Table of Contents

MATH2019 / G12ISC (2018-2019) Coursework 1

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```
clear all;
close all;
clc
```

Question 2

```
% The code produces a table containing n, pn and f(pn) during the
 bisection method.

format long
f=@(x)x.^3+4*x.^2-10;
[p_vec,fp_vec]=bisect(f,1,2,20);
n=[1:20]';
table(n,p_vec,fp_vec)
```

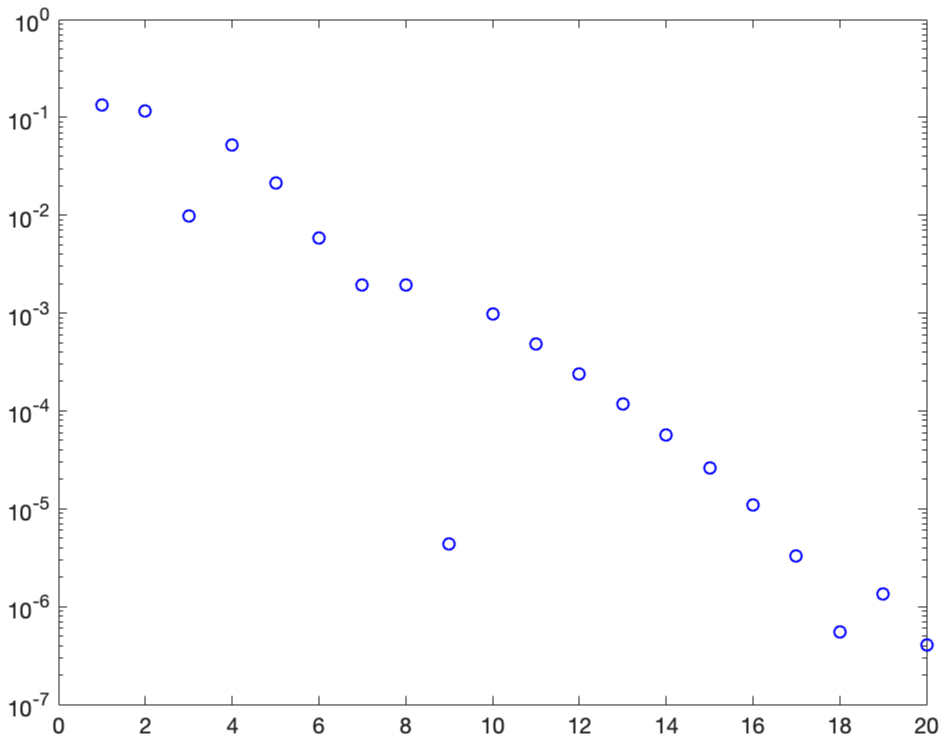
```
ans =

  20×3 table
```

n	p_vec	fp_vec
1	1.5	2.375
2	1.25	-1.796875
3	1.375	0.162109375
4	1.3125	-0.848388671875
5	1.34375	-0.350982666015625
6	1.359375	-0.0964088439941406
7	1.3671875	0.032355785369873
8	1.36328125	-0.0321499705314636
9	1.365234375	7.20247626304626e-05
10	1.3642578125	-0.0160466907545924
11	1.36474609375	-0.0079892628127709
12	1.364990234375	-0.00395910152292345
13	1.3651123046875	-0.00194365901006677

```
14     1.36517333984375     -0.000935847281880342
15     1.36520385742188     -0.000431918799250752
16     1.36521911621094     -0.000179948903227256
17     1.36522674560547     -5.39625415285627e-05
18     1.36523056030273      9.03099274296437e-06
19      1.3652286529541     -2.24658038447956e-05
20     1.36522960662842      -6.7174129139147e-06
```

Question 3

```
% The code creates a figure ploting the error versus n during the
 bisection method.

p=1.365230013;
for i=1:20
    e=abs(p-p_vec(i));
    semilogy(i,e,'bo')
    hold on
end
```



Question 5

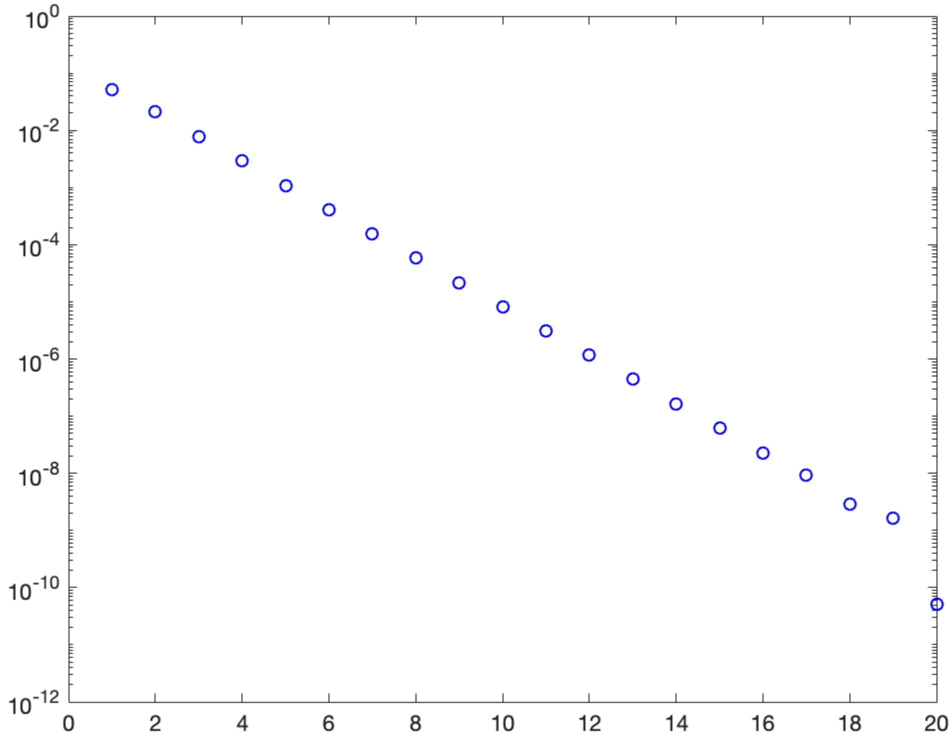
```
% The code produces a table containing n and pn during the fixed-
 point iteration.
```

```
clear all;
close all;
clc

format long
f=@(x)x.^3+4*x.^2-10;
g=@(x)x-1/12*f(x);
p_vec=fpiter(g,1,20);
n=[1:20]';
table(n,p_vec)
```

```
ans =

  20×2 table

    n          p_vec
    __    ________________

     1    1.41666666666667
     2    1.34408757716049
     3     1.3728812557799
     4    1.36231272240944
     5    1.36632151543739
     6    1.36481867753577
     7    1.36538460952031
     8    1.36517185112966
     9    1.36525188693197
    10    1.36522178609837
    11    1.36523310779837
    12    1.36522884955838
    13    1.36523045115863
    14    1.36522984877099
    15    1.36523007533908
    16    1.36522999012308
    17    1.36523002217423
    18    1.36523001011926
    19    1.36523001465334
    20      1.365230012948
```

Question 6

```
% The code creates a figure ploting the error versus n during the
 fixed- point iteration.

p=1.365230013;
for i=1:20
    e=abs(p-p_vec(i));
    semilogy(i,e,'bo')
    hold on
end
```



Question 7

```
% This code produces the pmax that for any p0 >= pmax, the fixed-point
 iteration won't converge.

% A general fixed-point method converges linearly if it converges. So
 a
% criterion that can be taken to judge if the iteration converges is
 the
% difference between p and p20 after 20 iterations. If it's large, say
 large
% than 0.001, the iteration doesn't converge.

% This experimental method isn't accurate enough as 0.001 and 20 don't
% have a very strong theoretical basis. The accuracy is also
 influenced by
% the amount of data being chosen.

a=1.37;
% The experimental data {an} being chosen is an arithmetic progression
 with
% a0=1.37, d=0.5 and n=10.
for i=1:10
    p_vec=fpiter(g,a,20);
    if abs(p-p_vec(20,1))>0.001
```

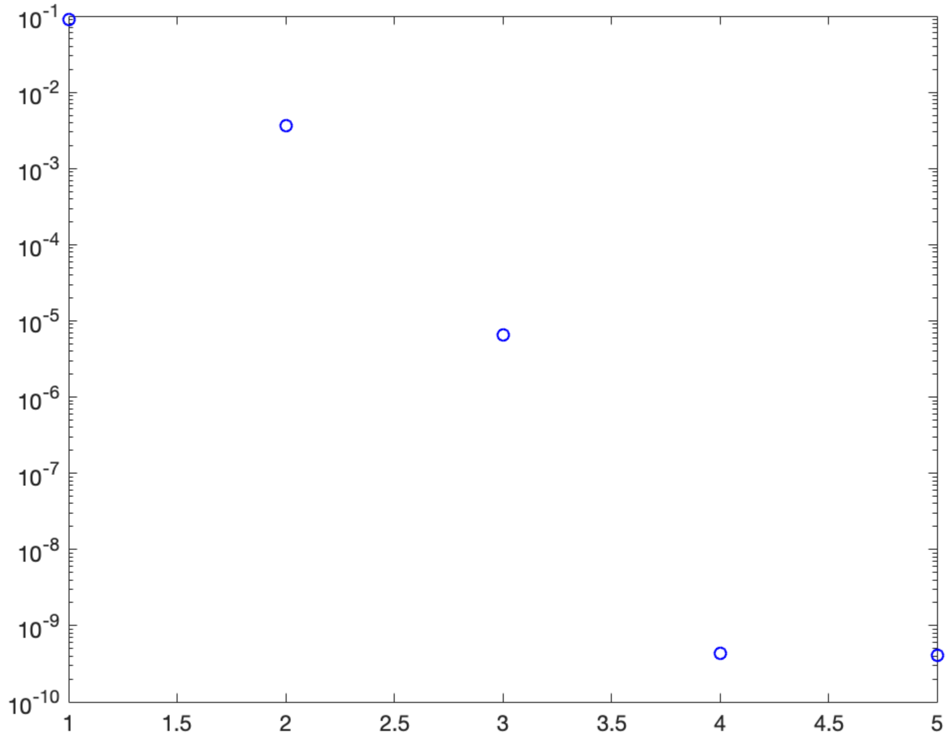
```
        pmax=a
        break;
    else
        a=a+0.5;
    end
end
```

```
pmax =

   3.370000000000000
```

Question 9

```
% This code produces a table containing n and pn during Newton's
 method.

clear all;
close all;
clc

format long
f=@(x)x.^3+4*x.^2-10;
df=@(x)3*x.^2+8*x;
p_vec=newton(f,df,1,40,1e-10);
n=[1:size(p_vec,1)]';
table(n,p_vec)

% The code creates a figure ploting the error versus n during Newton's
 method.

p=1.365230013;
for i=1:size(p_vec,1)
    e=abs(p-p_vec(i));
    semilogy(i,e,'bo')
    hold on
end
```

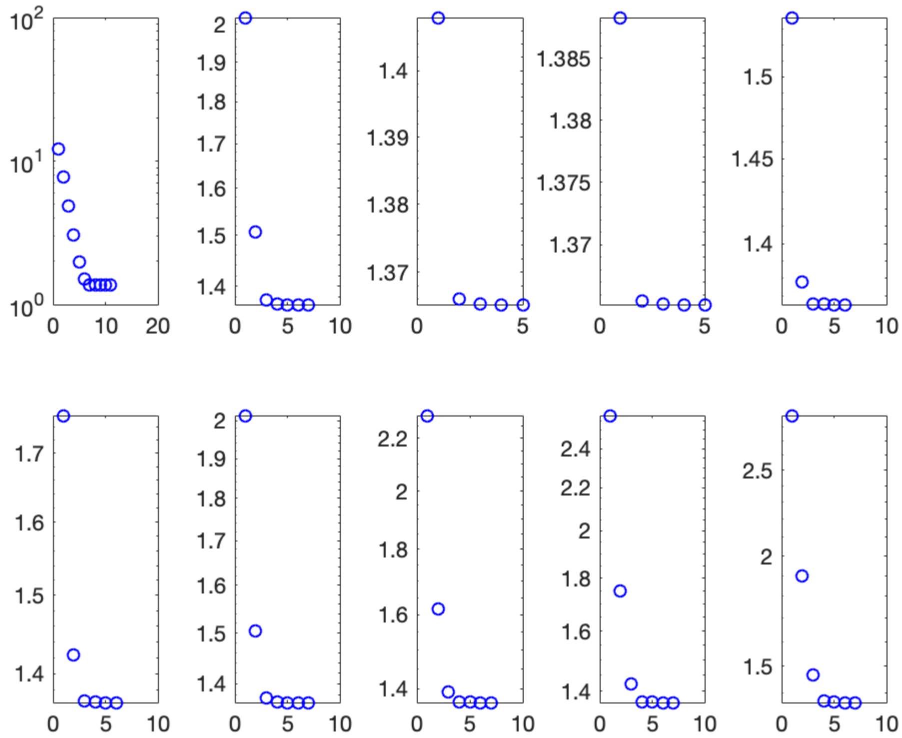
```
ans =

  5×2 table

    n          p_vec
    _    ________________

    1    1.45454545454545
    2    1.36890040106952
    3    1.36523660020212
    4    1.36523001343537
    5     1.3652300134141
```



Question 10

```
% This part invesgates the convergence behaviour of Newton's method
 for values
% of p0 that approach 0 from above.

a=0.1;
% The experimental data {an} being chosen is an arithmetic progression
 with
% a0=0.1, d=0.5 and n=10.

% The code produces figures ploting pn versus n during the iteration
 for each p0.

for i=1:10
    p_vec=newton(f,df,a,40,1e-10);
    n=size(p_vec,1);
    subplot(2,5,i);
    for j=1:n
        semilogy(j,p_vec(j),'bo')
        hold on
    end
    a=a+0.5;
end
```

```
% From the gragh, it can be figured out that the Newton's method
 converges
% quite quickly for p0 near 0 from above.
```



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