March Madness Selection: Calculation or Conjecture?

Task Statement

Student Material



Every year, as winter comes to a close, the National Collegiate Athletic Association (NCAA) Men's and Women's divisions hold a national college basketball tournament. The top teams compete. This American tradition throws sports fanatics into a frenzy. It happens from the second week of March through the first week of April. Hence, the nickname March Madness.

Unfortunately, the selection process is not as straightforward as it may appear on TV. Each year, a selection committee decides which 68 teams will take part in the tournament. The committee has 10 stakeholders, athletic directors, and conference commissioners from each division.

Thirty-two teams gain automatic entry, which is their reward for winning their conferences or season title. The remaining teams are chosen at the discretion of the selection committee. For those teams that aren't invited, there is no appeals process. The committee's decisions are final. There are few statistical resources the committee may use during the selection process, as they also may rely on personal, subjective, and opinion-based criteria. So, what happens to those teams from the tougher conferences that end up sitting at home instead of playing against a team that is part of an easier conference? Should they be penalized because they played great basketball against elite teams?

Since 1981, the NCAA has used the RPI, or the Rating Percentage Index, to gauge team strength. In 2019, a new system, NET, was introduced, but only for men's basketball. Then, starting with the 2020–2021 season, women's basketball began using the new system. Is NET a better measure of team strength than RPI? Should this method also be used for women's basketball, or is there a better way?

Critics of RPI were able to instigate change for men's basketball. Now it's your turn to advocate on behalf of women's basketball programs. How can we provide mathematical reasoning and evidence to support the selection process, justifying the committee's conclusions and ensuring a fair selection process? Explore and identify the variables you believe should be considered during the selection process. Design your own selection criteria to share with the women's oversight committee.

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March Madness Selection: Calculation or Conjecture? *Analytic Rubric*

Student Material

	Novice	Apprentice	Practitioner	Expert
Selection Method	includes: • justification for use of two categorical variables and two quantitative variables • sample two-way frequency table • scatter plot of bivariate data • computation of correlation coefficient • outline of process in clearly detailed steps	includes: • justification for use of two categorical variables and two quantitative variables • sample two-way frequency table with joint frequencies and marginal frequencies labeled • scatter plot of bivariate data with function to fit data • computation and interpretation of correlation coefficient • outline of process in clearly detailed steps	includes: • justification for use of two categorical variables and two quantitative variables • sample two-way frequency table with joint frequencies and marginal frequencies labeled • scatter plot of bivariate data with function labeled as linear, quadratic, or exponential • computation and interpretation of correlation coefficient • outline of process in clearly detailed steps	all of *Practitioner* plus: includes example of data extrapolation

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Mathematical Reasoning	calculates outcomes of decisions	• uses probability to calculate outcomes of decisions • justifies conclusions based on investigations • reviews previous March Madness team selections	• evaluates outcomes of decisions, taking into account the probability of specific team interactions • makes inferences and justifies conclusions based on investigations • analyzes previous March Madness team selections and addresses errors based on mathematical and statistical evidence	all of *Practitioner* plus: compares personal selection method with those used by the NCAA
Research	includes: • relevant information from three or more reliable print and digital sources	includes: • summary of information from four or more reliable print and digital resources • summary of NCAA selection process	includes: • synthesis of information from five or more reliable print and digital resources • summary of NCAA selection process • identification of gaps or inconsistencies in texts regarding March Madness selection process	all of *Practitioner* plus: analyzes author's purpose for providing an explanation and identifies potential bias

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Written Presentation	includes: • introduction establishing claim • logical sequencing of the claim, counterclaim, reasons, and evidence • two or more strengths and limitations of both the claim and possible counterclaims • formal style throughout • conclusion	includes: • introduction in which claim and its significance are established • logical sequencing of the claim, counterclaim, reasons, and evidence • two or more strengths of both the claim and possible counterclaims • two or more limitations of both the claim and possible counterclaims • formal style throughout • conclusion	includes: • introduction in which knowledgeable claim and its significance are established • logical sequencing of the claim, counterclaim, reasons, and evidence • two or more strengths of each the claim and possible counterclaims • two or more limitations of each the claim and possible counterclaims • formal style throughout • conclusion	all of *Practitioner* plus: creates short (one minute or less) audio and/or video summary of work to accompany written presentation

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March Madness Selection: Calculation or Conjecture? *Scaffold for Learning*

Teacher Material



Benchmark Video and Discussions
- Unit Launch "March Madness"
- All Kinds of Data

Instructional Activities: Learning

Instructional Activities: Additional

Instructional Texts/Websites	Instructional Videos	How-to Sheets	Practice
• Read graphs to describe patterns (I, P) • Univariate scatter plots (I) • Compare and contrast: types of graphical representations (IV) • Synthesize information (I, P) • Read various graphs (I, P) • Create a preparation plan (I, P, SG, IV)	• Univariate Scatter Plots (I, P) • Learn shapes of distributions (I) • Features of distributions (outliers, clusters, and gaps) (IV) • Scatterplots/bivariate data (P) • Compare two distributions (P)	• Create a scatter plot • Identify an outlier • Exploring linear, quadratic, and exponential functions in scatter plots	• Create each type of graphical representation (P) • Write a story based on a graph (I) • Represent data numerically and graphically (I, P)
			Application • Compare and contrast purposes for specific graphical representations (P, SG) • Synthesize information (I) • Design a presentation (I, P) • Create a way to educate others (I, P, SG)
Interactive Websites • Core Math Tools • Tinkerplots • Statistical Simulations	**Learning Centers** • Compare and contrast data representations (P, SG) • Identify symmetrical and nonsymmetrical distributions (P) • Identify and analyze outliers, clusters, and gaps (SG) • Compare and draw conclusions from two distributions (P, SG)	**Small-Group Mini-Lessons** • Types of data representation • Understanding skew • Bivariate scatter plots	**Assessment** • Self-assess graph reading (I) • Self-assess reading a data table (I) • Using rubric, peer edit task (P) • Using rubric, self-assess task (I)
			Reflection (I) In your *Efficacy Notebook*, reflect: Why are there various types of graphs and how do you determine which one to use?

Key: Individual **(I)**, Pairs **(P)**, Small Groups **(SG)**, Activities suitable for Homework **(HW)**, Insights Video **(IV)**

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March Madness Selection: Calculation or Conjecture? *Facilitation Grid (Week 1 Sample)*

Teacher Material

Students	Defines linear function	Defines quadratic function	Defines exponential functions	Creates scatter plots	Defines univariate data	Defines bivariate data	Identifies which representation is best for a given data set	Justifies why a representation is best for a given data set	Identifies symmetrical data representations	Identifies nonsymmetrical data representations	Explains significance of symmetry in data representations	Identifies outliers	Identifies clusters	Identifies gaps	Explains significance of outliers	Explains significance of clusters	Explains significance of gaps	Compares distributions	Draws conclusions based on comparisons of two distributions			

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March Madness Selection: Calculation or Conjecture? *Facilitation Questions*

Teacher Material

COMPREHENSION *Ask questions that ensure students understand content and skills needed to solve the problem.*	• How does data influence the choice of graph? • How is the likelihood of an event determined and communicated? • How are the teams selected for March Madness? What is the selection process? • What is the importance of statistical data? • What kinds of questions can be answered using different data displays?
APPLICATION *Ask questions that ensure the ability of students to apply learning to new situations.*	• Why is the selection process for March Madness highly debated? • In which situations are personal or subjective opinions valued? • How is probability used to evaluate outcomes of decisions?
CONNECTION *Ask questions that ensure the ability of students to apply learning to their lives.*	• What strategies do/would you use to determine the expected outcome of a situation in your life, e.g., high vs. low car insurance deductible? • How do you determine if something is fair or not? • How could you use data to influence others?
SYNTHESIS *Ask questions that encourage students to create new information from existing data.*	• Evaluate the risks associated with collecting sample data. • Do statistics lie? • What would some of the critics say about the statistical tool that you have created? Are there any negatives?
METACOGNITION *Ask questions that prompt students to think about their own thinking process.*	• Do you think you have found the best solution? • Have you thought about another way this could be done? • How do you know your selection method is reasonable?

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Student Material

Sample Activity List Week 1
March Madness Selection: Calculation or Conjecture? *Authentic Learning Unit*

I=Independent, P=Partner, G=Group, WG=Whole Group

Creating Scatter Plots			
Choose 1 of 3	Watch the video "Univariate Scatter Plots" and design a unique univariate scatter plot with 20 data points.	P	30 min
	Explore Shodor's Interactivate scatter plot learning activities and design a unique univariate scatter plot with 20 data points.	I	30 min
	Attend a *small-group mini-lesson* on univariate scatter plots and design a unique univariate scatter plot with 20 data points.	I	30 min
Choose 1 of 3	Complete "Scatter plots/bivariate data" tutorial and design a unique bivariate scatter plot with 20 data points.	I	40 min
	Watch the video "Construct and Interpret Bivariate Data in Scatter Plots" and design a unique bivariate scatter plot with 20 data points.	I	30 min
	Attend a *small-group mini-lesson* on bivariate scatter plots and design a unique bivariate scatter plot with 20 data points.	I	30 min
Required	Read the textbook section on univariate and bivariate scatter plots and develop a plan for using scatter plots to solve the March Madness problem.	G	30 min
Linear, Exponential, and Quadratic Functions with Scatter Plots			
Choose 2 of 4	Use the *how-to sheet* to work through exploring linear, quadratic, and exponential functions on scatter plots.	I or P	30 min
	Watch the video lesson on "Linear, Quadratic, and Exponential Functions on Scatter Plots" and take notes.	I or P	25 min
	Work through the textbook pages on this topic (pp. 46–50).	I	20 min
	Attend the *small-group mini-lesson* on this topic.	I	15 min
Required	Use three scatter plots you've designed thus far and write a discussion on the related functions.	P	60 min
Optional	Complete the 7 problems on Khan Academy's "Fitting Quadratic and Exponential Equations to Scatter Plots."	I	20 min

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March Madness Selection: Calculation or Conjecture? *Performance Task*

Student Material

Understanding statistics and probability is a valuable skill to possess in life. You can read and analyze studies and reports with a critical eye, compare data to make informed decisions, and, as you experienced in this ALU, persuade others using your knowledge of mathematical concepts.

Utilize your understanding of statistics and probability to your own advantage. What final grades would you like to get this grading period? Based on your past performances, what is the probability of you achieving those grades?

When sharing your findings, be sure to include the following:

- ☐ Identification and explanation of univariate and/or bivariate data used in your calculations
- ☐ Correlation of approximate/estimated study time and test scores
- ☐ Comparison of distributions across subject areas and with normal distribution
- ☐ Explanation of conditional probability as it relates to this task

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March Madness Selection: Calculation or Conjecture? *Teacher Notes Guide*

Teacher Material

Unit Overview

Understanding statistics and probability is an important skill to have in life. You are able to read and analyze studies and reports with a critical eye, compare data to make informed decisions, and persuade others using your knowledge of mathematical concepts. In this unit, students will explore the mathematics behind the NCAA March Madness selection process. They will compare NET, RPI, and their own methods for selecting teams.

Common Core State Standards Addressed

CCSS.ELA-LITERACY.RST.9-10.1; CCSS.ELA-LITERACY.RST.11-12.1;
CCSS.ELA-LITERACY.RST.9-10.2; CCSS.ELA-LITERACY.RST.11-12.2;
CCSS.ELA-LITERACY.WSHT.9-10.1; CCSS.ELA-LITERACY.WSHT.11-12.1

CCSS.MATH-CONTENT.HSS.ID.A.1; CCSS.MATH-CONTENT.HSS.ID.A.2;
CCSS.MATH-CONTENT.HSS.ID.A.3; CCSS.MATH-CONTENT.HSS.ID.A.4;
CCSS.MATH-CONTENT.HSS.ID.B.5; CCSS.MATH-CONTENT.HSS.ID.B.6;
CCSS.MATH-CONTENT.HSS.ID.C.7; CCSS.MATH-CONTENT.HSS.ID.C.8;
CCSS.MATH-CONTENT.HSS.ID.C.9; CCSS.MATH-CONTENT.HSS.CP.A.1;
CCSS.MATH-CONTENT.HSS.CP.A.2; CCSS.MATH-CONTENT.HSS.CP.A.3;
CCSS.MATH-CONTENT.HSS.CP.A.4; CCSS.MATH-CONTENT.HSS.CP.A.5

Enduring Understandings	Essential Questions
• A selection process must be clear, well-defined, and approved by all involved parties. • Various qualities or characteristics can be the basis for this selection process. • Both subjective and objective reasoning can be used in making a decision. • Probability describes the likelihood that an event will occur. • Measuring the spread of data is essential for comparing data sets. • Graphs produce visual displays of data in meaningful ways.	• Why is data collected and analyzed? • How do people use data to influence others? • How can predictions be made based on data? • How is probability used to infer data? • How does the study of probability integrate itself into the study of statistics?

21st Century Skills Addressed

Core Content and Interdisciplinary Themes
- Subject-Area Mastery

Learning and Innovation
- Critical Thinking and Problem Solving
- Creativity and Imagination

Information and Media Literacy
- Information Literacy
- Media Literacy
- Information and Communication Technology

Life and Career
- Flexibility and Adaptability
- Initiative and Self-Direction

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