This Teacher Resource Guide has been developed to provide supporting materials to help educators successfully implement the Indiana Academic Standards for Finite Math Mathematics – Adopted April 2014. These resources are provided to help you in your work to ensure all students meet the rigorous learning expectations set by the Academic Standards. Use of these resources is optional – teachers should decide which resource will work best in their school for their

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The examples in this document are for illustrative purposes only, to promote a base of clarity and common understanding. Each example illustrates a standard but please note that examples are not intended to limit interpretation or classroom applications of the standards.

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GOOD WEBSITES FOR MATHEMATICS:

http://nlvm.usu.edu/en/nav/vlibrary.html
http://www.math.hope.edu/swanson/methods/applets.html
http://learnzillion.com
http://illuminations.nctm.org
https://teacher.desmos.com
http://illustrativemathematics.org
http://www.insidemathematics.org
https://www.khanacademy.org/
https://www.teachingchannel.org/
http://map.mathshell.org/materials/index.php
https://www.istemnetwork.org/index.cfm
http://www.azed.gov/azccrs/mathstandards/

	Indiana Academic Standard for Mathematics Finite Math – Adopted April 2014	Highlighted Vocabulary Words from the Standard Defined	Specific Finite Math Example for the Standard	Specific Finite Math Electronic Resource for the Standard
		Sets		
MA.FM.S.1:	FM.S.1: Know and use the concepts of **sets, elements, and subsets.**	**Set**-a collection of distinct objects **Element**-the disinct objects in a set **Subset**-a set contained in another set	Thus for example {1, 2, 3} = {3, 2, 1} , that is the order of elements does not matter, and {1, 2, 3} = {3, 2, 1, 1}, that is duplications do not make any difference for sets. For example {1, 2}$\subseteq$ {3, 2, 1} . Also {1, 2}$\subset$ {3, 2, 1} .	http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0CEgQFjAG&url=http%3A%2F%2Fwww.math.fsu.edu%2F~wooland%2Fpps%2FP1M1.pps&ei=mMydU_WbOo2TyATng4D4Cw&usg=AFQjCNFMHxkt0WqHtdjBPGlay__V7Rw0Ow&bvm=bv.68911936,d.aWw
MA.FM.S.2:	FM.S.2: Perform operations on sets (**union, intersection, complement, cross product**) and illustrate using Venn diagrams.	**Union**-set of all distinct elements in the collection **Intersection**-the set of elements common to different sets **Compliment**- elements not in the set of question **Cross Product**- each element of one set is matched with the elements of another set	Set F = {1, 2, 3, 4, 6} Set H = {4, 5, 6, 8, 9} Union - F $\cup$ H = {1, 2, 3, 4, 5, 6, 8, 9} Ιντερσεχτιον – F $\cap$ H = {4, 6}	http://www.algebranation.com/wp-content/uploads/2013/02/FINAL-01-Sets-and-Venn-Diagrams-Packet-v3-copy.pdf
		Matrices		
MA.FM.MA.1:	FM.MA.1: Add, subtract, and multiply **matrices** of appropriate dimensions (i.e. up to 3x3 matrices). Multiply matrices by **scalars**. Calculate row and column sums for matrix equations.	**Matrices**- Plural of matric, a rectangular array of numbers, symbols, or expressions **Scalar**- a real number in linear algebra	$A = \begin{bmatrix} -1 & 3 & -2 & 4 \\ 0 & 4 & 3 & -1 \\ -12 & 13 & -5 & 7 \end{bmatrix}$ $B = \begin{bmatrix} -5 & 13 & 22 & -24 \\ 10 & 4 & -3 & -11 \\ -2 & 3 & -15 & 7 \end{bmatrix}$ $A - B = \begin{bmatrix} 4 & -10 & -24 & 28 \\ -10 & 0 & 6 & 10 \\ -10 & 10 & 10 & 0 \end{bmatrix}$	http://www.mathcentre.ac.uk/resources/uploaded/sigma-matrices3-2009-1.pdf http://www.virtualnerd.com/common-core/hsn-number-quantity/HSN-VM-vector-matrix/C/8
MA.FM.MA.2:	FM.MA.2: Understand that the **zero and identity matrices** play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers.	**Zero Matrix**- the null matrix, all entries being zero **Identity Matric**- the unit matrix of size n		https://www.khanacademy.org/math/algebra2/algebra-matrices/zero-identity-matrix-tutorial/e/zero-and-identity-matrices
MA.FM.MA.3:	FM.MA.3: Understand the **determinant** of a square matrix is nonzero if and only if the matrix has a **multiplicative inverse**.	**Determinant**-a value associated with a square matrix. It can be computed from the entries of the matrix by a specific arithmetic expression **Mulitplicative Inverse**-reciprocal for a number x, denoted by 1/x or x−1, is a number which when multiplied by x yields the multiplicative identity, 1.	The determinant of a 2×2 matrix is found much like a pivot operation. It is the product of the elements on the main diagonal minus the product of the elements off the main diagonal. $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$	http://www.mathamazement.com/Lessons/Pre-Calculus/08_Matrices-and-Determinants/determinants-and-inverses.html
MA.FM.MA.4:	FM.MA.4: Solve problems represented by matrices using row-reduction techniques and properties of matrix multiplication, including identity and inverse matrices.		http://www.purplemath.com/modules/mtrxrows2.htm	https://www.khanacademy.org/math/linear-algebra/vectors_and_spaces/matrices_elimination/v/matrices-reduced-row-echelon-form-1

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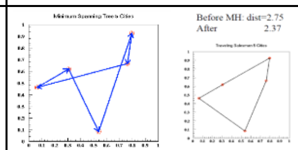
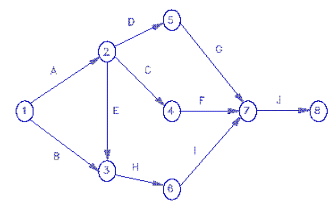
MA.FM.MA.5:	FM.MA.5: Use matrices to solve real-world problems that can be modeled by a system of equations (i.e. up to 3 linear equations) in two or three variables using technology.		http://www.mathplanet.com/education/algebra-2/matrices/using-matrices-when-solving-system-of-equations	https://www.missouriwestern.edu/cas/wp-content/uploads/sites/217/2013/12/Matrices-on-TI-2013-updated-fall.pdf
MA.FM.MA.6:	FM.MA.6: Build and use matrix representations to model polygons, transformations, and computer animations.		https://www.khanacademy.org/math/precalculus/precalc-matrices/transformation-matrix/v/transforming-position-vector	http://www.math.washington.edu/~king/coursedir/m308a01/Projects/m308a01-pdf/yip.pdf
		Networks		
MA.FM.N.1:	FM.N.1: Use **networks, traceable paths**, **tree diagrams**, **Venn diagrams,** and other pictorial representations to find the number of outcomes in a problem situation.	**Networks** - a set of objects (called nodes or vertices) that are connected together **Tracable Paths** - a path in an undirected or directed graph that visits each vertex exactly once **Tree Diagram** - a simply a way of representing a sequence of events **Venn Diagram** - a diagram that shows all possible logical relations between a finite collection of different sets	In a motel there are 4 different elevators that go from Joan's room to the pool and 3 different doors to the pool area. Use a tree diagram to show how many different ways Joan can get from her room to the pool.	https://www.khanacademy.org/math/precalculus/prob_comb/addition_rule_prob_precalc/v/probability-with-playing-cards-and-venn-diagrams
MA.FM.N.2:	FM.N.2: Optimize networks in different ways and in different contexts by finding **minimal spanning trees**, shortest paths, and **Hamiltonian paths** including real-world problems.	**Minimal Spanning Tree**- Given a connected, undirected graph, a spanning tree of that graph is a subgraph that is a tree and connects all the vertices together. **Hamiltonian Path**- a path in an undirected or directed graph that visits each vertex exactly once.		http://cgi.di.uoa.gr/~vassilis/co/L4_HamiltonianPath_BB.pdf
MA.FM.N.3:	FM.N.3: Use **critical-path analysis** in the context of scheduling problems and interpret the results.	**critical-path analysis**-algorithm for scheduling a set of project activities		http://www.stanford.edu/class/cee320/CEE320B/CPM.pdf

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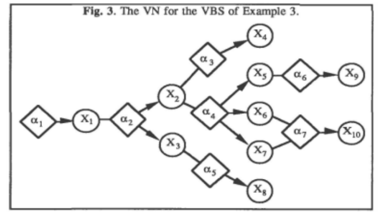
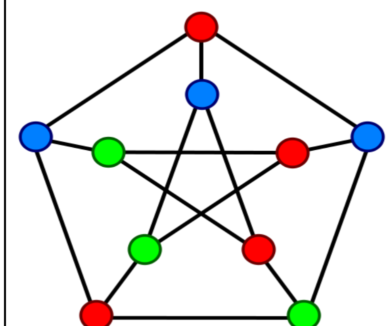
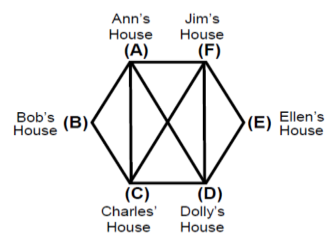
MA.FM.N.4:	FM.N.4: Construct and interpret **directed and undirected graphs**, decision trees, networks, and flow charts that model real-world contexts and problems.	**Directed Graph**- a graph, or set of nodes connected by edges, where the edges have a direction associated with them **Undirected Graph**- graph in which edges have no orientation	**Example 3**. Consider a VBS consisting of variables X_1, ..., X_{10}, and conditionals α_1 for X_1 given $\varnothing$, α_2 for $\{X_2, X_3\}$ given X_1, α_3 for X_4 given X_2, α_4 for $\{X_5, X_6, X_7\}$ given X_2, α_5 for X_8 given X_3, α_6 for X_9 given X_5, and α_7 for X_{10} given $\{X_6, X_7\}$. Figure 3 shows the VN for this VBS. If τ denotes $\alpha_1 \oplus ... \oplus \alpha_7$, then $\alpha_1 = \tau(X_1)$, $\alpha_2 = \tau(X_2, X_3 \mid X_1)$, $\alpha_3 = \tau(X_4 \mid X_2)$, $\alpha_4 = \tau(X_5, X_6, X_7 \mid X_2)$, $\alpha_5 = \tau(X_8 \mid X_3)$, $\alpha_6 = \tau(X_9 \mid X_5)$, $\alpha_7 = \tau(X_{10} \mid X_6, X_7)$. **Fig. 3.** The VN for the VBS of Example 3. 	http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&ved=0CEkQFjAF&url=http%3A%2F%2Feniac.cs.qc.cuny.edu%2Fandrew%2Fgcml-11%2FLecture6.ppt&ei=HeWdU_yiNIOqyATdkIK4BQ&usg=AFQjCNFEm2jbHjn5DKd4ATwPldWV5VHLXQ&bvm=bv.68911936,d.aWw
MA.FM.N.5:	FM.N.5: Use graph-coloring techniques to solve problems.		Use a map of the United States with all fifty states. Give students 4 colors to color the map so that no two states touch with the same color shading them in 	http://www.cs.bme.hu/~dmarx/papers/marx-pp.pdf
MA.FM.N.6:	FM.N.6: Construct **vertex-edge graph** models involving relationships among a finite number of elements. Describe a vertex-edge graph using an **adjacency matrix**. Use vertex-edge graph models to solve problems in a variety of real-world settings.	**Vertex Edge Graph**-diagram consisting of a set of points (called vertices) along with segments or arcs (called edges) joining some or all of the points Adjacency matrix- a means of representing which vertices of a graph are adjacent to which other vertices.	 List two paths from Charles' house (C) to Ellen's house (E)?	http://wsfcs.k12.nc.us/cms/lib/NC01001395/Centricity/Domain/1707/INTERATED%20unit04.pdf

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		Optimization		
MA.FM.O.1:	FM.O.1: Use **bin-packing** techniques to solve problems of optimizing resource usage.	**Bin-packing**-objects of different volumes must be packed into a finite number of bins or containers each of volume V in a way that minimizes the number of bins used		http://www.or.deis.unibo.it/kp/Chapter8.pdf
MA.FM.O.2:	FM.O.2: Use geometric and algebraic techniques to solve **optimization** problems with and without technology.	**Optimization**-is the selection of a best element (with regard to some criteria) from some set of available alternatives	Enclose a field with a rectangular fence. Use 500 ft of fencing material and a building is on one side of the field and so won't need any fencing. Determine the dimensions of the field that will enclose the largest area. Maximize: A = xy Constraint: x + 2y = 500	https://www.math.ucdavis.edu/~kouba/CalcOneDIRECTORY/maxmindirectory/MaxMin.html https://cims.nyu.edu/~kiryl/Calculus/Section_4.5--Optimization%20Problems/Optimization_Problems.pdf
MA.FM.O.3:	FM.O.3: Use the **Simplex method** to solve optimization problems with and without technology.	**Simplex method**- Dantzig's simplex algorithm is a popular algorithm for linear programming		http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CC0QFjAA&url=http%3A%2F%2Fwww-lehre.inf.uos.de%2F~sbitzer%2Fclp%2Fthe%2520simplex%2520algorithm.ppt&ei=I_GdU9ykKISZyATOxoH4DQ&usg=AFQjCNFTWUgJG9NNnhdExhHPsUF01vcd-g&bvm=bv.68911936,d.aWw
		Probability		
MA.FM.P.1:	FM.P.1: Use **Markov chains** to solve problems with and without technology.	**Markov chains**- mathematical system that undergoes transitions from one state to another on a state space. It is a random process usually characterized as memoryless: the next state depends only on the current state and not on the sequence of events that preceded it	http://www.sosmath.com/matrix/markov/markov.html	http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/Chapter11.pdf
MA.FM.P.2:	FM.P.2: Understand and use the **addition rule** to calculate probabilities for **mutually exclusive** and nonmutually exclusive events.	**Addition rule**-When two events, A and B, are mutually exclusive, the probability that A or B will occur is the sum of the probability of each event. P(A or B) = P(A) + P(B) **Mutually Exclusive**-2 events that cannot occur at the same time	On New Year's Eve, the probability of a person having a car accident is 0.09. The probability of a person driving while intoxicated is 0.32 and probability of a person having a car accident while intoxicated is 0.15. What is the probability of a person driving while intoxicated or having a car accident? Probabilities: P(intoxicated or accident) = P(intoxicated) + P(accident) - P(intoxicated and accident) = 0.32 + 0.09 - 0.15 = 0.26	http://www.mathgoodies.com/lessons/vol6/addition_rules.html http://statistics.about.com/od/Formulas/a/Addition-Rules-In-Probability.htm
MA.FM.P.3:	FM.P.3: Understand and use the **multiplication rule** to calculate probabilities for independent and dependent events. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	**Multiplication rule**- a mthod for finding the probability that both of two events occur	https://ttcobjects.tridenttech.edu/academics/spring2009/MAT/probabilities/player.html	https://www.illustrativemathematics.org/content-standards/HSS/CP/A/2/tasks/943

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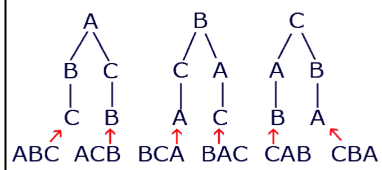
MA.FM.P.4:	FM.P.4: Understand the **multiplication counting principle, permutations, and combinations**; use them to solve real-world problems. Use simulations with and without technology to solve counting and probability problems.	**Multiplication counting principle**: If there are a ways for one activity to occur, and b ways for a second activity to occur, then there are a • b ways for both to occur. **Permutations**- rearranging, members of a set into a particular sequence or order **Combinations**- a way of selecting members from a grouping, such that the order of selection does not matter		http://dmc122011.delmar.edu/math/pjohnson/Webpage/businessmath/notes/9.2.pdf http://www.mhhe.com/math/precalc/barnettpc5/graphics/barnett05pcfg/ch10/others/bpc5_ch10-05.pdf
MA.FM.P.5:	FM.P.5: Calculate the probabilities of complementary events.	**Complementary event**s-those events where the probability of one event precludes the happening of the other event	The probability of getting a white ball from a bag of balls is $\frac{1}{4}$ $P(\text{ball is not white}) = 1-\frac{1}{4}=\frac{3}{4}$	http://www.mathsisfun.com/data/probability-complement.html
MA.FM.P.6:	FM.P.6: Calculate the expected value of a random variable; interpret it as the mean of the **probability distribution**.	**Probability distribution**- assigns a probability to each measurable subset of the possible outcomes of a random experiment, survey, or procedure of statistical inference	Find the mean of the following probability distribution? X P(X) 1 0.20 2 0.10 3 0.35 4 0.05 5 0.30 Mean of a discrete probability distribution (as this one) is given by Sum x*P(x) = 1*0.2 + 2*0.1 + 3*0.35 + 4*0.05 + 5*0.3 = 3.15	http://www.statisticshowto.com/how-to-find-the-mean-of-the-probability-distribution-or-binomial-distribution/
MA.FM.P.7:	FM.P.7: Analyze decisions and strategies using probability concepts. Analyze probabilities to interpret odds and risk of events.			http://www.vaoutcomes.org/downloads/probability_and_odds_ratio.pdf
MA.FM.P.8:	FM.P.8: Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events.		http://sites.stat.psu.edu/~jiali/course/stat416/notes/chap1.pdf	http://www.math.uiuc.edu/~kkirkpat/SampleSpace.pdf
MA.FM.P.9:	FM.P.9: Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.		A probability distribution is a table or an equation that links each outcome of a statistical experiment with its probability of occurrence. Consider the coin flip experiment described above. The table below, which associates each outcome with its probability, is an example of a probability distribution. Number of heads Probability 0 0.25 1 0.50 2 0.25	http://www.stats.gla.ac.uk/steps/glossary/probability_distributions.html https://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/random-variables
MA.FM.P.10:	FM.P.10: Use the **relative frequency** of a specified outcome of an event to estimate the probability of the outcome and apply the **law of large numbers** in simple examples.	**Relative Frequency**-the absolute frequency normalized by the total number of events **Law of large numbers**-a theorem that describes the result of performing the same experiment a large number of times	https://www.khanacademy.org/math/probability/random-variables-topic/expected-value/v/law-of-large-numbers	http://www.math.uah.edu/stat/sample/LLN.html