Many accents have been re-defined

```
c \c{c} \pi \cpi
```

$$c c \pi \boldsymbol{\pi}$$

```
int \e{\im x} \d{x}
```

$$\int \mathrm{e}^{\mathrm{i}x}\, \mathrm{d}x$$

```
\^{\beta_1}=b_1
```

$$\widehat{\beta_1} = b_1$$

```
\=x=\frac{1}{n}\sum x_i
```

$$\bar{x} = \frac{1}{n} \sum x_i$$

```
\b{x} = \frac{1}{n} \wrap[()]{x_1 +\.+ x_n}
```

$$\bar{x} = \frac{1}{n} \left(x_1 + \ldots + x_n\right)$$

Sometimes overline is better: `\b{x} \vs \ol{x}`

$$\bar{x} \text{ vs. } \overline{x}$$

And, underlines are nice too: `\ul{x}`

$$\underline{x}$$

A few other nice-to-haves:

```
\chisq
```

$$\chi^2$$

```
\deriv{x}{x^2+y^2}
```

$$\frac{\mathrm{d}}{\mathrm{d}x} \left[x^2 + y^2\right]$$

```
\pderiv{x}{x^2+y^2}
```

$$\frac{\partial}{\partial x} \left[x^2 + y^2\right]$$

```
\Gamma[n+1]=n!
```

$$\Gamma\left(n+1\right) = n!$$

```
\binom{n}{x}
```

$$\binom{n}{x}$$

```
\e{x}
```

$$\mathrm{e}^{x}$$

```
\H_0: \mu=0 \vs \H_1: \mu \neq 0 (\neg \H_0)
```

$$\mathrm{H}_0 : \mu = 0 \text{ vs. } \mathrm{H}_1 : \mu \neq 0 (\neg \mathrm{H}_0)$$

```
\logit \wrap{p} = \log \wrap{\frac{p}{1-p}}
```

$$\mathrm{logit}\left[p\right] = \log\left[\frac{p}{1-p}\right]$$

Common distributions along with other features follows:

Normal Distribution

```
Z ~ \N{0}{1}, \where \E{Z}=0 \and \V{Z}=1
```

$$Z \sim \mathrm{N}\left(0,\ 1\right),\ \text{where } \mathrm{E}\left[Z\right]=0 \text{ and } \mathrm{V}\left[Z\right]=1$$

```
\P{|Z|>z_\ha}=\alpha
```

$$\mathrm{P}\left[|Z|>z_{\frac{\alpha}{2}}\right]=\alpha$$

```
\pN[z]{0}{1}
```

$$\frac{1}{\sqrt{2\pi}}\mathrm{e}^{-\frac{1}{2}z^2}$$

or, in general

```
\pN[z]{\mu}{\sd^2}
```

$$\frac{1}{\sqrt{2\pi\sigma^2}}\mathrm{e}^{-\frac{1}{2\sigma^2}(z-\mu)^2}$$

Sometimes, we subscript the following operations:

```
\E[z]{Z}=0, \V[z]{Z}=1, \and \P[z]{|Z|>z_\ha}=\alpha
```

$$\mathrm{E}_z\left[Z\right]=0, \mathrm{V}_z\left[Z\right]=1,\ \text{and } \mathrm{P}_z\left[|Z|>z_{\frac{\alpha}{2}}\right]=\alpha$$

Multivariate Normal Distribution

```
\bm{X} ~ \N[p]{\bm{\mu}}{\sfsl{\Sigma}}
```

$$\boldsymbol{X} \sim \mathrm{N}_p\left(\boldsymbol{\mu},\ \mathit{\Sigma}\right)$$

Chi-square Distribution

```
Z_i \iid \N{0}{1}, \where i=1 ,\., n
```

$$Z_i \overset{\text{iid}}{\sim} \mathrm{N}\left(0,\ 1\right),\ \text{where } i=1,\ldots,n$$

```
\chisq = \sum_i Z_i^2 ~ \Chi{n}
```

$$\chi^2=\sum_i Z_i^2 \sim \chi^2\left(n\right)$$

```
\pChi[z]{n}
```

$$\frac{2^{-\frac{n}{2}}}{\Gamma\left(\frac{n}{2}\right)}z^{\frac{n}{2}-1}\mathrm{e}^{-\frac{z}{2}}\mathrm{I}_z\left(0,\infty\right),\ \text{where } n>0$$

t Distribution

```
\frac{\N{0}{1}}{\sqrt{\frac{\Chisq{n}}{n}}} ~ \t{n}
```

$$\frac{\mathrm{N}\left(0,\ 1\right)}{\sqrt{\frac{\chi^2(n)}{n}}} \sim \mathrm{t}\left(n\right)$$

F Distribution

```
X_i, Y_{\~i} \iid \N{0}{1} \where i=1 ,\., n; \~i=1 ,\., m \and \V{X_i, Y_{\~i}}=\sd_{xy}
```

$$X_i, Y_{\widetilde{i}} \overset{\text{iid}}{\sim} \mathrm{N}\left(0,\ 1\right) \text{ where } i=1,\ldots,n; \widetilde{i}=1,\ldots,m \text{ and } \mathrm{V}\left[X_i, Y_{\widetilde{i}}\right]=\sigma_{xy}=0$$

```
\chisq_x = \sum_i X_i^2 ~ \Chi{n}
```

$${\chi^2}_x = \sum_i X_i^2 \sim \chi^2\left(n\right)$$

```
\chisq_y = \sum_{\~i} Y_{\~i}^2 ~ \Chi{m}
```

$${\chi^2}_y = \sum_{\widetilde{i}} Y_{\widetilde{i}}^2 \sim \chi^2\left(m\right)$$

```
\frac{\chisq_x}{\chisq_y} ~ \F{n}{m}
```

$$\frac{{\chi^2}_x}{{\chi^2}_y} \sim \mathrm{F}\left(n,\ m\right)$$

Beta Distribution

```
B=\frac{\frac{n}{m}F}{1+\frac{n}{m}F} ~ \Bet{\frac{n}{2}}{\frac{m}{2}}
```

$$B=\frac{\frac{n}{m}F}{1+\frac{n}{m}F} \sim \mathrm{Beta}\left(\frac{n}{2},\ \frac{m}{2}\right)$$

```
\pBet{\alpha}{\beta}
```

$$\frac{\Gamma\left(\alpha+\beta\right)}{\Gamma\left(\alpha\right)\Gamma\left(\beta\right)} x^{\alpha-1}\left(1-x\right)^{\beta-1} \mathrm{I}_x\left(0,\ 1\right), \text{ where } \alpha>0 \text{ and } \beta>0$$

Gamma Distribution

```
G ~ \Gam{\alpha}{\beta}
```

$$G \sim \mathrm{Gamma}\left(\alpha,\ \beta\right)$$

```
\pGam{\alpha}{\beta}
```

$$\frac{\beta^\alpha}{\Gamma\left(\alpha\right)} x^{\alpha-1} \mathrm{e}^{-\beta x} \mathrm{I}_x\left(0, \infty\right), \text{ where } \alpha>0 \text{ and } \beta>0$$

Cauchy Distribution

```
C ~ \Cau{\theta}{\nu}
```

$$C \sim \mathrm{Cauchy}\left(\theta,\ \nu\right)$$

```
\pCau{\theta}{\nu}
```

$$\frac{1}{\nu\pi\left[1+\left(\frac{x-\theta}{\nu}\right)^2\right]}, \text{ where } \nu>0$$

Uniform Distribution

```
X ~ \U{0, 1}
```

$$X \sim \mathrm{U}\left(0, 1\right)$$

```
\pU{0}{1}
```

$$\mathrm{I}_x\left(0,\ 1\right)$$

or, in general

```
\pU{a}{b}
```

$$\frac{1}{b-a}\mathrm{I}_x\left(a,\ b\right),\ \text{where } a < b$$

Exponential Distribution

```
X ~ \Exp{\lambda}
```

$$X \sim \mathrm{Exp}\left(\lambda\right)$$

```
\pExp{\lambda}
```

$$\frac{1}{\lambda}\mathrm{e}^{-\frac{x}{\lambda}}\mathrm{I}_x\left(0, \infty\right),\ \text{where } \lambda > 0$$

Hotelling's T^2 Distribution

```
X ~ \Tsq{\nu_1}{\nu_2}
```

$$X \sim \mathrm{T}^2\left(\nu_1,\ \nu_2\right)$$

Inverse Chi-square Distribution

```
X ~ \IC{\nu}
```

$$X \sim \chi^{-2}\left(\nu\right)$$

Inverse Gamma Distribution

```
X ~ \IG{\alpha}{\beta}
```

$$X \sim \mathrm{Gamma}^{-1}\left(\alpha,\ \beta\right)$$

Pareto Distribution

```
X ~ \Par{\alpha}{\beta}
```

$$X \sim \mathrm{Pareto}\left(\alpha,\ \beta\right)$$

```
\pPar{\alpha}{\beta}
```

$$\frac{\beta}{\alpha\left(1+\frac{x}{\alpha}\right)^{\beta+1}}\mathrm{I}_x\left(0, \infty\right),\ \text{where } \alpha > 0 \text{ and } \beta > 0$$

Wishart Distribution

```
\sfsl{X} ~ \W{\nu}{\sfsl{S}}
```

$$\mathsf{X} \sim \mathrm{Wishart}\left(\nu,\ \mathsf{S}\right)$$

Inverse Wishart Distribution

```
\sfsl{X} ~ \IW{\nu}{\sfsl{S^{-1}}}
```

$$\mathsf{X} \sim \mathrm{Wishart}^{-1}\left(\nu,\ \mathsf{S}^{-1}\right)$$

Binomial Distribution

```
X ~ \Bin{n}{p}
```

$$X \sim \mathrm{Bin}\left(n,\ p\right)$$

```
\pBin{n}{p}
```

$$\binom{n}{x} p^{x} \left(1-p\right)^{n-x} \mathrm{I}_{x}\left(\{0,1,\ldots,n\}\right),\ \text{where } p \in (0,1) \text{ and } n = 1,2,\ldots$$

Bernoulli Distribution

```
X ~ \B{p}
```

$$X \sim \mathrm{B}\left(p\right)$$

Beta-Binomial Distribution

```
X ~ \BB{p}
```

$$X \sim \mathrm{BetaBin}\left(p\right)$$

```
\pBB{n}{\alpha}{\beta}
```

$$\frac{\Gamma\left(n+1\right)\Gamma\left(\alpha+x\right)\Gamma\left(n+\beta-x\right)\Gamma\left(\alpha+\beta\right)}{\Gamma\left(x+1\right)\Gamma\left(n-x+1\right)\Gamma\left(n+\alpha+\beta\right)\Gamma\left(\alpha\right)\Gamma\left(\beta\right)} \mathrm{I}_{x}\left(\{0,1,\ldots,n\}\right),\ \text{where } \alpha > 0,\ \beta > 0 \text{ and } n = 1,2,\ldots$$

Negative-Binomial Distribution

```
X ~ \NB{n}{p}
```

$$X \sim \mathrm{NegBin}\left(n,\ p\right)$$

Hypergeometric Distribution

```
X ~ \HG{n}{M}{N}
```

$$X \sim \mathrm{Hypergeometric}\left(n,\ M,\ N\right)$$

Poisson Distribution

```
X ~ \Poi{\mu}
```

$$X \sim \mathrm{Poisson}\left(\mu\right)$$

```
\pPoi{\mu}
```

$$\frac{1}{x!}\mu^{x}\mathrm{e}^{-\mu}\mathrm{I}_{x}\left(\{0,1,\ldots\}\right),\ \text{where } \mu > 0$$

Dirichlet Distribution

```
\bm{X} ~ \Dir{\alpha_1 \. \alpha_k}
```

$$\boldsymbol{X} \sim \mathrm{Dirichlet}\left(\alpha_{1}\ldots\alpha_{k}\right)$$

Multinomial Distribution

```
\bm{X} ~ \M{n}{\alpha_1 \. \alpha_k}
```

$$\boldsymbol{X} \sim \mathrm{Multinomial}\left(n,\ \alpha_{1}\ldots\alpha_{k}\right)$$

To compute critical values for the Normal distribution, create the NCRIT program for your TI-83 (or equivalent) calculator. At each step, the calculator display is shown, followed by what you should do (■ is the cursor):

■
PRGM →NEW→1:Create New
Name=■
NCRIT ENTER
:■
PRGM →I/O→2:Prompt
:Prompt ■
ALPHA **A**, ALPHA **T** ENTER
:■
2nd **DISTR**→DISTR→3:invNorm(
:invNorm(■
1-(ALPHA **A** ÷ ALPHA **T**)) STO⇒ ALPHA **C** ENTER
:■
PRGM →I/O→3:Disp
:Disp ■
ALPHA **C** ENTER
:■
2nd **QUIT**

Suppose A is α and T is the number of tails. To run the program:

■
PRGM →EXEC→NCRIT
prgmNCRIT■
ENTER
A=?■
0.05 ENTER
T=?■
2 ENTER
1.959963986