Formulas:

$\binom{n}{k} = \frac{n!}{k!(n-k)!}$ $\quad P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $\quad P(A \mid B) = \frac{P(A \cap B)}{P(B)}$

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

$$P(B \mid A) = \frac{P(A \mid B)P(B)}{P(A \mid B)P(B) + P(A \mid B^c)P(B^c)} \qquad P(B_k \mid A) = \frac{P(A \mid B_k)P(B_k)}{\sum_{i=1}^{n} P(A \mid B_i)P(B_i)}$$

$$\overline{X} = \frac{1}{n}\sum_{k=1}^{n} X_k \qquad Var(X) = \frac{1}{n-1}\sum_{k=1}^{n}(X_k - \overline{X})^2 \qquad Var(X) = E(X^2) - (E(X))^2$$

$f(x) = \binom{n}{x}p^x(1-p)^{n-x}$ for $x = 0, 1, 2, \ldots, n$ $\quad E(X) = np$ $\quad Var(X) = np(1-p)$

$f(x) = \binom{x+r-1}{r-1}p^r(1-p)^x$ for $x = 0, 1, 2, \ldots$ $\quad E(X) = \frac{r(1-p)}{p}$ $\quad Var(X) = \frac{r(1-p)}{p^2}$

$f(x) = \frac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}}$ for $\max(0, n-N+M) \le x \le \min(n, M)$ $\quad E(X) = n\frac{M}{N}$ $\quad Var(X) = n\frac{M}{N}\left(\frac{N-n}{N-1}\right)\left(1 - \frac{M}{N}\right)$

$f(x) = \frac{e^{-\lambda}\lambda^x}{x!}$ for $x = 0, 1, 2, \ldots$ $\quad E(X) = \lambda$ $\quad Var(X) = \lambda$

$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$ for $-\infty < x < \infty$ $\quad E(X) = \mu$ $\quad Var(X) = \sigma^2$

$f(x) = \lambda e^{-\lambda x}$ for $x \ge 0$ $\quad E(X) = \frac{1}{\lambda}$ $\quad Var(X) = \frac{1}{\lambda^2}$

$$\overline{x} \pm z_{1-\alpha/2}\frac{\sigma}{\sqrt{n}} \qquad \overline{x} \pm z_{1-\alpha/2}\frac{s}{\sqrt{n}} \qquad \overline{x} \pm t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}} \qquad z = \frac{\overline{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}} \qquad t = \frac{\overline{x} - \mu_0}{\frac{s}{\sqrt{n}}} \qquad \hat{p} = \frac{n_1\hat{p}_1 + n_2\hat{p}_2}{n_1 + n_2}$$

$$t = \frac{\overline{x} - \overline{y} - \Delta_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad \nu = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}} \qquad z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\left(\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}\right)}} \qquad z = \frac{\hat{p}_1 - \hat{p}_2 - \Delta_0}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$\text{Cov}(X, Y) = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \overline{X}_n)(Y_i - \overline{Y}_n) \qquad \hat{b} = \frac{\text{Cov}(X, Y)}{\text{Var}(X)} \qquad \hat{a} = \overline{Y} - m\overline{X}$$

$$SSE = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \qquad MSE = \frac{SSE}{n-2} \qquad R = \frac{\text{Cov}(X, Y)}{\sqrt{\text{Var}(X)\text{Var}(Y)}} \qquad \hat{\beta}_1 \pm t_{1-\alpha/2,n-2}\sqrt{\frac{MSE}{(n-1)\text{Var}(X)}}$$

$$\hat{y}_i \pm t_{1-\alpha/2,n-2}\sqrt{MSE\left(1 + \frac{1}{n} + \frac{(X_i - \overline{X})^2}{(n-1)\text{Var}(X)}\right)} \qquad \hat{y}_i \pm t_{1-\alpha/2,n-2}\sqrt{MSE\left(\frac{1}{n} + \frac{(X_i - \overline{X})^2}{(n-1)\text{Var}(X)}\right)}$$

R code:

```
mean(x)   mean(x,trim=p)   var(x)   sd(x)   summary(x)   hist(x)   choose(n,k)   factorial(k)
p=c(p1,p2,...,pn)   x=c(x1,x2,...,xn)   sum(x*p)   sum(x^2*p)-sum(x*p)^2
dbinom(x,size=n,prob=p)   pbinom(x,size=n,prob=p)   qbinom(q,size=n,prob=p)
dnbinom(x,size=r,prob=p)   pnbinom(x,size=r,prob=p)   qnbinom(q,size=r,prob=p)
dhyper(x,m,n,k)   phyper(x,m,n,k)   qhyper(p,m,n,k)
dpois(x,lambda=λ)   ppois(x,lambda=λ)   qpois(p,lambda=λ)
dnorm(z,mean=μ,sd=σ)   pnorm(z,mean=μ,sd=σ)   qnorm(p,mean=μ,sd=σ)
dt(t,df=ν)   pt(t,df=ν)   qt(p,df=ν)
dexp(x,rate=λ)   pexp(x,rate=λ)   qexp(p,rate=λ)
cov(x,y)   cor(x,y)   n=length(x)   b=cov(x,y)/var(x)   a=mean(y)-b1*mean(x)   lm(y~x)
linefit=a+b*x   SSE=sum((y-linefit)^2)   MSE=SSE/(n-2)
```