Diminishing marginal utility

Consumers derive utility from their consumption of goods and services. In symbols, we can write $U = f(X)$ where U is utility and X is the amount of a particular good being consumed by a typical consumer. We can assume that for most goods and services, $f(X) > 0$: total utility is positive. Marginal utility is the change in utility from consuming another unit of the good: $MU_X = \Delta U/\Delta X = f'(X)$. Marginal utility is assumed to be positive, and the law of diminishing marginal utility implies that $f'(X)$ is declining in X. These two assumptions can be written symbolically as: $f'(X) > 0, f''(X) < 0$.

More generally, utility depends on consumption of <u>all</u> goods and services: $U = f(X_1, X_2, X_3, \ldots)$. In this more general specification, there is positive but diminishing marginal utility for each good if the utility function satisfies $\partial f/\partial X_i > 0$ and $\partial^2 f/\partial X_i^2 < 0$ for each good.