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Joint cdf of uniform distribution

After considering the discrete case, we now look at the combined distribution for continuous random variables. If the continuous random variable \(X\) and \(Y\) are defined in the same sample location\ (s\), so their combined probability density function (combined PDF) is a piece-piece continuous function, which satisfies the following. \(x,y)\geq0\), \(x, y) for all in mathbb {R}^2\)\0 (limits_\ DisplayStyle {\0 f (x, y) \, dx\, dy = 1}\) \(\ DisplayStyle {P((X, Y)\0 in a) = \0 iint \ limits_A \! the first two terms in definition 5.2.1 (A\subseteq\mathbb{R}^2\), for anyone (a\subseteq\mathbb)\, dx\, dy}\), provide requirements for a function to be a valid federed PDF. The third position indicates how to use a combined PDF to calculate probabilities. As an example of applying the third condition in definition 5.2.1, the combined CDF \(X\) and \(Y\) forms for continuous random variables are achieved by integrating the combined density function on a set of $A. = \{(x, y) \ In \0 mathbb {R}^ 2 \ \ \ X \ leq a\0 Text { and } \0 Y \ leq b\}, otag $$$ where \0 (a\) and \0 (b\) are constants. Specifically, if returned as above, then \(X\) and \(Y\), at the point \(a, b)\0 combined cdf, $$F (a, b) = P (X\\0 a\0 Text {and}\0 Y \ leq b) = \ int \limits ^b_ {-in a_fty }\ f (x,y)\, dx\, dy.otag $$$ note that the possibilities for continuously combined random variables are now versions in the case of a constant random variable rather than fields. In discrete case, we can also get individual, maginal PDF's \(X\) and \(Y\) from the combined PDF. Let's say the continuous random variable \(X\) and \(Y\) combined density function \0 (f (x, y) \ is. Marginal PDFs of \(X\) and \(Y\) are given by the following, respectively.\0 Start {align*} f_X (x) &= \0 int \ Limit ^{\infty}_{infty}\!! f (x, y) \ f_Y \ f (x, y) \\ dx \quad (\text{}\ Set a value of Y, \0 Text { and }\0 Integrate on all possible values of X) \0 End {align*} Suppose a radioactive particle lies in a unit class. We can define random variables \(X\) and \(Y\) to define \(x\) - and \(y\) coordinates of the particle's location in the unit class, with the bottom left corner placed on the original. Radioactive particles adhere to completely random behavior, which means that the location of the particle must be evenly distributed over the unit class. This means that the combined density function of \(X\) and \(Y\) must be constant on the unit class, which we can write as $$f (x,y) = \0 Left \0 {\ Start {array}{l} C, and \0 Text {if\0 0\ leq x \ leq 1 \ \ Text { and }\0 0 \ leq y\ leq 1 \ \ 0, and \0 Text { otherwise}, end {array}right.otag $$ where \(c\) we can find the value of \(c\) by using the first condition in definition 5.2.1 and resolving the following: $$\iint\limits_ {\0 f (x,y)\, dx\, dy = 1 \quad\Rightarrow\quad c\, dx\, dy=1\quad\Rightarrow\quad c\int\limits^1_0_int\limit^1_0\! 1\, dx\, dy=1\quad\Rightarrow\quad c=1otag $$$ Now we can use the combined PDF of \(X\) and \(Y\) to calculate the possibilities that the particle unit is in some specific area of the class. For example, consider this area $ $A = \{(x,y)\0 x-y > 0.5 \}, otag $$$ which is graphed in Figure 1 below. If we are likely the location of the particle is in the lower right corner of the unit class that manipulates the area \0 (\ \ limits_A> $P. f (x,y)\, dx\, dy = \int ^{0.5}_0\! \ int ^ {1}_{y + 0.5 }\! 1\, dx\, dy=0.125otag $$, we apply definition 5.2.2 to marginal PDF \(X\) and \00.0. (Y\). Start {align*} f_X (x) &= \0 int \ Limit ^1_0 \! 1 \, dy = 1, \quad\text {for}\ 0\leq x\leq 1 \\ f_Y (y) and =\0 int \ Limit ^1_0 \! 1 \, dx = 1, \quad\text {for}\ 0\leq y\leq 1 \end {align*} Note that both \(X\) and \(Y\) are individually identical random variables, at each interval \(0,1]\). That shouldn't be too surprising. Given that the particle's location was evenly distributed over the unit class, we should expect that individual coordinates will also be evenly distributed at unit intervals. At a special gas station, gasoline is stocked in a bulk tank every week. Random variables represent the ratio of the capacity of the \(X\) tank that is stocked in a given week, and represents the ratio of the capacity of the \(Y\) tank that is sold in the same week. Note that a gas station cannot sell more than what is stocked in a given week, which means that the value of \(Y\) cannot exceed the value of \(X\). A possible combined PDF of \(X\) and \(Y\) $$f (x, y) = \left\' Is given by {\'ranni}{l} 3x, and \text {if}\0 0\leq y\\0, and \0 Text {otherwise.} end {array}\0 right.otag $$ note that this function is nonzero only on the triangular area \0 (\{(x, y) \ \ \ \ 0 \ leq y \ leq x \ leq 1 \} \ We get the combined CDF of \(X\) and \(Y\) on point\\0 (x,y) = (1/2, 1/3)\: Start {align*} F \} left (\0) frac{1}{2}, \ frac{1}{3} \ right) = P \left(X\\\\0 frac{1}{2} \ Text { and } Y \leq\0 frac{1}{3} \ Right) &= \0 int ^{1/3}__y 0\ 3x\, dxdy \\ &=\int ^{1/3}_0\! \ Left (\0 frac{3}{2}x ^2 \ Big.^{0.5}_y \ Right) \\0 dy = \ int ^{1/3}_0 \!\ Left (\0 frac{3}{8}-\ frac{3}{2}y ^2\ Right), dy\\ {3} {8}y-\ frac{1}{2}y ^ 3 \ big.^{1/3}_0 \ Approximately 0.1065 \0 End {Align*} Thus, there is a 10.65% probability that less than half of the tank is stock and less than a third of the tank is sold in less than a week. Note that in finding the above integral part, we see the area given by \(x,y) \\0 x \ leq1/2, y \ leq1/3 \}\) cuts the area on which the combined PDF is nongero, i.e., the graph field in Figure 2. It tells us what the range of integration is in double Below is a graph of the intersection at figure 3 desmos.com: Figure 3: Intersection (\{{{(x, y)\\\\0 x \leq1/2, y \leq1/3\}}\) the region on which the combined PDF \(x,y)\) is nonzero. Next, we are likely to have less than half the amount of gas sold which is stocked in a given week. In other words, we get (P(Y<0.5X). To find this possibility, we need to find the area on which we will integrate the combined PDF. To do this, figure 2 with the field \{(x, y) <\0 Look for the intersection of the given area. Which is graphed in Figure 4 below: Figure 4: Intersection \(x,y)\0 Intersection of (\0) y < 0.5x\}\) the area on which the combined PDF \(x,y)\) is nonzero. The calculation is as follows: Start {align*} P(Y<0.5X) &=\0 int ^1_0 \int ^{0.5x}_0\! 3x \, dydx \\ \\ &= \ 1_0 \! \ Left (3xy\Big.^{0.5x}_0\right)\!\0 Left (\0 frac{3}{2}x ^2-0\ Right) \0 , dx = \ frac{1}{2}x ^ 3 \ Big. ^ 1_0 \\ &=\frac{1}{2} \#align*} Thus, there is a 50% chance that the amount of gas sold in a given week maintains less than half of the gas. As we did in the discrete case of jointly distributed random variables, we can also see the expected value of continuous random variables distributed combined. Then we focus on the expected value of the applicable functions for the pair \((x, y)\), because the expected value is defined for the same quantity. At this point, it should not surprise you that the following theorem theorem is similar to theorem theorem 5.1.1, except the amount has been replaced by the result in discrete settings by integral. Let's say \(X\) and \(Y\) are distributed continuously random variables with combined PDFs\'000 (f(x,y)\). If \(g(X,Y))) is a function of these two random variables, its expected value is limits_ given by the following: $\ We can also define independent random variables in a continuous case, just as we did for discrete random variables. If the combined PDF factor in the product of marginal PDF: $X_1 $f X_2 (X_n x_1, x_2, \ldots, x_n) = f_ {X_1} (x_1)\0 cdot f_ {X_2}(x_2)\cdots f_ {X_n}(x_n). Consider the continuous random variable defined in example 5.2.1, where \(X\) and \(Y\) replaced the radioactive particle. We will show that \(X\) and \(Y\) are independent and then verify that theorem 5.1.2 also applies in continuous settings. Recall that we found the marginal PDF as following: \start {align*} f_X (x) (x) (=1, \0. Text {for}\\0 0 \ leq x \ leq1 \ \ f_Y (y) and =1, \0 i.e., \(0\leq x\leq1\) and \(0\leq y\\\) we have $$f (x,y)=1=1\cdot1=f_X(x) f_Y(y), otag $$ and outside unit square, will have at least one marginal PDF So $$f (x, y) = 0 = f_X (x) f_Y (y)otag$$ We have shown as follows that \(f(x, y) = f_X (x) \ f_Y (y) \ \ For everyone ((x, y)\0 In mathematics antig {R}^2\), and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and hence definition 5.2.3, And so definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3, and therefore definition 5.2.3 by \(x\) and \(Y\) are free. Now let's look at the expected value of the product of \(X\) and \(Y\). To calculate this we apply theorem 5.2.1: $$\text{E}[XY] =\$$\text{E}[XY].\$\text{E}[XY]. iint_ {iint_ {iint_{11\cdot f(x,y)\, dxdy =\int^1_0\int^1_0!xy\cdot\, dxdy=\int^1_0\!\left(\frac{x^2}{2}\big.^1_0\right){1}{4}\\\\.\.\}\00 Therefore, their expected values are both 1/2, which are the midpoints of \(0,1]).). Putting it all together, we $\\text{E}[XY] =\+000 frac{1}{4} = \ frac{1}{2} \ cdot \ frac{1}{2} = \ Text {E}[X]\0 Link to Video: Independent Continuous Random Variables Variables

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