total internal vehicle trips. 76,274 total internal + external trips.

[5] The Trips by Purpose for the surrounding rural areas of Suffolk and Isle of Wight are HBW 32%, HBO 48%, and NHB 20% in the region's 2000 model.

SCREENLINES AND CORDON LINES

Screenlines are large traffic analysis lines which bisect a model area. For Franklin, four screenlines were used to analyze traffic patterns within the City. Cordon lines are analysis lines which completely encompass a subarea within the model area. A cordon line was used in the Franklin model to measure the amount of traffic going to/from the downtown area of Franklin.

Table 12 on the following page shows the screenline results for the Franklin model. Screenline 1 produced volumes much higher than the 1999 traffic counts, especially for the segment of South Street between US Highway 58 and College Drive. In an attempt to correct this problem, HRPDC staff examined the socioeconomic data in the nearby TAZs, external station data, highway network attributes, as well as turn prohibitions. It was determined that the centroid and centroid connector for TAZ 953 needed to be shifted eastward to represent the true center of activity. This shift improved volumes somewhat. Adding turn penalties to the intersection of College Drive and South Street also improved volumes significantly. However, since all turn movements along this segment are permitted, turn penalties could not be justified. It should be noted that even though South Street provides access to US Highway 58, signage in Franklin as well as along US Highway 58 encourage vehicles to use Armory Drive to access Franklin/US Highway 58. This may account for the discrepancy between what the model forecasts for this segment of South Street and actual 1999 traffic counts. The other screenlines produced volumes close to VDOT's recommended guidelines for screenlines.

Map 9: Screenlines and Cordon Line

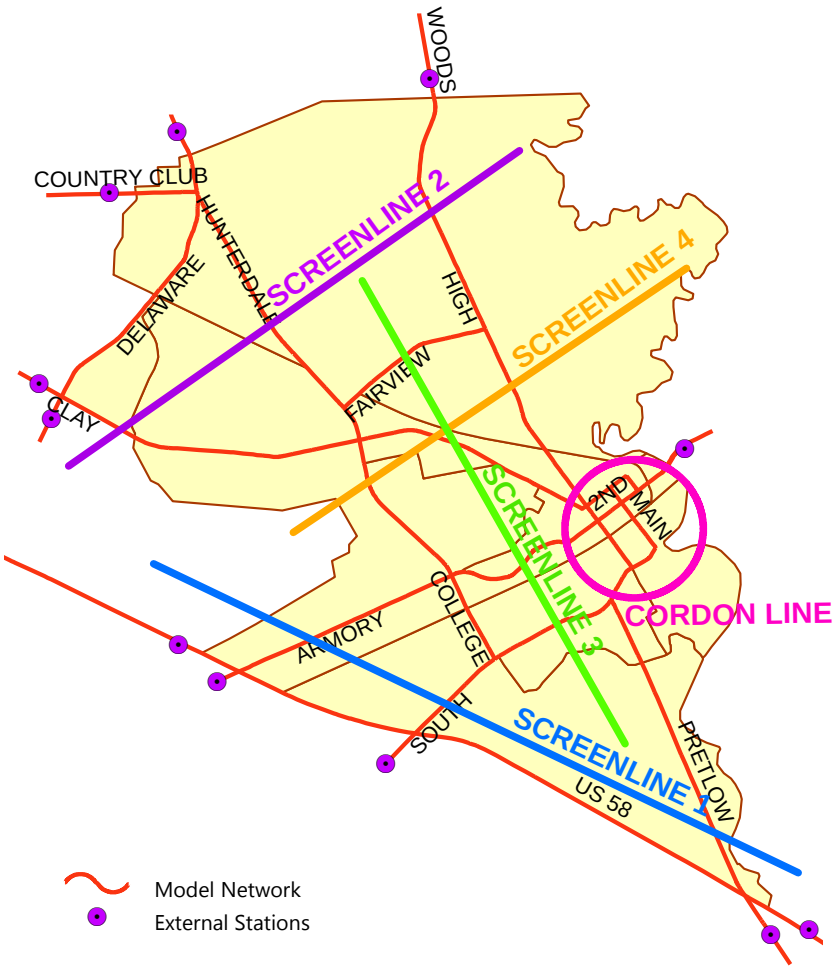


Table 12: Model Validation Using Screenlines

Guideline for Volumes <54,000	Franklin Model			
	Street	1999 Counts	Total Model Volume	Percent Difference
± 10%	**Screenline 1**			
	Armory Dr	13,884	12,178	-12.3%
	South St	4,423	9,898	+123.8%
	Pretlow St	2,369	2,878	+21.5%
	TOTAL	**20,676**	**24,954**	**+20.7%**
	Screenline 2			
	Hunterdale Rd	6,326	6,076	-4%
	Clay St	3,775	3,035	-19.6%
	High St	1,731	1,700	-1.8%
	TOTAL	**11,832**	**10,810**	**-8.6%**
	Screenline 3			
	Fairview Dr	4,572	5,714	+25%
	Clay St	6,194	4,747	-23.4%
	Armory Dr	8,940	8,232	-7.9%
	South St	9,076	6,039	-33.5%
	TOTAL	**28,782**	**24,732**	**-14.1%**
	Screenline 4			
	College Dr	8,728	11,219	+28.5%
	Clay St	5,329	4,403	-17.4%
	High St	4,304	5,004	+16.3%
	TOTAL	**18,361**	**20,627**	**+12.3%**

Table 13: Model Validation Using Cordon Line

Guideline for Volumes <54,000	Franklin Model			
	Street	1999 Counts	Total Model Volume	Percent Difference
± 10%	High St	4,304	5,004	+16.3%
	Clay St	3,689	4,403	+19.4%
	2nd St	8,330	7,296	-12.4%
	High St	4,931	4,386	-11%
	Main St	3,936	3,757	-4.6%
	2nd St	13,357	9,976	-25.3%
	TOTAL	**38,547**	**35,653**	**-9.7%**

Volumes produced by the model within the cordon line are within VDOT's recommended guidelines for cordon lines.

EXTERNAL STATIONS

External trips are manually input into the model via the external trip table. The model uses this trip table to reproduce model volumes at the specified external stations. These volumes were checked to insure the model replicated the traffic counts correctly.

Map 10: External Stations

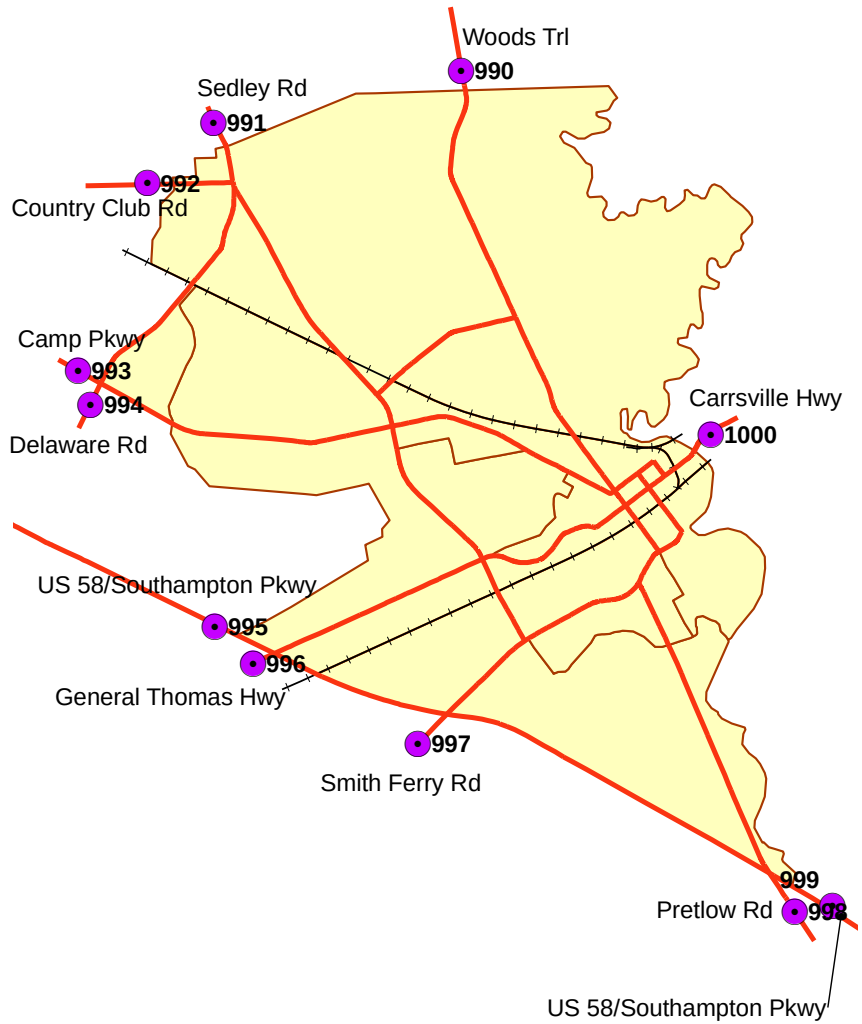


Table 14: Model Validation of External Stations

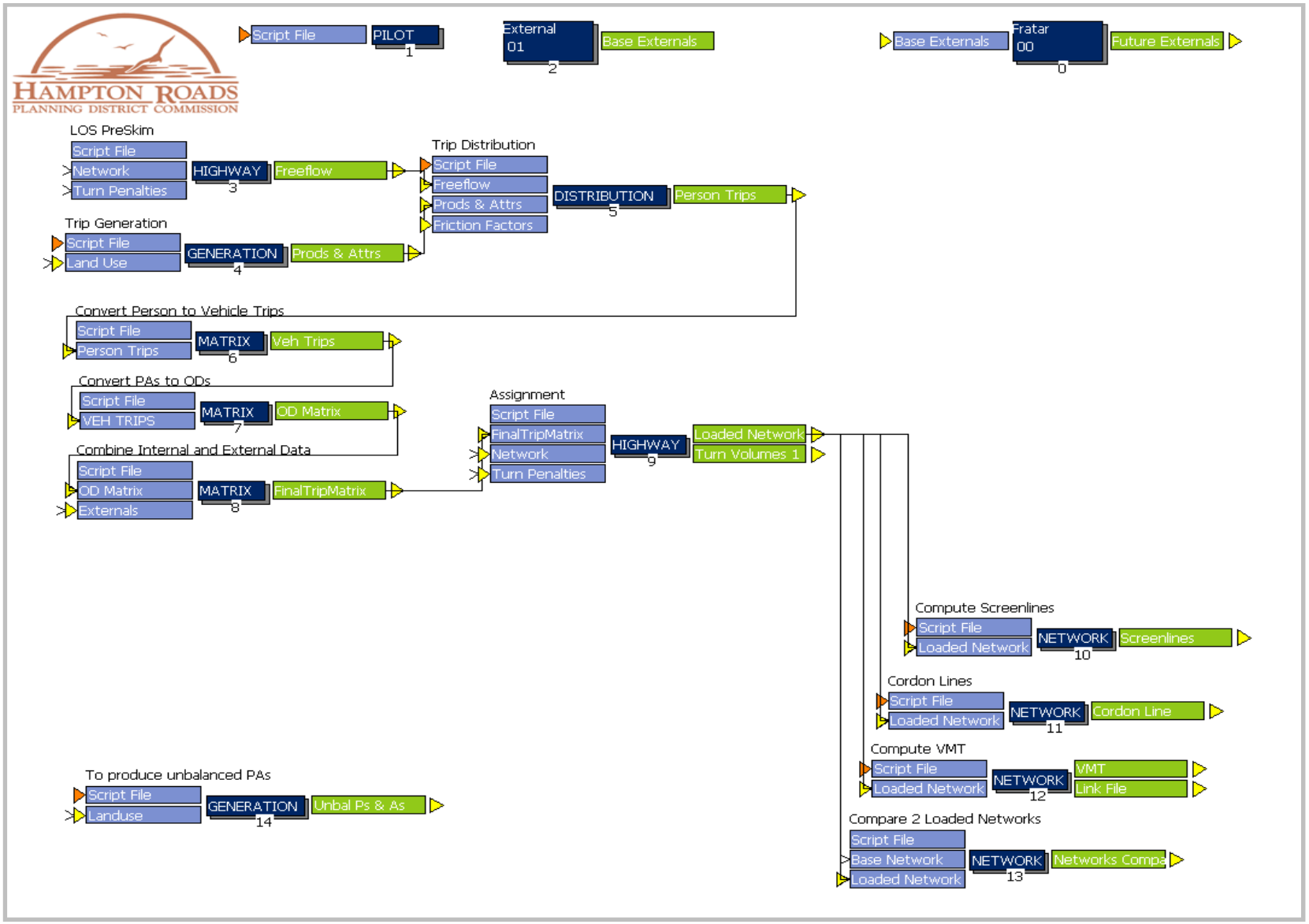
TAZ	Street	1999 Count	Model Volume
990	Woods Trl	1,700	1,700
991	Sedley Rd	2,928	2,928
992	Country Club Rd	2,129	2,130
993	Camp Pkwy	2,826	2,826
994	Delaware Rd	1,142	1,142
995	US 58/Southampton Pkwy	21,820	21,820
996	General Thomas Hwy	6,900	6,900
997	Smith Ferry Rd	4,066	4,066
998	Pretlow Rd	1,505	1,506
999	US 58/Southampton Pkwy	21,820	21,820
1000	Carrsville Hwy	9,976	9,976

NEXT STEPS

The next steps for the Franklin model will be to forecast future traffic congestion and to test candidate projects for use in the development of the Hampton Roads Rural Long Range Transportation Plan.

APPENDIX A
CUBE VOYAGER SCRIPTS

FRANKLIN MODEL CATALOG



TRIP GENERATION SCRIPT

```
;;<<PROCESS TEMPLATE>><<GENERATION>>;;
;{note1,note,10,"3 Purpose Trip Generation Model"}  Trip Generation >>>
;
;
;
;Production Equation 1: {prod1,editbox,"Production Equation Purpose 1",T,"(0.31*HH)+(0.93*VEH)+(0.58*RETAIL)"}
;Production Equation 2: {prod2,editbox,"Production Equation Purpose 2",T,"1.70*VEH"}
;Production Equation 3: {prod3,editbox,"Production Equation Purpose 3",T,"1.5*((0.73*HH)+(0.20*RETAIL)+(0.15*NONRETAIL))"}
;Attraction Equation 1: {attr1,editbox,"Attraction Equation Purpose 1",T,"(0.24*HH)+(0.90*TOT_EMP)+(0.44*RETAIL)"}
;Attraction Equation 2: {attr2,editbox,"Attraction Equation Purpose 2",T,"1.6*((1.04*HH)+(1.51*RETAIL))"}
;Attraction Equation 3: {attr3,editbox,"Attraction Equation Purpose 3",T,"(1.15*HH)+(0.32*TOT_EMP)"}
;;<<End Parameters>>;;
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=GENERATION MSG='Trip Generation'
; *** Standard 3 purpose model, please modify as needed
;   ----- land use data file
FILEI ZDATI[1] = "{LAND USE}"
;     DBF: Z=zone field name
;     TXT: Z=zone field location, var=field location, var=field location ....
    ZONES = {Total Zones}

;     7/3/08 Factored HBO Attractions by 1.6 and NHB Productions by 1.5 to help get total P/A ratio beteen 0.9 and 1.1

;   ----- calculate productions by purpose
    P[1] = {prod1};HBW
    P[2] = {prod2};HBO
    P[3] = {prod3};NHB
;   ----- calculate attractions by purpose
    A[1] = {attr1};HBW
    A[2] = {attr2};HBO
    A[3] = {attr3};NHB
;   ----- adjust zonal attractions so total attractions match total productions
    PHASE=ADJUST
    A[1] = P[1][0]/A[1][0] * A[1]  ; adjust a's to match p's
     A[2] = P[2][0]/A[2][0] * A[2]
    P[3] = A[3][0]/P[3][0] * P[3]
                    ; set p's to a's in nhb
;   ----- output zonal productions and attractions

ENDPHASE

FILEO PAO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\FRANKLINPA.DBF",
FORM=6.0, LIST=Z, P[1] P[2] P[3]  A[1] A[2] A[3], DBF=N,NAMES=TAZ, PHBW, PHBO, PNHB, AHBW, AHBO, ANHB
ENDRUN
```

LOS PRESKIM SCRIPT (Calculate Freeflow Times)

```
;;<<End Parameters>>;;

; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=HIGHWAY MSG='LOS PreSkim'

FILEI NETI = "G:\TRANS\RLRP\FRANKLINTDM\BASE\BASE\FRANKLIN.NET"
FILEI TURNPENI = "G:\TRANS\RLRP\FRANKLINTDM\CALIBRATIONCONSTANTS\PENALTY.PEN"
FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOS.MAT",
   MO=1-2, NAME=TIME,DISTANCE


; Use HWYLOAD to skim off-peak time and distances based on a path set that minimizes
; "freeflow" travel time
;SPDCAP Freeflow SPEED Lookup
SPDCAP SPEED[01]=25,0,25,0,25,0,25,0,25,0
SPDCAP SPEED[11]=50,0,50,0,55,0,55,0,58,0
SPDCAP SPEED[21]=50,0,50,0,55,0,55,0,58,0
SPDCAP SPEED[31]=26,0,29,0,39,0,42,0,51,0
SPDCAP SPEED[41]=28,0,26,0,32,0,39,0,47,0
SPDCAP SPEED[51]=25,0,27,0,28,0,32,0,36,0
SPDCAP SPEED[61]=0,0,25

PROCESS PHASE=LINKREAD
; Define variables for path set definition
lw.speed = speedfor(li.lanes,li.spdclass)
IF (LW.SPEED>0)
   T0 = (li.distance*60)/(LW.speed) ; time units are minutes
ELSEIF (SPEED=0)
ENDIF

T1=T0

ENDPHASE

PROCESS PHASE=ILOOP
  PATHLOAD PATH=COST, PENI=1-2 ,      ; include turn penalties
      MW[1]=pathtrace(TIME), MW[2]=pathtrace(LI.DISTANCE)
      MW[1][I] = ROWMIN(1) * 0.5  ; Intrazonal time
      MW[2][I] = 0                ; Set Intrazonal Dist = 0


ENDPROCESS

ENDRUN
```

TRIP DISTRIBUTION SCRIPT

```
;;<<PROCESS TEMPLATE>><<DISTRIBUTION>>;;
;{note1,note,10,"3 Purpose Gravity Model using Standard Cube Voyager Production and Attraction File"}  Trip Distribution from
VOYAGER PA File >>>
;
;
;
;Output PA Matrix Names: {matnames,editbox,"Enter Output Matrix Names",T,"HBW, HBO, NHB"}
;Maximum Iterations: {maxiters,editbox,"Maximum Iterations",N,"99"}
;Maximum RMSE:       {maxRMSE,editbox,"Maximum RMSE",N,"5"}
;Print comparison report: {prt2,checkbox,"Print comparison report on last iteration",1,";",""}
;Report trip length frequency: {prt3,checkbox,"Report trip length frequency",1,";",""}
;;<<End Parameters>>;;
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=DISTRIBUTION MSG='Trip Distribution'
;   ----- specify input p & a file and los file
FILEI ZDATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\FRANKLINPA.DBF",
Z=#1, PHBW=#2,PHBO=#3,PNHB=#4, AHBW=#5,AHBO=#6,ANHB=#7
FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOS.MAT"
FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\PADIST",
MO=1-3,NAME={matnames}
    MAXITERS={maxiters},MAXRMSE={maxRMSE}
;   ----- setup friction factor lookup tables, input from file
    LOOKUP FILE = "{FRICTION FACTOR}",
 INTERPOLATE=Y, LIST=N, NAME=FF,
        LOOKUP[1]=1,RESULT=2,
        LOOKUP[2]=1,RESULT=3,
        LOOKUP[3]=1,RESULT=4
;   ----- setup the working p's and a's
    SETPA P[1]=ZI.1.PHBW  P[2]=ZI.1.PHBO P[3]=ZI.1.PNHB
    SETPA A[1]=ZI.1.AHBW A[2]=ZI.1.AHBO A[3]=ZI.1.ANHB
;   ----- get the los matrix into work matrix 10
    MW[10] = MI.1.1
;   ----- do 3 gravity models, each followed by a frequency summation
    GRAVITY   PURPOSE=1, LOS=MW[10], FFACTORS=FF
    GRAVITY   PURPOSE=2, LOS=MW[10], FFACTORS=FF
    GRAVITY   PURPOSE=3, LOS=MW[10], FFACTORS=FF
{prt3} FREQUENCY VALUEMW=1  BASEMW=10,  RANGE=1-300
{prt3} FREQUENCY VALUEMW=2  BASEMW=10,  RANGE=1-300
{prt3} FREQUENCY VALUEMW=3  BASEMW=10,  RANGE=1-300

;   ----- get a comparison report on last iteration
{prt2} REPORT ACOMP=1-3, ITERATIONS=99
ENDRUN
```

MATRIX SCRIPT– CONVERT PERSON TRIPS TO VEHICLE TRIPS

```
;;<<PROCESS TEMPLATE>><<MATRIX>>;;

;Output Matrix Names: {matnames,editbox,"Enter Output Matrix Names",T,"HBW, HBO, NHB"}
;;<<End Parameters>>;;

; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Convert Person to Vehicle Trips'
MSG='Convert Person Trips to Vehicle Trips'

;*********************************************************************
; (5) Auto Occupancy                                                 *
;*********************************************************************

ID = Auto Occupancy and Matrix Balancing

;    Output from trip distribution
FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\PADIST"
FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VEHTRIPS",
MO=1-3,NAME={matnames}


; The following method is used to convert PERSON trips to VEHICLE trips:


JLOOP

; -HBW-
mw[1] = (MI.1.1)/1.09


; -HBO-
mw[2] = (MI.1.2)/1.54


; -NHB-
mw[3] = (MI.1.3)/1.38

mw[4]=mw[1]+mw[2]+mw[3]




ENDJLOOP


ENDRUN
```

MATRIX SCRIPT– CONVERT PRODUCTIONS & ATTRACTIONS TO ORIGINS & DESTINATIONS

```
;;<<PROCESS TEMPLATE>><<MATRIX>>;;
;{Title,note,12,"Convert from daily Production-Attraction to Origin-Destination"}>>>
;{Description,note,10,"The script will apply a daily matrix balancing"}>>>
;{Example,note,8,"example: (mi.1.1+mi.1.1.T)/2"}>>>
;
;
;Output OD Matrix Names: {matnames,editbox,"Enter Output Matrix Names",T,"HBW, HBO, NHB"}
;;<<End Parameters>>;;
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Convert PAs to ODs'

FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VEHTRIPS"
FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\ODMATRIX",
         MO=1-3,NAME={matnames}
; Balance internal trips
mw[1] = (MI.1.1 + MI.1.1.T)/2
mw[2] = (MI.1.2 + MI.1.2.T)/2
mw[3] = (MI.1.3 + MI.1.3.T)/2



ENDRUN
```

MATRIX SCRIPT– TRANSPOSE EXTERNAL MATRIX

```
;;<<PROCESS TEMPLATE>><<MATRIX>>;;
;{note1,note,12,"Transpose a table"}   >>>
;{note2,note,10,"The script will generate the transposed table of a selected input table"}  >>>
;{note3,note,8,"Example: transpose mi.1.3"}   >>>
;Input Matrix File: {mati1,filename,"Enter Input Trip Matrix 1",x,"G:\TRANS\RLRP\FRANKLINTDM\BASE\EXTOD.MAT","Trip Matrix
(*.mat)|*.mat"}
;Output Matrix File: {mato1,filename,"Enter Output Matrix File",x,"G:\TRANS\RLRP\FRANKLINTDM\BASE\EXTOD_T.MAT","Matrix File
(*.mat)|*.mat"}
;*****************************************************************
;                    TRANPOSE A TABLE                             *
;*****************************************************************
; BY CITILABS
;
;;<<End Parameters>>;;

; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Transpose External Matrix'


FILEI MATI[1] = {MATI1.Q}

FILEO MATO[1] = {MATO1.Q},
      MO=1, name=TRANSPOSED

mw[1]=mi.1.1.t

ENDRUN
```

MATRIX SCRIPT– COMBINE EXTERNAL MATRICES

```
;;<<PROCESS TEMPLATE>><<MATRIX>>;;
;{note1,note,12,"Perform basic mathematical operations on 2 tables"}   >>>
;{note2,note,10,"The script will operate on the first table of each file"}  >>>
;{note3,note,8,"Example:  mi.1.table1 + mi.2.table1"}   >>>
;Input Matrix File 1: {mati1,filename,"Enter Input Trip Matrix 1",x,"G:\TRANS\RLRP\FRANKLINTDM\BASE\EXTOD.MAT","Trip Matrix
(*.mat)|*.mat"}
;Input Matrix File 2: {mati2,filename,"Enter Input Trip Matrix 2",x,"G:\TRANS\RLRP\FRANKLINTDM\BASE\EXTOD_T.MAT","Trip Matrix
(*.mat)|*.mat"}
;Output Matrix File:   {mato,filename,"Enter Output Matrix File Name",x,"G:\TRANS\RLRP\FRANKLINTDM\BASE\FINALEXT.MAT","Matrix
File (*.mat)|*.mat"}
;Mathematical Operator: {operator,RadioBtn,"Chose Operation","+","*","/","-"}
;*******************************************************************
;                    BASIC MATHEMATICS                              *
;*******************************************************************
; BY CITILABS
;
; THIS SCRIPT READS TWO TRIP MATRICES, CREATES A MATRIX WITH THE RESULT
;;<<End Parameters>>;;


; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Combine External Matrices'
FILEI MATI[1] = {MATI1.Q}
FILEI MATI[2] = {MATI2.Q}

FILEO MATO[1] = {MATO.Q},
      MO=10


MW[1]=mi.1.1
MW[2]=mi.2.1

if ('{operator}'<>'/')
   MW[10]=MW[1]{operator}MW[2]

else
   JLOOP
   if (MW[2]<>0) MW[10]=MW[1]{operator}MW[2]
    ENDJLOOP
ENDIF

ENDRUN
```

MATRIX SCRIPT– COMBINE INTERNAL AND EXTERNAL DATA

```
;;<<PROCESS TEMPLATE>><<MATRIX>>;;
;{note1,note,12,"Perform basic mathematical operations on 2 tables"}   >>>
;{note2,note,10,"The script will operate on the first table of each file"}  >>>
;{note3,note,8,"Example:  mi.1.table1 + mi.2.table1"}   >>>
;
;
;
;Mathematical Operator: {operator,RadioBtn,"Chose Operation","+","*","/","-"}
;*****************************************************************
;                    BASIC MATHEMATICS                            *
;*****************************************************************
; BY CITILABS
;
; THIS SCRIPT READS TWO TRIP MATRICES, CREATES A MATRIX WITH THE RESULT
;;<<End Parameters>>;;


; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Combine Internal and External Data'
FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\ODMATRIX"
FILEI MATI[2] = {Externals}

FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VEHTRIPSFINAL",
      MO=10


MW[1]=mi.1.1 + mi.1.2 + mi.1.3
MW[2]=mi.2.1


if ('{operator}'<>'/')
   MW[10]=MW[1]{operator}MW[2]

else
   JLOOP
   if (MW[2]<>0) MW[10]=MW[1]{operator}MW[2]
   ENDJLOOP
ENDIF

ENDRUN
```

TRIP ASSIGNMENT SCRIPT

```
;;<<PROCESS TEMPLATE>><<HIGHWAY>>;;
;{Title,note,12,"Single Matrix Equilibrium Traffic using Time"}>>>
;{note2,note,10,"Input / Output Specification"}>>>
;{note3,note,10,"Cost Function"} Highway Assignment>>>
;Cost function:{cost_fun,editbox,"Cost Function e.g. TIME*1+LI.DISTANCE*0.3",T,"TIME*1"}
;Number of paths:{NPATH,editbox,"Number of paths to be generated",N,"10"}
;Maximum RMSE:       {maxRMSE,editbox,"Maximum RMSE",N,"25"}

;;<<End Parameters>>;;

; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=HIGHWAY MSG='Assignment'
;*********************************************************************
; Highway Assignment                                                 *
;*********************************************************************
; ---------------------------------------------------------------------

FILEI NETI = "{NETWORK}"
FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VEHTRIPSFINAL"
FILEI TURNPENI = "{TURN PENALTY}"
FILEO NETO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOADEDNETWORK_{YEAR}{ALTERNATIVE}.NET"
FILEO TURNVOLO[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\TURNFILEARMORY_{YEAR}{ALTERNATIVE}.DBF",
 format=dbf
      TURNS N=5189, 5192, 5191, 5090, 5140, 5153, 5114

; General Parameters

PAR MAXITERS={NPATH}
    VOT=16.64  ;Value of time = $16.64/hr in year 2000 dollars

    MAXRMSE={maxRMSE}

PHASE=LINKREAD

FUNCTION {
   V = VOL[1] + VOL[2]

; Path cost in US cents
   COST[1] = 1.0*(TIME/60*VOT*100) + 1.0*(10*LI.DISTANCE)
   COST[2] = 1.0*(TIME/60*VOT*100) + 0.5*(10*LI.DISTANCE)
   COST[3] = 1.0*(TIME/60*VOT*100) + 0.5*(10*LI.DISTANCE)
   COST[4] = 1.0*(TIME/60*VOT*100) + 0.5*(10*LI.DISTANCE)
   COST[5] = 1.0*(TIME/60*VOT*100) + 1.0*(10*LI.DISTANCE)
```

TRIP ASSIGNMENT SCRIPT (Continued)

```
; Volume-Delay Relationships
   TC[1] = T0 ; centroids
   TC[2] = T0 * (1 + 0.15 * (VC)^4); Freeways
   TC[3] = T0 * (1 + 0.83 * (VC)^2.7); Principal Arterials
   TC[4] = T0 * (1 + 0.60 * (VC)^2.1); Minor Arterials
   TC[5] = T0 * (1 + 0.80 * (VC)^4); Collectors
}

;SPDCAP SPEED Lookup
SPDCAP SPEED[01]=25,0,25,0,25,0,25,0,25,0
SPDCAP SPEED[11]=50,0,50,0,55,0,55,0,58,0
SPDCAP SPEED[21]=50,0,50,0,55,0,55,0,58,0
SPDCAP SPEED[31]=26,0,29,0,39,0,42,0,51,0
SPDCAP SPEED[41]=28,0,26,0,32,0,39,0,47,0
SPDCAP SPEED[51]=25,0,27,0,28,0,32,0,36,0
SPDCAP SPEED[61]=0,0,25

; Define v/c ratio for daily assignment
C=(Capacityfor(li.LANES,li.CAP_LN)/0.12)  ; Peak Hour Factor - 12% (default)
VC = V/C

; Define free-flow time as a function of speed
speed = speedfor(li.LANES,li.SPDCLASS)
T0 = (li.DISTANCE*60)/(speed)  ; time units are minutes


; Define link classes for capacity restraint

; Centroid Connectors
if (li.func_class=0)
   linkclass = 1
endif
; Freeways (70 mph design speed)
if (li.func_class=1-2)
   linkclass = 2
endif
; Principle Arterials (Multi-Lane, 50 mph design speed)
if (li.func_class=3)
   linkclass = 3
endif
; Minor Arterials (Multi-Lane, 50 mph design speed)
if (li.func_class=4)
   linkclass = 4
endif
```

TRIP ASSIGNMENT SCRIPT (Continued)

```
; Collectors
if (li.func_class=5)
   linkclass = 5
endif

ENDPHASE


;    The input trip table has 2 Total Vehicle Tables:
;     1 - Total Internal
;     One path used: 1)SOV
;     2 - I-X/X-I and X-X
;     One path used: 1)SOV

PROCESS PHASE=ILOOP
      PATHLOAD  PATH=TIME, PENI=1-2 ,      ; include turn penalties
                           VOL[1]=MI.1.1   ; load trips


ENDPHASE




ENDRUN
```

NETWORK SCRIPT - SCREENLINES

```
Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=NETWORK MSG='Compute Screenlines'
FILEI LINKI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOADEDNETWORK_{YEAR}{ALTERNATIVE}.NET"
FILEO LINKO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\SCREENLINE_{YEAR}{ALTERNATIVE}",
 INCLUDE=A,B,SCREENLINE00,ROUTE_NAME,CNT99,VT_1,V_1


PARAMETERS  ZONES={Total Zones}




;PROCESS  PHASE=INPUT,
; Use this phase to modify data as it is read, such as recoding node numbers.
;ENDPROCESS

;PROCESS  PHASE=NODEMERGE
; ==========================================================
; LINKMERGE PHASE
; ==========================================================
PHASE=LINKMERGE

IF(SCREENLINE00=0) DELETE

ENDPHASE

; ==========================================================
; SUMMARY REPORTING
; ==========================================================
PHASE=SUMMARY


ENDPHASE

ENDRUN
```

NETWORK SCRIPT – CORDON LINES

```
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=NETWORK MSG='Cordon Lines'


FILEI LINKI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOADEDNETWORK_{YEAR}{ALTERNATIVE}.NET"
FILEO LINKO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\CORDONLINE_{YEAR}{ALTERNATIVE}",
 INCLUDE=A,B,CORDON00,ROUTE_NAME,CNT99,VT_1,V_1

PARAMETERS  ZONES={Total Zones}


;PROCESS  PHASE=INPUT,
; Use this phase to modify data as it is read, such as recoding node numbers.
;ENDPROCESS

;PROCESS  PHASE=NODEMERGE
; ========================================================
; LINKMERGE PHASE
; ========================================================
PHASE=LINKMERGE

IF(CORDON00=0) DELETE
;

ENDPROCESS

; ========================================================
; SUMMARY REPORTING
; ========================================================
PHASE=SUMMARY


ENDPHASE

ENDRUN
```

NETWORK SCRIPT – COMPUTE VMT

```
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=NETWORK MSG='Compute VMT'


FILEI LINKI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOADEDNETWORK_{YEAR}{ALTERNATIVE}.NET"
FILEO NETO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VMTNETWORK_{YEAR}"
FILEO LINKO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\VMT_{YEAR}",
 INCLUDE=A,B,DESCRIPTIO,DISTANCE,ROUTE_NAME,FUNC_CLASS,JURIS_NAME,CNT99,CNTSTN,VT_1,V_1,LW.VMT

PARAMETERS  ZONES={Total Zones}


;PROCESS  PHASE=INPUT,
; Use this phase to modify data as it is read, such as recoding node numbers.
;ENDPROCESS

;PROCESS  PHASE=NODEMERGE
; ==========================================================
; LINKMERGE PHASE
; ==========================================================


PHASE=LINKMERGE

IF (FUNC_CLASS>0)

LW.VMT = V_1 * DISTANCE

ENDIF

ENDPHASE


; ==========================================================
; SUMMARY REPORTING
; ==========================================================
PHASE=SUMMARY



ENDPHASE

ENDRUN
```

NETWORK SCRIPT– COMPARE TWO LOADED NETWORKS

```
RUN PGM=NETWORK MSG='Compare 2 Loaded Networks'
FILEI LINKI[1] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\BASE\LOADEDNETWORK_2000A.NET"
FILEI LINKI[2] = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\LOADEDNETWORK_{YEAR}{ALTERNATIVE}.NET"

   LOAD1=LI.1.V_1
   LOAD2=LI.2.V_1
   LOADCHG=(LOAD2-LOAD1)
   ABSLOADCHG=ABS(LOAD2-LOAD1)

if (load1>0) PRCLOADCHG=LOADCHG/LOAD1

   CSPD1=LI.1.CSPD_1
   CSPD2=LI.2.CSPD_1
   CSPDCHG=(CSPD1-CSPD2)
   ABSCSPDCHG=ABS(CSPD1-CSPD2)

if (CSPD1>0) PRCCSPDCHG=CSPDCHG/CSPD1

   TIME1=LI.1.TIME_1
   TIME2=LI.2.TIME_1
   TIMECHG=(TIME1-TIME2)
   ABSTIMECHG=ABS(TIME1-TIME2)

if (TIME1>0) PRCTIMECHG=TIMECHG/TIME1

   VC1=LI.1.VC_1
   VC2=LI.2.VC_1
   VCCHG=(VC1-VC2)
   ABSVCCHG=ABS(VC1-VC2)

if (VC1>0) PRCVCCHG=VCCHG/VC1

FILEO NETO = "G:\TRANS\RLRP\FRANKLINTDM\OUTPUT\{SCENARIO_FULLNAME}\COMPARENETWORK_{YEAR}{ALTERNATIVE}.NET",
     INCLUDE=A B LOAD1 LOAD2 LOADCHG ABSLOADCHG PRCLOADCHG,
            CSPD1 CSPD2 CSPDCHG ABSCSPDCHG PRCCSPDCHG,
            TIME1 TIME2 TIMECHG ABSTIMECHG PRCTIMECHG,
            VC1 VC2 VCCHG ABSVCCHG PRCVCCHG

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```

FRATAR SCRIPT– CALCULATE FUTURE EXTERNAL TRIPS

```
RUN PGM=FRATAR MSG='Calculate Future External Trips'
ID = FRATAR 1999 EXTERNAL O-D TO 2035 FOR FRANKLIN MODEL

FILEI MATI[1] = "{EXTERNALS}"
FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\{SCENARIO_SHORTNAME}\FRATAR_{Year}{Alternative}.MAT",
   MO=1
PARAMETERS
     maxiters=6

; HOUSEHOLD GROWTH FOR PRODUCTION FACTORS FOR ZONES INSIDE REGION
;2000HH=3,387 2035HH=4,800
SETPA PGF[1]={PGF} include=950-980

; FOR ATTRACTION FACTORS FOR ZONES AT EXTERNAL STATIONS
SETPA A[1]=1000 include=990
SETPA A[1]=3500 include=991
SETPA A[1]=2300 include=992
SETPA A[1]=3250 include=993
SETPA A[1]=1250 include=994
SETPA A[1]=21500 include=995
SETPA A[1]=9400 include=996
SETPA A[1]=4250 include=997
SETPA A[1]=3750 include=998
SETPA A[1]=21500 include=999
SETPA A[1]=8860 include=1000

; **** repeat above line for each external station

; Control totals are based on attraction targets; only productions in "adjustable"
; zones will change
SETPA MW[1]=MI.1.1 CONTROL=AL

; Reports
REPORT pcomp=1,acomp=1

ENDRUN
```

FRATAR SCRIPT CONT– TRANSPOSE AND COMBINE FUTURE EXTERNAL MATRICES

```
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Transpose Matrix'


FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\FRATAR\FRATAR_2000A.MAT"

FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\{SCENARIO_SHORTNAME}\FRATAR_T_{YEAR}{ALTERNATIVE}.MAT",
      MO=1, name=TRANSPOSED

mw[1]=mi.1.1.t

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;;<<PROCESS TEMPLATE>><<MATRIX>>;;
;{note1,note,12,"Perform basic mathematical operations on 2 tables"}   >>>
;{note2,note,10,"The script will operate on the first table of each file"}  >>>

;Mathematical Operator: {operator,RadioBtn,"Chose Operation","+","*","/","-"}
; BY CITILABS
;
; THIS SCRIPT READS TWO TRIP MATRICES, CREATES A MATRIX WITH THE RESULT
;;<<End Parameters>>;;

; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Combine Matrices'
FILEI MATI[1] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\{SCENARIO_SHORTNAME}\FRATAR_{Year}{Alternative}.MAT"
FILEI MATI[2] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\{SCENARIO_SHORTNAME}\FRATAR_T_{YEAR}{ALTERNATIVE}.MAT"

FILEO MATO[1] = "G:\TRANS\RLRP\FRANKLINTDM\BASE\{SCENARIO_SHORTNAME}\FUTUREEXT_{YEAR}{ALTERNATIVE}.MAT",
      MO=10


MW[1]=mi.1.1
MW[2]=mi.2.1

if ('{operator}'<>'/')
   MW[10]=MW[1] {operator} MW[2]

else
   JLOOP
   if (MW[2]<>0) MW[10]=MW[1]{operator}MW[2]
   ENDJLOOP
ENDIF

ENDRUN
```

TRIP GENERATION CALIBRATION SCRIPT – COMPUTE UNBALANCED PRODUCITONS & ATTRACTIONS

```
;<<PROCESS TEMPLATE>><<GENERATION>>;;
;{note1,note,10,"3 Purpose Trip Generation Model"}  Trip Generation >>>
;Input Zonal Data File: {zdati,filename,"Enter Input Zonal Data File
Name",x,"G:\TRANS\LRP\MISC\RLRP\FRANKLIN\MODEL\DATA\FRANKLINTAZ.DBF","Data File (*.dbf;*.txt;*.dat)|*.dbf;*.txt;*.dat"}
;Output PA File: {pao,filename,"Enter Output PA File
Name",x,"G:\TRANS\LRP\MISC\RLRP\FRANKLIN\MODEL\WORKINGOUTPUT\UNBALANCEDPA","Dbase File (*.dbf)|*.dbf"}
;Highest Zone Number: {zones,editbox,"Highest Zone Number",N,"1000"}
;Production Equation 1: {prod1,editbox,"Production Equation Purpose 1",T,"(0.31*HH)+(0.93*VEH)+(0.58*RETAIL)"}
;Production Equation 2: {prod2,editbox,"Production Equation Purpose 2",T,"1.70*VEH"}
;Production Equation 3: {prod3,editbox,"Production Equation Purpose 3",T,"1.5*((0.73*HH)+(0.20*RETAIL)+(0.15*NONRETAIL))"}
;Attraction Equation 1: {attr1,editbox,"Attraction Equation Purpose 1",T,"(0.24*HH)+(0.90*TOT_EMP)+(0.44*RETAIL)"}
;Attraction Equation 2: {attr2,editbox,"Attraction Equation Purpose 2",T,"1.6*((1.04*HH)+(1.51*RETAIL))"}
;Attraction Equation 3: {attr3,editbox,"Attraction Equation Purpose 3",T,"(1.15*HH)+(0.32*TOT_EMP)"}
;;<<End Parameters>>;;
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=GENERATION MSG='To produce unbalanced PAs'
; *** Standard 3 purpose model, please modify as needed
;   ----- land use data file
FILEI ZDATI[1] = {ZDATI.Q}
;     DBF: Z=zone field name
;     TXT: Z=zone field location, var=field location, var=field location ....
    ZONES = {zones}
;   ----- calculate productions by purpose
    P[1] = {prod1};HBW
    P[2] = {prod2};HBO
    P[3] = {prod3};NHB
;   ----- calculate attractions by purpose
    A[1] = {attr1};HBW
    A[2] = {attr2};HBO
    A[3] = {attr3};NHB
;   ----- adjust zonal attractions so total attractions match total productions

;   ----- output zonal productions and attractions


FILEO PAO[1] = {PAO.Q},
FORM=6.0, LIST=Z, P[1] P[2] P[3]  A[1] A[2] A[3], DBF=N,NAMES=TAZ, PHBW, PHBO, PNHB, AHBW, AHBO, ANHB

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```

APPENDIX B
DATA TABLES

2000 SOCIOECONOMIC DATA BY TAZ						
TAZ	**HH**	**POP**	**VEH**	**TOTAL EMP**	**RETAIL EMP**	**NONRETAIL EMP**
950	150	923	176	239	7	232
951	1	2	1	20	0	20
952	181	441	309	0	0	0
953	496	694	581	101	0	101
954	0	0	0	405	157	248
955	132	342	155	25	0	25
956	513	1,237	875	105	21	84
957	90	256	173	100	74	27
958	12	39	14	94	11	83
959	4	13	5	130	20	110
960	1	3	2	225	27	198
961	128	266	246	295	0	294
962	0	0	0	301	132	169
963	47	119	55	222	17	205
964	0	0	0	368	18	349
965	0	0	0	0	0	0
966	0	0	0	0	0	0
967	189	417	363	225	0	225
968	33	60	63	266	62	204
969	0	0	0	982	735	252
970	61	168	117	56	0	55
971	188	477	381	79	0	79
972	414	1,213	794	890	13	875
973	382	823	774	59	0	58
974	117	257	237	71	0	71
975	3	8	6	10	0	10
976	7	20	13	68	11	57
977	80	177	136	10	10	0
978	23	52	39	45	0	45
979	66	170	134	179	85	94
980	69	177	132	0	0	0
TOTAL	**3,387**	**8,354**	**5,781**	**5,570**	**1,400**	**4,170**

UNBALANCED PRODUCTIONS AND ATTRACTIONS						
TAZ	PRODUCTIONS			ATTRACTIONS		
	HBW	HBO	NHB	HBW	HBO	NHB
950	214	299	219	254	267	249
951	1	2	6	18	2	8
952	343	525	198	43	301	208
953	694	988	566	210	825	603
954	91	0	103	434	379	130
955	185	264	150	54	220	160
956	985	1,488	587	227	904	624
957	232	294	127	144	329	136
958	23	24	35	92	47	44
959	17	9	35	127	55	46
960	18	3	54	215	67	73
961	268	418	206	296	213	242
962	77	0	78	329	319	96
963	76	94	103	219	119	125
964	10	0	84	339	43	118
965	0	0	0	0	0	0
966	0	0	0	0	0	0
967	396	617	258	248	314	289
968	105	107	101	275	205	123
969	426	0	277	1,207	1,776	314
970	128	199	79	65	102	88
971	413	648	224	116	313	241
972	874	1,350	654	906	720	761
973	838	1,316	431	145	636	458
974	257	403	144	92	195	157
975	7	10	6	10	5	7
976	21	22	24	68	38	30
977	157	231	91	33	157	95
978	43	66	35	46	38	41
979	194	228	119	214	315	133
980	144	224	76	17	115	79
Total	**7,237**	**9,829**	**5,070**	**6,443**	**9,019**	**5,678**

FRICTION FACTORS												
TIME	**HBW**	**HBO**	**NHB**		**TIME**	**HBW**	**HBO**	**NHB**		**TIME**	**HBW**	**HBO**	**NHB**
1	58526	3843224	61524		**33**	54	6	27		**65**	2	1	8
2	21247	283669	20089		**34**	48	7	3		**66**	2	1	6
3	11411	62103	10044		**35**	43	3	22		**67**	2	1	1
4	7195	20342	5812		**36**	39	9	17		**68**	2	1	1
5	4953	7403	4175		**37**	35	9	8		**69**	2	1	6
6	3604	5899	5537		**38**	31	6	13		**70**	1	1	6
7	2725	3248	2688		**39**	28	8	3		**71**	1	1	1
8	2119	2505	3532		**40**	26	10	18		**72**	1	3	6
9	1684	1158	1450		**41**	23	6	5		**73**	1	1	1
10	1361	889	1110		**42**	21	6	5		**74**	1	1	1
11	1115	565	946		**43**	19	10	6		**75**	1	2	1
12	924	327	504		**44**	17	3	4		**76**	1	1	7
13	773	285	368		**45**	15	1	4		**77**	1	2	1
14	651	182	313		**46**	14	3	0		**78**	1	1	1
15	553	153	178		**47**	13	4	14		**79**	1	1	1
16	472	118	141		**48**	11	6	6		**80**	1	1	1
17	406	100	193		**49**	10	6	5		**81**	1	1	1
18	350	61	196		**50**	9	4	2		**82**	1	2	1
19	303	71	83		**51**	9	4	0		**83**	0	1	1
20	264	54	98		**52**	8	1	0		**84**	0	1	1
21	230	33	68		**53**	7	1	1		**85**	0	1	9
22	202	35	68		**54**	6	2	2		**86**	0	1	1
23	177	29	58		**55**	6	1	6		**87**	0	1	1
24	156	28	14		**56**	5	4	0		**88**	0	1	1
25	137	30	59		**57**	5	2	1		**89**	0	1	1
26	122	16	42		**58**	4	5	0		**90**	0	1	1
27	108	10	42		**59**	4	4	12		**91**	0	1	1
28	96	19	30		**60**	4	3	1		**92**	0	0	1
29	85	6	21		**61**	3	2	8		**93**	0	0	1
30	76	9	13		**62**	3	1	17		**94**	0	0	1
31	68	14	13		**63**	3	1	9		**95**	0	0	1
32	60	9	16		**64**	3	1	10					

GLOSSARY

Attractions	-	The final end point of a trip (Destination).
Centroid Connector	-	Segments on which trips are loaded onto the model highway network (representation of local roads)
Centroids	-	Represent the center of activity in each TAZ.
Cordon Line	-	Analysis lines which completely encircle a subarea within the model region.
External Station	-	Centroids which represent the points at which external trips enter or leave the model area.
Free-flow Speed	-	Average speed that a motorist would travel if there were no congestion or other adverse conditions
GIS	-	Geographic Information Systems.
Gravity Model	-	Spatial allocation model that allocates trips between zones based on the attractiveness of each zone and some measure of impedance or separation between zones.
HBO	-	Home Based Other trips (Non-work trips that begin or end at home).
HBW	-	Home Based Work trips (Work trips that begin or end at home).
HRPDC	-	Hampton Roads Planning District Commission
Impedance	-	Resistance of trips from one node/zone to another.
Intrazonal Travel Time	-	Average travel time within each TAZ (internal travel time).
Link	-	Represents individual roadway segments in model.
Local	-	These streets provide direct access to adjacent land and provide access to the higher systems. Service to through traffic is discouraged.
Minor Arterial	-	These highways interconnect and supplement the principal arterial system with a greater emphasis on land access and a lower level of traffic mobility.
Mode Choice	-	Model process that splits the trip by available transportation modes.
NHB	-	Non-Home Based Other trips (trips that neither begin nor end at home).
Node	-	Generally represents intersections of roadway segments but are also used to maintain a truer representation of the highway system in the model.
Principal Arterial	-	These highways are the most significant roads in the urban area and serve the major centers of activity, constitute the highest traffic volume corridors, serve the longest trips, carry the major portion of traffic in the urban area, and provide continuity between rural arterials.

Productions	-	The starting point of a trip (Origin).
RLRP	-	Rural Long Range Transportation Plan
Screenline	-	Traffic analysis lines which bisect the entire model region.
TAZ	-	Transportation Analysis Zone (basic unit of geography for travel demand model).
Trip Assignment	-	Model process that loads trips onto the network.
Trip Distribution	-	Model process that links pairs of trip productions to trip attractions.
Trip Generation	-	Model process that produces estimates of trip productions and trip attractions for each Transportation Analysis Zone.
Urban Collector	-	These highways provide access and connectivity within residential, commercial, and industrial areas. They collect local traffic and distribute it to the arterial system.
VDOT	-	Virginia Department of Transportation
VMT	-	Vehicle miles traveled