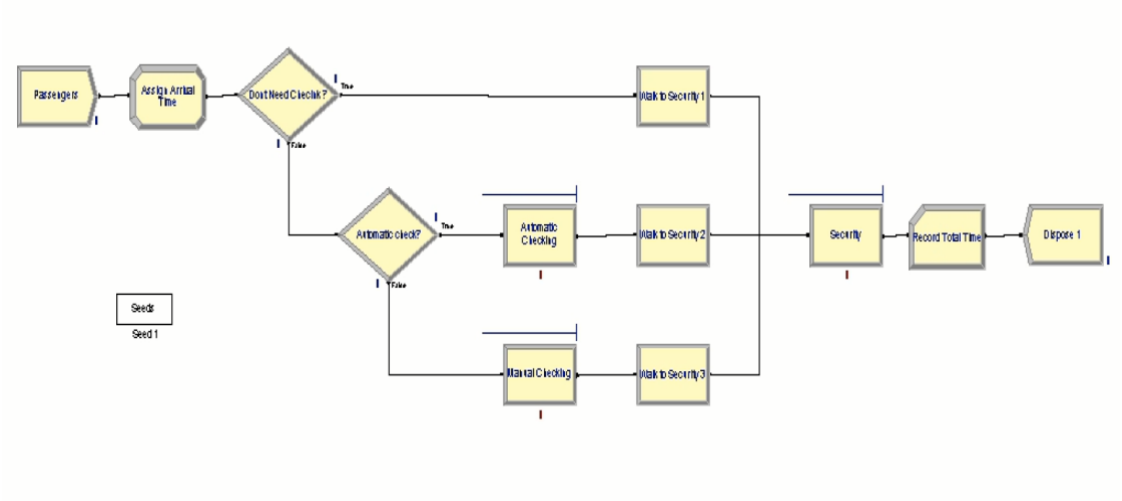
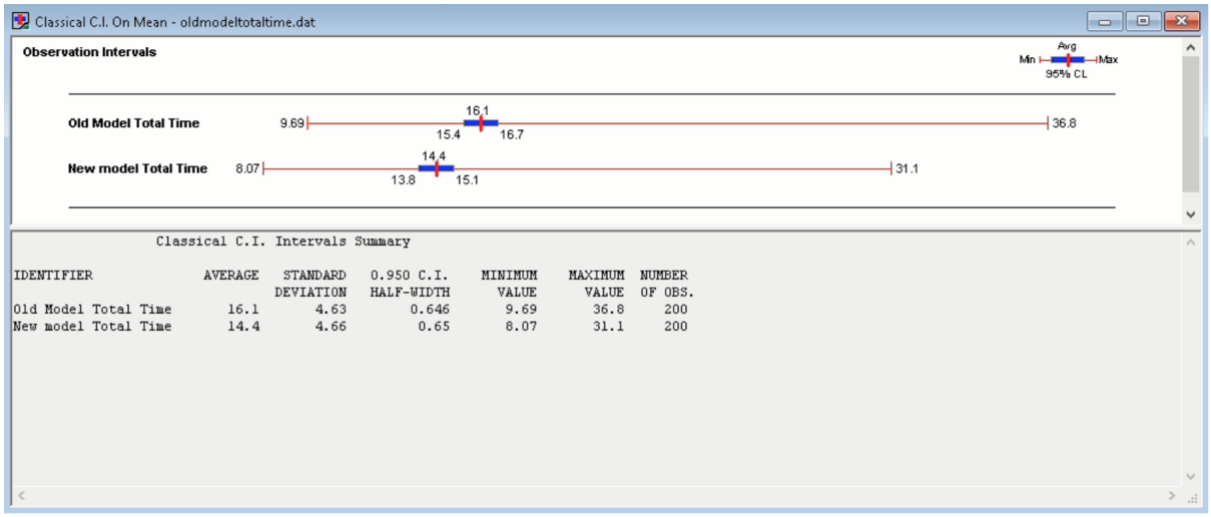
# PERFORMANCE ANALYSIS WITH SIMULATION

Management wants to study Terminal 3 at a hub airport with an eventual eye toward improvement. The first step is to model it as it is during the 8 hours through the busiest part of a typical weekday. We'll model the check-in and security operations only, that is, once passengers get through security they're on their way to their gate and out of our model. Passengers arrive one at a time through the front door from curbside ground transportation with interarrival times distributed exponentially with mean 0.5 minute (all times are in minutes unless otherwise noted). Of these passengers, 35% go left to an old-fashioned manual check-in counter, 50% go right to a new-fangled automated check-in counter, and the remaining 15% don't need to check in at all and proceed directly from the front door to security (it takes these latter types of passengers between 3 and 5 minutes, uniformly distributed, to make the walk from the front door to the entrance to the security area; the other two passenger types move instantly from their arrival to the manual or automated check-in counter as the case may be). There are two agents at the manual check-in station, fed by a single FIFO queue; manual check-in times follow a triangular distribution between 1 and 5 minutes with a mode of 2 minutes. After manual check-in, passengers walk to the security area, a stroll that takes them be- tween 2.0 and 5.8 minutes, uniformly distributed. The automated check-in has two stations (a station consists of a touch-screen kiosk and an employee to take checked bags; view a kiosk-employee pair as a single unified unit, that is, the kiosk and its employee cannot be separated), fed by a single FIFO queue, and check-in times are triangularly distributed between 0.5 and 1.5 with a mode of 1. After automated check-in, passengers walk to the security area, taking between 1 and 3 minutes, uniformly distributed, to get there (automated check-in passengers are just quicker than manual check-in passengers at everything). All passengers eventually get to the security area, where there are six stations fed by a single FIFO queue; security-check times are triangularly distributed between 1 and 6 with a mode of 2 (this distribution captures all the possibilities there, like x-ray of carry-ons, walking through the metal detector, bag search, body wanding, shoes off, laptop checking, etc.). Once through the security check (everybody passes, though it takes some longer than others to do so), passengers head to their gates and are no longer in our model.

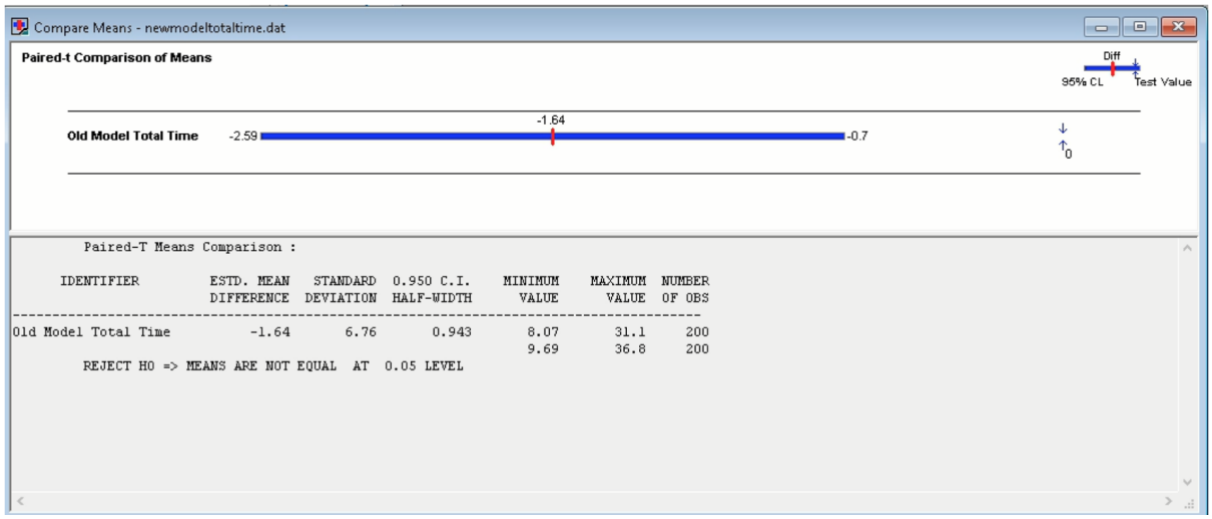





Classical C.I. Intervals Summary

| IDENTIFIER | AVERAGE | STANDARD DEVIATION | 0.950 C.I. HALF-WIDTH | MINIMUM VALUE | MAXIMUM VALUE | NUMBER OF OBS. |
|---|---|---|---|---|---|---|
| Old Model Total Time | 16.1 | 4.63 | 0.646 | 9.69 | 36.8 | 200 |
| New model Total Time | 14.4 | 4.66 | 0.65 | 8.07 | 31.1 | 200 |

Shown above are the mean total time for old system and new system with their confidence intervals. The systems have non-overlapping confidence intervals. Since we are measuring time in the system, we can conclude that new model performs better than the old model.




Paired-T Means Comparison :

| IDENTIFIER | ESTD. MEAN DIFFERENCE | STANDARD DEVIATION | 0.950 C.I. HALF-WIDTH | MINIMUM VALUE | MAXIMUM VALUE | NUMBER OF OBS |
|---|---|---|---|---|---|---|
| Old Model Total Time | -1.64 | 6.76 | 0.943 | 8.07 | 31.1 | 200 |
| | | | | 9.69 | 36.8 | 200 |

REJECT H0 => MEANS ARE NOT EQUAL AT 0.05 LEVEL

There is an improvement in the system because the new model has increased efficiency for the automated queue. The number of people in the manual queue has reduced and their wait times as well.