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Interest Rates

An interest rate is the cost of borrowing money or the return earned on savings or investments, expressed as a percentage of the principal amount over a period of time.

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Effective Interest Rate

The Effective Interest Rate (EIR) is the true annual rate of interest, accounting for the effects of compounding during the year. It shows the actual cost of a loan or the real return on an investment, beyond just the nominal rate.

$$\text{EIR} = \left(1 + \frac{r}{n}\right)^n - 1$$

Where:

r = nominal annual interest rate

n = number of compounding periods per year

Why It Matters:

- EIR is higher than the nominal rate if interest is compounded more than once a year.
- It helps compare loans or investments with different compounding frequencies fairly.

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Nominal Interest Rate

The nominal interest rate is the stated or advertised rate of interest on a loan or investment, not accounting for compounding or inflation. It's usually expressed as an annual percentage.

If a bank offers a loan at 10% nominal annual interest, it means you'll be charged 10% per year, but the actual cost could be higher if interest is compounded monthly or quarterly.

🔄 **Nominal vs. Effective Interest Rate:**
Nominal Rate = Does not include compounding effects.
Effective Interest Rate (EIR) = Reflects true cost or return, including compounding.

Where:
r = Nominal annual interest rate
EIR = Effective annual interest rate
n = Number of compounding periods per year (e.g., 12 for monthly, 4 for quarterly)

$$r = n \times \left((1 + \mathrm{EIR})^{\frac{1}{n}} - 1 \right)$$

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Discount Rate

The discount rate is the interest rate used to calculate the present value (PV) of future cash flows. It reflects the time value of money—how much a future amount is worth in today's terms.

It's commonly used in:

- Finance (to discount future payments or investments)
- Business valuation
- Bond pricing
- Net Present Value (NPV) analysis

$$d = \frac{i}{1+i}$$

Where:

i = interest rate (based on future value: "add-on" interest)

d = discount rate (based on present value: "upfront" discount)

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Present Value, Accumulated Value

The present value is the current worth of a future sum of money or stream of cash flows, discounted at a specific rate.

VS

The accumulated value is the amount a present sum will grow to after earning interest over time.

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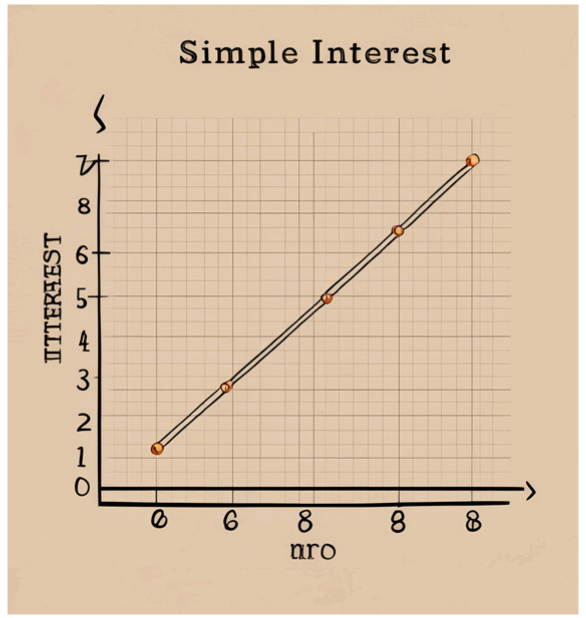
Simple V/s Compound

You are 25 years old today and want to retire at 60. That gives you 35 years to save. You decide to save a fixed amount every month — either $10 or $50 — and earn a 5% annual interest rate (simple interest).



Calculate:

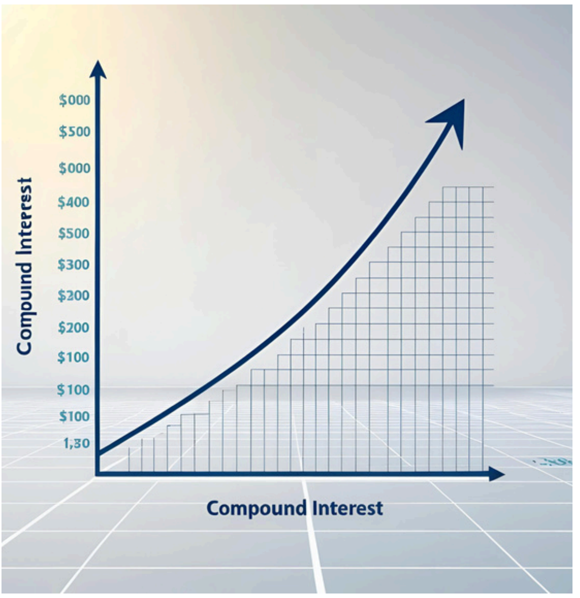
Accumulated value using simple interest

$A = P * 12 * t * (1+rt)$

Accumulated value using compound interest

$$A = P \times \left(\frac{(1+r/n)^{nt}-1}{r/n}\right)$$

Monthly Pension = Savings × Interest Rate ÷ Number of Years in Retirement.



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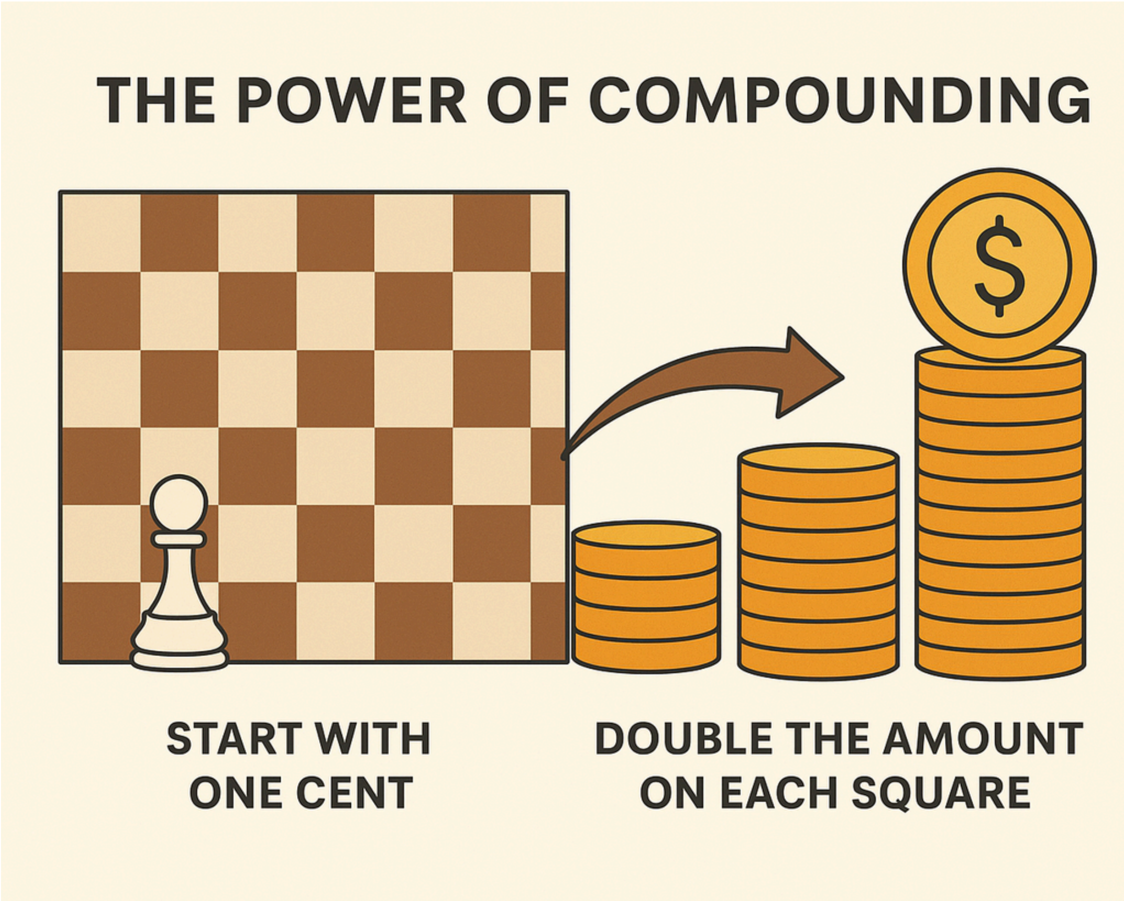
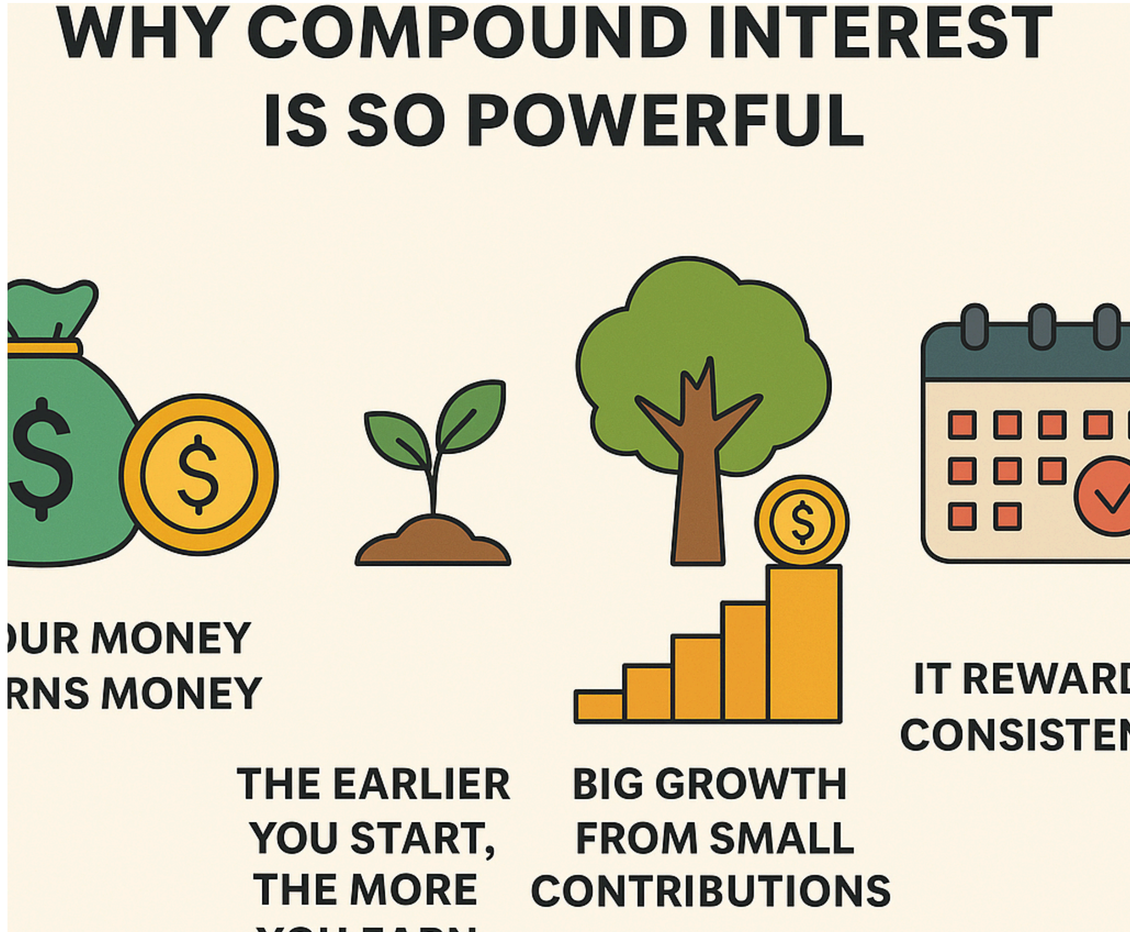
Power of Compounding

Compound interest is powerful because it allows your money to earn interest not only on the amount you save but also on the interest that has already been added. The longer your money has to grow, the more it compounds, leading to exponential growth. Even small, consistent contributions can result in significant wealth over time, making it a highly effective way to build savings.



📊 $20/Month – Simple vs. Compound Interest (5% Annual Rate)

Years Saved	Simple Interest	Compound interest
5	$1,300	$1,360
10	$2,600	$3,120
30	$7,800	$16,600



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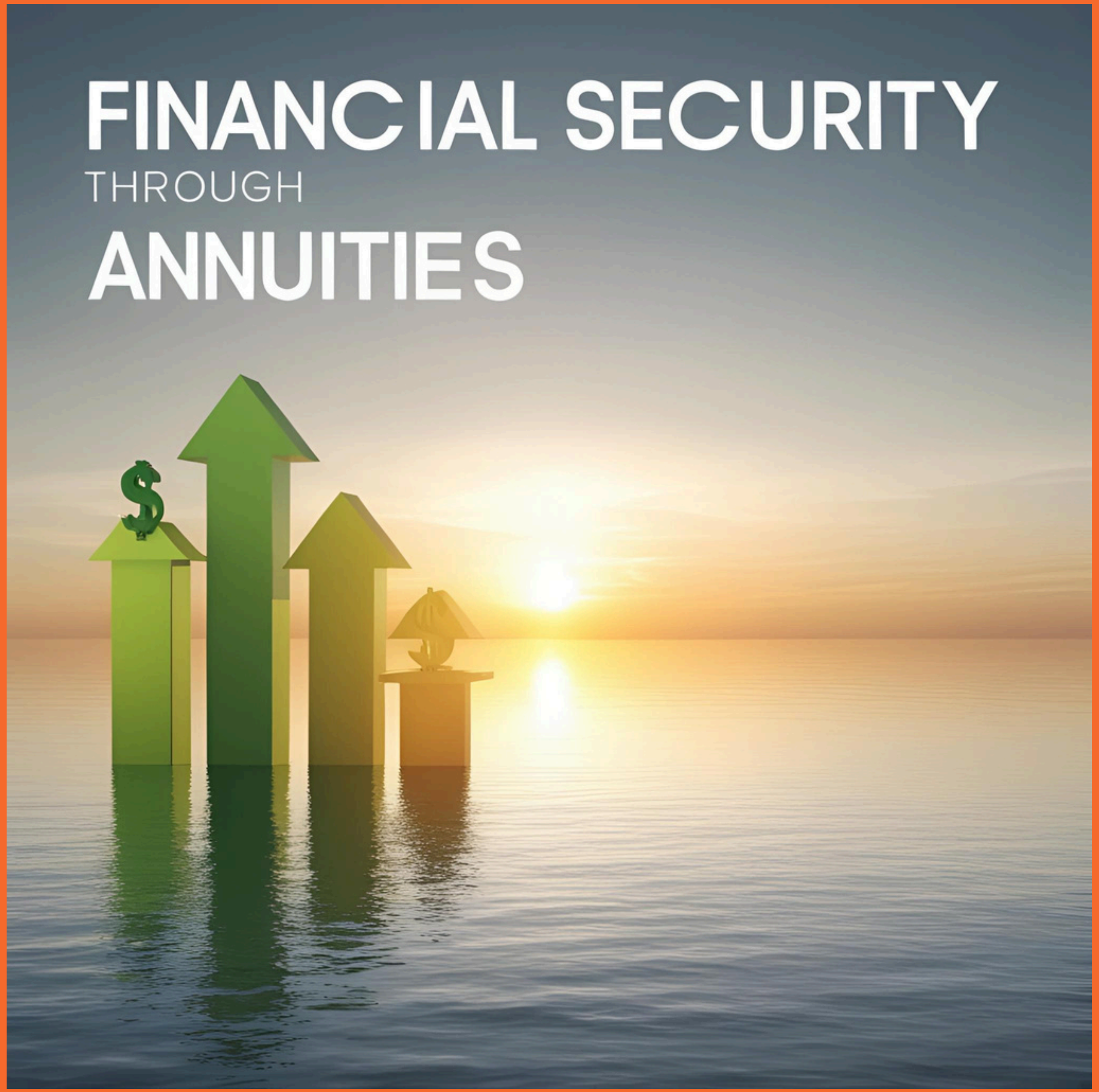
Annuities

An annuity is a series of equal payments or receipts made at regular intervals over a period of time.

🔑 **Key Features of Annuities:**

- Payments are equal in amount.
- They occur at regular intervals (e.g., monthly, annually).
- Common in loans, pensions, insurance, and investment products.

When you take a loan (like a home loan, car loan, or student loan), the repayment is often structured as an annuity — that is, a series of equal periodic payments made over time. These payments are used to repay both the interest and the principal.



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Loan Schedule

Here is a 15-year loan amortization schedule for a loan of ₹40,00,000 at a 1% monthly effective interest rate, assuming equal annual payments (i.e., an annuity loan):

$$A = P \times \frac{r(1+r)^n}{(1+r)^n - 1}$$

Applications of annuities

Where:

- A = annual payment
- P = loan amount = ₹40,00,000
- r = annual interest rate = 1% = 0.01
- n = number of payments = 15*12 =180

A couple takes out a loan of INR 40,00,000 to purchase a yacht. As the couple have a low current income, but are expecting their income to grow in the coming years, they agree to make monthly repayments in arrears for 15 years. The monthly rate is 1%.

By constructing the loan schedule for the whole term of the loan showing:

The amount of each repayment

The split of each repayment between interest and capital and

The capital outstanding after each repayment

Calculate the amount of the first monthly repayment needed to ensure that the capital outstanding is 0 at the end of the term of the loan.

Loan amount	4000000
Term in years	15
Payment structure	Annual
Repayment amount	48,006.72
Monthly increase in repayment amount	0
Monthly effective interest rate	1.0000%

Month	**Year**	**Loan at the start of the time period**	**Repayment**	**Interest**	**Capital Repayment**	**Loan at the end of the time period**
1	0.0833333333333333	4000000	48006.7224836605	40000	8006.7224836605	3991993.27751634
2	0.166666666666667	3991993.27751634	48006.7224836605	39919.93277516	8086.7897084971	3983906.48780784
3	0.25	3983906.48780784	48006.7224836605	39839.06487807	8167.65760558208	3975738.83020226
4	0.333333333333333	3975738.83020226	48006.7224836605	39757.38830202	8249.3341816379	3967489.49602062
5	0.416666666666667	3967489.49602062	48006.7224836605	39674.89496020	8331.82752345427	3959157.66849717
6	0.5	3959157.66849717	48006.7224836605	39591.57668497	8415.14579868882	3950742.52269848
7	0.583333333333333	3950742.52269848	48006.7224836605	39507.42522698	8499.2972566757	3942243.2254418
8	0.666666666666667	3942243.2254418	48006.7224836605	39422.43225441	8584.29022924246	3933658.93521256
9	0.75	3933658.93521256	48006.7224836605	39336.58935212	8670.13313153488	3924988.80208103

10	0.833333333333333	3924988.80208103	48006.7224836605	39249.8880208103	8756.83446285023	3916231.96761818
11	0.916666666666667	3916231.96761818	48006.7224836605	39162.3196761818	8844.40280747873	3907387.5648107
12	1	3907387.5648107	48006.7224836605	39073.875648107	8932.84683555352	3898454.71797514
13	1.08333333333333	3898454.71797514	48006.7224836605	38984.5471797514	9022.17530390906	3889432.54267124
14	1.16666666666667	3889432.54267124	48006.7224836605	38894.3254267124	9112.39705694815	3880320.14561429
15	1.25	3880320.14561429	48006.7224836605	38803.2014561429	9203.52102751763	3871116.62458677
16	1.33333333333333	3871116.62458677	48006.7224836605	38711.1662458677	9295.5562377928	3861821.06834898
17	1.41666666666667	3861821.06834898	48006.7224836605	38618.2106834898	9388.51180017073	3852432.55654881
18	1.5	3852432.55654881	48006.7224836605	38524.3255654881	9482.39691817244	3842950.15963063
19	1.58333333333333	3842950.15963063	48006.7224836605	38429.5015963063	9577.22088735416	3833372.93874328
20	1.66666666666667	3833372.93874328	48006.7224836605	38333.7293874328	9672.99309622771	3823699.94564705
21	1.75	3823699.94564705	48006.7224836605	38236.9994564705	9769.72302718998	3813930.22261986
22	1.83333333333333	3813930.22261986	48006.7224836605	38139.3022261986	9867.42025746188	3804062.8023624
23	1.91666666666667	3804062.8023624	48006.7224836605	38040.628023624	9966.0944600365	3794096.70790236
24	2	3794096.70790236	48006.7224836605	37940.9670790236	10065.7554046369	3784030.95249773
25	2.08333333333333	3784030.95249773	48006.7224836605	37840.3095249773	10166.4129586832	3773864.53953904
26	2.16666666666667	3773864.53953904	48006.7224836605	37738.6453953904	10268.0770882701	3763596.46245077
27	2.25	3763596.46245077	48006.7224836605	37635.9646245077	10370.7578591528	3753225.70459162
28	2.33333333333333	3753225.70459162	48006.7224836605	37532.2570459162	10474.4654377443	3742751.23915388
29	2.41666666666667	3742751.23915388	48006.7224836605	37427.5123915388	10579.2100921217	3732172.02906175
30	2.5	3732172.02906175	48006.7224836605	37321.7202906175	10685.002193043	3721487.02686871
31	2.58333333333333	3721487.02686871	48006.7224836605	37214.8702686871	10791.8522149734	3710695.17465374
32	2.66666666666667	3710695.17465374	48006.7224836605	37106.9517465374	10899.7707371231	3699795.40391662
33	2.75	3699795.40391662	48006.7224836605	36997.9540391662	11008.7684444944	3688786.63547212
34	2.83333333333333	3688786.63547212	48006.7224836605	36887.8663547212	11118.8561289393	3677667.77934318
35	2.91666666666667	3677667.77934318	48006.7224836605	36776.6777934318	11230.0446902287	3666437.73465295
36	3	3666437.73465295	48006.7224836605	36664.3773465295	11342.345137131	3655095.38951582
37	3.08333333333333	3655095.38951582	48006.7224836605	36550.9538951582	11455.7685885023	3643639.62092732
38	3.16666666666667	3643639.62092732	48006.7224836605	36436.3962092732	11570.3262743873	3632069.29465293
39	3.25	3632069.29465293	48006.7224836605	36320.6929465293	11686.0295371312	3620383.2651158

40	3.33333333333333	3620383.2651158	48006.7224836605	36203.832651158	11802.8898325025	3608580.3752833
41	3.41666666666667	3608580.3752833	48006.7224836605	36085.803752833	11920.9187308275	3596659.45655247
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43	3.58333333333333	3584619.32863434	48006.7224836605	35846.193286343	12160.5291973171	3572458.79943702
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108	9	2478781.55558374	48006.7224836605	24787.815555837	23218.9069278231	2455562.64865592
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111	9.25	2408425.94570175	48006.7224836605	24084.259457017	23922.463026643	2384503.4826751
112	9.33333333333333	2384503.4826751	48006.7224836605	23845.034826751	24161.6876569095	2360341.79501819
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114	9.5	2335938.49048472	48006.7224836605	23359.384904847	24647.3375788133	2311291.1529059
115	9.58333333333333	2311291.1529059	48006.7224836605	23112.911529059	24893.8109546015	2286397.3419513
116	9.66666666666667	2286397.3419513	48006.7224836605	22863.973419513	25142.7490641475	2261254.59288715
117	9.75	2261254.59288715	48006.7224836605	22612.545928871	25394.176554789	2235860.41633236
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119	9.91666666666667	2210212.29801203	48006.7224836605	22102.122980120	25904.5995035402	2184307.69850849
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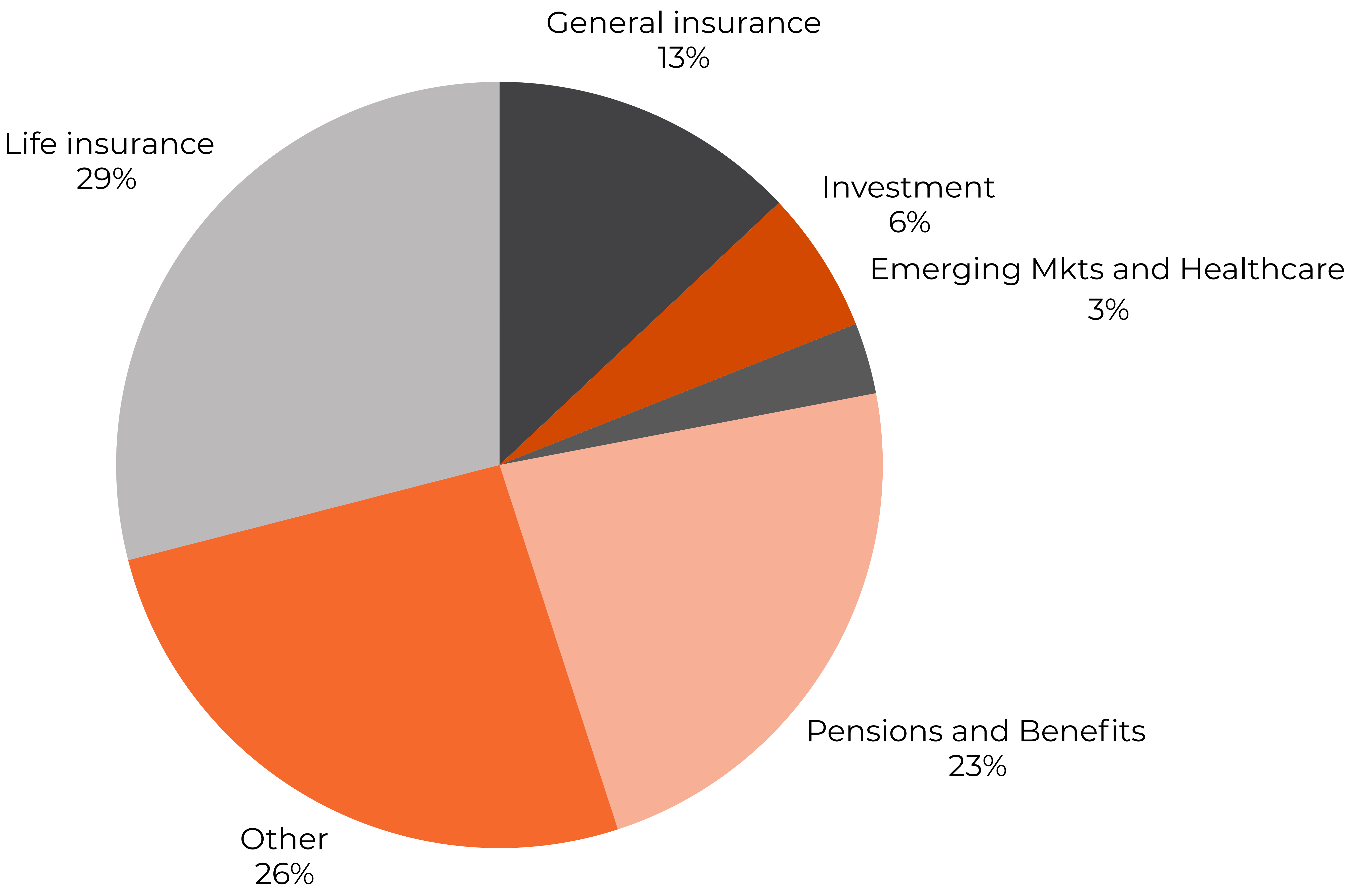

Thank you