1. (2 points) The real interest rate is the difference between the nominal interest rate and the inflation rate. The nominal interest rate is 11 percent, but we need to solve for the inflation rate. We do this with the quantity equation expressed in percentage-change form:

\[ \text{%Change in } M + \text{%Change in } V = \text{%Change in } P + \text{%Change in } Y. \]

Rearranging this equation tells us that the inflation rate is given by:

\[
\begin{align*}
\text{%Change in } P &= \text{%Change in } M + \text{%Change in } V - \text{%Change in } Y. \\
&= 14\% + 0\% - 5\% \\
&= 9\%.
\end{align*}
\]

Thus, the real interest rate is 2 percent: the nominal interest rate of 11 percent minus the inflation rate of 9 percent.

2. (3 points, each subquestion one point) The money demand function is given as

\[ \left( \frac{M}{P} \right)_d = kY \]

a. To find the average inflation rate the money demand function can be expressed in terms of growth rates:

\[ \text{%growth } M_d - \text{%growth } P = \text{%growth } Y. \]

The parameter k is a constant, so it can be ignored. The percentage change in nominal money demand \( M_d \) is the same as the growth in the money supply because nominal money demand has to equal nominal money supply. If nominal money demand grows 12 percent and real income \( (Y) \) grows 4 percent then the growth of the price level is 8 percent.
b. From the answer to part (a), it follows that an increase in real income growth will result in a lower average inflation rate. For example, if real income grows at 6 percent and money supply growth remains at 12 percent, then inflation falls to 6 percent. In this case, a larger money supply is required to support a higher level of GDP, resulting in lower inflation.

c. If velocity growth is positive, then all else the same inflation will be higher. From the quantity equation we know that:

\[\text{% growth } M + \text{% growth } V = \text{% growth } P + \text{% growth } Y.\]

Suppose that the money supply grows by 12 percent and real income grows by 4 percent. When velocity growth is zero, inflation is 8 percent. Suppose now that velocity grows 2 percent: this will cause prices to grow by 10 percent. Inflation increases because the same quantity of money is being used more often to chase the same amount of goods. In this case, the money supply should grow more slowly to compensate for the positive growth in velocity.

3. (6 points, each subquestion 1 point) a. The demand for labor is determined by the amount of labor that a profit-maximizing firm wants to hire at a given real wage. The profit-maximizing condition is that the firm hire labor until the marginal product of labor equals the real wage, 

\[MPL = \frac{W}{P}\]

The marginal product of labor is (see Chapter 3 for more discussion),

\[MPL = \frac{2}{3} \frac{Y}{L} = \frac{3}{3} \frac{K}{L^{\frac{1}{3}}} L^{\frac{1}{3}}\]

In order to solve for labor demand, we set the MPL equal to the real wage and solve for L:

\[\frac{2}{3} K^{\frac{1}{3}} L^{-\frac{1}{3}} = \frac{W}{P}\]

\[L = \frac{8}{27} K \left(\frac{W}{P}\right)^{-3}.\]

Notice that this expression has the intuitively desirable feature that increases in the real wage reduce the demand for labor.

b. We assume that the 1,000 units of capital and the 1,000 units of labor are supplied inelastically (i.e., they will work at any price). In this case
we know that all 1,000 units of each will be used in equilibrium, so we can substitute them into the above labor demand function and solve for $\frac{W}{P}$

$$1000 = \frac{8}{27}1000 \left( \frac{W}{P} \right)^{-3}$$

$$\frac{W}{P} = \frac{2}{3}$$

In equilibrium, employment will be 1,000, and multiplying this by 2/3 we find that the workers earn 667 units of output. The total output is given by the production function:

$$Y = K^{\frac{1}{3}}L^{\frac{2}{3}}$$

$$= 100$$

Notice that workers get two-thirds of output, which is consistent with what we know about the Cobb-Douglas production function from Chapter 3.

c. The congressionally mandated wage of 1 unit of output is above the equilibrium wage of 2/3 units of output.

d. Firms will use their labor demand function to decide how many workers to hire at the given real wage of 1 and capital stock of 1,000:

$$L = \frac{8}{27}1000 (1)^{-3}$$

$$= \frac{296}{296}$$

so 296 workers will be hired for a total compensation of 296 units of output. To find the new level of output, plug the new value for labor and the value for capital into the production function and you will find $Y = 444$.

e. The policy redistributes output from the 704 workers who become involuntarily unemployed to the 296 workers who get paid more than before. The lucky workers benefit less than the losers lose as the total compensation to the working class falls from 667 to 296 units of output.

f. This problem does focus the analysis of minimum-wage laws on the two effects of these laws: they raise the wage for some workers while downward-sloping labor demand reduces the total number of jobs. Note, however, that if labor demand is less elastic than in this example, then the loss of employment may be smaller, and the change in worker income might be positive.
4. (3 points, each subquestion 1 point)  

a. The labor demand curve is given by the marginal product of labor schedule faced by firms. If a country experiences a reduction in productivity, then the labor demand curve shifts to the left. If labor becomes less productive, then at any given real wage, firms demand less labor.

b. If the labor market is always in equilibrium, then, assuming a fixed labor supply, an adverse productivity shock causes a decrease in the real wage but has no effect on employment or unemployment.

c. If unions constrain real wages to remain unaltered, then employment falls to $L_1$ and unemployment equals $L - L_1$. This example shows that the effect of a productivity shock on an economy depends on the role of unions and the response of collective bargaining to such a change.

5. (1 points) From the main NBER web page (www.nber.org), I followed the link to Business Cycle Dates As of this writing, the latest recession starts in December 2007, when the economy switched from expansion to contraction, and ends in June 2009.

Previous recessions (contractions) over the past two decades were March 2001 to November 2001; July 1990 to March 1991.