How to Use the Binomial Distribution Table to Calculate Probabilities

Authored by
stats writer

March 12, 2026

The **Binomial Distribution Table** serves as an indispensable resource for practitioners of **statistics** and **probability** theory. At its core, this tool is designed to simplify the process of determining the likelihood of achieving a specific number of successful outcomes across a fixed number of independent **Bernoulli trials**. Instead of requiring researchers and students to manually calculate complex **binomial coefficients** and exponential products for every inquiry, the table provides pre-calculated values that align with standard probability parameters. This efficiency is vital in fields ranging from quality control in manufacturing to the analysis of clinical trial results, where understanding the variance and expectation of binary outcomes is essential for rigorous **data analysis**.

In the realm of **decision-making**, the ability to predict the frequency of a "success" or "failure" allows organizations to mitigate risk and optimize their operational strategies. For instance, a business might use the **binomial distribution** to estimate the number of defective products likely to emerge from a production line or the probability that a specific percentage of customers will respond favorably to a marketing campaign. The table acts as a bridge between abstract mathematical theory and practical application, providing a visual and structured reference that ensures accuracy while saving significant time. By standardizing these values, the table also helps in maintaining consistency across different statistical reports and academic evaluations.

Furthermore, the **Binomial Distribution Table** is particularly useful when dealing with **discrete random variables**, where the outcomes are countable and mutually exclusive. While modern software and graphing calculators have largely automated these calculations, the table remains a foundational educational tool that helps students visualize the relationship between different variables. It illustrates how changes in the **sample size** or the individual probability of success influence the overall shape of the distribution. Understanding how to navigate this table is a prerequisite for mastering more advanced statistical concepts, such as hypothesis testing and the normal approximation to the binomial distribution.

Read the Binomial Distribution Table

The Mathematical Framework of a Binomial Experiment

The **binomial distribution** is predicated on a specific set of criteria that define a binomial experiment. First and foremost, the experiment must consist of a fixed number of trials, each of which results in only one of two possible outcomes, traditionally labeled as "success" and "failure." These **Bernoulli trials** must be independent, meaning the outcome of one trial does not influence the outcome of another. This independence is a critical assumption in **probability**, as it allows for the multiplication of individual probabilities to find the likelihood of a sequence of events. Without these strict conditions, the data would not follow a binomial pattern, and the table would not provide accurate predictions.

Another fundamental requirement is that the **probability** of success remains constant across all trials. In real-world scenarios, such as flipping a fair coin or shooting a free throw, this constancy is assumed to hold true under stable conditions. The **Binomial Distribution Table** essentially maps out the entire **probability mass function** for different combinations of trial counts and success rates. By organizing these values into a grid, the table allows users to observe how the **expected value** and variance of the distribution shift as the underlying parameters are adjusted. This structural clarity is why the table remains a staple in introductory **statistics** courses worldwide.

To effectively utilize the table for **data analysis**, one must first identify three specific parameters that define the scenario. These variables act as the coordinates needed to locate the precise intersection within the table's rows and columns. When these values are correctly identified, the table provides a **probability** value typically expressed as a decimal between 0 and 1. This value represents the specific chance of a defined number of successes occurring within the given constraints. Mastering the identification of these variables is the first step toward becoming proficient in **statistics** and quantitative reasoning.

The three critical values required for any lookup are defined as follows:

n: This represents the total number of trials or the **sample size** being conducted in the experiment.
r: This indicates the specific number of successful outcomes you are interested in measuring within those n trials.
p: This is the individual **probability** of achieving a success on any single, isolated trial.

Analyzing the Interplay of Trials, Successes, and Probabilities

The relationship between **n**, **r**, and **p** is the engine that drives the **binomial distribution**. The variable **n** sets the scale of the experiment; as the number of trials increases, the number of possible outcomes for **r** also expands, ranging from zero successes to a maximum of **n** successes. In the context of the table, **n** is usually found in the leftmost column or as a primary header for a section of the table. Because the table has physical space limitations, it typically covers a range of common **sample sizes**, such as 1 through 20 or 25, after which the distribution begins to resemble a normal curve.

The variable **r**, often referred to as **k** in some textbooks, defines the specific target outcome. For example, if you are conducting 10 trials, you might want to know the **probability** of exactly 5 successes. In the table, **r** is listed as a sub-category under each value of **n**. It is important to distinguish between calculating the probability of "exactly r" successes versus "at most r" or "at least r" successes. The standard **Binomial Distribution Table** provides the probability for exact values, though cumulative tables also exist to provide the sum of probabilities for a range of outcomes.

Finally, the variable **p** represents the likelihood of success on a per-trial basis, often expressed as a decimal like 0.5 for a 50% chance. These values are typically found across the top horizontal axis of the table. By finding the column associated with **p** and the row associated with **n** and **r**, the user can pinpoint the exact probability needed for their analysis. This three-way intersection is the core mechanism of the table, enabling rapid **decision-making** without the need for a calculator. This method is particularly robust because it minimizes the risk of arithmetic errors that often occur when calculating large **binomial coefficients** by hand.

Using these three numbers, you can use the **Binomial Distribution Table** to find the probability of obtaining exactly **r** successes during **n** trials when the probability of success on each trial is **p**. The following examples illustrate the practical steps for reading the table and interpreting the results in different contexts.

Example 1: Navigating Exact Probability Calculations

To understand the practical application of these concepts, consider a scenario involving a basketball player named Jessica. In this example, we are told that Jessica has a consistent performance record where she successfully makes 60% of her free-throw attempts. This 60% figure represents our **p** value, or the **probability** of success on a single trial, which we convert to the decimal 0.60. The question asks us to determine the likelihood of a very specific outcome: if Jessica shoots exactly 6 free throws (our **n**, or number of trials), what is the chance that she successfully makes exactly 4 of them (our **r**)?

To solve this using the **Binomial Distribution Table**, we first locate the section of the table dedicated to **n = 6**. Once we are in the correct section, we look down the rows to find **r = 4**. This row represents the outcome of exactly four successes. Next, we scan across the top of the table to find the column corresponding to **p = 0.60**. By following the row for **r = 4** until it intersects with the column for **p = 0.60**, we find the value that represents the probability of this specific event occurring. This visual navigation is much faster than applying the **binomial distribution** formula manually.

Question: Jessica makes 60% of her free-throw attempts. If she shoots 6 free throws, what is the probability that she makes exactly 4?

To answer this question, we can look up the value in the **Binomial Distribution Table** that corresponds to **n = 6**, **r = 4**, and **p = 0.60**:

									p								
n	*r*	.01	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75
2	0	.980	.902	.810	.723	.640	.563	.490	.423	.360	.303	.250	.203	.160	.123	.090	.063
	1	.020	.095	.180	.255	.320	.375	.420	.455	.480	.495	.500	.495	.480	.455	.420	.375
	2	.000	.002	.010	.023	.040	.063	.090	.123	.160	.203	.250	.303	.360	.423	.490	.563
3	0	.970	.857	.729	.614	.512	.422	.343	.275	.216	.166	.125	.091	.064	.043	.027	.016
	1	.029	.135	.243	.325	.384	.422	.441	.444	.432	.408	.375	.334	.288	.239	.189	.141
	2	.000	.007	.027	.057	.096	.141	.189	.239	.288	.334	.375	.408	.432	.444	.441	.422
	3	.000	.000	.001	.003	.008	.016	.027	.043	.064	.091	.125	.166	.216	.275	.343	.422
4	0	.961	.815	.656	.522	.410	.316	.240	.179	.130	.092	.062	.041	.026	.015	.008	.004
	1	.039	.171	.292	.368	.410	.422	.412	.384	.346	.300	.250	.200	.154	.112	.076	.047
	2	.001	.014	.049	.098	.154	.211	.265	.311	.346	.368	.375	.368	.346	.311	.265	.211
	3	.000	.000	.004	.011	.026	.047	.076	.112	.154	.200	.250	.300	.346	.384	.412	.422
	4	.000	.000	.000	.001	.002	.004	.008	.015	.026	.041	.062	.092	.130	.179	.240	.316
5	0	.951	.774	.590	.444	.328	.237	.168	.116	.078	.050	.031	.019	.010	.005	.002	.001
	1	.048	.204	.328	.392	.410	.396	.360	.312	.259	.206	.156	.113	.077	.049	.028	.015
	2	.001	.021	.073	.138	.205	.264	.309	.336	.346	.337	.312	.276	.230	.181	.132	.088
	3	.000	.001	.008	.024	.051	.088	.132	.181	.230	.276	.312	.337	.346	.336	.309	.264
	4	.000	.000	.000	.002	.006	.015	.028	.049	.077	.113	.156	.206	.259	.312	.360	.396
	5	.000	.000	.000	.000	.000	.001	.002	.005	.010	.019	.031	.050	.078	.116	.168	.237
6	0	.941	.735	.531	.377	.262	.178	.118	.075	.047	.028	.016	.008	.004	.002	.001	.000
	1	.057	.232	.354	.399	.393	.356	.303	.244	.187	.136	.094	.061	.037	.020	.010	.004
	2	.001	.031	.098	.176	.246	.297	.324	.328	.311	.278	.234	.186	.138	.095	.060	.033
	3	.000	.002	.015	.042	.082	.132	.185	.236	.276	.303	.312	.303	.276	.236	.185	.132
	4	.000	.000	.001	.006	.015	.033	.060	.095	.138	.186	.234	.278	.311	.328	.324	.297
	5	.000	.000	.000	.000	.002	.004	.010	.020	.037	.061	.094	.136	.187	.244	.303	.356
	6	.000	.000	.000	.000	.000	.000	.001	.002	.004	.008	.016	.028	.047	.075	.118	.178

By observing the intersection in the table provided above, we can clearly see the result. The probability that Jessica makes exactly 4 out of 6 free throws is **0.311**. This suggests that in approximately 31.1% of such instances, Jessica will achieve this exact score. This type of analysis is vital for understanding performance consistency and setting realistic expectations in competitive or industrial environments.

Example 2: Solving for Outcomes Below a Threshold

While finding the **probability** of an exact outcome is useful, many real-world **statistics** problems require calculating the likelihood of a range of outcomes. This is often referred to as cumulative probability. For instance, we might want to know the probability that Jessica makes "less than 4" free throws. This phrase "less than 4" is a **discrete random variable** problem that encompasses several distinct possibilities: she could make 0, 1, 2, or 3 free throws. Because each of these outcomes is mutually exclusive, we can find the total probability of the set by adding their individual probabilities together.

Using the same parameters as before (**n = 6** and **p = 0.60**), we return to the **Binomial Distribution Table**. Instead of looking for a single intersection, we must identify and record the values for **r = 0**, **r = 1**, **r = 2**, and **r = 3**. Each of these values represents a different point on the **Bernoulli trial** spectrum. Summing these values allows us to determine the cumulative risk or likelihood of a "below-average" performance. This method is essential for **data analysis** where thresholds are more important than specific integers.

Question: Jessica makes 60% of her free-throw attempts. If she shoots 6 free throws, what is the probability that she makes less than 4?

To find this probability, we actually have to add up the following probabilities:

P(makes less than 4) = P(makes 0) + P(makes 1) + P(makes 2) + P(makes 3)

So, we can look up each of these four probabilities in the **Binomial Distribution Table** and add them up:

										p							
n	*r*	.01	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75
2	0	.980	.902	.810	.723	.640	.563	.490	.423	.360	.303	.250	.203	.160	.123	.090	.063
	1	.020	.095	.180	.255	.320	.375	.420	.455	.480	.495	.500	.495	.480	.455	.420	.375
	2	.000	.002	.010	.023	.040	.063	.090	.123	.160	.203	.250	.303	.360	.423	.490	.563
3	0	.970	.857	.729	.614	.512	.422	.343	.275	.216	.166	.125	.091	.064	.043	.027	.016
	1	.029	.135	.243	.325	.384	.422	.441	.444	.432	.408	.375	.334	.288	.239	.189	.141
	2	.000	.007	.027	.057	.096	.141	.189	.239	.288	.334	.375	.408	.432	.444	.441	.422
	3	.000	.000	.001	.003	.008	.016	.027	.043	.064	.091	.125	.166	.216	.275	.343	.422
4	0	.961	.815	.656	.522	.410	.316	.240	.179	.130	.092	.062	.041	.026	.015	.008	.004
	1	.039	.171	.292	.368	.410	.422	.412	.384	.346	.300	.250	.200	.154	.112	.076	.047
	2	.001	.014	.049	.098	.154	.211	.265	.311	.346	.368	.375	.368	.346	.311	.265	.211
	3	.000	.000	.004	.011	.026	.047	.076	.112	.154	.200	.250	.300	.346	.384	.412	.422
	4	.000	.000	.000	.001	.002	.004	.008	.015	.026	.041	.062	.092	.130	.179	.240	.316
5	0	.951	.774	.590	.444	.328	.237	.168	.116	.078	.050	.031	.019	.010	.005	.002	.001
	1	.048	.204	.328	.392	.410	.396	.360	.312	.259	.206	.156	.113	.077	.049	.028	.015
	2	.001	.021	.073	.138	.205	.264	.309	.336	.346	.337	.312	.276	.230	.181	.132	.088
	3	.000	.001	.008	.024	.051	.088	.132	.181	.230	.276	.312	.337	.346	.336	.309	.264
	4	.000	.000	.000	.002	.006	.015	.028	.049	.077	.113	.156	.206	.259	.312	.360	.396
	5	.000	.000	.000	.000	.000	.001	.002	.005	.010	.019	.031	.050	.078	.116	.168	.237
6	0	.941	.735	.531	.377	.262	.178	.118	.075	.047	.028	.016	.008	.004	.002	.001	.000
	1	.057	.232	.354	.399	.393	.356	.303	.244	.187	.136	.094	.061	.037	.020	.010	.004
	2	.001	.031	.098	.176	.246	.297	.324	.328	.311	.278	.234	.186	.138	.095	.060	.033
	3	.000	.002	.015	.042	.082	.132	.185	.236	.276	.303	.312	.303	.276	.236	.185	.132
	4	.000	.000	.001	.006	.015	.033	.060	.095	.138	.186	.234	.278	.311	.328	.324	.297
	5	.000	.000	.000	.000	.002	.004	.010	.020	.037	.061	.094	.136	.187	.244	.303	.356
	6	.000	.000	.000	.000	.000	.000	.001	.002	.004	.008	.016	.028	.047	.075	.118	.178

According to the table, the values are as follows: P(0) = .004, P(1) = .037, P(2) = .138, and P(3) = .276. By performing the addition, we find that **P(makes less than 4) = .004 + .037 + .138 + .276 = 0.455**. Therefore, the probability that Jessica makes less than 4 free throws is **0.455**, or 45.5%. This indicates a significant chance that she will not reach the four-shot threshold, which could be critical information for a coach during a high-stakes game.

Example 3: Assessing Success Thresholds and the "At Least" Model

Another common inquiry in **statistics** is determining the likelihood that a subject will meet or exceed a certain performance level. This is often phrased as "at least" or "X or more." In Jessica's case, we might want to calculate the **probability** that she makes 4 or more free throws out of her 6 attempts. This calculation includes the outcomes for 4, 5, and 6 successes. In **probability** theory, this is the complement of the "less than 4" scenario we just calculated, and it represents the upper end of the **binomial distribution** curve for this specific set of trials.

To find the answer, we again use **n = 6** and **p = 0.60**. We locate the row entries for **r = 4**, **r = 5**, and **r = 6** in the **Binomial Distribution Table**. By aggregating these specific values, we arrive at the total probability for the desired range. This technique is particularly valuable in **decision-making** processes where a minimum number of successes is required to achieve a goal, such as a sales target or a passing grade on a standardized test. The table makes these cumulative calculations much more accessible than repeatedly applying the binomial formula.

Question: Jessica makes 60% of her free-throw attempts. If she shoots 6 free throws, what is the probability that she makes 4 or more?

To find this probability, we have to add up the following probabilities:

P(makes 4 or more) = P(makes 4) + P(makes 5) + P(makes 6)

So, we can look up each of these three probabilities in the **Binomial Distribution Table** and add them up:

		p															
n	*r*	.01	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75
2	0	.980	.902	.810	.723	.640	.563	.490	.423	.360	.303	.250	.203	.160	.123	.090	.063
	1	.020	.095	.180	.255	.320	.375	.420	.455	.480	.495	.500	.495	.480	.455	.420	.375
	2	.000	.002	.010	.023	.040	.063	.090	.123	.160	.203	.250	.303	.360	.423	.490	.563
3	0	.970	.857	.729	.614	.512	.422	.343	.275	.216	.166	.125	.091	.064	.043	.027	.016
	1	.029	.135	.243	.325	.384	.422	.441	.444	.432	.408	.375	.334	.288	.239	.189	.141
	2	.000	.007	.027	.057	.096	.141	.189	.239	.288	.334	.375	.408	.432	.444	.441	.422
	3	.000	.000	.001	.003	.008	.016	.027	.043	.064	.091	.125	.166	.216	.275	.343	.422
4	0	.961	.815	.656	.522	.410	.316	.240	.179	.130	.092	.062	.041	.026	.015	.008	.004
	1	.039	.171	.292	.368	.410	.422	.412	.384	.346	.300	.250	.200	.154	.112	.076	.047
	2	.001	.014	.049	.098	.154	.211	.265	.311	.346	.368	.375	.368	.346	.311	.265	.211
	3	.000	.000	.004	.011	.026	.047	.076	.112	.154	.200	.250	.300	.346	.384	.412	.422
	4	.000	.000	.000	.001	.002	.004	.008	.015	.026	.041	.062	.092	.130	.179	.240	.316
5	0	.951	.774	.590	.444	.328	.237	.168	.116	.078	.050	.031	.019	.010	.005	.002	.001
	1	.048	.204	.328	.392	.410	.396	.360	.312	.259	.206	.156	.113	.077	.049	.028	.015
	2	.001	.021	.073	.138	.205	.264	.309	.336	.346	.337	.312	.276	.230	.181	.132	.088
	3	.000	.001	.008	.024	.051	.088	.132	.181	.230	.276	.312	.337	.346	.336	.309	.264
	4	.000	.000	.000	.002	.006	.015	.028	.049	.077	.113	.156	.206	.259	.312	.360	.396
	5	.000	.000	.000	.000	.000	.001	.002	.005	.010	.019	.031	.050	.078	.116	.168	.237
6	0	.941	.735	.531	.377	.262	.178	.118	.075	.047	.028	.016	.008	.004	.002	.001	.000
	1	.057	.232	.354	.399	.393	.356	.303	.244	.187	.136	.094	.061	.037	.020	.010	.004
	2	.001	.031	.098	.176	.246	.297	.324	.328	.311	.278	.234	.186	.138	.095	.060	.033
	3	.000	.002	.015	.042	.082	.132	.185	.236	.276	.303	.312	.303	.276	.236	.185	.132
	4	.000	.000	.001	.006	.015	.033	.060	.095	.138	.186	.234	.278	.311	.328	.324	.297
	5	.000	.000	.000	.000	.002	.004	.010	.020	.037	.061	.094	.136	.187	.244	.303	.356
	6	.000	.000	.000	.000	.000	.000	.001	.002	.004	.008	.016	.028	.047	.075	.118	.178

According to the values found in the table, P(4) = .311, P(5) = .187, and P(6) = .047. Adding these together yields: **P(makes 4 or more) = .311 + .187 + .047 = 0.545**. The probability that Jessica makes 4 or more free throws is **0.545**, or 54.5%. Note that if you add this result to the result from Example 2 (0.455), the total is exactly 1.00, which confirms that we have accounted for all possible outcomes in the **probability** space (0, 1, 2, 3, 4, 5, and 6).

The Enduring Utility of Statistical Tables in Education and Research

The **Binomial Distribution Table** remains a cornerstone of statistical literacy, despite the proliferation of digital computing tools. For students, the table provides a physical manifestation of **probability** theory, allowing them to trace the relationships between **sample size**, success rate, and outcome frequency with their own eyes. This pedagogical value cannot be overstated, as it fosters a deeper intuition for how **discrete random variables** behave under different conditions. By removing the "black box" of a computer algorithm, the table invites learners to engage directly with the mathematical structure of the **binomial distribution**.

In professional settings, the table serves as a quick-reference guide for **data analysis** when a full computer setup may not be necessary or available. It allows for "back-of-the-envelope" calculations that can quickly validate or invalidate a hypothesis during a preliminary discussion.

Furthermore, the use of standardized tables ensures that everyone is working from the same set of foundational assumptions, which is vital for collaborative research and **statistics** reporting. The clarity and simplicity of the table format reduce the likelihood of input errors that are common when using software formulas or complex calculators.

Ultimately, the purpose of the **Binomial Distribution Table** is to democratize access to complex statistical insights. It transforms a daunting mathematical task--calculating the odds of specific outcomes in **Bernoulli trials**--into a simple act of looking up values on a grid. Whether you are a student learning the basics of **probability**, a coach analyzing player performance, or a quality control engineer monitoring a factory line, this table provides the accuracy and convenience needed to make informed, data-driven decisions. Its continued presence in textbooks and reference manuals is a testament to its fundamental utility in the ever-evolving field of quantitative analysis.