2024 IM^{2}C
Global Sports League

Background

Fair competition in sports requires a balance of logistics, equity, and practicality, especially when organizing sporting competitions on an international scale. The International Multi-Continental Matchmaking Committee (IMMC) seeks your expertise to develop a scheduling system for their upcoming Global Sports League (GSL). This league will feature teams from around the world, emphasizing geographic diversity, competitive equity, and logistical feasibility. The IMMC also values economic and environmental sustainability, wants to ensure fair matchups and requires the league to include 20 teams with at least two teams from each continent (excluding Antarctica). The GSL season runs between 8 and 9 months.

While the IMMC has outlined key criteria for the league, they have not yet determined the sport to be played in the GSL. Some sports already have an established international presence, while others have limited global reach. The IMMC is open to considering any **team sport**, provided your team can demonstrate its potential for global expansion within the GSL framework. This is where your expertise is needed.

Your team is invited to select a sport you are passionate about, develop a model that produces a fair and effective schedule for the GSL, and test how well your scheduling model adapts to changes in the league.

Requirements

1. Identify key factors
    a. What is the sport? The GSL is a **team sport** competition (see Glossary for details).
    b. Who are the teams and where are they located? Identify 20 teams to participate, ensuring at least two teams represent each continent (excluding Antarctica). Clearly explain the criteria used to select these teams.

c. What aspects need to be considered when building a league schedule? The IMMC expects the schedule to consider travel distance, the number of games played and equitable matchups, but they are unsure of other components that may be of importance. Identify any additional key components that should be considered when developing a fair GSL schedule and discuss trade-offs involved in balancing these factors.

2. Develop the initial schedule

   Build a mathematical model to construct a fair and practical schedule for the 20 team GSL. At the very least, ensure your scheduling model accounts for

   - Fair distribution of games across teams,
   - Equitable travel time and distance,
   - Balanced competitiveness of matchups.

   Use your model to create a full season league schedule for your selected sport and provide evidence that demonstrates how it achieves IMMC goals of fairness, sustainability, and geographic representation. Additionally, determine the number of games each team must play to reasonably declare a league winner at the conclusion of the season.

3. Expand the GSL and extend the model
   a. Add four teams to the Global Sports League. Clearly explain the criteria used to select these teams.
   b. Evaluate how this expansion impacts the league schedule. Make sure to address fairness, sustainability, and geographic representation.
   c. Assess how the addition of four teams impacts the number of games that need to be played by each team in order to reasonably declare a league winner.
   d. Analyze how changes to key constraints (e.g., travel distances, change in home location of a team, number of league games) impact your model.

4. Generalize the model

   In two pages or less, discuss how one could adapt your model to different team sports with distinct rules, game lengths, and team dynamics.

5. Communicate your solution to a non-technical audience
   a. Write a one-page letter to the IMMC summarizing your findings. In your letter, explain how your model aligns with the IMMC's goals for the league. Ensure your explanation is accessible to a non-technical audience.
   b. Provide a **visual graphic** of the initial 20-team GSL schedule on a separate page.

Your PDF submission should consist of:

- One-page Summary Sheet.
- One-page Table of Contents.
- One-page *Letter to the Decision Makers* with your recommendation (as noted in question 5a).

    Write a one-page letter to the IMMC summarizing your findings. In your letter, explain how your model aligns with the IMMC's goals for the league. Ensure your explanation is accessible to a non-technical audience.
- One-page Visual Graphics of the initial 20-team GSL schedule (as noted in question 5b).
- Your complete solution. Twenty pages (maximum) communicating essential aspects of your solution.
- Reference List.
- AI Use Report (if used).
- The following items do not count towards the 24-page limit: Reference List and Appendices (including AI Use Report).

Note: There is no specific required minimum page length for a complete IM^{2}C submission. We permit the careful use of AI such as ChatGPT, although it is not necessary to create a solution to this problem. If you choose to utilize a generative AI, you must follow the IM^{2}C AI use policy. This will result in an additional AI use report that you must add to the end of your PDF solution file and does not count toward the 24 total page limit for your solution.

Your PDF submission paper must be typed and in English using A4, margins at least 1.5cm (OR) Letter, margins at least 0.6in with at least 12-point font size. For detailed information about IM^{2}C submission guidelines and the general expectations for each portion of your solution please review the Full Submission Guidelines.

Glossary

A **team sport** is a sport in which multiple players collaborate to achieve a common objective, ultimately leading to victory in a game or match. To qualify for potential inclusion in the GSL, the sport must require a minimum of five players per team actively participating on the field, court, or playing area at all times throughout the match.
Examples of eligible sports (non-exhaustive): football (soccer), basketball, cricket, rugby, American football, volleyball, handball, water polo, and lacrosse.

A **visual graphic** is a visual representation of information, data, or ideas, typically combining images, text, and design elements to communicate a message effectively.

2025 IM^{2}C Full Submission Guidelines

Teams may use any inanimate source of data, materials, computers, software, references, websites, books, etc. Be sure to credit all sources used.

Teams may not use any person (other than team members) to discuss or obtain ideas for solving their problem **nor may they seek help in obtaining an answer from the teams' advisor or anyone else**. Any team that discusses the problem with anyone in a position to supply them with information reflecting experience or professional expertise will be disqualified. The relevant issue is one of intent: each team of students is expected to develop all of its substantive analysis without the help of others.

Partial solutions are acceptable. There is no passing or failing cutoff score, nor will numerical scores be assigned. The IM^{2}C judges are primarily interested in a teams' approach and methods.

The solution must consist entirely of written text and possibly figures, charts, or other written material only. No non paper support such as computer disks or applications will be accepted.

Each page of the solution should contain the team control number and the page number at the top of the page; we suggest using a page header on each page for example: Team # 2024000 page 6 of 13.

The names of the students, advisor, or institution must not appear on any page of the solution. The solution must not contain any identifying information other than the team Control Number.

Teams should keep in mind the following guidelines while preparing their solution papers:

- Conciseness and organization are extremely important. Key statements should present major ideas and results.
- Present a clarification or restatement of the problem as appropriate.
- Present a clear exposition of all variables, assumptions, and hypotheses.
- Present an analysis of the problem, motivating or justifying the modeling to be used.
- Include a design of the model. Discuss how the model could be tested.
- Discuss any apparent strengths or weaknesses to your model or approach.
- Incorporate lengthy derivations, computations, or illustrative examples in appendices. Summarize these in the main report. Results must be explicitly stated in the body of the report.

Your PDF solution should include:

- **One page Summary Sheet.**

  The Audience for the summary sheet is anyone unfamiliar with the problem. Hence, in your own words briefly outline the problem, the main solution approach, and your conclusion.

To write a good summary, imagine that a reader may choose whether to read the body of the paper based on your summary. Thus, a summary should clearly describe your approach to the problem and, most prominently, what your most important conclusions were. The summary should inspire a reader to learn the details of your work. Your concise presentation of the summary should inspire a reader to learn the details of your work.

- **One page Table of Contents.**

  This allows the reader to easily find various parts of your solution, especially if they chose not to read though in order (as is typical when reading long reports).

- **One page *Letter to the Decision Makers* with your recommendation.**

  Addressed to the Directors of the IMMC, this letter should concisely present your recommendation for developing a scheduling system for the Global Sports League (GSL) based on your chosen sport. Since the audience is already familiar with the problem and has reviewed your Summary Sheet, avoid repetition and focus on essential insights from your solution. Clearly communicate key details of your proposed scheduling model, emphasizing its alignment with the IMMC's goals. The letter should be concise, persuasive, and easily understandable, ensuring decision-makers can quickly grasp the strengths of your approach found in your full report.

- **One-page Visual Graphic**

  The one-page visual graphic should be clear, engaging, and designed for a non-technical audience, supporting the ***Letter to the Decision Makers*** by visually summarizing key insights from your initial 20-team GSL schedule. The goal is to present as much relevant information as possible in a visually intuitive way, ensuring that stakeholders, including the Directors of the IMMC, can quickly grasp the impact and effectiveness of your scheduling model.

- **Twenty-page** (maximum) **report** communicating the essential aspects of your solution.

- The specifications of a complete solution:
  - A4, margins at least 1.5cm (OR) Letter, margins at least 0.6in
  - Papers must be typed and in English.
  - At least 12-point font size.
  - **Note that (excluding references and appendices, see below) you have a maximum of 24 pages to communicate your solution.** Your summary sheet, letter to the decision makers, visual graphic, and your table of contents all count towards the 24-page limit (excluding references and appendices) of your solution.

Compliance: *Failure to meet these specifications or attempts to circumvent them may result in a lower designation or disqualification.*

- **Reference List, Appendices, and AI Use Report.**

  A list of references, any appendices, and the AI Use Report, ***do not count*** toward the 24-page limit and should appear after your completed solution. You should not make use of unauthorized images and materials whose use is restricted by copyright laws. Ensure you cite the sources of all ideas and materials (data, images, etc.) so it is clear to the reader what ideas and mathematical work was completed by your team and where you are building in ideas of others.

Use of Large Language Models and Generative AI Tools in the IM^{2}C

This policy is motivated by the rise of large language models (LLMs) and generative AI assisted technologies. The policy aims to provide greater transparency and guidance to teams, advisors, and judges. This policy applies to all aspects of student work, from research and development of models (including code creation) to the written report. Since these emerging technologies are quickly evolving, IM^{2}C will refine this policy as appropriate.

Teams must be open and honest about all their uses of AI tools. The more transparent a team and its submission are, the more likely it is that their work can be fully trusted, appreciated, and correctly used by others. These disclosures aid in understanding the development of intellectual work and in the proper acknowledgement of contributions. Without open and clear citations and references of the role of AI tools, it is more likely that questionable passages and work could be considered plagiarism and disqualified.

Solving the problems does not require the use of AI tools, although their responsible use is permitted. The IM^{2}C recognizes the value of LLMs and generative AI as productivity tools that can help teams in preparing their submission; to generate initial ideas for a structure, for example, or when summarizing, paraphrasing, language polishing etc.

If, for example, you are writing your IM^{2}C article in a language other than English and translating to English using LLMs or reading an article in English and translating into another language for understanding in your AI report please state, "we used LLMs for translation purposes."

However, there are many tasks in model development where human creativity and teamwork is essential, and where a reliance on AI tools introduces risks. Therefore, we advise caution when using these technologies for tasks such as model selection and building, assisting in the creation of code, interpreting data and results of models, and drawing scientific conclusions.

It is important to note that LLMs and generative AI have limitations and are unable to replace human creativity and critical thinking. IM^{2}C advises teams to be aware of these risks if they choose to use LLMs:

- Objectivity: Previously published content containing racist, sexist, or other biases can arise in LLM-generated text, and some important viewpoints may not be represented.
- Accuracy: LLMs can ‘hallucinate’ i.e. generate false content, especially when used outside of their domain or when dealing with complex or ambiguous topics. They can generate content that is linguistically but not scientifically plausible, they can get facts wrong, and they have been shown to generate citations that don’t exist. Some LLMs are only trained on content published before a particular date and therefore present an incomplete picture.
- Contextual understanding: LLMs cannot apply human understanding to the context of a piece of text, especially when dealing with idiomatic expressions, sarcasm, humor, or metaphorical language. This can lead to errors or misinterpretations in the generated content.
- Training data: LLMs require a large amount of high-quality training data to achieve optimal performance. In some domains or languages, however, such data may not be readily available, thus limiting the usefulness of any output.

Guidance for teams

Teams are required to:

1. **Clearly indicate the use of LLMs or other AI tools in their report,** including which model was used and for what purpose. Please use inline citations and the reference section. Also append the Report on Use of AI (described below) after your 23-page solution.
2. **Verify the accuracy, validity, and appropriateness** of the content and any citations generated by language models and correct any errors or inconsistencies.
3. **Provide citation and references, following guidance provided here.** Double-check citations to ensure they are accurate and are properly referenced.
4. **Be conscious of the potential for plagiarism** since LLMs may reproduce substantial text from other sources. Check the original sources to be sure you are not plagiarizing someone else's work.

IM^{2}C will take appropriate action when we identify submissions likely prepared with undisclosed use of such tools.

Citation and Referencing Directions

Think carefully about how to document and reference whatever tools the team may choose to use. A variety of style guides are beginning to incorporate policies for the citation and referencing of AI tools. Use inline citations and list all AI tools used in the reference section of your 24-page solution.

Whether or not a team chooses to use AI tools, the main solution report is still limited to 24 pages. If a team chooses to utilize AI, following the end of your report, add a new section titled Report on Use of AI. This new section has no page limit and will not be counted as part of the 24-page solution. Examples (this is *not* exhaustive – adapt these examples to your situation):

Report on Use of AI

1. OpenAI *ChatGPT* (Nov 5, 2023 version, ChatGPT-4)
   Query1: <*insert the exact wording you input into the AI tool*>
   Output: <*insert the complete output from the AI tool*>

2. OpenAI *Ernie* (Nov 5, 2023 version, Ernie 4.0)
   Query1: <*insert the exact wording of any subsequent input into the AI tool*>
   Output: <*insert the complete output from the second query*>

3. Github *CoPilot* (Feb 3, 2024 version)
   Query1: <*insert the exact wording you input into the AI tool*>
   Output: <*insert the complete output from the AI tool*>

4. Google *Bard* (Feb 2, 2024 version)
   Query: <*insert the exact wording of your query*>
   Output: <*insert the complete output from the AI tool*>

5. GitHub *CoPilot* (Jan 16, 2024 version) *Auto-completions for code used in preparing our models*.