

1.23 Use the first seven terms in Eq. (1.21) to calculate an estimated value of e . Do the calculation with MATLAB (use `format long` to display the numbers). Determine the true relative error. For the exact value of e , use `exp(1)` in MATLAB.

Solution

The calculations are performed in the command window of MATLAB:

```
>> format compact
>> format long
>> x=1;
>> approx = 1+x+(x^2)/2+(x^3)/3/2+(x^4)/4/3/2+(x^5)/5/4/3/2+(x^6)/6/
5/4/3/2)
approx =
    2.71805555555556
>> exact=exp(1)
exact =
    2.71828182845905
>> TRE=abs((exact-approx)/exact)
TRE =
    8.324114928817323e-005
>> percent=TRE*100
percent =
    0.00832411492882
```

As can be seen, the first 7 terms of Eq. (1.21) using the built-in double-precision feature of MATLAB yields 2.71805555555556, with the exact answer being 2.71828182845905. The true relative error in truncating the Taylor expansion to 7 terms with double precision is therefore about 8.3×10^{-5} or about 0.8%.

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