8.4: Normal approximation to the binomial distribution

Question 1

(a) $n = 60,\ p = 0.4$

$np = 24 \ ; > 5$

$nq = 36 \ ; > 5$

Normal approximation should be reasonable

(b) $n = 45,\ p = 0.1$

$np = 4.5 \ ; < 5$

$nq = 40.5 \ ; > 5$

Normal approximation is not reasonable, $np < 5$

(c) $n = 80,\ p = 0.1$

$np = 8 \ ; > 5$

$nq = 72 \ ; > 5$

Normal approximation should be reasonable

(d) $n = 30,\ p = 0.8$

$np = 24 \ ; > 5$

$nq = 6 \ ; > 5$

Normal approximation should be reasonable

Question 2

$\mu = np$

$\sigma = \sqrt{npq}$

Sample size, n	p	μ	σ	
60	0.4	24	3.795	$P(X<22) = 0.255$
200	07	140	6.481	$P(X<160) = 0.9987$
75	0.6	45	4.243	$P(X>50) = 0.0974$
250	0.2	50	6.325	$P(X>48) = 0.5937$
1000	08	800	12.649	$P(780<x<840) = 0.9375$
90	0.65	58.5	4.525	$P(52<X<62) = 0.6539$
100	0.36	36	4.800	$P(x=40) = 0.0587$
3000	0.52	1560	27.364	$P(X=1650) = 0.0000$

$P(X<22) = P(X<21.5)$

$P(X<160) = P(X<159.5)$

$P(X>50) = P(X>50.5)$

$P(X>48) = P(X>48.5)$

$P(780<X<840) = P(780.5<X<839.5)$

$P(52<X<62) = P(52.5<X<61.5)$

$P(X=40) = P(39.5<X<40.5)$

$P(X=1650) = P(1649.5<X<1650.5)$

Question 3

$p = 0.62$ $\quad \mu = 1500 \times 0.62 = 930$

$n = 1500$ $\quad \sigma = \sqrt{1500 \times 0.62 \times 0.38} = 18.7989$

$P(X \geq 950) = P(X > 949.5)$

$$Z = \frac{949.5 - 930}{18.7989} = 1.0373$$

$P(Z > 1.0373) = 0.1498$

Question 5

$p = 0.07$

$n = 250$

$P(n < 20) = P(X < 19.5)$

$M = 250 \times 0.07 = 17.5$

$\sigma = \sqrt{250 \times 0.07 \times 0.93} = 4.034$

$Z = \frac{19.5 - 17.5}{4.034} = 0.4953$

$P(Z < 0.4953) = 0.690$