

# 28 | UTILITY FUNCTIONS AND INDIFFERENCE CURVES

Purpose: To show the relationship between utility functions, indifference curves, and total utility curves.

Computer files: **cdutil98.xls** and **cesutil98.xls**

Instructions and questions:

The *utility function* defines the level of utility or satisfaction as a function of the quantities of commodities consumed. The function embodies the consumer's preferences. In the utility function the dependent variable is utility, and the independent variables are the amounts consumed of goods or services.

An *indifference curve* shows all of the amounts of goods that give the consumer the same level of satisfaction. (An indifference curve is an implicit function that has the amounts of goods as variables. It doesn't have dependent and independent variables in the sense of there being a cause and effect.) A collection of amounts of goods, say five plates of spaghetti and thirty tacos, is referred to a "consumption bundle" or "market basket of commodities".

A *total utility curve* shows total utility as a function of one good, holding all other goods constant.

Economists usually assume that utility functions have several properties or characteristics. For example, the preferences behind the utility function are assumed to be "complete" and transitive. In addition, preferences have the characteristic that "more is better", and that indifference curves are convex.

Completeness means that the consumer can decide for any pair of bundles whether she prefers one to the other or is indifferent between them. There are no bundles about which the consumer just throws up her hands and says she can't make up her mind.

Transitivity means that the consumer's preferences are consistent in the sense that if she prefers bundle B to A, and prefers bundle C to B, then we know she will prefer C to A without even asking her. The implication of the transitivity assumption is that indifference curves can't cross each other.

"More is better", sometimes called the nonsatiety assumption or the "pig principle", is the assumption that more of a good always increases total utility if the amounts of other goods are

held constant. This means that total utility curves will always be positively sloped, and that so-called "higher" indifference curves lie above and to the right of "lower" indifference curves.

Convexity of indifference curves (*i.e.*, "Indifference curves are convex when viewed from the origin.") is sometimes referred to as the assumption of increasing marginal rate of substitution. The marginal rate of substitution of spaghetti for tacos is the number of tacos needed to compensate the consumer for the loss of one unit of spaghetti. It is minus the slope of an indifference curve.

If you now open the Excel file **cdutil98.xls** you will see a three dimensional graph of a utility function for a typical consumer who gets satisfaction from consuming spaghetti (S), and tacos (T). Click on any of the vertices of the graph. Small black dots appear on all vertices. You can drag on any black dot to change the orientation of the graph. [Put the mouse pointer on a dot, and depress the left mouse button. If you hold the button down the graph will change form and move with the pointer as you move the mouse.]

If you reorient the graph so that you are, in effect, looking at it from above, you can see the indifference curves for the consumer. If you reorient it so you are viewing it from the side in, say, the tacos direction, you can see the total utility curves for spaghetti.

As an extra credit exercise open the file **cesutil98.xls**. You'll see another utility function that has a different mathematical form. Does this function conform to the assumptions economists usually make about utility functions?

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**MATH MAVEN'S CORNER:** The utility function used to generate the graph in **cdutil98.xls** is given by

$$U = (10)S^3T^5$$

where S is the amount of spaghetti consumed and T is the amount of tacos consumed. Exponential functions of this sort that are used to describe utility functions and production functions (to be taken up later) are called Cobb-Douglas functions, though the term is sometimes reserved for the special case in which the exponents sum to one.

The utility function used to generate the graph in **cesutil98.xls** is given by

$$U = (S^5 + T^5)^2$$

This is a special case of a class of functions used by economists called Constant Elasticity of Substitution (CES) functions.

## UTILITY FUNCTIONS AND INDIFFERENCE CURVES

### Questions

- 1) For the part of the function shown in the graph, are preferences complete? (yes or no)
- 2) For the part of the utility function shown in the graph, is the nonsatiety assumption true? (yes or no)
- 3) Reorient the graph so that it shows the indifference curves between spaghetti and tacos. Print the graph (or save it as a file) and turn it in with your other answers.
- 4) For the part of the utility function shown in the graph, are the indifference curves "convex"? (yes or no)
- 5) For the part of the utility function shown in the graph, are preferences transitive? (yes or no)
- 6) Reorient the graph so it shows either the total utility curves for tacos, or the total utility curves for spaghetti. Print the graph (or save it as a file) and turn it in with your other answers. [If you save as a file be sure to change the file name to end in a "2" so you don't overwrite the file saved in question 3.]
- 7) Do the total utility curves have the property of "diminishing marginal utility" so long as some of each good is consumed? (yes or no)