**BAIRSTOW METHOD**

**#Generalized Solver For Bairstow Method**

**R,S,ER,ES,Sol,w,k,A=[],[],[],[],[],0,0,[]**

**n=int(input('Enter the highest power of x:'))**

**r=float(input('Enter initial value of r:'))**

**s=float(input('Enter initial value of s:'))**

**error=float(input('Enter the allowed percenatge error:'))**

**for i in range(0,n+1):**

**a=float(input('Enter the coefficient of x^'+str(i)+':'))**

**A.append(a)**

**from pandas import DataFrame**

**def linsol(r,s):**

**x=-s/r**

**return x**

**def quadsol(r,s):**

**xo=(r+((r)\*\*2+(4\*s))\*\*0.5)/2**

**xi=(r-((r)\*\*2+(4\*s))\*\*0.5)/2**

**return xo,xi**

**while(w==0):**

**k=k+1**

**B=[0]\*(len(A))**

**C=[0]\*(len(A))**

**for i in range(len(A)-1,-1,-1):**

**if i==len(A)-1:**

**B[i]=A[i]**

**if i==len(A)-2:**

**B[i]=A[i]+r\*B[i+1]**

**if i<len(A)-2:**

**B[i]=A[i]+r\*B[i+1]+s\*B[i+2]**

**for i in range(len(A)-1,-1,-1):**

**if i==len(A)-1:**

**C[i]=B[i]**

**if i==len(A)-2:**

**C[i]=B[i]+r\*C[i+1]**

**if i<len(A)-2:**

**C[i]=B[i]+r\*C[i+1]+s\*C[i+2]**

**DR=(B[0]\*C[3]-B[1]\*C[2])/(C[2]\*\*2-C[1]\*C[3])**

**DS=(C[1]\*B[1]-C[2]\*B[0])/(C[2]\*\*2-C[1]\*C[3])**

**r=r+DR**

**s=s+DS**

**ERR=(abs(DR/r))\*100**

**ERS=(abs(DS/s))\*100**

**df=DataFrame({'a':A[::-1],'b':B[::-1],'c':C[::-1]})**

**print('at r=',r,'ans s=',s,'with Err(a,r)=',ERR,'%','and the Err(a,s)=',ERS,'%')**

**print(df)**

**if ERR<error and ERS<error:**

**print('r=',r,'s=',s)**

**print('Iterations=',k)**

**X=quadsol(r,s)**

**Sol.append(X)**

**A.reverse()**

**AT=[0]\*len(A)**

**for j in range(0,len(X)):**

**for i in range(0,len(A)-1):**

**A[i]=(A[i]+AT[i])**

**print('a',A[i])**

**if i<len(A)-2:**

**AT[i+1]=X[j]\*A[i]**

**print('b',AT[i+1])**

**print('c',X[j])**

**print(A)**

**A.pop()**

**A.reverse()**

**print(A)**

**if len(A)==4:**

**w=0**

**if len(A)==3:**

**Sol.append(quadsol(-A[1]/A[2],-A[0]/A[2]))**

**w=1**

**if len(A)==2:**

**Sol.append(-A[0]/A[1])**

**w=1**

**else:**

**w=0**

**print('Solutions of the given equation are',Sol)**

**OUTPUT:**

**Enter the highest power of x:5**

**Enter initial value of r:-1**

**Enter initial value of s:-1**

**Enter the allowed percenatge error:0.01**

**Enter the coefficient of x^0:1.25**

**Enter the coefficient of x^1:-3.875**

**Enter the coefficient of x^2:2.125**

**Enter the coefficient of x^3:2.75**

**Enter the coefficient of x^4:-3.5**

**Enter the coefficient of x^5:1**

**at r= -0.6441698600140768 ans s= 0.1381090169703605 with Err(a,r)= 55.23855772732791 % and the Err(a,s)= 824.065685164213 %**

**a b c**

**0 1.000 1.000 1.000**

**1 -3.500 -4.500 -5.500**

**2 2.750 6.250 10.750**

**3 2.125 0.375 -4.875**

**4 -3.875 -10.500 -16.375**

**5 1.250 11.375 32.625**

**at r= -0.511113096451135 ans s= 0.46973362528145046 with Err(a,r)= 26.03274392435035 % and the Err(a,s)= 70.59843929895169 %**

**a b c**

**0 1.000 1.000000 1.000000**

**1 -3.500 -4.144170 -4.788340**

**2 2.750 5.557658 8.780271**

**3 2.125 -2.027423 -8.344722**

**4 -3.875 -1.801432 4.786621**

**5 1.250 2.130423 -2.105455**

**at r= -0.499686473667509 ans s= 0.5002023199048257 with Err(a,r)= 2.286758474720944 % and the Err(a,s)= 6.091274152661382 %**

**a b c**

**0 1.000 1.000000 1.000000**

**1 -3.500 -4.011113 -4.522226**

**2 2.750 5.269866 8.050969**

**3 2.125 -2.452652 -8.691850**

**4 -3.875 -0.145984 8.078345**

**5 1.250 0.172521 -8.039281**

**at r= -0.5000000652645258 ans s= 0.49999998961237047 with Err(a,r)= 0.06271831121679894 % and the Err(a,s)= 0.04046605933173432 %**

**a b c**

**0 1.000 1.000000 1.000000**

**1 -3.500 -3.999686 -4.499373**

**2 2.750 5.248792 7.997270**

**3 2.125 -2.498403 -8.745127**

**4 -3.875 -0.001124 8.368950**

**5 1.250 0.000855 -8.555329**

**at r= -0.49999999999998906 ans s= 0.5000000000000169 with Err(a,r)= 1.3052907343593722e-05 % and the Err(a,s)= 2.077529289228845e-06 %**

**a b c**

**0 1.000 1.000000e+00 1.000000**

**1 -3.500 -4.000000e+00 -4.500000**

**2 2.750 5.250000e+00 8.000001**

**3 2.125 -2.500000e+00 -8.750001**

**4 -3.875 4.879636e-07 8.375002**

**5 1.250 -4.556987e-07 -8.562503**

**r= -0.49999999999998906 s= 0.5000000000000169**

**Iterations= 5**

**a 1.0**

**b 0.5000000000000149**

**c 0.5000000000000149**

**a -2.999999999999985**

**b -1.500000000000037**

**c 0.5000000000000149**

**a 1.249999999999963**

**b 0.625**

**c 0.5000000000000149**

**a 2.75**

**b 1.3750000000000409**

**c 0.5000000000000149**

**a -2.499999999999959**

**[1.0, -2.999999999999985, 1.249999999999963, 2.75, -2.499999999999959, 1.25]**

**a 1.0**

**b -1.000000000000004**

**c -1.000000000000004**

**a -3.999999999999989**

**b 4.000000000000004**

**c -1.000000000000004**

**a 5.249999999999967**

**b -5.2499999999999885**

**c -1.000000000000004**

**a -2.4999999999999885**

**[1.0, -3.999999999999989, 5.249999999999967, -2.4999999999999885, -2.499999999999959]**

**[-2.4999999999999885, 5.249999999999967, -3.999999999999989, 1.0]**

**at r= 1.7321428571428579 ans s= 3.660714285714257 with Err(a,r)= 128.86597938144266 % and the Err(a,s)= 86.34146341463358 %**

**a b c**

**0 1.00 1.00 1.00**

**1 -4.00 -4.50 -5.00**

**2 5.25 8.00 11.00**

**3 -2.50 -8.75 -16.75**

**at r= 1.665164198325826 ans s= -1.3576288733458446 with Err(a,r)= 4.022345597171306 % and the Err(a,s)= 369.64027928284355 %**

**a b c**

**0 1.00 1.000000 1.000000**

**1 -4.00 -2.267857 -0.535714**

**2 5.25 4.982462 7.715242**

**3 -2.50 -2.171642 9.231163**

**at r= 1.8984110788810904 ans s= -1.205916201605331 with Err(a,r)= 12.286426430504104 % and the Err(a,s)= 12.580697691809073 %**

**a b c**

**0 1.00 1.000000 1.000000**

**1 -4.00 -2.334836 -0.669672**

**2 5.25 0.004486 -2.468256**

**3 -2.50 0.677311 -2.523575**

**at r= 1.992598223247929 ans s= -1.2411835681350971 with Err(a,r)= 4.726850765394826 % and the Err(a,s)= 2.8414303440026893 %**

**a b c**

**0 1.00 1.000000 1.000000**

**1 -4.00 -2.101589 -0.203178**

**2 5.25 0.054404 -1.537227**

**3 -2.50 0.137621 -2.535652**

**at r= 2.000016593851757 ans s= -1.2499449680529302 with Err(a,r)= 0.3709154527333971 % and the Err(a,s)= 0.700942852826624 %**

**a b c**

**0 1.00 1.000000 1.000000**

**1 -4.00 -2.007402 -0.014804**

**2 5.25 0.008871 -1.261810**

**3 -2.50 0.009231 -2.486675**

**at r= 1.9999999980980359 ans s= -1.24999999972457 with Err(a,r)= 0.0008297876868472202 % and the Err(a,s)= 0.004402533732163706 %**

**a b c**

**0 1.00 1.000000 1.000000**

**1 -4.00 -1.999983 0.000033**

**2 5.25 0.000055 -1.249824**

**3 -2.50 -0.000021 -2.499730**

**r= 1.9999999980980359 s= -1.24999999972457**

**Iterations= 11**

**a 1.0**

**b (0.9999999990490179+0.5000000016265342j)**

**c (0.9999999990490179+0.5000000016265342j)**

**a (-3.000000000950971+0.5000000016265342j)**

**b (-3.249999999724559-1.0000000042040451j)**

**c (0.9999999990490179+0.5000000016265342j)**

**a (2.000000000275408-1.0000000042040451j)**

**[1.0, (-3.000000000950971+0.5000000016265342j), (2.000000000275408-1.0000000042040451j), -2.4999999999999885]**

**a 1.0**

**b (0.9999999990490179-0.5000000016265342j)**

**c (0.9999999990490179-0.5000000016265342j)**

**a (-2.000000001901953+0j)**

**[1.0, (-2.000000001901953+0j), (2.000000000275408-1.0000000042040451j)]**

**[(-2.000000001901953+0j), 1.0]**

**Solutions of the given equation are [(0.5000000000000149, -1.000000000000004), ((0.9999999990490179+0.5000000016265342j), (0.9999999990490179-0.5000000016265342j)), (2.000000001901953-0j)]**