Broadening Access in Michigan Medicine's Primary Care

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Background

- KVVJ Solutions has been tasked with developing solutions to the patient access issues within our client, Michigan Medicine's, clinic.
- We were required to find solutions to a Michigan Medicine Metric of 95% of patients scheduled within one week, along with our clinic specific target (primary care clinic) of 95% of patients within three weeks.
- To accomplish this goal, KVVJ Solutions used complex, computational models to simulate all possible scenarios, ensuring an optimized outcome focused on maximizing healthcare access and cost-efficiency.

Parameters

Distribution	Gaussian
Mean Weekly Demand	100
Standard Deviation	20
Michigan Medicine Target Metric	95 percent of patients seen in 1 week
Client Specific Target Metric	95 percent of patients seen in 3 weeks

Methods

- **Slot Capacity Testing:** We tested a range of weekly slot capacities from 80 to 120 slots per week, one standard deviation from the mean demand, using the values 110, 112, 113, 114, 115, and 120 to find 114 to be the lowest number to meet the Michigan Medicine Target Metric. For client-specific, we began with the 114 slots and experimenting to find that 85 slots met the client-specific metric.
- **Number of Replications Testing:** We experimented with increased replication lengths to observe their effect on variability. Extending from 4 to 8 and then to 12 weeks resulted in a significant reduction in standard error of the mean queue length, while maintaining minimal outliers. Increasing beyond this led to diminishing returns and increased computational cost.
- **Number of Weeks Testing:** Starting from five (which yielded high error), we tested fifteen (low error but high cost) and then intermediate values. Ultimately, we found that ten replications provided acceptable error at a feasible computational cost.
- While the Michigan Medicine metric represents a gold-standard benchmark, we used the client-specific 3-week metric in our final analysis because it better reflects the clinic's realistic scheduling goals and constraints. It also was more easily replicable since the replications followed a much more similar upward trend of queue. Each appointment slot was assumed to cost $200, accounting for labor and operational expenses.
- Patients who were not scheduled within 3 weeks incurred a late cost of $100 representing lost revenue or delayed care consequences.
- Total weekly cost = (Number of Slots × Slot Cost) + (Late Patients × Penalty Cost)
- From this, we then found annual and total cost and compared it to annual and total revenue (Table 4)
- We then examined the impact of increasing and decreasing variance to sse if we would pay to decrease variance

Results

SIMULATION OVERVIEW

- **Demand Model:** Modeled as a Gaussian distribution with a mean of 100 patients and a standard deviation of 20.
- Reflects that physicians see ~93 patients per week [1] and variety of appointments and variability within weeks for high variability[2]
- **Access Goal:** schedule 95% of patients within three weeks

MICHIGAN MEDICINE METRIC

- **Requirement:** To meet a stricter target of 95% of patients scheduled within one week, our simulation indicated that 114 slots per week are needed.
- **Cost Impact:** This results in a weekly cost of $22,900 and higher operational expenses.

CLIENT-SPECIFIC METRIC

Rationale: A smaller primary care clinic benefits from a more flexible target. By extending the scheduling window to three weeks, the client can reduce costs while still maintaining high-quality care. It also follows a stronger trend between replications, showing more consistency for future uses compared to the Michigan Medicine metric.

CLIENT-SPECIFIC RESULTS

Initial Client-Specific Model: Required 85 slots per week at a weekly cost of $17,100.

Optimized Client-Specific Model: Reduced further to 81 slots per week by incurring 4 percent of people being late rather than 1 percent, lowering the weekly cost to $16,600 without compromising the 95% access goal.

COST AND PROFIT SUMMARY
Optimized Client-Specific Model

WEEKLY

Operational Cost: $16,600

Revenue Estimate: With 100 patients per week and revenue ranging from $250–$300 per patient, weekly revenue is estimated between $25,000 and $30,000.

Estimated Profit: Weekly profit ranges from $3,650 to $7,700.

TOTAL RUNTIME (120 Weeks)

Operational Cost: $1,992,000

Revenue: Between $3,000,000 and $3,600,000 [3]

Profit: Between $1,008,000 and $1,608,000

Figures

Table 1. Summary of Total Cost and Performance For Client-Specific and Michigan Medicine Parameters

Metric	Client-Specific Metric	Michigan Medicine Metric
Slots per week	85	114
Operational cost	85 × $200 = $17,000	114 × $200 = $22,800
Late patients/week	1	1
Late fees	1 × $100 = $100	1 × $100 = $100
Total weekly cost	$17,100	$22,900

Table 2. Final Parameters and Cost Post-Cost Optimization

| Metric	Value
Slots per week	81
Operational cost	81 × $200 = $16,200
Late patients/week	~4
Late fees	4 × $100 = $400
Total weekly cost	$16,600

Table 3. Summary of Weekly, Annual, and Total Costs Per Client Metric

Configuration	Total Runtime	Weekly Slots	Weekly Cost	Annual Cost	Total Runtime Cost
Michigan Medicine Metric	120 weeks	114	$22,900	$1,190,800	$2,748,000
Original Client-Specific Metric	120 weeks	85	$17,100	$889,200	$2,052,000
Optimized Client-Specific Metric	120 weeks	81	$16,600	#863,200	$1,992,000

Table 4. Estimated Minimum and Maximum Revenue Per Patient, Weekly Patients, Annual Patients, and Total Patients During Runtime
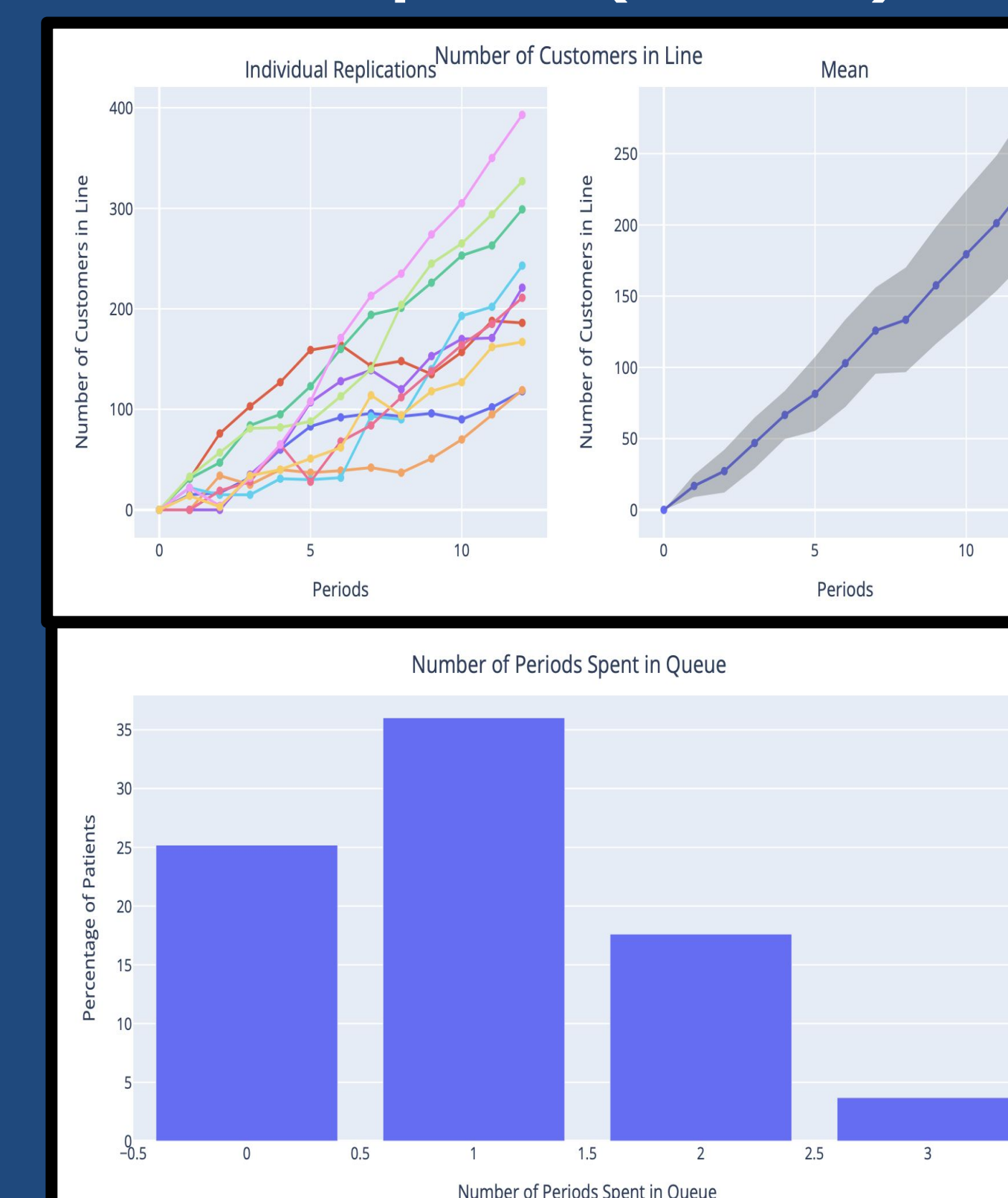
Type of Estimate	Revenue per Patient	Weekly Revenue	Annual Revenue	Total Runtime Revenue (120 weeks)
Minimum	$250	$25,000	$1,300,000	$3,000,000
Maximum	$300	$30,000	$1,560,000	$3,600,000

Michigan Medicine (114 slots)
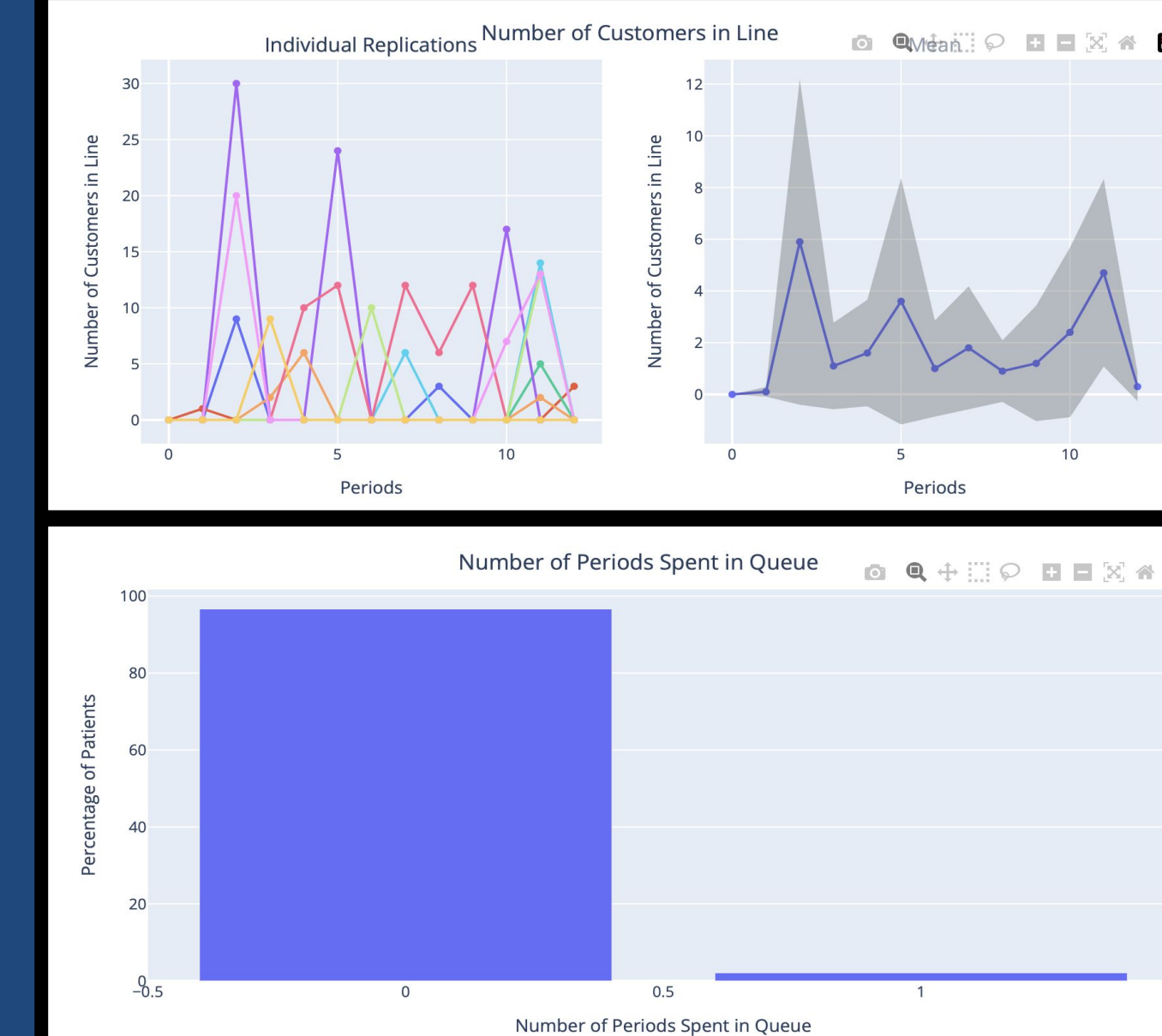
Over 95 percent assisted in one week, but the replications vary a lot, leading to high error.

Client-Specific (81 Slots)

Over 95 percent assisted in three week, (almost 5 percent late) and consistent trends between individual replications.

Discussion

Decreasing Variance
Primary care clinics attract many different patients with a great variety of ailments – the diversity in appointments leads to this clinic having a high variance in patients per week, and a large amount of slots must be created. Artificially lowering the variance would drastically lower the standard deviation of patients, so less slots will be used.

Increasing Variance
Since this clinic already has a high variance, it would not be beneficial to increase it in order to receive discounts on the slots. Since increasing variance means more slots have to be included, it would not be worth it for the clinic unless the discount given is extremely high.

Conclusion
By calculating the amount of slots needed to maintain appropriate performance in a Michigan Medicine primary care clinic while meeting particular clinic goals, our results have mimicked patient access issues. By cutting the number of slots from 85 to 81 per week, KVVJ was able to minimize the overall weekly cost of operation while still configuring our data to retain 95% of patients within metric across all replications. KVVJ created an 81-slot arrangement for the primary provider in our minimization, generating between $25,000 and $30,000 in weekly income overall. In the 120 weeks that the simulation is run, the contribution of lowering staffing costs, and late fees remains under 3% of total cost, indicating strong access performance even though the estimated total revenue is between $3,000,000 and $3,600,000. Moreover, KVVJ the use of substantial funds within 120 weeks for our overall cost balances out due to our optimization of the number of slots, thus decreasing the overall cost in the final analysis. In the end KVVJ ensures prompt, effective care for every patient, and cost-effectiveness, and guides our customer in caring for a variety of patients.

Recommendation

Number of Replications	10
Number of Periods	12
Number of Slots Per Week (fulfills client-specific metric)	81

References

[1]"Primary Care in the United States A Chartbook of Facts and Statistics." Available: https://www.graham-center.org/content/dam/rgc/documents/publications-reports/reports/primary-care-chartbook.pdf

[2]L. B. closeLenny B. covering health and medicineEmailEmailBioBioFollowFollowHealth reporter, "How many patients should your doctor see each day?," *Washington Post*. https://www.washingtonpost.com/news/to-your-health/wp/2014/05/22/how-many-patients-should-your-doctor-see-each-day/

[3]"How profitable is a medical clinic?," *BusinessDojo*, Oct. 29, 2023. https://dojobusiness.com/blogs/news/medical-clinic-profitability