Application of Binomial Probabilities in Testing a New Drug

- Current drug used is 50% effective but costs $100/unit
- New discovery: The pharmaceutical company claims that their new drug is 70% effective, but will cost much more ($1,100)
- Problem for hospital: Decide whether or not to switch to new drug. Look for evidence to support or reject the company's claim
- Hospital buys eight doses and tries it on $n = 8$ patients
- Let X : # patients cured. The possible values are, naturally, $\{0, 1, 2, \ldots, 8\}$. So, X is binomial with $p = 0.7$
- The decision rule used by the hospital is as follows:

$$\text{Decision Rule } = \begin{cases} \text{Adopt the new drug,} & \text{if } X = 7 \text{ or } 8 \\ \text{Don't adopt the new drug,} & \text{if } X = 0, 1, \ldots, 6 \end{cases}$$

- That is, if either 7 or 8 patients are cured, then they will adopt it
- It is possible that they may decide **not** to adopt the new drug **even if is truly effective**, as claimed
- What is the probability of this?

$$\begin{aligned} \Pr\{\text{Don't adopt}\} &= \Pr\{X = 0, 1, \ldots, 6\} \\ &= \binom{8}{0}(0.7)^0(0.3)^8 + \binom{8}{1}(0.7)^1(0.3)^7 + \cdots + \binom{8}{6}(0.7)^6(0.3)^2 \\ &= 0.74 \end{aligned}$$

- So, there is a 0.74 probability of not adopting a truly effective drug
- This is very large and it may be unfair to the drug company
- We will call this probability the probability of Type I error (later in Chapter 8)