Data analysis on COVID-19 in Italians regions (06-04-2020)

Data from : https://github.com/pcm-dpc/COVID-19

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```
clear all
close all
warning off;

% Add the function folder
path1 = '\COVID-19-master\dati-province';
addpath(genpath([pwd,path1]))
path2 = '\COVID-19-master\dati-regioni';
addpath(genpath([pwd,path2]))
path3 = '\COVID-19-master\dati-aree';
addpath(genpath([pwd,path3]))
path4 = '\fnc';
addpath(genpath([pwd,path4]))
```

Upload the data

```
% Upload all the filename in a variable 'date'
files_names
for j = 1:length(date)
    name_file = [prefix,date(j,:),'.csv'];
    TT(j).T = readtable(name_file);
end
```

Select the regions to compare

```
% Region code:
% 1  : Piemonte                    | 11 : Marche
% 2  : Valle d'Aosta               | 12 : Lazio
% 3  : Lombardia                   | 13 : Abruzzo
% 4  : P.A. Trento                 | 14 : Molise
% 5  : Veneto                      | 15 : Campania
% 6  : Friuli Venezia Giulia       | 16 : Puglia
% 7  : Liguria                     | 17 : Basilicata
% 8  : Emilia-Romagna              | 18 : Calabria
% 9  : Toscana                     | 19 : Sicilia
% 10 : Umbria                      | 20 : Sardegna
Region_ID = [3, 5, 8];
% Regions population
Region_pop = [4392526, 126883, 10018806, 1062860, 4907529, 1217872,...
    1565307, 4448841, 3742437, 888908, 1538055, 5898124, 1322247,...
    310449, 5839084, 4063888, 570365, 1965128, 5056.641, 1653135];
```

Extract all the data for the reagion

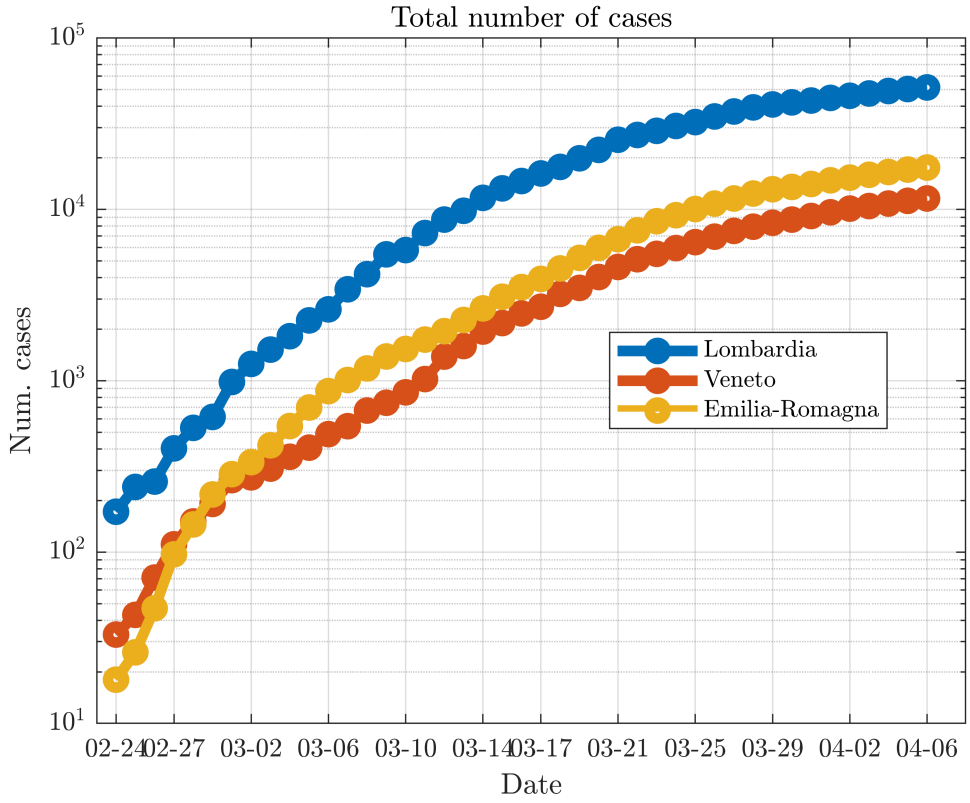
```
Date = [];
```

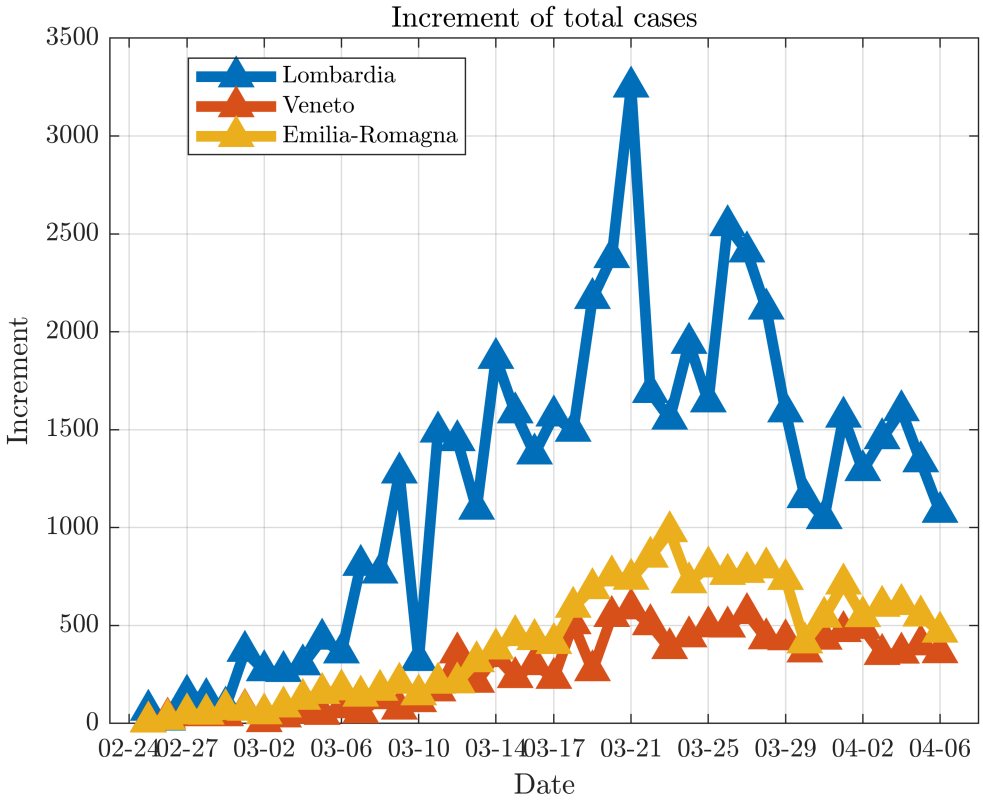
```
for j = 1:length(Region_ID)
    Region_Data = []; Date = [];
    for i = 1:length(TT)
        % Select the table row associated to the reagion
        ind_Region = find(TT(i).T.codice_regione == Region_ID(j));
        % The days associated to the data
        Date = [Date; cell2mat(TT(i).T.data(ind_Region))];
        %  Data of the contagion
        Region_Data = [Region_Data;
                    TT(i).T.ricoverati_con_sintomi(ind_Region),...  % # hospitalized
                    TT(i).T.totale_positivi(ind_Region),...         % total positives
                    TT(i).T.nuovi_positivi(ind_Region),...          % new cases
                    TT(i).T.deceduti(ind_Region),...                % deaths
                    TT(i).T.totale_casi(ind_Region),...             % total cases
                    TT(i).T.tamponi(ind_Region),...                 % total tests
                    Region_pop(Region_ID(j))];                      % region population
    end
    % In some cases the data are wrong, i.e., tot number of tests is decreasing.
    % Fixed by putting the the same number of test as the previous day
    tot_tst = Region_Data(:,6); tot_tst2 = [0;Region_Data(:,6)]; tot_tst2(end) = [];
    ind_bad_test = find(tot_tst-tot_tst2 < 0); ind_bad_test2 = ind_bad_test-1;
    tot_tst(ind_bad_test) = tot_tst(ind_bad_test2);
    % number of daily test
    Region_Data(:,6) = tot_tst; tot_tst2 = [0;Region_Data(:,6)]; tot_tst2(end) = [];
    daily_tst = tot_tst-tot_tst2;
    Region_Data = [Region_Data, daily_tst];
    %%
    Region_cmp(j).name = TT(i).T.denominazione_regione(ind_Region);
    Region_cmp(j).data = Region_Data;
end
% Trim dates string
Date = Date(:,6:10);
```

1) Total number of cases and increment

```
leg = strings(1,length(Region_cmp));leg2 = strings(1,length(Region_cmp));
for l = 1:length(Region_cmp)
    cases = Region_cmp(l).data(:,5);
    figure(1);
    semilogy(1:length(Date),cases,'o-','Linewidth',4)
    grid on; hold on
    title('Total number of cases');
    plot_style;
    ax.YAxis.Label.String = 'Num. cases';
    leg(l) = Region_cmp(l).name;
    [a,b] = legend(leg,'Location','best'); a.Interpreter = 'latex';

    figure(2)
    increment = cases- circshift(cases,1); increment(1) = NaN;
    plot(1:length(Date),increment,'^-','Linewidth',4)
    grid on; hold on
    title('Increment of total cases');
    plot_style;
    ax.YAxis.Label.String = 'Increment';
    leg2(l) = Region_cmp(l).name;
    [c,d] = legend(leg2,'Location','best'); c.Interpreter = 'latex';
```

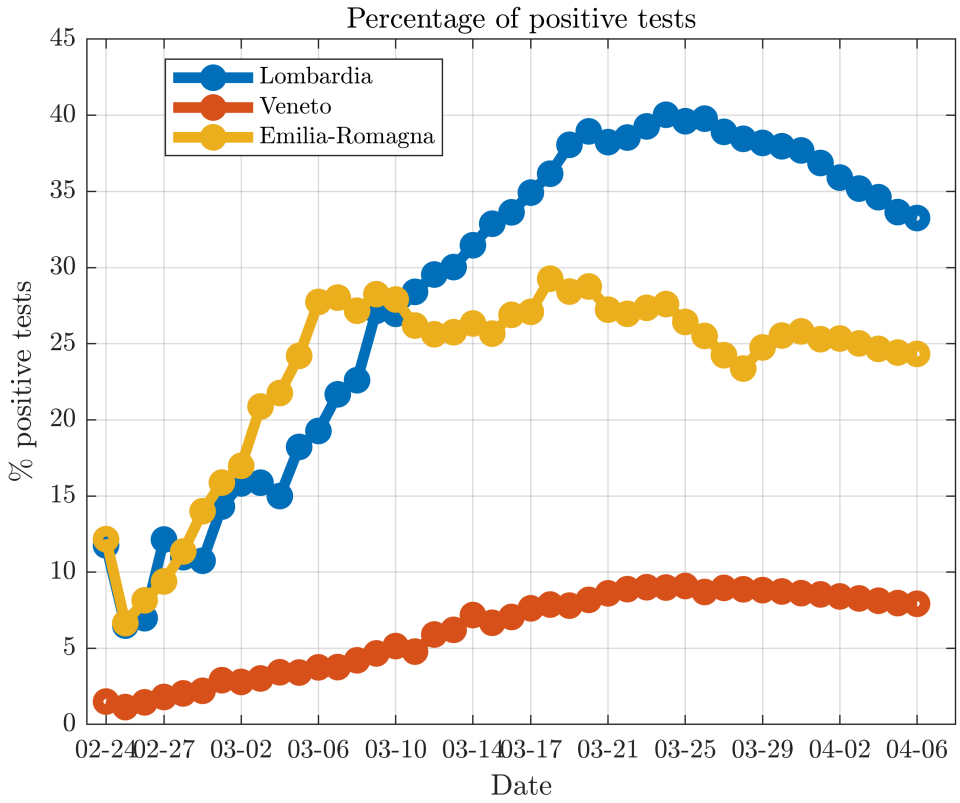
```
end
```


Total number of cases
Num. cases
Date
Lombardia
Veneto
Emilia-Romagna
10^5
10^4
10^3
10^2
10^1
02-24 02-27 03-02 03-06 03-10 03-14 03-17 03-21 03-25 03-29 04-02 04-06


Increment of total cases
Increment
Date
Lombardia
Veneto
Emilia-Romagna
3500
3000
2500
2000
1500
1000
500
0
02-24 02-27 03-02 03-06 03-10 03-14 03-17 03-21 03-25 03-29 04-02 04-06

2) Percentage of tests resulted positive

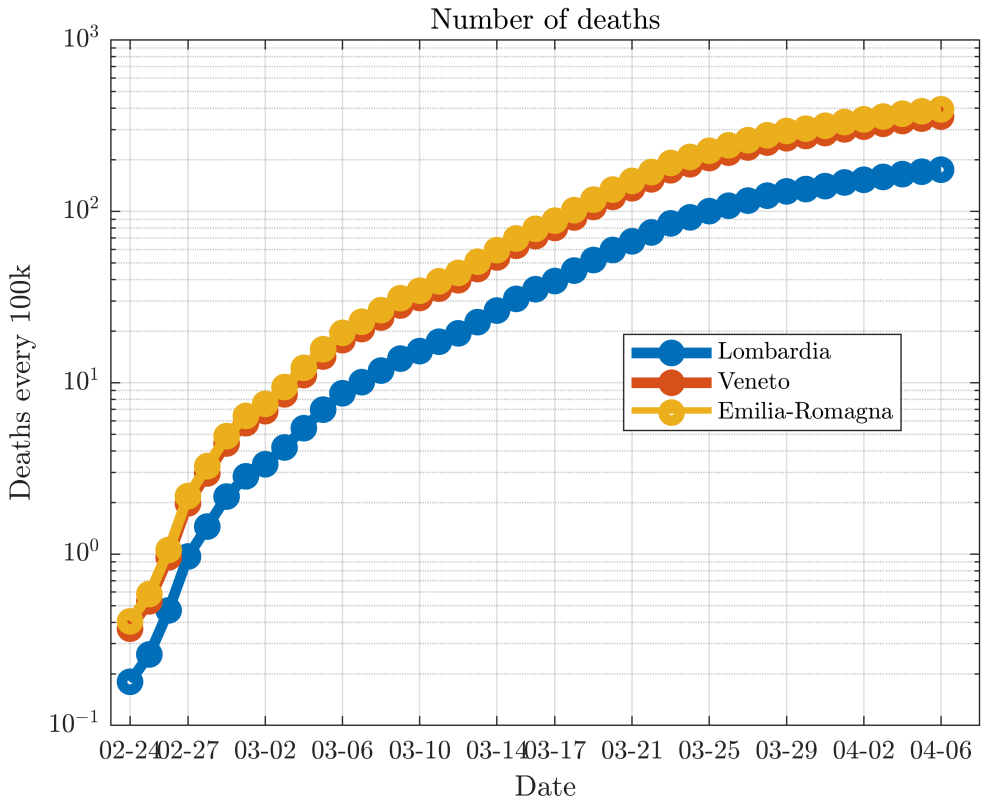
```
leg = strings(1,length(Region_cmp));
for l = 1:length(Region_cmp)
    cases = Region_cmp(l).data(:,5);
    total_cases = Region_cmp(l).data(:,5); d_tests = Region_cmp(l).data(:,6);
    % Percentage of positive tests
    perc_tst = total_cases./d_tests*100;

    figure(3)
    plot(1:length(Date),perc_tst,'o-','Linewidth',4)
    grid on; hold on
    title('Percentage of positive tests');
    plot_style;
    ax.YAxis.Label.String = '\% positive tests';
    leg(l) = Region_cmp(l).name;
    [a,b] = legend(leg,'Location','best'); a.Interpreter = 'latex';

end
```



3) Number of death per 100k

```
leg = strings(1,length(Region_cmp));
for l = 1:length(Region_cmp)
    deaths = Region_cmp(l).data(:,4);
    pop = Region_cmp(l).data(:,7);
    figure(4)
```

```
    semilogy(1:length(Date),cases./pop*10^5,'o-','Linewidth',4)
    grid on; hold on;
    title('Number of deaths');
    plot_style;
    ax.YAxis.Label.String = 'Deaths every 100k';
    leg(l) = Region_cmp(l).name;
    [a,b] = legend(leg,'Location','best'); a.Interpreter = 'latex';
end
```

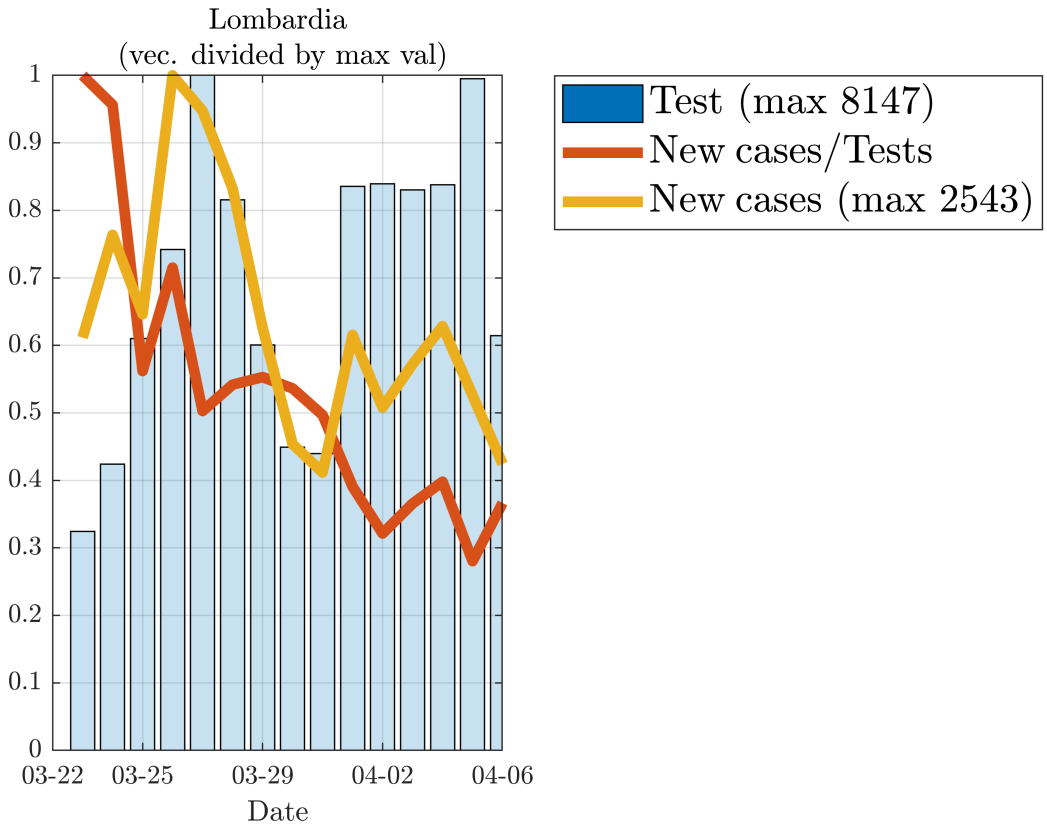


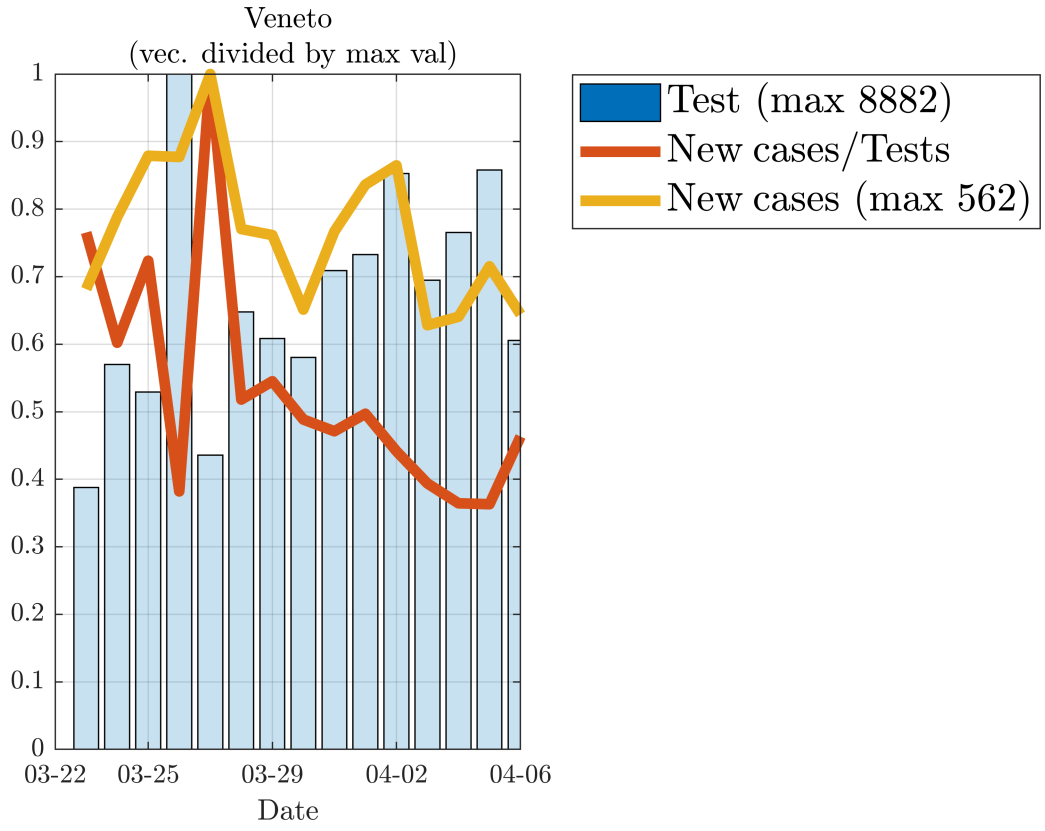
4) Number of cases normalized for tests (last 20 days)

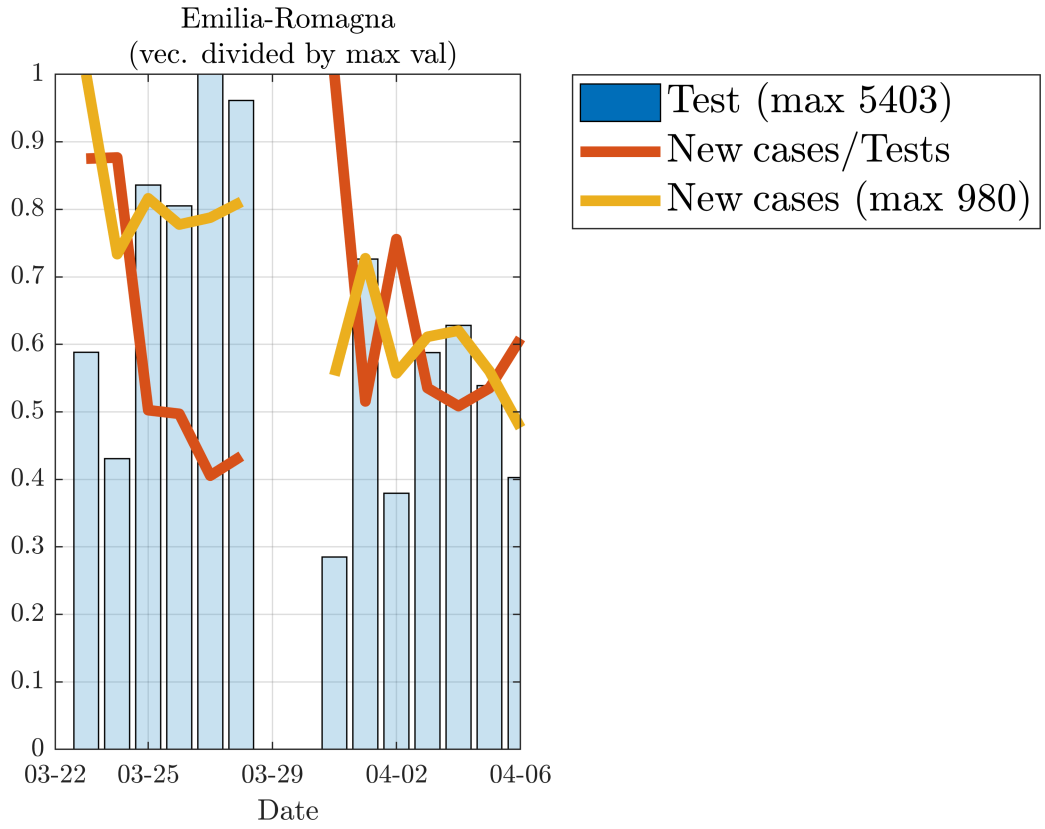
Every vector is divided by its maximum value to facilitate the plot. The "number of cases/ daily tests" is interesting because it takes into account the variation w.r.t. the growing number of tests performed. Therefore, it shows how some fast increments in the number of daily infected may be due to the increment in tests and not to a faster spread of the dissease.

```
N = 15; % number of days to consider
for l = 1:length(Region_cmp)
    nuovi_pos = Region_cmp(l).data(:,3); nuovi_pos(1:end-N) = NaN;
    d_tests = Region_cmp(l).data(:,8);d_tests(1:end-N) = NaN;
    % find the days with no tests
    no_tst = find(d_tests == 0); nuovi_pos(no_tst) = NaN; d_tests(no_tst) = NaN;
    % if the # new cases > # tests => error
    ind_error = find(nuovi_pos > d_tests); nuovi_pos(ind_error) = NaN; d_tests(ind_error) = NaN;
    casi_normalizzati = nuovi_pos./d_tests.*(max(nuovi_pos./d_tests))^(-1);

    figure(4+l)
    bar(1:length(Date),d_tests./max(d_tests),'FaceAlpha',0.2)
    grid on
```

```
    hold on
    semilogy(1:length(Date),casi_normalizzati,'-','Linewidth',4)
    semilogy(1:length(Date),nuovi_pos/max(nuovi_pos),'-','Linewidth',4)
    title('New cases normalized');
    grid on; hold on;
    title([ Region_cmp(l).name,' (vec. divided by max val)' ]);
    tick_start = length(Date)-N; % plot only the last 20 days
    ax = gca; ax.XTick = 1:length(Date) ; ax.XTick = floor(linspace(tick_start,length(Date),5));
    ax.XTickLabel = Date(floor(linspace(tick_start,length(Date),5)),:);   ax.TickLabelInterpreter = 'Lat
    ax.XAxis.Label.String = 'Date';  ax.XLabel.Interpreter = 'Latex';
    ax.YLabel.Interpreter = 'Latex'; ax.Title.Interpreter = 'Latex';
    ax.XLim = [length(Date)-N length(Date)];
    %ax.YAxis.Label.String = 'Deaths every 100k';
    str_tst =['$\mathrm{Test}$ (max ', num2str(max(d_tests)),')']; %'$\mathrm{Test}$'
    str_cases = ['$\mathrm{New\: cases}$ (max ', num2str(max(nuovi_pos)),')'];%'$\mathrm{New\: cases}$'
    [ll,mm] = legend(str_tst,'$\mathrm{New\: cases}/\mathrm{Tests} $', str_cases, 'Location','northeasto
    ll.Interpreter = 'latex';
    ll.FontSize = 15;
    ll.Title.String = 'vectors div. by their max val';
end
```




Veneto
(vec. divided by max val)
Test (max 8882)
New cases/Tests
New cases (max 562)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
03-22
03-25
03-29
04-02
04-06
Date


Emilia-Romagna
(vec. divided by max val)
Test (max 5403)
New cases/Tests
New cases (max 980)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
03-22
03-25
03-29
04-02
04-06
Date