

# Week 15

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## 37 Lecture 37

### 37.1 Central Limit Theorem (11.4)

- Motivation: Experience tells us that if a certain variable is measured repeatedly, then usually the sum or the average of the measurements approaches a normal distribution. The measurement may have a discrete or continuous (not necessarily known) distribution.
  
- Central Limit Theorem: Let  $X_1, X_2, \dots, X_n$  be independent and identically distributed random variables each with finite mean  $\mu$  and finite nonzero variance  $\sigma^2$ . Then for  $n > 30$

- Examples:

1. Suppose I roll a 20-sided fair die 50 times and compute the average outcome.
  - (a) What is the probability that the average falls between 10 and 11?

- (b) How often should I roll the 20-sided die to be at least 90% certain that the average of the outcomes will be between 10 and 11?

2. The lifetime of lightbulbs produced by a certain company are exponentially distributed with an average lifetime of 100 hours. What is the probability that the average lifetime of a random sample of 500 lightbulbs of this company is at least 1010 hours?

