Mathematical Fundamentals

Properties of Logarithms: 1

- Log_b is strictly increasing
  - If $x<y$ then $\log_b x < \log_b y$
- Log_b is one-to-one
  - if $\log_b x = \log_b y$ then $x = y$
- $Log_b\ 1 = 0$
- $Log_b\ b^a = a$ $\quad$ ($Log_b\ b = 1$)

Properties of Logarithms: 2

- $\text{Log}_b (xy) = \text{Log}_b x + \text{Log}_b y$
- $\text{Log}_b x^a = a \text{Log}_b x$
- $x^{\text{Log}_b y} = y^{\text{Log}_b x}$
- $\text{Log}_a x = (\text{Log}_b x)/(\text{Log}_b a)$

Probability

- $X=(x_1, x_2, \ldots, x_n)$ X is a set of numbers
- $P=(p_1, p_2, \ldots, p_n)$ P is a set of probabilities
- For all $1 \le i \le n$, p_n is the probability of x_n
- Average $= x_1p_1+x_2p_2+ \ldots + x_np_n$
- Usually written

Summations

$$\sum_{i=0}^{n} 2^i = 2^{n+1} - 1$$

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Induction: Basis Step

$$\sum_{i=1}^{1} i = 1 = \frac{2}{2} = \frac{1+1}{2} = \frac{1(1+1)}{2}$$

Induction: Inductive Step

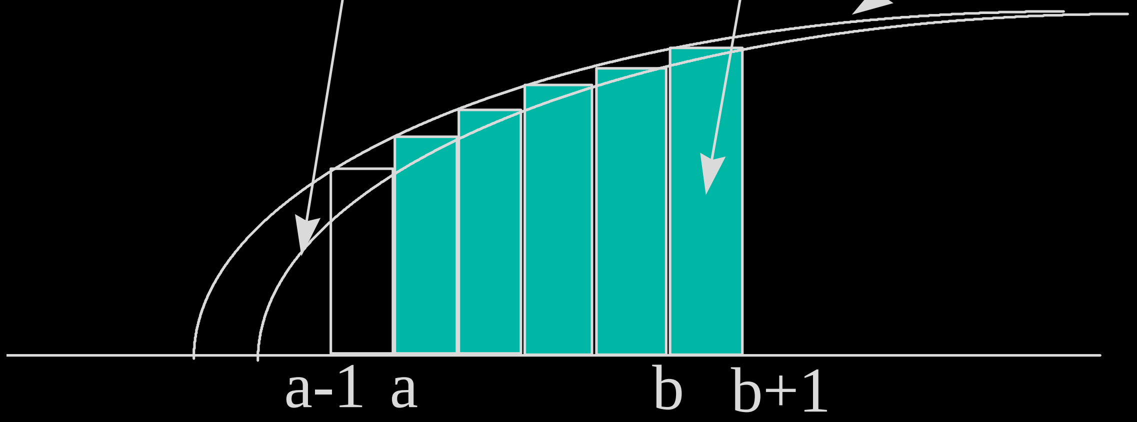
$$\sum_{i=1}^{n+1} i = \sum_{i=1}^{n} i + (n+1) = \frac{n(n+1)}{2} + (n+1)$$

$$= \frac{n(n+1)}{2} + \frac{2(n+1)}{2} = \frac{(n+2)(n+1)}{2}$$

$$= \frac{(n+1)[(n+1)+1]}{2}$$

Integral Formulas

$$\int_{a-1}^{b} f(x)\,dx \le \sum_{i=a}^{b} f(i) \le \int_{a}^{b+1} f(x)\,dx$$



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- $\mathrm{Log}_b\,x^a = a\,\mathrm{Log}_b\,x$
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- $\mathrm{Log}_a\,x = (\mathrm{Log}_b\,x)/(\mathrm{Log}_b\,a)$

Probability

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- Average = $x_1p_1+x_2p_2+ \ldots + x_np_n$
- Usually written $\sum_{i=1}^{n} x_i p_i$

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