Excel Formulas - Digital Finance Exam Revision Guide

Overview

This comprehensive guide covers all Excel formulas used in Digital Finance course exercises. Each formula includes practical examples from actual exercises to help you understand their application in exam scenarios.

Files Analyzed: 7 Excel solution files
Total Formulas Found: 4,956
Unique Formula Types: 15

SECTION 1: Statistical & Descriptive Analysis Formulas

1. AVERAGE Function

Syntax: `=AVERAGE(range)`

What it does: Calculates the arithmetic mean (average) of numbers in a range.

Exercise 3 Example - Bitcoin Returns:
`=AVERAGE(C279:C382)`

- **Column C:** Bitcoin Monthly Returns (%)
- **Purpose:** Calculate average monthly return for Bitcoin over the period
- **Result:** 0.19303 (19.303% average monthly return)

Exercise 5 Example - Fund Performance:
`=AVERAGE(C294:EO294)`

- **Row 294:** Large-Cap Fund Monthly Returns
- **Purpose:** Calculate equal-weighted average return across all large-cap funds
- **Result:** 0.7661% per month (9.19% annualized)

When to use in exam: Anytime you need to calculate mean returns, average prices, or central tendency of financial data.

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2. STDEV.S Function (Standard Deviation)

Syntax: `=STDEV.S(range)` or `=_xlfn.STDEV.S(range)`

What it does: Calculates sample standard deviation, measuring volatility/risk of returns.

Exercise 3 Example - Bitcoin Volatility:
`=_xlfn.STDEV.S(C279:C382)`

- **Column C:** Bitcoin Monthly Returns

- **Purpose:** Measure volatility (risk) of Bitcoin returns
- **Result:** 0.63239 (63.239% monthly volatility - very high!)

Exercise 5 Example - Fund Risk:
=_xlfn.STDEV.S(C294:EO294)

- **Row 294:** Large-Cap Fund Returns
- **Purpose:** Calculate standard deviation of fund returns
- **Result:** 5.2749% per month (18.27% annualized)

When to use in exam: Calculate volatility, risk measures, or dispersion of returns. Essential for Sharpe ratio calculations.

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3. SKEW Function

Syntax: `=SKEW(range)`

What it does: Measures asymmetry of return distribution. Positive = more extreme positive returns (right-skewed), Negative = more extreme negative returns (left-skewed).

Exercise 3 Example - Bitcoin Distribution:
=SKEW(C279:C382)

- **Column C:** Bitcoin Monthly Returns
- **Purpose:** Assess whether Bitcoin returns are skewed
- **Result:** 4.51568 (highly positively skewed - large positive outliers)

Interpretation:

- Skewness = 0: Perfectly symmetric distribution
- Skewness > 0: Right-skewed (Bitcoin case - occasional huge gains)
- Skewness < 0: Left-skewed (more frequent losses)

When to use in exam: Analyze risk characteristics beyond volatility, especially for tail risk assessment.

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4. KURT Function

Syntax: `=KURT(range)`

What it does: Measures degree of outliers/"fat tails" in distribution. Higher values = more extreme outliers.

Exercise 3 Example - Bitcoin Tail Risk:
=KURT(C279:C382)

- **Column C:** Bitcoin Monthly Returns
- **Purpose:** Measure tail risk and extreme events
- **Result:** 26.03884 (extremely high kurtosis - many outliers)

Comparison:

- Normal distribution: Kurtosis ≈ 0
- Bitcoin: Kurtosis = 26.04 (extreme outliers)

- MSCI World: Kurtosis = 1.01 (moderate outliers)

When to use in exam: Assess extreme risk, compare risk profiles of different assets.

SECTION 2: Correlation & Regression Formulas

5. CORREL Function

Syntax: `=CORREL(range1, range2)`

What it does: Calculates correlation coefficient between two variables (-1 to +1). Measures strength and direction of linear relationship.

Exercise 5 Example - BASF vs DAX:
=CORREL(C2:C132,B2:B132)

- **Column B:** DAX Monthly Returns
- **Column C:** BASF Stock Monthly Returns
- **Purpose:** Measure how closely BASF moves with DAX index
- **Result:** 0.9849 (very high positive correlation - moves together)

Exercise 7 Example - Factor Correlation Matrix:
=CORREL($C2 :C$62,D$2:D$62)

- **Column C:** Market Factor (Mkt-RF) Returns
- **Column D:** SMB (Size) Factor Returns
- **Purpose:** Check if factors are independent (low correlation = good diversification)
- **Result:** Various correlations for factor analysis

Interpretation:

- Correlation = +1: Perfect positive relationship
- Correlation = 0: No linear relationship
- Correlation = -1: Perfect negative relationship

When to use in exam: Portfolio diversification analysis, factor independence checks, CAPM preliminary analysis.

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6. SLOPE Function

Syntax: `=SLOPE(y_range, x_range)`

What it does: Calculates slope of linear regression line. In finance, this is the **beta coefficient** (systematic risk).

Exercise 5 Example - BASF Beta Estimation:
=SLOPE(F2:F133,G2:G133)

- **Column F (y):** BASF Excess Returns (stock return - risk-free rate)
- **Column G (x):** MSCI World Excess Returns
- **Purpose:** Calculate BASF beta relative to MSCI World
- **Result:** 1.172 beta (17.2% more volatile than market)

Exercise 5 Example - Large-Cap Fund Beta:
=SLOPE(C299:EO299,C300:EO300)

- **Row 299 (y):** Fund Returns
- **Row 300 (x):** DAX Returns
- **Purpose:** Calculate fund's market exposure (beta)
- **Result:** 0.9880 (tracks market closely)

Beta Interpretation:

- Beta = 1: Moves exactly with market
- Beta > 1: More volatile than market (BASF = 1.172)
- Beta < 1: Less volatile than market
- Beta = 0: No relationship to market

When to use in exam: CAPM beta estimation, systematic risk measurement, regression analysis.

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7. INTERCEPT Function

Syntax: `=INTERCEPT(y_range, x_range)`

What it does: Calculates y-intercept of regression line. In finance, this is **alpha** (excess return not explained by market).

Exercise 5 Example - Large-Cap Fund Alpha:
=INTERCEPT(C299:EO299,C300:EO300)

- **Row 299 (y):** Fund Returns
- **Row 300 (x):** DAX Returns
- **Purpose:** Calculate alpha (manager skill/outperformance)
- **Result:** -0.0416% per month (-0.50% per year)

Interpretation:

- Alpha > 0: Outperforming benchmark (positive value-added)
- Alpha = 0: Matching benchmark (no excess return)
- Alpha < 0: Underperforming benchmark (negative value-added)

Real Result: Large-cap funds underperformed DAX by 0.5% per year after fees.

When to use in exam: Evaluate fund performance, active management assessment, CAPM regression analysis.

SECTION 3: Financial Functions

8. PMT Function

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

What it does: Calculates periodic payment for loan or investment with constant interest rate.

Exercise 2 Example - Mortgage Payment:
=PMT($C2, $B6, C$3,0,0)

- **$C$2:** Monthly interest rate (e.g., 19.99%/12 = 1.666%)
- **B6:** Number of payment periods (e.g., 360 months for 30-year loan)
- **$C$3:** Present value/loan amount (e.g., -100,000 EUR)
- **0:** Future value (loan paid off completely)
- **0:** Payment at end of period

Parameters:

- rate: Interest rate per period
- nper: Total number of payment periods
- pv: Present value (loan amount, usually negative)
- fv: Future value (usually 0 for loans)
- type: 0 = end of period, 1 = beginning

When to use in exam: Calculate loan payments, annuity payments, mortgage calculations.

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9. NPER Function

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

What it does: Calculates number of periods needed to pay off loan or reach investment goal.

Exercise 2 Example - Loan Duration:
=NPER($C2, $B19, C$3,0,0)

- **$C$2:** Monthly interest rate (1.666%)
- **B19:** Monthly payment amount (e.g., -500 EUR)
- **$C$3:** Present value/loan amount (100,000 EUR)
- **0:** Future value
- **0:** Payment timing

Purpose: "How many months to pay off 100,000 EUR loan with 500 EUR monthly payments?"

When to use in exam: Determine loan payoff time, savings goal timeframe, investment horizon calculations.

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10. CUMIPMT Function with ABS

Syntax: `=ABS(CUMIPMT(rate, nper, pv, start_period, end_period, type))`

What it does: Calculates cumulative interest paid between two periods. ABS makes result positive.

Exercise 2 Example - Total Interest Paid:
=ABS(CUMIPMT($C2, $B6, −1∗C$3,1,B6,0))

- **$C$2:** Monthly interest rate (1.666%)

- **B6:** Total number of periods (360 months)
- *-1$C$3:** Loan amount as positive (100,000)
- **1:** Start period (month 1)
- **B6:** End period (final month)
- **0:** Payment at end of period

Purpose: Calculate total interest paid over entire loan period.

When to use in exam: Interest expense calculations, loan cost analysis, compare financing options.

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11. EDATE Function

Syntax: `=EDATE(start_date, months)`

What it does: Returns date that is N months before/after start date.

Exercise 2 Example - Monthly Date Series:
`=EDATE(A2,1)`

- **A2:** Starting date (e.g., 01/01/2020)
- **1:** Number of months to add

Purpose: Generate monthly time series for amortization schedules, payment dates, or time series analysis.

Pattern in solutions:

- A3: `=EDATE(A2,1)` → Next month
- A4: `=EDATE(A3,1)` → Month after that
- Copy down for entire series

When to use in exam: Create payment schedules, generate date sequences, time series data.

SECTION 4: Risk-Return Calculations

12. Sharpe Ratio Calculation

Formula: `=(average_return - risk_free_rate) / std_dev`

What it does: Calculates risk-adjusted return (excess return per unit of risk). Higher is better.

Exercise 3 Example - Bitcoin Sharpe Ratio:
`=J390/_xlfn.STDEV.S(J279:J382)`
Where J390 contains: `=AVERAGE(J279:J382) - 0.0001` (average excess return)

Step-by-step:

1. Calculate average return: `=AVERAGE(C279:C382)` = 0.19303
2. Subtract risk-free rate: `=0.19303 - 0.00012` = 0.19291 (excess return)
3. Calculate std dev: `=STDEV.S(C279:C382)` = 0.63239

4. Divide: `=0.19291 / 0.63239` = **0.30509**

Comparison (Exercise 3 results):

- Bitcoin Sharpe Ratio: 0.305 (moderate risk-adjusted return)
- MSCI World: 0.282 (similar)
- Barclays Bonds: 0.199 (lower)

When to use in exam: Compare investments on risk-adjusted basis, portfolio performance evaluation.

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13. Annualization of Volatility

Formula: `=monthly_std_dev * 12^(1/2)` or `=monthly_std_dev * SQRT(12)`

What it does: Converts monthly standard deviation to annual standard deviation.

Exercise 5 Example - Annualized Volatility:
`=I11*12^(1/2)`

- **I11:** Monthly standard deviation (e.g., 5.2749%)
- **12^(1/2):** Square root of 12 = 3.464
- **Result:** 18.27% (annualized volatility)

Why square root? Volatility scales with square root of time, not linearly.

Formula variations:

- Monthly to Annual: `=monthly * SQRT(12)` or `=monthly * 12^(1/2)`
- Daily to Annual: `=daily * SQRT(252)` (252 trading days)
- Weekly to Annual: `=weekly * SQRT(52)`

When to use in exam: Convert volatility to different time periods, compare investments with different measurement frequencies.

SECTION 5: Basic Operations & Utilities

14. Percentage to Rate Conversion

Formula: `=annual_rate / 12`

Exercise 2 Example - Monthly Interest Rate:
`=19.99%/12`

- **Purpose:** Convert annual percentage rate (APR) to monthly rate
- **Result:** 1.666% per month

Cell C2 in Exercise 2: This becomes the rate parameter for PMT, NPER, CUMIPMT functions.

Common conversions:

- Annual to Monthly: Divide by 12
- Annual to Daily: Divide by 365

- Monthly to Annual: Multiply by 12 (for rates, not volatility!)

When to use in exam: Prepare data for financial functions, interest rate conversions.

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15. SUM Function

Syntax: `=SUM(range)`

Exercise 2 Example - Total Calculation:
=SUM(D4:D9)

- **Column D:** Individual payment amounts or interest paid
- **Purpose:** Calculate total of all payments or total interest

When to use in exam: Sum columns of data, calculate totals, aggregate values.

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16. Basic Arithmetic Operations

Subtraction - Calculate Returns:
=D4-C4

- **Purpose:** Calculate period-over-period return or difference
- **Example:** Current period return minus previous period

Multiplication with Absolute Reference:
=($J$3/12)*F3

- **$J$3/12:** Monthly interest rate (absolute reference - doesn't change when copied)
- **F3:** Outstanding balance (relative reference - changes when copied down)
- **Purpose:** Calculate monthly interest charge

Exercise 3 Example - Excess Returns:
=C10-E10

- **Column C:** Bitcoin return
- **Column E:** Risk-free rate
- **Column J:** Excess return (for Sharpe ratio)

When to use in exam: Returns calculations, differences, scaling values, intermediate calculations.

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17. Cross-Sheet References

Syntax: `=SheetName!CellRef`

Exercise 5 Example - Data Linking:
='Monthly Returns Adidas BASF'!D2

- **Purpose:** Reference BASF return data from another worksheet
- **Benefit:** Keep raw data separate from analysis, organize complex workbooks

Pattern in Exercise 5:
='Monthly Index Returns'!B2 (DAX return)

='Monthly Returns Adidas BASF'!C2 (Adidas return)
='Monthly Returns Adidas BASF'!D2 (BASF return)

When to use in exam: Reference data from other sheets, keep workbook organized, link related analyses.

SECTION 6: Advanced Excel Tools

Data Analysis ToolPak - Regression Analysis

Access: Data → Data Analysis → Regression

When to use: Multivariate regression (multiple independent variables)

Exercise 5 & 7 Example - Three-Factor Model:

Research Question (Exercise 7 - DFSVX Fund):
"Evaluate to what extent the Dimensional Fund Advisors US Small-Cap Value Fund exploits size and value premia."

Regression Model:
$r_{DFSVX,t} - r_{f,t} = \alpha + \beta_{Mkt} \times (Mkt_t - r_{f,t}) + \beta_{SMB} \times SMB_t + \beta_{HML} \times HML_t + \varepsilon_t$

Setup:

1. **Y Range:** DFSVX excess returns (one column)
2. **X Range:** Three columns (Mkt-RF, SMB, HML)
3. **Output:** New worksheet with regression statistics

Key Outputs:

Output	Interpretation
Adjusted R^2	0.95 = Factors explain 95% of fund returns
Intercept (α)	-0.0001 = Alpha ≈ 0 (no excess return)
β_Mkt coefficient	1.02 = Similar volatility to market
β_SMB coefficient	0.83 = Significant small-cap exposure
β_HML coefficient	0.51 = Significant value exposure
t-statistics	Check if coefficients significantly different from 0
p-values	< 0.05 = statistically significant

Interpretation for Exercise 7:

- Fund successfully captures size premium (β_SMB = 0.83)
- Fund successfully captures value premium (β_HML = 0.51)
- Alpha ≈ 0 (no outperformance beyond factor exposure)

- Conclusion: Fund does good job at ETF-like cost

When to use in exam: Multivariate regression, factor model analysis, fund performance evaluation with multiple factors.

Quick Reference Table - Formula Summary

Formula	Purpose	Exercise	Example Result
=AVERAGE(range)	Mean return	Ex 3, 5, 7	0.19303 (Bitcoin)
=STDEV.S(range)	Volatility	Ex 3, 5, 7	0.63239 (Bitcoin)
=SKEW(range)	Asymmetry	Ex 3	4.516 (Bitcoin)
=KURT(range)	Tail risk	Ex 3	26.04 (Bitcoin)
=CORREL(y,x)	Correlation	Ex 5, 7	0.9849 (BASF-DAX)
=SLOPE(y,x)	Beta	Ex 5	1.172 (BASF beta)
=INTERCEPT(y,x)	Alpha	Ex 5	-0.0416% (fund)
=PMT(r,n,pv)	Loan payment	Ex 2	Payment amount
=NPER(r,pmt,pv)	Periods	Ex 2	Number of months
=CUMIPMT()	Total interest	Ex 2	Interest paid
=EDATE(date,m)	Date shift	Ex 2	Next month
=(r-rf)/σ	Sharpe ratio	Ex 3, 7	0.305 (Bitcoin)
=σ_m*SQRT(12)	Annualize	Ex 5	18.27% annual

Exam Tips & Common Mistakes

1. STDEV vs STDEV.S vs STDEV.P

- **Use STDEV.S** for sample data (most common in finance)
- STDEV.P for entire population (rare)
- Modern Excel: Use STDEV.S (older: STDEV)

2. Absolute vs Relative References

- **$C$2** = Absolute (doesn't change when copied)
- **C2** = Relative (changes when copied)
- **$C2** = Mixed (column fixed, row relative)

3. SLOPE and INTERCEPT Order

- **SLOPE(y, x)** = y first, then x
- **INTERCEPT(y, x)** = same order
- Remember: "y comes first" (dependent variable)

4. PMT Function Signs

- Loan amount (PV): Negative (money borrowed)
- Payment (PMT): Usually negative (money paid out)
- Or flip signs consistently

5. Annualization

- **Returns:** Multiply by 12 (or 252 for daily)
- **Volatility:** Multiply by SQRT(12) or 12^(1/2)
- Don't confuse the two!

6. Sharpe Ratio

- Need **excess return** (return - risk-free rate)
- Divide by **standard deviation** (not variance)
- Higher is better

7. Beta Interpretation

- Beta > 1: More volatile than market
- Beta = 1: Same as market
- Beta < 1: Less volatile
- Beta < 0: Moves opposite to market

8. Alpha Interpretation

- Positive: Outperformance
- Zero: Fair pricing/matching benchmark
- Negative: Underperformance
- Often very small numbers (monthly %)

Practice Checklist

Before your exam, ensure you can:

- [ ] Calculate mean, standard deviation, skewness, kurtosis from return data
- [ ] Compute Sharpe ratio from returns and volatility
- [ ] Use CORREL to find correlation between two return series
- [ ] Use SLOPE to estimate beta (CAPM regression)
- [ ] Use INTERCEPT to find alpha
- [ ] Calculate loan payments with PMT
- [ ] Find loan duration with NPER
- [ ] Create date series with EDATE
- [ ] Annualize monthly volatility correctly (SQRT rule)
- [ ] Convert annual rates to monthly rates

- [ ] Use absolute ($) references appropriately
- [ ] Interpret regression output from Data Analysis ToolPak
- [ ] Link data between worksheets with sheet references

Key Formulas to Memorize

CAPM Formula (for reference):

$E(r_i) = r_f + \beta_i \times [E(r_m) - r_f]$
$\alpha_i = E(r_i) - r_f - \beta_i \times [E(r_m) - r_f]$

Sharpe Ratio:

$S = (r_j - r_f) / \sigma_j$

Volatility Annualization:

$\sigma_{annual} = \sigma_{monthly} \times \sqrt{12}$

Three-Factor Model:

$r_{p,t} - r_{f,t} = \alpha + \beta_{Mkt} \times (Mkt_t - r_{f,t}) + \beta_{SMB} \times SMB_t + \beta_{HML} \times HML_t + \varepsilon_t$

Good luck with your exam preparation!