### MATH 180A: INTRO TO PROBABILITY (FOR DATA SCIENCE)

www.math.ucsd.edu/~tkemp/180A



Lab 7 Due Wednesday, Dec 4 Homework 8 Due Friday, Dec 6 Final Exam: Monday, Dec 9, 11:30a-2:30p in REC GYM

Reminder: Chebyshev's Inequality

For any random variable X with finite E(X) = M  $Var(X) = 5^{-2}$ 

## $P(|X-\mu| \ge k_{\text{E}}) \le \frac{1}{k^2}$

9.

We proved this using the fact that E is monotone:  $X \le Y \implies E(X) \le E(Y)$ 

Eg. Ramen Menya Ultra has, en average, 1000 customers /day, with a standard deviation of 15. Estimate the probability that today they will have between 956 and 1044 customers. (Weak) Law of Large Numbers

Let X, X, X, X, , , be an infinite sequence of i.e. vandom voriables, each with F(X;)= , and Var(X;)= 52 finite.

Let Sn = X, +X2+ -- + Xn. Then for any fixed E>O,

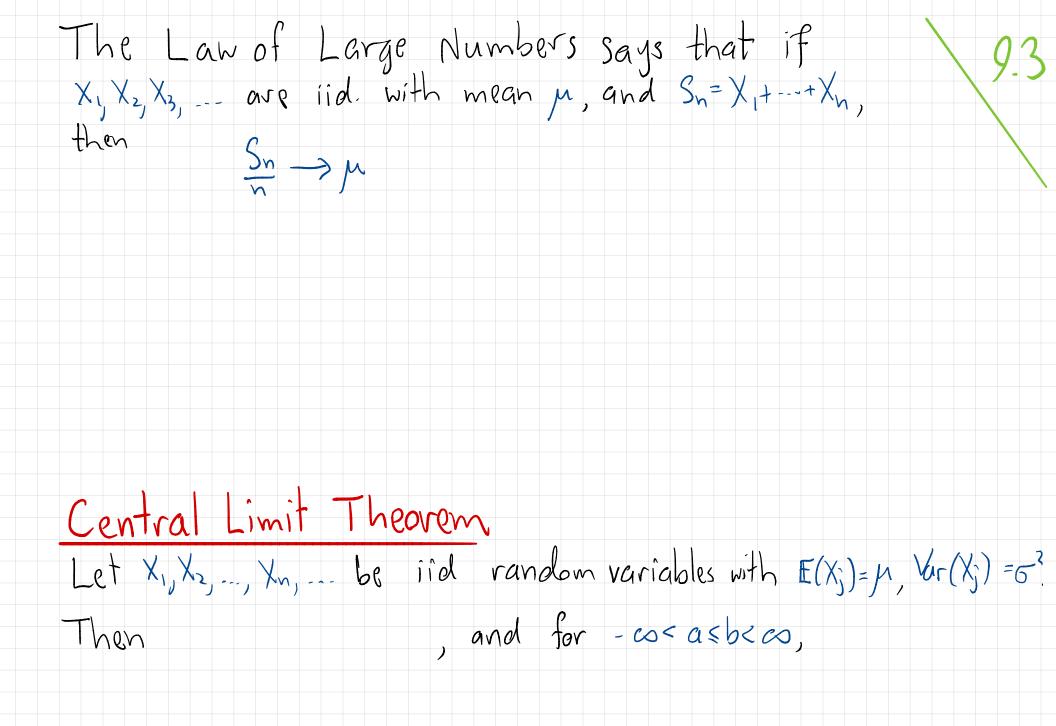
E.g. The Large Hadron Collider was built to detect and measure the mass of the Higgs Boson. Call the mass M.

For theoretical reasons, it is known that M ≤ 1.78×10-23 g

How many trials do the LHC physicists need to do to estimate the correct mass (via sample mean) within 10-24g, with probability = 95%?

Strong Law of Large Numbers Let X, X, X, ..., X,... be an infinite sequence of i.i.d. random variables each with E(X;)=µ.

Let  $\overline{X}_n = \frac{X_1 + X_2 + \dots + X_n}{n}$ . Then



## Proef. Let Yn= (Sn-nM)/555. We will show that

$$M_{Y_n}(t) \longrightarrow M_{\mathcal{N}(0,1)}(t) = e^{t^2/2}$$
 for all  $t \in \mathbb{R}$ 

# Rate of Convergence in CLTTheorem (Berry - Esseen, 1941-42) $P(S_{n-nM} \leq x) - \overline{\Phi}(x) \leq \frac{3F[1X-M1^3]}{5^3}$

Eq. What does the p.d.f. of a Poisson (n) r.v. look like for large n?