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EXECUTIVE SUMMARY

As population density increases, and socioeconomic factors trend downward, increasing crime rates become a major concern for our country. This paper analyzes how to allocate police resources to minimize the crime rate throughout the target cities. The provided analysis brings to light new evidence on crime trends were possibly missed with previous statistical methods. This analysis will help determine how to cross train the police force effectively to respond to specific crimes and an overall increasing crime rate.

1 PROBLEM DEFINITION

In the initial stage of the analysis, in order to achieve the objectives, current societal norms and preliminary project plans are established.

Lowering crime rates and keeping police forces in line with future predictable natural phenomena is of particular interest to the law enforcement community. The lowering of crime rates are also important to those that support or pay for those enforcement activities. “Statistics released in the FBI’s *Preliminary Semiannual Uniform Crime Report* reveal declines in both the violent crime and the property crime reported in the first six months of 2013 when compared with figures for the first six months of 2012. The report has information from 12,723 law enforcement agencies that submitted three to six months of comparable data to the FBI Uniform Crime Reporting (UCR) Program for the first six months of 2012 and 2013” (James B. Comey, 2013). Improving crime prediction accuracy could improve the above referenced FBI statistics and improve the quality of life for those affected.

Other than population and socioeconomic factors, multiple studies have explored additional predictors of crimes in specific areas. Prior studies imply that the availability of light may affect the amount and types of crimes committed. The significance of daylight savings time is currently being evaluated. It is hypothesized that more daylight results in less crime. (Sanders, 2012) E.G. Cohn discussed weather and temporal variations (time of day, day of week, holidays, etc.) during requests for police services (Cohn, 1993) and A.D. Pokorny & J. Jachimczyk used phases of the moon as a possible predictor to explore the relationship between homicides and the lunar cycle. (A.D. Pokorny, 1974)

Even though these studies used data mining techniques, all of these studies attempted their exploration with a narrow scope. They failed to take into account the broader possibilities leading to inadequate factors that affect the frequency or type of crimes committed.

This study attempts to model crime on a broader set of possibilities to determine which factors are significant, allowing for the most efficient police resource allocation. Utilizing the Cross Industry Standard Process for Data Mining (CRISM-DM) model, this model breaks our task down into six nodes: problem definition, data understanding, data preparation, modeling, evaluation, and deployment. This allows ideas and processes to flow freely throughout the nodes allowing progress towards a common goal.

2 DATA UNDERSTANDING

Stage two of the analysis begins with familiarization and exploration of the provided data.

2.1 Identifying Data Quality

Of the nine provided data sets, eight were utilized; Heating_Cooling_Days was not used because its relevant information was extracted from the other provided data sets. Of the remaining datasets, two contained missing values. CRIME_V2 had 130 missing tract_id values; these observations were not used because the dataset was large enough (over 4,000,000 observations) to compensate for the loss. Weather had one missing value each for temperature_low, temperature_high, and pressure; for this dataset, missing values were imputed with the average of the surrounding day’s values.

The original Population dataset did not contain any missing values; however, it only provided data for the years 2000 and 2010. In order to provide a complete dataset that includes population values for every year from 2005 to 2012, values were extrapolated based on the 2000 and 2010 data. Additionally, time and naming conventions used were inconsistent; therefore, values were reformatted for consistency.

2.2 Initial Insights

Two models, binary and numeric, were constructed to determine significant factors for crime prediction. The binary model uses a binary response as the target. This model determines if any crimes occurred. The binary model also targets significant factors to improve the accuracy of the second models numerical response. The numerical model uses the numerical number of crimes as the target, and indicates how many total crimes occurred. This model is useful in revealing the effect of the significant factors for each type of crime. A third model was developed by taking the numeric crime type, dividing it by the population total, and then multiplying it by 100. This equation created a crime_ratio response variable. This model is useful in evaluating the problem statement.

3 Data Preparation

Stage three addresses merging, variable creation, and variable selection.

3.1 Our Process

After performing data validation, the selected datasets were then merged into a single SAS file before being uploaded into Enterprise Miner. Figure 1 below outlines how the merging was performed.

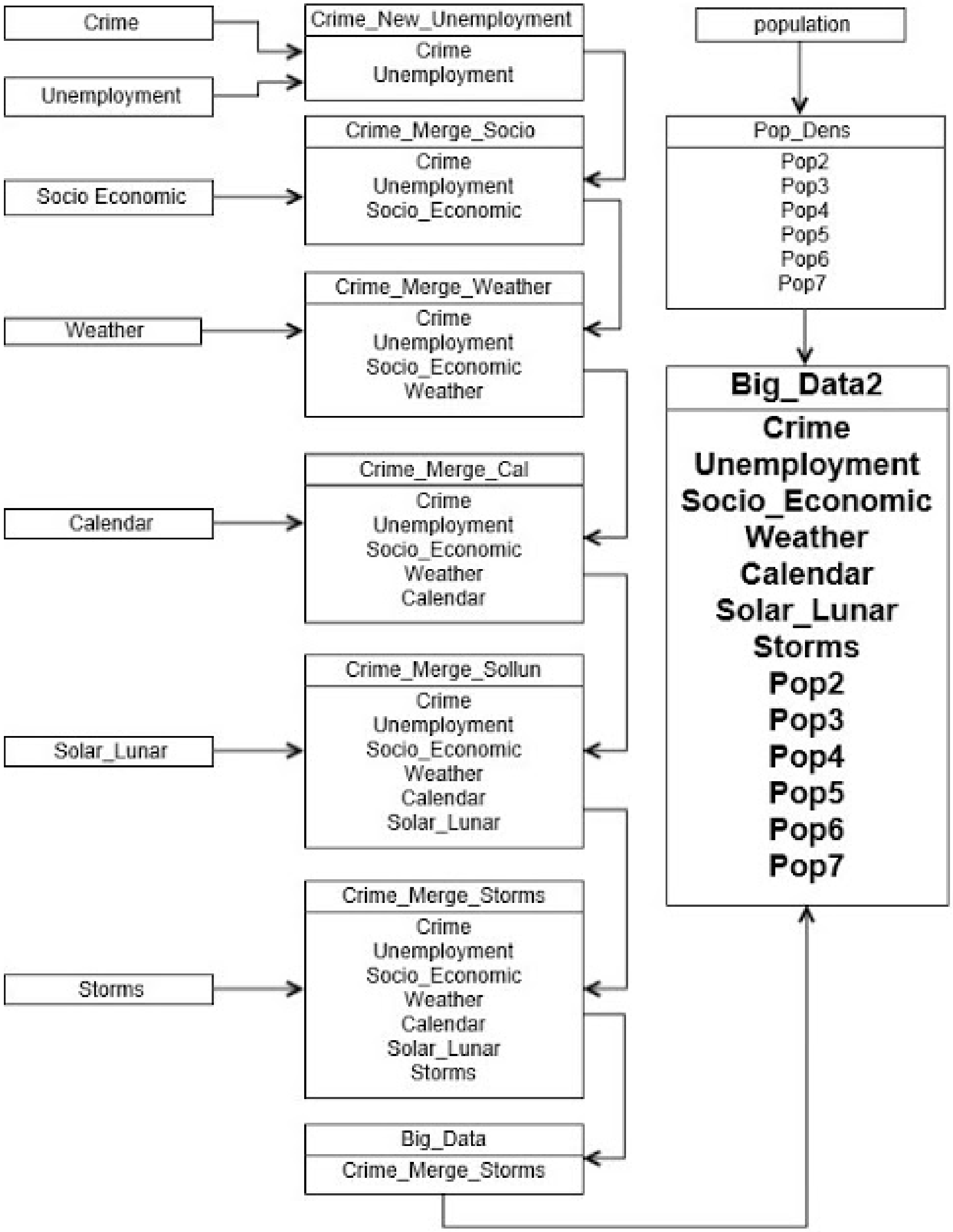
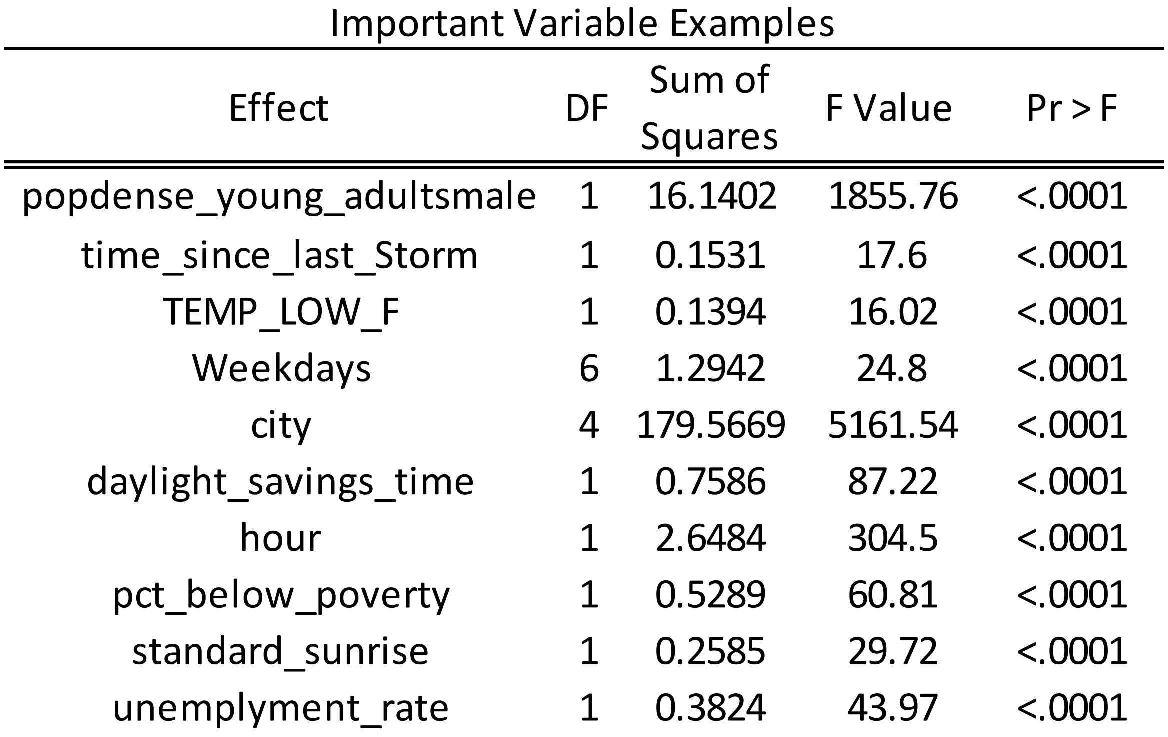


Figure 1: Data Merge Process

Once the merging was completed, a data source was created in Enterprise Miner. Three separate data models were then created. The first data model was established as the Binary set. The binary set was modeled representing whether a crime occurred or did not occur. The second model contained the numeric response for total crimes, which represented how many crimes were committed per day. Finally, the third model was created which establishes the crime ratio. The crime ratio is the crime per 100 people per day.

3.2 Data Description

The SAS dataset, Big_Data2, was used to create the data source in Enterprise Miner. There were 4,283,472 observations and 130 variables in the final dataset. Table 1 shows a few of the important variables discovered via Enterprise Miner. These variables were revealed by running a stepwise regression.



Important Variable Examples

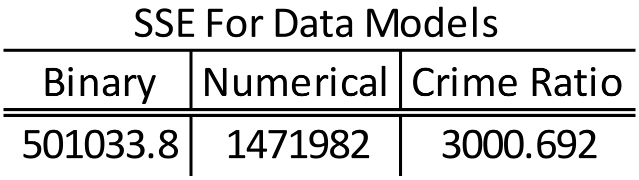
Effect	DF	Sum of Squares	F Value	Pr > F
popdense_young_adultsmale	1	16.1402	1855.76	<.0001
time_since_last_Storm	1	0.1531	17.6	<.0001
TEMP_LOW_F	1	0.1394	16.02	<.0001
Weekdays	6	1.2942	24.8	<.0001
city	4	179.5669	5161.54	<.0001
daylight_savings_time	1	0.7586	87.22	<.0001
hour	1	2.6484	304.5	<.0001
pct_below_poverty	1	0.5289	60.81	<.0001
standard_sunrise	1	0.2585	29.72	<.0001
unemplyment_rate	1	0.3824	43.97	<.0001

Table 1: Important Variable Examples

4 MODELING

Stage four addresses selecting several modeling techniques and applying them to find the most important variables.

All three models, the binary, the numeric, and crime ratio model were run to see which model was the most statistically significant. Based on the SSE values (shown in Table 2), the crime ratio model was the best model. Figure 2 shows the best model diagram in Enterprise Miner. The crime ratio model was used for all future analysis.



SSE For Data Models

Binary	Numerical	Crime Ratio
501033.8	1471982	3000.692

Table 2: SSE For Data Model

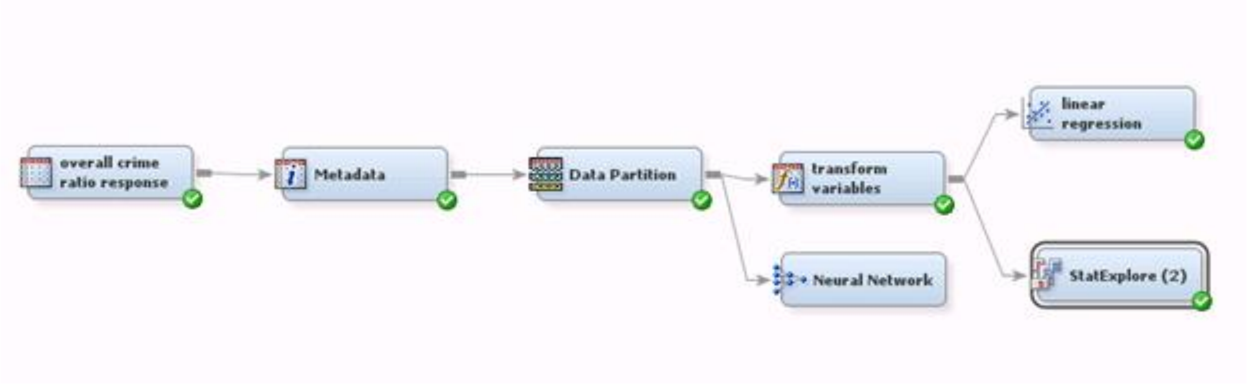


Figure 2: Best Model Diagram

4.1 Daylight Savings Model

The Kruskal-Wallis test was used to compare the means of crime rates of each crime type by whether or not daylight savings time was implemented. The Kruskal-Wallis Rank Sum Test was necessary due to the non-normal distribution of the crime ratio responses. The *p*-values indicate if the differences in means are significant. In general, it was discovered that crime rate increases when daylight savings is implemented.

4.2 Temperature Change Model

The stepwise linear regression model determined the variables for the temperature change model. A new variable called new_temp was created by adding 0.71 degrees to the average temperature. After the linear regression models were developed, the coefficients for the new temperature variables determined if an increase or decrease in the crime ratio per crime type occurred. All models are significant with *p*-values less than 0.001. Figure 3 is the steps taken to generate the temperature change model in Enterprise Miner.

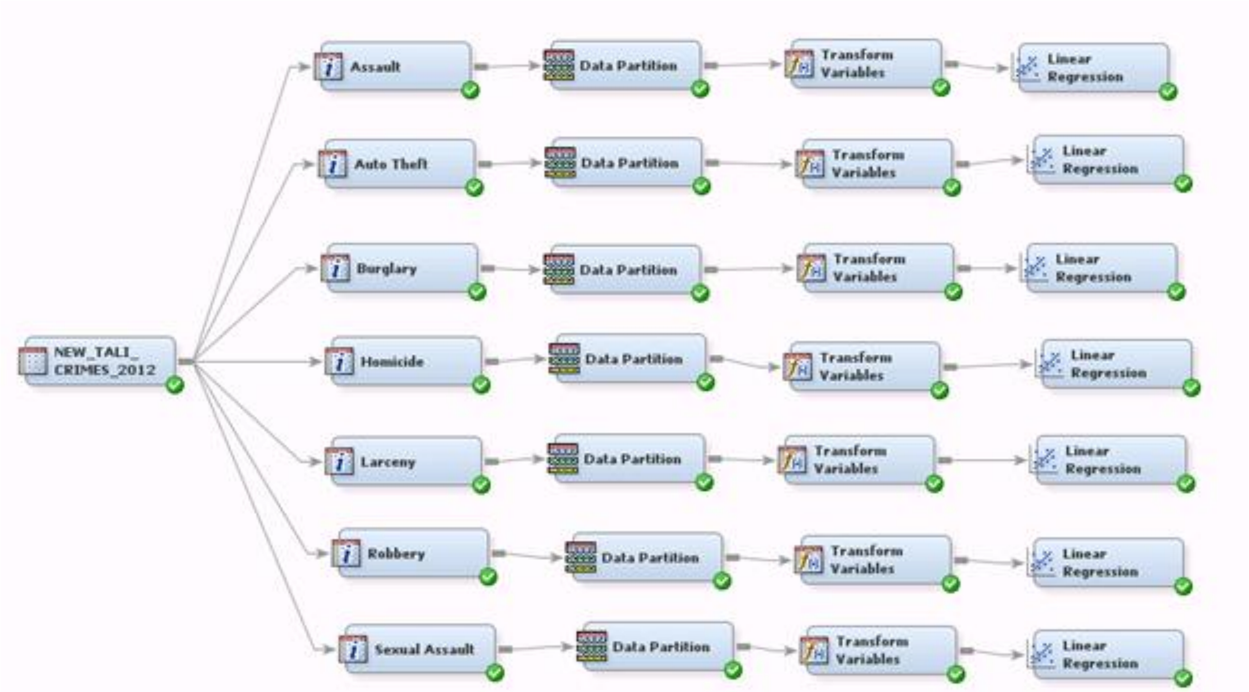


Figure 3: Temperature Change Model Diagram

4.3 Future Scoring

Data was restructured in order to extrapolate monthly total crimes by city using Base SAS 9.3. After establishing the monthly total crimes a model was built based on the restructured data. At that time sexual assault and homicide were found to be rare, therefore an accurate prediction model could not be obtained.

For the other crime types, a full linear regression was run to eliminate variables that contained multi-collinearity. Variance inflation factors (VIF) determined which variables were carrying the same information. A stepwise linear regression was then performed to determine the best model for each crime type. Figure 4 shows the best model in Enterprise Miner for predicting the future model scenarios.

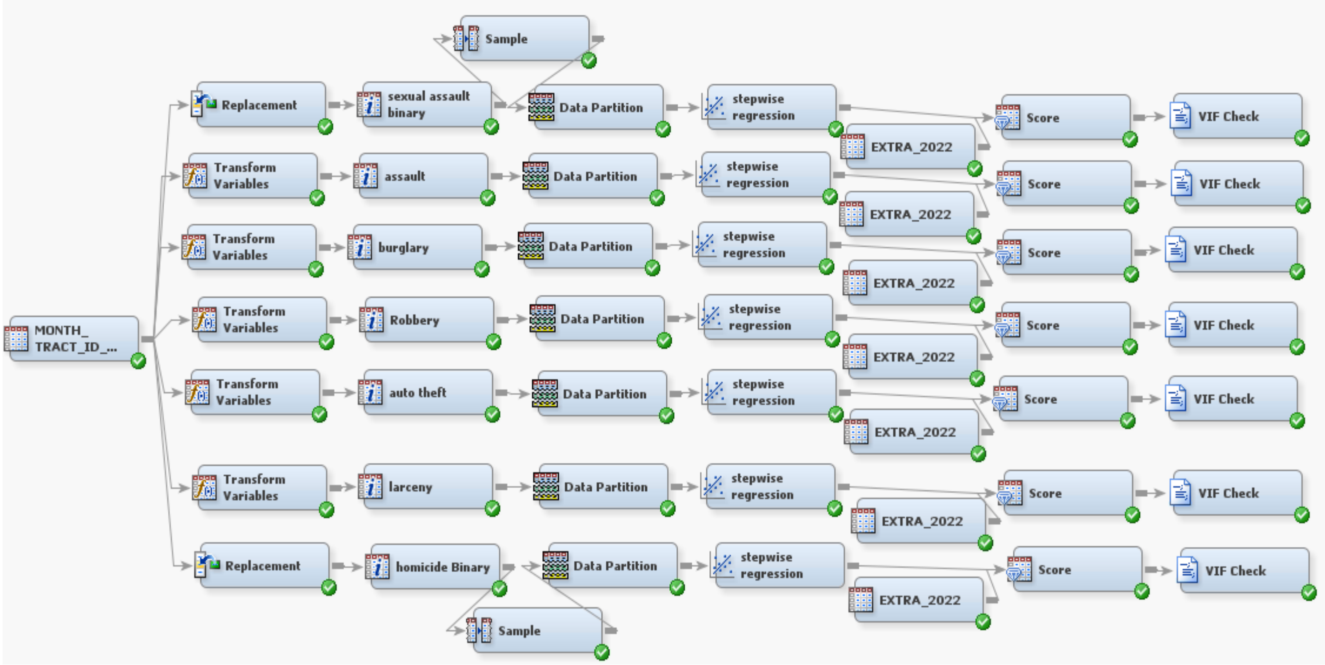


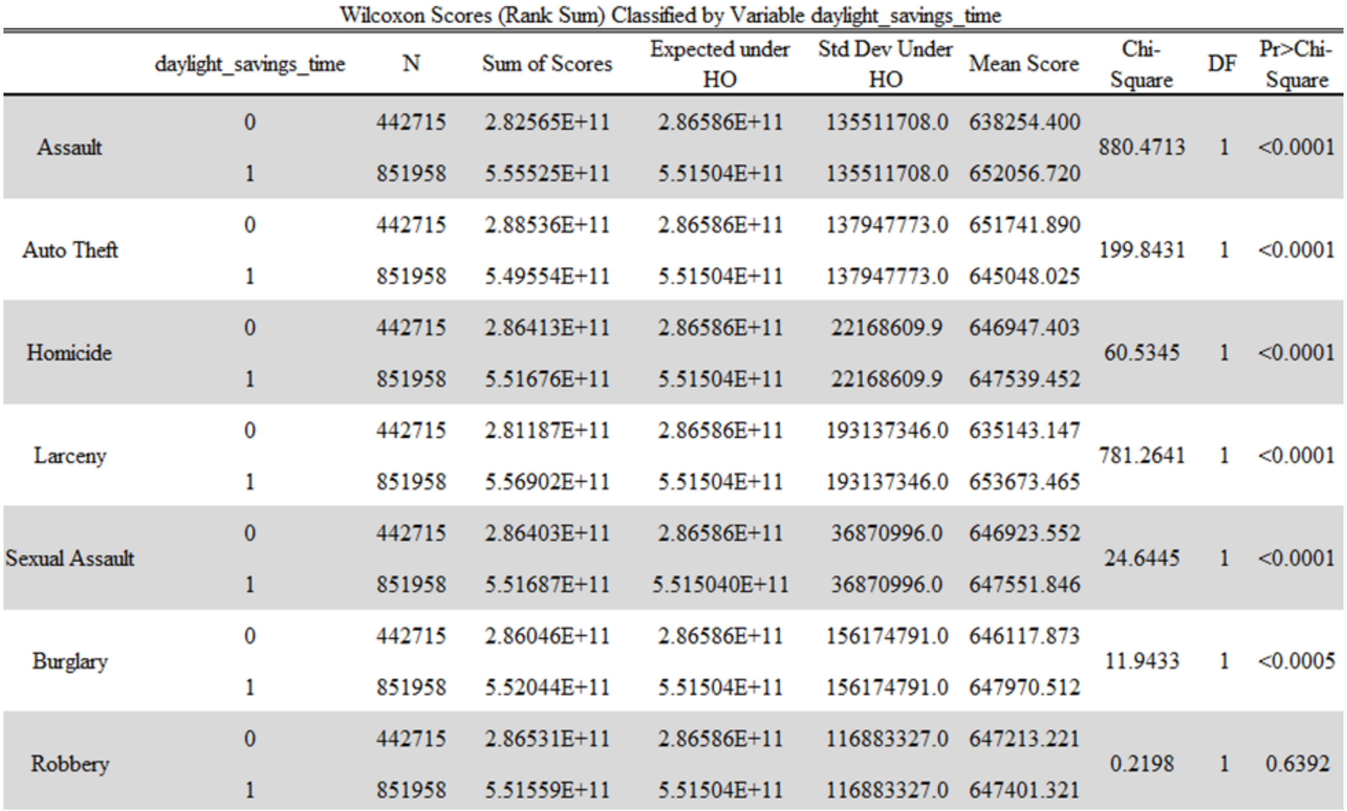
Figure 4: Model for Future Scenarios

5 EVALUATION

Stage five addresses the results from the models that have been run to answer the questions as stated in our Problem Definition in stage one.

5.1 Evaluating the Daylight Savings Model

The daylight savings model addresses what would happen if daylight savings were in effect year round. Results from this test revealed that most of the crime types were statistically significant ($p < 0.001$) and increases with the implementation of daylight savings time all year. The exception to this is with the crime types, auto theft and robbery. Auto theft is statistically significant; however, it will decrease upon the absence of daylight savings time. Daylight savings time does not have a statistically significant effect on robbery ($p = 0.6392$). See table 3 below for the detailed findings.



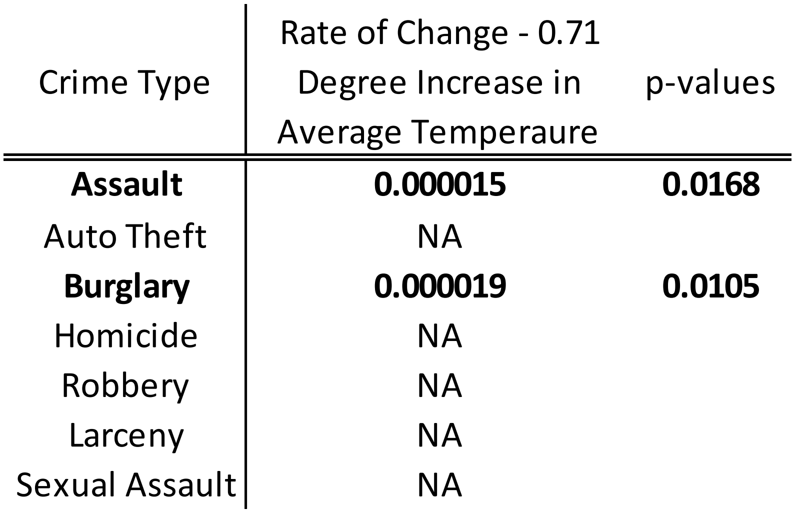
Wilcoxon Scores (Rank Sum) Classified by Variable daylight_savings_time

	daylight_savings_time	N	Sum of Scores	Expected under HO	Std Dev Under HO	Mean Score	Chi-Square	DF	Pr>Chi-Square
Assault	0	442715	2.82565E+11	2.86586E+11	135511708.0	638254.400	880.4713	1	<0.0001
	1	851958	5.55525E+11	5.51504E+11	135511708.0	652056.720			
Auto Theft	0	442715	2.88536E+11	2.86586E+11	137947773.0	651741.890	199.8431	1	<0.0001
	1	851958	5.49554E+11	5.51504E+11	137947773.0	645048.025			
Homicide	0	442715	2.86413E+11	2.86586E+11	22168609.9	646947.403	60.5345	1	<0.0001
	1	851958	5.51676E+11	5.51504E+11	22168609.9	647539.452			
Larceny	0	442715	2.81187E+11	2.86586E+11	193137346.0	635143.147	781.2641	1	<0.0001
	1	851958	5.56902E+11	5.51504E+11	193137346.0	653673.465			
Sexual Assault	0	442715	2.86403E+11	2.86586E+11	36870996.0	646923.552	24.6445	1	<0.0001
	1	851958	5.51687E+11	5.515040E+11	36870996.0	647551.846			
Burglary	0	442715	2.86046E+11	2.86586E+11	156174791.0	646117.873	11.9433	1	<0.0005
	1	851958	5.52044E+11	5.51504E+11	156174791.0	647970.512			
Robbery	0	442715	2.86531E+11	2.86586E+11	116883327.0	647213.221	0.2198	1	0.6392
	1	851958	5.51559E+11	5.51504E+11	116883327.0	647401.321			

Table 3: Kruskal-Wallis Test

5.2 Evaluating Temperature Change Model

A stepwise linear regression model was used for each crime type. The table below shows the rate of change for each crime type when the average temperature for the year 2012 is increased by 0.71 degrees. This explains how crime rates will be effected by temperatures in the year 2032. Table 4 shows that Assault and Burglary will be effected if all other factors remain the same. The crime rate for assault will increase by an average of 0.000015 and the crime rate for burglary will increase by an average of 0.000019.

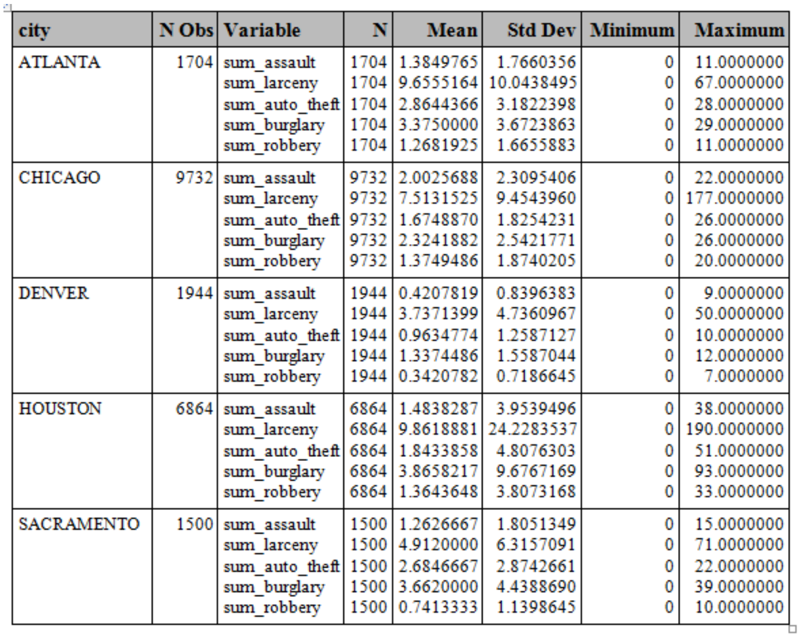


Crime Type	Rate of Change - 0.71 Degree Increase in Average Temperaure	p-values
Assault	**0.000015**	**0.0168**
Auto Theft	NA	
Burglary	**0.000019**	**0.0105**
Homicide	NA	
Robbery	NA	
Larceny	NA	
Sexual Assault	NA	

Table 4: Rate of Change

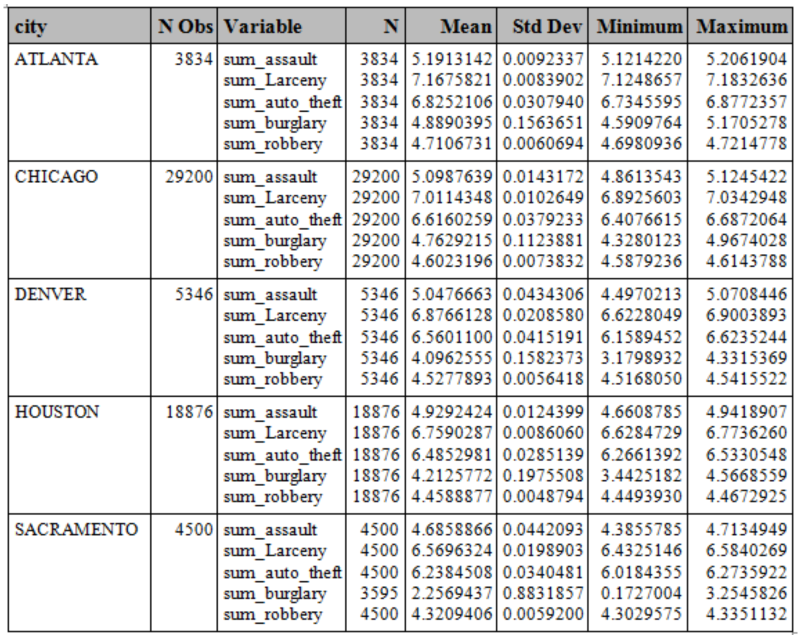
5.3 Evaluating the Future Scoring

Tables 5 and 6 show the predicited crime number for each crime type by city and by month, for the year 2012 and 2022. In can be determined from the tables that the overall crime rate in every city will increase for the majority of the crime types. The only crime type that appears to be getting lower is Larceny in Atlanta, Chicago, and Houston.



city	N Obs	Variable	N	Mean	Std Dev	Minimum	Maximum
ATLANTA	1704	sum_assault	1704	1.3849765	1.7660356	0	11.0000000
		sum_larceny	1704	9.6555164	10.0438495	0	67.0000000
		sum_auto_theft	1704	2.8644366	3.1822398	0	28.0000000
		sum_burglary	1704	3.3750000	3.6723863	0	29.0000000
		sum_robbery	1704	1.2681925	1.6655883	0	11.0000000
CHICAGO	9732	sum_assault	9732	2.0025688	2.3095406	0	22.0000000
		sum_larceny	9732	7.5131525	9.4543960	0	177.0000000
		sum_auto_theft	9732	1.6748870	1.8254231	0	26.0000000
		sum_burglary	9732	2.3241882	2.5421771	0	26.0000000
		sum_robbery	9732	1.3749486	1.8740205	0	20.0000000
DENVER	1944	sum_assault	1944	0.4207819	0.8396383	0	9.0000000
		sum_larceny	1944	3.7371399	4.7360967	0	50.0000000
		sum_auto_theft	1944	0.9634774	1.2587127	0	10.0000000
		sum_burglary	1944	1.3374486	1.5587044	0	12.0000000
		sum_robbery	1944	0.3420782	0.7186645	0	7.0000000
HOUSTON	6864	sum_assault	6864	1.4838287	3.9539496	0	38.0000000
		sum_larceny	6864	9.8618881	24.2283537	0	190.0000000
		sum_auto_theft	6864	1.8433858	4.8076303	0	51.0000000
		sum_burglary	6864	3.8658217	9.6767169	0	93.0000000
		sum_robbery	6864	1.3643648	3.8073168	0	33.0000000
SACRAMENTO	1500	sum_assault	1500	1.2626667	1.8051349	0	15.0000000
		sum_larceny	1500	4.9120000	6.3157091	0	71.0000000
		sum_auto_theft	1500	2.6846667	2.8742661	0	22.0000000
		sum_burglary	1500	3.6620000	4.4388690	0	39.0000000
		sum_robbery	1500	0.7413333	1.1398645	0	10.0000000

Table 5: Mean Predictions per Crime Type for year 2012



city	N Obs	Variable	N	Mean	Std Dev	Minimum	Maximum
ATLANTA	3834	sum_assault	3834	5.1913142	0.0092337	5.1214220	5.2061904
		sum_Larceny	3834	7.1675821	0.0083902	7.1248657	7.1832636
		sum_auto_theft	3834	6.8252106	0.0307940	6.7345595	6.8772357
		sum_burglary	3834	4.8890395	0.1563651	4.5909764	5.1705278
		sum_robbery	3834	4.7106731	0.0060694	4.6980936	4.7214778
CHICAGO	29200	sum_assault	29200	5.0987639	0.0143172	4.8613543	5.1245422
		sum_Larceny	29200	7.0114348	0.0102649	6.8925603	7.0342948
		sum_auto_theft	29200	6.6160259	0.0379233	6.4076615	6.6872064
		sum_burglary	29200	4.7629215	0.1123881	4.3280123	4.9674028
		sum_robbery	29200	4.6023196	0.0073832	4.5879236	4.6143788
DENVER	5346	sum_assault	5346	5.0476663	0.0434306	4.4970213	5.0708446
		sum_Larceny	5346	6.8766128	0.0208580	6.6228049	6.9003893
		sum_auto_theft	5346	6.5601100	0.0415191	6.1589452	6.6235244
		sum_burglary	5346	4.0962555	0.1582373	3.1798932	4.3315369
		sum_robbery	5346	4.5277893	0.0056418	4.5168050	4.5415522
HOUSTON	18876	sum_assault	18876	4.9292424	0.0124399	4.6608785	4.9418907
		sum_Larceny	18876	6.7590287	0.0086060	6.6284729	6.7736260
		sum_auto_theft	18876	6.4852981	0.0285139	6.2661392	6.5330548
		sum_burglary	18876	4.2125772	0.1975508	3.4425182	4.5668559
		sum_robbery	18876	4.4588877	0.0048794	4.4493930	4.4672925
SACRAMENTO	4500	sum_assault	4500	4.6858866	0.0442093	4.3855785	4.7134949
		sum_Larceny	4500	6.5696324	0.0198903	6.4325146	6.5840269
		sum_auto_theft	4500	6.2384508	0.0340481	6.0184355	6.2735922
		sum_burglary	3595	2.2569437	0.8831857	0.1727004	3.2545826
		sum_robbery	4500	4.3209406	0.0059200	4.3029575	4.3351132

Table 6: Mean Predictions per Crime Type for year 2022

6 CONCLUSIONS

The Time Series Plots in Appendix A supports cross training officers in February or early November for other crime types. Those months are recommended because the overall crime rates are uniformly lower in all of the represented cities allowing time to be spent on training.

The Time Series Plots (see Appendix A) show that over all larceny and burglaries have the highest occurrence. Support is given for providing training for these crime types so that additional coverage is provided during the peak crime periods. It is beneficial to say it is feasible for temporary re-assignment of officers from one city to another for special circumstances. Without making a large number of assumptions about current police force size, or departmental budgets, there is no reliable way to recommend reassignment of police officers for special circumstances. There is not enough data to support or deny this claim.

Population density, city, percent below poverty, normalized income were variables that showed up as significant in almost every model produced. These variables could prove to be very effective in helping to further allocate law enforcement resources and predict the possibility of a crime occurring. Further exploration of these variables should be used in further analysis of the crime situation in the five referenced cities.

Works Cited

A.D. Pokorny, J. J. (1974). The questionable relationship between homicides and the lunar cycle. *American Journal of Psychiatry, 131*, 827-829.

Cohn, E. (1993). The prediction of police calls for service: The influence of weather and temporal variables on rape and domestic violence. *Journal of Environmental Psychology, 13*, 71-83.

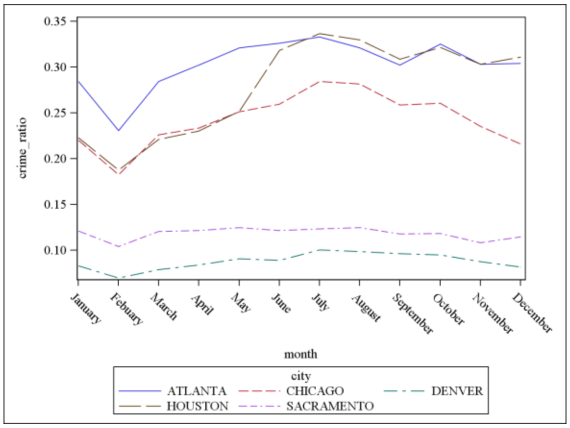
James B. Comey, D. F. (2013). *Preliminary Semiannual Uniform Crime Report, January-June 2013*. James B. Comey, Director, Federal Bureau of Investigation.

Sanders, J. L. (2012, November). Under the Cover of Darkness: Using Daylight Saving Time to Measure How Ambient. *Faculty Working Paper*. Virginia: University of Virginia.

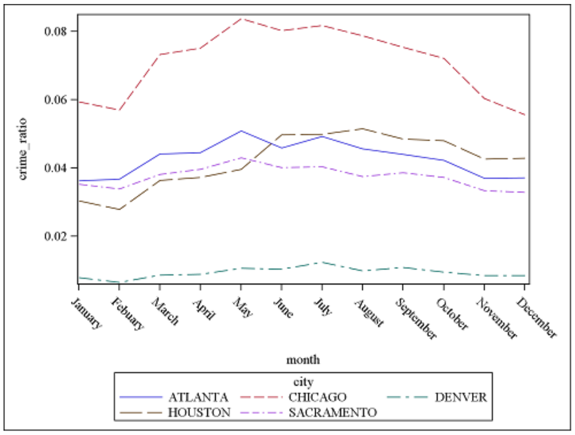
APPENDIX A: Time Series Plots

Crime Type Rates By Month and City

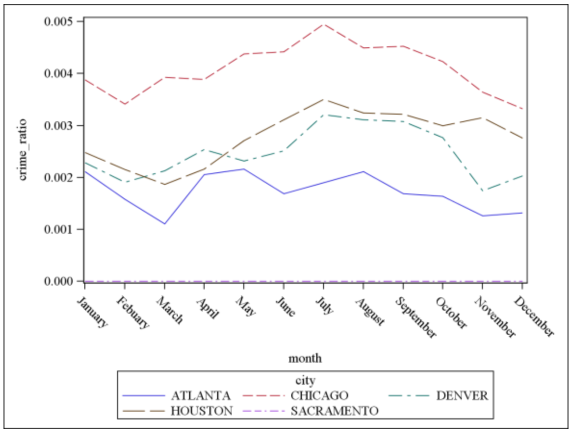
Larceny



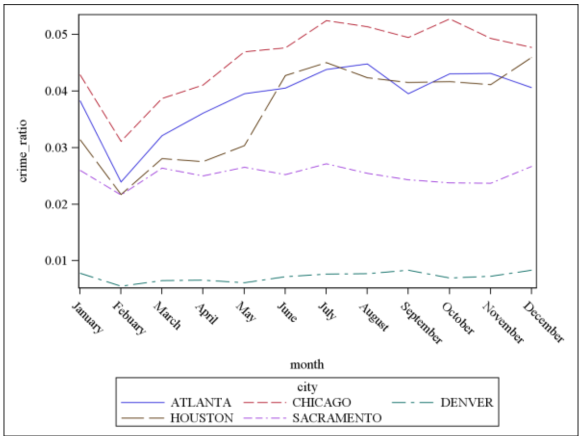
Assault



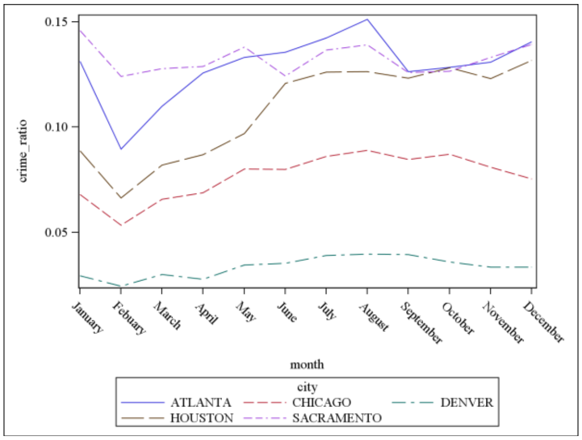
Sexual Assault



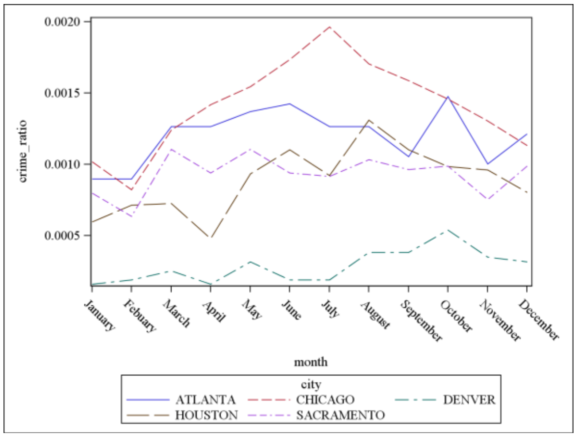
Robbery



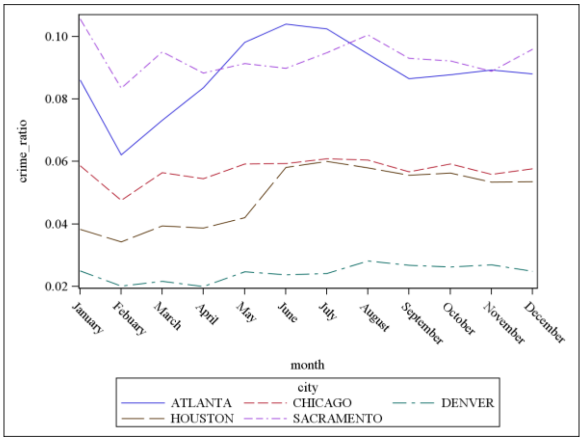
Burglary



Homicide



Auto_Theft



APPENDIX B: SAS Code Used

```
*The version of SAS used was SAS Base 9.3 and Enterprise Minor 7.1 Version
9.03.01;

*Please change the folder directory for the DATMIN library within the ‘ ’
below to the folder directory that includes the datasets specified in Step 0
in the file “SAS and Enterprise Miner Instructions”;
LIBNAME DATMIN '' ;

******************************************************************************
******************************************************************************
Data Set: Crime Data
Goal: Create a binary response variable to indicate that a crime occurred.
This response variable will be used to compare crime occurred to no crime
occurred. We also created a numeric response to keep track of the total
number of crimes committed for future analysis. Next, crime type (Assault,
Burglary, etc.) is made into a variable. Lastly, the crime data set only
gives us the days a crime occurred. For example, if no crime were committed/
reported on January 2nd then no observation would be recorded for that day.
Some of the other data sets we were given have observations for every day of
the year. Unfortunately, if we were to merge the crime data set with these
data sets it would create a lot of missing entries. To overcome this we
modified the original crime data set by adding in the days of the year
          in which no crime occurred and filled in the missing information
appropriately.
Objectives:
1.  Create a binary and numeric response for days where a crime occurred.
2.  Turn each crime type into its own variable within the crime dataset.
3.  Create a data set that contains the completed records (Crime Type, City,
Day, etc.) for every day where no crimes
          occurred.
4.  Merge the NO_CRIME data set with the CRIME_2 data set for a completed
data set that contains records for every day
          of the year.
Output: At the end of this portion of code no output will be seen, but a new
data set CRIME_NEW will be created that has resolved
          the issue with the crime data set. We will begin merging everything
from here on out with the CRIME_NEW data set.
          CRIME_2 info:
                *after proc sort - variables = 12 and observations = 2205564
                *after objective 1 - variables = 14 and observations =
1738711
          CRIME_TRANS info:
                *variables = 10 and observations = 1298550
          CRIMES info:
                *variables = 20 and observations = 1298550
          NO_CRIME info:
                *variables = 3 and observations = 4283472
          CRIME_NEW info:
                *variables = 27 and observations = 4283472

Comments from the Log:
    * None to report.
******************************************************************************
******************************************************************************
```

```
*sorts the data by tract_id and then date;

PROC SORT DATA= DATMIN.CRIME_V2 OUT=CRIME_2;
BY TRACT_ID DATE CRIME_TYPE;
RUN;
/* Objective 1 - Note that if Binary Response = 1 then a crime was committed,
all observations with a missing tract_id have
          been deleted, and "If LAST.DATE" is used to remove all duplicated
responses. Also, a numeric response was created
          to keep tract of the total number of crimes committed each day by
tract_id.*/
*CREATE NUMERIC RESPONSE, DELETE MISSING TRACT_IDS, REMOVE DUPLICATE
OBSERVATIONS (BASED OF TRACT_ID AND DATE);
DATA CRIME_2;
SET CRIME_2;
BY TRACT_ID DATE CRIME_TYPE;
IF TRACT_ID = . THEN DELETE;
BINARY_RESPONSE=1;
IF AREA_RATIO=0 THEN DELETE;
IF FIRST.CRIME_TYPE THEN CRIME= 1;
ELSE CRIME+1;
IF LAST.CRIME_TYPE;
RUN;
/*Objective 2 - Create a dataset CRIME_TRANS that lists crime types as a
variable, and then merges that dataset with the
                            CRIMES dataset.*/

proc transpose data=crime_2 OUT = CRIME_TRANS let;
by tract_id date;
id crime_type;
var CRIME;
run;
DATA CRIMES (DROP = _NAME_ CRIME);
MERGE CRIME_2 CRIME_TRANS;
BY TRACT_ID DATE;
IF LAST.TRACT_ID OR LAST.DATE;
RUN;
/*Objective 3 – The NO_CRIME data set was created to keep a record of days in
each city where no crime occurred. The code
          below takes the crime data set and fills in any missing dates
(meaning a crime did not occur) between Jan. 1st –
          Dec. 31st with a “no crime” record and stores it in the NO_CRIME
data set. */
*CREATE BINARY NO CRIME DATA;
DATA NO_CRIME;
SET CRIME_2 (KEEP = CITY TRACT_ID);
BY TRACT_ID;
IF LAST.TRACT_ID;
IF (CITY = 'SACRAMENTO' OR CITY= 'CHICAGO') THEN DO;
DO DATE = '01JAN2005'D TO '31DEC2012'D;
OUTPUT;
END;
END;
ELSE IF (CITY = 'DENVER' OR CITY = 'HOUSTON') THEN DO;
DO DATE = '01JAN2008'D TO '31DEC2012'D;
OUTPUT;
```

```
END;
END;
ELSE IF CITY = 'ATLANTA' THEN DO;
DO DATE = '01JAN2009'D TO '31DEC2012'D;
OUTPUT;
END;
END;
FORMAT DATE DATE9.;
RUN;
/*Objective 4 - Takes both data sets (NO_CRIME and CRIMES) and merges them
together. This way each city has a completed record
          Jan.1st - Dec. 31st that contains every day of the year and whether
or not a crime committed.
For days that did not have a crime and were added to the data set, the
variable hour was given a random integer 0-23 for the time of the crime using
the rand(UNIFORM) function. */

*MERGE NOCRIME AND CRIME DATA FILL IN VARIABLE VALUES FOR NOCRIME DATA;
DATA CRIME_NEW (DROP=WDAY CRIME_TYPE);
MERGE NO_CRIME CRIMES;
BY TRACT_ID DATE;
IF LARCENY= . THEN LARCENY=0; IF ASSAULT= . THEN ASSAULT = 0;
IF SEXUAL_ASS= . THEN SEXUAL_ASS = 0; IF BURGLARY = . THEN BURGLARY = 0;
IF AUTO_THEFT = . THEN AUTO_THEFT=0; IF ROBBERY= . THEN ROBBERY = 0;
IF HOMICIDE = . THEN HOMICIDE = 0;
IF LARCENY NE 0 THEN B_LARCENY=1; ELSE B_LARCENY = 0;
IF ASSAULT NE 0 THEN B_ASSAULT=1; ELSE B_ASSAULT = 0;
IF SEXUAL_ASS NE 0 THEN B_SEXUAL_ASS=1; ELSE B_SEXUAL_ASS = 0;
IF BURGLARY NE 0 THEN B_BURGLARY =1; ELSE B_BURGLARY = 0;
IF AUTO_THEFT NE 0 THEN B_AUTO_THEFT =1; ELSE B_AUTO_THEFT = 0;
IF ROBBERY NE 0 THEN B_ROBBERY =1; ELSE B_ROBBERY = 0;
IF HOMICIDE NE 0 THEN B_HOMICIDE =1; ELSE B_HOMICIDE = 0;
NUMERIC_RESPONSE=
lARCENY+ASSAULT+SEXUAL_ASS+BURGLARY+AUTO_THEFT+ROBBERY+HOMICIDE;
IF ID = . THEN DO;
YEAR = YEAR(DATE); MONTH=MONTH(DATE); DATE_NUM=DAY(DATE);
WDAY=WEEKDAY(DATE);
HOUR=FLOOR(RAND("UNIFORM")*24);
BINARY_RESPONSE = 0;
NUMERIC_RESPONSE= 0;
CRIMEAREA='ALL';
END;
IF WDAY = 1 THEN DAY= 'Sun';
ELSE IF WDAY = 2 THEN DAY = 'Mo';
ELSE IF WDAY = 3 THEN DAY = 'Tue';
ELSE IF WDAY = 4 THEN DAY = 'We';
ELSE IF WDAY = 5 THEN DAY = 'Thu';
ELSE IF WDAY = 6 THEN DAY = 'Fri';
ELSE IF WDAY = 7 THEN DAY = 'Sat';
RUN;
*****************************************************************************
*****************************************************************************
Data Set: Unemployment
Goal: The unemployment data set is fine as is. It just needs to be merged
together with the CRIME_NEW dataset.
Objectives:
```

```
1.  Merge the unemployment data set with the CRIME_NEW data set.
Output: At the end of this portion of code no output will be seen, but a new
data set CRIME_MERGE_UNEMPLOY will be created.

          UNEMPLOYMENT info:
                *variables = 5 and observations = 448704
          CRIME_MERGE_UNEMPLOY info:
                * variables = 28 and observations = 4283472

Comments from the Log:
    *Note: Input data set (Unemployment) is already sorted, it has been
copied to the output data set.
*****************************************************************************
*****************************************************************************
*Objective 1- Sorts the data by TRACT_ID, YEAR, and then MONTH and merges it
with CRIME_NEW;

PROC SORT DATA = datmin.unemployment out = unemployment;
BY TRACT_ID YEAR MONTH;
run;
DATA CRIME_MERGE_UNEMPLOY (DROP=CITYNAME);
MERGE CRIME_NEW UNEMPLOYMENT;
BY TRACT_ID YEAR MONTH;
IF DATE = . THEN DELETE;*Any unemployment data that has dates that do not
match with data CRIME_NEW gets deleted;
RUN;
*****************************************************************************
*****************************************************************************
Data Set: Socioeconomic
Goal: The socioeconomic data set is fine as is. It just needs to be merged
together with the CRIME_MERGE_UNEMPLOY dataset.
Objectives:
1.  Merge the socioeconomic data set with the CRIME_MERGE_UNEMPLOY data set.
Output: At the end of this portion of code no output will be seen, but a new
data set CRIME_MERGE_SOCIO will be created.
          SOCIOECON info:
                * variables = 6 and observations = 37392
          CRIME_MERGE_SOCIO info:
                * variables = 31 and observations 4283472
Comments from the Log:
*None to report
*****************************************************************************
*****************************************************************************
*Objective 1 - Sorts the Socioeconomic Data by tract_id and year and then
merges it with the CRIME_MERGE_UNEMPLOY dataset;

PROC SORT DATA = DATMIN.SOCIOECONOMIC out=SOCIOECON;
BY TRACT_ID YEAR;
RUN;
DATA CRIME_MERGE_SOCIO;
MERGE CRIME_MERGE_UNEMPLOY SOCIOECON;
BY TRACT_ID YEAR;
IF DATE = . THEN DELETE;*Any socioeconomic data that has dates that do not
match with data CRIME_NEW gets deleted;
RUN;
*****************************************************************************
```

```
*****************************************************************************
Data Set: Weather
Goal: To use the weather data as is in addition to using the weather 
information to calculate the heating and cooling 
          information. This way the Heating_Cooling_Days does not have to be 
merged into the larger dataset.
Objectives:
    1.  Calculates the missing values in the Sacramento data.
    2.  Convert all the degrees into Fahrenheit and then calculate if the day 
was a heating/cooling day and by how much.
    3.  Sorts the datasets by a common variable(s) and merges them together.
Output: At the end of this portion of code no output will be seen, but a new 
data set CRIME_MERGE_WEATHER will be created.
          WEATHER info:
                * variables = 14 and observations = 14610
          CRIME_MERGE_SOCIO info:
                * variables = 31 and observations 4283472
          CRIME_MERGE_WEATHER info:
                * variables = 41 and observations = 4283472
Comments from the Log:
*After running the data weather set the following note was issued in the log.
          NOTE: Missing values were generated as a result of performing an 
operation on missing values.
               Each place is given by: (Number of times) at (Line):(Column).
               1 at 158:33   1 at 159:31   1 at 160:30   1 at 163:25
*****************************************************************************
*****************************************************************************
/* Objective 1 & 2 - Calculates the missing values in the Sacramento data.*/;
DATA WEATHER;
SET datmin.WEATHER;
FORMAT DATE DATE9.;
DROP DAY;
TEMP_HIGH_F= (TEMPERATURE_HIGH*9)/5 +32;
TEMP_LOW_F= (TEMPERATURE_LOW*9)/5 +32;
/* 05/14/2012 sacramento has missing high/low temp so using 05/13 and 05/15 
to fill in missing value */
if TEMP_HIGH_F=. then TEMP_HIGH_F=(75.02+80.96)/2;
if TEMP_LOW_F=. then TEMP_LOW_F=(53.06+57.02)/2;
/* 12/17/2006 sacramento has missing pressure so using 12/16 and 12/18 values 
to fill in missing */
if pressure=. then pressure=(1010.2+1023.9)/2;
AVERAGE_TEMP= (TEMP_HIGH_F + TEMP_LOW_F)/2;
IF AVERAGE_TEMP < 65 THEN DO;
DEGREE_DAY='HEATING';
TOTAL_DEGREE_DAY = 65-AVERAGE_TEMP;
END;
IF AVERAGE_TEMP > 65 THEN DO
DEGREE_DAY = 'COOLING';
TOTAL_DEGREE_DAY = AVERAGE_TEMP -65;
END;
RUN;

/* Objective 3 - Sorts the datasets by a common variable(s) and merges them 
together.*/;

*SORT BY CITY DATE SO IT CAN BE MERGED;
```

```
PROC SORT DATA = WEATHER;
BY CITY DATE;
RUN;

PROC SORT DATA = CRIME_MERGE_SOCIO;
BY CITY DATE;
RUN;

*MERGE IN WEATHER;
DATA CRIME_MERGE_WEATHER;
MERGE CRIME_MERGE_SOCIO
WEATHER;
BY CITY DATE;
IF CRIMEAREA = ' ' THEN DELETE;
RUN;
*****************************************************************************
*****************************************************************************
Data Set: Calendar Days
Goal: To merge the CALENDAR_DAYS data into the combined data sets. This is
competed through the objectives below.
Objectives:
    1. Formatting the Calendar_days dataset to prepare it for the merger.
    2. Sorting the CALDAYS dataset and the CRIME_MERGE_POP dataset and then
merging.
Output: At the end of this portion of code the new combined data set
(CRIME_MERGE_CAL) has been created.
                CALDAYS info:
                      *variables = 7 and observations = 7312
                CRIME_MERGE_WEATHER info:
                      *variables = 41 and observations = 4283472
                CRIME_MERGE_CAL
                      *variables = 47 and observations = 4283472
Log Comments:
*None to report
*****************************************************************************
*****************************************************************************
*Objective 1 - All the dates in CALENDAR_DAYS is being reformatted to match
the other datasets (DDMonYYYY ex. 01Jan2008) and
                            instead of blanks for non-holiday info the blanks
are being replaced with "NA" so that Enterprise Miner
                            does not mistake these blanks as missing values;

/* Objective 1 - SFormatting the Calendar_days dataset to prepare it for the
merger.*/;
DATA CALDAYS;
SET DATMIN.CALENDAR_DAYS;
FORMAT DATE DATE9.;
IF HOLIDAYNAME='' THEN HOLIDAYNAME="NA";
IF HOLIDAY_WEEK='' THEN HOLIDAY_WEEK="NA";
RUN;
/* Objective 2 - Sorting the CALDAYS dataset and the CRIME_MERGE_POP dataset
and then merging./;
PROC SORT DATA = CALDAYS;
BY DATE;
RUN;
PROC SORT DATA = CRIME_MERGE_WEATHER;
```

```
BY DATE;
RUN;

*MERGING CALENDAR_DAYS;
/*CALDAYS does not contain a TRACT_ID so if there are dates that don’t align
the two data sets then those from
          CRIME_MERGE_WEATHER that are not included in CALDAYS are deleted*/;
DATA CRIME_MERGE_CAL;
MERGE CRIME_MERGE_WEATHER CALDAYS;
BY DATE;
IF TRACT_ID = . THEN DELETE;
RUN;

*****************************************************************************
*****************************************************************************
Data Set: Solar Lunar
Goal: To merge the SOLAR_LUNAR data into the combined data sets and calculate
the total time from noon until sunset.
          This is competed through the objectives below.
Objectives:
    1. Formatting the SOLAR_LUNAR dataset to prepare it for the merger and
calculating the total time from noon until sunset.
                This calculation does take into account daylight savings
time.
    2. Sorting the SOLLUN dataset and the CRIME_MERGE_CAL dataset and then
merging.
Output: At the end of this portion of code the new combined data set
(CRIME_MERGE_SOLLUN) has been created.
                SOLLUN info:
                      *variables = 9 and observations = 14610
               CRIME_MERGE_CAL info:
                      *variables = 47 and observations = 4283472
                CRIME_MERGE_SOLLUN
                      *variables = 54 and observations = 4283472
Log Comments:
*None to report
*****************************************************************************
****************************************************************************;
*Objective 1 - All the dates in SOLAR_LUNAR is reformatted to match the other
datasets (DDMonYYYY ex. 01Jan2008). Also, the
          number of number of hours between noon and sundown is calculated.
This also takes into account when daylight savings
          is in effect.;
*Merging Solar_Lunar;
DATA SOLLUN (DROP=NOON);
SET DATMIN.SOLAR_LUNAR;
FORMAT DATE DATE9.;
IF DAYLIGHT_SAVINGS_TIME=0 THEN NOON = 43200;*12 hours * 60 minutes * 60
seconds = 43200;
ELSE NOON = 39600; *If daylight savings is in effect then noon is 11am and
calculated similarly to the above calculation;
DAYLIGHT_HOURS_AFTER_NOON=STANDARD_SUNSET - NOON;
format DAYLIGHT_HOURS_AFTER_NOON TIME8.;
     *to get city names to "match" for merge;
     if city = "Atlanta" then city = "ATLANTA";
     if city = "Chicago" then city = "CHICAGO";
     if city = "Denver" then city = "DENVER";
     if city = "Houston" then city = "HOUSTON";
     if city = "Sacramento" then city = "SACRAMENTO";
RUN;
/*Objective 2 - Sorting both data sets by city and then date and merges them
together.*/

PROC SORT DATA = SOLLUN;
BY CITY DATE;
RUN;
PROC SORT DATA = CRIME_MERGE_CAL;
BY CITY DATE;
RUN;
/*SOLAR_LUNAR does not conatin a CRIME_TYPE so if there are cities/dates that
don't mesh up between the two data sets then those
          from CRIME_MERGE_CAL that are not included in SOLLUN are deleted*/

DATA CRIME_MERGE_SOLLUN;
MERGE CRIME_MERGE_CAL SOLLUN;
BY CITY DATE;
      if tract_id = . then delete;
RUN;
*****************************************************************************
*****************************************************************************
Data Set: Storms
Goal: To expand the observations (days) in which a storm occurred so that
each storm day is its own observation, and then
          merges this new dataset with the big dataset.
Objectives:
    1.  To expand the duration of each storm day into its own observation.
    2.  Sorting the storm dataset and then merging.
Output: At the end of this portion of code the new combined data set
(CRIME_MERGE_STORM) has been created.
                STORM info:
                      *variables = 9 and observations = 1483
                CRIME_MERGE_STORM
                      *variables = 61 and observations = 4283472
Log Notes:
    *After running the data storms step we got this note:
          NOTE: Character values have been converted to numeric values at the
places given by:
               (Line):(Column).
               265:19   265:38   266:17   266:34
    *After running the data CRIME_MERGE_STORM we got this note:
          NOTE: MERGE statement has more than one data set with repeats of BY
values
*****************************************************************************
****************************************************************************;
/*Objective 1 - The original storm dataset indicated the start day of each
storm and how many days the storm lasted. For example,
                            start date: January 1st and Duration: 3 days. We
needed each day the storm occurred to be its own observation,
                            so that we could see if there were higher crime
rates on days that a storm was occurring. By the end of
                            objective 1 the storm data will have an
observation for everyday of the storm. Using the same example as
```

```
                            above, now instead of saying start date: January
1st and Duration: 3 days an observation is shown for
                            January 1st, January 2nd, and January 3rd. Note
that only days where a storm was reported are observed.
                            For instance, if there was no storm on March 2nd,
then there will not be an observation that corresponds
                            to March 2nd.*/

*Merging Storms;
data storm (KEEP= CITY STORM_CLASS BEGIN_TIME END_TIME BINARY_STORM
START_DATE END_DATE DAYS DATE );
set datmin.storms_V2;
BINARY_STORM=1;
bmonth =substrn(begin_yearmonth,5,2);
byear = substrn(begin_yearmonth,1,4);
emonth =substrn(end_yearmonth,5,2);
eyear = substrn(end_yearmonth,1,4);
start_date =mdy(bmonth, begin_day, byear);
end_date =mdy(emonth, end_day, eyear);
days = 1+(end_date - start_date);
do i = 0 to days-1;
IF I= 0 THEN DATE=START_DATE;
ELSE DATE = DATE+1;
output;
end;
FORMAT END_DATE START_DATE DATE DATE9.;
run;
/*Objective 2 - Sort the storm data and then merge it with the
CRIME_MERGE_SOLLUN dataset. Note that there will be dates
                            in the CRIME_MERGE_SOLLUN dataset where no crime
occurred. If that is the case then that cell is marked
                            with "NA", so that when the final data set is
uploaded into Enterprise Miner, Enterprise Miner does
                            not treat those cells as missing data.*/

proc sort data = storm;
by CITY DATE;
run;
DATA CRIME_MERGE_STORM;
MERGE CRIME_MERGE_SOLLUN STORM;
BY CITY DATE;
IF CRIMEAREA=' ' THEN DELETE;
      if storm_class = " " then do;
           storm_class = "NA";
           begin_time = .;
           end_time = .;
           binary_storm = 0;
           start_date = date;
           end_date = date;
           days = 0;
      end;
RUN;
****************************************************************************
****************************************************************************
Data Set: Population
```

```
Goal: To create population densities and subdivide the population into
smaller groups for future analysis.
Objectives:
            1.  This code is used more to prepare the data for future
analysis by cleaning of some of the original data values.
               The following changes were made:
                     a.  Make a copy of the Population dataset called
population
                     b.  Breaks the ages data into smaller groups (e.g.
Miners, Adults, etc.)based off of their age ranges.
                         This was done because in Enterprise Miner we wanted
to explore the idea that certain variables
                         might cause a rise of crime in various age groups.
                     c.  Reformats the tract_id so it has a length of 12.
This prevents SAS from putting these values into
                         scientific notation and preserve the uniqueness of
each tract_id. Also, it takes some of the vaguer
                         ages (such as under 1) and assigns these character
values to a numeric integer
            2.  Finds the summation of all the population totals by year,
tract_id, gender, and then age group.
            3.  Sorts the data and removes any duplicates. We no longer need
individual ages. Instead we are know only concerned with the
                 age groups (minors, young adults, etc.)
            4.  Sorts the data so we can transpose the years. This is need in
order to do the do loops for the extrapolation calculation.
            5.  Extrapolates the data using an exponential function to
generate data for all the years.*/
            6.  Sorts the data for proc transpose. The proc transpose command
was used so that each age group (minors, adults, etc.)
              is its own variable rather than just listed in a single column.
            7.  Sorting both data sets by city and then date and merges them
together.
Output:
Log Notes:
            *None to Report
*****************************************************************************
*****************************************************************************;

*Temporary copy to use when working with population;
DATA BIG_DATA;
     SET CRIME_MERGE_STORM;
RUN;

/* Objective 1 - This code is used more to prepare the data for future
analysis by cleaning of some of the original data values.
                            The following changes were made:
                                  a.  Make a copy of the Population dataset
called population
                                  b.  Breaks the ages data into smaller
groups (e.g. Miners, Adults, etc.)based off of their age ranges.
                                              This was done because in
Enterprise Miner we wanted to explore the idea that certain variables
                                              might cause a rise of crime in
various age groups.
```

```
                                  c.  Reformats the tract_id so it has a
length of 12. This prevents SAS from putting these values into
                                              scientific notation and
preserve the uniqueness of each tract_id. Also, it takes some of the vaguer
                                              ages (such as under 1) and
assigns these character values to a numeric integer */
/* Objective 1a */

DATA POPULATION;
     SET DATMIN.POPULATION_V2;
RUN;
/* Objective 1b */
proc format;
     value agefmt
     0-17= 'Minors'
     18-24='Young Adults'
     25-34='Adults'
     35-44='Older Adults'
     45-65='Middle Aged'
     65-80='Seniors'
     81-high='Super Seniors';
run;
/* Objective 1c - Changes age group called "Under_1" to "0" years,
"100_to_104" to "100" years, "105_to_109" to "105" years,
                                 and "110_and_over" to "110" years. */
data population2 (drop=age_group);
     set population;
     if age_group='under_1' then age=0;else
     if Age_group = "100_to_104" then age = 100; else
     if Age_group = "105_to_109" then age = 105; else
     if Age_group = "110_and_over" then age = 110; else
     age = input(Age_group, best8.);
     AgeGroup=PUT(Age,AGEFMT.);*converts AgeGroup variable from character to
numeric;
     format  Tract_ID best12.;*converting Tract_ID variable to numeric
variable of length 12 rather than using "best10." format/informat;
run;
/* Objective 2 - Finds the summation of all the population totals by year,
tract_id, gender, and then age group. */
proc sql;
     create table pop3 as
     select *, sum(population) as group_Pop
     from population2
     Group by Year, tract_id, GENDER, AGEGROUP;
quit;
/*Objective 3 - Sorts the data and removes any duplicates. We no longer need
individual ages. Instead we are know only concerned with the
                            age groups (minors, young adults, etc.)*/

PROC SORT DATA =POP3 nodupkey OUT=POP4;
BY YEAR TRACT_ID GENDER AGEGROUP;
RUN;
/*Objective 4 - Sorts the data so we can transpose the years. This is need in
order to do the do loops for the extrapolation calculation.*/

PROC SORT DATA=POP4 OUT=SORTED;
```

```
BY TRACT_ID GENDER AGEGROUP;
RUN;
PROC TRANSPOSE DATA = SORTED OUT=POP_TRANS LET;
ID YEAR;
BY TRACT_ID GENDER AGEGROUP;
VAR GROUP_POP;
RUN;
/*Objective 5 - Extrapolates the data using an exponential function to
generate data for all the years.*/
DATA POP6 (DROP=_2000 _2010 RATE _NAME_);
     SET POP_TRANS;
     IF _2000 AND _2010 NE 0 THEN DO;
           DO YEAR=2000 TO 2012;
           RATE=(1/10)*LOG(_2010/_2000);
           PREDICT_POP=_2000*EXP(RATE*(YEAR-2000));
           OUTPUT;
           END;
     END;
RUN;
/*Objective 6 - Sorts the data for proc transpose. The proc transpose command
was used so that each age group (minors, adults, etc.)
                            is its own variable rather than just listed in a
single column. */
PROC SORT DATA = POP6;
     BY TRACT_ID YEAR;
RUN;
PROC TRANSPOSE DATA=POP6 OUT=POP7 (DROP=_NAME_);
     ID AGEGROUP GENDER;
     BY TRACT_ID YEAR;
RUN;
/*Objective 7 - Sorting both data sets by city and then date and merges them
together.*/

PROC SORT DATA=POPULATION2 NODUPKEY OUT=POP2_SORTED;
     BY TRACT_ID YEAR;
RUN;
PROC SORT DATA = POP7;
     BY TRACT_ID;
RUN;
DATA MERGED (DROP=I);
     MERGE POP2_SORTED (KEEP=CITY TRACT_ID TRACT_AREA) POP7;
     BY TRACT_ID;
     ARRAY TEST_MISS(*) _NUMERIC_;
           DO I=1 TO DIM(TEST_MISS);
                 IF TEST_MISS(I) = . THEN TEST_MISS(I)=0;
           END;
     fem_total=adultsfemale + middle_agedfemale + minorsfemale +
older_adultsfemale + seniorsfemale + super_seniorsfemale +
young_adultsfemale;
     male_total=adultsmale + middle_agedmale + minorsmale + older_adultsmale
+ seniorsmale + super_seniorsmale + young_adultsmale;
     Total_pop = fem_total+male_total;
     adults_total= adultsfemale+adultsmale;
     middle_aged_total= middle_agedfemale+ middle_agedmale;
     minors_total= minorsfemale+minorsmale;
     older_adults_TOTAL= older_adultsFEMALE+older_adultsMALE;
     SENIORS_TOTAL=seniorsfemale+seniorsmale;
     super_seniors_TOTAL= super_seniorsfemale+super_seniorsmale;
     young_adults_TOTAL= young_adultsfemale+young_adultsmale;
RUN;
/*Created pop densities stuff 1st array for diff age groups 2nd array where
he is going to place density info then uses doloop to set popdensities for
each group*/

data popdens;
set merged;
     array population {24} adultsfemale middle_agedfemale minorsfemale
older_adultsfemale seniorsfemale super_seniorsfemale young_adultsfemale
           adultsmale middle_agedmale minorsmale older_adultsmale seniorsmale
super_seniorsmale young_adultsmale fem_total male_total Total_pop
adults_total middle_aged_total minors_total
           older_adults_TOTAL SENIORS_TOTAL super_seniors_TOTAL
young_adults_TOTAL;
     array popdense{24} popdense_adultsfemale popdense_middle_agedfemale
popdense_minorsfemale popdense_older_adultsfemale popdense_seniorsfemale
popdense_super_seniorsfemale popdense_young_adultsfemale
           popdense_adultsmale popdense_middle_agedmale popdense_minorsmale
popdense_older_adultsmale popdense_seniorsmale popdense_super_seniorsmale
popdense_young_adultsmale popdense_fem_total
           popdense_male_total popdense_Total_pop popdense_adults_total
popdense_middle_aged_total popdense_minors_total
           popdense_older_adults_TOTAL popdense_SENIORS_TOTAL
popdense_super_seniors_TOTAL popdense_young_adults_TOTAL;
           do i = 1 to 24;
     popdense{i}=population{i}/tract_area;
     population{i}=round(population{i},1);
end;
run;
/*sort to merge*/
proc sort data=big_data;
     by tract_id year;
run;
Data Big_data2;
     merge big_data popdens;
     by tract_id year;
     if date=. then delete;
run;
*Create Crime Ratio variable;
data big;
     set big_data2;
STORM_DAYS= (DATE-
START_DATE)+1;



             IF BINARY_STORM= 0 THEN
STORM_DAYS=0;


            If Holiday_Week = 'NA' THEN
B_HOLIDAY_WEEK=0;
```

```
               ELSE
B_HOLIDAY_WEEK=1;


             If HolidayNAME = 'NA' THEN
B_HOLIDAY_NAME=0;

               ELSE
B_HOLIDAY_NAME=1;


           IF DAYLIGHT_SAVINGS_TIME=0 THEN
SUNRISE_MIN=STANDARD_SUNRISE/60;

               ELSE IF DAYLIGHT_SAVINGS_TIME=1
THEN          SUNRISE_MIN=(STANDARD_SUNRISE/60)+60;

      IF DAYLIGHT_SAVINGS_TIME=0 THEN
SUNSET_MIN=STANDARD_SUNSET/60;

               ELSE IF DAYLIGHT_SAVINGS_TIME=1 THEN
SUNSET_MIN=(STANDARD_SUNSET/60)+60;
run;
*******************Crime Data Set******************;
*Create Crime Ratio variable;
data big_cr;
     set BIG;
    IF Total_pop NE 0 THEN
CRIME_RATIO=NUMERIC_RESPONSE/Total_pop*100;

     ELSE CRIME_RATIO=0;
    IF Total_pop NE 0 THEN
ASSAULT_CRIME_RATIO=ASSAULT/Total_pop*100;

     ELSE ASSAULT_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
AUTO_THEFT_CRIME_RATIO=AUTO_THEFT/Total_pop*100;


     ELSE AUTO_THEFT_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
BURGLARY_CRIME_RATIO=BURGLARY/Total_pop*100;

     ELSE BURGLARY_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
HOMICIDE_CRIME_RATIO=HOMICIDE/Total_pop*100;


     ELSE HOMICIDE_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
LARCENY_CRIME_RATIO=LARCENY/Total_pop*100;


     ELSE LARCENY_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
ROBBERY_CRIME_RATIO=ROBBERY/Total_pop*100;


     ELSE ROBBERY_CRIME_RATIO=0;
     IF Total_pop NE 0 THEN
SEXUAL_ASS_CRIME_RATIO=SEXUAL_ASS/Total_pop*100;



     ELSE SEXUAL_ASS_CRIME_RATIO=0;
run;






*Below creates a datetime formatted variable accounting for the length of
time between crime to storm start time and storm end time;

data TIMES ;
set big_cr;
    crime_time=catx(':',put(hour,z2.),'00');
    /*convert hour to time of crime by adding 0's for mins/secs and
converting to time8 format */
    crime_time=catx(':',crime_time,'00');
    crime_time=input(crime_time,time8.);/* create crime time and format it to
datetime */
    crime_timedate=dhms(date,0,0,crime_time);
    format crime_timedate datetime13.;
    if begin_time<1000 then do;
    begin_time2=put(begin_time,z3.);/* convert to char */
    begin_hour=substr(begin_time2,1,1);/* get hour*/
    begin_minutes=substr(begin_time2,2,2);/*get mins */
    t=catx('',begin_hour,begin_minutes);/*mins and secs together */
    t1=input(t,time8.); /* convert to time */
    storm_start=dhms(date,0,0,t1); /* convert to datetime */
    format storm_start datetime13.;
    end;
    if begin_time>=1000 then do;
    begin_time3=put(begin_time,z4.);
    begin_hour=substr(begin_time3,1,2);/* get hour*/
    begin_minutes=substr(begin_time3,3,2);/*get mins */
    t=catx('',begin_hour,begin_minutes);
    t1=input(t,time8.);
    storm_start=dhms(date,0,0,t1);
    format storm_start datetime13.;
    end;
    if end_time<1000 then do;
    end_time2=put(end_time,z3.);
    end_hour=substr(end_time2,1,1);
    end_minutes=substr(end_time2,2,2);
    t=catx('',end_hour,end_minutes);
    t1=input(t,time8.);
    storm_end=dhms(date,0,0,t1);
    format storm_end datetime13.;
    end;
    if end_time>=1000 then do;
    end_time3=put(end_time,z4.);
    end_hour=substr(end_time3,1,2);
    end_minutes=substr(end_time3,3,2);
    t=catx('',end_hour,end_minutes);
    t1=input(t,time8.);
    storm_end=dhms(date,0,0,t1);
    format storm_end datetime13.;
    end;

     if  binary_storm = 1 then S_end= storm_end;
     retain s_end;


run;
data TIME_STORMS (drop=s_end end_time3 end_minutes end_hour end_time2 x);
     set TIMES;
     if binary_response= 1 then x=s_end;
     else x= .;
     if crime_timedate-x > 1209600 theN X =.;
     time_since_last_Storm= crime_timedate-x;
      IF TIME_SINCE_LAST_STORM=. AND BINARY_RESPONSE= 1 THEN
TIME_SINCE_LAST_STORM=1209601;
      IF TIME_SINCE_LAST_STORM < 0 AND TIME_SINCE_LAST_STORM NE . THEN
TIME_SINCE_LAST_STORM=0;
     IF BINARY_STORM=1 AND BINARY_RESPONSE= 1 THEN TIME_SINCE_LAST_STORM=0.1;
run;
data TIME_STORMS2;
     set TIME_STORMS (drop=t begin_time3 begin_hour begin_minutes begin_time2
t1);
     if binary_Storm=0 then storm_start=.;
     if binary_Storm=0 then storm_end=.;
          time_until_storm_ends=storm_end-crime_timedate;
       time_since_storm_started=crime_timedate-storm_start;
           IF time_until_storm_ends=0 THEN time_until_storm_ends=0.1;
           IF time_until_storm_ends =. THEN time_until_storm_ends=0;
           IF time_since_storm_started=0 THEN time_since_storm_started=0.1;
           IF time_since_storm_started=. THEN time_since_storm_started=0;
run;

*Creates permanent datasets (Tali & Tali_Crimes);
DATA DATMIN.TALI;
     SET TIME_STORMS2;
RUN;
```

```
data DATMIN.TALI_CRIMES;
     set TIME_STORMS2;
     if binary_response=1;
run;
*Create Data set with averages and sum by month or year;
data DATMIN.TALI;
     set TIME_STORMS2 (drop=i);
run;

proc sql;
     create table average_sum as
     select sum(school_day), tract_id, city, month(date) as month, year(date)
as year, mean(average_temp) as avg_average_temp, mean(cloud_cover) as
avg_Cloud_cover,
     mean(daylight_hours_after_noon) as avg_daylight_hours_after_noon,
mean(pressure) as avg_pressure, sum(assault) as sum_assault,
     sum(Auto_theft) as sum_auto_theft, sum(burglary) as sum_burglary,
sum(homicide) as sum_Homicide, sum(larceny) as sum_larceny,
     sum(Robbery) as sum_robbery, sum(sexual_ass) as sum_sexual_ass,
sum(Numeric_response) as Sum_crimes, mean(precipitation) as
     avg_precipitation, MEAN(SUNRISE_MIN) as sunrise, mean(SUNSET_MIN) as
sunset, sum(precipitation) as sum_precipitation, mean(temp_high_F) as
avg_temp_high_F,
     mean(temp_low_F) as avg_temp_low_F, sum(school_day) as sum_school_day,
sum(full_moon) as sum_Full_moon,
     sum(full_moon_group) as sum_full_moon_group, mean(standard_sunrise) as
avg_Standard_sunrise, mean(standard_sunset) as
     avg_Standard_sunset,sum(binary_storm) as
sum_binary_storm,mean(crime_ratio) as avg_crime_ratio,sum(minorsfemale) as
fem_Minors, sum(young_adultsfemale) as Fem_YoungAdults, sum(adultsfemale) as
     Fem_Adults, sum(older_adultsfemale) as older_Fem_Adults,
sum(middle_agedfemale) as fem_MiddleAged, sum(seniorsfemale) as
     Fem_Seniors, sum(super_seniorsfemale) as Fem_SuperSeniors,
sum(minorsmale) as Male_Minors, Sum(young_adultsmale) as
     Male_YoungAdults, sum(adultsmale) as Male_OlderYoungAdults,
sum(adultsmale) as Male_Adults,
     sum(middle_agedmale) as Male_MiddleAged, sum(seniorsmale) as
Male_Seniors, sum(super_seniorsmale) as Male_SuperSeniors,
     mean(unemplyment_rate) as avg_Unemployment_rate, mean(normalincome) as
Avg_NormalIncome, avg(dropoutrate) as avg_dropoutrate,sum(tract_area) as
city_tract_area ,
     mean(pct_below_poverty) as avg_pct_below_poverty, sum(fem_total) as
Femal_total, sum(male_total) as c_male_total, sum(Total_pop) as city_pop,
sum(adults_total)as adult_total,
       sum(middle_aged_total) as total_middle_aged, sum(minors_total) as
total_minors, sum(older_adults_TOTAL) as total_older_adults,
sum(SENIORS_TOTAL) as total_seniors,
     sum(super_seniors_TOTAL) as total_super_seniors, sum(young_adults_TOTAL)
as total_young_adults
     from datmin.final_alls
     group by tract_id, year, month;
quit;
data average_sum2;
     set average_sum;
    BY TRACT_ID YEAR MONTH;
    if last.month;
```

```
     if avg_average_temp> 65 then Heating=0;
     else if avg_average_temp < 65 then Heating= 65-avg_average_temp;
     if avg_average_temp < 65 then cooling=0;
     else if avg_average_temp > 65 then cooling= avg_average_temp-65;
     format avg_daylight_hours_after_noon time8. avg_standard_sunrise time8. 
avg_standard_sunset time8.;
run;

data city_popdens;
set AVERAGE_SUM2;
     array population {24} fem_Minors Fem_YoungAdults
                 Fem_Adults older_Fem_Adults fem_MiddleAged Fem_Seniors 
Fem_SuperSeniors Male_Minors Male_YoungAdults Male_OlderYoungAdults 
Male_Adults
                 Male_MiddleAged Male_Seniors Male_SuperSeniors Femal_total 
c_male_total city_pop adult_total total_middle_aged total_minors 
total_older_adults
                 total_seniors total_super_seniors total_young_adults;
     array popdense{24} popdense_fem_Minors popdense_Fem_YoungAdults
                 popdense_Fem_Adults popdense_older_Fem_Adults 
popdense_fem_MiddleAged popdense_Fem_Seniors popdense_Fem_SuperSeniors 
popdense_Male_Minors popdense_Male_YoungAdults popdense_Male_OlderYoungAdults 
popdense_Male_Adults
                 popdense_Male_MiddleAged popdense_Male_Seniors 
popdense_Male_SuperSeniors popdense_Femal_total popdense_c_male_total 
popdense_city_pop popdense_adult_total popdense_total_middle_aged 
popdense_total_minors popdense_total_older_adults
                 popdense_total_seniors popdense_total_super_seniors 
popdense_total_young_adults;
           do i = 1 to 24;
     popdense{i}=population{i}/city_tract_area;
end;
run;
*Creates permenent dataset (Month_TRACT_ID_crime);
data datmin.Month_TRACT_ID_crime;
     set city_popdens;
run;
```