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$$r' * y = x \quad y$$



$$(Γ) \quad I_\nu \quad K_\nu \quad J_\nu \quad Y_\nu$$

$$\geq 0$$

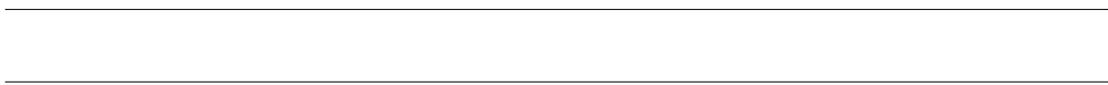
$$I_\nu \quad K_\nu$$

$$e^{-x}I_\nu(x) \quad e^xK_\nu(x)$$

$$\nu < 0$$

$\langle \quad \quad \quad \rangle$

$$\Gamma(x) \quad B(x)$$





$$R'R = x$$

$$R \quad R'R = x$$



$$\sqrt{x^2 + y^2} \quad \phi = \quad (z) \quad x = r * \cos(\phi) \quad \begin{matrix} z = x + iy \\ y = r * \sin(\phi) \end{matrix} \quad x \quad y \quad r = \quad (z) =$$







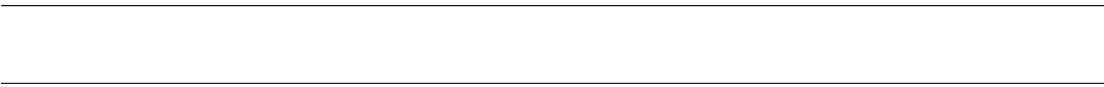


[20, 500]



+1 -1

$O(n^2)$



p

$p \times p$

k

k



$$n \qquad 28 + 8[(n + 1)/8]$$

$$v_{i_j} \leq x_j < v_{i_j+1} \quad v_0 := -\infty \quad v_{N+1} := +\infty$$

$N \quad N - 1$

$\{1, \dots, N - 1\}$

$O(n \log N)$

$O(n)$

X_1, \dots, X_n

$nF_n(t; X_1, \dots, X_n)$

F_n

$= \max(\text{vec})$

n







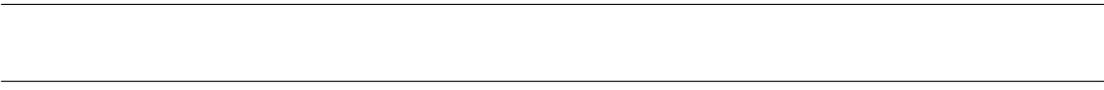






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-1
-1



$\pm 2 \times 10^9$



R *QR*

kappa

QR

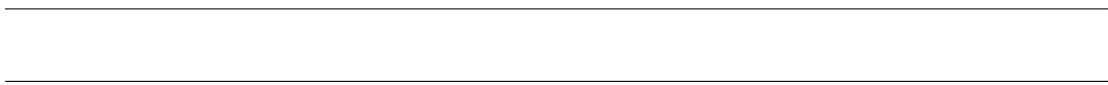
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$$\log(1+x)$$

$$|x| \ll 1$$

$$x \approx -1$$

$$\exp(x) - 1$$

$$|x| \ll 1$$









10^{-5}



$$2^{10} = 1024$$

$$2^{30} = 1073741824$$

$$2^{20} = 1048576$$

$$2^{31} - 1 \approx 2 \cdot 10^9$$







< >





$n - 1$

$$p(x) = z_1 + z_2x + \cdots + z_nx^{n-1}$$

$n - 1$

$p(x)$

$n - 1 \quad n$

> 1

$$\begin{array}{l} 10^{\lfloor \log_{10}(c) \rfloor} \\ h = \begin{array}{l} u \\ f = \end{array} \begin{array}{l} b \leq c < 10b \\ \{1, 2, 5, 10\}b \end{array} \end{array} \geq 0 \quad c/b \in [1, 10)$$



≤ 1024



$$Ax = b$$

$$A \quad b$$

Q

Q^R

Q



Q X

R

X

X

X

Q

x



$$6.9536 \times 10^{12}$$

$$2^{60}$$

$$\approx 4.6 \times 10^{18}$$

$$2^{19937} - 1$$

$$X_j = (X_{j-100} - X_{j-37}) \bmod 2^{30}$$

$$2^{129}$$

2^{32}





10^{-14}



-1



$$O(n^{4/3})$$



$$B(a, b) = \frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)}.$$

$$B(a, b) = \int_0^1 t^{a-1}(1-t)^{b-1} dt$$

$\Gamma(x)$

$$\Gamma(x) = \int_0^\infty t^{x-1} e^{-t} dt$$

$x!$

$\psi(x)$

$$= \psi(x) = \frac{d}{dx} \ln \Gamma(x) = \frac{\Gamma'(x)}{\Gamma(x)}$$

$$1)/k! \quad 1 \quad k=0 \quad 0 \quad k \quad n \quad k \quad k \geq 1 \quad n(n-1) \cdots (n-k+1)$$













$$X = UDV',$$

$$U \quad V \quad V' \quad D$$
$$D_{ii} \quad D = U'XV$$





(x, y)

$\pi/2$

$[1, \infty)$

$(-\infty i, -1i]$

$(-\infty, -1]$ $[1, \infty)$
 $(-\infty, -1]$
 $(-\infty i, -1i]$ $[1i, \infty i)$
 $[1i, \infty i)$





$O(n^2)$



< >

< >



x y



$\mu \quad /m^2$

CO_2

CO_2



$$n = 16$$

$$1954 = 100$$

$$\geq$$









8 × 8





[0, 100]

I_g

[0, 1]

[0, 100]







< >

n

n
 $n \equiv 2 \pmod{4}$

$n \equiv 1 \pmod{4}$



[0, 1]

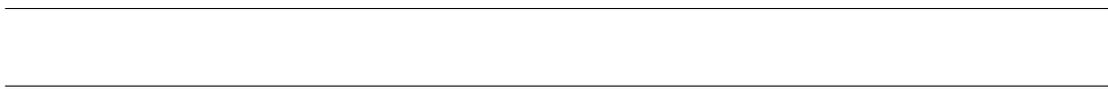


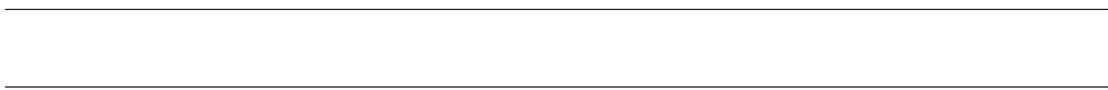


$$\geq 1$$

$$(start^\gamma, \dots, end^\gamma)^{1/\gamma}$$

$(r^\gamma, g^\gamma, b^\gamma)$ (r, g, b) $[0, 1]$





L_2





$$\geq 1$$

$$= 1$$

$$\frac{2}{6}$$

$$\frac{3}{6}$$

$$\frac{4}{6}$$

$$\frac{5}{6}$$

$$\frac{1}{6}$$

<

>





$[0, M]$ M



$[0, M]$ $M =$

$\langle \langle \quad \rangle \rangle$

4×4
 (x, y, z)

(x, y, z, t)





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$$(f_{ij} - e_{ij})/\sqrt{e_{ij}}$$

$$f_{ij} - e_{ij}$$

$$\chi^2 \quad i, j \quad d_{ij} =$$

$$d_{ij}$$

$$\sqrt{e_{ij}}$$

$$d_{ij} = 0$$



x

$P(y|x)$

x

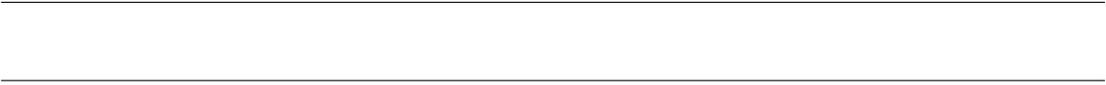
x

\langle

\rangle

×

y/x



k

k

k

$$\sqrt{f_{ij}} \quad f_{ij} \quad k$$

k

k



10^{-7}

$n + 1$

n

$$\hat{f}(x_i)$$
$$\sum_i \hat{f}(x_i)(b_{i+1} - b_i) = 1 \quad b_i$$

n



$$\begin{matrix} N \\ \{1, \dots, N-1\} \end{matrix}^N$$

i

i

N

$$\geq 1$$



χ^2

χ^2

ij

[0, 1]

$[0, 1]$

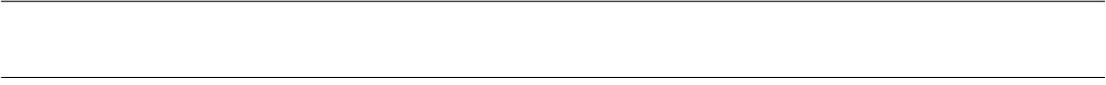
$$\begin{array}{r} k10^j \\ k10^j \end{array} \quad \begin{array}{r} 10^j \\ k \in \{1, 5\} \\ k \in \{1, 2, 5\} \end{array} \quad j$$

$$(nx - 1)(ny - 1)$$

(x, y, z)

4×4

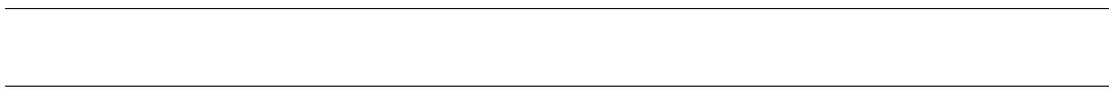
(x, y, z, t)



(x_1, y_1) (x_2, y_2) $x_1 < x_2$



y/x





×





[0, 1]



[0, 1]

< < > >











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$10 \log_{10}(N/m)$

N

m



C_p

χ^2

C_p

$2p \quad p$

$C_p \text{ RSS}/scale + 2p - n \quad C_p$

C_p



kn_{par}

n_{par}
 $k = \log(n) \quad n$

-2 $+$
 $k = 2$



C_p

σ^2



σ^2

σ^2

C_p



F

$$f(t - m)$$

$$s > 1$$

$$m$$

$$s \neq 1$$

$$s \frac{f((t - m)/s)}{s}$$

$$s < 1$$

s

s

s

s^2

s

s^2

k

$10 \log_{10}(N)$ N

$$x_t - \mu = a_1(x_{t-1} - \mu) + \cdots + a_p(x_{t-p} - \mu) + e_t$$



$10 \log_{10}(N)$ N

$$x_t - \mu = a_0 + a_1(x_{t-1} - \mu) + \cdots + a_p(x_{t-p} - \mu) + e_t$$

a_0

μ



(p, d, q)

$$X_t = a_1 X_{t-1} + \dots + a_p X_{t-p} + e_t + b_1 e_{t-1} + \dots + b_q e_{t-q}$$

$$X_{t-m} \quad X_t$$



(p, d, q)

$$X_t = a_1 X_{t-1} + \dots + a_p X_{t-p} + e_t + b_1 e_{t-1} + \dots + b_q e_{t-q}$$

$$X - m \quad X$$



$0, \dots, \max(p, q + 1)$

k



$P[X \leq x]$

$P[X > x]$

$$= a \qquad = b$$

$$f(x) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} x^a (1-x)^b$$

$$a > 0 \quad b > 0 \quad 0 \leq x \leq 1 \qquad x = 0 \quad x = 1$$

$$a/(a+b) \qquad ab/((a+b)^2(a+b+1))$$

$$B_x(a, b) = \int_0^x t^{a-1} (1-t)^{b-1} dt,$$

$$I_x(a, b) = B_x(a, b)/B(a, b) \qquad B(a, b) = B_1(a, b)$$

$$I_x(a, b)$$

$$X/(X+Y) \qquad X \sim \chi_{2a}^2(\lambda) \qquad Y \sim \chi_{2b}^2$$

$$P[X \leq x] \qquad P[X > x]$$

$$= n \qquad = p$$

$$p(x) = \binom{n}{x} p^x (1-p)^{n-x}$$

$$x = 0, \dots, n$$

$$p(x)$$

$$x \qquad F(x) \geq p \qquad F$$





$n \times p_1$
 $n \times p_2$

p_1



$$P[X \leq x]$$

$$P[X > x]$$

$$f(x) = \frac{1}{\pi s} \left(1 + \left(\frac{x-l}{s} \right)^2 \right)^{-1}$$

x



$|O - E|$

χ^2

$$P[X \leq x]$$

$$P[X > x]$$

$$= n > 0$$

$$f_n(x) = \frac{1}{2^{n/2} \Gamma(n/2)} x^{n/2-1} e^{-x/2}$$

$$x > 0$$

$$n \quad 2n$$

$$= n$$

$$= \lambda$$

$$f(x) = e^{-\lambda/2} \sum_{r=0}^{\infty} \frac{(\lambda/2)^r}{r!} f_{n+2r}(x)$$

$$x \geq 0$$

$$n$$

$$n$$

$$E(X) = n + \lambda \quad \text{Var}(X) = 2(n + 2 * \lambda) \quad E((X - E(X))^3) = 8(n + 3 * \lambda)$$

$$= n$$

$$\lambda > 0$$

$$n = 0$$

$$\alpha = n/2 \quad \sigma = 2^n$$





$\{1, 2, \dots, n-1\}$

c^*
 $n-1$

$$d_{ij} \qquad c^* \qquad d_{ij} + c^*$$

$$n - 1$$

$$\begin{aligned} & (\sum_{j=1}^k \lambda_j) / (\sum_{j=1}^n T_i(\lambda_j)) \qquad \lambda_j \\ T_1(v) = |v| \qquad T_2(v) = \max(v, 0) \end{aligned} \qquad (g_1, g_2) \qquad g_i =$$



$$r_k = \sum_i x_{k-m+i} y_i$$
$$i \quad k = 1, \dots, n + m - 1$$
$$n = m \quad i, k = 1, \dots, n$$
$$x_j := x_{n+j} \quad j < 1$$

$n - 1$

τ

ρ

$[-1, 1]$ 0

τ

ρ

ρ



$$(n-1) \quad 1/n$$





< >



$$\begin{aligned} &= 1 \\ R(K) &= \int K^2(t)dt \end{aligned}$$

$$R(K)$$

$$\sigma_K^2 = \int t^2 K(t)dt$$

$$\sigma_K R(K)$$

$$R(K)$$





x y

x y

$$\sum_i |x_i - y_i| / |x_i + y_i|$$

p

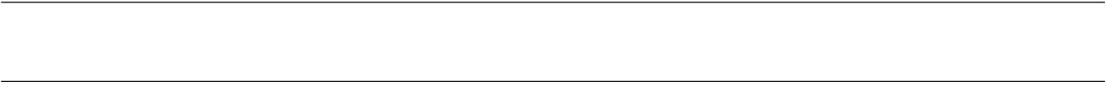
p

p

n^2

$i < j \leq n$

$n*(n-1)/2$



$$F_n(t) = \frac{1}{n} \sum_{i=1}^n \mathbf{1}_{[x_i \leq t]}$$

i F_n i/n
 (x_1, x_2, \dots, x_n) F_n t

$1/n$

$\langle \quad \quad \quad \rangle$





r



$$P[X \leq x]$$

$$P[X > x]$$

$$\lambda$$

$$f(x) = \lambda e^{-\lambda x}$$

$$x \geq 0$$

$$H(t) = -\log(1 - F(t))$$



≡

$$AIC = -2 \log L + k \times \quad ,$$

L

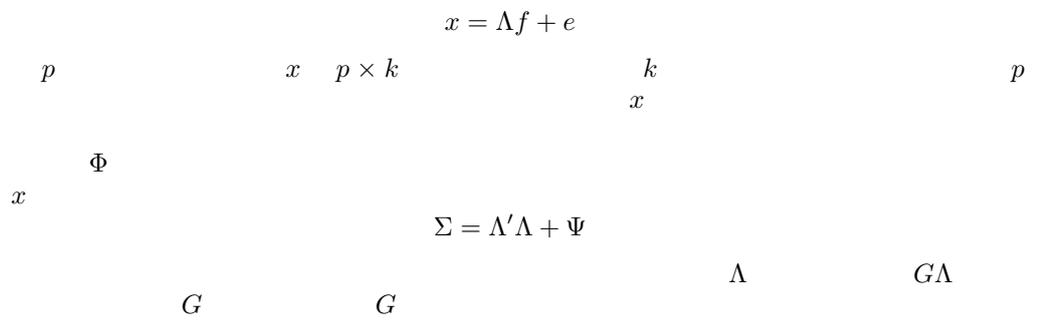
C_p

$$s \frac{-2 \log L}{n \log(RSS/n)} \quad \frac{RSS}{s-n}$$

w

$$n \log(RSS/n) - n + n \log 2\pi - \sum \log w$$





$[0, 1]$

$f \quad x$

$$\hat{f} = \Lambda' \Sigma^{-1} x$$

f

Λ

$$d\mu/d\eta$$



$$P[X \leq x] \qquad P[X > x]$$

$$f(x) = \frac{\Gamma(n_1/2 + n_2/2)}{\Gamma(n_1/2)\Gamma(n_2/2)} \left(\frac{n_1}{n_2}\right)^{n_1/2} x^{n_1/2-1} \left(1 + \frac{n_1x}{n_2}\right)^{-(n_1+n_2)/2}$$

$$x > 0$$

t_m n_1 n_2
 m m t_m



e



$$y_i = x_i + f_1 y_{i-1} + \cdots + f_p y_{i-p}$$

$$y_i = f_1 x_{i+o} + \cdots + f_p x_{i+o-(p-1)}$$



2×2

2×2

$>= 2$

2×2

$$2 \times 2$$

$$2 \times 2$$

$$2^{31} - 1$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$r * c$

$r \times c$

±



k

$$a(i) = \text{qnorm}((1+i/(n+1))/2)$$

X^2



$$p \quad \log(p)$$

$$P[X \leq x] \quad P[X > x]$$

$$= \alpha \quad = \sigma$$

$$f(x) = \frac{1}{\sigma^\alpha \Gamma(\alpha)} x^{\alpha-1} e^{-x/\sigma}$$

$$x > 0 \quad \alpha > 0 \quad \sigma > 0 \quad \Gamma(\alpha)$$

$$E(X) = \alpha\sigma \quad Var(X) = \alpha\sigma^2$$

$$H(t) = -\log(1 - F(t))$$

$$P(a, x) = \frac{1}{\Gamma(a)} \int_0^x t^{a-1} e^{-t} dt$$

$$P(a, x)$$

$$P[X \leq x]$$

$$P[X > x]$$

$$= p$$

$$p(x) = p(1 - p)^x$$

$$x = 0, 1, 2, \dots \quad 0 < p \leq 1$$

$$x \quad F(x) \geq p \quad F$$



$$|dev_{old}|/(|dev| + 0.1) < \epsilon \quad |dev -$$

n

$2^{(n-1)}$

n

$n - 1$

$n-1$

i
 j

$-j$ i



alpha

beta

gamma

$s_1[0] \dots s_p[0]$

$$\hat{Y}[t+h] = a[t] + hb[t] + s[t+1 + (h-1) \bmod p],$$

$a[t]$ $b[t]$ $s[t]$

$$a[t] = \alpha(Y[t] - s[t-p]) + (1-\alpha)(a[t-1] + b[t-1])$$

$$b[t] = \beta(a[t] - a[t-1]) + (1-\beta)b[t-1]$$

$$s[t] = \gamma(Y[t] - a[t]) + (1-\gamma)s[t-p]$$

$$\hat{Y}[t+h] = (a[t] + hb[t]) \times s[t+1 + (h-1) \bmod p].$$

$a[t]$ $b[t]$ $s[t]$

$$a[t] = \alpha(Y[t]/s[t-p]) + (1-\alpha)(a[t-1] + b[t-1])$$

$$b[t] = \beta(a[t] - a[t-1]) + (1-\beta)b[t-1]$$

$$s[t] = \gamma(Y[t]/a[t]) + (1-\gamma)s[t-p]$$

α β γ

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$$P[X \leq x] \quad P[X > x]$$

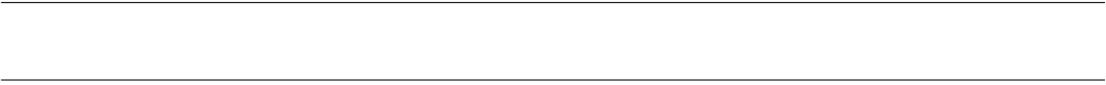
$$Np \quad N - Np \quad n$$

$$p(x) = \binom{m}{x} \binom{n}{k-x} / \binom{m+n}{k}$$

$$x = 0, \dots, k$$



X H_{ii}



$N(m, 1)$ X





$m(x)$

$m'(x)$

$m(x)$

$$\geq 0$$

$$\mathcal{N}(0, \kappa h) \quad e \sim \mathcal{N}(0, \kappa Q) \quad \kappa \quad (\eta \equiv \eta), \eta \sim$$

$$t - 1$$

$$\kappa$$

k

k

k

k



$O(n^2p)$

n

$O(n^2p)$



α

x

$\alpha < 1$

x

$$\frac{(1 - (\text{dist}/\text{maxdist})^3)^3}{\alpha^{1/p}}$$

x

$\alpha > 1$

α

p



$$P[X \leq x] \qquad P[X > x]$$

$$F(x) = \frac{1}{1 + e^{-(x-\mu)/\sigma}}$$

$$f(x) = \frac{1}{\sigma} \frac{e^{(x-\mu)/\sigma}}{(1 + e^{(x-\mu)/\sigma})^2}$$

$\mu \qquad \pi^2/3\sigma^2$

$$\text{logit}(p) = \log(p/(1 - p))$$





$$P[X \leq x]$$

$$P[X > x]$$

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma x} e^{-(\log(x)-\mu)^2/2\sigma^2}$$

$$E(X) = \exp\left(\mu + \frac{\sigma^2}{2}\right)$$

$$\text{Var}(X) = \exp(2\mu + \sigma^2) (\exp(\sigma^2) - 1)$$

$$E(X) = \exp\left(\mu + \frac{\sigma^2}{2}\right)$$

$$\sigma < 1/2$$

$$H(t) = -\log(1 - F(t))$$



h_{ii}

H

σ



β

$$Y = X\beta + \epsilon$$

β



$$1/\Phi^{-1}(\frac{3}{4})$$

$$E[mad(X_1, \dots, X_n)] = \sigma$$

$$X_i \quad N(\mu, \sigma^2) \quad n$$



$$\Sigma =$$

$$\mu =$$

$$D^2 = (x - \mu)' \Sigma^{-1} (x - \mu)$$

p

p

$p \times p$



$$d\mu/d\eta$$

$$\lambda = \mu^\lambda$$

$$d\mu/d\eta$$



K

K

K

K

K

K

K

K

K

K



$$l \qquad s \qquad f(x-l) \qquad f((x-l)/s)/s$$

$s = 1$



K

N

K

K

K

K

$$P(X_1 = x_1, \dots, X_K = x_k) = C \times \prod_{j=1}^K \pi_j^{x_j}$$

C
 $1, \dots, K$

$$C = N! / (x_1! \cdots x_K!) \quad N = \sum_{j=1}^K x_j \quad j =$$

$$P_1 = \pi_1 \pi$$
$$P_j = \pi_j / (1 - \sum_{k=1}^{j-1} \pi_k)$$

$$Bin(n_j, P_j)$$
$$j \geq 2$$

$$n_1 = N$$
$$n_j = N - \sum_{k=1}^{j-1} n_k$$





$$P[X \leq x]$$

$$P[X > x]$$

$$= n \quad = p$$

$$p(x) = \frac{\Gamma(x+n)}{\Gamma(n)x!} p^n (1-p)^x$$

$$x = 0, 1, 2, \dots \quad n > 0 \quad 0 < p \leq 1$$

Γ

$$n(1-p)/p^2$$

$$x \quad F(x) \geq p \quad F$$

$$y = f(x, \theta) + \epsilon$$

$$y = f(x, \theta)$$



$$P[X \leq x]$$

$$P[X > x]$$

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-(x-\mu)^2/2\sigma^2}$$

 μ σ

R^d

ϵ x_0 $\epsilon|x_0| + (tol/3)$ $\epsilon|x| + (tol/3) \quad x_0$ $\epsilon|x_0| + tol$ $\phi = (\sqrt{5} - 1)/2 = 0.61803..$ $x_2 = a + \phi(b - a)$ $x_1 = a + (1 - \phi)(b - a)$ $[x_1, x_2]$



k $k-1$



$y = 0$

< >



$$\sqrt{|residuals|}$$

E

$\sqrt{|E|}$

$|E|$

$R_i/(s \times \sqrt{1 - h_{ii}})$

h_{ii}



$$P[X \leq x]$$

$$P[X > x]$$

$$p(x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

$$x = 0, 1, 2, \dots$$

$$E(X) = \text{Var}(X) = \lambda$$

$$p(x)$$

$$x$$

$$P(X \leq x) <$$

q



$$\eta = \mu^\lambda$$

p

p



$(0, 1)$

$0 < a < 1$

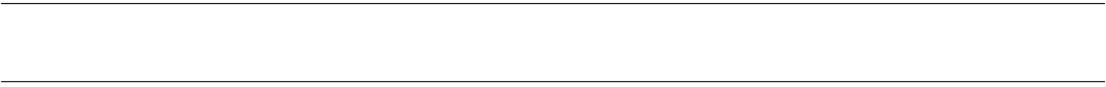
$[0, 1]$

$(0, 1)$



< >

σ^2



$[-1, 1]$

$[0, 1]$

[0, 1]

i

$$Q_i(p) = (1 - \gamma)x_j + \gamma x_{j+1}$$

$$1 \leq i \leq 9 \quad \frac{j-m}{n} \leq p < \frac{j-m+1}{n} \quad x_j \quad j \quad \gamma \quad n$$

m
 $g = np + m - j$

k

$p(k)$

$$p(k) = \frac{k - \alpha}{n - \alpha - \beta + 1}$$

$\alpha \quad \beta$

$$m = \alpha + p(1 - \alpha - \beta) \quad \gamma = g$$

$$p(k) = \frac{k}{n}$$

$$p(k) = \frac{k-0.5}{n}$$

$$p(k) = \frac{k}{n+1}$$

$$p(k) = \frac{k-1}{n-1}$$

$$p(k) = \frac{k-\frac{1}{3}}{n+\frac{1}{3}}$$

$$p(k) = \frac{k-\frac{3}{8}}{n+\frac{1}{4}}$$

$$p(k) = [F(x_k)]$$

$$p(k) = [F(x_k)]$$

$$p(k) \approx [F(x_k)]$$



j

$f(w_j)$

f

w_j

$k_2 + 1, \dots, n\}$

k_2

$j \in \{1, \dots, k_2; n -$

$O(n \log k)$

$O(n \times k)$

$k \quad n$

$\langle \quad \rangle$





W
W
W



$P[X \leq x]$

$P[X > x]$

$n(n+1)/2$

$n(n+1)/4$

$n(n+1)(2n+1)/24$

0

$$S(y) + S(y - S(y))$$

$$S(y)$$



$(0, 1]$ λ

n

$n > 49$

[low, high]

$$\begin{aligned} & \frac{tr(X'WX)}{tr(\Sigma)} \quad \lambda \\ & W \quad B_k(\cdot) \quad k \\ & c \quad f_i = f(x_i) \quad f = Xc \quad c \\ & \quad \quad \quad \quad \quad \quad L = (y - f)'W(y - f) + \lambda c' \Sigma c \\ & \quad \quad \quad \quad \quad \quad (X'WX + \lambda \Sigma)c = X'Wy \\ & \quad \quad \quad \quad \quad \quad \lambda \quad \quad \quad s = s_0 + 0.0601 * \log \lambda \\ & \quad \quad \quad \quad \quad \quad \lambda \quad \quad \quad \log \lambda \end{aligned}$$

$$(x_i, y_i, w_i), i = 1, \dots, n$$

λ

$$n \quad n > 49$$

$$O(n_k) + O(n) \quad n_k$$

$$O(n^{0.2})$$



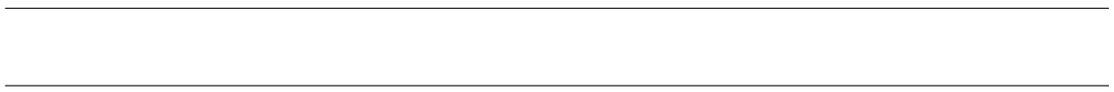
$(-\pi, \pi]$

2π

$(-0.5, 0.5]$

$$i < j$$

$$i + \frac{(j-1) * (j-2)}{2}$$





C_p



$$\begin{array}{llll} & (x_1, \dots, x_n) & (y_0, y_1, \dots, y_n) & \\ & & fn(t) = c_i & t \in (x_i, x_{i+1}) \\ & & fn(x_i) = y_i & \\ fn(x_i) = y_{i-1} & i = 1, \dots, n & & \\ & c_i & & \\ c_i & & y & c_i = (1 - f)y_i + f \cdot y_{i+1} \end{array}$$



μ_t

$$\mu_{t+1} = \mu_t + \xi_t, \quad \xi_t \sim N(0, \sigma_\xi^2)$$

$$x_t = \mu_t + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma_\epsilon^2)$$

$\sigma_\xi^2 \quad \sigma_\epsilon^2$

μ_t

$$\mu_{t+1} = \mu_t + \nu_t + \xi_t, \quad \xi_t \sim N(0, \sigma_\xi^2)$$

$$\nu_{t+1} = \nu_t + \zeta_t, \quad \zeta_t \sim N(0, \sigma_\zeta^2)$$

$$\sigma_\zeta^2 = 0$$

$\sigma_\xi^2 = 0$

$$x_t = \mu_t + \gamma_t + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma_\epsilon^2)$$

γ_t

$$\gamma_{t+1} = -\gamma_t + \dots + \gamma_{t-s+2} + \omega_t, \quad \omega_t \sim N(0, \sigma_\omega^2)$$
$$\sigma_\omega^2 = 0$$

 t σ_ϵ^2



$p \times 4$

$$\hat{\sigma}^2 = \frac{1}{n-p} \sum_i w_i R_i^2,$$

R_i i

$(p, n-p, p^*)$

R^2

$$R^2 = 1 - \frac{\sum_i R_i^2}{\sum_i (y_i - y^*)^2},$$

y^*

y_i

$p \times p$ R^2

$\hat{\beta}_j$ $j = 1, \dots, p$

$$\hat{\sigma}^2 = \frac{1}{n-p} \sum_i R_i^2,$$

R_i i

$(p, n-p)$

n

$p \times p$







$$(c_j, c_{j+1}] = s_j = c_j$$

$$c_1 s_1 c_2 s_2 \dots s_n c_{n+1}$$

c_j

s_j

$\langle \quad \quad \quad \rangle$





> 0

δ

$P[X \leq x]$

$P[X > x]$

$t = \nu$

$$f(x) = \frac{\Gamma((\nu + 1)/2)}{\sqrt{\pi\nu}\Gamma(\nu/2)}(1 + x^2/\nu)^{-(\nu+1)/2}$$

$x \quad 0 \quad \nu > 1 \quad \frac{\nu}{\nu-2} \quad \nu > 2$

$t \quad (\nu, \delta)$

$$T_\nu(\delta) := \frac{U + \delta}{\chi_\nu / \sqrt{\nu}}$$

$U \quad \chi_\nu$

$U \sim \mathcal{N}(0, 1) \quad \chi_\nu^2$

$$T = \frac{\bar{X} - \mu_0}{S/\sqrt{n}}$$

\bar{X}
 $N(\mu, \sigma^2)$

T

S

$$= (\mu - \mu_0)\sqrt{n}/\sigma$$

t

t

X_1, X_2, \dots, X_n

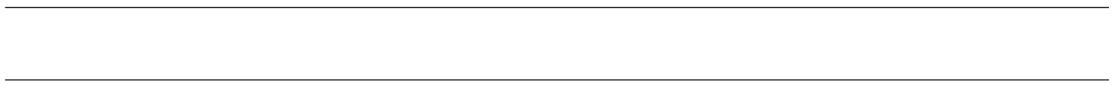
$$= n - 1$$

$x \neq 0$

t









n s^2

R/s

R

df

s

$P[X \leq x]$

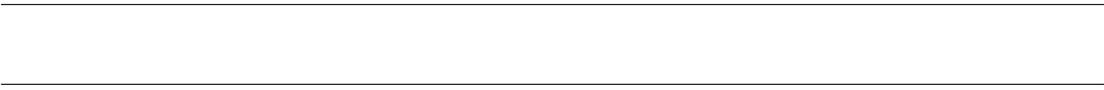
$P[X > x]$

$n_g =$

R

n_g





$$P[X \leq x]$$

$$P[X > x]$$

$$f(x) = \frac{1}{max - min}$$

$$min \leq x \leq max$$

$$u := min == max$$

$$X \equiv u$$



p $k < p$



$$P[X \leq x] \qquad P[X > x]$$

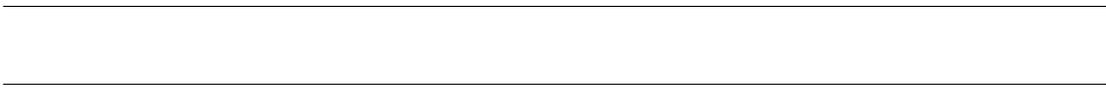
$$a \qquad \sigma$$

$$f(x) = (a/\sigma)(x/\sigma)^{a-1} \exp(-(x/\sigma)^a)$$

$$x > 0 \\ E(X) = \sigma\Gamma(1 + 1/a)$$

$$F(x) = 1 - \exp(-(x/\sigma)^a) \\ Var(X) = \sigma^2(\Gamma(1 + 2/a) - (\Gamma(1 + 1/a))^2)$$

$$H(t) = -\log(1 - F(t))$$
$$H(t) = (t/b)^a$$



 $\sqrt{w_i}$ w_i R_i n' n'

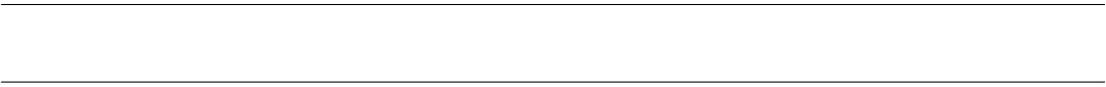
$u \quad v$

F
 $F \quad F$

$(u + v)/2$

$$m(m+1)/2$$

$$m$$



$$P[X \leq x] \qquad P[X > x]$$

< >





-1

-1



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