# BIOSTAT 701 一页速查卡（中英文对照）

## 1. Random Variables & Probability 随机变量与概率

Random Variable (RV 随机变量): Discrete / Continuous

Probability laws (概率公式): 0 ≤ P(A) ≤ 1; P(A^c) = 1 - P(A); P(A ∪ B) = P(A)+P(B)-P(A ∩ B)

Conditional probability: P(A|B) = P(A ∩ B) / P(B)

Independence: P(A ∩ B) = P(A)P(B)

Bayes’ theorem: P(A|B) = [P(B|A)P(A)] / [P(B|A)P(A)+P(B|A^c)P(A^c)]

## 2. Discrete Random Variables 离散型随机变量

PMF: f(x) = P(X=x), Σ f(x)=1

CDF: F(x) = P(X ≤ x)

Bernoulli(p): E(X)=p, Var(X)=p(1-p)

Binomial(n,p): P(X=k)={n choose k}p^k(1-p)^(n-k)

Poisson(λ): P(X=k)=λ^k/k! \* e^(−λ), E(X)=Var(X)=λ

Geometric(p): P(X=k)=(1-p)^(k-1)p

Negative Binomial(r,p): until r successes

Hypergeometric(N,K,n): 无放回抽样

## 3. Continuous Random Variables 连续型随机变量

PDF: f(x) ≥ 0, ∫ f(x) dx = 1

CDF: F(x) = ∫ f(t)dt

Uniform(a,b): f(x)=1/(b-a)

Normal(μ,σ²): f(x)=(1/(σ√2π)) e^(-(x-μ)²/(2σ²))

Standard Normal Z: Z=(X-μ)/σ

Empirical rule: 68–95–99.7%

Chi-square(df): sum of squared standard normals

t-distribution: heavier tails, → Normal as df ↑

F-distribution: ratio of chi-squares / variances

Exponential(λ): f(x)=λe^(−λx), x≥0, 无记忆性

## 4. Likelihood & MLE 似然与极大似然估计

Likelihood: L(θ|x) = fθ(x)

MLE: θ^ = argmax L(θ)

Log-likelihood: ℓ(θ)=log L(θ)

Examples: Poisson(λ): λ^ = X̄; Normal: μ^ = X̄, σ^2 = (1/n)Σ(Xi−X̄)²

## 5. Central Limit Theorem (CLT) 中心极限定理

Sample mean: E(X̄)=μ, Var(X̄)=σ²/n

If X ~ Normal: X̄ ~ Normal(μ,σ²/n)

If X not Normal: for n≥30, X̄ ≈ Normal(μ,σ²/n)

CLT formula: (X̄−μ)/(σ/√n) ≈ N(0,1)

## 6. Moments & MGFs 矩与矩母函数

Moments: mean, variance, skewness, kurtosis

MGF: M\_X(t)=E[e^(tX)]

Derivatives at 0 → moments

Linear: M\_{aX+b}(t)=e^(bt)M\_X(at)

Sum: M\_{X+Y}(t)=M\_X(t)M\_Y(t) (indep.)

Example: Poisson(λ): M(t)=exp(λ(e^t−1))