CH 5 Multivariate Probability Distribution

mrevanisworking

August 11, 2020

0.1 Intro

multivariate probability distributions useful when need to check for the intersections of two or more events.

0.2 Bivariate and Multivariate Probability Distributions

think multiple dice

0.2.1 Definition of Joint or Bivariate Probability Fxn

Let Y1 and Y2 be DRV. The joint probability fxn (JPF, BPF) for Y1 and Y2:

$$p(y_1, y_2) = P(Y_1 = y_1, Y_2 = y_2), -\infty < y_1 < \infty, -\infty < y_2 < \infty$$

0.2.2 Properties of JPF

If Y1 and Y2 are DRV w/ JPF $p(y_1, y_2)$ 1. $p(y_1, y_2) \geq 0$ for all y1, y2
2. $\sum_{y_1,y_2} p(y_1, y_2) = 1$ where the sum is over all values (y_1, y_2) that are assigned NZ P
Sometimes called the Joint probability mass fxn because it sepcifies P (mass) associated w/ each of the possible pairs of values for RV.

0.2.3 Definition of Joint Distribution Fxn

Joint CDF
For any RV Y1, Y2 the joint (bivariate) distribution function is $F(y_1, y_2) = P(Y_1 \leq y_1, Y_2 \leq y_2)$, $-\infty < y_1 < inf, -\infty < y_2 < \infty$

0.2.4 Definition of Join PDF

Let Y1 and Y2 be CRV w/ JCDF $F(y_1, y_2)$. If there exists a nonnegative fxn $f(y_1, y_2)$such that

$$F(y_1, y_2) = \int_{-\infty}^{y_1} \int_{-\infty}^{y_2} f(t_1, t_2) dt_2 dt_1$$

for all $-\infty < y_1 < \infty, -\infty < y_2 < \infty$, then Y1 and Y2 are said to be Jointly CRV. The fxn $f(y_1, y_2)$ is the joint PDF.

0.2.5 Properties of JCDF Theorem

If Y1 and Y2 are RV w/ JCDF $F(y_1, y_2)$, then: 1.$F(-\infty, -\infty) = F(-\infty, y_2) = F(y_1, -\infty) = 0$
2.$F(\infty, \infty) = 1$
3. If $y_1 * \geq y_1$ and $y_2 * \geq y_2$, then

$$F(y_1^*, y_2^*) - F(y_1^*, y_2) - F(y_1, y_2^*) + F(y_1, y_2) \geq 0$$

0.2.6 Properties of JPDF Theorem

If Y1 and Y2 are JCRV w/ JPDF $f(y_1, y_2)$, then 1.$f(y_1, y_2) \geq 0$ for all y1, y2
2.$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(y_1, y_2) dy_1 dy_2 = 1$
SEE FIG 5.2 on 252