

O GRAPHS AND FUNCTIONS FINDING INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION THAT MODELS A...

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UNDERSTANDING HOW TO ANALYZE FUNCTIONS THROUGH THEIR GRAPHS IS FUNDAMENTAL IN MATHEMATICS, ESPECIALLY WHEN DEALING WITH COMPLEX MODELS THAT INVOLVE MULTIPLE STEPS OR STAGES. ONE COMMON SCENARIO INVOLVES TWO-STEP FUNCTIONS, WHICH ARE OFTEN USED TO REPRESENT PROCESSES THAT CHANGE IN STAGES OR INVOLVE CONDITIONAL OPERATIONS. THESE FUNCTIONS CAN BE VISUALIZED AND UNDERSTOOD BETTER THROUGH THEIR GRAPHS, WHICH REVEAL THE INPUTS (DOMAIN) AND OUTPUTS (RANGE) AND HOW THEY RELATE ACROSS DIFFERENT PARTS OF THE FUNCTION. IN THIS ARTICLE, WE WILL EXPLORE THE CONCEPT OF TWO-STEP FUNCTIONS, HOW TO INTERPRET THEIR GRAPHS, AND METHODS FOR FINDING THEIR INPUTS AND OUTPUTS EFFECTIVELY.

WHAT IS A TWO-STEP FUNCTION?

DEFINITION OF A TWO-STEP FUNCTION

A TWO-STEP FUNCTION IS A TYPE OF PIECEWISE FUNCTION THAT OPERATES IN TWO DISTINCT STAGES OR SEGMENTS. IT APPLIES DIFFERENT RULES OR FORMULAS TO THE INPUT VALUES DEPENDING ON THE INTERVAL IN WHICH THE INPUT FALLS. THESE FUNCTIONS ARE OFTEN USED TO MODEL REAL-WORLD SCENARIOS WHERE A PROCESS CHANGES AFTER A CERTAIN THRESHOLD OR CONDITION IS MET.

EXAMPLES OF TWO-STEP FUNCTIONS

- TAX BRACKETS: A TAX RATE APPLIED DIFFERENTLY BASED ON INCOME LEVELS.
- SHIPPING COSTS: A FLAT RATE FOR INITIAL WEIGHT, THEN ADDITIONAL CHARGES BEYOND A CERTAIN WEIGHT.
- GRADING SCHEMES: DIFFERENT POINT ALLOCATIONS FOR DIFFERENT SCORE RANGES.

UNDERSTANDING THESE EXAMPLES HELPS CLARIFY THE PRACTICAL SIGNIFICANCE OF TWO-STEP FUNCTIONS AND THEIR GRAPHS.

VISUALIZING TWO-STEP FUNCTIONS THROUGH GRAPHS

COMPONENTS OF A GRAPH OF A TWO-STEP FUNCTION

A GRAPH OF A TWO-STEP FUNCTION TYPICALLY CONSISTS OF:

- MULTIPLE LINE SEGMENTS OR CURVES, EACH REPRESENTING A DIFFERENT RULE OR FORMULA APPLIED TO A SPECIFIC INTERVAL.
- BREAKPOINTS OR TRANSITION POINTS, WHERE THE RULE CHANGES FROM ONE SEGMENT TO ANOTHER.
- VERTICAL LINES AT THE BOUNDARY POINTS, INDICATING THE TRANSITION BETWEEN STEPS (THESE ARE OFTEN DASHED OR MARKED FOR CLARITY).

HOW TO SKETCH THE GRAPH

1. IDENTIFY THE INTERVALS AND THE RULES FOR EACH SEGMENT.
2. PLOT THE POINTS AT THE BOUNDARY OF EACH INTERVAL.
3. DRAW THE LINE SEGMENTS ACCORDING TO THE FORMULAS, ENSURING CONTINUITY OR DISCONTINUITY AS DICTATED BY THE FUNCTION.
4. MARK THE TRANSITION POINTS CLEARLY TO SHOW THE CHANGE IN RULE.

VISUAL REPRESENTATION MAKES IT EASIER TO INTERPRET THE FUNCTION'S BEHAVIOR AND TO FIND SPECIFIC INPUTS AND OUTPUTS.

FINDING INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION

DETERMINING THE DOMAIN (INPUTS)

THE DOMAIN OF A TWO-STEP FUNCTION IS THE SET OF ALL POSSIBLE INPUT VALUES FOR WHICH THE FUNCTION IS DEFINED.

STEPS TO FIND THE DOMAIN:

- LOOK AT THE ENTIRE RANGE OF INPUT VALUES PROVIDED OR IMPLIED BY THE PROBLEM.
- CHECK FOR RESTRICTIONS: ANY VALUES THAT CAUSE DIVISION BY ZERO, SQUARE ROOTS OF NEGATIVE NUMBERS, OR OTHER UNDEFINED OPERATIONS.
- FOR MOST COMMON TWO-STEP FUNCTIONS, THE DOMAIN IS OFTEN ALL REAL NUMBERS UNLESS SPECIFIED OTHERWISE.

FINDING THE RANGE (OUTPUTS)

THE RANGE CONSISTS OF ALL POSSIBLE OUTPUT VALUES OF THE FUNCTION.

STEPS TO FIND THE RANGE:

- ANALYZE EACH SEGMENT OF THE FUNCTION SEPARATELY.
- FOR EACH SEGMENT, DETERMINE THE SET OF OUTPUTS BASED ON THE FORMULA AND THE INPUT INTERVAL.
- COMBINE THESE OUTPUTS TO FIND THE OVERALL RANGE OF THE FUNCTION.

USING THE GRAPH TO FIND INPUTS AND OUTPUTS

- TO FIND THE OUTPUT FOR A SPECIFIC INPUT, LOCATE THE INPUT VALUE ON THE X-AXIS AND FOLLOW VERTICALLY UNTIL YOU REACH THE GRAPH. THE Y-COORDINATE GIVES THE OUTPUT.
- TO FIND THE INPUT(S) FOR A SPECIFIC OUTPUT, LOCATE THE OUTPUT VALUE ON THE Y-AXIS AND FOLLOW HORIZONTALLY UNTIL INTERSECTING THE GRAPH. THE X-COORDINATE(S) AT THE INTERSECTION(S) ARE THE INPUTS.

STEP-BY-STEP EXAMPLE OF ANALYZING A TWO-STEP FUNCTION

SUPPOSE WE HAVE A PIECEWISE FUNCTION MODELED AS FOLLOWS:

$$f(x) = \begin{cases} 2x + 3, & x \leq 0 \\ -x + 5, & x > 0 \end{cases}$$

GRAPHING THE FUNCTION

- FOR $(x \leq 0)$, PLOT THE LINE $(y=2x+3)$, WHICH PASSES THROUGH POINTS LIKE $(-1, 1)$ AND $(0, 3)$.
- FOR $(x > 0)$, PLOT THE LINE $(y=-x+5)$, PASSING THROUGH POINTS LIKE $(1, 4)$ AND $(2, 3)$.
- CONNECT THE POINTS WITH APPROPRIATE LINE SEGMENTS, NOTING THE BOUNDARY AT $(x=0)$.

FINDING INPUTS AND OUTPUTS

- DOMAIN: ALL REAL NUMBERS $((-\infty, \infty))$.
- RANGE: FOR $(x \leq 0)$, AS (x) DECREASES, $(f(x))$ DECREASES WITHOUT BOUND; AT $(x=0)$, $(f(0)=3)$. FOR $(x > 0)$, $(f(x))$ DECREASES FROM 5 AT $(x=0^+)$ DOWNWARD. OVERALL, THE RANGE IS $((-\infty, 5])$.
- TO FIND THE OUTPUT FOR $(x=2)$, LOCATE $(x=2)$ ON THE GRAPH, SEE THAT $(f(2)=-2+5=3)$.
- TO FIND THE INPUT FOR $(f(x)=4)$, LOCATE $(y=4)$ ON THE GRAPH, SEE THAT $(x=1)$ IN THE SECOND SEGMENT GIVES $(f(1)=4)$.

APPLICATIONS OF TWO-STEP FUNCTIONS AND GRAPHS

REAL-WORLD MODELING

TWO-STEP FUNCTIONS ARE INVALUABLE IN MODELING SITUATIONS INVOLVING THRESHOLDS AND CONDITIONAL BEHAVIORS. FOR EXAMPLE:

- TAX CALCULATIONS THAT CHANGE BASED ON INCOME BRACKETS.
- UTILITY BILLING THAT CHARGES DIFFERENT RATES AFTER CERTAIN USAGE LEVELS.
- POPULATION MODELS WITH DIFFERENT GROWTH RATES AT DIFFERENT STAGES.

DATA ANALYSIS AND INTERPRETATION

GRAPHS HELP IN VISUALIZING DATA THAT FOLLOWS TWO-STEP PATTERNS, ALLOWING ANALYSTS TO IDENTIFY TRANSITION POINTS, OUTLIERS, AND OVERALL TRENDS EFFICIENTLY.

EDUCATIONAL VALUE

TEACHING STUDENTS ABOUT PIECEWISE FUNCTIONS AND THEIR GRAPHS ENHANCES UNDERSTANDING OF FUNCTION BEHAVIOR, CONTINUITY, AND DISCONTINUITY.

TIPS FOR ANALYZING AND SKETCHING TWO-STEP FUNCTIONS

- ALWAYS IDENTIFY THE BOUNDARY POINTS WHERE THE RULE CHANGES.
- PAY ATTENTION TO WHETHER THE BOUNDARY POINTS ARE INCLUDED (CLOSED DOTS) OR EXCLUDED (OPEN DOTS).
- USE GRAPHING TOOLS OR PLOTTING SOFTWARE FOR PRECISE VISUALIZATION OF COMPLEX FUNCTIONS.

- PRACTICE WITH DIFFERENT FUNCTIONS TO BECOME COMFORTABLE RECOGNIZING PATTERNS AND TRANSITION BEHAVIORS.

CONCLUSION

UNDERSTANDING HOW TO FIND INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION THROUGH ITS GRAPH IS AN ESSENTIAL SKILL IN MATHEMATICS, ENABLING BETTER COMPREHENSION OF PIECEWISE FUNCTIONS AND THEIR APPLICATIONS. BY CAREFULLY ANALYZING EACH SEGMENT, IDENTIFYING TRANSITION POINTS, AND VISUALIZING THE FUNCTION, STUDENTS AND PROFESSIONALS ALIKE CAN INTERPRET COMPLEX MODELS WITH CONFIDENCE. WHETHER IN ACADEMIC SETTINGS, DATA ANALYSIS, OR REAL-WORLD PROBLEM-SOLVING, MASTERING THE INTERPRETATION OF TWO-STEP FUNCTIONS EMPOWERS BETTER DECISION-MAKING AND CLEARER INSIGHTS.

REMEMBER, THE KEY LIES IN BREAKING DOWN THE FUNCTION INTO MANAGEABLE PARTS, UNDERSTANDING THE RULES GOVERNING EACH SEGMENT, AND LEVERAGING THE POWER OF GRAPHICAL REPRESENTATION TO SEE THE BIGGER PICTURE.

FREQUENTLY ASKED QUESTIONS

WHAT IS A TWO-STEP FUNCTION IN GRAPH AND FUNCTION MODELING?

A TWO-STEP FUNCTION IS A MATHEMATICAL FUNCTION WHERE THE OUTPUT IS DETERMINED BY APPLYING TWO SEQUENTIAL OPERATIONS OR RULES, OFTEN REPRESENTED BY TWO DIFFERENT EQUATIONS OR PIECES OF A PIECEWISE FUNCTION, TO MODEL MORE COMPLEX RELATIONSHIPS.

HOW DO YOU FIND THE INPUT VALUES FOR A TWO-STEP FUNCTION FROM ITS GRAPH?

TO FIND INPUTS, LOCATE THE X-VALUES ON THE GRAPH FOR WHICH THE FUNCTION'S OUTPUT (Y-VALUE) CORRESPONDS TO THE GIVEN DATA, CONSIDERING THE PIECEWISE SEGMENTS IF APPLICABLE. INPUTS ARE OFTEN THE X-VALUES WHERE THE GRAPH IS DEFINED OR CHANGES BEHAVIOR.

HOW DO YOU DETERMINE THE OUTPUT OF A TWO-STEP FUNCTION FOR A GIVEN INPUT?

IDENTIFY THE INPUT VALUE, DETERMINE WHICH PART OF THE PIECEWISE FUNCTION APPLIES, AND THEN APPLY THE CORRESPONDING RULE OR OPERATION TO COMPUTE THE OUTPUT VALUE.

WHAT ARE COMMON METHODS TO MODEL A TWO-STEP FUNCTION USING A GRAPH?

COMMON METHODS INCLUDE USING PIECEWISE FUNCTIONS WITH DIFFERENT FORMULAS FOR EACH SEGMENT, PLOTTING EACH PART SEPARATELY, AND ENSURING CONTINUITY OR IDENTIFYING POINTS OF TRANSITION BETWEEN STEPS.

HOW CAN YOU VERIFY IF A GRAPH REPRESENTS A TWO-STEP FUNCTION?

CHECK IF THE GRAPH CONSISTS OF TWO DISTINCT SEGMENTS OR REGIONS, EACH FOLLOWING ITS OWN RULE, WITH POSSIBLE JUMPS OR CHANGES AT SPECIFIC POINTS, CHARACTERISTIC OF TWO-STEP FUNCTIONS.

WHAT IS THE SIGNIFICANCE OF IDENTIFYING INPUTS AND OUTPUTS IN A TWO-STEP FUNCTION?

IDENTIFYING INPUTS AND OUTPUTS HELPS UNDERSTAND THE RELATIONSHIP MODELED BY THE FUNCTION, ALLOWS FOR SOLVING FOR UNKNOWN, AND AIDS IN GRAPHING OR APPLYING THE FUNCTION TO REAL-WORLD PROBLEMS.

CAN A TWO-STEP FUNCTION BE CONTINUOUS? HOW DOES THIS AFFECT FINDING INPUTS

AND OUTPUTS?

YES, A TWO-STEP FUNCTION CAN BE CONTINUOUS IF THE PIECES CONNECT SMOOTHLY; OTHERWISE, IT MAY HAVE JUMPS. CONTINUITY AFFECTS HOW YOU INTERPRET INPUTS AND OUTPUTS, ESPECIALLY AT TRANSITION POINTS WHERE THE FUNCTION MAY BE DISCONTINUOUS.

HOW DO YOU INTERPRET A TWO-STEP FUNCTION FROM ITS GRAPH IN TERMS OF REAL-WORLD APPLICATIONS?

A TWO-STEP FUNCTION MODELS SCENARIOS WHERE A CHANGE OCCURS AFTER A CERTAIN THRESHOLD, LIKE TAX BRACKETS OR PRICING TIERS, WITH INPUTS REPRESENTING INDEPENDENT VARIABLES AND OUTPUTS REPRESENTING THE RESULTING VALUES AFTER APPLYING EACH STEP.

WHAT CHALLENGES MIGHT ARISE WHEN FINDING INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION FROM A GRAPH?

CHALLENGES INCLUDE IDENTIFYING THE CORRECT SEGMENT OF THE PIECEWISE FUNCTION, DEALING WITH DISCONTINUITIES, AND ACCURATELY READING VALUES AT TRANSITION POINTS, ESPECIALLY IF THE GRAPH IS COMPLEX OR UNCLEAR.

HOW CAN UNDERSTANDING TWO-STEP FUNCTIONS HELP IN SOLVING REAL-WORLD PROBLEMS?

UNDERSTANDING THESE FUNCTIONS ALLOWS FOR MODELING SITUATIONS WITH MULTIPLE PHASES OR RULES, MAKING IT EASIER TO ANALYZE AND PREDICT OUTCOMES, OPTIMIZE SOLUTIONS, AND INTERPRET DATA ACCURATELY IN FIELDS LIKE ECONOMICS, ENGINEERING, AND SOCIAL SCIENCES.

ADDITIONAL RESOURCES

○ GRAPHS AND FUNCTIONS: FINDING INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION THAT MODELS A PROCESS

UNDERSTANDING HOW FUNCTIONS WORK IS FUNDAMENTAL IN MATHEMATICS, ESPECIALLY WHEN MODELING REAL-WORLD PROCESSES. WHEN DEALING WITH ○ GRAPHS AND FUNCTIONS, ONE COMMON CHALLENGE IS DETERMINING THE INPUTS AND OUTPUTS OF A TWO-STEP FUNCTION. THESE FUNCTIONS, OFTEN COMPOSED OF MULTIPLE OPERATIONS, REQUIRE CAREFUL ANALYSIS TO DECODE HOW DIFFERENT VALUES ARE TRANSFORMED THROUGH EACH STAGE. WHETHER YOU'RE A STUDENT PREPARING FOR EXAMS, A TEACHER DESIGNING LESSON PLANS, OR A PROFESSIONAL APPLYING MATHEMATICAL MODELS TO DATA, MASTERING THE PROCESS OF ANALYZING TWO-STEP FUNCTIONS IS ESSENTIAL.

IN THIS GUIDE, WE'LL EXPLORE HOW TO INTERPRET AND ANALYZE TWO-STEP FUNCTIONS USING GRAPHS AND ALGEBRAIC METHODS. WE'LL FOCUS ON HOW TO IDENTIFY INPUTS AND OUTPUTS, UNDERSTAND THE COMPOSITION OF FUNCTIONS, AND INTERPRET THE GRAPHICAL REPRESENTATIONS EFFECTIVELY.

UNDERSTANDING TWO-STEP FUNCTIONS

BEFORE DIVING INTO THE ANALYSIS, LET'S CLARIFY WHAT A TWO-STEP FUNCTION ENTAILS.

WHAT IS A TWO-STEP FUNCTION?

A TWO-STEP FUNCTION IS A FUNCTION THAT APPLIES TWO DIFFERENT OPERATIONS SEQUENTIALLY TO AN INPUT VALUE. FORMALLY, IF WE DENOTE THE TWO FUNCTIONS AS (f) AND (g) , THEN THE TWO-STEP PROCESS INVOLVES COMPUTING:

$$\begin{aligned} & \backslash[\\ h(x) &= g(f(x)) \\ & \backslash] \end{aligned}$$

HERE, FOR EACH INPUT x , THE FUNCTION FIRST APPLIES f TO PRODUCE AN INTERMEDIATE VALUE, THEN APPLIES g TO THIS INTERMEDIATE VALUE TO PRODUCE THE FINAL OUTPUT. THIS PROCESS IS CALLED COMPOSITION OF FUNCTIONS.

EXAMPLE OF A TWO-STEP FUNCTION

SUPPOSE:

- $f(x) = 2x + 3$,
- $g(x) = x^2$.

THEN, THE COMBINED FUNCTION $h(x) = g(f(x)) = (2x + 3)^2$.

ANALYZING SUCH FUNCTIONS INVOLVES UNDERSTANDING THE OUTPUTS AT EACH STAGE, WHICH CAN BE VISUALIZED OR CALCULATED ALGEBRAICALLY.

VISUALIZING TWO-STEP FUNCTIONS WITH GRAPHS

GRAPHS ARE INVALUABLE TOOLS FOR VISUALIZING THE BEHAVIOR OF FUNCTIONS. THEY HELP US SEE HOW INPUTS ARE MAPPED TO OUTPUTS AND UNDERSTAND THE EFFECT OF EACH STEP.

THE GRAPH OF $f(x)$

THE FIRST STEP INVOLVES PLOTTING THE GRAPH OF $f(x)$. THIS GRAPH SHOWS HOW EACH INPUT x IS TRANSFORMED INTO AN INTERMEDIATE VALUE $f(x)$.

THE GRAPH OF $g(x)$

NEXT, WE EXAMINE $g(x)$. WHEN COMPOSED, THE OUTPUT OF $f(x)$ BECOMES THE INPUT OF g , WHICH CAN BE VISUALIZED AS A TRANSFORMATION OF THE GRAPH OF f .

THE GRAPH OF THE COMPOSITE FUNCTION $h(x) = g(f(x))$

THE FINAL GRAPH COMBINES THE EFFECTS OF BOTH FUNCTIONS. IT CAN BE CONSTRUCTED BY:

- PLOTTING $f(x)$,
- APPLYING g TO THE $f(x)$ VALUES,
- PLOTTING THE POINTS $(x, g(f(x)))$.

STEP-BY-STEP PROCESS FOR FINDING INPUTS AND OUTPUTS

ANALYZING A TWO-STEP FUNCTION INVOLVES SYSTEMATICALLY DETERMINING WHICH INPUTS PRODUCE WHICH OUTPUTS. HERE'S A DETAILED APPROACH.

1. IDENTIFY THE COMPONENT FUNCTIONS

START BY EXPLICITLY DEFINING THE FUNCTIONS $f(x)$ AND $g(x)$. UNDERSTANDING THEIR DOMAINS AND RANGES IS CRUCIAL SINCE CERTAIN INPUTS MIGHT BE RESTRICTED OR PRODUCE UNDEFINED OUTPUTS.

2. ANALYZE THE FIRST STEP: FIND $f(x)$

- FOR A GIVEN INPUT x , COMPUTE $f(x)$.
- DETERMINE THE DOMAIN OF f — THE SET OF ALL INPUTS FOR WHICH $f(x)$ IS DEFINED.
- RECORD THE RANGE OF f — THE SET OF POSSIBLE OUTPUTS FROM THE FIRST STEP.

3. ANALYZE THE SECOND STEP: FIND $g(f(x))$

- FOR EACH $(f(x))$, COMPUTE $(g(f(x)))$.
- CHECK THE DOMAIN OF (g) ; ENSURE THAT $(f(x))$ FALLS WITHIN THIS DOMAIN.
- THE OUTPUTS OF THE SECOND STEP ARE THE FINAL OUTPUTS OF THE COMPOSITE FUNCTION.

4. DETERMINE INPUTS AND OUTPUTS

- INPUTS: ALL (x) VALUES IN THE DOMAIN OF THE ENTIRE PROCESS (CONSIDERING ANY RESTRICTIONS).
- OUTPUTS: THE RESULTING $(h(x) = g(f(x)))$ VALUES FOR EACH INPUT.

5. USE GRAPHS TO CONFIRM

- PLOT POINTS FOR VARIOUS (x) VALUES TO SEE HOW THE FUNCTION BEHAVES.
- VERIFY THE OUTPUTS VISUALLY AND ENSURE THE CALCULATIONS ALIGN WITH THE GRAPH.

PRACTICAL EXAMPLE: MODELING A PROCESS WITH A TWO-STEP FUNCTION

LET'S WALK THROUGH AN EXAMPLE TO SOLIDIFY THESE CONCEPTS.

SUPPOSE:

- $(f(x) = 3x - 2)$,
- $(g(x) = \sqrt{x})$.

QUESTION: FIND THE OUTPUT WHEN THE INPUT IS $(x=4)$, AND DETERMINE THE OVERALL INPUT-OUTPUT RELATIONSHIP.

STEP 1: COMPUTE $(f(4))$

$$\begin{aligned} &[\\ f(4) &= 3(4) - 2 = 12 - 2 = 10 \\ &] \end{aligned}$$

STEP 2: COMPUTE $(g(f(4)))$

$$\begin{aligned} &[\\ g(10) &= \sqrt{10} \approx 3.16 \\ &] \end{aligned}$$

FINAL OUTPUT: APPROXIMATELY 3.16.

NOTE: SINCE $(g(x))$ INVOLVES A SQUARE ROOT, THE DOMAIN OF (g) IS $(x \geq 0)$. THEREFORE, $(f(x))$ MUST PRODUCE OUTPUTS (≥ 0) . FOR $(f(x) = 3x - 2 \geq 0)$, SOLVING:

$$\begin{aligned} &[\\ 3x - 2 &\geq 0 \rightarrow x \geq \frac{2}{3} \\ &] \end{aligned}$$

THUS, THE DOMAIN OF THE ENTIRE PROCESS IS $(x \geq \frac{2}{3})$.

WORKING WITH GRAPHS: INTERPRETING AND CONSTRUCTING

UNDERSTANDING THE GRAPHICAL APPROACH IS ESSENTIAL FOR VISUAL LEARNERS AND FOR VERIFYING ALGEBRAIC CALCULATIONS.

PLOTTING THE COMPONENTS

- PLOT $(f(x) = 3x - 2)$, A STRAIGHT LINE WITH SLOPE 3 AND Y-INTERCEPT (-2) .

- Plot $(g(x) = \sqrt{x})$, a half-parabola starting at $(0,0)$.
- To visualize $(h(x) = g(f(x)))$, compute several points:

x	$f(x)$	$g(f(x))$	Remarks
0.5	$3(0.5) - 2 = 1.5 - 2 = -0.5$	Not defined (since $f(0.5) < 0$)	Outside domain, exclude
0.667	$3(0.667) - 2 \approx 2 - 2 = 0$	$\sqrt{0} = 0$	Valid input at domain start
1	$3(1) - 2 = 1$	$\sqrt{1} = 1$	
2	$3(2) - 2 = 6 - 2 = 4$	$\sqrt{4} = 2$	
3	$3(3) - 2 = 9 - 2 = 7$	$\sqrt{7} \approx 2.65$	

Plotting these points gives a sense of how the composite function behaves.

ANALYZING THE DOMAIN AND RANGE OF A TWO-STEP FUNCTION

One of the critical aspects of working with functions is understanding their domain (possible inputs) and range (possible outputs).

DOMAIN CONSIDERATIONS

- The domain of the composite function $(h(x) = g(f(x)))$ is constrained by:
- The domain of f .
- The domain of g evaluated at $f(x)$.
- For example, if $(g(x) = \sqrt{x})$, then $f(x)$ must be (≥ 0) . This restricts the domain of h to those x for which $f(x) \geq 0$.

RANGE CONSIDERATIONS

- The range of f influences the possible inputs to g .
- The overall range of h depends on the combined transformation.

EXAMPLE SUMMARY:

In our earlier example:

- Domain of f : $(x \geq \frac{2}{3})$,
- Output of f for $(x \geq \frac{2}{3})$: $(f(x) \geq 0)$,
- Domain of g : $(x \geq 0)$,
- Composition $(h(x) = \sqrt{f(x)})$ is defined for $(x \geq \frac{2}{3})$.

APPLICATIONS OF TWO-STEP FUNCTIONS IN REAL-WORLD MODELING

Understanding how to find inputs and outputs of two-step functions is critical when modeling real-world processes, such as:

- Financial calculations: Calculating interest after applying a rate, then deducting taxes.
- Physics: Converting units, then applying a formula.
- Computer science: Input processing followed by data transformation.

EXAMPLE: TAX CALCULATION MODEL

Suppose an initial income x is taxed at 20%, and then a flat fee of \$50 is deducted.

- First step: $(f(x) = 0.8x)$,

O Graphs And Functionsfinding Inputs And Outputs Of A Two Step Function That Models A

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