Lista 2 Cálculo Numérico A2

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Exercício 1

Tarefa 1

Para $k = 10$, no ponto $x = 0.7688$, ao rodar ex1.txt tarefa 1, obtemos o resultado na figura 1:

```
[1] "Questao 1 tarefa 1:"
                      [,1]
 [1,]  1.0000000000000000
 [2,]  0.7688000000000004
 [3,]  0.3865801600000006
 [4,] -0.0171952883199986
 [5,] -0.3130696609057276
 [6,] -0.4194820888917828
 [7,] -0.3303546374685648
 [8,] -0.1121148364807319
 [9,]  0.1274467709980197
[10,]  0.2847330011201696
```

Figure 1: Saída do Código ex1.txt tarefa 1 em R

Tarefa 2.1

Calculando os coeficientes α_i para $k = 9$ e $m = 10^4$, ao rodar ex1.txt tarefa 2.1, obtemos o resultado na figura 2:

```
[1] "Questao 1 tarefa 2.1"
[1]  8.437694987151190e-17 -9.424777650706611e+00  1.500000049348023e+01  1.143139019764924e+01 -5.748515581127830e+00
[6] -2.164299943421593e+00  6.525329066146578e-01  1.642541411309481e-01 -3.549414764736054e-02
```

Figure 2: Saída do Código ex1.txt tarefa 2.1 em R

Tarefa 2.2

A rodar ex1.txt tarefa 2.2, calculando os valores G_7, obtemos na figura 3: 3:

```
[1] "Questao 1 Tarefa 2.2"
     [,1]                [,2]                [,3]                [,4] [,5]
[1,]   -1 -1.397232532698183 0.9998587162914276 1.396239362119744   -1
```

Figure 3: Saída do Código ex1.txt tarefa 2.2 em R

Tarefa 2.3

Calculando o Erro, para os diferentes valores de $k = 2...30$ com $m = 10^4$ e 10117 sub intervalos, ao rodar ex1.txt tarefa 2.3 em R, obtemos na figura 4: 4:

```
[1] "Questao 1 tarefa 2.3"
 [1] 4.659265187843303e-01 1.291243762817875e-01 2.690847729198187e-02 5.339684324614735e-03 9.090280624604041e-04
 [6] 1.430311078562951e-04 2.026392592668902e-05 2.657317319076924e-06 3.530550125585563e-07 6.401721952542516e-08
[11] 8.180586474892948e-08 8.179753985260163e-08 8.545296192874474e-08 8.720898025948998e-08 7.790359002335379e-08
[16] 6.218857675488465e-07 4.164877415391288e-06 9.267975932036876e-06 4.866146426407703e-05 4.730948692188708e-04
[21] 1.832239944771064e-02 6.005757203469342e+00 1.071133935334159e+02 1.060522722198539e+03 2.982441786100704e+05
[26] 1.728052925889444e+08 8.476821094258975e+10 9.638770638846586e+12 4.864050462719986e+14
```

Figure 4: Saída do Código ex1.txt tarefa 2.3 em R

Tarefa 3.1

Recalculando os erros com $m = 10^5$, para regra dos trapézios, rodando ex1.txt tarefa 3.1 em R, obtemos na figura 5:

Tarefa 3.2

Recalculando os erros com $m = 10^5$, para regra de Simpson, rodando ex1.txt tarefa 3.2 em R, obtemos na figura 6:

```
[1] "Questao 1 tarefa 3.1"
 [1] 4.659264645443685e-01 1.291244391272177e-01 2.690845110870943e-02 5.339683753501800e-03 9.089939546469417e-04
 [6] 1.431007597885170e-04 2.023078503388120e-05 2.648882849953793e-06 3.189833990835389e-07 3.496430811544826e-08
[11] 4.117241880763345e-09 1.170977537157114e-09 8.994133215978195e-10 1.208335631552870e-08 1.033516627835240e-07
[16] 6.512083727816531e-07 3.963769931170091e-06 8.694766782557650e-06 5.465498078804920e-05 4.557753074412307e-04
[21] 2.004287122620840e-02 5.410211896258964e+00 1.163964127463130e+02 8.098531816068020e+02 3.123449550092876e+05
[26] 1.737007725908744e+08 8.473922764658583e+10 9.635197091838586e+12 4.862976720895986e+14
```

Figure 5: Saída do Código ex1.txt tarefa 3.1 em R

```
[1] "Questao 1 tarefa 3.2"
 [1] 4.659264639965116e-01 1.291244397619882e-01 2.690845084418858e-02 5.339683747710877e-03 9.089936102326668e-04
 [6] 1.431014633110905e-04 2.023045039667437e-05 2.648797641668921e-06 3.186700069379711e-07 3.574511819870452e-08
[11] 3.736359888151242e-09 3.710449725247145e-10 5.200417874107188e-11 1.161239149283233e-08 1.046139703753113e-07
[16] 6.513884422965077e-07 3.962830678938545e-06 8.695160259808432e-06 5.424846303170305e-05 4.474681284103443e-04
[21] 1.651518276493191e-02 6.041743765155855e+00 1.134936953287341e+02 8.738096418676125e+02 3.023113286539255e+05
[26] 1.728795051203317e+08 8.463457484658923e+10 9.637101305854588e+12 4.860099092807666e+14
```

Figure 6: Saída do Código ex1.txt tarefa 3.2 em R

Tarefa 3.3

Plotando os gráficos desejados para análise, rodando ex1.txt tarefa 3.3. em R, obtemos na figura 7:

O método de Simpson teve um desempenho superior, mas muito similar ao do trapézio. Os métodos com maior quantidade de pontos para o cálculo dos coeficientes tiveram uma redução no erro entre $k = 11$ e $k = 16$ quando comparado ao método do trapézio com $m = 10^4$.

Tarefa 4.1

Ajustando os dados calculados anteriormente, por uma função quadrática, utilizando o método dos mínimos quadrados, foram encontrada a seguinte matriz e vetor de termos independentes, rodando ex1.txt tarefa 4.1 em R, obtemos a saída na figura 8:

Tarefa 4.2

Resolvendo o sistema com o método da Eliminação de Gauss implementada na lista anterior, obtemos os seguintes coeficientes, rodando ex1.txt tarefa 4.2 em R, obtemos na figura 9:

Tarefa 4.3

Plotando os a função obtida com os dados amostrados, rodando ex1.txt tarefa 4.3 em R, obtemos na figura 10:

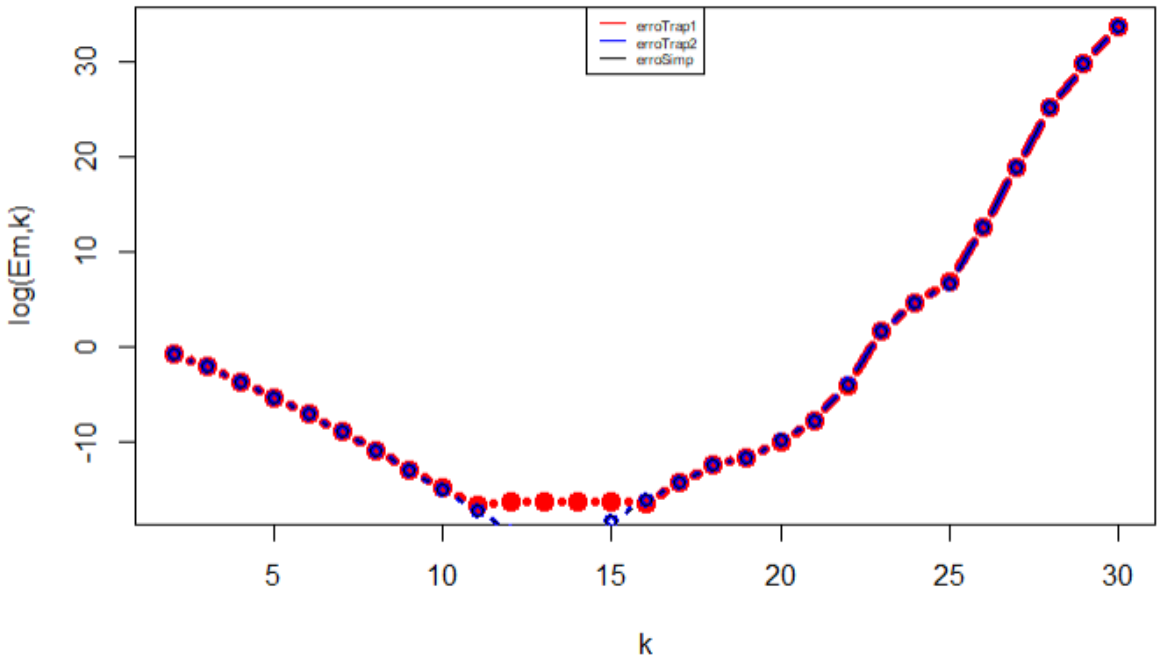

Figure 7: Gráficos de saída do Código ex1.txt tarefa 3.3 em R

Exercício 2

Item 1

Valores calculados obtidos após rodar o código exercicio2.txt, obtemos o resultado da figura 11:

Item 2

Rodando o código do exercicio2.txt, podemos perceber na figura 12, que os valore ficaram bem próximos a 1:

Item 3

Plotando o gráfico gerado pelo código exercicio2.txt, adicionando o parâmetro angle=135 na função scatterplot3d(), obtemos o resultado da figura 13:

```
[1] "Tarefa 4 - 1"
     [,1]  [,2]   [,3]
[1,]   15   135   1495
[2,]  135  1495  18495
[3,] 1495 18495 243847
                      [,1]
[1,]   -11.45591189836832
[2,]  -276.34212318751372
[3,] -5404.89575148288168
```

Figure 8: Saída do Código ex1.txt tarefa 4.1 em R

```
"Tarefa 4 - 2"
-12.4934790579321664   4.3764759372982516  -0.2775103528860534
```

Figure 9: Saída do Código ex1.txt tarefa 4.2 em R

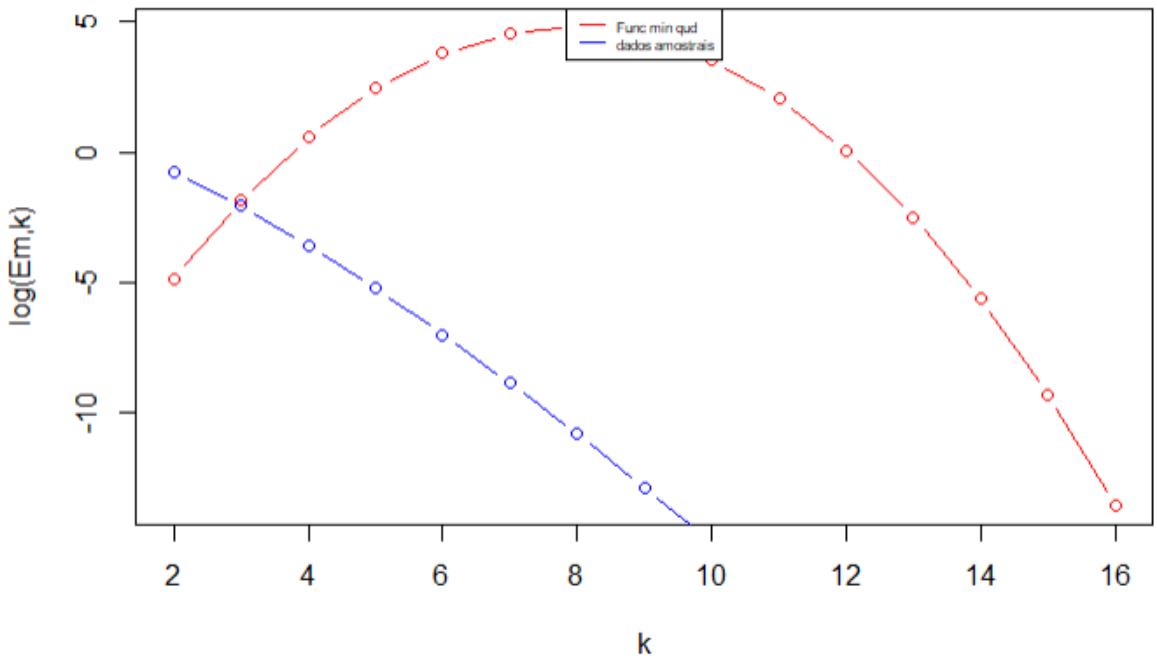

Figure 10: Gráficos de saída do Código ex1.txt tarefa 4.3 em R

```
       [,1]                [,2]                [,3]                [,4]                [,5]                [,6]
[1,]  0.7416 -0.1057087383000269 -0.3825910070541036 -0.3454967420574033 -0.1666973805143016 0.04558324437497994
[2,]  0.7416  0.2592034696369486  0.1941261079947429  0.3443375673886087  0.5722039900057310 0.79012998934100798
[3,] -0.4832  0.8465052686630778  1.1884648990593600  1.0011591746687938  0.5944933905085704 0.16428676628401256
                    [,7]                [,8]                [,9]               [,10]               [,11]
[1,]  0.2303822381377078  0.3602077374197272  0.4299154265198815  0.4479382826611338  0.4295734927095610
[2,]  0.9484084346399546  1.0250641209450282  1.0174873664985742  0.9356635384125486  0.7968144666720847
[3,] -0.1787906727776624 -0.3852718583647554 -0.4474027930184554 -0.3836018210736823 -0.2263879593816455
                   [,12]               [,13]               [,14]               [,15]               [,16]
[1,]  0.39204762217018707 0.3510982554064185 0.3188274641476461 0.30259959946736947  0.30477304053200244
[2,]  0.62127766569691878 0.4294592418416195 0.2397063243725082 0.06695481661607895 -0.07798177686932439
[3,] -0.01332528786710572 0.2194425027519617 0.4414662114798454 0.63044558391655148  0.77320873633732135
                   [,17]               [,18]               [,19]               [,20]               [,21]
[1,]  0.3230726715383136  0.3514269963752500  0.3811109386636962  0.4020525129455121  0.4041786909109937
[2,] -0.1886067320898910 -0.2625320222151619 -0.3009721356567341 -0.3080342031473526 -0.2898888821839702
[3,]  0.8655340605515768  0.9111050258399117  0.9198611969930380  0.9059816902018406  0.8857101912729763
                   [,22]               [,23]               [,24]               [,25]               [,26]
[1,]  0.3786929246716974  0.3191939272033635  0.2225624482014776  0.08955992170980183 -0.07489999999999999
[2,] -0.2538964880414120 -0.2077529014063498 -0.1587098235243560 -0.11291399059587373 -0.07489999999999999
[3,]  0.8752035633697148  0.8885589742029870  0.9361473753228787  1.02335406888607228  1.14979999999999993
                   [,27]               [,28]               [,29]               [,30]               [,31]
[1,] -0.26182887370170521 -0.4585945629271287 5 -0.6496935772864462 8 -0.8178350864469238 2 -0.9452899037029429 7
[2,] -0.04726144176805131 -0.0305150695719388 1 -0.0231627863354503 2 -0.0219462604195995 4 -0.0222790291762681 6
[3,]  1.30909031546975640  1.4891096324990669 2  1.6728563636218964 9  1.8397813468665225 0  1.9675689328792103 1
                   [,32]               [,33]               [,34]               [,35]               [,36]
[1,] -1.01544059595239800 -1.0144517387767635 34 -0.9329621972043172 8 -0.7676841746182167 0 -0.522776634153323
[2,] -0.01883098750743398 -0.0062301999103369 76  0.0201629846679912 2  0.0634644950003510 9  0.124522715763594
[3,]  2.03427158345983106  2.0206819386871002 21  1.9127992125363240 1  1.7042196796178648 0  1.398253918389728
                   [,37]               [,38]               [,39]               [,40]               [,41]               [,42]
[1,] -0.21084355588078636 0.1466096216217376 0.5194452467923940  0.8700892333795217  1.1558715602009344  1.3327466552623566
[2,]  0.20129717988848330 0.2884446323539441 0.3772072819636306  0.4557080165952234  0.5097673168253491  0.5243665617855154
[3,]  1.00954637892303010 0.5649457460243180 0.1033474712439754 -0.3257972499747450 -0.6656388770262827 -0.8571132170478714
                   [,43]               [,44]               [,45]               [,46]               [,47]
[1,]  1.3606460472052408  1.2107327817553610  0.8748442418884775 4 0.3774271485471423 8 -0.2097143431394864
[2,]  0.4858923803636184  0.3853066599932802  0.2223967844338996 0 0.0112706311011954 8 -0.2127291823350128
[3,] -0.8465384275688588 -0.5960394417486412 -0.0972410263223775 5 0.6113022203516610 4  1.4224435254744974
                   [,48]               [,49]               [,50]   [,51]
[1,] -0.7495193990631358 -1.0182649215837740 -0.6802812959114994 0.7416
[2,] -0.3845073532121318 -0.3988998429646208 -0.0983553528547705 4 0.7416
[3,]  2.1340267522752674  2.4171647645483905  1.7786366487662692 6 -0.4832
```

Figure 11: Saída do Código exercicio2.txt para o exercício 2.1 em R

```
 [1] 1.0000000000000000 0.9999999999999996 0.9999999999999993 0.9999999999999992 0.9999999999999998 1.0000000000000004
 [7] 0.9999999999999999 1.0000000000000000 1.0000000000000002 1.0000000000000002 1.0000000000000000 1.0000000000000000
[13] 0.9999999999999998 0.9999999999999997 0.9999999999999999 0.9999999999999993 0.9999999999999994 0.9999999999999998
[19] 1.0000000000000000 1.0000000000000000 0.9999999999999999 1.0000000000000002 1.0000000000000007 1.0000000000000004
[25] 1.0000000000000004 1.0000000000000000 0.9999999999999999 0.9999999999999993 0.9999999999999999 0.9999999999999991
[31] 0.9999999999999992 0.9999999999999991 0.9999999999999998 0.9999999999999980 0.9999999999999992 0.9999999999999993
[37] 0.9999999999999996 0.9999999999999998 1.0000000000000000 1.0000000000000000 1.0000000000000009 1.0000000000000009
[43] 1.0000000000000004 1.0000000000000000 0.9999999999999996 0.9999999999999989 0.9999999999999982 0.9999999999999998
[49] 0.9999999999999956 0.9999999999999993 1.0000000000000000
```

Figure 12: Saída do Código exercicio2.txt para o exercício 2.2 em R

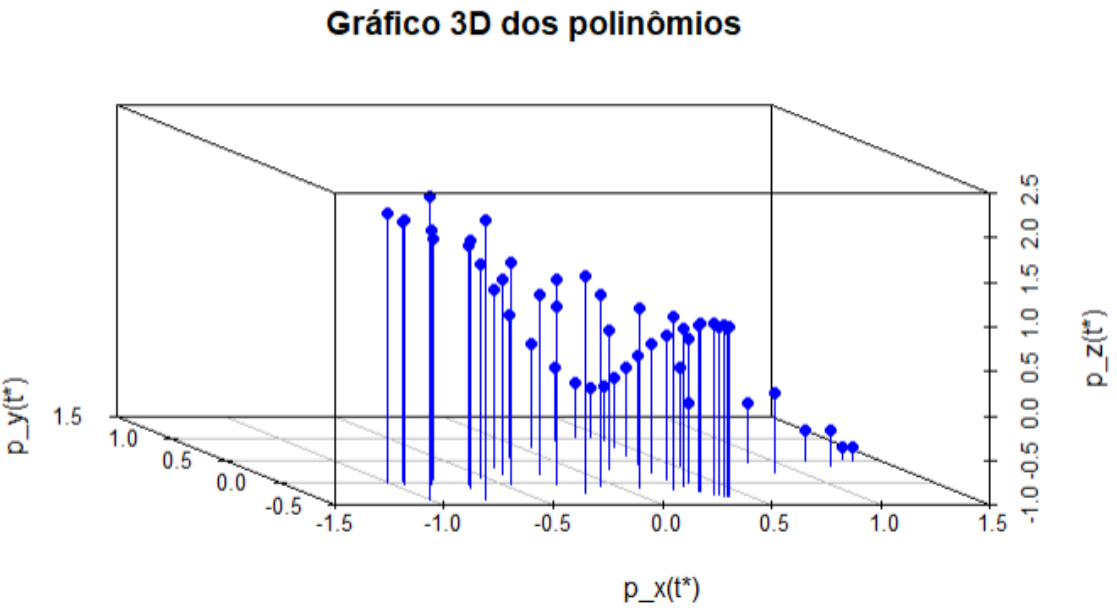

Figure 13: Saída do Código exercicio2.txt para o exercício 2.3 em R