

FULL MARKS  
= 30

STATS 3N03/3J04 - T02 SOLUTIONS

2006-11-06

1. LET  $X_A$  = YIELD WITH CATALYST A,  $X_B$  = YIELD WITH CATALYST B,  
(8) ASSUME VARIATION FOLLOWS A NORMAL DISTRIBUTION  
IN EACH CASE, SO  $X_A \sim N(.83, .01^2)$ ,  $X_B \sim N(.88, .02^2)$   
AND  $X_A - X_B \sim N(-.05, .01^2 + .02^2)$   
FOR A GIVEN PAIR OF RUNS,  $P(X_A > X_B)$   
 $= P(X_A - X_B > 0) = 1 - P(X_A - X_B \leq 0)$

$$= 1 - \Phi\left(\frac{0 - (-.05)}{\sqrt{.01^2 + .02^2}}\right) = 1 - \Phi(2.2361) = 0.0127$$

2. LET A BE THE EVENT THAT THE 2-HEADED COIN IS  
(8) SELECTED AND LET X = NUMBER OF HEADS IN 3 TOSSES.  
WE HAVE  $P(A) = \frac{1}{2}$ ,  $X|A \sim \text{BIN}(3, 1)$ ,  $X|A' \sim \text{BIN}(3, \frac{1}{2})$

$$P(A|X=3) = \frac{P(X=3|A)P(A)}{P(X=3|A)P(A) + P(X=3|A')P(A')}$$
$$= \frac{\binom{3}{3} 1^3 0^0 \frac{1}{2}}{\binom{3}{3} 1^3 0^0 \frac{1}{2} + \binom{3}{3} \frac{1}{2}^3 \frac{1}{2}} = \frac{1 \times \frac{1}{2}}{1 \times \frac{1}{2} + \frac{1}{8} \times \frac{1}{2}} = \frac{8}{9}$$

3. LET X = NUMBER OF FLAWS IN A GIVEN PANEL  
LET Y = NUMBER OF PANELS OUT OF 50 WITH 1 OR MORE FLAWS

- (8) GIVEN  $X \sim \text{POIS}(.02)$ , SO  $P(X \geq 1) = 1 - P(X=0) = 1 - e^{-.02}$   
 $\therefore Y \sim \text{BIN}(50, 1 - e^{-.02})$ , SO  $\quad \quad \quad = 0.01980$

$$P(Y \leq 2) = \binom{50}{0} (1 - e^{-.02})^0 (e^{-.02})^{50} + \binom{50}{1} (1 - e^{-.02})^1 (e^{-.02})^{49} + \binom{50}{2} (1 - e^{-.02})^2 (e^{-.02})^{48}$$
$$= e^{-1} + 50(1 - e^{-.02})e^{-.98} + 1225(1 - e^{-.02})^2 e^{-.96}$$
$$= .36788 + .37158 + .18391 = 0.92337$$

2006-11-06

4. PARAMETER: A SCALAR OR VECTOR THAT INDEXES A FAMILY OF PROBABILITY DISTRIBUTIONS

3 STATISTIC: ANY FUNCTION OF THE OBSERVATIONS IN A SAMPLE. IT MAY NOT INCLUDE ANY UNKNOWN PARAMETERS.

SAMPLING DISTRIBUTION: THE DISTRIBUTION OF A STATISTIC, DESCRIBING HOW IT WILL VARY FROM ONE SAMPLE TO ANOTHER.

### 5. FLORENCE NIGHTINGALE

- 3
- WENT TO SCUTARI IN NOVEMBER 1854 AS A NURSING ADMINISTRATOR IN THE CRIMEAN WAR
  - SAW THAT UNSANITARY CONDITIONS WERE CAUSING HIGH MORTALITY FROM CHOLERA AND TYPHUS IN HOSPITAL
  - MILITARY AUTHORITIES UNWILLING TO LISTEN TO HER
  - COLLECTED DATA AND ORGANIZED A RECORD KEEPING SYSTEM
  - CALCULATED MORTALITY RATES AND SHOWED THAT IMPROVED SANITARY CONDITIONS WOULD DECREASE MORTALITY
  - BY SPRING OF 1855, MORTALITY HAD DROPPED FROM 60% TO 2.2% AS A RESULT OF HER ACTIONS.
  - DEvised THE "POLAR AREA DIAGRAM" OR "COXCOMB" TO SHOW MONTHLY MORTALITY FROM CONTAGIOUS DISEASES, WOUNDS, AND OTHER CAUSES AND DEMONSTRATED THAT CONTAGIOUS DISEASE, IF UNCHECKED, WOULD HAVE WIPED OUT THE BRITISH ARMY.