



COMPETENCY STANDARD

DATA SCIENCE - ANALYTICS AND BIG DATA

Level: 04

(ICT Sector)

Competency Standard Code: CS-ICT-DSABD-L4-EN-V1



**National Skills Development Authority
Prime Minister's Office
Government of the People's Republic of Bangladesh**

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National Skills Development Authority

Prime Minister's Office

Level: 10-11, Biniyog Bhaban,

E-6 / B, Agargaon, Sher-E-Bangla Nagar Dhaka-1207, Bangladesh.

Email: ec@nsda.gov.bd

Website: www.nsga.gov.bd.

National Skills Portal: <http://skillsportal.gov.bd>

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This Competency Standard for **Data Science - Analytics and Big Data** is a document for the development of curricula, teaching and learning materials, and assessment tools. It also serves as the document for providing training consistent with the requirements of industry in order to meet the qualification of individuals who graduated through the established standard via competency-based assessment for a relevant job.

This document has been validated by NSDA in association with ICT Sector ISC, industry representatives, academia, related specialist, trainer and related employee.

Public and private institutions may use the information contained in this standard for activities benefitting Bangladesh.

Introduction

The NSDA aims to enhance an individual's employability by certifying completeness with skills. NSDA works to expand the skilling capacity of identified public and private training providers qualitatively and quantitatively. It also aims to establish and operationalize a responsive skills ecosystem and delivery mechanism through a combination of well-defined set of mechanisms and necessary technical supports.

Key priority economic growth sectors identified by the government have been targeted by NSDA to improve current job skills along with existing workforce to ensure required skills to industry standards. Training providers are encouraged and supported to work with industry to address identified skills and knowledge to enable industry growth and increased employment through the provision of market responsive inclusive skills training program. "Data Science - Analytics and Big Data" is selected as one of the priority occupations of Informal Sector. This standard is developed to adopt a demand driven approach to training with effective inputs from Industry Skills Councils (ISC's), employer associations and employers.

Generally, a competency standard informs curriculum, learning materials, assessment and certification of trainees enrolled in Skills Training. Trainees who successfully pass the assessment will receive a qualification in the National Skills Qualification Framework (NSQF) under Bangladesh National Qualification Framework (BNQF) and will be listed on the NSDA's online portal.

This competency standard is developed to improve skills and knowledge in accordance with the job roles, duties and tasks of the occupation and ensure that the required skills and knowledge are aligned to industry requirements. A series of stakeholder consultations, workshops were held to develop this document.

The document also details the format, sequencing, wording and layout of the Competency Standard for an occupation which is comprised of Units of Competence and its corresponding Elements.

Overview

A competency standard is a written specification of the knowledge, skills and attitudes required for the performance of an occupation, trade or job corresponding to the industry standard of performance required in the workplace.

The purpose of a competency standards is to:

- provide a consistent and reliable set of components for training, recognising and assessing people's skills, and may also have optional support materials
- enable industry recognised qualifications to be awarded through direct assessment of workplace competencies
- encourage the development and delivery of flexible training which suits individual and industry requirements
- encourage learning and assessment in a work-related environment which leads to verifiable workplace outcomes

Competency standards are developed by a working group comprised of representative from NSDA, Key Institutions, ISC, and industry experts to identify the competencies required of an occupation in Informal Sector.

Competency standards describe the skills, knowledge and attitude needed to perform effectively in the workplace. CS acknowledge that people can achieve technical and vocational competency in many ways by emphasizing what the learner can do, not how or where they learned to do it.

With competency standards, training and assessment may be conducted at the workplace or at training institute or any combination of these.

Competency standards consist of a number of units of competency. A unit of competency describes a distinct work activity that would normally be undertaken by one person in accordance with industry standards.

Units of competency are documented in a standard format that comprises of:

- unit title
- nominal duration
- unit code
- unit descriptor
- elements and performance criteria
- variables and range statement
- curricular content guide
- assessment evidence guides

Together, all the parts of a unit of competency:

- describe a work activity
- guide the assessor to determine whether the candidate is competent or not yet competent

The ensuing sections of this document comprise of a description of the relevant occupation, trade or job with all the key components of a unit of competency, including:

- a chart with an overview of all Units of Competency for the relevant occupation, trade or job including the Unit Codes and the Unit of Competency titles and corresponding Elements
- the Competency Standard that includes the Unit of Competency, Unit Descriptor, Elements and Performance Criteria, Range of Variables, Curricular Content Guide and Assessment Evidence Guide.

**Competency Standards for National Skills Certificate – Level-4 in
Data Science - Analytics and Big Data in ICT Sector**
Level Descriptors of NSQF (BNQF 1-6)

Level & Job classification	Knowledge Domain	Skills Domain	Responsibility Domain
6-Mid-Level Manager/ Sub Assistant Engineer	Comprehensive actual and theoretical knowledge within a specific work or study area with an awareness of the validity and limits of that knowledge, able to analyse, compare, relate and evaluate.	Specialised and wider range of cognitive and practical skills required to provide leadership in the development of creative solutions to defined problems. Communicate professional issues and solutions to the team and to external partners/users.	Work under broad guidance and self-motivation to execute strategic and operational plan/s. Lead lower-level management. Diagnose and resolve problems within and among work groups.
5-Supervisor	Broad knowledge of the underlying, concepts, principles, and processes in a specific work or study area, able to scrutinize and break information into parts by identifying motives or causes.	Broad range of cognitive and practical skills required to generate solutions to specific problems in one or more work or study areas. Communicate practice-related problems and possible solutions to external partners.	Work under guidance of management and self-direction to resolve specific issues. Lead and take responsibility for the work and actions of group/team members. Bridge between management.
4-Highly Skilled Worker	Broader knowledge of the underlying, concepts, principles, and processes in a specific work or study area, able to solve problems to new situations by comparing and applying acquired knowledge.	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying the full range of methods, tools, materials and information. Communicate using technical terminology and IT technology with partners and users as per workplace requirements.	Work under minimal supervision in specific contexts in response to workplace requirements. Resolve technical issues in response to workplace requirements and lead/guide a team/ group.
3-Skilled Worker	Moderately broad knowledge in a specific work or study area, able to perceive ideas and abstract from drawing and design according to workplace requirements.	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools. Communicate with his team and limited external partners upholding the values, nature and culture of the workplace	Work or study under supervision with considerable autonomy. Participate in teams and responsible for group coordination.
2-Semi Skilled Worker	Basic understanding of underpinning knowledge in a specific work or study area, able to interpret and apply common occupational terms and instructions.	Skills required to carry out simple tasks, communicate with his team in the workplace presenting and discussing results of his work with required clarity.	Work or study under supervision in a structured context with limited scope of manipulation
1 –Basic Skilled Worker	Elementary understanding of ability to interpret the underpinning knowledge in a specific study area, able to interpret common occupational terms and instructions.	Specific Basic skills required to carry out simple tasks. Interpret occupational terms and present the results of own work within guided work environment/ under supervision.	Work under direct supervision in a structured context with limited range of responsibilities.

List of Abbreviations

NSDA	National Skills Development Authority
NSQF	National Skills Qualifications Framework
SCVC	Standards and Curriculum Validation Committee
STP	Skills Training Provider
UoC	Unit of Competency
AI	Artificial intelligence
IoT	Internet of Things
AutoML	Automated machine learning
DB	Database
IBM	International Business Machines
OCI	Oracle Cloud Infrastructure
GCP	Google Cloud Platform
AWS	Amazon Web Services
ANOVA	Analysis of Variance
DMBS	Database Management System
SQL	Structured Query Language
EDA	Exploratory Data Analysis
BI	Business intelligence
ETL	Extract, Transform, Load
API	Application Programming Interface
SVM	Support Vector Machine
kNN	K-Nearest Neighbors
CNN	Convolutional Neural Network
KD	knowledge discovery
HDFS	Hadoop Distributed File System
YARN	Yet Another Resource Negotiator
MLlib	Machine Learning Library

Approval of Competency Standard

Approved by
9th Executive Committee (EC) Meeting of NSDA
Held on 16 June 2022


16.6.22

Md. Sanjul Ferdous
Deputy Director (Admin)
National Skills Development Authority
Prime Minister's Office

and
Officer of Secretarial Duties for EC Meeting
National Skills Development Authority

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**Competency Standards for National Skill Certificate –4 in
Data Science - Analytics and Big Data in ICT Sector**

Course Structure

SL	Unit Code and Title		UoC Level	Nominal Duration (Hours)
Generic Competencies				45
1.	GU-08-L2-V1	Work in the Team Environment	2	15
2.	GU-13-L4-V1	Apply Interpersonal and Communication Skills	4	15
3.	GU-14-L4-V1	Support Innovation and Manage Change	4	15
Sector Specific Competencies				15
4.	SU-ICT-04-L3-V1	Comply to Ethical Standards in the ICT Workplace	2	15
Occupation Specific Competencies				300
5.	OU-ICT-DSABD-01-L4-V1	Work with Business Domain and Data	4	20
6.	OU-ICT-DSABD-02-L4-V1	Apply Statistical Methods	4	60
7.	OU-ICT-DSABD-03-L4-V1	Apply Programming Skills for Data Science	4	60
8.	OU-ICT-DSABD-04-L4-V1	Prepare and Visualize Data	4	40
9.	OU-ICT-DSABD-05-L4-V1	Build, Validate and Deploy Machine Learning Model	4	60
10.	OU-ICT-DSABD-06-L4-V1	Work with Big Data	4	60
Total Nominal Learning Hours				360

Units and Elements Table

Generic Competencies (45 hrs.)

Code	Unit of competency	Elements of competency	Duration (hours)
GU-08-L2-V1	Work in a Team Environment	<ol style="list-style-type: none"> 1 Identify team goals and processes 2 Communicate and cooperate with team members 3 Work as a team member 4 Solve problems as a team member 	15
GU-13-L4-V1	Apply Interpersonal and Communication Skills	<ol style="list-style-type: none"> 1 Apply interpersonal skills at the workplace 2 Understand and communicate information and ideas 3 Prepare and present reports and workplace documents 	15
GU-14-L4-V1	Support Innovation and Manage Change	<ol style="list-style-type: none"> 1 Identify needs for innovation in the workplace 2 Apply creative approach and solution 3 Support flexible and innovative ways of working 4 Adapt to emerging technological changes and opportunities 	15
Total Hours			45

Sector-Specific Competencies (15 hrs.)

Code	Unit of competency	Elements of competency	Duration (hours)
SU-ICT-04-L3-V1	Comply to Ethical Standards in the ICT Workplace	<ol style="list-style-type: none"> 1. Uphold the requirements of clients 2. Deliver quality products and services 3. Maintain professionalism at workplace 4. Maintain workplace code of conduct. 	15
Total Hours			15

Occupation Specific Competencies (300 hrs.)

Code	Unit of competency	Elements of competency	Duration (hours)
OU-ICT-DSABD-01-L4-V1	Work with Business Domain and Data	<ol style="list-style-type: none"> 1. Interpret the domain of business and data science 2. Interpret concepts of data analytics 3. Derive business insights 4. Use methodologies in executing data science project cycle 	20
OU-ICT-DSABD-02-L4-V1	Apply Statistical Methods	<ol style="list-style-type: none"> 1. Interpret probability rules and probability distributions 2. Apply measures of descriptive statistics 3. Carry out sampling 4. Carry out inferential statistics 5. Implement regression models 	60
OU-ICT-DSABD-03--L4-V1	Apply Programming Skills for Data Science	<ol style="list-style-type: none"> 1. Work with database management system 2. Work with python 3. Use Pandas and NumPy libraries 4. Use python to implement descriptive and inferential statistics 	60
OU-ICT-DSABD-04-L4-V1	Prepare and Visualize Data	<ol style="list-style-type: none"> 1. Identify and collect data 2. Manipulate, transform and clean data 3. Conduct Exploratory Data Analysis (EDA) 4. Visualize and report data 	40
OU-ICT-DSABD-05-L4-V1	Build, Validate and Deploy Machine Learning Model	<ol style="list-style-type: none"> 1. Perform data pre-processing 2. Apply modelling techniques 3. Perform data modelling 4. Carry out data validation 5. Carry out model deployment 	60
OU-ICT-DSABD-06-L4-V1	Work with Big Data	<ol style="list-style-type: none"> 1. Interpret big data work elements 2. Interpret big data ecosystems 3. Work on big data platforms 	60
Total Hours			300

Generic Units of Competencies

Unit Code and Title	GU-08-L2-V1: Work in a Team Environment
Unit descriptor	This unit covers the knowledge, skills and attitudes required to work in a team environment. It specifically includes identifying team goals and processes, communicating and cooperating with team members, participating in team discussions, working as a team member and solving problems as a team member.
Nominal Hours	15 Hours
Elements of Competency	Performance Criteria Bold & Underlined terms are elaborated in the Range of Variables Training Components
1. Identify team goals and processes	1.1 Team goals and collaborative decision-making processes are identified. 1.2 Role and common goals of the team are defined from available sources of information. 1.3 Team structure, responsibilities and reporting relations are identified from team discussions and other external sources.
2. Communicate and cooperate with team members	2.1 Communication and negotiation skills are applied and maintained in all relevant situations. 2.2 Constructive contributions are made to workplace discussions on such issues as production, quality and safety. 2.3 Goals/ objectives and action plans undertaken in the workplace are communicated promptly. 2.4 Information regarding problems and issues are organized coherently to ensure clear and effective communication. 2.5 Dialogue is initiated with appropriate personnel. 2.6 Communication problems and issues are raised 2.7 Barriers to communication are identified and resolved
3. Work as a team member	3.1 Effective forms of communication are used to interact with team members in discussing team activities and objectives. 3.2 Mutual respect, empathy and active collaboration are demonstrated 3.3 Communication channels are followed as per workplace context.
4. Solve problems as a team member	4.1 Current and potential problems faced by team are identified. 4.2 Problems are investigated and analyzed. 4.3 Potential solutions of problem are identified. 4.4 Recommendations about possible solutions are developed, documented, ranked and presented to team members for decision.
Range of Variables	
Variables	Range (may include but not limited to)
1. Sources of information	1.1 Organizational structures 1.2 Operations Manuals 1.3 Job description 1.4 Standard operating procedures
2. Workplace discussions	2.1 Coordination meetings 2.2 Toolbox discussion 2.3 Peer-to-peer discussion
3. Team members	3.1 Coach / members 3.2 Supervisor / manager 3.3 Peers / colleagues 3.4 Other members /Employee representative of the organization.

4. Workplace context	4.1 National Laws and Statutes 4.2 Standard Operating Procedures 4.3 Workplace Rules and Regulations
Evidence guides The evidence must be authentic, valid, sufficient, reliable, consistent and recent and meet the requirements of the current version of the unit of competency.	
1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1 demonstrated knowledge in working in a team environment. 1.2 satisfied the requirements mentioned in the performance criteria and range of variables.
2. Underpinning knowledge	2.1 Sources of information define 2.2 Team structure, role, and responsibility. 2.3 Individual member’s roles and responsibilities. 2.4 Effective verbal communication methods 2.5 Communication flow and reporting structures. 2.6 Interpersonal communication skills. 2.7 Organization requirements for written and electronic communication methods 2.8 Communication problems and issues 2.9 Barriers in communication 2.10 Team planning. 2.11 Team meeting procedures. 2.12 Workplace etiquette 2.13 Industry maintenance, service and helpdesk practices, processes and procedures 2.14 Industry standard diagnostic tools 2.15 Malfunctions and resolutions
3. Underpinning skill	3.1 Organizing sources of information 3.2 Identifying the role and responsibility of the team. 3.3 Identifying roles and responsibilities of individual members. 3.4 Identifying effective verbal communication methods 3.5 Identifying communication flow and reporting structure. 3.6 Identifying interpersonal communication skills 3.7 Complying with organization requirements for the use of written and electronic communication methods 3.8 Negotiation and communication skills 3.9 Participating in team discussion. 3.10 Working as a team member. 3.11 Participating in a variety of workplace discussions 3.12 Effective clarifying and probing skills 3.13 Identifying issues 3.14 Identifying current industry standard diagnostic tools 3.15 Describing common malfunctions and resolutions. 3.16 Determining the root cause of a routine malfunction
4. Required attitude	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Eagerness to learn 4.5 Tidiness and timeliness 4.6 Environmental concerns 4.7 Respect for rights of peers and seniors at workplace 4.8 Communication with peers and seniors at workplace

5. Resource implication	The following resources must be provided: 5.1 Workplace (actual or simulated). 5.2 Relevant materials and equipment. 5.3 Relevant specifications or work instructions.
6. Methods of assessment	Methods of assessment may include but not limited to: 6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of assessment	7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/ nominated assessor
<p>Accreditation Requirements</p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit Code and Title	GU-13-L4-V1: Apply Interpersonal and Communication Skills
Unit Descriptor	This unit covers the knowledge, skills and attitude required to Apply Interpersonal and Communication Skills. It specifically includes applying interpersonal skills at the workplace, understanding and communicating information and ideas, preparing and presenting reports and documents.
Nominal Hours	15 Hours
Elements of Competency	Performance Criteria Bold & Underlined terms are elaborated in the Range of Variables Training Components
1. Apply interpersonal skills at the workplace	1.1 <u>Workplace interpersonal skills</u> are interpreted. 1.2 The impacts of interpersonal skills are described. 1.3 Interpersonal skills are performed in accordance with workplace procedures. 1.4 <u>Ways of improving interpersonal skills</u> are identified and followed.
2. Understand and communicate information and ideas	2.1 <u>Communication tools and equipment</u> are operated, and faults are identified and reported. 2.2 Consultative process is used to collect and convey information. 2.3 Information systems is used to store, retrieve and update information. 2.4 Information data and information are analyzed and interpreted. 2.5 Information is communicated with individuals and groups.
3. Prepare and present reports and workplace documents	3.1 <u>Workplace documents</u> are interpreted. 3.2 Appropriate format for document is used to meet workplace requirements. 3.3 Document is drafted in accordance with workplace procedures. 3.4 Document is edited and presented in a final version appropriate to task.
Range of Variables	
Variable	Range (may include but not limited to)
1. Workplace Interpersonal skills	1.1 Effective communication 1.2 Cooperation 1.3 Giving and receiving feedback, feed-forward and professional criticism 1.4 Pressure handling 1.5 Time management 1.6 Acceptance of diversity 1.7 Supporting and encouraging others 1.8 Inclusiveness 1.9 Problem solving 1.10 Negotiation 1.11 Conflict management
2. Ways of improving interpersonal skills	2.1 Cultivate a positive outlook 2.2 Ask trusted friends or colleagues for constructive criticism 2.3 Control emotions

	<ul style="list-style-type: none"> 2.4 Observe other positive interpersonal interactions 2.5 Practice active listening 2.6 Seek out opportunities to build relationships 2.7 Practice empathy
3. Communication tools and equipment	<ul style="list-style-type: none"> 3.1 Telephone 3.2 Internet 3.3 Mobile Phone 3.4 Fax machines 3.5 Two-way radio
4. Workplace documents	<ul style="list-style-type: none"> 4.1 Business Letters 4.2 Business Reports 4.3 Transactional Documents 4.4 Memos 4.5 Forms 4.6 Memorandum 4.7 Requisitioning Form 4.8 Personnel Form 4.9 Safety Report Form
<p>Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent and recent and meet the requirements of the current version of the Unit of Competency.</p>	
1. Critical Aspects of Competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 interpreted interpersonal skills 1.2 communicated information and ideas 1.3 prepared and presented workplace documents
2. Underpinning Knowledge	<ul style="list-style-type: none"> 2.1. Interpersonal skills 2.2. Impacts of interpersonal skills 2.3. Consultative processes 2.4. Workplace documents
3. Underpinning Skills	<ul style="list-style-type: none"> 3.1 Demonstrating interpersonal skills 3.2 Collecting workplace information 3.3 Analyzing information and ideas 3.4 Preparing workplace documents 3.5 Presenting workplace documents
4. Underpinning Attitudes	<ul style="list-style-type: none"> 4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Tidiness and timeliness 4.7 Respect to rights of peers and seniors in workplace 4.8 Communicate with peers and seniors in workplace
5. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 5.1. Work place Procedure 5.2. Materials relevant to the proposed activity 5.3. All tools, equipment, material and documentation required. 5.4. Relevant specifications or work instructions
6. Methods of Assessment	<ul style="list-style-type: none"> 6.1. Written test 6.2. Demonstration 6.3. Oral questioning

7. Context of Assessment	<p>7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module.</p> <p>7.2 Assessment should be done by NSDA certified/nominated assessor</p>
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit Code and Title	GU-14-L4-V1: Support Innovation and Manage Change
Unit Descriptor	This unit covers the knowledge, skills, and attitudes required to support innovation and manage change. It specifically includes identifying needs for innovation in the workplace, applying creative approaches and solution, supporting flexible and innovative ways of working and adapting to emerging technological changes and opportunities
Nominal Hours	15 Hours
Elements of Competency	Performance Criteria <u>Bold and underlined</u> terms are elaborated in the range of variables.
1 Identify needs for innovation in the workplace	1.1. The need for <u>innovation</u> in scope of work is recognized 1.2. The value of <u>innovative practices</u> in the workplace is recognized 1.3. Existing way of working in the workplace are interpreted. 1.4. Drawbacks of existing way of working are identified. 1.5. Benefits of change are identified to make it consistent with organizational requirements 1.6. Realistic timelines and targets for implementation of changes are set.
2 Apply creative approach and solution	2.1 Opportunities and creative approaches to implement innovation practices are identified 2.2 Creative approaches of coworkers pertaining to work practices are analyzed and incorporated 2.3 Innovation in accordance with organizational requirements changes are implemented
3 Support flexible and innovative ways of working	3.1 Maximum innovative opportunities are promoted. 3.2 Work assignments to facilitate innovative work skills are organized. 3.3 Team members are provided with guidance and coaching on innovation in the workplace. 3.4 Models of innovative work practice are provided and discussed 3.5 Appropriate environment for learning and innovation is maintained.
4 Adapt to emerging technological changes and opportunities	4.1 Usages of different <u>technologies</u> is determined based on job requirements. 4.2 Appropriate technology is selected as per work specifications. 4.3 Relevant technology is effectively used in carrying out functions. 4.4 Appropriate implementation tools are used as per task requirement.
Range of Variables	
Variables	Range (may include but not limited to)
1 Innovative practices	1.1 Self-directed support to implement new ideas 1.2 Collaborative arrangement to apply new method of working 1.3 Making scope of work more efficient to use new technology
2 Innovation	2.1 New ideas 2.2 Different ideas 2.3 New methods of doing work 2.4 Use of new Technology
3 Technologies	3.1 Office technology

	<ul style="list-style-type: none"> 3.2 Industrial technology 3.3 System technology 3.4 Information technology 3.5 Training technology
<p>Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent and recent and meet the requirements of the current version of the Unit of Competency.</p>	
1 Critical aspects of competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 identified need for innovation in the area of work 1.2 recognized innovative and creative ideas 1.3 supported individuals and people to access flexible and innovative ways of working 1.4 analyzing and evaluating problems associated with change 1.5 developing processes to introduce change 1.6 gathering evidence on the effect of change 1.7 presenting information on the causes and introduction of the change 1.8 selected appropriate technology consistent with work requirements 1.9 applied relevant technology 1.10 maintained and enhanced operative ability of relevant technology
2 Underpinning Knowledge	<ul style="list-style-type: none"> 2.1 Definition of innovation 2.2 Current practice in own scope of work 2.3 Workplace procedures 2.4 Support required to generate creative ideas 2.5 Difference between innovation and creativity 2.6 Common effects of change and innovation in the workplace 2.7 Industrial and organizational context of change 2.8 Organization's policies, plans, procedures and structure 2.9 Knowledge of resources required by the organization's operations 2.10 Awareness on technology and its function 2.11 Operating instructions 2.12 Applicable software 2.13 Company policy in relation to relevant technology 2.14 Technology adaptability
3 Underpinning Skills	<ul style="list-style-type: none"> 3.1 Identifying resources required for creativity and innovation 3.2 Contributing to brainstorming session 3.3 Identifying issues and concerns of one's scope of work 3.4 Encouraging co-workers to generate and develop ideas 3.5 Evaluating potential obstacles to and opportunities for creativity and innovation 3.6 Sharing of best practices related to innovation and creativity 3.7 Applying relevant technology 3.8 Using update machine and Software 3.9 Acquiring troubleshooting skills
4 Underpinning attitudes	<ul style="list-style-type: none"> 4.1 Attitude of sharing and participation 4.2 Tidiness, timeliness and orderliness 4.3 Sincerity and honesty to duties 4.4 Adaptability

5 Resource implications	The following resources must be provided: 5.1 Relevant tools, Equipment, Software and Facilities needed to perform the activities. 5.2 Required learning materials.
6 Methods of assessment	Methods of assessment may include but not limited to: 6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of assessment	7.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after completion of the training module 7.2 Assessment should be done by NSDA certified/ nominated assessor
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Sector Specific Unit of Competencies

Unit Code and Title	SU-ICT-04-L3-V1: Comply to Ethical Standards in the ICT Workplace	
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to comply to ethical standards in the ICT workplace. It specifically includes upholding the requirements of clients, delivering quality products and services, maintaining professionalism at workplace and maintaining workplace code of conduct.	
Nominal Hours	15 Hours	
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables	
1. Uphold the requirements of clients	1.1 Clients' requirements are identified. 1.2 Confidentiality of information is maintained in accordance with workplace policies/organizational policies/national legislation. 1.3 Potential conflicts of interest are identified and involved parties of potential conflicts are notified. 1.4 <u>Proprietary rights of client/customer is asserted.</u>	
2. Deliver quality products and services	2.1. Products and services are provided according to the clients' requirements. 2.2. Work is completed as per standards. 2.3. Quality processes are implemented when developing products and services.	
3. Maintain professionalism at workplace	3.1 Work processes are delivered as per standards. 3.2 Skills, knowledge and qualifications are presented in a professional manner. 3.3 Services and products developed by self and others are delivered as per workplace standard. 3.4 Unbiased and objective information are provided to clients. 3.5 Realistic estimates for time, cost and delivery of outputs are presented during negotiation.	
4. Maintain workplace code of conduct.	4.1 Workplace code of conduct are interpreted 4.2 Workplace code of conduct is followed.	
Range of variables		
Variables	Range (may include but not limited to)	
Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent and recent and meet the requirements of the current version of the Unit of Competency		
1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1 asserted proprietary rights of client/customer. 1.2 completed work to industry and international standards. 1.3 implemented quality processes when developing products and services. 1.4 delivered services and products developed by self and others. 1.5 provided unbiased and objective information to clients. 1.6 followed workplace code of conduct.	

2. Underpinning knowledge	<ul style="list-style-type: none"> 2.1. Corporate code of confidentiality of information 2.2. organizational policies, national legislation and workplace policies in relation to IT sector 2.3. Law and regulations pertaining to proprietary rights 2.4. Quality processes for products and services 2.5. Procedure of provided to client information 2.6. Method of estimating for time, cost and delivery products and services 2.7. Workplace code of conduct in IT sector
3. Underpinning Skills	<ul style="list-style-type: none"> 3.1. Upholding confidentiality of information in accordance with organizational policies, national legislation and workplace policies 3.2. Asserting proprietary rights of client/customer 3.3. Completing work in accordance with industry and international standards 3.4. Implementing quality processes when developing products and services 3.5. Delivering correctly services and products developed by self and others 3.6. Providing unbiased and objective information are to clients. 3.7. Presenting realistic estimates for time, cost and delivery of outputs during negotiation 3.8. Following workplace code of conduct
4. Underpinning Attitudes	<ul style="list-style-type: none"> 4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Tidiness and timeliness 4.7 Respect for rights of peers and seniors in workplace 4.8 Communication with peers and seniors in workplace.
5. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 5.1 Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6. Methods of Assessment	<ul style="list-style-type: none"> 6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of Assessment	<ul style="list-style-type: none"> 7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by a suitably qualified/certified assessor.

Accreditation Requirements

Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Occupation Specific Units of Competencies

Unit code and title	OU-ICT-DSABD-01-L4-V1: Work with Business Domain and Data
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to work with business domain and data. It specifically includes interpreting the domain of business and data science and concepts of data analytics, deriving business insights, and using methodologies in executing data science project cycle.
Nominal Hours	20 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Interpret the domain of business and data science	1.1 Data science is defined. 1.2 <u>Scopes of data science</u> are interpreted. 1.3 Benefits of using data science are articulated. 1.4 domains of business are recognized and accessed. 1.5 <u>Tools and technologies related to data science</u> are described. 1.6 Roles of <u>occupations of data science</u> are recognized.
2. Interpret concepts of data analytics	2.1 <u>Data analytics processes</u> are described. 2.2 Services of data analytics platform are interpreted and their applications are explained. 2.3 End to end perspective of data products is interpreted.
3. Derive business insights	3.1 Business problem is converted into quantifiable form. 3.2 Cross-functional stakeholders are identified for a business problem. 3.3 Collaboration with stakeholders is arranged to identify quantifiable improvements. 3.4 Key business indicators and target improvement metrics are identified. 3.5 Problems and/or opportunities are identified. 3.6 A business plan is formulated.
4. Use methodologies in executing data science project cycle	4.1 Application of <u>scientific method</u> to data science business problems are applied. 4.2 Cross-industry standard process for data mining (<u>CRISP-DM methodology</u>) is described. 4.3 Data pipelining is explained. 4.4 Application of experimental approach for finding insights and solutions are explained and applied. 4.5 Application of the scientific method and the CRISP-DM methodology are followed during setting up new data science project.
Range of Variables	
Variables	Range (may include but not limited to)
1. Scopes of data science	1.1 Business application 1.2 Industrial application 1.3 Research and Development 1.4 Risk management 1.5 E-commerce 1.6 Telecom 1.7 Medical 1.8 Public sector

	<ul style="list-style-type: none"> 1.9 Media and entertainment 1.10 Education sector 1.11 Digital Marketing
2. Tools and technologies related to data science	<ul style="list-style-type: none"> 2.1 Technologies of data science <ul style="list-style-type: none"> 2.1.1 Artificial intelligence (AI) 2.1.2 Cloud services 2.1.3 Internet of Things (IoT) 2.1.4 Big data 2.1.5 Automated machine learning (AutoML) 2.2 Tools of data science <ul style="list-style-type: none"> 2.2.1 Python 2.2.2 R 2.2.3 Excel 2.2.4 Tableau 2.2.5 Power BI 2.2.6 TensorFlow 2.2.7 Pytorch 2.2.8 MongoDB 2.2.9 Apache Spark 2.2.10 Apache Hadoop 2.2.11 AWS, Azure, OCI, GCP 2.2.12 Yarn 2.2.13 Apache KAFKA 2.2.14 Flume 2.3 IBM Watson
3. Occupations of data science	<ul style="list-style-type: none"> 3.1 Data analyst 3.2 Data scientist 3.3 Data engineer 3.4 ML engineer 3.5 Data architect 3.6 Business intelligence developer
4. Data analytics process	<ul style="list-style-type: none"> 4.1 Problem Statements 4.2 Gathering data requirements 4.3 Data collection 4.4 Data cleansing 4.5 Data analysis 4.6 Data interpretation 4.7 Data visualization 4.8 Pattern Recognition
5. Scientific method	<ul style="list-style-type: none"> 5.1 Observe 5.2 Question 5.3 Hypothesize 5.4 Test 5.5 Conclude 5.6 Redo
6. CRISP-DM methodology	<ul style="list-style-type: none"> 6.1 Business understanding 6.2 Data understanding 6.3 Data preparation 6.4 Modeling 6.5 Evaluation 6.6 Deployment
<p>Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.</p>	

1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1 derived business insights 1.2 used methodologies in executing data science project cycle
2 Underpinning knowledge	2.1 Tools and techniques of data science 2.2 Data analytics processes 2.3 Scientific method 2.4 CRISP-DM methodology 2.5 Data pipelining
3 Underpinning skills	3.1 Converting business problems into quantifiable form 3.2 Identifying key business indicators and target improvement metrics 3.3 Constructing research questions and hypotheses 3.4 Following CRISP-DM for new data science project
4 Underpinning Attitudes	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Addressing and accepting feedback 4.7 Tidiness and timeliness 4.8 Respect for rights of peers and seniors in workplace 4.9 Communication with peers and seniors in workplace
5 Resource implications	The following resources must be provided: 5.1 Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6 Methods of assessment	6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7 Context of assessment	7.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/nominated assessor
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit code and title	OU-ICT-DSABD-02-L4-V1: Apply Statistical Methods
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to apply statistical methods. It specifically includes interpreting probability rules and probability distributions, applying measures of descriptive statistics, carrying out sampling, carrying out inferential statistics, implementing regression models
Nominal Hours	60 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Interpret probability rules and probability distributions	1.1 <u>Fundamental rules of probability</u> are explained. 1.2 <u>Rules for Conditional probability and independence</u> are described. 1.3 Bayes rule is interpreted. 1.4 <u>Common continuous and discrete probability distributions</u> are described. 1.5 Z-score and standard normal distribution are interpreted. 1.6 Proportions are computed using z-table. 1.7 Probabilities are computed using normal distribution.
2. Apply measures of descriptive statistics	2.1 <u>Types of data</u> and <u>data measurement scales</u> are described. 2.2 <u>Measures of central tendency</u> are explained. 2.3 <u>Measures of dispersion</u> are explained. 2.4 <u>Measures of association</u> are explained. 2.5 Mean, median, mode, variance and standard deviation are calculated from sample problems.
3. Carry out sampling	3.1 <u>Sampling methods</u> are described. 3.2 Sampling is performed. 3.3 Biases in sampling are interpreted and corrective measures are performed. 3.4 Sampling distribution and its characteristics are explained and applied. 3.5 Central limit theorem is interpreted and applied. 3.6
4. Carry out inferential statistics	4.1 Confidence interval is explained. 4.2 Hypothesis testing is interpreted. 4.3 <u>Hypothesis test</u> is performed using critical value and p-value approach. 4.4 Type-I and Type-II errors are interpreted. 4.5 Inference for comparing means (ANOVA) is explained. 4.6 <u>Non-parametric tests</u> are performed.
5. Implement regression models	5.1 Simple linear regression and its underlying assumptions are explained and used. 5.2 Techniques for testing and validating assumptions of regression are applied. 5.3 Impact of multicollinearity and heteroscedasticity are explained tested.

	<p>5.4 Simple and Multivariate linear regression models are used to predict numeric values.</p> <p>5.5 Logistic regression is explained and applied.</p>
Range of Variables	
Variables	Range (may include but not limited to)
1. Fundamental rules of probability	<p>1.1 Basic properties of probability</p> <p>1.2 Sum of probabilities</p> <p>1.3 Complement rule</p> <p>1.4 Probabilities involving multiple events</p> <p>1.5 Addition rule for disjointed events</p> <p>1.6 General addition rule</p>
2. Rules for conditional probability and independence	<p>2.1 Multiplication rule for independent events</p> <p>2.2 Conditional probability</p> <p>2.3 General multiplication rule</p>
3. Common continuous and discrete probability distributions	<p>3.1 Continuous probability distributions</p> <p>3.1.1 Normal distribution</p> <p>3.1.2 Student-t distribution</p> <p>3.1.3 Chi-square distribution</p> <p>3.2 Discrete probability distribution</p> <p>3.2.1 Bernoulli distribution</p> <p>3.2.2 Binomial distribution</p> <p>3.2.3 Multinomial distribution</p> <p>3.2.4 Poisson distribution</p>
4. Types of data	<p>4.1 Qualitative/ Categorical Data</p> <p>4.1.1 Nominal data</p> <p>4.1.2 Ordinal data</p> <p>4.1.3 Binary Data</p> <p>4.2 Quantitative/ Numeric data</p> <p>4.2.1 Discrete data</p> <p>4.2.2 Continuous data</p>
5. Data measurement scales	<p>5.1 Nominal</p> <p>5.2 Ordinal</p> <p>5.3 Interval</p> <p>5.4 Ratio</p>
6. Measures of central tendency	<p>6.1 Mean</p> <p>6.2 Median</p> <p>6.3 Mode</p> <p>6.4 Skewness</p> <p>6.5 Kurtosis</p>
7. Measures of dispersion	<p>7.1 Range</p> <p>7.2 Quartile</p> <p>7.3 Variance</p> <p>7.4 Standard deviation</p>
8. Measures of association	<p>8.1 Covariance</p> <p>8.2 Correlation</p>
9. Sampling methods	<p>9.1 Probability sampling</p> <p>9.1.1 Simple random sampling</p> <p>9.1.2 Systematic sampling</p> <p>9.1.3 Stratified sampling</p>

	<ul style="list-style-type: none"> 9.1.4 Cluster sampling 9.2 Non-probability sampling <ul style="list-style-type: none"> 9.2.1 Convenience sampling 9.2.2 Consecutive sampling 9.2.3 Purposive sampling 9.2.4 Quota sampling 9.2.5 Snowball sampling
10. Hypothesis test	<ul style="list-style-type: none"> 10.1 Tests about proportions 10.2 Tests about one mean 10.3 Tests of the equality of two means 10.4 Tests of variances
11. Non-parametric tests	<ul style="list-style-type: none"> 11.1 Wilcoxon signed ranked test 11.2 Kruskal-Wallis test 11.3 Mann-Whitney test 11.4 Spearman rank correlation
<p>Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.</p>	
1. Critical aspects of competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1. applied measures of descriptive statistics 1.2. carried out sampling 1.3. carried out inferential statistics 1.4. implemented regression models
2. Underpinning knowledge	<ul style="list-style-type: none"> 2.1. Probability distributions 2.2. Data Types 2.3. Measures of central tendency 2.4. Measures of dispersion 2.5. Measures of association 2.6. Sampling methods 2.7. Hypothesis test 2.8. Non-parametric tests 2.9. ANOVA 2.10. Simple linear regression 2.11. Logistic regression 2.12. Multicollinearity and heteroscedasticity
3. Underpinning skills	<ul style="list-style-type: none"> 3.1. Computing probabilities using normal distribution 3.2. Calculating mean, median, mode, variance and standard deviation 3.3. Testing hypothesis using critical value and p-value approach 3.4. Predicting numeric values using linear regression models

4. Underpinning Attitudes	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Addressing and accepting feedback 4.7 Tidiness and timeliness 4.8 Respect for rights of peers and seniors in workplace 4.9 Communication with peers and seniors in workplace
5. Resource implications	The following resources must be provided: 5.1 Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6. Methods of assessment	6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of assessment	7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/ nominated assessor
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit code and title	OU-ICT-DSABD-03-L4-V1: Apply Programming Skills for Data Science
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to apply programming skills for data science. It specifically includes working with database management system, working with Python, using Pandas and NumPy libraries, and using python to implement descriptive and inferential statistics.
Nominal Hours	60 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Work with database management system	<p>1.1 Suitable <u>Database Management System (DBMS)</u> is setup according to the organizational requirements.</p> <p>1.2 <u>SQL commands</u> and <u>Logical Operators</u> are written to access the database.</p> <p>1.3 <u>Different types of JOINS</u> are written to combine data from multiple sources.</p> <p>1.4 <u>Aggregate functions</u> are used to extract basic information about data and transform data according to analysis requirements.</p> <p>1.5 Subqueries are written as required.</p> <p>1.6 <u>Window functions</u> and partitioning are used to complete complex tasks.</p>
2. Work with python	<p>2.1 Appropriate Anaconda/ Miniconda version is setup for using Python for data analysis.</p> <p>2.2 Suitable <u>Python IDE</u> is selected for data analysis.</p> <p>2.3 Logical statements are created using <u>Python data types and structures, Python operators</u> and variables.</p> <p>2.4 Syntax, whitespace and style guidelines are implemented.</p> <p>2.5 Conditional statements and loops are used for multiple iteration and decision making.</p> <p>2.6 Custom functions and lambda expressions are defined in code.</p> <p>2.7 Modules in Python Standard Libraries and third-party libraries are used.</p> <p>2.8 <u>Git commands</u> are demonstrated to use with python scripts/ Jupyter notebooks.</p>
3. Use Pandas and NumPy libraries	<p>3.1 Objects in Pandas Series and DataFrames are created, accessed and modified.</p> <p>3.2 CSV, JSON, XML and XLS files are read using Pandas.</p> <p>3.3 Multidimensional NumPy arrays (ndarrays) are created, accessed, modified and sorted.</p> <p>3.4 Slicing, Boolean indexing and set operations are performed to select or change subset of ndarray.</p> <p>3.5 Element-wise operations are done on ndarrays.</p>
4. Use python to implement descriptive and inferential statistics	<p>4.1 Usage of Python Scipy library is demonstrated.</p> <p>4.2 Mean, median, mode, standard deviation, percentiles, skewness and kurtosis are calculated using python.</p> <p>4.3 Python code is used to test hypothesis.</p> <p>4.4 Correlations are measured.</p>

	4.5 Continuous variable is predicted using regression and regression assumptions are validated.
Range of Variables	
Variables	Range (may include but not limited to)
1. Database Management System (DMBS)	1.1 Oracle Database 1.2 MySQL 1.3 Microsoft SQL Server 1.4 PostgreSQL 1.5 NoSQL 1.6 MonGO DB 1.7 Hive QL 1.8 HBase
2. SQL commands	2.1 SELECT 2.2 UPDATE 2.3 DELETE 2.4 INSERT 2.5 ALTER 2.6 CREATE 2.7 DROP
3. Logical operators	3.1 LIKE 3.2 AND 3.3 OR
4. Different types of JOINS	4.1 INNER JOIN 4.2 OUTER JOIN 4.2.1 LEFT JOIN 4.2.2 RIGHT JOIN 4.2.3 FULL JOIN
5. Aggregate functions	5.1 COUNT 5.2 SUM 5.3 MIN 5.4 MAX 5.5 AVERAGE
6. Window functions	6.1 time 6.2 timeBatch 6.3 batch 6.4 timeLength 6.5 length 6.6 lengthBatch 6.7 RANK 6.8 NTILE 6.9 LAG 6.10 LEAD
7. Python IDE	7.1 Spyder 7.2 Pycharm 7.3 Jupyter Notebook 7.4 Kaggle 7.5 Google Colab 7.6 Atom

	7.7 Vscode
8. Python data types & Structure	8.1 Python data types 8.1.1 Integers 8.1.2 Floats 8.1.3 Booleans 8.1.4 Strings 8.2 Data Structure 8.2.1 Lists 8.2.2 Tuples 8.2.3 Sets 8.2.4 Dictionaries
9. Python operators	9.2.1 Arithmetic 9.2.2 Assignment 9.2.3 Comparison 9.2.4 Logical 9.2.5 Membership 9.2.6 Identity
10. Git commands	10.1 Git config 10.2 Git init 10.3 Git add 10.4 Git commit 10.5 Git push 10.6 Git pull 10.7 Git checkout 10.8 Git merge
Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.	
1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1. worked with database management system 1.2. worked with python 1.3. used pandas and numpy libraries 1.4. used python to implement descriptive and inferential statistics
2. Underpinning knowledge	2.1. Database Management System (DBMS) 2.2. Window functions 2.3. Python data types and structures 2.4. Git commands
3. Underpinning skills	3.1 Setting up Database Management System (DBMS) 3.2 Writing SQL commands and logical operators 3.3 Writing JOINS in SQL 3.4 Using aggregate functions 3.5 Writing windows functions 3.6 Creating logical statements 3.7 Defining custom functions and lambda expressions in python 3.8 Using loops and conditional statements in python 3.9 Using common git commands 3.10 Accessing CSV, JSON and XLS files in python 3.11 Modifying and sorting numpy arrays

	<p>3.12 Slicing, Boolean indexing and set operations in python</p> <p>3.13 Doing element-wise operations in ndarrays</p> <p>3.14 Calculating mean, median, mode, standard deviation, percentiles, skewness and kurtosis using python</p> <p>3.15 Measuring correlation</p> <p>3.16 Predicting using regression</p> <p>3.17 Validating regression assumptions</p>
4. Underpinning Attitudes	<p>4.1 Commitment to occupational health and safety</p> <p>4.2 Promptness in carrying out activities</p> <p>4.3 Sincere and honest to duties</p> <p>4.4 Environmental concerns</p> <p>4.5 Eagerness to learn</p> <p>4.6 Addressing and accepting feedback</p> <p>4.7 Tidiness and timeliness</p> <p>4.8 Respect for rights of peers and seniors in workplace</p> <p>4.9 Communication with peers and seniors in workplace</p>
5. Resource implications	<p>The following resources must be provided:</p> <p>5.1 Relevant tools, Equipment, software and facilities needed to perform the activities.</p> <p>5.2 Required learning materials.</p>
6. Methods of assessment	<p>6.1 Written test</p> <p>6.2 Demonstration</p> <p>6.3 Oral questioning</p>
7. Context of assessment	<p>7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module.</p> <p>7.2 Assessment should be done by NSDA certified/ nominated assessor.</p>
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit Code and Title	OU-ICT-DSABD-04-L4-V1: Prepare and Visualize Data
Unit Descriptor	This unit covers the knowledge, skills, and attitudes required to prepare and visualize data. It specifically includes identifying, collecting, manipulating, transforming and cleaning data, conducting exploratory data analysis (EDA), and visualizing and reporting data.
Nominal Hours	40 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Identify and collect data	1.1 <u>Data sources</u> are identified that are relevant the business problem. 1.2 Data is loaded from multiple data sources. 1.3 Complex data is loaded using appropriate <u>data acquisition techniques</u> . 1.4 Data is stored in the required format.
2. Manipulate, transform and clean data	2.1 Cases which require data transformations are identified. 2.2 Impacts of imbalanced data are explained. 2.3 <u>Feature selection techniques</u> are applied. 2.4 <u>Data transformation</u> is performed. 2.5 Slicing, indexing, sub-setting, merging and joining datasets are performed. 2.6 Facts, Dimensions and schemas are identified and explained. 2.7 Techniques are applied to <u>handle missing values</u> . 2.8 Outliers are identified, visualized and dealt with. 2.9 Fully usable dataset is constructed by cleaning and transforming data.
3. Conduct Exploratory Data Analysis (EDA)	3.1 <u>Steps of EDA</u> are described. 3.2 Appropriate features/ variables are identified for the analysis. 3.3 <u>Statistical characteristics</u> of the variables are analyzed. 3.4 Dataset is parsed by cleaning, treating missing values & outliers and transforming as required. 3.5 Bi-variate and multivariate analysis are performed to find associations between variables.
4. Visualize and report data	4.1 Variables and relationships are visualized using various <u>visualization methods</u> suitable for various data types. 4.2 Python visualization libraries (matplotlib, plotly) or Power BI or Tableau are used to plot charts and graphs. 4.3 Plots are analyzed to identify important patterns. 4.4 Reports are generated using Power BI or Tableau. 4.5 Reports are shared with stakeholders.
Range of Variables	
Variables	Range (may include but not limited to)
1. Data sources	1.1. Databases 1.2. Flat files

	<ul style="list-style-type: none"> 1.3. Web services 1.4. Cloud data 1.5. Multidimensional 1.6. Large datasets from distributed frameworks like hadoop 1.7. Meta Data
2. Data acquisition techniques	<ul style="list-style-type: none"> 2.1. ETL batch processing 2.2. ELT batch processing 2.3. Web scrappers 2.4. Web crawlers 2.5. API Data Loading
3. Feature selection techniques	<ul style="list-style-type: none"> 3.1. Filter methods 3.2. Wrapper methods 3.3. Embedded methods 3.4. Hybrid methods 3.5. Information Gains 3.6. Gini Index 3.7. Chi Square
4. Data Transformation	<ul style="list-style-type: none"> 4.1. Mapping 4.2. Encoding 4.3. Normalization 4.4. Standardization
5. Handle missing values	<ul style="list-style-type: none"> 5.1. Drop missing values/ columns/ rows 5.2. Imputation
6. Steps of EDA	<ul style="list-style-type: none"> 6.1. Variable Identification 6.2. Univariate Analysis 6.3. Bi-variate Analysis 6.4. Missing values treatment 6.5. Outlier treatment 6.6. Variable transformation 6.7. Variable creation
7. Statistical characteristics	<ul style="list-style-type: none"> 7.1. Mean 7.2. Median 7.3. Mode 7.4. Percentile 7.5. Standard deviations 7.6. Variance 7.7. Correlation 7.8. Covariance 7.9. Normality
8. Visualization methods	<ul style="list-style-type: none"> 8.1. Histogram 8.2. Box plot 8.3. Scatter plot 8.4. Pie chart 8.5. Pareto chart 8.6. Q-Q plot

Evidence Guide	
The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.	
1. Critical aspects of competency	Assessment required evidence that the candidate: <ul style="list-style-type: none"> 1.1. identified and collected data 1.2. manipulated, transformed and cleaned data 1.3. conducted exploratory data analysis (EDA) 1.4. visualized and reported data
2. Underpinning knowledge	<ul style="list-style-type: none"> 2.1 Data sources 2.2 data acquisition techniques 2.3 Feature selection techniques 2.4 Data transformation techniques 2.5 Missing data handling 2.6 Steps of EDA 2.7 Multivariate analysis 2.8 Visualization methods
3. Underpinning skills	<ul style="list-style-type: none"> 3.1 Loading data from multiple data sources 3.2 Applying feature selection techniques 3.3 Transforming data 3.4 Handling missing values 3.5 Analyzing statistical characteristics 3.6 Performing bi or multivariate analysis 3.7 Visualizing data using python or Power BI 3.8 Generating reports based on EDA
4. Underpinning attitudes	<ul style="list-style-type: none"> 4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Addressing and accepting feedback 4.7 Tidiness and timeliness 4.8 Respect for rights of peers and seniors in workplace 4.9 Communication with peers and seniors in workplace
5. Resource Implications	The following resources must be provided: <ul style="list-style-type: none"> 5.1 Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6. Methods of assessment	<ul style="list-style-type: none"> 6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of assessment	<ul style="list-style-type: none"> 7.1 Competency assessment must be done in an assessment/training center or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/ nominated assessor

Accreditation Requirements

Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Unit Code and Title	OU-ICT-DSABD-05-L4-V1: Build, Validate and Deploy Machine Learning Model
Unit Descriptor	This unit covers the knowledge, skills, and attitudes required to build, validate and deploy machine learning model. It specifically includes performing data pre-processing, applying modeling techniques, performing data modelling, carrying out data validation and model deployment.
Nominal Hours	60 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Perform data pre-processing	1.1. Feature engineering is applied 1.2. Feature selection techniques are applied. 1.3. Data transformation is applied.
2. Apply modeling techniques	2.1 <u>Machine learning and Deep learning models</u> are interpreted and applied. 2.2 <u>Ensemble learning models</u> are explained and applied.
3. Perform data modeling	3.1 Potential models are selected based on the available data, data distributions and goals of the project. 3.2 <u>Dimension reduction techniques</u> are applied. 3.3 Usages of Scikit-learn library to build models are demonstrated. 3.4 Supervised and unsupervised models are tested on the dataset.
4. Carry out data validation	4.1 <u>Cross validation techniques</u> are applied on the dataset to validate model. 4.2 Machine learning model's performance is evaluated using <u>performance evaluation factors</u> 4.3 Report is prepared with findings and conclusions for the data science/ business audience.
5. Carry out model deployment	5.1 <u>Deployment tools</u> are interpreted 5.2 Deployment tools are used for deploying model 5.3 Project is evaluated and drawbacks are incorporated and rectified.
Range of Variables	
Variables	Range (may include but not limited to)
1. Machine learning and deep learning models	1.1 Supervised 1.1.1.Linear Regression 1.1.2.Logistic Regression 1.1.3.Decision Tree 1.1.4.Support Vector Machine (SVM) 1.1.5.Naive Bayes 1.1.6.K-Nearest Neighbors (kNN) 1.1.7.Random Forest 1.1.8.Convolutional Neural Network (CNN) 1.2 Unsupervised learning 1.2.1.K-means 1.2.2.Association rules 1.3 Reinforcement learning 1.3.1.Q-learning 1.3.2.Temporal difference 1.4 Deep learning 1.4.1 Artificial Neural Network (ANN)

	<ul style="list-style-type: none"> 1.4.2 Convolutional Neural Network (CNN) 1.4.3 Generative Adversarial Network (GAN) 1.4.4 Recurrent Neural Network (RNN)
2. Ensemble learning techniques	<ul style="list-style-type: none"> 2.1 Stacking 2.2 Blending 2.3 Bagging 2.4 Boosting (AdaBoost, Gradient Boost, XGBoost)
3. Dimension reduction techniques	<ul style="list-style-type: none"> 3.1. Missing Values Ratio 3.2. Low Variance Filter 3.3. High Correlation Filter 3.4. Random Forests/Ensemble Trees 3.5. Principal Component Analysis (PCA) 3.6. Backward Feature Elimination 3.7. Forward Feature Construction 3.8. Factor Analysis
4. Cross validation techniques	<ul style="list-style-type: none"> 4.1. Bagging 4.2. Bootstrap
5. Performance evaluation factors	<ul style="list-style-type: none"> 5.1. Confusion matrix 5.2. Gain and lift chart 5.3. Gini coefficient 5.4. Accuracy 5.5. Precision 5.6. Recall /True Positive (TP) rate/ Sensitivity 5.7. ROC and AUC 5.8. R² and adjusted R² score 5.9. Adjusted R² score 5.10. Root mean squared error 5.11. Elbow method 5.12. Performance measurement for clusters
6. Deployment tools	<ul style="list-style-type: none"> 6.1. DJANGO, REST API 6.2. Flask
Evidence Guide	
The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.	
1 Critical aspects of competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 performed data pre-processing 1.2 demonstrated understanding of modeling techniques 1.3 performed data modeling 1.4 carried out data validation 1.5 carried out model deployment
2 Underpinning Knowledge	<ul style="list-style-type: none"> 2.1 Supervised learning 2.2 Unsupervised learning 2.3 Reinforcement learning 2.4 Dimension reduction techniques 2.5 Cross validation techniques 2.6 performance evaluation factors
3 Underpinning Skills	<ul style="list-style-type: none"> 3.1 Selecting potential models 3.2 Testing Supervised and unsupervised models on dataset 3.3 Applying feature selection techniques 3.4 Applying dimensionality reduction techniques 3.5 Cross validating 3.6 Evaluating model performance 3.7 Evaluating Project and incorporating and rectifying drawbacks.

4 Underpinning attitudes	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Addressing and accepting feedback 4.7 Tidiness and timeliness 4.8 Respect for rights of peers and seniors in workplace 4.9 Communication with peers and seniors in workplace
5 Resource implications	The following resources must be provided: 5.1 Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6 Methods of assessment	6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7 Context of assessment	7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/ nominated assessor
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit Code and Title	OU-ICT-DSABD-06-L4-V1: Work with Big Data
Unit Descriptor	This unit covers the knowledge, skills, and attitudes required to work with big data. It specifically includes interpreting big data work elements, big data ecosystems, and working on big data platforms.
Nominal Hours	60 hours
Elements of Competency	Performance Criteria <u>Bold and Underlined</u> terms are elaborated in the Range of Variables.
1. Interpret big data work elements	1.1. Big data is explained. 1.2. Usage of big data in different organizations are described. 1.3. Major applications of distributed and cloud platforms are explained. 1.4. <u>Cloud-based solutions</u> are identified.
2. Interpret big data ecosystems	2.1. Big data ecosystems are interpreted. 2.2. <u>Major components of a big data ecosystem</u> are described.
3. Work on big data platforms	3.1. <u>Components of Hadoop ecosystem</u> are identified. 3.2. <u>Components of Spark ecosystem</u> are identified. 3.3. Spark framework is used to complete a small big-data project. 3.4. Big data project is evaluated and drawbacks are incorporated and rectified.
Range of Variables	
Variables	Range (may include but not limited to)
1. Cloud-based solutions	1.1 AWS instance types 1.2 Amazon Redshift 1.3 Amazon Sage Maker 1.4 Azure Data factory 1.5 Azure Synapse 1.6 GCP big query
2. Major components of big data ecosystems	2.1. Data sources 2.2. Data management (integration, storage and processing) 2.3. Data analytics, business intelligence (BI) and knowledge discovery (KD)
3. Components of hadoop ecosystem	3.1 Hadoop Distributed File System (HDFS) 3.2 Yet Another Resource Negotiator (YARN) 3.3 Hadoop MapReduce 3.4 Hadoop Common (Hadoop Core)
4. Components of spark ecosystem	4.1 Spark Core 4.2 Spark SQL 4.3 Spark Streaming and Structured Streaming 4.4 Machine Learning Library (MLlib) 4.5 GraphX
Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.	

1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1 worked on big data platforms
2. Underpinning Knowledge	2.1 Big data 2.2 Cloud-based data solutions 2.3 Big data ecosystems 2.4 Major components of a big data ecosystem 2.5 Components of Hadoop ecosystem 2.6 Components of Spark ecosystem
3. Underpinning Skills	3.1 Identifying Cloud-based solutions. 3.2 Using Spark framework 3.3 Evaluating Big Data Project and incorporating and rectifying drawbacks.
4. Underpinning attitudes	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Addressing and accepting feedback 4.7 Tidiness and timeliness 4.8 Respect for rights of peers and seniors in workplace 4.9 Communication with peers and seniors in workplace
5. Resource implications	The following resources must be provided: 5.1. Relevant tools, Equipment, software and facilities needed to perform the activities. 5.2 Required learning materials.
6. Methods of assessment	6.1 Written test 6.2 Demonstration 6.3 Oral questioning
7. Context of assessment	7.1 Competency assessment must be done in an assessment/training centre or in an actual or simulated work place after Completion of the training module. 7.2 Assessment should be done by NSDA certified/ nominated assessor
<p>Accreditation Requirements Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Development of Competency Standard

The Competency Standards for National Skills Certificate in Data Science - Analytics and Big Data, Level 4 is developed by SEIP on 17 October 2021.

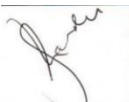
Competency standard development workshop participants (Held on 17 October 2021)

S.N.	Name and Address	Position in the committee
1.	Mr. Mohammed Nasir, Chairman, RTISC	Chairperson
2.	Dr. Md. Nurul Islam, TVET Specialist, SEIP	Member
3.	Mr. Mursil Mahmud, Quality Assurance, SEIP Officer (CSE)	Member
4.	Khairul Al Mamun, Managing Director, ARK Technology	Member
5.	Marzia Ahmed, Lecturer, DIU	Member
6.	Md. Nazmus Sakib, Program Manager (IT), New Horizon, Dhaka.	Member
7.	Md. Toifiquir Rahman, Manager, Business, New Horizon Development	Member
8.	Md. Monirul Islam, Lecturer, Uttara University	Member
9.	Fazly Rabbi, Assistant Programmer, PDBF, Ministry of LGRD&C	Member
10.	Mst. Khaleda Mousumee, Coordinator – Training, BASIS-SEIP -3 Project Monitoring & Assessment	Member
11.	Mr. Syed Azharul Haque, CEO, Skills Zone	Member
12.	Mr. Md. Abu Saleh, Technical Head, UCEP	Member
13.	Wg Cdr Zaglul Hayder (Rtd), CEO RTISC	Member
14.	Mr. Md. Sharif Nowaz, Executive (Curriculum development & Training), RTISC	Member
15.	Mr. Md. Moniruzzaman, Executive (Assessment & Certification), RTISC	Member

Validation of Competency Standard by Standard and Curriculum Validation Committee (SCVC)

The Competency Standards for National Skills Certificate in Data Science - Analytics and Big Data, Level 4 is validated by NSDA on 10 April 2022.

List of Members of the SCVC

S/N	Name and Address	Position in the committee	Signature and Date
1.	Shafquat Haider, Chairman, ICT ISC, ciproco@bol-online.com , shafquat.haider@gmail.com, Mobile No. 01711532597	Chairperson	
2.	Dr. SM Aminul Haque, Associate Professor, Daffodil Int'l University, 01847140129, aminul.cse@daffodilvarsity.edu.bd.	Member	
3.	Ayesha Siddika, Assistant Professor, Dept. of CSE, World university of Bangladesh, Email: ayeshareba.cse@gmail.com or ayesha@cse.wub.edu.bd , Mobile: 01864081423.	Member	
4.	Name: Rahat Mahamud, Sub-Inspector, Special Branch, Bangladesh Police, Email: rahatmahamudsohel@gmail.com, Mobile: 01724-700421	Member	
5.	Md. Rakibul Islam, Sub-Inspector, Special Branch, Bangladesh Police, Email: inr.rakib@gmail.com, Mobile: 01717-365787	Member	
6.	Asif Mredha, Executive (Big Data, Data Science), New Horizons, Email: asifmridha21@gmail.com, Mobile: 01762640569	Member	
7.	Mr. Fazly Rabbi, Assistant Programmer, PDBF, Ministry of LGRD & C, Email: fazzlayrabbi77@gmail.com, Mobile: 01557243803	Member	
8.	AKM Mashukur Rahman Mazumdar, Trainer, Pondit, Dhaka, Email: mashuq.odelltech@odell.com, Mobile: 01676323576	Member	
9.	Naz Ahmed, CEO, Naztech inc. Email: nazahmed@naztech.us.com , Mobile: 01743003796	Member	
10.	Tareq Naushad, CTO, Naztech inc. Email: tareq.naushad@naztech.us.com , Mobile: 01713397552	Member	
11.	Soyam Mazumder, COO, Naztech inc. soyam.mazumdar@naztech.us.com , Mobile: 01708492986	Member	
12.	Mahbub Huda, Consultant, Specialist, NSDA, Email: huda73@gmail.com , Mobile: 01735490491.	Member	
13.	Md. Saif Uddin, Process Expert, National Skills Development Authority, Email: engrbd.saif@gmail.com , Mobile: 01723004419.	Member	

