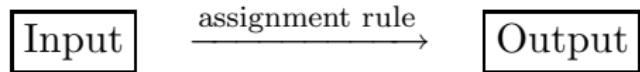
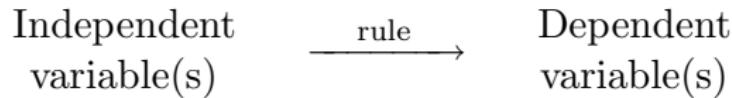
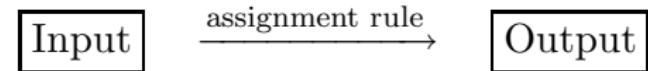


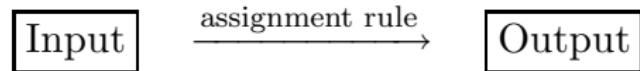
Functions



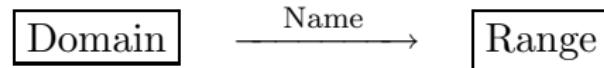
Functions



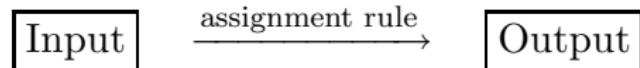
Functions



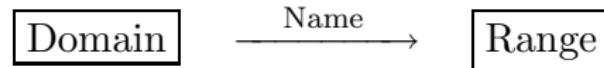
Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



Functions



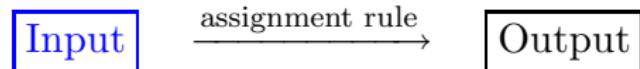
Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



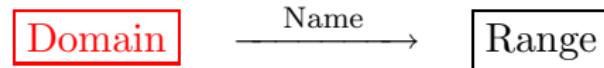
Name: Domain \rightarrow Range

$$f: \mathbb{R} \rightarrow \mathbb{R} , \quad y = f(x)$$

Functions



Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



Name: Domain \rightarrow Range

$$f: \mathbb{R} \rightarrow \mathbb{R} , \quad y = f(x)$$

Functions



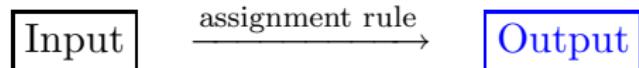
Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



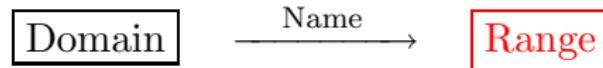
Name: Domain \rightarrow Range

$$f: \mathbb{R} \rightarrow \mathbb{R} , \quad y = f(x)$$

Functions



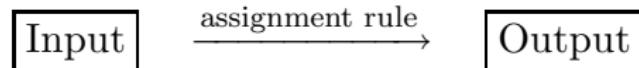
Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



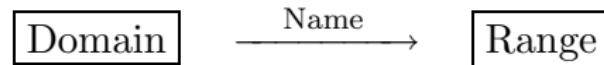
Name: Domain \rightarrow Range

$$f: \mathbb{R} \rightarrow \mathbb{R} , \quad y = f(x)$$

Functions



Independent variable(s) $\xrightarrow{\text{rule}}$ Dependent variable(s)



Name: Domain \rightarrow Range

$$f: \mathbb{R} \rightarrow \mathbb{R} , \quad y = f(x)$$

Read: “ y equals f of x ”

Catastrophic mistake: “ y equals f times x ”

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var:

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the **tax** is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: **tax (T)**;

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the **tax** is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: **tax (T)**;
- Independent var:

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your **taxable income** is over 31,850 but not over 77,100, then the **tax** is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: **tax (T)**;
- Independent var: **taxable income (ti)**;

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your **taxable income** is over 31,850 but not over 77,100, then the **tax** is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: **tax (T)**;
- Independent var: **taxable income (ti)**;
- Rule:

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: tax (T);
- Independent var: taxable income (ti);
- Rule: $4,386.25 + 25\%$ of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is 4,386.25 + 25% of the amount over 31,850.

- Dependent var: tax (T);
- Independent var: taxable income (ti); Domain= [31850,77100]
- Rule: 4,386.25 + 25% of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is 4,386.25 + 25% of the amount over 31,850.

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain= $[31850, 77100]$
- Rule: $4,386.25 + 25\%$ of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is 4,386.25 + 25% of the amount over 31,850.

- Dependent var: tax (T); Range = [4386.25, 15698.75]
- Independent var: taxable income (ti); Domain= [31850,77100]
- Rule: 4,386.25 + 25% of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is 4,386.25 + 25% of the amount over 31,850.

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain= $[31850, 77100]$
- Rule: $4,386.25 + 25\%$ of the amount over 31,850.

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is 4,386.25 + 25% of the amount over 31,850.

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain = $[31850, 77100]$
- Rule: $T = f(ti)$ Name = f

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | Over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| | But not over— | | |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain = $[31850, 77100]$
- Rule: $T = f(ti)$ Name = f

$$f: [31850, 77100] \rightarrow [0, \infty), T = f(ti)$$

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | But not over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

- Dependent var: tax (T);
- Independent var: taxable income (ti);
- Rule: $T = g(ti)$

Name = g

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | But not over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

- Dependent var: tax (T);
- Independent var: taxable income (ti); Domain = $[0, \infty)$
- Rule: $T = g(ti)$ Name = g

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | But not over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain = $[0, \infty)$
- Rule: $T = g(ti)$ Name = g

Verbal Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

- Dependent var: tax (T); Range = $[0, \infty)$
- Independent var: taxable income (ti); Domain = $[0, \infty)$
- Rule: $T = g(ti)$ Name = g

$$g: [0, \infty) \rightarrow [0, \infty), T = g(ti)$$

Numerical Representation of Functions

Example: Taxable income of \$50505

Numerical Representation of Functions

Example: Taxable income of \$50505

“The Tax Rate Schedules are shown so you can see the tax rate that applies to all levels of taxable income. Do not use them to figure your tax. Instead, see the instructions for line 44 that begin on page 33.”

Numerical Representation of Functions

Example: Taxable income of \$50505

| If line 43 (taxable income) is— | | And you are— | | | |
|---------------------------------------|---------------------|--------------|-----------------------------------|--------------------------------------|--------------------------------|
| At least | But less than | Single | Married filing jointly * | Married filing sepa- rately | Head of a house- hold |
| Your tax is— | | | | | |
| 50,000 | | | | | |
| 50,000 | 50,050 | 8,930 | 6,721 | 8,930 | 7,681 |
| 50,050 | 50,100 | 8,943 | 6,729 | 8,943 | 7,694 |
| 50,100 | 50,150 | 8,955 | 6,736 | 8,955 | 7,706 |
| 50,150 | 50,200 | 8,968 | 6,744 | 8,968 | 7,719 |
| 50,200 | 50,250 | 8,980 | 6,751 | 8,980 | 7,731 |
| 50,250 | 50,300 | 8,993 | 6,759 | 8,993 | 7,744 |
| 50,300 | 50,350 | 9,005 | 6,766 | 9,005 | 7,756 |
| 50,350 | 50,400 | 9,018 | 6,774 | 9,018 | 7,769 |
| 50,400 | 50,450 | 9,030 | 6,781 | 9,030 | 7,781 |
| 50,450 | 50,500 | 9,043 | 6,789 | 9,043 | 7,794 |
| 50,500 | 50,550 | 9,055 | 6,796 | 9,055 | 7,806 |
| 50,550 | 50,600 | 9,068 | 6,804 | 9,068 | 7,819 |
| 50,600 | 50,650 | 9,080 | 6,811 | 9,080 | 7,831 |
| 50,650 | 50,700 | 9,093 | 6,819 | 9,093 | 7,844 |
| 50,700 | 50,750 | 9,105 | 6,826 | 9,105 | 7,856 |
| 50,750 | 50,800 | 9,118 | 6,834 | 9,118 | 7,869 |
| 50,800 | 50,850 | 9,130 | 6,841 | 9,130 | 7,881 |
| 50,850 | 50,900 | 9,143 | 6,849 | 9,143 | 7,894 |
| 50,900 | 50,950 | 9,155 | 6,856 | 9,155 | 7,906 |
| 50,950 | 51,000 | 9,168 | 6,864 | 9,168 | 7,919 |

Numerical Representation of Functions

Example: Taxable income of \$50505

| If line 43 (taxable income) is— | | And you are— | | | |
|---------------------------------------|---------------------|--------------|-----------------------------------|--------------------------------------|--------------------------------|
| At least | But less than | Single | Married filing jointly * | Married filing sepa- rately | Head of a house- hold |
| Your tax is— | | | | | |
| 50,000 | | | | | |
| 50,000 | 50,050 | 8,930 | 6,721 | 8,930 | 7,681 |
| 50,050 | 50,100 | 8,943 | 6,729 | 8,943 | 7,694 |
| 50,100 | 50,150 | 8,955 | 6,736 | 8,955 | 7,706 |
| 50,150 | 50,200 | 8,968 | 6,744 | 8,968 | 7,719 |
| 50,200 | 50,250 | 8,980 | 6,751 | 8,980 | 7,731 |
| 50,250 | 50,300 | 8,993 | 6,759 | 8,993 | 7,744 |
| 50,300 | 50,350 | 9,005 | 6,766 | 9,005 | 7,756 |
| 50,350 | 50,400 | 9,018 | 6,774 | 9,018 | 7,769 |
| 50,400 | 50,450 | 9,030 | 6,781 | 9,030 | 7,781 |
| 50,450 | 50,500 | 9,043 | 6,789 | 9,043 | 7,794 |
| 50,500 | 50,550 | 9,055 | 6,796 | 9,055 | 7,806 |
| 50,550 | 50,600 | 9,068 | 6,804 | 9,068 | 7,819 |
| 50,600 | 50,650 | 9,080 | 6,811 | 9,080 | 7,831 |
| 50,650 | 50,700 | 9,093 | 6,819 | 9,093 | 7,844 |
| 50,700 | 50,750 | 9,105 | 6,826 | 9,105 | 7,856 |
| 50,750 | 50,800 | 9,118 | 6,834 | 9,118 | 7,869 |
| 50,800 | 50,850 | 9,130 | 6,841 | 9,130 | 7,881 |
| 50,850 | 50,900 | 9,143 | 6,849 | 9,143 | 7,894 |
| 50,900 | 50,950 | 9,155 | 6,856 | 9,155 | 7,906 |
| 50,950 | 51,000 | 9,168 | 6,864 | 9,168 | 7,919 |

Numerical Representation of Functions

| | | |
|--------|--------|-------|
| 50,400 | 50,450 | 9,030 |
| 50,450 | 50,500 | 9,043 |
| 50,500 | 50,550 | 9,055 |
| 50,550 | 50,600 | 9,068 |
| 50,600 | 50,650 | 9,080 |
| 50,650 | 50,700 | 9,093 |
| 50,700 | 50,750 | 9,105 |

Numerical Representation of Functions

Example: Taxable income of \$50505 \implies Tax of \$9055.

| If line 43 (taxable income) is— | | And you are— | | | |
|---------------------------------------|---------------------|--------------|-----------------------------------|--------------------------------------|--------------------------------|
| At least | But less than | Single | Married filing jointly * | Married filing sepa- rately | Head of a house- hold |
| Your tax is — | | | | | |
| 50,000 | | | | | |
| 50,000 | 50,050 | 8,930 | 6,721 | 8,930 | 7,681 |
| 50,050 | 50,100 | 8,943 | 6,729 | 8,943 | 7,694 |
| 50,100 | 50,150 | 8,955 | 6,736 | 8,955 | 7,706 |
| 50,150 | 50,200 | 8,968 | 6,744 | 8,968 | 7,719 |
| 50,200 | 50,250 | 8,980 | 6,751 | 8,980 | 7,731 |
| 50,250 | 50,300 | 8,993 | 6,759 | 8,993 | 7,744 |
| 50,300 | 50,350 | 9,005 | 6,766 | 9,005 | 7,756 |
| 50,350 | 50,400 | 9,018 | 6,774 | 9,018 | 7,769 |
| 50,400 | 50,450 | 9,030 | 6,781 | 9,030 | 7,781 |
| 50,450 | 50,500 | 9,043 | 6,789 | 9,043 | 7,794 |
| 50,500 | 50,550 | 9,055 | 6,796 | 9,055 | 7,806 |
| 50,550 | 50,600 | 9,068 | 6,804 | 9,068 | 7,819 |
| 50,600 | 50,650 | 9,080 | 6,811 | 9,080 | 7,831 |
| 50,650 | 50,700 | 9,093 | 6,819 | 9,093 | 7,844 |
| 50,700 | 50,750 | 9,105 | 6,826 | 9,105 | 7,856 |
| 50,750 | 50,800 | 9,118 | 6,834 | 9,118 | 7,869 |
| 50,800 | 50,850 | 9,130 | 6,841 | 9,130 | 7,881 |
| 50,850 | 50,900 | 9,143 | 6,849 | 9,143 | 7,894 |
| 50,900 | 50,950 | 9,155 | 6,856 | 9,155 | 7,906 |
| 50,950 | 51,000 | 9,168 | 6,864 | 9,168 | 7,919 |

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your **taxable income** is **over 31,850** but **not over 77,100**, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

- Taxable income: ti , $31850 \leq ti \leq 77100$

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the **amount over 31,850**.

- Taxable income: ti , $31850 \leq ti \leq 77100$
- Amount over 31850: **$ti - 31850$**

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\% \text{ of the amount over } 31,850$.

- Taxable income: ti , $31850 \leq ti \leq 77100$
- Amount over 31850: $ti - 31850$
- 25% of amount over 31850: $0.25(ti - 31850)$

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is **$4,386.25 + 25\% \text{ of the amount over } 31,850$** .

- Taxable income: ti , $31850 \leq ti \leq 77100$
- Amount over 31850: $ti - 31850$
- 25% of amount over 31850: $0.25(ti - 31850)$
- Tax due: **$4386.25 + 0.25(ti - 31850)$**

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\% \text{ of the amount over } 31,850$.

- Taxable income: $ti, 31850 \leq ti \leq 77100$
- Amount over 31850: $ti - 31850$
- 25% of amount over 31850: $0.25(ti - 31850)$
- Tax due: $4386.25 + 0.25(ti - 31850)$

$$T = f(ti) = 4386.25 + 0.25(ti - 31850)$$

Analytical Representation of Functions

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

If your taxable income is over 31,850 but not over 77,100, then the tax is $4,386.25 + 25\%$ of the amount over 31,850.

- Taxable income: ti , $31850 \leq ti \leq 77100$
- Amount over 31850: $ti - 31850$
- 25% of amount over 31850: $0.25(ti - 31850)$
- Tax due: $4386.25 + 0.25(ti - 31850)$

$$T = f(50505) = 4386.25 + 0.25(50505 - 31850) = 9050$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|----------------------|-------------------------|----------------------------|
| Over— | <i>But not over—</i> | | <i>of the amount over—</i> |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|----------------------|-------------------------|----------------------------|
| Over— | <i>But not over—</i> | | <i>of the amount over—</i> |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti)$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|----------------------|------------------|----------------------------|
| Over— | <i>But not over—</i> | | <i>of the amount over—</i> |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|-------------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | But not over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| Over— | Over— | | |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | <i>But not over—</i> | The tax is: | <i>of the amount over—</i> |
|----------------------------|----------------------|------------------|----------------------------|
| Over— | | | |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

- To compute $f(20000)$:

Schedule X—If your filing status is Single

| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

- To compute $f(20000)$:

$$ti = 20000$$

Schedule X—If your filing status is Single

| If your taxable income is: | The tax is: | of the amount over— |
|----------------------------|---------------|--------------------------|
| Over— | But not over— | |
| \$0 | \$7,825 | 10% \$0 |
| 7,825 | 31,850 | \$782.50 + 15% 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% 160,850 |
| 349,700 | ..... | 101,469.25 + 35% 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

- To compute $f(20000)$:

$$ti = 20000$$

Schedule X—If your filing status is Single

| If your taxable income is: | But not over— | The tax is: | of the amount over— |
|----------------------------|---------------|------------------|---------------------|
| Over— | Over— | | |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

- To compute $f(20000)$: $ti = 20000$
- $f(20000)$

Schedule X—If your filing status is Single

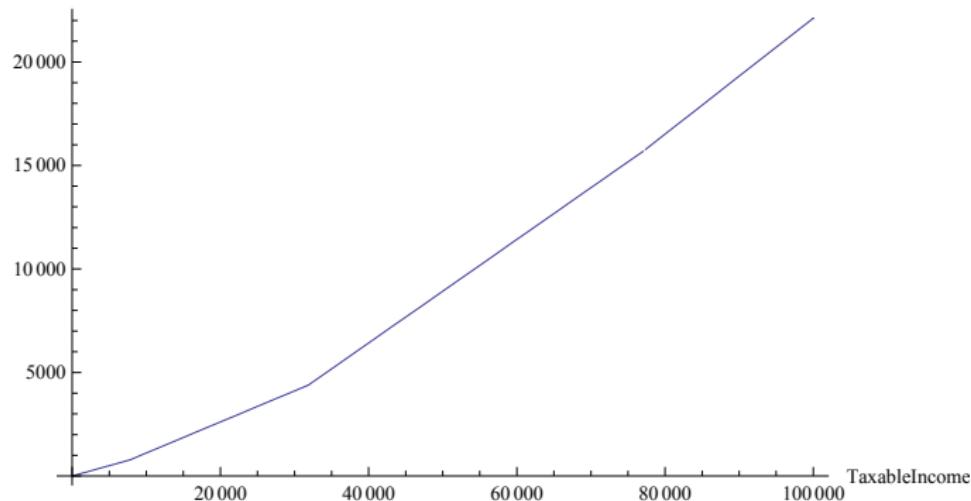
| If your taxable income is: | | The tax is: | |
|----------------------------|---------------|------------------|---------------------|
| Over— | But not over— | | of the amount over— |
| \$0 | \$7,825 | 10% | \$0 |
| 7,825 | 31,850 | \$782.50 + 15% | 7,825 |
| 31,850 | 77,100 | 4,386.25 + 25% | 31,850 |
| 77,100 | 160,850 | 15,698.75 + 28% | 77,100 |
| 160,850 | 349,700 | 39,148.75 + 33% | 160,850 |
| 349,700 | ..... | 101,469.25 + 35% | 349,700 |

$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ 39148.75 + 0.33(ti - 160850) & \text{if } 160850 < ti \leq 349700 \\ 101469.25 + 0.35(ti - 349700) & \text{if } 349700 < ti \end{cases}$$

- To compute $f(20000)$: $ti = 20000$
- $f(20000) = 782.5 + 0.15(20000 - 7825) = 2608.75$

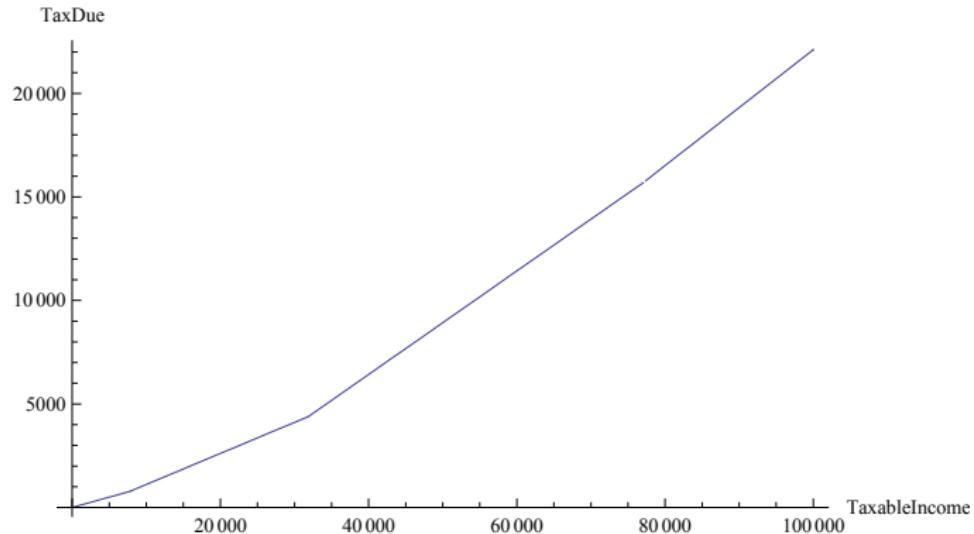
Graphical Representation of Functions

TaxDue

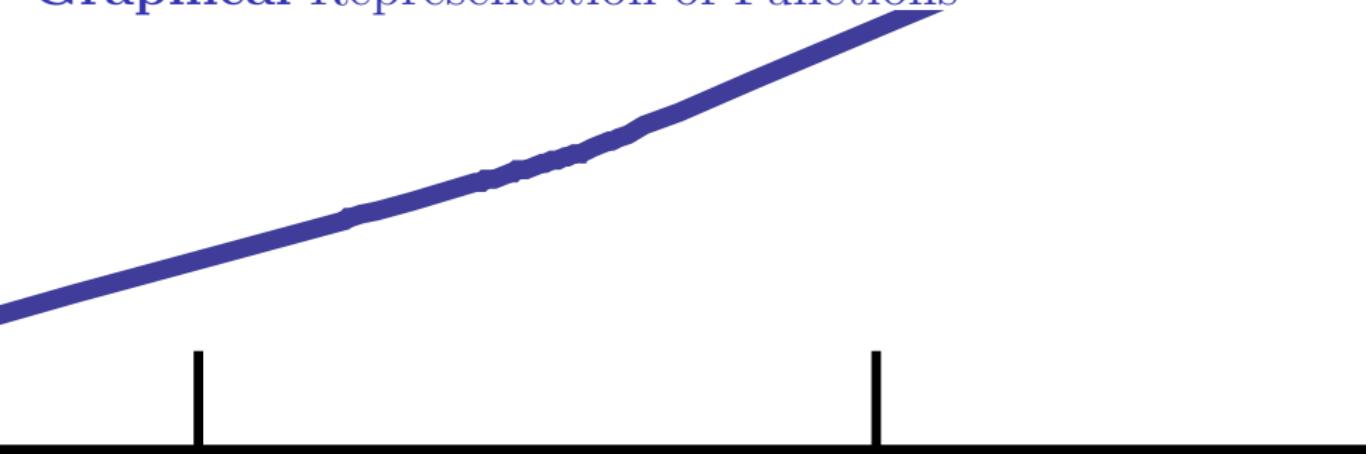


$$T = f(ti) = \begin{cases} 0.1ti & \text{if } 0 < ti \leq 7825 \\ 782.5 + 0.15(ti - 7825) & \text{if } 7825 < ti \leq 31850 \\ 4386.25 + 0.25(ti - 31850) & \text{if } 31850 < ti \leq 77100 \\ 15698.75 + 0.28(ti - 77100) & \text{if } 77100 < ti \leq 160850 \\ \dots & \dots \end{cases}$$

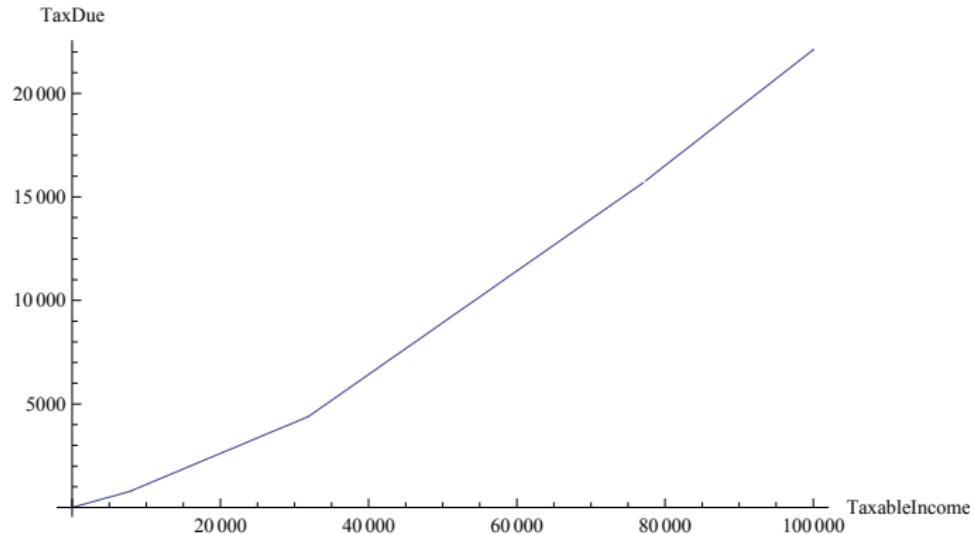
Graphical Representation of Functions



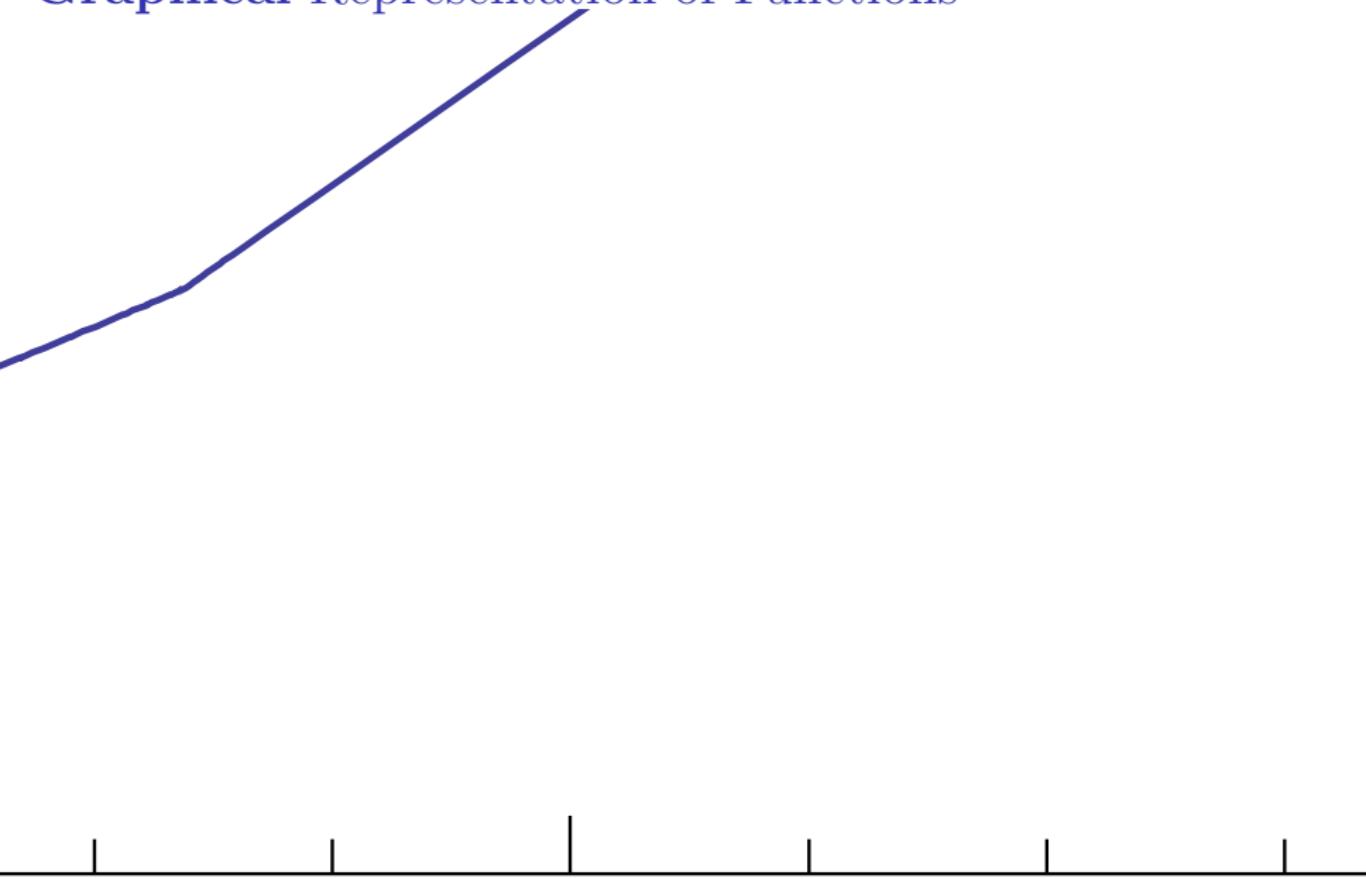
Graphical Representation of Functions



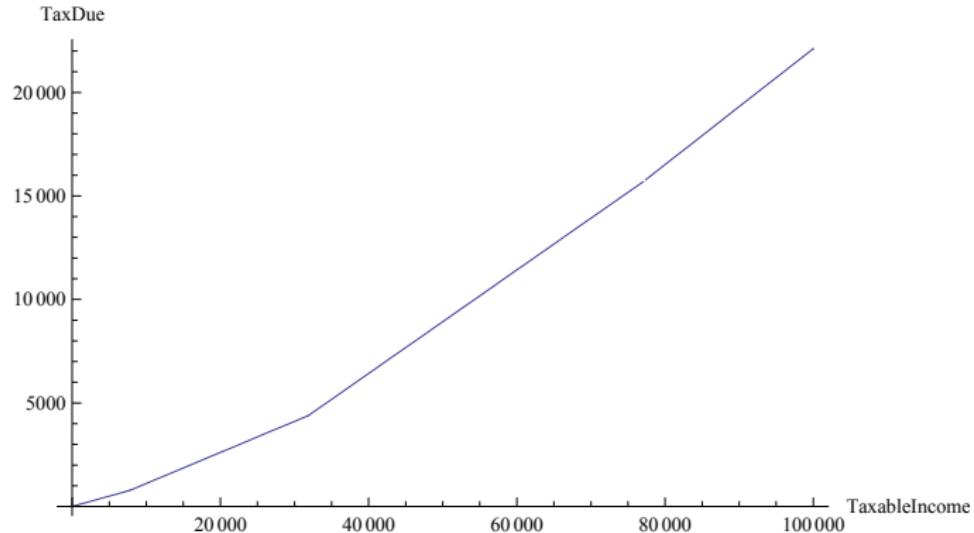
Graphical Representation of Functions



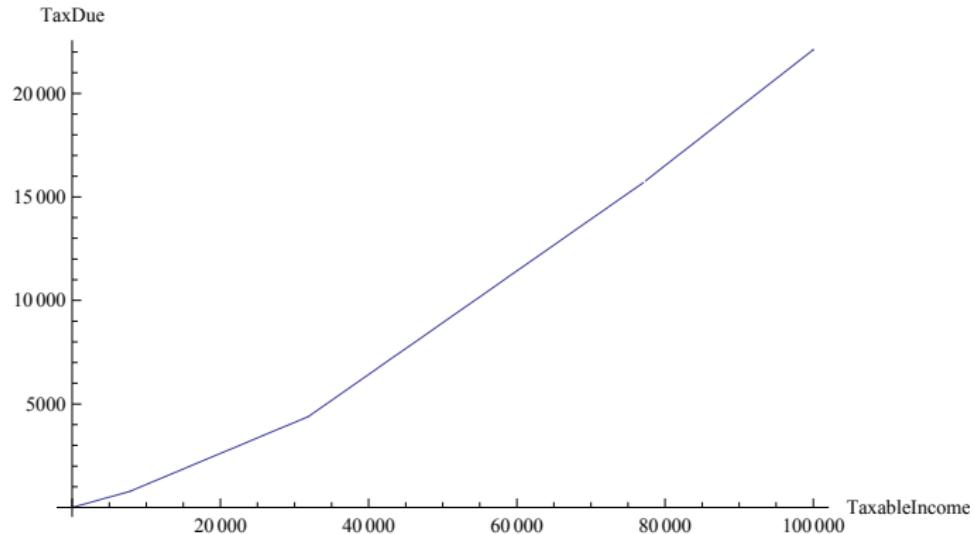
Graphical Representation of Functions



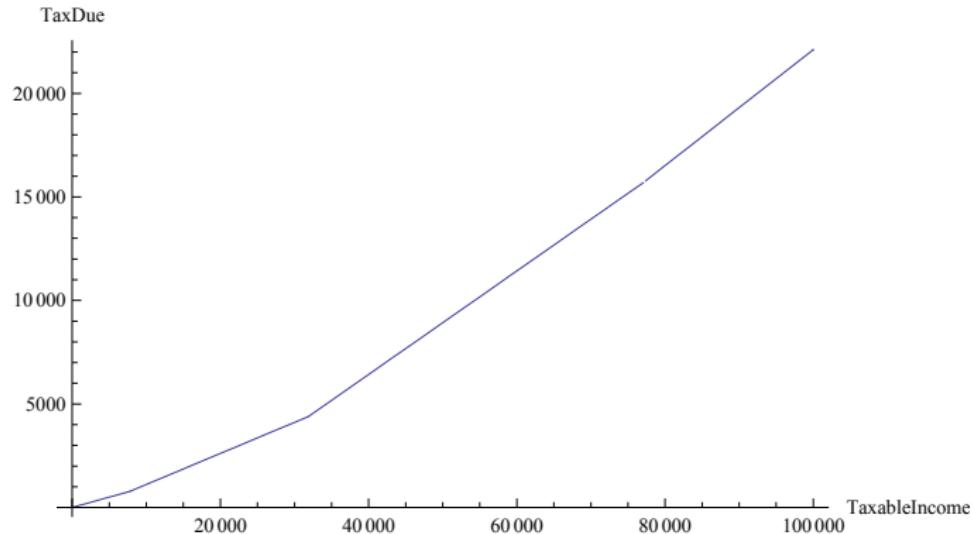
Graphical Representation of Functions



Graphical Representation of Functions

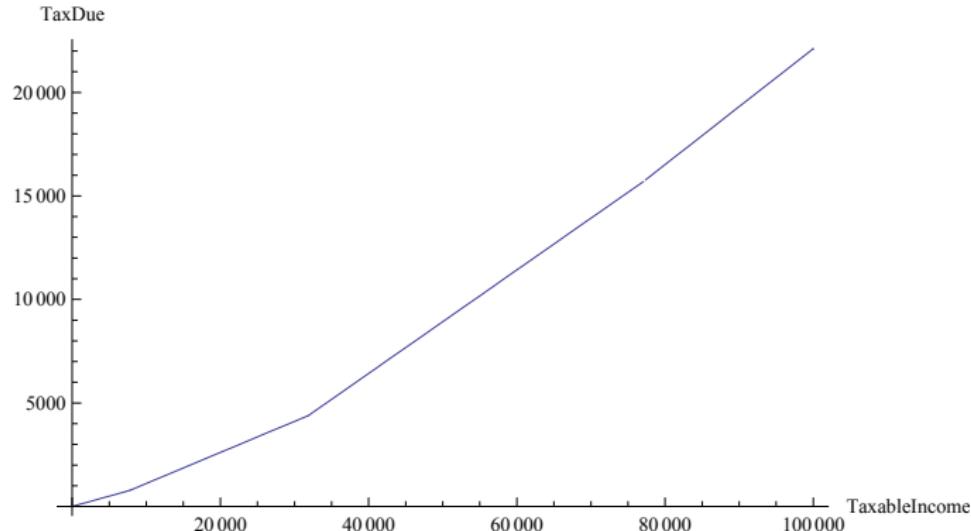


Graphical Representation of Functions



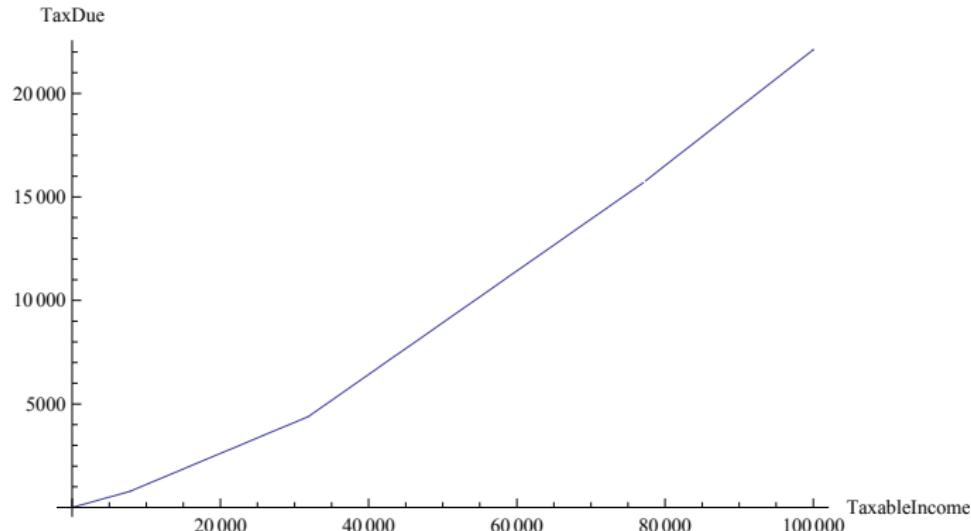
- Sequence of line segments

Graphical Representation of Functions



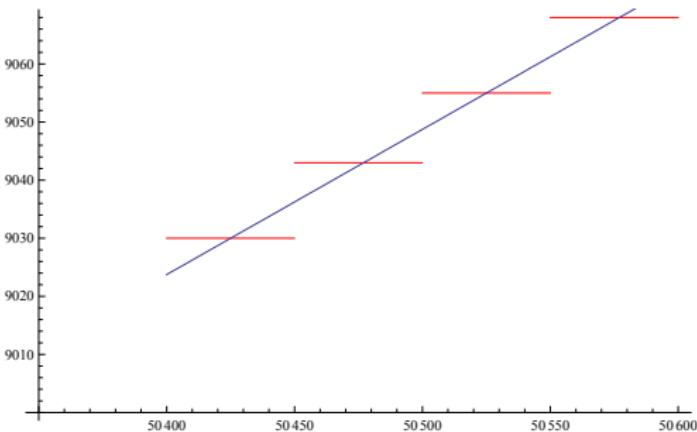
- Sequence of line segments
- Segments meet at bracket endpoints

Graphical Representation of Functions

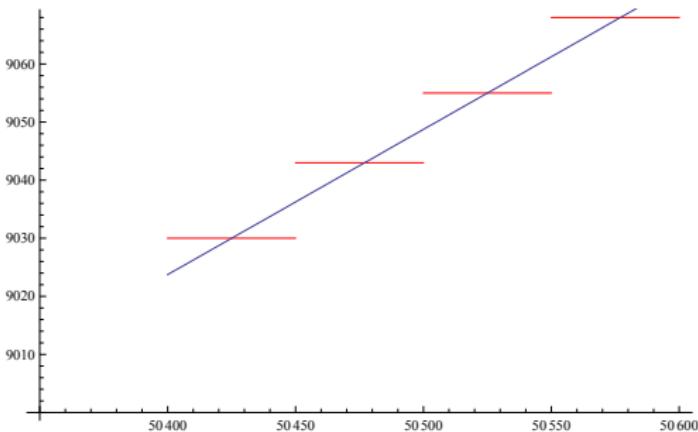


- Sequence of line segments
- Segments meet at bracket endpoints
- Slopes 10%, 15%, 25%, ...

Tax Rule vs. Tax Table

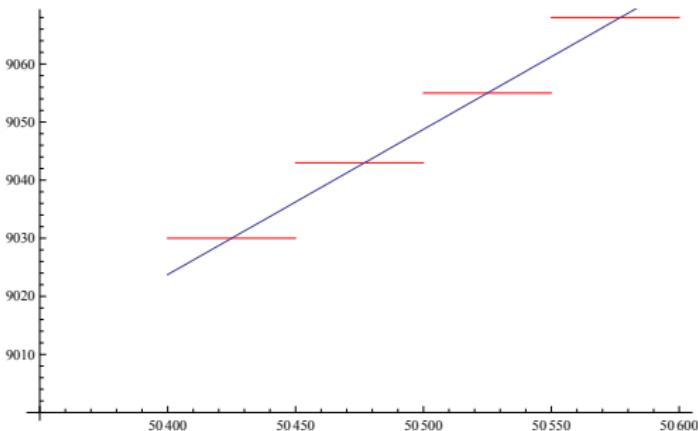


Tax Rule vs. Tax Table



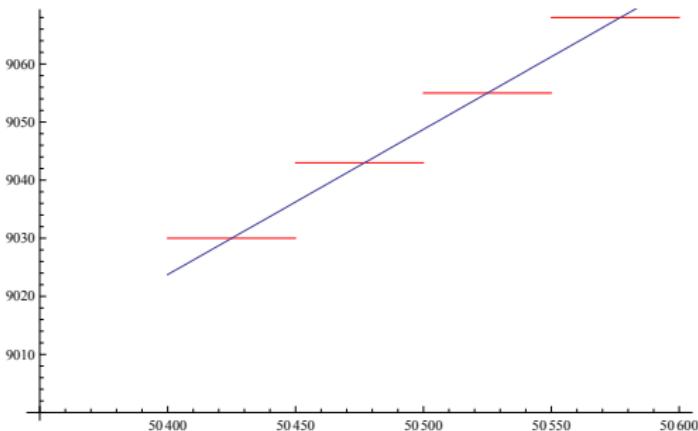
- Blue: Tax Rule

Tax Rule vs. Tax Table



- Blue: Tax Rule
 - ▶ Increasing with a constant slope

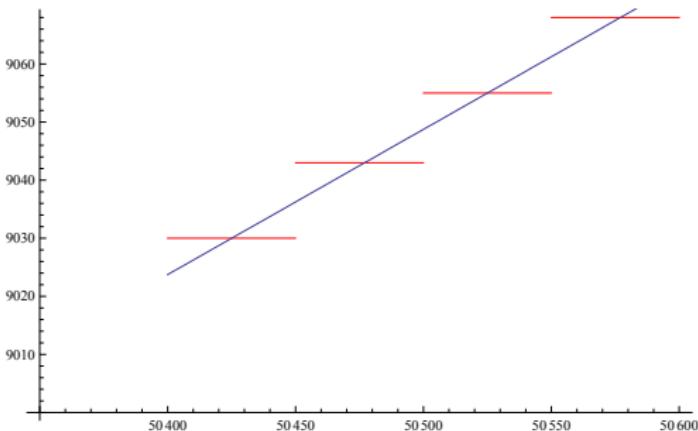
Tax Rule vs. Tax Table



- Blue: Tax Rule

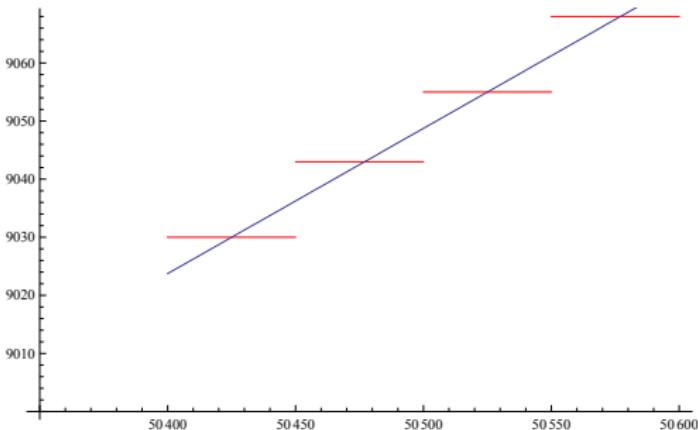
- ▶ Increasing with a constant slope
- ▶ Rate: 25 cents for each extra dollar (*marginal tax rate*)

Tax Rule vs. Tax Table



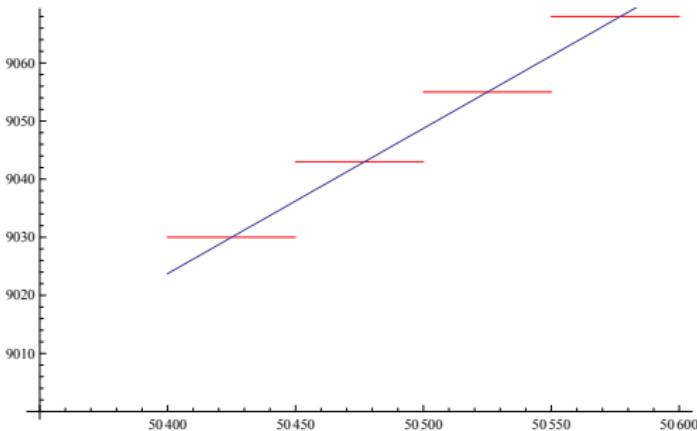
- Blue: Tax Rule
 - ▶ Increasing with a constant slope
 - ▶ Rate: 25 cents for each extra dollar (*marginal tax rate*)
- Red: Tax table

Tax Rule vs. Tax Table



- Blue: Tax Rule
 - ▶ Increasing with a constant slope
 - ▶ Rate: 25 cents for each extra dollar (*marginal tax rate*)
- Red: Tax table
 - ▶ Constant value on small intervals (step function)

Tax Rule vs. Tax Table



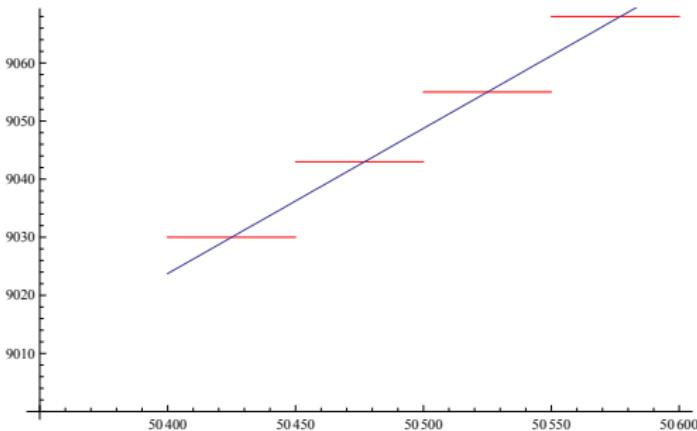
- Blue: Tax Rule

- Increasing with a constant slope
- Rate: 25 cents for each extra dollar (*marginal tax rate*)

- Red: Tax table

- Constant value on small intervals (step function)
- Value from midpoint

Tax Rule vs. Tax Table



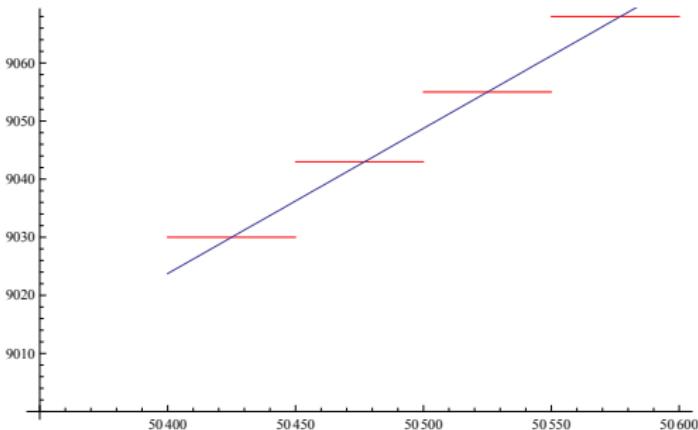
- Blue: Tax Rule

- Increasing with a constant slope
- Rate: 25 cents for each extra dollar (*marginal tax rate*)

- Red: Tax table

- Constant value on small intervals (step function)
- Value from midpoint
- Give a little, get a little.

Tax Rule vs. Tax Table



- Blue: Tax Rule

- Increasing with a constant slope
- Rate: 25 cents for each extra dollar (*marginal tax rate*)

- Red: Tax table

- Constant value on small intervals (step function)
- Value from midpoint
- Give a little, get a little. Really?

