

```
1 from google.colab import drive
2 drive.mount('/content/drive', force_remount=True)
```

Mounted at /content/drive

```
1 from matplotlib.ticker import MaxNLocator
2 from scipy import signal
3 from scipy.interpolate import make_interp_spline, BSpline
4 import matplotlib.pyplot as plt
5 import networkx as nx
6 import numpy as np
7 import pandas as pd
```

▼ Graphs

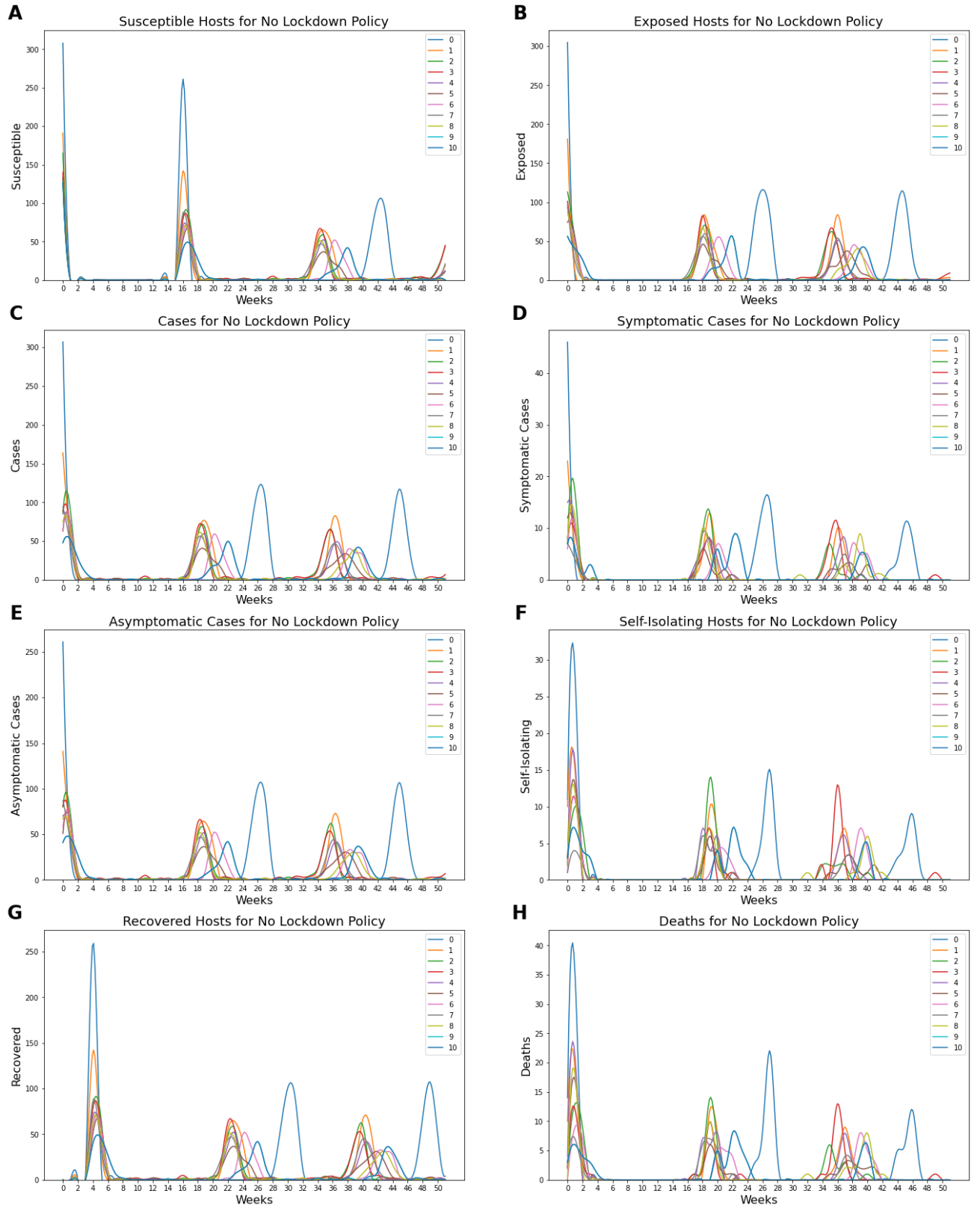
▼ Across Automata for No Lockdown Policy

```
1 paths = ["/content/drive/My Drive/simulations/no_policy/susceptible/automaton.csv",
2           "/content/drive/My Drive/simulations/no_policy/exposed/automaton.csv",
3           "/content/drive/My Drive/simulations/no_policy/cases/automaton.csv",
4           "/content/drive/My Drive/simulations/no_policy/cases/symptomatic/automaton.csv",
5           "/content/drive/My Drive/simulations/no_policy/cases/asymptomatic/automaton.csv",
6           "/content/drive/My Drive/simulations/no_policy/self-isolating/automaton.csv",
7           "/content/drive/My Drive/simulations/no_policy/recovered/automaton.csv",
8           "/content/drive/My Drive/simulations/no_policy/deaths/automaton.csv"]
9
10 titles = ["Susceptible Hosts for No Lockdown Policy",
11           "Exposed Hosts for No Lockdown Policy",
12           "Cases for No Lockdown Policy",
13           "Symptomatic Cases for No Lockdown Policy",
14           "Asymptomatic Cases for No Lockdown Policy",
15           "Self-Isolating Hosts for No Lockdown Policy",
16           "Recovered Hosts for No Lockdown Policy",
17           "Deaths for No Lockdown Policy"]
18
19 y_labels = ["Susceptible",
20            "Exposed",
21            "Cases",
22            "Symptomatic Cases",
23            "Asymptomatic Cases",
24            "Self-Isolating",
25            "Recovered",
26            "Deaths"]
27
28 plt.figure(figsize=(23,60))
29
30 subplots = [1, 2, 3, 4, 5, 6, 7, 8]
31 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H']
```

```
32
33 for index, path in enumerate(paths):
34     df = pd.read_csv(path)
35
36     ax = plt.subplot(8,2,subplots[index])
37
38     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
39            fontsize=26, fontweight='bold', va='top', ha='right')
40
41     plt.title(titles[index], fontsize=18)
42
43     x = np.array(df.index.values)
44     x_new = np.linspace(x.min(), x.max(), 300)
45
46     y = np.array(df['0'])
47     spl = make_interp_spline(x, y, k=3)
48     y_new = spl(x_new)
49     plt.plot(x_new, y_new, label="0")
50     plt.ylim(0)
51
52     y = np.array(df['1'])
53     spl = make_interp_spline(x, y, k=3)
54     y_new = spl(x_new)
55     plt.plot(x_new, y_new, label="1")
56     plt.ylim(0)
57
58     y = np.array(df['2'])
59     spl = make_interp_spline(x, y, k=3)
60     y_new = spl(x_new)
61     plt.plot(x_new, y_new, label="2")
62     plt.ylim(0)
63
64     y = np.array(df['3'])
65     spl = make_interp_spline(x, y, k=3)
66     y_new = spl(x_new)
67     plt.plot(x_new, y_new, label="3")
68     plt.ylim(0)
69
70     y = np.array(df['4'])
71     spl = make_interp_spline(x, y, k=3)
72     y_new = spl(x_new)
73     plt.plot(x_new, y_new, label="4")
74     plt.ylim(0)
75
76     y = np.array(df['5'])
77     spl = make_interp_spline(x, y, k=3)
78     y_new = spl(x_new)
79     plt.plot(x_new, y_new, label="5")
80     plt.ylim(0)
81
82     y = np.array(df['6'])
83     spl = make_interp_spline(x, y, k=3)
84     y_new = spl(x_new)
85     plt.plot(x_new, y_new, label="6")
86     plt.ylim(0)
```

```
87
88 y = np.array(df['7'])
89 spl = make_interp_spline(x, y, k=3)
90 y_new = spl(x_new)
91 plt.plot(x_new, y_new, label="7")
92 plt.ylim(0)
93
94 y = np.array(df['8'])
95 spl = make_interp_spline(x, y, k=3)
96 y_new = spl(x_new)
97 plt.plot(x_new, y_new, label="8")
98 plt.ylim(0)
99
100 y = np.array(df['9'])
101 spl = make_interp_spline(x, y, k=3)
102 y_new = spl(x_new)
103 plt.plot(x_new, y_new, label="9")
104 plt.ylim(0)
105
106 y = np.array(df['9'])
107 spl = make_interp_spline(x, y, k=3)
108 y_new = spl(x_new)
109 plt.plot(x_new, y_new, label="10")
110 plt.ylim(0)
111
112 plt.xticks(list(df.index))
113 plt.locator_params(axis='x', nbins=37)
114 plt.xlabel("Weeks", fontsize=16)
115 plt.ylabel(y_labels[index], fontsize=16)
116
117 legend = plt.legend()
118
119 plt.show
```

<function matplotlib.pyplot.show>



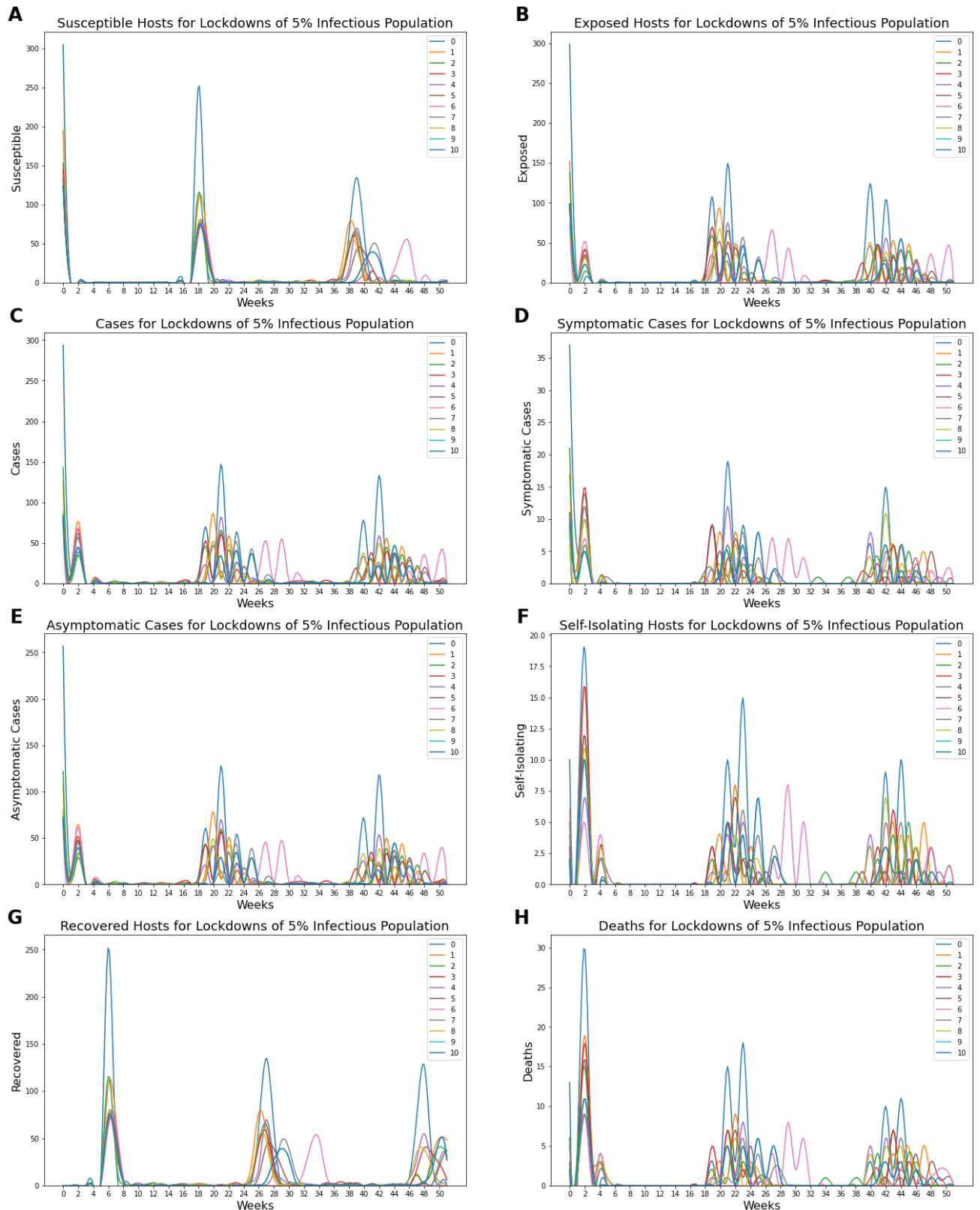
▼ Across Automata for Lockdowns of 5% Infectious Population

```
1 paths = ["/content/drive/My Drive/simulations/5%_infectious/susceptible/automaton.csv",
2           "/content/drive/My Drive/simulations/5%_infectious/exposed/automaton.csv",
3           "/content/drive/My Drive/simulations/5%_infectious/cases/automaton.csv",
4           "/content/drive/My Drive/simulations/5%_infectious/cases/symptomatic/automaton.csv",
5           "/content/drive/My Drive/simulations/5%_infectious/cases/asymptomatic/automaton.csv",
6           "/content/drive/My Drive/simulations/5%_infectious/self-isolating/automaton.csv",
7           "/content/drive/My Drive/simulations/5%_infectious/recovered/automaton.csv",
8           "/content/drive/My Drive/simulations/5%_infectious/deaths/automaton.csv"]
9
10 titles = ["Susceptible Hosts for Lockdowns of 5% Infectious Population",
11           "Exposed Hosts for Lockdowns of 5% Infectious Population",
12           "Cases for Lockdowns of 5% Infectious Population",
13           "Symptomatic Cases for Lockdowns of 5% Infectious Population",
14           "Asymptomatic Cases for Lockdowns of 5% Infectious Population",
15           "Self-Isolating Hosts for Lockdowns of 5% Infectious Population",
16           "Recovered Hosts for Lockdowns of 5% Infectious Population",
17           "Deaths for Lockdowns of 5% Infectious Population"]
18
19 y_labels = ["Susceptible",
20            "Exposed",
21            "Cases",
22            "Symptomatic Cases",
23            "Asymptomatic Cases",
24            "Self-Isolating",
25            "Recovered",
26            "Deaths"]
27
28 plt.figure(figsize=(23,60))
29
30 subplots = [1, 2, 3, 4, 5, 6, 7, 8]
31 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H']
32
33 for index, path in enumerate(paths):
34     df = pd.read_csv(path)
35
36     ax = plt.subplot(8,2,subplots[index])
37
38     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
39            fontsize=26, fontweight='bold', va='top', ha='right')
40
41     plt.title(titles[index], fontsize=18)
42
43     x = np.array(df.index.values)
44     x_new = np.linspace(x.min(), x.max(), 300)
```

```
45
46 y = np.array(df['0'])
47 spl = make_interp_spline(x, y, k=3)
48 y_new = spl(x_new)
49 plt.plot(x_new, y_new, label="0")
50 plt.ylim(0)
51
52 y = np.array(df['1'])
53 spl = make_interp_spline(x, y, k=3)
54 y_new = spl(x_new)
55 plt.plot(x_new, y_new, label="1")
56 plt.ylim(0)
57
58 y = np.array(df['2'])
59 spl = make_interp_spline(x, y, k=3)
60 y_new = spl(x_new)
61 plt.plot(x_new, y_new, label="2")
62 plt.ylim(0)
63
64 y = np.array(df['3'])
65 spl = make_interp_spline(x, y, k=3)
66 y_new = spl(x_new)
67 plt.plot(x_new, y_new, label="3")
68 plt.ylim(0)
69
70 y = np.array(df['4'])
71 spl = make_interp_spline(x, y, k=3)
72 y_new = spl(x_new)
73 plt.plot(x_new, y_new, label="4")
74 plt.ylim(0)
75
76 y = np.array(df['5'])
77 spl = make_interp_spline(x, y, k=3)
78 y_new = spl(x_new)
79 plt.plot(x_new, y_new, label="5")
80 plt.ylim(0)
81
82 y = np.array(df['6'])
83 spl = make_interp_spline(x, y, k=3)
84 y_new = spl(x_new)
85 plt.plot(x_new, y_new, label="6")
86 plt.ylim(0)
87
88 y = np.array(df['7'])
89 spl = make_interp_spline(x, y, k=3)
90 y_new = spl(x_new)
91 plt.plot(x_new, y_new, label="7")
92 plt.ylim(0)
93
94 y = np.array(df['8'])
95 spl = make_interp_spline(x, y, k=3)
96 y_new = spl(x_new)
97 plt.plot(x_new, y_new, label="8")
98 plt.ylim(0)
99
```

```
100 y = np.array(df['9'])
101 spl = make_interp_spline(x, y, k=3)
102 y_new = spl(x_new)
103 plt.plot(x_new, y_new, label="9")
104 plt.ylim(0)
105
106 y = np.array(df['9'])
107 spl = make_interp_spline(x, y, k=3)
108 y_new = spl(x_new)
109 plt.plot(x_new, y_new, label="10")
110 plt.ylim(0)
111
112 plt.xticks(list(df.index))
113 plt.locator_params(axis='x', nbins=37)
114 plt.xlabel("Weeks", fontsize=16)
115 plt.ylabel(y_labels[index], fontsize=16)
116
117 legend = plt.legend()
118
119 plt.show
```

<function matplotlib.pyplot.show>



▼ Lockdowns for 5% Infectious Population

```
1 path = "/content/drive/My Drive/simulations/5%_infectious/lockdowns/automaton.c:
2
```

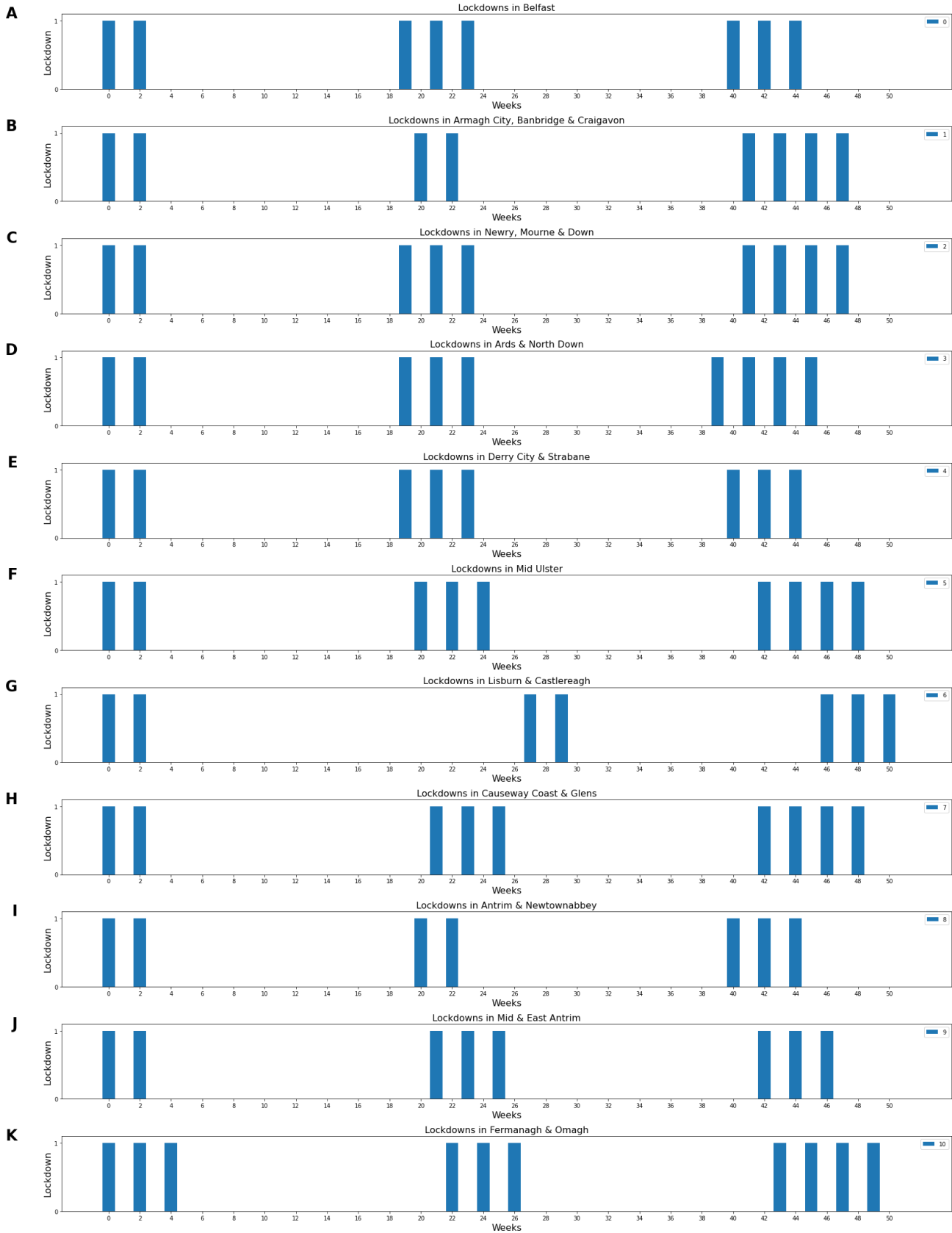


```

3 titles = ["Lockdowns in Belfast",
4           "Lockdowns in Armagh City, Banbridge & Craigavon",
5           "Lockdowns in Newry, Mourne & Down",
6           "Lockdowns in Ards & North Down",
7           "Lockdowns in Derry City & Strabane",
8           "Lockdowns in Mid Ulster",
9           "Lockdowns in Lisburn & Castlereagh",
10          "Lockdowns in Causeway Coast & Glens",
11          "Lockdowns in Antrim & Newtownabbey",
12          "Lockdowns in Mid & East Antrim",
13          "Lockdowns in Fermanagh & Omagh"]
14
15 plt.figure(figsize=(23,30))
16
17 subplots = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
18 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K']
19
20 for index in range(11):
21     df = pd.read_csv(path)
22
23     ax = plt.subplot(11,1,subplots[index])
24
25     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
26            fontsize=26, fontweight='bold', va='top', ha='right')
27
28     plt.title(titles[index], fontsize=16)
29
30
31     x = np.array(df.index.values)
32
33     y = np.array(df[str(index)])
34     plt.bar(x, y, label=index)
35     plt.ylim(0)
36
37     plt.xticks(list(df.index))
38
39     plt.locator_params(axis='x', nbins=37)
40     plt.xlabel("Weeks", fontsize=16)
41     plt.ylabel("Lockdown", fontsize=16)
42
43     plt.yticks(np.arange(0, 2, step=1))
44     plt.ylim((0,1.1))
45
46     legend = plt.legend()
47
48 plt.tight_layout()
49 plt.show

```

<function matplotlib.pyplot.show>



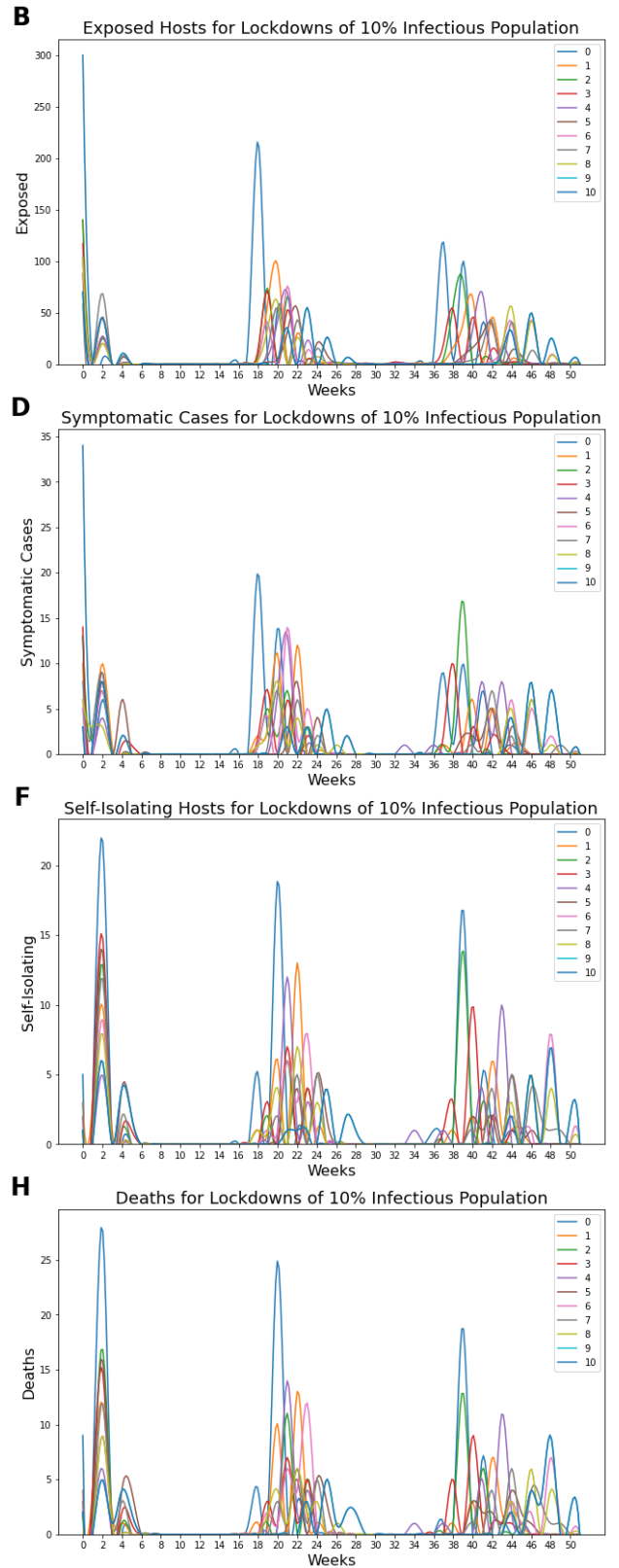
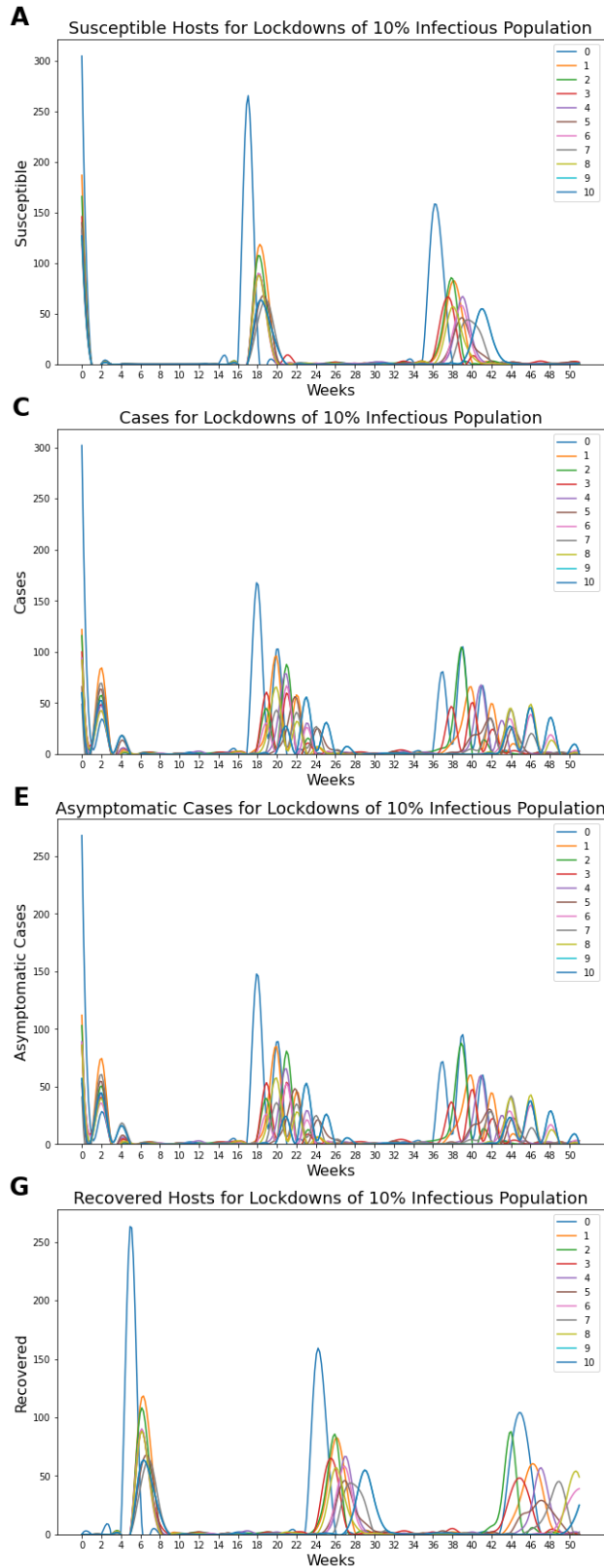
▼ Across Automata for 10% Infectious Population

```
1 paths = ["/content/drive/My Drive/simulations/10%_infectious/susceptible/automaton.cs",
2           "/content/drive/My Drive/simulations/10%_infectious/exposed/automaton.cs",
3           "/content/drive/My Drive/simulations/10%_infectious/cases/automaton.cs",
4           "/content/drive/My Drive/simulations/10%_infectious/cases/symptomatic/automaton.cs",
5           "/content/drive/My Drive/simulations/10%_infectious/cases/asymptomatic/automaton.cs",
6           "/content/drive/My Drive/simulations/10%_infectious/self-isolating/automaton.cs",
7           "/content/drive/My Drive/simulations/10%_infectious/recovered/automaton.cs",
8           "/content/drive/My Drive/simulations/10%_infectious/deaths/automaton.cs"]
9
10 titles = ["Susceptible Hosts for Lockdowns of 10% Infectious Population",
11           "Exposed Hosts for Lockdowns of 10% Infectious Population",
12           "Cases for Lockdowns of 10% Infectious Population",
13           "Symptomatic Cases for Lockdowns of 10% Infectious Population",
14           "Asymptomatic Cases for Lockdowns of 10% Infectious Population",
15           "Self-Isolating Hosts for Lockdowns of 10% Infectious Population",
16           "Recovered Hosts for Lockdowns of 10% Infectious Population",
17           "Deaths for Lockdowns of 10% Infectious Population"]
18
19 y_labels = ["Susceptible",
20            "Exposed",
21            "Cases",
22            "Symptomatic Cases",
23            "Asymptomatic Cases",
24            "Self-Isolating",
25            "Recovered",
26            "Deaths"]
27
```

```
28 plt.figure(figsize=(23,60))
29
30 subplots = [1, 2, 3, 4, 5, 6, 7, 8]
31 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H']
32
33 for index, path in enumerate(paths):
34     df = pd.read_csv(path)
35
36     ax = plt.subplot(8,2,subplots[index])
37
38     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
39     fontsize=26, fontweight='bold', va='top', ha='right')
40
41     plt.title(titles[index], fontsize=18)
42
43     x = np.array(df.index.values)
44     x_new = np.linspace(x.min(), x.max(), 300)
45
46     y = np.array(df['0'])
47     spl = make_interp_spline(x, y, k=3)
48     y_new = spl(x_new)
49     plt.plot(x_new, y_new, label="0")
50     plt.ylim(0)
51
52     y = np.array(df['1'])
53     spl = make_interp_spline(x, y, k=3)
54     y_new = spl(x_new)
55     plt.plot(x_new, y_new, label="1")
56     plt.ylim(0)
57
58     y = np.array(df['2'])
59     spl = make_interp_spline(x, y, k=3)
60     y_new = spl(x_new)
61     plt.plot(x_new, y_new, label="2")
62     plt.ylim(0)
63
64     y = np.array(df['3'])
65     spl = make_interp_spline(x, y, k=3)
66     y_new = spl(x_new)
67     plt.plot(x_new, y_new, label="3")
68     plt.ylim(0)
69
70     y = np.array(df['4'])
71     spl = make_interp_spline(x, y, k=3)
72     y_new = spl(x_new)
73     plt.plot(x_new, y_new, label="4")
74     plt.ylim(0)
75
76     y = np.array(df['5'])
77     spl = make_interp_spline(x, y, k=3)
78     y_new = spl(x_new)
79     plt.plot(x_new, y_new, label="5")
80     plt.ylim(0)
81
82     y = np.array(df['6'])
```

```
83 spl = make_interp_spline(x, y, k=3)
84 y_new = spl(x_new)
85 plt.plot(x_new, y_new, label="6")
86 plt.ylim(0)
87
88 y = np.array(df['7'])
89 spl = make_interp_spline(x, y, k=3)
90 y_new = spl(x_new)
91 plt.plot(x_new, y_new, label="7")
92 plt.ylim(0)
93
94 y = np.array(df['8'])
95 spl = make_interp_spline(x, y, k=3)
96 y_new = spl(x_new)
97 plt.plot(x_new, y_new, label="8")
98 plt.ylim(0)
99
100 y = np.array(df['9'])
101 spl = make_interp_spline(x, y, k=3)
102 y_new = spl(x_new)
103 plt.plot(x_new, y_new, label="9")
104 plt.ylim(0)
105
106 y = np.array(df['9'])
107 spl = make_interp_spline(x, y, k=3)
108 y_new = spl(x_new)
109 plt.plot(x_new, y_new, label="10")
110 plt.ylim(0)
111
112 plt.xticks(list(df.index))
113 plt.locator_params(axis='x', nbins=37)
114 plt.xlabel("Weeks", fontsize=16)
115 plt.ylabel(y_labels[index], fontsize=16)
116
117 legend = plt.legend()
118
119 plt.show
```

<function matplotlib.pyplot.show>

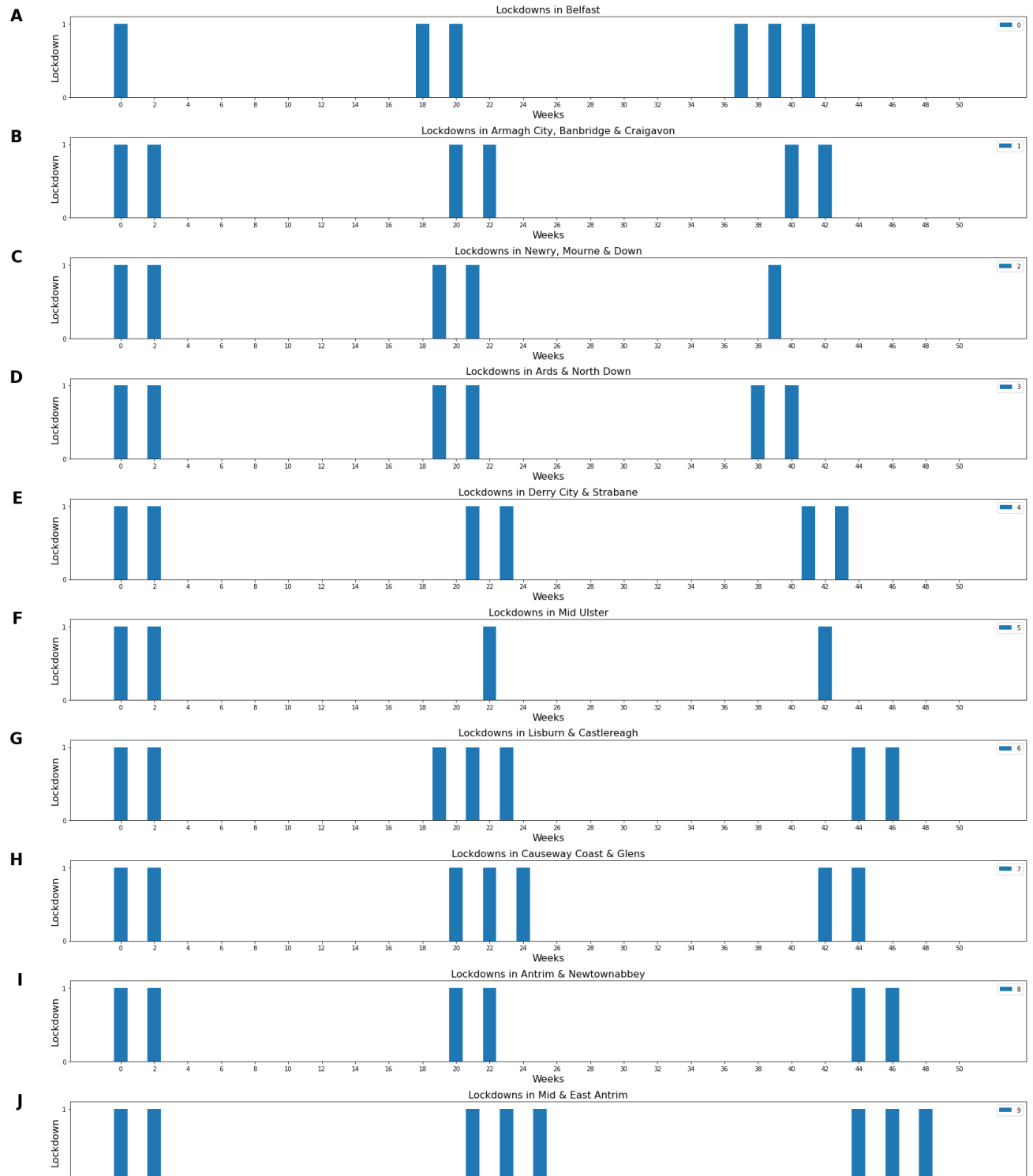


▼ Lockdowns for 10% Infectious Population

```
1 path = "/content/drive/My Drive/simulations/10%_infectious/lockdowns/automaton.csv"
2
3 titles = ["Lockdowns in Belfast",
4           "Lockdowns in Armagh City, Banbridge & Craigavon",
5           "Lockdowns in Newry, Mourne & Down",
6           "Lockdowns in Ards & North Down",
7           "Lockdowns in Derry City & Strabane",
8           "Lockdowns in Mid Ulster",
9           "Lockdowns in Lisburn & Castlereagh",
10          "Lockdowns in Causeway Coast & Glens",
11          "Lockdowns in Antrim & Newtownabbey",
12          "Lockdowns in Mid & East Antrim",
13          "Lockdowns in Fermanagh & Omagh"]
14
15 plt.figure(figsize=(23,30))
16
17 subplots = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
18 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K']
19
20 for index in range(11):
21     df = pd.read_csv(path)
22
23     ax = plt.subplot(11,1,subplots[index])
24
25     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
26            fontsize=26, fontweight='bold', va='top', ha='right')
27
28     plt.title(titles[index], fontsize=16)
29
30
31     x = np.array(df.index.values)
32
33     y = np.array(df[str(index)])
34     plt.bar(x, y, label=index)
35     plt.ylim(0)
36
37     plt.xticks(list(df.index))
38
39     plt.locator_params(axis='x', nbins=37)
40     plt.xlabel("Weeks", fontsize=16)
```

```
41 plt.ylabel("Lockdown", fontsize=16)
42
43 plt.yticks(np.arange(0, 2, step=1))
44 plt.ylim((0,1.1))
45
46 legend = plt.legend()
47
48 plt.tight_layout()
49 plt.show
```


<function matplotlib.pyplot.show>



▼ Across Automata for 15% Infectious Population

```

1 paths = ["/content/drive/My Drive/simulations/15%_infectious/susceptible/automata",
2           "/content/drive/My Drive/simulations/15%_infectious/exposed/automata",
3           "/content/drive/My Drive/simulations/15%_infectious/cases/automata",
4           "/content/drive/My Drive/simulations/15%_infectious/cases/symptomatic/automata",
5           "/content/drive/My Drive/simulations/15%_infectious/cases/asymptomatic/automata",
6           "/content/drive/My Drive/simulations/15%_infectious/self-isolating/automata",
7           "/content/drive/My Drive/simulations/15%_infectious/recovered/automata",
8           "/content/drive/My Drive/simulations/15%_infectious/deaths/automata"]
9
10 titles = ["Susceptible Hosts for Lockdowns of 15% Infectious Population",

```

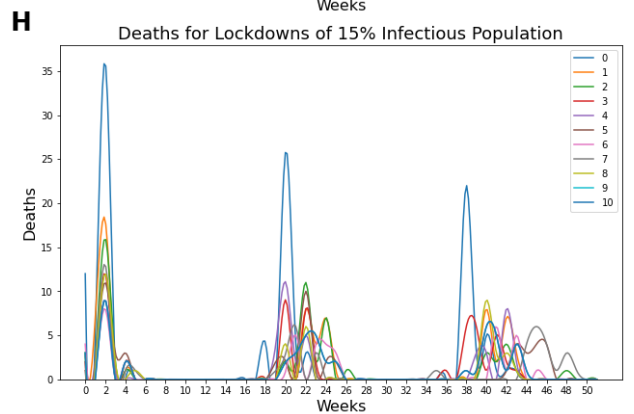
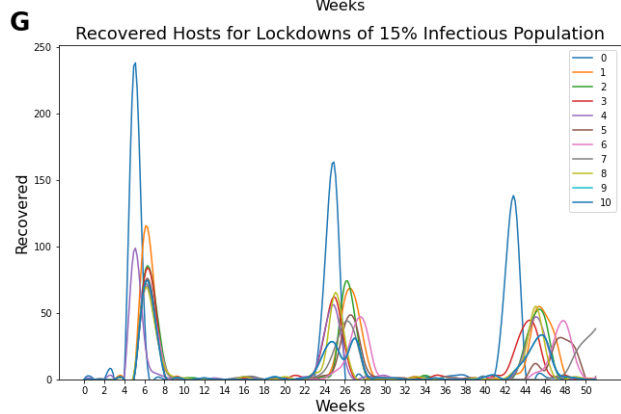
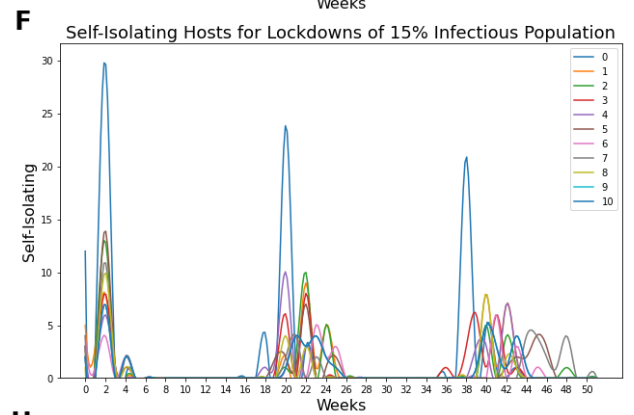
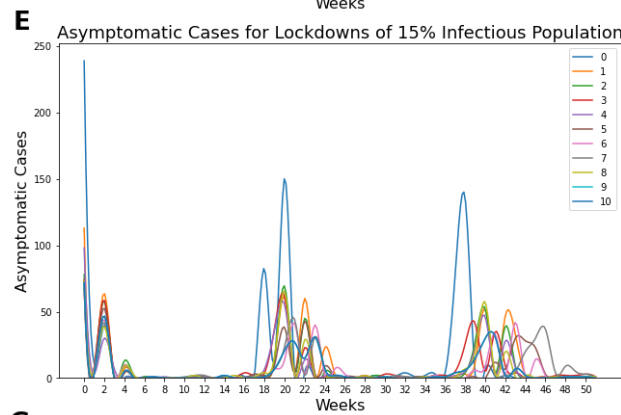
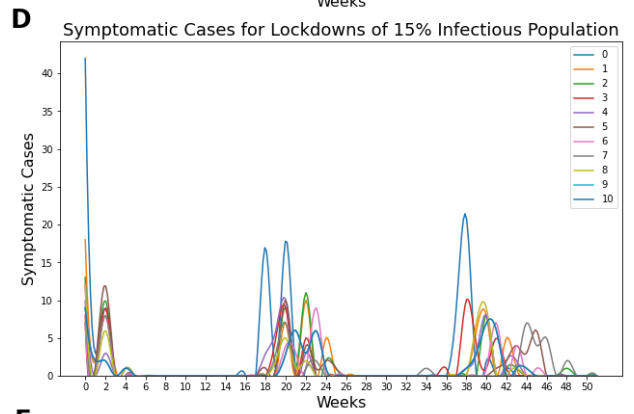
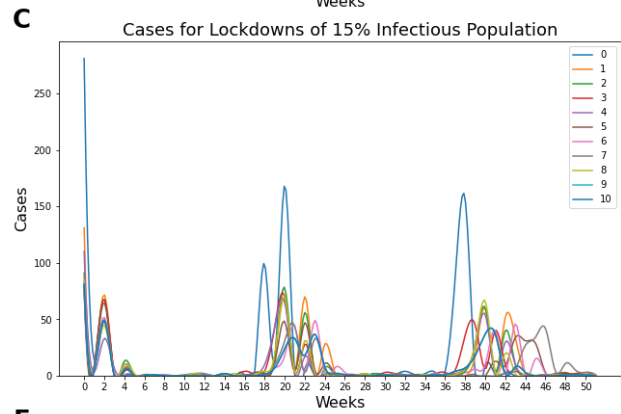
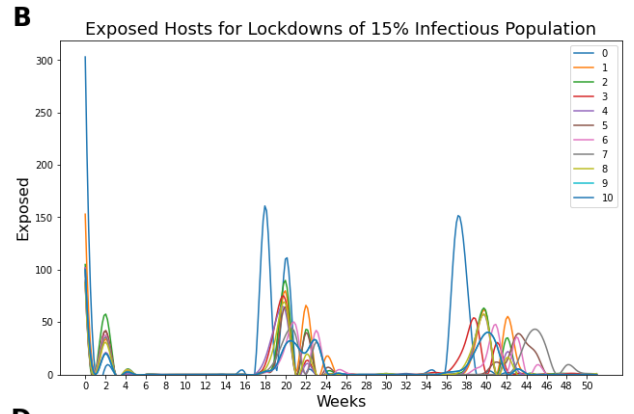
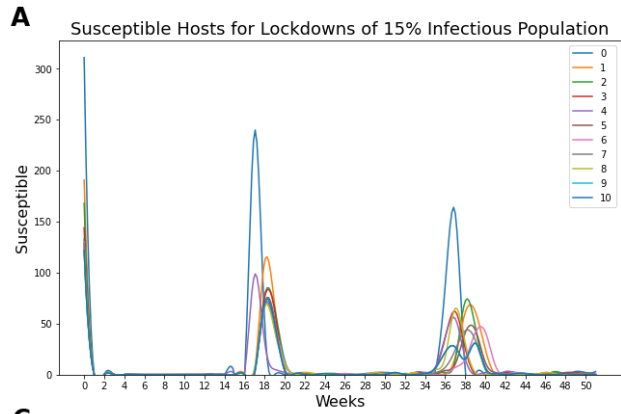
```

11         "Exposed Hosts for Lockdowns of 15% Infectious Population",
12         "Cases for Lockdowns of 15% Infectious Population",
13         "Symptomatic Cases for Lockdowns of 15% Infectious Population",
14         "Asymptomatic Cases for Lockdowns of 15% Infectious Population",
15         "Self-Isolating Hosts for Lockdowns of 15% Infectious Population",
16         "Recovered Hosts for Lockdowns of 15% Infectious Population",
17         "Deaths for Lockdowns of 15% Infectious Population"]
18
19 y_labels = ["Susceptible",
20             "Exposed",
21             "Cases",
22             "Symptomatic Cases",
23             "Asymptomatic Cases",
24             "Self-Isolating",
25             "Recovered",
26             "Deaths"]
27
28 plt.figure(figsize=(23,60))
29
30 subplots = [1, 2, 3, 4, 5, 6, 7, 8]
31 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H']
32
33 for index, path in enumerate(paths):
34     df = pd.read_csv(path)
35
36     ax = plt.subplot(8,2,subplots[index])
37
38     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
39            fontsize=26, fontweight='bold', va='top', ha='right')
40
41     plt.title(titles[index], fontsize=18)
42
43     x = np.array(df.index.values)
44     x_new = np.linspace(x.min(), x.max(), 300)
45
46     y = np.array(df['0'])
47     spl = make_interp_spline(x, y, k=3)
48     y_new = spl(x_new)
49     plt.plot(x_new, y_new, label="0")
50     plt.ylim(0)
51
52     y = np.array(df['1'])
53     spl = make_interp_spline(x, y, k=3)
54     y_new = spl(x_new)
55     plt.plot(x_new, y_new, label="1")
56     plt.ylim(0)
57
58     y = np.array(df['2'])
59     spl = make_interp_spline(x, y, k=3)
60     y_new = spl(x_new)
61     plt.plot(x_new, y_new, label="2")
62     plt.ylim(0)
63
64     y = np.array(df['3'])
65     spl = make_interp_spline(x, y, k=3)

```

```
66 y_new = spl(x_new)
67 plt.plot(x_new, y_new, label="3")
68 plt.ylim(0)
69
70 y = np.array(df['4'])
71 spl = make_interp_spline(x, y, k=3)
72 y_new = spl(x_new)
73 plt.plot(x_new, y_new, label="4")
74 plt.ylim(0)
75
76 y = np.array(df['5'])
77 spl = make_interp_spline(x, y, k=3)
78 y_new = spl(x_new)
79 plt.plot(x_new, y_new, label="5")
80 plt.ylim(0)
81
82 y = np.array(df['6'])
83 spl = make_interp_spline(x, y, k=3)
84 y_new = spl(x_new)
85 plt.plot(x_new, y_new, label="6")
86 plt.ylim(0)
87
88 y = np.array(df['7'])
89 spl = make_interp_spline(x, y, k=3)
90 y_new = spl(x_new)
91 plt.plot(x_new, y_new, label="7")
92 plt.ylim(0)
93
94 y = np.array(df['8'])
95 spl = make_interp_spline(x, y, k=3)
96 y_new = spl(x_new)
97 plt.plot(x_new, y_new, label="8")
98 plt.ylim(0)
99
100 y = np.array(df['9'])
101 spl = make_interp_spline(x, y, k=3)
102 y_new = spl(x_new)
103 plt.plot(x_new, y_new, label="9")
104 plt.ylim(0)
105
106 y = np.array(df['9'])
107 spl = make_interp_spline(x, y, k=3)
108 y_new = spl(x_new)
109 plt.plot(x_new, y_new, label="10")
110 plt.ylim(0)
111
112 plt.xticks(list(df.index))
113 plt.locator_params(axis='x', nbins=37)
114 plt.xlabel("Weeks", fontsize=16)
115 plt.ylabel(y_labels[index], fontsize=16)
116
117 legend = plt.legend()
118
119 plt.show
```

<function matplotlib.pyplot.show>

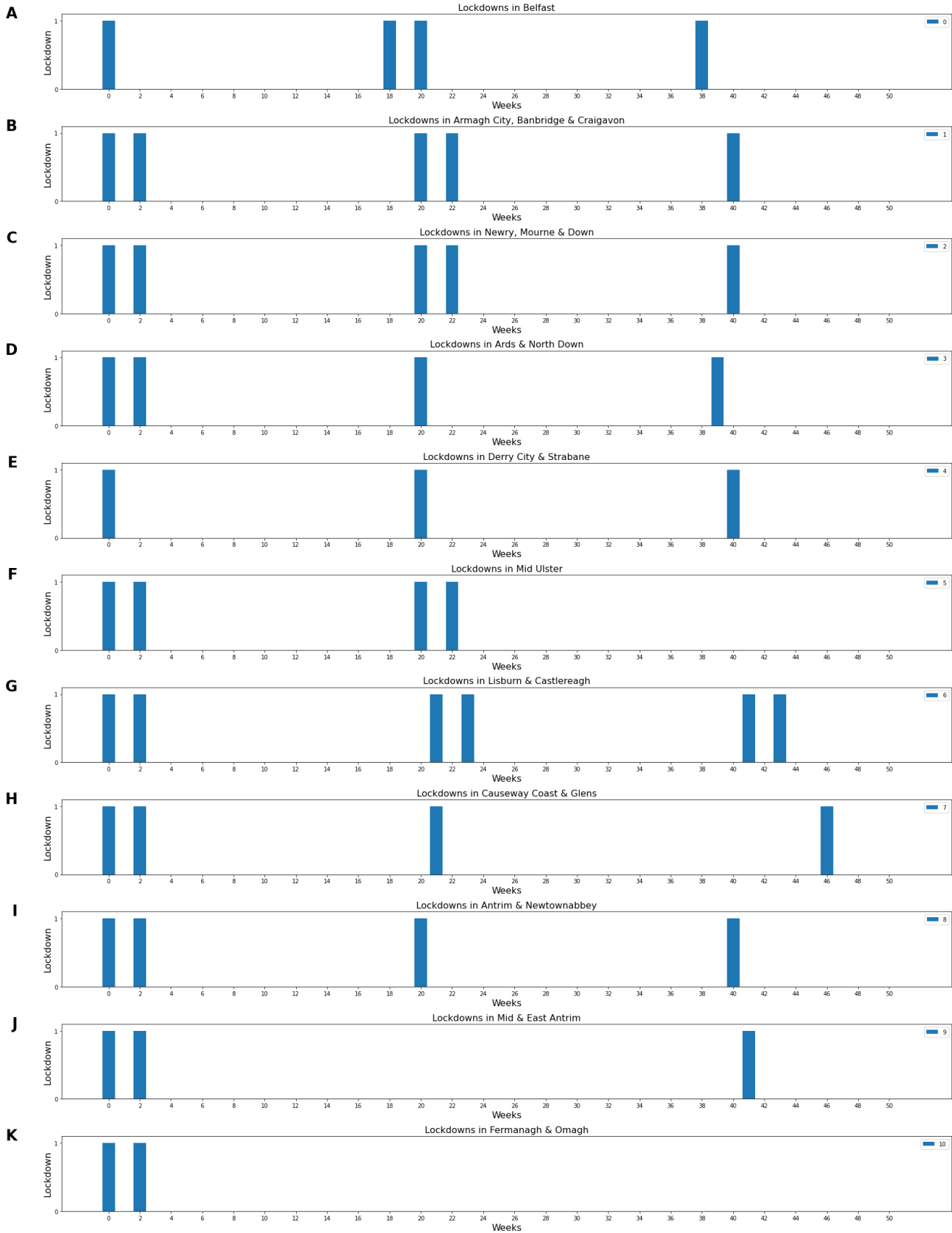


▼ Lockdowns for 15% Infectious Population

```
1 path = "/content/drive/My Drive/simulations/15%_infectious/lockdowns/automaton
2
3 titles = ["Lockdowns in Belfast",
4           "Lockdowns in Armagh City, Banbridge & Craigavon",
5           "Lockdowns in Newry, Mourne & Down",
6           "Lockdowns in Ards & North Down",
7           "Lockdowns in Derry City & Strabane",
8           "Lockdowns in Mid Ulster",
9           "Lockdowns in Lisburn & Castlereagh",
10          "Lockdowns in Causeway Coast & Glens",
11          "Lockdowns in Antrim & Newtownabbey",
12          "Lockdowns in Mid & East Antrim",
13          "Lockdowns in Fermanagh & Omagh"]
14
15 plt.figure(figsize=(23,30))
16
17 subplots = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
18 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K']
19
20 for index in range(11):
21     df = pd.read_csv(path)
22
23     ax = plt.subplot(11,1,subplots[index])
```

```
24
25 ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
26         fontsize=26, fontweight='bold', va='top', ha='right')
27
28 plt.title(titles[index], fontsize=16)
29
30
31 x = np.array(df.index.values)
32
33 y = np.array(df[str(index)])
34 plt.bar(x, y, label=index)
35 plt.ylim(0)
36
37 plt.xticks(list(df.index))
38
39 plt.locator_params(axis='x', nbins=37)
40 plt.xlabel("Weeks", fontsize=16)
41 plt.ylabel("Lockdown", fontsize=16)
42
43 plt.yticks(np.arange(0, 2, step=1))
44 plt.ylim((0,1.1))
45
46 legend = plt.legend()
47
48 plt.tight_layout()
49 plt.show
```

```
<function matplotlib.pyplot.show>
```



▼ Across Automata for Optimal Lockdown Policy

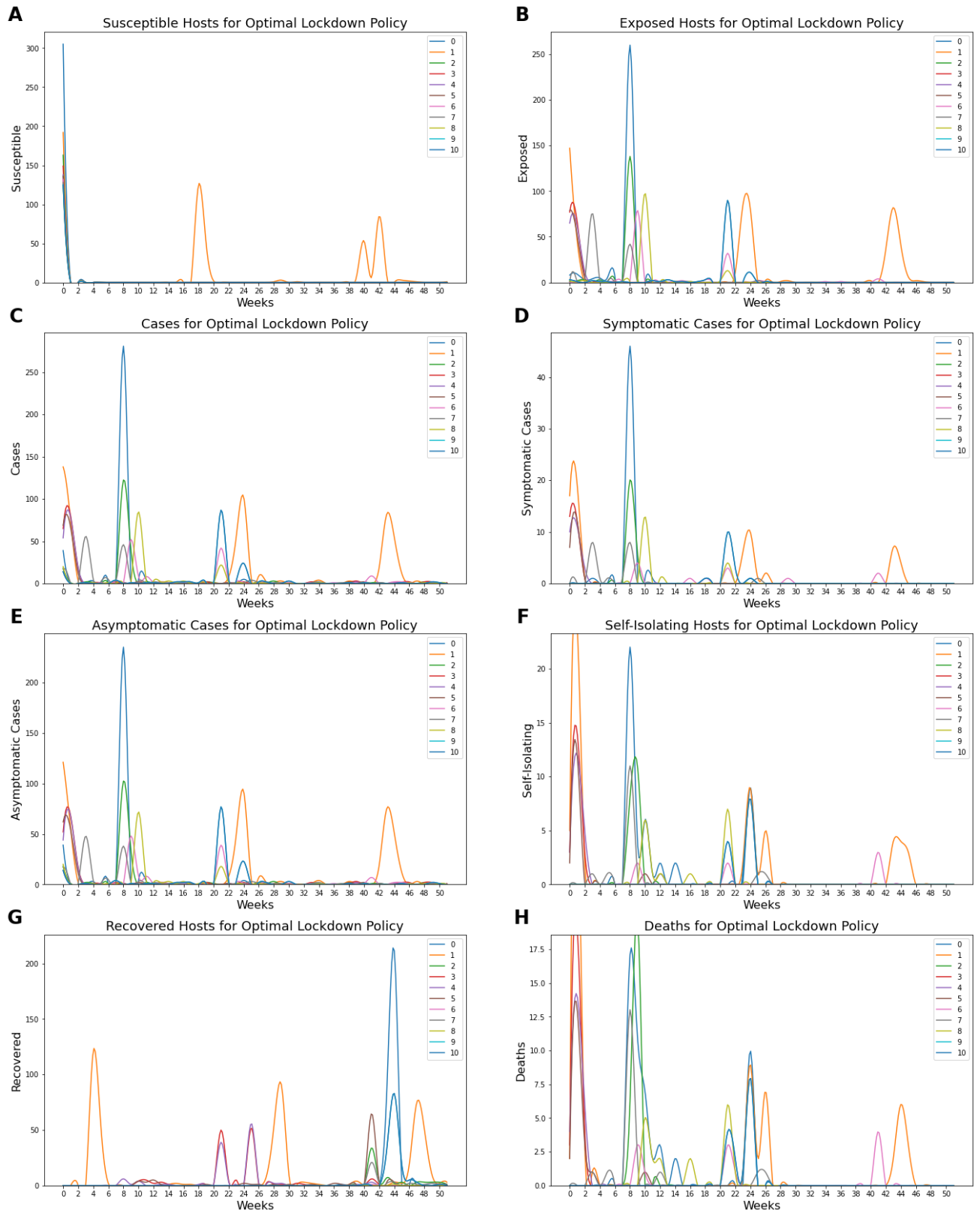
```
1 paths = ["/content/drive/My Drive/simulations/dqn/susceptible/automaton.csv",
2           "/content/drive/My Drive/simulations/dqn/exposed/automaton.csv",
3           "/content/drive/My Drive/simulations/dqn/cases/automaton.csv",
4           "/content/drive/My Drive/simulations/dqn/cases/symptomatic/automaton.csv",
5           "/content/drive/My Drive/simulations/dqn/cases/asymptomatic/automaton.csv",
6           "/content/drive/My Drive/simulations/dqn/self-isolating/automaton.csv",
7           "/content/drive/My Drive/simulations/dqn/recovered/automaton.csv",
8           "/content/drive/My Drive/simulations/dqn/deaths/automaton.csv"]
9
10 titles = ["Susceptible Hosts for Optimal Lockdown Policy",
11           "Exposed Hosts for Optimal Lockdown Policy",
12           "Cases for Optimal Lockdown Policy",
13           "Symptomatic Cases for Optimal Lockdown Policy",
14           "Asymptomatic Cases for Optimal Lockdown Policy",
15           "Self-Isolating Hosts for Optimal Lockdown Policy",
16           "Recovered Hosts for Optimal Lockdown Policy",
17           "Deaths for Optimal Lockdown Policy"]
18
19 y_labels = ["Susceptible",
20             "Exposed",
21             "Cases",
22             "Symptomatic Cases",
23             "Asymptomatic Cases",
24             "Self-Isolating",
25             "Recovered",
26             "Deaths"]
27
28 plt.figure(figsize=(23,60))
29
30 subplots = [1, 2, 3, 4, 5, 6, 7, 8]
31 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H']
32
33 for index, path in enumerate(paths):
34     df = pd.read_csv(path)
35
36     ax = plt.subplot(8,2,subplots[index])
37
38     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
39            fontsize=26, fontweight='bold', va='top', ha='right')
40
41     plt.title(titles[index], fontsize=18)
42
43     x = np.array(df.index.values)
44     x_new = np.linspace(x.min(), x.max(), 300)
45
46     y = np.array(df['0'])
47     spl = make_interp_spline(x, y, k=3)
48     y_new = spl(x_new)
```



```
49 plt.plot(x_new, y_new, label="0")
50 plt.ylim(0)
51
52 y = np.array(df['1'])
53 spl = make_interp_spline(x, y, k=3)
54 y_new = spl(x_new)
55 plt.plot(x_new, y_new, label="1")
56 plt.ylim(0)
57
58 y = np.array(df['2'])
59 spl = make_interp_spline(x, y, k=3)
60 y_new = spl(x_new)
61 plt.plot(x_new, y_new, label="2")
62 plt.ylim(0)
63
64 y = np.array(df['3'])
65 spl = make_interp_spline(x, y, k=3)
66 y_new = spl(x_new)
67 plt.plot(x_new, y_new, label="3")
68 plt.ylim(0)
69
70 y = np.array(df['4'])
71 spl = make_interp_spline(x, y, k=3)
72 y_new = spl(x_new)
73 plt.plot(x_new, y_new, label="4")
74 plt.ylim(0)
75
76 y = np.array(df['5'])
77 spl = make_interp_spline(x, y, k=3)
78 y_new = spl(x_new)
79 plt.plot(x_new, y_new, label="5")
80 plt.ylim(0)
81
82 y = np.array(df['6'])
83 spl = make_interp_spline(x, y, k=3)
84 y_new = spl(x_new)
85 plt.plot(x_new, y_new, label="6")
86 plt.ylim(0)
87
88 y = np.array(df['7'])
89 spl = make_interp_spline(x, y, k=3)
90 y_new = spl(x_new)
91 plt.plot(x_new, y_new, label="7")
92 plt.ylim(0)
93
94 y = np.array(df['8'])
95 spl = make_interp_spline(x, y, k=3)
96 y_new = spl(x_new)
97 plt.plot(x_new, y_new, label="8")
98 plt.ylim(0)
99
100 y = np.array(df['9'])
101 spl = make_interp_spline(x, y, k=3)
102 y_new = spl(x_new)
103 plt.plot(x_new, y_new, label="9")
```

```
104 plt.ylim(0)
105
106 y = np.array(df['9'])
107 spl = make_interp_spline(x, y, k=3)
108 y_new = spl(x_new)
109 plt.plot(x_new, y_new, label="10")
110 plt.ylim(0)
111
112 plt.xticks(list(df.index))
113 plt.locator_params(axis='x', nbins=37)
114 plt.xlabel("Weeks", fontsize=16)
115 plt.ylabel(y_labels[index], fontsize=16)
116
117 legend = plt.legend()
118
119 plt.show
```

<function matplotlib.pyplot.show>



▼ Lockdowns for Optimal Lockdown Policy

```
1 path = "/content/drive/My Drive/simulations/dqn/lockdowns/automaton.csv"
2
3 titles = ["Lockdowns in Belfast",
4           "Lockdowns in Armagh City, Banbridge & Craigavon",
5           "Lockdowns in Newry, Mourne & Down",
6           "Lockdowns in Ards & North Down",
```

```
7         "Lockdowns in Derry City & Strabane",
8         "Lockdowns in Mid Ulster",
9         "Lockdowns in Lisburn & Castlereagh",
10        "Lockdowns in Causeway Coast & Glens",
11        "Lockdowns in Antrim & Newtownabbey",
12        "Lockdowns in Mid & East Antrim",
13        "Lockdowns in Fermanagh & Omagh"]
14
15 plt.figure(figsize=(23,30))
16
17 subplots = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
18 subplot_labels = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K']
19
20 for index in range(11):
21     df = pd.read_csv(path)
22
23     ax = plt.subplot(11,1,subplots[index])
24
25     ax.text(-0.05, 1.1, subplot_labels[index], transform=ax.transAxes,
26            fontsize=26, fontweight='bold', va='top', ha='right')
27
28     plt.title(titles[index], fontsize=16)
29
30
31     x = np.array(df.index.values)
32
33     y = np.array(df[str(index)])
34     plt.bar(x, y, label=index)
35     plt.ylim(0)
36
37     plt.xticks(list(df.index))
38
39     plt.locator_params(axis='x', nbins=37)
40     plt.xlabel("Weeks", fontsize=16)
41     plt.ylabel("Lockdown", fontsize=16)
42
43     plt.yticks(np.arange(0, 2, step=1))
44     plt.ylim((0,1.1))
45
46     legend = plt.legend()
47
48 plt.tight_layout()
49 plt.show
```

<function matplotlib.pyplot.show>



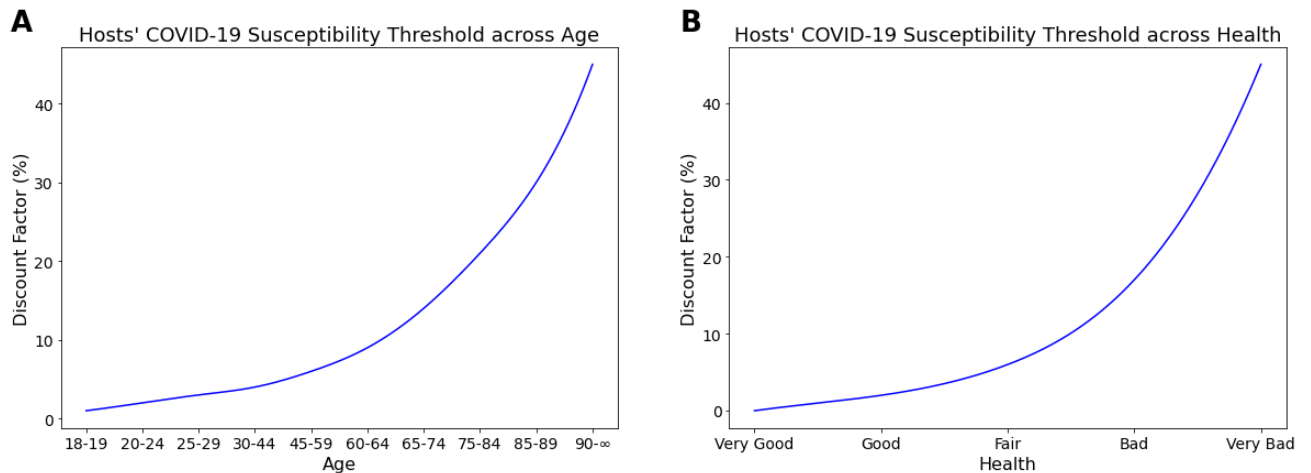
▼ COVID-19 Thresholds

```
1 plt.figure(figsize=(20,14))
2
3 subplots = [1, 2]
4 subplot_labels = ['A', 'B']
5
6 titles = ["Hosts' COVID-19 Susceptibility Threshold across Age", "Hosts' COVID-19 Susceptibility Threshold across Health"]
7 colours = ["blue", "blue"]
8 x_ticks = [[0,1,2,3,4,5,6,7,8,9], [0,1,2,3,4]]
9 x_val = [['18-19', '20-24', '25-29', '30-44', '45-59', '60-64', '65-74', '75-84', '85-89'], ['0-1', '2-4', '5-9', '10-14', '15-19', '20-24', '25-29', '30-34', '35-39', '40-44', '45-49', '50-54', '55-59', '60-64', '65-69', '70-74', '75-79', '80-84', '85-89']]
10 y_val = [[1, 2, 3, 4, 6, 9, 14, 21, 30, 45], [0, 2, 6, 17, 45]]
11 x_labels = ["Age", "Health"]
12
13 for i in range(2):
14     ax = plt.subplot(2,2,subplots[i])
15
16     ax.text(-0.05, 1.1, subplot_labels[i], transform=ax.transAxes,
17            fontsize=26, fontweight='bold', va='top', ha='right')
18
19     plt.title(titles[i], fontsize=18)
20
21     x = np.array(x_val[i])
22     y = np.array(y_val[i])
23
24     x = np.array(x_ticks[i])
25     x_new = np.linspace(x.min(), x.max(), 300)
26
27     spl = make_interp_spline(x, y, k=3)
28     y_new = spl(x_new)
29     plt.plot(x_new, y_new, color=colours[i])
30
```

```

31 plt.xticks(x_ticks[i], x_val[i])
32
33 plt.xlabel(x_labels[i], fontsize=16)
34 plt.ylabel("Discount Factor (%)", fontsize=16)
35
36 ax.tick_params(axis='both', labelsize=14)
37
38 plt.show()

```



▼ Lockdown Affects on Cases vs. Economic Impact

```

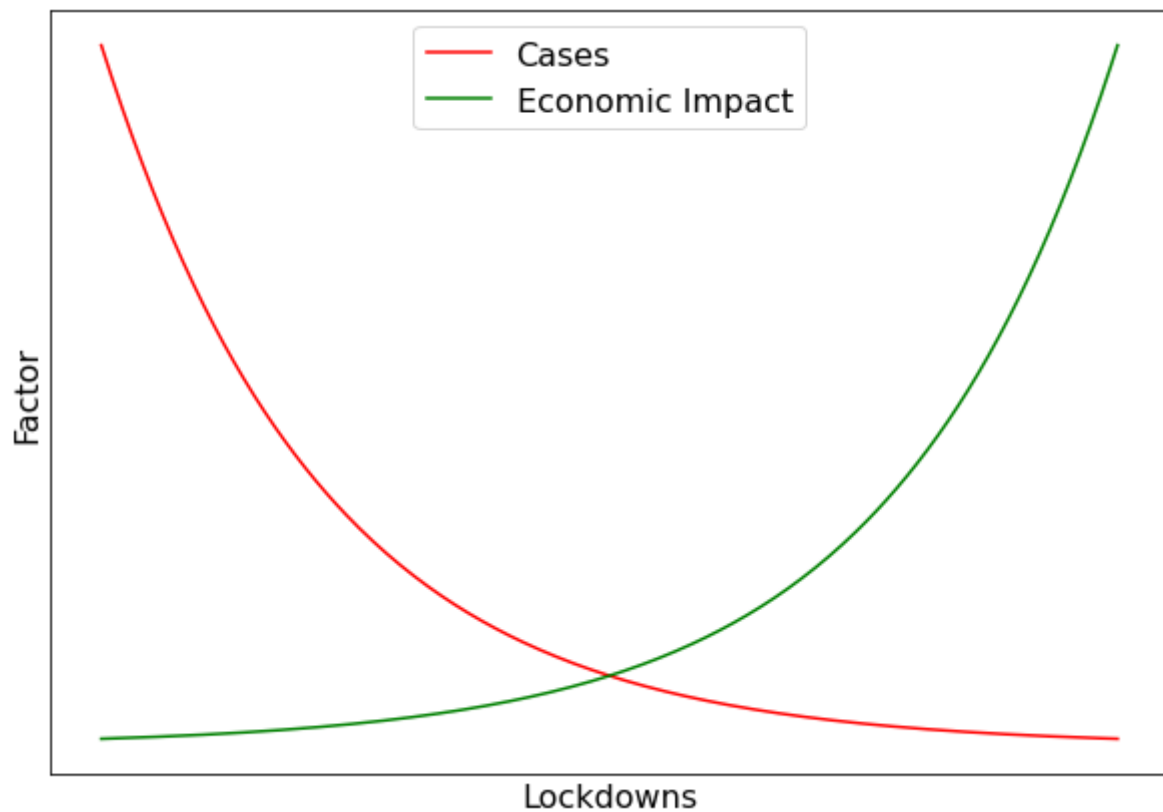
1 plt.figure(figsize=(10,7))
2
3 colours = ["red", "green"]
4 x_val = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
5 y_val = [[100.00, 63.10, 39.81, 25.12, 15.85, 10.00, 6.31, 3.98, 2.51, 1.58, 1.0],
6          [100.00, 63.10, 39.81, 25.12, 15.85, 10.00, 6.31, 3.98, 2.51, 1.58, 1.0]]
7
8
9 x = np.array(x_val)
10 y = np.array(y_val[0])
11
12 x_new = np.linspace(x.min(), x.max(), 300)
13
14 spl = make_interp_spline(x, y, k=3)
15 y_new = spl(x_new)
16 plot1 = plt.plot(x_new, y_new, label='Cases', color=colours[0])
17
18 y = np.array(y_val[1])

```

```

18 y = np.array(y_val[1])
19
20 spl = make_interp_spline(x, y, k=3)
21 y_new = spl(x_new)
22 plot2 = plt.plot(x_new, y_new, label='Economic Impact', color=colours[1])
23
24 plt.xlabel("Lockdowns", fontsize=16)
25 plt.ylabel("Factor", fontsize=16)
26
27 plt.tick_params(axis='both', which='both', bottom=False, left=False, labelbottom=False)
28
29 legend = plt.legend(fontsize=16)
30
31 plt.show()

```



✓ 0s completed at 13:07

