Contents

Introduction

The United States Election Assistance Commission and the University of Rhode Island's Engineering for Democracy Institute have partnered to create the Hand Count Workload Calculator. This tool helps estimate the number of work hours and counting teams needed to complete a hand count of ballots within a specified period of time. Whether preparing to tabulate all ballots by hand or conducting a hand count as part of an audit or recount, the calculator enables quick planning based on information about ballots and staffing.

Users begin by entering the number of contests on a ballot, the number of ballots to count, and timing information for counting contests (if available). They also specify staffing levels, including the number of counting teams, daily work hours, and the number of days available to complete the count. The calculator will then return the total work hours required for counting and determine if the count can be completed in the time available. If it cannot, the tool will calculate the minimum number of counting teams needed to complete the count on time.

The remainder of this document outlines the methodology and assumptions made when generating results (page 3-4), data required to use the tool (page 6), features and functions of the Hand Count Workload Calculator (pages 6-13), and offers a step-by-step example (pages 14-17) of how to use the tool.

Methodology

The Hand Count Workload Calculator utilizes a series of equations to estimate the time required to perform a hand count and understand the workload based on a series of user inputs. To model the hand count process, we must simplify the process by making certain assumptions due to the complexity of the real world and human behavior. Furthermore, to ensure that the tool is useful for users that do not have access to hand count data, default values are included for the time required to hand count ballot questions, based on data collected by the Engineering for Democracy Institute.

Below, the assumptions made in this calculator and the data used for default **Time to Count One Contest** options are described in detail.

Assumptions:

This calculator assumes a simplified hand count process that may or may not align with real-world conditions. Some assumptions made in the calculator include:

- All ballots are fully and properly voted for all contests and questions
- Working hours per day remain static throughout the counting timeframe,
- All counting teams operate at approximately the same speed, and
- Time to count each contest reflects actual counting time per contest.

While one or more of these assumptions may not align with the hand count process in your location, the estimated results are still broadly applicable across locations and can assist in making staffing decisions.

Default Time to Count One Contest Options:

Default **Time to Count One Contest** (see page 8) options use statistical distributions to generate the time needed to count one Yes/No contest and one candidate contest. These defaults use data collected by the Engineering for Democracy Institute in November 2024. These data were collected in a Northeastern state whose ballot contained 3 ranked choice voting contests (these have been excluded from this analysis), 5 single-select candidate races, and 5 Yes/No contests. Each question type was observed independently, allowing time estimates to be constructed per question type.

Data Collection Process

Each ballot consisted of two sheets of paper, one double-sided, one single-sided. The front of the first sheet included all the ranked-choice voting contests, with all the single-select candidate races on the back. The front of the second sheet included all the Yes/No questions on the ballot. Prior to counting, the ballot sheets were separated into two piles based on sheet number and then further sorted into batches of 50 sheets. For the double-

sided sheet, one side of all 50 ballots was counted first. The entire batch was then flipped over to count the second side of the sheet.

During data collection, the total time it took to count all contests on one side of one ballot was collected. From this total time, the average time per contest was calculated by dividing the total time per side by the number of contests on the respective ballot side. The table below presents the quantity and descriptive statistics of the data used to construct the *Default Time* option:

Group	Observations	Mean (seconds)	Std. Dev. (seconds)	Min (seconds)	Max (seconds)	Range (seconds)
Candidate Contests	2260	1.34	0.89	0.1	7.9	7.8
Yes/No Contests	2080	2.05	1.18	0.5	9.7	9.2

Validating Hand Count Workload Calculator Results

To ensure the Hand Count Workload Calculator generates accurate results, we compare known results to the estimates made by the application. In this case, we use data from a real hand counting process observed by the Engineering for Democracy Institute. The observed hand counting process was conducted with 2 counting teams working simultaneously. Teams began preparing ballots to be counted (i.e., flattening and sorting into batches) at 8pm. The counting concluded at 10:53pm. For the observed election, 472 ballots, each with 5 candidate contests with 5 total valid candidate selections and 5 Yes/No contests, were hand counted. Excluding preparation time, the contests were counted in 1 hour and 2 minutes. For the remaining calculator inputs, we assume that the counting team had 4 hours to complete the count across 1 day.

Entering these values into the Hand Count Workload Calculator yields an estimated 1.1 working hours (i.e., 1 hour and 6 minutes) required to hand count all 472 ballots. Comparing the actual number of working hours to the estimated required working hours, we see a difference of 4 minutes. This represents an overestimation of 6.5%.

Note: While this validation demonstrates a high degree of accuracy, unique characteristics of election processes and hand counting procedure may result in less accurate results. Additional time should be allotted to account for ballot preparation prior to hand counting and post-count verification, recounts, and packaging.

Definitions

Candidate Contests – Ballot questions that require the selection of one or more candidates to fill an elected position (e.g., president, school board).

Total Candidates to Be Elected – The total number of candidates who will be elected across the entire ballot. Add all the x's from "vote for x" across all candidate contests. For example, a ballot with 3 "vote for 1" contests and 2 "vote for 2" contests, this number would be 7.

Yes/No Contests – Referenda, initiatives, retention votes, or other ballot questions where a Yes/No or Approve/Reject vote is required.

Counting Team – A group of workers (typically 2–4 people) assigned to count the same ballots together.

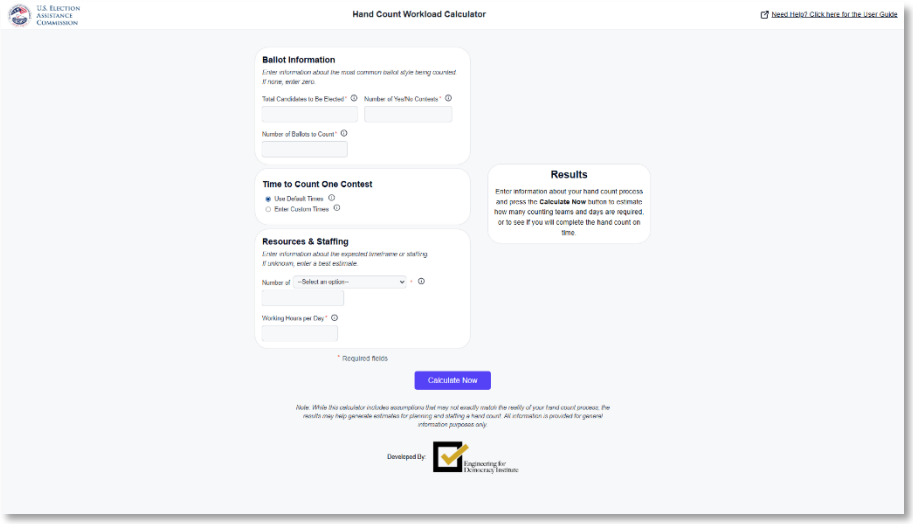
Working Hours per Day – The number of hours per day that workers can count ballots (e.g., the length of a shift; not including break times).

Work Hours Available – The hours of working time available to complete the count before a particular deadline. Deadlines will vary depending on what the hand count is used for (initial tabulation, audit, recount, etc.), the election calendar in a particular jurisdiction, and applicable laws and regulations.

Work Hours Needed – The hours of working time needed to complete the count under the specified constraints (i.e., number of teams and working hours per day.)

Work Days to Complete the Count – The total number of work days available to conduct the count before any deadlines a jurisdiction may be subject to. For example, if the hand count is part of an audit that must be completed prior to certification, a jurisdiction might count backwards from the certification deadline to determine how many days are available to complete the hand count. (If no external deadline exists, choose the optimal number of work days based on the election office's own calendar)

Getting Started



What You Will Need:

To use the Hand Count Workload Calculator, visit the tool online at handcountcalc.eac.gov and input the required ballot information and staffing details. The calculator does not require installation and is designed to operate on a modern web browser.

You will need:

- The number of Yes/No contests and Valid Candidate Selections on the ballot.
- The total number of ballots to be counted.
- [Optional] Custom estimates of how long it takes to count a contest.
- Staffing plans, including the daily work hours and either the number of counting teams or the work days to complete the count.

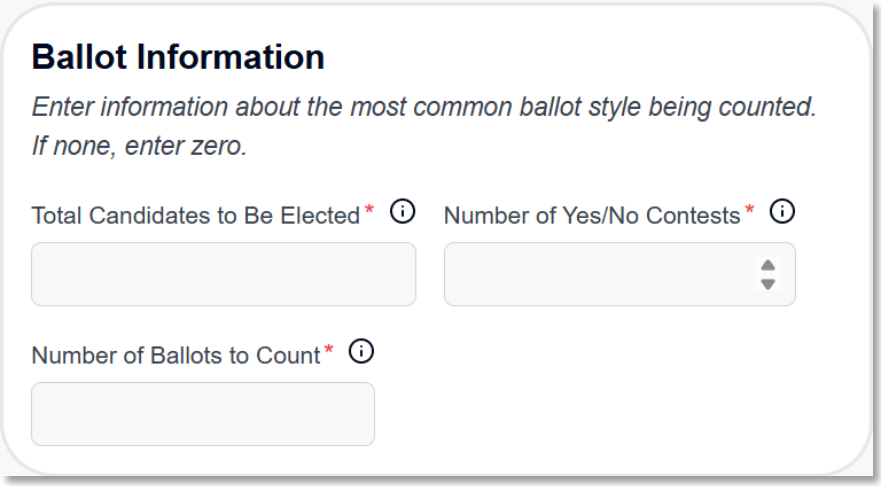
Assumptions:

Before using the Hand Count Workload Calculator, it is important to understand the core assumptions that the tool operates on. These include:

- All ballots are fully and properly voted for all contests and questions
- Working hours per day remain static throughout the counting timeframe,
- All counting teams operate at approximately the same speed, and
- Time to count each contest reflects actual counting time per contest.

To account for the expected variability in counting ballots, this tool uses statistical randomness in processing times to improve the accuracy of estimated results.

Ballot Information



In the **Ballot Information** menu, enter information about ballot contests and the number of ballots to count. If multiple ballot styles must be counted, enter the ballot contest information for the most common ballot style.

Total Candidates to Be Elected:

The total number of candidates that can be selected across all candidate contests on the ballot to have a fully voted ballot with no over or under votes. Sum the total number of "vote for" selections available across all candidate contests on the ballot, including both vote for one and vote for multiple options. Example: A ballot style with three "vote for 1" candidate contests and two "vote for 2" candidate contests would have 7 Valid Candidate Selections.

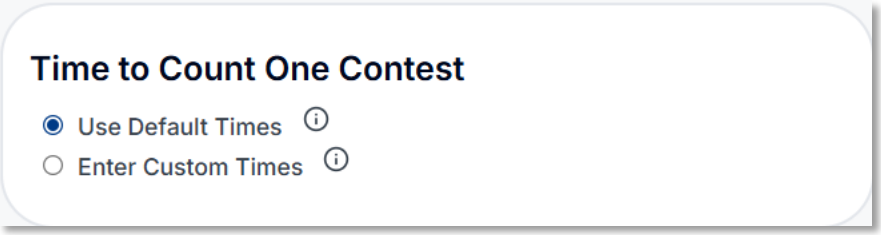
Number of Yes/No Contests:

The number of referenda, initiatives, retention votes, or other questions across the entire ballot that require a binary Yes/No or Approve/Reject rather than candidate selection(s). This option can be left blank or set to 0 if the ballot contains only candidate contests.

Number of Ballots to Count:

The number of ballots that must be hand counted. This number is the total number of full ballots, not the total number of ballot pages or cards. For example, a single ballot that consists of 3 separate sheets of paper should be counted as 1 ballot.

Time to Count One Contest



The **Time to Count One Contest** menu offers two options:

1. *Use Default Times*
2. *Enter Custom Times*

Default Time:

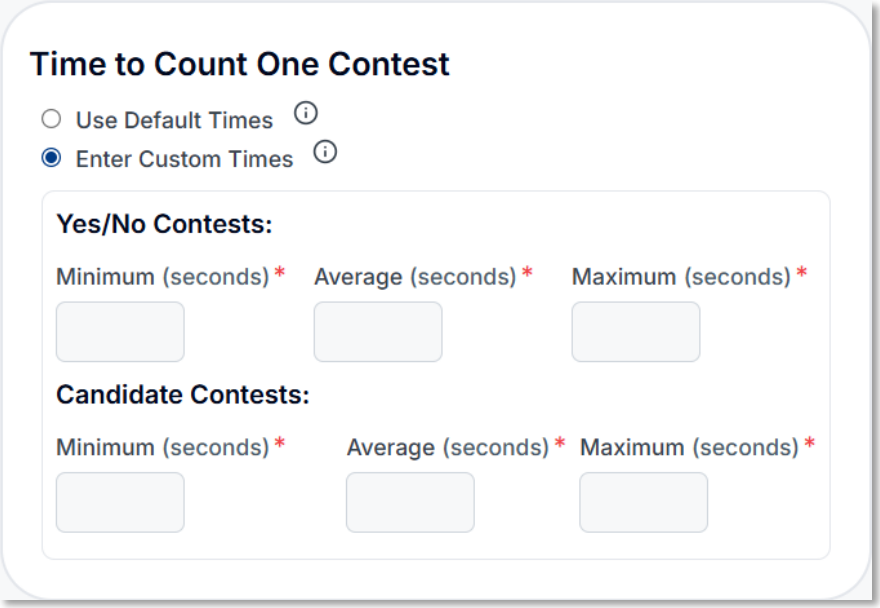
When the *Use Default Times* option is selected, the Hand Count Workload Calculator will perform estimates using hand counting time data collected by the Engineering for Democracy Institute in November 2024. The table below presents the quantity and descriptive statistics of the data used to construct the *Default Times* option:

Group	Observations	Mean (seconds)	Std. Dev. (seconds)	Min (seconds)	Max (seconds)	Range (seconds)
Candidate Races	2260	1.34	0.89	0.1	7.9	7.8
Referenda	2080	2.05	1.18	0.5	9.7	9.2

Custom Time:

When the *Enter Custom Times* option is selected, additional inputs appear within the **Time to Count One Contest** menu. For both Yes/No Contests and Candidate Contests, inputs are required for:

- Minimum (seconds)
- Average (seconds)
- Maximum (seconds)



Here, you can enter values for the minimum, average, and maximum time to count candidate contests and Yes/No contests in seconds. To generate these values, you can use known estimates from past hand counts, or you can conduct a time study for a more accurate estimate.

To perform a time study, use a stopwatch to measure the time it takes for a team to count only candidate contests on 10 to 20 ballots, recording the time per ballot. Then repeat this, measuring the time it takes for a team to count only Yes/No contests on 10 to 20 ballots, recording the time per ballot.

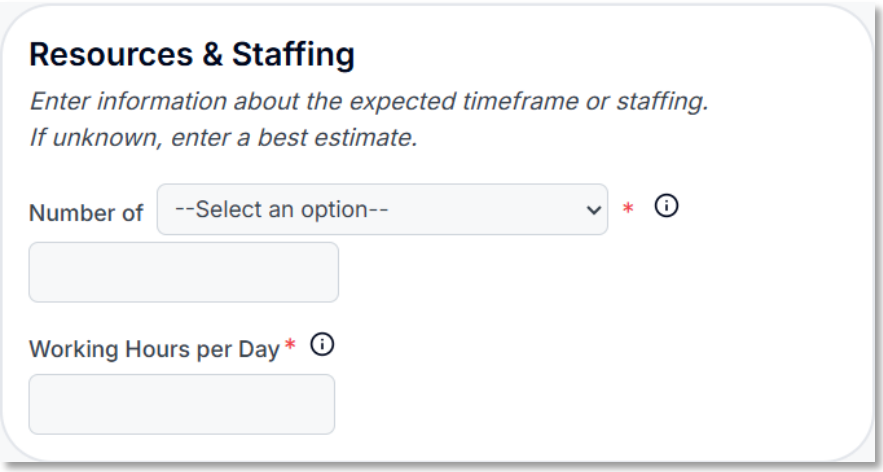
Next, separately calculate the minimum, average, and maximum time across all counted ballots for both candidate contests and Yes/No contests.

Finally, divide these statistics by the total number of candidates to be elected on the ballot for the time study on candidate contests and divide the time study statistics for Yes/No contests by the number of Yes/No contests on the ballot. Ensure these values are in seconds and then enter them into the corresponding inputs under *Enter Custom Times*.

Example:

> 60 seconds to count all candidate contests ÷ 10 candidates to be elected = 6 seconds per candidate
>
> 25 seconds to count all yes/no contests ÷ 5 yes/no contests = 5 seconds per yes/no contest
>
> Repeat each time study on 10 to 20 ballots to calculate minimum, average, and maximum seconds per contest for each contest type.

Resources & Staffing



Number of Counting Teams *or* Work Days to Complete the Count:

Within the **Resources & Staffing** menu, a dropdown field provides the option to specify either the *Number of Counting Teams* or the *Work Days to Complete the* Count. Select which option you have an estimate or known value for and enter the corresponding value.

If *Number of Counting Teams* is selected, this value should reflect the number of teams that can process one ballot at a time. Counting teams typically consist of between 2 and 4 workers; however, this input does not depend on the number of workers per team. In cases where one team can process two ballots simultaneously, count them as two teams.

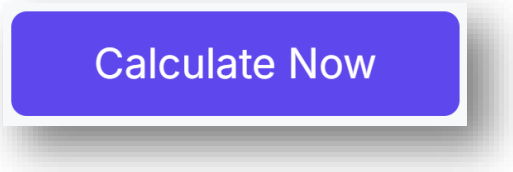
If *Work Days to Complete the Count* is selected, enter the number of days available to count ballots. If counting teams do not work on weekends, exclude those days from the number of work days.

Working Hours per Day:

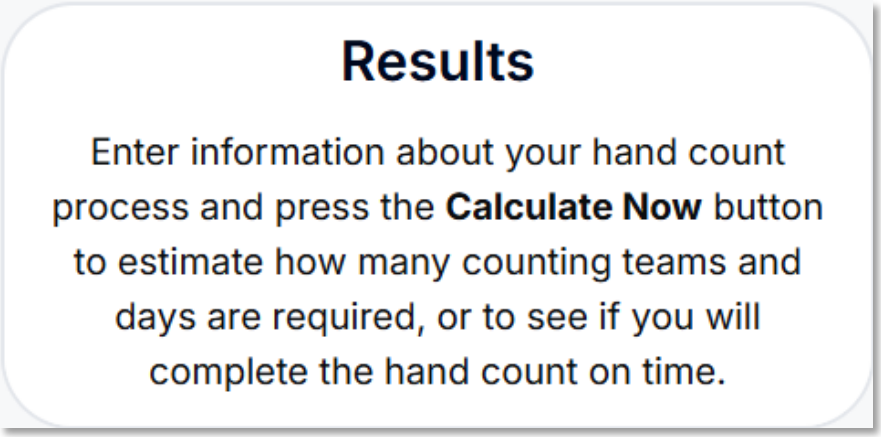
The *Working Hours per Day* input requires the number of hours counting teams will be actively counting ballots. This will likely correspond to the length of the work shift for counting teams minus any time for breaks. For example, if a team's work shift is from 8 AM to 4 PM with a 1-hour break for lunch, then 7 should be entered in the *Working Hours per Day* input. If working hours change throughout the counting period, enter the most common number of working hours per day or the average number of working hours per day.

Calculate Now:

Once all information is entered, review the inputs and ensure all values are accurate and were entered correctly. Press the *Calculate Now* button and wait for your results to appear on the right side of the screen. *Note: If a large number of ballots are entered, the tool may take several minutes to generate results. For instance, entering 500,000 ballots to count can take up to 5 minutes.*



Results



Upon pressing the *Calculate Now* button, the **Results** panel on the right side of the screen will update. On the panel, a sentence describing the estimated work requirements for the entered number of counting teams or work days available will appear, depending on which value was selected on the **Resources & Staffing** dropdown.

If *Number of Counting Teams* was selected, the number of estimated required working hours and required working days will be explained.

If *Number of Work Days to Complete the Count* was selected, the number of estimated required working hours and required counting teams will be explained.

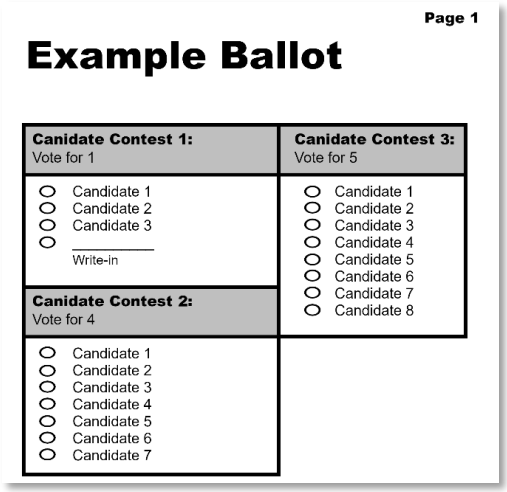
At the bottom of the **Results** panel, a calculation is presented for the estimated *Minimum Counting Teams to Hand Count* or *Days Required*.

The Results display the:

- *Work Hours Needed* – The number of working hours required to process all ballots, regardless of the number of counting teams.
- *Work Hours Available* – The number of working hours available based on the number of *Working Hours per Day* and *Number of Work Days to Complete the Count* or *Number of Counting Teams*.
- Either:
    - [If *Number of Work Days to Complete the Count* is entered] *Minimum Counting Teams* – The estimated number of counting teams required to complete the count within the specified timeframe. or;
    - [If *Number of Counting Teams* is entered] *Days Required* – The estimated number of work days required to complete the count with the specified number of counting teams.

Step-by-Step Example

A jurisdiction must hand count 18,450 ballots. Each ballot has 5 Yes/No contests and 3 candidate contests with 10 valid candidate selections (the total number of "vote for" selections available across all candidate contests on the ballot).



Page 1

Example Ballot

Canidate Contest 1:
Vote for 1

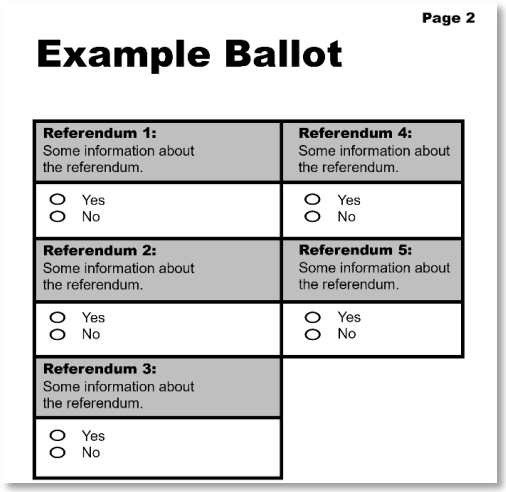
- Candidate 1
- Candidate 2
- Candidate 3
- _____ Write-in

Canidate Contest 2:
Vote for 4

- Candidate 1
- Candidate 2
- Candidate 3
- Candidate 4
- Candidate 5
- Candidate 6
- Candidate 7

Canidate Contest 3:
Vote for 5

- Candidate 1
- Candidate 2
- Candidate 3
- Candidate 4
- Candidate 5
- Candidate 6
- Candidate 7
- Candidate 8



Page 2

Example Ballot

Referendum 1:
Some information about the referendum.
- Yes
- No

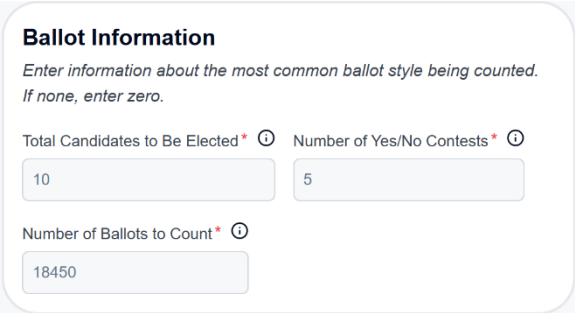
Referendum 2:
Some information about the referendum.
- Yes
- No

Referendum 3:
Some information about the referendum.
- Yes
- No

Referendum 4:
Some information about the referendum.
- Yes
- No

Referendum 5:
Some information about the referendum.
- Yes
- No

Based on observation, each candidate contest takes between 2 and 5 seconds to count, with an average of 3 seconds, and each Yes/No contest takes between 1 and 4 seconds to count, with an average of 2 seconds. The current staffing plan consists of 4 counting teams counting ballots for 8 hours per day with a goal of completing the count in 7 days. Use the *Hand Count Workload Calculator* to determine if the jurisdiction needs additional counting teams:



Ballot Information

Enter information about the most common ballot style being counted. If none, enter zero.

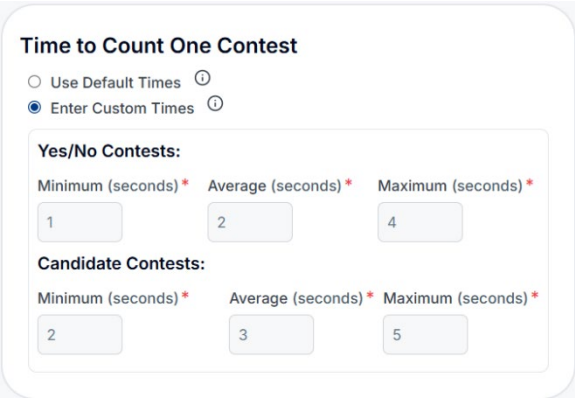
Total Candidates to Be Elected * 10

Number of Yes/No Contests * 5

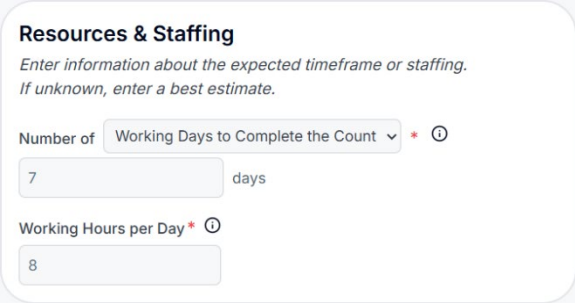
Number of Ballots to Count * 18450

1. In the **Ballot Information** menu:
    a. Enter 10 in the *Total Candidates to Be Elected* input,
    b. Enter 5 in the *Number of Yes/No Contests* input, and
    c. Enter 18,450 in the *Number of Ballots to Count* input.

2. In the **Time to Count One Contest** menu:
    a. Select *Enter Custom Times*.
    b. Under *Yes/No Contests*:
        i. Enter 1 for the *Minimum* time,
        ii. Enter 2 for the *Average* time, and
        iii. Enter 4 for the *Maximum* time in seconds.
    c. Under *Candidate Contests*:
        i. Enter 2 for the *Minimum* time,
        ii. Enter 3 for the *Average* time, and
        iii. Enter 5 for the *Maximum* time.



3. In the **Resource & Staffing** menu:
    a. Select *Work Days to Complete the Count* from the *Number of…* dropdown menu,
    b. Enter 7 for the *Number of Work Days to Complete the Count* input, and
    c. Enter 8 for the *Working Hours per Day* input.

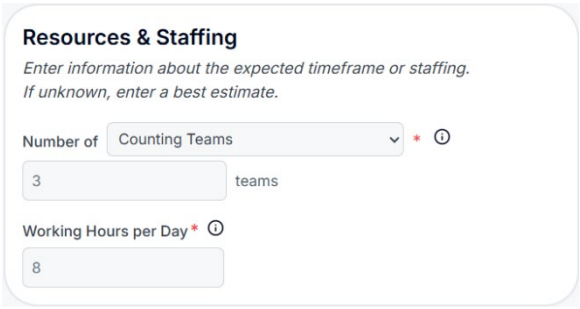


4. Double check the inputs to make sure they are correct and click the *Calculate Now* button.

5. After generating the estimates, the **Results** panel will display information about the hand count workload. With these inputs, the hand count should require 5 counting teams to complete the count with 7 work days available.

Let's use the tool again to see how many work days are required if only 3 counting teams are available:

6. In the **Resource & Staffing** menu:
   a. Change the *Number of…* dropdown to *Counting Teams,*
   b. Enter 3 for the *Number of Counting Teams* input.



7. Press the *Calculate Now* button.

8. After generating the estimates, the **Results** panel will display new information. Now, we can see that, with 3 counting teams, 10 work days should be required to complete the count.

Results

The hand count requires 230.6 total work hours. With 3 counting teams, the count should be complete in 76.9 work hours across 10 days.

Time Required with 3 Counting Teams:

Total Work Hours Needed	230.6
Number of Counting Teams	3
Working Hours per Day	8
Work Hours per Team	230.6 / 3 = 76.9
Days Required	76.9 / 8 = **10**