Three kind of coordinate system.

$$dV = dxdydz = rdrd\theta dz = \rho^2 \sin\psi d\rho d\psi d\theta$$

**Taylor series** 

$$f(a+u,b+v) = f(a,b) + \sum_{k=1}^{\infty} rac{1}{k!} (urac{\partial}{\partial x} + vrac{\partial}{\partial y})^k f(a,b)$$

**Taylor Series** 

$$f(a+u)=f(a)+\sum_{k=1}^{\infty}rac{f^{(k)}(a)}{k!}\cdot(x-a)^k$$

Normally used ones

$$egin{align} rac{1}{1-x} &= \sum_{n=0}^\infty x^n \quad orall |x| < 1 \ (1+x)^lpha &= \sum_{n=0}^lpha C_n^lpha \cdot x^n \quad orall |x| < 1 egin{align} lpha \wedge \oplus rak n \wedge \oplus n \end{pmatrix} \ e^x &= \sum_{n=0}^\infty rac{x^n}{n!} \ \ln(1+x) &= \sum_{n=1}^\infty rac{(-1)^n+1}{n} \cdot x^n \quad orall x \in (-1,1] \end{aligned}$$

# **Statistics**

# **Expectation**

$$E(X) = E[(X - E(X))^{2}] = E(X^{2}) - (E(X))^{2}$$

Law of Total Expectation

$$EX = E[E(X|Y)]$$

$$E(Y\ast f(X)|X)=f(X)E(Y|X)$$

**Variance** 

$$Var(aX + Y + b) = a^2 Var(X) + Var(Y)$$

#### Covariance

$$egin{aligned} var(X\pm Y) &= D(X) + D(Y) \pm 2cov(X,Y) \\ cov(X,Y) &= E(XY) - E(X)E(Y) \\ cov(X,Y) &= cov(Y,X) \\ cov(aX,bY) &= ab \cdot cov(X,Y) \\ cov(X_1+X_2,Y) &= cov(X_1,Y) + cov(X_2,Y) \end{aligned}$$

## **Chebyshev's Inequality**

$$Pr[|X-EX| \geq t] \leq rac{var(X)}{t^2}$$

## **Markov's Inequality**

$$P(X \geq a) \leq \frac{E(X)}{a}$$