

STATISTICAL CORRELATIONS

EXTRAPOLATIONS & INTERPOLATIONS



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Common Core Standards

Multiplicative Reasoning & Operations (Grades 4–6)

Standards Involved:

- **CCSS.Math.Content.4.OA.A.3 – Solve multistep word problems using the four operations.**
- **CCSS.Math.Content.5.OA – Apply multiplication and division to solve problems in real-world contexts.**

Explanation:

The story problems (e.g., Samantha’s Lemonade Stand and Jason’s Apple Quest) require students to use multiplication and division to find totals (such as money earned or cost incurred) based on a constant rate. These problems help reinforce fluency with arithmetic operations in a contextual setting.

Ratios & Proportional Relationships (Grade 6)

Standards Involved:

- **CCSS.Math.Content.6.RP.A.1 – Understand the concept of a ratio and use ratio reasoning to solve problems.**
- **CCSS.Math.Content.6.RP.A.3 – Use ratio and rate reasoning to solve real-world and mathematical problems.**

Explanation:

Many of the problems (for instance, Emma’s Step Tracker Adventure and Concert Ticket Rush!) highlight how one quantity increases at a constant rate relative to another—an idea at the heart of ratios and proportional reasoning. Although the language of “correlation” is used to make the ideas engaging, the underlying mathematical skill is recognizing and working with constant rates.

Foundations for Understanding Linear Relationships (Precursor to Algebra)

Standards Involved:

- **CCSS.Math.Content.6.EE – Begin to use variables and expressions to represent relationships.**

Explanation:

By exploring “perfect positive correlation,” students practice thinking about situations where a change in one quantity causes a consistent change in another (as seen in problems like the water dispenser and reading challenge). This builds a conceptual foundation for later work on linear equations and functions.

Mathematical Problem Solving & Reasoning (Mathematical Practices)

Standards Involved:

- **MP1: Make sense of problems and persevere in solving them.**
- **MP4: Model with mathematics.**
- **MP7: Look for and make use of structure.**

Explanation:

Each story problem presents a real-life scenario that students must translate into a mathematical model. They are encouraged to identify the constant rate (the “structure” of the problem), set up the necessary calculations, and reason through the results. This approach develops critical thinking and problem-solving skills that are central to the Common Core’s emphasis on mathematical practices.

Real-World Application & Communication

Standards Involved:

- **Mathematical Practice standards such as MP3 (Construct viable arguments and critique the reasoning of others) and MP8 (Look for and express regularity in repeated reasoning).**

Explanation:

The engaging narrative format of these problems not only connects math to everyday situations but also invites students to explain how they arrived at their answers. This supports effective communication of mathematical ideas and builds a bridge between abstract computation and real-world application.

Suggested Additional Cross Disciplinary Standards

English Language Arts (ELA)

Reading Comprehension & Analysis:

The narrative format of the story problems requires students to read carefully, understand context, and extract important information, thereby strengthening comprehension skills.

Writing & Communication:

When students explain their reasoning or create their own story problems, they practice organizing ideas, using precise language, and constructing coherent narratives.

Science and Inquiry

Data Analysis & Interpretation:

Exploring correlations, extrapolation, and interpolation introduces students to methods used in scientific inquiry. They learn to recognize patterns, analyze trends, and consider variables—skills critical to scientific experiments and investigations.

Measurement & Experimentation:

Problems that involve rates, growth, or changes (such as plant growth or temperature shifts) provide opportunities to discuss measurement units, the importance of consistent data collection, and factors that might affect results in a real experiment.

Social Studies and Economic Literacy

Real-World Application:

Scenarios like Samantha's Lemonade Stand and Jason's Apple Quest touch on basic economic concepts such as pricing, revenue, and resource management. This can bridge into discussions about business, supply and demand, and basic financial literacy.

Critical Thinking About Daily Life:

Students consider how mathematical relationships mirror real-life decisions and societal trends, fostering a broader understanding of how quantitative reasoning applies to everyday situations.

Technology Integration

Digital Tools & Data Visualization:

The concepts explored in the problems (like linear relationships and rates of change) can be extended with technology. Students might use graphing calculators, spreadsheet software, or educational apps to visualize data, create charts, and simulate real-life scenarios.

Coding and Algorithmic Thinking:

For older or more advanced students, translating word problems into code (for example, using simple programming platforms) supports logical thinking and introduces the basics of algorithmic problem solving.

Art and Visual Literacy

Visual Representations:

Converting numerical data and story problem contexts into visual formats—such as graphs, infographics, or storyboards—encourages creativity and helps students connect abstract numbers to concrete images.

Creative Storytelling:

Designing illustrations or comics based on the narrative problems fosters an integration of artistic skills with mathematical reasoning, emphasizing the role of creativity in problem-solving.

Health and Physical Education

Understanding Rates in Health Contexts:

Problems involving exercise, sleep, or energy (as seen in some high and low correlation scenarios) allow teachers to incorporate lessons on personal health, the importance of balanced activity, and how our bodies respond to various stimuli.

Data-Driven Health Decisions:

Discussing trends and patterns (such as improved health with increased exercise, up to a point) can lead to broader conversations about healthy habits and the analysis of personal health data.

Background Knowledge

Perfect Positive Correlation

Two variables have a perfect positive correlation when every increase in one variable is matched by a proportional increase in the other. In statistical terms, the correlation coefficient is exactly +1, meaning the relationship is perfectly linear and predictable.

Perfect Negative Correlation

Two variables exhibit a perfect negative correlation when every increase in one variable is accompanied by a proportional decrease in the other. Here, the correlation coefficient is exactly -1 , indicating a perfectly inverse linear relationship.

High Positive Correlation

A high positive correlation occurs when two variables generally increase together in a strong, nearly linear pattern, though not perfectly. The correlation coefficient is close to +1 (for example, between 0.7 and 0.9), showing a robust positive association.

Low Negative Correlation

A low negative correlation describes a weak inverse relationship between two variables. While there is a slight tendency for one variable to decrease as the other increases, the correlation coefficient is only slightly below 0 (for instance, between -0.1 and -0.3), indicating a minimal relationship.

High Negative Correlation

A high negative correlation exists when two variables move in strongly opposite directions in a nearly linear fashion. The correlation coefficient is close to -1 (typically between -0.7 and -0.9), demonstrating a strong inverse relationship.

Low Positive Correlation

A low positive correlation is present when two variables have a weak tendency to increase together. The relationship is not strong or consistent, with a correlation coefficient just above 0 (commonly between 0.1 and 0.3), indicating only a slight association.

Extrapolation

Extrapolation is the process of estimating or predicting values outside the range of the known data by extending an established trend. This method assumes that the pattern observed within the data will continue beyond the measured range, though it can be less reliable the further the prediction is from the known data.

Interpolation

Interpolation involves estimating values within the range of known data points. By assuming that the trend or pattern between these points continues smoothly, interpolation provides a method to fill in missing data in a relatively accurate manner compared to extrapolation.

Answer Key

Perfect Positive Correlation

PPC-1:

\$20 for 10 cups ($\2×10) and \$30 for 15 cups ($\2×15).

PPC-2

30 pages in 15 minutes (2×15) and 60 pages in 30 minutes (2×30).

PPC-3

1,000 feet for 500 steps (200×5) and 2,000 feet for 1,000 steps (200×10).

PPC-4

\$15 for 5 pounds ($\3×5) and \$24 for 8 pounds ($\3×8).

PPC-5

12 minutes for 60 pages ($60 \div 5$) and 60 pages in 12 minutes (5×12).

PPC-6

8 seconds for 4,000 mL ($4,000 \div 500$) and 5 seconds for 2,500 mL ($2,500 \div 500$).

PPC-7

300 tickets in 6 hours (50×6) and 400 tickets in 8 hours (50×8).

PPC-8

60 extra cones for a 15°F increase (20×3), and 140 total cones at 100°F ($100 + 40$).

Perfect Negative Correlation

PNC-1

At 90°F , it melts in **18 minutes** ($20 - 10\%$). At 100°F , it melts in **16 minutes** (another 10% decrease).

PNC-2

At 10 kids, it fills at **16 gallons per minute** ($20 - 4$). At 20 kids, it fills at **12 gallons per minute** ($20 - 8$).

PNC-3

At 80% brightness, it lasts **4.5 hours** ($6 - 1.5$). At 100% brightness, it lasts **3.5 hours** ($6 - 2.5$).

PNC - 4

At 10 feet lower, it takes **16 seconds** ($12 + 4$). At 20 feet lower, it takes **20 seconds** ($12 + 8$).

PNC-5

After 15 minutes, it will be **130°F** ($160 - 30$). After 30 minutes, it will be **100°F** ($160 - 60$).

PNC-6

At 7 mph, he can run for **40 minutes** ($50 - 10$). At 9 mph, he can run for **30 minutes** ($50 - 20$).

PNC-7

After 10 hours, it will be **70% bright** ($100 - 30$). After 20 hours, it will be **40% bright** ($100 - 60$).

PNC-8

At 42°F , it will be **26 inches** wide ($30 - 4$). At 52°F , it will be **22 inches** wide ($30 - 8$).

High Positive Correlation

HPC-1

His score might be around **90-92%** after 7 hours, but he may not necessarily reach **100%** after 10 hours since studying more has **diminishing returns**.

HPC-2

She might make around **8 mistakes** per minute at 80 WPM, but slowing to 30 WPM won't necessarily mean **zero mistakes**—other factors like tiredness or distractions play a role.

HPC-3

The **6'0" student** might have a shoe size of **11**, but it's not exact—some people have naturally larger or smaller feet. Yes, a **5'2" student** could have a **size 10** due to genetics!

HPC-4

At **25 guests**, it might be around **90 decibels**, but other factors, like playing loud music, could change it. With **1 person**, noise won't be **zero** because people still talk and move around

HPC-5

After **12 weeks**, he might lift around **90 lbs**, but at some point, progress will slow down because bodies have limits.

HPC-6

She might reach **70-75% accuracy**, but **no one is perfect**—even professional players miss!

HPC-7

At **10 hours**, he might have **95% energy**, but at **14 hours**, his energy could **drop** because too much sleep can make you tired!

HPC-8

Three layers might last **90 minutes**, but **10 layers won't protect forever**—sun and water still break it down over time.

High Negative Correlation

HNC-1

She might have around **5 problems left** after 45 minutes, but if she gets distracted, she might have **more** left than expected.

HNC-2

He might have **6 gallons left**, but if he drives too fast or gets stuck in traffic, he could have **even less**.

HNC-3

He will have **50% battery left** after 2 hours, but lowering the brightness might help him **save some battery** and play longer!

HNC-4

She might have **about 3 scoops left** after 15 minutes, but if it melts too fast, she might need to **eat quicker!**

HNC-5

She will have **180 pages left**, but if she speeds up, she might finish **even sooner** than expected.

HNC-6

He will have **1 gallon left**, but if he spills water, he will run out **even faster** than expected

HNC-7

He might have **50% energy left** after 250 jumps, but breaks could help him **keep going longer!**

HNC-8

They will have **4 pancakes left** after 20 minutes, but if a friend joins, they **might run out even faster!**

Low Negative Correlation

LNC-1

His grade might be around **88-89%**, but since the correlation is low, TV time **doesn't always** mean bad grades. Watching educational shows might even help!

LNC-2

Her energy might drop to **85%**, but since the effect isn't strong, she could still feel energetic depending on sleep, water intake, and other foods she eats

LNC-3

She might feel **70% nervous**, but because the correlation is low, she might **still get butterflies** no matter how much she practices!

LNC-4

He might yawn around **16 times**, but yawning isn't only caused by lack of sleep—it can also happen due to boredom or lack of fresh air!

LNC-5

Maybe **40 people** visit, but some people love the rain or don't mind getting wet!

LNC-6

He might make **6 mistakes**, but because the correlation is low, practice **doesn't make him perfect—just better!**

LNC-7

She might feel **79% tired**, but other factors like **hydration, sleep, and weather** can still affect her energy.

LNC-8

He might last **3 hours**, but because the correlation is low, sun exposure and water can still cause sunburn even with sunscreen.

Low Positive Correlation

LPC-1

Her score might be around **87%**, but overstudying can make her **tired or stressed, which might lower her performance!**

LPC-2

He might sleep **7.5 hours**, but if he exercises too late, **his body could stay too active, making sleep harder!**

LPC-3

She might focus for **38 minutes**, but **sleep, noise, and nutrition** also play a role in concentration.

LPC-4

She might reach **163 WPM**, but if she reads **harder books**, she could slow down instead of speeding up!

LPC-5

His accuracy might be **55%**, but if he gets **too tired or frustrated**, he could actually **miss more shots!**

LPC-6

He might reach **75% energy**, but **sleep, hydration, and exercise** are also important!

LPC-7

She might be able to play **5 or 6 songs well**, but **if she doesn't practice between lessons, she might not improve as much!**

LPC-8

She might improve to **7.5/10**, but **some skills take longer to develop, and creativity doesn't always improve at a steady rate!**

Extrapolation

EXT-1

Her next test might be around **90%**, but **no one can score over 100%**! Extrapolating too far can lead to **unrealistic predictions**.

EXT-2

It might reach **30 inches**, but **puppies don't grow at the same rate forever**—extrapolating too far might overestimate its adult size.

EXT-3

He might have **\$100**, but **unexpected spending** or a change in savings habits could make the prediction inaccurate.

EXT-4

She might gain **400 followers**, but as accounts grow, **gaining followers usually slows down**—so extrapolating too far may be unrealistic.

EXT-5

It might be **30 cm taller**, but **weather, soil quality, or plant health** could affect its growth, making extrapolation uncertain.

EXT-6

They might sell **800 ice creams**, but **weather changes or new competition** could affect sales, making long-term extrapolation risky.

EXT-7

He might reach **7:00 minutes**, but **athletes have limits**—extrapolating too far could suggest an impossible time!

EXT-8

They might get **25 inches**, but **weather is unpredictable**, and patterns don't always continue the same way!

Interpolation

INT-1

Her second test score might be around **82%** because it's between her first and third scores. **Interpolation is more accurate than extrapolation because we are working within existing data.**

INT-2

It might have been **16 inches tall**, assuming a steady growth rate. **Interpolation works well because we're estimating between two known points.**

INT-3

He likely had **\$30**, but if he skipped a week, interpolation wouldn't be as accurate because the pattern would be broken.

INT-4

It was likely **70°F**, but sudden weather changes like clouds or wind could make the actual temperature different.

INT-5

They likely sold around **150 cones**, but on weekends, sales might be much higher due to more customers.

INT-6

He likely finished in **9:00 minutes** since his time is improving at a steady rate. **Interpolation works because we are filling in a missing value within known data.**

INT-7

They likely had around **14 inches** in Year 2, but storms or warmer winters could affect actual snowfall.

INT-8

She likely read **7 books**, but December might have holiday breaks that change her reading habits.



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