Normal Approximation to the Binomial

Recall that for a binomial distribution

$$\mu = n \cdot p \quad \text{and} \quad \sigma = \sqrt{n \cdot p(1-p)}$$

and the random variable x was the number of successes in n trials.

If $p = 0.5$ (the probability of a success for one trial is 0.5) then
$\mu = n \cdot p$ should be right in the middle of the possible x values.

Example: Find the probability distribution for the binomial distribution where n=10, and p=0.5. Use this information to make a histogram representing the binomial experiment (values of x on x-axis, probabilities on y)

Repeat this process for the cases $n=10$, $p=0.80$ and $n=10$, $p=0.20$

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In that last two situations if we were to use n=100 instead of n=10 we could still use a normal distribution to approximate the binomial distribution (the histogram is "stretched out").

Under certain conditions we can use the normal distribution to approximate the binomial distribution. As a rule, we will say that we can use a normal distribution to approximate a binomial distribution if

$$n \cdot p \geq 5 \qquad \text{and} \qquad n \cdot (1 - p) \geq 5$$

This will ensure that p is close enough to 0.5 and n is large enough for a fairly accurate approximation.

Procedure for the normal approximation to the binomial

1) Verify that both $n \cdot p \geq 5$ and $n \cdot (1 - p) \geq 5$

2) Calculate $\sigma = \sqrt{n \cdot p(1 - p)}$

3) Compute the **continuity correction** (this is to correct for the fact that we are using a distribution for a continuous random variable to approximate a distribution for a discrete random variable). Add or subtract 0.5 to the x value to find the interval of the continuous variable x.

4) Calculate the z-scores for the endpoints of the interval found in step 3.

5) Find the corresponding area under the standard normal curve.

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Example: Use the normal distribution to estimate the binomial probability

$P(4 \leq x \leq 10)$ if n= 20 and p=0.45

Example: A candy company produces jellybeans. According to the company 24% of the jellybeans made are black. In a bag of 100 jellybeans you found that 27 were black. Assuming the claim the company is making is correct, find the chances of getting a bag of 100 jellybeans that has 27 or more black jellybeans. (If possible use a normal approximation to solve this problem).

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