# Analysis and Approaches Topic Checklist

Standard and Higher

Higher only

IB-A&A		00	
Number and A	lgebra		
Standard Form			
Arithmetic Series			
Geometric series (including sum of infinite geometric series) Sigma Notation			
Series applications (simple Interest, compound Interest, depreciation/population growth/spread of			
disease)			 
Indices rules – multiplication, division and negative powers Logs – Index rule and natural logarithms			
Approximation, decimal places, significant figures			
Upper and lower bounds of rounded numbers.			
Percentage errors Estimation			
Amortization and annuities using technology			
Use technology to solve:			
<ul> <li>Systems of linear equations in up to 3 variables</li> <li>Polynomial equations</li> </ul>			
Solving logs and exponential equations (including hidden quadratics with exponentials)			
Logs – 5 rules (index, power, multiplication, division, change of base)			
Indices Rules – rational powers and getting like bases in order to simplify The sum of infinite geometric sequences			
Complex numbers			
Matrices			
Eigenvalues and eigenvectors			
Function	s		
3 forms of a straight line (gradient intercept, general, point-gradient)			
Gradients and intercepts Midpoint and distances			
Straight Line Graphs – finding equations			
Parallel lines			
Perpendicular lines Functions – basic concept, notation and domain and range			
Functions - inverse (inverse function reverses or undoes the effect of a function). Concept of inverse			
function as a reflection in the line $y = x$ , and the notation $f^{-1}(x)$			 
Creating a sketch from information given or a context, including transferring a graph from screen to paper.			
Using technology to graph functions including their sums and differences.			
Using a calculator to sketch and locate key features of graphs of functions (max, min, zeros, intercepts, vertex, asymptotes, intersection of 2 curves)			
Modelling			
• Linear $f(x) = mx + c$			
<ul> <li>Quadratics (axis of symmetry, vertex, zeros, x and y intercepts) f(x) = ax<sup>2</sup> + bx + c</li> <li>Exponential growth and decay f(x) = ka<sup>x</sup> + c, f(x) = ka<sup>-x</sup> + c, f(x) = ke<sup>rx</sup> + c</li> </ul>			
Including horizontal asymptotes			
• Direct/inverse variation $f(x) = ax^n$			
• Cubic models $f(x) = ax^3 + bx^2 + cx + d$ • Trig models $f(x) = asin(bx) + c \cdot f(x) = acos(bx) + d$			
• Trig models $f(x) = asin(bx) + c$ , $f(x) = acos(bx) + d$ Modelling skills:			
Use the modelling process described above section to create, fit and use the theoretical			
<ul> <li>models in section SL2.5 and their graphs.</li> <li>Develop and fit the model:</li> </ul>			
<ul> <li>Given a context recognize and choose an appropriate model and possible parameters.</li> </ul>			
Determine a reasonable domain for a model.			
<ul> <li>Find the parameters of a model.</li> <li>Comment on the appropriateness and reasonableness of a model.</li> </ul>			
<ul> <li>Justify the choice of a particular model, based on the shape of the data, properties of the</li> </ul>			
curve and/or on the context of the situation.			
Reading, interpreting and making predictions based on the model.  Functions – composite and types of functions (one to one, many to one)			
Functions – composite and types of infictions (one to one, many to one)			
Transformations of graphs			
Translations: $y = f(x) + b$ , $y = f(x - a)$ Reflections: in the x axis $y = -f(x)$			
Reflections in the y axis $y = f(-x)$			
Vertical stretch with scale factor $p$ : $y = p f(x)$ .			
Horizontal stretch with scale factor $\frac{1}{q}$ , $y = f(qx)$			
Composite transformations. Modelling			
Exponential models to calculate half-life.			
Natural logarithmic models $f(x) = a + b \ln x$			
Sinusoidal models $f(x) = asin(b(x - c) + d$			

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Reliability of data sources and bias in sampling     Interpretation of outliers     Interpretation of outliers						
Interpretation of outliers						
Sampling techniques and their effectiveness						
	Sampling techniques and their effectiveness					

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Presentation of data (discrete and continuous): frequency distributions (tables)			
Cumulative frequency; cumulative frequency graphs; use to find median, quartiles, percentiles, range			
and interquartile range (IQR)		<u> </u>	
Histograms			
Production and understanding of box and whisker diagrams			
Measures of central tendency (mean, median and mode)			
Estimation of mean from grouped data			
Modal class			
Measures of dispersion (interquartile range, standard deviation and variance).			
Effect of constant changes on the original data			
Quartiles of discrete data			
Scatter diagrams; lines of best fit, by eye, passing through the mean point			
Linear correlation of bivariate data			
Pearson's product-moment correlation coefficient and line of best fit			
Use of the equation of the regression line for prediction purposes (reliability)			
Equation of the regression line of $y$ on $x$			
Interpret the meaning of the parameters, <i>a</i> and <i>b</i> , in a linear regression $y = ax + b$			
Basic probability and sample space			
Venn diagrams			
Tree diagram			
Two-way tables			
Addition formula			
Mutually exclusive events			
Independent events			
Conditional probability			
Concept of discrete random variables and their probability distributions	[		
Expected value (mean), for discrete data	[		
Applications such as fair game			
Binomial distribution (including mean and variance)			
Normal distribution (probability calculations and working backwards to find the value, mean or s.d.			
Spearman's rank correlation coefficient, $r_{\rm c}$	<u> </u>		
Awareness of the appropriateness and limitations of Pearson's product moment correlation coefficient			
and Spearman's rank correlation coefficient, and the effect of outliers on each Formulation of null and alternative hypotheses $H_0$ and $H_1$		<u> </u>	
Significance levels			
p -values			
$x^2$ test for independence, contingency tables, degrees of freedom, critical value			
$x^2$ goodness of fit			
The <i>t</i> -test			
Use of the $p$ -value to compare the means of two populations			
Using one-tailed and two-tailed tests			
Design of valid data collection methods, such as surveys and questionnaires			
Selecting relevant variables from many variables			
Choosing relevant and appropriate data to analyse			
Categorizing numerical data in a $\chi^2$ table and justifying the choice of categorisation			
Choosing an appropriate number of degrees of freedom when estimating parameters from data when			
carrying out the $\chi^2$ goodness of fit test			
Definition of reliability and validity. Reliability tests. Validity tests			
Non-linear regression			
Evaluation of least squares regression curves using technology			
Sum of square residuals (SS <sub>res</sub> ) as a measure of fit for a model	1		
The coefficient of determination $R^2$ . Evaluation of $R^2$ using technology			
Linear transformation of a single random variable			
0			
Expected value of linear combinations of $n$ random variables. Variance of linear combinations of $n$ independent random variables.			
$\vec{x}$ as an unbiased estimate of $\mu$			
$s_{n-1}^2$ as an unbiased estimate of $\sigma^2$			
A linear combination of <i>n</i> independent normal random variables is normally distributed (sample)			
$X \sim N(\mu, \sigma^2) \Longrightarrow \bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$			
Central limit theorem			
Confidence intervals for the mean of a normal population		ļ	
Poisson distribution, its mean and variance			
Sum of two independent Poisson distributions has a Poisson distribution			
Critical values and critical regions			
Test for population mean for normal distribution			
Test for proportion using binomial distribution	[		
Test for population mean using Poisson distribution			
Use of technology to test the hypothesis that the population product moment correlation coefficient ( $\rho$ )			
is 0 for bivariate normal distributions.			
Type I and II errors including calculations of their probabilities	1		
Transition matrices and powers of transition matrices			
Regular Markov chains			
Initial state probability matrices			
inderstate probability indertees	1	1	
	1		
Calculation of steady state and long-term probabilities by repeated multiplication of the transition matrix or by solving a system of linear equations.			

Calculus				
Concept of a limit				
Derivative interpreted as gradient function and as rate of change.				
Increasing/Decreasing (including graphical representations of $f'(x) > 0$ , $f'(x) < 0$ , $f'(x) = 0$ )				
$y = x^n$ differentiation technique (exponents are integers)				
Equations of Tangents and Normals				
Stationary maximum and minimum points.				
Optimisation problems in context`				
Approximating areas using the trapezoidal rule.				
Composite functions differentiation techniques – chain rule $((f(x))^n, lnf(x), e^{f(x)}, sinf(x), cos f(x))$				
Product and Quotient Rule				
Related rates of change				
Second derivative and using this to test for max/min				
Kinematics				
$\int x^n$ Integration technique				
Definite integrals				
Finding area under a curve (between the x axis) and between two curves				
Composite functions integration techniques $(f(x))^n$ , $e^{f(x)}$ , $sinf(x)$ , $cos f(x)$ , etc)				
Finding area under a curve (between the y axis)				
Integration by inspection/recognition/reverse chain rule				
Volume of revolution (between the $x$ and $y$ axis)				
Setting up a model/differential equation from a context.				
Solving by separation of variables				
Slope fields and their diagrams.				
Euler's method for finding the approximate solution to first order differential equations.				
Numerical solution of $\frac{dy}{dx} = f(x, y)$ .				
Numerical solution of the coupled system				
$\frac{dx}{dt} = f_1(x, y, t), \frac{dy}{dt} = f_2(x, y, t)$				
Phase portrait for the solutions of coupled differential equations of the form:				
$\frac{dx}{dt} = ax + by$				
$\frac{dx}{dt} = ax + by$ $\frac{dy}{dt} = cx + dy$				
dt = cx + ay Qualitative analysis of future paths for distinct, real, complex and imaginary eigenvalues.				
Sketching trajectories and using phase portraits to identify key features such as equilibrium points,				
stable populations and saddle points.				
Solutions of $\frac{d^2x}{dt^2} = f\left(x, \frac{dx}{dt}, t\right)$ by Euler's method.				