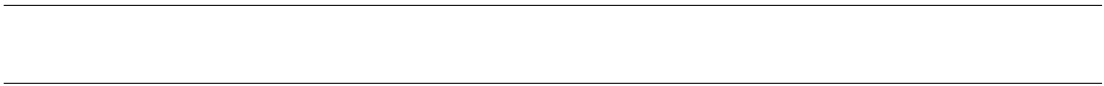

< >

\geq

<

>



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

$$(\Gamma) \qquad \qquad \qquad I_\nu \qquad K_\nu \qquad \qquad \qquad J_\nu \qquad Y_\nu$$

$$\geq 0$$

$$I_\nu \qquad K_\nu$$

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

$$\nu < 0$$

$$\langle \hspace{1.5cm} \rangle$$

$$\Gamma(x) \qquad B(x)$$



$$R'R = x$$

$$R \qquad R'R = x$$

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

[20, 500]

+1 -1

$$O(n^2)$$

$$p$$

$$p \times p$$

k

k

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

$$\begin{array}{c} \hline \\ \hline \end{array}$$

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

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

$$O(n \log N)$$

$$O(n)$$

$$X_1, \dots, X_n$$

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

$$F_n$$

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

$$n$$

≥

< >

$$\begin{matrix} & -1 \\ -1 & \end{matrix}$$

$$\pm 2 \times 10^9$$

R QR

kappa

QR

<

>

$$\log(1+x)$$

$$|x| \ll 1$$

$$x \approx -1$$

$$\exp(x) - 1$$

$$|x| \ll 1$$

10^{-5}

$$2^{10} = 1024$$

$$2^{30} = 1073741824$$

$$2^{20} = 1048576$$

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

< >

$$n-1$$

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

$$n-1 \qquad p(x)$$

$$n-1 \qquad n$$

$$>~1$$

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

$$\leq 1024$$

$$Ax = b \qquad A \qquad b$$

$$Q$$

$$Q^R$$

$$Q$$



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

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

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

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

$$\Gamma(x)$$

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

$$x!$$

$$\psi(x)$$

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

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

$$X = UDV',$$

$$\begin{array}{ccccc} U & V & V' & D \\ & D_{ii} & D = U'XV & \end{array}$$

$$(x,y)$$

$$\pi/2$$

$$[1,\infty)$$

$$\begin{matrix} (-\infty,-1] & [1,\infty) \\ (-\infty,-1] \end{matrix}$$

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

$$\begin{matrix} (-\infty i,-1i] & [1i,\infty i) \\ [1i,\infty i) \end{matrix}$$



$$O(n^2)$$

< >

< >

x y

$$\mu \quad /m^2$$

CO_2

CO_2

$$n = 16$$

$$1954 = 100$$

$$\geq$$



8 × 8

$[0, 100]$

I_g

$[0, 1]$

$[0, 100]$

k

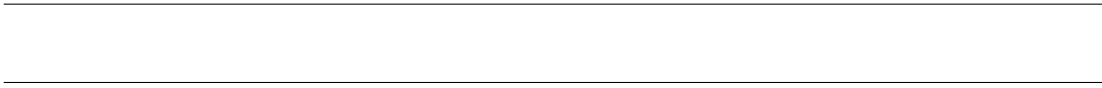
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$$n$$

$$n$$

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

$$n \equiv 1 \pmod{4}$$



$[0, 1]$

$$\geq 1$$

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

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

L_2





$$\geq 1$$

$$= 1$$

$$\frac{2}{6} \qquad \frac{3}{6} \qquad \frac{4}{6} \qquad \frac{5}{6} \qquad \frac{1}{6}$$

<

>

$$[0, M] \quad M$$

$$[0, M] \quad M =$$

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

$$\begin{matrix} 4 \times 4 \\ (x, y, z) \end{matrix}$$

$$(x, y, z, t)$$



< >

$$\begin{array}{rcl}
 (f_{ij} - e_{ij})/\sqrt{e_{ij}} & f_{ij} & e_{ij} \\
 d_{ij} & & \sqrt{e_{ij}} \\
 d_{ij} = 0 & & \chi^2 \quad i, j \quad d_{ij} =
 \end{array}$$

3×

x

$P(y|x)$

x

x

\langle

\rangle

×

$$y/x$$

k

k

k

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

$$k$$

$$k$$

$$10^{-7}$$

$$\begin{array}{c} n+1 \\ n \end{array}$$

$$\hat{f}(x_i)$$

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

$$n$$

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

i

i

N

$$\geq 1$$

$$\chi^2$$

$$\chi^2$$

ij

$[0, 1]$

$$[0,1]$$

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

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

$$(x,y,z)$$

$$4\times 4$$

$$(x,y,z,t)$$

$-1 \quad 1$

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

$$y/x$$

×

$$\begin{array}{ccccc}
 & P(y|x) & & P(x) & \\
 & & & & x \quad y \\
 x & & & x &
 \end{array}$$

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



$[0, 1]$



$[0, 1]$

< < > >

< >

<

>

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

$$N$$

$$m$$

C_p

χ^2

C_p

$$2p \qquad p$$

$$C_p \; RSS/scale + 2p - n \qquad C_p$$

$$C_p$$

$$kn_{par} \quad n_{par} \quad -2 \quad +$$

$$k = \log(n) \quad n \quad k = 2$$

C_p

σ^2

$$\sigma^2$$

$$\sigma^2$$

$$C_p$$

F

$$f(t-m)$$

$$m$$

$$f((t-m)/s)/s$$

$$s$$

$$s$$

$$s \neq 1$$

$$s > 1$$

$$s < 1$$

$$s$$

s

s

s^2

s

s^2

k

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

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



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

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

$$a_0$$

$$\mu$$

$$(p, d, q)$$

$$X_t = a_1X_{t-1} + \cdots + a_pX_{t-p} + e_t + b_1e_{t-1} + \cdots + b_qe_{t-q}$$

$$X-m \qquad X$$

$$(p, d, q)$$

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

$$X - m \qquad X$$

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

k

$P[X \leq x]$

$P[X > x]$

$$=a\qquad\qquad\qquad=b$$

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

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

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

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

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

$$I_x(a,b)$$

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

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

$$=n \qquad =p$$

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

$$x=0,\ldots,n$$

$$p(x)$$

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

$$n \times p_1$$

$$n \times p_2$$

$$p_1$$



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

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

x

$$|O - E|$$

χ^2

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

$$=n>0$$

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

$$\begin{array}{ccc}x>0&&n\qquad 2n\\&&=n\end{array}$$

$$=\lambda$$

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

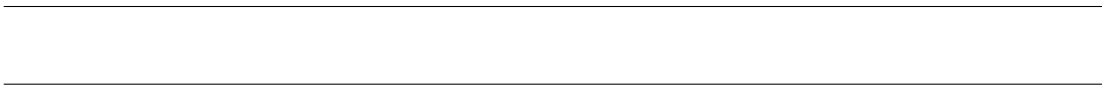
$$\begin{array}{ccccc}x\geq 0&&&n&&n\\&&\lambda&&&\end{array}$$

$$E(X)=n+\lambda\;Var(X)=2(n+2*\lambda)\qquad E((X-E(X))^3)=8(n+3*\lambda)$$

$$\qquad\qquad\qquad =n\qquad\qquad\qquad\lambda>0$$

$$n=0$$

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



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

$$\begin{matrix} c^* \\ n-1 \end{matrix}$$

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

$$n-1$$

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

$$\begin{array}{lll} r_k = \sum_i x_{k-m+i} y_i & & \\ i & k = 1, \dots, n+m-1 & \\ n = m & & i, k = 1, \dots, n \\ x_j := x_{n+j} & j < 1 & \end{array}$$

$$n-1$$

$$\tau$$

$$\rho$$

$$[-1,1] \quad 0$$

$$\tau \qquad \rho$$

$$\rho$$

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



< >

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

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

$$\sigma_K R(K)$$

$$R(K)$$

$$R(K)$$

x y

x y

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

$$p$$

$$p$$

$$p$$

$$i < j \leq n$$

$$n*(n-1)/2$$

$$n^2$$

$$\begin{aligned}
 & \qquad \qquad \qquad i \qquad \qquad \qquad F_n \qquad \qquad \qquad i/n \\
 & = (x_1, x_2 \quad x_n) \ F_n \qquad \qquad \qquad t \\
 & F_n(t) = \#\{x_i \leq t\} /n = \frac{1}{n} \sum_{i=1}^n \mathbf{1}_{[x_i \leq t]}.
 \end{aligned}$$

$$1/n$$

$$\langle \quad \rangle$$

r

r



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

$$\lambda$$

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

$$x \geq 0$$

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

≡

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

L

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

w

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



$$\begin{array}{ccccccc}
& & & x = \Lambda f + e & & & \\
p & & x & p \times k & & k & p \\
& & & & & x & \\
x & \Phi & & & & & \\
& & \Sigma = \Lambda' \Lambda + \Psi & & & & \\
& G & G & & \Lambda & G\Lambda &
\end{array}$$

$$[0,1]$$

$$f \quad x$$

$$\begin{array}{l} f \\ \hat{f} = \Lambda' \Sigma^{-1} x \end{array}$$

$$f \qquad \qquad \Lambda$$

$$d\mu/d\eta$$



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

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

$$x > 0$$

$$\begin{array}{ccccccc}
 & & n_1 & & n_2 & & \\
 & & m & & & & t_m \\
 t_m & & & & m & &
 \end{array}$$

e

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

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

$$2 \times 2$$

$$2 \times 2$$

$$>= 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2^{31} - 1$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$2 \times 2$$

$$r * \mathcal{C}$$

$$r \times \mathcal{C}$$

±

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

$$X^2$$

$$p \qquad \qquad \log(p)$$

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

$$= \alpha \qquad \qquad = \sigma$$

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

$$x>0 \; \alpha>0 \qquad \sigma>0 \qquad \Gamma(\alpha)$$

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

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

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

$$P(a,x)$$

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

$$=p$$

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

$$x=0,1,2,\ldots \; 0< p\leq 1$$

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

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

n

$2^{(n-1)}$

n

$n-1$

$n-1$

j j i j

$-j$ i

alpha

beta

gamma

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

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

$$a[t] \quad b[t] \quad s[t]$$

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

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

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

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

$$a[t] \quad b[t] \quad s[t]$$

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

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

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

$$\alpha \qquad \beta \qquad \gamma$$

$$\langle \qquad \qquad \qquad \rangle$$

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

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

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

$$x=0,\ldots,k$$

$$X \quad H_{ii}$$

$$N(m,1) \qquad X$$

$$m(x) \qquad m'(x) \qquad m(x)$$

$$\geq 0$$

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

$$\kappa$$

$$t-1$$

$$\kappa$$

k

k

k

k

$$O(n^2p)$$

n

$O(n^2p)$

α

x

x

x

$\alpha < 1$

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

$\frac{\alpha}{\alpha > 1}$

α

p

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

$$\begin{array}{cc} = \mu & = \sigma \\ F(x) = \frac{1}{1 + e^{-(x-\mu)/\sigma}} \end{array}$$

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

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

$$logit(p) \, = \, \log(p/(1 - p))$$

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

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

$$\begin{array}{lll} \mu & \sigma & E(X)=exp(\mu+ \\ 1/2\sigma^2) & \sqrt{exp(\sigma^2)-1} & Var(X)=exp(2\mu+\sigma^2)(exp(\sigma^2)-1) \\ & \sigma & \sigma<1/2 \end{array}$$

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

h_{ii}

H

σ

$$\beta$$

$$\mathbf{Y} = \mathbf{X}\beta + \epsilon$$

β

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

$$E[{\it mad}(X_1,\ldots,X_n)]=\sigma$$

$$X_i$$

$$N(\mu,\sigma^2)$$

$$n$$

$$\Sigma =$$

$$\mu =$$

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

$$p$$

$$p$$

$$p \times p$$

$$d\mu/d\eta$$

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

$$d\mu/d\eta$$

K

K

K

K

K

K

K

K

K

K

$$\begin{array}{ccccc}
 l & & & & s \\
 & & & & \\
 & s = 1 & & &
 \end{array}
 \qquad
 \begin{array}{cc}
 f(x-l) & f((x-l)/s)/s
 \end{array}$$



K

N

K

K

K

$$K$$

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

$$C$$

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

$$X_j$$

$$j =$$

$$1,\ldots,K$$

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

$$\begin{array}{l}n_1=N\\n_j=N-\sum_{k=1}^{j-1}n_k\end{array}$$

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

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

$$=n\qquad\qquad=p$$

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

$$x=0,1,2,\ldots\,\,n>0\qquad 0<p\leq 1$$

$$\Gamma$$

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

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

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

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



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

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

$$\mu$$

$$\sigma$$

R^d

$$\epsilon \qquad \qquad \qquad x_0 \qquad \qquad \qquad \epsilon |x_0| \; + \; (tol/3)$$

$$\epsilon \; |x| \; + \; (tol/3) \qquad \qquad x_0 \qquad \qquad \qquad \epsilon |x_0| \; + \; tol$$

$$\begin{array}{l} \phi = (\sqrt{5}-1)/2 = 0.61803.. \qquad \qquad \qquad x_1 = a + (1-\phi)(b-a) \\ x_2 = a + \phi(b-a) \qquad \qquad \qquad \qquad \qquad \qquad [x_1, x_2] \end{array}$$

$$k \qquad k-1$$



$$y = 0$$

< >

$$\sqrt{|residuals|}$$

$$E$$

$$\sqrt{|E|}$$

$$|E|$$

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

$$h_{ii}$$

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

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

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

$$E(X) = Var(X) = \lambda$$

$$p(x)$$

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

$$q$$

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

p

p

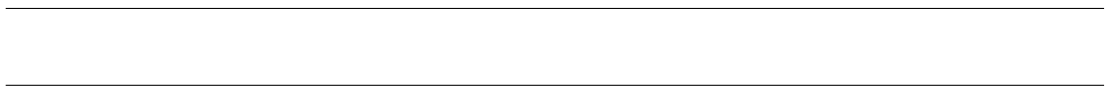


$$(0, 1)$$

$$0 < a < 1$$

$$[0, 1]$$

$$(0, 1)$$



< >

$$\sigma^2$$



$$[-1, 1]$$

$$[0, 1]$$

$[0, 1]$

$$i$$

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

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

$$m \quad \gamma$$

$$g = np + m - j$$

k	$p(k)$
-----	--------

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

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

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

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

$$p(k) = \frac{k}{n+1} \qquad p(k) = \lfloor F(x_k) \rfloor$$

$$p(k) = \frac{k-1}{n-1} \qquad p(k) = \lceil F(x_k) \rceil$$

$$p(k) = \frac{k-\frac{1}{3}}{n+\frac{1}{3}} \qquad p(k) \approx \lfloor F(x_k) \rfloor$$

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

j	$f(w_j)$	f	w_j
-----	----------	-----	-------

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

$$k_2$$

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

$$O(n\log k)$$

$$O(n\times k)$$

$$k\quad n$$

$$\langle \hspace{1.5cm} \rangle$$

$$W$$
$$W$$
$$W$$

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

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

$$n(n+1)/4$$

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

$$0$$

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

$$S(y)$$

$(0, 1]$ λ

n $n > 49$

$$[low,high]$$

$$\begin{array}{llll} & & \lambda & \\ tr(X'WX)/tr(\Sigma) & \Sigma & s = spar & \lambda = r * 256^{3s-1} & r = \\ W & & \Sigma_{ij} = \int B''_i(t)B''_j(t)dt & X & X_{ij} = B_j(x_i) \\ & B_k(.) & k & & \\ & & f_i = f(x_i) & & f = Xc \\ & & & & L = (y-f)'W(y-f) + \lambda c'\Sigma c \\ & c & & & (X'WX + \lambda \Sigma)c = X'Wy \end{array}$$

$$\lambda \hspace{10em} s = s0 + 0.0601 * \mathbf{log} \hspace{0.1em} \lambda$$

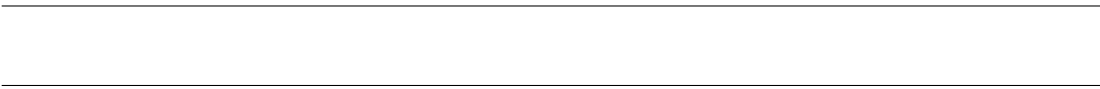
$$\lambda \hspace{2em} \log \lambda$$

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

$$\lambda$$

$$n \qquad n > 49 \qquad O(n^{0.2})$$

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



$(-\pi, \pi]$ 2π $(-0.5, 0.5]$

$$i < j$$

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

$$C_p$$

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

$$\mu_t$$

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

$$\begin{array}{cc} x_t = \mu_t + \epsilon_t, & \epsilon_t \sim N(0, \sigma_\epsilon^2) \\ \sigma_\xi^2 & \sigma_\epsilon^2 \end{array}$$

$$\mu_t$$

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

$$\begin{array}{cc} \nu_{t+1} = \nu_t + \zeta_t, & \zeta_t \sim N(0, \sigma_\zeta^2) \\ & \sigma_\zeta^2 = 0 \end{array}$$

$$\sigma_\xi^2 = 0$$

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

$$\gamma_t$$

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

$$\sigma_\omega^2=0$$

$$t$$

$$\sigma_\epsilon^2$$

$$p \times 4$$

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

$$R_i \qquad i$$

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

$$R^2$$

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

$$y^* \qquad y_i$$

$$R^2$$

$$p \times p \qquad \qquad \qquad \hat{\beta}_j \quad j=1,\ldots,p$$

$$p \times 4$$

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

$$R_i \qquad i$$

$$(p,n-p) \qquad n$$

$$p \times p$$

$$= c_j$$

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

$$c_1s_1c_2s_2\ldots s_nc_{n+1}$$

$$c_j$$

$$s_j$$

$$\langle \hspace{1.5cm} \rangle$$

$$\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty}e^{-\frac{1}{2}x^2}dx=1$$

$$\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty}e^{-\frac{1}{2}x^2}dx=1$$

$$>0$$

$$\delta$$

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

$$t = \nu$$

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

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

$$T_\nu(\delta) \mathrel{\mathop:}= \frac{U+\delta}{\chi_\nu/\sqrt{\nu}} \qquad \begin{matrix} t \\ U \end{matrix} \qquad \chi_\nu \qquad (\nu,\delta) \qquad U \sim \mathcal{N}(0,1) \qquad \chi_\nu^2$$

$$T=\frac{\bar{X}-\mu_0}{S/\sqrt{n}}\qquad \bar{X}\qquad S\qquad t\qquad X_1,X_2,\ldots,X_n$$

$$N(\mu,\sigma^2)\qquad T\qquad =(\mu-\mu_0)\sqrt{n}/\sigma\qquad t\qquad =n-1$$

$$x \neq 0$$

$$t$$

$$n \qquad s^2 \qquad R/s \qquad R \qquad df$$

$$s$$

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

$n_g =$

R

n_g

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

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

$$min \leq x \leq max$$

$$u := min == max \qquad X \equiv u$$

$$p \qquad k < p$$

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

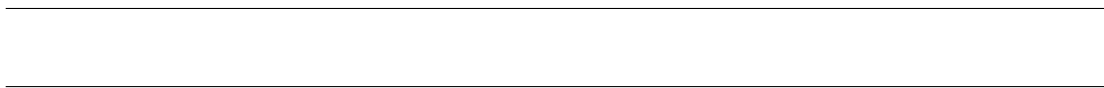
$$a \qquad \qquad \qquad \sigma$$

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

$$\begin{array}{ll} x > 0 & F(x) = 1 - \exp(-(x/\sigma)^a) \\ E(X) = \sigma \Gamma(1 + 1/a) & Var(X) = \sigma^2(\Gamma(1 + 2/a) - (\Gamma(1 + 1/a))^2) \end{array}$$

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

$$H(t) = (t/b)^a$$



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

$$u \quad v$$

$$\begin{matrix} F \\ F \quad F \end{matrix}$$

$$(u+v)/2$$

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

$$m$$

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

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-1

-1

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