MTH 201: Business Mathematics I – Lab Manual

BBM · 3 Credits · Lab sheets for Units 1–6 of the course syllabus

How to Use This Manual

Each lab matches one unit of the syllabus and covers the lab work listed for it. Work in Microsoft Excel (or LibreOffice Calc / Google Sheets). Unit 4 also uses the Smart Math Calculator software.

General rules for every lab

- Create one workbook per lab (for example, Lab1_LinearFunctions.xlsx) with one sheet per exercise.
- Put all inputs (parameters, rates, coefficients) in labelled cells and refer to them with cell references. Do not type numbers into formulas.
- Label every chart: title, axis titles, legend.
- Write a one-line interpretation under each result.
- Check your Excel results against hand calculations where the answer is given.

Lab	Unit	Topic
1	Unit 1	Introducing Excel; Excel for Linear Functions
2	Unit 2	Excel for Simultaneous Linear Equations
3	Unit 3	Excel for Quadratic Equations
4	Unit 4	Excel for Non-linear Functions; Bisection and Newton-Raphson Methods
5	Unit 5	Excel for Financial Mathematics
6	Unit 6	Excel for Applications of Derivatives

Lab 1: Introducing Excel and Excel for Linear Functions

Unit 1: Straight Lines and Functions

Objectives

- Become comfortable with the Excel interface, formulas, and charts.
- Tabulate and graph linear functions.
- Apply linear functions to demand, supply, cost, revenue, elasticity, and budget constraints.
- Fit a line of best fit by the least squares method, including time-series trend.

Excel tools: cell references (relative `A1`, absolute `$A$1`), fill handle, SUM, AVERAGE, SLOPE, INTERCEPT, RSQ, FORECAST.LINEAR, LINEST, Scatter chart, Trendline.

Exercise 1.1: Getting started

1. Open a new workbook and identify the ribbon, formula bar, name box, and sheet tabs.
2. In A1:A5 enter 10, 20, 30, 40, 50. In B1 enter `=A1*2+5` and fill down. Put a rate in D1 and use `=A1*$D$1` in C1 to see the difference between relative and absolute references.
3. Format a table: bold headers, borders, number format with 2 decimals, and freeze the top row.
4. Use `=SUM()`, `=AVERAGE()`, `=MAX()`, `=MIN()` on your column.

Exercise 1.2: Linear function and its graph

1. For y = mx + c, put m = 3 in B1 and c = 5 in B2.
2. Create x values 0 to 20 (step 1) from A5 downward and compute y with `=$B$1*A5+$B$2`.
3. Insert a Scatter chart with straight lines.
4. Use `=SLOPE()` and `=INTERCEPT()` on the table and confirm they return 3 and 5.
5. Change m to a negative value and observe the graph.

Exercise 1.3: Demand, supply, cost, and revenue

Demand: Qd = 100 − 2P. Supply: Qs = −20 + 4P.

1. Tabulate P from 0 to 50 (step 5) with columns Qd and Qs. Plot both with P on the vertical axis.
2. Read the equilibrium point from the chart. It should be P = 20, Q = 60. Confirm with a formula.
3. Cost and revenue: C = 500 + 12Q, R = 30Q. Tabulate Q = 0 to 80 (step 10), compute Profit = R − C, and plot R and C together. State the quantity at which profit is zero (Q ≈ 27.8).

Exercise 1.4: Elasticity of demand

Using Qd = 100 − 2P:

1. Compute point elasticity E = (dQ/dP) × (P/Q) = −2P / (100 − 2P) for P = 10, 20, 30, 40.
2. Add a column with `=IF(ABS(E)>1,"Elastic",IF(ABS(E)=1,"Unitary","Inelastic"))`.
3. Compute arc elasticity between P = 10 and P = 20 using the midpoint formula.
4. At which price is demand unit elastic? (Answer: P = 25.)

Exercise 1.5: Budget constraint

A consumer has income M = 1,000 and buys goods X and Y at prices Px = 20 and Py = 50.

1. Write the budget line 20X + 50Y = 1,000 and compute Y for X = 0, 5, 10, …, 50.
2. Plot the line. Identify the intercepts (X = 50, Y = 20).
3. Change Px to 25 and add the new line to the same chart. Describe the shift.

Exercise 1.6: Least squares line of best fit

Advertising (x, in thousand)	2	4	5	7	8	10
Sales (y, in lakh)	20	28	33	41	47	55

1. Build columns x, y, xy, x^2 and compute the sums Σx, Σy, Σxy, Σx^2.
2. Calculate $b = (n\Sigma xy - \Sigma x\Sigma y) / (n\Sigma x^2 - (\Sigma x)^2)$ and $a = (\Sigma y - b\Sigma x) / n$. Expected: b ≈ 4.43, a ≈ 10.76.
3. Verify with SLOPE, INTERCEPT, RSQ, and LINEST.

4. Plot a Scatter chart, add a linear trendline with equation and R^2, and forecast sales for x = 12.

Exercise 1.7: Least squares for time series

Year code (t)	1	2	3	4	5	6	7
Sales	120	128	141	150	158	171	180

1. Fit the trend line y = a + bt using the normal equations. Expected: b ≈ 10.11, a ≈ 109.29.
2. Forecast sales for t = 8 and t = 9 (t = 8 gives ≈ 190.1).
3. Plot actual values and trend line together.

Practice problems

1. Demand Qd = 500 − 5P and supply Qs = 20 + 3P. Find equilibrium and plot.
2. Fit a least squares line to your own data of 8 observations (for example, study hours vs marks) and interpret the slope.

Submit: workbook with Exercises 1.1–1.7, three charts, and written interpretations.

Lab 2: Excel for Simultaneous Linear Equations

Unit 2: Simultaneous Equations

Objectives

- Solve systems of linear equations in Excel using matrices.
- Find market equilibrium and break-even points.
- Compute consumer, producer, and total surplus.
- Solve a simple IS-LM model.

Excel tools: MINVERSE, MMULT, MDETERM, array formulas (Ctrl+Shift+Enter in older versions), Goal Seek, Scatter chart.

Exercise 2.1: Matrix method

Solve 2x + 3y = 12 and x − y = 1.

1. Enter the coefficient matrix A in A2:B3 and the constants vector B in D2:D3.
2. Compute det(A) with `=MDETERM(A2:B3)`. A unique solution exists only if det ≠ 0.
3. Compute the inverse with `=MINVERSE(A2:B3)` as an array formula.
4. Compute the solution $X = A^{-1}B$ with `=MMULT(inverse, D2:D3)`. Expected: x = 3, y = 2.
5. Verify by substituting back into both equations.

Now solve the 3 × 3 system x + y + z = 6, 2x − y + z = 3, x + 2y − z = 2 (expected: x = 1, y = 2, z = 3).

Exercise 2.2: Market equilibrium

Qd = 120 − 3P and Qs = −30 + 2P.

1. Rewrite as Qd + 3P = 120 and Qs − 2P = −30, set Qd = Qs = Q, and solve with the matrix method. Expected: P = 30, Q = 30.
2. Tabulate P = 0 to 40 and plot both curves.
3. A per-unit tax of 5 is imposed on suppliers, so Qs = −30 + 2(P − 5). Find the new equilibrium (P = 32, Q = 24) and show both on the chart.
4. Report how much of the tax is paid by consumers (price rises 2 of 5).

Exercise 2.3: Break-even analysis

Fixed cost = 20,000, variable cost = 40 per unit, selling price = 90.

1. Build a table for Q = 0 to 800 (step 100) with TC and TR.
2. Find the break-even quantity from the formula Q = FC / (P − VC) = 400.
3. Use Goal Seek (Data → What-If Analysis) to set Profit = 0 by changing Q.
4. Plot TR, TC, and mark the break-even point.
5. Run a sensitivity check: how does break-even change if price falls to 80?

Exercise 2.4: Consumer, producer, and total surplus

Using Exercise 2.2 (before tax):

1. Inverse demand: P = 40 − Q/3. Inverse supply: P = 15 + Q/2.
2. Consumer surplus = ½ × (40 − 30) × 30 = 150.
3. Producer surplus = ½ × (30 − 15) × 30 = 225.
4. Total surplus = 375. Compute each with cell formulas and shade the areas in a chart if you can.
5. After the tax, recompute surplus and find the deadweight loss.

Exercise 2.5: National income and the IS-LM model

Goods market: C = 200 + 0.75Y, I = 250 − 20r, G = 150, so IS: Y = 2,400 − 80r. Money market: M = 400, L = 0.5Y − 40r, so LM: Y = 800 + 80r.

1. Tabulate r = 0 to 20 and compute Y on IS and LM.
2. Solve the two equations with MINVERSE/MMULT. Expected: r = 10, Y = 1,600.
3. Plot IS and LM on one chart with r on the vertical axis.
4. Raise G to 190 and find the new equilibrium. Comment on the effect on Y and r.

Practice problems

1. Solve a 3-commodity market model of your own choice using MINVERSE.
2. Find the break-even for a product with FC = 50,000, VC = 120, price = 200.

Submit: workbook with Exercises 2.1–2.5, charts for 2.2, 2.3, and 2.5.

Lab 3: Excel for Quadratic Equations

Unit 3: Quadratic Equations

Objectives

- Graph quadratic functions and identify vertex and roots.
- Build a reusable quadratic equation solver.
- Apply quadratics to revenue, profit, and market equilibrium.

Excel tools: SQRT, IF, Goal Seek, Solver, Scatter chart with smooth lines.

Exercise 3.1: Graphs of quadratic functions

1. Plot $y = x^2 - 6x + 8$ for $x = -1$ to 7 (step 0.5). Identify the roots (2 and 4) and the vertex (3, −1).
2. Compute the vertex using $x = -b/(2a)$.
3. Plot $y = -x^2 + 6x - 5$ on the same sheet and compare the direction of opening.
4. Change a, b, c in input cells and observe how the graph changes.

Exercise 3.2: Quadratic equation solver

1. Inputs: a, b, c in three cells.
2. Discriminant: $D = b^2 - 4ac$.
3. Roots: `=IF(D<0,"No real roots",(-b+SQRT(D))/(2*a))` and the corresponding formula with minus.
4. Add a column that states the nature of the roots using IF (two distinct, repeated, or none).
5. Test with: $x^2 - 5x + 6$ (2, 3), $x^2 + 2x + 5$ (no real roots), $4x^2 - 12x + 9$ (repeated root 1.5).

Exercise 3.3: Goal Seek check

1. Enter a guess for x in a cell and the formula $y = x^2 - 5x + 6$ in another.
2. Use Goal Seek to set y = 0 by changing x. Try starting guesses 0 and 5 and see which root you reach.

Exercise 3.4: Business applications

(a) Revenue maximisation. Demand: $P = 100 - 2Q$, so $R = 100Q - 2Q^2$.

1. Tabulate R for Q = 0 to 50 and plot.
2. Find the vertex: Q = 25, R = 1,250. Confirm with `=MAX()`.

(b) Profit and break-even. Cost: $C = 200 + 20Q$.

1. Profit $= 80Q - 2Q^2 - 200$. Maximum profit at Q = 20 (profit = 600).
2. Solve for break-even: $Q^2 - 40Q + 100 = 0$, so $Q \approx 2.68$ and $Q \approx 37.32$. Use your solver from 3.2.
3. Plot profit and mark both break-even points.

(c) Non-linear equilibrium. Demand: $P = 40 - 2Q$. Supply: $P = Q^2 + 4$.

1. Equate to get $Q^2 + 2Q - 36 = 0$. Solve with your template: $Q \approx 5.08$ (reject the negative root).
2. Find the equilibrium price $P \approx 29.84$ and justify why the negative root is rejected.

Practice problems

1. A firm's profit is $\pi = -3Q^2 + 60Q - 150$. Find output for maximum profit and the break-even outputs.
2. Demand $P = 80 - Q$ and supply $P = Q^2/2 + 5$. Find equilibrium.

Submit: workbook with the solver template, charts for 3.1 and 3.4, and all interpretations.

Lab 4: Excel for Non-linear Functions; Bisection and Newton-Raphson Methods

Unit 4: Non-linear Functions, Their Graphs and Applications

Objectives

- Graph cubic, exponential, logarithmic, and hyperbolic functions.
- Solve non-linear equations numerically with the bisection and Newton-Raphson methods.
- Verify results with the Smart Math Calculator software.

Excel tools: EXP, LN, LOG, LOG10, POWER, IF, ABS, fill-down iteration tables, Scatter chart.

Exercise 4.1: Polynomial functions

1. Plot $f(x) = x^3 - 6x^2 + 11x - 6$ for x = 0 to 4 (step 0.1). Read the roots from the graph (1, 2, 3).
2. Plot a cubic cost function $C(Q) = Q^3 - 9Q^2 + 30Q + 50$ for Q = 0 to 10 and describe its shape.
3. Plot a quartic of your choice and count the turning points.

Exercise 4.2: Exponential and logarithmic functions

1. Growth: y = 1,000 × e^(0.05t), t = 0 to 30. Use `=1000*EXP(0.05*A2)`. Find the doubling time (about 13.9 years) with `=LN(2)/0.05`.
2. Decay: y = 1,000 × e^(−0.08t) and plot with the growth curve.
3. Logarithmic: y = ln(x) for x = 0.5 to 20. Compare with LOG10. Describe how the curve flattens.
4. Business use: if sales follow S = 50 + 20 ln(A) where A is advertising spend, tabulate S for A = 1 to 30 and discuss diminishing returns.

Exercise 4.3: Hyperbolic functions of the form a/(bx + c)

1. Plot y = 100 / (2x + 5) for x = 0 to 20 and identify the vertical asymptote (x = −2.5) and the horizontal asymptote (y = 0).
2. Average cost: AC = 500/Q + 10 for Q = 5 to 100. Observe how AC approaches 10 as Q grows.
3. Use IF to avoid division by zero: `=IF(2*A2+5=0,NA(),100/(2*A2+5))`.

Exercise 4.4: Bisection method

Solve $f(x) = x^3 - x - 2 = 0$ on the interval [1, 2]. The root is about 1.5214.

1. Create columns: Iteration, a, b, c = (a + b)/2, f(a), f(c), Error = |b − a|/2.
2. Check that f(1) < 0 and f(2) > 0 so a root lies between.
3. Next row: if f(a) × f(c) < 0 then b = c and a stays, else a = c and b stays. Use `=IF(E2*F2<0, ...)`.
4. Fill down for 15 iterations or until Error < 0.0001.
5. Record the number of iterations needed.

Exercise 4.5: Newton-Raphson method

Same equation $f(x) = x^3 - x - 2$, with $f'(x) = 3x^2 - 1$.

1. Columns: n, x_n, $f(x_n)$, $f'(x_n)$, $x_{n+1} = x_n - f(x_n)/f'(x_n)$, $|x_{n+1} - x_n|$.
2. Start from $x_0 = 1.5$ and fill down 6 rows. The result should settle at 1.52138 within 3–4 iterations.
3. Try $x_0 = 0.5$ and $x_0 = 2$ and compare convergence.
4. Apply to a business problem: find the time t such that 1,000e^(0.08t) = 2,000, writing f(t) = 1,000e^(0.08t) − 2,000.

Exercise 4.6: Verification with Smart Math Calculator

1. Enter $f(x) = x^3 - x - 2$ in the software and run the Bisection method over [1, 2] with tolerance 0.0001.
2. Run Newton-Raphson with $x_0 = 1.5$.
3. Prepare a comparison table: method, starting value or interval, iterations, root, error. Explain in two lines why Newton-Raphson is faster.

Practice problems

1. Find the positive root of $x^3 + 2x - 5 = 0$ using both methods.
2. Solve 2^x = 3x using bisection on [0, 1] or [3, 4] (pick intervals where the sign changes).

Submit: workbook with graphs from 4.1–4.3, iteration tables for 4.4–4.5, and the comparison table from 4.6.

Lab 5: Excel for Financial Mathematics

Unit 5: Financial Mathematics

Objectives

- Generate arithmetic and geometric sequences and sums.
- Compute simple and compound interest and effective annual rates.
- Compute depreciation, NPV, IRR, annuities, loan repayments, and sinking funds.
- Study the relation between interest rates and bond prices.

Excel tools: FV, PV, PMT, IPMT, PPMT, NPER, RATE, NPV, IRR, EFFECT, SLN, DB, SYD, SUM, POWER.

Exercise 5.1: Sequences and series

1. Arithmetic: a = 5, d = 3, n = 12. Build the terms with `=A2+$B$1` and compute the sum with the formula $S_n = n/2 \times [2a + (n - 1)d]$ and with `=SUM()`. Both should agree.
2. Geometric: a = 2, r = 3, n = 8. Compute terms using a × r^(n−1), and the sum $S_n = a(r^n - 1)/(r - 1)$ = 6,560.
3. Infinite GP: a = 10, r = 0.5. Show that partial sums approach a/(1 − r) = 20.

Exercise 5.2: Simple and compound interest

Principal = 10,000, rate = 8% per annum, time = 5 years.

1. Simple interest = P × r × t = 4,000, so A = 14,000.

2. Compound annually: A = P(1 + r)^n = 14,693.28. Use `=FV(8%,5,0,-10000)`.
3. Compound monthly: `=FV(8%/12,60,0,-10000)` ≈ 14,898.
4. Effective annual rate for monthly compounding: `=EFFECT(8%,12)` ≈ 8.30%.
5. Build a table of A for 1 to 10 years under simple and compound interest and plot both to show the gap widening.

Exercise 5.3: Depreciation

Asset cost = 500,000, salvage value = 50,000, life = 5 years.

1. Straight line: `=SLN(500000,50000,5)` = 90,000 per year.
2. Declining balance: `=DB(500000,50000,5,year)`.
3. Sum-of-years-digits: `=SYD(500000,50000,5,year)`.
4. Show the book value year by year for all methods and plot them.

Exercise 5.4: NPV and IRR

Project: initial outlay 100,000; cash flows 30,000, 35,000, 40,000, 45,000 in years 1–4. Discount rate 10%.

1. NPV = `NPV(10%, cash flows)` − 100,000. Expected ≈ 16,986 (accept).
2. IRR = `IRR(range)` with the outlay as a negative first value. Expected ≈ 17%.
3. Build an NPV profile: NPV for discount rates 0% to 25% (step 5%) and plot. Mark where the curve crosses zero.
4. Compare with a second project of your choice and decide using NPV and IRR.

Exercise 5.5: Annuities, loans, and sinking funds

1. **Annuity:** PV of 5,000 per year for 10 years at 7% is `=PV(7%,10,-5000)`. FV is `=FV(7%,10,-5000)`.
2. **Sinking fund:** to accumulate 500,000 in 10 years at 6% annually, the payment is `=PMT(6%,10,0,-500000)` ≈ 37,934.
3. **Loan repayment:** borrow 1,000,000 at 12% per annum for 5 years with monthly payments. EMI = `=PMT(12%/12,60,-1000000)` ≈ 22,244.
4. **Amortisation schedule:** build a 60-row table with columns: month, opening balance, EMI, interest (IPMT), principal (PPMT), closing balance. Check that the final balance is 0 and total interest = 60 × EMI − 1,000,000.
5. Use NPER and RATE to find how long it takes to repay if EMI is raised to 30,000.

Exercise 5.6: Bond prices and interest rates

Face value 1,000, coupon 8% (annual), maturity 5 years.

1. Price = `=PV(yield,5,80,1000)` with a negative sign for display.
2. Calculate for yields 4%, 6%, 8%, 10%, 12%. Expected: ≈ 1,084 at 6%, 1,000 at 8%, ≈ 924 at 10%.
3. Plot price against yield. State the relationship between interest rate and price in words, and say when the bond trades at a premium, par, or discount.

Practice problems

1. A machine costs 800,000 and has a 10% salvage value over 8 years. Prepare a depreciation schedule by two methods.
2. Find the EMI and the total interest on a 2,500,000 loan at 10% for 15 years (monthly).
3. Which is better at 12%: Project A (−50,000; 20,000 per year for 4 years) or Project B (−50,000; 5,000, 15,000, 25,000, 40,000)?

Submit: workbook with Exercises 5.1–5.6, including the amortisation table and charts for 5.2, 5.4, and 5.6.

Lab 6: Excel for Applications of Derivatives

Unit 6: Limit and Differentiation, Applications of Derivatives

Objectives

- Explore limits and derivatives numerically.
- Verify differentiation rules using Excel.
- Perform marginal analysis and locate maxima, minima, and points of inflection.
- Compute elasticity of demand using derivatives.

Excel tools: formulas with small step h, fill-down tables, Scatter chart, MAX, MIN, INDEX/MATCH, Solver.

Exercise 6.1: Idea of a limit

1. Let $f(x) = (x^2 - 1)/(x - 1)$. Approach $x = 1$ from both sides with $x = 0.9, 0.99, 0.999, 0.9999$ and $1.1, 1.01, 1.001, 1.0001$. The values approach 2.
2. Let $f(x) = (3x + 2)/(x + 1)$. Evaluate at $x = 10, 100, 1{,}000, 10{,}000, 100{,}000$. The values approach 3 (limit at infinity).
3. Plot both to see the behaviour near the point and at infinity.

Exercise 6.2: Slope and the first-principle derivative

1. For $f(x) = x^2$, compute $[f(x + h) - f(x)]/h$ at $x = 3$ for $h = 1, 0.1, 0.01, 0.001, 0.0001$. The values approach 6.
2. Repeat for $f(x) = e^x$ at $x = 1$ (limit $e \approx 2.71828$) and $f(x) = \ln x$ at $x = 2$ (limit 0.5).
3. Plot $f(x) = x^2$ and the tangent line at $x = 3$ ($y = 6x - 9$).

Exercise 6.3: Verifying rules of differentiation

Build a table with $x = 1, 2, 3, 4, 5$ and two columns for each function: numerical derivative ($h = 0.0001$, central difference) and exact derivative from the rule. Check that they agree.

Rule	Function	Derivative
Power	x^5	$5x^4$
Sum	$x^3 + 4x^2$	$3x^2 + 8x$

Rule	Function	Derivative
Product	$x^2 \cdot e^x$	$2x \cdot e^x + x^2 \cdot e^x$
Quotient	$x / (x + 1)$	$1/(x + 1)^2$
Chain	$(3x + 2)^4$	$12(3x + 2)^3$

Exercise 6.4: Marginal analysis and profit maximisation

Demand: $P = 80 - 0.5Q$. Total cost: $C = 0.1Q^3 - 2Q^2 + 20Q + 100$.

1. Derive $R = 80Q - 0.5Q^2$, $MR = 80 - Q$, $MC = 0.3Q^2 - 4Q + 20$.
2. Tabulate Q = 0 to 40 (step 2) with R, C, Profit, MR, MC.
3. Plot MR and MC. Find where MR = MC (Q = 20).
4. Check the second-order condition: $\pi'' = 3 - 0.6Q = -9$ at Q = 20, so it is a maximum.
5. Compute maximum profit (900) and confirm it matches `=MAX()` in the table.

Exercise 6.5: Stationary points, inflection, and higher derivatives

Let $f(x) = x^3 - 6x^2 + 9x + 1$.

1. Compute $f'(x) = 3x^2 - 12x + 9$, $f''(x) = 6x - 12$, and $f'''(x) = 6$.
2. Tabulate f, f′, f″ for x = −1 to 5 (step 0.25) and plot f.
3. Stationary points: x = 1 (local maximum, f = 5) and x = 3 (local minimum, f = 1).
4. Point of inflection: x = 2, f = 3.
5. Add a column to classify intervals as increasing or decreasing from the sign of f′, and concave up or down from the sign of f″.

Exercise 6.6: Implicit and parametric differentiation

1. Circle $x^2 + y^2 = 25$. The implicit derivative is $dy/dx = -x/y$. At (3, 4) the slope is −0.75. Check numerically using points near (3, 4) on the circle.
2. Parametric curve $x = t^2$, $y = t^3$. Then $dy/dx = (dy/dt)/(dx/dt) = 3t/2$. For t = 1, 2, 3 compute the slopes and verify numerically.

Exercise 6.7: Elasticity of demand and the derivative

1. For $Q = 100 - 2P$, compute $E = (dQ/dP)(P/Q)$ at P = 10, 20, 30, 40 and compare with Lab 1, Exercise 1.4.
2. For $Q = 200P^{(-1.5)}$, show that E = −1.5 at every price (constant elasticity).
3. For $R = P \times Q(P)$, show that marginal revenue is positive when $|E| > 1$ and negative when $|E| < 1$. Test using the linear demand above.

Exercise 6.8: Optimisation with Solver

1. Using the cost function in 6.4, compute average cost AC = C/Q.
2. Use Solver (Data → Solver) to minimise AC by changing Q (Q > 0). Compare with the point where MC = AC.
3. Report the minimum AC and the output at which it occurs.

Practice problems

1. A firm has total cost $C = Q^3 - 12Q^2 + 60Q + 100$. Find the output that minimises MC and the output that minimises AC.
2. Demand is $P = 120 - 3Q$. Find the output and price that maximise revenue, and the elasticity at that point (it should be -1).
3. Find the maximum and minimum points of $y = 2x^3 - 9x^2 + 12x$ and classify them.

Submit: workbook with Exercises 6.1–6.8, charts for 6.2, 6.4, and 6.5, and a short note comparing numerical and analytical results.

Assessment Guide (suggested)

Criterion	Weight
Correct formulas and results	40%
Use of cell references and input cells	20%
Charts and formatting	15%
Interpretation of results	15%
Neatness and submission on time	10%

References

- Mike Rosser, Basic Mathematics for Economists, Routledge.
- Teresa Bradley, Essential Mathematics for Economics and Business, Wiley.
- Alpha C. Chiang, Fundamental Methods of Mathematical Economics, McGraw-Hill.
- Other references as listed in the course syllabus.