Question 1

Part A

(a), (b), (e), and (f) will converge to A as n goes to infinity. Because they are first density and second the support of f is contained in the support of h.

(c) is not because it is not the we want to use for importance sampling as it doesn’t have the indicator function like in A.

(d) is not because the support of f does not contain in the support of h

Part B

**Setup functions:**

Text

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**Function (a):**

Text

Description automatically generated



Confidence Interval:

A picture containing text

Description automatically generated

The 90% confidence interval is about [0.357, 0.390]

Meaningful?

Yes, because the relative error is smaller than 1.



**Function (b):**

**Text, letter

Description automatically generated**



Confidence Interval:

A picture containing text

Description automatically generated

The 90% confidence interval is about [0.380, 0.394]

Meaningful?

Yes, because the relative error is smaller than 1.



**Function (e):**

**Text

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****

Confidence Interval:

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The 90% confidence interval is about [0.381, 0.406]

Meaningful?

Yes, because the relative error is smaller than 1.



**Function (f):**

**Graphical user interface, text, application

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Confidence Interval:

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Description automatically generated

The 90% confidence interval is about [0.354, 0.390]

Meaningful?

Yes, because the relative error is smaller than 1.

****

Question 2

Part A

1. U1, . . . , Un i.i.d. samples from Uniform([−1, 1]3) . Then the law of large numbers implies that

Text

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1. if we wanted to estimate the volume of a region A in [0, 1]d , then we could consider h to be the indicator function of A. That is, we could estimate A’s volume with:



For the quantity **(1) and (2)** we can use **(a)** to estimate

Text

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A picture containing diagram

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For the quantity **(4)** we can use **(b)** to estimate





We cannot use this uniform sample to estimate **(3)** because **(3)** is covering the real line R, but our sample is only covering Uniform([−1, 1]3).

Part B

**Setup functions:**

A picture containing text

Description automatically generated

**Quantity(a)**

Text

Description automatically generated

Graphical user interface, text, application, website

Description automatically generated

The 90% confidence interval is about [1.908, 2.158]

**Quantity(b)**

Text

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Graphical user interface, text, application, email

Description automatically generated

The 90% confidence interval is about [0.218, 0.325]

**Quantity(c)**

**Text

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**Graphical user interface, text, application, email, website

Description automatically generated**

The 90% confidence interval is about [3.241, 3.501]

**Quantity(d)**

Text

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A picture containing graphical user interface

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The 90% confidence interval is about [0.321, 0.587]

Question 3

Part A

Text, letter

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Part B

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Description automatically generated

Part C

(a)

Parametric

Graphical user interface, text, application, email

Description automatically generated

Graphical user interface, text, application

Description automatically generated

Non-parametric

Text

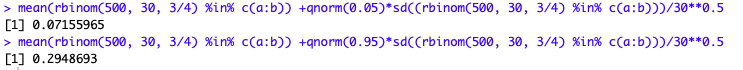
Description automatically generated

Graphical user interface, text, application

Description automatically generated

CLT





The 90% confidence interval is about [0.072, 0.295]

(b)

Parametric

Graphical user interface, text, application

Description automatically generated

Graphical user interface, text, application

Description automatically generated

Non-parametric

Graphical user interface, text

Description automatically generated

Graphical user interface, text, application

Description automatically generated

CLT

Text

Description automatically generated

A picture containing graphical user interface

Description automatically generated

The 90% confidence interval is about [1.509, 1.979]

A picture containing text

Description automatically generated

A picture containing text

Description automatically generated

The 90% confidence interval is about [1.655, 2.345]

Question 4

Part A

Text, letter

Description automatically generated

Part B

Intuition

Text, letter

Description automatically generated

Implementation

Text, application

Description automatically generated

A side note I repeated this algorithm for different step size and set it accordingly

**Graphical user interface, text, application

Description automatically generated**

**Chart, line chart

Description automatically generated**

**Comment**

It seems like the larger the step the faster it converges, however if step is too large then it will drop to quickly and if step is too small it will not/take longer to converge.