310 Quals Strategy Compendium

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Distribution	**Support**	**p.m.f.** $P(X = x)$	**c.d.f.** $F(x)$
Bernoulli(p)	$\{0, 1\}$	$p^x(1-p)^{1-x}$	$\mathbf{1}_{x\geqslant 1}p + \mathbf{1}_{0\leqslant x<1}(1-p)$
Binomial(n, p)	$\{0, \ldots, n\}$	$\binom{n}{x}p^x(1-p)^{n-x}$	$\sum_{k=0}^{\lfloor x\rfloor}\binom{n}{k}p^k(1-p)^{n-k}$
Geometric (p) (shift-1)	$\{1, 2, \ldots\}$	$(1-p)^{x-1}p$	$1-(1-p)^{\lfloor x\rfloor}$
Negative Binomial(r, p)	$\{0, 1, \ldots\}$	$\binom{r+x-1}{x}(1-p)^r\, p^x$	$1 - \mathrm{B}_p(\lfloor x\rfloor + 1, r)$ (B_p = regularized Beta)
Poisson(λ)	$\{0, 1, \ldots\}$	$e^{-\lambda}\dfrac{\lambda^x}{x!}$	$e^{-\lambda}\sum_{k=0}^{\lfloor x\rfloor}\dfrac{\lambda^k}{k!}$
Hypergeometric(N, K, n)	$\{0, \ldots, n\}$	$\dfrac{\binom{K}{x}\binom{N-K}{n-x}}{\binom{N}{n}}$	$\sum_{k=0}^{\lfloor x\rfloor}\dfrac{\binom{K}{k}\binom{N-K}{n-k}}{\binom{N}{n}}$
Discrete Uniform(a:b)	$\{a, a+1, \ldots, b\}$	$\dfrac{1}{b-a+1}$	$\dfrac{\lfloor x\rfloor - a + 1}{b-a+1}\,\mathbf{1}_{x\geqslant a}$

Table 1: Common discrete distributions. Here $\mathbf{1}_A$ is the indicator of event A.

Distribution	Support	p.d.f. $f(x)$	c.d.f. $F(x)$
Uniform(a, b)	(a, b)	$\dfrac{1}{b-a}$	$\dfrac{x-a}{b-a},\ a < x < b$
Exponential(λ)	$(0, \infty)$	$\lambda e^{-\lambda x}$	$1 - e^{-\lambda x}$
Gamma(α, θ)	$(0, \infty)$	$\dfrac{x^{\alpha-1} e^{-x/\theta}}{\Gamma(\alpha)\theta^{\alpha}}$	$\dfrac{\gamma(\alpha, x/\theta)}{\Gamma(\alpha)}$ (γ = lower incomplete Γ)
χ^2_k	$(0, \infty)$	$\dfrac{x^{k/2-1} e^{-x/2}}{2^{k/2}\Gamma(k/2)}$	$P\big(k/2, x/2\big)$ (regularized Γ)
Normal(μ, σ^2)	$(-\infty, \infty)$	$\dfrac{1}{\sqrt{2\pi\sigma^2}} \exp\Big[-\dfrac{(x-\mu)^2}{2\sigma^2}\Big]$	$\Phi\Big(\dfrac{x-\mu}{\sigma}\Big)$ (Φ = standard normal c.d.f.)
Lognormal(μ, σ)	$(0, \infty)$	$\dfrac{1}{x\sigma\sqrt{2\pi}} \exp\Big[-\dfrac{(\ln x-\mu)^2}{2\sigma^2}\Big]$	$\Phi\Big(\dfrac{\ln x-\mu}{\sigma}\Big)$
Student-$t(\nu)$	$(-\infty, \infty)$	$\dfrac{\Gamma\big(\frac{\nu+1}{2}\big)}{\sqrt{\nu\pi}\,\Gamma\big(\frac{\nu}{2}\big)} \big(1 + \frac{x^2}{\nu}\big)^{-(\nu+1)/2}$	$\frac{1}{2} + x\, \dfrac{{}_2F_1\big(\frac{1}{2}, \frac{\nu+1}{2}; \frac{3}{2}; -\frac{x^2}{\nu}\big)}{\sqrt{\nu\pi}\, B\big(\frac{\nu}{2}, \frac{1}{2}\big)}$ (symmetric)
Cauchy(x_0, γ)	$(-\infty, \infty)$	$\dfrac{1}{\pi\gamma\,[1 + ((x-x_0)/\gamma)^2]}$	$\dfrac{1}{\pi} \arctan\Big(\dfrac{x-x_0}{\gamma}\Big) + \dfrac{1}{2}$
Laplace(μ, b)	$(-\infty, \infty)$	$\dfrac{1}{2b} \exp\big(-\frac{\lvert x-\mu\rvert}{b}\big)$	$\begin{cases} \frac{1}{2}\exp\big(\frac{x-\mu}{b}\big), & x < \mu, \\ 1 - \frac{1}{2}\exp\big(-\frac{x-\mu}{b}\big), & x \geqslant \mu, \end{cases}$
Weibull(k, λ)	$(0, \infty)$	$\dfrac{k}{\lambda}\Big(\dfrac{x}{\lambda}\Big)^{k-1} e^{-(x/\lambda)^k}$	$1 - e^{-(x/\lambda)^k}$
Pareto(x_m, α)	(x_m, ∞)	$\dfrac{\alpha x_m^{\alpha}}{x^{\alpha+1}}$	$1 - \Big(\dfrac{x_m}{x}\Big)^{\alpha}$
Beta(α, β)	$(0, 1)$	$\dfrac{x^{\alpha-1}(1-x)^{\beta-1}}{\mathrm{B}(\alpha, \beta)}$	$I_x(\alpha, \beta)$ (I_x = regularized Beta)
Rayleigh(σ)	$(0, \infty)$	$\dfrac{x}{\sigma^2} \exp\big(-x^2/(2\sigma^2)\big)$	$1 - \exp\big(-x^2/(2\sigma^2)\big)$
Triangular(a, c, b)	(a, b)	$\dfrac{2(x-a)}{(b-a)(c-a)}\mathbf{1}_{a \leqslant x < c} + \dfrac{2(b-x)}{(b-a)(b-c)}\mathbf{1}_{c \leqslant x < b}$	piecewise quadratic (integral of pdf)

Table 2: Common continuous distributions. Special-function notation follows standard texts.