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Midterm Examination — Spring 2011
Econ 505 — Page Total = 3

1. Short Answer: 15 points each

DO ALL QUESTIONS. ALL QUESTIONS ARE EQUALLY WEIGHTED.

SA1. Consider the following Python code. Explain what algorithm this code implements: what is it doing and how? Be *very* specific and detailed. Then provide a careful comment for each line of code, explaining that line does and how it contributes to the overall algorithm. Illustrate the production of the result step by step for a simple example of your choosing.

```python
def mysteryfn(f, S):
    S = set(S)
    xkeep = S.pop()
    fkeep = f(xkeep)
    for x in S:
        ftest = f(x)
        if ftest > fkeep:
            xkeep, fkeep = x, ftest
    return xkeep
```

SA2. Suppose you seize a business opportunity on campus and start selling potato salad at lunch. Suppose the quantity demanded (in pounds) is a function of the price you charge, as represented by the equation

$$Q = 1350 - 50P$$

What is the price elasticity of demand that you face (at each price).

What is the inverse demand curve? What is total revenue (as a function of quantity produced)? What is marginal revenue (as a function of quantity produced)? At what quantity does marginal revenue become zero? (Explain. Feel free to use top-heavy fractions in your answers.) Would a producer ever supply beyond that quantity? (Explain.)

Suppose your cost of production is $C(Q) = 50 + Q^2/2$. What is marginal cost? What is the economic interpretation of marginal cost?

Suppose that you want to produce where marginal revenue equals marginal cost. What quantity do you produce? (You may express your answer as an improper fraction.) Can you see any reason to find it desirable to produce this quantity?

SA3. Consider the two structural equations:

$$\begin{aligned} Y &= A(Y, i - \pi, F) \\ m &= L(i, Y) \end{aligned} \tag{1}$$

Here Y is aggregate income, F is the "fiscal stance", i is the interest rate, π is expected inflation, and m is the real money supply. In addition, A is the aggregate demand function with $A_r < 0$, $0 < A_Y < 1$, $A_F > 0$, and L is the money demand function with $L_i < 0$, $L_Y > 0$.

Following the procedure developed in class, totally differentiate the structural equations, and then give an intuitive *interpretation* of each of the resulting equations. (Be very explicit; this will require about one paragraph per equation.)

Set up the matrix equality representing this system of equations when this is the structure of a "Keynesian" model. (That is, when the endogenous variables are Y and i). Produce a "reduced form" matrix solution for this model. Find the response (partial derivative) of each endogenous variable to a change in F. Comment on whether it is possible to determine the qualitiative effect (i.e., the sign of the response) of an increase in F.

2. Very Short Answers: 10 points each

DO ALL OF THE FOLLOWING QUESTIONS. ALL QUESTIONS ARE EQUALLY WEIGHTED. (Please clearly label your answers with the question number.) When notation is important to your answer, state precisely what your notation means. Some questions are "multiple choice;" please clearly indicate your choice from the offered alternatives.

VSA1. Consider the function defined by the rule $f(x) = x^2/2$. Calculate the difference quotient for this function. What happens to the difference quotient as h approaches 0? Write the difference quotient at $x = 1$ as a function of h, where h is the distance from 1. What would you say is the slope of f at $x = 1$? Explain.

VSA2. Find the first, second, third, and fourth-order derivatives of the following functions.

$$f(x) = 5x^4 + 4x^3 + 3x^2 + 2x + 1 \qquad f(x) = e^{2x} \qquad f(x) = \ln x \qquad f(x) = \log_{10} x$$

If the derivative has an unambiguous sign, state it.

VSA3. Define the "internal rate of return". Suppose an initial investment of \$40 yields two years of cash flows: \$25 and then \$25. Determine the internal rate of return of this project, using the quadratic formula to do so. Explain each step of your calculation, being explicit about an economic reasoning.

VSA4. Let $f(x) = 5x^2 + 2x + 10$. Find the differential approximation to the change in the value of f when x rises from 1 to 2.

3. Definitions: 6 points each

DO ALL OF THE FOLLOWING QUESTIONS. ALL QUESTIONS ARE EQUALLY WEIGHTED.

Whenever possible, offer *all three* of the following: a verbal defintion *and* a mathematical definition *and* an illustrative example. (An example is not a definition!) Be sure to show clearly how your example fits the definition. (Often this requires an algebraic demonstartion.)

Def 1. convex combination

Def 2. convex function

Def 3. Jensen's inequality

Def 4. difference quotient (of a function $f : \Re \to \Re$).

Def 5. derivative (of a function $f : \Re \to \Re$)

Def 6. inflection point (of a function $f : \Re \to \Re$)

4. Multiple Choice: 6 points each

DO ALL OF THE FOLLOWING QUESTIONS. ALL QUESTIONS ARE EQUALLY WEIGHTED.

(Multiple choice questions do *not* require any explanation, but give one if you think it will clarify your choice.)

MC 1. Suppose $b > 1$ is a constant. Define a function $f(x) = b^x$ on a domain of all real numbers. Then if we graph this function

(a) $b^x > 0$ always.

(b) the function has a positive slope.

(c) the function has an increasing slope.

(d) a. and c.

(e) all of the above

MC 2. Consider the **Python** statement

```
for i in range(5):
    print i+1
```

This statement will cause the interpreter to

(a) sequentially print the numbers from 0 to 4

(b) sequentially print the numbers from 1 to 5

(c) sequentially print the numbers from 2 to 6

(d) randomly print numbers drawn from the range from 1 to 5

(e) exit with an error message.

MC 3. After an `import numpy as np` statement, the **NumPy** statement `x = np.mat('2 4;6 8')`

(a) assigns a 4×1 matrix to the variable x.

(b) assigns a 1×4 matrix to the vector x.

(c) assigns a 2×2 matrix to the variable x.

(d) tests whether x is equal to an array of numbers.

(e) is not "legal".

MC 4. A *linear combination* of points is

(a) any weighted sum of points.

(b) any *finite* weighted sum of points.

(c) a *finite* weighted sum of points, with positive weights.

(d) a *finite* weighted sum of points, with positive weights that sum to one.

(e) all of the above

MC 5. If $h(x) = f(g(x))$ where $g(x) = (x+1)^2$ and $f(y) = y^2$ then $h'(x) =$

(a) $4(x+1)^3$

(b) $f'(g(x)) \cdot g'(x)$

(c) $f'(x) \cdot g'(x)$

(d) a. and b.

(e) all of the above