5 Loops framework

- Looked at two strategies for succinctly representing a research project
  - Gowin's Vee
  - Lakehead framework

- 5 loops framework:
  - Looks at alternative strategies for evaluating truth value of propositions

form conclusions

analyze data

1

gather data

~~problem statement~~
incentive

Loop 1

form conclusions

analyze data

1

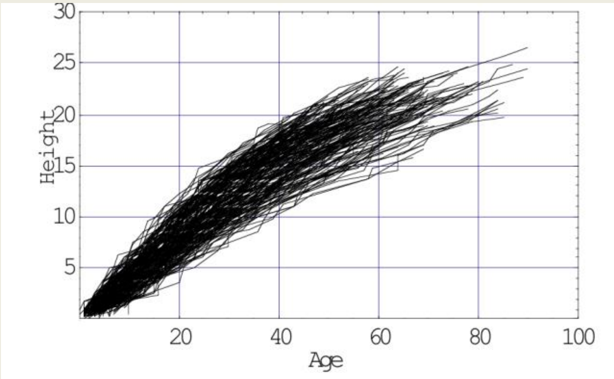
gather data

incentive

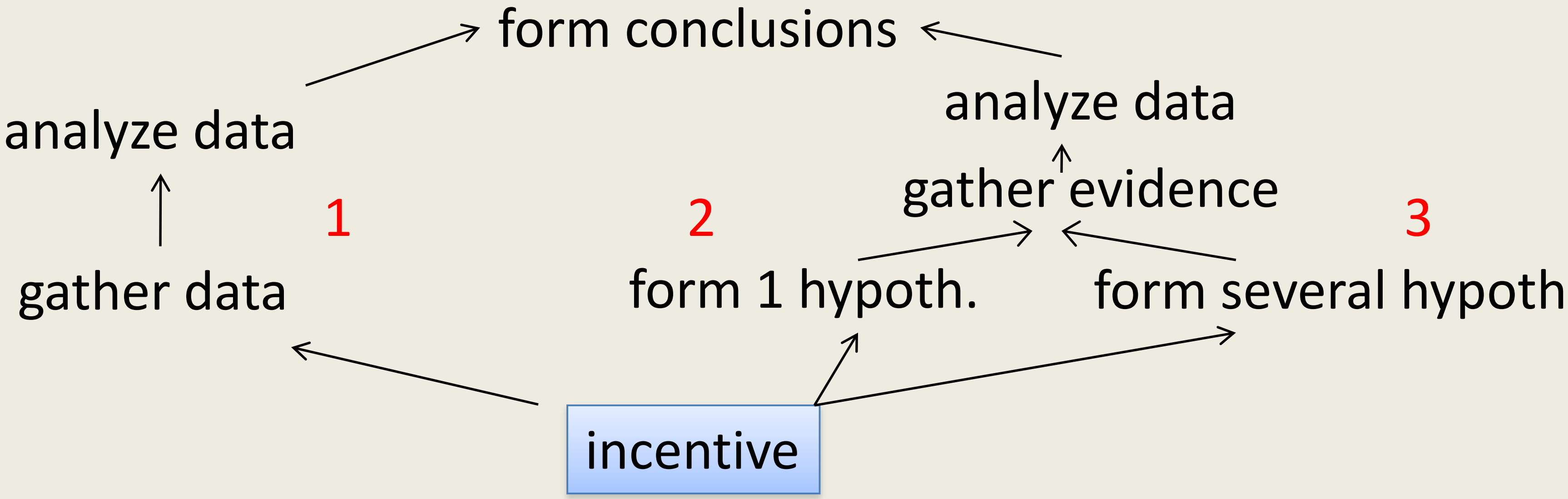
RMSE = ?

Serial Correlation = ??

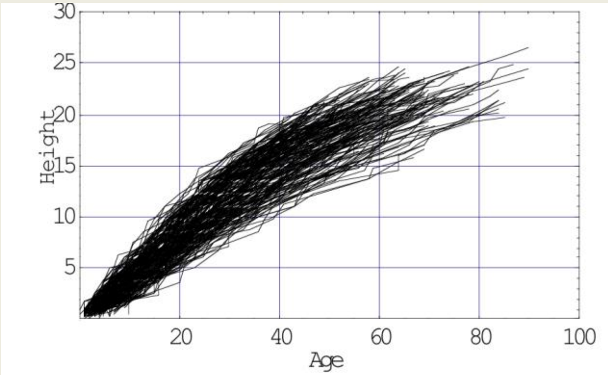
other measures



W. C. Carmean data


form conclusions
analyze data
analyze data
gather evidence
1
2
3
gather data
form 1 hypoth.
form several hypoth.
incentive

Loop 3

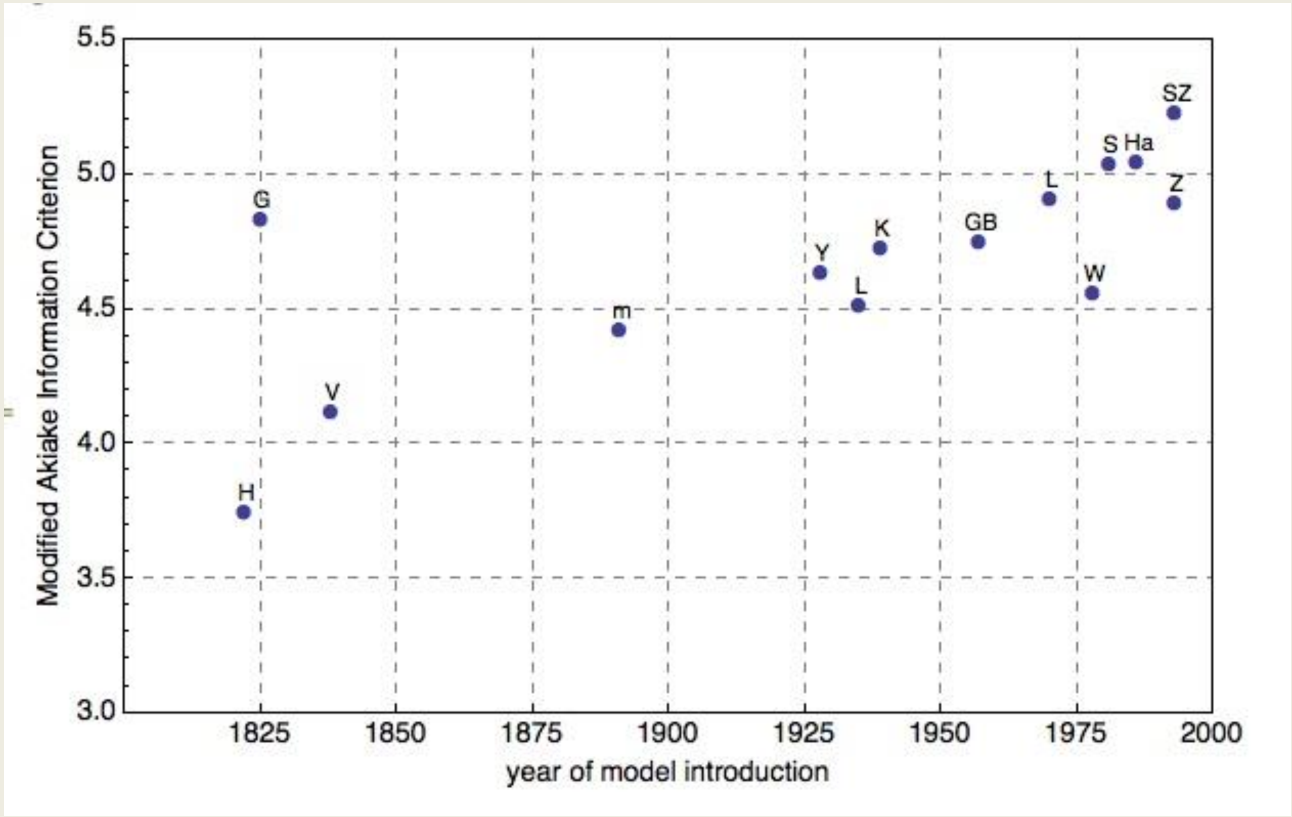


W. C. Carmean data

Are we making progress in mathematically representing sugar maple height growth?

Equation name	year model introduced	Differential form
1st order expressible in closed form:		
Hossfeld IV	1822	$h' = h^2 A B t^{(-B-1)}$
Gompertz	1825	$h' = h A B e^{(-B t)}$
Verhulst ~~logistic~~	1838	$h' = h(B - B/A)h$
monomolecular	1891	$h' = B(A - h)$
Yoshida I	1928	
Levakovic I	1935	$h' = h A B \frac{C}{t(A + t^C)}$
Korf	1939	$h' = h A B t^{(-B-1)}$
Generalized Bertalanfy	1959	$h' = A h^C - B h$
Weibull	1978	$h' = (1-h) A B t^{(B-1)}$
1st order with no closed form solution		
Leary	1970	$h' = A h e^{-Bh}$
Leary/Zeide	1993	$h' = A h^C e^{-Bh}$
2nd order		
Schnute	1981	$h' = h k$ $k' = k(A + B k)$
Schnute/Zeide	1993	$h' = h k$ $k' = k(A k^B)$
Umemura, Hamlin	1987	$h' = k$ $k' = C - A k - B h$
Integro-differential		
Hamlin	1987	$h' = C t - A h - B \int_{u=0}^{u=t} f(h(u)) du$

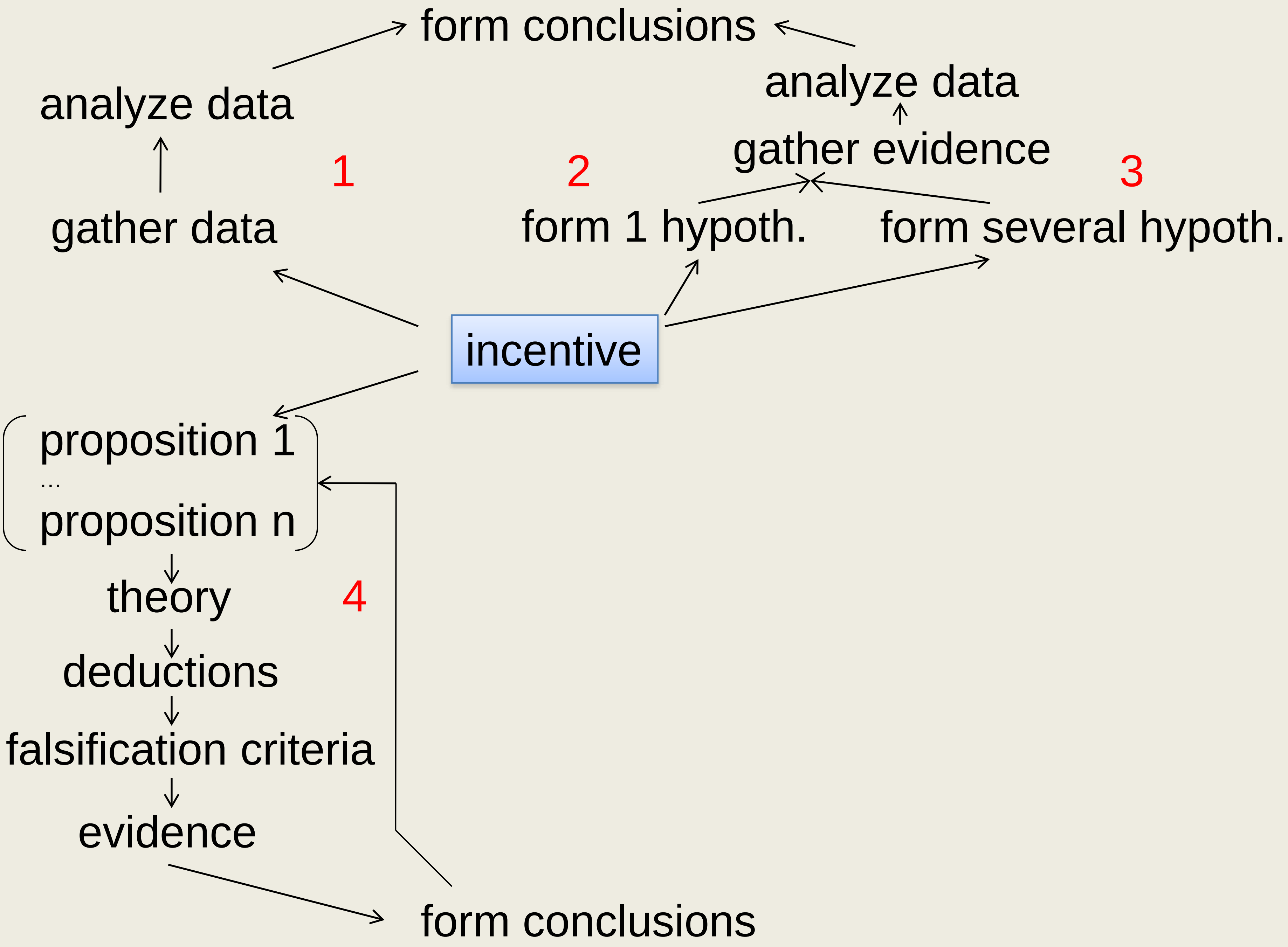
Equations 1-9,11-13 from Zeide (1993), #s 10,16, 17 added by Leary (1996).



Loop 3

Conclusion? Surprising progress has been made over the last 185 years in representing (sugar maple) height growth.

$$MAIC = 3.85 + 0.0070 \times (years\ from 1822), \quad R^2 = .999^*$$


form conclusions
analyze data
analyze data
gather evidence
1
2
3
gather data
form 1 hypoth.
form several hypoth.
incentive
proposition 1
...
proposition n
theory
4
deductions
falsification criteria
evidence
form conclusions

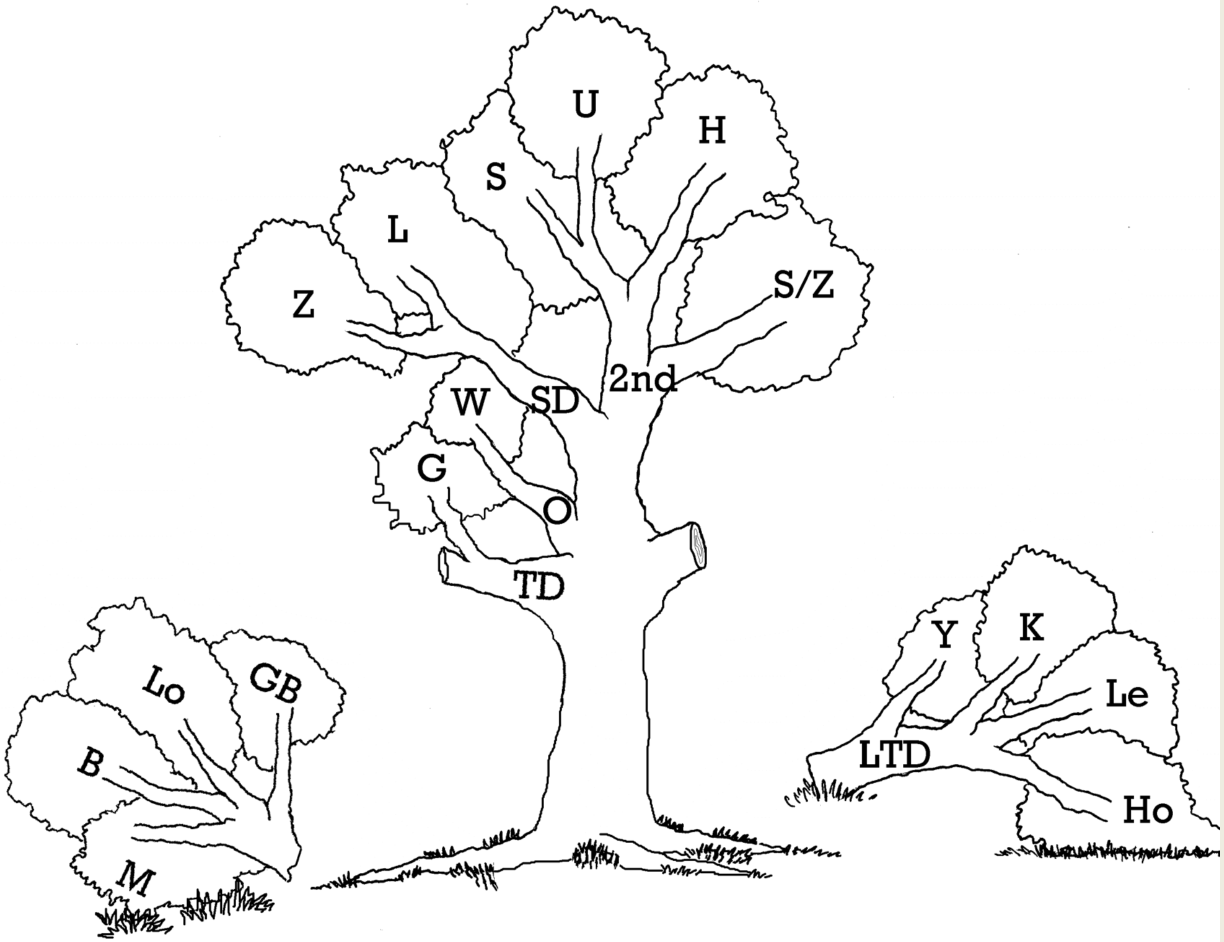
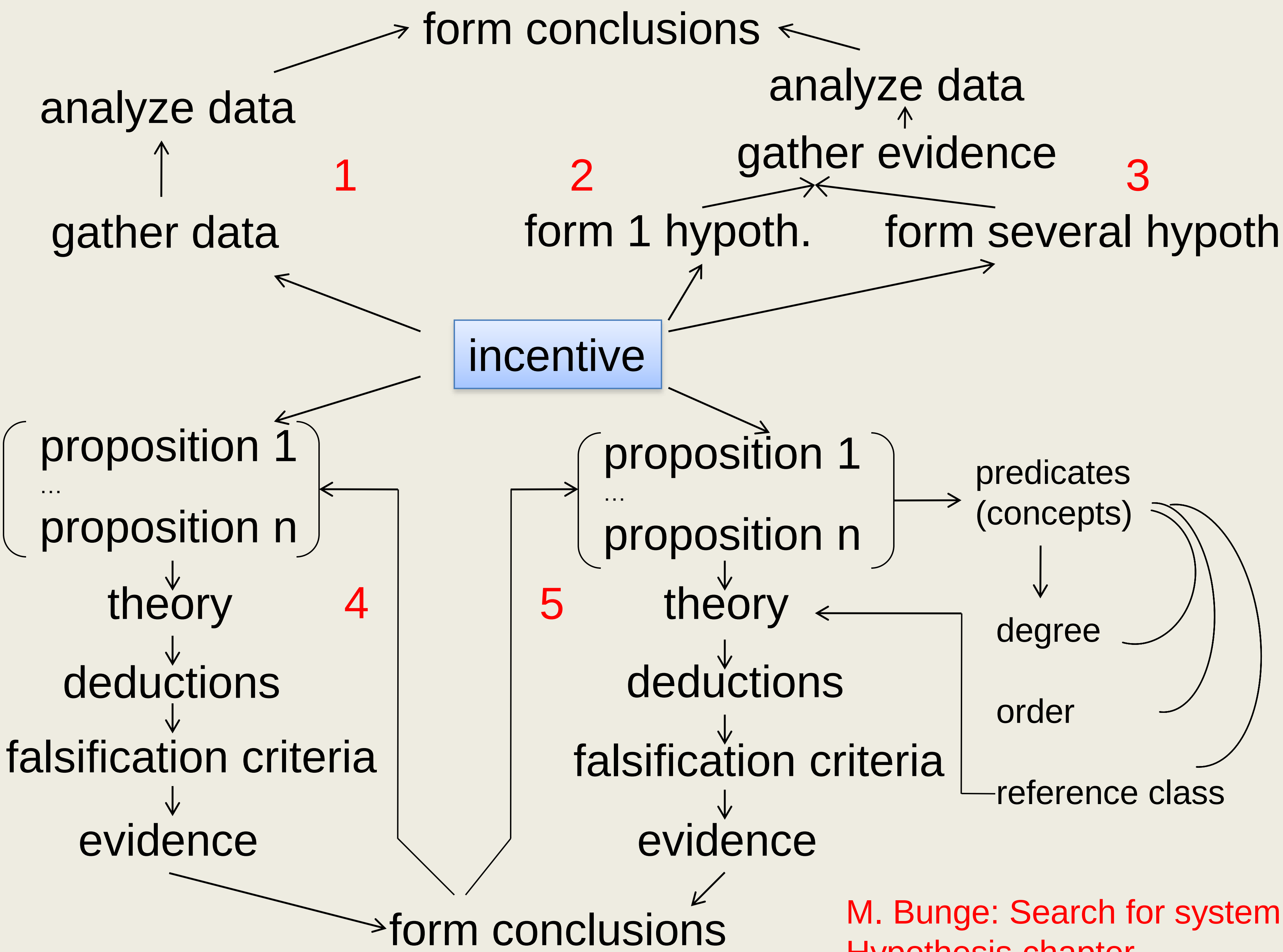


Figure 5. Idealised execution of the second iteration of a strong inference strategy based on the large range in initial heights predicted by TD equations. The Gompertz equation is not falsified.


form conclusions
analyze data
analyze data
gather evidence
1
2
3
gather data
form 1 hypoth.
form several hypoth.
incentive
proposition 1
...
proposition n
proposition 1
...
proposition n
predicates
(concepts)
theory
4
5
theory
degree
deductions
deductions
order
falsification criteria
falsification criteria
reference class
evidence
evidence
form conclusions
M. Bunge: Search for system
Hypothesis chapter.

Loop 5

Hossfeld IV (1822)

$$\begin{pmatrix} \text{proposition 1} \\ \ldots \\ \cancel{\text{proposition n}} \end{pmatrix}$$

1. Degree (how many things is it about?)
2. Order (what is nature of things …?)
3. Reference class (how widely applicable?)

$$h' = h^2 ABt^{(-B-1)}$$

1. {h’, h, t} – Degree – 3
2. {h–state, t–time, h’–relation (state and time)} -- Order – (0^{th},1^{st})
3. 1 tree species in 1 geographic region – Reference Class -- {limited – for now

Schnute (1981), Zeide (1993)

$$\left(\begin{array}{l}\text{proposition 1} \\ \dots \\ \text{proposition n}\end{array}\right)$$

1. Degree (how many things is it about?)
2. Order (what is nature of things …?)
3. Reference class (how widely applicable?)

$$h' = h\,k \qquad \frac{h'}{h} = k$$

k = Relative growth rate of h

$$k' = k(Ak^{B}) \qquad \frac{k'}{k} = (Ak^{B})$$

Ak^{B} = Relative growth rate of relative growth rate of h

1. Degree (how many things is Schnute equation about?)

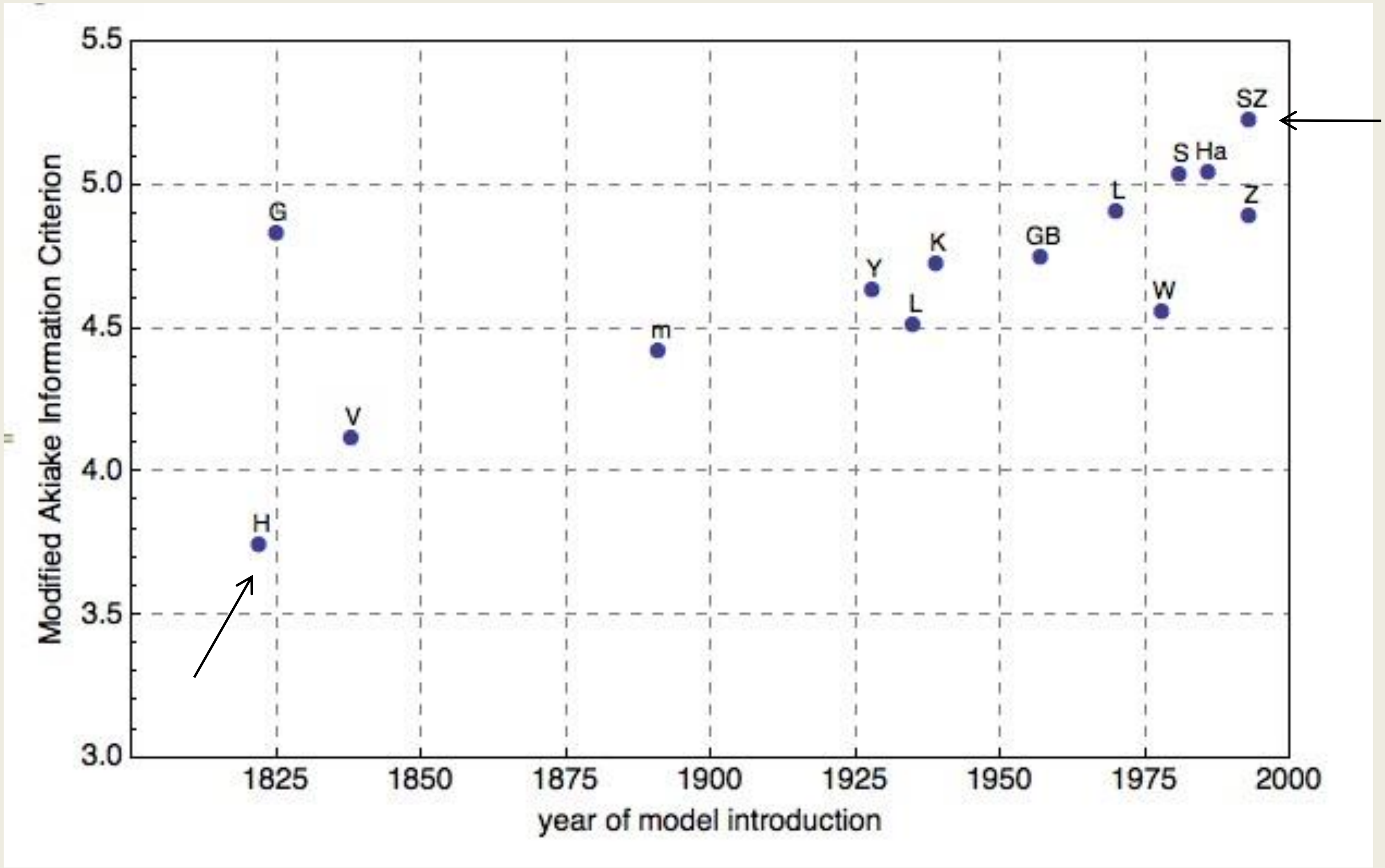
$$\left\langle t, h, h', \frac{h'}{h} = k, k', \frac{k'}{k} \right\rangle = 6$$

1. Order (what is nature of things …?)

   (time, size, rate of size change, relative rate of size change, rate of rate of size change, relative rate of relative rate of size change) – 4th order

2. Reference class (how widely applicable?)

   Originally applied to fisheries, now forests, ??? (perhaps all biological organisms).



5.5
5.0
4.5
4.0
3.5
3.0
Modified Akiake Information Criterion
1825
1850
1875
1900
1925
1950
1975
2000
year of model introduction
G
V
H
m
Y
L
K
GB
L
W
S
Ha
SZ
Z

Take Aways:

1. ‘5 (different) loops’ get at strategies for testing hypotheses (propositions).

2. Loop #5 may provide some insight to why some propositions represent nature better than others.

Take Aways (continued):

3. Would a "loops analysis" of research in your area of science, published over several decades, show an increase (upward slope) to a graph of 'loop score' vs. decade?

Thank you