

## BINOMIAL PROBABILITIES

- 1) 90% of the graduates of Wissahickon High who apply to Bucknell University are admitted. This year, there were 6 graduates from Wissahickon who applied to Bucknell. What is the probability that

a) 4 were admitted

$${}^6C_4 (.9)^4 (.1)^2 = .0984$$

b) more than 4 were admitted

$${}^6C_5 (.9)^5 (.1)^1 + {}^6C_6 (.9)^6 (.1)^0 = .8857$$

- 2) According to FBI statistics, there is an average of 2,300 vehicles stolen per day in the U.S. That puts the chances of your car being stolen at about 1 out of 120. The McBride family owns 4 cars. What is the probability that

a) none will be stolen today

$${}^4C_0 \left(\frac{1}{120}\right)^0 \left(\frac{119}{120}\right)^4 = .9671$$

b) at least one will be stolen today

$$1 - .9671 = .0329$$

- 3) Mario is taking a multiple-choice exam that consists of 6 questions. Each question has 4 choices. If he guesses at each answer and he must get 4 questions correct to pass, what is the probability that he will pass the exam.

$${}^6C_4 \left(\frac{1}{4}\right)^4 \left(\frac{3}{4}\right)^2 + {}^6C_5 \left(\frac{1}{4}\right)^5 \left(\frac{3}{4}\right)^1 + {}^6C_6 \left(\frac{1}{4}\right)^6 \left(\frac{3}{4}\right)^0 = \frac{77}{2048} = .0376$$

- 4) A shipment of 100 tires from the Apex Tire Corporation is known to contain 20 defective tires. Five tires are selected at random and each tire is replaced before the next tire is selected. What is the probability that not more than two defective tires will be chosen.

$${}^5C_0 \left(\frac{20}{100}\right)^0 \left(\frac{80}{100}\right)^5 + {}^5C_1 \left(\frac{20}{100}\right)^1 \left(\frac{80}{100}\right)^4 = \frac{2304}{3125} = .7373$$

- 5) If the conditions are the same in the previous problem except now that 15 tires are selected, what is the probability of getting at least one defective tire?

$$1 - {}^{15}C_0 \left(\frac{20}{100}\right)^0 \left(\frac{80}{100}\right)^{15} = .9648$$

- 6) Studies indicate that in 70% of the families of Blue Bell, both the husband and wife work. If 7 families are randomly selected from Blue Bell, what is the probability that

a) exactly 4 of them work.

$${}^7C_4 (.7)^4 (.3)^3 = .2269$$

b) more than 4 work

$${}^7C_5 (.7)^5 (.3)^2 + {}^7C_6 (.7)^6 (.3)^1 + {}^7C_7 (.7)^7 (.3)^0 = .6471$$

- 7) A researcher claims that 80% of all the families in Houston have a VCR. If 6 families in Houston are randomly selected, what is the probability that all 6 families have VCR's.

$${}^6C_6 (.8)^6 (.2)^0 = .2621$$

- 8) According to the National Institute of Health, 32% if all women will suffer a hip fracture because of osteoporosis by the age of 90. If 6 women aged 90 are selected at random, find the probability that

a) 3 of them suffer or will suffer a hip fracture

$${}^6C_3 (.32)^3 (.68)^3 = .2061$$

b) none of them suffer or will suffer a hip fracture

$${}^6C_0 (.32)^0 (.68)^6 = .0989$$

## BINOMIAL PROBABILITIES (Cont'd)

9) According to the Internal Revenue Service, the chances of your tax return being audited are 3 in 100 if your income is \$60,000 or less and 8 in 100 if your income is more than \$60,000. 6 tax payers are chosen

a. earning less than \$60,000. Find the probability that none will be audited.

$${}_6C_0 (.03)^0 (.97)^6 = \boxed{.8330}$$

b. earning more than \$60,000. Find the probability that more than half are audited.

$${}_6C_4 (.08)^4 (.92)^2 + {}_6C_5 (.08)^5 (.92)^1 + {}_6C_6 (.08)^6 (.92)^0 = \boxed{.0005}$$

10) A survey indicated that 3 out of every 5 people support the President's tax cuts. If 10 people are chosen at random, find the probability that

a. 5 support the president

$${}_{10}C_5 (.6)^5 (.4)^5 = \boxed{0.2007}$$

b) 9 or more support the president

$${}_{10}C_9 (.6)^9 (.4)^1 + {}_{10}C_{10} (.6)^{10} (.4)^0 = \boxed{0.0464}$$

11) According to FBI statistics, only 52% of all rape cases are reported to the police. If 10 rape cases are randomly selected, what is the probability that no more than 1 is reported to the police?

$${}_{10}C_0 (.52)^0 (.48)^{10} + {}_{10}C_1 (.52)^1 (.48)^9 = \boxed{0.0077}$$

12) The Wissahickon Student Council determines that only  $\frac{1}{10}$  of the student body returns surveys. They choose 8 students to randomly receive a survey. What is the probability that

a) they get 4 surveys back.

$${}_8C_4 \left(\frac{1}{10}\right)^4 \left(\frac{9}{10}\right)^4 = 0.0046$$

b) they get no surveys back.

$${}_8C_0 \left(\frac{1}{10}\right)^0 \left(\frac{9}{10}\right)^8 = 0.4301$$

13) The probability that a driver making a gas purchase will pay by credit card is  $\frac{3}{5}$ . If 6 cars pull up to the station to buy gas, what is the probability that 4 or more of the drivers will pay by credit card?

$${}_6C_4 \left(\frac{3}{5}\right)^4 \left(\frac{2}{5}\right)^2 + {}_6C_5 \left(\frac{3}{5}\right)^5 \left(\frac{2}{5}\right)^1 + {}_6C_6 \left(\frac{3}{5}\right)^6 \left(\frac{2}{5}\right)^0 = .5443$$

14) On 7-11's shelves, there are 40 loaves of bread. Ten of them are stale. Gail checks 4 of the loaves for freshness, replacing them after she selects them. Find the probability that

a) all are fresh

$${}_4C_4 \left(\frac{30}{40}\right)^4 \left(\frac{10}{40}\right)^0 = \frac{81}{256} = .3164$$

b) half are fresh

$${}_4C_2 \left(\frac{30}{40}\right)^2 \left(\frac{10}{40}\right)^2 = .2109$$

15) in Lansdale, 44% of all fire alarms are false alarms. On a certain day, there were 12 fire alarms. Find the probability that

a) none is a false alarm

$${}_{12}C_0 (.44)^0 (.56)^{12}$$

b) there are at least 2 false alarms.

$$1 - ({}_{12}C_0 (.44)^0 (.56)^{12} + {}_{12}C_1 (.44)^1 (.56)^{11})$$

$$= .000951$$

$$= .9901$$