



A Program of The Actuarial Foundation

Modeling the Future Challenge

Session #1: Actuarial Process Training

Institute of Competition Sciences || Spring 2022

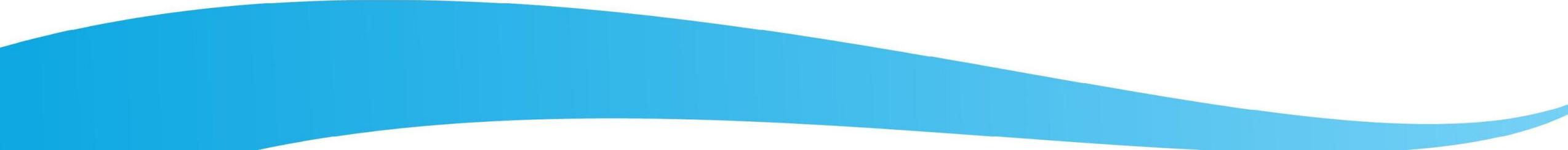
Session 1 - Agenda

10:00-10:10 AM	Welcome & Intros
10:10-10:50 AM	MTFC, Challenge-based learning & Actuarial Science
10:50-11:00 AM	Brain Break
11:00-11:50 AM	The Actuarial Process
11:50-12:00 PM	Brain Break
12:00-12:50 PM	Work Session: Training Scenario
12:50-1:00 PM	Wrap-up and overview of upcoming materials



Participant Introductions

Welcome!

- Short introductions:
 - Name
 - School/Affiliation + Location
 - What is a risky thing you've done in the last year?
- 



Modeling the Future Challenge Overview

Understanding Actuarial Science + Mathematics Connections

- **Actuarial Science**

- An actuary is a business professional who analyzes the financial consequences of risk.
- Actuaries use mathematics, statistics, and finance to study uncertain future events, most often those involving insurance and pensions.
- An actuary evaluates the likelihood and potential severity of future events and designs ways to reduce the impact, likelihood and severity of undesirable events.

- **Mathematics Connections**

- Critical thinking & mathematical logic
- Math & statistics concepts: expected value, basic probabilities, logic, descriptive and inferential statistics, cross-curricular applications.

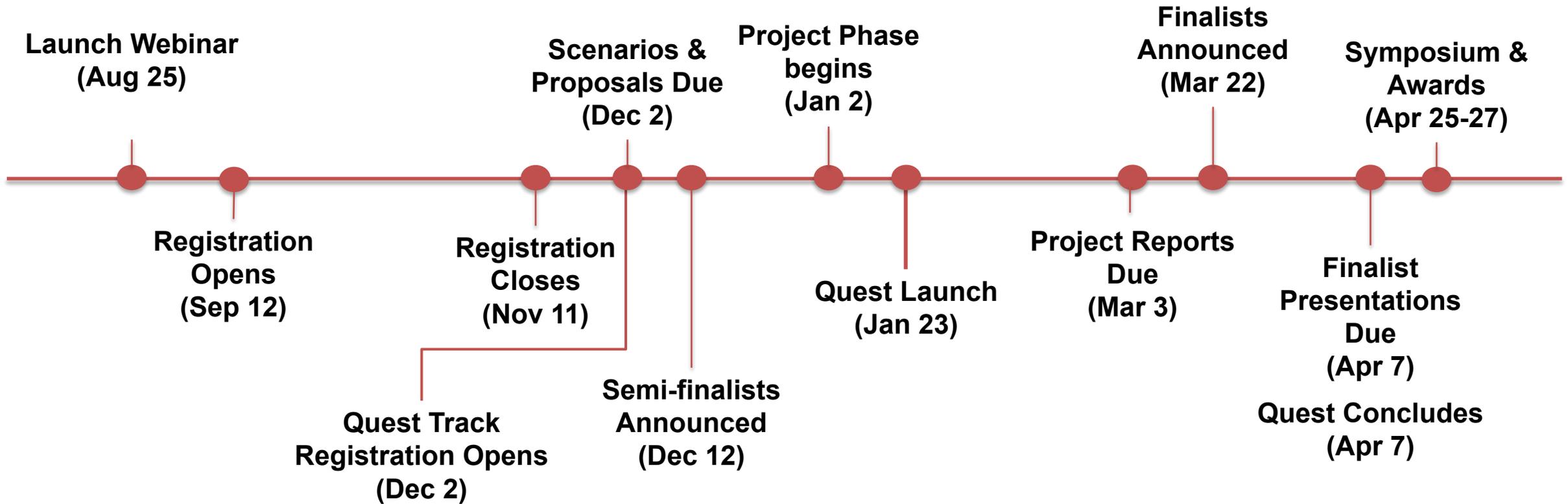
What is Actuarial Science? What does an Actuary do?

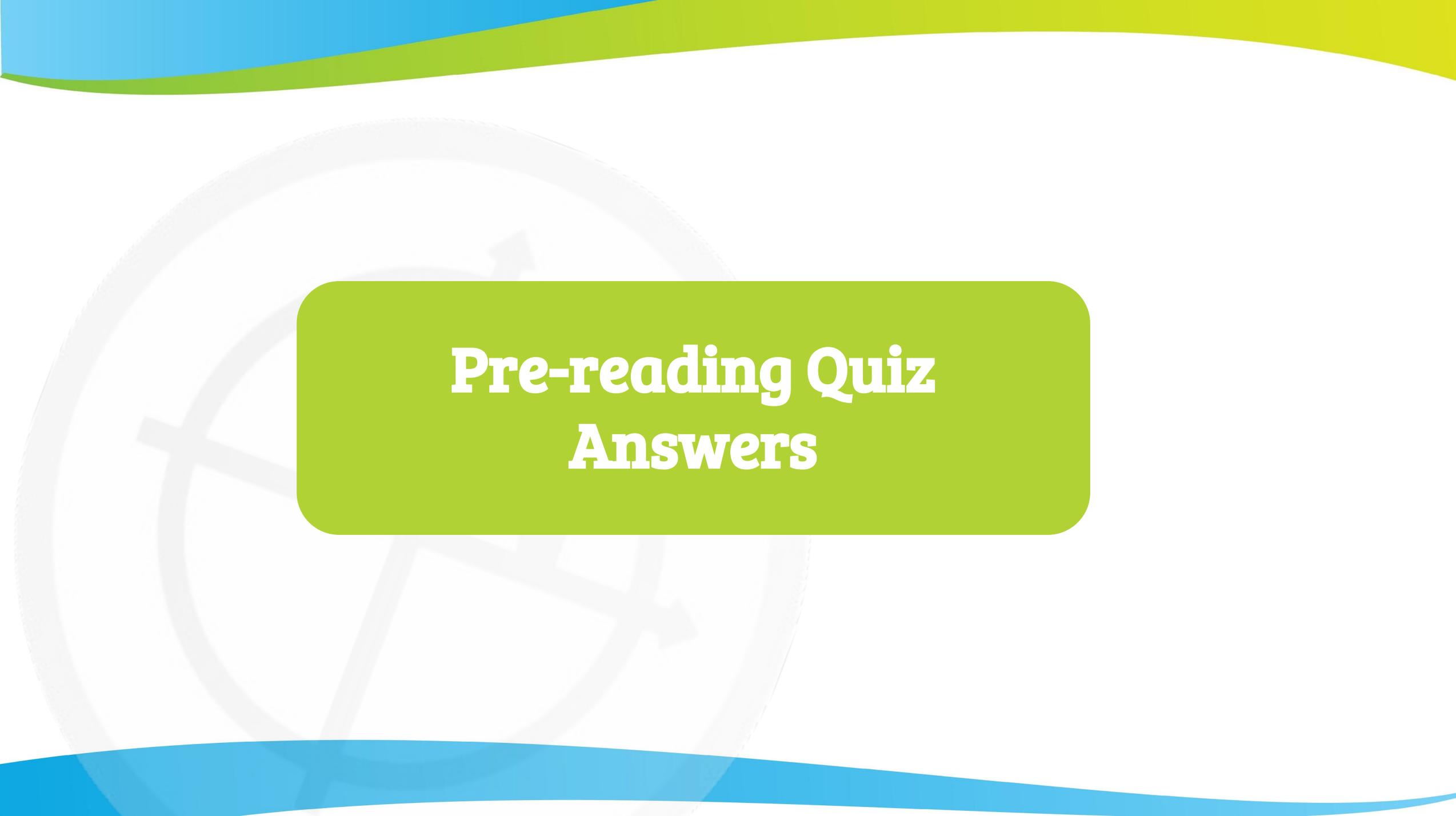
- Resource: [What is an Actuary?](#)
 - www.beanactuary.org
- Think Like an Actuary Videos
 - <https://www.mtfchallenge.org/video-resources/>
-

MTFC 2022-23 Key Dates

Pre-Season	Scenario Phase	Project Phase	Finalist Phase
Launch Webinar (Wed, Aug 25)	Registration Opens (Mon, Sep 12)	Challenge Projects Launch (Jan 2)	Finalist Videos + Papers Due (Apr 7)
	Fall Teacher Training (Saturdays, Sep 10, 17, 24)	Quest Launch Event (Jan 23)	Quest Projects Due (Apr 7)
	Registration Closes (Fri, Nov 11)	Challenge Project Reports Due (Mar 3)	National Symposium (Apr 25-27)
	Scenarios + Proposals Due (Fri, Dec 2)	Finalist Announcement (Mar 22)	
	Semi-Finalist Announcement (Mon, Dec 12)		
	How to Meet with Mentors (Thur, Dec 15)		

2022-23 Timeline & Milestones





Pre-reading Quiz Answers

Question 1:
**What are the phases of the
Modeling the Future Challenge?**

Answer:

- **Scenario Phase**
- **Project Phase**
- **Finalist Phase**

Question 2:
**What is the project theme for
the MTFC?**

Answer:
**Open theme, teams
choose their own topics**

Question 3:
How many steps are there in the Actuarial Process?

Answer: 5

- 1. Project Definition**
- 2. Data Identification & Analysis**
- 3. Mathematical Modeling**
- 4. Risk Analysis**
- 5. Recommendations**

Question 4:
What do teams need to submit at the end
of the Scenario Phase (in December)?

Answer:
Project Proposal, Scenario
Response, Waivers

Question 5:
When are teams matched up with an actuarial mentor?

Answer:
As semi-finalists (during the project phase)

Question 6:
**What do semi-finalist teams submit at
the end of the project phase?**

Answer:
A written project report

Question 7:
What kinds of resources are available on the MTFC Resource Library?

Answer:
Training Scenarios, Data Sources, Project Proposal Examples, Scaffolding Guides (all listed options)

Question 8:

Based on your current understanding, what is an actuary and what do they do?

Answer:

An actuary is a business professional who deals with the measurement and management of risk and uncertainty.

Question 9:
What is something that you still have a question about after the webinar and exploring the MTFC website?

If we can contact the mentor more frequently and how much support do we provide for our teams? Should we just be supervising or be actively involved in the process? Should we stand back and let the kids do it all on their own?

How can I justify this for my classes if not all groups are selected to continue since they will not have any work to continue on and will feel defeated by not being selected?

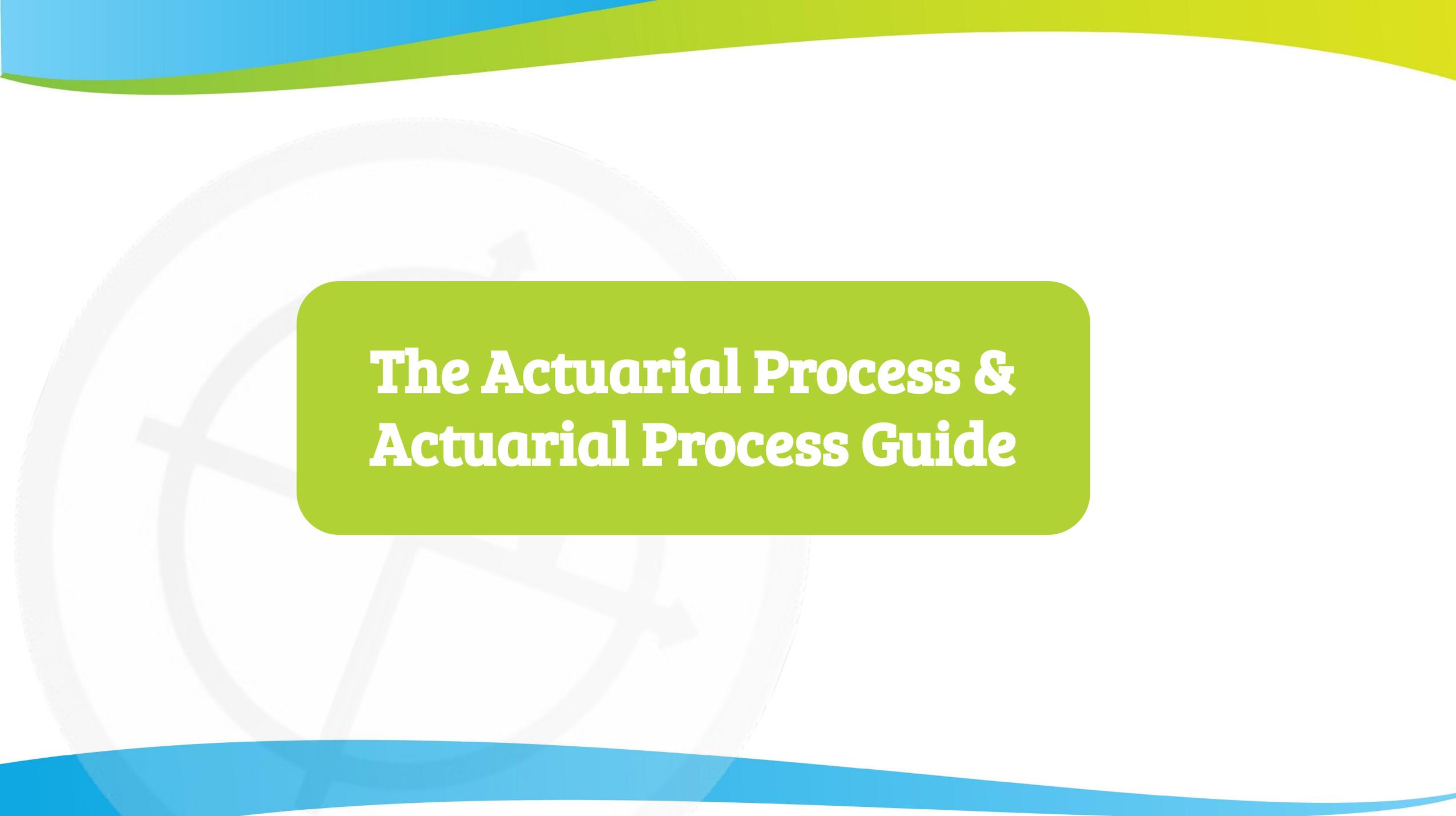
How involved are the mentors in the project phase, how often do they meet with teams or does it depend on the needs of the team?

Is the MTFC open to international high school teams?

Question 10:
What are you particularly hoping to gain
and learn from this training?

I hope to create enthusiasm for my students as far as math AND teamwork is concerned.

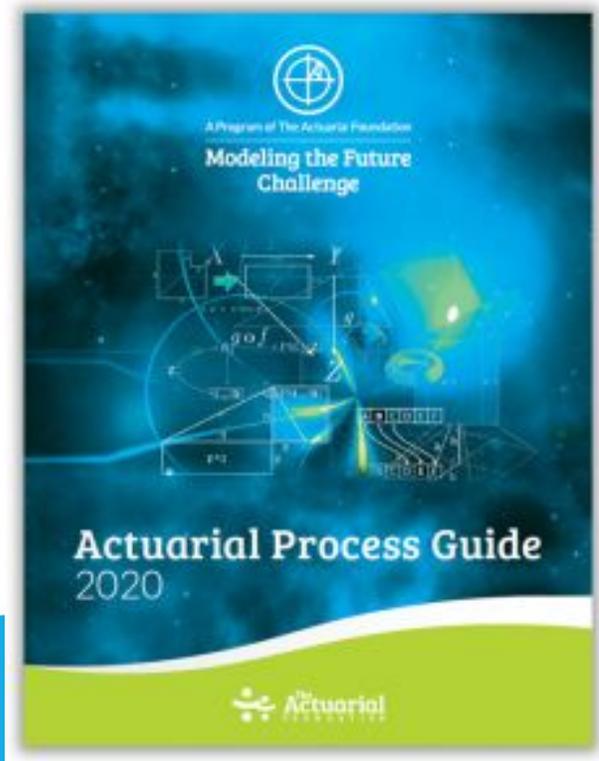
Ideas for incorporating this into either Geometry, Data Science (statistics/probability),
and/or Financial Math classes in meaningful ways that will still teach to the required high
school standards too



The Actuarial Process & Actuarial Process Guide

The Actuarial Process & Guide

[The Actuarial Process Guide](#) can be found on the MTF Challenge website.

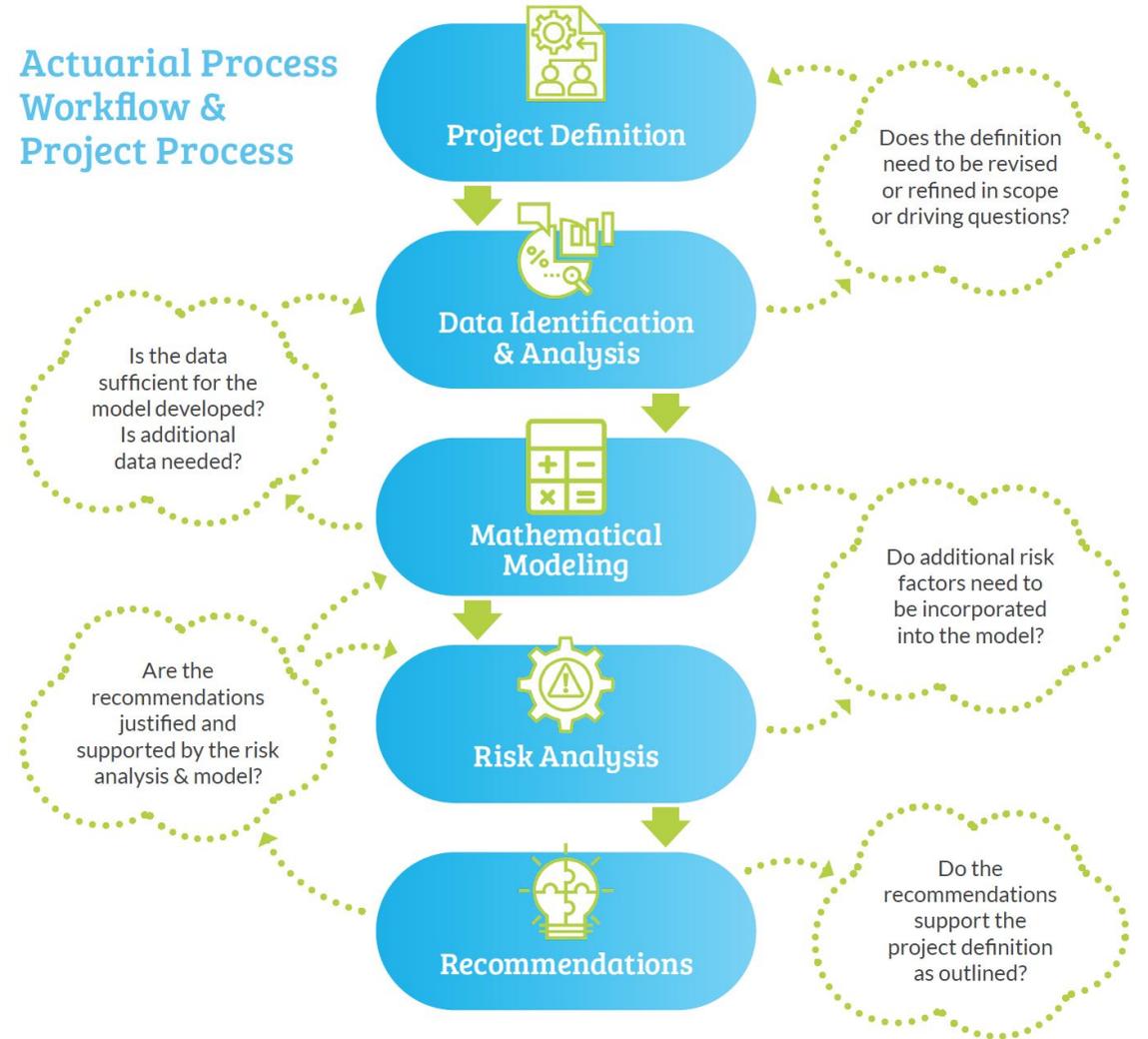


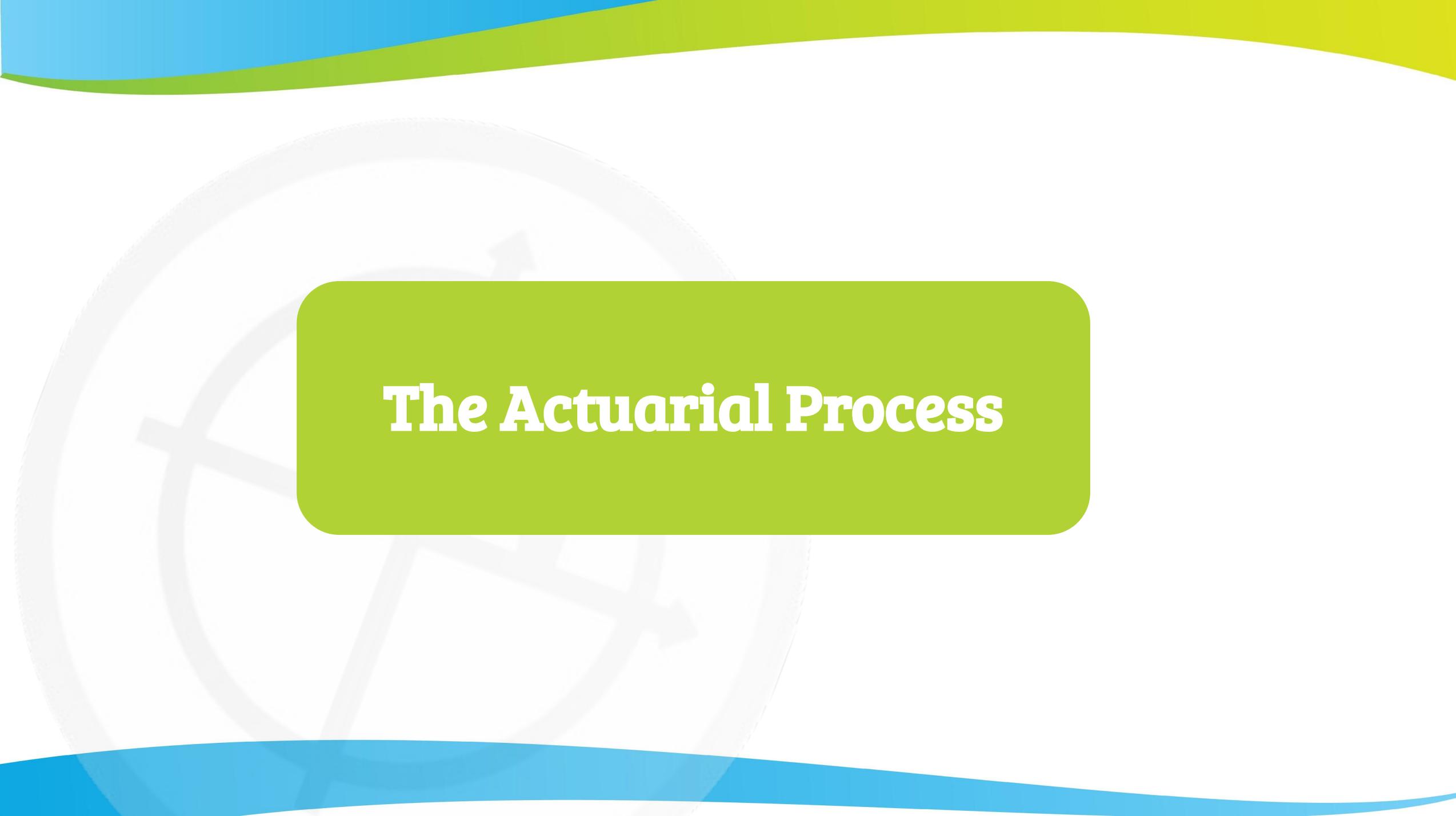
- 1 Project Definition 
- 2 Data Identification & Analysis 
- 3 Mathematical Modeling 
- 4 Risk Analysis 
- 5 Recommendations 

The Actuarial Process Guide

Much like the Scientific Process, the Actuarial Process is an **iterative**, **systemic** method for approaching complex problems involving mathematical, analytical, and communication capacities.

The **Actuarial Process Guide** (APG) is a robust resource that lays out the core 5-step structure of how to successfully identify, analyze, and manage risks to conduct a successful MTFC Project.





The Actuarial Process



Step 1: Project Definition

The problem statement should:

1. Identify a risk (i.e. a potential economic loss, property loss, opportunity loss, loss of life or health, etc).
2. Define who is at risk.
3. Identify possible risk mitigation strategies.



Step 1: Project Definition, continued

Risk should be defined in terms of **frequency and severity of loss**. Combining these two provides the **expected value of potential losses**.

E.V. = sum of all outcomes

each outcome = (frequency of loss, often a %) * (severity of loss, often \$)



Step 1: Project Definition, continued

Risk mitigation strategies (all 3 need to be addressed and considered in the MTFC, but only one fully pursued and recommended in the recommendations).

1. Insurance
2. Behavior Changes
3. Modifying Outcomes



Step 1: Project Definition, continued

A good MTFC Problem Statement (1-3 sentences!)

1. It identifies a scenario in which there is a possibility for a loss (risk).
2. It identifies what the potential risk is (in general terms).
3. It identifies who is at risk.
4. It identifies possible risk mitigation strategies.



Step 2: Data Identification

The Five types of data most suitable for Modeling the Future Challenge Projects:

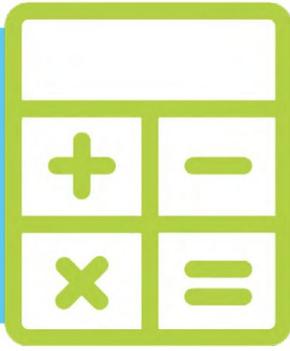
1. **Defining historical trends** – These data and datasets may be used to explore a behavior or phenomenon. They may be descriptive of a once-occurring phenomena.
2. **Projecting future trends** – These data and datasets are similar to historical trends, captured over time, allowing for explanatory possibilities.
3. **Separating potential outcomes** – These data and datasets provide more detail about behaviors and phenomena, and may present an opportunity to aggregate outcomes by samples, populations, and products.
4. **Defining the severity of potential losses** – These data and datasets place a value on a good resource. These losses may be private, to an individual or organization, and/or social costs, which attempts to also consider the cost of externalities that are unaccounted for within the free market (e.g., carbon/climate data and datasets)
5. **Defining the frequency of potential outcomes** – These data and datasets offer an opportunity to understand how frequently an event occurs.



Step 2: Data Identification, continued

At the conclusion of the Data Identification section, you should have:

1. Identified one or more datasets that together meet the five points on enabling a good analysis discussed above.
2. Identified any basic needs for cleaning or adjustments in your datasets.
3. Examined the credibility of your data – is the dataset large enough to make a valid analysis and recommendations?

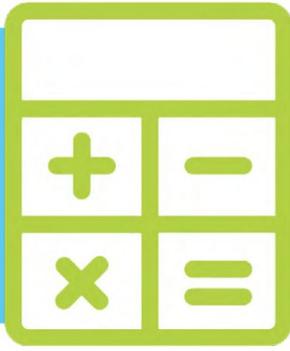


Step 3: Mathematical Modeling

A mathematical model is NOT just:

- a crazy large coding model and system
 - lots of calculus
 - an elaborate system that gives a clear and concise answer by plugging in a few numbers
- ... although it can be this.

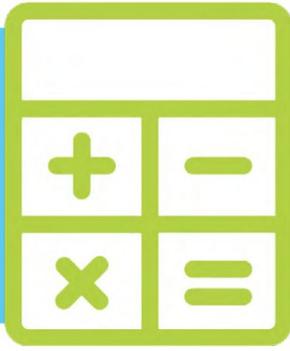
A mathematical model is a description of a system that answers some defining questions that allow conclusions and recommendations to be made.



Step 3: Mathematical Modeling, continued

In general, your mathematical model should:

- Identify the frequencies (likelihoods) that each potential outcome for your scenario will happen.
- Identify the severities (size) of possible losses.
- Identify expected values of potential loss for your scenario.
- Understand the distribution of potential outcomes.
- Identify trends in the data and understand how potential outcomes and associated risks may be changing over time.
- Identify possible risk mitigation strategies, and quantify their effects.



Step 3: Mathematical Modeling, continued

Some notes...

- define assumptions that simplify the situation
 - discussing these assumptions provides basis for a sensitivity analysis later
- the math does NOT need to be complicated
 - the model can answer a series of smaller questions
 - linear regressions, loss ratios, averages, etc. can be useful components



Step 4: Risk Analysis

Before analysis can take place, risk needs to be quantified. The easiest way to do this is with **expected value**.



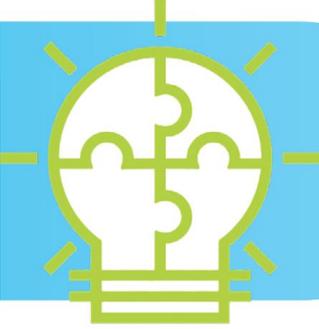
Identifying Risk

- A **risk** is the uncertain possibility of something harmful happening.
 - Mortality risk (dying too soon)
 - Longevity risk (living too long)
 - Morbidity risk (getting sick)
 - Property risk (damage to, or loss of, your property)
 - Liability risk (you total a someone else's Rolls Royce)
- A **loss** occurs when an event anticipated as a risk takes place.



Managing Risk

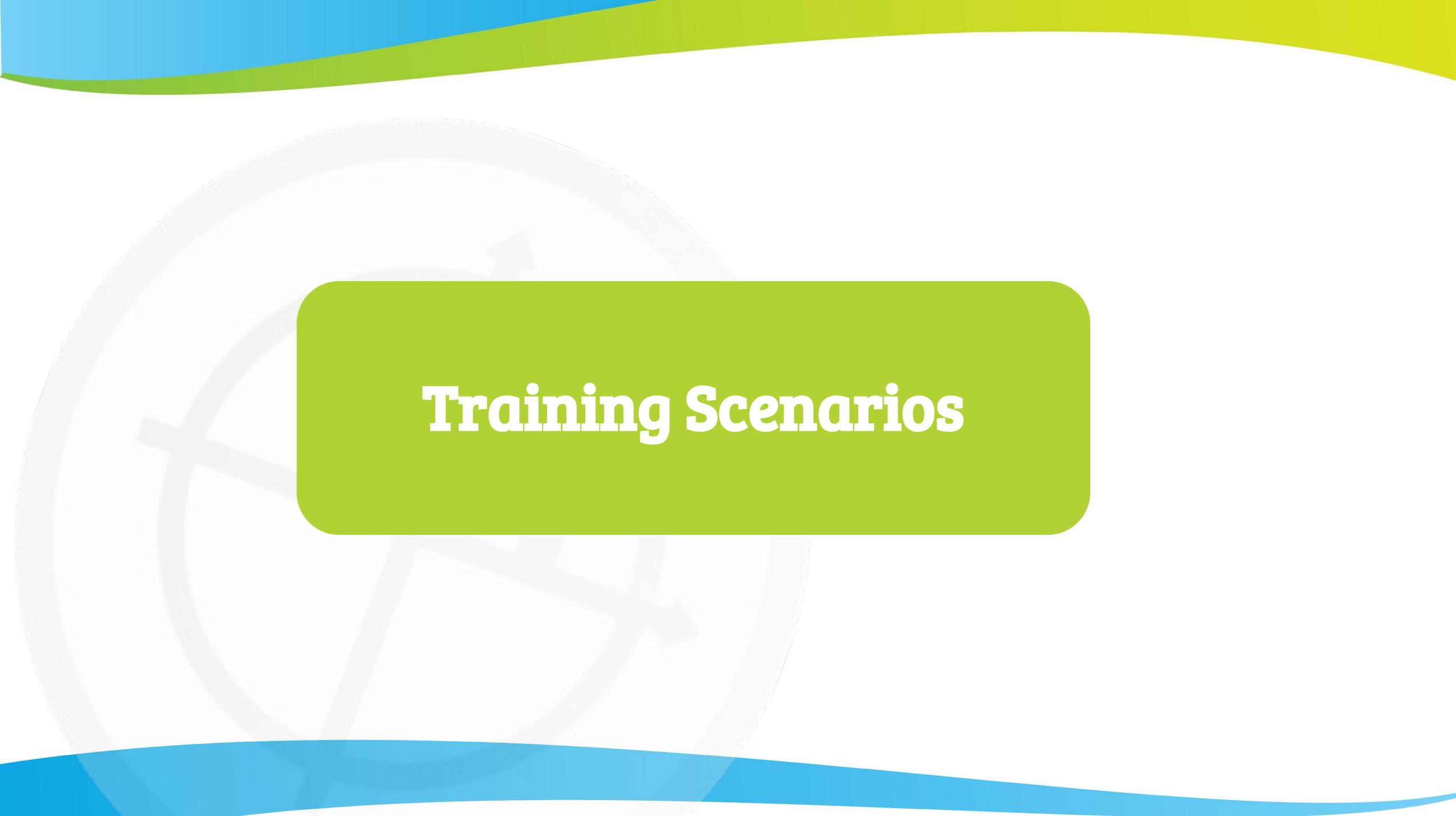
- As an example, let's consider the property risk if you own a home
- There are several ways to manage this risk
 - Avoidance (don't own a home; rent instead)
 - Transference (buy homeowners insurance)
 - Reduction (install impact-resistant windows)



Step 5: Recommendations

The best recommendations in an MTFC project follow these rules of thumb:

- 1) **Be data driven:** make sure that your recommendations extend from the data and mathematical modeling you have produced. The recommendations should be based upon sound math and real data.
- 2) **Be quantified:** just like your risks, recommendations are best when they are quantified. Don't just say that something should change, say how much it should change, and show evidence from your data and math models defending that.
- 3) **Respond to the problem:** make sure that your recommendations address the original problem statement you identified in defining your project. There may be many things you think could change associated with the project, but be clear about how those changes will improve the problem and help manage or mitigate risks.
- 4) **Be clear and concise:** recommendations, just like your whole projects, are best when they are clearly stated, and not overly verbose. Describe the recommendations in as much detail as possible, but avoid adding unnecessary information.



Training Scenarios

The MTFC Scenario

- Each team submits the official MTFC Qualifying Scenario by the December deadline
 - there are three items due:
 - The Scenario
 - The Project Proposal
 - Waivers
 - The scenario is scored & used to determine Semi-Finalists for Project Phase or Quest Track Teams
 - Resource: [MTFC Training Scenarios](#)

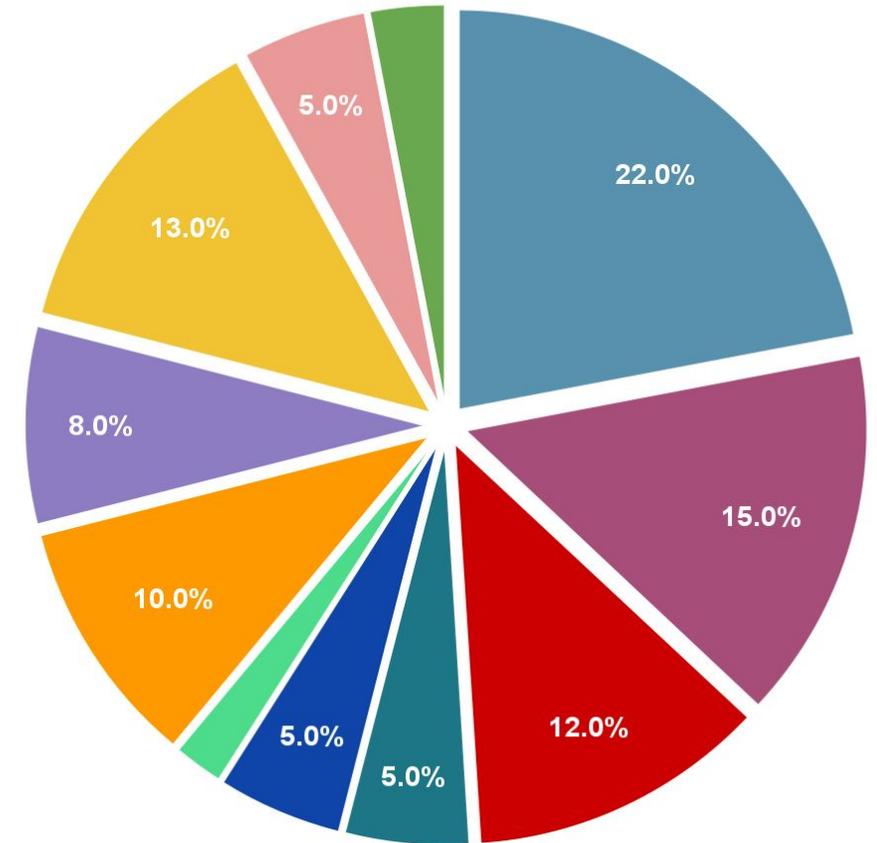


**Participation Options & Team
Building / Implementation
Resources**

What Projects Could Be Done?

2020-2021 Project Topics

- Algorithm to detect foodborne illnesses using Google/Twitter Search Data
- Direct medical expenditures of stroke
- Cyber attacks and cost-effective cyber security
- Pandemic impact on airplane companies
- Ambulance diversions effect on mortality rate
- Harmful algal blooms and nutrient pollution



How to Implement MTFC?

- [How to Build a Team](#)
- Structure of a strong team
- Team Roles
- Project “hook”
- Preparation & Materials
- Completing Scenarios + Proposals
- Challenge Track Projects or Quest Track Projects
- Grading

Implementation Structure

The structure for your MTFC team will frame your role as team coach and your team's participation in the challenge for the duration of the challenge. Teams have had success with such a variety of formats and each format will provide unique challenges and opportunities. Possibilities include:

- offering the MTFC as a class or component of a class.
- offering the MTFC as a guided extracurricular activity.
- offering limited guidance/supervision/meeting space for a team.

Choosing the structure will depend on availability, schedules, student motivation, and support (among other factors). Regardless of the structure and format, meeting regularly (weekly, biweekly, etc) with your team will establish good camaraderie and keep the team on track.

Support & Collaboration

Having support from administration, department, other teachers, students, and families is immensely helpful for successful MTFC participation. Consider recruiting another teacher (even cross-departmentally) to work with you with the MTFC. Since the MTFC has such strong real-world application, recruiting students from other courses can help build a strong team with well-rounded skills.

Student & Team Selection

Hand-picking students by recruiting them to participate as well as students from within a course can both lead to strong MTFC teams. If the MTFC will be integrated within your course, consider whether you will form teams or have students self-select.

Whether students forming the MTFC teams can be recruited across courses, consider having a mix of **strong writers, coders, researchers, and mathematical modelers** on the team.

MTFC Coach & Team Roles

As team coach, your role will be one of balancing guidance while not over-guiding and staying within the MTFC Rules and Guidelines. Providing teams with resources, training and guidance through the different phases of the MTFC will equip students for success in more than just the competition.

Teams tackling open-ended and real-world problems like those posed with the MTFC will often benefit from identifying team roles (writer, coder, modeler, project manager, etc.), setting team goals and consensus on values, and establishing standard communication and checkin channels.

Resources & Instructional Familiarity

The MTFC Resource Library has materials for understanding and using the Actuarial Process, Actuarial Process Guide, sample scenarios, videos, and other resources.

Suggested Implementation

- Decide on implementation structure
 - required/optional? in-class/extra-curricular?
- Have a “hook event”
 - Basic Phone Insurance Scenario
- Practice Several Training Scenarios
- Practice Project Proposals
- Teach specific concepts needed (probabilities, conditional probability, expected value, determining frequency / severity, making assumptions)
- Complete the Scenario & Project Proposal
- Complete Projects (Challenge or Quest)
- Have presentations!