



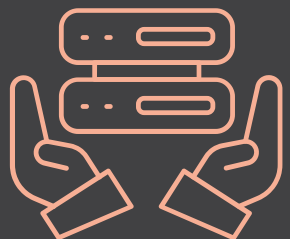
# IAQS

INSTITUTE OF ACTUARIAL  
& QUANTITATIVE STUDIES



# 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.



# 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.



# 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)

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

# 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)



# 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.



# 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:

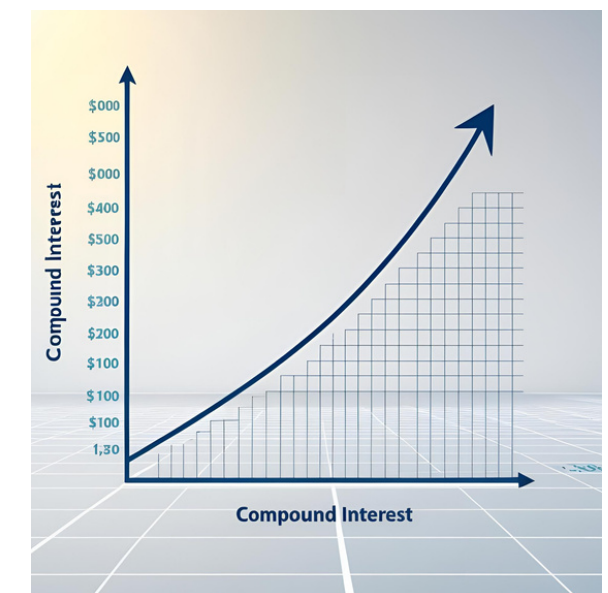
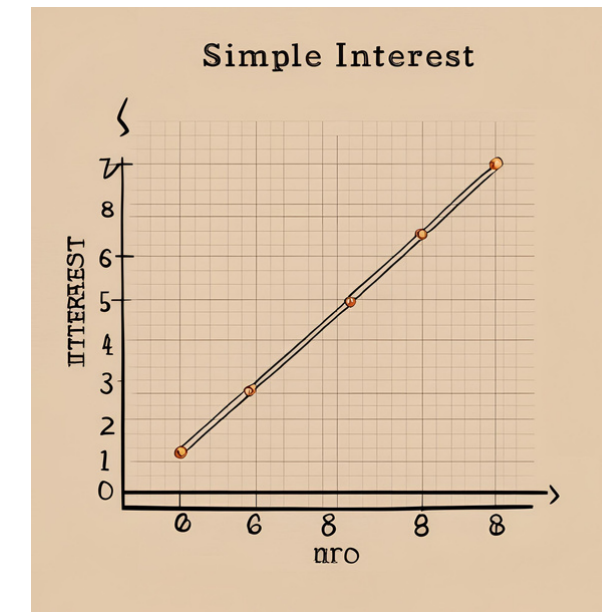
Accumulated value using simple interest

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

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.



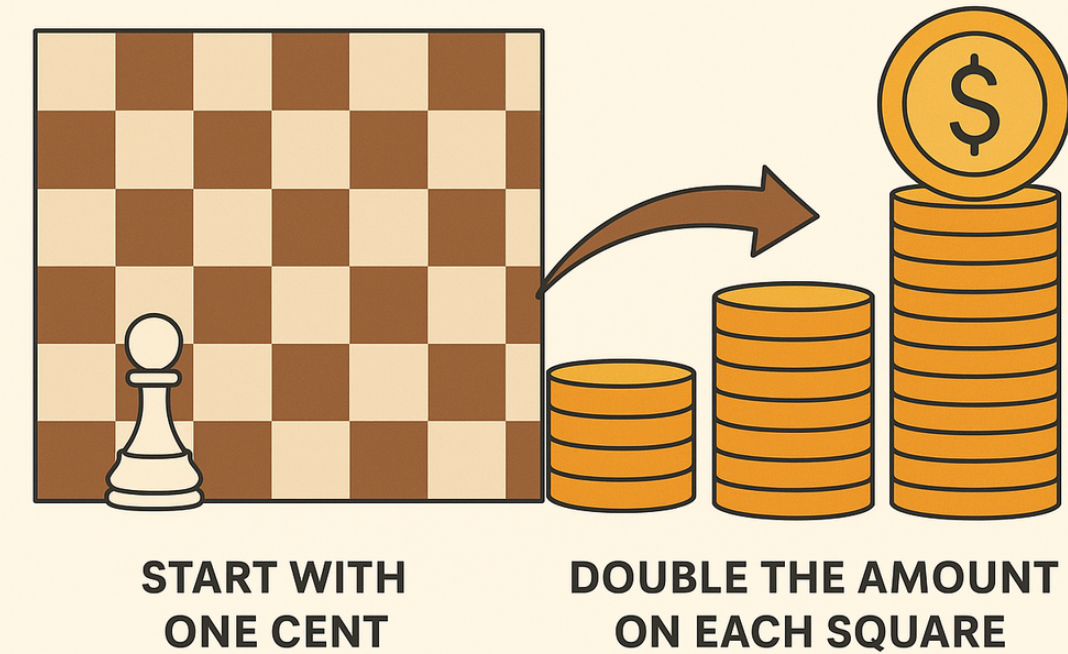
# Power of Compounding

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.

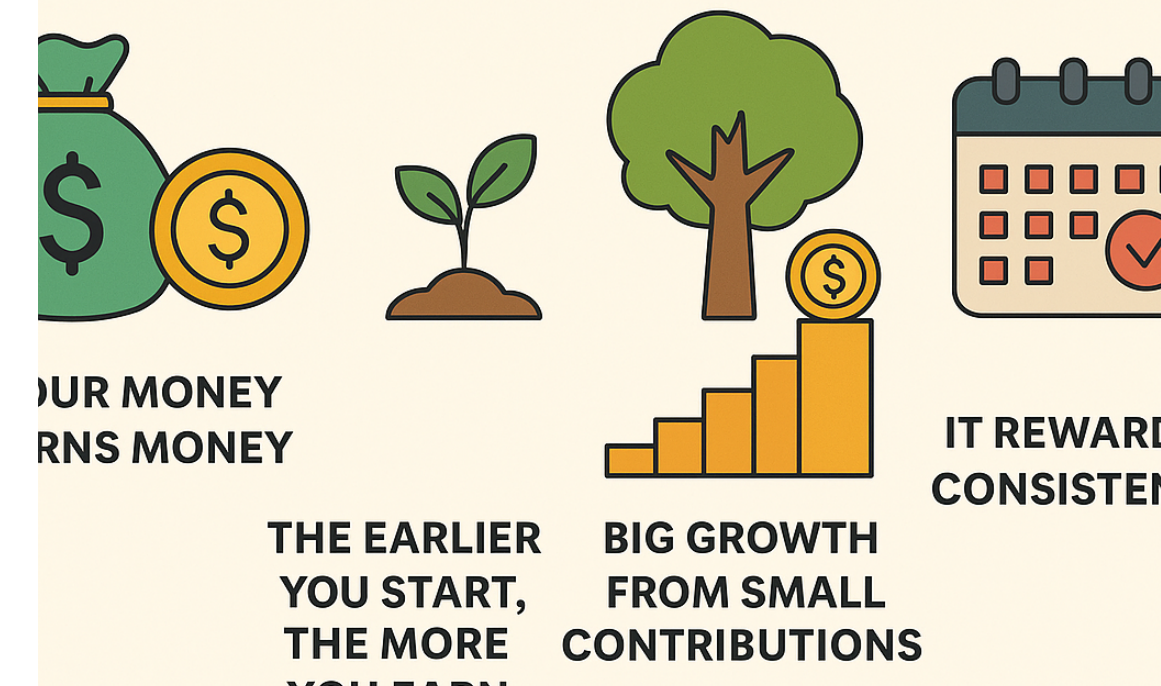
## \$20/Month – Simple vs. Compound Interest (5% Annual Rate)

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

## THE POWER OF COMPOUNDING



## WHY COMPOUND INTEREST IS SO POWERFUL



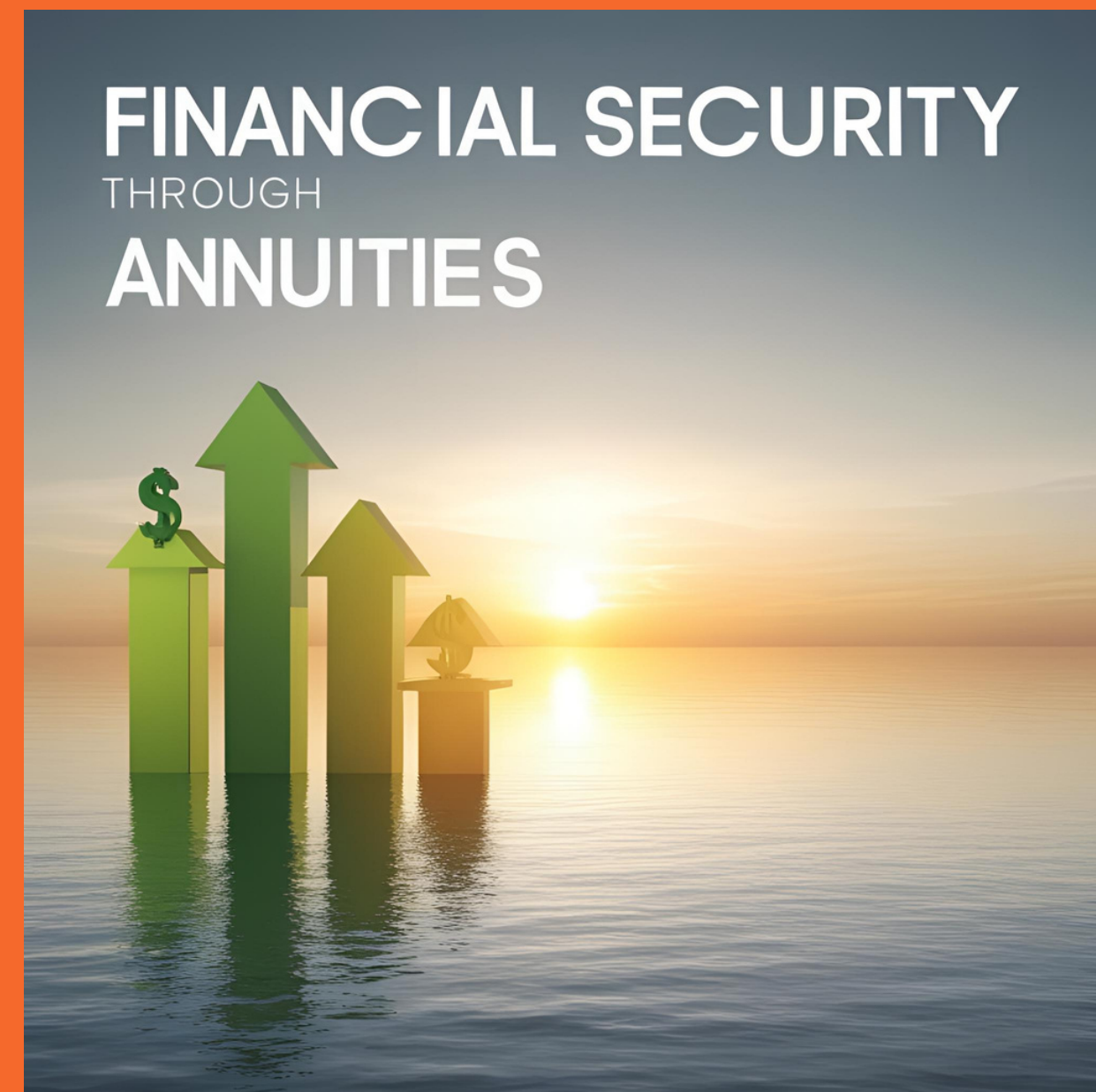
# Annuities

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.



# 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     | 0.1666666666666667 | 3991993.27751634                     | 48006.7224836605 | 39919.9327751634 | 8086.7897084971   | 3983906.48780784                   |
| 3     | 0.25               | 3983906.48780784                     | 48006.7224836605 | 39839.0648780784 | 8167.65760558208  | 3975738.83020226                   |
| 4     | 0.3333333333333333 | 3975738.83020226                     | 48006.7224836605 | 39757.3883020226 | 8249.3341816379   | 3967489.49602062                   |
| 5     | 0.4166666666666667 | 3967489.49602062                     | 48006.7224836605 | 39674.8949602062 | 8331.82752345427  | 3959157.66849717                   |
| 6     | 0.5                | 3959157.66849717                     | 48006.7224836605 | 39591.5766849717 | 8415.14579868882  | 3950742.52269848                   |
| 7     | 0.5833333333333333 | 3950742.52269848                     | 48006.7224836605 | 39507.4252269848 | 8499.2972566757   | 3942243.2254418                    |
| 8     | 0.6666666666666667 | 3942243.2254418                      | 48006.7224836605 | 39422.432254418  | 8584.29022924246  | 3933658.93521256                   |
| 9     | 0.75               | 3933658.93521256                     | 48006.7224836605 | 39336.5893521256 | 8670.13313153488  | 3924988.80208103                   |

|    |                    |                  |                  |                  |                  |                  |
|----|--------------------|------------------|------------------|------------------|------------------|------------------|
| 10 | 0.8333333333333333 | 3924988.80208103 | 48006.7224836605 | 39249.8880208103 | 8756.83446285023 | 3916231.96761818 |
| 11 | 0.9166666666666667 | 3916231.96761818 | 48006.7224836605 | 39162.3196761818 | 8844.40280747873 | 3907387.5648107  |
| 12 | 1                  | 3907387.5648107  | 48006.7224836605 | 39073.875648107  | 8932.84683555352 | 3898454.71797514 |
| 13 | 1.0833333333333333 | 3898454.71797514 | 48006.7224836605 | 38984.5471797514 | 9022.17530390906 | 3889432.54267124 |
| 14 | 1.1666666666666667 | 3889432.54267124 | 48006.7224836605 | 38894.3254267124 | 9112.39705694815 | 3880320.14561429 |
| 15 | 1.25               | 3880320.14561429 | 48006.7224836605 | 38803.2014561429 | 9203.52102751763 | 3871116.62458677 |
| 16 | 1.3333333333333333 | 3871116.62458677 | 48006.7224836605 | 38711.1662458677 | 9295.5562377928  | 3861821.06834898 |
| 17 | 1.4166666666666667 | 3861821.06834898 | 48006.7224836605 | 38618.2106834898 | 9388.51180017073 | 3852432.55654881 |
| 18 | 1.5                | 3852432.55654881 | 48006.7224836605 | 38524.3255654881 | 9482.39691817244 | 3842950.15963063 |
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| 20 | 1.6666666666666667 | 3833372.93874328 | 48006.7224836605 | 38333.7293874328 | 9672.99309622771 | 3823699.94564705 |
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| 26 | 2.1666666666666667 | 3773864.53953904 | 48006.7224836605 | 37738.6453953904 | 10268.0770882701 | 3763596.46245077 |
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| 36 | 3                  | 3666437.73465295 | 48006.7224836605 | 36664.3773465295 | 11342.345137131  | 3655095.38951582 |
| 37 | 3.0833333333333333 | 3655095.38951582 | 48006.7224836605 | 36550.9538951582 | 11455.7685885023 | 3643639.62092732 |
| 38 | 3.1666666666666667 | 3643639.62092732 | 48006.7224836605 | 36436.3962092732 | 11570.3262743873 | 3632069.29465293 |
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|    |                 |                  |                  |                 |                  |                  |
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| 67 | 5.5833333333333 | 3256607.72173429 | 48006.7224836605 | 32566.077217342 | 15440.6452663176 | 3241167.07646798 |
| 68 | 5.6666666666667 | 3241167.07646798 | 48006.7224836605 | 32411.670764679 | 15595.0517189807 | 3225572.02474899 |
| 69 | 5.75            | 3225572.02474899 | 48006.7224836605 | 32255.720247489 | 15751.0022361706 | 3209821.02251282 |

|    |                  |                  |                  |                  |                  |                  |
|----|------------------|------------------|------------------|------------------|------------------|------------------|
| 70 | 5.83333333333333 | 3209821.02251282 | 48006.7224836605 | 32098.2102251282 | 15908.5122585323 | 3193912.51025429 |
| 71 | 5.91666666666667 | 3193912.51025429 | 48006.7224836605 | 31939.1251025429 | 16067.5973811176 | 3177844.91287317 |
| 72 | 6                | 3177844.91287317 | 48006.7224836605 | 31778.4491287317 | 16228.2733549288 | 3161616.63951825 |
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| 74 | 6.16666666666667 | 3145226.08342977 | 48006.7224836605 | 31452.2608342977 | 16554.4616493628 | 3128671.6217804  |
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| 76 | 6.33333333333333 | 3111951.61551455 | 48006.7224836605 | 31119.5161551455 | 16887.206328515  | 3095064.40918603 |
| 77 | 6.41666666666667 | 3095064.40918603 | 48006.7224836605 | 30950.6440918603 | 17056.0783918002 | 3078008.33079423 |
| 78 | 6.5              | 3078008.33079423 | 48006.7224836605 | 30780.0833079423 | 17226.6391757182 | 3060781.69161851 |
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| 85 | 7.08333333333333 | 2953743.36253815 | 48006.7224836605 | 29537.4336253815 | 18469.288858279  | 2935274.07367987 |
| 86 | 7.16666666666667 | 2935274.07367987 | 48006.7224836605 | 29352.7407367987 | 18653.9817468618 | 2916620.09193301 |
| 87 | 7.25             | 2916620.09193301 | 48006.7224836605 | 29166.2009193301 | 18840.5215643304 | 2897779.57036868 |
| 88 | 7.33333333333333 | 2897779.57036868 | 48006.7224836605 | 28977.7957036868 | 19028.9267799737 | 2878750.6435887  |
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| 96 | 8                | 2740112.15190602 | 48006.7224836605 | 27401.1215190602 | 20605.6009646003 | 2719506.55094142 |
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| 100 | 8.33333333333333  | 2656445.14914376 | 48006.7224836605 | 26564.4514914376 | 21442.2709922229 | 2635002.87815153 |
| 101 | 8.41666666666667  | 2635002.87815153 | 48006.7224836605 | 26350.0287815153 | 21656.6937021452 | 2613346.18444939 |
| 102 | 8.5               | 2613346.18444939 | 48006.7224836605 | 26133.4618444939 | 21873.2606391666 | 2591472.92381022 |
| 103 | 8.58333333333333  | 2591472.92381022 | 48006.7224836605 | 25914.7292381022 | 22091.9932455583 | 2569380.93056466 |
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| 105 | 8.75              | 2547068.01738665 | 48006.7224836605 | 25470.6801738665 | 22536.042309794  | 2524531.97507686 |
| 106 | 8.83333333333333  | 2524531.97507686 | 48006.7224836605 | 25245.3197507686 | 22761.4027328919 | 2501770.57234396 |
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| 108 | 9                 | 2478781.55558374 | 48006.7224836605 | 24787.8155558374 | 23218.9069278231 | 2455562.64865592 |
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| 110 | 9.16666666666667  | 2432111.55265882 | 48006.7224836605 | 24321.1155265882 | 23685.6069570723 | 2408425.94570175 |
| 111 | 9.25              | 2408425.94570175 | 48006.7224836605 | 24084.2594570175 | 23922.463026643  | 2384503.4826751  |
| 112 | 9.33333333333333  | 2384503.4826751  | 48006.7224836605 | 23845.034826751  | 24161.6876569095 | 2360341.79501819 |
| 113 | 9.41666666666667  | 2360341.79501819 | 48006.7224836605 | 23603.4179501819 | 24403.3045334786 | 2335938.49048472 |
| 114 | 9.5               | 2335938.49048472 | 48006.7224836605 | 23359.3849048472 | 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 | 22612.5459288715 | 25394.176554789  | 2235860.41633236 |
| 118 | 9.83333333333333  | 2235860.41633236 | 48006.7224836605 | 22358.6041633236 | 25648.1183203369 | 2210212.29801203 |
| 119 | 9.91666666666667  | 2210212.29801203 | 48006.7224836605 | 22102.1229801203 | 25904.5995035402 | 2184307.69850849 |
| 120 | 10                | 2184307.69850849 | 48006.7224836605 | 21843.0769850849 | 26163.6454985756 | 2158144.05300991 |
| 121 | 10.08333333333333 | 2158144.05300991 | 48006.7224836605 | 21581.4405300991 | 26425.2819535614 | 2131718.77105635 |
| 122 | 10.16666666666667 | 2131718.77105635 | 48006.7224836605 | 21317.1877105635 | 26689.534773097  | 2105029.23628325 |
| 123 | 10.25             | 2105029.23628325 | 48006.7224836605 | 21050.2923628325 | 26956.430120828  | 2078072.80616242 |
| 124 | 10.33333333333333 | 2078072.80616242 | 48006.7224836605 | 20780.7280616242 | 27225.9944220363 | 2050846.81174039 |
| 125 | 10.41666666666667 | 2050846.81174039 | 48006.7224836605 | 20508.4681174039 | 27498.2543662566 | 2023348.55737413 |
| 126 | 10.5              | 2023348.55737413 | 48006.7224836605 | 20233.4855737413 | 27773.2369099192 | 1995575.32046421 |
| 127 | 10.58333333333333 | 1995575.32046421 | 48006.7224836605 | 19955.7532046421 | 28050.9692790184 | 1967524.35118519 |
| 128 | 10.66666666666667 | 1967524.35118519 | 48006.7224836605 | 19675.2435118519 | 28331.4789718086 | 1939192.87221339 |
| 129 | 10.75             | 1939192.87221339 | 48006.7224836605 | 19391.9287221339 | 28614.7937615266 | 1910578.07845186 |

|     |                  |                  |                  |                  |                  |                  |
|-----|------------------|------------------|------------------|------------------|------------------|------------------|
| 130 | 10.8333333333333 | 1910578.07845186 | 48006.7224836605 | 19105.7807845186 | 28900.9416991419 | 1881677.13675272 |
| 131 | 10.9166666666667 | 1881677.13675272 | 48006.7224836605 | 18816.7713675272 | 29189.9511161333 | 1852487.18563658 |
| 132 | 11               | 1852487.18563658 | 48006.7224836605 | 18524.8718563658 | 29481.8506272947 | 1823005.33500929 |
| 133 | 11.0833333333333 | 1823005.33500929 | 48006.7224836605 | 18230.0533500929 | 29776.6691335676 | 1793228.66587572 |
| 134 | 11.1666666666667 | 1793228.66587572 | 48006.7224836605 | 17932.2866587572 | 30074.4358249033 | 1763154.23005082 |
| 135 | 11.25            | 1763154.23005082 | 48006.7224836605 | 17631.5423005082 | 30375.1801831523 | 1732779.04986767 |
| 136 | 11.3333333333333 | 1732779.04986767 | 48006.7224836605 | 17327.7904986767 | 30678.9319849838 | 1702100.11788268 |
| 137 | 11.4166666666667 | 1702100.11788268 | 48006.7224836605 | 17021.0011788268 | 30985.7213048337 | 1671114.39657785 |
| 138 | 11.5             | 1671114.39657785 | 48006.7224836605 | 16711.1439657785 | 31295.578517882  | 1639818.81805997 |
| 139 | 11.5833333333333 | 1639818.81805997 | 48006.7224836605 | 16398.1881805997 | 31608.5343030608 | 1608210.28375691 |
| 140 | 11.6666666666667 | 1608210.28375691 | 48006.7224836605 | 16082.1028375691 | 31924.6196460914 | 1576285.66411081 |
| 141 | 11.75            | 1576285.66411081 | 48006.7224836605 | 15762.8566411081 | 32243.8658425524 | 1544041.79826826 |
| 142 | 11.8333333333333 | 1544041.79826826 | 48006.7224836605 | 15440.4179826826 | 32566.3045009779 | 1511475.49376728 |
| 143 | 11.9166666666667 | 1511475.49376728 | 48006.7224836605 | 15114.7549376728 | 32891.9675459877 | 1478583.5262213  |
| 144 | 12               | 1478583.5262213  | 48006.7224836605 | 14785.835262213  | 33220.8872214475 | 1445362.63899985 |
| 145 | 12.0833333333333 | 1445362.63899985 | 48006.7224836605 | 14453.6263899985 | 33553.096093662  | 1411809.54290619 |
| 146 | 12.1666666666667 | 1411809.54290619 | 48006.7224836605 | 14118.0954290619 | 33888.6270545986 | 1377920.91585159 |
| 147 | 12.25            | 1377920.91585159 | 48006.7224836605 | 13779.2091585159 | 34227.5133251446 | 1343693.40252644 |
| 148 | 12.3333333333333 | 1343693.40252644 | 48006.7224836605 | 13436.9340252644 | 34569.7884583961 | 1309123.61406805 |
| 149 | 12.4166666666667 | 1309123.61406805 | 48006.7224836605 | 13091.2361406805 | 34915.48634298   | 1274208.12772507 |
| 150 | 12.5             | 1274208.12772507 | 48006.7224836605 | 12742.0812772507 | 35264.6412064098 | 1238943.48651866 |
| 151 | 12.5833333333333 | 1238943.48651866 | 48006.7224836605 | 12389.4348651866 | 35617.2876184739 | 1203326.19890018 |
| 152 | 12.6666666666667 | 1203326.19890018 | 48006.7224836605 | 12033.2619890018 | 35973.4604946587 | 1167352.73840552 |
| 153 | 12.75            | 1167352.73840552 | 48006.7224836605 | 11673.5273840552 | 36333.1950996052 | 1131019.54330592 |
| 154 | 12.8333333333333 | 1131019.54330592 | 48006.7224836605 | 11310.1954330592 | 36696.5270506013 | 1094323.01625532 |
| 155 | 12.9166666666667 | 1094323.01625532 | 48006.7224836605 | 10943.2301625532 | 37063.4923211073 | 1057259.52393421 |
| 156 | 13               | 1057259.52393421 | 48006.7224836605 | 10572.5952393421 | 37434.1272443184 | 1019825.39668989 |
| 157 | 13.0833333333333 | 1019825.39668989 | 48006.7224836605 | 10198.2539668989 | 37808.4685167616 | 982016.928173131 |
| 158 | 13.1666666666667 | 982016.928173131 | 48006.7224836605 | 9820.16928173131 | 38186.5532019292 | 943830.374971202 |
| 159 | 13.25            | 943830.374971202 | 48006.7224836605 | 9438.30374971202 | 38568.4187339485 | 905261.956237254 |

|     |                  |                  |                  |                 |                  |                          |
|-----|------------------|------------------|------------------|-----------------|------------------|--------------------------|
| 160 | 13.3333333333333 | 905261.956237254 | 48006.7224836605 | 9052.6195623725 | 38954.102921288  | 866307.853315966         |
| 161 | 13.4166666666667 | 866307.853315966 | 48006.7224836605 | 8663.0785331596 | 39343.6439505008 | 826964.209365465         |
| 162 | 13.5             | 826964.209365465 | 48006.7224836605 | 8269.6420936546 | 39737.0803900059 | 787227.128975459         |
| 163 | 13.5833333333333 | 787227.128975459 | 48006.7224836605 | 7872.2712897545 | 40134.4511939059 | 747092.677781553         |
| 164 | 13.6666666666667 | 747092.677781553 | 48006.7224836605 | 7470.9267778155 | 40535.795705845  | 706556.882075708         |
| 165 | 13.75            | 706556.882075708 | 48006.7224836605 | 7065.5688207570 | 40941.1536629034 | 665615.728412804         |
| 166 | 13.8333333333333 | 665615.728412804 | 48006.7224836605 | 6656.1572841280 | 41350.5651995325 | 624265.163213272         |
| 167 | 13.9166666666667 | 624265.163213272 | 48006.7224836605 | 6242.6516321327 | 41764.0708515278 | 582501.092361744         |
| 168 | 14               | 582501.092361744 | 48006.7224836605 | 5825.0109236174 | 42181.7115600431 | 540319.380801701         |
| 169 | 14.0833333333333 | 540319.380801701 | 48006.7224836605 | 5403.1938080170 | 42603.5286756435 | 497715.852126058         |
| 170 | 14.1666666666667 | 497715.852126058 | 48006.7224836605 | 4977.1585212605 | 43029.5639623999 | 454686.288163658         |
| 171 | 14.25            | 454686.288163658 | 48006.7224836605 | 4546.8628816365 | 43459.8596020239 | 411226.428561634         |
| 172 | 14.3333333333333 | 411226.428561634 | 48006.7224836605 | 4112.2642856163 | 43894.4581980442 | 367331.97036359          |
| 173 | 14.4166666666667 | 367331.97036359  | 48006.7224836605 | 3673.3197036359 | 44333.4027800246 | 322998.567583565         |
| 174 | 14.5             | 322998.567583565 | 48006.7224836605 | 3229.9856758356 | 44776.7368078248 | 278221.83077574          |
| 175 | 14.5833333333333 | 278221.83077574  | 48006.7224836605 | 2782.2183077574 | 45224.5041759031 | 232997.326599837         |
| 176 | 14.6666666666667 | 232997.326599837 | 48006.7224836605 | 2329.9732659983 | 45676.7492176621 | 187320.577382175         |
| 177 | 14.75            | 187320.577382175 | 48006.7224836605 | 1873.2057738217 | 46133.5167098388 | 141187.060672336         |
| 178 | 14.8333333333333 | 141187.060672336 | 48006.7224836605 | 1411.8706067233 | 46594.8518769371 | 94592.2087953991         |
| 179 | 14.9166666666667 | 94592.2087953991 | 48006.7224836605 | 945.92208795399 | 47060.8003957065 | 47531.4083996926         |
| 180 | 15               | 47531.4083996926 | 48006.7224836605 | 475.31408399692 | 47531.4083996636 | 0.0000000290310708805919 |



# ACTUARIES IN NON-TRADITIONAL ROLES



## Data Science

Actuaries' expertise in statistical modeling and predictive analytics makes them ideal for roles in machine learning and big data analytics across industries.



## Finance

Actuaries apply their financial knowledge in investment management, banking, and corporate finance to analyze risks, manage investments, and offer financial advice.



## Consulting

Actuaries work as consultants, advising businesses on risk management, financial planning, and strategic decision-making.



## Healthcare

In healthcare, actuaries analyze costs, manage patient data, and predict trends, often collaborating with insurers and policymakers.



## Public Policy

Actuaries use their analytical skills to inform public policy by analyzing demographic, economic, and social data to aid decision-making.



## Business Start-ups

Actuaries support e-commerce and start-ups with risk management, forecasting, and financial planning strategies.

