1. Mary knows that, given her family history, she is threatened by a rather debilitating disease. Her normal disposable income when she works is $60,000. With probability 0.2 she may catch the disease, in which case she will be able to work only half the year, and will have to incur medical expenses, so that her disposable income will be reduced to $20,000 (hence her loss of disposable income is $40,000). Suppose that Mary can buy insurance from a not-for-profit company which is willing to offer any fair (= zero-profit) contract and lets her choose the deductible D. Let \( W_1 \) denote her wealth if she has the disease (the “bad state”) and \( W_2 \) her wealth if she does not have the disease (the “good state”). Find the values of \( W_1 \) and \( W_2 \) in the following cases:

(a) She takes no insurance.

(b) \( D = \$30,000 \).

(c) \( D = \$20,000 \).

(d) She takes full insurance

(e) If she wants to increase her wealth by \$1,000 in the case where she gets the disease, how much does she need to reduce her income in the case where she does not get the disease?

(f) (f.1) Represent the set of zero-profit contracts in a graph where you measure \( W_1 \) on the horizontal axis. \textit{Give the coordinates of two points on that line.}

(f.2) What is the slope of the line?

(g) (g.1) Suppose that Mary has the von Neumann-Morgenstern utility-of-money function \( U(m) = \ln(m) \). Sketch some of her indifference curves in the \((W_1, W_2)\) plane, measuring \( W_1 \) on the horizontal axis.

(g.2) What is the slope of her indifference curve that goes through the no insurance point at the no insurance point?

(g.3) What is the slope of the indifference curve that goes through the full insurance point on the line of part (f.1) (that is, the zero-profit line)?

(h) In the graph of part (f.1) represent Mary’s optimal choice using indifference curves.

(i) By how much does the availability of insurance increase her utility?

2. Consider the following money lotteries: \( L = \begin{pmatrix} \frac{24}{12} & \frac{60}{12} & \frac{120}{12} \end{pmatrix} \) and \( M = \begin{pmatrix} \frac{24}{12} & \frac{30}{12} & \frac{60}{12} & \frac{80}{12} & \frac{120}{12} \end{pmatrix} \). Lottery \( M \) is a mean-preserving spread of lottery \( L \). What are the values of \( p \) and \( q \)?