## 25 Easy Pieces in MATHSTAT

- 1. Write the expectation of a random variable (r.v.) Z, E(Z), extensively
  - a) for a discrete random variable
  - b) for a continuous random variable
- 2. Var(Z) can be written as E(Y). What is Y?
- 3. Write Var(Z) extensively
  - a) for a discrete random variable
  - b) for a continuous random variable
- 4. What does the cumulative density function or cumulative distribution function (c.d.f.) tell you?

 $F_X(x) =$ 

- 5. X is a continuous r.v.. How are the c.d.f.  $F_X(x)$  and the density function (d.f.)  $f_X(x)$  related?
- 6. Cov(X,Y) can be written as E(Z). What is Z?
- 7. Write Cov(X,Y) extensively for X and Y
  - a) as discrete r.v.s.
  - b) as continuous r.v.s.
- 8. Express  $E_{XY}(XY)$  as a function of Cov(X,Y)
- 9. Write  $E_{XY}(XY)$  extensively for X and Y
  - a) as discrete r.v.s.
  - b) as continuous r.v.s.
- 10. g(X) denotes a measurable function of the r.v. X (like e.g.  $X^2$ , ln(X)). Write extensively E(g(X)) for the continuous r.v. X
- 11. X and Y are cont. r.v.s.. Z = g(X,Y) is a measurable function. Write extensively E(g(X,Y))
- 12. X and Y are cont. r.v.s.. What does the joint c.d.f.  $F_{XY}(x,y)$  tell you? Write the c.d.f. extensively. What does the joint p.d.f.  $f_{XY}(x,y)$  tell you? (discrete case)
- 13. How are  $F_{XY}(x,y)$  and  $f_{XY}(x,y)$  (joint density) related? (X and Y are cont. r.v.s.)
- 14. If X and Y are independent:

$$F_{XY}(x,y) =$$

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15. If X and Y are independent:

$$E_{XY}(X \cdot Y) = Cov(X, Y) =$$

16. If X and Y are independent:

$$E_{XY}(h(X) * g(Y)) =$$

17.  $E_{XY}(X+Y) =$ 

$$E_{XYZ}(X+Y+Z) = Var(X+Y) =$$

18. Write extensively for X and Y as discrete r.v.s. and X and Y as continuous

$$f_{X|Y}(X|Y=y)$$

$$E_{X|Y}(X|Y=y)$$

$$E_{X|Y}(X|Y=y)$$

$$E_{X|Y}(X^2|Y=y)$$

19. E(aX) =

$$Var(aX) =$$

(a is a nonrandom scalar)

20. For  $\underline{X} = (X_1, X_2, \dots, X_n)'$ 

$$E(\underline{X})=\mu,\mu=?$$

$$Var(X) = \Sigma, \Sigma = ?$$

$$Var(\underline{X}) = \mu, \mu = 0$$

$$Var(\underline{X}) = \Sigma, \Sigma = 0$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_n \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

$$(A_{11} : a_{12} : a_{13} : a_{14} : a_{15} :$$

(A is a nonrandom matrix)

$$\underline{Z} = A * \underline{X}$$

$$E(\underline{Z}) =$$

$$Var(Z) =$$

21. Y = a + b \* X

$$E(Y) =$$

$$E(Y|X=x) =$$

- 22. Given joint density  $f_{XY}(x,y)$ . How do you get  $f_X(x)$  and  $f_Y(y)$ ?
  - a) as discrete r.v.s.
  - b) as continuous r.v.s.
- 23. Under which circumstances can you get  $f_{XY}(x,y)$  from  $f_X(x)$  and  $f_Y(y)$ ?
- 24. X and Y are jointly normally distributed

$$\begin{pmatrix} X \\ Y \end{pmatrix} \sim BVN(\mu_X, \mu_Y, \sigma_X^2, \sigma_Y^2, \rho_{XY}).$$

What is the relation of parameters and moments?

$$X \sim$$

$$Y \sim$$

$$X|(Y=y)$$

$$Y|(X=x)$$

$$E(X|Y=y) =$$

$$Var(X|Y=y) =$$

25. X, Y and Z are normally distributed.  $W = a*X + b*Y + c*Z \sim$  How is W distributed?