

<b>PUBLISHER:</b>			
<b>SUBJECT:</b>		<b>SPECIFIC GRADE:</b>	
<b>COURSE:</b>		<b>TITLE</b>	
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**NON-NEGOTIABLE EVALUATION CRITERIA**

**2018-2024  
Group VI – Mathematics  
Advanced Mathematical Modeling**

<b>Equity, Accessibility and Format</b>			
Yes	No	CRITERIA	NOTES
		<b>1. INTER-ETHNIC</b> The <b>instructional</b> materials meets the requirements of inter-ethnic: concepts, content and illustrations, as set by WV Board of Education Policy 2445.41.	
		<b>2. EQUAL OPPORTUNITY</b> The instructional material meets the requirements of equal opportunity: concepts, content, illustration, heritage, roles contributions, experiences and achievements of males and females in American and other cultures.	
		<b>3. FORMAT</b> This resource includes an interactive electronic/digital component for students.	
		<b>4. BIAS</b> The instructional material is free of political bias.	
		<b>5. COMMON CORE</b> The instructional materials do not reference Common Core academic standards. (WV Code §18-2E-1b-1).	

## GENERAL EVALUATION CRITERIA

### 2018-2024 Group VI – Mathematics Advanced Mathematical Modeling

The general evaluation criteria apply to each grade level and are to be evaluated for each grade level unless otherwise specified. These criteria consist of information critical to the development of all grade levels. In reading the general evaluation criteria and subsequent specific grade level criteria, **e.g. means “examples of” and i.e. means that “each of” those items must be addressed.** Eighty percent of the general and eighty percent of the specific criteria must be met with I (in-depth) or A (adequate) in order to be recommended.

(Vendor/Publisher) SPECIFIC LOCATION OF CONTENT WITHIN PRODUCTS	(IMR Committee) Responses				
	I=In-depth, A=Adequate, M=Minimal, N=Nonexistent	I	A	M	N
	<i>In addition to alignment of Content Standards, materials must also clearly connect to Learning for the 21<sup>st</sup> Century which includes opportunities for students to develop:</i>				
<b>Communication and Reasoning</b>					
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:					
	1. Explain the correspondence between equations, verbal descriptions, tables, and graphs.				
	2. Make conjectures and build a logical progression of statements to explore the truth of their conjectures.				
	3. Distinguish correct logic or reasoning from that which is flawed.				
	4. Justify their conclusions, communicate them to others, and respond to the arguments of others.				
	5. Evaluate the reasonableness of intermediate results.				
	6. Communicate precisely to others using appropriate mathematical language. When more than one term can describe a concept, use				

	vocabulary from the West Virginia College- and Career-Readiness Standards.						
	7. Articulate thoughts and ideas through oral, written, and multimedia communications.						
<b>Mathematical Modeling</b>							
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:							
	8. Apply mathematics to solve problems in everyday life.						
	9. Use concrete objects, pictures, diagrams, or graphs to help conceptualize and solve a problem.						
	10. Use multiple representations.						
	11. Use a variety of appropriate tools strategically.						
	12. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.						
	13. Interpret their mathematical results in the context of the situation.						
	14. Reflect on whether the results make sense, improving the model if it has not serve its purpose.						
	15. Explore careers which apply the understanding of mathematics.						
<b>Seeing Structure and Generalizing</b>							
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:							
	16. Look closely to discern a pattern or structure.						
	17. Look both for general methods and for shortcuts.						
	18. Make sense of quantities and their relationships in problem situations.						

	19. Assess and evaluate the type of mathematics needed to solve a particular problem.						
	20. Apply appropriate mathematical skills to unfamiliar complex problems.						
	21. Maintain the oversight of the process of solving a problem while attending to the details.						
<b>Instructor Resources and Tools</b>							
The instructional materials provide:							
	22. An ongoing spiraling approach.						
	23. Ongoing diagnostic, formative, and summative assessments.						
	24. A variety of assessment formats, including performance tasks, data-dependent questions, and open-ended questions.						
	25. Necessary mathematical content knowledge, pedagogy, and management techniques for educators to guide learning experiences.						
	26. Presentation tools for educators to guide learning.						
	27. Multiple research-based strategies for differentiation, intervention, and enrichment to support all learners.						

## SPECIFIC EVALUATION CRITERIA

2018-2024

### Group VI – Mathematics Advanced Mathematical Modeling

All West Virginia teachers are responsible for classroom instruction that integrates content standards and mathematical habits of mind. Primary focal points of Advanced Mathematical Modeling include the analysis of information using statistical methods and probability, modeling change and mathematical relationships, mathematical decision making in finance, and spatial and geometric modeling for decision-making. Students will learn to become critical consumers of the quantitative data that surround them every day, knowledgeable decision makers who use logical reasoning and mathematical thinkers who can use their quantitative skills to solve problems related to a wide range of situations. As students solve problems in various applied situations, they will develop critical skills for success in college and careers, including investigation, research, collaboration and both written and oral communication of their work. As students work with these topics, they will rely on mathematical processes, including problem-solving techniques, appropriate mathematical language and communication skills, connections within and outside mathematics and reasoning. Students will use multiple representations, technology, applications and modeling and numerical fluency in problem-solving contexts. Mathematical habits of mind, which should be integrated in these content areas, include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively; constructing viable arguments and critiquing the reasoning of others; modeling with mathematics; using appropriate tools strategically; attending to precision, looking for and making use of structure; and looking for and expressing regularity in repeated reasoning. Students will continue developing mathematical proficiency in a developmentally-appropriate progressions of standards. Continuing the skill progressions from previous courses, the following chart represents the mathematical understandings that will be developed:

<b>Developing College and Career Skills</b> <ul style="list-style-type: none"><li>Develop and apply skills used in college and careers, including reasoning, planning and communication, to make decisions and solve problems in applied situations.</li></ul>	<b>Finance</b> <ul style="list-style-type: none"><li>Create and analyze mathematical models to make decisions related to earning, investing, spending and borrowing money.</li></ul>
<b>Probability</b> <ul style="list-style-type: none"><li>Use basic rules of counting and probability to analyze and evaluate risk and return in the context of everyday situations.</li></ul>	<b>Statistics</b> <ul style="list-style-type: none"><li>Make decisions based on understanding, analysis and critique of reported statistical information and summaries.</li></ul>
<b>Modeling</b> <ul style="list-style-type: none"><li>Analyze numerical data in everyday situations using a variety of quantitative measures and numerical processes.</li></ul>	<b>Networks</b> <ul style="list-style-type: none"><li>Use a variety of network models represented graphically to organize data in quantitative situations, make informed decisions, and solve problems.</li></ul>
<b>Social Decision Making</b> <ul style="list-style-type: none"><li>Analyze the mathematics behind various methods of ranking and selection and consider the advantages/disadvantages of each method.</li></ul>	<b>Geometry</b> <ul style="list-style-type: none"><li>Solve geometric problems involving inaccessible distances.</li><li>Use vectors to solve applied problems.</li></ul>

For student mastery of content standards, the instructional materials will provide students with the opportunity to

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	I=In-depth, A=Adequate, M=Minimal, N=Nonexistent	I	A	M	N
<b>Developing College and Career Skills</b>					
Math as a language					
	1. Demonstrate reasoning skills in developing, explaining and justifying sound mathematical arguments and analyze the soundness of mathematical arguments of others.				
	2. Communicate with and about mathematics orally and in writing as part of independent and collaborative work, including making accurate and clear presentations of solutions to problems.				
Tools for problem solving					
	3. Gather data, conduct investigations and apply mathematical concepts and models to solve problems in mathematics and other disciplines.				
<b>Finance</b>					
Understanding financial models					
	4. Determine, represent and analyze mathematical models for loan amortization and the effects of different payments and/or finance terms (e.g., Auto, Mortgage, and/or Credit Card).				
	5. Determine, represent and analyze mathematical models for investments involving simple and compound interest with and without additional deposits. (e.g., Savings accounts, bonds, and/or certificates of deposit.)				
	6. Determine, represent, and analyze mathematical models for Inflation and the Consumer Price Index using concepts of rate of change and percentage growth.				
Personal use of finance					

	7. Research and analyze personal budgets based on given parameters (e.g., Fixed and discretionary expenses, insurance, gross vs. net pay, types of income, wage, salary, commission), career choice, geographic region, retirement and/or investment planning, etc.).						
	8. Research and analyze taxes including payroll, sales, personal property, real estate and income tax returns.						
<b>Probability</b>							
Analyzing information using probability and counting							
	9. Use the Fundamental Counting Principle, Permutations and Combinations to determine all possible outcomes for an event; determine probability and odds of a simple event; explain the significance of the Law of Large Numbers.						
	10. Determine and interpret conditional probabilities and probabilities of compound events by constructing and analyzing representations, including tree diagrams, Venn diagrams, two-way frequency tables and area models, to make decisions in problem situations.						
Managing uncertainty							
	11. Use probabilities to make and justify decisions about risks in everyday life.						
	12. Calculate expected value to analyze mathematical fairness, payoff and risk.						
<b>Statistics</b>							
Critiquing statistics							
	13. Identify limitations or lack of information in studies reporting statistical information, especially when studies are reported in condensed form.						
	14. Interpret and compare the results of polls, given a margin of error.						

	15. Identify uses and misuses of statistical analyses in studies reporting statistics or using statistics to justify particular conclusions, including assertions of cause and effect versus correlation.						
	16. Describe strengths and weaknesses of sampling techniques, data and graphical displays and interpretations of summary statistics and other results appearing in a study, including reports published in the media.						
Conducting statistical analysis							
	17. Identify the population of interest, select an appropriate sampling technique and collect data.						
	18. Identify the variables to be used in a study.						
	19. Determine possible sources of statistical bias in a study and how such bias may affect the ability to generalize the results.						
	20. Create data displays for given data sets to investigate, compare, and estimate center, shape, spread and unusual features.						
	21. Determine possible sources of variability of data, both those that can be controlled and those that cannot be controlled.						
Communicating statistical information							
	22. Report results of statistical studies to a particular audience, including selecting an appropriate presentation format, creating graphical data displays and interpreting results in terms of the question studied.						
	23. Communicate statistical results in both oral and written formats using appropriate statistical and nontechnical language.						
<b>Modeling</b>							
Managing numerical data							
	24. Solve problems involving large quantities that are not easily measured.						
	25. Use arrays to efficiently manage large collections of data and add, subtract, and multiply matrices to solve applied problems.						



Modeling data and change with functions							
	26. Determine or analyze an appropriate model for problem situations - including linear, quadratic, power, exponential, logarithmic and logistic functions (e.g., stopping distance, period of a pendulum, population growth, Richter Scale, and/or Fujita Tornado Scale).						
	27. Determine or analyze an appropriate cyclical model for problem situations that can be modeled with trigonometric functions (e.g., predator-prey models, tide heights, diurnal cycle, and/or music).						
	28. Determine or analyze an appropriate piecewise model for problem situations (e.g., postal rates, phase change graphs, sales tax, and/or utility usage rates).						
	29. Solve problems using recursion or iteration (e.g., fractals, compound interest, population growth or decline, and/or radioactive decay).						
	30. Collect numerical bivariate data; use the data to create a scatter plot; determine whether or not a relationship exists; if so, select a function to model the data, justify the selection and use the model to make predictions.						
<b>Networks</b>							
Networking for decision making							
	31. Solve problems involving scheduling or routing situations that can be represented by a vertex-edge graph; find critical paths, Euler paths, Hamiltonian paths, and minimal spanning trees (e.g., Konigsberg bridge problem, mail vs. Fed Ex delivery routes, kolam drawings of India, traveling salesman problem, and/or map coloring).						
	32. Construct, analyze, and interpret flow charts in order to develop and describe problem solving procedures.						
<b>Social Decision Making</b>							
Making decisions using ranking and voting							

	33. Apply and analyze various ranking algorithms to determine an appropriate method for a given situation (e.g., fair division, apportionment, and/or search engine results).						
	34. Analyze various voting and selection processes to determine an appropriate method for a given situation (e.g., preferential vs. non-preferential methods, and/or weighted voting).						
<b>Geometry</b>							
Concrete geometric representation (physical modeling)							
	35. Create and use two- and three-dimensional representations of authentic situations using paper techniques or dynamic geometric environments for computer-aided design and other applications.						
	36. Solve geometric problems involving inaccessible distances.						
Abstract geometric representation (matrix modeling)							
	37. Use vectors to represent and solve applied problems.						
	38. Use matrices to represent geometric transformations and solve applied problems.						