x
θ

$$x = (cos\theta, sen\theta)$$

$$z = e^{i\theta} = cos\theta + isen\theta$$

$x_1, \ldots, x_n$
θ_i
$i = 1, \ldots, n$
$\bar{\theta}$
$\theta_1, \ldots, \theta_n$
$x_1 + \ldots + x_n$
$\bar{x}$
$x_1, \ldots, x_n$
x_j
$(cos\theta_j, sen\theta_j)$
$(\bar{C}, \bar{S})$

$$\bar{C} = \frac{1}{n}\sum_{j=1}^{n} cos\theta_j \quad (1)$$

$$\bar{S} = \frac{1}{n}\sum_{j=1}^{n} sen\theta_j \quad (2)$$

$\bar{\theta}$
????
$x_1 + \ldots + x_n$

$$\bar{C} = \bar{R}cos\bar{\theta} \quad (3)$$

$$\bar{S} = \bar{R}sen\bar{\theta} \quad (4)$$

$\bar{R} > 0$
$\bar{R}$

$$\bar{R} = \sqrt{\bar{C}^2 + \bar{S}^2} \quad (5)$$

$\bar{\theta}$
$\bar{R} = 0$
$\bar{R} > 0$
θ

$$\bar{\theta} = \begin{cases} tan^{-1}(\bar{S}/\bar{C}) & \bar{C} \geq 0 \\ tan^{-1}(\bar{S}/\bar{C}) + \pi & \bar{C} < 0 \end{cases}$$

$\bar{\theta}$
$(\theta_1 + \ldots + \theta_n)/n$
$\bar{\theta}$
$(\theta_1, \ldots, \theta_n)$
ϕ
$[\phi, \phi + \pi)$
ϕ
$\phi + \pi$
$\bar{R}$
??
$\bar{x}$
$\bar{R} = \sqrt{\bar{C}^2 + \bar{S}^2}$
$x_1, \ldots, x_n$
$0 \leq \bar{R} \leq 1$
$\theta_1, \ldots, \theta_n$
$\bar{R} = 1$
$\theta_1, \ldots, \theta_n$
$\bar{R}$
$\bar{R}$
R
$x_1 + \ldots + x_n$
$R = n\bar{R}$
$\bar{R}$

$$v = \sqrt{-2log\bar{R}} \quad (6)$$

θ

π
$\alpha \leq$
$\beta \leq$
$\alpha +$
2π

$$Pr(\alpha < \theta \leq \beta) = F(\beta) - F(\alpha) = \int_{\alpha}^{\beta} dF(x)$$

(8)

$$lim_{x \to \infty} F(x) = \infty lim_{x \to -\infty} F(x) = -\infty$$

$$F(0) = 0 F(2\pi) = 1$$

??
$F(\beta) -$
$F(\alpha)$
$\int_{\alpha}^{\beta} f(x)dx =$
$F(\beta) -$
$F(\alpha), -\infty <$
$\alpha \leq$
$\beta <$
∞
$f(\theta) \geq$
0
$(-\infty, \infty)$
$\int_0^{2\pi} f(\theta)d\theta =$
1
$f(\theta) =$
$f(\theta +$
$2\pi)$
$(-\infty, \infty)$
??
$\frac{2\pi r}{m}$
??
$p_r =$
$\frac{1}{m}$

$$Pr(\theta = v + \frac{2\pi r}{m}) = p_r r = 0, 1, \cdots, m - 1 \quad (9)$$

$$p_r \geq 0, \sum_{r=0}^{m-1} p_r = 1 \quad (10)$$

$\theta) =$
$\frac{1}{2\pi}$
$\alpha \leq$
$\beta \leq$
$\alpha +$
2π
$\alpha \leq$
$\theta \leq$
$\beta) =$
$\frac{\beta - \alpha}{2\pi}$
??
$\theta =$
μ
$\theta =$
μ
$\theta =$
$\mu +$
π
$e^{2\kappa}$
κ

$$g(\theta; \mu, \kappa) = \frac{1}{2\pi I_0(\kappa)} e^{\kappa cos(\theta - \mu)} \quad (11)$$

$$F(\theta; 0, \kappa) = \frac{1}{I_0(\kappa)} \int_0^{\theta} e^{\kappa cosu} du$$

I_0

$$I_0(\kappa) = \frac{1}{2\pi} \int_0^{2\pi} e^{\kappa cos\theta} d\theta, I_0(\kappa) = \sum_{r=0}^{\infty} \frac{1}{(r!)^2} (\frac{\kappa}{2})^{2r}$$

μ
$kappaappa$
$_m ises.eps Representacindela funcindedensidadde Distribucinvon Mises M(0, \kappa$
κ

$\bar{R}S_n^2$
κ
??
??
??
κ
$M(\pi, \kappa)$
κ
??
??
??

$$S_n^2(\theta) = \frac{1}{n}\sum_{i=1}^{n} d^2(\theta_i, \theta) \quad (12)$$

$$\theta = min_y S_n^2(y)$$

$$d^2(\theta_i, \theta j) = 2(1 - (cos(\theta_i - \theta_j))) \quad (13)$$

$$d^2(\theta_i, \theta j) = \pi - |\pi - |\theta_i - \theta_j|| \quad (14)$$

$\bar{R} =$
$\sqrt{\bar{C}^2 + \bar{S}^2}$
$\sqrt{-2log(\bar{R})}$
κ
S_n^2
κ
$\bar{R}$
κ
$\bar{R}S_n^2$
κ