#### 1.SI模型

import numpy as np  
import matplotlib.pyplot as plt  
#population   
  
N = 1e7  
  
#simuation Time 模拟时间  
  
T = 70  
# susceptiable ratio 易感染比例  
s = np.zeros([T])  
# infective ratio 感染比例  
i = np.zeros([T])  
  
# 由我们的实验可以知道，lamda是有取值范围的，似乎超过1就不可以了  
# concat rate感染比率  
  
lamda = 0.9  
  
# initial infective people 每天感染人数  
i[0] = 45.0 / N  
#healthy people 健康人数  
s[0] = 1-i[0]  
  
for t in range(T-1):  
 i[t+1] = i[t] + i[t] \* lamda \* (1.0 - i[t])  
 s[t+1] = 1 - i[t+1]  
   
  
#感染者随着天数的变化曲线  
fig, ax = plt.subplots(figsize=(10,7))  
ax.plot(i, c='r', lw=2)  
ax.plot(s, c='b', lw=2)  
  
ax.set\_xlabel('Day',fontsize=20)  
ax.set\_ylabel('Infective Ratio', fontsize=20)  
ax.grid(1)  
plt.xticks(fontsize=20)  
plt.yticks(fontsize=20);  
plt.show()

#### SIS模型

import matplotlib.pyplot as plt  
import numpy as np  
  
N = 1e7  
T = 70  
  
# susceptiable ratio  
  
s = np.zeros([T])  
  
# infective ratio  
  
i = np.zeros([T])  
  
# concat rate(这个其实是有效的感染率)  
  
lamda = 1.0  
  
# recover rate(治愈率)  
  
gamma = 0.5  
  
# initial infective people   
  
i[0] = 45.0 / N  
s[0] = 1-i[0]  
  
for t in range(T-1):  
 i[t+1] = i[t] + i[t] \* (1- i[t])\* lamda - i[t] \* gamma  
 s[t+1] = 1 - i[t+1]  
  
fig, ax = plt.subplots(figsize=(10,7))  
ax.plot(i, c='r', lw=2)  
ax.plot(s, c='b', lw=2)  
  
ax.set\_xlabel('Day',fontsize=20)  
ax.set\_ylabel('Infective Ratio', fontsize=20)  
ax.grid(1)  
plt.xticks(fontsize=20)  
plt.yticks(fontsize=20);  
plt.show()

#### SIR模型

import matplotlib.pyplot as plt  
import numpy as np  
# population  
#初始易感人数1千万，初始感染者10人  
  
N = 1e7 + 10   
  
# simuation Time / Day  
T = 170  
  
# susceptiable ratio  
  
s = np.zeros([T])  
  
# infective ratio  
  
i = np.zeros([T])  
  
#remove ratio  
r = np.zeros([T])  
  
# contact rate 感染率  
  
lamda = 0.2586  
  
# recover rate 治愈率  
  
gamma = 0.0821  
  
# initial infective people  
  
i[0] = 10.0 / N  
  
s[0] = 1e7 / N  
  
for t in range(T-1):  
 i[t+1] = i[t]+i[t]\* lamda \* s[t] - gamma\*i[t]  
   
 s[t+1] = s[t] - lamda \* i[t]\*s[t]  
   
 r[t+1] =r[t] + gamma \* i[t]  
  
fig, ax = plt.subplots(figsize=(10,7))  
ax.plot(s, c='b', lw=2, label='S')  
ax.plot(i, c='r', lw=2, label='I')  
ax.plot(r, c='g', lw=2, label='R')  
ax.set\_xlabel('Day',fontsize=20)  
ax.set\_ylabel('Infective Ratio', fontsize=20)  
ax.grid(1)  
plt.xticks(fontsize=20)  
plt.yticks(fontsize=20)  
plt.legend()  
plt.show()

#### SEIR模型

import matplotlib.pyplot as plt  
import numpy as np  
# population  
#易感人数1千万，感染者10人，潜伏者5人  
N = 1e7 + 10 + 5  
# simuation Time / Day  
T = 170  
# susceptiable ratio  
s = np.zeros([T])  
# exposed ratio  
e = np.zeros([T])  
# infective ratio  
i = np.zeros([T])  
# remove ratio  
r = np.zeros([T])  
  
  
# contact rate  
lamda = 0.5  
# recover rate  
gamma = 0.0821  
  
  
# 潜伏期  
  
# exposed period  
  
  
  
sigma = 1 / 4  
  
# initial infective people  
i[0] = 10.0 / N  
s[0] = 1e7 / N  
e[0] = 40.0 / N  
  
  
for t in range(T-1):  
 s[t + 1] = s[t] - lamda \* s[t] \* i[t]  
 e[t + 1] = e[t] + lamda \* s[t] \* i[t] - sigma \* e[t]  
 i[t + 1] = i[t] + sigma \* e[t] - gamma \* i[t]  
 r[t + 1] = r[t] + gamma \* i[t]  
  
fig, ax = plt.subplots(figsize=(10,7))  
ax.plot(s, c='b', lw=2, label='S')  
ax.plot(e, c='orange', lw=2, label='E')  
ax.plot(i, c='r', lw=2, label='I')  
ax.plot(r, c='g', lw=2, label='R')  
ax.set\_xlabel('Day',fontsize=20)  
ax.set\_ylabel('Infective Ratio', fontsize=20)  
ax.grid(1)  
plt.xticks(fontsize=20)  
plt.yticks(fontsize=20)  
plt.legend()  
plt.show()