CEACOV RSA - Presentation to Care Probs

August 18, 2020

[2]:
```
import numpy as np
```

[27]:
```
# Mean duration of health states for each path

            # path:    #1  #2  #3  #4
durations = np.array([[2.6,2.6,2.6,2.6],  # pre-infectious incubation
                      [9.5,2.0,2.0,2.0],  # asymptomatic
                      [0.0,10.0,6.5,3.0], # mild/moderate
                      [0.0,0.0,10.5,7.1], # severe
                      [0.0,0.0,0.0,11.9], # critical
                      [0.0,0.0,0.0,5.7]]) # recuperation

# Age distribution
# 3 x 1 matrix
age_dist = np.array([0.47,  # 0-19
                     0.44,  # 20-59
                     0.09]) # 60+


# Severity distribution by age
# 4 x 3 matrix
                            # 0-19 # 20-59 # 60+
severity_dist = np.array([[0.5239,0.2620,0.1800],   # path 1
                          [0.4710,0.7195,0.7879],   # path 2
                          [0.0050,0.0118,0.0009],   # path 3
                          [0.0001,0.0067,0.0312]])  # path 4

# Multiply severity distribution by age distribution to get fraction of people␣
 ↪on each path
# 4 x 1 matrix

weights = np.matmul(severity_dist,age_dist)

# Take weighted average to get time spent in each disease state

# No symptoms
average_duration = np.zeros(6)
```

```
average_duration[0] = sum(durations[0,:]*weights)/sum(weights)          #␣
 ↪pre-infectious incubation
average_duration[1] = sum(durations[1,:]*weights)/sum(weights)          #␣
 ↪asymptomatic
average_duration[2] = sum(durations[2,1:]*weights[1:])/sum(weights[1:]) # mild/
 ↪moderate
average_duration[3] = sum(durations[3,2:]*weights[2:])/sum(weights[2:]) # severe
average_duration[4] = sum(durations[4,3:]*weights[3:])/sum(weights[3:]) #␣
 ↪critical
average_duration[5] = sum(durations[5,3:]*weights[3:])/sum(weights[3:]) #␣
 ↪recuperation
```

[45]:
```
# Daily probability by health state

# BC
BC = np.array([0.00,  # pre-infectious incubation
               0.00,  # asymptomatic
               0.30,  # mild/moderate
               1.00,  # severe
               1.00,  # critical
               1.00]) # recuperation

# CT
CT = np.array([0.10,
               0.10,
               0.35,
               1.00,
               1.00,
               1.00])

# CT+IC
CT_IC = np.array([0.10,
                  0.10,
                  0.35,
                  1.00,
                  1.00,
                  1.00])

# CT+IC+MSS
CT_IC_MSS = np.array([0.10,
                      0.10,
                      0.40,
                      1.00,
                      1.00,
                      1.00])

# CT+IC+QC
```

```
CT_IC_QC = np.array([0.10,
                     0.10,
                     0.35,
                     1.00,
                     1.00,
                     1.00])

# CT+IC+QC+MSS
CT_IC_QC_MSS = np.array([0.10,
                         0.10,
                         0.40,
                         1.00,
                         1.00,
                         1.00])

p1 = np.array([BC,
               CT,
               CT_IC,
               CT_IC_MSS,
               CT_IC_QC,
               CT_IC_QC_MSS])

t1 = np.array([average_duration,
               average_duration,
               average_duration,
               average_duration,
               average_duration,
               average_duration])

p1 = p1.T
t1 = t1.T
```

[46]:
```
def get_p2(p1,t1,t2):
    p2 = 1 - (1 - p1)**(t2/t1)
    return(p2)
```

[51]:
```
p2 = get_p2(p1,t1,1)
#print(np.round(p1,6))
#print(np.round(t1,6))
print(np.round(p2,4))
```

```
[[0.     0.0397 0.0397 0.0397 0.0397 0.0397]
 [0.     0.0216 0.0216 0.0216 0.0216 0.0216]
 [0.0354 0.0426 0.0426 0.0503 0.0426 0.0503]
 [1.     1.     1.     1.     1.     1.    ]
 [1.     1.     1.     1.     1.     1.    ]
 [1.     1.     1.     1.     1.     1.    ]]
```

	HT	HT+CT	HT+CT+IC	HT+CT+IC+MSS	HT+CT+IC+QC	HT+CT+IC+QC-
Susceptible	–	–	–	–	–	–
Incubation	0 %	10 %	10 %	10 %	10 %	10 %
Asymptomatic	0 %	10 %	10 %	10 %	10 %	10 %
Mild/Moderate	30 %	35 %	35 %	40 %	35 %	40 %
Severe	100 %	100 %	100 %	100 %	100 %	100 %
Critical	100 %	100 %	100 %	100 %	100 %	100 %
Recuperation	100 %	100 %	100 %	100 %	100 %	100 %
Recovered	–	–	–	–	–	–

	HT	HT+CT	HT+CT+IC	HT+CT+IC+MSS	HT+CT+IC+QC	HT+CT+IC+QC
Susceptible	–	–	–	–	–	–
Incubation	0 %	3.97 %	3.97 %	3.97 %	3.97 %	3.97 %
Asymptomatic	0 %	2.16 %	2.16 %	2.16 %	2.16 %	2.16 %
Mild/Moderate	3.54 %	4.26 %	4.26 %	5.03 %	4.26 %	5.03 %
Severe	100 %	100 %	100 %	100 %	100 %	100 %
Critical	100 %	100 %	100 %	100 %	100 %	100 %
Recuperation	100 %	100 %	100 %	100 %	100 %	100 %
Recovered	–	–	–	–	–	–

	Path 1	Path 2	Path 3	Path 4
Incubation	2.6	2.6	2.6	2.6
Asymptomatic	9.5	2.0	2.0	2.0
Mild/Moderate	–	10.0	6.5	3.0
Severe	–	–	10.5	7.1
Critical	–	–	–	11.9
Recuperation	–	–	–	5.7

	Path 1	Path 2	Path 3	Path 4
0-19	52.39 %	47.10 %	0.50 %	0.01 %
20-59	26.20 %	71.95 %	1.18 %	0.67 %
60+	18.00 %	78.79 %	0.09 %	3.12 %

	Percentage of Population
0-19	47 %
20-59	44 %
60+	9 %

	Average Duration of Health State
Susceptible	–
Incubation	2.6
Asymptomatic	4.83
Mild/Moderate	9.89
Severe	9.03
Critical	11.9
Recuperation	5.7
Recovered	–

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