Dear Reviewer,

Thank you for your thorough refereeing of our manuscript Application of the multi-objective cross-entropy method to the vehicle routing problem with soft time windows. We appreciate your constructive criticism, and we want to respond to your comments as follows:

Explicit remarks
Your comments:


Line 5. Subsequently -> consequently Changed.

Page 3 and 4. There are no sub-tour elimination constraints. I think these are needed to complete the model. Alternately it would be enough for me to just mention that these constraints are excluded for brevity. Added in text as requested.

Page 6. Point 2. is -> are Changed.


Line 12. solve -> find a good local minimum for Changed.

Page 7 six lines from bottom. vector -> matrix Changed.

Page 8. Line 3 of section 5. these where -> which Changed.

Page 8 two thirds down. The letter q has changed meaning from vehicle capacity to route index. We discovered the mistake after submission; we changed the vehicle capacity to $C_k$, $q$ is still the route index.

Page 11, line 7 of the algorithm. Feas3, the cut off time back at depot is a new concept. Up till now we have only talked about the makespan. We changed it to read “vehicle is back at the depot in time”. This check is to ensure that the route is not too long, i.e. it takes longer than a “business day” to traverse the route. If that happens, the solution is not feasible.

Page 11, last line before section 6. Random -> Random according to the probabilities of the row of P Changed.

Page 12, first line of 6.2. Explain what a unary indicator is. We explained it, it as a function returning a single real-value from $\mathbb{R}$.

Page 14, line 8. What are $f_1$ and $f_2$? The $f_1$ and $f_2$ are irrelevant and we removed them.

Page 15 results. This is where I would like more comparison on total distance. Please see 3 below.

Page 17. Why is a 250 customer problem too large? Even in 2GB computers should be no problem. We tried to say that larger problems take significantly longer, but failed to do so. We changed the topic and stated that algorithm performance comparison should be done in future work. We are currently doing that, but we still do not know which metaheuristic to select and which not. If we compare the MOO CEM performance to metaheuristic “A”, then the question is “Why not “B”?” If we use “B”, the question is “Why not “A”?” and so on.

General comments
1. Your comments: Overall, this paper is well written with a good grasp of the subject. However I do not feel it is ready for publication as it contains what I consider to be a flaw that I would first like to be corrected before it is published. The paper does a good job of showing how the
cross entropy method can be used to deal with multiple conflicting objectives, but there is no evidence that in this setting the actual routes that are found by the method are good.

We have nothing to compare the results against. At the time of writing, there were no other studies found using this problem set. This problem set was published in 2011 (Castro-Gutierrez et al., 2011), and we are trying to be the first team to provide benchmark results for other researchers to use. We stated this in the article on page 2, line 4. On p. 6, six lines above Section 4, we again mention that we provide reference solution sets for other researchers, and also in the Conclusions (the latter was added during this revision). There are many single-objective reference sets for the VRPSTW in literature, but not for the multi-objective case with true conflicting objectives.

We have confidence in the results, for example the solution set shown in Figure 7 includes a solution with zero delay time. Of course we do not know if there is another solution also with five vehicles and zero delay time, which is shorter. But the latter was not an objective in this case. Figure 15 also shows that the MOO CEM found the absolute best (0,0), and based on these, we also believe that the other solutions are good.

2. I would like to first be assured that the solving method works well on single objective problems and I would also like to see comparisons between the solutions provided by the proposed method and the methods referenced in the literature.

The solving method works well on single-objective problems, as was shown by Ma (2011) and Chepuri & Homem-de-Mello (2005). Our objective was to extend the CEM to the multi-objective optimisation case.

3. There is insufficient comparison of total travel distance between the solutions. In practice, it would be important to understand the costs and trade-offs between the various solutions and this is not mentioned at all.

Travel distance is one of five objectives ($Z_2$). This is used as objective in for example Figure 9. We tried to show that the decision maker could use two objectives in various pairs to do multi-objective optimisation. Should he/she only want to minimise travel distance, the problem takes on the single-objective nature and falls outside of our research domain.

We mentioned in the text (p. 6, seven lines from the top) that total travel distance and number of vehicles as objectives are actually in harmony, so it is sufficient to minimise only one of these to minimise cost. We attempted to provide a broader decision spectrum to the decision maker.

4. In essence I would first need to be convinced that cross entropy is a competitive solution method for VRP problems before applying it to multiple objective VRP type problems.

We refer you to a previous response above: The solving method works well on single-objective problems, as was shown by Ma (2011) and Chepuri & Homem-de-Mello (2005). The foundation was laid through studies of the Travelling Salesperson Problem (TSP) by (Rubinstein & Kroese, 2004).
References


