# Arithmetic progression

\ a_n = a_1 + (n - 1)d,

\ a_n = a_m + (n - m)d.

 S_n=\frac{n}{2}[ 2a_1 + (n-1)d].

 S_n=\frac{n(a_1 + a_n)}{2}

# Summation

\sum_{i=m}^n 1 = n+1-m \,

\sum_{i=m}^n i = \frac{n(n+1)}{2} - \frac{m(m-1)}{2} = \frac{(n+1-m)(n+m)}{2} \sum_{i=0}^n i = \sum_{i=1}^n i = \frac{n(n+1)}{2}

\sum_{i=0}^n i^2 = \frac{n(n+1)(2n+1)}{6} = \frac{n^3}{3} + \frac{n^2}{2} + \frac{n}{6} )

\sum_{i=0}^n i^3 = \left(\frac{n(n+1)}{2}\right)^2 = \frac{n^4}{4} + \frac{n^3}{2} + \frac{n^2}{4} = \left[\sum_{i=1}^n i\right]^2 \,

\sum_{i=0}^n i^4 = \frac{n(n+1)(2n+1)(3n^2+3n-1)}{30} = \frac{n^5}{5} + \frac{n^4}{2} + \frac{n^3}{3} - \frac{n}{30} \,

\sum_{i=m}^{n-1} a^i = \frac{a^m-a^n}{1-a}

\sum_{i=0}^{n-1} a^i = \frac{1-a^n}{1-a}

\sum_{i=0}^n {n \choose i} = 2^n \,

\sum_{i=1}^{n} i{n \choose i} = n2^{n-1}

\sum_{i=0}^{n} {i \choose k} = {n+1 \choose k+1} \,

\sum_{i=0}^n {n \choose i}a^{(n-i)} b^i=(a + b)^n

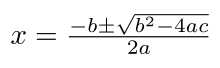
\sum_{i=0}^n {m+i-1 \choose i} = {m+n \choose n} \,

a + ar + a r^2 + a r^3 + \cdots + a r^{n-1} = \sum_{k=0}^{n-1} ar^k= a \, \frac{1-r^{n}}{1-r},

# Taylor series

 \sum_{n=0} ^ {\infty} \frac {f^{(n)}(a)}{n!} \, (x-a)^{n}

# Quadratic equation



# Probability

|  |  |
| --- | --- |
| **Summary of probabilities** | |
| **Event** | **Probability** |
| A | P(A)\in[0,1]\, |
| not A | P(A^c)=1-P(A)\, |
| A or B | \begin{align} P(A\cup B) & = P(A)+P(B)-P(A\cap B) \\ P(A\cup B) & = P(A)+P(B) \qquad\mbox{if A and B are mutually exclusive} \\ \end{align} |
| A and B | \begin{align} P(A\cap B) & = P(A|B)P(B) = P(B|A)P(A)\\ P(A\cap B) &  = P(A)P(B) \qquad\mbox{if A and B are independent}\\ \end{align} |
| A given B | P(A \mid B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B)} \, |

# Binomial distribution

# Geometric distribution

# Factorization

# Inversion

Number of permutations of n elements with k permutations

**Mahonian Numbers**

1. 1
2. 1, 1
3. 1, 2, 2, 1
4. 1, 3, 5, 6, 5, 3, 1
5. 1, 4, 9, 15, 20, 22, 20, 15, 9, 4, 1
6. 1, 5, 14, 29, 49, 71, 90, 101, 101, 90, 71, 49, 29, 14, 5, 1