Worked Example Income Tax and the Budget Constraint

If the marginal income tax rate is 0% on annual incomes of £ 0 - £ 5,000, so the tax threshold is £ 5,000, 20% on annual incomes of £ 5,000 - £ 20,000 and 40% on annual incomes above £ 20,000) how much income tax do tax payers with incomes of £15,000 and £30,000 pay?

The calculations are set out in tables 1 and 2. The key step is calculating how much income the tax payer has in each tax bracket. Here u_i is the lower limit of the tax bracket, v_i is the upper limit of the tax bracket, t_i is the marginal tax rate, y is income, and x_i is income in the tax bracket.

Table 1: Calculating Income Tax with Income y = £15,000				
	formulae	tax brackets		
tax bracket	£ u_i - £ v_i	£ 0 - £ 5000	£ 5000 - £ 20,000	> £ 20, 0000
marginal tax rate	t_i	0	0.20	0.40
income in tax bracket	$x_i = $ $\begin{cases} 0 & \text{if } y < u_i \\ y - u_i & \text{if } u_i \leq y \leq v_i \\ v_i - u_i & \text{if } v_i < y \end{cases}$	5000	10,000	0
tax on income in tax bracket	$t_i\, x_i$	0	2,000	0
total income tax	$A = \Sigma_i\, t_i\, x_i$	£ 2,000		

Thus a tax payer with an income of £15,000 pays £2,000 income tax under this tax system. The tax payer's average tax rate is 2,000/15,000 =13%. The tax payer's marginal tax rate is the fraction of any extra pound earned which goes on income tax, in this case 20% because income, £15,000, falls in the 20% tax bracket.

Table 2: Calculating Income Tax with Income y = £30,000				
	formulae	tax brackets		
tax bracket	£ u_i - £ v_i	£ 0 - £ 5000	£ 5000 - £ 20,000	>£ 20, 0000
marginal tax rate	t_i	0	0.20	0.40
income in tax bracket	$x_i =$ 0 if $y < u_i$ $y - u_i$ if $u_i \leq y \leq v_i$ $v_i - u_i$ if $v_i < y$	5000	15,000	10,000
tax on income in tax bracket	$t_i x_i$	0	3,000	4,000
total income tax	$A = \Sigma_i t_i x_i$	£ 7,000		

Thus a tax payer with an income of £30,000 pays £7,000 income tax under this tax system. The tax payer's average tax rate is 7,000/30,000 = 23%. The tax payer's marginal tax rate is the fraction of any extra pound earned which goes on income tax, in this case 40% because income, £30,000, falls in the 40% tax bracket.

Drawing a Budget Constraint Given an Income Tax System

Suppose that a worker earns £ 4.00 per hour and faces an income tax system with the marginal tax rates outlined above (0% on annual incomes of £ 0 - £ 5,000, , 20% on annual incomes of £ 5,000 - £ 20,000 and 40% on annual incomes above £ 20,000). Show the worker's budget constraint.

The first step is Table 3. Note that 8760 = 365 x 24 = number of hours in a year.

Table 3: Calculating Consumption and Time Outside Employment at the Tax Bracket Boundaries			
Income y at tax bracket boundary	£ 0	£ 5,000	£20,000
time outside employment (hours) **8760 – y/w** where w = hourly wage = £4.00	8760	7510	3760
total income tax A calculated as tables 1 and 2	0 x 0 = 0	0 x 5,000 = 0	0 x 5,000 + 0.20 x 15,000 = 3,000
consumption c = y – A	0	5,000	17,000

Note for Continental Europeans: This uses the British and US convention for commas and decimal points, so 1,500 is one thousand five hundred and 1.500 = 3/2.

Table 4: Calculating the Slope of the Budget Line in Each Tax Bracket			
income	y < £ 5,000	£ 5,000 ≤ y ≤ £ 20,000	£ 20,000 < y
marginal tax rate t_i	0	0.20	0.40
slope of budget line - w (1 – t_i) where w = hourly wage = 4	-4.00	- 3.20	- 2.40

Given this information you can now use table 3 to plot the points
(time outside employment, consumption) corresponding to each of the tax bracket
boundaries. In this example these are (8760, 0), (7510, 5000) and (3760, 17000). Join up
the point (8760, 0) to (7510, 5000) and join the point (7510, 5000) to (3760, 17000) to
get the budget constraint for time outside employment between 3760 and 8760 hours. These
lines will have slopes – 4.0 and – 3.2 calculated in table 3. The slope for time outside
employment of less than 3760 hours is from table 4 – 2.4.

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