1. (a) \( W_0 = 7,300, \ell = 7,300 - 2,500 = 4,800 \). Since the slope of an isoprofit line is \(-\frac{p}{1-p}\)
we must solve \(-\frac{p}{1-p} = -\frac{1}{4}\), that is, \(4p = 1 - p\), which gives \( p = \frac{1}{5} = 0.2 \).

(b) \( NI = \left( \frac{7,300}{\frac{4}{5}}, \frac{2,500}{\frac{1}{5}} \right) \) so that \( E[NI] = \frac{4}{5}7,300 + \frac{1}{5}2,500 = 6,340 \).

(c) Since the isoprofit line that goes through \( NI \) is the zero-profit line, \( \pi(C) = 0 \).

(d) Starting from \( NI \), if you reduce the horizontal coordinate to 0 (that is, by 2,500) then the
vertical coordinate must be increased by \( \frac{1}{4}2,500 = 625 \) and thus to
\( 7,300 + 625 = 7,925 \) (giving the vertical intercept). Thus the equation of the line is
\( W_2 = 7,925 - \frac{1}{4}W_1 \).

(e) Since point \( C \) is on the 45° line, its coordinates must be equal: \( W_1^C = W_2^C \). Using this fact in
the equation we write \( W_1^C = 7,925 - \frac{1}{4}W_1^C \) and solve for \( W_1^C \) to get \( W_1^C = 6,340 \). Hence
\( C = (6340, 6340) \). The premium of contract \( C \) is \( 7,300 - 6,340 = 960 \) and the deductible is
0 (it is a full-insurance contract). Alternatively, since \( \pi(C) = 0 \) and \( C \) is a full-insurance
contract, then the premium must be equal to the expected loss \( p\ell = \frac{1}{5}4,800 = 960 \).

(f) \( h_A = 7,300 - 6,500 = 800, D_A = 6,500 - 5,500 = 1,000 \).

(g) Since \( B \) is on the isoprofit line that goes through \( A \), \( \pi(B) = \pi(A) \). Now, using (f),
\[ \pi(A) = h_A - p(\ell - D_A) = 800 - \frac{1}{5}(4,800 - 1,000) = 40. \]

(h) Starting from \( A \) if the horizontal co-ordinate is reduced to 0 (thus by 5,500) then the
vertical coordinate must be increased by \( \frac{1}{4}5,500 = 1,375 \) to 6,500 + 1,375 = 7,875 (this is
the vertical intercept). Thus the equation is \( W_2 = 7,875 - \frac{1}{4}W_1 \).

(i) Since point \( B \) is on the 45° line, its coordinates must be equal: \( W_1^B = W_2^B \); thus from
\( W_1^B = 7,875 - \frac{1}{4}W_1^B \) solve for \( W_1^B \) to get \( W_1^B = 6,300 \). Hence \( B = (6300, 6300) \). Thus the
premium of contract \( B \) is \( 7,300 - 6,300 = 1,000 \) and the deductible is 0. Alternatively, since
\( B \) is a full-insurance contract, the profit from contract \( B \) is \( h_B - p\ell \) and by (g) this is equal
to 40; thus solving \( h_B = \frac{1}{5}4,800 = 40 \) we get \( h_B = 1,000 \).

(j) \( A = \left( \frac{5,500}{\frac{4}{5}}, \frac{6,500}{\frac{1}{5}} \right), B = \left( \frac{6,300}{\frac{4}{5}}, \frac{6,300}{1} \right) \). \( E[A] = \frac{4}{5}6,500 + \frac{1}{5}5,500 = 6,300 = E[B] \).

(k) No Insurance and contract \( C \) have the same expected value, namely 6,340.

(l) \( B \) gives the expected value of \( A \) for sure.

(m) She prefers $6,300 for sure to \( NI \), whose expected value is $6,340. Since more money is
better than less, $6,340 is better than $6,300. Hence she must prefer $6,340 to \( NI \) and thus
is risk averse.
2. (a) Her normalized utility function is \( z_1 + z_2 z_3 \) with \( 0 < a < 1 \). The expected utility of lottery \( O \) is \( \frac{96}{100} \) while the expected utility of \( N \) is \( a \). Hence, if she decides to have the operation, it must be that \( a < \frac{96}{100} \).

(b) This is a meaningless question, since the notion of risk aversion applies only to money lotteries and the two lotteries \( O \) and \( N \) are not money lotteries. Thus the answer is "we cannot tell".

(c) \( 1 2 3 4 5 \): No insurance, operation, success \( ($9,000, H) \)

\( 1 2 3 4 5 \): No insurance, no operation \( ($9,000, P) \)

(d) \( O \) and \( N \) are as before: \( O = \left( \frac{z_1}{96} \frac{z_3}{100} \right) \), \( N = \left( \frac{z_2}{4} \right) \). \( I = \left( \frac{z_4}{96} \frac{z_5}{100} \right) \).

(e) We don’t know how she ranks \( O \) versus \( N \) (because we don’t know whether \( U(z_2) \) is greater than, less than, or equal to, \( \frac{96}{100} \)). However, from her ranking we know that \( U(z_4) > U(z_2) \) and thus the expected utility of \( I \) is certainly higher than the expected utility of \( N \). Hence she will have the operation; what we don’t know is whether she will also buy insurance, because we don’t know how she ranks \( I \) versus \( O \).

(f) Her answer means that she prefers \( I \) to \( O \). As in part (a), \( U(z_1) = 1 \) and \( U(z_3) = 0 \) so that \( \mathbb{E}[U(O)] = \frac{96}{100} \). On the other hand, \( \mathbb{E}[U(I)] = \frac{96}{100} U(z_4) + \frac{4}{100} U(z_5) \). Thus it must be that \( \frac{96}{100} U(z_4) + \frac{4}{100} U(z_5) > \frac{96}{100} \), that is, \( 24 U(z_4) + U(z_5) > 24 \).

(g) From \( \left( \frac{z_3}{0.08} \frac{z_1}{0.92} \right) \sim z_5 \) we get \( U(z_5) = 0.92 \) and from \( \left( \frac{z_5}{\frac{3}{8}} \frac{z_1}{\frac{5}{8}} \right) \sim z_4 \) we get \( U(z_4) = \frac{5}{8} 0.92 + \frac{3}{8} 1 = 0.97 \). Thus \( \mathbb{E}[U(I)] = \frac{96}{100} 0.97 + \frac{4}{100} 0.92 = 0.968 > 0.96 = \mathbb{E}[U(O)] \). Hence her answer is indeed consistent.

(h) It follows from the above that Amy will buy insurance and have the operation (since \( I \succ O \) and \( I \succ N \)).

3. First of all, note that \( \mathbb{E}[L] = \mathbb{E}[M] = 250 \).

(a) Ann prefers \( M \) to $258 for sure and she prefers $258 to $250. Thus, by transitivity, she must prefer \( M \) to $250, that is, \( M \) to \( \mathbb{E}[M] \) for sure. Hence she is risk loving.

(b) Bruno prefers $245 for sure to \( L \) and prefers $250 to $245. Thus, by transitivity, he must prefer $250 to \( L \), that is, \( \mathbb{E}[L] \) for sure to \( L \). Hence he is risk averse.

(c) All we can say for sure is that Charlie is not risk neutral, because a risk-neutral person would be indifferent between \( L \) and \( M \).