

TEACHER AND STUDENT RESOURCE

Probability Models and Decisions Under Uncertainty



NC Math 4 • NC.M4.SP.3

Statistics and Probability

Seven instructional sections with 30 multiple-choice and 30 open or performance tasks, teaching scripts, original mathematical visuals, generous workspaces, and worked keys.

Free sample | Contents

NC.M4.SP.3 | NC Math 4 mathematics

This sample contains 22 complete selected pages from the 95-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-17, 32-33, 62, 77-78

Representative activities

M01: sample PDF page(s) 18; original page(s) 17

M02: sample PDF page(s) 18; original page(s) 17

O01: sample PDF page(s) 19; original page(s) 32

O02: sample PDF page(s) 20; original page(s) 33

Selected teacher prompts and keys: original page(s) 62, 77-78

Using this sample

Read the preparation and access guidance before using a selected activity.
Keep teacher keys and private preparation pages separate from student copies.
Use the original resource contents to see the scope of the complete packet.

Complete paid download

The complete resource includes the full PDF task bank and teaching materials.
Its required companion lab is included with the complete paid download.
The sample does not include that complete companion archive.

ALIGNMENT

Standard and learning targets

Apply probability distributions in making decisions in uncertainty.

T1 NC.M4.SP.3.1 Build and interpret discrete probability distributions, including expected outcomes and decisions that also consider variability.

T2 NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

T3 NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

T4 NC.M4.SP.3.4 Standardize, find normal probabilities and percentiles, and interpret modeled likelihoods in context.

NC.M4.SP.3.1 Implement discrete probability distributions to model random phenomenon and make decisions (e.g., expected value of playing a game, etc.).

NC.M4.SP.3.2 Implement the binomial distribution to model situations and make decisions.

NC.M4.SP.3.3 Recognize from simulations of sampling distributions of sample means and proportions that a normal distribution can be used as an approximate model in certain situations.

NC.M4.SP.3.4 Implement the normal distribution as a probability distribution to determine the likelihood of events occurring.

Each item names its own target. The bank supports multiple sessions; do not assign all 60 tasks in one sitting.

NAVIGATION

Choose evidence deliberately

Warm-up: M01-M04 and O01-O04

I Do: M05-M08 and O05-O08

We Do: M09-M13 and O09-O13

Collaborative practice: M14-M18 and O14-O18

Independent practice: M19-M23 and O19-O23

Small-group reteach: M24-M27 and O24-O27

Exit ticket: M28-M30 and O28-O30

T1: M01, M05, M09, M13, M17, M21, M25, M29, O03, O07, O11, O15, O19, O23, O27

T2: M02, M06, M10, M14, M18, M22, M26, M30, O04, O08, O12, O16, O20, O24, O28

T3: M03, M07, M11, M15, M19, M23, M27, O01, O05, O09, O13, O17, O21, O25, O29

T4: M04, M08, M12, M16, M20, M24, M28, O02, O06, O10, O14, O18, O22, O26, O30

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Diagnose and model

Learning target: NC.M4.SP.3.1 Build and interpret discrete probability distributions, including expected outcomes and decisions that also consider variability.

Learning target: NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

Use warm-up evidence to choose explicit I Do models. Collect predictions before revealing the worked solution.

Session 2 Compare and explain

Learning target: NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

Learning target: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

Learning target: NC.M4.SP.3.4 Standardize, find normal probabilities and percentiles, and interpret modeled likelihoods in context.

Use selected We Do and collaborative tasks. Ask each learner for an initial representation, then compare methods and checks.

Session 3 Transfer independently

Learning target: Apply the objectives with explicit restrictions, checks and contextual interpretations.

Choose independent items across every objective. Use small-group tasks for a documented gap and a fresh exit task to test transfer.

PLANNING

Materials, access and pacing

Materials

A calculator with binomial probability, normal CDF and inverse-normal functions is useful. A spreadsheet or the supplied Python 3 standard-library simulation lab is required for simulation tasks. The companion archive includes `distributions_lab.py`, four replicate CSV files and `distribution_results.json`. Use the supplied four-panel reference chart for comparison, then save your own technology output when a task requests a simulation. No real betting or purchase is involved in token-game examples.

Prerequisites

Probability as a number from 0 to 1, mutually exclusive outcomes, means, standard deviation, combinations, powers and normal CDF/inverse-normal technology.

Pacing

Use a short diagnostic warm-up, a model and shared task in one session; collaborative and independent reasoning in later sessions; then targeted reteaching and an exit task. Select two to four tasks at a time based on evidence. Each section's full bank is reusable, not mandatory in one lesson.

Neutral access

Read directions aloud without interpreting the graph, enlarge a page, supply a writing or pointing response method, and allow a learner to dictate an explanation. Keep axes, units, data and mathematical demand unchanged.

Separate instruction from evidence

Keep the learner's first response. Record answer-supplying cues separately from access supports. A completed teacher graph or worked key is for discussion after independent work, never a student construction template.

Review convention

All contexts, probability models and simulated populations are invented instructional examples. For a discrete variable, probabilities must be nonnegative and sum to 1; $E(X) = \sum xP(X=x)$. A binomial count has fixed n , independent binary trials and constant success probability p . Its mean is np and SD is $\sqrt{np(1-p)}$. For normal models in this packet, $N(\mu, \sigma)$ explicitly names the mean and standard deviation, not the variance. Use $z = (x-\mu)/\sigma$ and $\sigma > 0$. For a proportion approximation, the classroom check is $np \geq 10$ and $n(1-p) \geq 10$, along with a justified independent-sampling model. This check is a guide, not proof that an approximation is exact. Retain full calculator precision until the final answer.

TECHNOLOGY LABORATORY

Probability technology laboratory

Discrete and binomial calculations

Create a table of possible values and their probabilities, check the total and compute weighted sums. For X counting successes in n independent trials with success probability p , use $P(X=k) = C(n, k)p^k(1-p)^{n-k}$. Add mutually exclusive counts for a cumulative event. “At least one” is often easier as $1-P(X=0)$. Record the event and calculator command, not only a decimal.

Normal calculations

The standard normal CDF $\Phi(z)$ is the area to the left of z . Subtract two CDF values for a between-event; subtract from 1 for an upper tail. For a percentile, first identify its left-tail probability, find z with the inverse CDF, then return to the original units with $x = \mu + z\sigma$. A density height is not itself a probability.

Simulation models

Each run contains 5000 independently generated complete samples. `P_common_n100` uses $p = 0.40$, $n = 100$, seed 301. `P_rare_n25` uses $p = 0.02$, $n = 25$, seed 302. `Mean_n5` and `Mean_n200` sample a population taking 0 with probability 0.90 and 10 with probability 0.10, using $n = 5$ and 200, seeds 303 and 304. Each replicate records a proportion or a mean, not one individual outcome.

Run and inspect

Run `distributions_lab.py` using Python 3. It writes the four CSV files and summary JSON. Import the CSV files into a spreadsheet if preferred. Compare the simulated center and SD with the theoretical values; inspect the shape before using a normal approximation. More simulation replicates improve the picture of the same sampling distribution, not the original sample's information.

Primary method references

NIST/SEMATECH binomial distribution:

<https://www.itl.nist.gov/div898/handbook/eda/section3/eda366i.htm>

NIST/SEMATECH normal distribution and sampling-mean discussion:

<https://www.itl.nist.gov/div898/handbook/eda/section3/eda3661.htm>

The simulations and instructional examples here are original.

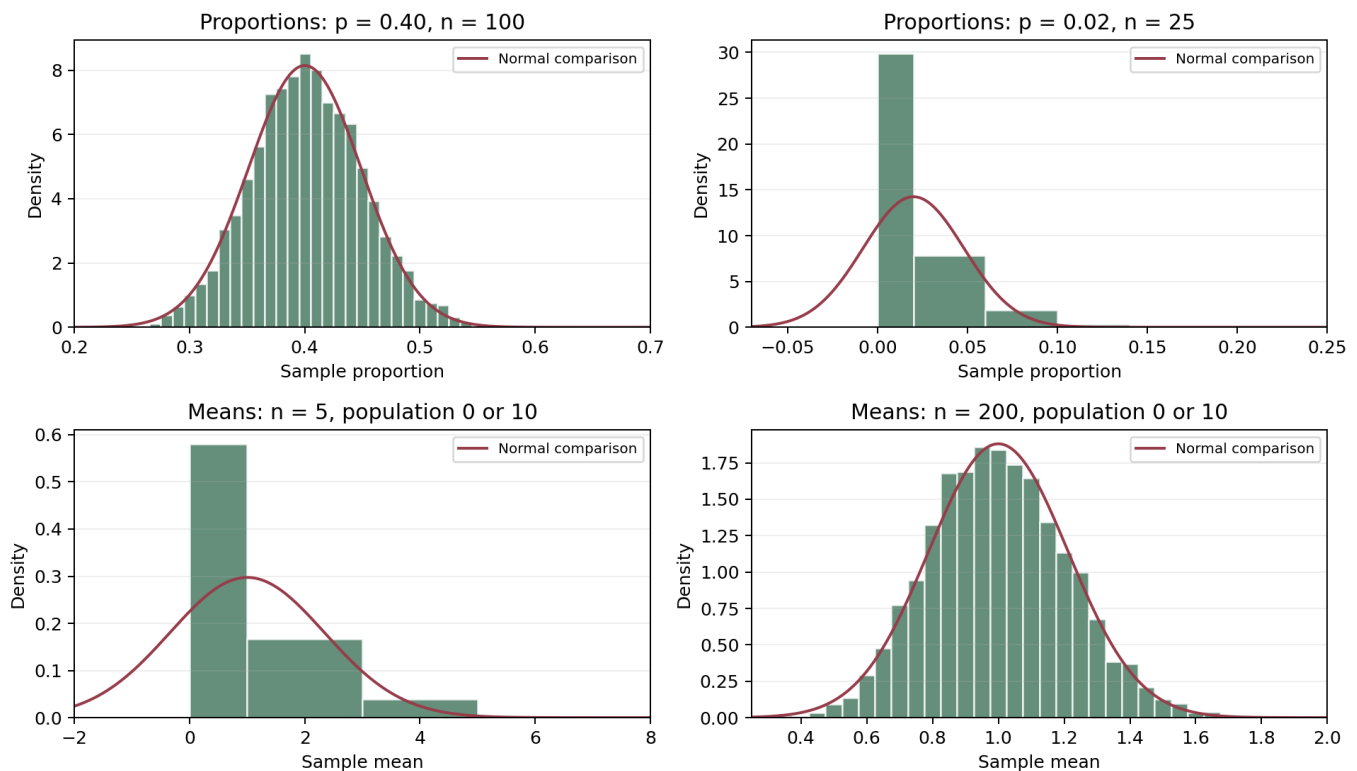
TECHNOLOGY LABORATORY

When does a normal shape fit?

Read the display

All four panels show sampling distributions, with density rather than raw count on the vertical axis. The smooth curve in each panel is a normal comparison with the theoretical mean and SD. A displayed curve does not certify a good approximation. Inspect skew, discrete piles and any probability the curve assigns to impossible values. Horizontal scales differ, so read them before comparing spread.

5000 simulated samples per panel; normal curves are comparisons, not automatic fits



Original charts from the four supplied seeded simulation files. For the sample-mean panels, the population mean is 1 and the population SD is 3. Every panel uses 5000 complete samples. The rare-proportion and small-sample-mean panels deliberately show poor normal approximations.

TEACHER MODEL

Name the event before calculating

Eight independent orders each have replacement probability 0.20. How likely is at least one replacement?

Say: “My variable X counts replacement orders, not the cost or waiting time. It has fixed $n = 8$, binary outcomes, stated independence and the same $p = 0.20$. I need $P(X \geq 1)$, not the average number. The complement is no replacements, so $P(X \geq 1) = 1 - (0.80)^8 \approx 0.8322$. I check that the result is a probability between 0 and 1. The product $np = 1.6$ is meaningful too, but it answers a different question: the expected count.” Ask learners to explain which words in the problem select the event and which justify the model.

REUSABLE REASONING GUIDE

Represent, justify, interpret

Name: _____ Date: _____

Givens, quantities and restrictions**Representation and calculation****Justification or check****Conclusion, domain and units**

WARM-UP

Teaching script

Core: 001 • T3: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

Optional bank: M01–M04; O01–O04. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O01, including its graph when present. Invite a first independent response before discussion. Ask, “What do the symbols represent? What evidence supports your claim?”

Core task

Use the supplied four-panel simulation reference. Classify each panel as a reasonable or poor normal approximation for its main shape, and justify each decision using sample size, counts or visible shape. Do not say that the original population taking only 0 and 10 becomes normal.

Teacher solution and discussion

P_common_n100 is reasonably close to normal: independent trials have expected counts 40 and 60, and the histogram is approximately symmetric and bell-shaped. P_rare_n25 is poor: expected successes are 0.5, proportions pile at zero and the distribution is right-skewed. Mean_n5 is poor: the average has only widely spaced possible values and substantial right skew. Mean_n200 is much closer to a normal shape because it averages many independent finite-variance values; its histogram is concentrated near 1 and roughly bell-shaped. The underlying mean-simulation population remains 0 with probability 0.90 and 10 with probability 0.10.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M01 to compare all alternatives after evidence is collected.

I DO

Teaching script

Core: 005 • T3: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

Optional bank: M05–M08; O05–O08. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–12 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O05, including its graph when present. Think aloud through the core task. Say, “I will identify the quantities first, then build a representation and check it against the stated domain.” Hide the worked key until after predictions.

Core task

Run or import P_common_n100. Calculate the empirical mean and sample SD of the 5000 sample proportions. Compare them with theoretical values and describe whether a normal approximation is supported. Include a graph with the sample statistic on its horizontal axis.

Teacher solution and discussion

The supplied empirical mean is 0.401938 and sample SD is about 0.048942. The theoretical center is 0.40 and SD is $\sqrt{(0.40 \cdot 0.60/100)} \approx 0.048990$. Expected counts 40 and 60 are adequate for the classroom check, and the histogram is approximately bell-shaped. A normal approximation is reasonable for many central probabilities in this independent model, but the proportions remain discrete and approximate tail probabilities are not guaranteed exact. Save the CSV calculation and a labeled histogram; different runs may have slightly different summaries.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M05 to compare all alternatives after evidence is collected.

WE DO

Teaching script

Core: 009 • T3: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

Optional bank: M09–M13; O09–O13. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O09, including its graph when present. Have learners propose the next step, then ask a partner to verify it using the original representation. Record more than one valid explanation.

Core task

Use P_{rare_n25} to compute the fraction of simulated samples with zero successes. Compare it with the exact model probability $(0.98)^{25}$. Explain why a normal curve with the same mean and SD is a poor substitute.

Teacher solution and discussion

The supplied zero fraction is 0.5978. The exact probability of no successes is $(0.98)^{25} \approx 0.60346$, close enough for a finite simulation comparison. The expected success count is only $25(0.02) = 0.5$. The sampling distribution is strongly right-skewed, has a large point mass at zero and takes values in increments of $1/25 = 0.04$. A continuous symmetric normal curve both smooths away that pile and assigns positive area to impossible negative proportions. Use the discrete model or simulation instead.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M09 to compare all alternatives after evidence is collected.

COLLABORATIVE PRACTICE

Teaching script

Core: O14 • T4: NC.M4.SP.3.4 Standardize, find normal probabilities and percentiles, and interpret modeled likelihoods in context.

Optional bank: M14–M18; O14–O18. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O14, including its graph when present. Assign reader, representer, checker and explainer roles. Each learner first makes a private prediction; compare reasoning and resolve differences with the data.

Core task

A normal model has mean 50 and SD 5. Calculate $P(X < 42.5)$ and $P(42.5 < X < 57.5)$. Explain how symmetry helps check both results.

Teacher solution and discussion

The cutoffs correspond to $z = -1.5$ and $z = 1.5$. $P(X < 42.5) = \Phi(-1.5) \approx 0.066807$. The central probability is $\Phi(1.5) - \Phi(-1.5) \approx 0.866386$. Symmetry gives an equal upper tail above 57.5, so $1 - 2(0.066807) \approx 0.866386$. The central interval is symmetric around the mean and covers substantially more than half the modeled outcomes.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M14 to compare all alternatives after evidence is collected.

INDEPENDENT PRACTICE

Teaching script

Core: O19 • T1: NC.M4.SP.3.1 Build and interpret discrete probability distributions, including expected outcomes and decisions that also consider variability.

Optional bank: M19–M23; O19–O23. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O19, including its graph when present. Provide the printed task and neutral access supports. Preserve the first independent response; do not point to the requested answer or select a method for the learner.

Core task

The net outcome X of a token activity is -3, 1 or 7 with probabilities 0.50, 0.30 and 0.20. Calculate $E(X)$, $P(X < 0)$ and $P(X > 0)$. Explain how a positive expectation can coexist with a high chance of losing tokens on one play.

Teacher solution and discussion

$E(X) = -3(0.50) + 1(0.30) + 7(0.20) = -1.50 + 0.30 + 1.40 = 0.20$ token. $P(X < 0) = 0.50$ and $P(X > 0) = 0.30 + 0.20 = 0.50$. The occasional larger positive outcome raises the weighted average even though half the individual plays lose tokens. A positive expected value is not a guarantee or a recommendation to participate; the full outcome distribution and the decision context matter.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M19 to compare all alternatives after evidence is collected.

SMALL-GROUP RETEACH

Teaching script

Core: O24 • T2: NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

Optional bank: M24–M27; O24–O27. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O24, including its graph when present. Start with the learner’s prior evidence. Rebuild one representation with explicit terms and operations, then use a fresh item to check transfer without the prior cue.

Core task

Each independent trial succeeds with probability 0.20. Find the smallest integer n for which the chance of at least one success is at least 0.90. Use a logarithm or a technology search, and verify the neighboring integer.

Teacher solution and discussion

Require $1 - (0.80)^n \geq 0.90$, or $(0.80)^n \leq 0.10$. Since $\ln(0.80)$ is negative, division reverses the inequality: $n \geq \ln(0.10)/\ln(0.80) \approx 10.3189$. The smallest integer is 11. At $n = 10$ the probability is about 0.892626, below 0.90; at $n = 11$ it is about 0.914101, above 0.90. This calculation assumes the common p and independence remain valid as trials are added.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M24 to compare all alternatives after evidence is collected.

EXIT TICKET

Teaching script

Core: O28 • T2: NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

Optional bank: M28–M30; O28–O30. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O28, including its graph when present. Ask for a concise claim supported by the representation. Collect the response before sharing a solution; use it to choose the next instructional step.

Core task

For four independent binary trials with success probability 0.60, construct the full probability distribution of the success count X . Verify the probabilities sum to 1, find $P(X \geq 3)$ and calculate the expected count both from the table and from np .

Teacher solution and discussion

For $k = 0, 1, 2, 3$ and 4, the binomial probabilities $C(4, k)(0.60)^k(0.40)^{4-k}$ are 0.0256, 0.1536, 0.3456, 0.3456 and 0.1296. They sum to 1. $P(X \geq 3) = 0.3456 + 0.1296 = 0.4752$. The weighted mean is $0 + 0.1536 + 0.6912 + 1.0368 + 0.5184 = 2.4$, agreeing with $np = 4(0.60) = 2.4$. The equal probabilities at counts 2 and 3 do not make all five counts equally likely.

Evidence and response

Ask learners to name the random variable and its possible values before choosing a formula. For a probability, identify the event, draw or describe the relevant outcomes or region and check the answer lies in $[0, 1]$. For expected value, distinguish a long-run average from a guaranteed individual result. For a normal approximation, examine simulation shape, center, spread, discreteness and design rather than relying only on a memorized sample-size rule.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M28 to compare all alternatives after evidence is collected.

MULTIPLE-CHOICE BANK

M01 / M02 • Select and justify**M01 | Warm-up | T1**

A discrete variable has values 0, 1, 2 with probabilities 0.20, 0.50 and q . Which q makes a valid distribution?

- A. 0.70
- B. 1.00
- C. 0.30
- D. -0.30

Reasoning: _____

M02 | Warm-up | T2

Which situation is directly modeled by a binomial count with $n = 10$?

- A. Count successes in 10 independent trials, each with success probability 0.30.
- B. Count trials until the first success
- C. Measure the total waiting time for 10 customers
- D. Draw 10 items without replacement from a box of 12 containing 6 marked items

Reasoning: _____

WARM-UP

001 • Show your reasoning

T3: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

Use the supplied four-panel simulation reference. Classify each panel as a reasonable or poor normal approximation for its main shape, and justify each decision using sample size, counts or visible shape. Do not say that the original population taking only 0 and 10 becomes normal.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T4: NC.M4.SP.3.4 Standardize, find normal probabilities and percentiles, and interpret modeled likelihoods in context.

Processing time X is modeled as normal with mean 30 minutes and SD 4 minutes. Find $P(26 < X < 38)$. Draw a labeled normal curve, shade the event and connect the original cutoffs to z-scores.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02

M01 • T1: NC.M4.SP.3.1 Build and interpret discrete probability distributions, including expected outcomes and decisions that also consider variability.

Answer: C. 0.30

The probabilities must sum to 1, so $q = 1 - 0.20 - 0.50 = 0.30$.

Check each alternative

- A. That is the sum of the two known probabilities, not the remaining probability.
- B. The total would become 1.70.
- C. Correct. The probabilities must sum to 1, so $q = 1 - 0.20 - 0.50 = 0.30$.
- D. Probabilities cannot be negative.

M02 • T2: NC.M4.SP.3.2 Check binomial assumptions and calculate exact or cumulative binomial probabilities to answer contextual questions.

Answer: A. Count successes in 10 independent trials, each with success probability 0.30.

A binomial count requires a fixed number of independent binary trials with the same p .

Check each alternative

- A. Correct. A binomial count requires a fixed number of independent binary trials with the same p .
- B. The number of trials is not fixed at 10.
- C. The response is a quantitative time, not a count of binary successes.
- D. The success probability changes substantially and trials are dependent.

WORKED TEACHER KEYS

001

001 • T3: NC.M4.SP.3.3 Use simulations of sample means and proportions to recognize when a normal approximation is reasonable and when it is not.

P_common_n100 is reasonably close to normal: independent trials have expected counts 40 and 60, and the histogram is approximately symmetric and bell-shaped. P_rare_n25 is poor: expected successes are 0.5, proportions pile at zero and the distribution is right-skewed. Mean_n5 is poor: the average has only widely spaced possible values and substantial right skew. Mean_n200 is much closer to a normal shape because it averages many independent finite-variance values; its histogram is concentrated near 1 and roughly bell-shaped. The underlying mean-simulation population remains 0 with probability 0.90 and 10 with probability 0.10.

Evidence to assess

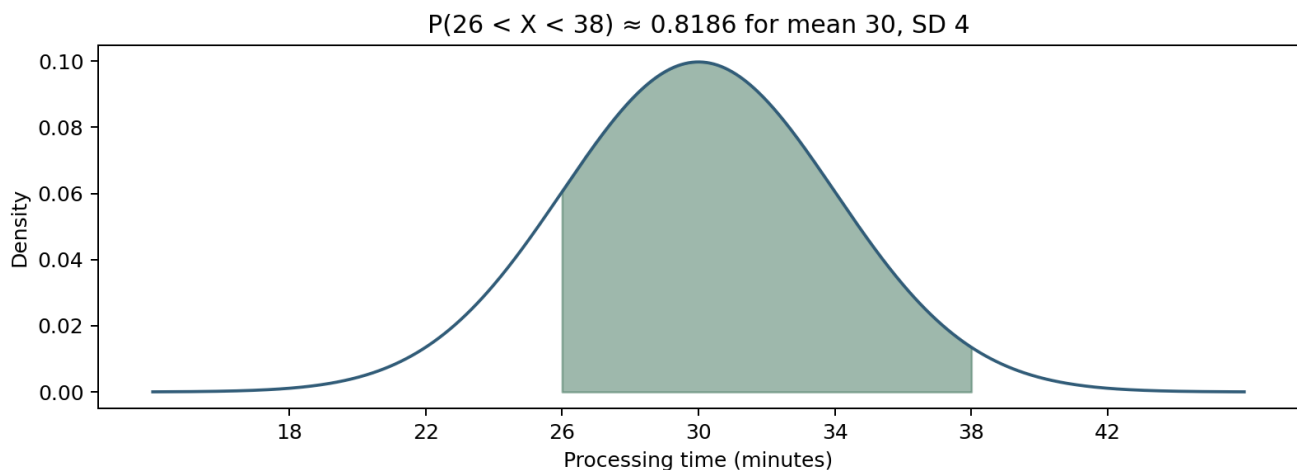
Full evidence: Four separate classifications supported by the actual displays or model counts, plus a correct distinction between population and sampling distributions. Partial credit: preserve and score a valid intermediate representation or justified step separately from the final accuracy.

WORKED TEACHER KEYS

002

002 • T4: NC.M4.SP.3.4 Standardize, find normal probabilities and percentiles, and interpret modeled likelihoods in context.

The cutoffs standardize to -1 and 2. Therefore $P(26 < X < 38) = \Phi(2) - \Phi(-1) \approx 0.97725 - 0.15866 = 0.81859$, or about 81.86%. Draw the curve centered at 30, mark 26 and 38 and shade only the region between them. The interval extends one SD below and two SD above the mean, so the shaded region is not symmetric around 30. Boundary inclusion does not change this continuous-model probability.

**Evidence to assess**

Full evidence: Correct standardization, difference of CDF areas, probability and units, plus a correctly labeled and shaded region. Partial credit: preserve and score a valid intermediate representation or justified step separately from the final accuracy.