

```
In [1]: import agate
import os, csv, re
```

## Temperature and crime

Using weather data and crime data, can we find out whether there has historically been more crime on warmer days in St. Louis?

We will load and filter crime data, load and filter weather data, put them together and generate a chart.

### Load the crime data

I've previously downloaded monthly crime reports from the St. Louis Metropolitan Police Department website. I've trimmed them by crime code to just the ones we're interested in: UCR codes 10000 to 40000. Then I exported those into a .csv file.

Here we're going to load them into a table in a data analysis library called agate.

```
In [2]: violent_crimes = agate.Table.from_csv('violent_crimes.csv')
```

Let's take a look at the table, ordered by date.

```
In [3]: violent_crimes.order_by('Date', reverse=True).print_table()

print('\nThere are {:,} crimes in the dataset.'.format(violent_crimes.aggregate(
    agate.Sum('Count'))))
```

Date	Count	Crime	Description
-----	----	-----	-----
2018-04-30 22:26:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-30 22:26:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-30 22:26:00	1	41,021	AGG.ASSAULT-FIREA...
2018-04-30 22:26:00	1	41,021	AGG.ASSAULT-FIREA...
2018-04-30 22:26:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-30 20:33:00	1	38,411	ROBBERY CARJACKIN...
2018-04-30 16:50:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-30 16:00:00	1	41,021	AGG.ASSAULT-FIREA...
2018-04-30 16:00:00	1	41,021	AGG.ASSAULT-FIREA...
2018-04-30 15:22:00	1	36,211	ROBBERY-COMMERCE ...
2018-04-30 14:14:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-30 12:41:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-29 23:41:00	1	31,112	ROBBERY-HIGHWAY ...
2018-04-29 21:00:00	1	21,000	RAPE -- FORCIBLE
2018-04-29 21:00:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-29 20:30:00	1	32,111	ROBBERY-RESIDENCE...
2018-04-29 20:00:00	1	10,000	HOMICIDE
2018-04-29 19:55:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-29 19:55:00	1	41,011	AGG.ASSAULT-FIREA...
2018-04-29 19:33:00	1	41,011	AGG.ASSAULT-FIREA...
...	...	...	...

There are 62,493 crimes in the dataset.

We can see a couple interesting things here. One, there are dates from well before 2008, when the first files are from. This is because people have reported crimes that occurred in the past. Second, we can see that the "Count" column sometimes includes negative numbers. This is because sometimes reports are discovered to be unfounded or are re-classified.

We've summed the "Count" column to get the total number of crimes in the entire set: 62,493.

In this analysis we're only interested in the date when the crime happened, not the time. So we'll create a new column with just the date.

```
In [4]: dates = violent_crimes.compute([
    ('just_date', agate.Formula(agate.Date(), lambda row: row['Date'].date()))
])

dates.print_table()
```

Date	Count	Crime	Description	just_date
-----	----	-----	-----	-----
2018-01-14 20:00:00	-1	31,111	ROBBERY-HIGHWAY ...	2018-01-14
2018-02-11 17:00:00	1	21,000	RAPE -- FORCIBLE	2018-02-11
2018-03-04 20:00:00	-1	43,015	ASSLT-AGGRAV-OTH-...	2018-03-04
2018-03-10 22:00:00	1	21,000	RAPE -- FORCIBLE	2018-03-10
2018-03-12 12:40:00	1	38,421	ROBBERY CARJACKIN...	2018-03-12
2018-03-12 17:00:00	1	44,023	AGG.ASSAULT-HNDS,...	2018-03-12
2018-03-14 10:57:00	1	41,015	ASSLT-AGGRAV-FIRE...	2018-03-14
2018-03-15 21:30:00	1	38,311	ROBBERY CARJACKIN...	2018-03-15
2018-03-16 17:00:00	-1	31,112	ROBBERY-HIGHWAY ...	2018-03-16
2018-03-17 01:00:00	1	23,000	RAPE-ATTEMPT FORC...	2018-03-17
2018-03-17 23:00:00	1	10,000	HOMICIDE	2018-03-17
2018-03-19 03:50:00	-1	41,011	AGG.ASSAULT-FIREA...	2018-03-19
2018-03-21 20:00:00	1	44,026	ASLT-AGGRV-HND/FS...	2018-03-21
2018-03-23 12:00:00	1	43,015	ASSLT-AGGRAV-OTH-...	2018-03-23
2018-03-24 13:00:00	1	32,421	ROBBERY-RESIDENCE...	2018-03-24
2018-03-24 14:00:00	1	31,421	ROBBERY-HIGHWAY ...	2018-03-24
2018-03-24 21:40:00	1	41,014	ASSLT-AGGRAV-FIRE...	2018-03-24
2018-03-25 08:00:00	1	21,000	RAPE -- FORCIBLE	2018-03-25
2018-03-26 19:54:00	1	23,000	RAPE-ATTEMPT FORC...	2018-03-26
2018-03-28 18:15:00	1	10,000	HOMICIDE	2018-03-28
...	...	...	...	...

And now we'll group the table by dates and add up the "Count" of all crimes on that date to get the total of how many crimes were reported that day. This is similar to running a PivotTable in Microsoft Excel.

```
In [5]: by_date = dates.group_by("just_date")

counts_by_date = by_date.aggregate([
    ('Count', agate.Sum('Count')),
])

counts_by_date.order_by('just_date').print_table()
```

just_date	Count
-----	-----
1900-01-01	1
1967-06-21	1
1971-05-01	1
1973-07-01	1
1974-04-08	1
1976-05-06	1
1976-08-01	1
1977-01-01	1
1977-08-14	1
1980-10-21	1
1981-09-12	0
1982-12-15	1
1983-10-01	1
1984-01-01	1
1984-02-07	1
1984-07-01	2
1985-12-01	1
1988-07-16	0
1988-09-19	1
1989-09-26	1
...	...

Finally, let's trim the table to just the dates we're interested in: those after 2008.

```
In [6]: current_counts = counts_by_date.where(lambda row: row['just_date'].year >= 2008)

current_counts.order_by("just_date").print_table()

print('\nThere are {:,} crimes on {:,} different dates, an average of {:,} per day.'.format(
    current_counts.aggregate(agate.Sum('Count')),
    len(current_counts.rows),
    round(current_counts.aggregate(agate.Sum('Count')) / len(counts_by_date.rows), 1),
))
```

just_date	Count
-----	-----
2008-01-01	33
2008-01-02	6
2008-01-03	12
2008-01-04	18
2008-01-05	15
2008-01-06	14
2008-01-07	21
2008-01-08	14
2008-01-09	18
2008-01-10	9
2008-01-11	8
2008-01-12	33
2008-01-13	20
2008-01-14	14
2008-01-15	14
2008-01-16	24
2008-01-17	14
2008-01-18	16
2008-01-19	17
2008-01-20	17
...	...

There are 62,232 crimes on 3,766 different dates, an average of 15.6 per day.

## Load the weather data

The NOAA only outputs files in 10-year chunks and we have slightly more than that. We need to load, trim and merge two files.

```
In [7]: weather_1 = agate.Table.from_csv('lambert_1.csv')

weather_trim_1 = weather_1.select(['DATE', 'TMAX'])

weather_2 = agate.Table.from_csv('lambert_2.csv')

weather_trim_2 = weather_2.select(['DATE', 'TMAX'])

weather = weather_trim_1.merge([weather_trim_1, weather_trim_2])

weather.print_table()

print('\nThere are {:,} observations'.format(
    len(weather.rows))
)
```

DATE	TMAX
-----	----
2008-01-01	29
2008-01-02	23
2008-01-03	34
2008-01-04	45
2008-01-05	58
2008-01-06	73
2008-01-07	73
2008-01-08	66
2008-01-09	45
2008-01-10	46
2008-01-11	44
2008-01-12	54
2008-01-13	35
2008-01-14	36
2008-01-15	36
2008-01-16	46
2008-01-17	39
2008-01-18	43
2008-01-19	19
2008-01-20	22
...	...

There are 3,773 observations

## Join the tables

Next we're going to combine the two tables, joining on the date column.

```
In [8]: joined = counts_by_date.join(weather, 'just_date', 'DATE')

joined.print_table()

print('\nThere are {:,} observations'.format(
    len(joined.rows))
)
```

just_date	Count	TMAX
-----	-----	----
2018-01-14	28	27
2018-02-11	7	26
2018-03-04	-1	60
2018-03-10	15	53
2018-03-12	6	47
2018-03-14	1	57
2018-03-15	1	69
2018-03-16	-1	50
2018-03-17	2	48
2018-03-19	-1	48
2018-03-21	3	51
2018-03-23	3	52
2018-03-24	6	43
2018-03-25	4	50
2018-03-26	1	55
2018-03-28	0	50
2018-03-29	2	49
2018-03-30	1	57
2015-04-01	16	78
2017-04-01	18	60
...	...	...

There are 4,000 observations

## Create the groupings by temperature

Here's where things get interesting. We want to group by the temperature, so we can see how many crimes were reported on 60-degree days, 61-degree days and so on. We also want to see whether these numbers differ by season.

We're creating two separate tables grouped by temperature — one using the full year and one just March through August. Next we're calculating the average number of crimes reported per day on each temperature, how many total crimes were reported on days with each temperature and how many days had highs of that temperature. Then we're joining those tables back together.

```

In [9]: # Create the grouped table of all dates
all_by_tmax = joined.group_by('TMAX')

# Create the grouped table of only Spring/Summer dates
ss_by_tmax = joined.where(lambda row: row['just_date'].month in [3,4,5,6,7,8])
                .group_by('TMAX')

# Calculate the new fields for each table
avg_by_tmax = all_by_tmax.aggregate([
    ('avg', agate.Mean('Count')),
    ('crime_count', agate.Sum('Count')),
    ('day_count', agate.Count())
])

ss_avg_by_tmax = ss_by_tmax.aggregate([
    ('ss_avg', agate.Mean('Count')),
    ('ss_crime_count', agate.Sum('Count')),
    ('ss_day_count', agate.Count())
])

# Join the two tables back together again
crimes_by_temp = avg_by_tmax.join(ss_avg_by_tmax, 'TMAX').rename(column_names =
{'TMAX': 'tmax'}).where(lambda row: row['tmax'] is not None)

crimes_by_temp.order_by('tmax', reverse=True).print_table(max_columns=None)

print("\nThere are {:,} different temperatures accounted for. There are {:,} total crimes, {:,} ({:.1%} of the total) in the spring/summer months.\n
      \nThere are {:,} total days, {:,} of them in the spring/summer.".format(
    len(crimes_by_temp.rows),
    crimes_by_temp.aggregate(agate.Sum('crime_count')),
    crimes_by_temp.aggregate(agate.Sum('ss_crime_count')),
    crimes_by_temp.aggregate(agate.Sum('ss_crime_count')) / crimes_by_temp.aggregate(agate.Sum('crime_count')),
    crimes_by_temp.aggregate(agate.Sum('day_count')),
    crimes_by_temp.aggregate(agate.Sum('ss_day_count')),
    )
)

```



	tmax	avg	crime_count	day_count	ss_avg	ss_crime_count	ss_da
y_count							
	108	20.000...	60	3	20.000...	60	
3	107	14.500...	29	2	14.500...	29	
2	106	18.750...	75	4	18.750...	75	
4	105	17.333...	52	3	17.333...	52	
3	104	14.333...	43	3	13.500...	27	
2	103	16.667...	100	6	16.667...	100	
6	102	16.571...	116	7	16.571...	116	
7	101	17.222...	155	9	18.286...	128	
7	100	14.533...	218	15	14.533...	218	
15	99	21.625...	346	16	21.733...	326	
15	98	16.963...	458	27	17.160...	429	
25	97	18.077...	470	26	18.391...	423	
23	96	19.324...	657	34	18.968...	588	
31	95	16.730...	619	37	16.382...	557	
34	94	18.898...	926	49	18.841...	829	
44	93	18.826...	1,299	69	19.302...	1,216	
63	92	17.614...	1,233	70	17.508...	1,033	
59	91	17.833...	1,177	66	17.737...	1,011	
57	90	20.224...	1,355	67	19.729...	1,164	
59	89	18.742...	1,162	62	18.962...	986	
52	...	...	...	...	...	...	
...							

There are 100 different temperatures accounted for. There are 62,232 total crimes, 33,460 (53.8% of the total) in the spring/summer months. There are 3,766 total days, 1,894 of them in the spring/summer.

Next we can create a scatterplot to look at the average number of crimes reported in the spring and summer, by temperature.

```
In [10]: crimes_by_temp.scatterplot('tmax', 'ss_avg')
```

```
Out[10]:
```

