CHAPTER ONE

- $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- $P(A \cap B) = 0$ IF A & B ARE M.E.
- $P(A') = 1 - P(A)$
- $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$
- $_nP_r = n!/(n-r)!$ - PERMUTATIONS (ORDER IMPT!)
- $_nC_r = \binom{n}{r} = n!/r!(n-r)!$ - COMBINATIONS (ORDER NOT IMPT!)
- $P(A|B) = P(A \cap B)/P(B)$
- $P(A \cap B) = P(A|B)\,P(B)$
- $P(A|B) = P(A)$ IF A & B ARE INDEP. $(P(A \cap B) = P(A)P(B))$
- $P(A) = P(A|B_1)P(B_1) + P(A|B_2)P(B_2) + \dots + P(A|B_n)P(B_n)$ (TOTAL PROB RULE)
  WHERE $B_1, \dots, B_n$ FORM A PARTITION OF SS.
- $P(B_k|A) = P(A|B_k)P(B_k)/P(A)$ (BAYES RULE)

CHAPTER TWO

- IF X IS A DISCRETE RV W/ PMF $f(x)$

  $\mu = E(X) = \sum_x x f(x)$ $\qquad \sigma^2 = E(X^2) - \mu^2$

  $\qquad\qquad = \left(\sum_x x^2 f(x)\right) - \mu^2$

- GENERALLY, $E(g(x)) = \sum_x g(x) f(x)$

- BINOMIAL DIST. – X = # SUCCESSES IN n TRIALS

$f(x) = \binom{n}{x} p^x (1-p)^{n-x}$ $\quad x = 0, 1, \ldots, n$ $\quad \mu = np$

$\sigma^2 = npq$

- CDF FOR A DISCRETE RV

$F(x) = P(X \le x) = \sum_{k \le x} f(k)$

- POISSON DIST – X = # EVENTS PER UNIT TIME / SPACE

$f(x) = e^{-\lambda} \lambda^x / x!$ $\quad x = 0, 1, 2, \ldots$ $\quad \mu = \lambda \quad \sigma^2 = \lambda$

- NEGATIVE BINOMIAL – X = # TRIAL ON WHICH RTH SUCCESS OCCURS

$f(x) = \binom{x-1}{r-1} p^r (1-p)^{x-r}$ $\quad x = r, r+1, \ldots$ $\quad \mu = \frac{r}{p} \quad \sigma^2 = \frac{rq}{p^2}$

- GEOMETRIC – X = # TRIAL ON WHICH 1ST SUCCESS OCCURS
(r=1 IN NEG. BINOMIAL)

$f(x) = (1-p)^{x-1} p$ $\quad x = 1, 2, 3, \ldots$ $\quad \mu = \frac{1}{p} \quad \sigma^2 = \frac{(1-p)}{p^2}$

- HYPERGEOMETRIC – PROB. THAT X OBJ ARE FROM CLASS 1 (N_1)
AND n–X ARE FROM CLASS 2 (N_2)

$f(x) = \binom{N_1}{x}\binom{N_2}{n-x} / \binom{N}{n}$ $\quad N_1 + N_2 = N$ $\quad \mu = \frac{nN_1}{N}$ $\quad p = \frac{N_1}{N}$

$\sigma^2 = np(1-p)\left(\frac{N-n}{N-1}\right)$ $\quad (1-p) = \frac{N_2}{N}$

- MLE ESTIMATION — $L(\theta) \Rightarrow \ell(\theta) \Rightarrow d/d\theta = 0 \Rightarrow d^2/d\theta^2 < 0$
- JOINT PMF FOR INDEP RVS.

$$P(X_1 = x_1, X_2 = x_2, \ldots, X_n = x_n) = \prod_{i=1}^{n} P(X_i = x_i)$$

IF $Y = a_1 X_1 + a_2 X_2 + \cdots + a_n X_n \Rightarrow \mu_Y = a_1\mu_1 + a_2\mu_2 + \cdots + a_n\mu_n$

$\sigma_Y^2 = a_1^2\sigma_1^2 + a_2^2\sigma_2^2 + \cdots + a_n^2\sigma_n^2$

CHAPTER THREE

- X IS A CONT RV W/ PDF $f(x)$

$$\mu = E(X) = \int_{-\infty}^{\infty} x f(x)\,dx \qquad \sigma^2 = \left(\int_{-\infty} x^2 f(x)\,dx\right) - \mu^2$$

- GENERALLY, $E(g(X)) = \int_{-\infty}^{\infty} g(x) f(x)\,dx$
- UNIFORM DIST (EQUALLY LIKELY) $f(x) = \begin{cases} \frac{1}{b-a} & a \le x \le b \\ 0 & \text{o.w.} \end{cases}$
- EXPONENTIAL — X = TIME TO FAILURE OR WAITING TIME $f(x) = \begin{cases} \frac{1}{\theta} e^{-x/\theta} & x \ge 0 \\ 0 & \text{o.w.} \end{cases}$
- P^{TH} PERCENTILE (π_p)

$$\int_{-\infty}^{\pi_p} f(x)\,dx = p \qquad (\text{MEDIAN} \Rightarrow p = .5)$$

- GAMMA $f(x) = \begin{cases} \frac{1}{\Gamma(\alpha)\theta^\alpha} x^{\alpha-1} e^{-x/\theta} & x \geq 0 \\ 0 & \text{o.w.} \end{cases}$ $\Gamma(\alpha) = (\alpha-1)!$

- χ^2 - GAMMA W/ $\theta = 2$ AND $\alpha = \frac{r}{2} \ni r$ IS POSINT.

- NORMAL $f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$ $x \in \mathbb{R}$

- STANDARD NORMAL - NORMAL W/ $\mu = 0$ $\sigma = 1$ $\Rightarrow Z = \frac{X-\mu}{\sigma}$ $f(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}$

- MLE - SEE PREVIOUS DISC.

- CENTRAL LIMIT THEOREM - IF $X_1, X_2, \ldots, X_n$ FORM A RS FROM SOME PROB. DIST. W/ MEAN μ AND VAR σ^2, THEN

$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \;\dot\sim\; N(\mu, \frac{\sigma^2}{n})$ MEAN $= \mu$ VAR $= \sigma^2/n$ n IS RS SIZE

$\Rightarrow Z = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0,1)$

CHAPTER FOUR

- $\frac{(n-1)S^2}{\sigma^2}$ - χ^2 W/ $n-1$ DOF

- $\bar{X} \;\dot\sim\; N(\mu, \frac{\sigma^2}{n})$

- $\frac{\bar{X}-\mu}{S/\sqrt{n}}$ — t WITH $(n-1)$ DOF

- $\frac{S_X^2/\sigma_X^2}{S_Y^2/\sigma_Y^2}$ — F W/ $(n-1)$ NUMERATOR DOF
  $(m-1)$ DENOMINATOR DOF

- CONFIDENCE INTERVALS — ONE-SIDED OR TWO-SIDED

FOR σ^2 $\left(\frac{(n-1)S^2}{\chi^2_{\frac{\alpha}{2}}}, \frac{(n-1)S^2}{\chi^2_{1-\frac{\alpha}{2}}} \right)$

FOR $\frac{\sigma_X^2}{\sigma_Y^2}$ $\left(\frac{1}{F_{\frac{\alpha}{2}, (n-1), (m-1)}} \frac{S_X^2}{S_Y^2}, F_{\frac{\alpha}{2}, m-1, n-1} \frac{S_X^2}{S_Y^2} \right)$

FOR μ $\left(\bar{X} - t_{\frac{\alpha}{2}} \frac{S}{\sqrt{n}}, \bar{X} + t_{\frac{\alpha}{2}} \frac{S}{\sqrt{n}} \right)$

$\left(\bar{X} - z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}, \bar{X} + z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \right)$

FOR $\mu_1 - \mu_2$ $\left((\bar{X}_1 - \bar{X}_2) - t_{\frac{\alpha}{2}} S_p \sqrt{\frac{1}{n} + \frac{1}{m}}, (\bar{X}_1 - \bar{X}_2) + t_{\frac{\alpha}{2}} S_p \sqrt{\frac{1}{n} + \frac{1}{m}} \right)$

$\Rightarrow S_p = \frac{(n-1)S_X^2 + (m-1)S_Y^2}{n+m-2}$

- HYPOTHESIS TESTS — ONE OR TWO-SAMPLE
  ONE OR TWO-SIDED

TYPE 1 ERROR — α
TYPE 2 ERROR — β

p-VALUE