13.

a. $P(X \le 3) = p(0) + p(1) + p(2) + p(3) = .10+.15+.20+.25 = .70$.

b. $P(X < 3) = P(X \le 2) = p(0) + p(1) + p(2) = .45$.

c. $P(X \ge 3) = p(3) + p(4) + p(5) + p(6) = .55$.

d. $P(2 \le X \le 5) = p(2) + p(3) + p(4) + p(5) = .71$.

e. The number of lines not in use is $6 - X$, and $P(2 \le 6 - X \le 4) = P(-4 \le -X \le -2) =$ $P(2 \le X \le 4) = p(2) + p(3) + p(4) = .65$.

f. $P(6 - X \ge 4) = P(X \le 2) = .10 + .15 + .20 = .45$.

17.

a. $p(2) = P(Y = 2) = P(\text{first 2 batteries are acceptable}) = P(AA) = (.9)(.9) = .81$.

b. $p(3) = P(Y = 3) = P(UAA \text{ or } AUA) = (.1)(.9)^2 + (.1)(.9)^2 = 2[(.1)(.9)^2] = .162$.

c. The fifth battery must be an A, and exactly one of the first four must also be an A. Thus, $p(5) = P(AUUUA \text{ or } UAUUA \text{ or } UUAUA \text{ or } UUUAA) = 4[(.1)^3(.9)^2] = .00324$.

d. $p(y) = P(\text{the } y^{\text{th}} \text{ is an } A \text{ and so is exactly one of the first } y - 1) = (y - 1)(.1)^{y-2}(.9)^2$, for $y = 2, 3, 4, 5, \ldots$.

30.

a. $E(Y) = \sum_{y=0}^{3} y \cdot p(y) = 0(.60) + 1(.25) + 2(.10) + 3(.05) = .60$.

b. $E(100Y^2) = \sum_{y=0}^{3} 100y^2 \cdot p(y) = 0(.60) + 100(.25) + 400(.10) + 900(.05) = \$110$.

32.

a. $E(X) = (16)(.2) + (18)(.5) + (20)(.3) = 18.2 \text{ ft}^3$; $E(X^2) = (16)^2(.2) + (18)^2(.5) + (20)^2(.3) = 333.2$. Put these together, and $V(X) = E(X^2) - [E(X)]^2 = 333.2 - (18.2)^2 = 1.96$.

b. Use the linearity/rescaling property: $E(70X - 650) = 70\mu - 650 = 70(18.2) - 650 = \$624$. Alternatively, you can figure out the price for each of the three freezer types and take the weighted average.

c. Use the linearity/rescaling property again: $V(70X - 650) = 70^2\sigma^2 = 70^2(1.96) = 9604$. (The 70 gets squared because variance is itself a square quantity.)

d. We cannot use the rescaling properties for $E(X - .008X^2)$, since this isn't a linear function of X. However, since we've already found both $E(X)$ and $E(X^2)$, we may as well use them: the expected actual capacity of a freezer is $E(X - .008X^2) = E(X) - .008E(X^2) = 18.2 - .008(333.2) = 15.5344 \text{ ft}^3$. Alternatively, you can figure out the actual capacity for each of the three freezer types and take the weighted average.

47.

a. $B(4;15,.7) = .001$.

b. $b(4;15,.7) = B(4;15,.7) – B(3;15,.7) = .001 – .000 = .001$.

c. Now $p = .3$ (multiple vehicles). $b(6;15,.3) = B(6;15,.3) – B(5;15,.3) = .869 – .722 = .147$.

d. $P(2 \le X \le 4) = B(4;15,.7) – B(1;15,.7) = .001$.

e. $P(2 \le X) = 1 – P(X \le 1) = 1 – B(1;15,.7) = 1 – .000 = 1$.

f. The information that 11 accidents involved multiple vehicles is redundant (since $n = 15$ and $x = 4$). So, this is actually identical to **b**, and the answer is .001.

48. $X \sim \text{Bin}(25, .05)$

a. $P(X \le 3) = B(3;25,.05) = .966$, while $P(X < 3) = P(X \le 2) = B(2;25,.05) = .873$.

b. $P(X \ge 4) = 1 – P(X \le 3) = 1 – B(3;25,.05) = .1 – .966 = .034$.

c. $P(1 \le X \le 3) = P(X \le 3) – P(X \le 0) = .966 – .277 = .689$.

d. $E(X) = np = (25)(.05) = 1.25$, $\sigma_X = \sqrt{np(1-p)} = \sqrt{25(.05)(.95)} = 1.09$.