Ahern-Dissertation-AppendixD

November 22, 2015

1 Moran model

In [3]:
```
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

In [69]:
```
def flip(n, k, s, u):
    """Flip a three sided coin to determine movement"""
    # Probabilities of moving up or down
    p_down = (n-k)*k/(n*((1+s)*k + n - k))
    p_up = (1+s)*k*(n-k)/(n*((1+s)*k + n - k))
    #
    if u < p_down: # p_down
        return -1
    elif u < p_down + p_up: # p_up
        return 1
    else:
        return 0

 def moran(n, k0, t, s):
    # Create vector to store population counts
    pop = np.empty(t)
    pop[0] = k0
    # Sample random uniform variable
    flips = np.random.rand(t,)
    #
    for i in range(1,t):
        pop[i] = pop[i-1] + flip(n, pop[i-1], s, flips[i,])

    return pop
```

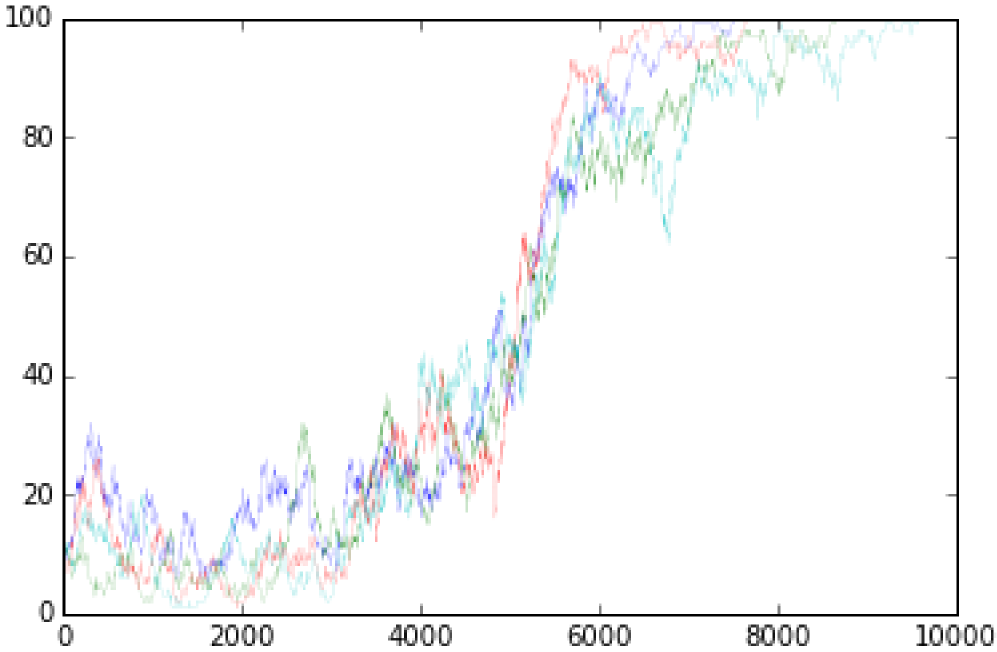
In [8]:
```
# Population size
N = 100
# Number of individuals replaced
t = 10000
```

1.1 Drift that looks like selection

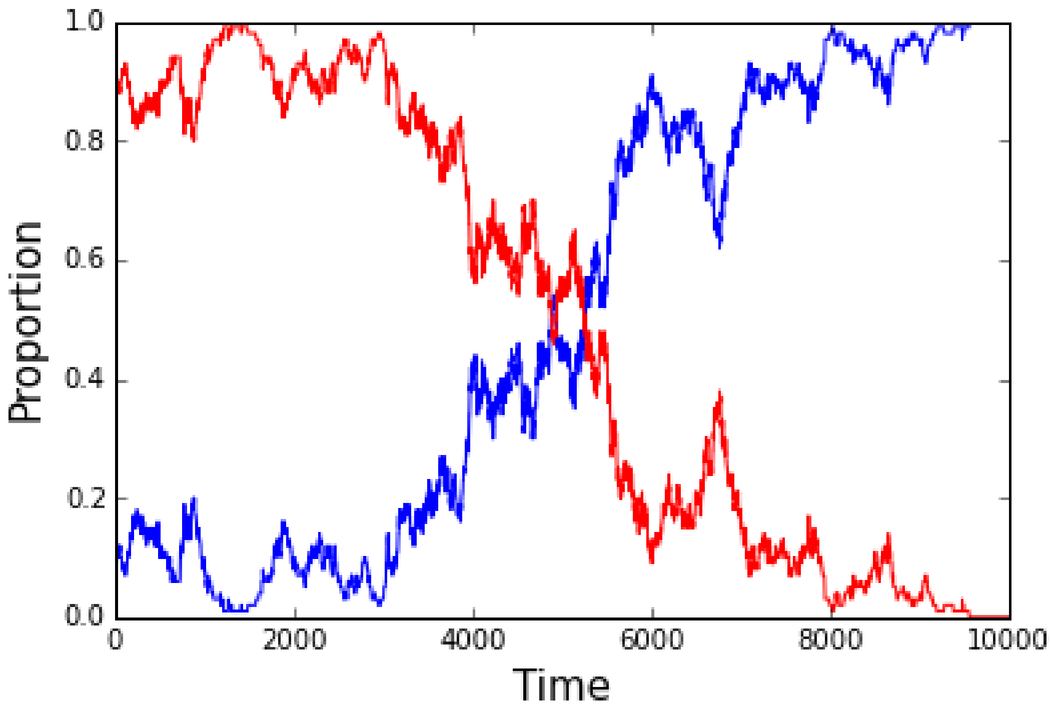
In [4]:
```
drift = []
for i in range(100000):
    np.random.seed(i)
    test = moran(N, 10, 10000, 0)
    if test[-1] > .95*N and test[t/2] < .5*N and test[t/4] < test[t/2] and test[3*t/4] > test[t
        drift.append(i)
```

```
In [44]: interesting_drift = [8190, 13610, 13034, 20241, 30009, 30071, 40691, 44753, 46069, 46526, 4652
                              46695, 46843, 46888, 49371, 49852, 56414, 61232, 61595, 62961, 64616, 6484
                               65491, 68332, 71765, 80327, 81877, 83354, 83388, 88942, 92106, 94190, 959
                              97710, 99917]
```

```
In [49]: for i in [64844, 81877, 94190, 99917]:
             np.random.seed(i)
             test = moran(N, 10, t, 0)
             plt.plot(test, linewidth=.1)
             plt.ylim(0,100)
         plt.show()
```

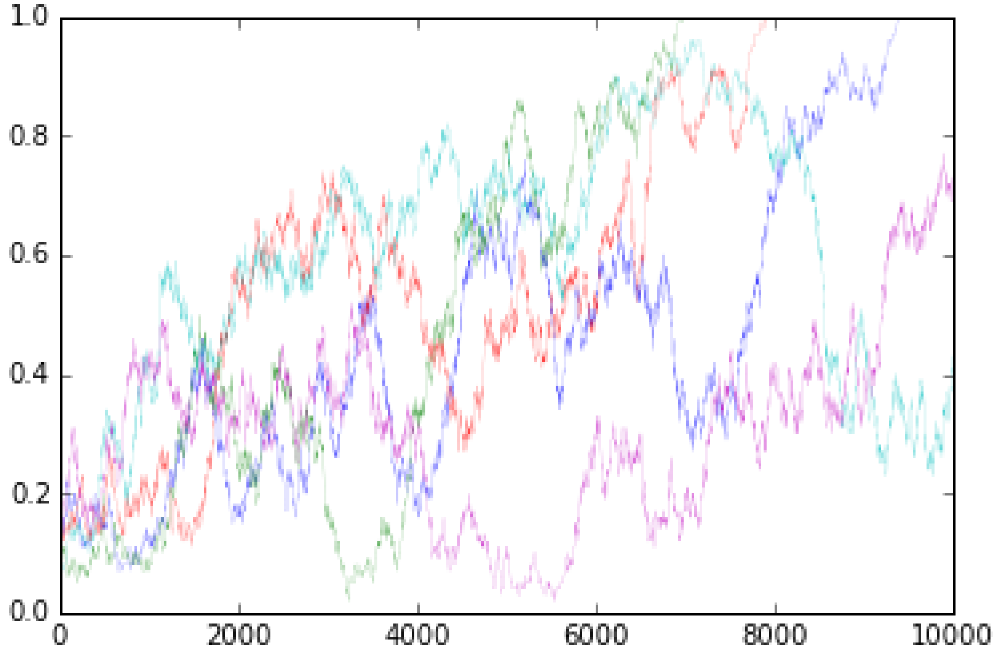



```
In [63]: np.random.seed(99917)
         test = moran(N, 10, t, 0)/float(N)
         plt.plot(test, 'b')
         plt.plot(1 - test, 'r')
         plt.xlabel('Time', fontsize=15)
         plt.ylabel('Proportion', fontsize=15)
         plt.savefig("drift-selection.png", format='png', dpi=600)
         plt.ylim(0,1)
         plt.show()
```

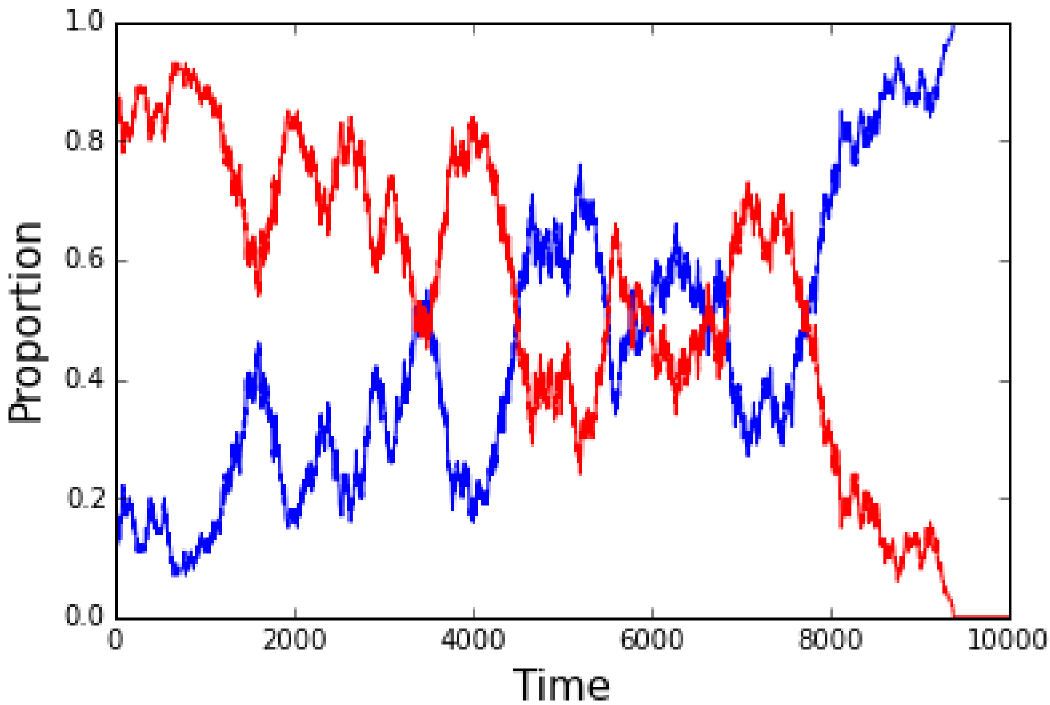


1.2 Selection that looks like drift

```
In [93]: for i in [9, 10,  28, 57, 89]:
             np.random.seed(i)
             test = moran(N, 10, t, .1)/float(N)
             plt.plot(test, linewidth=.1)
         plt.ylim(0,1)
         plt.show()
```




```
In [97]: np.random.seed(9)
         test = moran(N, 10, t, .1)/float(N)
         plt.plot(test, 'b')
         plt.plot(1 - test, 'r')
         plt.ylim(0,1)
         plt.xlabel('Time', fontsize=15)
         plt.ylabel('Proportion', fontsize=15)
         plt.savefig("selection-drift.png", format='png', dpi=600)
         plt.show()
```

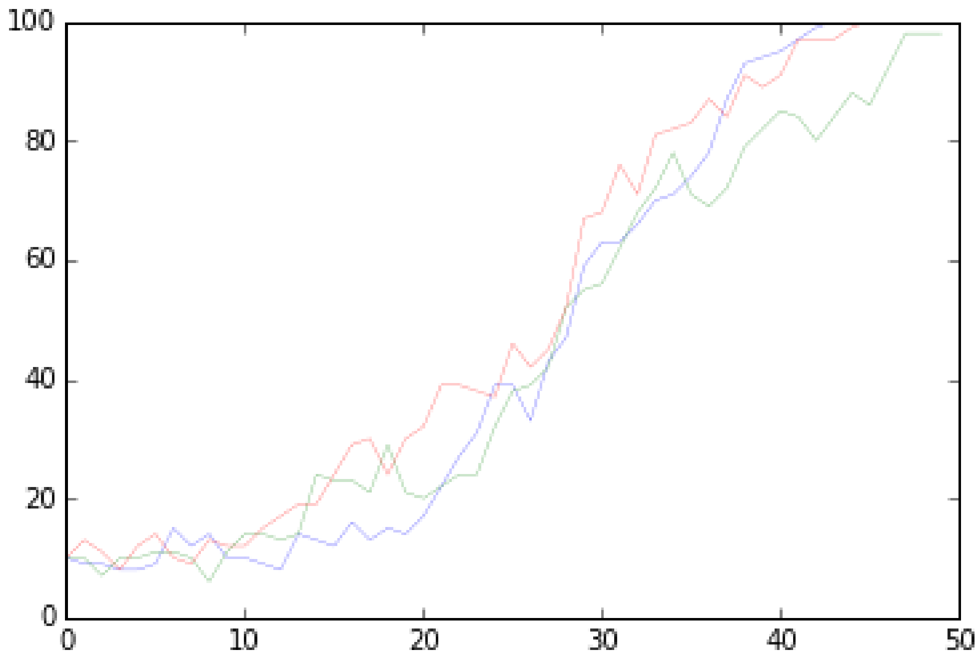


2 Wright-Fisher model

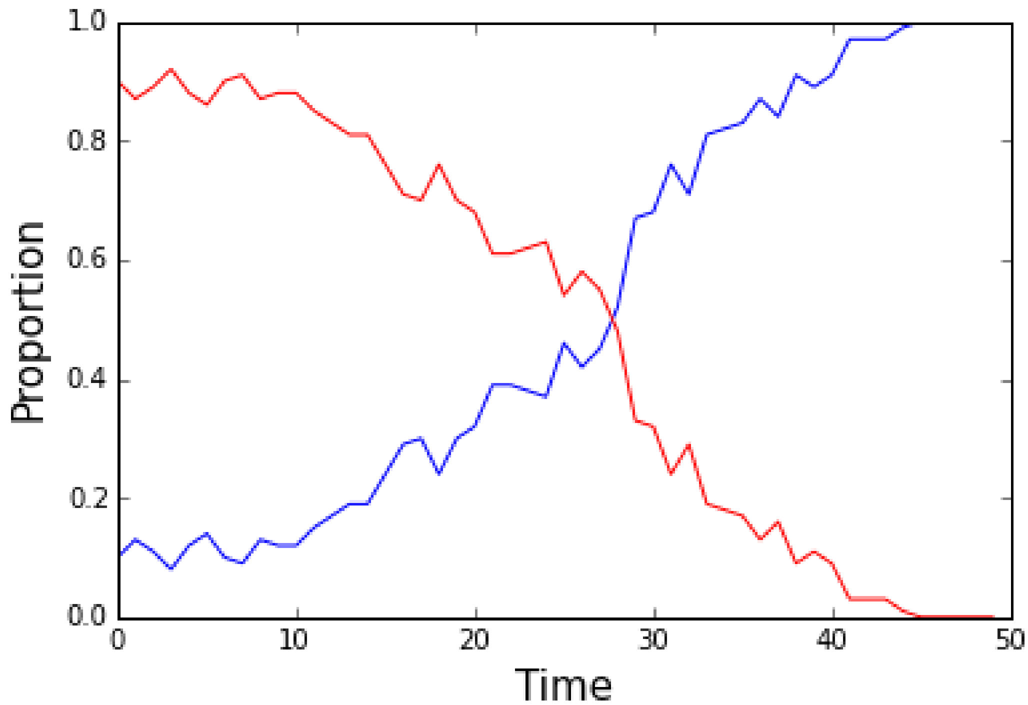
In [75]:
```
def wright_fisher(n, k0, t, s):
    population = np.empty(t)
    population[0] = k0
    for i in range(1,t):
        k = population[i-1]
        prob = k*(1+s)/(k*(1+s) + (n-k))
        population[i] = np.random.binomial(n, prob)
    return population
```

In [30]:
```
drift = []

for i in range(100000):
    np.random.seed(i)
    test = wright_fisher(N, 10, 50, 0)
    if test[-1] > .95*N and test[24] < .5*N and test[12] < test[24] and test[36] > test[24]:
        drift.append(i)
```

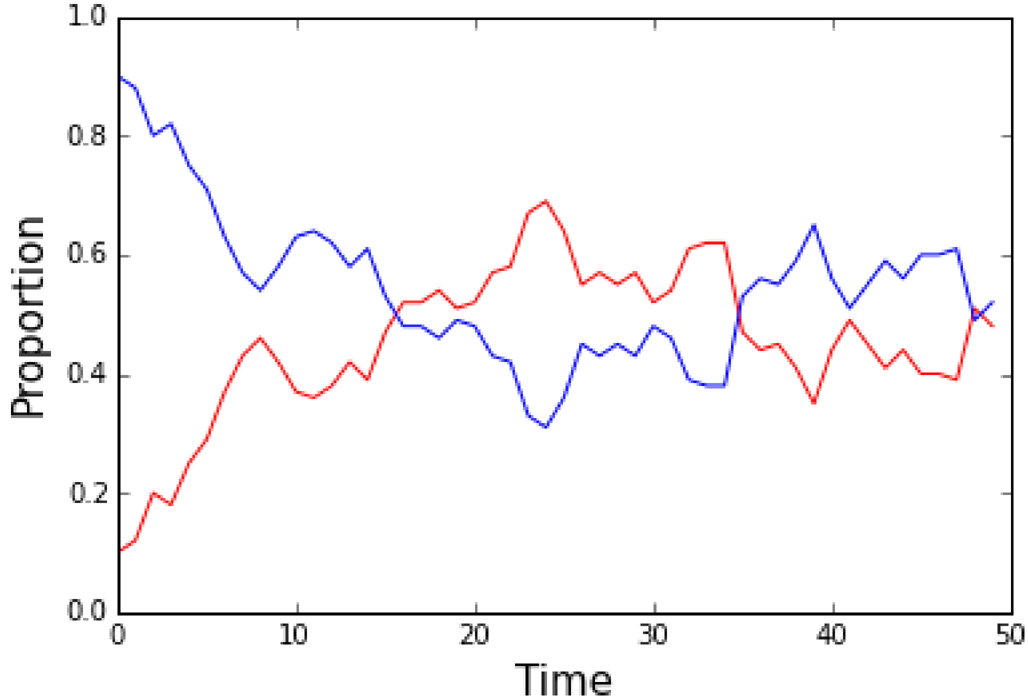
In [83]:
```
for i in [14881, 37182, 86336]:
    np.random.seed(i)
    test = wright_fisher(100, 10, 50, 0)
    plt.plot(test, linewidth=.2)
    plt.ylim(0,100)
plt.show()
```



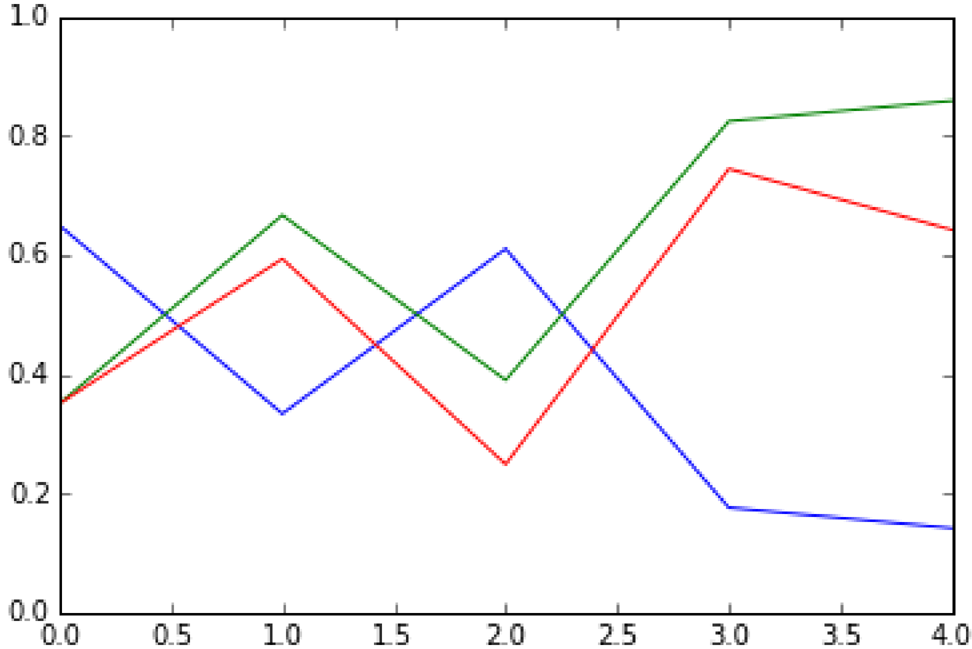

```
In [34]: np.random.seed(86336)
         test = wright_fisher(100, 10, 50, 0)/float(100)
         plt.plot(test, 'b-')
         plt.plot(1-test, 'r-')
         plt.ylim(0,1)
         plt.xlabel('Time', fontsize=15)
         plt.ylabel('Proportion', fontsize=15)
         plt.savefig("wright-fisher-drift-selection.png", format='png', dpi=600)
         plt.show()
```




```
In [6]: selection = []

        for i in range(100000):
            np.random.seed(i)
            test = wright_fisher(100, 10, 50, 0.1)
            if test[-1] < 50 and test[-1] > test[0] and test[24] > 50 and test[13] < test[24] and test[3
                selection.append(i)

In [38]: np.random.seed(31888)
         test = wright_fisher(100, 10, 50, 0.1)/float(100)
         plt.plot(test, 'r-')
         plt.plot(1-test, 'b-')
         plt.ylim(0,1)
         plt.xlabel('Time', fontsize=15)
         plt.ylabel('Proportion', fontsize=15)
         plt.savefig("wright-fisher-selection-drift.png", format='png', dpi=600)
         plt.show()
```




```
In [9]: embracing = [52/float(80), 58/float(174), 252/float(413), 51/float(290), 14/float(99)]
        postverbal = [1 - item for item in embracing]

In [35]: def rescale(freq):
             Y = np.zeros(len(freq)-1)
             for i in range(len(freq)-1):
                 Y[i] = (freq[i+1] - freq[i])/np.sqrt(2*freq[i]*(1-freq[i])*50)
             return Y

In [41]: rescale(postverbal)

Out[41]: array([ 0.06639137, -0.05872582,  0.08905004,  0.00904851])

In [37]: from scipy.stats import ttest_1samp

In [39]: ttest_1samp(rescale(postverbal), 0)

Out[39]: Ttest_1sampResult(statistic=0.80112643659279636, pvalue=0.48163676461901322)

In [16]: plt.plot(embracing)
         plt.plot(postverbal)
         plt.plot(rescale(postverbal))
         plt.ylim(0,1)
         plt.show()
```


1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0