

MTH232

Introduction to the Symbolic Math Toolbox

Project 1– Exercises

NAME: _____
SECTION: _____
INSTRUCTOR: _____

Exercise 1:

Find the zeros of $f(x) = x^3 - x^2 - 18$ symbolically.

- First, what MATLAB command defines x to be a symbolic variable?

(1) Answer:

- What command defines $f(x)$ symbolically?

(2) Answer:

- What command symbolically determines the zeros of $f(x)$?

(3) Answer:

- How many real roots are there?

(4) Circle one:

1. 1 2. 2 3. 3 4. 4

- What are the zero(s) of $f(x)$?

(5) Circle one:

1. 3 and $-1 \pm \sqrt{5}$

2. $-1 \pm \sqrt{5}$

3. 3

4. $2 \pm \sqrt{2}$

- What command verifies your results, that is, evaluates $f(a)$ where a is one of the roots?
(6) Answer:

Exercise 2:

The *linear approximation*, $P_1(x)$, of a function $f(x)$ is defined as

$$P_1(x) = f(a) + f'(a)(x - a)$$

Further, the *quadratic approximation* is defined as

$$P_2(x) = f(a) + f'(a)(x - a) + 1/2 f''(a)(x - a)^2$$

Use symbolic math to find $P_1(x)$ and $P_2(x)$ if $f(x) = \arcsin x$ and $a = 1/2$ (note: $\arcsin x$ in MATLAB is `asin(x)`)

For the following: use fractions, not decimal notation, for constants.

- Assume `syms x` has been entered.
- What MATLAB command defines $f(x) = \arcsin x$ symbolically?
(7) Answer:
- What MATLAB command finds $f'(x)$, and assigns it to a variable called `fp`?
(8) Answer:
- What command evaluates $f(1/2)$ symbolically, and assigns it to a variable named `f1`?
(9) Answer:

- What command evaluates $f'(1/2)$ symbolically, and assigns it to a variable named fp1?

(10) Circle one:

1. `fp1=simplify(fp,x,'1/2')`
2. `fp1=solve(fp,x,'1/2')`
3. `fp1=subs(fp,x,'1/2')`
4. `subs(fp,x,'1/2')`

- With all the above commands typed in ,what command would you now use to define $P_1(x)$ in MATLAB, call it p1?

(11) Circle one:

1. `p1=fp1*(x-1/2)`
2. `p1=f1+fp1(x-1/2)`
3. `p1=f1+fp1*x-1/2`
4. `p1=f1+fp1*(x-1/2)`

- $P_1(x)$, when *simplified*, is equal to...

(12) Circle one:

1. $1/6 \pi + \sqrt{3} (2/3 x - 1/3)$
2. $\pi + \sqrt{2} (2/3 x - 1/3)$
3. $1/6 \pi + \sqrt{2} (2/3 x - 1/3)$
4. $\sqrt{3} (2/3 x - 1/3)$

- What command defines fpp as the second derivative of $f(x)$? (Hint: take the derivative of fp)

(13) Answer:

- What command evaluates $f''(1/2)$ symbolically, and assigns it to a variable named fpp1?

(14) Circle one:

1. `fpp1=simplify(fpp,x,'1/2')`
2. `fpp1=solve(fpp,x,'1/2')`
3. `fpp1=subs(fpp,x,'1/2')`
4. `subs(fpp,x,'1/2')`

- What command would you use to define $P_2(x)$ in MATLAB, call it p2?

(15) Circle one:

1. $p2=f1+fp1*(x-1/2)$
2. $p2=f1+fp1*(x-1/2)+1/2*fp1*(x-1/2)^2$
3. $p2=f1+fp1*(x-1/2)^2+1/2*fp1*(x-1/2)$
4. $p2=1/2*fp1*(x-1/2)^2$

- $P_2(x)$, when simplified, is equal to....

(16) Circle one:

1. $1/6 \pi - 5/18 \sqrt{3} + 2/9 \sqrt{3}x^2$
2. $1/6 \pi + 4/9 \sqrt{3}x - 5/18 \sqrt{3} + 2/9 \sqrt{3}x^2$
3. $1/6 \pi + 4/9 \sqrt{3}x + 2/9 \sqrt{3}x^2$
4. $2/9 \sqrt{3}x^2 - 5/18 \sqrt{3}$

Exercise 3:

Find the inverse of $f(x) = 4x/\sqrt{x^2 + 15}$.

- What command defines $f(x)$?

(17) Answer:

- What command defines a function g as the (potential) inverse of f ?

(18) Answer:

- What command verifies that $g(f(x)) = x$

(19) Answer:

- Does $f(g(x)) = g(f(x)) = x$

(20) Circle one:

1. yes
2. no

- Is $g(x)$ the inverse function of $f(x)$?

(21) Circle one:

1. yes
2. no

- What is $f^{-1}(x)$?

(22) Circle one:

1. $x(-15/(x^2 - 16))^{1/2}$
2. $-15x(1/(x^2 - 16))^{1/2}$
3. $x - 15(x^2 - 16)^{1/2}$
4. $x(-15/(x^2 - 16))^{1/2}$
5. $f(x)$ is not invertible

- Using the subs and the diff commands, determine $f'(g(x))$ and $g'(x)$. Then, plot the graphs of these functions, along with their product, $f'(g(x)) \cdot g'(x)$. (Use the hold on command.)

(23) Attach your graph to the worksheet.

- What can be said about the relationship between $f'(g(x))$ and $g'(x)$?

(24) Answer:

- Is it true that $f'(f^{-1}(x)) = 1/f^{(-1)'}(x)$?

(25) Circle one:

1. yes
2. no