TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

COMPETENCY BASED CURRICULUM

FOR

APPLIED STATISTICS

LEVEL 6

TVET CDACC

P.O BOX 15745-00100

NAIROBI

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Council Secretary/CEO
TVET Curriculum Development, Assessment and Certification Council
P.O. Box 15745–00100
Nairobi, Kenya
Email: info@tvetcdacc.go.ke

FOREWORD

The provision of quality education and training is fundamental to the Government's overall strategy for social economic development. Quality education and training will contribute to achievement Kenya's development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, Curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

It is my conviction that this Curriculum will play a great role towards development of competent human resource for the Mathematics and Statistics sector's growth and sustainable development.

PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING
MINISTRY OF EDUCATION

PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, "middle-income country providing a high-quality life to all its citizens by the year 2030". Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 and the Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform Curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) in conjunction with Applied Statistics Sector Skills Advisory Committee (SSAC), have developed this Curriculum.

This Curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

This Curriculum is designed and organized with an outline of learning outcomes; Suggested Methods Instructions, training/learning resources and methods of assessing the trainee's achievement. The Curriculum is competency-based and allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretariat, Applied Statistics SSAC, expert workers and all those who participated in the development of this Curriculum.

CHAIRMAN, TVET CDACC

ACKNOWLEDGEMENT

This Curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the Curriculum, significant involvement and support was received from various organizations.

I recognize with appreciation the role of the Applied Statistics Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the Curriculum. I also thank all stakeholders in the Applied Statistics sector for their valuable input and all those who participated in the process of developing this Curriculum.

I am convinced that this Curriculum will go a long way in ensuring that workers in business will acquire competencies that will enable them to perform their work more efficiently.

COUNCIL SECRETARY/CEO

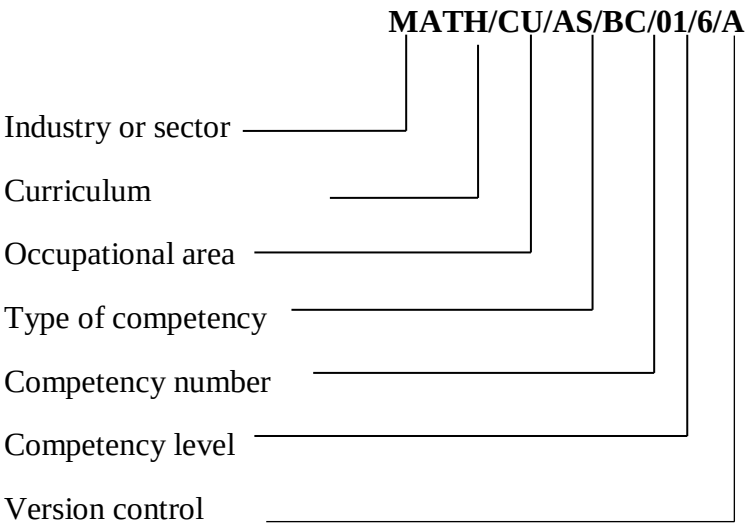
TVET CDACC

Table of Contents

ABBEVIATIONS AND ACRONYMS

BC	Basic Competency
CR	Core Competency
CU	Curriculum
CC	Common Competency
CBET	Competency Based Education and Training
CDACC	Curriculum Development Assessment and Certification Council
ICT	Information Communication Technology
KCSE	Kenya Certificate of Secondary Education
KNQA	Kenya National Qualifications Authority
OS	Occupational Standard
OSHS	Occupation Safety and Health Standards
PPE	Personal Protective Equipment
SSAC	Sector Skills Advisory Committee
TVET	Technical and Vocational Education and Training
SPSS	Statistical packages in social statistics
ANOVA	Analysis of variance
PAPI	Paper and Pencil Interviewing
CAPI	Computer Assisted Personal Interviewing
GDG	Focused group discussions
SD	standard deviation
DB	database
SQL	Structured Query Language
AIC	Akaike information criterion
GLM's	Generalised linear models
GNP	Gross National Products
ODK	Open Data kit

KEY TO UNIT CODE



COURSE OVERVIEW

Applied Statistics Level 6 qualification consists of competencies that an individual must achieve in order to prepare research concept, design and data collection tools, collect and manage research data, carry out descriptive data analysis, carry out inferential data analysis, design experiments and improve industrial process quality

The Units of Learning comprising applied statistics level 6 qualifications include the following:

BASIC UNITS OF LEARNING

Unit Code	Unit Title	Duration in hours	Credit Factor
MATH/CU/AS/BC/01/6/A	Communication Skills	40	4
MATH/CU/AS/BC/02/6/A	Numeracy Skills	60	6
MATH/CU/AS/BC/03/6/A	Digital literacy	60	6
MATH/CU/AS/BC/04/6/A	Entrepreneurial Skills	100	10
MATH/CU/AS/BC/05/6/A	Employability Skills	80	8
MATH/CU/AS/BC/06/6/A	Environmental Literacy	40	4
MATH/CU/AS/BC/07/6/A	Occupational Safety and Health Practices	40	4
TOTAL		**420**	**42**

COMMON UNITS OF LEARNING

Unit Code	Unit Title	Duration in hours	Credit Factor
MATH/CU/AS/CC/01/6/A	Mathematics for Statistics	200	20
MATH/CU/AS/CC/02/6/A	Statistical Techniques	200	20
MATH/CU/AS/CC/03/6/A	Research Methods	130	13
MATH/CU/AS/CC/04/6/A	Database Management Systems	150	15

MATH/CU/AS/CC/05/6/A	Statistical Data Management	140	14
TOTAL		**820**	**82**

CORE UNITS OF LEARNING

Unit Code	**Unit Title**	**Duration in hours**	**Credit Factor**
MATH/CU/AS/CR/01/6/A	Research Concepts	**160**	**16**
MATH/CU/AS/CR/02/6/A	Collection And Management of Research Data	**160**	**16**
MATH/CU/AS/CR/03/6/A	Descriptive Data Analysis	**200**	**20**
MATH/CU/AS/CR/04/6/A	Inferential Data Analysis	**200**	**20**
MATH/CU/AS/CR/05/6/A	Designing Research Experiments	**200**	**20**
MATH/CU/AS/CR/06/6/A	Improvement Of Process Quality	**200**	**20**
	Industrial Attachment	480	**48**
	Project/Term Paper		
TOTAL		**1600**	**160**
GRAND TOTAL		**2840**	**284.0**

The core units of learning are independent of each other and may be taken independently.

The total duration of the course is 2840 hours, which is equivalent to 95 weeks at 30 hours of learning per week including 480 hours (12 weeks) of field attachment.

Field Attachment

It is envisaged that the trainee will have undergone a field training and assessment with a recognized statistics consultancy firm/industry. At least 480 hours (12 weeks) will be spent on a supervised and assessed field attachment.

Research Project/Term paper

Its required that the trainee will carry out a research project in a field of his/her choice and submit it to the institution for marking and marks awarded before issue of the final certificate.

Entry Requirements

An individual entering this course should have any of the following minimum requirements:

a) Attained KCSE Mean Grade C- (minus)

Or

b) National Applied Statistics Certificate Qualification (Level 5)

Or

c) Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

Trainer qualification- to be added

A trainer for this course should have a higher qualification than the level of this course

Assessment

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an accredited internal verifier while external assessment is conducted by accredited external assessors appointed by TVET CDACC.

Certification

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the National Applied Statistics Level 6 Certificate, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

BASIC UNITS OF LEARNING

COMMUNICATION SKILLS

UNIT CODE: MATH/CU/AS/BC/01/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate Communication Skills

Duration of Unit: 40 hours

Unit Description
This unit covers the competencies required to demonstrate communication skills. It involves, meeting communication needs of clients and colleagues; developing communication strategies, establishing and maintaining communication pathways, conducting interviews, facilitating group discussion and representing the organization.

Summary of Learning Outcomes

1. Meet communication needs of clients and colleagues
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. Represent the organization

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Meet communication needs of clients and colleagues	• Communication process • Modes of communication • Medium of communication • Effective communication • Barriers to communication • Flow of communication • Sources of information • Organizational policies • Organization requirements for written and electronic communication methods • Report writing • Effective questioning techniques (clarifying and probing)	• Interview • Written texts

	• Workplace etiquette • Ethical work practices in handling communication • Active listening • Feedback • Interpretation • Flexibility in communication • Types of communication strategies • Elements of communication strategy	
2. Develop communication strategies	• Dynamics of groups • Styles of group leadership • Openness and flexibility in communication • Communication skills relevant to client groups	• Interview • Written texts
3. Establish and maintain communication pathways	• Types of communication pathways	• Interview • Written texts
4. Promote use of communication strategies	• Application of elements of communication strategies • Effective communication techniques	• Interview • Written texts
5. Conduct interview	• Types of interview • Establishing rapport • Facilitating resolution of issues • Developing action plans	• Interview • Written texts
6. Facilitate group discussion	• Identification of communication needs • Dynamics of groups • Styles of group leadership • Presentation of information • Encouraging group members participation • Evaluating group communication strategies	• Interview • Written texts

7. Represent the organization	• Presentation techniques • Development of a presentation • Multi-media utilization in presentation • Communication skills relevant to client groups	• Interview • Written texts

Suggested Methods of Instruction

- Discussion
- Role playing
- Simulation
- Direct instruction

Recommended Resources

- Desktop computers/laptops
- Internet connection
- Projectors
- Telephone

NUMERACY SKILLS

UNIT CODE: MATH/CU/AS/BC/02/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate Numeracy Skills.

Duration of Unit: 60 hours

Unit Description
This unit describes the competencies required to demonstrate numeracy skills. It involves applying a wide range of mathematical calculations for work; applying ratios, rates and proportions to solve problems; estimating, measuring and calculating measurement for work; using detailed maps to plan travel routes for work; using geometry to draw and construct 2D and 3D shapes for work; collecting, organizing and interpreting statistical data; using routine formula and algebraic expressions for work and using common functions of a scientific calculator.

Summary of Learning Outcomes

1. Apply a wide range of mathematical calculations for work
2. Apply ratios, rates and proportions to solve problems
3. Estimate, measure and calculate measurement for work
4. Use detailed maps to plan travel routes for work
5. Use geometry to draw and construct 2D and 3D shapes for work
6. Collect, organize and interpret statistical data
7. Use routine formula and algebraic expressions for work
8. Use common functions of a scientific calculator

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply a wide range of mathematical calculations for work	• Fundamentals of mathematics
	  • Addition, subtraction, multiplication and division of positive and negative numbers
	  • Algebraic expressions manipulation
	• Forms of fractions, decimals and percentages
	• Expression of numbers as
		• Written tests
		• Assignments
		• Supervised exercises

	powers and roots	

2. Apply ratios, rates and proportions to solve problems	• Rates, ratios and proportions
	  • Meaning
	  • Conversions into percentages
	  • Direct and inverse proportions determination
	  • Performing calculations
	  • Construction of graphs, charts and tables
	  • Recording of information
		• Written tests
		• Assignments
		• Supervised exercises

3. Estimate, measure and calculate measurement for work	• Units of measurements and their symbols • Identification and selection of measuring equipment • Conversion of units of measurement • Perimeters of regular figures • Areas of regular figures • Volumes of regular figures • Carrying out measurements • Recording of information	• Assignments • Supervised exercises • Written tests
4. Use detailed maps to plan travel routes for work	• Identification of features in routine maps and plans • Symbols and keys used in routine maps and plans • Identification and interpretation of orientation of map to North • Demonstrate understanding of direction and location • Apply simple scale to estimate length of objects, or distance to location or object • Give and receive directions using both formal and informal language	• Written • Practical test

	• Planning of routes • Calculation of distance, speed and time	
5. Use geometry to draw and construct 2D and 3D shapes for work	• Identify two dimensional shapes and routine three dimensional shapes in everyday objects and in different orientations • Explain the use and application of shapes • Use formal and informal mathematical language and symbols to describe and compare the features of two dimensional shapes and routine three dimensional shapes • Identify common angles • Estimate common angles in everyday objects • Evaluation of unknown angles • Use formal and informal mathematical language to describe and compare common angles • Symmetry and similarity • Use common geometric instruments to draw two dimensional shapes • Construct routine three dimensional objects from given nets	•

6. Collect, organize and interpret statistical data	• Classification of data
	  • Grouped data
	  • Ungrouped data
	• Data collection
	  • Observation
	  • Recording
	• Distinguishing between sampling and census
	• Importance of sampling
		• Assignments
		• Supervised exercises
		• Written tests

	• Errors in sampling
	• Types of sampling and their limitations e.g.
	  • Stratified random
	  • Cluster
	  • Judgmental
	• Tabulation of data
	  • Class intervals
	  • Class boundaries
	  • Frequency tables
	  • Cumulative frequency
	• Diagrammatic and graphical presentation of data e.g.
	  • Histograms
	  • Frequency polygons
	  • Bar charts
	  • Pie charts
	  • Cumulative frequency curves
	• Interpretation of data	

7. Use routine formula and algebraic expressions for work	• Solving linear equations
	• Linear graphs
	  • Plotting
	  • Interpretation
	• Applications of linear graphs
	• Curves of first and second degree
	  • Plotting
	  • Interpretation
		• Assignments
		• Supervised exercises
		• Written tests

8. Use common functions of a scientific calculator	• Identify and use keys for common functions on a calculator • Calculate using whole numbers, money and routine decimals and percentages • Calculate with routine fractions and percentages • Apply order of operations to solve multi-step calculations	• • Written • Practical test

	• Interpret display and record result	

Suggested Methods of Instruction

- Group discussions
- Demonstration by trainer
- Practical work by trainee
- Exercises

Recommended Resources

- Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice

DIGITAL LITERACY

UNIT CODE: MATH/CU/AS/BC/03/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate Digital Literacy

Duration of Unit: 60 hours

Unit Description
This unit describes competencies required to demonstrate digital literacy. It involves in identifying computer software and hardware, applying security measures to data, hardware, software in automated environment, computer software in solving task, internet and email in communication at workplace, desktop publishing in official assignments and preparing presentation packages.

Summary of Learning Outcomes
1. Identify computer software and hardware
2. Apply security measures to data, hardware, software in automated environment
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace
5. Apply desktop publishing in official assignments
6. Prepare presentation packages

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify computer hardware and software	• Concepts of ICT • Functions of ICT • History of computers • Components of a computer • Classification of computers	• Written tests • Oral presentation
2. Apply security measures to data, hardware, software in automated environment	• Data security and control • Security threats and control measures • Types of computer crimes • Detection and protection against computer crimes • Laws governing protection of ICT	• Written tests • Oral presentation • Project

3. Apply computer software in solving tasks	• Operating system • Word processing • Spread sheets • Data base design and manipulation • Data manipulation, storage and retrieval	• Oral questioning • Project
4. Apply internet and email in communication at workplace	• Computer networks • Network configurations • Uses of internet • Electronic mail (e-mail) concept	• Oral questioning • Written report
5. Apply desktop publishing in official assignments	• Concept of desktop publishing • Opening publication window • Identifying different tools and tool bars • Determining page layout • Opening, saving and closing files • Drawing various shapes using DTP • Using colour pellets to enhance a document • Inserting text frames • Importing and exporting text • Object linking and embedding • Designing of various publications • Printing of various publications	• Oral questioning • Written report • Project
6. Prepare presentation packages	• Types of presentation packages • Procedure of creating slides • Formatting slides • Presentation of slides	• Oral questioning • Written report • Project

	• Procedure for editing objects	

Suggested Methods of Instruction

- Instructor led facilitation of theory
- Demonstration by trainer
- Practical work by trainee
- Viewing of related videos
- Project
- Group discussions

Recommended Resources

- Computers
- Printers
- Storage devices
- Internet access

ENTREPRENEURIAL SKILLS

UNIT CODE: MATH/CU/AS/BC/04/6/A

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Demonstrate Entrepreneurial Skills

Duration of unit: 100 hours

Unit Description

This unit covers the competencies required to demonstrate understanding of entrepreneurship. It involves demonstrating understanding of an entrepreneur, entrepreneurship and self-employment. It also involves identifying entrepreneurship opportunities, creating entrepreneurial awareness, applying entrepreneurial motivation and developing business innovative strategies.

Summary of Learning Outcomes

1. Demonstrate understanding of who an entrepreneur
2. Demonstrate knowledge of entrepreneurship and self-employment
3. Identify entrepreneurship opportunities
4. Create entrepreneurial awareness
5. Apply entrepreneurial motivation
6. Develop business innovative strategies
7. Develop Business plan

Learning Outcome	Content	Suggested Assessment Methods

1. Demonstrate knowledge of entrepreneurship and self-employment	• Importance of self-employment • Requirements for entry into self-employment • Role of an Entrepreneur in business • Contributions of Entrepreneurs to National development • Entrepreneurship culture in Kenya • Born or made entrepreneurs	• Individual/group assignments • Projects • Written tests • Oral questions • Third party report
2. Identify entrepreneurship opportunities	• Business ideas and opportunities • Sources of business ideas • Business life cycle • Legal aspects of business • Assessment of product demand • Business environment • Factors to consider when evaluating business environment • Technology in business	• Individual/group assignments • Projects • Written tests • Oral questions • Third party report • Interviews
3. Create entrepreneurial awareness	• Forms of businesses • Sources of business finance • Factors in selecting source of business finance • Governing policies on Small Scale Enterprises (SSEs) • Problems of starting and operating SSEs	• Individual/group assignments • Projects • Written tests • Oral questions • Third party report • Interviews

4. Apply entrepreneurial motivation	• Internal and external motivation • Motivational theories • Self-assessment • Entrepreneurial orientation • Effective communications in entrepreneurship • Principles of communication • Entrepreneurial motivation	• Case studies • Individual/group assignments • Projects • Written tests • Oral questions • Third party report • Interviews
5. Develop business innovative strategies	• Innovation in business • Small business Strategic Plan • Creativity in business development • Linkages with other entrepreneurs • ICT in business growth and development	• Case studies • Individual/group assignments • Projects • Written tests • Oral questions • Third party report • Interviews
6. Develop Business Plan	• Business description • Marketing plan • Organizational/Management • plan • Production/operation plan • Financial plan • Executive summary • Presentation of Business Plan	• Case studies • Individual/group assignments • Projects • Written tests • Oral questions • Third party report • Interviews

Suggested Methods of Instruction

- Direct instruction
- Project
- Case studies
- Field trips
- Discussions
- Demonstration
- Question and answer
- Problem solving
- Experiential
- Team training

Recommended Resources

- Case studies
- Business plan templates
- Computers
- Overhead projectors
- Internet
- Mobile phone
- Video clips
- Films
- Newspapers and Handouts
- Business Journals
- Writing materials

EMPLOYABILITY SKILLS

UNIT CODE: MATH/CU/AS/BC/05/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate Employability Skills

Duration of Unit: 80 hours

Unit Description
This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing ethical performance.

Summary of Learning Outcomes

1. Conduct self-management
2. Demonstrate interpersonal communication
3. Demonstrate critical safe work habits
4. Lead a workplace team
5. Plan and organize work
6. Maintain professional growth and development
7. Demonstrate workplace learning
8. Demonstrate problem solving skills
9. Manage ethical performance

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct self-management	• Self-awareness • Formulating personal vision, mission and goals • Strategies for overcoming life challenges • Managing emotions • Emotional intelligence • Assertiveness versus aggressiveness • Expressing personal thoughts, feelings and beliefs	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report

	• Developing and maintaining high self-esteem • Developing and maintaining positive self-image • Setting performance targets • Monitoring and evaluating performance • Articulating ideas and aspirations • Accountability and responsibility • Good work habits • Self-awareness • Values and beliefs • Self-development • Financial literacy • Healthy lifestyle practices • Adopting safety practices	
2. Demonstrate interpersonal communication	• Meaning of interpersonal communication • Listening skills • Types of audience • Public speaking • Writing skills • Negotiation skills • Reading skills • Meaning of empathy • Understanding customers' needs • Establishing communication networks • Assertiveness • Sharing information	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report
3. Demonstrate critical safe work habits	• Stress and stress management • Time concept • Punctuality and time consciousness • Leisure	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report

	• Integrating personal objectives into organizational objectives • Resources mobilization • Resources utilization • Setting work priorities • Developing healthy relationships • HIV and AIDS • Drug and substance abuse • Managing emerging issues	
4. Lead a workplace team	• Leadership qualities • Power and authority • Team building • Determination of team roles and objectives • Team parameters and relationships • Individual responsibilities in a team • Forms of communication • Complementing team activities • Gender and gender mainstreaming • Human rights • Developing healthy relationships • Maintaining relationships • Conflicts and conflict resolution • Coaching and mentoring skills	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report
5. Plan and organize work	• Functions of management • Planning • Organizing • Time management • Decision making concept • Task allocation • Developing work plans	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report

	• Developing work goals/objectives and deliverables • Monitoring work activities • Evaluating work activities • Resource mobilization • Resource allocation • Resource utilization • Proactive planning • Risk evaluation • Problem solving • Collecting, analysing and organising information • Negotiation	
6. Maintain professional growth and development	• Avenues for professional growth • Training and career opportunities • Assessing training needs • Mobilizing training resources • Licenses and certifications for professional growth and development • Pursuing personal and organizational goals • Managing work priorities and commitments • Recognizing career advancement	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report
7. Demonstrate workplace learning	• Managing own learning • Mentoring • Coaching • Contributing to the learning community at the workplace • Cultural aspects of work • Networking • Variety of learning context • Application of learning • Safe use of technology	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report

	• Taking initiative/proactivity • Flexibility • Identifying opportunities • Generating new ideas • Workplace innovation • Performance improvement • Managing emerging issues • Future trends and concerns in learning	
8. Demonstrate problem solving skills	• Critical thinking process • Data analysis tools • Decision making • Creative thinking • Development of creative, innovative and practical solutions • Independence in identifying and solving problems • Solving problems in teams • Application of problem-solving strategies • Testing assumptions • Resolving customer concerns	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report
9. Manage ethical performance	• Meaning of ethics • Ethical perspectives • Principles of ethics • Ethical standards • Organization code of ethics • Common ethical dilemmas • Organization culture • Corruption, bribery and conflict of interest • Privacy and data protection • Diversity, harassment and mutual respect • Financial responsibility/accountability • Etiquette • Personal and professional integrity	• Written tests • Oral questioning • Interviewing • Portfolio of evidence • Third party report

	• Commitment to jurisdictional laws • Emerging issues in ethics	

Suggested Methods of Instruction

- Demonstrations
- Simulation/Role play
- Group Discussion
- Presentations
- Assignments
- Q&A

Recommended Resources

- Computers
- Stationery
- Charts
- Video clips
- Audio tapes
- Radio sets
- TV sets
- LCD projectors

ENVIRONMENTAL LITERACY

UNIT CODE: MATH/CU/AS/BC/06/6/A

Relationship to Occupational Standards:
This unit addresses the Unit of Competency : Demonstrate Environmental Literacy

Duration of Unit: 40 hours

Unit Description
This unit describes the competencies required demonstrate environmental literacy.it involves controlling environmental hazard, controlling environmental pollution, complying with workplace sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs, monitoring activities on environmental protection/programs, analysing resource use and developing resource conservation plans.

Summary of Learning Outcomes
1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs
8. Analyze resource use
9. Develop resource conservation plans

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Control environmental hazard	• Purposes and content of Environmental Management and Coordination Act 1999 • Storage methods for environmentally hazardous materials • Disposal methods of hazardous wastes	• Written questions • Oral questions

	• Types and uses of PPE in line with environmental regulations • Occupational Safety and Health Standards (OSHS)	
2. Control environmental Pollution control	• Types of pollution • Environmental pollution control measures • Types of solid wastes • Procedures for solid waste management • Different types of noise pollution • Methods for minimizing noise pollution	• Written questions • Oral questions • Role play
3. Demonstrate sustainable resource use	• Types of resources • Techniques in measuring current usage of resources • Calculating current usage of resources • Methods for minimizing wastage • Waste management procedures • Principles of 3Rs (Reduce, Reuse, Recycle) • Methods for economizing or reducing resource consumption	• Written questions • Oral questions • Role play
4. Evaluate current practices in relation to resource usage	• Collection of information on environmental and resource efficiency systems and procedures, • Measurement and recording of current resource usage • Analysis and recording of current purchasing strategies. • Analysis of current work processes to access information and data • Identification of areas for improvement	• Written questions • Oral questions • Role play
5. Identify Environmental legislations/conventions	• Environmental issues/concerns	• Written questions • Oral questions

for environmental concerns	• Environmental legislations /conventions and local ordinances • Industrial standard /environmental practices • International Environmental Protocols (Montreal, Kyoto) • Features of an environmental strategy	
6. Implement specific environmental programs	• Community needs and expectations • Resource availability • 5s of good housekeeping • Identification of programs/Activities • Setting of individual roles /responsibilities • Resolving problems /constraints encountered • Consultation with stakeholders	• Written questions • Oral questions • Role play
7. Monitor activities on Environmental protection/Programs	• Periodic monitoring and Evaluation of activities • Gathering feedback from stakeholders • Analyzing data gathered • Documentation of recommendations and submission • Setting of management support systems to sustain and enhance the program • Monitoring and reporting of environmental incidents to concerned /proper authorities	• Oral questions • Written tests • Practical test
8. Analyze resource use	• Identification of resource consuming processes • Determination of quantity and nature of resource consumed • Analysis of resource flow through different parts of the process.	• Written tests • Oral questions • Practical test

	• Classification of wastes for possible source of resources.	
9. Develop resource Conservation plans	• Determination of efficiency of use/conversion of resources • Causes of low efficiency of use of resources • Plans for increasing the efficiency of resource use	• Written tests • Oral questions • Practical test

Suggested Methods of Instruction

- Instructor led facilitation of theory
- Practical demonstration of tasks by trainer
- Practice by trainees
- Observations and comments and corrections by trainers

Recommended Resources

- Standard operating and/or other workplace procedures manuals
- Specific job procedures manuals
- Environmental Management and Coordination Act 1999
- Machine/equipment manufacturer's specifications and instructions
- Personal Protective Equipment (PPE)
- ISO standards
- Company environmental management systems (EMS)
- Montreal Protocol
- Kyoto Protocol

OCCUPATIONAL SAFETY AND HEALTH PRACTICES

UNIT CODE: MATH/CU/AS/BC/07/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate Occupational Safety and Health Practices

Duration of Unit: 40 hours

Unit Description
This unit specifies the competencies required to demonstrate occupational health and safety practices. It involves identifying workplace hazards and risk, identifying and implementing appropriate control measures to hazards and risks and implementing OSH programs, procedures and policies/guidelines.

Summary of Learning Outcomes
1. Identify workplace hazards and risk
2. Control OSH hazards
3. Implement OSH programs

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify workplace hazards and risks	• Identification of hazards in the workplace and/or the indicators of their presence • Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace • Gathering of OSH issues and/or concerns	• Oral questions • Written tests • Portfolio of evidence • Third party report
2. Control OSH hazards	• Prevention and control measures e.g. use of PPE • Risk assessment • Contingency measures	• Oral questions • Written tests • Portfolio of evidence • Third party report
3. Implement OSH programs	• Company OSH program, evaluation and review • Implementation of OSH programs	• Oral questions • Written tests

	• Training of team members and advice on OSH standards and procedures • Implementation of procedures for maintaining OSH-related records	• Portfolio of evidence • Third party report

Suggested Methods of Instruction

- Assigments
- Discussion
- Q&A
- Role play
- Viewing of related videos

Recommended Resources

- Standard operating and/or other workplace procedures manuals
- Specific job procedures manuals
- Machine/equipment manufacturer's specifications and instructions
- Personal Protective Equipment (PPE) e.g.
    - Mask
    - Face mask/shield
    - Safety boots
    - Safety harness
    - Arm/Hand guard, gloves
    - Eye protection (goggles, shield)
    - Hearing protection (ear muffs, ear plugs)
    - Hair Net/cap/bonnet
    - Hard hat
    - Face protection (mask, shield)
    - Apron/Gown/coverall/jump suit
    - Anti-static suits
    - High-visibility reflective vest

COMMON UNITS OF LEARNING

MATHEMATICS FOR STATISTICS

UNIT CODE: MATH/CU/AS/CC/01/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply mathematics for statistics

Duration of Unit: 200 hours

Unit Description

This unit describes the competencies required by a technician in order to apply algebra apply trigonometry and hyperbolic functions, apply complex numbers, apply coordinate geometry, carry out binomial expansion, apply calculus, solve ordinary differential equations, apply power series, apply statistics, apply numerical methods, apply vector theory, apply matrix and apply quantitative techniques

Summary of Learning Outcomes

1. Apply Algebra
2. Apply Trigonometry and hyperbolic functions
3. Apply complex numbers
4. Apply Coordinate Geometry
5. Carry out Binomial Expansion
6. Apply Calculus
7. Solve Ordinary differential equations
8. Apply Power Series
9. Apply Numerical methods
10. Apply Vector theory
11. Apply Matrix
12. Apply quantitative techniques

Learning Outcomes, Content and Suggested Assessment Methods

Learning outcome	Content	Suggested assessment methods
1. Apply Algebra	• Base and Index • Law of indices • Indicial equations • Laws of logarithm • Logarithmic equations • Conversion of bases • Use of calculator • Reduction of equations	• Written tests • Oral questioning • Assignments • Supervised exercises

Learning outcome	Content	Suggested assessment methods
	• Solutions to quadratic equations • Solution of equations reduced to quadratic form • Solutions of system of linear equations in three unknowns • Solutions of problems involving sequence and series	
2. Apply Trigonometry and hyperbolic functions	• Half -angle formula • Factor formula • Trigonometric functions • Parametric equations • Relative and absolute measures • Measures calculation • Definition of hyperbolic equations • Properties of hyperbolic functions • Evaluations of hyperbolic functions • Hyperbolic identities • Osborne's Rule • Ash + bush = C equation • One-to-one relationship in functions • Onto relationships in functions • Inverse functions for one-to-one relationship • Inverse functions for onto relationships • Inverse functions for trigonometric functions • Graph of inverse functions • Inverse hyperbolic functions • Application of trigonometry to obtain area and perimeter of shapes and solids	• Written tests • Oral questioning • Assignments • Supervised exercises

Learning outcome	Content	Suggested assessment methods
3. Apply complex numbers	• Definition of complex numbers • Stating complex numbers in numbers in terms of conjugate argument and Modulus • Representation of complex numbers on the Argand diagram • Arithmetic operation of complex numbers Application of De Moiré's theorem • Application of complex numbers to applied statistics	• Assignments • Oral questioning • Supervised exercises • Written tests
4. Apply Coordinate Geometry	• Polar equations • Cartesian equation • Graphs of polar equations • Normal and tangents • Definition of a point • Locus of a point in relation to a circle • Loci of points for given conditions	• Written tests • Oral questioning • Assignments • Supervised exercises
5. Carry out Binomial Expansion	• Binomial theorem • Power series using binomial theorem • Roots of numbers using binomial theorem. • Estimation of errors of small changes using binomial theorem.	• Written tests • Oral questioning • Assignments • Supervised exercises
6. Apply Calculus	• Definition of derivatives of a function • Differentiation from fist principle • Tables of some common derivatives • Rules of differentiation • Introduction to second derivative and its application • Rate of change and small change • Stationery points of functions of two variables and partial derivatives • Definition of integration • Indefinite and definite integral • Methods of integration application of integration. • Integrals of hyperbolic and inverse functions	• Written tests • Oral questioning • Assignments • Supervised exercises

Learning outcome	Content	Suggested assessment methods
7. Solve Ordinary differential equations	• Types of first order differential equations • Formation of first order differential equation • Solution of first order differential equations • Application of first order differential equations • Formation of second order differential equations for various systems • Solution of second order differential equations • Application of second order differential equations	• Written tests • Oral questioning • Assignments • Supervised exercises
8. Apply Power Series	• Definition of the term power series • Taylor's theorem • Deduction of McLaurin's theorem to obtain power series • Application of Taylor's theorem and McLaurin's theorems in numerical work	• Written tests • Oral questioning • Assignments • Supervised exercises
9. Apply Numerical methods	• Definition of interpolation and extrapolation • Application of interpolation • Application of interactive methods to solve equations • Application of interactive methods to areas and volumes	• Assignments • Oral questioning • Supervised exercises • Written tests
10. Apply Vector theory	• Vectors and scalar in two and three dimensions • Operations on vectors: Addition and Subtraction • Position vectors • Resolution of vectors	• Assignments • Oral questioning • Supervised exercises • Written tests
11. Apply Matrix methods	• Matrix operation • Determinant of 3x3 matrix • Inverse of 3x3 matrix • Solution of linear simultaneous equations in 3 unknowns	• Assignments • Oral questioning • Supervised exercises • Written tests

Learning outcome	Content	Suggested assessment methods
	• Application of matrices	

12. Apply quantitative techniques	• solving linear programming models
	  • graphical methods
	  • simplex method
	  ✓ row reduction
	  • profit maximisation and cost minimisation
		• Assignments
		• Oral questioning
		• Supervised exercises
		• Written tests

Suggested Methods Instructions

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Scientific Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice
- Computers with internet connection

STATISTICAL TECHNIQUES

UNIT CODE: MATH/CU/AS/CC/02/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply Statistical Techniques

Duration of Unit: 200 hours

Unit Description

This unit describes the competencies required by a statistician in order to apply statistical concepts, apply statistical methods, apply statistical methods 2 and apply statistics for business in a work place environment.

Summary of Learning Outcomes

1. Apply statistical concepts
2. Apply statistical methods 1
3. Apply statistical methods 2
4. Apply statistics for business

Learning Outcomes, Content and Suggested Assessment Methods

Learning outcome	Content	Suggested assessment methods

1. Apply statistical concepts	• Definitions
	  ◦ Branches
	  ◦ Types of statistics
	  ◦ Importance of statistics
	  ◦ Limitation of statistics
	• Terms and symbols in statistics
	• Levels of measurements
	  ◦ Nominal
	  ◦ Ordinal
	  ◦ Likert
	  ◦ Ratio
	• Data collection
	  ◦ Sources of data
	  ◦ Methods of data collection
	• Data organisation
		• Written tests
		• Oral questioning
		• Assignments
		• Supervised exercises

	• Classification • Tabulation • Data presentation • Histogram • Frequency tables • Pie charts • Bar charts • Line graphs • Polygons • Data compilation • Data clean-up • Checking response level • Editing raw data • Disseminating raw data • Measures of central tendency • Mean • Mode • Median • Measures of dispersion • Range • Quartiles • Percentiles • Variance • SD • Skewness • Kurtosis	
2. Apply statistical methods 1	• Elementary probability theory • Definition of probability • Laws of probability • Permutation and Combination • Expectation variance and S.D • Population and sample • Statistics • Parameter • Sampling procedures • Techniques • Types	• Written tests • Oral questioning • Assignments • Supervised exercises

	• Central limit theorem
	• Sampling distribution
	  • Distribution of sample mean
	• Probability distributions
	  • Discrete
	  • Binomial
	  • Poisson
	  • Continuous
	  • Normal
	  • Exponential
	• Mathematical expectation
	  • Moments
	  • Moments generating functions	

3. Apply statistical methods 2	• Theory of estimation
	• Statistical inference
	  • Introduction
	  • Normality test
	  • Test for heteroscedasticity
	  • One sample mean
	  • n < 30
	  • n is greater than or equal to 30
	  • Comparing two variances
	  • Comparing two independent group means
	  • Wedge sample test
	  • Pooled variance
	  • Comparing two dependent sample means
	  • One sample proportion
	  • Two sample proportion
	  • Contingency tables
	  Chi-square statistics
	  • Non-parametric
	  • One sample Wilcoxon test
		• Assignments
		• Oral questioning
		• Supervised exercises
		• Written tests

	• Two sample Wilcoxon test (Man Whitney test)
	• Confidence intervals and hypothesis testing (reference to statistical tables)
	• Correlation
	  • Pearson's
	  • Spearman's
	• Regression analysis
	  • Simple linear regression
	  • Scatter plots
	  • Regression Parameter Estimates
	  • Test of hypothesis on the regression parameters
	  • Confidence intervals on regression parameters
	  • ANOVA for simple linear regression
	  • Goodness of fit
	  • Coefficient of determination
	  • Alternative measures for the goodness of fit e.g. AIC
	  • Prediction of response variable
	  • Model validation
	  • Multiple linear regression
	  • Variable selection
	  • Introduction to regression with binary or count response variable (GLMs)
	  ➢ Logistic
	• Experimental design
	  • One way	

	• Two way	

4. Apply statistics for business	• Index numbers
	  • Introduction
	  • What are index number s?
	  • Uses of index numbers
	  • Types of index numbers
	  • Simple index numbers
	  • Composite index numbers
	  • Simple aggregative price/quantity index
	  • Index of average price/quantity relatives
	  • Weighted aggregative price/quantity
	  • Index of weighted average of price/quantity relatives
	  • Test of adequacy of index numbers
	  • Special issues in the construction of index numbers
	  • Problems of constructing index numbers
	• Time series
	  ✓ time series data
	  ✓ Components of time series
	  ✓ Application of time series
	• Introduction to economic statistics
	  • Definitions
	  • GDP
		• Written tests
		• Oral questioning
		• Assignments
		• Supervised exercises

	• GNP • National income equation • Demand and supply • Quantity demanded • Quantity supplied • Applications • Matrix • Statistical quality control Control charts Control limits Sampling plans • Statistical consulting Professional ethics Customer service	

Suggested Methods Instructions

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Scientific Calculators
- Rulers, pencils, erasers
- Graph books
- Teaching aids (Dice, coins, cards etc.)
- Computers with internet connection
- Datasets
- Projector
- Statistical Software
- White board
- White board marker

RESEARCH METHODS

UNIT CODE: MATH/CU/AS/CC/03/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply Research methods

Duration of Unit: 130 hours

Unit Description

This unit covers the competencies required to carry out statistical data management. It involves formulating the research problem, carry out literature review, develop research objectives, develop research design and sample design, develop research budget proposal & time plan, collect research data, analyse collected research data, interpret findings and present findings

Summary of Learning Outcomes

1. Formulating the Research Problem
2. Carry out Extensive Literature Review
3. Develop research objectives
4. Develop Research Design and Sample Design
5. Develop research budget proposal & Time plan
6. Collecting research Data
7. Analysis of collected research Data
8. Interpretation, Research Findings
9. Present research findings

Learning Outcomes, Content and Suggested Assessment Methods

Learning outcome	Content	Suggested assessment methods
1. Formulating the Research Problem	• Sources of research problems • Definition of research Philosophies • validity and reliability • Characteristics of research • Types of research • The research processes	• Written tests • Oral questioning • Assignments • Supervised exercises

	• Sources of research problems • Formulation of research problems	
2. Carry out Literature review	• Reviewing the literature • Sources of literature review • Theoretical framework • Conceptual framework • Referencing and citations • Introduction to Google scholar, research gate • Internet search engines	• Written tests • Oral questioning • Assignments • Supervised exercises
3. Develop research objectives/hypothesis or research questions	• Formulation of objectives • main objectives • sub-objectives • characteristics of objectives • characteristics of research hypothesis • formulation of research hypothesis	• Assignments • Oral questioning • Supervised exercises • Written tests

4. Develop Research Design and Sample Design	• Preparing the research design
	• Identifying Variables
	• Measurement scales
	• Study research design
	  • observational
	  • interventional
	• Types of Sampling techniques
	  • Probability and non-probability
		• Written tests
		• Oral questioning
		• Assignments
		• Supervised exercises

	• Sample size determination	

5. Develop research budget proposal & Time plan	• Budget and Costing Development
	  • Direct costs
	  • Indirect costs
	• Factors to consider when costing
	  • Materials and equipment
	  • Logistics
	  • Administrative
	• Development of Time plan
	  • Gant charts
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Collect research Data	• Methods of Data Collection and their limitations • Research instruments/ data collection tools • Types of questionnaires • Design of questionnaires • Constructing questionnaires • Digitising questionnaires • Mobile technology (ODK) • Piloting the Questionnaire • Ethical issues concerning research participants • Ethical issues relating to the researcher	• Written tests • Oral questioning • Assignments • Supervised exercises
7. Analyse collected research data	• Data Processing • Data management. • Data Analysis Methods	• Written tests • Oral questioning • Assignments

		• Supervised exercises
8. Interpret research findings	• Interpretations of parameters • Predicting of values	• Written tests • Oral questioning • Assignments • Supervised exercises
9. Present of findings	• reporting of findings • Research Project Report Format • List of References /Bibliography	• Written tests • Oral questioning • Assignments • Supervised exercise

Suggested Methods Instructions

- Group discussions
- Demonstration by trainer
- Exercises by trainee
- Use of teaching aids

Recommended Resources

- Charts with presentations of data
- Dice
- Computers with internet connection
- Datasets
- Projector
- Statistical Software
- Notes

DATABASE MANAGEMENT SYSTEM

UNIT CODE: MATH/CU/AS/CC/04/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Develop database Management System

Duration of Unit: 150 hours

Unit Description:
This unit specifies competencies required to manage database system. They include identification of database management systems, designing of database, Creation and manipulation of database, database testing e.g. using dummy data, implementation of the designed database, establishing transaction and concurrency mechanism and managing database security

Summary of Learning Outcomes:

1. Identify database management system
2. Design database
3. Create and manipulate database
4. Perform database testing e.g. using dummy data
5. Implement designed database (roll out)
6. Establish transaction and concurrency mechanism
7. Manage database security

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Method

1. Identify database management system	• Define database management system, components and terminologies
	• Classification of databases
	• Understand various database management system
	• Introduction to database management systems
	  • Excel
	  • Access
	  • SQL
		• Practical exercises
		• Oral questioning
		• Written test
		• Learner portfolio of evidence.

2. Design database system	• Define data abstraction, instances and schemas
	• Types of Database structures
	• Database operations
	  • INSERT
	  • SELECT
	  • UPDATE
	  • DELETE
	• Data models
	  • ER- Models
	  • Relational Models
	  • Hierarchical models
	  • Network Models
		• Practical exercises
		• Oral questioning
		• Written test
		• Learner portfolio of evidence.

3. Create and manipulate database system	• Creation of tables • Primary and secondary key • Linking of tables • Data variables • Database integration • Database Querying - SQL	• Practical exercises • Oral questioning • Written test • Learner portfolio of evidence.

4. Perform database testing e.g. using dummy data	• Integration testing
	• DB Query testing
	• Database test techniques
	  • Schema testing
	  • Stored procedure
	  • Trigger
	  • Stress
	  • views
	  • Benchmarking etc.
	• Perform database testing
	• Generate test report
		• Practical exercises
		• Oral questioning
		• Written test
		• Learner portfolio of evidence.

5. Implement designed database (roll out)	• Run the designed database • Test the design and Database functionality	• Practical exercises • Oral questioning • Written test • Learner portfolio of evidence
6. Establish transaction and concurrency mechanism	• Transaction mechanisms • Concurrency mechanisms • Management of multiple transactions	• Practical exercises • Oral questioning • Written test • Learner portfolio of evidence

7.Manage database security	• Restriction of access as per Internal policy • Types of restrictions • Backup and recovery methods • Statement sanitisation to remove SQL injections	• Practical exercises • Oral questioning • Written test

Suggested Methods of Instructions

- Presentations
- practical demonstrations by trainer;
- Guided learner activities
- research to develop underpinning knowledge;
- Supervised activities a
- projects in a workshop;
- Visiting lecturer/trainer from the ICT sector;
- Industrial visits.

Recommended Resources

Tools

- DB Comparer
- Ad miner
- Firebird
- Beaver
- phpMyAdmin
- Navicat for MySQL
- Test Data Generator
- Visual Query Designer

Equipment

- computers
- Servers

STATISTICAL DATA MANAGEMENT

UNIT CODE: MATH/CU/AS/CC/05/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Manage Statistical Data

Duration of Unit: 140 hours

Unit Description:
This unit specifies competencies required to manage database system. They include data management using excel, R, SPSS and Python.

Summary of Learning Outcomes:

1. Data management using excel
2. Data management using R
3. Data management using SPSS
4. Manage statistical data on Python

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Method
1. Manage statistical data on excel spreadsheet	• Excel Environment • Worksheets • Workbooks • Data labelling, coding and entry • validation • Multiple-key sorting • Sorting of data based on custom lists • creating single- and multi-level subtotals • Filtering of data using text, numeric, date • Filtering of tables using slicers • Advanced Filter • eliminating duplicate	• Practical exercises • Oral questioning • Written test • Learner portfolio of evidence.

	• Use of SUMIF and related functions for quick data analysis
	• of Index & Match
	• Conditional Formatting
	• Filtering & Sorting
	• Find & Replace
	• Data Analysis in Excel
	  • Descriptive statistics
	  • Correlation & Covariance
	  • ANOVA
	  • Regression
	  • T-test & Z-test
	• Random numbers
	• Data Presentation
	  • Pivot Table & Charts
	• CSV conversion	

2. Manage statistical data on R	• Installing R and R studio
	• Getting started with R
	• Data structures in R
	• Data entry in R
	  • Arrays
	  • Data frames
	  • Lists
	  • Vectors
	  • Matrices
	• Creating R projects
	• Importing data into R
	• Installing R packages
	• Data manipulation in R
	  • Sorting
	  • Merging
	  • Aggregating
	  • Creating new variables
	  • Indexing
	  • Sub setting
	  • Exporting
	• Exploratory data analysis
	  • Scatter plot
	  • Line graphs
		• Practical exercises
		• Oral questioning
		• Written test
		• Learner portfolio of evidence.

	• Histogram • Density plot • Pie charts • Bar charts • Box plot etc. • Descriptive statistics • Mean • Mode • Median • Dispersion • Statistical inference • Regression analysis • Time series analysis in R • Probability distribution in R • Random numbers • R commander • Built-in functions in R	
3. Manage statistical data on SPSS	• Installing SPSS • SPSS Environment • Data views • Variable views • Output Window • Data transformations • Creation of variable & data coding • Data entry • SPSS syntax • Data Analysis in SPSS • Descriptive statistics • Mean • Frequencies • Cumulative Frequencies • Pearson Correlation & Covariance • ANOVA • Regression • T-test & Z-test • Random numbers	• Practical exercises • Oral questioning • Written test • Learner portfolio of evidence.

	• Data Presentation • Table & Charts	

4. Manage statistical data on Python	• Python Basics
	  • Running Python
	  • Literals
	  • Python Comments
	  • Data Types
	  • Variables
	  • Writing a Python Module
	  • print () Function
	  • Named Arguments
	  • Collecting User Input
	  • Getting Help
	• Functions and Modules
	  • Defining Functions
	  • Variable Scope
	  • Global Variables
	  • Function Parameters
	  • Returning Values
	  • Importing Modules
	• Math
	  • Arithmetic Operators
	  • Modulus and Floor Division
	  • Assignment Operators
	  • Built-in Math Functions
	  • The math Module
	  • The random Module
	  • Seeding
	• Python Strings
	  • Quotation Marks and Special Characters
	  • String Indexing
	  • Slicing Strings
	  • Concatenation and Repetition
	  • Common String Methods
	  • String Formatting
	  • Built-in String Functions
		• Practical exercises
		• Oral questioning
		• Written test
		• Learner portfolio of evidence.

	• Sequences, Dictionaries, and Sets
	  • Definitions
	  • Sequences
	  • Unpacking Sequences
	  • Dictionaries
	  • The Len () Function
	  • Sets
	  • *args and **kwargs
	• Flow Control
	  • Conditional Statements
	  • The is and is not Operators
	  • Python's Ternary Operator
	  • Loops in Python
	  • The enumerate() Function
	  • Generators
	  • List Comprehensions
	• File Processing
	  • Opening Files
	  • The os and os.path Modules
	• Exception Handling
	  • Wildcard except Clauses
	  • Getting Information on Exceptions
	  • The else Clause
	  • The finally Clause
	  • Using Exceptions for Flow Control
	  • Exception Hierarchy
	• Dates and Times
	  • Understanding Time
	  • The time Module
	  • The date-time Module
	• Running Python Scripts from the Command Line
	  • The sys Module
	  • sys.argv	

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources and equipment

- Computer
- Internet connection
- Stationary
- Printer
- Internet
- Notes
- Data sets
- SPSS
- R
- Python
- Projector

CORE UNITS OF LEARNING

RESEARCH CONCEPTS

UNIT CODE: MATH/CU/AS/CR/01/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Develop Research Concepts .
Duration of Unit: 160 hours

Unit Description
This unit describes the skills, knowledge and competences required to: Formulate a research problem, objectives/hypothesis, develop research proposal/literature review, develop sampling procedures, develop data collection tools, develop data analysis framework, develop research budget proposal & time plan, pilot data collection tools, analyse pilot data and validate data collection tools

It applies to leaders or managers using applied research to ensure learning can enhance individual, team and organisational performance. The intended purpose and approach to applied research may vary across a range of contexts and organisations. In this unit, the focus is on applied research to attain improved organisational outcomes.

Summary of Learning Outcomes
1. Formulate a research problem, objectives/hypothesis
2. Develop research Proposal/literature review
3. Develop sampling procedures
4. Develop data collection tools
5. Develop data analysis framework/matrix
6. Develop research budget proposal & Time plan
7. Pilot data collection tools
8. Analyse pilot data and validate data collection tools

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Formulate a research problem, objectives, research question/hypothesis	• Proposal development
	• Research problem
	  ◦ Definitions of terms
	  ◦ Problem identification
	  ◦ Examples of research problems
	• Research Objectives/hypothesis
	  ◦ Formulation of objectives/hypothesis
	  ◦ Characteristics of objectives/hypothesis
	• Sampling and sampling techniques
	• Importance of sampling
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods

	• Errors in sampling
	• Types of sampling and their limitations e.g.
	  • Simple random
	  • Multistage
	  • Stratified random
	  • Cluster
	  • Judgmental
	• Referencing and citation
	• Laws relating to Copywriting and plagiarism	

2. Develop research Proposal/literature review	• Format in Proposal writing
	  • Difference between Concept paper and proposal
	• Literature review
	  • Library searches
	  • Internet searches
	  • Google scholar
	  • Research gates
	  • Wikipedia
	  • Citation and referencing
	  • Plagiarism
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

3. Develop sampling procedures	• Definitions of terms
	  • Population
	  • Sample
	• Sample size determination
	  • Means
	  • Proportions
	• Sampling techniques
	  • Probability and Non-Probability
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

4. Develop data collection tools	• Questionnaire development
	• Open and closed ended questions
	• Other data collection tools
	  • Interviews guides
	  • Audio
	  • Document analysis guide
	  • ODK (mobile based data collection tools)
	  • Google forms
	• Other emerging techniques e.g. internet adds
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods

5. Develop data analysis framework/matrix	• Data analysis tools
	  • Statistical software
	  • Calculators
	• Description of statistical methods/models
	  • Correlation
	  • Regression
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Develop research budget proposal & Time plan	• Budget and Costing Development
	  • Direct costs
	  • Indirect costs
	• Factors to consider when costing
	  • Materials and equipment
	  • Logistics
	  • Administrative
	• Development of Time plan
	  • Gant charts
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

7. Pilot data collection tools	• Pretesting for reliability • Validation of data collection tools • Research assistants	• Written test • Observation • Third party report • Oral questioning • Interviews
8. Analyse pilot data and validate data collection tools	• Data entry • Coding • Cleaning	• Written test • Observation • Third party report • Oral questioning • Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1 Computer
2 Internet connection
3 Workstation
4 Stationary
5 Printer

COLLECTION AND MANAGEMENT OF RESEARCH DATA

UNIT CODE: MATH/CU/AS/CR/02/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Collect and manage research data

Duration of Unit: 160 hours

Unit Description
This unit specifies the competencies required to collect and manage research data. It involves, preparing data collection tools and equipment, selecting a representative sample, carrying out data collection, preparing code book, entering research data/merging to servers, performing data clean-up, developing, and storing data source files.

Summary of Learning Outcomes

1. Prepare data collection tools and equipment
2. Select a representative sample
3. Carry out data collection
4. Prepare code book
5. Enter research data/Upload to servers
6. Perform data clean-up
7. Store data source files

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Prepare data collection tools and equipment	• Printing • Sorting • Serializing and recording	• Written test • Observation • Third party report • Oral questioning • Interviews

2. Select a representative sample	• Sampling procedures
	  • Types of sampling
	• Random numbers
	  • Lottery
	  • Calculator/Excel
	• Systematic
		• Written test
		• Observation
		• Third party report
		• Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	• Strata	• Interviews
3. Carry out data collection	• Types of data collection techniques • Skills of Interviewing • Focused group discussions • Experimentation • Ethics and consenting • Reconnaissance • Google forms/docs	• Written test • Observation • Third party report • Oral questioning • Interviews

4. Prepare code book	• Coding of variables
	• Template preparation
	  • Manual (PAPI)
	  • Electronic (CAPI)
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

5. Enter research data/Upload to servers	• Data capture
	  • Data capture methods
	  • Offline and online
	  • Merging/Integration
	  • ODK
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Perform data clean-up	• Editing of outliers • Missing variables • Verification of data entries • Inconsistencies • Removing duplicates	• Written test • Observation • Third party report • Oral questioning • Interviews

7. Store data source files	• Archiving
	  • CD writing
	  • Cloud computing
	  • Filling
	  • Coordinate system
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1. Printer
2. Stationary
3. Software
4. Computer
5. Internet
6. Telephone
7. Site
8. Treatments

DESCRIPTIVE DATA ANALYSIS

UNIT CODE: MATH/CU/AS/CR/03/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Perform descriptive data analysis

Duration of Unit: 200 hours

Unit Description
This unit specifies the competencies required to perform descriptive data analysis. The analysis describes the basic features of the data in a study. They provide simple summaries about the sample and the measures used in the data. The unit involves, receive data from primary or secondary source, perform further clean up if from secondary source, apply descriptive statistical tools, record descriptive statistics output, interpret output and prepare report, prepared presentation tools

Summary of Learning Outcomes

1. Receive data from primary or secondary source
2. Perform further clean up if from secondary source
3. Apply descriptive statistical tools
4. Record descriptive statistics output
5. Interpret output and prepare report.
6. Prepared presentation tools

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Receive data from primary or secondary source	• Preparation for data capture
	  • Indexing
	  • Sorting
	  • Transformation
	  • Data entry
	  • Keying
	  • Scanning
	  • Transcription
	  • Downloading
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

2. Perform further clean up	• Editing, deletion of • Inconsistencies in data • Missing data	• Written test • Observation • Third party report

Learning Outcome	Content	Suggested Assessment Methods
	• Any other, e.g. leading responses	• Oral questioning • Interviews

3. Apply descriptive statistical tools	• Data summaries
	  • Measures of central tendency
	  • Mode, Median and Mean
	  • Grouped
	  • Interval data
	  ▪ Class boundaries
	  ▪ Class limits
	  ▪ Estimation formulae
	  • Measures of variations
	  • Range, Variance & standard deviation
	  • Coefficient of variation (*CV*)
	• Presentation of Results
	  • Tables
	  • Ordinary/Simple tables
	  • Cross tabulation
	  • Custom tables
	  • Charts/Graphs
	  • Histograms/stem & leaf displays
	  • Frequency polygons
	  • Bar and Pie charts
	  • Cumulative frequency curves
	  • Percentiles/Box & Whisker plots
	• Pivot tables
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods
4. Record descriptive statistics output	• Saving outputs of Analysis • Exporting outputs to other applications, e.g. spread sheets, word processors etc. • Further Analysis/Presentation	• Written test • Observation • Third party report • Oral questioning • Interviews

5. Interpret output and prepare report.	• Interpretation of data
	  • Deductive
	  • Logical
	• Report writing
	  • Types of reports
	  • Informational
	  • Analytical
	  • Report formats
	  • Terms of reference
	• Grammar rules & Usage
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Prepared presentation tools	• PowerPoint preparation	• Written test • Observation • Third party report • Oral questioning • Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1. Computer
2. Software
3. Stationary
4. Printer
5. Data sets

INFERENTIAL DATA ANALYSIS

UNIT CODE: MATH/CU/AS/CR/04/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Perform inferential data analysis

Duration of Unit: 200 hours

Unit Description
This unit specifies the competencies required to perform inferential data analysis. It involves, apply data transformation techniques, create new variables, perform statistical model selection, obtain parameter estimates, interpret analysis results, prepare analysis report and Prepare findings presentation

Summary of Learning Outcomes

1. Apply data transformation techniques
2. Create new variables.
3. Perform statistical model selection
4. Obtain parameter estimates.
5. Interpret analysis results.
6. Prepare analysis report.
7. Prepare findings presentation

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply data ***transformation techniques***	• Transformation formulas & Procedures
	  • Number assignment (coding)
	  • Logarithmic
	  • Reciprocals
	  • Powers
	  • Grouping
	  • Exponents
	  • Likelihood functions
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

2. Create new variables.	• Creating new variables • Recording into new variables	• Written test • Observation • Third party report • Oral questioning • Interviews

Learning Outcome	Content	Suggested Assessment Methods

3. Perform ***statistical model*** selection	• Statistical Modelling
	  • Definition of terms
	  • Theory
	  ▪ Independent & dependent variables
	  ▪ Type of variables
	  • Practice
	  ▪ Practical examples & illustrations
	  ▪ Simulations
	• Statistical models
	  • Generalized linear models (GLM)
	  ▪ Simple and
	  ▪ Multiple regression
	  • Non-linear models
	  • Logistic regressions
	• Choice of statistical models
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

4. Obtain parameter estimates.	• Estimation of Model Parameters and Its Inferences
	  • Mean (μ)
	  • Standard deviation (δ)
	  • Proportion (*p*) in Binomial distribution
	  • Difference of Mean ($\mu_1 - \mu_2$)
	• Confidence Intervals (CI)
	  • 95% CI
	  • 99% CI
	• Coefficients for simple linear and multiple linear regression
	  • OLS
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods

5. Interpret analysis results.	• Interpretation of analysed data based on
	  • Parameter estimates - decision making
	  • Statistical method (e.g. Correlation, Student t-test, ANOVA
	  • Regression Model estimates
	  • Prediction
	  • Forecasting
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Prepare analysis report.	• Report writing
	  • Types of reports
	  • Informational
	  • Analytical
	  • Report formats
	  • Terms of reference
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

7. Prepare findings presentation	• Presentation of Results
	  • Tables
	  • Ordinary/Simple tables
	  • Cross tabulation
	  • Custom tables
	  • Charts/Graphs
	  • Histograms/stem & leaf displays
	  • Frequency polygons
	  • Bar and Pie charts
	  • Cumulative frequency curves
	  • Percentiles/Box & Whisker plots
	• PowerPoint
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer

- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1. Computer
2. Software
3. Stationary
4. Printer
5. Data sets
6. Projector

DESIGNING RESEARCH EXPERIMENTS

UNIT CODE: MATH/CU/AS/CR/05/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Design research experiments

Duration of Unit: 200 hours

Unit Description
This unit specifies the competencies required to design experiments. It involves recognise and develop statement of the problem, Determine the treatments and outcome variables, Design research experiments, Conduct the experiment, analyse experimental data, write report, draw conclusions and make recommendation sand making recommendations.

Summary of Learning Outcomes

1. Recognise and develop statement of the problem
2. Determine the treatments and outcome variables
3. Design research experiments
4. Conduct the experiment
5. Analyse experimental data
6. Write report, draw conclusions and make recommendations

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Recognise and develop statement of the problem	• Problem identification
	• Application of Experimental designs
	  ◦ Improve process yields
	  ◦ Improving product yields
	  ◦ Reduction of manufacturing costs
	• Introduction & definition of terms
	  ◦ Experimentation
	  ◦ Objective
	  ◦ Hypothesis
	• Research Problem
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods
	• Formulation of hypothesis	

2. Determine the ***treatments*** and outcome variables	• Choice of variable
	• Independent variables
	  • Factors
	  • Levels
	  • Ranges
	• Response variables
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

3. Design research experiments	• History of statistical designs
	• Principles of experimental design
	  • Randomization
	  • Replication
	  • Blocking
	• Designing clinical trials
	• Experimental designs
	  • Simple Comparative designs
	  • Small samples, n<30(t-test)
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

4. Conduct the experiment	• Strategy of Experimentation
	  • Best guess approach
	  • One factor at a time approach without replication
	  • One factor at a time approach with replication
	  • Factorial approach
	• Data observation & recording
	  • Data capture
	  • Data storage
	• Upload /Archiving
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Learning Outcome	Content	Suggested Assessment Methods

5. Analyse and interpret experimental data	• Choice of statistical technique
	  • Reasons
	  • Assumptions of technique
	• Statistical data Analysis
	  • T-test Analysis
	  • ANOVA
	• ANOVA as a special case of regression
	• Interpretation
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

6. Write report, draw conclusions and make recommendations	• Report format of
	  • T-test Analysis
	  • Analysis of Variance (ANOVA)
	• Conclusion & Recommendations
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1. Statistical software
2. Computer
3. Stationary
4. Workstation
5. Data sets

IMPROVEMENT OF PROCESS QUALITY

UNIT CODE: MATH/CU/AS/CR/06/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Improve Process Quality

Duration of Unit: 200 hours

Unit Description
This unit specifies the competencies required to improve industrial process quality. It involves determining process quality characteristics (attributes and/or variables), developing sampling plans, collecting quality-control data, performing Statistical Process Control (SPC), Preparing and interpreting control charts.

Summary of Learning Outcomes

1. Determine process quality characteristics (attributes and/or variables
2. Develop sampling plans
3. Collect quality-control data
4. Perform Statistical Process Control (SPC)
5. Prepare and interpret control charts

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Determine process quality characteristics (attributes and/or variables)	• Process Capability
	  • Normality
	  • Stability
	  • Performance
	  • Centrality
	  • Capability
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

2. Develop sampling plans	• Acceptance Sampling
	  • Sampling plans
	  • Sampling plan calculations
	  • Outgoing quality
	  • Double sampling plans
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

3. Collect quality-control data	• Measurements quality validation	• Written test • Observation

Learning Outcome	Content	Suggested Assessment Methods
	• Data collection methods	• Third party report • Oral questioning • Interviews

4. Perform Statistical Process Control (SPC)	• Statistical Process Control
	  • Control limits
	  • Individual charts
	  • Xbar charts
	  • Np charts
	  • C-charts
	  • R-charts
	• setting up an SPC system
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

5. Prepare and interpret quality tools and decision making	• Basic quality tools
	  • Control charts
	  • Fishbone diagram
	  • Check sheets
	  • Histogram
	  • Pareto chart
	  • Scatter plot
	  • Run chart
		• Written test
		• Observation
		• Third party report
		• Oral questioning
		• Interviews

Suggested Methods of Instructions

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions
- Direct instruction

Recommended Resources

1. Computer
2. Software
3. Stationary
4. Printer
5. Measurement tools
6. Datasets