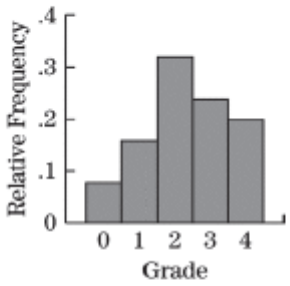
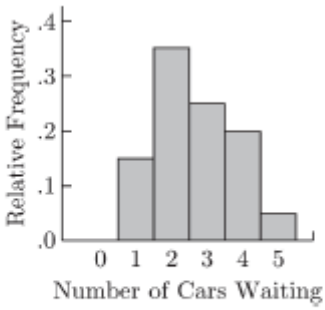
1.

Grade	Relative Frequency
0	$\frac{2}{25} = 0.08$
1	$\frac{4}{25} = 0.16$
2	$\frac{8}{25} = 0.32$
3	$\frac{6}{25} = 0.24$
4	$\frac{5}{25} = 0.20$



2.

Number of cars waiting	Relative Frequency
0	$\frac{0}{60} = 0$
1	$\frac{9}{60} = 0.15$
2	$\frac{21}{60} = 0.35$
3	$\frac{15}{60} = 0.25$
4	$\frac{12}{60} = 0.20$
5	$\frac{3}{60} = 0.05$



3.

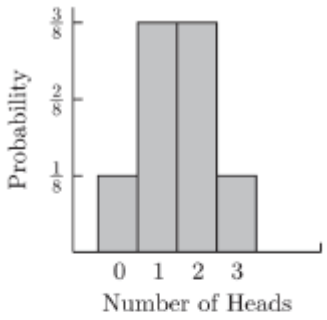
Number of calls during minute	Relative Frequency
20	$\frac{3}{60} = 0.05$
21	$\frac{3}{60} = 0.05$
22	$\frac{0}{60} = 0$
23	$\frac{6}{60} = 0.10$
24	$\frac{18}{60} = 0.30$
25	$\frac{12}{60} = 0.20$
26	$\frac{0}{60} = 0$
27	$\frac{9}{60} = 0.15$
28	$\frac{6}{60} = 0.10$
29	$\frac{3}{60} = 0.05$

4.

Number produced during hour	Relative Frequency
50	$\frac{2}{40} = 0.05$
51	$\frac{0}{40} = 0$
52	$\frac{6}{40} = 0.15$
53	$\frac{8}{40} = 0.20$
54	$\frac{12}{40} = 0.30$
55	$\frac{6}{40} = 0.15$
56	$\frac{4}{40} = 0.10$
57	$\frac{0}{40} = 0$
58	$\frac{0}{40} = 0$
59	$\frac{2}{40} = 0.05$

5. HHH, HHT, HTH, THH, HTT, THT, TTH, TTT

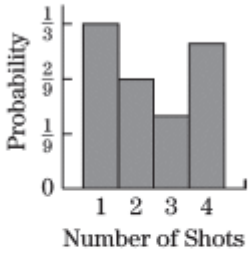
Number of Heads	Probability
0	$\frac{\binom{3}{0}}{2^3} = \frac{1}{8}$
1	$\frac{\binom{3}{1}}{2^3} = \frac{3}{8}$
2	$\frac{\binom{3}{2}}{2^3} = \frac{3}{8}$
3	$\frac{\binom{3}{3}}{2^3} = \frac{1}{8}$



6. Probability of hit $= \frac{1}{3}$

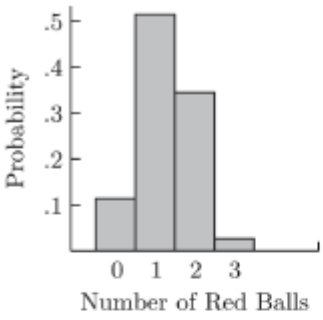
Probability of miss $= \frac{2}{3}$

Number of Shots	Probability
1	$\frac{1}{3}$
2	$\left(\frac{2}{3}\right)\left(\frac{1}{3}\right) = \frac{2}{9}$
3	$\left(\frac{2}{3}\right)^2\left(\frac{1}{3}\right) = \frac{4}{27}$
4	$\left(\frac{2}{3}\right)^3 = \frac{8}{27}$



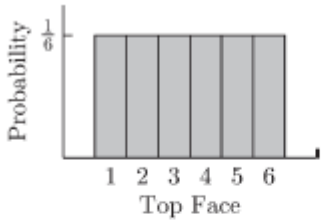
7.

Number of Red Balls	Probability
0	$\frac{\binom{3}{0}\binom{4}{3}}{\binom{7}{3}} = \frac{4}{35}$
1	$\frac{\binom{3}{1}\binom{4}{2}}{\binom{7}{3}} = \frac{18}{35}$
2	$\frac{\binom{3}{2}\binom{4}{1}}{\binom{7}{3}} = \frac{12}{35}$
3	$\frac{\binom{3}{3}\binom{4}{0}}{\binom{7}{3}} = \frac{1}{35}$



8.

Top Face	Probability
1	$\frac{1}{6}$
2	$\frac{1}{6}$
3	$\frac{1}{6}$
4	$\frac{1}{6}$
5	$\frac{1}{6}$
6	$\frac{1}{6}$



9.

No. Red Balls	Player's Earnings	Probability
2	\$5	$\frac{\binom{2}{2}\binom{4}{0}}{\binom{6}{2}} = \frac{1}{15}$
1	\$1	$\frac{\binom{2}{1}\binom{4}{1}}{\binom{6}{2}} = \frac{8}{15}$
0	–1\$	$\frac{\binom{2}{0}\binom{4}{2}}{\binom{6}{2}} = \frac{6}{15}$

10.

Number of tosses	Player's Earnings	Probability
1	–50¢	$\frac{1}{2}$
2	0¢	$\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{4}$
3	50¢	$\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right) = \frac{1}{8}$
4	\$1	$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

11. $\Pr(5 \le X \le 7)$
$= \Pr(X = 5) + \Pr(X = 6) + \Pr(X = 7)$
$= .2 + .1 + .3$
$= .6$

12. The outcome is between 8 and 12, inclusive.

13.

k	$\Pr(X^2 = k)$
0	0.1
1	0.2
4	0.4
9	0.1
16	0.2

14.

k	$\Pr(Y^2 = k)$
25	0.3
100	0.4
225	0.1
400	0.1
625	0.1

15.

k	$\Pr(X - 1 = k)$
–1	0.1
0	0.2
1	0.4
2	0.1
3	0.2

16.

k	$\Pr(Y - 15 = k)$
–10	0.3
–5	0.4
0	0.1
5	0.1
10	0.1

17.

k	$\Pr\left(\frac{1}{5}Y = k\right)$
1	0.3
2	0.4
3	0.1
4	0.1
5	0.1

18.

$2X^2 = k$	$\Pr(2X^2 = k)$
$2(0)^2 = 0$	0.1
$2(1)^2 = 2$	0.2
$2(2)^2 = 8$	0.4
$2(3)^2 = 18$	0.1
$2(4)^2 = 32$	0.2

19.

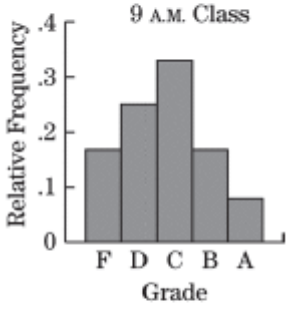
$(X+1)^2 = k$	$\Pr((X+1)^2 = k)$
$(0+1)^2 = 1$	0.1
$(1+1)^2 = 4$	0.2
$(2+1)^2 = 9$	0.4
$(3+1)^2 = 16$	0.1
$(4+1)^2 = 25$	0.2

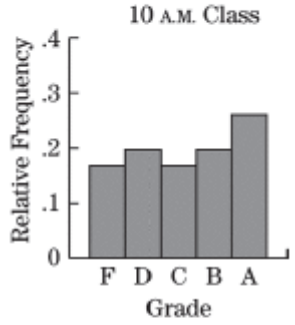
20.

$\left(\frac{1}{5}Y+1\right)^2 = k$	$\Pr\left(\left(\frac{1}{5}Y+1\right)^2 = k\right)$
$\left(\frac{1}{5}\cdot 5+1\right)^2 = 4$	0.3
$\left(\frac{1}{5}\cdot 10+1\right)^2 = 9$	0.4
$\left(\frac{1}{5}\cdot 15+1\right)^2 = 16$	0.1
$\left(\frac{1}{5}\cdot 20+1\right)^2 = 25$	0.1
$\left(\frac{1}{5}\cdot 25+1\right)^2 = 36$	0.1

21.

	Relative Frequency	
Grade	9 A.M. class	10 A.M. class
F	$\frac{10}{60} \approx 0.17$	$\frac{17}{100} = 0.17$
D	$\frac{15}{60} = 0.25$	$\frac{20}{100} = 0.20$
C	$\frac{20}{60} \approx 0.33$	$\frac{17}{100} = 0.17$
B	$\frac{10}{60} \approx 0.17$	$\frac{20}{100} = 0.20$
A	$\frac{5}{60} \approx 0.08$	$\frac{26}{100} = 0.26$





The 9 A.M. class has the distribution centered on the C grade with relatively few A's. The 10A.M. class has a large percentage of A's and D's with fewer C's.

22. **a.** percentage with C or less (9 A.M.):

$$\left(\frac{20+15+10}{60}\right)\times 100\% = 75\%$$

b. percentage with C or less (10 A.M.):

$$\left(\frac{17+20+17}{100}\right)\times 100\% = 54\%$$

c. percentage with D or F (9 A.M.):

$$\left(\frac{15+10}{60}\right)\times 100\% \approx 41.7\%$$

d. percentage with C or more (both classes):

$$\left(\frac{20+10+5+17+20+26}{60+100}\right)\times 100\% = 61.25\%$$

23. percentage with C or higher:

$$\left(\frac{8+6+5}{25}\right)\times 100\% = 76\%$$

24. percentage of time waiting line has 4 or more cars:

$$\left(\frac{12+3}{60}\right)\times 100\% = 25\%$$

25. a. less than 22: 3 + 3 = 6
more than 27: 6 + 3 = 9
combined: $\left(\frac{6+9}{60}\right)\times 100\% = 25\%$

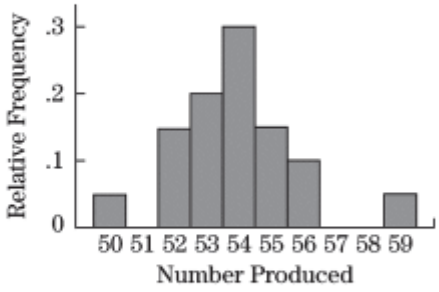
b. between 23 and 25:

$$\left(\frac{6+18+12}{60}\right)\times 100\% = 60\%$$

26. a. $\left(\frac{6+4+2}{40}\right)\times 100\% = 30\%$

b. $\left(\frac{8+12+6}{40}\right)\times 100\% = 65\%$

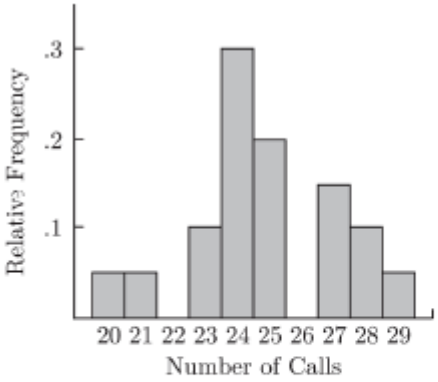
c.



d. 59

e. Estimate an average of 54 items produced

c.



d. Estimated average number of calls would be 24 since that number has the highest frequency of occurrence.
It is actually ≈ 25.

27. a. $\Pr(U=4)=1-\left(\frac{4}{15}+\frac{2}{15}+\frac{4}{15}+\frac{3}{15}\right)$

$=1-\frac{13}{15}$

$=\frac{2}{15}$

b. $\Pr(U\geq 2)=\Pr(U=2)+\Pr(U=3)+\Pr(U=4)$

$=\frac{4}{15}+\frac{3}{15}+\frac{2}{15}$

$=\frac{9}{15}$

$=\frac{3}{5}$

c. $\Pr(U\leq 3)=1-\Pr(U=4)$

$=1-\frac{2}{15}$

$=\frac{13}{15}$

d.

$U+2=K$	$\Pr(U+2=K)$
$0+2=2$	$\frac{4}{15}$
$1+2=3$	$\frac{2}{15}$
$2+2=4$	$\frac{4}{15}$
$3+2=5$	$\frac{3}{15}$
$4+2=6$	$\frac{2}{15}$

$\Pr(U+2<4)$

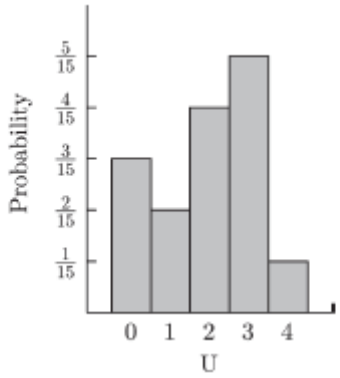
$=\Pr(U+2=2)+\Pr(U+2=3)$

$=\frac{4}{15}+\frac{2}{15}$

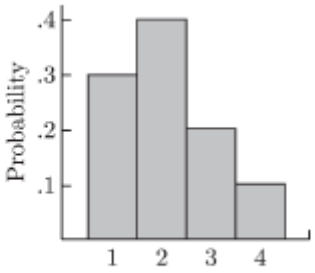
$=\frac{6}{15}$

$=\frac{2}{5}$

e.



28. a.



b. $\Pr(X = 2) + \Pr(X = 3) = 0.40 + 0.20 = 0.60$

c. $\Pr(X \geq 2) = \Pr(X = 2) + \Pr(X = 3) + \Pr(X = 4) = 0.40 + 0.20 + 0.10 = 0.70$

d.

$X + 2 = k$	$\Pr(X + 3 = k)$
$1 + 2 = 3$	0.30
$2 + 2 = 4$	0.40
$3 + 2 = 5$	0.20
$4 + 2 = 6$	0.10

$\Pr(X + 2 \geq 5) = \Pr(X + 2 = 5) + \Pr(X + 2 = 6) = 0.20 + 0.10 = 0.30$

e.

$2X = k$	$\Pr(2X = k)$
$2(1) = 2$	0.30
$2(2) = 4$	0.40
$2(3) = 6$	0.20
$2(4) = 8$	0.10