

View Reviews

Paper ID

2441

Paper Title

Data-Driven Reinforcement Learning for Risk-Sensitive Player Evaluation in Ice Hockey

Reviewer #1

Questions

1. Please briefly summarize the main contributions of the paper in your own words. (Please do not include your evaluation of the paper here).

This paper proposes a method for measuring a player's impact over a season from data through a distributional RL model and a feature-space density estimator, which captures aleatoric risk and epistemic risk respectively. This former enables conditioning evaluation of performance on risk-averse/risk-seeking behavior via a confidence parameter and the latter alleviates the issue of OoD state-action pairs during testing. They evaluated their proposed architecture in the Ice Hockey performance evaluation setting, and showed that their method outperforms other methods of measuring performance of players.

2. What are the main strengths of the paper? Please focus on novelty, soundness, significance and impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility (as specified in our reproducibility guidelines).

- Paper is quite well-written with thorough explanations and diagrams to illustrate key concepts and contextual information on Ice Hockey in the paper, which is much appreciated from someone with not much Ice Hockey background; the paper was an easy read and definitions were mostly clear.
- Detailed ablation studies were done on the proposed method which proposed the use of CMAF and Distributional RL over other baseline methods. The comparisons with baselines using commonly used metrics in Ice Hockey is illustrative and seems to be sufficiently thorough as they compare against a pure RL approach, a naïve approach, an alternative GDA approach, a supervised learning approach and even includes other non-ML evaluation frameworks
- The use of distributional RL for player evaluation is an interesting and novel application; the risk sensitive evaluation seems particularly applicable in such a setting

3. What opportunities are there to improve the paper?

- The evaluation was done on a single dataset, and I would have liked to see it being applied on a different dataset or a variation of the existing dataset to see if the relationship in the correlations still stands
- One doubt I have is the effectiveness of the CMAF in estimating a low density for OoD samples, especially since it's applied in a post-hoc manner --- Section 6.3 tries to show this but if there is some sort of illustration or metric that directly measures the effectiveness/performance on OoD samples that would be helpful

Typos

- Expected-Goal in page 5 should have a space before the parenthesis
- Additional space after GDA-RiGIM in Section 6.2
- The OTG graph in Figure 6 seems to be incorrect and doesn't match the data shown in Table 4

4. What pressing questions do you have for the authors in the rebuttal ? List (and number) only questions about specific issues here that 1) could directly influence your evaluation of the paper, and 2) do not require providing new results. Typical questions include requests to clarify or justify particular issues, or about important relationships to other works.

- I noticed that even strength statistics (e.g. EVG/EVP) were omitted from the evaluation. I don't know enough about Ice Hockey but these statistics were found in the site linked and I was curious as to what the data would look like.
- In Figure 2, 3 agents are considered but in Section 3.1, only 2 agents (home, away) are defined. Could you clarify on how Figure 2 and Figure 3 should be interpreted?
- What is GIM (T1) in Table 4?
- In Figure 3, why are the action-values for Neither scored so high when the game is near ending?

5. Overall assessment.

Weak accept. Useful. A good paper. The results and insights will benefit the field. I believe it should be accepted.

6. Justify your score in a few lines. Please focus on novelty, soundness, significance, expected impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility.

Please see main comment.

7. Are the results in this paper easily reproducible ?

CONVINCING : I am convinced that the obtained results can be reproduced, possibly with some effort. Key resources (e.g., proofs, code, data) are already available, will be made available upon acceptance, or good reasons as to why they are not (e.g., proprietary data or code) are reported in the paper. Key details (e.g., proofs, experimental setup) are sufficiently well described but their exact recovery may require some work.

8. Independent of your judgement of the quality of the work, are there any ethical concerns with regard to responsible research or potential negative societal impacts of this submission that must be considered by IJCAI-ECAI 2022 before the paper can be accepted? Papers with a yes here will undergo additional ethical screening by senior members of the program committee. In case of glaring violations of well accepted ethical principles, IJCAI-ECAI 2022 reserves the right to reject the submission. Please check our Ethics Policy in the Call for papers for more details.

NA

Reviewer #2

Questions

1. Please briefly summarize the main contributions of the paper in your own words. (Please do not include your evaluation of the paper here).

1. This paper tries to use Distributional RL to capture both the aleatoric uncertainty and the epistemic uncertainty.
2. They propose a new metric called Risksensitive Game Impact Metric (RiGIM) to evaluate players' performance in Ice Hockey

2. What are the main strengths of the paper? Please focus on novelty, soundness, significance and impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility (as specified in our reproducibility guidelines).

1. The paper tries to use distributional RL method and the MAF model capture the aleatoric and epistemic uncertainties with action-value distributions
2. They design a data-driven RL framework that enables post-hoc calibrations on action values according to their uncertainties.

3. What opportunities are there to improve the paper?

See Question 4

4. What pressing questions do you have for the authors in the rebuttal ? List (and number) only questions about specific issues here that 1) could directly influence your evaluation of the paper, and 2) do not require providing new results. Typical questions include requests to clarify or justify particular issues, or about important relationships to other works.

1. In section 4.2, the density estimation is based on the expectation of Z , which is the Q function. Thus, it seems like there is no fundamental difference between this part and the CMAF. I want to know if more quantile information can be used here.

2. This paper uses NDQFN (Zhou et.al. 2021) to estimate the quantile distribution. However, NDQFN is designed for IQN, while some simple method such as NC-QRDQN can work for the QRDQN which is employed by this paper according to equation (1) of Section 4.1, and may be empirically more efficient. Some explorations about this is required.

Reference: Zhou, Fan, Jianing Wang, and Xingdong Feng. "Non-crossing quantile regression for distributional reinforcement learning." Advances in Neural Information Processing Systems 33 (2020): 15909-15919.

3. I'd like to see the potential application of this framework in other RL environments other the Ice Hockey in this paper.

5. Overall assessment.

Borderline Accept. Marginally above the acceptance threshold. Technically correct, but not particularly exciting or inspiring. Could be accepted more or less in its current form. Not a big loss if it is not included in the program. Please use sparingly.

6. Justify your score in a few lines. Please focus on novelty, soundness, significance, expected impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility.

This paper tries to use distributional RL method and the MAF model to do the offline evaluation, which captures the aleatoric and epistemic uncertainties with action-value distributions. However, some further studies are required as mentioned in the question part.

7. Are the results in this paper easily reproducible ?

CREDIBLE: I believe that the obtained results can, in principle, be reproduced. Even though key resources (e.g., proofs, code, data) are unavailable at this point, the key details (e.g., proof sketches, experimental setup) are sufficiently well described for an expert to confidently reproduce the main results, if given access to the missing resources.

8. Independent of your judgement of the quality of the work, are there any ethical concerns with regard to responsible research or potential negative societal impacts of this submission that must be considered by IJCAI-ECAI 2022 before the paper can be accepted? Papers with a yes here will undergo additional ethical screening by senior members of the program committee. In case of glaring violations of well accepted ethical principles, IJCAI-ECAI 2022 reserves the right to reject the submission. Please check our Ethics Policy in the Call for papers for more details.

No

Reviewer #3

Questions

1. Please briefly summarize the main contributions of the paper in your own words. (Please do not include your evaluation of the paper here).

This paper proposed a new player evaluation metric using distributional Q -value function estimations and density model for the Ice Hockey game. Compared with previous works, they utilized the Conditional Masked Auto-regressive Flow (CMAF) to estimate the epistemic uncertainty, in order to take the risk of the actions of the agent into consideration. Some empirical studies with ablations and variations of previous methods showed the superiority of the proposed method.

2. What are the main strengths of the paper? Please focus on novelty, soundness, significance and impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility (as specified in our reproducibility guidelines).

1. Good paper writing;
2. Detailed empirical studies.

3. What opportunities are there to improve the paper?

1. The motivation is not very reasonable;
2. The environment is limited.

4. What pressing questions do you have for the authors in the rebuttal ? List (and number) only questions about specific issues here that 1) could directly influence your evaluation of the paper, and 2) do not require providing new results. Typical questions include requests to clarify or justify particular issues, or about important relationships to other works.

The authors stated in section 3 about the motivation that "a distributional shift between the games in the training and testing dataset," meanwhile offline RL algorithms cannot be used to avoid this problem while evaluating the players' performance.

However, in section 5, the authors utilized a density model to measure the uncertainty of the value function, and made the value function avoid the uncertainty based on the density estimation. This methodology is the same as the uncertainty-based offline RL algorithms, such as [O'Donoghue et al., 2018; Agarwal et al., 2020; Kumar et al., 2020]. Besides, to solve the distributional shift between training and testing datasets, it is more natural to think of supervised learning technologies such as importance-weighting for the density-ratio calibration, or the outlier detection to avoid the out-of-distribution data. It is weird to connect it with a risk-averse situation.

Also, This work only considers the ice hockey dataset. But there exist many mature multi-agent simulators. Why just narrow the method to this environment?

[O'Donoghue et al., 2018] The uncertainty bellman equation and exploration. ICML 2018.

[Agarwal et al., 2020] An optimistic perspective on offline reinforcement learning. ICML 2020.

[Kumar et al., 2020] Conservative q-learning for offline reinforcement learning. NeurIPS 2020.

5. Overall assessment.

Borderline Accept. Marginally above the acceptance threshold. Technically correct, but not particularly exciting or inspiring. Could be accepted more or less in its current form. Not a big loss if it is not included in the program. Please use sparingly.

6. Justify your score in a few lines. Please focus on novelty, soundness, significance, expected impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility.

This paper used distributional value function estimation to evaluate the players' performance with offline datasets and utilized density estimation technologies to avoid the action risk while learning. I think it is novel to consider the risk-averse problem during evaluation. Also, the proposed method is reasonable. But it is unnatural to motivate this work by comparisons with the distributional shift between training and testing datasets, as well as the comparisons with offline RL scenarios.

7. Are the results in this paper easily reproducible ?

CONVINCING : I am convinced that the obtained results can be reproduced, possibly with some effort. Key resources (e.g., proofs, code, data) are already available, will be made available upon acceptance, or good reasons as to why they are not (e.g., proprietary data or code) are reported in the paper. Key details (e.g., proofs, experimental setup) are sufficiently well described but their exact recovery may require some work.

8. Independent of your judgement of the quality of the work, are there any ethical concerns with regard to responsible research or potential negative societal impacts of this submission that must be considered by IJCAI-ECAI 2022 before the paper can be accepted? Papers with a yes here will undergo additional ethical screening by senior members of the program committee. In case of glaring violations of well accepted ethical principles, IJCAI-ECAI 2022 reserves the right to reject the submission. Please check our Ethics Policy in the Call for papers for more details.

None.

Questions

1. Please briefly summarize the main contributions of the paper in your own words. (Please do not include your evaluation of the paper here).

The paper tackles the problem of evaluating the performance of players in Ice Hockey. The authors propose an approach based on data-driven reinforcement learning. The key feature is that the approach is risk-sensitive, and takes into account both aleatoric uncertainty and epistemic uncertainty. The proposed Risk-sensitive Game Impact model relies on the adoption of a distributional bellman Operator to model aleatoric uncertainty, while for the epistemic uncertainty the authors rely on conditional masked auto-regressive flow to estimate OoD samples. The approach is evaluated on a large set of data, demonstrating substantial correlation capabilities.

2. What are the main strengths of the paper? Please focus on novelty, soundness, significance and impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility (as specified in our reproducibility guidelines).

The paper is well written. It tackles an interesting problem. It appears to be sound. The experimental evaluation is solid and demonstrates substantial improvements over the competitor approaches.

3. What opportunities are there to improve the paper?

The paper is not self contained. It is very technical and lack the intuitions underlying the approach; it is especially hard to understand the link to the ice hockey game. There are several underlying assumptions that should be made explicit, and that seem to limit the significance of the contribution.

Specifically, the definitions of aleatoric uncertainty and epistemic uncertainty are unclear.

“(2) we demonstrate” -> We

End of sec 4, avoid scattered refs to implementation.

Typo – Plus/minus

RiGIM has often extra spaces, use xspace macros.

4. What pressing questions do you have for the authors in the rebuttal ? List (and number) only questions about specific issues here that 1) could directly influence your evaluation of the paper, and 2) do not require providing new results. Typical questions include requests to clarify or justify particular issues, or about important relationships to other works.

Section 3.1 – isn't the defensive game taken into account? See also Caption of Figure 2, please clarify.

The division of a game into goal-scoring episodes seems to be quite limiting – what about for examples situations where a Home play does not lead to scoring, and is followed by a subsequent Away action, possibly multiple times, until a team scores? Is a numerical discount factor sufficient? Wouldn't a more fine-grained episode decomposition be more informative?

Apparently Actions are labeled with the team – however, an action is the result of players moving without ball and possibly fainting movements. Is this aspect of the game disregarded?

Is the number of players in the field (e.g. due to expulsions) taken into account?

Please justify the need for a risk-sensitive player evaluation metric, the motivation is only technical but fails to justify why it is important to better capture relevant aspects of the game itself?

5. Overall assessment.

Borderline Accept. Marginally above the acceptance threshold. Technically correct, but not particularly exciting or inspiring. Could be accepted more or less in its current form. Not a big loss if it is not included in the program.

Please use sparingly.

6. Justify your score in a few lines. Please focus on novelty, soundness, significance, expected impact, relevance to AI, clarity of exposition, and credibility with regard to reproducibility.

The paper presents a new approach that leads to improvements over the state of the art. It appears to be sound.

7. Are the results in this paper easily reproducible ?

CREDIBLE: I believe that the obtained results can, in principle, be reproduced. Even though key resources (e.g., proofs, code, data) are unavailable at this point, the key details (e.g., proof sketches, experimental setup) are sufficiently well described for an expert to confidently reproduce the main results, if given access to the missing resources.

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NO