1. 
   a. Histogram
   b. Scatter diagram
   c. Side-by-side box plots
   d. Time series graph
   e. Side-by-side box plots

2. Perhaps the correlation runs in the other direction, in that people with healthy hearts are more likely to marry and stay married. [Ginger Adams Otis, “Married people have less heart problems than those who are single, divorced: study,” Daily News, March 28, 2014.]

3. Multiplying all the values by two doubles the values of the minimum, maximum, first quartile, median, and third quartile:

4. The bar widths should reflect the income interval widths; e.g. the width of the $15,000 - $24,999 bar should be twice the width of the $10,000 - $14,999 bar. The middle class is defined here as the middle three intervals of nine arbitrary intervals, leaving 11% with lower incomes and 45% with higher incomes. If the middle class was instead defined as $25,000 to $74,999, it would be the middle 50%, with 25% having higher incomes and 25% lower incomes.

5. The probability that any hand will contain the same 5 cards as the previous hand (not necessarily in order) is

\[
\frac{5 \ 4 \ 3 \ 2 \ 1}{52 \ 51 \ 50 \ 49 \ 48}
\]

In 1,000 hands, there are 999 opportunities for a repeat hand. The probability of 999 no-repeats is

\[
\left(1 - \frac{5 \ 4 \ 3 \ 2 \ 1}{52 \ 51 \ 50 \ 49 \ 48}\right)^{999}
\]

The probability of at least one repeat is one minus this:

\[
1 - \left(1 - \frac{5 \ 4 \ 3 \ 2 \ 1}{52 \ 51 \ 50 \ 49 \ 48}\right)^{999} = 0.00038431
\]

6. This is the fallacious law of averages. Perhaps Buffett has lost his Midas touch. [Eric Chemi, “Is Warren Buffett Approaching an All-Time Losing Streak?,” Bloomberg Businessweek, October 16, 2013.]
7. This is a Bayesian problem using binomial probabilities. The order in which the tests are taken doesn’t matter because the test results are independent. Bayes’ rule is

\[
P[M \text{ if 1 of 2 positive}] = \frac{P[M]P[\text{1 of 2 positive if } M]}{P[M]P[\text{1 of 2 positive if } M] + P[B]P[\text{1 of 2 positive if } B]} = \frac{0.01P[\text{1 of 2 positive if } M]}{0.01P[\text{1 of 2 positive if } M] + 0.99P[\text{1 of 2 positive if } B]}
\]

where

\[
P[\text{1 of 2 positive if } M] = \binom{2}{1} \cdot 0.8 \cdot 0.2 = 0.32
\]

\[
P[\text{1 of 2 positive if } B] = \binom{2}{1} \cdot 0.1 \cdot 0.9 = 0.18
\]

The numerical answer is

\[
P[M \text{ if 1 of 2 positive}] = \frac{0.01(0.32)}{0.01(0.32) + 0.99(0.18)} = 0.0176
\]

This problem can also be answer in two steps. The first test, with the positive mammogram result, implies

\[
P[M \text{ if positive}] = \frac{P[M]P[\text{positive if } M]}{P[M]P[\text{positive if } M] + P[B]P[\text{positive if } B]} = \frac{0.01(0.8)}{0.01(0.8) + 0.99(0.1)} = \frac{8}{107} = 0.075
\]

For the second step, the prior probability, before the negative test result, that the lump is malignant is 8/107, not 0.01.

\[
P[M \text{ if negative}] = \frac{P[M]P[\text{negative if } M]}{P[M]P[\text{negative if } M] + P[B]P[\text{negative if } B]} = \frac{8}{107}(0.2) \div \left[ \frac{8}{107}(0.2) + \frac{99}{107}(0.9) \right] = \frac{16}{907} = 0.0176
\]

Bayes’ Rule is internally consistent, in that the answer is the same whether we consider the two tests together or analyze them one after the other.

This problem can also be solved using a contingency table.

8. The player has to get either: (a) 9 points on the first card and an Ace on the second card; (b) 10 points on the first card and an Ace or 10 points on the second card; or (b) an Ace on the first card and 9 or 10 points on
the second card. So, the probability is
\[ \frac{4}{52} \cdot \frac{4}{51} + \frac{16(4+15)}{52} \cdot \frac{4}{51} = 0.15083 \]

9. The probabilities are

<table>
<thead>
<tr>
<th>number of dice</th>
<th>probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(5/6)(5/6)(5/6) = 0.5787</td>
</tr>
<tr>
<td>1</td>
<td>3(1/6)(5/6)(5/6) = 0.3472</td>
</tr>
<tr>
<td>2</td>
<td>3(1/6)(1/6)(5/6) = 0.0694</td>
</tr>
<tr>
<td>3</td>
<td>(1/6)(1/6)(1/6) = 0.0046</td>
</tr>
</tbody>
</table>

The expected value of the payoff is about an 8 percent loss per dollar wagered:
\[ 0(0.5787) + 2(0.3472) + 3(0.0694) + 4(0.0046) = 0.921 \]

10. There is self-selection bias here in that the people who choose to get higher degrees may have more aptitude and desire for work, particularly higher paying jobs [Nicole Allan and Derek Thompson, The Myth of the Student-Loan Crisis, *The Atlantic*, March 2013. Michael, DegreeCouncil.org, April 18, 2014. http://degreecouncil.org/2014/is-more-education-better/]