Lab 1
Markov Chains for Targeting

Use Excel to answer the following questions. The original data tables need to be included on your first worksheet, and all tables should be formatted for ease of reading. You can answer each question on a separate worksheet, but more credit will be given for more compact tools (i.e., one table of answers, and you modify the data for each question.)

Scenario: U.S. Intelligence has learned that a large number of ISIS fighters are moving from the border of Iraq (represented by camp 0) through a series of camps to a staging camp in Syria (represented by camp 7) in preparation for a planned offensive. Each camp along the route is a day's travel and brings the fighters closer to camp 7. Additionally, some fighters remain in the same camp or discontinue the journey each day. The intelligence provided in Table 1 is two weeks old; assume steady state is now reached. Intelligence updates are cumulative.

a) Create an (estimated!) transition matrix based on the daily movement of ISIS fighters, where location 0 represents a source for new fighters and a sink for attrition.

\To From	0	1	2	3	4	5	6	7
0	0	1840	0	0	0	0	0	0
1	150	400	1015	0	0	0	0	0
2	318	0	110	1913	0	0	0	0
3	534	0	0	472	1252	0	0	0
4	186	0	0	0	263	414	0	0
5	163	0	0	0	0	456	254	0
6	83	0	0	0	0	0	88	212
7	42	0	0	0	0	0	0	412

Table 1: Number of ISIS forces moving daily from location i to location j

b) Use worksheet (array) formulas to calculate the steady-state number of ISIS fighters.

c) Intelligence has provided an update, the original transition probability for p_{33} should have been 0.20. Alter your transition matrix to account for this change and assume that the other, unaccounted-for fighters in camp 3 attrite (Hint: you still need this row to sum to 1). What is the new steady state population vector?

d) Intelligence provides another update that the original retention rate of ISIS fighters in camp 1 should be increased by 10% and assume that increase is taken from the population of fighters moving on to camp 2. How would you reflect this in your transition matrix? What are the new steady-state populations?

e) Intelligence provides yet another update, ISIS made the decision two weeks ago to reduce the percentage of fighters moving from camp 5 to camp 6 by 33%. Assume remaining fighters stay in camp 5 and don't add to attrition. How would you reflect this in your transition matrix? What are the new steady-state populations?

f) The coalition plans to execute a missile strike on one camp. Assume targeting the camp with the highest population of ISIS fighters will do the most damage to their cause. Which camp do you recommend targeting?