**Topic List**

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| **Unit 01 – Series, Factorials, and Applications*** Arithmetic Series
* Geometric Series
* Factorials/Permutations/Combinations
* Binomial Theorem

**Unit 02 – Functions and Transformations*** Composite and Inverse Functions
* One-to-one and many-to-one
* Even and Odd Functions
* Transformations of Graphs

**Unit 03 – Exponents and Logarithms** * Exponents and Factoring
* Logarithm Rules and Change of Base

**Unit 04 – Trigonometry and Geometry*** Trig Graphs (Amp, Period, Horiz/Vert Shift)
* Solving Trig Equations and Unit Circle
* Sector Area/Arc Length/Triangle Area
* Law of Sines/Cosines

**Unit 05 – Intro Stats*** Mean/Median/Mode/Range
* Mean, Variance and Standard Deviation
* Probability Tree Diagrams
* Conditional Probability (Bayes’ Theorem)

**Unit 06 – Mathematical Induction*** Mathematical Induction
 | **Unit 07 – Polynomials and Complex Numbers*** Viete’s Theorem (Quadratics and Cubics)
* Operations with complex numbers
* Polynomial, conjugate roots, and synthetic division

**Unit 08 – Vectors, Polar, and Operations*** Cross Products
* Vector, parametric, and Cartesian forms of lines and planes
* Dot Product and Angles of Lines/Planes
* Euler’s Form and Polar Coordinates
* Demoirve’s Theorem (Powers and Roots)

**Unit 09 – Advanced Stats*** Binomial Distribution
* Poisson Distribution
* Normal Distribution
* CDF vs PDF, Expected Value
* Probability Density Functions

**Unit 10 – Differential Calculus*** Derivatives
* Max/Min/Points of Inflection
* Related Rates and Optimization

**Unit 12 – Integral Calculus*** Indefinite Integrals
* Definite Integrals
* Area Under/Between Curves
* Volume of Rotations
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***Pre-Calculus***

Composite and Inverse Functions

* Composite Functions: 
* Inverse Functions:   , flip x and y, solve for y

Transformations

* Transformations of  including: 
* Combinations of more than one of the above

Trig Functions and Graphs

* 
* a = Amplitude, b = Period  , c = Phase/Horizontal Shift, d = Vertical Shift

Exponents and Logarithms

* Solving using exponents and factoring: Example Solve 2(5*x*+1) = 1 + 
* Solving using logarithms: Example log2 (5*x*2 – *x* – 2) = 2 + 2 log2 *x*
* Exponential vs Logarithmic Form: 
* Change of base: 

Solving Trig Equations

* Remember key identities/formulas
	+ Trig sheet
		- Reciprocal and Pythagorean identities
		- Double angle and sum/difference formulas
* Unit Circle values = Know them well

Mean, Variance, and Standard Deviation

* Mean  = Average
* Variance =
	+ Find sum of all terms squared, divide by number of terms, subtract mean squared
* Standard deviation = Square root of variance

Cumulative Frequency Diagrams and Box and Whisker Plots

* Minimum, first quartile, median, third quartile, maximum

Venn Diagrams and Conditional Probability

* Conditional Probability:  is the probability of A given B

Probability Tree Diagrams and Bayes’ Theorem

* Use trees to find individual probabilities

Mathematical Induction

* Step 1: Prove P(1) – First term true
* Step 2: Assume P(k) true – Change rule where all n become k
* Step 3: Prove P(k+1) true – Start with step 2, use Algebra to prove step 3, ending with P(k+1) being true

Complex Numbers, Operations, and Equations

* Solve for z where 
* Look for common terms to pull out such as 

Roots of Complex Numbers

* Square root of complex number: 

Conjugate Root Theorem

* If a + bi is a root of polynomial, then a – bi is also a root
* Use synthetic division

Viete’s Theorem (Including cubics)

* For quadratics  with roots  :
	+ Sum of roots:  , Product of roots: 
* For cubics  with roots  :
	+ Sum of roots:  , Product of roots: 
	+ Also, 

2D and 3D Vectors

* Magnitude:  , where  is in component form
* Dot product:  , result is a scalar
	+ Dot product can be positive (acute angle), negative (obtuse angle), or zero (perpendicular/orthogonal)
* Cross product: , result is a vector perpendicular to both u and v

Equations of Vectors, Lines, and Planes

|  |  |  |
| --- | --- | --- |
| * Vector Form of Line:
* Vector Form of Plane:
 | * Parametric Form of Line:
* Parametric Form of Plane:
 | * Cartesian Form of Line:

* Vector Form of Plane:

,  normal to plane |

Angles Formed by Vectors, Lines, and Planes

|  |  |  |  |
| --- | --- | --- | --- |
|  **2 Vectors***
*
 |  **2 Lines***
*
 | **1 line and 1 Plane***
*
* n normal vector to plane
 |  **2 Planes***
*
* m and n normal vectors to the planes
 |
| Polar Coordinates*

Modulus Argument Form*

Euler’s Form*
 | * Cartesian to Polar
	+
* Polar to Cartesian
	+
 |

DeMoivre’s Theorem and Operations with Complex Numbers



* Multiplication: 
* Reciprocal: 
* Division: 
* Powers: 
* Roots: 

***Calculus***

Slope/Gradient of a Function

Tangent/Normal to a Curve

* Tangent = Touches curve once
* Normal = Perpendicular to tangent

Max/Min of Functions

Derivative Rules

Graphs of a Function, along with First and Second Derivatives

Implicit Differentiation

Optimization, Kinematics, and Related Rates

Integration Rules

Indefinite vs. Definite Integrals

Area Under a Curve, Between Curves

Volumes of Revolution – 

***Advanced Stats***



|  |  |
| --- | --- |
| **Variable or Distribution Type** | **Important Formulas** |
| **Discrete Random Variables** probability of a specific outcome occurring  Sum of the probabilities of all possible outcomes = 1***Ex #1:*** A discrete random variable is given by the discrete random variable *W* where .Find the exact value of *k, E(W)*, and *Var(W).*  |  |
| **Binomial Distribution**Fixed number of trials (*n*) with only two outcomes Probability of success (*p*) and failure (*q*)***Ex #2:*** 60% of people who purchase sports cars are men. If a random number of owners is selected, let *M* be the number of male owners.1. If 10 sports car owners are selected randomly, find *P(M>7).*
2. If 50 random cars owners are selected, what is *E(M*)? The standard deviation of *M*?
 |  |
| **Poisson Distribution*****Ex #3:*** On a particular road, serious accidents occur at a rate of 2 per week and can be modelled using Poisson distribution. 1. What is the probability that zero serious accidents occur in a given week?
2. What is the probability that at least 8 serious accidents occur in a given 4-week period?
3. Given the probability of at least one serious accident occurring in a period of *n* weeks is 0.99, find the least possible value of *n* where .
 |  |
| **Continuous Random Variables*****Ex #4:*** If *X* is a continuous random variable with PDF below:1. Find the value of *k*.
2. Find the variance of *X*.
 |  |
| **Normal Distribution** ***Ex #5:*** The test scores of a group of students are normally distributed with a mean of 62 and a variance of 144.1. Find the percentage of students with scores above 80%.
2. What is the IQR of the scores?
3. What is the lowest score that needs to be achieved to be in the 95 percentile or higher?

***Ex #6:*** *Let .* Find the following: 1.
2.
3.
4. (Requires inverse normal)
 | ,  or |
| **Standard Normal Distribution**Uses *z*-scoresCan be used when  are unknown Can be used compare data sets with different  **Inverse Normal Distribution**Used when area under curve is givenOften paired with Standard Normal Distribution ***Ex #7:*** The weights adult zebras follow a normal distribution.25% of zebras weight more than 430 kg and 15% weight less than 335 kg. Estimate the mean and standard deviation of the weights of adult zebras.  |  |