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Net Area and Integrals

1. The integral $\int_a^b e^{-x^2}\,dx$ is important in statistics,[1] but it is infamously hard to compute. Many statistics textbooks include a table which lists the value of the integral for different values of a and b. We will use Reimann Sums to generate one of these approximations.

   (a) Express the integral $\int_0^1 e^{-x^2}\,dx$ as the limit of its Right Reimann Sums.

   (b) Approximate $\int_0^1 e^{-x^2}\,dx$ using Right Sums and $n = 1$. Use a calculator to simplify.

   (c) Approximate $\int_0^1 e^{-x^2}\,dx$ using Right Sums and $n = 2$. Use a calculator to simplify.

   (d) Approximate $\int_0^1 e^{-x^2}\,dx$ using Right Sums and $n = 4$. Use a calculator to simplify.

   (e) Approximate $\int_0^1 e^{-x^2}\,dx$ using Right Sums and $n = 8$. Use a calculator to simplify.

   (f) How do these compare to the correct value of $\int_0^1 e^{-x^2}\,dx = .7468241\ldots$?

[1] This and other similar integrals are needed to compute the probability of events that follow a normal distribution. See, for example, `http://en.wikipedia.org/wiki/Standard_normal_distribution#Cumulative_distribution`.

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2. What is the graphical meaning of $\int_0^{2\pi} \cos(x)\,dx$? Compute this area geometrically.

3. What is the graphical meaning of $\int_0^1 x + 2\,dx$? Compute this area geometrically.

4. What is the graphical meaning of $\int_0^1 2x - 1\,dx$? Compute this area geometrically.

5. What is the graphical meaning of $\int_0^2 2x - 1\,dx$? Compute this area geometrically.

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6. Determine if the following are **True or False**

(a) $\int_a^b (f(x)+g(x))\,dx = \int_a^b f(x)\,dx + \int_a^b g(x)\,dx$ True False

(b) $\int_a^b (c\cdot f(x))\,dx = c\cdot\left(\int_a^b f(x)\,dx\right)$ True False

(c) $\int_a^b (f(x)-g(x))\,dx = \int_a^b f(x)\,dx - \int_a^b g(x)\,dx$ True False

7. Suppose that $\int_0^3 f(x)\,dx = 5$, $\int_4^3 f(x)\,dx = 2$, and $\int_4^6 f(x)\,dx = 10$. Find

(a) $\int_0^4 f(x)\,dx =$

(b) $\int_3^6 f(x)\,dx =$

(c) $\int_0^6 f(x)\,dx =$

8. Suppose that $\int_0^4 f(x)\,dx = 5$, $\int_3^4 f(x)\,dx = -2$, and $\int_3^6 f(x)\,dx = 10$. Find

(a) $\int_0^3 f(x)\,dx =$

(b) $\int_4^6 f(x)\,dx =$

(c) $\int_0^6 f(x)\,dx =$

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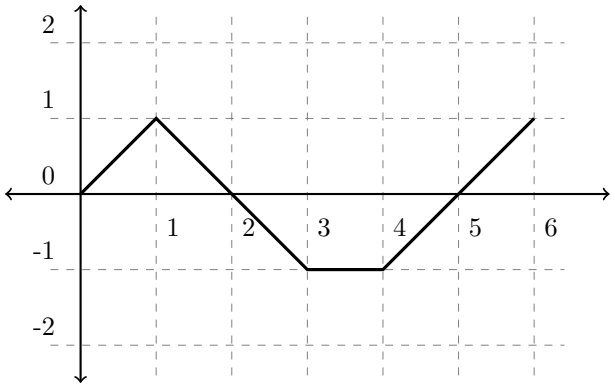
The Fundamental Theorems

1. Compute $\dfrac{d}{dx}\left[\displaystyle\int_5^x t^2+1\,dt\right]$.

2. Compute $\dfrac{d}{dx}\left[\displaystyle\int_1^x \sin(5t)\,dt\right]$.

3. Compute $\dfrac{d}{dx}\left[\displaystyle\int_{-3}^x \sin(\cos(e^t))\,dt\right]$.

4. Suppose that the function $f(x)$ is given by the following graph.



Let $A(x)=\displaystyle\int_0^x f(t)\,dt$. Compute the following

(a) $A(1)=$

(b) $A(2)=$

(c) $A(4)=$

(d) $A'(1)=$

(e) $A'(2)=$

(f) $A'(4)=$

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Computing Integrals Quickly

1. $\int \left[\sin(x) + e^x - 2\cos(x) + 6x^2\right]\, dx$

2. $\int_0^1 \frac{1}{x^2+1}\, dx$

3. $\int \frac{x^2+x+1}{x}\, dx$

4. $\int_{-1}^1 (x^2+3)(x-1)\, dx$

5. $\int \frac{x^{3/2}+\sqrt{x}+1}{\sqrt{x}}\, dx$

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6. $\int x\sqrt{x^2+3}\,dx$

7. $\int \frac{1}{x+1}\,dx$

8. $\int \sin(5x)+1\;\;dx$

9. $\int \cos(x)\cdot e^{\sin(x)}\;\;dx$

10. $\int \left[\frac{1}{x^2+1}+\frac{1}{x+1}\right]\,dx$