



# CALIFORNIA STATE SCIENCE FAIR 2012 PROJECT SUMMARY

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<b>Project Title</b> Cashier Strategies	
<b>Abstract</b> <b>Objectives/Goals</b> Determine which cashier strategy is most efficient. In this case, the strategy that results in the shortest average waiting time in the queue is the most efficient. I considered two cashier strategies: single-line and multi-line; the single-line strategy uses a single queue for all registers, and the multi-line strategy uses a single queue per register. <b>Methods/Materials</b> The experiment is performed by simulating a shop. To be able to do this, you need a computer and a C# development environment (I used Microsoft Visual Studio 2008). You also need the react.NET library for C# which provides basic functions for discrete simulations.  I created three different classes: Shop, Customer, and Register. A single instance (object) of the Shop class creates instances of both the Register and the Customer class. A Register object is created for each simulated register at the start of the simulation and Customer objects are created with a delay from an exponential distribution to simulate the arrival of customers in the simulated shop. For each Customer object, the simulation waits the browsing time (from a uniform distribution) before putting the Customer object in a queue where it waits for an available Register object. Register objects wait the serving time (from a uniform distribution) for each customer before releasing that customer. The Customer object then records its browsing time, waiting time and serving time. Each Register object records its idle time. <b>Results</b> In all 12 trials that I have conducted, the single-line method had a lower average waiting time than the multi-line method. These differences were sometimes very subtle, but some showed a large difference in average waiting time. The register idle time for the single-line method turned out to be lower than for the multi-line method; except in two of the trials. <b>Conclusions/Discussion</b> By observing the data, I conclude that the single-line method triumphs over the multi-line method in efficiency because the single-line method has a smaller average waiting time (a reduced average waiting time does not imply the waiting time using the single-line method is less for each individual simulated customer). Moreover, I conclude that the reduced average waiting time is caused by a reduced average register idle time with the single-line method. Further study is required to determine why the idle time was longer for the single-line method in two of the trials.	
<b>Summary Statement</b> Using a computer simulation, determine which cashier strategy, the multi-line or the single-line method, is more efficient.	
<b>Help Received</b> My father helped with the C# program.	