Econ 301
Intermediate Microeconomics
Prof. Marek Weretka

Midterm 1 (A)

You have 70 minutes to complete the exam. The midterm consists of 4 questions (55+15+15+15=100 points) + bonus (just for fun). Make sure you answer the first four questions before working on the bonus one!

Problem 1 (55p) (Well-behaved preferences)

Ava is a big fun of delicious gourmet steaks: their robust and hearty beef flavors is what she likes the most. Her two most favorite steaks are marinated ribeye (x_1) and top sirloin (x_2).

a) The price of a marinated ribeye steak is $p_1 = \$50$, the price of top sirloin is $p_2 = \$25$, and her income (spent entirely on steaks) is $m = \$500$. Show geometrically Ava's budget constraint. Mark the two extreme consumption bundles (give concrete values). Show on the graph how her budget set would be affected by inflation that increased the prices of both steaks by 100%, leaving m unchanged (draw a new budget line).

b) Ava's utility function over both types of steaks is $U(x_1, x_2) = x_1^5 x_2^5$. Find her marginal rate of substitution (MRS) for any bundle (x_1, x_2) (give a formula for MRS). What is the value of MRS at bundle $(2, 4)$ (one number)? Which of the two steak types is more valuable to Ava?

d) Write down two secrets of happiness, assuming that p_1, p_2, m are parameters (two equations).

- Provide economic intuition behind the two conditions (two sentences for each).

- Derive optimal consumption of x_1 and x_2 as a function of p_1, p_2, m (show the derivation of magic formulas).

- Using magic formulas determine whether the solution is interior for all values of p_1, p_2, m (one sentence).

- What fraction of total income is spent on top sirloin?

e) Find the optimal consumption levels of two types of steak (x_1, x_2) for:

- $p_1 = \$50, p_2 = \$25$ and $m = \$500$ (give two numbers).

and after the price of ribeye decreased:

- for $p_1 = \$25, p_2 = \$25$ and $m = \$500$ (give two numbers).

What is the total change in consumption of marinated ribeye? (give a number). Illustrate the change on the graph. Is marinated ribeye an ordinary of a Giffen good? (Chose one + one sentence explaining why.)

f) Decompose the total change in consumption of x_1 from e) into a substitution and income effect. (Calculate the two numbers and show how can you find the effect on the graph.)

Problem 2 (15p) (Perfect complements)

Alex is a hotdog lover. In each hotdog bun (x_1) Alex always inserts two hotdogs (x_2): he hates hotdogs with ratios of buns to hotdogs different from 1:2.

a) Propose a utility function that captures Alex's preferences over (x_1) and (x_2) (function $U(x_1, x_2)$).

b) In the commodity space, carefully depict Alex's indifference curves (marking the optimal proportion line).

c) Assume prices $p_1 = 4$ and $p_2 = 3$ and income $m = 40$. Write down two secrets of happiness (two equations) and determine the optimal choice (two numbers). Is your solution interior (yes or no)?

d) Suppose price of a hotdog bun goes down to $p_1 = 2$, while price $p_2 = 3$ income $m = 40$ are unchanged. Find optimal choice (two numbers). Without calculations, how much of this change can be attributed to a substitution effect (number + one sentence explaining the number).

Problem 3 (15p) (Perfect substitutes)

Pepsi x_1 and Coke x_2 both are goods that are indistinguishable.

a) Propose a utility function (the "craziest" function you can imagine), which captures preferences for such perfect substitutes.

b) Plot the budget line, assuming $p_1 = \$2$, $p_2 = \$3$ and $m = \$12$. In the same graph plot indifference curves.

c) Find the optimal bundle for $U(x_1, x_2) = x_1 + x_2$. (give two numbers). Is your solution interior or corner? (one sentence)

d) Plot income offer curve and Engel curve given fixed prices $p_1 = \$2, p_2 = \$3$. (two graphs). Is Pepsi normal or inferior (choose one + one sentence)

Problem 4 (15p) (Quasilinear Preferences, Labor Supply)

Your best friend Aiden asked you to help him to determine how much time he should spend at work. His total available time (each day) is 24h and his only source of income is labor income given wage rate $w = \$10$. His spending on consumption good C is equal to what he earns. The price of such good is $p_c = 2$

a) What is his real wage rate? (number+interpretation, one sentence)

b) Plot his budget set on the graph.

c) Aiden has quasilinear utility function $U(R, C) = \ln R + C$ where R is leisure (or relaxation time) and C is consumption of other goods. Write down two secrets of happiness that determine optimal choice of R, C for arbitrary w, p_c. Find optimal R as a function w, p_c (you can assume interior solution).

d) What is Aiden's labor supply L if $w = \$1$ and $p_c = \$10$ (one number). How about $w = \$2$ and $p_c = \$10$ (one number). Is labor supply increasing in real wage rate, when preferences are quasilinear? (yes no answer)

Bonus question (Just for fun)

Let MRS^V and MRS^U be marginal rates of substitution of utility functions $V(x_1, x_2)$ and $U(x_1, x_2)$ respectively. Moreover, assume that $V(x_1, x_2) = f[U(x_1, x_2)]$ where $f[\cdot]$ is a strictly monotone transformation. Show that $MRS^V = MRS^U$. (Hint: Use formula for the derivative of a composite function)

Econ 301
Intermediate Microeconomics
Prof. Marek Weretka

Midterm 1 (B)

You have 70 minutes to complete the exam. The midterm consists of 4 questions (55+15+15+15=100 points) + bonus (just for fun). Make sure you answer the first four questions before working on the bonus one!

Problem 1 (55p) (Well-behaved preferences)

Ava is a big fun of delicious gourmet steaks: their robust and hearty beef flavors is what she likes the most. Her two most favorite steaks are marinated ribeye (x_1) and top sirloin (x_2).

a) The price of a marinated ribeye steak is $p_1 = \$10$, the price of top sirloin is $p_2 = \$5$, and her income (spent entirely on steaks) is $m = \$100$. Show geometrically Ava's budget constraint. Mark the two extreme consumption bundles (give concrete values). Show on the graph how her budget set would be affected by inflation that increased the prices of both steaks by 200%, leaving m unchanged (draw a new budget line).

b) Ava's utility function over both types of steaks is $U(x_1, x_2) = x_1^3 x_2^3$. Find her marginal rate of substitution (MRS) for any bundle (x_1, x_2) (give a formula for MRS). What is the value of MRS at bundle $(3, 6)$ (one number)? Which of the two steak types is more valuable to Ava?

d) Write down two secrets of happiness, assuming that p_1, p_2, m are parameters (two equations).

- Provide economic intuition behind the two conditions (two sentences for each).

- Derive optimal consumption of x_1 and x_2 as a function of p_1, p_2, m (show the derivation of magic formulas).

- Using magic formulas determine whether the solution is interior for all values of p_1, p_2, m (one sentence).

- What fraction of total income is spent on top sirloin?

e) Find the optimal consumption levels of two types of steak (x_1, x_2) for:

- $p_1 = \$10, p_2 = \$5$ and $m = \$100$ (give two numbers).

and after the price of ribeye decreased:

- for $p_1 = \$5, p_2 = \$5$ and $m = \$100$ (give two numbers).

What is the total change in consumption of marinated ribeye? (give a number). Illustrate the change on the graph. Is marinated ribeye an ordinary of a Giffen good? (Chose one + one sentence explaining why.)

f) Decompose the total change in consumption of x_1 from e) into a substitution and income effect. (Calculate the two numbers and show how can you find the effect on the graph.)

Problem 2 (15p) (Perfect complements)

Alex is a hotdog lover. In each hotdog bun (x_1) Alex always inserts three hotdogs (x_2): he hates hotdogs with ratios of buns to hotdogs different from 1:3.

a) Propose a utility function that captures Alex's preferences over (x_1) and (x_2) (function $U(x_1, x_2)$).

b) In the commodity space, carefully depict Alex's indifference curves (marking the optimal proportion line).

c) Assume prices $p_1 = 4$ and $p_2 = 2$ and income $m = 40$. Write down two secrets of happiness (two equations) and determine the optimal choice (two numbers). Is your solution interior (yes or no)?

d) Suppose price of a hotdog bun goes down to $p_1 = 2$, while price $p_2 = 2$ income $m = 40$ are unchanged. Find optimal choice (two numbers). Without calculations, how much of this change can be attributed to a substitution effect (number + one sentence explaining the number).

Problem 3 (15p) (Perfect substitutes)

Pepsi x_1 and Coke x_2 both are goods that are indistinguishable.

a) Propose a utility function (the "craziest" function you can imagine), which captures preferences for such perfect substitutes.

b) Plot the budget line, assuming $p_1 = \$4$, $p_2 = \$2$ and $m = \$12$. In the same graph plot indifference curves.

c) Find the optimal bundle for $U(x_1, x_2) = x_1 + x_2$. (give two numbers). Is your solution interior or corner? (one sentence)

d) Plot income offer curve and Engel curve given fixed prices $p_1 = \$4, p_2 = \$2$. (two graphs). Is Pepsi normal or inferior (choose one + one sentence)

Problem 4 (15p) (Quasilinear Preferences, Labor Supply)

Your best friend Aiden asked you to help him to determine how much time he should spend at work. His total available time (each day) is 24h and his only source of income is labor income given wage rate $w = \$10$. His spending on consumption good C is equal to what he earns. The price of such good is $p_c = 2$

a) What is his real wage rate? (number+interpretation, one sentence)

b) Plot his budget set on the graph.

c) Aiden has quasilinear utility function $U(R, C) = \ln R + C$ where R is leisure (or relaxation time) and C is consumption of other goods. Write down two secrets of happiness that determine optimal choice of R, C for arbitrary w, p_c. Find optimal R as a function w, p_c (you can assume interior solution).

d) What is Aiden's labor supply L if $w = \$1$ and $p_c = \$10$ (one number). How about $w = \$2$ and $p_c = \$10$ (one number). Is labor supply increasing in real wage rate, when preferences are quasilinear? (yes no answer)

Bonus question (Just for fun)

Let MRS^V and MRS^U be marginal rates of substitution of utility functions $V(x_1, x_2)$ and $U(x_1, x_2)$ respectively. Moreover, assume that $V(x_1, x_2) = f[U(x_1, x_2)]$ where $f[\cdot]$ is a strictly monotone transformation. Show that $MRS^V = MRS^U$. (Hint: Use formula for the derivative of a composite function)

Econ 301
Intermediate Microeconomics
Prof. Marek Weretka

Midterm 1 (C)

You have 70 minutes to complete the exam. The midterm consists of 4 questions (55+15+15+15=100 points) + bonus (just for fun). Make sure you answer the first four questions before working on the bonus one!

Problem 1 (55p) (Well-behaved preferences)

Ava is a big fun of delicious gourmet steaks: their robust and hearty beef flavors is what she likes the most. Her two most favorite steaks are marinated ribeye (x_1) and top sirloin (x_2).

a) The price of a marinated ribeye steak is $p_1 = \$10$, the price of top sirloin is $p_2 = \$5$, and her income (spent entirely on steaks) is $m = \$200$. Show geometrically Ava's budget constraint. Mark the two extreme consumption bundles (give concrete values). Show on the graph how her budget set would be affected by inflation that increased the prices of both steaks by 100%, leaving m unchanged (draw a new budget line).

b) Ava's utility function over both types of steaks is $U(x_1, x_2) = x_1^{\frac{1}{2}} x_2^{\frac{1}{2}}$. Find her marginal rate of substitution (MRS) for any bundle (x_1, x_2) (give a formula for MRS). What is the value of MRS at bundle $(3, 6)$ (one number)? Which of the two steak types is more valuable to Ava?

d) Write down two secrets of happiness, assuming that p_1, p_2, m are parameters (two equations).

- Provide economic intuition behind the two conditions (two sentences for each).

- Derive optimal consumption of x_1 and x_2 as a function of p_1, p_2, m (show the derivation of magic formulas).

- Using magic formulas determine whether the solution is interior for all values of p_1, p_2, m (one sentence).

- What fraction of total income is spent on top sirloin?

e) Find the optimal consumption levels of two types of steak (x_1, x_2) for:

- $p_1 = \$10, p_2 = \$5$ and $m = \$200$ (give two numbers).

and after the price of ribeye decreased:

- for $p_1 = \$5, p_2 = \$5$ and $m = \$200$ (give two numbers).

What is the total change in consumption of marinated ribeye? (give a number). Illustrate the change on the graph. Is marinated ribeye an ordinary of a Giffen good? (Chose one + one sentence explaining why.)

f) Decompose the total change in consumption of x_1 from e) into a substitution and income effect. (Calculate the two numbers and show how can you find the effect on the graph.)

Problem 2 (15p) (Perfect complements)

Alex is a hotdog lover. In each hotdog bun (x_1) Alex always inserts four hotdogs (x_2): he hates hotdogs with ratios of buns to hotdogs different from 1:4.

a) Propose a utility function that captures Alex's preferences over (x_1) and (x_2) (function $U(x_1, x_2)$).

b) In the commodity space, carefully depict Alex's indifference curves (marking the optimal proportion line).

c) Assume prices $p_1 = 6$ and $p_2 = 1$ and income $m = 40$. Write down two secrets of happiness (two equations) and determine the optimal choice (two numbers). Is your solution interior (yes or no)?

d) Suppose price of a hotdog bun goes down to $p_1 = 4$, while price $p_2 = 1$ income $m = 40$ are unchanged. Find optimal choice (two numbers). Without calculations, how much of this change can be attributed to a substitution effect (number + one sentence explaining the number).

Problem 3 (15p) (Perfect substitutes)

Pepsi x_1 and Coke x_2 both are goods that are indistinguishable.

a) Propose a utility function (the "craziest" function you can imagine), which captures preferences for such perfect substitutes.

b) Plot the budget line, assuming $p_1 = \$6$, $p_2 = \$2$ and $m = \$12$. In the same graph plot indifference curves.

c) Find the optimal bundle for $U(x_1, x_2) = x_1 + x_2$. (give two numbers). Is your solution interior or corner? (one sentence)

d) Plot income offer curve and Engel curve given fixed prices $p_1 = \$6, p_2 = \$2$. (two graphs). Is Pepsi normal or inferior (choose one + one sentence)

Problem 4 (15p) (Quasilinear Preferences, Labor Supply)

Your best friend Aiden asked you to help him to determine how much time he should spend at work. His total available time (each day) is 24h and his only source of income is labor income given wage rate $w = \$10$. His spending on consumption good C is equal to what he earns. The price of such good is $p_c = 2$

a) What is his real wage rate? (number+interpretation, one sentence)

b) Plot his budget set on the graph.

c) Aiden has quasilinear utility function $U(R, C) = \ln R + C$ where R is leisure (or relaxation time) and C is consumption of other goods. Write down two secrets of happiness that determine optimal choice of R, C for arbitrary w, p_c. Find optimal R as a function w, p_c (you can assume interior solution).

d) What is Aiden's labor supply L if $w = \$1$ and $p_c = \$10$ (one number). How about $w = \$2$ and $p_c = \$10$ (one number). Is labor supply increasing in real wage rate, when preferences are quasilinear? (yes no answer)

Bonus question (Just for fun)

Let MRS^V and MRS^U be marginal rates of substitution of utility functions $V(x_1, x_2)$ and $U(x_1, x_2)$ respectively. Moreover, assume that $V(x_1, x_2) = f[U(x_1, x_2)]$ where $f[\cdot]$ is a strictly monotone transformation. Show that $MRS^V = MRS^U$. (Hint: Use formula for the derivative of a composite function)

Econ 301
Intermediate Microeconomics
Prof. Marek Weretka

Midterm 1 (D)

You have 70 minutes to complete the exam. The midterm consists of 4 questions (55+15+15+15=100 points) + bonus (just for fun). Make sure you answer the first four questions before working on the bonus one!

Problem 1 (55p) (Well-behaved preferences)

Ava is a big fun of delicious gourmet steaks: their robust and hearty beef flavors is what she likes the most. Her two most favorite steaks are marinated ribeye (x_1) and top sirloin (x_2).

a) The price of a marinated ribeye steak is $p_1 = \$4$, the price of top sirloin is $p_2 = \$2$, and her income (spent entirely on steaks) is $m = \$80$. Show geometrically Ava's budget constraint. Mark the two extreme consumption bundles (give concrete values). Show on the graph how her budget set would be affected by inflation that increased the prices of both steaks by 100%, leaving m unchanged (draw a new budget line).

b) Ava's utility function over both types of steaks is $U(x_1, x_2) = x_1^{\frac{1}{3}} x_2^{\frac{1}{3}}$. Find her marginal rate of substitution (MRS) for any bundle (x_1, x_2) (give a formula for MRS). What is the value of MRS at bundle $(3, 6)$ (one number)? Which of the two steak types is more valuable to Ava?

d) Write down two secrets of happiness, assuming that p_1, p_2, m are parameters (two equations).

- Provide economic intuition behind the two conditions (two sentences for each).

- Derive optimal consumption of x_1 and x_2 as a function of p_1, p_2, m (show the derivation of magic formulas).

- Using magic formulas determine whether the solution is interior for all values of p_1, p_2, m (one sentence).

- What fraction of total income is spent on top sirloin?

e) Find the optimal consumption levels of two types of steak (x_1, x_2) for:

- $p_1 = \$4, p_2 = \$2$ and $m = \$80$ (give two numbers).

and after the price of ribeye decreased:

- for $p_1 = \$2, p_2 = \$2$ and $m = \$80$ (give two numbers).

What is the total change in consumption of marinated ribeye? (give a number). Illustrate the change on the graph. Is marinated ribeye an ordinary of a Giffen good? (Chose one + one sentence explaining why.)

f) Decompose the total change in consumption of x_1 from e) into a substitution and income effect. (Calculate the two numbers and show how can you find the effect on the graph.)

Problem 2 (15p) (Perfect complements)

Alex is a hotdog lover. In each hotdog bun (x_1) Alex always inserts two hotdogs (x_2): he hates hotdogs with ratios of buns to hotdogs different from 1:2.

a) Propose a utility function that captures Alex's preferences over (x_1) and (x_2) (function $U(x_1, x_2)$).

b) In the commodity space, carefully depict Alex's indifference curves (marking the optimal proportion line).

c) Assume prices $p_1 = 2$ and $p_2 = 2$ and income $m = 30$. Write down two secrets of happiness (two equations) and determine the optimal choice (two numbers). Is your solution interior (yes or no)?

d) Suppose price of a hotdog bun goes down to $p_1 = 1$, while price $p_2 = 2$ income $m = 30$ are unchanged. Find optimal choice (two numbers). Without calculations, how much of this change can be attributed to a substitution effect (number + one sentence explaining the number).

Problem 3 (15p) (Perfect substitutes)

Pepsi x_1 and Coke x_2 both are goods that are indistinguishable.

a) Propose a utility function (the "craziest" function you can imagine), which captures preferences for such perfect substitutes.

b) Plot the budget line, assuming $p_1 = \$2$, $p_2 = \$6$ and $m = \$12$. In the same graph plot indifference curves.

c) Find the optimal bundle for $U(x_1, x_2) = x_1 + x_2$. (give two numbers). Is your solution interior or corner? (one sentence)

d) Plot income offer curve and Engel curve given fixed prices $p_1 = \$2, p_2 = \$6$. (two graphs). Is Pepsi normal or inferior (choose one + one sentence)

Problem 4 (15p) (Quasilinear Preferences, Labor Supply)

Your best friend Aiden asked you to help him to determine how much time he should spend at work. His total available time (each day) is 24h and his only source of income is labor income given wage rate $w = \$10$. His spending on consumption good C is equal to what he earns. The price of such good is $p_c = 2$

a) What is his real wage rate? (number+interpretation, one sentence)

b) Plot his budget set on the graph.

c) Aiden has quasilinear utility function $U(R, C) = \ln R + C$ where R is leisure (or relaxation time) and C is consumption of other goods. Write down two secrets of happiness that determine optimal choice of R, C for arbitrary w, p_c. Find optimal R as a function w, p_c (you can assume interior solution).

d) What is Aiden's labor supply L if $w = \$1$ and $p_c = \$10$ (one number). How about $w = \$2$ and $p_c = \$10$ (one number). Is labor supply increasing in real wage rate, when preferences are quasilinear? (yes no answer)

Bonus question (Just for fun)

Let MRS^V and MRS^U be marginal rates of substitution of utility functions $V(x_1, x_2)$ and $U(x_1, x_2)$ respectively. Moreover, assume that $V(x_1, x_2) = f[U(x_1, x_2)]$ where $f[\cdot]$ is a strictly monotone transformation. Show that $MRS^V = MRS^U$. (Hint: Use formula for the derivative of a composite function)