Formula sheets and MCQ quizzes

Part I — Mathematics

Chapter 1: Mathematical Logic

Formula and rule sheet

Operation	Symbol	Meaning
Negation	$\sim p$	Not p
Conjunction	$p \wedge q$	p and q
Disjunction	$p \vee q$	p or q
Implication	$p \rightarrow q$	If p, then q
Biconditional	$p \leftrightarrow q$	p if and only if q

Important equivalences:

1.	$p \vee p \equiv p$	Idempotent laws	$p \wedge p \equiv p$
2.	$p \vee (q \vee r)$ $\equiv (p \vee q) \vee r$ $\equiv p \vee q \vee r$	Associative laws	$p \wedge (q \wedge r)$ $\equiv (p \wedge q) \wedge r$ $\equiv p \wedge q \wedge r$
3.	$p \vee q \equiv q \vee p$	Commutative laws	$p \wedge q \equiv q \wedge p$
4.	$p \vee (q \wedge r)$ $\equiv (p \vee q) \wedge (p \vee r)$	Distributive laws	$p \wedge (q \vee r)$ $\equiv (p \wedge q) \vee (p \wedge r)$
5.	$p \vee c \equiv p$ $p \vee t \equiv t$	Identity laws	$p \wedge c \equiv c$ $p \wedge t \equiv p$
6.	$p \vee \sim p \equiv t$ $\sim t \equiv c$	Complement laws	$p \wedge \sim p \equiv c$ $\sim c \equiv t$
7.	$\sim (\sim p) \equiv p$	Involution law (law of double negation)	
8.	$\sim (p \vee q)$ $\equiv \sim p \wedge \sim q$	DeMorgan's laws	$\sim (p \wedge q)$ $\equiv \sim p \vee \sim q$

Chapter 2: Matrices

Important formulas

The inverse exists when $|A| \neq 0$

Matrix multiplication is generally not commutative: $AB \neq BA$

chapter 3: Differentiation

Standard derivatives

1) $\frac{d}{dx}(x) = 1$

2) $\frac{d}{dx}(x^n) = nx^n$

3) $\frac{d}{dx}(logx) = \frac{1}{x}$

4) $\frac{d}{dx}(a^x) = a^x \log a$

5) $\frac{d}{dx}(e^x) = e^x$

6) $\frac{d}{dx}\left(\frac{1}{x}\right) = -\frac{1}{x^2}$

7) $\frac{d}{dx}\ k = 0$

8) $\frac{d}{dx}(u.v) = u\frac{d}{dx}v + v\frac{d}{dx}u$

9) $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{d}{dx}u - u\frac{d}{dx}v}{v^2}$

Chapter 4: Applications of Derivatives

Important rules

- Critical points: solve $f'(x) = 0$, and also check points where the derivative is undefined if they are in the domain.
- If $f'(x) > 0$ on an interval, the function is increasing there.
- If $f'(x) < 0$ on an interval, the function is decreasing there.
- At a stationary point, $f''(x) > 0$ indicates a local minimum; $f''(x) < 0$ indicates a local maximum, under the usual second-derivative test conditions.
- In economics, marginal cost and marginal revenue are represented by derivatives of cost and revenue functions.

Chapter 5: Integration

Standard formulas

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$\int \frac{1}{x} \, dx = \ln |x| + C$$

$$\int e^x \, dx = e^x + C$$

1. $\int (a^x) \, dx = \frac{a^x}{\log a} + c$

2. $\int (k) \, dx = kx + c$

3. $\int (u.v) \, dx = u \int v \, dx - \int \left[\frac{du}{dx} \int v \, dx\right] + c$

Use “LIATE” Rule for deciding what is u and v.

Chapter 6: Definite Integration

Important formulas

If $F'(x) = f(x)$, then

$$\int_a^b f(x) \, dx = F(b) - F(a)$$

$$\int_a^a f(x) \, dx = 0$$

$$\int_a^b f(x) \, dx = -\int_b^a f(x) \, dx$$

For an integrable function, splitting the interval gives

Chapter 7: Applications of Definite Integration

Important formulas

Area under a non-negative curve $y = f(x)$ from $x = a$ to $x = b$:

$$A = \int_a^b f(x)\,dx$$

Chapter 8: Differential Equation and Applications

Important formulas and rules

A differential equation contains an unknown function and one or more of its derivatives.

- Order: highest order derivative present.
- A general solution usually includes arbitrary constants.
- A particular solution is obtained using specified initial or boundary conditions, when applicable.

Variable-separable form:

$$\frac{dy}{dx} = g(x)h(y)$$

$$\frac{dy}{h(y)} = g(x)\,dx$$

Linear first-order form:

$$\frac{dy}{dx} + Py = Q$$

Integrating factor:

$$IF = e^{\int P\,dx}$$

Part II — Statistics and Commercial Mathematics

Chapter 9: Commission, Brokerage and Discount

Important formulas

$$\text{Commission} = \frac{r}{100} \times S$$

$$\text{Brokerage} = \frac{r}{100} \times V$$

$$\text{Trade discount} = \frac{d}{100} \times MP$$

$$\text{Net price} = MP - \text{Discount}$$

Here, r is the applicable rate, S is sales, V is transaction value, and MP is marked price.

Chapter 10: Insurance and Annuity

Important formulas

Ordinary annuity (payments at the end of each period), with payment R, interest rate i per period and n periods:

$$FV = R\frac{(1+i)^n - 1}{i}$$

Present value of an ordinary annuity:

$$PV = R\frac{1-(1+i)^{-n}}{i}$$

For an annuity due, multiply the corresponding ordinary-annuity value by $(1+i)$, assuming the same payment schedule shifted one period earlier.

Chapter 11: Linear Regression

Important formulas

Regression line of y on x:

$$y - \bar{y} = b_{yx}(x - \bar{x})$$

Regression line of x on y:

$$x - \bar{x} = b_{xy}(y - \bar{y})$$

Regression coefficients:

$$b_{yx} = r\frac{\sigma_y}{\sigma_x}, \qquad b_{xy} = r\frac{\sigma_x}{\sigma_y}$$

$$r = \pm\sqrt{b_{xy}b_{yx}}$$

The sign of r agrees with the signs of the regression coefficients.

Chapter 12: Time Series

Important formulas

Arithmetic mean:

$$\bar{x} = \frac{\sum x}{n}$$

Straight-line trend:

$$Y_c = a + bt$$

When the coded time values satisfy $\sum t = 0$:

$$a = \frac{\sum Y}{n}, \qquad b = \frac{\sum tY}{\sum t^2}$$

Moving averages are used to smooth short-term fluctuations and identify underlying trends.

Chapter 13: Index Numbers

Important formulas

Simple price relative:

$$P = \frac{p_1}{p_0} \times 100$$

Simple aggregative price index:

$$P_{01} = \frac{\sum p_1}{\sum p_0} \times 100$$

Laspeyres price index:

$$P_L = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

Paasche price index:

$$P_P = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$$

Here p_0, p_1 are base-year and current-year prices, while q_0, q_1 are the corresponding quantities.

Chapter 14: Linear Programming

Important concepts

General objective function:

Z=ax+by

Subject to linear constraints, such as:

a1x+b1y≤c1,

x≥0, y≥0

Graphical method:

1. Define the decision variables.
2. Formulate the objective function.
3. Write the constraints and non-negativity conditions.
4. Draw the constraint lines and identify the feasible region.
5. Evaluate the objective function at the feasible corner points.

Chapter 15: Assignment Problem and Sequencing

Important rules

- The assignment problem allocates jobs to persons or machines to minimize cost or maximize profit.
- The Hungarian method is used to obtain an optimal assignment.

- For a maximization assignment problem, one common conversion is to subtract each profit from the largest profit in the matrix.
- For sequencing n jobs on two machines, Johnson's rule selects the smallest remaining processing time. If it occurs on the first machine, place the job as early as possible; if on the second machine, place it as late as possible.

Chapter 16: Probability Distributions

Important formulas

For a discrete random variable X:

$$\sum_x P(X = x) = 1$$

Expected value:

$$E(X) = \sum_x xP(X = x)$$

Variance:

$$\mathrm{Var}(X) = E(X^2) - [E(X)]^2$$

Standard deviation:

$$\sigma = \sqrt{\mathrm{Var}(X)}$$

Binomial distribution, where included in the prescribed course:

$$P(X = r) = \binom{n}{r} p^r (1-p)^{n-r}$$

$$E(X) = np, \qquad \mathrm{Var}(X) = np(1-p)$$

Poisson distribution, where prescribed:

$$P(X = r) = \frac{e^{-\lambda}\lambda^r}{r!}$$

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