**TIME VALUE OF MONEY (TVM)**

**FOUNDATIONAL CONCEPTS & EXCEL FUNCTION PRIMER**

**Pre-Session Learning Resource for Financial Modelling Using Excel**

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# 1. Introduction and Learning Objectives

## 1.1 Why Time Value of Money Matters

The **Time Value of Money (TVM)** is a foundational principle in finance, stating that money available today is worth more than the same amount in the future due to its earning potential. This principle underlies:

- Loan repayments and EMIs
- Investment valuation
- Retirement planning
- Project finance and capital budgeting
- Corporate financial modelling

All Excel-based models used later in this course—**PMT models, amortization schedules, FV accumulation, RATE targeting, NPER estimation**—are direct applications of TVM logic.

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## 1.2 Learning Outcomes of This Resource

After studying this material, students will be able to:

- Understand **core TVM concepts** and their financial meaning
- Identify **correct inputs** for different TVM problems
- Use **Excel TVM functions correctly**, with proper arguments
- Avoid **common modelling and sign-convention errors**
- Prepare confidently for hands-on Excel modelling sessions

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# 2. Core Time Value of Money Concepts

## 2.1 Present Value (PV)

**Present Value** represents the **current worth of a future cash flow**, discounted at a given rate of return.

**Applications:**

- Loan amount disbursed today
- Initial investment value
- Discounting future receipts

**Financial intuition:**

PV answers the question:

"How much is a future amount worth today?"

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## 2.2 Future Value (FV)

**Future Value** is the **value of money at a future date**, after earning interest over time.

**Applications:**

- Investment growth
- Retirement corpus
- Savings accumulation

FV can arise from:

- A **single lump-sum investment**
- A **series of periodic deposits**

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## 2.3 Interest Rate (Rate)

The **interest rate** represents the **price of money over time**.

Key points:

- Must always be expressed as a **periodic rate**
- Annual rates must be adjusted for compounding frequency

**Example:**

- Annual rate = 12%
- Monthly rate = 12% ÷ 12 = 1%

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## 2.4 Number of Periods (NPER)

**NPER** represents the **total number of compounding or payment periods**.

Examples:

- 5 years with monthly payments → 5 × 12 = 60 periods

- 10 years with quarterly deposits → 10 × 4 = 40 periods

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## 2.5 Periodic Payment (PMT)

**PMT** is a **fixed periodic cash flow**, such as:

- EMI on a loan
- Monthly savings deposit

PMT may represent:

- **Cash outflow** (loan repayment, investment deposit)
- **Cash inflow** (annuity receipt)

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## 2.6 Compounding Frequency

Compounding determines **how often interest is calculated and applied**.

Common frequencies:

- Annual (1)
- Semi-annual (2)
- Quarterly (4)
- Monthly (12)
- Weekly (52)

**Higher frequency → higher effective interest impact**

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# 3. Cash Flow Timing Convention

## 3.1 End-of-Period vs Beginning-of-Period

Excel distinguishes cash flows by **timing**:

- **End of period (Type = 0)**
    - Default in Excel
    - EMIs, SIPs, deposits usually occur here
- **Beginning of period (Type = 1)**
    - Rent payments, advance payments

Unless explicitly stated, **assume end-of-period payments**.

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# 4. Excel Sign Convention (CRITICAL)

## 4.1 Borrower vs Investor Perspective

Excel requires **opposite signs** for cash inflows and outflows.

| Perspective | Cash Flow | Sign |
|---|---|---|
| Borrower | Loan received | Positive |
| Borrower | EMI paid | Negative |
| Investor | Investment made | Negative |
| Investor | Future value received | Positive |

❗ **Incorrect signs lead to wrong results or errors**

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# 5. Excel TVM Functions – Conceptual & Practical Guide

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## 5.1 PMT Function – Periodic Payment

**Purpose**

Calculates **equal periodic payments** for loans or investments.

**Syntax**

=PMT(rate, nper, pv, [fv], [type])

**Key Arguments Explained**

- **rate** → Periodic interest rate
- **nper** → Total number of periods
- **pv** → Present value (loan or investment today)
- **fv** → Future value (balloon or target value, optional)
- **type** → 0 = end, 1 = beginning (optional)

**Typical Applications**

- EMI calculation
- Required savings per period

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## 5.2 FV Function – Future Value

**Purpose**

Calculates the **value of an investment at maturity**.

**Syntax**

=FV(rate, nper, pmt, pv, [type])

**Typical Applications**

- Retirement corpus
- Education fund
- Emergency savings

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## 5.3 RATE Function – Required Interest Rate

**Purpose**

Determines the **interest rate needed** to reach a target.

**Syntax**

=RATE(nper, pmt, pv, fv, [type])

**Typical Applications**

- Goal-based planning
- Return expectations

📌 Excel returns **periodic rate** → must annualize if needed.

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## 5.4 NPER Function – Required Time

**Purpose**

Calculates **how long it takes** to reach a goal.

**Syntax**

=NPER(rate, pmt, pv, fv, [type])

**Typical Applications**

- Retirement planning horizon
- Education savings duration

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## 6. Conceptual Link to Loan Amortization

### 6.1 What EMI Actually Represents

An EMI consists of:

- **Interest on outstanding balance**
- **Principal repayment**

Although EMI is constant:

- Interest **declines over time**
- Principal **increases over time**

This logic is expanded using:

- PMT → EMI
- IPMT → Interest portion
- PPMT → Principal portion

(Developed fully in amortization workbooks.)

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## 7. Common Student Mistakes to Avoid

### 7.1 Conceptual Errors

- Using **annual rate directly** instead of periodic rate
- Confusing **years with periods**
- Ignoring compounding frequency

### 7.2 Excel Modelling Errors

- Wrong sign for PV or PMT
- Forgetting balloon value in PMT
- Mixing frequencies (monthly rate with annual NPER)

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## 8. How This Resource Fits into the Course Flow

### 8.1 Learning Progression

1. **This document** – Conceptual grounding
2. PMT models – EMI mechanics
3. Loan amortization – Cash flow decomposition

4. FV models – Investment accumulation
5. RATE & NPER – Goal-based financial planning

Each workbook operationalizes concepts introduced here.

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## 9. Final Instruction to Students

Before attending the Excel lab session, students must:

- Read this document thoroughly
- Understand **each TVM variable conceptually**
- Be comfortable with **Excel TVM function arguments**

Excel will calculate instantly, but **financial understanding determines correctness**.

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