

1. Normal Distribution:

- (a) The general format of the R command is:

```
> pnorm(q, mean, sd)
```

This command gives the $\Phi(q)$ (area to the left of q with the given mean and standard deviation). The default is standard normal ($\mu = 0, \sigma = 1$).

Example: Suppose $X \sim N(2.5, 1.2)$. Find $P(X \leq 3)$.

```
> pnorm(.42)
[1] 0.6627573
> pnorm(.4167)
[1] 0.6615511
> pnorm(3, 2.5, 1.2)
[1] 0.6615389
```

- (b) Inverse Normal: The general format of the R command is:

```
> qnorm(p, mean, sd)

> qnorm(.80, 2.5, 1.2)
[1] 3.509945
> qnorm(.80)
[1] 0.8416212
```

2. Binomial Distribution:

- In general, the command for a pmf for the binomial distribution, $P(X = x)$ is:

```
dbinom(x, n, p)
```

where, “d” calculates the density or pmf.

- “pbinom” command finds the cdf, $P(X \leq x)$.
pbinom(x,n,p)

3. Hypergeometric pmf/cdf:

$$P(X = x) = \text{dhyper}(x, M, N - M, n)$$

$$P(X \leq x) = \text{phyper}(x, M, N - M, n)$$

4. Negative binomial distribution pmf/cdf:

$$\text{pmf: } P(X = x) = \text{dnbinom}(x, r, p)$$

$$\text{cdf: } P(X \leq x) = \text{pnbinom}(x, r, p)$$

5. Poisson Distribution example:

- Find $P(X = 5)$ given $X \sim \text{Poi}(\mu = 8)$: (Directly and using distribution)

```
> exp(-8)*8^5/factorial(5)
[1] 0.09160366
> dpois(5,8)
[1] 0.09160366
```

- Find $P(X \geq 5)$ given $X \sim \text{Poi}(\mu = 8)$: (Using distribution)

```
> 1 - ppois(2, 8)
[1] 0.986246
> 1 - dpois(0,8) - dpois(1,8) - dpois(2,8)
[1] 0.986246
```

where $P(X \leq 2) = \text{ppois}(2, 8)$.

6. Exponential Distribution: Suppose $X \sim \text{EXP}(\lambda)$: The general format is:

$$P(X \leq x) = \text{pexp}(x, \lambda)$$

7. Gamma Distribution: Suppose $X \sim \text{GAM}(\alpha, \beta)$: The general format is:

$$P(X \leq x) = \text{pgamma}(x, \alpha, 1/\beta)$$

8. Weibull Distribution: Suppose $X \sim \text{GAM}(\alpha, \beta)$: The general format is:

$$P(X \leq x) = \text{pweibull}(x, \alpha, \beta)$$

9. Lognormal Distribution: Suppose $X \sim \text{LOGNORMAL}(\mu, \sigma)$: The general format is:

$$P(X \leq x) = \text{plnorm}(x, \mu, \sigma)$$

10. Beta Distribution: Suppose $X \sim \text{BETA}(\alpha, \beta, A = 0, B = 1)$: The general format is:

$$P(X \leq x) = \text{pbeta}(x, \alpha, \beta)$$

11. t critical value: Example. $t_{.05/2} = t_{.025}$

In general, there is $1 - \alpha/2$ area to the left of the critical value.

```
> qt(.975,8)
[1] 2.306004
```

or

```
> qt(.025,8, lower.tail=F)
[1] 2.306004
```

12. χ^2 critical value:

Example: $\chi^2_{\alpha/2, n-1} = \chi^2_{.05/2, 19} = \chi^2_{.025, 19}$

```
> qchisq(.025,19, lower.tail=F)
[1] 32.85233
```