CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

In the Learning Outcomes that follow, the bulleted items are the Assessment Standards. The alphabetical points that follow (e.g. a, b, c) introduce the sub-skills, knowledge and attitudes of which each Assessment Standard is constituted.

Grade 10

Learning Outcome 1 ML.LO1 (FET)

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

Assessment Standards

We know this when the learner is able to:

10.1.1 Solve problems in various contexts, including financial contexts, by estimating and calculating accurately using mental, written and calculator methods where appropriate, inclusive of:

- working with simple formulae (e.g. \( A = P(1+i)^n \));
- using the relationships between arithmetical operations (including the commutative, distributive and associative laws) to simplify calculations where possible;
- working with positive exponents and roots.

(The range of problem types includes percentage, ratio, rate and proportion (direct and inverse), simple and compound growth, calculations with very small and very large numbers in decimal and scientific notation.)

For example:

* explore compound growth in various situations numerically and work with the compound interest formula;
Assessment Standards

We know this when the learner is able to:

11.1.1 In a variety of contexts, find ways to explore and analyse situations that are numerically based, by:

- estimating efficiently;
- working with complex formulae by hand and with a scientific calculator, for example:
  \[
  x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
  \]
- showing awareness of the significance of digits when rounding;
- checking statements and results by doing relevant calculations;
- working with positive exponents and roots;
- involving ratio and proportion in cases where more than two quantities are involved.

For example:

* estimate the length of a side if the volume of a cube is 10 cubic units,
* do calculations to compare different currencies.

Assessment Standards

We know this when the learner is able to:

12.1.1 Correctly apply problem-solving and calculation skills to situations and problems dealt with.

For example:

* work with issues involving proportional representation in voting.
Learning Outcome 1
Continued

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

Grade 10

Assessment Standards

We know this when the learner is able to:

* find a percentage by which a quantity was increased;
* calculate the number of person hours needed for a job if the number of workers is increased;
* calculate proportional payments for work done by groups of people;
* calculate the amount of money allocated to education by the budget if it is 8.4% of R36,04 billion;
* criticise numerically-based arguments.

10.1.2 Relate calculated answers correctly and appropriately to the problem situation by:
* interpreting fractional parts of answers in terms of the context;
* reworking a problem if the first answer is not sensible, or if the initial conditions change;
* interpreting calculated answers logically in relation to the problem and communicating processes and results.

10.1.3 Apply mathematical knowledge and skills to plan personal finances (so as to enable effective participation in the economy), inclusive of:
* income and expenditure;
* simple interest problems and compound interest situations capitalised annually, half-yearly, quarterly and monthly, including calculation of either rate, principal amount or time when other variables are given or known.
Assessment Standards

We know this when the learner is able to:

* check a claim that costs of phone calls have risen by 8% by doing relevant calculations;
* check the effect of rounding on effective repayments on a loan or account (one of the payments will have to be adjusted to reach the total amount to be repaid).

11.1.2 Relate calculated answers correctly and appropriately to the problem situation by:
   • interpreting fractional parts of answers in terms of the context;
   • reworking a problem if the first answer is not sensible or if the initial conditions change;
   • interpreting calculated answers logically in relation to the problem, and communicating processes and results.

11.1.3 Investigate opportunities for entrepreneurship and determine profit and sustainability by analysing contributing variables, inclusive of:
   • specifying and calculating the value of income and expenditure items;
   • determining optimal selling prices;
   • estimating and checking profit margins.

12.1.2 Relate calculated answers correctly and appropriately to the problem situation by:
   • interpreting fractional parts of answers in terms of the context;
   • reworking a problem if the first answer is not sensible or if the initial conditions change;
   • interpreting calculated answers logically in relation to the problem and communicating processes and results.

12.1.3 Analyse and critically interpret a wide variety of financial situations mathematically, inclusive of:
   • personal and business finances;
   • the effects of taxation, inflation and changing interest rates on personal credit, investment and growth options;
   • financial and other indicators;
   • the effects of currency fluctuations;
   • critical engagement with debates about socially responsible trade.
Learning Outcome 1
Continued

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

For example:

* identify variable expenses and calculate new values to adapt a budget to deal with increased bond repayments due to rising interest rates,
* adapt a budget to accommodate a change in the price of petrol,
* calculate the value of the fraction of a bond repayment that goes towards repaying interest or capital,
* calculate the real cost of a loan of R10 000 for 5 years at 5% capitalised monthly and half yearly.
We know this when the learner is able to:

* calculate the effect of increased prices of imported vehicle parts on the profit margin of a motor car manufacturer or a small vehicle service workshop,
* investigate the effect of increasing the number of employees on the profit margin of a small company,
* investigate the effect of a sales discount on the profit margin.

For example:
* calculate the effect of a fixed interest rate against probable variations in interest rates when buying a house or when choosing an investment,
* calculate the net effect of different interest offerings and bank charges when saving schemes are considered,
* calculate and compare the projected yields of different retirement options,
* interpret changes in indices such as the consumer price index or the business confidence index,
* compare different credit options,
* calculate the effect of defaulting payments over a period of time,
* consider different currencies for investment purposes,
* calculate values in simplified situations in order to discuss the effect of import/export control, levies and rebates, linking the discussion to the way mathematics can be used to argue opposing points of view.
Learning Outcome 2 ML.LO2 (FET)

Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

Assessment Standards

We know this when the learner is able to:

10.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to establish relationships between variables by:

- finding the dependent variable;
- finding the independent variable;
- describing the rate of change.

(Types of relationships to be dealt with include linear, inverse proportion and compound growth in simple situations.)

For example:

- critique information about functional relationships in media articles such as telephone costs before and after rate changes,
- calculate relationships in speed, distance and time.
Assessment Standards

We know this when the learner is able to:

11.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to establish relationships between variables by:
- finding break-even points;
- finding optimal ranges.

(Types of relationships to be dealt with include two simultaneous linear functions in two unknowns, inverse proportion, compound growth [only positive integer exponents] and quadratic functions.)

For example:
- interpret and critique quotations for two similar packages given by cell phone providers or car hire companies,
- use rate of change to offset impressions created by magnification of scales on the axes of graphs.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to:
- solve design and planning problems;
  
  For example:
  * find optimal values for two discrete variables, subject to two or more linear constraints.

- investigate situations of compound change.

  For example:
  * investigate the rate of depletion of natural resources,
  * investigate the spread of HIV/AIDS and other epidemics,
  * critique articles and reports in the media that are based on graphs or tables.
Learning Outcome 2
Continued

Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

Grade 10

Assessment Standards

We know this when the learner is able to:

10.2.2 Draw graphs in a variety of real-life situations by:
   • point-by-point plotting of data;
   • working with formulae to establish points to plot;
   • using graphing software where available.

For example, draw graphs of:
* mass against time when on diet,
* surface area against side length of a cube,
* volume against surface area,
* lengths of a spring against mass added,
* amount of savings against the investment period.

10.2.3 Critically interpret tables and graphs that relate to a variety of real-life situations by:
   • finding values of variables at certain points;
   • describing overall trends;
   • identifying maximum and minimum points;
   • describing trends in terms of rates of change.

For example, interpret graphs that:
* compare the incidence of AIDS over time,
* indicate trends in road fatalities,
* show the expected changes in the mass of a baby with age.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.2.2 Draw graphs as required by the situations and problems being investigated.

For example:
* compare costs of cell phone packages for different call intervals by drawing graphs of cost against time.

11.2.3 Critically interpret tables and graphs depicting relationships between two variables in a variety of real-life and simulated situations by:
* estimating input and output values;
* using numerical arguments to verify relationships.

For example:
* do spot calculations of the rate of change of population growth in different countries by taking readings from supplied graphs to check figures quoted and to verify estimations of future growth.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.2.2 Draw graphs as required by the situations and problems being investigated.

For example:
* draw graphs of number of AIDS-related deaths and deaths caused by malaria over time, on the same system of axes to describe the extent of the AIDS epidemic.

12.2.3 Critically interpret tables and graphs in the media, inclusive of:
* graphs with negative values on the axes (dependant variable in particular);
* more than one graph on a system of axes.

For example:
* interpret graphs of temperature against time of day during winter over a number of years to investigate claims of global warming.
* compare graphs of indices such as the consumer price index and business confidence index to graphs of percentage change in those indices over a particular time interval.
Learning Outcome 3 ML.LO3 (FET)

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

10.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:
- estimating, measuring and calculating (e.g. by the use of the Theorem of Pythagoras) values which involve:
  * lengths and distances,
  * perimeters and areas of common polygons and circles,
  * volumes of right prisms,
  * angle sizes (0°–360°);
- checking values for solutions against the contexts in terms of suitability and degree of accuracy.

10.3.2 Convert units of measurement within the metric system.

* For example: convert km to m, mm³ to litres, km² to m², cm³ to m³.
Assessment Standards

We know this when the learner is able to:

11.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:
   - estimating, measuring and calculating (e.g. regular shapes, irregular shapes and natural objects) values which involve:
     * lengths and distances,
     * perimeters and areas of polygons,
     * volumes of right prisms and right circular cylinders,
     * surface areas of right prisms and right circular cylinders,
     * angle sizes (0°-360°);
   - making adjustments to calculated values to accommodate measurement errors and inaccuracies due to rounding.

11.3.2 Convert units of measurement between different scales and systems.

For example:
- convert km to m, mm³ to litres, miles to km, kg to lb,
- work with international times

12.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:
   - estimating, measuring and calculating (e.g. regular shapes, irregular shapes and natural objects) values which involve:
     * lengths and distances,
     * perimeters and areas of polygons,
     * volumes of right prisms, right circular cylinders, cones and spheres,
     * surface areas of right prisms, right circular cylinders, cones and spheres,
     * angle sizes (0°-360°);
   - making adjustments to calculated values to accommodate measurement errors and inaccuracies due to rounding.

12.3.2 Convert units of measurement between different scales and systems as required in dealing with problems.

For example:
- the dimensions of an imported washing machine are given in inches and must be converted accurately to centimetres for installation purposes,
- a recipe that is written with imperial measures must be rewritten with accurate metric measures,
- measures of temperature must be converted between Fahrenheit and Celsius (conversion ratios and formulae given).
Learning Outcome 3
Continued

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

10.3.3 Draw and interpret scale drawings of plans to represent and identify views.

For example:
* draw and interpret top, front and side views or elevations on a plan.

10.3.4 Solve real-life problems in 2-dimensional and 3-dimensional situations by the use of geometric diagrams to represent relationships between objects.

For example:
* draw floor plans and use symbols to indicate areas and positions taken up by furniture in different arrangements.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.3.3 Use and interpret scale drawings of plans to:
- represent and identify views, estimate and calculate values according to scale.

* For example:
  * study a plan of the school building and identify locations or calculate available real area for extensions.

11.3.4 Use grids, including the Cartesian plane and compass directions, in order to:
- determine locations;
- describe relative positions.

* For example:
  * local maps,
  * seat location in cinemas and stadiums,
  * room numbers in multi-levelled buildings.

11.3.5 Use basic trigonometric ratios (sine, cosine and tangent) and geometric arguments to interpret situations and solve problems about heights, distances and position.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.3.3 Use and interpret scale drawings of plans to:
- represent and identify views, estimate and calculate values according to scale, and build models.

* For example:
  * build a scale model of a school building, based on the plan of the building.

12.3.4 Use grids, including the Cartesian plane and compass directions, in order to:
- determine locations;
- describe relative positions.

* For example:
  * understand the use of latitude and longitude in global positioning systems.

12.3.5 Use basic trigonometric ratios (sine, cosine and tangent) and geometric arguments to interpret situations and solve problems about heights, distances, and position including the application of area, sine and cosine rules.
Grade 10

Learning Outcome 3
Continued

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

Assessment Standards

We know this when the learner is able to:

10.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures in natural and cultural forms.

* use the concepts of tessellation and symmetry in describing tilings, Zulu beadwork and other artefacts.
Assessment Standards

We know this when the learner is able to:

11.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures and solids in natural and cultural forms.

For example:
* use the concepts of rotation, symmetry and reflection in describing decorative Ndebele and Sotho mural designs.

12.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures and solids in natural and cultural forms.

For example:
* use the concepts of proportion and symmetry in describing local artefacts, art and architecture.
Learning Outcome 4 ML.LO4 (FET)

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Grade 10

Assessment Standards

We know this when the learner is able to:

10.4.1 Investigate situations in own life by:

- formulating questions on issues such as those related to:
  * social, environmental and political factors,
  * people’s opinions,
  * human rights and inclusivity;
- collecting or finding data by appropriate methods (e.g. interviews, questionnaires, the use of data bases) suited to the purpose of drawing conclusions to the questions.

For example, investigate:

- substance abuse in the school,
- water conservation,
- prevalence of flu during winter,
- approaches to discipline in the school.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.1 Investigate a problem on issues such as those related to:

- social, environmental and political factors;
- people’s opinions;
- human rights and inclusivity by:
  * using appropriate statistical methods;
  * selecting a representative sample from a population with due sensitivity to issues relating to bias;
  * comparing data from different sources and samples.

For example:

- conduct a survey in own school about home languages and comparing that with related data from other sources,
- identify possible sources of bias in gathering the data,
- investigate the increase in absenteeism at school (e.g. investigate the correlation between living conditions – squatter camps, houses – and absenteeism),
- investigate the correlation between distance from school and absenteeism.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.1 Investigate a problem on issues such as those related to:

- social, environmental and political factors;
- people’s opinions;
- human rights and inclusivity by:
  * using appropriate statistical methods;
  * selecting a representative sample from a population with due sensitivity to issues relating to bias;
  * comparing data from different sources and samples.

For example:

- challenge learners to compare claims about preferred TV programmes among teenagers with data from schools in their area,
- compare preferences across grades or gender.
Learning Outcome 4
Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Grade 10

Assessment Standards

We know this when the learner is able to:

10.4.2 Select, justify and use a variety of methods to summarise and display data in statistical charts and graphs inclusive of:

- tallies;
- tables;
- pie charts;
- histograms (first grouping the data);
- single bar and compound bar graphs;
- line and broken-line graphs.

For example:

* pie charts to show the relative proportions of learners who have flu,
* compound bar graphs to show the abuse of different substances in the respective Further Education and Training grades.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.2 Appropriately choose and interpret the use of methods to summarise and display data in statistical charts and graphs inclusive of:
- tallies;
- tables;
- pie charts;
- single and compound bar graphs;
- line and broken-line graphs;
- ogives of cumulative frequencies.

* interpret the meaning of points on a broken-line graph of house prices in 2002 – does it make sense to assign a monetary value to a point halfway between January and February?

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.2 Appropriately choose and interpret the use of methods to summarise and display data in statistical charts and graphs including the use of scatter-plots and intuitively-placed lines of best fit to:
- represent the association between variables (regression analysis not included);
- describe trends (e.g. a positive linear association).

* Does a positive correlation between age and height necessarily mean that height is dependent on age?
* Does a positive correlation between mathematics marks and music marks necessarily mean that facility in mathematics is dependent on musical aptitude?
* Does a positive correlation between pollution levels and TB infections necessarily mean that pollution causes TB?
Learning Outcome 4
Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of
statistics and probability to communicate, justify, predict and critically interrogate findings and draw
conclusions.

Grade 10

Assessment Standards

We know this when the learner is able to:

10.4.3 Calculate and use appropriate measures of central tendency and spread to make
comparisons and draw conclusions, inclusive of the:
• mean;
• median;
• mode;
• range.

For example:
* investigate the cost of a trolley of
groceries at three different shops in
the area and report the findings by
means of mean, median, mode and
range.

10.4.4 Critically interpret a single set of data and
representations thereof (with awareness of
sources of error) in order to draw
conclusions on questions investigated and to
make predictions.

For example:
* interpret data from the media on the
number of stolen and recovered
vehicles after a certain tracking
device has been installed.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.3 Calculate, interpret and compare two sets of data using measures of central tendency and spread, inclusive of the:
- mean;
- median;
- mode;
- range;
- variance (interpretation only);
- standard deviation (interpretation only);
- quartiles.

* conduct a survey in own school about home languages and compare that with related data from other sources,
* identify possible sources of bias in gathering the data,
* use concepts of average, mode or median to interpret the data.

11.4.4 Critically interpret two sets of data and representations thereof (with awareness of sources of error and bias) in order to draw conclusions on problems investigated and make predictions.

* compare data from two providers of tracking devices and draw conclusions about success rates.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.3 Compare different sets of data by calculating and using measures of central tendency and spread, including:
- mean;
- median;
- mode;
- variance (interpretation only);
- standard deviation (interpretation only);
- quartiles;
- percentiles.

* compare the increase in the cost of a trolley of groceries to the increase in the consumer price food index, and report the findings in terms of variance and standard deviation of specific items,
* compare academic results in own school to those in the province in terms of quartiles and percentiles.

12.4.4 Represent and critically analyse data, statistics and probability values in order to draw conclusions on problems investigated and to predict trends.

* compare data about stolen vehicles from providers of tracking devices with data provided by official sources like SAPS, and draw conclusions about the trend in vehicle thefts (types of cars most at risk, areas most at risk).
Learning Outcome 4
Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Grade 10

Assessment Standards

We know this when the learner is able to:

10.4.5 Work with probability concepts to:
- compare the relative frequency of an outcome with the probability of an outcome (establishing that it takes very many trials before the relative frequency approaches the value of the probability of an outcome, e.g. to get a 6 when rolling a die);
- express probability values in terms of fractions, ratios and percentages.

10.4.6 Effectively communicate conclusions and predictions (using appropriate terminology such as trend, increase, decrease, constant, impossible, likely, fifty-fifty chance), that can be made from the analysis and representation of data on learner-driven issues.
Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.5 Make and/or test predictions of compound outcomes in the context of games and real-life situations by:
   • designing simple contingency tables to estimate basic probabilities;
   • drawing tree diagrams.

   * draw a tree diagram to investigate the probability of getting three ‘heads’ when tossing three coins.

11.4.6 Manipulate data in different ways to justify opposing conclusions.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.5 Critically engage with the use of probability values in making predictions of outcomes in the context of games and real-life situations.

   * Investigate claims that the probability of winning a game of chance (e.g. a slot machine) improves if it has not produced a winner for some time.

12.4.6 Critically evaluate statistically-based arguments, describe the use and misuse of statistics in society, and make well-justified recommendations.