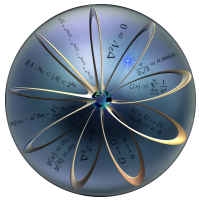

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joint continuous density function

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Let $X_1, X_2, ..., X_n$ be n random variables all defined on the same probability space. The **joint continuous density function** of $X_1, X_2, ..., X_n$, denoted by $f_{X_1,X_2,...,X_n}(x_1, x_2, ..., x_n)$, is the function $f_{X_1,X_2,...,X_n} : \mathbb{R}^n \to \mathbb{R}$ such that for any domain $D \subset \mathbb{R}^n$, we have

$$\int_D f_{X_1,X_2,...,X_n}(u_1, u_2, ..., u_n)du_1du_2...du_n = \text{Prob}(X_1, X_2, ..., X_n \in D)$$

As in the case where $n = 1$, this function satisfies:

1. $f_{X_1,X_2,...,X_n}(x_1, ..., x_n) \geq 0 \ \forall (x_1, ..., x_n)$
2. $\int_{x_1,...,x_n} f_{X_1,X_2,...,X_n}(u_1, u_2, ..., u_n)du_1du_2...du_n = 1$

As in the single variable case, $f_{X_1,X_2,...,X_n}$ does not represent the probability that each of the random variables takes on each of the values.