In the last project we mentioned how we can approximate binomial probabilities with normal probabilities and how we can compute with both. Refer to http://wiener.math.csi.cuny.edu/verzani/classes/MTH113/computer/binomial-normal.pdf if you need to review. (The key functions are pbinom() and pnorm for finding probabilities.)

For the following exercises, find the binomial model. Identify n and p and then find the answer using *both* the binomial and the normal approximation. I'll do the first one for you.

0.1 When grading MTH 020 Professor Verzani tosses a coin 2 times. If it lands heads both times the student fails, otherwise they pass. In a class of 30 students, what is the probability that 20 or more students pass?

Answer: Notice, that the number of students who pass, X, is binomial with n = 30 and p = 3/4 = 1 - P(two heads in two tosses). Thus the answer is $P(X \ge 20) = 1 - P(X \le 19)$. (Why?) The latter is answered with pbinom. So we get an answer of

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> 1 - pbinom(19,30,3/4)
[1] 0.8943
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The normal approximation says that $P(20 \le X \le 30) = P(20 - 1/2 \le Y \le 30 + 1/2)$ where *Y* is normal with mean $\mu = np$ and $\sigma^2 = np(1-p)$. Thus we would have

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> n = 30; p = 3/4
> mu = n*p; sigma = sqrt(n*p*(1-p))
> pnorm(30.5,mu,sigma) - pnorm(19.5,mu,sigma)
[1] 0.8967
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Notice 0.8967 is close to the exact answer of 0.8943.

Now it's your turn!

0.2 Derek Jeter is known to get on base with probability 0.4 each time he bats. What is the probability that in 40 atbats, he gets on base 10 or fewer times?

0.3 A CSI student has a 25% chance of getting a good parking spot. What is the probability that in a semester where they park 80 times that they get more than 25 good spots?

0.4 A spammer sends out 2,000,000 emails. If their success rate is 1/500,000, what is the probability that there are 6 or more successes?

0.5 A multiple choice test is taken by a student. Suppose they haven't studied much and have to guess at every question. They figure they can eliminate enough bad choices so that the probability of guessing a correct answer is 0.5. If the test has 15 questions, and they need 10 or more correct to pass, what is the probability that they will pass the exam?

0.6 A pollster asks believes that 10% of Americans believe the world is flat. If they ask 1000 people what they believe, what is the probability that more than 125 will say the world is flat?

0.7 A McDonald's worker finds that 35% of orders will include french fries. If there are much more than that during a shift, they will have troubles as the french fry guy is really slow. What is the probability that in 100 orders there are more than 45 orders with french fries?