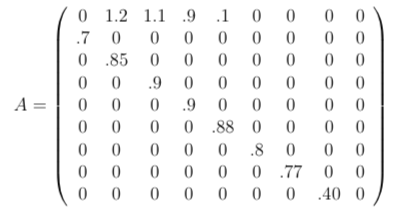
Part 3 Discussion:

Given Leslie Matirx A:



1) Interpret the data in the matrix, and discuss the social factors that influence those numbers.

As the age group increases, the sx (the fraction of individual that survives from age class x to age class x+1 (basically from one age class to the next age class)), decreases. This is because as age grows, people are more likely to pass away, making the survival rate much lower at age groups like 70-80, and 0 at the group 80-90. Likewise, fx, (the fecundity, or the per capita average number of female offspring reaching n1 (2.1x105 people) born from mother of age class x) also decreases. Clearly, in the age group 0-9, the fecundity (fx), is 0 since it is pretty much impossible for girls that age to even give birth. At age group 10-19 it is the highest because around the age of 18 and 19, women can easily give birth. Now as age increases, the fecundity decreases since older women cannot give birth that much. In the age group 20-29 the fecundity is very close to the fecundity of the age group before (10-19), since most women give birth in that age group before they reach their late twenties, but in the next two age groups (30-39 and 40-49), the fecundity drops to 0.9 and then sharply to 0.1 since almost no women give birth in their forties. As age increases, the harder it is for womens’ bodies to give birth, which is why the fecundity keeps decreasing and finally hits zero in the age group 50-60. The fraction of individuals that survive in a certain age group (sx ) decreases as the age group increases, and fecundity (per capita average number of female offsprings reaching n1 (2.1x105 people) born from mother of age class x) also decreases; therefore, sx and fecundity (fx) are directly proportional to each other.

2) What will the population distribution be in 2010? 2020? 2030? 2040? 2050? Calculate also the total population in those years, and by what fraction the total population changed each year.

2000

**Population Distribution:**

x 105

**Total Population:** 14.2 x 105 people

2010

**Population Distribution:**

x 105

**Total Population:** 17.349 x 105 people

**Fraction the total population changed by last year:**

= = 22.1761%

2020

**Population Distribution:**

x 105

**Total Population:** 18.283 x 105 people

**Fraction the total population changed by last year:**

= = 5.3836%

2030

**Population Distribution:**

x 105

**Total Population:**  22.1212 x 105 people

**Fraction the total population changed by last year:**

= = 20.9933%

2040

Population Distribution:

x 105

**Total Population:** 26.5051 x 105

**Fraction the total population changed by last year:**

= = 19.8176%

2050

**Population Distribution:**

x 105

**Total Population:** 33.8797 x 105

**Fraction the total population changed by last year:**

= = 27.8233%

3) Use the power method to calculate the largest eigenvalue of the Leslie matrix A. The iteration of the power method should stop when you get 8 digits of accuracy. What does this tell you? Will the population go to zero, become stable, or be unstable in the long run? Discuss carefully and provide the mathematical arguments for your conclusion. You might want to investigate the convergence of ||Ak||.

**max eigenvalue:** 1.2886562376686987

Since the maximum eigenvalue is greater than one, the population will become stable and slowly increase.

4) Suppose we are able to decrease the birth rate of the second age group by half in 2020. What are the predictions for 2030, 2040 and 2050? Calculate again the largest eigenvalue of A (to 8 digits of accuracy) with your program and discuss its meaning regarding the population in the long run.

**Max eigenvalue:** 1.1679027234002055

The age groups don’t really change. The number of young people and old people will stay the same relative to each other, but the population of the groups will increase by

**2030 new result:** **A’u\_2020**, where A’: A with decreased birth rate of second age group by half and u\_2020: Previous vector of results for 2020 from question #2

x 105 **Total Population:** 19.456 x 105

**2040 new result**: **A’u\_2030**, where A’: A with decreased birth rate of second age group by half and u\_2030: New vector of results for 2030 from question #4 (this question), which was calculated just above.

x 105 **Total Population:** 22.461 x 105

**2050 new result:** **A’u\_2040**, where A’: A with decreased birth rate of second age group by half and u\_2040: New vector of results for 2040 from question #4 (this question), which was calculated just above.

x 105 **Total Population:** 26.221 x 105