- Convex set: $t\mathbf{x}_0 + (1-t)\mathbf{x}_1 \in A \quad \forall\ \mathbf{x}_0, \mathbf{x}_1 \in A, t \in [0,1]$
- Superior set for $\mathbf{x}_0$: $\left\{\mathbf{x} \mid \mathbf{x} \in D \wedge f(\mathbf{x}) \geq f(\mathbf{x}_0)\right\}$
- Inferior set for $\mathbf{x}_0$: $\left\{\mathbf{x} \mid \mathbf{x} \in D \wedge f(\mathbf{x}) \leq f(\mathbf{x}_0)\right\}$
- Quasiconcave function: $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall t \in [0,1]$
- Strictly quasiconcave function: $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$
- Quasiconvex function: $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \ \ \forall t \in [0,1]$
- Strictly quasiconcave function: $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$
- Concave shape: A line connecting two points is underneath
- Strictly concave shape: A line connecting two points is strictly underneath
- Convex shape: A line connecting two points is above
- Strictly convex shape: A line connecting two points is strictly above
- Homothetic function: level sets have the same slope along rays from the origin

Cobb-Douglas Utility Function: $u(x, y) = x^\alpha\ y^\beta$

1. Superior set is always convex?

2. Inferior set is always convex?

3. u is a quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall t \in [0,1]$

4. u is a strictly quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$

5. u is a quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \ \ \forall t \in [0,1]$

6. u is a strictly quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$

The level sets (indfference curves) have a ...

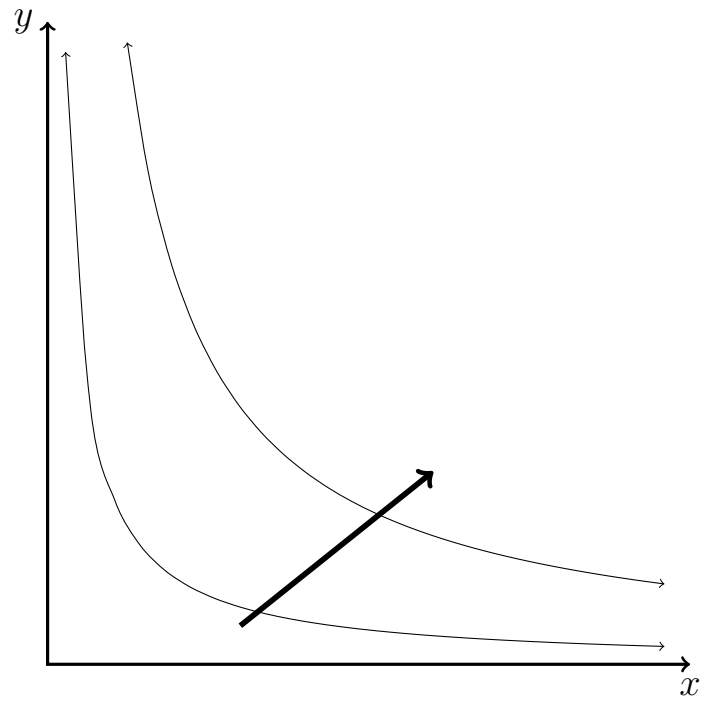
7. ... concave shape?

8. ... strictly concave shape?

9. ... convex shape?

10. ... strictly convex shape?

11. u is homothetic?



If both goods are "goods", then the indifference curves are downward sloping and increasing to the upper right.

Perfect Substitutes Utility Function: $u(x, y) = ax + by$

1. Superior set is always convex?

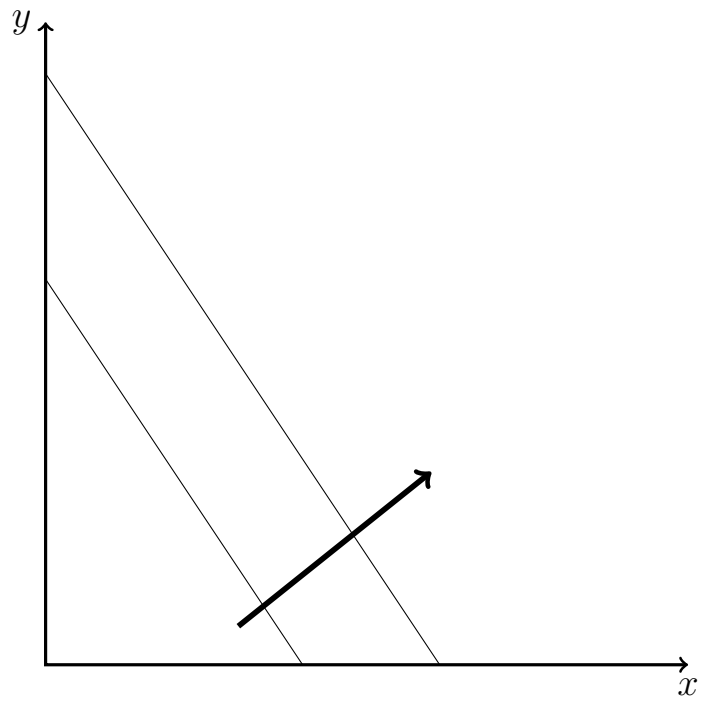
2. Inferior set is always convex?

3. u is a quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall t \in [0,1]$

4. u is a strictly quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1, \ t \in (0,1)$

5. u is a quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \ \ \forall t \in [0,1]$

6. u is a strictly quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \ \ \forall \mathbf{x}_0 \neq \mathbf{x}_1, \ t \in (0,1)$



The level sets (indfference curves) have a ...

7. ... concave shape?

8. ... strictly concave shape?

9. ... convex shape?

10. ... strictly convex shape?

11. u is homothetic?

Perfect Complements Utility Function: $u(x, y) = \min\{f(x), g(y)\}$

1. Superior set is always convex?

2. Inferior set is always convex?

3. u is a quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \quad \forall t \in [0,1]$

4. u is a strictly quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \quad \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$

5. u is a quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \quad \forall t \in [0,1]$

6. u is a strictly quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \quad \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$

The level sets (indfference curves) have a ...

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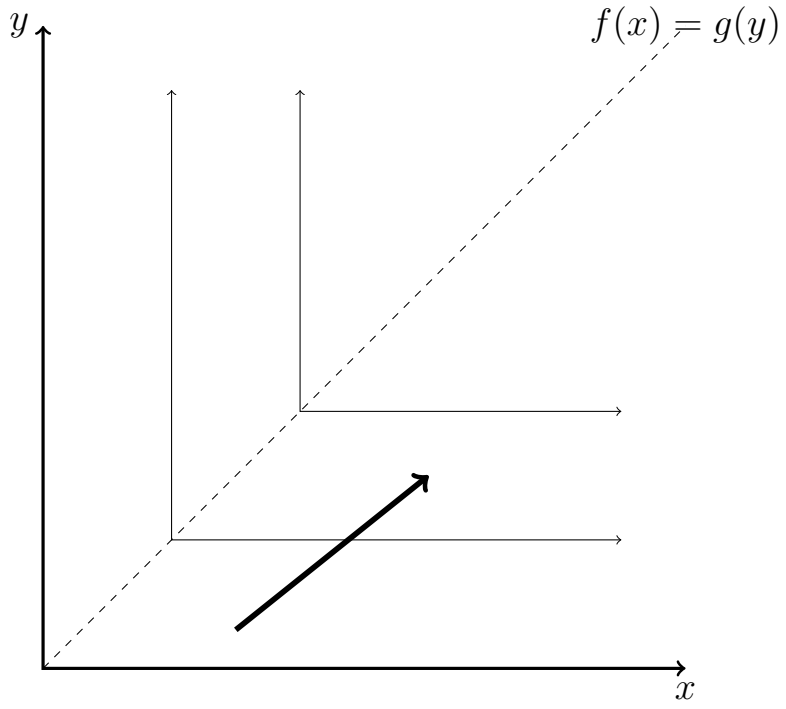
8. ... strictly concave shape?

9. ... convex shape?

10. ... strictly convex shape?

11. u is homothetic?



Prefers Extremes Utility Function: $u(x, y) = x^2 + y^2$

1. Superior set is always convex?

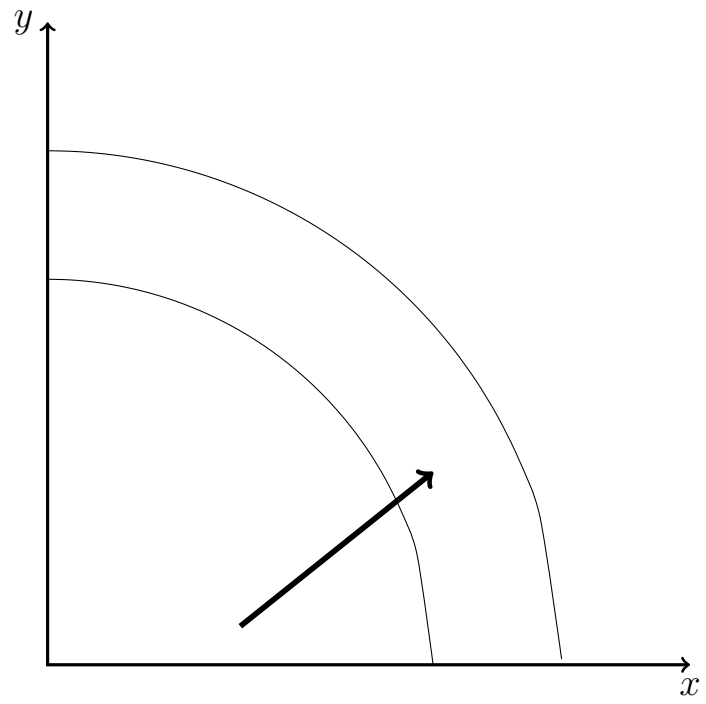
2. Inferior set is always convex?

3. u is a quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \quad \forall t \in [0,1]$

4. u is a strictly quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \quad \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$

5. u is a quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \quad \forall t \in [0,1]$

6. u is a strictly quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \quad \forall \mathbf{x}_0 \neq \mathbf{x}_1,\ t \in (0,1)$



The level sets (indfference curves) have a ...

7. ... concave shape?

8. ... strictly concave shape?

9. ... convex shape?

10. ... strictly convex shape?

11. u is homothetic?

Quasilinear Utility Function: $u(x, y) = x + \ln(y)$

1. Superior set is always convex?

2. Inferior set is always convex?

3. u is a quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \geq \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \;\; \forall t \in [0,1]$

4. u is a strictly quasiconcave function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) > \min\left\{f(\mathbf{x}_0), f(\mathbf{x}_1)\right\} \;\; \forall \mathbf{x}_0 \neq \mathbf{x}_1, \; t \in (0,1)$

5. u is a quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) \leq \max\{f(\mathbf{x}_0), f(\mathbf{x}_1)\} \;\; \forall t \in [0,1]$

6. u is a strictly quasiconvex function?
   $f(t\mathbf{x}_0 + (1-t)\mathbf{x}_1) < \max\left\{f(\mathbf{x}_0), f(\mathbf{x}_0)\right\} \;\; \forall \mathbf{x}_0 \neq \mathbf{x}_1, \; t \in (0,1)$

The level sets (indfference curves) have a ...

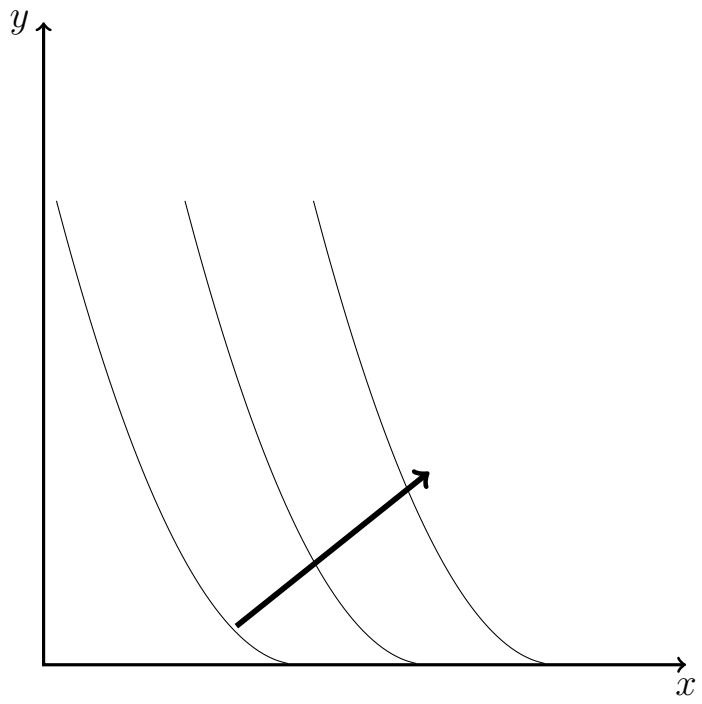
7. ... concave shape?

8. ... strictly concave shape?

9. ... convex shape?

10. ... strictly convex shape?

11. u is homothetic?



MRS Test

$$MRS(x,y) = \frac{\partial u/\partial x}{\partial u/\partial y}$$

What happens to the MRS as $x \uparrow$?

$$\frac{\partial MRS}{\partial x} =$$

What happens to the MRS as $y \downarrow$?

$$\frac{-\partial MRS}{\partial y} =$$

- $u(x,y) = x^{\alpha}\ y^{\beta}$
- $u(x,y) = ax + by$
- $u(x,y) = \min\{f(x), g(y)\}$
- $u(x,y) = x^2 + y^2$
- $u(x,y) = x + \ln(y)$