Outline of CLT steps

1. Write event you are interested in, in terms of sum of random variables.
2. Apply continuity correction if RVs are discrete.
   For every real number (values produced by $\mathcal{N}$), find the nearest value in the support of original random variable (what would it round to?)
   Rephrase event to include all real numbers that round to target values.
3. Standardize RV to have mean 0 and standard deviation 1.
4. Replace RV with $\mathcal{N}(0,1)$.
5. Write event in terms of Φ
6. Look up in table.

Using the CLT

$\mathbb{E}[\bar{X}] = \frac{1}{30}\mathbb{E}[\sum X_i] = \frac{.6 \cdot 30}{30} = \frac{3}{5}$.
$\text{Var}(\bar{X}) = \frac{1}{30^2}\text{Var}(\sum X_i) = \frac{1}{30} \cdot .6 \cdot .4 = \frac{1}{125}$.

$\mathbb{P}(\bar{X} \leq .5)$

Different dice

Roll two fair dice independently. Let U be the minimum of the two rolls and V be the maximum

Are U and V independent?

Write the joint distribution in the table

What's $p_U(z)$? (the marginal for U)

$p_{U,V}$	U=1	U=2	U=3	U=4
V=1				
V=2				
V=3				
V=4				

Analogues for continuous

Everything we saw today has a continuous version.

There are "no surprises"– replace pmf with pdf and sums with integrals.

	Discrete	Continuous
Joint PMF/PDF	$p_{X,Y}(x,y) = P(X=x, Y=y)$	$f_{X,Y}(x,y) \neq P(X=x, Y=y)$
Joint CDF	$F_{X,Y}(x,y) = \sum_{t \le x} \sum_{s \le y} p_{X,Y}(t,s)$	$F_{X,Y}(x,y) = \int_{-\infty}^{x} \int_{-\infty}^{y} f_{X,Y}(t,s) ds dt$
Normalization	$\sum_x \sum_y p_{X,Y}(x,y) = 1$	$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{X,Y}(x,y) dx dy = 1$
Marginal PMF/PDF	$p_X(x) = \sum_y p_{X,Y}(x,y)$	$f_X(x) = \int_{-\infty}^{\infty} f_{X,Y}(x,y) dy$
Expectation	$E[g(X,Y)] = \sum_x \sum_y g(x,y) p_{X,Y}(x,y)$	$E[g(X,Y)] = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} g(x,y) f_{X,Y}(x,y) dx dy$
Conditional PMF/PDF	$p_{X\mid Y}(x \mid y) = \frac{p_{X,Y}(x,y)}{p_Y(y)}$	$f_{X\mid Y}(x \mid y) = \frac{f_{X,Y}(x,y)}{f_Y(y)}$
Conditional Expectation	$E[X \mid Y=y] = \sum_x x p_{X\mid Y}(x \mid y)$	$E[X \mid Y=y] = \int_{-\infty}^{\infty} x f_{X\mid Y}(x \mid y) dx$
Independence	$\forall x, y, p_{X,Y}(x,y) = p_X(x) p_Y(y)$	$\forall x, y, f_{X,Y}(x,y) = f_X(x) f_Y(y)$