

# Throughput Forecast Monte Carlo – Read First

## Aim

To estimate the number of stories that will be completed by a team for a six (6) week timespan using historical weekly throughput samples from the same team. To understand the probability of achieving those estimates.

## The process

1. **Simulate one possible result:** A single six week throughput result is simulated (called a trial) by summing together six historical one-week throughput samples picked at random.
2. **Repeat:** This simulation process is repeated many times (eleven here, but it can be thousands of repetitions). Each trial represents a “possible” six-week throughput result given the team’s historical rate of delivery.
3. **Calculate likelihoods:** The proportion of trials that meet or exceed a given throughput value versus the total number of trials is the likelihood that value is achievable in the future.

## Questions and discussion topics

1. What could pollute the throughput samples (make them a poor predictor of the future)?
2. How might you correct for these sample pollution events?
3. Why can’t we just use the average or median values to forecast the next six weeks?
4. If life depended on this forecast, how many stories would you sign-up for?
5. How might you choose a likelihood to target in your company?
6. How many trials were needed before the actual average (57.75) was included in the range you saw?
7. How would you get more definition in the likelihood percentages?
8. What does 100% likelihood mean in this case?
9. How would you track progress against this forecast?
10. What is the impact of not returning the sample each time?

## Why it works

Historical throughput data for teams measures delivery rate for a wide portion of the development system (the wider the better). Team throughput per week accounts for delays; for example waiting time, impediments, staff availability, interruptions and un-recorded work. The impact of these delays is more significant to a forecast than the hands-on time alone. This is a reason developer estimates are unreliable when forecasting projects, they don’t account for delays and system dynamics. In a stable system (e.g. the team isn’t blown-up), throughput will be a good predictor of future delivery rate even with large item size variability.

## Team Throughput Sample Data

Samples represent the number of stories completed per week by the same team taken from an actual project.

Samples: 16,3,10,6,19,11,17,17,15,9,11,8,5,13,5,7,8,6,10,10,8,5,5,7

Count: 24 Sum: 231 Minimum: 3 Median: 8.5 Average: 9.625 Maximum: 19

## Resources

Forecasting spreadsheets: <https://github.com/FocusedObjective/FocusedObjective.Resources> (these spreadsheets do the process described here thousands of times instantly. This exercise is for learning purposes, don’t do it by hand!)

Reading: The Flaw of Averages by Sam Savage. How to Measure Anything by Douglas Hubbard.



# Exercise – Throughput Forecast Monte Carlo Worksheet

**Aim:** To estimate the number of stories that will be completed by a team for a six (6) week timespan using historical weekly throughput samples for that team. To understand the probability of achieving those estimates.

**Process:**

1. Shuffle the 24 throughput cards or dice (whichever method you choose)
2. Pick a card at random or throw dice and record sample in the table below
3. Return the card to the deck and reshuffle (“sample with replacement”)
4. Repeat until all squares are filled

We randomly sampled trials 4 to 11 for you to save time.

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	Trial 11
			7	11	7	5	17	5	10	16
			19	7	10	5	13	13	5	7
			6	5	5	3	5	16	6	5
			6	19	5	3	5	3	6	3
			5	7	10	5	6	8	8	6
			5	7	19	10	16	8	10	16

5. Sum of all samples for each trial by column (upper) / Nearest “tens” grouping rounded down (lower)

			48	56	56	31	62	53	45	53
			40+	50+	50+	30+	60+	50+	40+	50+

6. Minimum Sum (a):

Maximum Sum (b):

7. Minimum Sum with Lowest Removed (c):

Maximum Sum with Highest Removed (d):

Actual average 6 week throughput = 57.75. Is the average within the range you estimated in (a) to (b)?

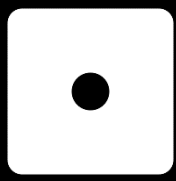
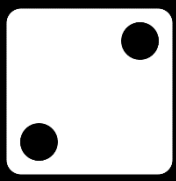




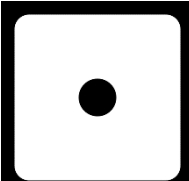
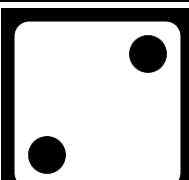
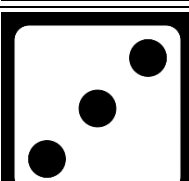
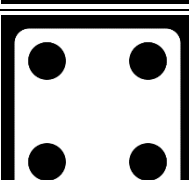
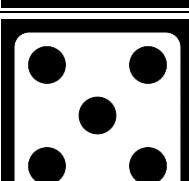
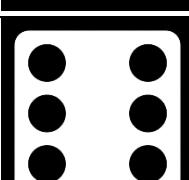
8. Probabilities of achieving at least n stories for a six week timespan

6 Week Throughput	Count trial sum groups at least 30,40, 50, etc. stories	(Count / 11) Likelihood
At least <b>30</b> stories		
At least <b>40</b> stories		
At least <b>50</b> stories		
At least <b>60</b> stories		
At least <b>70</b> stories		
At least <b>80</b> stories		
At least <b>90</b> stories		

This value is 0 to 1  
Multiply it by 100 to get a percentage.  
0% = no chance,  
100% means every trial achieved at least this level.

## Samples: Random Samples of Throughput by Six-Sided Dice

To generate random samples from the throughput history, throw two six-sided dice (or throw one six-sided dice twice) and use the sample value at the intersection of the two dice results. It's important to make certain samples are taken at random, and using a dice is often the fairest way to ensure you don't introduce bias!

						
	16	3	10	6	19	11
	17	17	15	9	11	8
	5	13	5	7	8	6
	10	10	8	5	5	7
	Roll again	Roll again	Roll again	Roll again	Roll again	Roll again
	Roll again	Roll again	Roll again	Roll again	Roll again	Roll again

## Samples: Random Samples of Throughput by Shuffled Cards

If you don't have six-sided dice on hand. Print out and cut up these cards (you should end up with 24 small sample cards). Pick one of these cards at random each time a sample is needed. Remember to ALWAYS replace the sample you take after noting its value. Shuffle well, or pick from a box/bag.

16

Card 1 – Throughput

3

Card 2 – Throughput

10

Card 3 – Throughput

6

Card 4 – Throughput

19

Card 5 – Throughput

11

Card 6 – Throughput

17

Card 7 – Throughput

17

Card 8 – Throughput

15

Card 9 – Throughput

9

Card 10 – Throughput

11

Card 11 – Throughput

8

Card 12 – Throughput

5

Card 13 – Throughput

13

Card 14 – Throughput

5

Card 15 – Throughput

7

Card 16 – Throughput

8

Card 17 – Throughput

6

Card 18 – Throughput

10

Card 19 – Throughput

10

Card 20 – Throughput

8

Card 21 – Throughput

5

Card 22 – Throughput

5

Card 23 – Throughput

7

Card 24 – Throughput

## Exercise – Throughput Forecast Monte Carlo Completed Example

**Aim:** To estimate the number of stories that will be completed by a team for a six (6) week timespan using historical weekly throughput samples for that team. To understand the probability of achieving those estimates.

**Process:**

1. Shuffle the 24 throughput cards
2. Pick a card at random from the deck and record in the table below
3. Return the card to the deck and reshuffle (“sample with replacement”)
4. Repeat until all squares are filled

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	Trial 11
17	5	17	7	11	7	5	17	5	10	16
5	8	16	19	7	10	5	13	13	5	7
17	5	16	6	5	5	3	5	16	6	5
13	6	7	6	19	5	3	5	3	6	3
7	7	5	5	7	10	5	6	8	8	6
11	8	7	5	7	19	10	16	8	10	16

5. Sum of all samples for each trial by column (upper) / Nearest “tens” grouping rounded down (lower)

<b>70</b>	<b>39</b>	<b>68</b>	<b>48</b>	<b>56</b>	<b>56</b>	<b>31</b>	<b>62</b>	<b>53</b>	<b>45</b>	<b>53</b>
70+	30+	60+	40+	50+	50+	30+	60+	50+	40+	50+

6. Minimum Sum (a): 31

Maximum Sum (b): 70

7. Minimum Sum with Lowest Removed (c): 39

Maximum Sum with Highest Removed (d): 68

Actual average 6 week throughput = 57.75.

8. Probabilities of achieving at least n stories for a six week timespan

6 Week Throughput	Count trial sum groups at least 30,40, 50, etc. stories	(Count / 11) Likelihood
At least <b>30</b> stories	11	1
At least <b>40</b> stories	9	0.82
At least <b>50</b> stories	7	0.63
At least <b>60</b> stories	3	0.28
At least <b>70</b> stories	1	0.09
At least <b>80</b> stories	0	0
At least <b>90</b> stories	0	0

This value is 0 to 1

Multiply it by 100 to get a percentage.

0% = no chance, 100% means every trial achieved at least this level.