MATH 471

9.7

Sect 2.1 #1, 2, 4, 9, 10, 11 Matlab Exercises,
Sect 2.2 #1, 3, 5, 8, 9, 14, 15

Sect 2.1

1a. $x^3 + 3x + 2$

$= x^3 + 0 \cdot x^2 + 3x + 2$

$= ((1 \cdot x + 0)x + 3)x + 2$

$\boxed{= ((x)x + 3)x + 2}$ ✓

1b. $x^6 + 2x^4 + 4x^2 + 1$

$= x^6 + 0 \cdot x^5 + 2x^4 + 0x^3 + 4x^2 + 0x + 1$

$(((((1 \cdot x + 0)x + 2)x + 0)x + 4)x + 0)x + 1$

$\boxed{= (((((x)x + 2)x)x + 4)x)x + 1}$ ✓

1c. $5x^6 + x^5 + 3x^4 + 3x^3 + x^2 + 1$

$= (((((5x + 1)x + 3)x + 3)x + 1)x + 0)x + 1$

$\boxed{= (((((5x + 1)x + 3)x + 3)x + 1)x)x + 1}$ ✓

1d. $x^2 + 5x + 6$

$\boxed{= (x + 5)x + 6}$ ✓

2a. $\frac{1}{6}x^6 + \frac{1}{2}x^4 + x^2 + 1$

$\boxed{= ((\frac{1}{6}x^2 + \frac{1}{2})x^2 + 1)x^2 + 1}$ ✓

2b. $\frac{1}{24}x^4 - \frac{1}{2}x^2 + 1$

$\boxed{= (\frac{1}{24}x^2 - \frac{1}{2})x^2 + 1}$ ✓

how about $\left(\left(\left(\left(\left(\frac{1}{7}x+1\right)\frac{x}{6}+1\right)\frac{x}{5}+1\right)\frac{x}{4}+1\right)\frac{x}{3}+1\right)\frac{x}{2}+1\Big)x$

4. See attached page
9. See attached page
10. $$\boxed{\begin{aligned} e^x &\approx 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120} \\ &= ((((\tfrac{1}{120}x + \tfrac{1}{24})x + \tfrac{1}{6})x + \tfrac{1}{2})x + 1)x + 1 \end{aligned}}$$

$$\sin x = \sin(0) + x\cos(0) + \frac{x^2}{2}(-\sin(0)) + \frac{x^3}{6}(-\cos(0)) + \frac{x^4}{24}(\sin(0)) + \frac{x^5}{120}(\cos(0))$$

$$\boxed{\begin{aligned} \sin x &\approx x - \frac{x^3}{6} + \frac{x^5}{120} \\ &= ((\tfrac{1}{120}x^2 - \tfrac{1}{6})x^2 + 1)x \end{aligned}}$$

11a. $e^{-x} \approx 1 - x + \frac{x^2}{2} - \frac{x^3}{6}$, $x \in [0,1]$

$$p(x) \boxed{= ((-\tfrac{1}{6}x + \tfrac{1}{2})x - 1)x + 1}$$

11b. $\ln(1+x) \approx x - \frac{x^2}{2} + \frac{x^3}{3}$, $x \in [-1,1]$

$$p(x) \boxed{= ((\tfrac{1}{3}x - \tfrac{1}{2})x + 1)x}$$

11c. $\sin x \approx x - \frac{x^3}{6}$, $x \in [0,\pi]$

$$p(x) \boxed{= (\tfrac{1}{6}x^2 - 1)x}$$

11d. $\ln(1+x) \approx x - \frac{x^2}{2} + \frac{x^3}{3}$, $x \in [-\tfrac{1}{2}, \tfrac{1}{2})$

$$p(x) \boxed{= ((\tfrac{1}{3}x - \tfrac{1}{2})x + 1)x}$$

Note: p(x) is the Taylor polynomial approximation for f(x)

11a cont.

$f(x) = e^{-x}$

$x \in [0,1]$

$|R_3(x)| < 1/24$

x	Matlab p(x)	Mathematica f(x)	|p(x) - f(x)|
0	1.0	1.0	0
.2	.8187	0.818731	.000031
.4	.6693	0.67032	.00102
.6	.5440	0.548812	.004812
.8	.4347	0.449329	.014629
1.0	.3333	0.367879	.034579

The biggest error on the interval = .034579 which is less than 1/24 so the required accuracy is obtained on the entire interval

11b. cont

$f(x) = \ln(1+x)$

$x \in [-1,1]$

$R_3(x)$ has no bound on this interval

x	Matlab p(x)	Mathematica f(x)	|p(x) - f(x)|
-1.0	-1.8333	$-\infty$	∞
-.75	-1.1719	-1.38629	.21439
-.5	-0.6667	-.693147	.026447
-.25	-0.2865	-.287682	.001182
0	0	0	0
.25	0.2240	.223144	.000856
.5	0.4167	.405465	.011235
.75	0.6094	.559616	.049784
1.0	0.8333	.693147	.140153

The error on this interval has no bound so by default the required accuracy is obtained on the entire interval.

1k cont.

$f(x) = \sin(x)$
$x \in [0, \pi]$

$|R_3(x)| < \frac{\pi^4}{24}$

≈ 4.058712

x	Matlab $p(x)$	Mathematica $f(x)$	$\lvert p(x)-f(x)\rvert$
0	0	0	0
$\pi/6$	0.4997	0.421075	.078625
$\pi/3$	0.8558	0.716472	.139328
$\pi/2$	0.9248	0.944216	.019416
$2\pi/3$	0.5632	1.12959	.56639
$5\pi/6$	-.3726	1.28592	1.65852
π	-2.0261	1.42108	3.44718

The biggest error on this interval is 3.44718 which is less than $\frac{\pi^4}{24}$ so the required accuracy is obtained on the entire interval ✓

1d. cont

$f(x) = \ln(1+x)$
$x \in [-\frac{1}{2}, \frac{1}{2}]$

$|R_3(x)| < .25$

x	Matlab $p(x)$	Mathematica $f(x)$	$\lvert p(x)-f(x)\rvert$
-.5	-.6667	-.693147	.026447
-.3	-.3540	-.356675	.002675
-.1	-.1053	-.105361	.000061
0	0	0	0
.1	.0953	.0953102	.00001
.3	.2640	.262364	.001636
.5	.4167	.405465	.011236

✓ The biggest error is .026447 which is less than .25 so the required accuracy is obtained on the entire interval

1e. $f(x) = \frac{1}{1+x} \approx 1 - x + x^2 - x^3$, $x \in [-\frac{1}{2}, \frac{1}{2}]$

$p(x) = ((-x+1)x-1)x+1$ $\quad |R_3(x)| < 2$

x	Matlab $p(x)$	Mathematica $f(x)$	$\lvert p(x)-f(x)\rvert$
-.5	1.875	2	.125
-.3	1.417	1.42857	.01157
-.1	1.111	1.11111	.00011
0	1	1	0
.1	.909	.909091	.000091
.3	.763	.769231	.006231
.5	.625	.666667	.041667

✓

The biggest error is .125 which is less than 2 so the required accuracy is obtained on the entire interval

Section 2.2

1. Consider $f(x-h)$

$$f(x-h) = f(x) - hf'(x) + \frac{h^2}{2} f''(c)$$

$$\Rightarrow hf'(x) = f(x) - f(x-h) + \frac{h^2}{2} f''(c)$$

$$\Rightarrow f'(x) = \frac{f(x) - f(x-h)}{h} + \frac{h}{2} f''(c)$$

$$\boxed{\therefore f'(x) = \frac{f(x) - f(x-h)}{h} + O(h)}$$ ✓

3. See attached page

5. Let $f(x) = ax^2 + bx + c$

we know $f'(x) = 2ax + b$, $f''(x) = 2a$, $f'''(x) = 0$

Using (2.5) we have:

$$f'(x) = \frac{a(x+h)^2 + b(x+h) + c - [a(x-h)^2 + b(x-h) + c]}{2h} - \frac{1}{6}h^2 f'''(c_x, h)$$

you worked harder than you had to all you needed to do was show $f'''(\xi) = 0$

$$\Rightarrow f'(x) = \frac{ax^2 + 2ahx + ah^2 + bx + bh + c - [ax^2 - 2ahx + ah^2 + bx - bh + c]}{2h} - \frac{h^2}{6} f'''(c_x, h)$$

$$\Rightarrow f'(x) = \frac{4ahx + 2bh}{2h} - \frac{h^2}{6} f'''(c_x, h)$$

$$\Rightarrow f'(x) = 2ax + b - \frac{h^2}{6} f'''(c_x, h)$$

$\Rightarrow f'(x) = 2ax + b - \frac{h^2}{6}(0)$, because $f'''(x) = 0 \ \forall$ quadratic equ

$\Rightarrow f'(x) = 2ax + b$

so we have $f'(x) = 2ax + b$ which is what we got for the actual derivative at the beginning of the problem. So this approximation is exact for any quadratic polynomial ✓

8. Consider $f(x+2h)$ \$ $f(x-2h)$

$$f(x+2h) = f(x) + 2hf'(x) + \frac{1}{2}(2h)^2 f''(x) + \frac{(2h)^3}{6} f'''(x) + \frac{(2h)^4}{24} f^{(4)}(x) + O(h$$

$$f(x+2h) = f(x) + 2hf'(x) + 2h^2 f''(x) + \frac{4h^3}{3} f'''(x) + \frac{2h^4}{3} f^{(4)}(x) + O(h^5$$

$$f(x-2h) = f(x) - 2hf'(x) + \frac{(2h)^2}{2} f''(x) - \frac{(2h)^3}{6} f'''(x) + \frac{(2h)^4}{24} f^{(4)}(x) + O(h^5$$

$$= f(x) - 2hf'(x) + 2h^2 f''(x) - \frac{4h^3}{3} f^{(3)}(x) + \frac{2h^4}{3} f^{(4)}(x) + O(h^5)$$

Now consider

$$f(x-2h) - f(x+2h) = -4hf'(x) - \frac{8h^3}{3} f^{(3)}(x) + O(h^5)$$

Now consider $8f(x+h)$ \$ $8f(x-h)$

$$8f(x+h) = 8f(x) + 8hf'(x) + 4h^2 f''(x) + \frac{4h^3}{3} f'''(x) + \frac{h^4}{3} f^{(4)}(x) + O(h^5)$$

$$8f(x-h) = 8f(x) - 8hf'(x) + 4h^2 f''(x) - \frac{4h^3}{3} f'''(x) + \frac{h^4}{3} f^{(4)}(x) + O(h^5)$$

Now consider

$$8f(x+h) - 8f(x-h) = 16hf'(x) + \frac{8h^3}{3} f'''(x) + O(h^5)$$

Finally consider

$$8f(x+h) - 8f(x-h) + f(x-2h) - f(x+2h) = 12hf'(x) + O(h^5)$$

$$\Rightarrow f'(x) + O(h^4) = \frac{8f(x+h) - 8f(x-h) - f(x+2h) + f(x-2h)}{12h}$$

$$\boxed{\Rightarrow f'(x) = \frac{8f(x+h) - 8f(x-h) - f(x+2h) + f(x-2h)}{12h} + O(h^4)}$$

So this approximation for $f'(x)$ is $O(h^4)$

9a. $f(x) = \sqrt{x+1}$, we know $f'(x) = \frac{1}{2\sqrt{x+1}}$

$$f'_{ap}(1) = \frac{8\sqrt{1+h+1} - 8\sqrt{1-h+1} - \sqrt{1+2h+1} + \sqrt{1-2h+1}}{12h}$$

$$\Rightarrow f'_{ap}(1) = \frac{8\sqrt{2+h} - 8\sqrt{2-h} - \sqrt{2+2h} + \sqrt{2-2h}}{12h}$$

h	$f'_{ap}(1)$	$f'(1)$	$\lvert f'_{ap}(1) - f'(1)\rvert$	Ratio	Expected Ratio
1/2	.353183	$\sqrt{2}/4$	0.00037		
1/4	.353534	$\sqrt{2}/4$	0.00002	18.6905	16
1/8	.353552	$\sqrt{2}/4$	0.000001	16.578	16

So the expected rate of decrease is approximately observed for the error (within 2.6905)

9b. $f(x) = \arctan(x)$, we know $f'(x) = \frac{1}{1+x^2}$

$$f'_{a_p}(1) = \frac{8\arctan(1+h) - 8\arctan(1-h) - \arctan(1+2h) + \arctan(1-2h)}{12h}$$

h	$f'_{a_p}(1)$	$f'(1)$	$\lvert f'_{a_p}(1) - f'(1)\rvert$	Ratio	Exp. Ratio
1/2	.50767	1/2	.00767	17.8637	16
1/4	.500429	1/2	.000429	17.1215	16
1/8	.500025	1/2	.000025		

$\boxed{\text{So the expected rate of decrease is approximately observed for the error (within 1.8637)}}$

9c. $f(x) = \sin(\pi x)$, we know $f'(x) = \pi\cos(\pi x)$

$$f'_{a_p}(1) = \frac{8\sin(\pi(1+h)) - 8\sin(\pi(1-h)) - \sin(\pi(1+2h)) + \sin(\pi(1-2h))}{12h}$$

h	$f'_{a_p}(1)$	$f'(1)$	$\lvert f'_{a_p}(1) - f'(1)\rvert$	Ratio	Exp Ratio
1/2	-2.666667	$-\pi$	.474926	12.8278	16
1/4	-3.10457	$-\pi$	.037023	15.1419	16
1/8	-3.13915	$-\pi$	.002445		

$\boxed{\text{So the expected rate of decrease is approximately observed for the error (within 3.1722)}}$

9d. $f(x) = e^{-x}$, we know $f'(x) = -e^{-x}$

$$f'_{a_p}(1) = \frac{8e^{-(1+h)} - 8e^{-(1-h)} - e^{-(1+2h)} + e^{-(1-2h)}}{12h}$$

h	$f'_{a_p}(1)$	$f'(1)$	$\lvert f'_{a_p}(1) - f'(1)\rvert$	Ratio	Exp Ratio
1/2	-.366709	-.367879	.00079	16.361	16
1/4	-.367831	-.367879	.000048	16.0895	16
1/8	-.3678716	-.367879	.000003		

$\boxed{\text{So the expected rate of decrease is approximately observed for the error (within .361)}}$

9e. $f(x) = \ln x$, we know $f'(x) = \frac{1}{x}$

$$f'_{ap}(1) = \frac{8\ln(1+h) - 8\ln(1-h) - \ln(1+2h) + \ln(1-2h)}{12h}$$

h	$f'_{ap}(1)$	$f'(1)$	$\lvert f'_{ap}(1) - f'(1) \rvert$	Ratio	Exp Ratio
$1/2$	undef.	1	N/A	N/A	16
$1/4$	.995998	1	.004002	19.3543	16
$1/8$	.999793	1	.000207		

So the expected rate of decrease is only approximately observed for the error between $h = 1/4$ & $h = 1/8$ (within 3.3543)

14. $$f(x+h) = f(x) + hf'(x) + \frac{h^2}{2}f''(x) + \frac{h^3}{6}f^{(3)}(x) + O(h^4)$$
$$f(x-h) = f(x) - hf'(x) + \frac{h^2}{2}f''(x) - \frac{h^3}{6}f^{(3)}(x) + O(h^4$$

$$f(x+h) + f(x-h) = 2f(x) + h^2 f''(x) + O(h^4)$$

$$\Rightarrow h^2 f''(x) + O(h^4) = f(x+h) - 2f(x) + f(x-h)$$

$$\Rightarrow f''(x) + O(h^2) = \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

$$\Rightarrow f''(x) = \frac{f(x+h) - 2f(x) + f(x-h)}{h^2} + O(h^2) = D$$

see attached page

15a. $f(x)=\ln(e^{\sqrt{x^2+1}}\sin(\pi x)+\tan(\pi x))$, let $h=1/8$

$$f'(x)=\frac{\ln(e^{\sqrt{(x+1/8)^2+1}}\sin(\pi(x+1/8))+\tan(\pi(x+1/8)))-\ln(e^{\sqrt{(x-1/8)^2+1}}\sin(\pi(x-1/8))+\tan(\pi(x-1/8)))}{1/4}$$

$$f'(0)=4\ln(e^{\sqrt{65}/8}\sin(\pi/8)+\tan(\pi/8))-4\ln(e^{\sqrt{65}/8}\sin(-\pi/8)+\tan(-\pi/8))$$

$$\Rightarrow f'(0)=1.52081333259-4\ln(-1.46258)$$

$$\boxed{\therefore f'(0) \text{ Does not exist}}$$

$$f'(.1)=4\ln(e^{1.025}\sin(.225(\pi))+\tan(.225(\pi)))-4\ln(e^{1.00031}\sin(-.025(\pi))+\tan(-.025(\pi)))$$

$$\Rightarrow f'(.1)=3.9195468250733-4\ln(-.292042)$$

$$\boxed{\therefore f'(.1) \text{ does not exist}}$$

$$f'(.2)=4\ln(e^{1.05149}\sin(.325\cdot\pi)+\tan(.325\cdot\pi))-4\ln(e^{1.00281}\sin(.075\cdot\pi)+\tan(.075\cdot\pi))$$

$$\Rightarrow f'(.2)=5.61657-(-.527572)$$

$$\boxed{\therefore f'(.2)=6.1441418168165}$$

$$f'(.25)=4\ln(e^{1.0680004681}\sin(.375\cdot\pi)+\tan(.375\cdot\pi))-4\ln(e^{1.00778}\sin(.125\cdot\pi)+\tan(.125\cdot\pi))$$

$$\Rightarrow f'(.25)=6.5187599780768-1.52081$$

$$\boxed{\therefore f'(.25)=4.99795}$$

15b. $f(x) = \ln\left(e^{\sqrt{x^2+1}} \sin(\pi x) + \tan(\pi x)\right)$

$$f'(x) = \frac{e^{\sqrt{x^2+1}}\left(\frac{x}{\sqrt{x^2+1}}\right)\sin(\pi x) + e^{\sqrt{x^2+1}}\pi\cos(\pi x) + \pi\sec^2(\pi x)}{e^{\sqrt{x^2+1}}\sin(\pi x) + \tan(\pi x)}$$

$$f'(0) = \frac{0 + e\pi + \pi}{0}$$

$\boxed{\therefore f'(0) \text{ is undefined}}$

$$f'(.1) = \frac{e^{1.00499}(.099504)(.309017) + e^{1.00499}(2.98783) + 3.47326}{e^{1.00499}(.309017) + .32492}$$

$\Rightarrow f'(.1) = 11.7197 / 1.16912$

$\boxed{\therefore f'(.1) = 10.0244}$

comment?

$$f'(.2) = \frac{e^{1.0198}(.196116)\sin(.2\cdot\pi) + e^{1.0198}(\pi\cos(.2\pi)) + \pi\sec^2(.2\pi)}{e^{1.0198}\sin(.2\pi) + \tan(.2\pi)}$$

$$\Rightarrow f'(.2) = \frac{.319615 + 7.04697 + 4.79993}{1.62972 + .726543} = \frac{12.1665}{2.35627} = \boxed{\therefore f'(.2) = 5.16347345621105}$$

$$f'(.25) = \frac{e^{1.03078}(.242536)\sin(.25\pi) + e^{1.03078}\pi\cos(.25\pi) + \pi\sec^2(.25\pi)}{e^{1.03078}\sin(.25\pi) + \tan(.25\pi)}$$

$$\Rightarrow f'(.25) = \frac{.480752 + 6.22724 + 6.28319}{1.98219 + 1} = \frac{12.9912}{2.98219} = \boxed{\therefore f'(.25) = 4.35625145743226}$$

Sect 2.1 #4


```
>> Sect2_1Num4
```

	1a f(k)	1a f'(k)	1b f(k)	1b f'(k)	1c f(k)	1c f'(k)	1d f(k)	1d f'(k)
k = 2	16	15	113	272	429	1176	20	9
k = 3	38	30	928	1698	4222	8106	30	11
k = 4	78	51	4673	6688	22481	32920	42	13
k = 5	142	78	16976	19790	83526	98610	56	15
k = 6	236	111	49393	48432	245629	242688	72	17

```
>>
```

Sect 2.1 #9

```
>> Sect2_1Num9
```

	7a		7b		7c	
	g(k)	f(k)	g(k)	f(k)	g(k)	f(k)
k = 2.0000	1.8333	1.8333	1.0000	1.0000	1.7000	1.7000
k = 3.0000	2.3000	2.3000	1.3810	1.3810	2.0000	2.0000
k = 4.0000	2.8000	2.8000	2.0000	2.0000	2.2667	2.2667
k = 5.0000	3.3333	3.3333	3.7143	3.7143	2.5000	2.5000
k = 6.0000	3.9000	3.9000	7.3810	7.3810	2.7000	2.7000

```
>>
```

where g(k) is using Horners method &
f(k) is naive method

Sect 2.1 #11

```
%Section 2.1 Number 11

coef_11a = [-1/6,1/2,-1,1];
coef_11b = [1/3,-1/2,1,0];
coef_11c = [-1/6,0,1,0];
coef_11d = [1/3,-1/2,1,0];
coef_11e = [-1,1,-1,1];

for k=-1/2:.2:1/2
[p_11a, d_11a] = rhpolyval(3,coef_11a, k);
[p_11b, d_11b] = rhpolyval(3,coef_11b, k);
[p_11c, d_11c] = rhpolyval(3,coef_11c, k);
[p_11d, d_11d] = rhpolyval(3,coef_11d, k);
[p_11e, d_11e] = rhpolyval(3,coef_11e, k);
disp([k, p_11e]);
end
```

Sect 2.1 #11

```
In[9]:= f[x_] := 1 / (1 + x)

In[11]:= For[k = -1 / 2, k ≤ 1 / 2, k = k + (0.5), Print[N[f[k]]]]

2.

1.

0.666667
```

Sect 2.2 #3a

MATLAB Command Window

3a

```
>> Sect2_2Nm3
```

h	D	f'(1)	f'(1)-D	Ratio	Exp Ratio
h= 0.2500	0.3431	0.3536	0.0104		
h= 0.1250	0.3482	0.3536	0.0054	1.9424	2.0000
h= 0.0625	0.3508	0.3536	0.0027	1.9700	2.0000
h= 0.0313	0.3522	0.3536	0.0014	1.9847	2.0000

h	D_2	f'(1)	f'(1)-D2	Ratio	Exp Ratio
h= 0.2500	0.3542	0.3536	-0.0007		
h= 0.1250	0.3537	0.3536	-0.0002	4.0207	4.0000
h= 0.0625	0.3536	0.3536	-0.0000	4.0051	4.0000
h= 0.0313	0.3536	0.3536	-0.0000	4.0013	4.0000

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>>
```

$$D = \frac{f(x+h)-f(x)}{h}$$

$$D2 = \frac{f(x+h)-f(x-h)}{2h}$$

Sect 2.2 #36

>> Sect2_2Num3

h	D	f'(1)	f'(1)-D	Ratio	Exp Ratio
0.2500	0.4426	0.5000	0.0574		
0.1250	0.4700	0.5000	0.0300	1.9153	2.0000
0.0625	0.4847	0.5000	0.0153	1.9578	2.0000
0.0313	0.4923	0.5000	0.0077	1.9790	2.0000

h	D2	f'(1)	f'(1)-D2	Ratio	Exp Ratio
0.2500	0.5051	0.5000	-0.0051		
0.1250	0.5013	0.5000	-0.0013	3.9419	4.0000
0.0625	0.5003	0.5000	-0.0003	3.9858	4.0000
0.0313	0.5001	0.5000	-0.0001	3.9965	4.0000

>>

Sect 2.2 #3c


```
>> Sect2_2Num3
```

h	D	f'(1)	f'(1)-D	Ratio	Exp Ratio
0.2500	-2.8284	-3.1416	-0.3132		
0.1250	-3.0615	-3.1416	-0.0801	3.9085	4.0000
0.0625	-3.1214	-3.1416	-0.0201	3.9769	4.0000
0.0313	-3.1365	-3.1416	-0.0050	3.9942	4.0000

h	D_2	f'(1)	f'(1)-D2	Ratio	Exp Ratio
0.2500	-2.8284	-3.1416	-0.3132		
0.1250	-3.0615	-3.1416	-0.0801	3.9085	4.0000
0.0625	-3.1214	-3.1416	-0.0201	3.9769	4.0000
0.0313	-3.1365	-3.1416	-0.0050	3.9942	4.0000

```
>>
```

>> Sect2_2Num3

h	D	f'(1)	f'(1)-D	Ratio	Exp Ratio
0.2500	-0.3255	-0.3679	-0.0424		
0.1250	-0.3458	-0.3679	-0.0221	1.9208	2.0000
0.0625	-0.3566	-0.3679	-0.0113	1.9594	2.0000
0.0313	-0.3622	-0.3679	-0.0057	1.9794	2.0000

h	D2	f'(1)	f'(1)-D2	Ratio	Exp Ratio
0.2500	-0.3717	-0.3679	0.0038		
0.1250	-0.3688	-0.3679	0.0010	4.0094	4.0000
0.0625	-0.3681	-0.3679	0.0002	4.0023	4.0000
0.0313	-0.3679	-0.3679	0.0001	4.0006	4.0000

>>

Sect 2.2 #3e


```
>> Sect2_2Num3
```

h	D	f'(1)	f'(1)-D	Ratio	Exp Ratio
0.2500	0.8926	1.0000	0.1074		
0.1250	0.9423	1.0000	0.0577	1.8606	2.0000
0.0625	0.9700	1.0000	0.0300	1.9241	2.0000
0.0313	0.9847	1.0000	0.0153	1.9603	2.0000

h	D2	f'(1)	f'(1)-D2	Ratio	Exp Ratio
0.2500	1.0217	1.0000	-0.0217		
0.1250	1.0053	1.0000	-0.0053	4.1180	4.0000
0.0625	1.0013	1.0000	-0.0013	4.0285	4.0000
0.0313	1.0003	1.0000	-0.0003	4.0071	4.0000

```
>>
```

Sect 2.2 #14

14a

\>> Sect2_1Num14

h	D	? $f'(1)$	$f'(1)-D$	Ratio	Exp Ratio
0.2500	0.3698	0.3679	-0.0019		
0.1250	0.3684	0.3679	-0.0005	4.0063	4.0000
0.0625	0.3680	0.3679	-0.0001	4.0016	4.0000
0.0313	0.3679	0.3679	-0.0000	4.0004	4.0000

is this e^{-x}?

4b \>> Sect2_1Num14

h	D	$f'(1)$	$f'(1)-D$	Ratio	Exp Ratio
0.2500	9.3726	9.8696	0.4970		
0.1250	9.7434	9.8696	0.1262	3.9388	4.0000
0.0625	9.8379	9.8696	0.0317	3.9846	4.0000
0.0313	9.8617	9.8696	0.0079	3.9961	4.0000

c \>> Sect2_1Num14

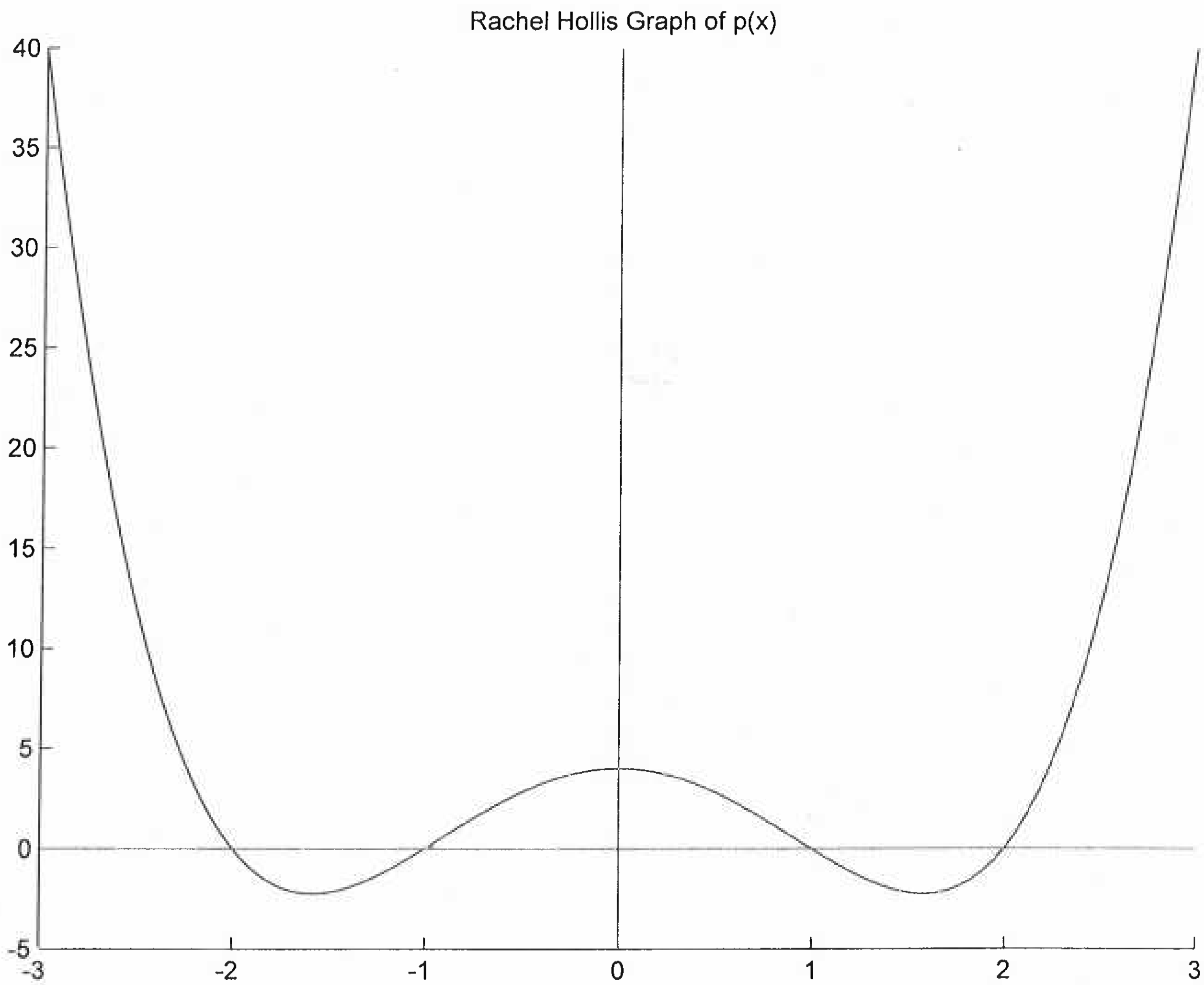
h	D	$f'(1)$	$f'(1)-D$	Ratio	Exp Ratio
0.2500	-0.0888	-0.0884	0.0004		
0.1250	-0.0885	-0.0884	0.0001	4.0249	4.0000
0.0625	-0.0884	-0.0884	0.0000	4.0062	4.0000
0.0313	-0.0884	-0.0884	0.0000	4.0015	4.0000

d \>> Sect2_1Num14

h	D	$f'(1)$	$f'(1)-D$	Ratio	Exp Ratio
0.2500	-1.0326	-1.0000	0.0326		
0.1250	-1.0079	-1.0000	0.0079	4.1313	4.0000
0.0625	-1.0020	-1.0000	0.0020	4.0316	4.0000
0.0313	-1.0005	-1.0000	0.0005	4.0078	4.0000

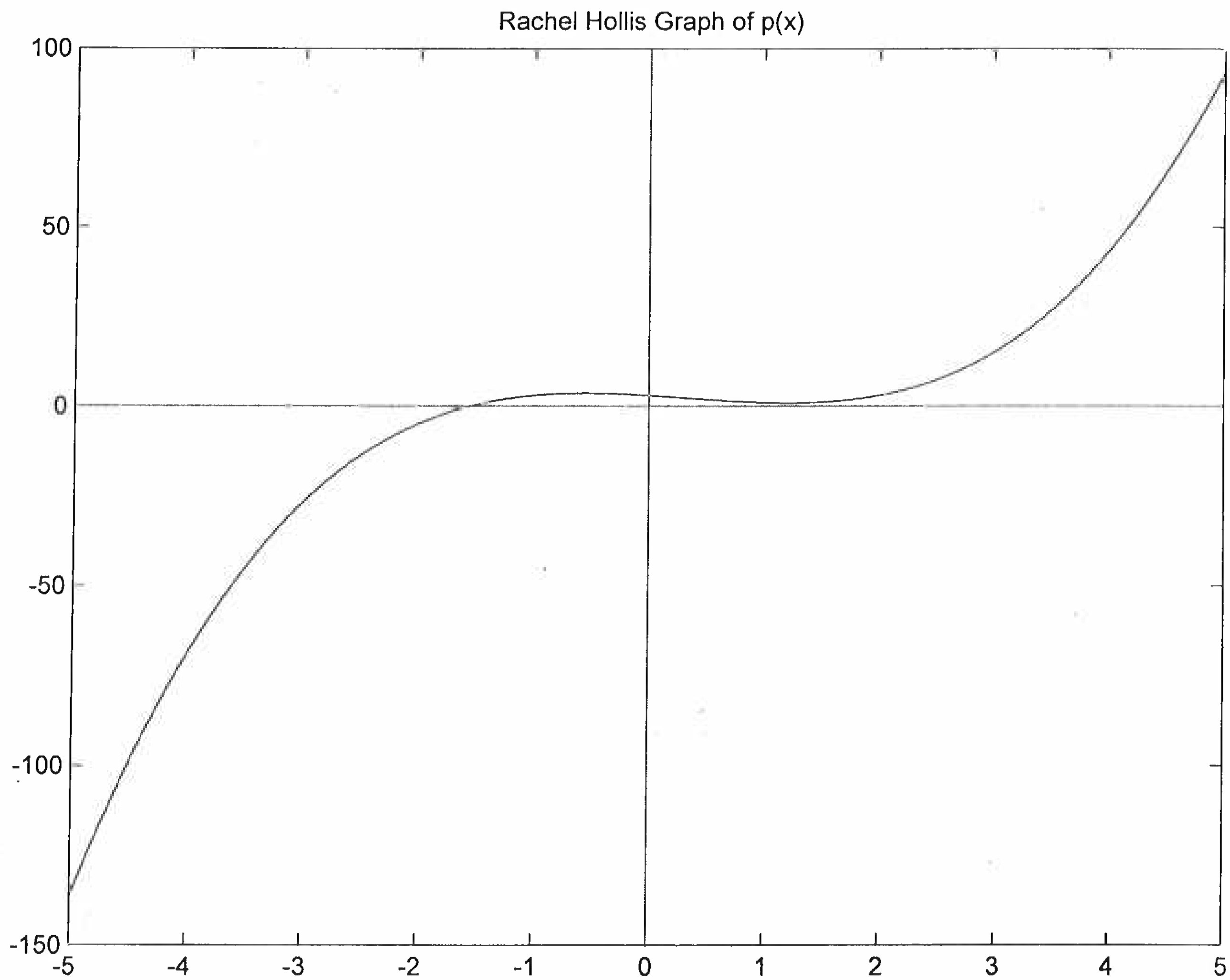
\>>

```
>> x = -3:0.001:3;
>> hold on;
>> y1 = x.^4 - 5.*x.^2 + 4;
>> y2 = 0;
>> plot(x, y1, 'Blue', x, y2, 'Green', [0, 0],[-5, 40], 'Red')
>> title('Rachel Hollis Graph of p(x)')
>>
```



Rachel Hollis Graph of p(x)
40
35
30
25
20
15
10
5
0
-5
-3
-2
-1
0
1
2
3

```
>> x = -5:0.001:5;
>> y1 = x.^3 - x.^2 - 2.*x + 3;
>> y2 = 0;
>> plot(x, y1, 'Blue', x, y2, 'Green', [0, 0],[-150, 100], 'Red')
>> title('Rachel Hollis Graph of p(x)')
>>
```


Rachel Hollis Graph of p(x)
100
50
0
-50
-100
-150
-5
-4
-3
-2
-1
0
1
2
3
4
5

Narrative

In Section 2.1 numbers 1, 2, and 10 were pretty simple because they only involved using the nested form of the polynomials. Numbers 4, 9, and 11 were more difficult because they involved writing code in Matlab. But once I got the polyval function working and figured out the Matlab syntax, they were very similar and it was just a lot of work to calculate the different numbers. In Section 2.2 numbers 1, 5, and 8 were similar in that they were all proofs like we've done in previous homeworks and in class. Numbers 9 and 15 were mostly calculations that were tedious and time consuming but once I got the feel of the problems they weren't too difficult to understand. Numbers 3 and 14 were more difficult because again the Matlab code involved. Once I got the code for number 3 working I just had to modify the code to calculate the second derivative instead of the first derivative. The two plots we had to do in Matlab did not take too long because the worksheet we got in class a few weeks ago had a similar problem that had the syntax included.

Overall this homework assignment did give me good practice for this section however it was very repetitive and time consuming. Between figuring out Matlab syntax and how to print things out in an understandable way, most of my time was spent on trying to get the code to work rather than understanding the problem. This was very frustrating but hopefully now that I have a little bit better of understand of Matlab future homework assignments won't be so frustrating.

Sometimes that is the nature of the beast. We spend hours trying to get code to do what we think it should do...

you forgot to comment on #15...