

# Knowledge Discovery & Decision Analysis in Managing US Inland Fisheries

Dissertation Proposal  
Caleb A. Aldridge

Department of Wildlife, Fisheries & Aquaculture  
College of Forest Resources  
Mississippi State University

7 March 2019 02:00 pm  
Tully Auditorium

Mississippi Cooperative Fish &  
Wildlife Research Unit



**MISSISSIPPI STATE UNIVERSITY™**  
**DEPARTMENT OF WILDLIFE,  
FISHERIES AND AQUACULTURE**

**Fishery Management &  
Aquatic Conservation Lab**



# Acknowledgements

- Faculty advisors:
  - Michael E. Colvin
  - Leandro E. (Steve) Miranda
- Committee members:
  - Anna C. Linhoss
  - Scott A. Rush
- MDWFP
- MS Cooperative Research Unit
- Wildlife, Fisheries & Aquaculture, Forest Resources
- Fishery Management & Aquatic Conservation Lab





Fish



Fishers



Habitat





Commercial



Recreational



Subsistence

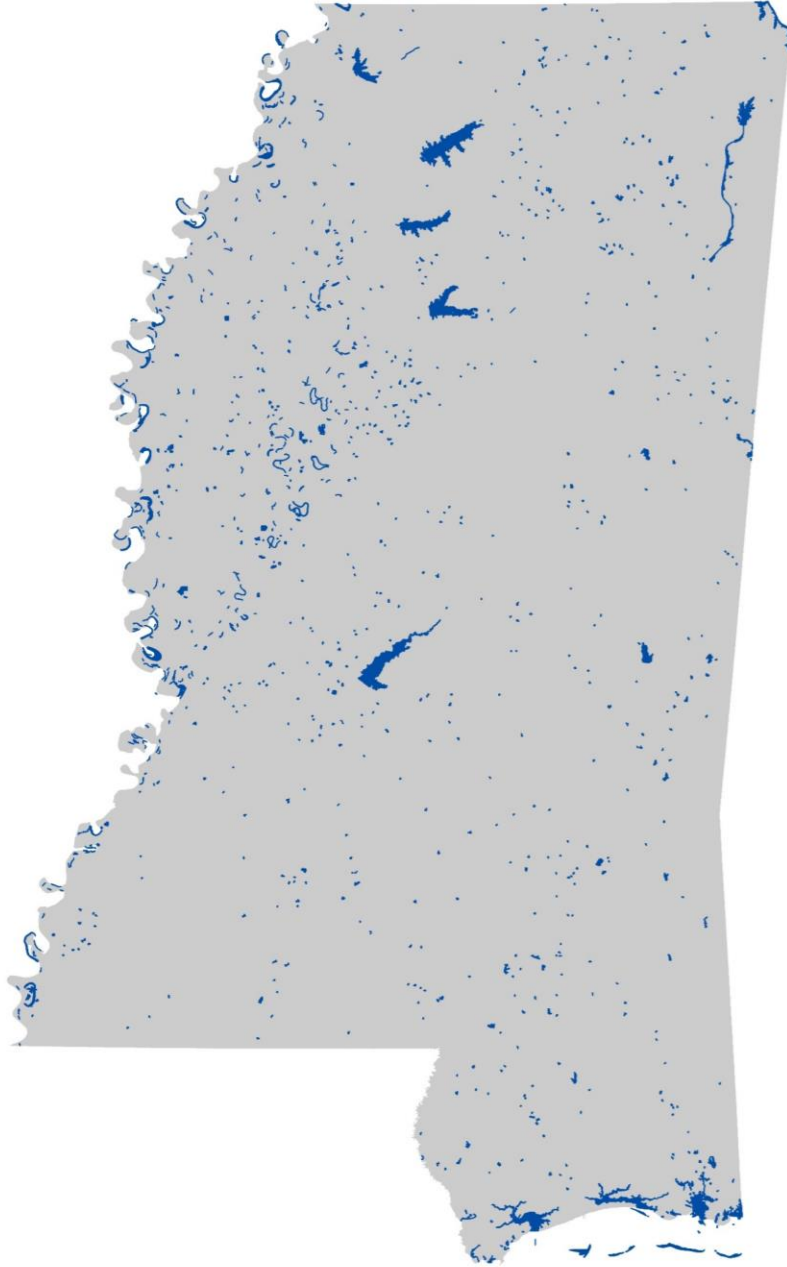






## Market & non-market values of recreational fisheries







# Monitoring metrics



Problem	Objective
<ul style="list-style-type: none"><li>• Reliability, comparability, &amp; shareability of sampling methods &amp; data management</li></ul>	<ul style="list-style-type: none"><li>• Survey &amp; relate sampling methods &amp; data handling protocols across US</li></ul>
<ul style="list-style-type: none"><li>• Untapped information in existing data</li></ul>	<ul style="list-style-type: none"><li>• Develop knowledge discovery guide</li></ul>



Problem	Objective	Sub-objective
Reliability, comparability, & shareability of sampling methods & data management	Survey & relate sampling methods & data handling protocols across US	Identify & assess connection between monitoring metrics & objectives to inform MS protocol

**Fish Sampling and Data Analysis Techniques**  
**Used by Conservation Agencies in the U.S. and Canada**

Fisheries Techniques Standardization Committee

Management Section, American Fisheries Society



## Reviewed

- Routine sampling
- Data analysis procedures

### **Fish Sampling and Data Analysis Techniques**

**Used by Conservation Agencies in the U.S. and Canada**

Fisheries Techniques Standardization Committee

Management Section, American Fisheries Society

## Reviewed

- Routine sampling
- Data analysis procedures

## Presented

### Maps

- Sampling
- Data analysis
- Types of sport fish
- Inland water type

## **Fish Sampling and Data Analysis Techniques**

**Used by Conservation Agencies in the U.S. and Canada**

Fisheries Techniques Standardization Committee

Management Section, American Fisheries Society





FIGURE 33. Use of DC boat electrofishing units at night to sample fish populations in rivers.



FIGURE 34. Use of AC boat electrofishing during the day to sample fish populations in rivers.

## Reviewed

- Routine sampling
- Data analysis procedures

## Presented

### Maps

- Sampling
- Data analysis
- Types of sport fish
- Inland water type

### **Fish Sampling and Data Analysis Techniques**

**Used by Conservation Agencies in the U.S. and Canada**

Fisheries Techniques Standardization Committee

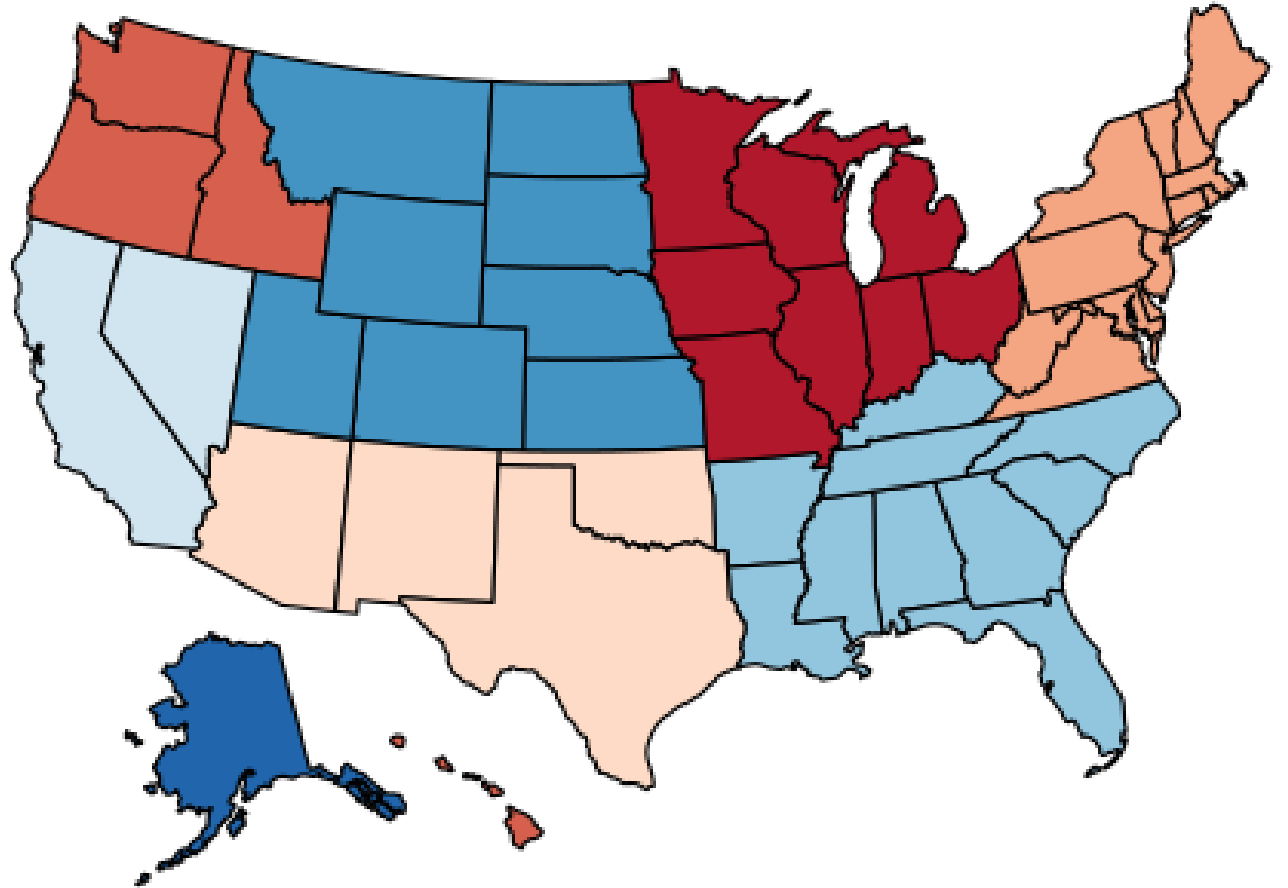
Management Section, American Fisheries Society

“Agencies are resistant to change, & habituation could prevent agencies from adopting better techniques & participating in collaborative efforts.”



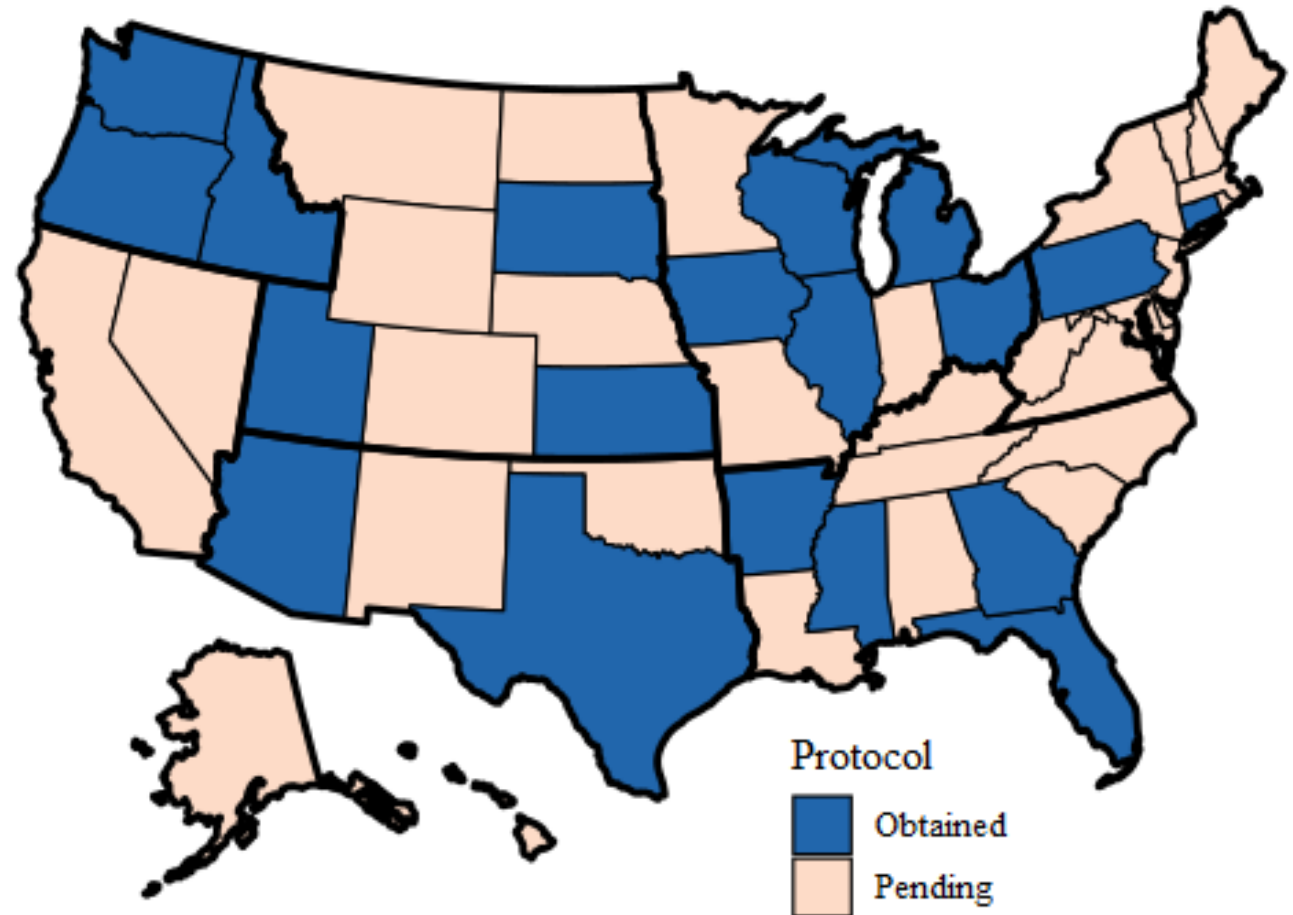
# Searches

- Initial scope to:
  - refine questions
  - identify databases & search engines
  - refine search terms & key words



# Searches

- Initial scope to:
  - refine question & objectives
  - identify databases & search engines
  - refine search terms & key words
- Databases & search engines
- Website searches
- Bibliography searches
- Contact agencies



# Filtering of Literature

- Title, abstract, & keywords are screened
- Full texts are examined & relevant papers retained
- Data from this final reference library is extracted & synthesized

## Monitoring Protocols for Inland Fisheries



Final Report No. 244  
July 1, 2000 – June 30, 2005

L. E. Miranda  
Mississippi Cooperative Fish and Wildlife Research Unit  
P.O. Box 9691  
Mississippi State, Mississippi 39762

Citation: Miranda, L. E. 2005. Monitoring Protocols for Inland Fisheries. Report No. 244, Miss. Wildlife, Fisheries & Parks, Jackson, MS. 314 pp.



# Filtering of Literature

- Title, abstract, & keywords are screened
- Full texts are examined & relevant papers retained
- Data from this final reference library is extracted & synthesized

## **Standard Fish Sampling Guidelines for Washington State Ponds and Lakes**

by

Scott A. Bonar, Bruce D. Bolding and Marc Divens  
Washington Department of Fish and Wildlife  
Fish Program  
Science Division  
Inland Fisheries Investigations  
600 Capitol Way North  
Olympia, Washington

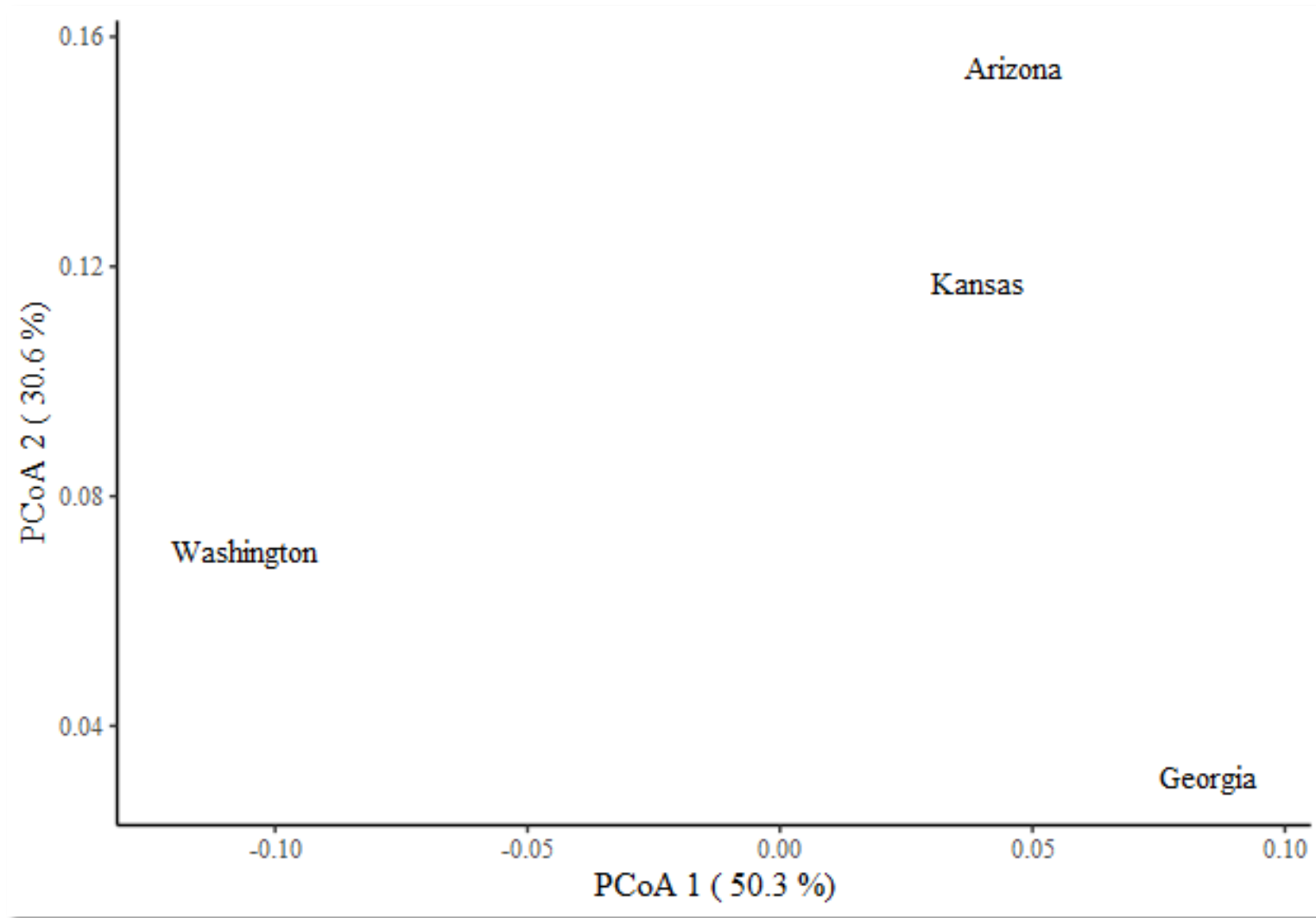
**June 2000**

# Metrics

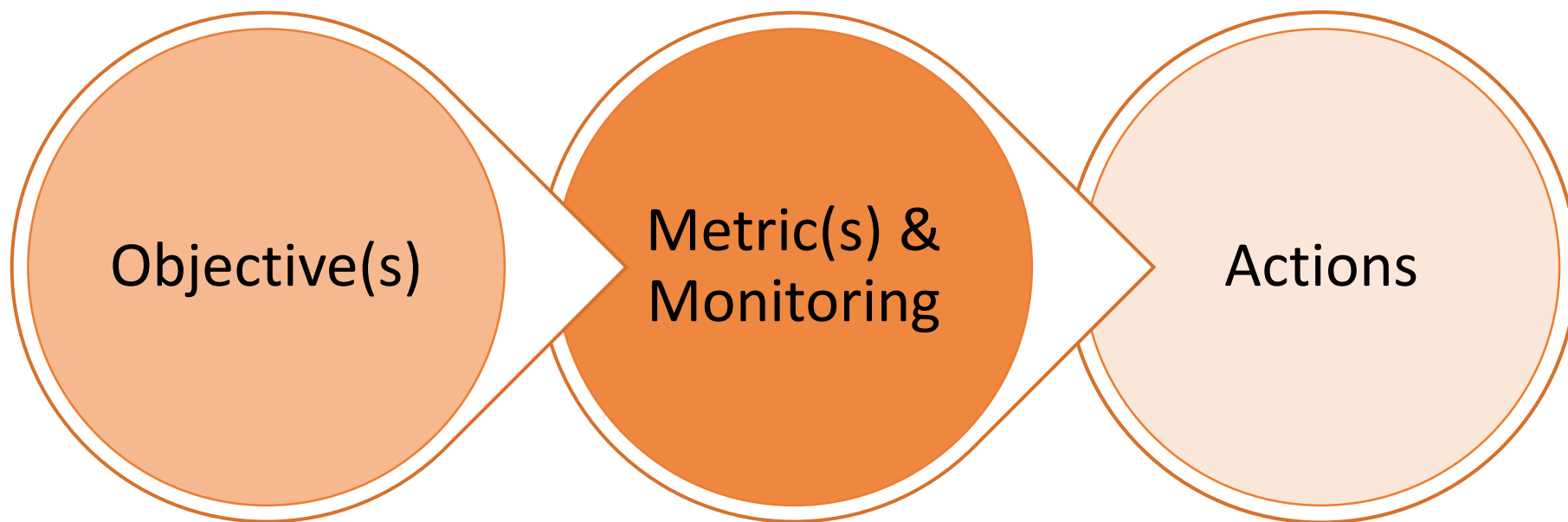
- Sampling procedures
  - Sampling design
    - Is there a tool or procedure for determining sample locations?
  - Sampling techniques
  - Fish sampled
    - Black Bass (*Micropterus* spp.)
  - Metrics measured
- Data handling procedures
  - Data recording & management
  - Data analysis
  - Reporting & dissemination

# Analysis

- Ordination via Principal coordinates analysis (PCoA)
- Characterize & describe



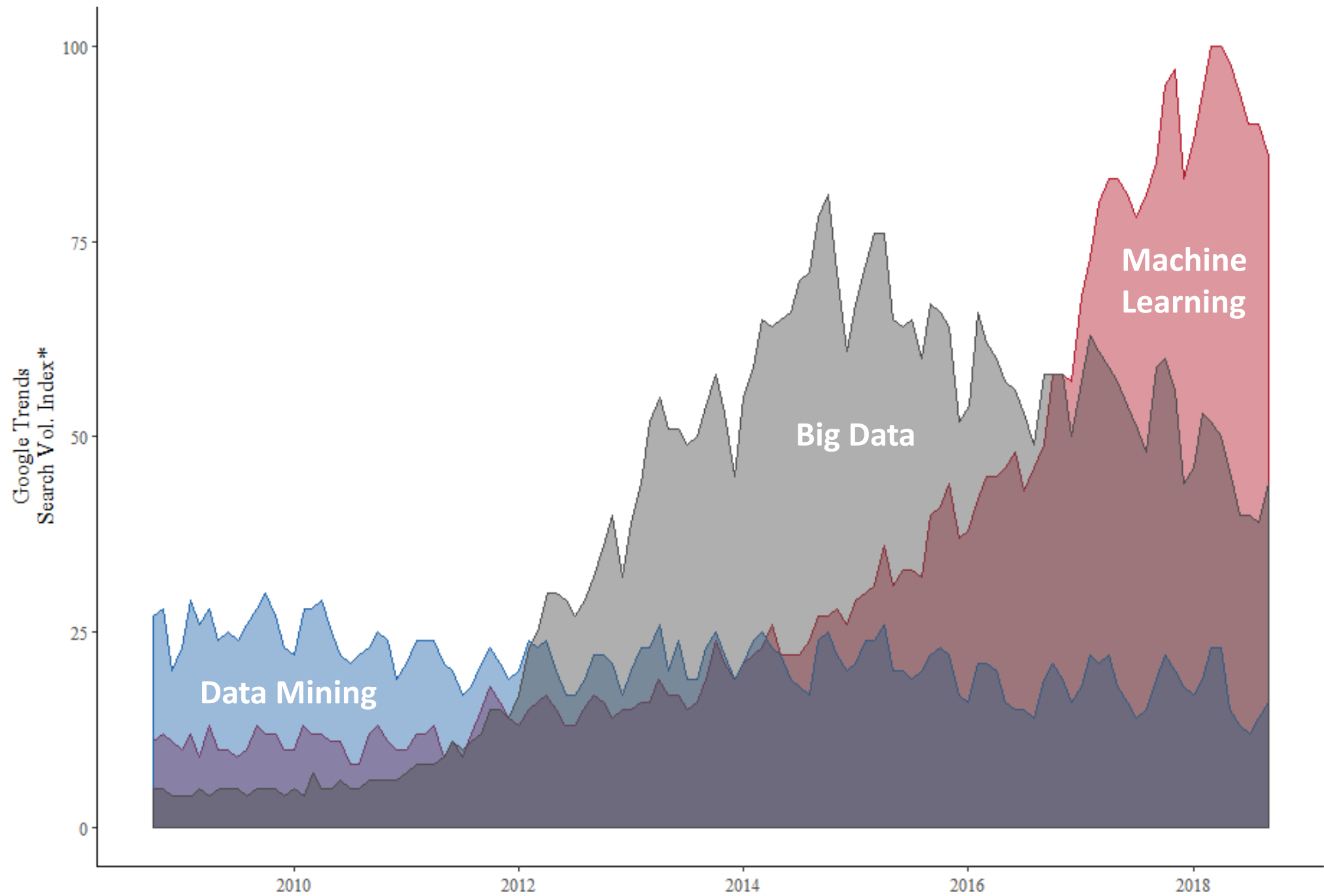


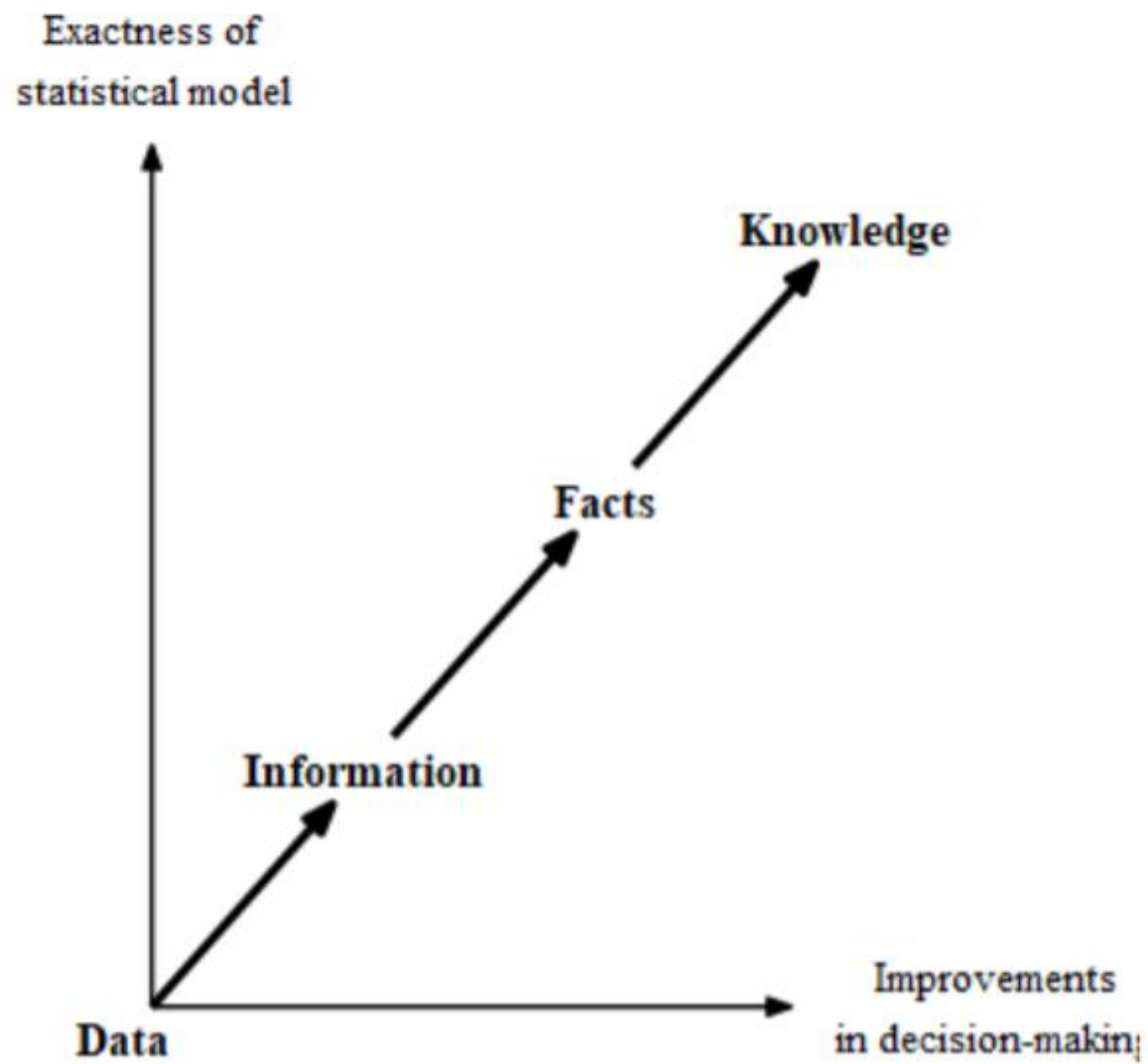


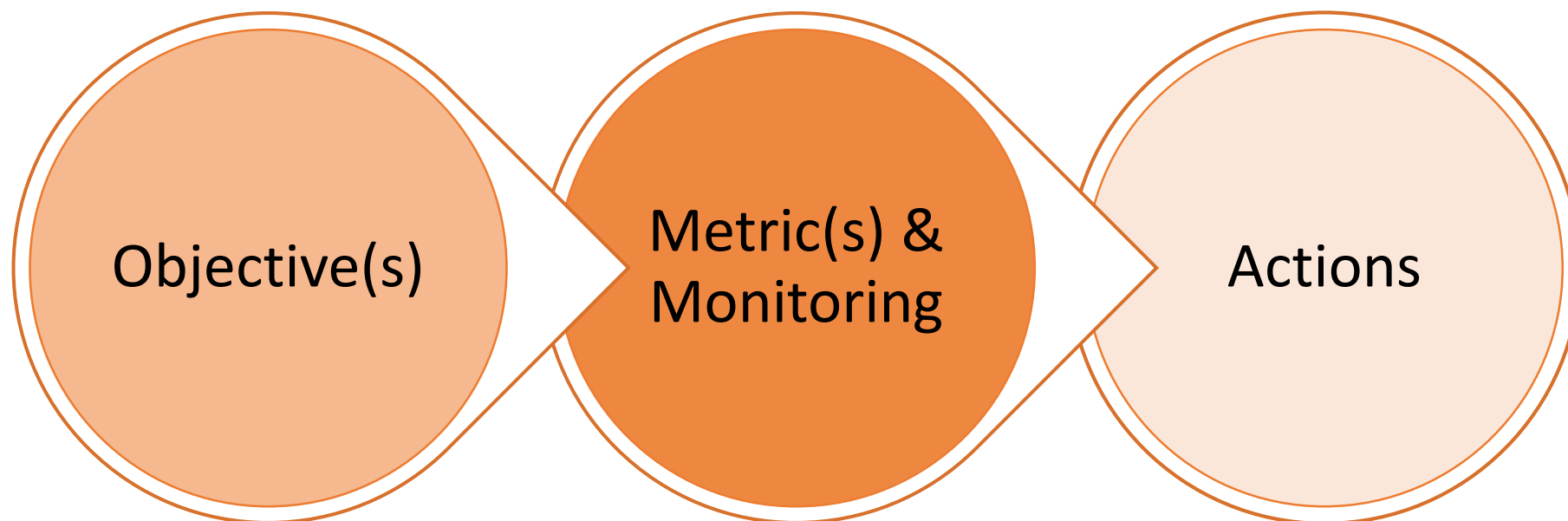
Problem	Objective	Sub-objective
Untapped information in existing data	Develop knowledge discovery guide	Provide information from long-term data to inform system interactions and identify potential areas for management

**Knowledge discovery** is the process of gaining insight about patterns, processes, & relationships from large amounts of data & has become increasingly popular in recent years.

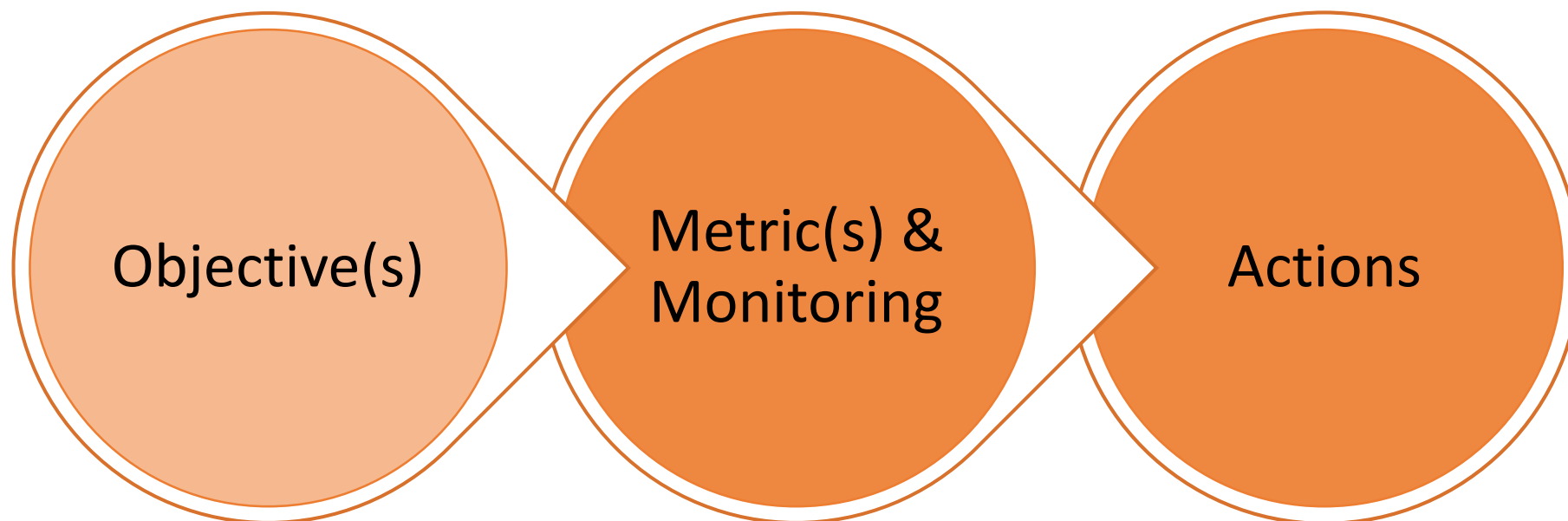






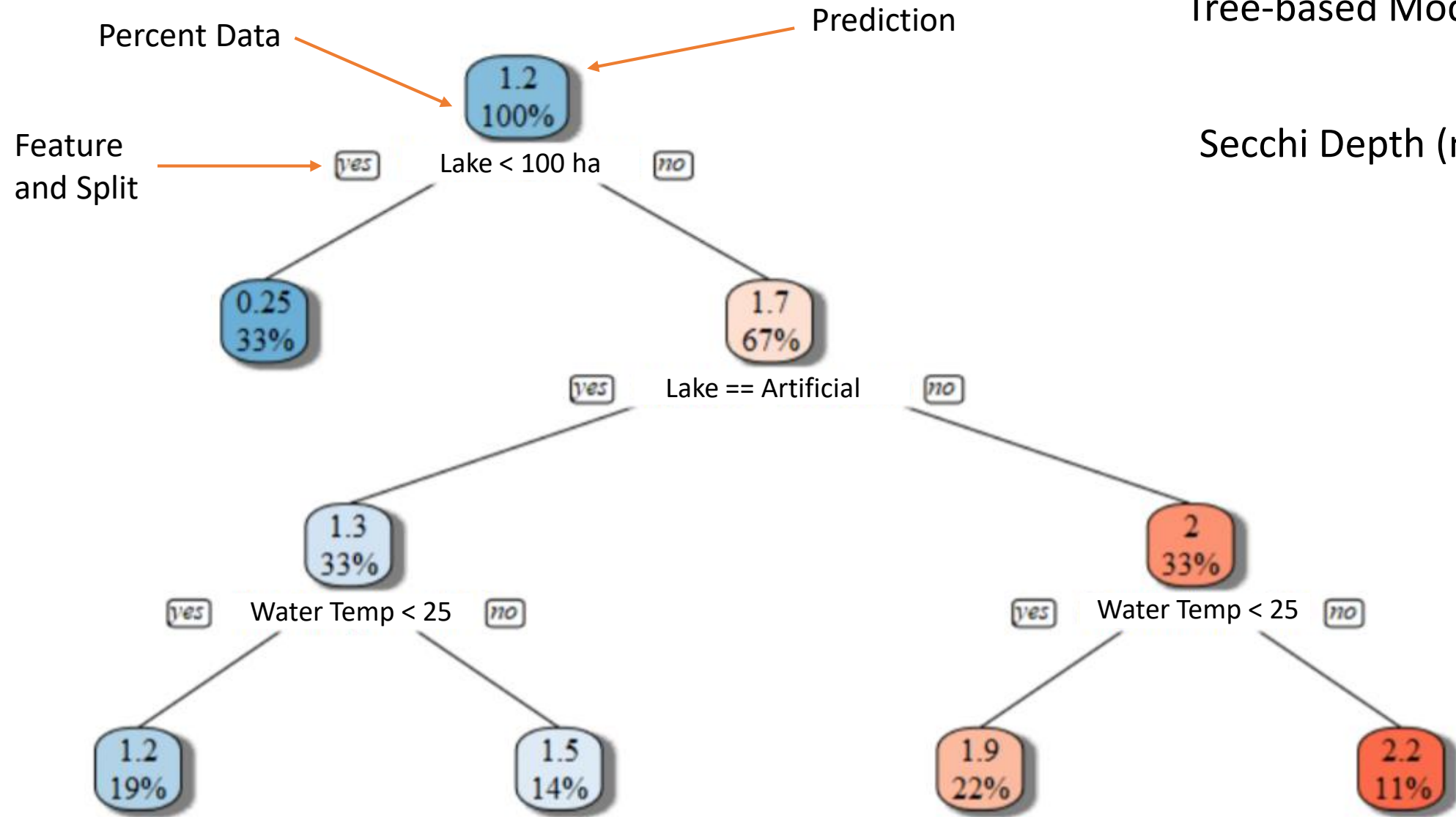


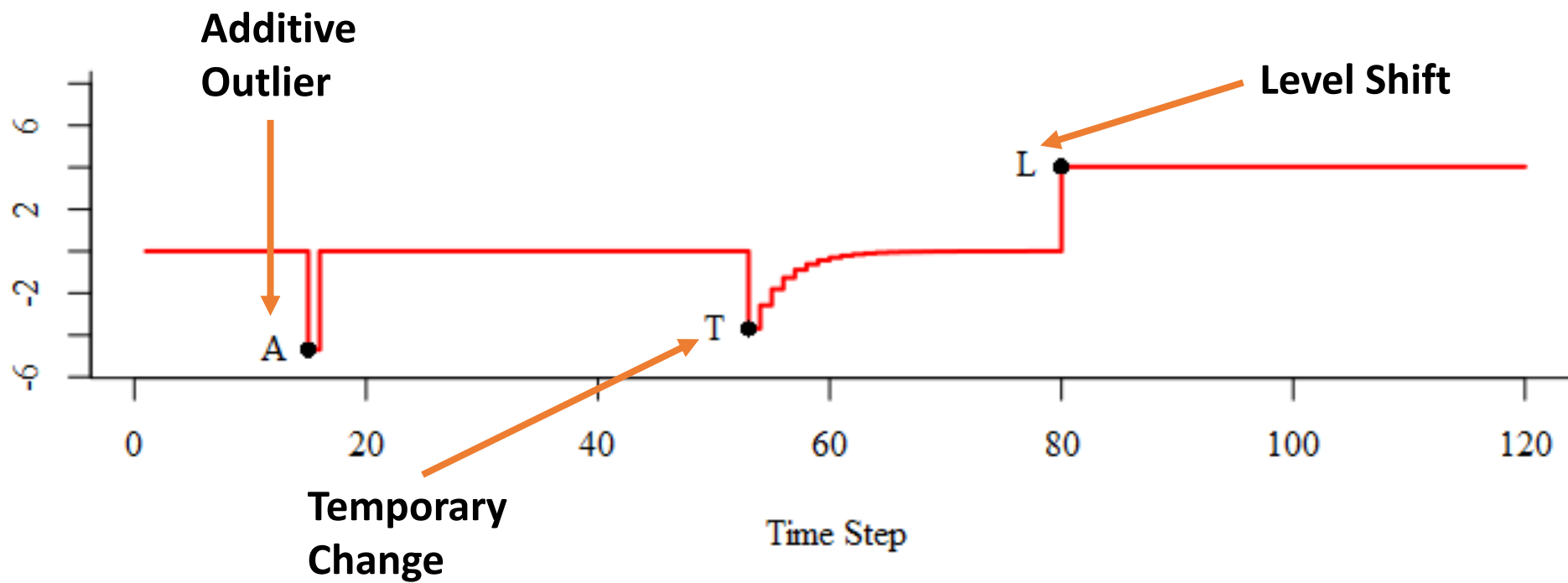
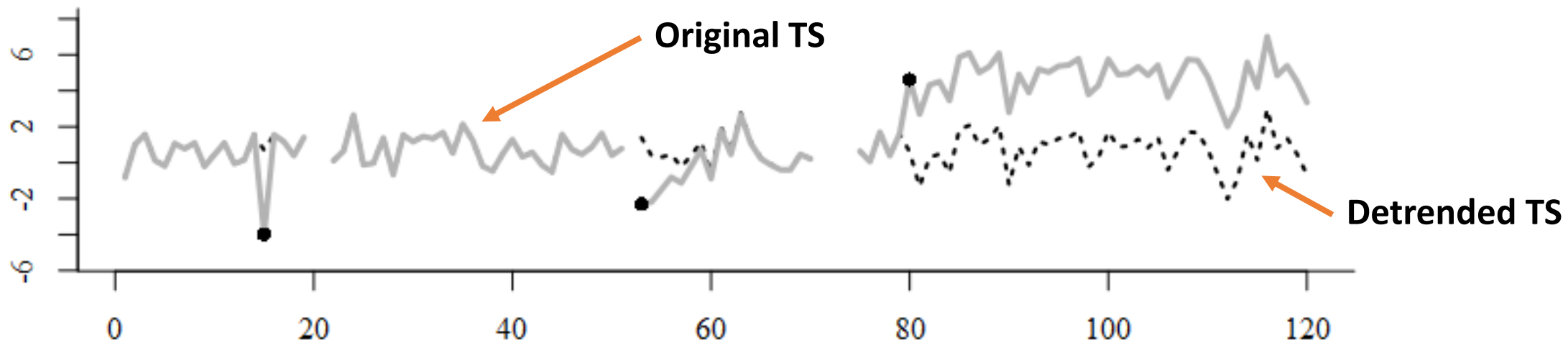




# Tree-based Model

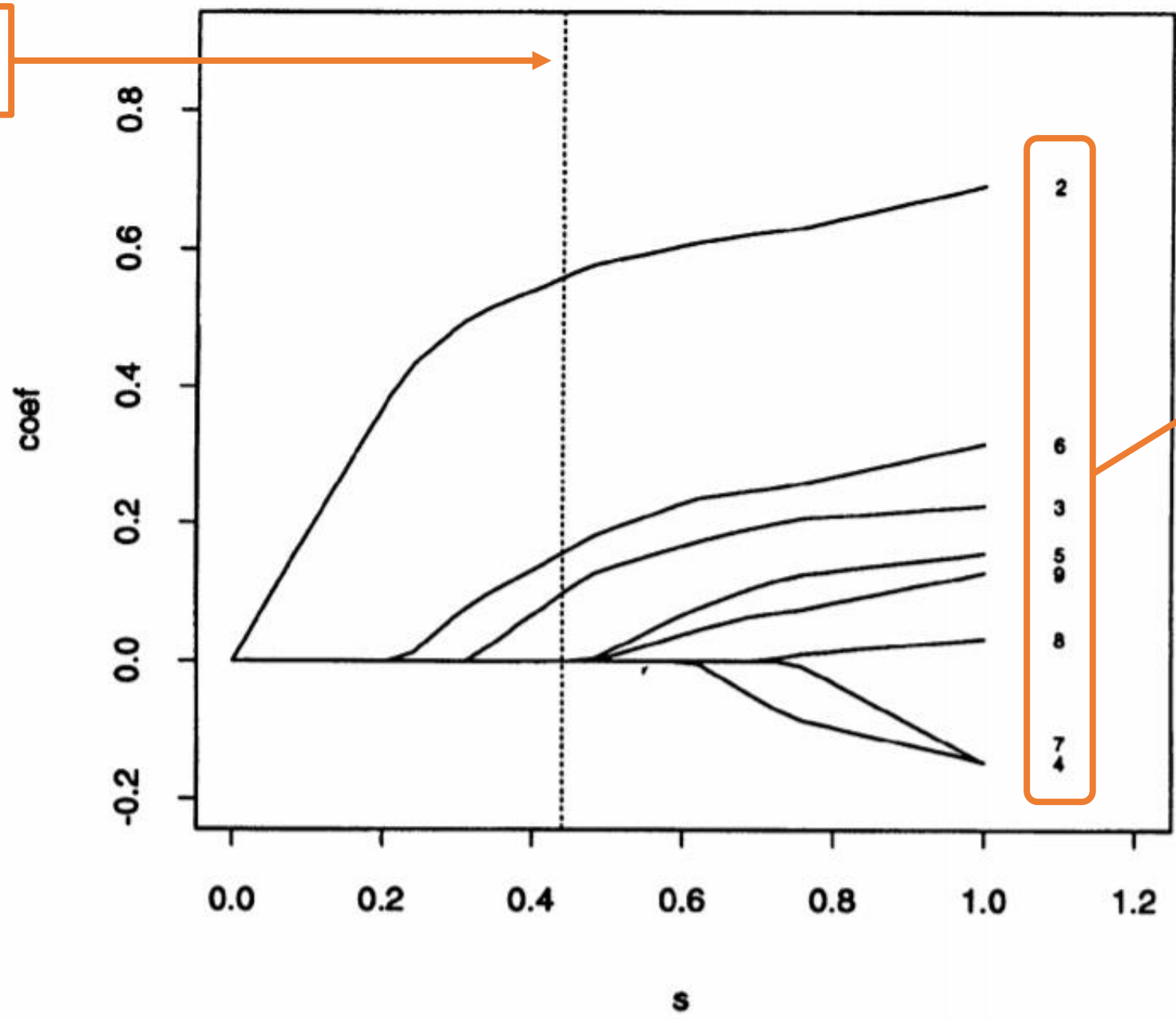
Secchi Depth (m)



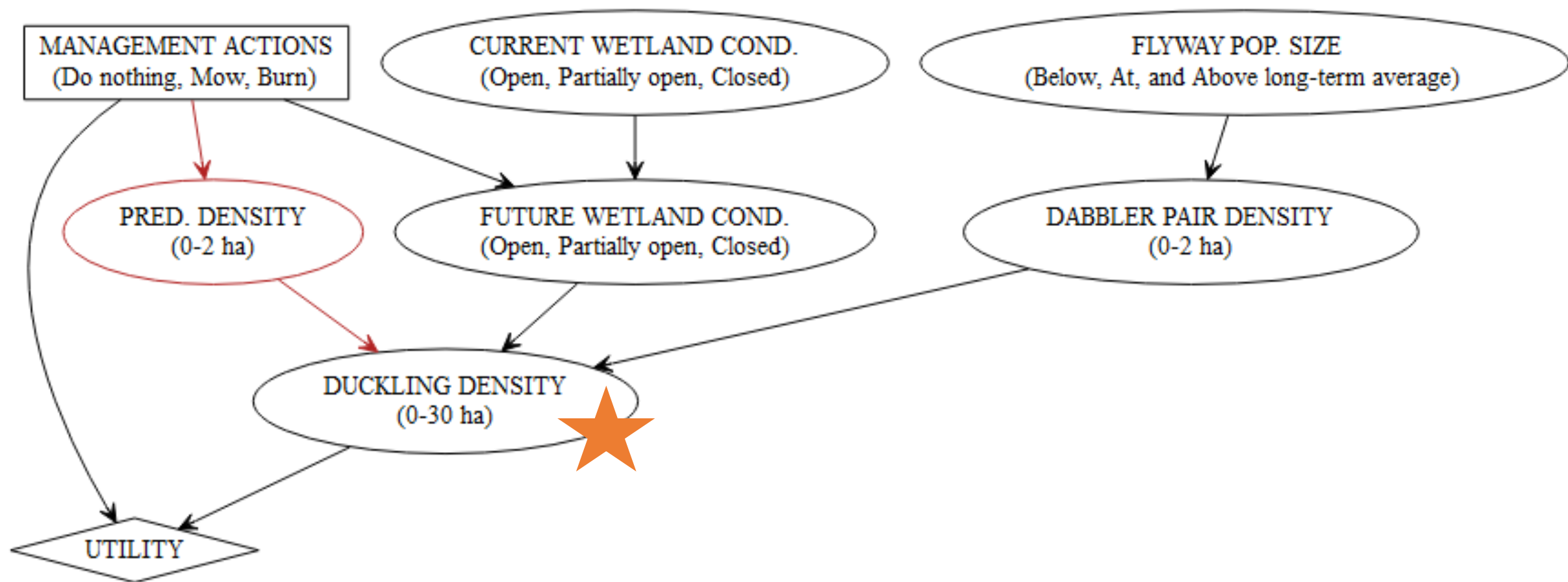


# LASSO

CV Selected Model



Features



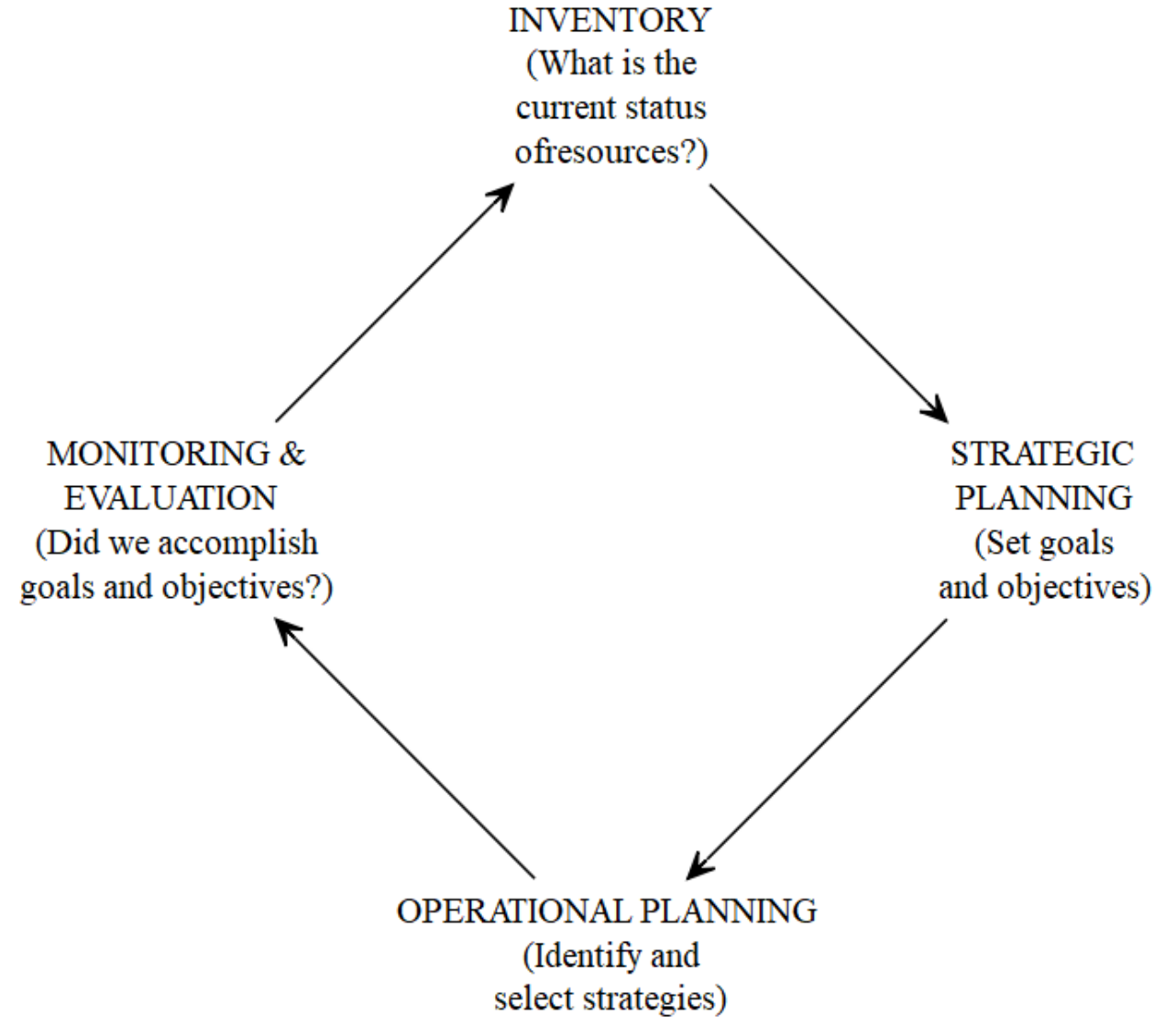




## Market & non-market values of recreational fisheries



## Structured **D**ecision-**M**aking & **A**daptive **M**anagement



# Problems & Objectives

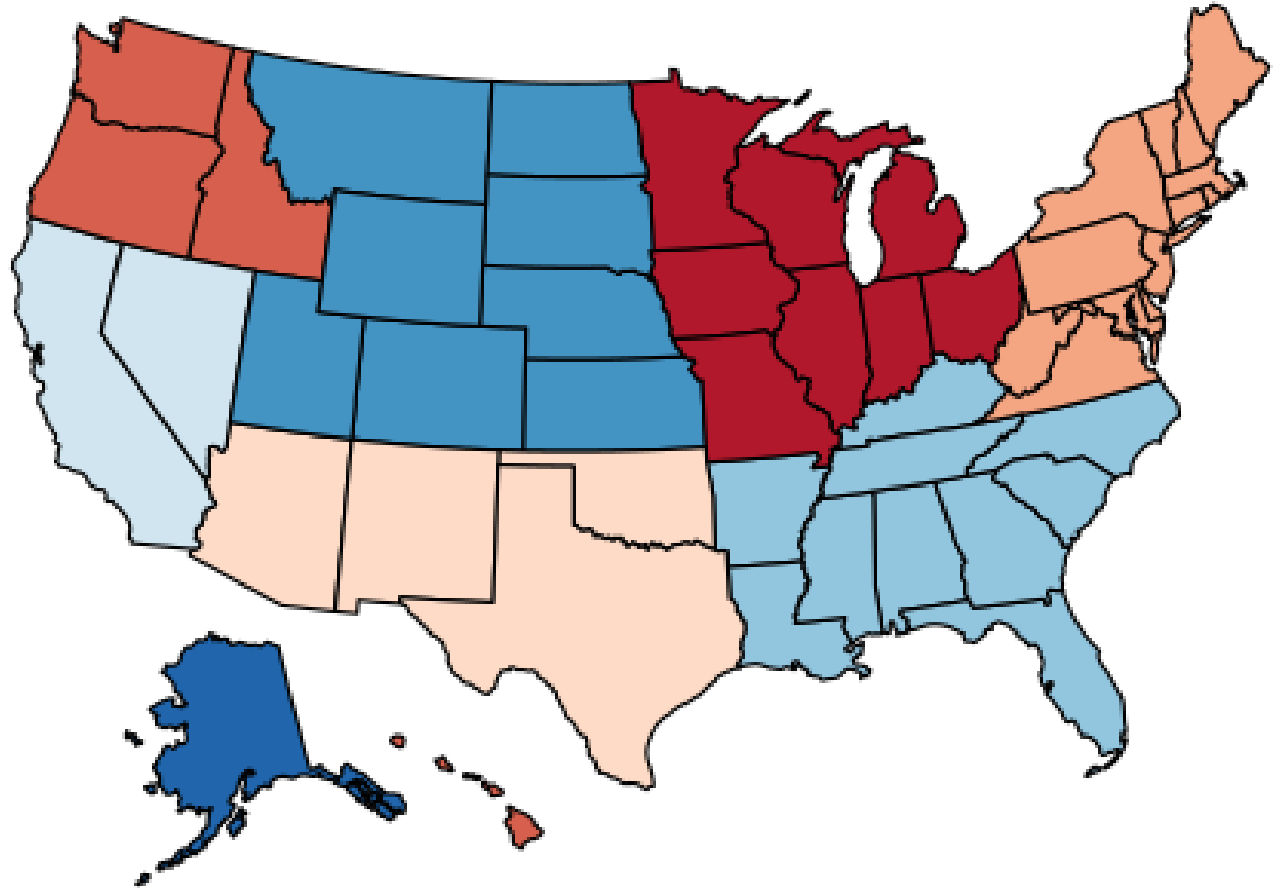
Problem	Objective
<ul style="list-style-type: none"><li>• Informal decision-making framework &amp; potential biases</li></ul>	<ul style="list-style-type: none"><li>• Review decision-making processes</li></ul>
<ul style="list-style-type: none"><li>• Sparsity of tools to assist managers in connecting decision components &amp; leverage information</li></ul>	<ul style="list-style-type: none"><li>• Construct a planning &amp; decision support tool</li></ul>

Problem	Objective	Sub-objective
Informal decision-making framework & potential biases	Review decision-making processes	Provide decision guidance to MDWFP Fisheries Bureau

# Searches

## Initial scope to:

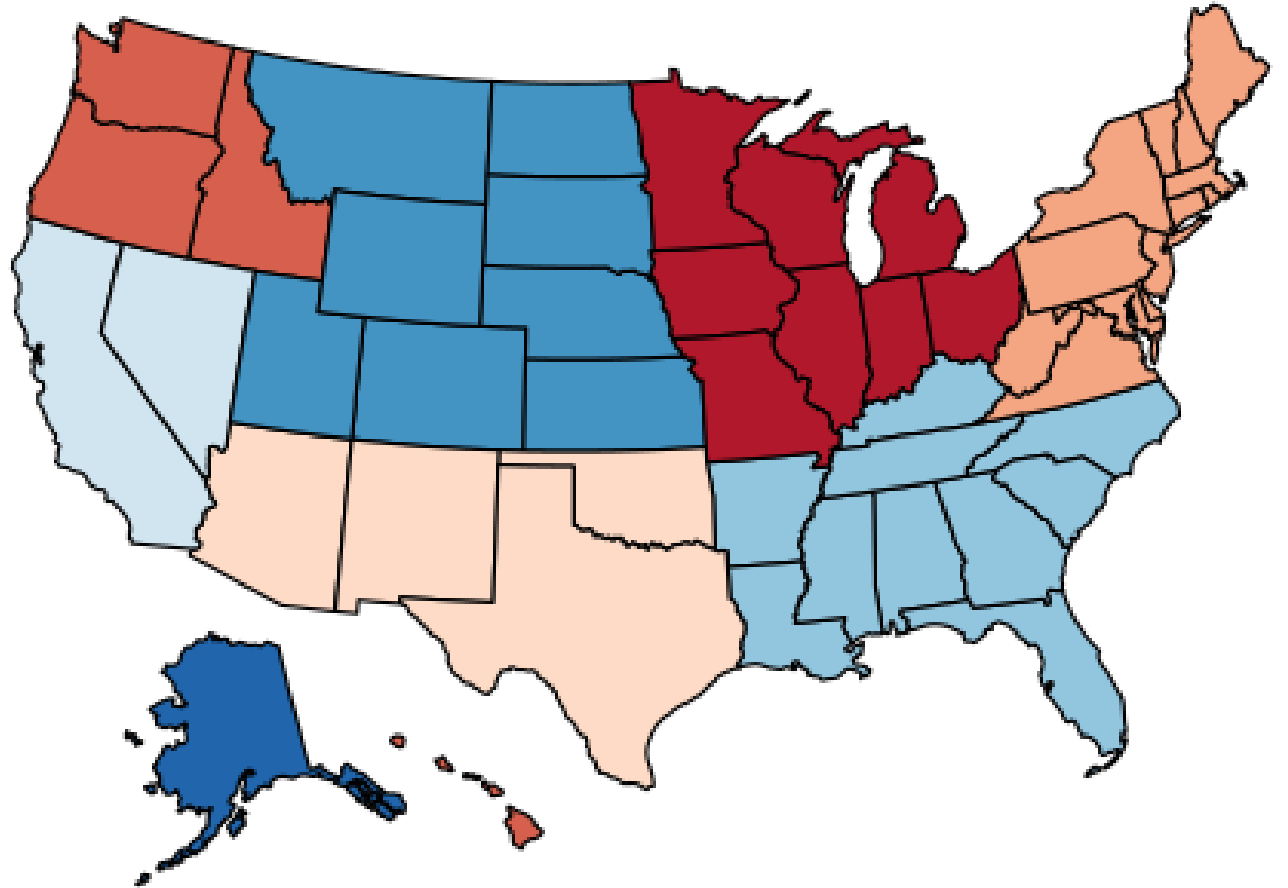
- refine questions
- identify databases & search engines
- refine search terms & key words





# Searches

- Initial scope to:
  - refine question & objectives
  - identify databases & search engines
  - refine search terms & key words
- Databases & search engines
- Website searches
- Bibliography searches
- Contact agencies



# Filtering of Literature

- Results are screened
  - title, abstract, & keywords
- Full texts of gathered literature are examined & relevant papers retained
- Data from this final reference library is extracted & synthesized

## Question

Outlines basic elements of a decision?

Link alternatives to objectives.

Illustrations & examples of decision process given?

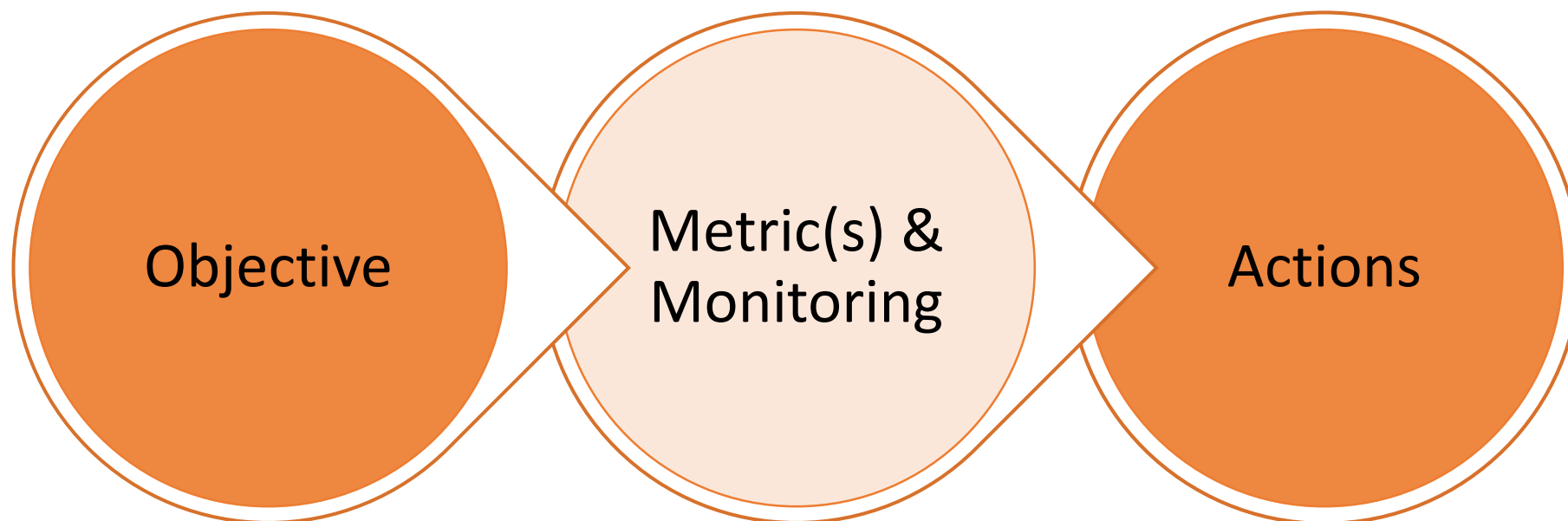
## Question

Outlines basic elements of a decision?

Link alternatives to objectives.

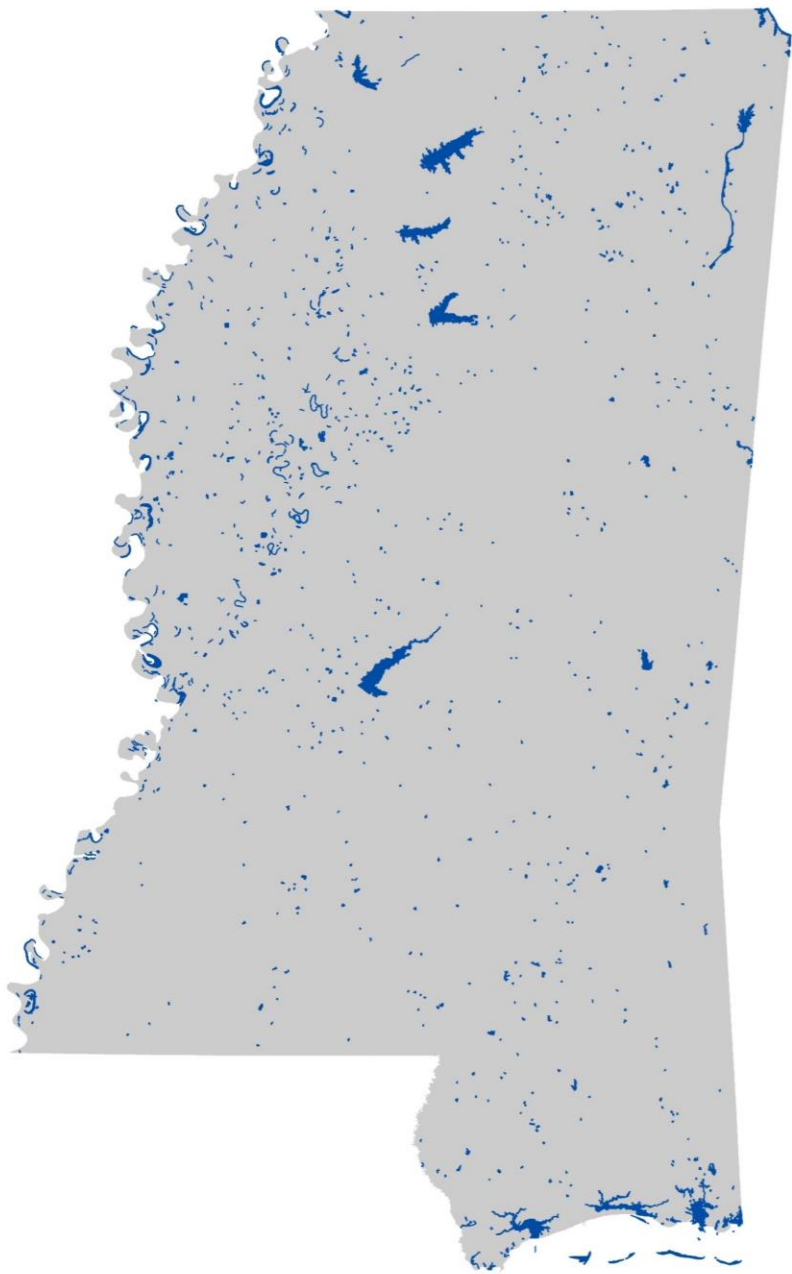
Illustrations & examples of decision process given?

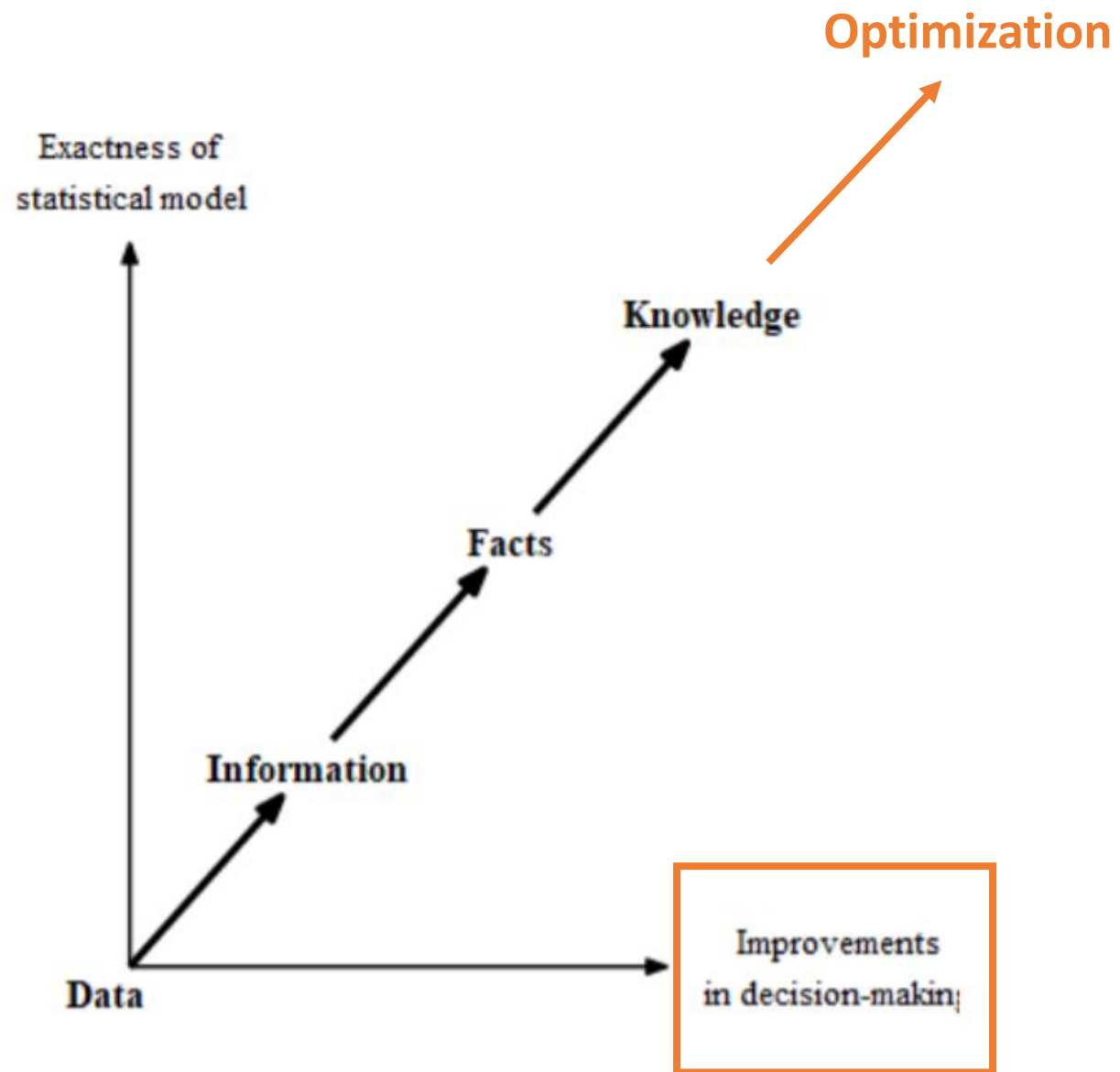
- Guidance—normative decision theory
- Procedures—prescriptive decision theory
- Applications—“case studies”



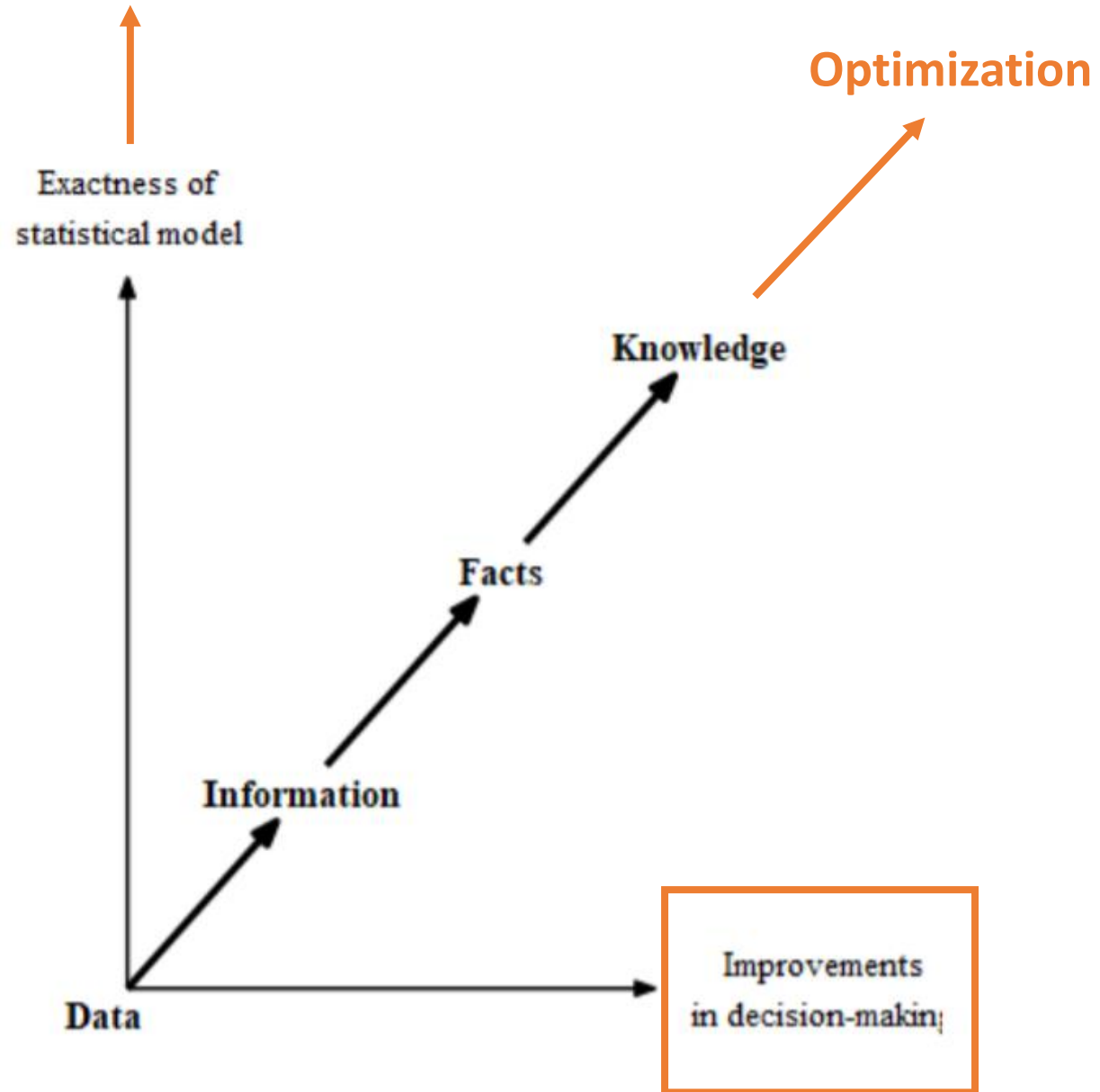


Problem	Objective	Sub-objective
Sparsity of tools to assist managers in connecting decision components & leverage information	Construct a planning & decision support tool	Provide MDWFP Fisheries Bureau with a tool to plan, not only report

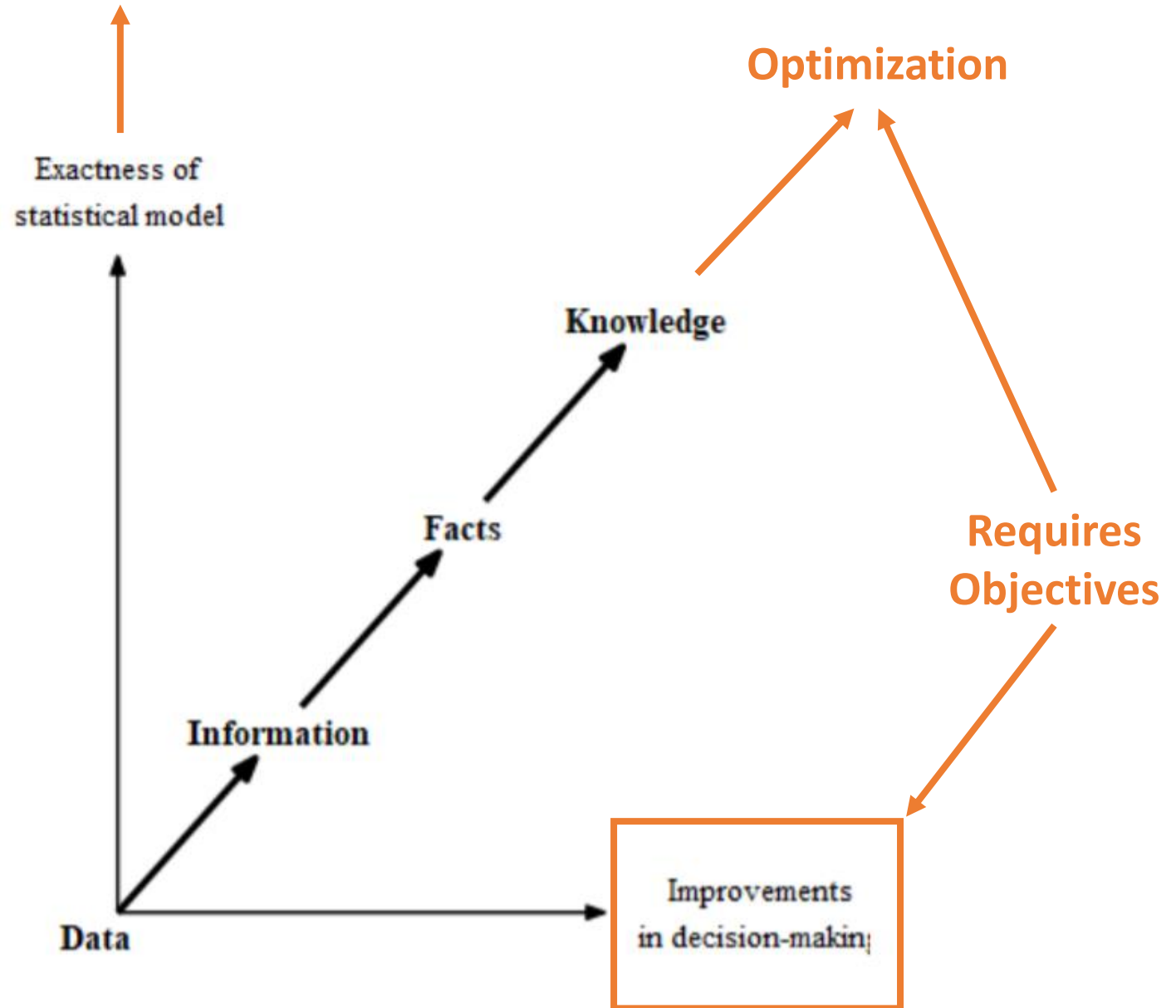




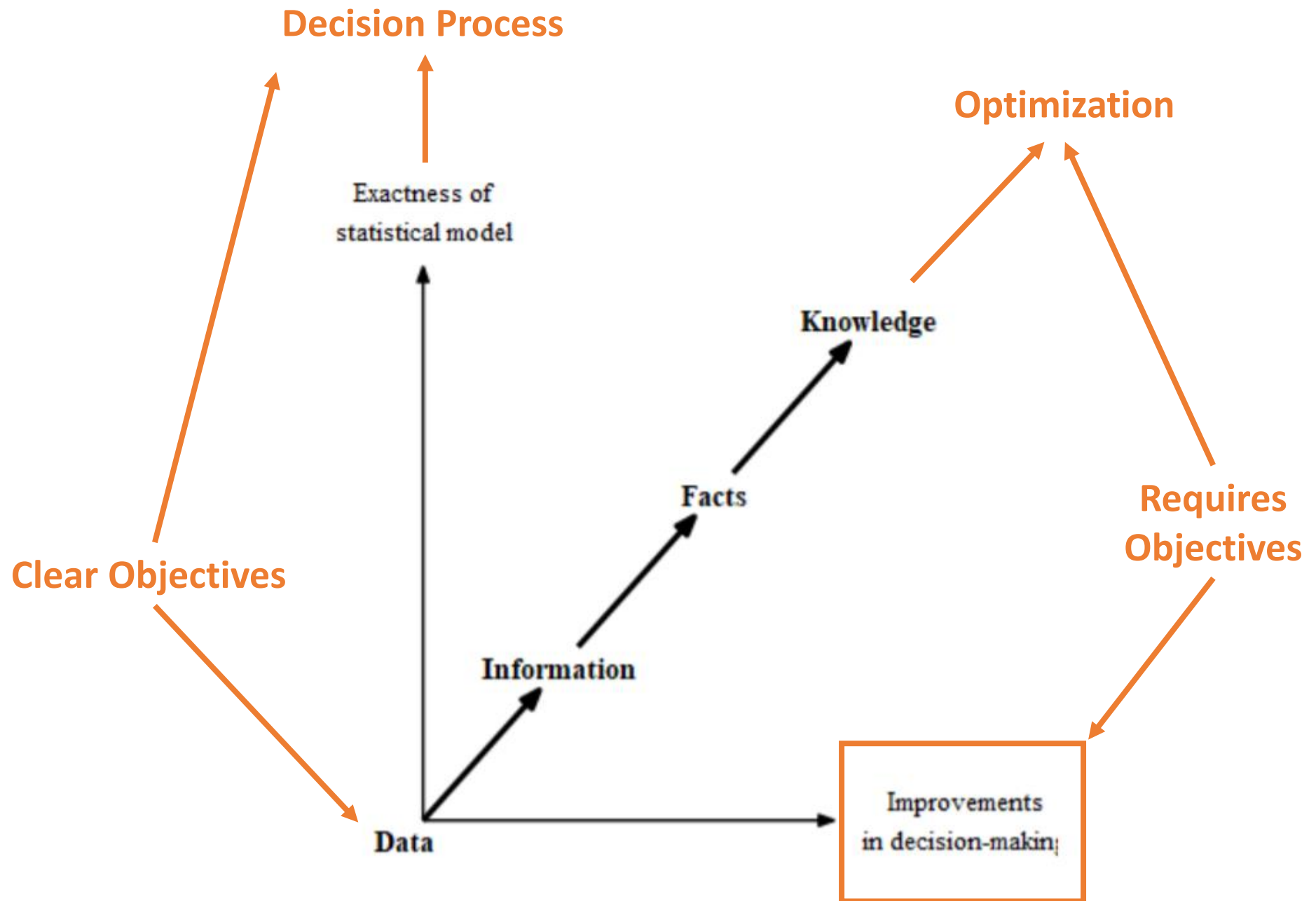
## Decision Process

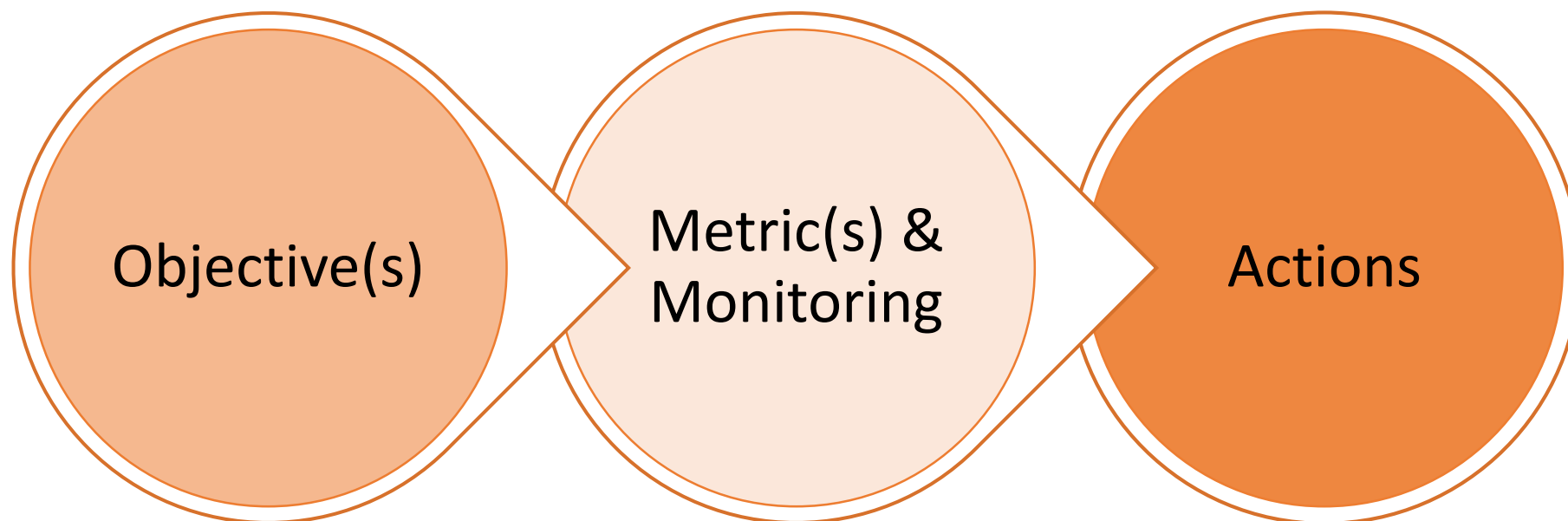


## Decision Process









global.R x ui.R x server.R x

```

1 shinyServer(function(input, output, session) {
2   # Place holder
3   source("serv_components/serv-place-holder.R", local = TRUE)$value
4
5   # Water body information
6   source("serv_components/serv-water-body.R", local = TRUE)$value
7
8   # Objectives
9   source("serv_components/serv-objectives.R", local = TRUE)$value
10
11  # Actions
12  source("serv_components/serv-actions.R", local = TRUE)$value
13 })
14

```

14:1 (Top Level)

R Script

Console Terminal x

```

~/research/dissertation-research/MDWFPps/MDWFP-FRASps/
Platform: x86_64-w64-mingw32/x64 (64-bit)

```

R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.

[Workspace loaded from ~/research/dissertation-research/MDWFPps/MDWFP-FRASps/.RData]

&gt; |

Environment History Connections Git

New Connection

Connection	Status

Files Plots Packages Help Viewer

New Folder Delete Rename More

Home &gt; research &gt; dissertation-research &gt; MDWFPps &gt; MDWFP-FRASps

	Name	Size	Modified
	..		
	.gitignore	28 B	Feb 20, 2019, 11:43 AM
	.RData	11.3 KB	Feb 20, 2019, 12:31 PM
	.Rhistory	8.5 KB	Feb 27, 2019, 11:14 AM
	.Rprofile	118 B	Feb 19, 2019, 11:51 AM
	bugs.md	96 B	Jan 18, 2019, 10:40 AM
	data		
	figures		
	global.R	773 B	Feb 20, 2019, 12:31 PM
	logo.md	302 B	Jan 18, 2019, 10:38 AM
	MDWFP-FRASps.Rproj	218 B	Mar 5, 2019, 3:34 PM
	packrat		
	serv_components		
	server.R	406 B	Feb 19, 2019, 5:00 PM
	ui.R	707 B	Feb 19, 2019, 8:34 PM
	ui_components		

## Fisheries Resources Analysis System: Planning Support (FRASps 0.1)

[Welcome](#)[Information about water body](#)[Objectives](#)[Actions](#)[Help \(Pending\)](#)[Reported Bugs & Status](#)[Example code as place holder](#)

Select the water body for which this management plan is being built.

**Name of Water Body:**

Aberdeen Lake

Select the species of management interest.

**Species:**

Largemouth bass Black crappie White crappie

**Lake**

**Species**

Aberdeen Lake Largemouth bass

Aberdeen Lake Black crappie

Aberdeen Lake White crappie

Select the alternative actions(s) to be considered.

Action alternatives:

Regulate the number of poles used in crappie fisheries

Fertilize lake to enhance number and size of fish available to anglers

Monitor relevant water quality parameters at appropriate temporal and spatial scales

Encourage lake administration organization to develop capacity to monitor water quality

Lake	Species
Aberdeen Lake	Largemouth bass
Aberdeen Lake	Black crappie
Aberdeen Lake	White crappie

Objectives

Maintain water quality

Attain target catch rates sizes

Alternatives

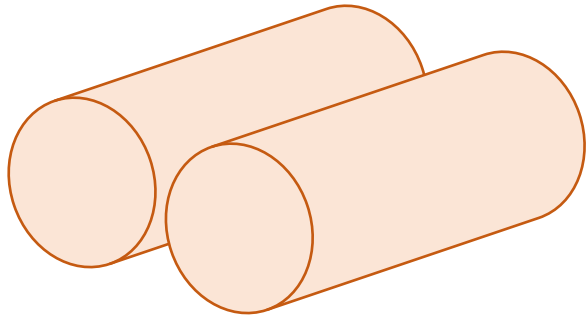
Regulate the number of poles used in crappie fisheries

Fertilize lake to enhance number and size of fish available to anglers

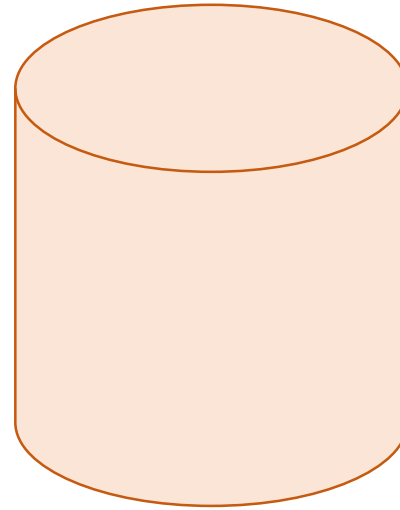
Monitor relevant water quality parameters at appropriate temporal and spatial scales

Encourage lake administration organization to develop capacity to monitor water quality

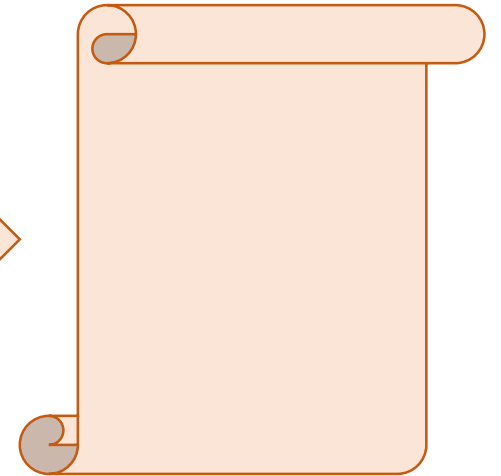
Monitoring



Modeling



Reporting &  
Planning





Problem	Objective
<ul style="list-style-type: none"> <li>Reliability, comparability, &amp; shareability of sampling methods &amp; data management</li> </ul>	<ul style="list-style-type: none"> <li>Survey &amp; relate sampling &amp; data handling protocols</li> </ul>
<ul style="list-style-type: none"> <li>Untapped information in existing data</li> </ul>	<ul style="list-style-type: none"> <li>Develop knowledge discovery guide</li> </ul>
<ul style="list-style-type: none"> <li>Informal decision-making framework &amp; potential biases</li> </ul>	<ul style="list-style-type: none"> <li>Review decision-making processes</li> </ul>
<ul style="list-style-type: none"> <li>Sparsity of tools to assist managers in connecting decision components &amp; leverage information</li> </ul>	<ul style="list-style-type: none"> <li>Construct a planning &amp; decision support tool</li> </ul>

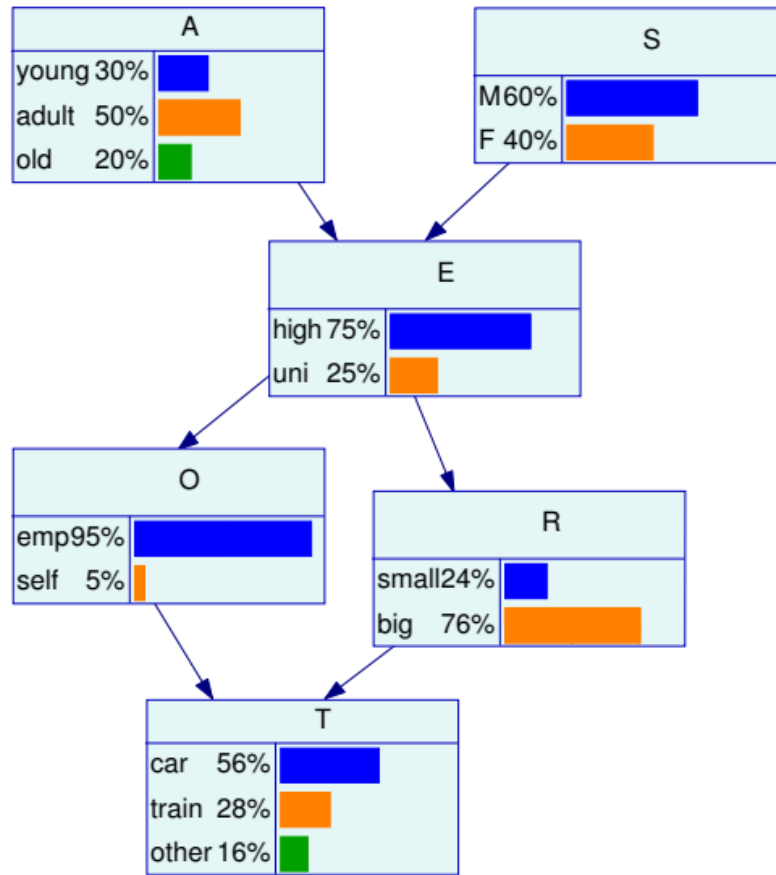


Questions?



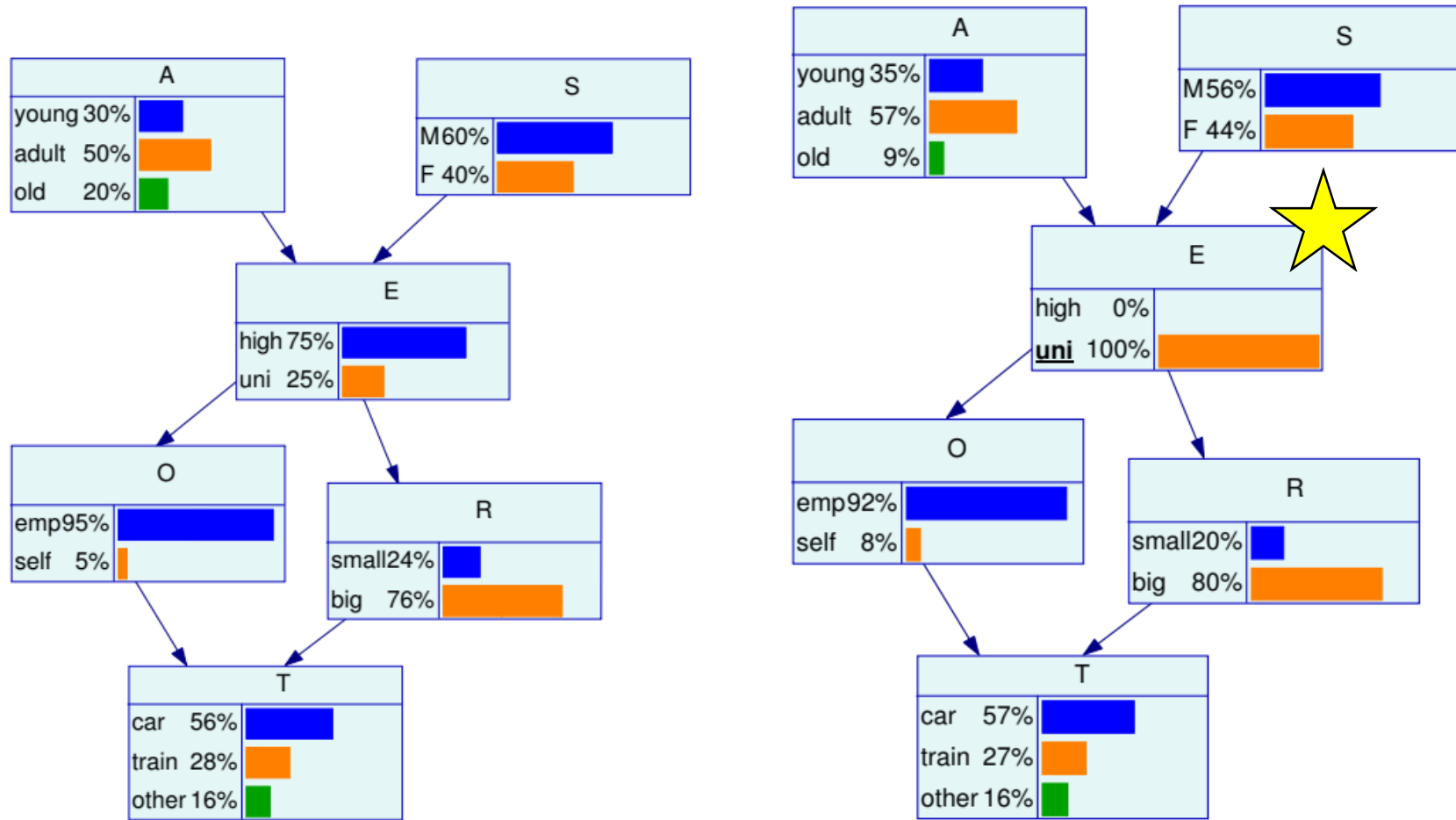


# The Effects of Conditioning on Hard Evidence



The original survey BN (left), and the posterior BN with hard evidence on Education (right).

# The Effects of Conditioning on Hard Evidence



The original survey BN (left), and the posterior BN with hard evidence on Education (right).