Center for the Advancement of Population Assessment Methodology

Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

CAPAM

CIAT
IATTC

IATTC – CAPAM Workshop on Model Weighting

Mark Maunder

Virtual meeting, 28 Nov – 2 Dec (8am to 11am - San Diego)

IATTC Welcome

- Director: Arnulfo Franco
- Coordinator of Scientific Research: Alexandre Aires-da-Silva

IATTC Welcome

- This workshop series follows a request from IATTC SAC to improve the risk analysis for the tropical tuna
- The model weighting in the risk analysis conducted in 2020 was mostly subjective. Our goal is to develop a method to more objectively assign weights in the risk analysis.
- First workshop on Diagnostics Jan 31-Feb 3, 2022
- We are using the CAPAM framework because it is a common challenge across all types of stock assessments and management.
- This workshop will continue at an ISSF sponsored session during the tuna good practices workshop in New Zealand 7-10 March 2023

Welcome

FIFA WORLD CUP
Qatar2022

Workshop Rules

- General
  - Keep microphone muted when not talking
  - Keep camera off if not talking
  - Limit chat to questions, discussions and technical issues
- Questions for presenters
  - Ask questions through the chat
  - Use “QUESTION:” before the question so it can be identified
  - Questions will be read at end of presentation after presentation
  - Order by Chairs prerogative
- Discussions
  - Raise hand to get permission to talk
  - Lower hand before talking
  - Mute yourself when finished talking
  - Moderators may read questions from the chat box

Technical questions

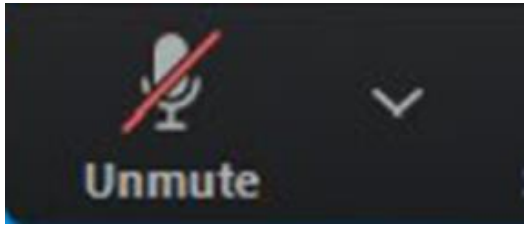
- Please use the chat to ask any technical questions
- Use “TECHNICAL:” before the question so it can be identified
- The IATTC staff will try to assist you

Presenters

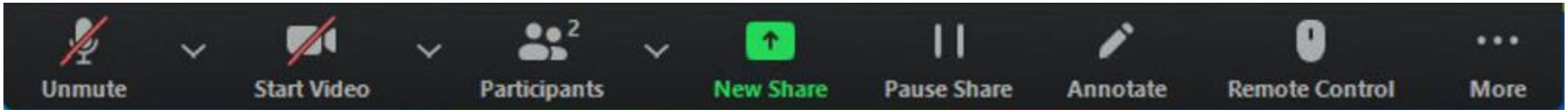
- Please leave 5-10 minutes for questions
- Stop sharing and mute yourself when finished presenting and answering questions
- Please provide presentations to be posted online

Attendee’s controls

If given permission to speak



Presenter’s controls



Warning

- Presentations and discussions will be recorded and posted online

Motivation: IATTC Risk analysis

- Assessments are uncertain
- IATTC HCR for tropical tunas (Resolution C-16-02) addresses uncertainty through probability statements
  - "if the probability that F will exceed the limit reference point (F_{LIMIT}) is greater than 10%, as soon as is practical management measures shall be established that have a probability of at least 50% of reducing F to the target level (F_{MSY}) or less, and a probability of less than 10% that F will exceed F_{LIMIT}."
- Transition from single base-case assessment to set of reference models
  - Model structure uncertainty

Why model weighting/averaging

- Better point estimates
- Better representation of uncertainty
  - Model uncertainty
- To answer probability statements
  - $P(B < B_{MSY}) < 0.1$
- To create Operating Models for Management Strategy Evaluation

IATTC Risk Analysis: Main concept

- A rigorous statistical framework is not applicable
  - Multiple model assumptions are possible
  - Stock assessment models are complex and highly parameterized
  - Models are misspecified
  - Process variation is ignored
  - Data are not weighted appropriately
- Fit to data (e.g. AIC) should not be solely used to weight models

Weighting system: Weight metrics

- W(Expert): Assigned “a-priori”, without consideration of model fit
- W(Convergence): Model convergence criteria of the estimation algorithm
- W(Fit): Fit of model to data
- W(Plausible parameters): Plausibility of estimates of parameters representing the hypothesis
- W(Plausible results): Plausibility of model results
- W(Diagnostics): Reliability of the model based on diagnostics

https://www.iattc.org/Meetings/Meetings2020/SAC-11/Docs/_English/SAC-11-INF-F_Implementing%20risk%20analysis.pdf

Weighting

- Subjective
- Panel of experts
- Differences in interpretation and scoring

First workshop

- Workshop on Model Diagnostics in Integrated Stock Assessments
- Virtual meeting, Jan 31-Feb 3, 2022
- Report on CAPAM website and in Google Drive

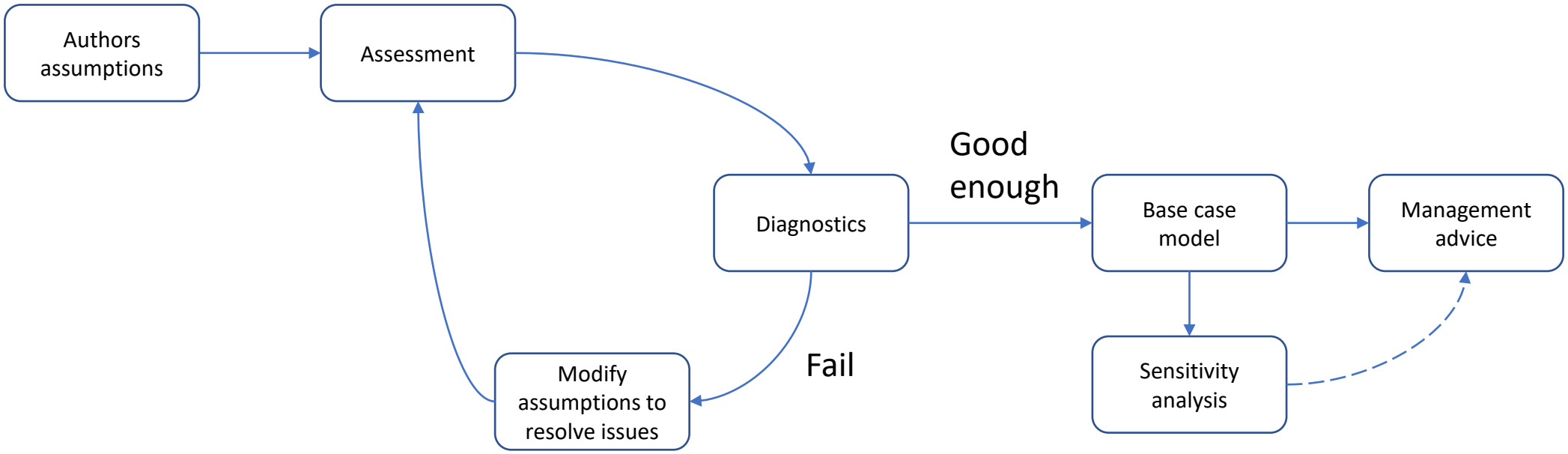
First workshop goals

- Design an approach to diagnostics that is more objective, transparent, and automated
  - Identifying and defining candidate diagnostics
  - Create quantitative criteria for using each diagnostic
  - Evaluate diagnostics
    - Identify model misspecification is present
    - Identify what is misspecified
    - Recommend how to fix the misspecification
  - Automate the diagnostics

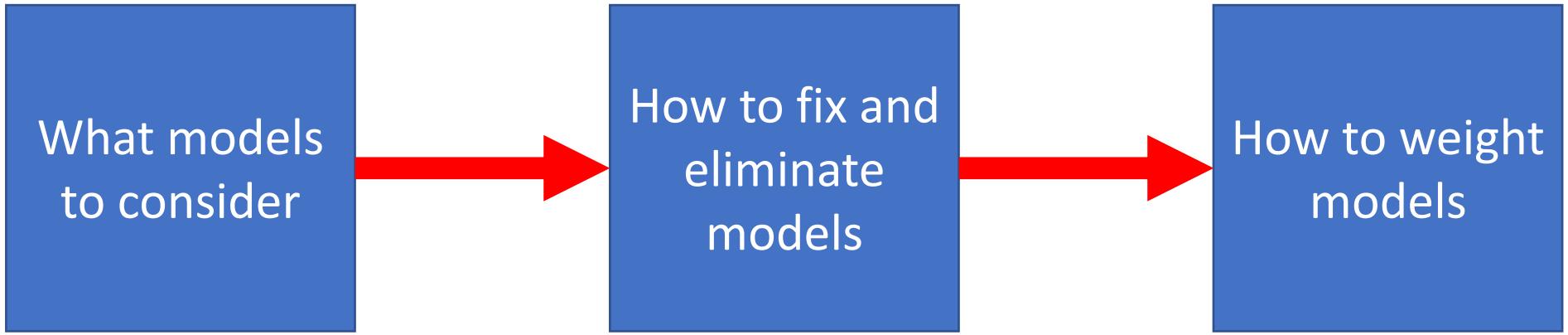
Second workshop goal

- Design an approach to create an ensemble and to weight models in that ensemble that is more objective, transparent, and automated.

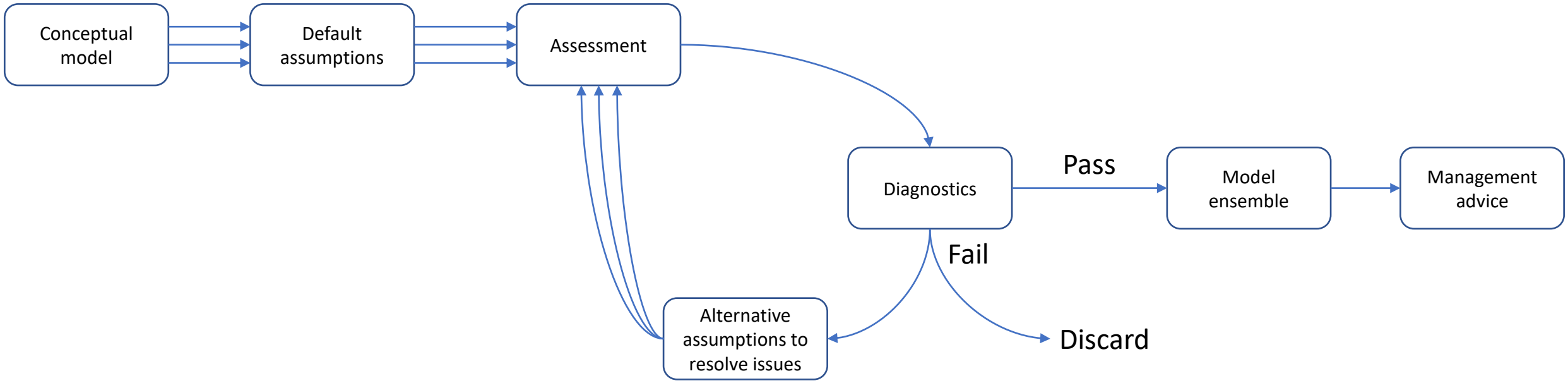
Typical historic approach



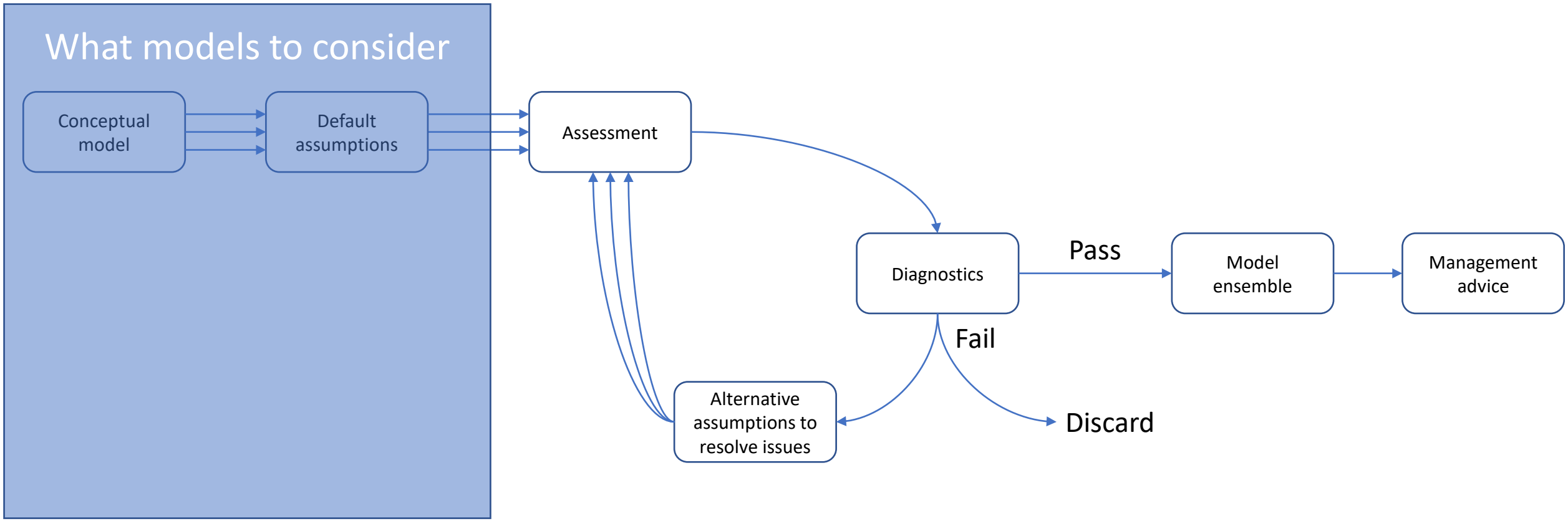
Model ensemble approach



Ensemble model approach



Expert system to construct an ensemble of models for fisheries stock assessment



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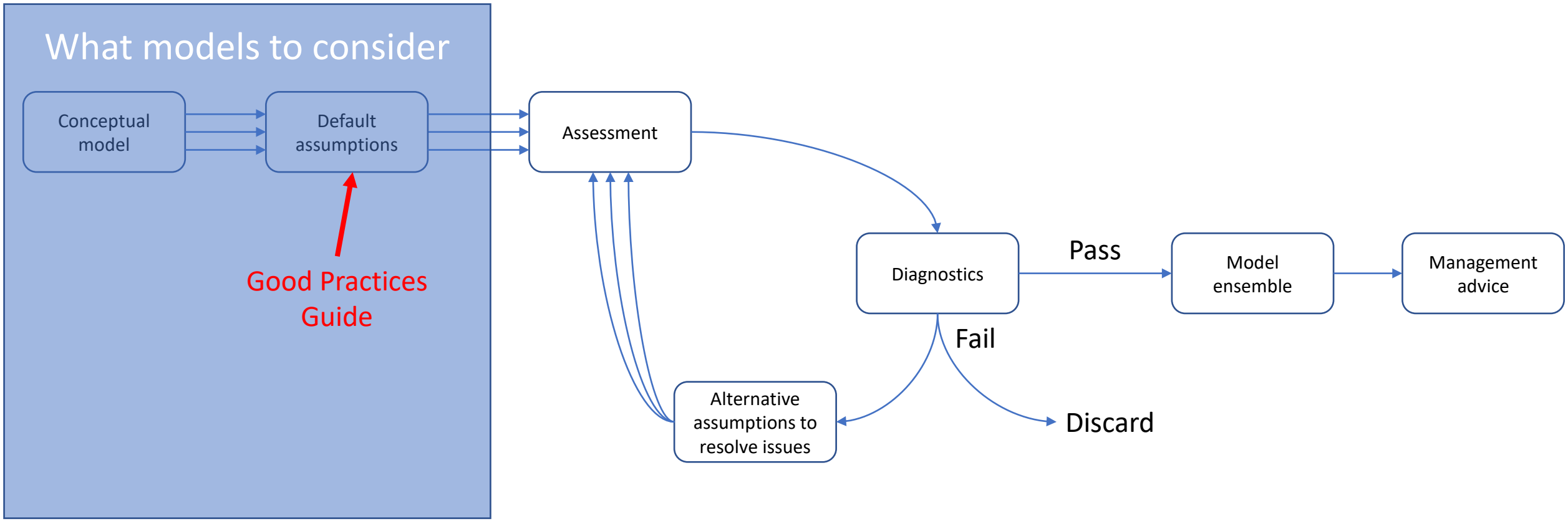

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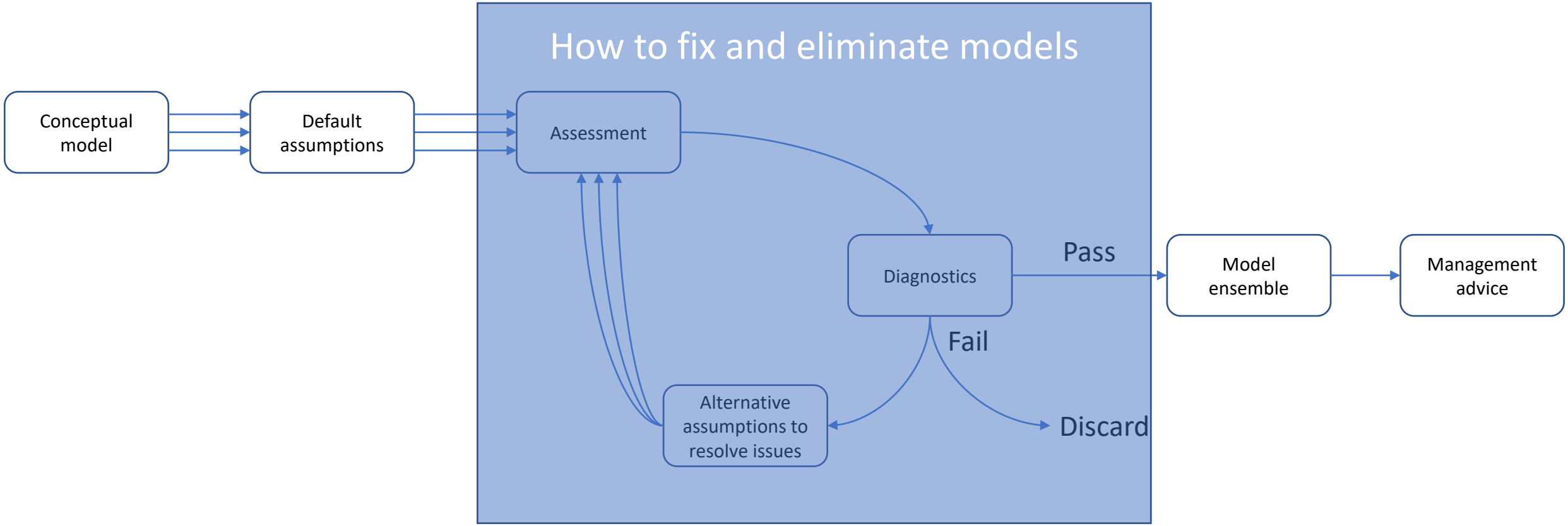

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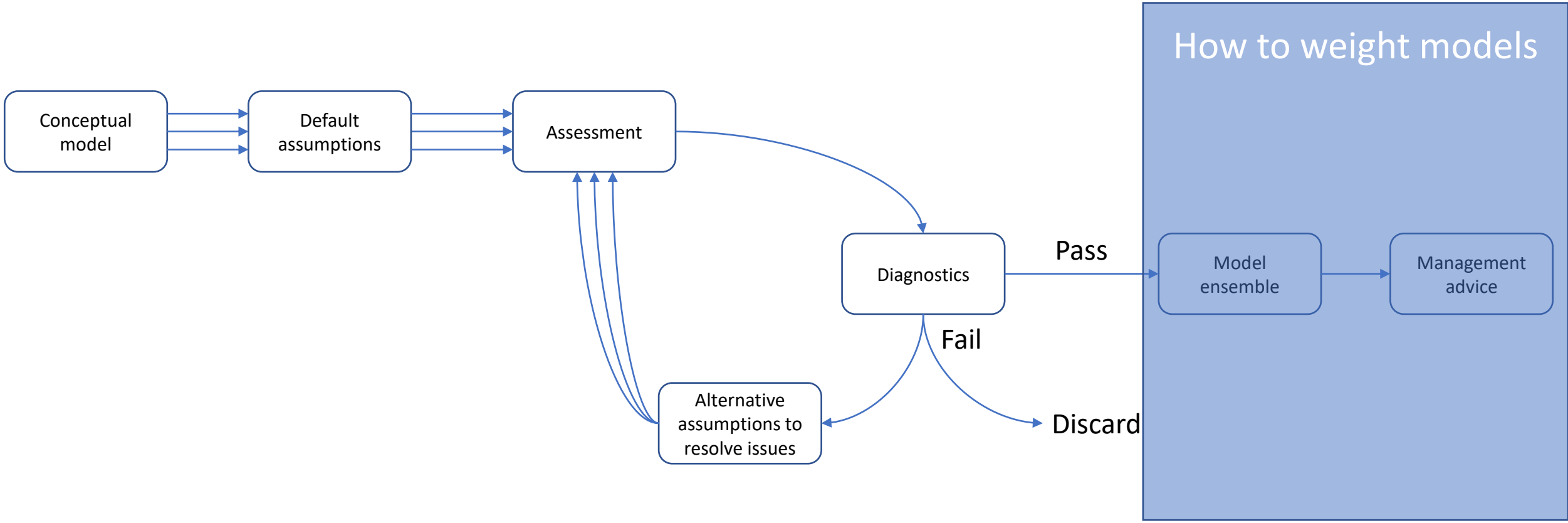

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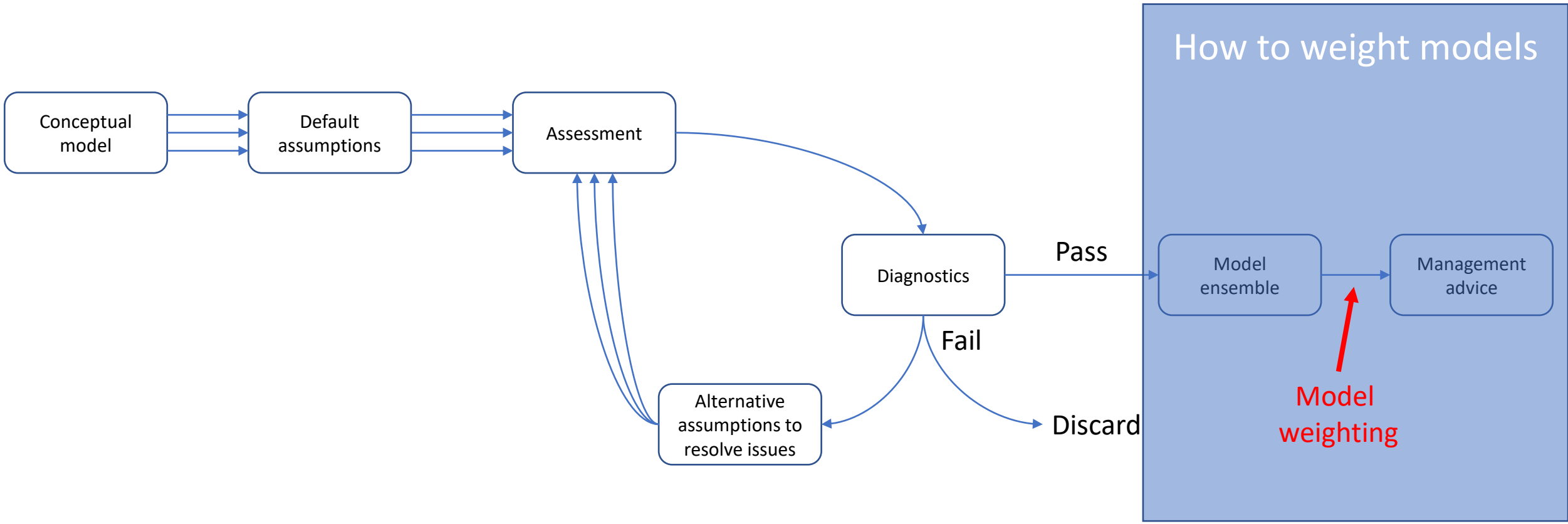

Model Weighting Issues in Fishery Stock Assessment

- Time series
  - Makes cross validation complicated
- Multiple data types
  - What data to predict
- Quantities of interest are not observed
  - e.g. B, F, B/B_{MSY}
  - Predict observation -> model is good -> predicts quantity of interest
- Data weighting is unreliable
  - Can't use fit to the data (e.g. AIC etc.)
- Completely different models with different structure and different data
- Correlated models
  - Have similar components, fit to the same data, estimate the same parameters
- Most, if not all, model fail at least one diagnostic
- Data that goes into the model is process and often has limited evaluation (e.g. CPUE standardization, raising composition data)
  - Data has to be representative of the population (i.e. spatially)

Approach

- Select candidate models
- Avoid duplicated models
- Eliminate bad models
- Simple prediction weighting based on data most connected to the quantity of interest
  - E.g. a reliable and representative index of relative abundance

Agenda

8am – 11am San Diego time
15 min breaks at 10am

- **Monday**
- Introduction
- **Tuesday**
- Which models to consider and what measures (diagnostics) should be used to exclude models
- What measures to use in weighting and how to determine the weight for each metric
- **Wednesday**
- How to combine weights
- **Thursday**
- Applications
- **Friday**
- Summary (if needed)

Agenda: Monday

- 8:00 Welcome: IATTC
- 8:10 Introduction: Mark Maunder
- 8:30 Model weighting in the IATTC risk analysis approach: Mark Maunder
- 9:00 A review of model averaging and the way forward: Carsten Dormann
- 10:00 Break
- 10:15 Summary of the ICES 2022 Network Session on ensemble models: Ernesto Jardim
- 10:45 Discussion

Key concept of CAPAM workshops

Discussion

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