QUALIFICATION SPECIFICATION									SECTION A
QUALIFICATION DEVELOPER	Botswana University of Agriculture and Natural Resources								
TITLE	Bachelor of Science in Biometry					**NCQF LEVEL**		7	
FIELD	Natural, Mathematical and Life Sciences				**SUB-FIELD**	BIOMETRY			
New qualification	√	Review of existing qualification							
SUB-FRAMEWORK	General Education		TVET		Higher Education	√			
QUALIFICATION TYPE	Certificate		Diploma		Bachelor	√			
	Bachelor Honours		Master		Doctor				
CREDIT VALUE	520								

RATIONALE AND PURPOSE OF THE QUALIFICATION

Rationale

The BSc Biometry qualification was developed in line with the Human Resources Development Council (HRDC) Top Occupations in Demand Report (2016), which identified the need for mathematicians, actuaries, statisticians, econometricians and agricultural scientists in the labour market (short term) as well as opportunities for employment growth (long term). In addition, the Basic Sciences department conducted a needs assessment survey in 2012 in which stakeholders indicated a need for the development of a Biometry academic qualification. Also, the Vision 2036 (http://www.statsbots.org.bw/sites/default/files/documents/Vision%202036.pdf) and National Development Plan (NDP) 11 (http://www.pinnacleplacemaking.co.bw/downloads/NDP%2011_FINAL.pdf) highlighted the necessity to transform the Botswana economy to a knowledge based economy driven by science, research, innovation and technology. A qualification in biometry is critical in that it supports the development of research, innovation and technology thereby contributing in propelling the country towards becoming a knowledge based economy.

According to the CTA Report (1998), there were 139 Biometricians registered with the International Biometric Society from all the Africa, Caribbean and Pacific (ACP) countries, majority of whom acquired their training outside the ACP countries. The report identified deficiencies in biometry skills, training opportunities of scientific research staff, availability of modern biometry facilities, institutional structures within universities and national agricultural institutes and strength of perception biometry as professional discipline by donor community and government departments. The current changing nature of agricultural research requires professional input of biometricians with clear planning, appropriate information collection, information summary, interpretation and presentation. This biometry qualification will equip the graduates with skills for employment in research organizations, government agencies, education and private business.

Purpose of the Qualification

The purpose of the BSc Biometry is to equip graduates with:

i. advanced understanding of the principles and concepts of biometry and its applications.

ii. skills to plan and execute research and critically evaluate the results and formulate relevant evidence based models.
iii. ability to communicate effectively information and ideas to different stakeholders.
iv. ability to operate at an advanced level in their assignments by exercising responsibility and accountability for achieving the desired team and individual outcomes.

ENTRY REQUIREMENTS (including access and inclusion)

- NCQF level IV with a minimum pass of credit in Biology, Chemistry, Physics, Mathematics and English Language or its equivalent or a minimum of BB in Science Double Award and a grade C in Mathematics and English Language or its equivalent.
- Other qualifying subjects such as Agriculture, Development Studies, Literature in English, Design and Technology, Food and Nutrition, Computer Studies, Business Studies must be at a minimum of grade C or its equivalent.
- RPL policy shall apply for candidates with at least relevant Level VI qualification or equivalent.
- Credits shall be recognized for students transferring from other accredited institutions and pursuing related qualifications.
- Mature age candidates with minimum of two years' relevant experience in mathematical sciences; Agriculture and Nature Conservation, and Education and Training will be considered for enrolment.
- The regulations that govern appreciation of students with special educational needs (SEN) whether physical or non-physical will be duly applied.

QUALIFICATION SPECIFICATION SECTION B	
GRADUATE PROFILE (LEARNING OUTCOMES) Holders of this qualification should be able to:	**ASSESSMENT CRITERIA**
1. Apply knowledge of professional practice and good work ethics	i. Demonstrate procedural and computational understanding of biometry and statistics. ii. Master proof techniques in various biometrical and statistical theories. iii. Demonstrate proficiency in applying mathematical and statistical theories to solve applied problems in various areas. iv. Formulate conjectures, produce new statistical and biometrical knowledge and conduct supervised original research in one of the areas of biometry and its applications.
2. Integrate knowledge towards entrepreneurship, innovation, creativity and experiential learning	i. Develop novel and useful ideas that transform and create new markets. ii. Apply creative ideas to produce unique and transformative new products and services. iii. Solve customer problems and produce innovative new products and services. iv. Raise awareness of creativity and its importance for society and for personal development. v. Increase understanding of the nature of creativity, creative persons, common barriers to creative thinking, and the creative process. vi. Present techniques for creative thinking. vii. Put new knowledge, skills and abilities, and attitudes into practice in everyday life.
3. Apply critical thinking and problem solving	i. Fully explain why the steps in a procedure are justified and create own procedures, as necessary. ii. Develop and adapt appropriate algorithms to solve problems, test hypothesis, and formulate predictions. iii. Apply mathematical and statistical logic and problem-solving skills to study data. iv. Define and explain appropriate techniques to process data and derive logical conclusions. v. Solve problems and visualize information in mathematics and statistics using graphing calculators and spreadsheets. vi. Interpret and critically evaluate qualitative and quantitative results in the context of the original problem, and make recommendations.

4.	Demonstrate team building, leadership and supervision	i. ii. iii. iv.	Effectively work in a multi-disciplinary environment. Accept comments and feedback, and learn from them. Explain fundamental mathematical or statistical concepts to non-experts. Justify choices made during problem solving and interpretation of results.
5.	Demonstrate the ability to collect, process assess and communicate information.	i. ii. iii. iv.	Present, examine, summarize, and evaluate presentations given by another individual or group. Present original work and new mathematical results in appropriate settings such as a class, seminar, professional meeting or publication. Apply symbolic software, graphing calculators and spreadsheets to present, visualize, model and interpret results. Analyze problems in mathematics or statistics using dynamic geometry software, programming languages, and symbolic mathematical and analytical software.
6.	Apply basic research skills, critical analysis and independent evaluation	i. ii. iii. iv.	Construct, evaluate, and revise complex problems to determine relevant mathematical or statistical principles and available software and hardware to solve problems. Identify basic arithmetic and algebraic manipulation skills to interpret fairly simple statistical problems using textual write-ups, lines, charts, graphs and tables. Apply mathematical logic and problem-solving skills to study data. Define and explain appropriate techniques to process data and derive logical conclusions. Identify practical applications of statistics, including data sets with significant variation.
7.	Demonstrate autonomy, initiative, authority, responsibility and accountability	i. ii. iii.	Devise a plan to organize and analyze data by applying and interpreting advanced mathematics and statistical procedures. Construct and assess applications of mathematical and statistical concepts. Evaluate whether applied procedures are appropriate and whether the results are accurate and clearly stated.

QUALIFICATION STRUCTURE SECTION C			
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	**Title**	**Level**	**Credits**
	Mathematics I	5	12
	General and Inorganic Chemistry	5	12
	Physics I	5	12
	Biology of Cells	5	12
	Computer Skills Fundamentals I	6	8
	Communication and Academic Literacy Skills I	6	12
	Mathematics II	5	12
	Physical and Organic Chemistry	5	12
	Physics II	5	12
	Biodiversity	5	12
	Computer Skills Fundamentals II	6	8
	Communication and Academic Literacy Skills II	6	12
CORE COMPONENT Subjects / Units / Modules /Courses	Calculus and Analytic Geometry	6	12
	Introduction to Linear Algebra	6	12
	Introduction to Biometry	6	12
	Ordinary Differential Equations	6	12
	Mathematical Statistics	6	12
	Probability Models	6	12
	Development of Entrepreneurial Skills in Agribusiness	6	12
	Field Practical Training I	7	12
	Theory of Statistics	7	12
	Scientific Writing and Presentation Skills	7	12
	Statistical Computing	7	12
	Experimental Design and Data Analysis	7	12
	Linear Regression	7	12
	Field Practical Training II	8	12

	Introduction to Survival Analysis	7	12
	Monitoring and Evaluation	7	12
	Bioinformatics	7	12
	Research Project I	7	12
	Generalized Linear Models	8	12
	Survey Methods	8	12
	Multivariate Analysis	8	12
	Research Project II	8	12
ELECTIVE COMPONENT Subjects / Units / Modules /Courses	**Two courses from (12 credits each):** Introduction to Animal Science Range Ecology Principles of Crop Production Introduction to Crop Pests	6	24
	One course from (12 credits each) : Evolutionary Biology Animal Health Introduction to Soil Science	6	12
	Two courses from (12 credits each): Conservation Ecology Crop Physiology Principles of Crop Protection Population and Community Ecology	6	24
	Two courses from (12 credits each): Wildlife Ecology and Management Animal Diseases Pests of Field Crops Introduction to Ecology and Conservation Plant Diversity Animal Diversity	6	24

	Two courses from (12 credits each): Modelling Population Dynamics Mathematical Epidemiology Range Analysis Community Forestry Environmental Management Agricultural and Food Policy Agricultural Finance Landscape Ecology Restoration Ecology Land Drainage	7	**24**
	One course from (12 credits each): Poultry Production Vegetable production Diseases of field crops Diseases of Horticultural Crops Policies in Wildlife Management Co-Management of Natural Resources	7	12
	One course from (12 credits each): Optimization and Control Theory Ecological Modelling Operations Research Environmental Modelling Mathematical Physiology	8	12

Rules of combinations, Credit distribution (where applicable):

This qualification has 520 credits and requires four years to complete. The credit distribution is as follows:

Level	**Credit Value**		
	Compulsory	**Elective**	**Total**
5	96	0	96
6	124	84	208

7	108	36	144
8	60	12	72
Total	**388**	**132**	**520**

MODERATION ARRANGEMENTS

Formative assessment

Formative assessment or continuous assessment contribution towards the award of credits should be based on course outcomes.

The assessment methods for this qualification are

a) Practical Courses
   - (i) Theoretical Tests 40%
   - (ii) Assignments/Quizzes/Laboratory reports 20%
   - (iii) Practical Tests 40%

b) Non-Practical Courses
   - (i) Theoretical Tests 60%
   - (ii) Assignments/Quizzes/Mini-projects 40%

The contribution of continuous (formative) assessment to the final grade is 50%.

Summative assessment

Candidates may undergo written final examination for each course. The final examination will constitute the other 50% of the overall course grade.

Research Project: Students will undertake a research project as partial fulfillment of the award of the qualification.

MODERATION ARRANGEMENTS

The purpose of moderation is to ensure that assessment and marking across all courses is fair, valid and reliable. It also ensures that assessment tool is aligned to the stated learning outcomes, that it is set at an appropriate level of study and, that the process of marking is consistent.

Internal Moderation

Moderation for all continuous assessment tools like tests and final examinations shall be carried out by internal moderators who are qualified and experienced academic staff in the university who have been trained as assessors and moderators.

Before assessment

The question papers and marking keys will be submitted for internal moderation to the respective moderator before students are given the assessment. The internal moderator will produce a question paper moderation report giving feedback on the paper. The assessor (assessment tool setter) will take the feedback from the internal moderator into consideration when finalizing the paper.

After Assessment

The question paper, marking key and scripts are shared with the moderator who will sample at least 10% or 20 scripts (whichever is larger) for moderation. The sampled scripts should be representative of all levels

of performance by the students (A+, A, A-, etc). For terminal courses/modules in a qualification, the internal moderator will produce a report which will be filed and shared with the external examiner.

External Moderation (Verification)
The University Senate will appoint appropriate qualified experts from accredited institutions for external moderation purposes. External moderation shall be conducted on final year qualification modules. The purpose of external moderation is to monitor the standards of assessment, assessors' decisions, credibility of assessment methods and question papers, check the internal moderation processes and provide advice through the feedback reports. The feedback reports from internal moderators, question papers, marking keys and scripts will be shared with the external examiner. A sample of 10% or 20 scripts (whichever is larger) will be moderated by the external examiner. The decisions of the external examiner are final and supersede those of the internal moderator.

RECOGNITION OF PRIOR LEARNING (if applicable)

RPL will also be assessed to determine whether it can be awarded credits to contribute to the exit learning outcomes.

Assessment shall be done to determine whether the candidate has an abundance of relevant knowledge and skills acquired through formal or informal methods, workplace learning or work experience gained from a related field. The relevant experience will be in Biometry and Statistics, Biological sciences, Agriculture and Natural Resources and other related training.

Candidates will be expected to provide evidence of learning such as references from employers to support their applications. Such evidence should meet the criteria of being relevant, sufficient, valid, verifiable and authentic. This knowledge shall be awarded credits based on developed criteria for such.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

- **Learning progression Pathways**

This qualification is a Biometry major, but apart from it, the enrolled candidates may opt for any of the following:

Horizontal:

i. Bachelor of Science in Biomathematics at NCQF 7
ii. Bachelor of Science in Biodiversity at NCQF 7
iii. Bachelor of Arts or Bachelor of Science in Statistics at NCQF 7
iv. Bachelor of Science in Applied Mathematics at NCQF 7
v. Any of the Bachelor of Science qualifications in agriculture and natural resources at NCQF 7

Holders of this qualification can progress into higher qualifications such as:

Vertical:

i. Bachelor of Science in Biometry (Honors) at NCQF Level 8
ii. Post Graduate Diploma in Biometry or equivalent at Level 8
iii. Master of Science in Biometry and related fields at NCQF Level 9

- **Employment Pathways**

BSc Biometry graduates can be employed as:

i. Data analysts in any field including agriculture and natural resources in government and private institutions
ii. Lecturers in tertiary institutions
iii. Teachers in public and private institutions
iv. Researchers in public and private institutions
v. Consultants in consultancy companies
vi. Set up their own data analysis consultancy firms

QUALIFICATION AWARD AND CERTIFICATION

Graduates shall be awarded a qualification in Bachelor of Science in Biometry upon attaining a minimum pass mark of 50% in each course/module and on attaining a total of 520 credits. On attainment of the qualification and certification, graduates should be able to demonstrate knowledge, skills and attitudes required to work and perform effectively as a biometrician. All the learning outcomes should be met for the award of the qualification. The qualification does not have any early exit (i.e. Certificate or Diploma) awards, but a candidate may be given a transcript indicating the credits attempted as evidence of achievement.

REGIONAL AND INTERNATIONAL COMPARABILITY

Summary:
This qualification was compared with similar or equivalent qualifications from various institutions. Their qualifications have been registered according to their respective frameworks.

Information gathered shows that there is no university locally which offers an undergraduate qualification in Biometry. Regionally and in the sub Saharan Africa, there is only one university offering an undergraduate qualification in Biometry. At International level, there are very few universities, if any, offering undergraduate qualifications in Biometry. The majority of universities offer undergraduate qualifications (BA/BSc) in Statistics. However, Biometry courses are taught in various universities offering qualifications in Economics or Agricultural Sciences.

Similarities:
This qualification has many common courses/modules in Mathematics: Calculus and Analytic Geometry, Differential Equations, Computational Mathematics, Linear Algebra, Real Analysis, Mathematical Statistics and Probability.

In particular, this qualification focuses on applications of Biometry to Natural, Mathematical and Life Sciences and Agriculture and Nature Conservation fields which is similar to the qualification offered at UKZN. Specific areas of applications include: Population and Community Ecology, Conservation Ecology, Plant and Animal Diversity, Evolutionary Biology; Agricultural Sciences: Animal and Crop Sciences; Natural Resources: Range Sciences and Wildlife Management.

Differences:
Some of the universities benchmarked with concentrated on applications of Biometry/Statistics to Biomedical Sciences, Biostatistics, Biophysical Sciences, as well as Neurosciences and Engineering or Economics.

The credit value of this qualification structurally varies from institution to institution.

REVIEW PERIOD
This qualification shall be reviewed after every five (5) years.
Other information – please add any supplementary information to help the application for this qualification for NCQF Registration.
Attachments: i. BS Report - Needs Assessment Report Mathematical Programmes ii. Departmental Advisory Board Meeting Report iii. National Development Plan 11, (http://www.pinnacleplacemaking.co.bw/downloads/NDP%2011_FINAL.pdf) iv. Vision 2036, (http://www.statsbots.org.bw/sites/default/files/documents/Vision%202036.pdf) v. Human Resources Development Council Top Occupations in Demand, 2016. (https://www.hrdc.org.bw/sites/default/files/Top%20Occupations%20Jan%202017.pdf) vi. Human Resources Development Council Top Occupations in Demand, 2016. http://www.baisago.ac.bw/common_up/isago/pub_1495553138.pdf vii. Strengthening Biometry and Statistics in Agricultural Research Study Report, CTA 1998. Published by the Technical Centre for Agricultural and Rural Cooperation (ACP-EU), ISBN 92 9081 1846 viii. Biometry Comparability Matrix (ATTACH)