



# ChanceForge

## *Meet the Cast*

STANDARD EDITION

# Spark & Anvil

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This book collects 6 chapter books from the ChanceForge cast — each character embodies a different curricular primitive; together they teach the full subject.

Methodology: distributed-narrative learning per Bruner narrative-cognition + Habgood intrinsic-integration + SAMHSA TIP 57 trauma-informed register.

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*For everyone who learns by hearing a story first.*

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# Introduction

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The ChanceForge cast was authored to embody the curriculum, not decorate around it. Each of the 6 characters you'll meet in this book teaches a specific primitive — a particular tactic, a particular technique, a particular way of seeing. Together they form an ensemble: the cast IS the curriculum.

Read in any order. Each chapter stands alone.

Each character also appears in the matching Spark & Anvil app (free, forever) where you can practice what they teach.

— *The editors at Spark & Anvil*

# Center

\*CENTER — \*mean, median, mode. three answers to "what's typical?"\*\*



A new creature hovered in the workshop doorway. It looked like a bumblebee, if a bumblebee was the size of a toaster and wore a neat little vest. It had six fuzzy legs, but it used two of them like hands. In them, it held a small device that clicked and whirred.

This was Center.

Center was always looking for the middle of things. The exact balance point. The place where everything felt just right. They had soft amber stripes over warm, creamy fuzz. Their big, dark eyes took in everything, missing no detail.

"I am Center," they buzzed, their voice a low, gentle hum. "The skill I teach is **central tendency**."

That sounded complicated.

"It just means finding the middle," Center said, as if reading my mind. "But there's a trick. There are three different kinds of middle."

My friends and I were sitting around a pile of Glimmer-Gems from last night's game. We had been arguing for ten minutes.



"I'm telling you, the typical player gets, like, thirty gems," Leo said. He puffed out his chest.

"No way!" Maya shot back. "I only got eight! You're just saying that because you got that one lucky treasure chest."

Leo had found a mega-chest. It gave him 150 gems. The rest of us had much smaller piles. My pile had seven. Maya's had eight. Sam's had ten.

Center hovered over our table. "A perfect problem," they buzzed happily. "You are asking 'what's typical?' You are looking for the middle."

Center pointed a fuzzy leg at Leo. "You are using the **mean**. That's one way to find a middle."

"The mean?" I asked.

"It's what most people call the average," Center explained. "You add up all the numbers. Then you divide by how many numbers you have."

We grabbed a pencil.

My 7 gems.

Maya's 8 gems.

Sam's 10 gems.

And Leo's 150 gems.

We added them up. It came to 175.

There were four of us. So we divided 175 by 4.

The answer was 43.75.



"See!" Leo shouted. "The average is almost 44 gems! I told you!"

But Maya crossed her arms. "That's not right. Three of us got around ten. Your giant number is messing everything up."

"Exactly," Center hummed. "Your one big number is an *outlier*. It's a piece of data that's way different from the others. The mean is sensitive. An outlier can pull it way up, or way down. It gives you a middle that doesn't feel very middling at all."

This made sense. The "average" of 44 didn't describe any of us.

"So what do we do?" Sam asked.

"We try a different middle," Center said. "Let's find the **median**."

Center had us write our scores on four separate cards. 7, 8, 10, 150.

"Now, line them up. Smallest to largest."

We arranged the cards on the floor.

7 ... 8 ... 10 ... 150.

"The median is the number that's physically in the middle of the line," Center said. "When you have an even number of cards, like you do, you look at the two in the middle."



We looked. The two middle cards were 8 and 10.

"Find the number that's halfway between them," Center instructed.

Halfway between 8 and 10 was 9.

"Your median is 9," Center buzzed.

Maya, Sam, and I all nodded. Nine felt *much* more typical. It was close to what we had all gotten. Leo's crazy-high score didn't wreck it.

"The median doesn't care about outliers," Center said. "It just cares about what's in the middle of the line. It's a good, honest middle when your data is skewed, or lopsided."

"Okay, so that's two middles," I said. "You said there were three."

"The last one is the **mode**," Center said, their antennae twitching. "The mode is the number that shows up most often."

Sam pointed at our cards. "But none of our numbers show up more than once."

"A fine observation!" Center buzzed. "For this set of data, there is no mode. But what if these were the scores?"



Center quickly wrote five new cards and laid them on the floor.  
12, 14, 9, 14, 11.

"What's the mode here?"

"Fourteen!" we all shouted. It appeared twice.

"Correct," Center said. "The mode is great when you want to know the most popular choice. Like the most common size of T-shirt sold in a store, or the most popular flavor of ice cream. You wouldn't want the 'average' flavor, would you?"

We all giggled. A mix of chocolate, vanilla, and strawberry probably tasted like mud.

Center hovered back up to the doorway. "So you see? You have three ways to answer the question, 'what's typical?'" They held up three fuzzy fingers.

"The **mean** is the average. Add and divide. But watch out for outliers."

"The **median** is the one in the middle of the line. It's tough and ignores outliers."

"And the **mode** is the most popular one."

Center gave a final, satisfied buzz. "The move is to know that **mean, median, and mode answer different questions. You must choose the right one for the shape of your data.**"

With that, they zipped out of the workshop, leaving us staring at our Glimmer-Gems. We finally knew what to do. We decided our typical score was 9. And Leo had to admit, that felt a lot more fair.

**Listen along + meet more of the cast at:**



<https://spark-and-anvil.com/cast/chanceforge/center>

# Display

\*DISPLAY — \*turn numbers into pictures. the right picture reveals the pattern.\*\*



A small monarch butterfly landed on the corner of my notebook. She was so light I barely felt her. Her wings were the color of warm cream and soft orange. She wore a small vest with many tiny pockets.

I was staring at a page full of numbers. It was a disaster.

"That's a lot of numbers," she said. Her voice was quiet, like rustling leaves.

I sighed. "It's my acorn collection data. I'm trying to see if I'm getting better at finding them. But it's just a jumble."

I pointed to the list.

*Monday: 5 acorns*

*Tuesday: 3 acorns*

*Wednesday: 8 acorns*

*Thursday: 6 acorns*

*Friday: 10 acorns*

"The numbers are all over the place," I said. "I can't tell what's happening."



The butterfly tilted her head. "Numbers can be shy. They don't always like to tell their story right away. But I can help." She took a tiny step forward. "I am Display. The skill I teach is **visualization**."

"Vizu-what?" I asked.

"**Visualization**," she repeated. "It's a big word for a simple idea. We turn numbers into pictures. The right picture shows you the pattern instantly."

From one of her vest pockets, she pulled out a tiny pencil and a blank card that looked like a grid. "Your numbers tell a story about something that changes over time. For that, you want a line graph."

"A line graph?"

"It's a special kind of picture," Display explained. "It uses a line to connect dots. It shows you if things are going up, down, or staying the same."

She drew two lines, one along the bottom and one up the side. Along the bottom, she wrote the days of the week. Up the side, she wrote numbers for the acorns.



Then she started making dots. "On Monday, you found five acorns." She put a dot above 'Monday' across from the number 5. "On Tuesday, three." She made another dot. She kept going, for Wednesday, Thursday, and Friday.

The dots were scattered on the page. They still looked like a jumble to me.

"Now for the magic," Display whispered. She carefully drew a line connecting the dots, from the first to the last.

Suddenly, I saw it. The line dipped a little at the start, but then it climbed. And climbed. And climbed.

"Whoa!" I said. "The line goes up! I *am* getting better!"

Display smiled, a tiny, happy smile. "See? The picture tells the story. The numbers were telling you that all along. They just needed the right graph to help them say it."

I stared at the line graph. It was so simple. So clear.

"What about this?" I asked, flipping to another page in my notebook. "My friends and I voted on our favorite bugs."



*Spiders: 4 votes*

*Ladybugs: 7 votes*

*Beetles: 2 votes*

"Would a line graph work for that?"

Display shook her head. "A line graph is for tracking one thing over time. Here, you're comparing different groups. For that, you need a different kind of picture."

She pulled out another card. "For this, you want a bar chart."

"What's that?"

"A bar chart uses blocks, or bars, to show how much of something you have," she said. "The taller the bar, the more you have. It's great for comparing things."

She drew the names of the bugs along the bottom of the card. Then, above 'Spiders,' she drew a bar that went up to the number 4. She drew a short bar for 'Beetles' that only went up to 2. And for 'Ladybugs,' she drew a tall bar that went all the way up to 7.

It was even clearer than the line graph. The ladybug bar was a skyscraper. The beetle bar was a tiny hut.



"Ladybugs won by a lot," I said.

"Exactly," said Display. She tapped the card with her pencil. "Turn numbers into pictures. The right picture reveals the pattern. But the wrong one..."

She quickly sketched my bug votes on a line graph. It was just a weird, zig-zagging line that didn't mean anything. It looked like nonsense.

"The wrong graph hides the story," she said. "Or even tells a lie."

She folded her little cards and tucked them back into her vest. "Remember that," she said. "Always choose the right picture."

With a flick of her cream-and-orange wings, she was gone.

I looked at my notebook. The jumble of numbers wasn't scary anymore. They were just stories, waiting for the right picture to be drawn.

**Listen along + meet more of the cast at:**



<https://spark-and-anvil.com/cast/chanceforge/display>

# Sample

\*SAMPLE — \*a small careful look that stands in for the whole.\*\*



Sample was an otter who took his job very seriously. He wore a special stats-vest, which bristled with pockets for all his tools. In one paw, he always carried a small metal bucket. In the other, he held a crisp estimate-card. Sample moved with quiet, thoughtful steps, as if the floor were covered in sleeping cats.

His fur was the color of a deep river, with stripes like soft grey pebbles. He was small, but he had a knack for guessing big things from just a handful of evidence. He watched everything with intense focus, especially how people chose things. He had a favorite saying. "A small, careful look can stand in for the whole," he'd murmur, polishing his bucket. "But only if it's a *careful* look."

The big idea Sample taught was **sampling**. It's a powerful trick for understanding huge things you could never measure completely. Think about it. You can't count every single fish in a lake. You can't ask every person in the country who they'll vote for. You definitely can't taste every cookie that rolls out of the factory. It would be impossible.

So instead, you take a **sample**. A small, carefully chosen handful that stands in for the whole thing. But "carefully chosen" is the most important part. If you only scoop fish from the sunny, shallow end of the lake, you'll get a wrong idea about the whole lake. You'll miss all the strange creatures lurking in the deep, dark parts. If you only ask your friends who they'll vote for, you'll just get friend-answers, not a real picture of the whole town. That mistake has a name: **sampling bias**. It's a sneaky trap that can ruin a perfectly good guess.

Sample had a whole toolkit of ideas for making good guesses. He showed us random **sampling**, which is a way to pick that gives everything an equal chance, like drawing names from a hat. He also warned us about convenience **sampling**—just grabbing whatever is easiest, which is usually a recipe for disaster. He explained that a bigger **sample** almost always makes for a better, more accurate guess. But he always came back to **sampling bias**. He called it the "silent killer" of good data.



If you asked him what his whole deal was, he'd polish his bucket and say, "I'm Sample. I teach **sampling**." He often reminded everyone of his most important rule: "How you pick," he'd say, his voice serious, "changes the answer you get."

Sample's biggest showdown happened, of all places, in the school cafeteria. The air smelled like mystery meat and floor cleaner. Principal Higgins, a woman who loved simple answers, had a very important question. "Do the students," she announced, "want pizza on Tuesdays?"

The week before, she had conducted her own survey. She stood right by the pizza line during lunch. "DO YOU WANT PIZZA?" she boomed at every kid who was already waiting for a slice.

Of course, every single one of them said yes.

"One hundred percent!" she had declared, beaming. "The data is clear! Everyone loves pizza!"



Sample, who was quietly observing from a corner, just shook his head. "That's not data," he muttered to his bucket. "That's an echo."

The next Tuesday, he set up his own station by the main cafeteria doors. He placed his bucket on a small stool and held his estimate-card like a tiny, serious scientist. Students poured into the noisy room. Sample didn't shout. He waited patiently. As the river of kids flowed past, he would politely stop every fifth person.

"Excuse me," he'd say. "Quick question. Would you want pizza on Tuesday?" He carefully marked each answer on his card. A check for yes, an X for no.

He did this through the entire lunch period. Finally, as the last student went through, he tallied his results. He held up his estimate-card for the principal to see. "According to my **sample**," he announced, "sixty percent of students want pizza."

Principal Higgins stared at the card. Her smile faltered. "Sixty? That's impossible! Last week I got one hundred percent!" she insisted. "I asked the kids in the pizza line myself!"



Sample nodded slowly, his expression calm. "Exactly. You asked the pizza-line kids," he explained. "So you got a pizza-line answer." He paused for effect. "I asked the door-kids. That gives us an answer that's closer to what the *whole school* thinks." He tapped his card. "Same school, different **sample**, very different number."

The principal looked baffled. She stared at her own mental number—100%—and then at Sample's—60%. How could they both be true?

Sample tilted his bucket, and a few small pebbles he used for counting rattled inside. "How you pick changes the answer," he said softly. "The pizza number isn't the real question." He looked her right in the eye. "The real question is *who* you asked."

For the first time, Principal Higgins looked past the pizza line. She saw the kids at the salad bar. The ones unpacking lunches from home. The kids grabbing tacos. Her eyes widened. She finally understood.

Everyone learned to trust Sample's numbers, because he was always honest about what they were: a guess. "This is a careful guess," he would say every single time he presented his findings. "It is not a known fact." He always added the most important part. "The bigger my **sample**, the closer my guess gets to the truth. But it's still a guess."



This was his job on the team. Tally could track the counts and Display could draw the cool charts. Center could find the middle of everything. But Sample was the one who kept them all honest. He was a constant, quiet reminder that their amazing charts and numbers all came from one small bucket. Just a handful. Not the whole pile. He made sure they never forgot where their data came from.

He had one rule he repeated more than any other. Whenever someone got too excited and declared they knew the absolute truth, Sample would clear his throat.

"A small, careful look," he'd say. "The *care* is the whole job."

### **A quick note on guessing vs. gambling**

Sample's big idea helps us see a common trap. Sometimes people think, "If I just keep trying, I'm bound to win eventually." That's the logic behind a slot machine. But Sample's way of thinking is the exact opposite. You take a **sample** because you know you *can't* test everything. You can't taste every cookie or ask every voter. **Sampling** is a humble, careful craft to get a good guess without having to try a million times. It's about being smart so you *don't* have to play forever. A casino's motto is "play more to win more." Sample's motto is "look carefully so you don't have to."

### **Where you'll see this idea again**

Sample's careful way of picking shows up in other places. In BioForge, scientists use his ideas to set up experiments with random groups. In TruthQuest, you'll use his skills to figure out if a news poll is trustworthy by asking, "Who did they ask, and how did they pick them?" And in CivicForge, you'll see that understanding a whole country often starts with a small, careful **sample** of voters.

**Listen along + meet more of the cast at:**



<https://spark-and-anvil.com/cast/chanceforge/sample>

# Tally and Display

*COUNT-AND-VISUALIZE* — statistical investigation has two complementary moves. Tally counts what happened. Display turns the count into a picture that reveals the pattern. Either move alone is incomplete.



Pip the squirrel had a problem.

He had been gathering acorns all autumn. He had a small wooden journal where he wrote down how many acorns he found each day, and where he found them. He had done this for *forty-two days*. The journal was, by now, almost full.

He sat under his favorite oak tree, leafing through it. He frowned. He turned the pages slowly. He stopped, scratched his head, and turned them again.

He could not see the pattern.

He had hoped that, by the end of autumn, he would *know* which part of the forest had the most acorns. He had thought it would be obvious. The journal would tell him, *the south slope has more acorns than the north slope*, and he would gather there next autumn, and his pantry would be full all winter.

Instead, the journal said this:

*Day 1: north slope, 5 acorns.*

*Day 2: south slope, 8.*

*Day 3: north slope, 3.*

*Day 4: south slope, 6.*

*Day 5: north slope, 11.*

...and so on, for forty-two days, alternating slopes, with numbers all over the place.

He could not see whether the south slope was better. The numbers were *all jumbled*. Some days the north was high. Some days the south was high. He had no idea what to do.

He was, when Tally landed on the journal, just about to give up.

"What happened, and how often?" Tally chirped.





"South *has more*. It wins on raw count. But hold on, Pip. Hold on."

Tally pointed at the journal again. "I noticed something while I was counting. You went to the north slope on *odd* days. Day 1, 3, 5, 7. You went to the south slope on *even* days. Day 2, 4, 6, 8. That means you went to *each slope the same number of times*. Twenty-one days at each."

"Yes," Pip said. "I wanted to be fair."

"That's exactly why I can compare the totals," Tally said. "If you'd gone to south fifteen times and north five times, the south's higher total wouldn't mean anything — you'd have just gone there more. *But you went the same number of times*. So the totals *do* mean something. South really is better."

Pip nodded slowly.

"But not by *much*," Tally added. "Seventy-five versus sixty-five. Ten acorns over forty-two days. That's *less than a quarter of an acorn difference per day*. Is that worth changing where you gather?"

Pip frowned. He did not know.

"That's where you call Display," Tally said. "I count. He shows. He'll know what to do."

She tilted her head up to the sky. A small monarch butterfly was already drifting down from a higher branch. She had been waiting for the call.

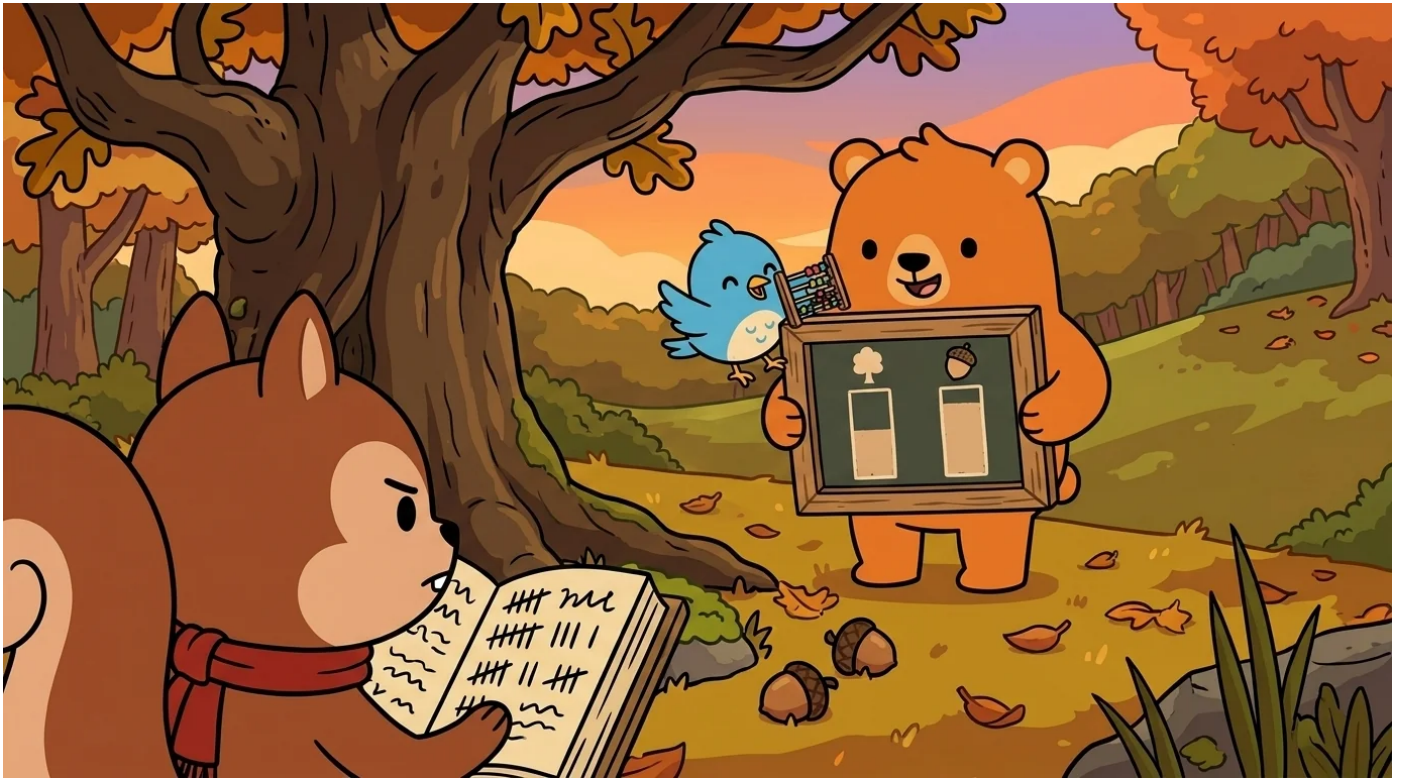
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Display landed on the journal next to Tally. He folded his wings carefully. He took a long look at Tally's two columns.

"Sixty-five," he said. "Seventy-five. Forty-two days."

"Yes."

"And the totals are *the bundle*. But Pip is asking whether the difference *matters*. That's a *visualization* question."



He pulled out a small piece of bark and a charcoal stub. He drew, very carefully, two columns side by side.

The North column went up to 65.

The South column went up to 75.

The South column was *taller*. But it was *not much taller*. The two columns looked almost the same height.

He held it up so Pip could see.

"Look," he said. "When you only saw the totals as numbers, *seventy-five versus sixty-five* sounded like a big difference. When you see them as *bars*, the difference is small. The bars are almost the same height."

Pip squinted. "They're almost the same."

"They're almost the same."

"So south is barely better."

"South is barely better."

Display flipped the bark over. He drew a different graph on the back. This one was a *line chart* — day on the bottom, acorns on the side. He plotted a few sample days: north on Day 1 was 5, south on Day 2 was 8, north on Day 3 was 3, south on Day 4 was 6.

"Look at this one," he said. "Same data. Different picture. Now you can see whether *some days* were much better than others on each slope."

Pip stared at it. He could see it now. The line for the south slope had a *spike* on day 14 — twelve acorns in one day. The line for the north slope had a spike on day 27 — fifteen acorns in one day.

"There was one *really* good day on the north slope," Pip said. "Better than any day on the south."

"Yes," Display said. "And there was one *really* good day on the south slope, almost as good. The averages are similar. The shapes are different. Each slope has a *good day* hiding somewhere. The averages cover that up."



Tally landed next to him. "So south is *steadier*. North has more *variance*. The slope that's better depends on what you want — steady supply, or the chance of a big haul."

"That's the whole picture," Display said.

Pip looked at the two graphs. He looked back at his journal.

He looked at Tally and Display.

"I don't think I have to pick *one slope*," he said slowly. "I can keep going to both. On steady days I'll go south. On lucky days I'll go north. As long as I keep counting, I'll know which one is doing better *this year*."

Tally and Display looked at each other.

"That's *exactly* the move," Tally said.

"That's the move a real data scientist makes," Display said.

---

That afternoon, Pip went back to the south slope. He gathered seven acorns. He wrote them in his journal. He wrote down the date. He wrote down the slope. *Steady south, 7 acorns*.

Tally fluttered down to perch on his journal. She read the new entry. She made a single tick on her own tally-sheet.

Display landed beside her. He had nothing to draw yet. One day's data is not a picture. *Forty-two days of data* is a picture. *A hundred days* is a better picture. He was patient.

The three of them sat there for a while in the late autumn light.

Pip turned the page in his journal. *Day 43*. He wrote *south: 7*.

The forest was quiet. The acorns were many. The data was still coming in.

**Listen along + meet more of the cast at:**



<https://spark-and-anvil.com/cast/chanceforge/tally-and-display>

# Tally

\*TALLY — \*what happened, how often?\*



Tally the magpie was obsessed with counting. She wore a special vest with a dozen tiny pockets. Each pocket held a perfectly sharpened colored pencil. Her tail, a creamy white, shimmered with faint rainbow colors when she moved. Clipped to her vest was her most important tool: a crisp, clean tally-sheet. She noticed everything. And she counted it all.

"What happened, and how often?" Tally chirped to herself. It was her favorite question in the whole world.

Today, Tally was watching Pip the squirrel. He was completely focused on the Berry Drop game. Pip selected a shiny red berry and held it carefully over the ramp. He let it go. The berry rolled down the twisty wooden track. It spun past little wooden pegs. *Plink!* It landed right in the "Acorn" basket.

"Yes!" Pip cheered, pumping a tiny fist. "The Acorn basket is totally the best! I just knew it!"

Tally tilted her head, her bright eyes blinking. "Are you *sure* it's the best?" she asked. "Or did it just happen to win that one time?"

Pip shrugged his furry shoulders. "I don't know. It just feels lucky," he said. He grabbed another berry, a big blue one. He dropped it. The berry bounced off a peg and veered sideways. *Plonk!* It landed in the "Leaf" basket.

"Oh," Pip mumbled. His ears drooped. "Maybe not so lucky after all."

Tally pulled out her tally-sheet and a tiny, sharp pencil. "We need to count," she said. Her voice was quiet but firm. "We need to find out what really happened. And exactly how many times it happened."



"But why?" Pip asked, clutching a yellow berry. He was ready to drop it.

"Because guessing is just... guessing," Tally explained. She tapped her pencil on the sheet. "If you want to understand what's really going on, you have to count first. Counting shows you the pattern."

"Sounds like a lot of work," Pip grumbled. Guessing was way faster.

"It's the best kind of work!" Tally chirped. She quickly drew a little chart on her sheet. She wrote the names of the four baskets: "Acorn," "Leaf," "Flower," and "Stone." Then she drew neat lines to make columns for each one.

"Okay, drop ten berries," Tally instructed. "Any color you want. Just drop them one at a time."

Pip sighed dramatically, but he started dropping berries. *Red, blue, yellow, green, purple.* Each one clattered down the ramp. Each one spun past the pegs. Each one landed with a soft *plink* or *plonk*.

Tally watched with fierce concentration. Her eyes never left the ramp. For every single drop, she made a mark.

- First berry: Acorn. Tally drew a straight line: | next to "Acorn."
- Second berry: Leaf. She drew | next to "Leaf."
- Third berry: Acorn. Another | went next to "Acorn."
- Fourth berry: Flower. A mark for "Flower": |
- Fifth berry: Acorn. A third mark for "Acorn."

"This is called a tally mark," Tally said, showing Pip the sheet. "Each little line means one thing happened. One berry landed in that basket."

Pip leaned in, his nose twitching. "So, Acorn has three so far?"

"Exactly!" Tally beamed, and her iridescent tail gave a little flick. "Keep going. Nice and steady."



Pip dropped the last five berries. Tally's pencil flew across the page. When she got to the fifth mark for a basket, she drew a line through the first four. ||||. "This makes big numbers easier to count later," she explained.

Soon, all ten berries sat in their baskets.

"Alright," Tally said, tapping her sheet. "Let's see what the numbers tell us."

She pointed her pencil at each row.

- Acorn basket: |||| = 4 times.
- Leaf basket: ||| = 3 times.
- Flower basket: || = 2 times.
- Stone basket: | = 1 time.

"Whoa," Pip said, his eyes wide. He looked from the sheet to the baskets. "Acorn really did get the most."

"It did," Tally agreed. "It happened four times. That's the **absolute frequency**."

"The absolute what-now?" Pip asked, scratching behind his ear.

"It's just a fancy name for the total count," Tally said patiently. "Four times for Acorn. Three for Leaf. Those are the simple, raw counts."

"So, the Acorn basket *is* lucky!" Pip declared, puffing out his chest.

Tally gently shook her head. "It's not about luck," she said. "We just know it happened more often *in this test*. Luck is for guessing. We don't guess. We count. We understand."



She pointed to her sheet again. "We dropped ten berries in total, right? Acorn got four of them. So, its score is four out of ten."

"Okay..." Pip said slowly.

"That's also called forty percent," Tally continued. "That's its **relative frequency**. It tells you how often something happened compared to all the other things that happened."

Pip's eyes lit up. "So, it means Acorn got almost half of all the drops?"

"Yes!" Tally nodded. "It seems more likely to land in Acorn. But it's not guaranteed. It's not magic. It's just a pattern the numbers are showing us."

Pip stared at the ramp, a new look on his face. "So... if I wanted the Flower basket to win more," he said, thinking hard. "I could change the ramp. Maybe I could tilt it a little more toward that side."

"You absolutely could!" Tally chirped. "That's **design-craft**! First you understand the numbers. Then you can build things to make a certain outcome more likely. People do it to design safer cars or to build better video games."

"So it's not like gambling?" Pip asked. His grandpa always told him never to gamble.

"Not at all," Tally said firmly. "Gambling is just closing your eyes and hoping. You don't know the real chances. We don't hope. We count. We use numbers to make smart choices."

Pip looked at the Berry Drop game again. He didn't see just a toy anymore. He saw a system. He saw numbers and chances. He saw how every little peg and every tiny slope mattered.



"Let's try fifty berries!" Pip said suddenly, his voice full of excitement. "I want to see a real pattern. And I'll help you count!"

Tally's smile was as bright as her tail feathers. "That's the spirit, Pip! What happened, how often?"

She pulled out a fresh, clean tally-sheet.

I am Tally. The idea I can teach you is **frequency counting**. The main move is simple: *count first, then figure out what it means*. This shows you that probability is a tool for designing things, not just a way to gamble.

## My whole deal

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I'm a magpie, and I am very precise. I like things to be neat and orderly. I notice the small details that other creatures might miss. I believe that counting is the first step to understanding almost anything in the world.

## A quick note about luck

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Some people think that probability is like gambling, but it's the total opposite. Gambling is closing your eyes and hoping for the best. We use numbers to open our eyes and *know* what's likely to happen. It's about making smart designs, not about taking wild chances.

## Where this idea comes from

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Counting how often things happen is the first step in a type of math called statistics. It's a real tool that scientists, engineers, and builders use every day. They use it to understand the world and to create amazing things.

**Listen along + meet more of the cast at:**



<https://spark-and-anvil.com/cast/chanceforge/tally>

# Tree

\*TREE — \*compound events branch. multiply the independent. add the disjoint.\*\*



Tree was a squirrel kid who looked like he was born halfway up a tall oak. He was small and a bit twiggy, with soft brown fur and green stripes that looked like new leaves. He always wore a chunky vest covered in little charts and numbers. In one paw, he clutched a small card showing a probability tree. In the other, a special branch-tracker. He watched everything with intense, curious eyes, always trying to see how one thing led to another.

Tree's whole thing was something called *compound events*. It sounds complicated, but it just means "many small paths." He had a saying for it. "Compound events branch. Multiply the independent. Add the disjoint." He believed you could figure out almost anything if you just drew the right map.

He had a few big rules. First, for **independent events**, you multiply the chances. Think about flipping a coin twice. The first flip doesn't change the second flip. The chance of getting heads is  $1/2$ . So getting heads then heads is  $1/2$  times  $1/2$ . That's  $1/4$ .

Second, for **disjoint events**, you add the chances. This is when you want one thing OR another, but not both at once. Like rolling a 1 OR a 6 on a die. The chance of a 1 is  $1/6$ . The chance of a 6 is  $1/6$ . So the chance of getting either one is  $1/6$  plus  $1/6$ . That equals  $2/6$ .



Then there was the tricky one. **Conditional events** are different. The first event changes the chances for the second one. Imagine drawing two cards from a deck without putting the first one back. The first card is gone. That changes the whole deck for your second draw.

Tree taught us to draw these paths using tree diagrams. His lessons helped us see the branches in everything. We used them in PuzzleLogic and even in CodeForge. It was all about the path.

Tree would tap his little card. *"I am Tree. My big lesson is compound events."* He'd nod his head seriously. *"The trick is to branch. Multiply the independent. Add the disjoint. And watch out for the conditional."*

*"Compound events branch,"* he'd whisper. *"Always mind the path."*

One time, we were all playing a board game called "Quest for the Golden Acorn." Center groaned. He needed to roll a six AND draw a hearts card to win. "What are my chances?" he asked, slumping over the board.

Tree didn't even blink. He calmly pulled out a napkin and a tiny pencil. "Let's draw the path," he said. He sketched a single line. "A six on a die is one chance in six." He drew that first branch.



"And a hearts card?" Center asked.

Tree sketched another branch coming off the first one. "There are four suits in a deck. So hearts is one chance in four." The little tree on the napkin looked like a tiny lightning bolt.

"These two things are independent," Tree explained. "The die doesn't care about the cards. The cards don't care about the die." He tapped the final branch. "So we multiply them." He wrote the numbers with a flourish:  $1/6 \times 1/4 = 1/24$ .

Sample leaned in, squinting. "So, it'll happen once every twenty-four tries?"

Tree nodded slowly. "On average, yes. If you played the game thousands of times." He looked right at Center. "Any single try is still just luck. But the overall chance is 1 in 24."

Center let out a huge puff of air. "Okay. Not great odds."



Tree just smiled a little. "Nope. But now you know the path."

The others really listened to Tree. He never just gave them a big, confusing number. He always showed them how it worked. Tally would help count the outcomes. Display drew amazing pictures of the possibilities. But Tree? Tree showed the exact path. He made sure no one just guessed.

*"Don't guess what you can branch,"* Tree would say. *"And don't multiply when you should add. And never, ever ignore conditionals."*

We learned about conditional events the hard way. We were trying to figure out the chance of drawing two aces in a row. "Easy!" said Tally. "It's 4 out of 52 for the first one. And 4 out of 52 for the second one!" We multiplied the numbers, very proud of our answer.

Tree just shook his head slowly. He took our diagram and made one tiny change. After the first branch—drawing an ace—he crossed out one of the aces from the deck. "The first card is gone," he said softly. "It's not in the deck anymore." He wrote the new numbers for the second branch. "Now there are only 3 aces left. And only 51 cards total."

The new answer was completely different. It was much smaller.



"Conditional events," Tree said, his voice serious. *"The first thing changes the second thing. They're the ones that bite you. Especially if you don't draw the tree."*

Of everyone in the group, Tree was the only one who really understood casinos. He saw the whole place as one enormous, tangled tree diagram. One afternoon, while looking at an ad for a new arcade, he explained it.

"The casino draws the tree before you even sit down," Tree said, his voice hushed. "They know every single branch." He explained that the paths that led to you winning were just a few tiny twigs. The paths that led to the casino winning were like giant, thick branches.

"The path where you win big?" Tree said, tapping his probability-tree-card. "It's a tiny, hidden branch. They want you to think it's the main trunk." He looked around at his friends. "It's not about luck. It's about the tree. And their tree is built to win."

After a while, we started seeing Tree's branches everywhere. In PuzzleLogic, the decision-trees looked exactly like his diagrams. In CodeForge, every 'if/else' statement was a choice, a fork in the path. And GambitTales, the chess game? That was a gigantic tree of compound events. Every move you made created a new branch. And your opponent? They were the conditional event that could change everything.

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<https://spark-and-anvil.com/cast/chanceforge/tree>

# About Spark & Anvil

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- **SynaForge** — sensory-affirming creative tools through Lull, Soften, and the Quiet that is Also Creating

## Methodology

Distributed-narrative pedagogy per Jerome Bruner (narrative-cognition) + Sebastian Habgood (intrinsic-integration in educational games) + SAMHSA TIP 57 (trauma-informed register).

Trauma-informed-design framework per Eggleston et al. (2025) and Stoltenburg et al. (2024).

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