

## 12-15 vuotiaiden rokottaminen/koodit

```
1 % LastenRooliROssa
2 clear
3
4 kuvat = 0;
5
6 alue = 1:21; % Koko Suomi
7 [Nalue,POP10alue,POP5alue] = populationALUE(alue);
8
9 % Contact structure for each period: T M VAIHTAA VAIN IK RYHMIEN
10 % KESKIN ISTEN KONTAKTIEN RAKENNETTA, KONTAKTIEN TASO RO MUUTOKSEN KAUTTA!
11 RestrictionInfo = ...
12 { 1, {}, 1, 0; % Old polymod, no restrictions, estimated
13 1, ... % Old polymod
14 {1:4, 1:4, 0.5; % Schoold closures reduce contacts among 0-19
15 1:4, 5:12, 0.3; % School closures, from children to adults
16 5:12, 1:4, 0.3; % School cllosures, from adults to children
17 15:18, 15:18, 0.5; % Isolation of elderies, among 70+
18 15:18, 1:14, 0.5; % Isolation of elderies, 70+ to younger
19 1:14,15:18, 0.5;},... % Isolation of elderis, younger to 70+
20 1, 0; % Estimated, no R0val
21 1, ... % Old polymod
22 {4, 4, 0.5; % Schoold closures reduce contacts among 15-19
23 4, 5:12, 0.3; % School closures, from 15-19 to adults
24 5:12, 4, 0.3; % School cllosures, from adults to 15-19
25 15:18, 15:18, 0.5; % Isolation of elderies, among 70+
26 15:18, 1:14, 0.5; % Isolation of elderies, 70+ to younger
27 1:14,15:18, 0.5;},... % Isolation of elderis, younger to 70+
28 1, 0; % No reference, no R0val
29 1, ...
30 {4, 4, 0.25; % Schoold closures reduce contacts among 15-19
31 4, 5:12, 0.3; % School closures, from 15-19 to adults
32 5:12, 4, 0.3; % School cllosures, from adults to 15-19
33 15:16, 15:16, 0.25; % Isolation of elderies, among 70-79+
34 15:16, 1:14, 0.25; % Isolation of elderies, 70-79 to younger
35 1:14,15:16, 0.25; % Isolation of elderis, younger to 70-79
36 17:18, 17:18, 0.5; % Isolation of elderies, among 70-79+
37 17:18, 1:16, 0.5; % Isolation of elderies, 70-79 to younger
38 1:16,17:18, 0.5;},... % Isolation of elderis, younger to 70-79
39 1, 0; % No reference, no R0val
40
41 CS = polymod3_0(1,RestrictionInfo{1,2},POP5alue,0);
42 CS2 = polymod3_0(1,RestrictionInfo{2,2},POP5alue,0);
43 CS3 = polymod3_0(1,RestrictionInfo{3,2},POP5alue,0);
44 CS4 = polymod3_0(1,RestrictionInfo{4,2},POP5alue,0);
45
46 % Ik kohtaiset reduktiot tartuttavuuteen ja alttiuteen:
47 relSUS = [.5; % 0-
48 .75; % 10-
49 1; % 20-
50 1; % 30-
51 1; % 40-
52 1; % 50-
53 1; % 60-
54 1; % 70-
55 1]; % 80-
56
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57 % Nyt kytetty
58 relINF2 = [.3 %.5; % 0-
59     .6 %.5; % 10-
60     1; % 20-
61     1; % 30-
62     1; % 40-
63     1; % 50-
64     1; % 60-
65     1; % 70-
66     1]; % 80-
67 % hybridi
68 relINF = [.5; % 0-
69     .5; % 10-
70     1; % 20-
71     1; % 30-
72     1; % 40-
73     1; % 50-
74     1; % 60-
75     1; % 70-
76     1]; % 80-
77
78 % Skaalaus
79 CS1 = diag(relSUS)*CS*diag(relINF2);
80 CS1 = CS1/eigs(CS1,1);
81
82 CS2 = diag(relSUS)*CS2*diag(relINF);
83 CS2 = CS2/eigs(CS2,1);
84
85 CS3 = diag(relSUS)*CS3*diag(relINF);
86 CS3 = CS3/eigs(CS3,1);
87
88 CS4 = diag(relSUS)*CS4*diag(relINF2);
89 CS4 = CS4/eigs(CS4,1);
90
91 figure(1)
92 subplot(1,3,1)
93 image(CS*255)
94 title('Polymod')
95 subplot(1,3,2)
96 image(CS3*255)
97 title('Hybridiraportti')
98 subplot(1,3,3)
99 image(CS4*255)
100 title('Nyt')
101
102 ROv = 1:0.2:5;
103 rOm = length(ROv);
104
105 rkatv = .5:0.05:1;
106 rkatm = length(rkatv);
107
108 VEsv = 0.4:0.2:0.8;
109 vesm = length(VEsv);
110
111 ROTulos1 = zeros(rkatm,vesm);
112 ROTulos2 = zeros(rkatm,vesm);
113
114 CSnow = CS4'; % Kontaktimatriisi skaalattu R0:n avulla NGM-matriisi muotoon
115 %CSnow = CS3'; % Kontaktimatriisi skaalattu R0:n avulla NGM-matriisi muotoon

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116 %CSnow = CS1'; % Kontaktimatriisi skaalattu R0:n avulla NGM-matriisi muotoon
117
118 % [V0,L0] = eig(CSnow);
119 % V0 = abs(V0(:,1));
120 % V0 = V0/sum(V0);
121
122 for j1=1:rkmatm
123     for j2 = 1:vesm
124
125         % Rokotuskattavuus:
126         rkat = rkatv(j1);
127
128
129         % 16+ rokotetaan
130         Rk = rkat*[0;
131             .4; % osuus ik ryhm st rokotuskohteena
132             ones(7,1)];
133
134         VEs = VEsV(j2); % Alttiutta vastaan teho
135         VEt = 0.5; % Tartuttavuutta vastaan teho (ehdolla ett rokotettu saanut tartunnan)
136
137         Rk1 = Rk*ones(1,9);
138
139         CSV1B = [(1-VEs)*(1-VEt)*CSnow.*Rk1', (1-VEt)*CSnow.*(1-Rk1');
140             CSnow.*Rk1'*(1-VEs), CSnow.*(1-Rk1')];
141
142
143         RROV1 = eigs(CSV1B,1);
144
145         R0tulos1(j1,j2) = 1-RROV1;
146
147         % Rokotuskattavuus, 12+ rokotetaan:
148         Rk = rkat*[0;
149             .8; % osuus ik ryhm st rokotuskohteena
150             ones(7,1)];
151
152         Rk1 = Rk*ones(1,9);
153
154         CSV2B = [(1-VEs)*(1-VEt)*CSnow.*Rk1', (1-VEt)*CSnow.*(1-Rk1');
155             CSnow.*Rk1'*(1-VEs), CSnow.*(1-Rk1')];
156
157         RROV2 = eigs(CSV2B,1);
158         R0tulos2(j1,j2) = 1-RROV2;
159
160     end
161 end
162
163
164 figure(5)
165 clf
166 plot(rkatv,R0tulos1,'LineWidth',2)
167 h=legend(num2str(VEsV),'Location','NorthWest','AutoUpdate','off');
168 title(h,'VE/alttius')
169 hold on
170 set(gca,'ColorOrderIndex',1);
171 plot(rkatv,R0tulos2,'-','LineWidth',2)
172 hold off
173 set(gca,'xlim',[min(rkatv),1],'ylim',[0,1]);
174 xlabel('Rokotuskattavuus')

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175 ylabel('1 - R_{eff}/R_0')
176 grid
177
178 figure(6)
179 clf
180 r0v = [1.5,2,2.5];
181 for j1 = 1:3
182 RO = r0v(j1);
183 subplot(1,3,j1)
184 plot(rkatv,RO*(1-ROtulos1),'LineWidth',2)
185 hold on
186 h=legend(num2str(VEsv'),'Location','NorthEast','AutoUpdate','off');
187 title(h,'VE/alttius')
188 set(gca,'ColorOrderIndex',1);
189 plot(rkatv,RO*(1-ROtulos2),'-','LineWidth',2)
190 plot([0,1],[1 1],'k','LineWidth',2)
191 plot([0.67,.75],[1.75 1.75],'k','LineWidth',2)
192 plot([0.67,.75],[1.65 1.65],'k-','LineWidth',2)
193 text(0.76,1.65,'12+')
194 text(0.76,1.75,'16+')
195 text(0.67,1.85,'Kohdev est ')
196
197 hold off
198 set(gca,'xlim',[min(rkatv),1],'ylim',[0,2]);
199 xlabel('Rokotuskattavuus')
200 ylabel('Tehollinen tartuttavuusluku')
201 title(['Tehollinen tartuttavuusluku, kun R_0 = ',num2str(RO)])
202 grid
203
204 end
205
206 rkatV = [ 0,.93,.93,.93,.93,.93,.93,.95,.93;
207          0,.80,.80,.80,.82,.86,.90,.95,.93;
208          0,.60,.65,.70,.75,.80,.85,.95,.93]';
209
210 ROTulos1B = zeros(3,vesm);
211 ROTulos2B = zeros(3,vesm);
212
213 for j1=1:3
214     for j2 = 1:vesm
215
216         % Rokotuskattavuus 16+:
217         rkat = rkatV(:,j1);
218         Rk = rkat.*[0;
219                   .4; % osuus ik ryhm st rokotuskohteena
220                   ones(7,1)];
221
222         VEs = VEsv(j2); % Alttiutta vastaan teho
223         VEt = 0.5; % Tartuttavuutta vastaan teho (ehdolla ett rokotettu saanut tartunnan)
224
225         Rk1 = Rk*ones(1,9);
226
227         CSV1B = [(1-VEs)*(1-VEt)*CSnow.*Rk1', (1-VEt)*CSnow.*(1-Rk1');
228                 CSnow.*Rk1'*(1-VEs), CSnow.*(1-Rk1')];
229
230         RROV1 = eigs(CSV1B,1);
231         ROTulos1B(j1,j2) = 1-RROV1;
232
233         % Rokotuskattavuus 12+:

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234     Rk = rkat.*[0;
235         .8; % osuus ik ryhm st rokotuskohteena
236         ones(7,1)];
237
238     Rk1 = Rk*ones(1,9);
239
240     CSV2B = [(1-VEs)*(1-VEt)*CSnow.*Rk1', (1-VEt)*CSnow.*(1-Rk1')];
241             CSnow.*Rk1'*(1-VEs), CSnow.*(1-Rk1')];
242
243     RROV2 = eigs(CSV2B,1);
244     R0tulos2B(j1,j2) = 1-RROV2;
245
246     end
247 end
248
249 ikaryhmat = {'0-9';
250             '16-19/12-19';
251             '20-29';
252             '30-39';
253             '40-49';
254             '50-59';
255             '60-69';
256             '70-79';
257             '80+'};
258 ikaryhmat(1) = [];
259
260 roksken = {'Erinomainen';
261           'Hyv ';
262           'Heikko'};
263 figure(7)
264 clf
265 merkki = 'oxs';
266 for j1=1:3
267     plot(0:10:80,rkatV(:,j1),merkki(j1),'LineWidth',2)
268     hold on
269     end
270     set(gca,'Xtick',10:10:80,'XtickLabel',ikaryhmat,'xlim',[6,84],'ylim',[0.5,1],...
271         'tickdir','out','box','off')
272     legend(roksken,'Location','SouthEast');
273     title('Rokotusskenaario')
274
275 figure(8)
276 clf
277 r0v = (1:.1:5)';
278 for j2 = 1:3
279     subplot(1,3,j2)
280     plot(r0v,r0v*(1-R0tulos1B(:,j2)),'LineWidth',2)
281     hold on
282     h=legend(roksken,'Location','NorthWest','AutoUpdate','off');
283     title(h,'Rokotusskenaario')
284     set(gca,'ColorOrderIndex',1);
285     plot(r0v,r0v*(1-R0tulos2B(:,j2)),'-.','LineWidth',2)
286     plot([1,5],[1 1],'k','LineWidth',2)
287     plot([1.25,1.75],[1.8 1.8],'k','LineWidth',2)
288     plot([1.25,1.75],[1.6 1.6],'k-','LineWidth',2)
289     text(1.8,1.6,'12+')
290     text(1.8,1.8,'16+')
291     text(1.25,2,'Kohdevest ')
292     set(gca,'xlim',[1,5],'ylim',[0 3])

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293 title(['Tehollinen R, kun VE ', num2str(VEsv(j2))])
294 xlabel('R_0')
295 ylabel('Tehollinen R')
296 end

1 function [Nalue, POP10alue, POP5alue] = populationALUE(alue)
2
3 % Total population by SHP:
4 Nkaikki = [1685983 127757 164456 210057 244236 98823 40258 252716 164465 410112 72306 77304
5 116866 60295 537226 193207 170925 482169 216752 169495 29884
6 ];
7
8 % Age-group-specific population by SHP: (0-4,5-9,...,80-84,85-)
9 popkaikki = [85706 4710 6029 8534 10332 3596 1234 11545 6487 22199 2738 4189 4877 2565 24612
10 9191 7043 21078 8948 8797 1514
11 96660 6034 7711 10551 12543 4442 1668 14392 8115 28083 3581 5154 6141 3314 29619 11258 9016
12 25031 11086 10162 1726
13 94648 6296 8180 11270 12738 4803 1806 14501 8167 28586 3806 5076 6039 3474 29674 11498 9977
14 25009 11470 10105 1702
15 88890 6272 8404 11112 12977 4905 2065 13820 8296 26113 3611 4736 5794 3367 28137 11379 9505
16 24981 11261 9485 1561
17 97500 7340 7296 10033 13604 4582 1526 17271 9943 25429 3291 3781 6414 2702 33772 9204 7813
18 29907 10525 10711 1300
19 128261 6641 7990 11296 14445 4577 1623 16928 9698 26142 3532 4114 7188 2980 36316 10083 8516
20 31696 11313 10661 1685
21 129496 6533 8331 11197 13921 4788 1709 15271 9002 24753 3547 4413 6965 3004 35464 10215 8968
22 29582 11533 10218 1858
23 127733 7145 9199 12134 14399 5017 1852 15767 9296 26431 3871 4576 6968 3329 36090 11242 10040
24 30677 12570 10535 1911
25 120392 7272 9572 12239 13328 5017 1922 14979 8520 25512 3625 4476 6132 3337 34107 10798 10538
26 30250 12496 10122 1841
27 104683 7154 9364 11990 12645 5119 2064 13484 7986 22161 3535 4016 5608 3076 30682 10174 10038
28 27454 11748 9443 1949
29 112778 8478 11354 14115 15619 6460 2716 14792 9850 23810 4605 4679 7388 3690 33334 12152 11747
30 31580 14232 10247 2168
31 108002 9277 12342 14691 17712 7632 3247 16597 12052 25097 5733 4808 9113 4496 33816 13154 12318
32 31482 15271 10041 1990
33 94369 9622 12668 14788 18400 8261 3587 16498 13394 25455 6230 4996 9518 4814 33012 13764 12213
34 30647 15421 10069 1893
35 86789 9879 12845 16052 18419 8495 3746 16606 13297 24743 6306 5198 8866 4995 33392 14198 12465
36 31741 16496 10487 1945
37 88170 9503 13127 16266 16915 8084 3637 16120 12036 22083 5432 5224 7642 4463 33824 13510 12377
38 32201 16496 10722 1899
39 53062 6073 7969 9951 10170 5138 2234 9640 7244 13278 3401 3163 4768 2536 20646 7881 7274
40 19507 10167 6787 1288
41 36375 4857 6112 7334 8253 4119 1875 7581 5719 10579 2850 2334 4026 2137 15695 6729 5710
42 14728 8266 5306 811
43 32469 4671 5963 6504 7816 3788 1747 6924 5363 9658 2612 2371 3419 2016 15034 6777 5367
44 14618 7453 5597 843];
45
46
47 % 10-year age groups
48 popkaikki2 = popkaikki(1:2:17,:) + popkaikki(2:2:18,:);
49
50 Nalue = sum(Nkaikki(alue));
51 POP10alue = sum(popkaikki2(:, alue), 2) / Nalue;
52 POP5alue = sum(popkaikki(:, alue), 2) / Nalue;

1 function [CS, CSseig] = polymod3_0(polymodversion, ...
2 RestrictionInfo, pop5, kuva)

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```

3 % function [CS,ika,n,p,GSeig] = polymodV3_0(polymodversion,...
4 %     RestrictionInfo,pop5,kuva)
5
6
7 if ~exist('kuva','var')
8     kuva = 0;
9 end
10
11 if polymodversion==1
12 % Polymod kontaktimatriisi - ladattu
13 % M(i,j) ik ryhm n j yksil n kontaktit ik ryhm n i pr pv
14 M = [1.41 0.78 0.29 0.17 0.12 0.53 0.65 0.40 0.17 0.19 0.14 0.08 0.31 0.05 0.12
15     0.81 2.30 0.71 0.22 0.00 0.30 0.23 0.60 0.32 0.23 0.10 0.07 0.18 0.05 0.00
16     0.25 0.93 3.68 0.67 0.16 0.02 0.28 0.48 0.62 0.31 0.03 0.07 0.03 0.08 0.00
17     0.16 0.15 0.51 1.59 0.33 0.18 0.03 0.02 0.25 0.38 0.10 0.05 0.03 0.06 0.04
18     0.11 0.14 0.08 0.30 1.03 0.54 0.20 0.06 0.08 0.19 0.10 0.05 0.02 0.03 0.00
19     0.47 0.23 0.10 0.16 0.47 0.93 0.22 0.23 0.13 0.05 0.20 0.15 0.16 0.06 0.08
20     0.68 0.53 0.19 0.10 0.10 0.49 0.68 0.37 0.27 0.22 0.10 0.23 0.18 0.08 0.00
21     0.56 0.63 0.42 0.15 0.07 0.12 0.40 0.58 0.20 0.16 0.14 0.13 0.08 0.06 0.15
22     0.36 0.66 0.70 0.24 0.05 0.14 0.15 0.24 0.75 0.30 0.24 0.17 0.27 0.14 0.12
23     0.26 0.29 0.44 0.41 0.09 0.09 0.20 0.21 0.47 0.45 0.32 0.22 0.08 0.11 0.08
24     0.22 0.21 0.22 0.16 0.24 0.26 0.18 0.18 0.32 0.39 0.42 0.43 0.19 0.11 0.15
25     0.15 0.13 0.06 0.08 0.07 0.05 0.15 0.10 0.07 0.11 0.27 0.48 0.42 0.14 0.12
26     0.34 0.19 0.04 0.06 0.00 0.09 0.22 0.03 0.07 0.06 0.08 0.18 0.73 0.23 0.19
27     0.16 0.14 0.05 0.02 0.00 0.02 0.03 0.05 0.08 0.03 0.08 0.07 0.27 0.31 0.50
28     0.07 0.11 0.12 0.07 0.03 0.00 0.07 0.08 0.20 0.09 0.17 0.05 0.31 0.31 1.15];
29 else
30     disp('Error. Polymod version does not exist')
31     return
32 end
33
34 mm = size(M,1); % viimeinen on t ss 70+
35 % 75-79,80-84,85+, jotta seuraavat sujuu
36 m2m = mm+3;
37
38 % Laajennus m2m ik ryhmiin
39 M2 = M;
40 m2m = mm; % Huom! V liaikaisesti pieneni!
41 for j = 1:3
42     M2new = zeros(m2m+1);
43     M2new(1:(m2m-1),1:m2m) = M2(1:(m2m-1),1:m2m); % Kontaktit -69v asti sama suuruus
44     % Kontaktit 70-74 ja 75+ ryhmiin jakautuu v est n suhteessa
45     pm2m = pop5(m2m); % viimeisin mukana
46     pm2mplus = sum(pop5((m2m+1):end));
47     pmtot = pm2m+pm2mplus;
48     M2new(m2m,(1:m2m)) = (pm2m/pmtot)*M2(m2m,:);
49     M2new(m2m+1,(1:m2m)) = (pm2mplus/pmtot)*M2(m2m,:); % Sarakesummat s ilyv t!
50     % saman verran tekev t m2m+1 ryhm :
51     M2new(:,m2m+1) = M2new(:,m2m);
52     M2 = M2new;
53     m2m = size(M2,1);
54     %keyboard
55 end
56
57 % RAJOITTEET:
58 restlkm = size(RestrictionInfo,1);
59
60 M4 = M2;
61

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```

62 for jr = 1:restlkm
63     FromInd = RestrictionInfo{jr,1};
64     ToInd = RestrictionInfo{jr,2};
65     rr = RestrictionInfo{jr,3};
66     M4(ToInd,FromInd) = (1-rr)*M4(ToInd,FromInd);
67 end
68
69 % 10-vuotis ik ryhmiin siirtyminen
70 m4m = m2m/2;
71 M5 = zeros(m4m);
72
73 for i1 = 1:m4m % RIVI
74     for j1 = 1:m4m % SARAKE
75         indsar1 = 2*(j1-1)*m2m+2*(i1-1)+(1:2);
76         indsar2 = indsar1+m2m;
77         vind1 = 2*(j1-1)+1;
78         vind2 = vind1+1; % j -indeksi (kontaktien tekij t)
79         M5(i1,j1) = ...
80             (pop5(vind1)*sum(M4(indsar1))+pop5(vind2)*sum(M4(indsar2)))/(pop5(vind1)+pop5(vind2));
81         %pause
82     end
83 end
84
85 % My s v kim r t 10v-ryhmiin - n m output:
86 pop10 = sum(reshape(pop5,2,m4m));
87
88 invp = pop10.^(-1);
89
90 % Balanssointi
91 CS = 0.5*(M5 + M5'.*(pop10(:)*invp));
92 CSeig = eigs(CS,1);
93 CS = CS/CSeig;
94
95 if kuva
96     figure(kuva)
97     colormap hot
98     h = colormap;
99     hm = size(h,1);
100    h = h(hm:-1:1,:);
101    colormap(h)
102    subplot(1,3,1)
103    imagesc(M)
104    colorbar
105    title('Alkuperinen')
106    subplot(1,3,2)
107    imagesc(M2)
108    colorbar
109    title('Ik jatko')
110    subplot(1,3,3)
111    imagesc(M4)
112    colorbar
113    title('Rajoitukset')
114
115    figure(kuva+1)
116    colormap(h)
117    subplot(1,2,1)
118    imagesc(M5)
119    title('Ei balanssointia')
120    colorbar

```



```
121 subplot(1,2,2)
122 imagesc(CS)
123 title('Balanssoitu, skaalattu')
124 colorbar
125 end
126
127 %keyboard
128
129 % CS(i,j) = ik ryhm n j kontakti ik ryhm n i
```