Formal Report Template

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(Dated: September 30, 2024)

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I. QUESTION 1

A. Part (a)

```
function RELATIVE_ERROR(VALUE, REFERENCE) {
    output absolute_value(VALUE - REFERNECE)
        / REFERENCE
}

function STD_METHOD_1(X_LIST) {
    LEN_X = length of X_LIST
    SUM_X = sum of X_LIST
    MEAN_X = SUM_X / LEN_X


    STD = 0

    for i=0 to LEN_X - 1 {
        STD = STD + power((X_LIST[i] -
            MEAN_X),2)
    }

    STD = power(((1/(LEN_X - 1)) * STD),
        0.5)

    output STD
}

function STD_METHOD_2(X_LIST) {
    LEN_X = length of X_LIST
    SUM_X = sum of X_LIST
    MEAN_X = SUM_X / LEN_X

    STD = 0

    for i=0 to LEN_X - 1 {
        STD = STD + power(X_LIST[i], 2) -
            LEN_X*power(MEAN_X, 2)
    }

    STD = power(((1/(LEN_X - 1)) * STD),
        0.5)

    output STD
}

X_DATA = some list of elements
STD_1 = STD_METHOD_1(X_DATA)
STD_2 = STD_METHOD_2(X_DATA)
TRUE_STD = numpy(X_DATA, ddof=1)

output "Method 1" : RELATIVE_ERROR(STD_1,
    TRUE_STD)

output "Method 2" : RELATIVE_ERROR(STD_1,
    TRUE_STD)
```

B. Part (b)

```
def part_1(route='cdata.txt'):
    x_data = load_data(route)
    ref_std = np.std(x_data, ddof=1)
    sigma1 = std_method_1(x_data)
    sigma2 = std_method_2(x_data)

    rel_er_sigma1 = relative(sigma1, ref_std
        )
    rel_er_sigma2 = relative(sigma2, ref_std
        )

    print(f"Method 1 Sigma: {rel_er_sigma1}"
        )
    print(f"Method 2 Sigma: {rel_er_sigma2}"
        )
```

```
>>> Method 1 Sigma: 0.0
>>> Method 2 Sigma: 2.2873460336752e-09
```

C. Part (c)

* **Location:** MP257

```
>>>  Normal 1 Method 1: 0.0
>>>  Normal 1 Method 2: 2.1836734414661424e-16
>>>  Normal 2 Method 1: 1.1228049282093325e-16
>>>  Normal 2 Method 2: 0.0006270506030315829
```

D. Part (d)

```
>>>  Psuedocode
```

II. QUESTION 2

A. Part (a)

B. Part (b)

C. Part (c)

D. Part (d)

```
>>>  STD NPY: 1.4087150935148697e-16
>>>  ROUNDOFF : 1.414213562373095e-16
```

III. QUESTION 3

A. Part (a)

$$\begin{aligned}\int_0^1 \frac{4}{1+x^2}\,dx &= 4\int_0^1 \frac{1}{1+x^2}\,dx \\ &= 4\arctan(x)\Big|_0^1 \\ &= 4(\frac{\pi}{4}-0) \\ &= \pi\end{aligned}$$

B. Part (b)

```
>>>  Simpson Method: 3.14156862745098
>>>  Trapezoidal Method: 3.1311764705882354
>>>  True Value: 3.141592653589793
>>>  Simpson Relative: 7.647757511045905e-06
>>>  Trapezoidal Relative 0.003315574025695356
```

C. Part (c)

```
>>>  Optimized Simpson with 16 Slices :
        3.141592651224822
>>>
>>>  Optimized Trapezoidal with 8192 Slices :
        3.1415926511062726
```

D. Part (d)

```
>>>  Error 2: 0.00016276037786200348
```

E. Part (e)