Midterm Project – Angel L.

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Project: Web application for Tax rates for 2021 year (filing 2022)

Application Type: Web application using ASP.NET framework.

Application Name: Federal Income Tax Calculator-2022

Website URL: https://federalincometaxcalculator.azurewebsites.net

Source: https://www.debt.org/tax/brackets/

Application URL: https://federalincometaxcalculator.azurewebsites.net

Tax Bracket Table

2021 Tax Brackets (Due April 2022)				
Tax rate	Single filers	Married filing jointly*	Married filing separately	Head of household
10%	$0 – $9,950	$0 – $19,900	$0 – $9,950	$0 – $14,200
12%	$9,951 – $40,525	$19,901 – $81,050	$9,951 – $40,525	$14,201 – $54,200
22%	$40,526 – $86,375	$81,051 – $172,750	$40,526 – $86,375	$54,201 – $86,350
24%	$86,376 – $164,925	$172,751 – $329,850	$86,376 – $164,925	$86,351 – $164,900
32%	$164,926 – $209,425	$329,851 – $418,850	$164,925 – $209,425	$164,901 – $209,400
35%	$209,426 – $523,600	$418,851 – $628,300	$209,426 – $314,150	$209,401 – $523,600
37%	$523,601 or more	$628,300 or more	$314,151 or more	$523,601 or more

Piecewise Function Math

Let p = taxable income

Let t = income tax

t = f(p)

It can be written as: t(p)

Single filer:

$$t(p) = \begin{cases} 0.1p; & 0 \le p \le 9950 \\ 0.12p - 199 & 9950 < p \le 40525 \\ 0.22p - 4251.5; & 40525 < p \le 86375 \\ 0.24p - 5979; & 86375 < p \le 164925 \\ 0.32p - 19173; & 164925 < p \le 209425 \\ 0.35p - 25455.75; & 209425 < p \le 523600 \\ 0.37p - 35927.75; & p > 523600 \end{cases}$$

First Bracket (10%)

t(p) = 0.10p

Second Bracket (12%)

a. **Max for 1st bracket: 9950*.10 = 995**
b. **t(p) = 995 + (.12(p – 9950)**
   t(p) = 995 + .12p – 1194
   t(p) = .12p – 199

Third Bracket (22%)

a. **Max for 1st bracket = 995**
b. **Max for 2nd bracket = ((40525 – 9950) * .12) = 3669**
c. **t(p) = 995 + 3669 + (.22(p – 40525)**
   t(p) = 4664 + .22p – 8915.5
   t(p) = .22p – 4251.50

Fourth Bracket (24%)

a. **Max for 1st bracket = 995**
b. **Max for 2nd bracket = 3669**
c. **Max for 3rd bracket = ((86375 – 40525) * .22) = 10087**
d. **t(p) = 995 + 3669 + 10087 + (.24(p – 86375)**
   t(p) = 14751 + .24p – 20730
   t(p) = .24p – 5975

Fifth Bracket (32%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = ((164925 – 86375) * .24) = 18852
e. t(p) = 995 + 3669 + 10087 + 18852 + (.32(p – 164925)
   t(p) = 33603 + .32p – 52776
   t(p) = .32p – 19173

Sixth Bracket (35%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = 18852
e. Max for 5th bracket = ((209425 – 164925) * .32) = 14240
f. t(p) = 995 + 3669 + 10087 + 18852 + 14240 + (.35(p – 209425)
   t(p) = 47843 + .35p – 73298.75
   t(p) =.35p – 25455.75

Seventh Bracket (37%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = 18852
e. Max for 5th bracket = 14240
f. Max for 6th bracket = ((523600 – 209425) * .35) = 109961.25
g. t(p) = 995 + 3669 + 10087 + 18852 + 14240 + 109961.25 +
   (.37(p – 523600)
   t(p) = 157804.25 + .37p - 193732
   t(p) = .37p – 35927.75

Married filing jointly

$$t(p) = \begin{cases} 0.1p; & 0 \le p \le 19900 \\ 0.12p - 398; & 19900 < p \le 81050 \\ 0.22p - 8503; & 81050 < p \le 172750 \\ 0.24p - 11958; & 172750 < p \le 329850 \\ 0.32p - 38346; & 329850 < p \le 418850 \\ 0.35p - 50911.50; & 418850 < p \le 628300 \\ 0.37p - 63477.50; & p > 628300 \end{cases}$$

First Bracket (10%)

t(p) = 0.10p

Second Bracket (12%)

a. Max for 1st bracket: (19900 * .10) = 1990
b. t(p) = 1990 + (.12(p - 19900))
   t(p) = 1990 + .12p – 2388
   t(p) = .12p – 398

Third Bracket (22%)

a. Max for 1st bracket = 1990
b. Max for 2nd bracket = ((81050 – 19900) * .12) = 7338
c. t(p) = 1990 + 7338 + (.22(p-81050))
   t(p) = 9328 + .22p – 17831
   t(p) = .22p – 8503

Fourth Bracket (24%)

a. Max for 1st bracket = 1990
b. Max for 2nd bracket = 7338
c. Max for 3rd bracket = ((172750 – 81050) * .22) = 20174
d. t(p) = 1990 + 7338 + 20174 + (.24(p-172750))
   t(p) = 29502 + .24p – 41460
   t(p) = .24p – 11958

Fifth Bracket (32%)

a. Max for 1st bracket = 1990
b. Max for 2nd bracket = 7338
c. Max for 3rd bracket = 20174
d. Max for 4th bracket = ((329850 – 172750) * .24) = 37704
e. t(p) = 1990 + 7338 + 20174 + 37704 + (.32(p – 329850))
   t(p) = 67206 + .32p – 105552
   t(p) =.32p – 38346

Sixth Bracket (35%)

a. Max for 1st bracket = 1990
b. Max for 2nd bracket = 7338
c. Max for 3rd bracket = 20174
d. Max for 4th bracket = 37704
e. Max for 5th bracket = ((418850 – 329850) * .32) = 28480
f. t(p) = 1990 + 7338 + 20174 + 37704 + 28480 + (.35(p – 418850))
   t(p) = 95686 + .35p – 146597.50

t(p) =.35p – 50911.50

Seventh Bracket (37%)

a. **Max for 1st bracket = 1990**
b. **Max for 2nd bracket = 7338**
c. **Max for 3rd bracket = 20174**
d. **Max for 4th bracket = 37704**
e. **Max for 5th bracket = 28480**
f. **Max for 6th bracket = ((628300 – 418850) * .35) = 73307.50**
g. **t(p) = 1990 + 7338 + 20174 + 37704 + 28480 + 73307.50 + (.37(p – 628300))**
   t(p) = 168993.50 + .37p – 232471
   t(p) =.37p – 63477.50

Married filing separately

$$t(p) = \begin{cases} 0.1p; & 0 \le p \le 9950 \\ 0.12p - 199; & 9950 < p \le 40525 \\ 0.22p - 4251.5; & 40525 < p \le 86375 \\ 0.24p - 5979; & 86375 < p \le 164925 \\ 0.32p - 19173; & 164925 < p \le 209425 \\ 0.35p - 25455.75; & 209425 < p \le 314150 \\ 0.37p - 31738.75; & p > 314150 \end{cases}$$

First Bracket (10%)

t(p) = 0.10p

Second Bracket (12%)

a. **Max for 1st bracket: 9950*.10 = 995**
b. **t(p) = 995 + (.12(p – 9950)**
   t(p) = 995 + .12p – 1194
   t(p) = .12p – 199

Third Bracket (22%)

a. **Max for 1st bracket = 995**

b. Max for 2nd bracket = ((40525 – 9950) * .12) = 3669
c. t(p) = 995 + 3669 + (.22(p – 40525)
   t(p) = 4664 + .22p – 8915.5
   t(p) = .22p – 4251.5

Fourth Bracket (24%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = ((86375 – 40525) * .22) = 10087
d. t(p) = 995 + 3669 + 10087 + (.24(p – 86375)
   t(p) = 14751 + .24p – 20730
   t(p) = .24p – 5975

Fifth Bracket (32%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = ((164925 – 86375) * .24) = 18852
e. t(p) = 995 + 3669 + 10087 + 18852 + (.32(p – 164925)
   t(p) = 33603 + .32p – 52776
   t(p) = .32p – 19173

Sixth Bracket (35%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = 18852
e. Max for 5th bracket = ((209425 – 164925) * .32) = 14240
f. t(p) = 995 + 3669 + 10087 + 18852 + 14240 + (.35(p – 209425)
   t(p) = 47843 + .35p – 73298.75
   t(p) =.35p – 25455.75

Seventh Bracket (37%)

a. Max for 1st bracket = 995
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = 10087
d. Max for 4th bracket = 18852
e. Max for 5th bracket = 14240
f. Max for 6th bracket = ((314150 – 209425) * .35) = 36653.75
g. t(p) = 995 + 3669 + 10087 + 18852 + 14240 + 36653.75 +
   (.37(p – 314150)

t(p) = 84496.75 + .37p – 116235.50
t(p) = .37p – 31738.75

Head of Household

$$t(p) = \begin{cases} 0.1p; & 0 \le p \le 14200 \\ 0.12p - 284; & 14200 < p \le 54200 \\ 0.22p - 7704; & 54200 < p \le 86350 \\ 0.24p - 5704; & 86350 < p \le 164900 \\ 0.32p - 20623; & 164900 < p \le 209400 \\ 0.35p - 26905; & 209400 < p \le 523600 \\ 0.37p - 39397; & p > 523600 \end{cases}$$

First Bracket (10%)

t(p) = 0.10p

Second Bracket (12%)

a. Max for 1st bracket: 14200*.10 = 1420
b. t(p) = 1420+ (.12(p – 14200)
   t(p) = 1420+ .12p – 1704
   t(p) = .12p – 284

Third Bracket (22%)

a. Max for 1st bracket = 1420
b. Max for 2nd bracket = ((54200 – 14200) * .12) = 4800
c. t(p) = 1420 + 4800 + (.22(p – 54200)
   t(p) = 4220 + .22p – 11924
   t(p) = .22p – 7704

Fourth Bracket (24%)

a. Max for 1st bracket = 1420
b. Max for 2nd bracket = 3669
c. Max for 3rd bracket = ((86350 – 54200) * .22) = 7073
d. t(p) = 1420 + 4800 + 7073 + (.24(p – 86350)
   t(p) = 13293 + .24p – 18997
   t(p) = .24p – 5704

Fifth Bracket (32%)

a. Max for 1st bracket = 1420
b. Max for 2nd bracket = 4800
c. Max for 3rd bracket = 7073
d. Max for 4th bracket = ((164900 – 86350) * .24) = 18852
e. t(p) = 1420 + 4800 + 7073 + 18852 + (.32(p – 164900)
   t(p) = 32145 + .32p – 52768
   t(p) = .32p – 20623

Sixth Bracket (35%)

a. Max for 1st bracket = 1420
b. Max for 2nd bracket = 4800
c. Max for 3rd bracket = 7073
d. Max for 4th bracket = 18852
e. Max for 5th bracket = ((209400 – 164900) * .32) = 14240
f. t(p) = 1420 + 4800 + 7073 + 18852 + 14240 + (.35(p – 209400)
   t(p) = 46385 + .35p – 73290
   t(p) =.35p – 26905

Seventh Bracket (37%)

a. Max for 1st bracket = 1420
b. Max for 2nd bracket = 4800
c. Max for 3rd bracket = 7073
d. Max for 4th bracket = 18852
e. Max for 5th bracket = 14240
f. Max for 6th bracket = ((523600 – 209400) * .35) = 109970
g. t(p) = 1420 + 4800 + 7073 + 18852 + 14240 + 109970 + (.37(p – 523600)
   t(p) = 154335 + .37p – 193732
   t(p) = .37p – 39397

Test Case for "Married Filing Jointly."

Notes:
I have selected seven random taxable income amounts.
I worked the math for married filing jointly.
I worked the math for each scenario arithmetically/manually (see below).
I also did the math using the piecewise function (see below).

Random numbers:

(1)$8000
(2)$32000
(3)$101930
(4)$240690
(5)$400100
(6)$490000
(7)$750930

Calculating random income – Arithmetic

(1)$8000 – falls within the first bracket (10%)
8000 * .10 = $800.00

(2)$32000 – falls within the second bracket (12%):

a. first piece: there is $19,900 out of the 32000 taxed at 10%
   19,900 * .10 = $1990
b. Second piece: the remaining of the $32000 should be taxed at 12%
   32000 – 19900 = $12100
   12100 * .12 = $1452
c. So, tax for income of $32000 is:
   1990 + 1452 = $3,442.00

(3)$101930 – falls under the third bracket (22%):

a. First piece: $1990
b. Second piece: calculate the range of income that will be taxed at 12% (anything falls under second bracket)
   81050 – 19900 = $61150
   61150 * .12 = $7338
c. Third piece: the remaining of the $101930 will be taxed at 22%
   101930 – 81050 = $20880
   20880 * .22 = $4593.60
d. So, tax for income of $101930 is:
   1990 + 7338 + 4593.60 = $13,921.60

(4)$240690 – Falls under the fourth bracket (24%):

a. First piece: $1990
b. Second piece: $7338
c. Third piece: calculate the range of income that will be taxed at 22% (anything falls under third bracket)

172750 – 81050 = $91700
91700 * .22 = $20174

d. Fourth piece: the remaining of the $240690 will be taxed at 24%
240690 – 172750 = $67940
67940 * .24 = $16,305.60
e. So, tax for income of $240690 is:
1990 + 7338 + 20174 + 16305.60 = $45,807.60

(5)$400100 - Falls under the Fifth bracket (32%):

a. First piece: $1990
b. Second piece: $7338
c. Third piece: $20174
d. Fourth piece: calculate the range of income that will be taxed at 24% (anything falls under fourth bracket)
329850 – 172750 = $157100
157100 * .24 = $37704
e. Fifth piece: the remaining of the $400100 will be taxed at 32%
400100 – 329850 = $70250
70250 * .32 = $22480
f. So, tax for income of $400100 is:
1990 + 7338 + 20174 + 37704 + 22480 = $89,686.00

(6)$490000 – Falls under the sixth bracket (35%):

a. First piece: $1990
b. Second piece: $7338
c. Third piece: $20174
d. Fourth piece: $37704
e. fifth piece: calculate the range of income that will be taxed at 32% (anything falls under fifth bracket):
418850 – 329850 = $89000
89000 * .32 = $28480
f. Sixth piece: the remaining of the $490000 will be taxed at 35%
490000 – 418850 = $71150
71150 * .35 = $24902.50
g. So, tax for income of $490000 is:
1990 + 7338 + 20174 + 37704 + 28480 + 24902.50 = $120,588.50

(7)$750930 – Falls under the seventh bracket (37%):

a. First piece: $1990
b. Second piece: $7338
c. Third piece: $20174

d. Fourth piece: $37704
e. fifth piece: $28480
f. sixth piece: calculate the range of income that will be taxed at 35% (anything falls under sixth bracket):
   628300 – 418850 = $209450
   209450 * .35 = $73,307.50
g. seventh piece: the remaining of the $750930 will be taxed at 37%
   750930 – 628300 = $122630
   122630 * .37 = $ 45373.10
h. So, tax for income of $750930 is:
i. 1990 + 7338 + 20174 + 37704 + 28480 + 73307.50 + 45373.10 = $214,366.60

Calculating random income – Piecewise function

(1)$8000 – falls within the first bracket (10%)
Piecewise function: t(p) = 0.10p
t(8000) = 0.10 * 8000 = $800.00

(2)$32000 – falls within the second bracket (12%):
Piecewise function: t(p) = .12p – 398
t(32000) = 0.12(32000) – 398
t(32000) = 3840 – 398 = $3,442.00

(3)$101930 – falls under the third bracket (22%):
Piecewise function: t(p) = .22p – 8503
t(101930) = .22(101930) – 8503
t(101930) = 22424.60 – 8503 = $13,921.60

(4)$240690 – Falls under the fourth bracket (24%):
Piecewise function: t(p) = .24p – 11958
t(240690) = .24(240690) – 11958
t(240690) = 57765.60 – 11958 = $45,807.60

(5)$400100 - Falls under the Fifth bracket (32%):
Piecewise function: t(p) = .32p – 38346
t(400100) = .32(400100) – 38346
t(400100) = 128032 – 38346= $89,686.00

(6)$490000 – Falls under the sixth bracket (35%):
Piecewise function: t(p) = .35p – 50911.50

t(490000) = .35(490000) – 50911.50
t(490000) = 171500 – 50911.50 = $120,588.50

(7)$750930 – Falls under the seventh bracket (37%):
Piecewise function: t(p) = .37p – 63477.50
t(750930) = .37(750930) – 63477.50
t(750930) = 277,844.10 – 63477.50 = $214,366.60

Reference

2020-2021 Tax Brackets & Rates For Each Income Level. Debt.org. (2021, October 12). Retrieved December 05, 2021, from https://www.debt.org/tax/brackets/#2021-tax-brackets.

Citation Format: APA version7.