

**Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Empowered Autonomous)**

Course & Credit Structure for T.Y.B.Com. (2024 Pattern as per NEP-2020)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
V	Major Mandatory	COM-301-MRM(E)	Quantitative Techniques – I	Theory	04
		COM-302-MRM(E)	Probability and Distribution Theory	Theory	04
	Minor (MN)	COM-307-MN(E)	Quantitative Techniques	Theory	02
VI	Major Mandatory	COM-351-MRM(E)	Quantitative Techniques – II	Theory	04
		COM-302-MRM(E)	Distribution Theory and Testing of Hypothesis	Theory	04

**CBCS Syllabus as per NEP 2.0 for T.Y.B.Com.
(2024 Pattern)**

Name of the Programme	: B.Com.
Programme Code	: UCOM
Class	: T.Y.B.Com.
Semester	: V
Course Type	: Major Mandatory (Theory)
Course Code	: COM-301-MRM(E)
Course Title	: Quantitative Techniques – I
No. of Credits	: 04
No. of Teaching Hours	: 60

Course Objectives:

1. To introduce the fundamental concepts and applications of game theory.
2. To develop the ability to make optimal decisions under risk and uncertainty.
3. To explain the principles and applications of Statistical Process Control.
4. To develop skills in quality control using control charts and capability analysis.
5. To introduce time series techniques for analyzing and interpreting real-life data.
6. To create awareness of IS and ISO standards in quality management systems.

Course Outcomes:

By the end of the course, students should be able to

- CO1:** Understand basic concepts of game theory and strategic decision-making.
- CO2:** Apply game theory principles to solve problems using pure and mixed strategies.
- CO3:** Analyze decision-making situations under certainty, risk, and uncertainty.
- CO4:** Evaluate decisions using EMV, EOL, and other decision criteria.
- CO5:** Understand the fundamentals of Statistical Process Control and sources of variation.
- CO6:** Apply control charts and process capability indices for quality improvement.
- CO7:** Understand IS and ISO standards related to statistical quality control.

CO8: Analyze time series data using trend estimation and smoothing methods.

TOPICS/CONTENTS:

UNIT 1 Game Theory: (15L)

Meaning, two-person zero-sum game, pure and mix strategies, Pay off tables, saddle points, minimax and maximin principles, Dominance principles. Examples and problems.

UNIT 2: Statistical Decision Theory: (15L)

Introduction, acts, states of nature, pay off, regret, Decision Making Under Risk, Expected Opportunity Loss (EOL) Criterion and Expected Monetary Value (EMV) Criterion. Decision Making Under Uncertainty, Maximin Criterion, Maximax, Minimax Regret Criterion, Laplace Criterion, Hurvitz Criterion, Examples and problems.

UNIT 3: Statistical Process Control: (20L)

Introduction, Chance and assignable Causes of variation, Uses of SQC, Control limits, specification limits, Tolerance limits Process and product control, Control charts for mean, range, P-Chart, C-Chart, Process, Capability study, Interpretation of capability index Cp and Cpk.

Indian Standards [IS] and International Organization for Standardization (ISO): Introduction to IS series and ISO series with reference to process statistical techniques [History, organization structure, clauses 4.3, 4.6, 4.9, 4.30]

UNIT 4: Time Series Analysis (10L)

Meaning and utility, Components of time series, Additive and multiplicative models, Methods of estimating trend, moving average method, least squares method and exponential smoothing method (with graph and interpretation). Numerical problems related to real life situations.

List of Practical's Based on this Topics:

Practical No.	Title
1	Game theory
2	Statistical Decision Theory
3	Statistical Process Control

References:

1. Taha, H. A. (2007). Operations research: An introduction (8th ed.). Pearson Education.
2. Swarup, K., Gupta, P. K., & Mohan, M. (2001). Operations research. Sultan Chand & Sons.
3. Sharma, J. K. (2011). Business mathematics. Vikas Publishing House.
4. Montgomery, D. C. (2012). Introduction to statistical quality control (7th ed.). Wiley.
5. Gupta, S. C., & Kapoor, V. K. (2000). Fundamentals of mathematical statistics. Sultan Chand & Sons.
6. Gupta, S. C. (2007). Fundamentals of statistics. Himalaya Publishing House.

Programme Outcomes and Course Outcomes Mapping:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	3	2	2	1	2	1	1	-	1	-	-	-	-	2	-
CO2	2	3	3	-	3	2	1	-	-	-	-	-	-	2	-
CO3	2	2	3	-	3	2	1	-	-	-	-	2	-	2	-
CO4	2	2	3	-	3	2	1	-	-	-	-	2	-	2	-
CO5	3	2	2	-	2	2	1	-	-	-	1	-	-	3	-
CO6	2	3	3	-	3	3	1	-	-	2	1	-	-	3	-
CO7	2	1	1	-	1	2	1	2	2	-	3	-	-	2	1
CO8	2	3	3	-	3	2	1	-	-	-	-	2	-	2	-

PO1: A Fundamental Knowledge and Coherent Understanding**CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8:**

Each CO builds a strong understanding of fundamental concepts such as game theory, decision-making under risk and uncertainty, statistical process control, quality standards, and time series analysis, which together ensure coherent and comprehensive subject knowledge.

(Weight: 3)

PO2: Procedural Knowledge for Skill Enhancement**CO1–CO8:**

All COs involve procedural skills such as applying strategies, using decision criteria, constructing control charts, and performing forecasting techniques, thereby enhancing students' problem-solving and analytical skills.

(Weight: 3 for CO2, CO6, CO8; 2 for CO1, CO3, CO4, CO5, CO7)

PO3: Critical Thinking and Problem-Solving Skills**CO2, CO3, CO4, CO6, CO8:**

These COs strongly emphasize logical reasoning, evaluation of alternatives, and analytical problem-

solving through strategic games, decision models, quality improvement, and forecasting methods.
(Weight: 3)

PO5: Analytical Reasoning Skills

CO2, CO3, CO4, CO6, CO8:

The course requires in-depth analysis of data, evaluation of decision outcomes, interpretation of control charts, and trend estimation, thereby strongly developing analytical reasoning skills.
(Weight: 3)

PO6: Innovation, Employability, and Entrepreneurial Skills

CO4, CO6, CO7:

Decision-making models, SPC tools, and IS/ISO standards enhance industry readiness, quality awareness, and employability, supporting innovation and entrepreneurial thinking.
(Weight: 2–3)

PO7: Multidisciplinary Competence

CO1–CO8:

Statistical and decision-making techniques learned in this course are applicable across management, economics, engineering, and service sectors, promoting multidisciplinary competence.
(Weight: 1–2)

PO8: Value Inculcation through Community Engagement

CO7:

Knowledge of quality standards and regulatory frameworks promotes social responsibility, service quality, and community welfare.
(Weight: 2)

PO9: Traditional Knowledge into Modern Application

CO1, CO3, CO5, CO7:

Classical statistical theories and decision models are applied to modern industrial, managerial, and quality control problems.
(Weight: 2)

PO10: Design and Development of System

CO6:

Application of control charts and process capability analysis contributes to the design and monitoring of quality control systems.
(Weight: 2)

PO11: Ethical and Social Responsibility

CO5, CO6, CO7:

Emphasis on quality standards, process control, and compliance fosters ethical practices and social responsibility in organizations.

(Weight: 2–3)

PO12: Research-Related Skills

CO3, CO4, CO8:

Students analyze data, interpret results, and apply statistical techniques relevant to research and empirical studies.

(Weight: 2)

PO13: Teamwork

CO2, CO6:

Problem-solving activities and applied exercises encourage collaborative learning and teamwork.

(Weight: 1)

PO14: Area Specific Expertise

CO1–CO8:

The course develops specialized expertise in statistics, decision sciences, quality control, and forecasting techniques.

(Weight: 3)

PO15: Environmental Awareness

CO6, CO7:

Quality improvement, waste reduction, and efficient process control indirectly support environmental sustainability.

(Weight: 1)

**CBCS Syllabus as per NEP 2.0 for T.Y.B.Com.
(2024 Pattern)**

Name of the Programme	: B.Com
Programme Code	: UCOM
Class	: T.Y.B.Com
Semester	: V
Course Type	: Major Mandatory
Course Code	: COM-302-MRM(E)
Course Title	: Probability and Distribution Theory
No. of Credits	: 04
No. of Teaching Hours	: 60

Course Objectives:

1. To distinguish between random and non-random experiments.
2. To introduce the concept of random variables and their role in probability distributions.
3. To introduce basic probability concepts, such as sample space, events, and probability measures
4. To compute probabilities of events.
5. To introduce some standard discrete probability distribution and their applications.
6. To apply discrete probability distributions to model real-world situations
7. To concept of bivariate discrete random variables and compute probabilities of discrete bivariate random variable.

Course Outcomes:

The students will be able to

- CO1.** distinguish between random and non-random experiments.
- CO2.** explore concept of random variables and their role in probability distributions.
- CO3.** use basic probability concepts, such as sample space, events, and probability measures.
- CO4.** compute probabilities of events.
- CO5.** demonstrate applications of standard discrete probability distributions.
- CO6.** apply discrete probability distributions to model real-world situations.
- CO7.** explore concept of bivariate discrete random variables and their role in probability distribution.

TOPICS/CONTENTS:**UNIT 1: Introduction to Probability (15L)**

- 1.1 Definitions of Permutation, Combination, Sample Space
- 1.2 Event, different types of events, Probability of an event
- 1.3 Conditional Probability, Independence of two events
- 1.4 Partition of sample space, Bayes Theorem (statement only)
- 1.5 Examples and problems.

UNIT 2: Uni-variate Discrete Probability Distribution (15L)

- 2.1 Definitions of random variable, discrete random variable.
- 2.2 Probability distribution of discrete random variable
- 2.3 Probability mass function (p.m.f.), Cumulative distribution function, mean, variance and standard deviation. Properties of distribution function.
- 2.4 Examples and problems.

UNIT 3: Some Standard Discrete Probability Distributions (15L)

- 3.1 Discrete uniform distribution
- 3.2 Bernoulli: p.m.f., mean and variance. (statement only)
- 3.3 Binomial: p.m.f., mean, variance and additive property. (Statement only), real life situation.
- 3.4 Poisson: p.m.f., mean, variance and additive property. (Statement only), real life situation.
- 3.5 Examples and problems.

UNIT 4: Bi-variate Discrete Probability Distribution (15L)

- 4.1 Bivariate discrete random variable
- 4.2 Joint probability distribution of bivariate discrete random variable
- 4.3 Marginal and conditional distribution and independence of two variables.
- 4.4 Examples and problems.

List of Practical's Based on This Topics:

Sr. No.	Title
1.	Applications of Binomial Distribution
2.	Applications of Poisson Distribution
3.	Application of Bivariate Discrete Probability Distribution-I

4.	Application of Bivariate Discrete Probability Distribution -II
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References:

1. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
2. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
3. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Programme Outcomes and Course Outcomes Mapping:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	3	2	3	1	3	2	2	1	1	2	2	2	2	3	1
CO2	3	2	3	1	3	2	2	1	2	2	2	2	1	3	1
CO3	3	2	3	1	3	2	2	1	2	2	2	2	2	3	1
CO4	3	2	3	1	3	2	2	1	2	2	2	2	2	3	1
CO5	3	2	3	1	3	3	2	1	2	3	2	2	2	3	1
CO6	3	2	3	1	3	3	2	1	2	3	2	2	2	3	1
CO7	3	2	3	1	3	3	2	1	2	3	2	2	2	3	1

Justification for Mapping:

PO1 (Fundamental Knowledge and Coherent Understanding): Strongly related (3) to all COs as the course builds fundamental knowledge in probability.

PO2 (Procedural Knowledge for Skill Enhancement): Moderately related (2) because students develop skills in probability computations and applications.

PO3 (Critical Thinking and Problem-Solving Skills): Strongly related (3) since the course involves probability-based problem-solving.

PO4 (Communication Skills): Partially related (1) as students may need to explain probability concepts but it is not the main focus.

PO5 (Analytical Reasoning Skills): Strongly related (3) as probability involves logical and analytical reasoning.

PO6 (Innovation, Employability, and Entrepreneurial Skills): Moderately related (2-3) since probability is applied in risk assessment and decision-making.

PO7 (Multidisciplinary Competence): Moderately related (2) as probability is used in various disciplines such as engineering, finance, and science.

PO8 (Value Inculcation through Community Engagement): Partially related (1) as probability concepts can be applied in social studies but are not directly engaged.

PO9 (Traditional Knowledge into Modern Application): Partially to Moderately related (1-2) as probability integrates classical and modern statistical techniques.

PO10 (Design and Development of Systems): Moderately to Strongly related (2-3) since probability is used in system modeling and risk analysis.

PO11 (Ethical and Social Responsibility): Moderately related (2) as probability helps in fair decision-making and policy design.

PO12 (Research-Related Skills): Moderately related (2) since probability is fundamental to research methodologies.

PO13 (Teamwork): Moderately related (2) as probability problems can be solved collaboratively.

PO14 (Area-Specific Expertise): Strongly related (3) as probability is crucial in many specialized fields like machine learning, data science, and finance.

PO15 (Environmental Awareness): Partially related (1) since probability can be used in environmental risk analysis but is not the core focus.

**CBCS Syllabus as per NEP 2.0 for T.Y.B.Com.
(2024 Pattern)**

Name of the Programme	: B.Com.
Programme Code	: UCOM
Class	: T.Y.B.Com.
Semester	: V
Course Type	: Minor (Theory)
Course Code	: COM-307-MN(E)
Course Title	: Quantitative Techniques
No. of Credits	: 02
No. of Teaching Hours	: 30

Course Objectives:

- 1.To introduce the fundamental concepts of game theory and competitive decision-making.
- 2.To develop the ability to analyze decision-making problems under risk and uncertainty.
- 3.To familiarize students with decision criteria such as EMV, EOL, and regret analysis.
- 4.To explain the principles and importance of inventory control in business operations.
- 5.To develop analytical skills for applying deterministic and probabilistic inventory models.

Course Outcomes:

After successful completion of the course, the students will be able to:

- CO1:** Understand the basic concepts of game theory including payoff matrices and strategic decisions.
- CO2:** Apply minimax, maximin, saddle point, and dominance principles to solve two-person zero-sum games.
- CO3:** Distinguish between pure and mixed strategies and solve related numerical problems.
- CO4:** Analyze decision-making situations under risk using EMV and EOL criteria.
- CO5:** Evaluate decisions under uncertainty using Maximin, Maximax, Minimax Regret, Laplace, and Hurwicz criteria.

CO6: Understand the necessity and role of inventory control in organizational efficiency.

CO7: Apply deterministic inventory models to determine EOQ, reorder level, and buffer stock.

CO8: Apply probabilistic inventory models to make optimal inventory decisions under uncertain demand.

TOPICS/CONTENTS:

UNIT 1 Game Theory: (10L)

Meaning, two-person zero-sum game, pure and mix strategies, Pay off tables, saddle points, minimax and maximin principles, Dominance principles. Examples and problems.

UNIT 2: Statistical Decision Theory: (10L)

Introduction, acts, states of nature, pay off, regret, Decision Making Under Risk, Expected Opportunity Loss (EOL) Criterion and Expected Monetary Value (EMV) Criterion. Decision Making Under Uncertainty, Maximin Criterion, Maximax, Minimax Regret Criterion, Laplace Criterion, Hurvitz Criterion, Examples and problems.

UNIT 3: Inventory Control: (10 L)

Meaning and necessity of inventory control. Deterministic inventory Model: Economic order quantity for instantaneous replenishment with uniform demand and a) shortages not allowed, b) shortages allowed, Lead time, Re – order level and Buffer stock, Probabilistic Inventory Model: Single period probabilistic model without set up costs.

References:

1. Gupta, P. K., & Hira, D. S. (2018). Operations research (4th ed.). S. Chand Publishing.
2. Gupta, S. C., & Kapoor, V. K. (2019). Fundamentals of mathematical statistics (12th ed.). Sultan Chand & Sons.
3. Goon, A. M., Gupta, M. K., & Das Gupta, B. (2016). Fundamentals of statistics (Vol. 2). The World Press Private Ltd.
4. Kapoor, V. K. (2017). Operations research. Sultan Chand & Sons.
5. Sharma, J. K. (2015). Operations research: Theory and applications (5th ed.). Macmillan Publishers India.
6. Swarup, K., Gupta, P. K., & Man Mohan. (2014). Operations research (14th ed.). Sultan Chand & Sons.
7. Taha, H. A. (2007). Operations research: An introduction (8th ed.). Pearson Education.

Programme Outcomes and Course Outcomes Mapping:

CO \ PO	PO1	PO2	PO3	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	3	1	2	2	1	1	–	1	–	–	–	–	2	–
CO2	2	3	3	3	2	1	–	–	–	–	–	–	2	–
CO3	2	3	2	2	1	1	–	–	–	–	–	–	2	–
CO4	2	2	3	3	2	1	–	–	–	–	2	–	2	–
CO5	2	2	3	3	2	1	–	–	–	–	2	–	2	–
CO6	3	2	2	2	2	2	–	–	–	1	–	–	3	–
CO7	2	3	3	3	3	2	–	–	2	1	–	–	3	–
CO8	2	3	3	3	3	2	–	–	–	–	2	–	3	–

Justification for Mapping:

PO1: Fundamental Knowledge and Coherent Understanding

CO1–CO8: The course develops strong foundational knowledge in game theory, decision theory, and inventory control. Concepts such as payoff matrices, decision criteria, EOQ models, and probabilistic inventory models ensure coherent understanding of operations research fundamentals.

(Strong to Moderate: 2–3)

PO2: Procedural Knowledge for Skill Enhancement

CO2, CO3, CO7, CO8: These COs emphasize procedural skills through numerical problem-solving, application of strategies, decision rules, and inventory models, thereby enhancing computational and analytical proficiency.

PO3: Critical Thinking and Problem-Solving Skills

CO2, CO4, CO5, CO7, CO8: Students analyze competitive situations, evaluate alternatives under risk and uncertainty, and solve complex inventory problems, strengthening critical thinking and problem-solving abilities.

PO5: Analytical Reasoning Skills

CO2, CO4, CO5, CO7, CO8: Analytical reasoning is developed through evaluation of EMV, EOL, regret criteria, optimization of inventory decisions, and interpretation of results.

PO6: Innovation, Employability, and Entrepreneurial Skills

CO4–CO8: Decision-making tools and inventory models used in real business environments enhance employability and support innovative and entrepreneurial thinking.

PO7: Multidisciplinary Competence

CO1–CO8: Techniques learned are applicable in management, economics, production, logistics, and service sectors, promoting multidisciplinary competence.

PO8: Value Inculcation through Community Engagement

CO7: Efficient inventory control indirectly supports better resource utilization and service to society.

PO9: Traditional Knowledge into Modern Application

CO1, CO4, CO5: Classical decision theories and optimization techniques are applied to modern managerial and industrial problems.

PO10: Design and Development of System

CO7: Inventory models contribute to the design of effective inventory management systems.

PO11: Ethical and Social Responsibility

CO6, CO7: Efficient inventory management promotes responsible use of resources and ethical business practices.

PO12: Research-Related Skills

CO4, CO5, CO8: Data analysis, evaluation of decision criteria, and probabilistic modeling support research-oriented thinking.

PO13: Teamwork

CO2, CO7: Problem-solving activities and numerical exercises encourage collaborative learning.

PO14: Area Specific Expertise

CO1–CO8: The course develops strong domain-specific expertise in operations research, decision sciences, and inventory management.

PO15: Environmental Awareness

CO7: Efficient inventory control indirectly reduces waste and supports sustainable practices.