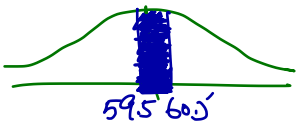
Lesson: Normal Approximation and Normal Approximation for Binomial Distribution

Normal Approximation:

- use when model normal distribution for discrete data
  (data set is large)
  (data falls into a symmetric unimodal bell shape)
  (discrete data)
- use Continuity Correction [treat discrete data as they are continuous
  i.e. "60 students" will be treated as $P(59.5 < X < 60.5)$

$P(59.5 < X < 60.5)$ → $P(X = 60)$



Example

A factory that makes chocolate covered peanuts packages them in a box. The number of peanuts in the box is assumed to be normally distributed. They found that the boxes have a mean of 200 peanuts with a standard deviation of 12. If a box has fewer than 190 peanuts it will be rejected by quality control. Also, a box with more than 215 peanuts will result in excess costs to the company.

a) What is the probability that a box chosen at random will have exactly 200 peanuts in it?

$P(X = 200)$ ↑ discrete

Using continuity correction

$P(199.5 < X < 200.5)$

$= P\left(\frac{199.5 - 200}{12} < Z < \frac{200.5 - 200}{12}\right)$

$= P(-0.04 < Z < 0.04)$

$= 0.5160 - 0.4840$

$= 0.0320$

b) What percent of the production would you expect to lie within acceptable values?

$P(190 \leq X \leq 215)$

Using continuity correction:

$P(189.5 < X < 215.5)$

$= P\left(\frac{189.5 - 200}{12} < Z < \frac{215.5 - 200}{12}\right)$

$= P(-0.875 < Z < 1.29)$

$= 0.9015 - \left(\frac{0.1922 + 0.1894}{2}\right)$

$= 0.9015 - 0.1908$

$= 0.7107.$

c) If your factory produces 200 000 boxes per shift, how many boxes would deemed rejects?

$200\,000(1 - 0.7107)$

$= 57\,860$ boxes

d) Comment on the quality control of your packaging process.

Approximately 57 860 boxes, which is more than a quarter of the production, are deemed rejected. It is considered a large amount of production being wasted. The company should consider an improvement plan to lower the rejected amount of boxes in the process. A new machine is recommended.