IE381/3081 – Modeling and Discrete Simulation Course

Mustafa Abdullah Hakkoz Marmara University, Istanbul, Turkey150117509 December 19, 2018

PROJECT-1 REPORT

FITNESS CENTER SIMULATION

PHASE – 2

* System description:

Aim of this project is showing how sport facility managers can use simulation to assist them with decisions concerning resource utilization. By runnig the simulation and considering output results sport facility managers can optimize workout programs by reducing queue times without overlooking personal preferences of agents.

* System components and their relations:
  + There are 2 types of new agents; bodybuilders and cardio persons. Bodybuilders will aim for workout-programs that use wight machines mostly. I accepted their standart weight as 80 kg and standart height as 1.80m for further calorie calculations.

Cardio persons will aim for work-out programs that burn calory by machines like bikes and treadmills. I produced their weight with rayleigh(10,80) and standart height as 1.80m for further calorie calculations.

* + 1 main coach named “main\_coach” who sends new comer agents to warm-up coach.
  + There are 3 assistant coaches. They will help people after deciding which program to follow. Actually we can say that each of them are abstract representions of one decision branch.
    - “warmup\_Coach\_7kmh”: sets system parameters (treadmillDuration, bikeDuration, treadmillFactor, bikeFactor) for light exercise (running speed:7kmh) due to warm newcomer agent up.
    - “weight\_Coach”: sets system parameters (treadmillDuration, bikeDuration, treadmillFactor, bikeFactor) for heavy weightlifting exercise.
    - “cardio\_Coach\_11kmh”: sets system parameters (treadmillDuration, bikeDuration, treadmillFactor, bikeFactor) for heavy cardio exercise exercise (running speed:11kmh).
  + There are 5 treadmills named “treadmills\_total5”, 3 bikes named “bikes\_total3” and their queue blocks in cardio exercise branch. This branch starts with “cardio\_Coach\_11kmh” and ends with a decision block named “isAgentBodyBuilder”. This decision block checks if the current agent is Bodybuilder or not. İf it is, the block sends it to weight lifting branch. Else, sends it to another decision block “limit\_cardio”. Main goal of this block is to seperate regular cardio exercies and warmups for weight exercises. “limit\_cardio”checks if the current agent (Cardio person) has reached the daily calorie limit to burn out (700 max.). If so, the block sends it to “exit” block; else sends it start of the cardio branch to repeat the process (with the probability of 30%. This operation is done by “stayDecision\_cardio”).
  + There are 5 weight machines named “weightMachines\_total5”, 3 weight benches named “benches\_total3” and their queue blocks in weight lifting branch. This branch starts with “weight\_Coach” and ends with a decision block named “limit\_weight”. “limit\_weight”checks if the current agent (Bodybuilder) has reached the daily work-out duration limit (120min max.). If so, the block sends it to “exit” block; else sends it start of the weight lifting brancs to repeat the process(with the probability of 60%. This operation is done by “stayDecision\_weight”).
* Input variables:
  + Interarrival time of agents:
    - Bodybuilder: poisson(10) mins
    - Cardio: poisson(8) mins
  + Service times of machines:
    - weightMachines\_total5: triangular( 1., 25., 30. )mins
    - benches\_total3: triangular( 1., 15., 20. ) mins
    - treadmills\_total5: triangular(1.,20.,30.) mins for regular, triangular(1.,15.,20.) mins for warmup exercixes.
    - bikes\_total3: triangular(1.,20.,30.) mins for regular,

triangular(1.,15.,20.) mins for warmup exercises.

* + Number of Machines:
    - Weight lifting machines(D1): 5
    - Wight lifting benches(D2): 5
    - Cardio treadmills(D3): 5
    - Cardio bikes(D4): 3
* Output variables:
  + Queue times of machines(Q1,Q2,Q3,Q4)
  + Service times of machines(S1,S2,S3,S4)
  + Average calorie spent in the system per customer(CSS)
  + Average calorie spent on the treadmill for 1 set of workout(CST)
  + Average calorie spent on the bike for 1 set of workout (CSB)
  + Average time spent in the system per customer (TSS)
  + Average time spent on the bench for 1 set of workout (TSB)
  + Average calorie spent on the weight machine for 1 set of workout (TSM)

CALCULATION AND ESTIMATION



* I decided to work only with CSS (calorie spent in sstem per agent)

1. 4 meaningful samples(underlying ones) are choosed for estimation.
2. 95% CI is calculated. 109,283 ≤ w0 ≤ 251,194
3. CI is narrowed down by 10%. 116,379 ≤ w1 ≤ 244,097
4. Number of repetitions is calculated. R=31
5. Interval of batches and new initial bias are calcuted. Int.=10000, Bias=31000

LONG-RUN PERFORMANCE OF MODEL-1



* I observed avg number of samples (174,67) is too low for daily goal of calorie (400).

It’s z-score is:

400-174,67=225,33

z-score = 255,33/19,12=11,79 its way too low so i decided to increase speeds of cardio machines (11 kmh -> 21 kmh) by increasing treadmillFactor and bikeFactor.

LONG-RUN PERFORMANCE OF MODEL-2



COMPARISON OF MODELS

