Q3

Let $X1$ be a random variable with CDF $F1(x)$, and $X2$ be a random variable with CDF $F2(x)$. By definition:

$P(X1 \le x) = F1(x)$ and $P(X2 \le x) = F2(x)$.

We need to show that $P(X1>X2)>0 =1-P(X1<=X2)>0$ or $P(X1<=X2)<1$

Proof by Contradiction

Suppose to the contrary, that $P(X1 \le X2) = 1$. This would imply that X1 is always less than or equal to X2, meaning:

$F1(x) = P(X1 \le x) \ge P(X2 \le x) = F2(x)$. But we know that $F1(x) < F2(x)$ for all x, which contradicts the assumption.

For Q3.

The above approach is not correct because:

1. Understanding the Problem:

- **Original Goal:** The aim is to show that a certain probability, P(X1>X2), equals 1.
- **Incorrect Approach:** The above approach shows that P(X1>X2) is greater than 0, which is insufficient

2. Specific Issues with the Approach:

  - The flawed approach demonstrates that there exists some w under which P(X1>X2)>0.
  - However, the problem demands showing X1>X2 for *all* possible **w.**

Other Common Mistakes:

  - The question requires a formal proof, not just an intuitive argument. Examples, such as tossing a coin, can help verify a claim but do not constitute proof.

For Q2

Common mistakes;

1. Assuming A and B were independent events , and using that to try to prove their independence via proving some tautology or ground truth. (ie : using it to prove P(A)=P(A)).
   This is invalid as a proof technique.
   Let's say you have statement q, you'd like to prove.
   If, under the assumption q, you establish the proof of some ground truth,ie: Some tautology, the statement you've proved is:
   Q implies T. (Q implies a Tautology).
   This does not mean Q is true. Q can still be false and :
   Q implies T, would still be true.
2. Assuming A and B were independent events, and using that to prove P(A intersection B) = P(A)P(B). This is the definition of independent events.