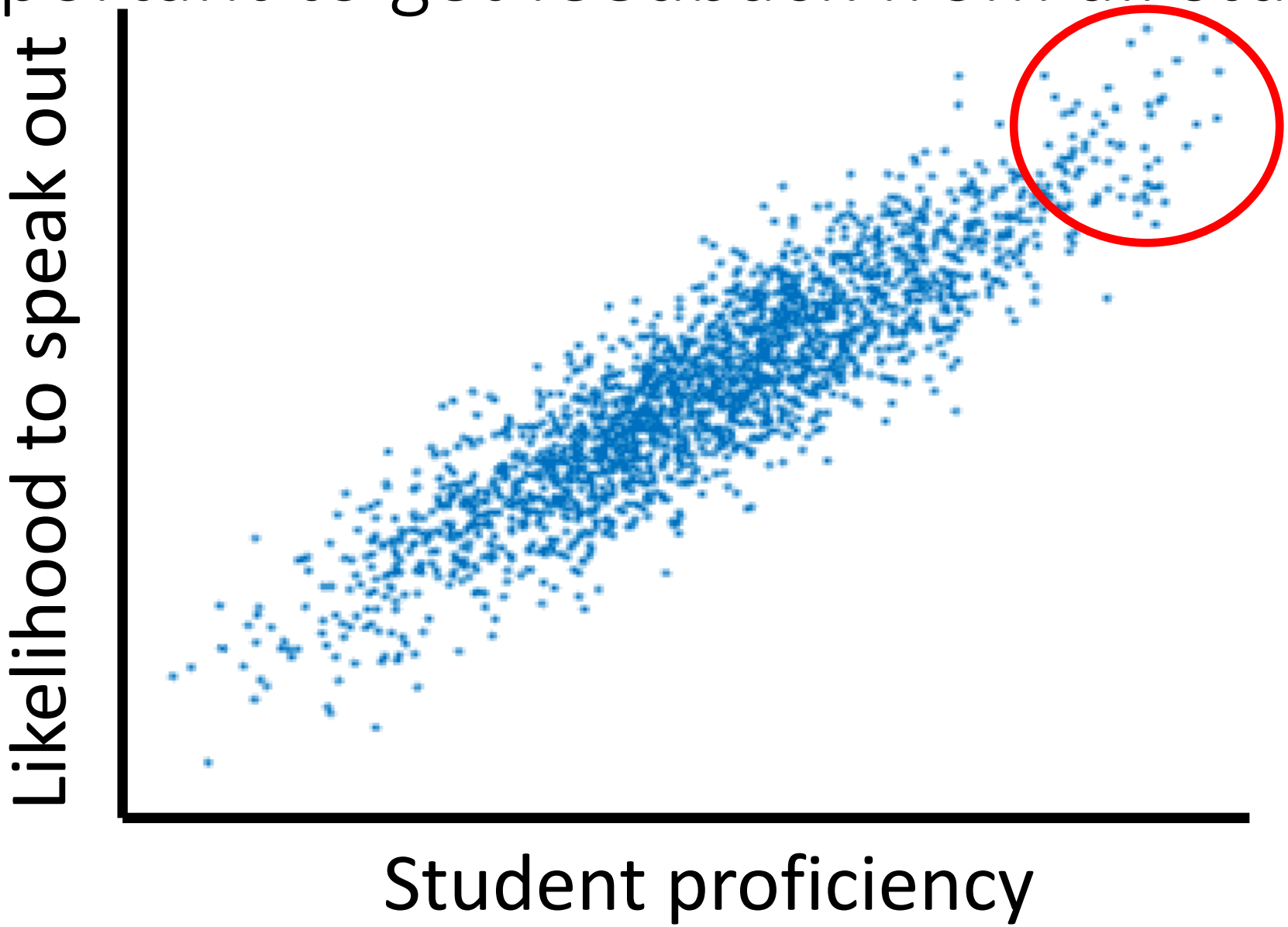
Remote calibration of class content and delivery, implementing rapid feedback loops with after-action assessments (AAA)

Pascal Wallisch, PhD
Center for Data Science & Department of Psychology
New York University

The problem: To properly calibrate a class, it is important to get feedback from all students



Before we went remote, this was straightforward: Clickers can be used to get this feedback at scale

The after-action assessment (AAA)

Assignment Instructions

Please type the following in the box below:

1) State the main takeaway from this lecture in your own words. 1 paragraph. Keep it brief.

2) What would you like to know more about? (If nothing: What surprised you?) 1 paragraph. Keep it brief.

That's it.

How to get the students to do this, per lecture?

Killing two birds with one stone – making it count for **participation** (giving them the flexibility to watch lecture recordings asynchronously, etc.)

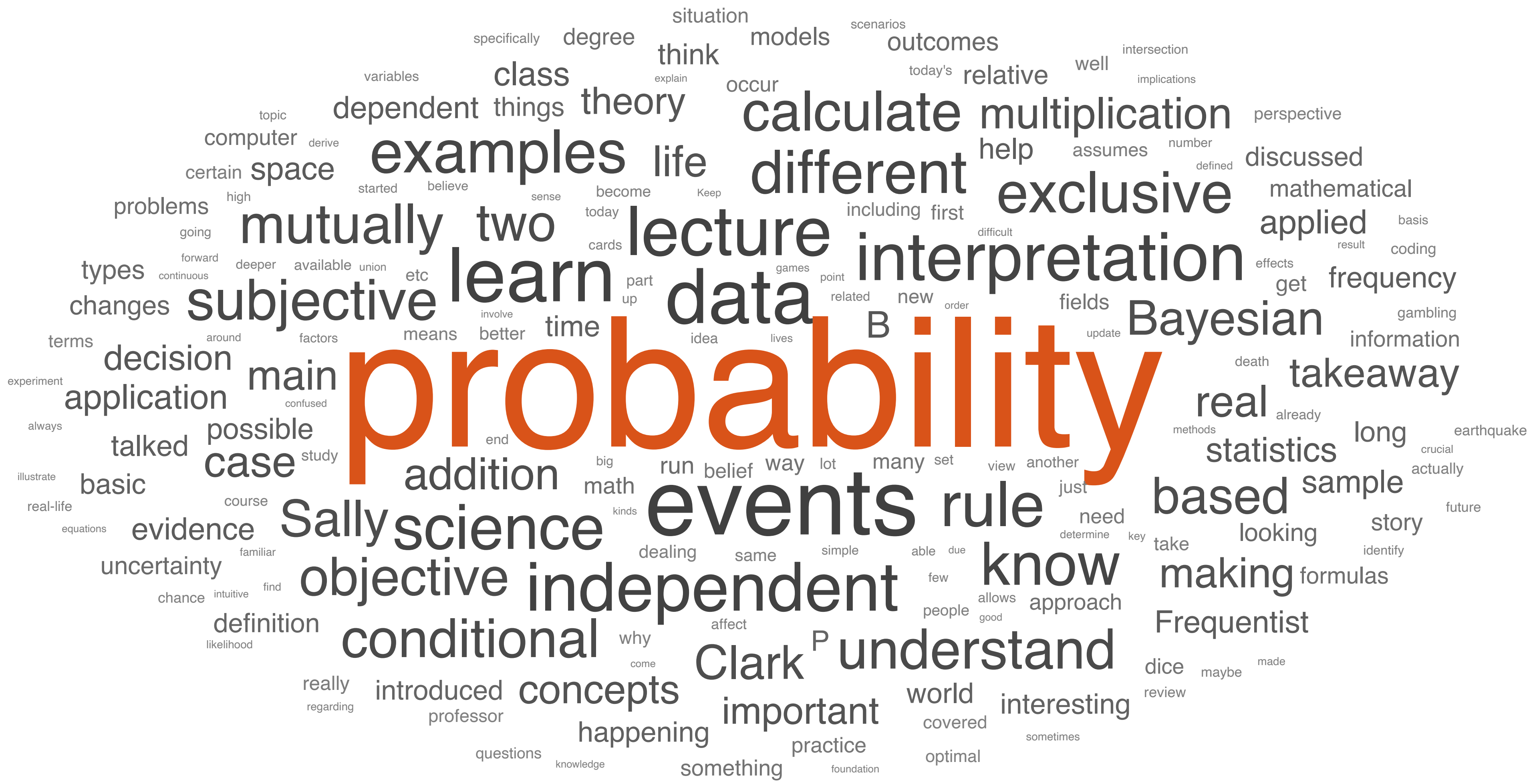
§2.0 Course grading: The total grade is calculated as follows:

A)	After action assessments (participation)	0.5% / lecture	10% total
B)	1 Big data analysis project	16%	16% total
C)	1 Course logistics quiz	1%	01% total
D)	7 Data analysis reports	2% / report	14% total
E)	1 Exam (cumulative)	15%	15% total
F)	7 Functions (Python)	2% / function	14% total

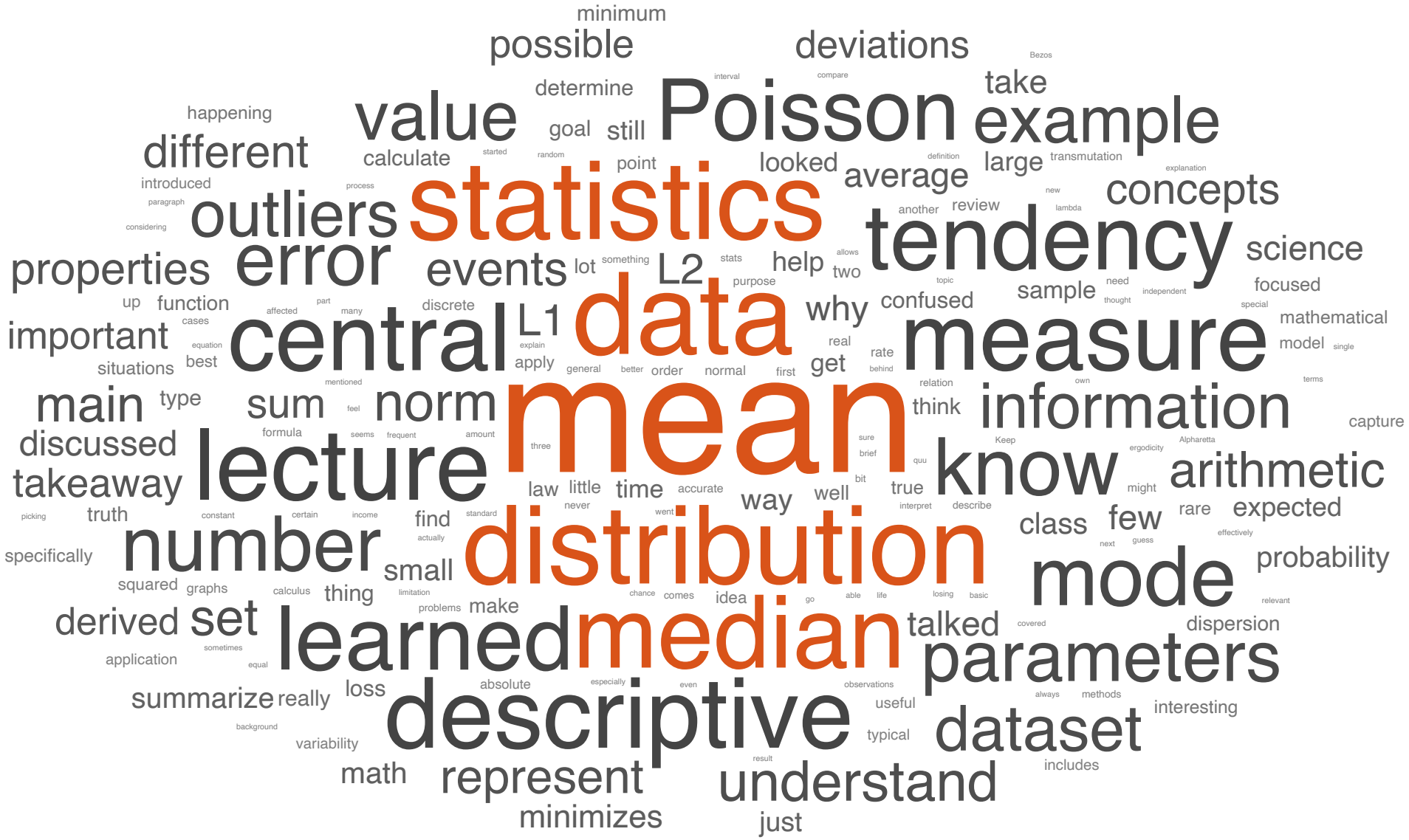
How closely are students following the course material?

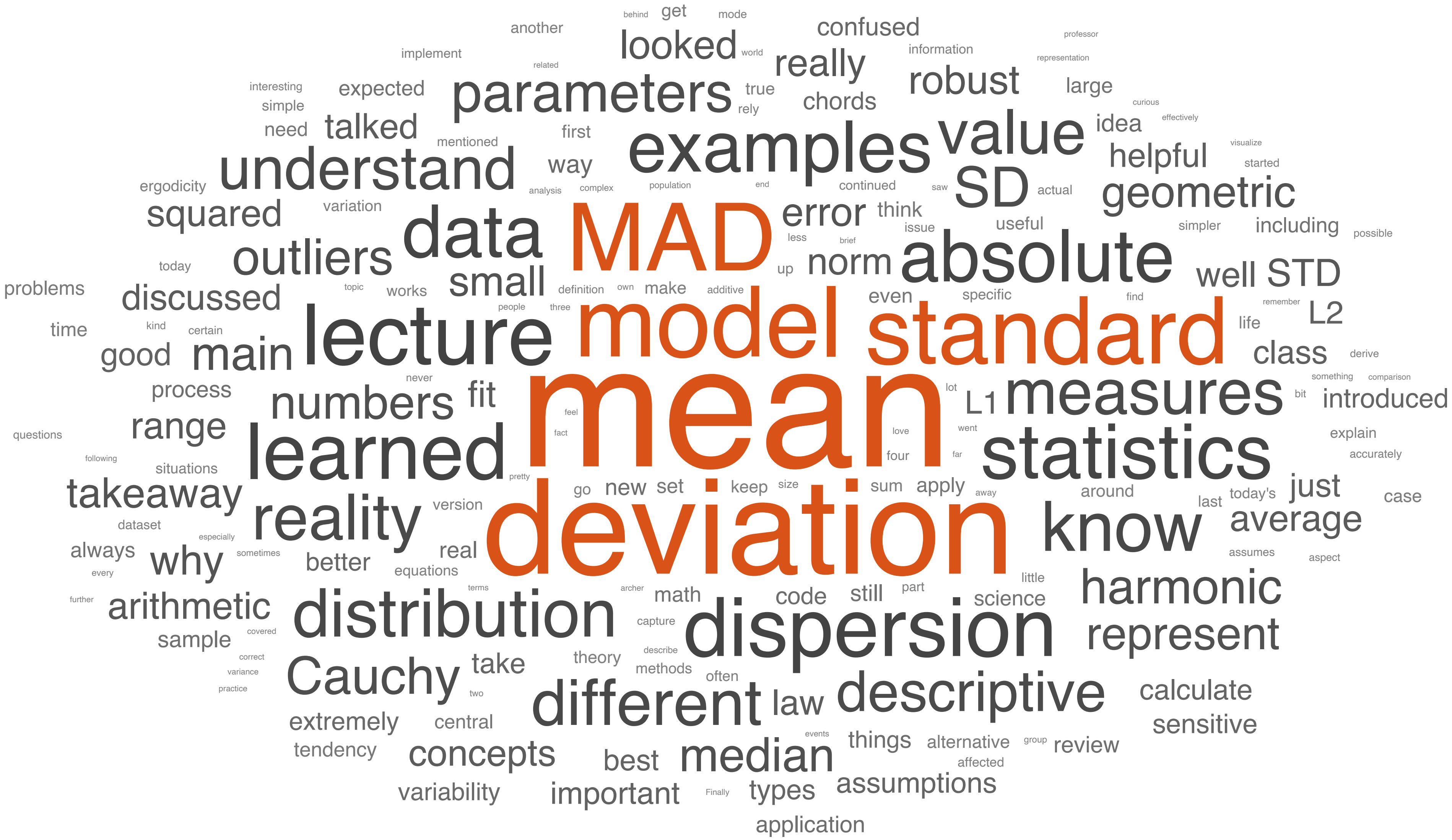
Lecture by lecture feedback from a Fall 2020 Introduction to Data Science class…

introduced
qualitative
aspects
mentioned
numbers
quantification
considered
Another
just
connection
took
rules
type
major
engineering
operationalization
come
class
mathematics
born
rather
better
confirmation
form
people
examples
math
part
possible
away
kind
practical
look
statistics
basic
questions
conclusions
logic
correct
exist
deduction
make
set
realized
work
discussed
always
falsification
related
based
lot
attempt
analyze
up
first
learn
fields
interesting
thought
many
collect
around
study
certain
think
true
even
defined
result
found
false
hypothesis
assumptions
intersection
premises
take
need
information
body
things
know
special
new
induction
useful
falsify
today
own
scientific
creating
actually
Keep
order
Professor
future
might
bias
general
data
main
process
really
gained
measurement
real
still
testing
lack
exactly
predictions
point
swan
find
lecture
important
prove
theory
world
disprove
uncertain
Although
explain
scientist
able
two
hard
feel
definition
reasoning
made
why
way
natural
observations
developed
role
wrong
draw
past
proof
takeaway
Finally
lead
help
problem
approach
idea
invention
computer
science
well
topics
constructs
terms
quantitative
knowledge
applied
coding
specific
goal
different
never
experiments
learnt
turkey
understanding
concepts
focus
reality
further
human
get
fact
already
methods
temperature
going
history
time
try
talked
something
quantify
long
analysis
essential
inherently
means
years
advantages
principles
applications
seems
anything
subject
enjoyed
words
combination
complex
characteristics

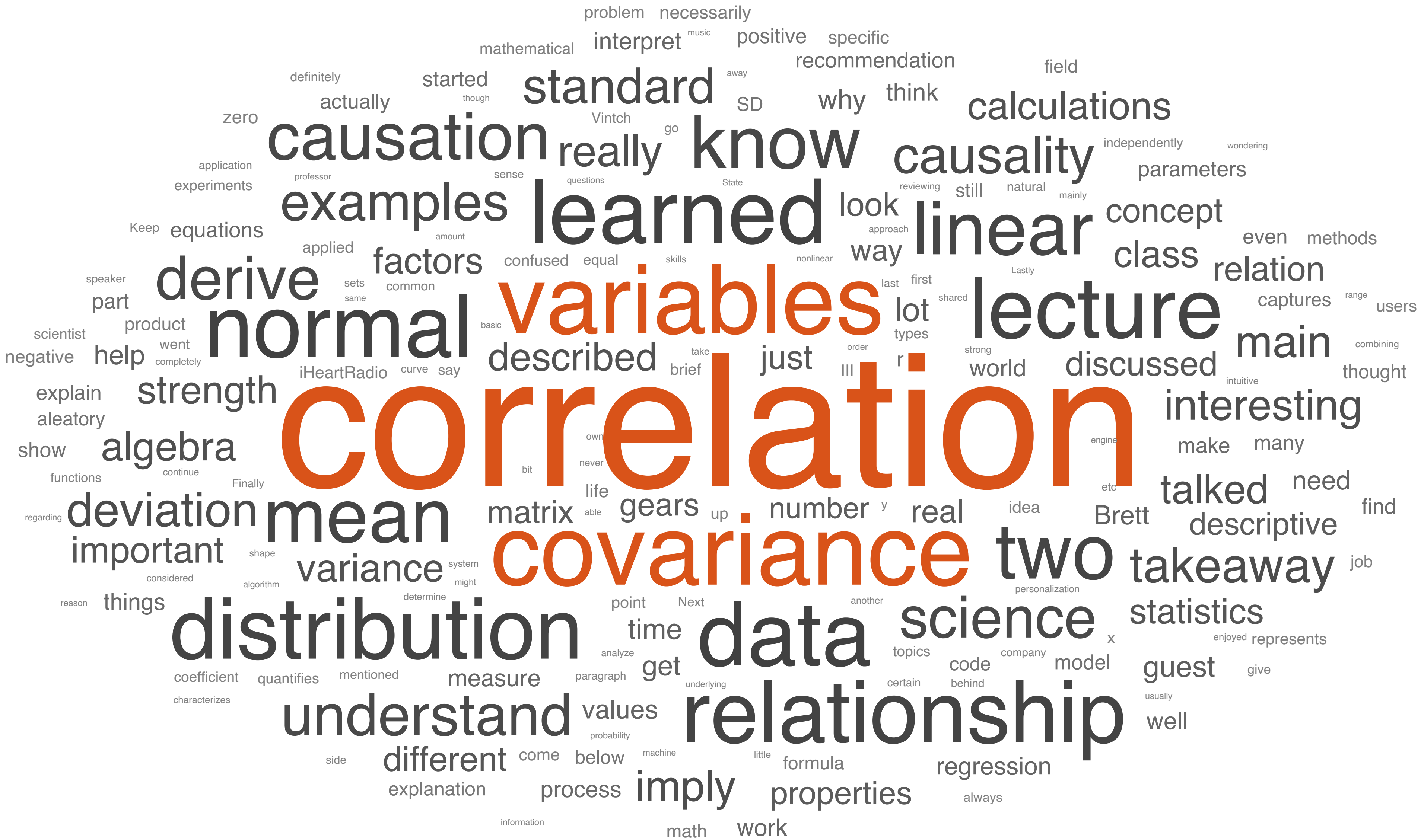

situation
specifically
degree
models
scenarios
outcomes
think
intersection
well
variables
class
explain
today's
relative
implications
occur
theory
topic
dependent
things
calculate
multiplication
perspective
computer
derive
examples
life
help
assumes
number
discussed
certain
space
different
defined
started
believe
become
Keep
mathematical
exclusive
high
sense
problems
including
first
applied
basis
today
going
mutually
two
lecture
difficult
result
coding
cards
forward
interpretation
types
deeper
available
union
effects
continuous
etc
games
part
point
frequency
get
learn
data
subjective
related
new
changes
up
fields
gambling
order
involve
B
Bayesian
terms
around
factors
means
better
time
idea
lives
update
information
decision
death
probability
takeaway
experiment
main
application
confused
real
already
always
methods
possible
long
earthquake
end
talked
statistics
study
crucial
case
way
many
set
view
another
illustrate
big
lot
actually
run
belief
sample
addition
basic
just
math
real-life
based
course
future
events
rule
need
kinds
Sally
science
story
equations
evidence
determine
key
looking
take
dealing
same
simple
able
due
identify
familiar
uncertainty
know
making
objective
formulas
few
find
chance
intuitive
independent
allows
approach
people
definition
good
affect
Frequentist
likelihood
conditional
P
why
understand
Clark
dice
made
maybe
come
really
world
review
introduced
concepts
regarding
important
interesting
professor
covered
happening
sometimes
practice
questions
optimal
knowledge
something
foundation

probability
distribution
sample
example
space
random
different
lecture
variable
learned
real
data
know
events
understand
main
exclusive
independent
problem
function
number
discussed
takeaway
conditional
concepts
important
mutually
looked
outcomes
games
get
time
make
furniture
IVF
class
think
science
known
interesting
world
maps
chance
changes
calculate
represent
continued
better
showed
generally
applications
misleading
experiment
graphs
population
terms
terrorism
uniform
lead
conclusions
bias
Americans
part
statistics
two
comes
case
situations
last
same
killed
went
even
find
end
Hall
possible
life
talked
go
actually
review
code
take
expectations
need
research
really
help
apply
mean
things
terrorist
increase
types
embryology
Cauchy
mentioned
confused
something
theory
inferred
error
Poisson
why
study
gear
set
deaths
might
Monty
process
many
embryo
normal
idea
people
project
cells
well
certain
just
little
specific
month
model
still


minimum
possible
deviations
Bezos
interval
compare
take
determine
Poisson
example
value
goal
still
happening
different
calculate
started
random
point
looked
definition
large
transmutation
average
explanation
introduced
process
paragraph
new
concepts
outliers
statistics
another
review
lambda
considering
tendency
science
properties
error
events
lot
something
L2
stats
help
allows
two
purpose
topic
sample
need
focused
up
function
affected
part
many
discrete
L1
data
why
confused
thought
independent
special
important
cases
central
mathematical
equation
explain
real
model
single
situations
best
apply
general
better
order
normal
first
get
rate
behind
measure
mentioned
relation
own
terms
main
type
sum
norm
mean
think
information
feel
capture
discussed
formula
seems
frequent
amount
three
sure
Keep
Alpharetta
ergodicity
brief
quu
takeaway
lecture
know
arithmetic
law
little
time
accurate
bit
true
might
never
went
way
well
interpret
describe
truth
picking
constant
certain
income
find
standard
class
few
rare
expected
number
distribution
actually
next
guess
effectively
specifically
small
mode
probability
squared
graphs
calculus
thing
limitation
chance
comes
idea
go
able
life
losing
basic
problems
make
relevant
derived
set
learned
median
talked
covered
dispersion
application
sometimes
equal
parameters
summarize
really
loss
absolute
especially
even
observations
always
methods
useful
interesting
background
descriptive
dataset
variability
typical
math
represent
result
includes
understand
minimizes
just

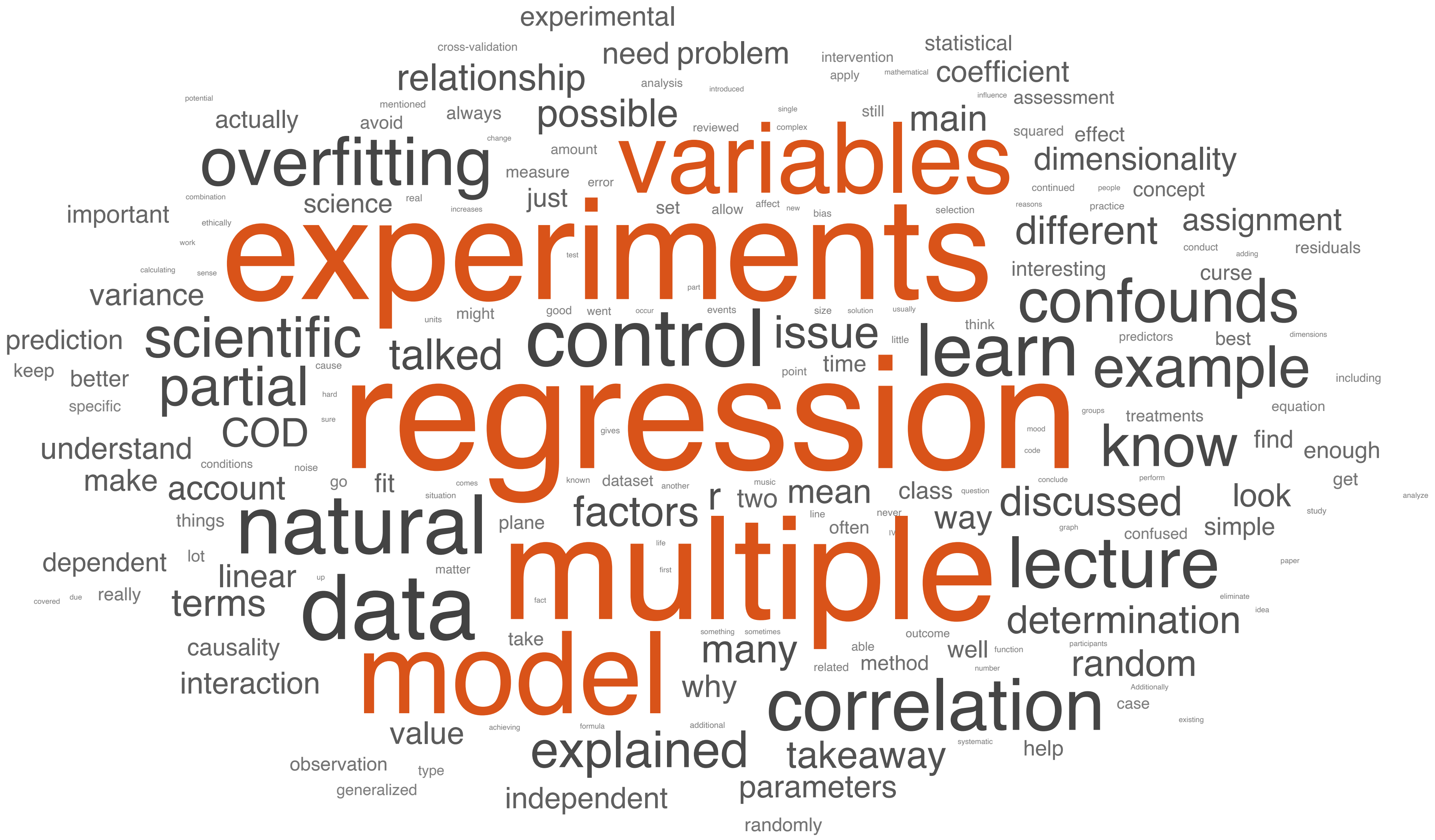


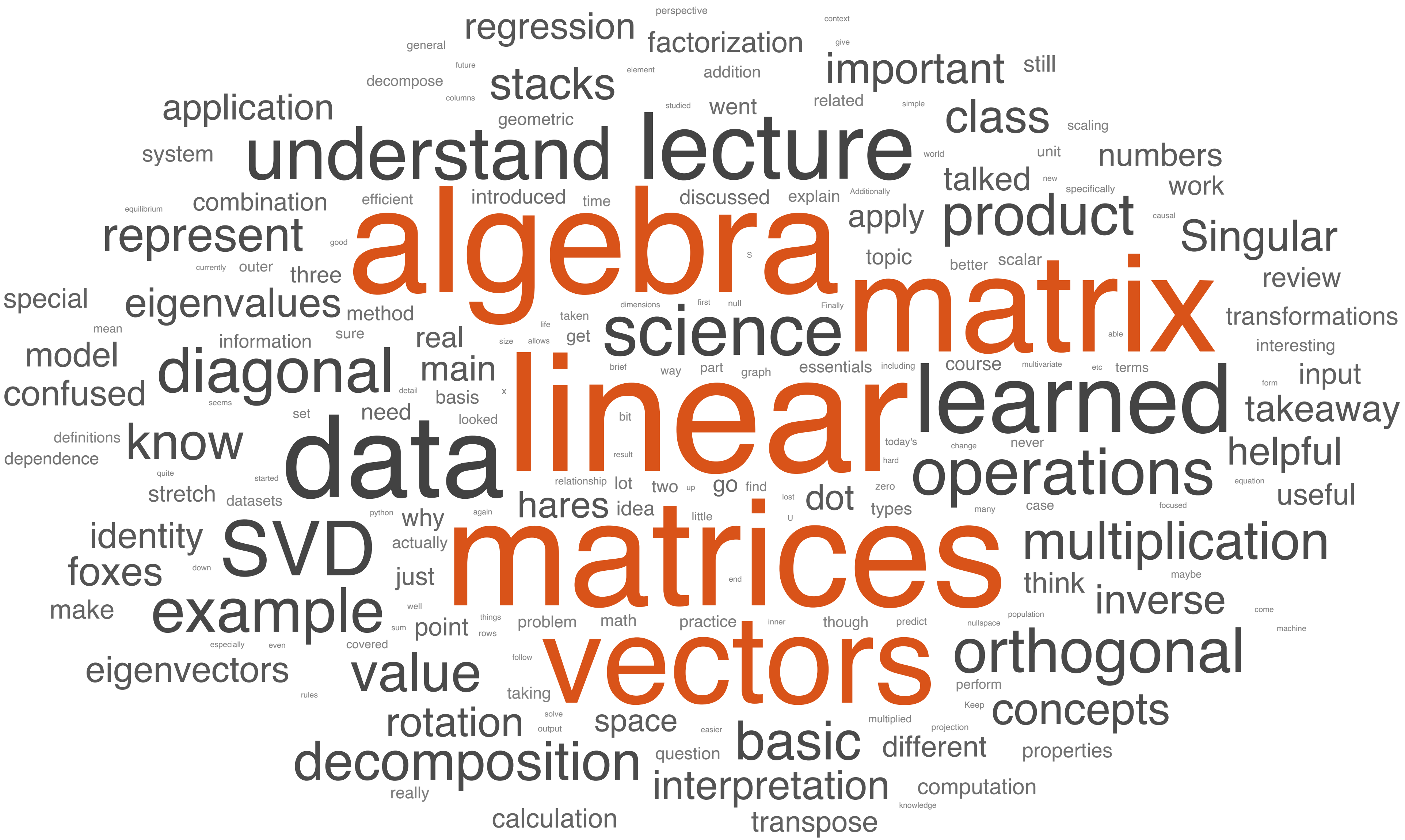
mean
deviation
model
standard
MAD
dispersion
distribution
absolute
examples
lecture
learned
data
understand
parameters
value
statistics
measures
know
descriptive
different
harmonic
represent
median
Cauchy
reality
SD
geometric
robust
looked
really
outliers
numbers
main
takeaway
arithmetic
concepts
squared
discussed
small
error
norm
well STD
L2
L1
class
introduced
just
average
talked
confused
information
chords
large
idea
helpful
including
possible
expected
implement
another
get
mode
behind
world
true
rely
first
way
mentioned
interesting
simple
need
ergodicity
variation
analysis
complex
population
end
continued
saw
actual
think
issue
useful
simpler
less
brief
up
make
additive
definition
own
people
three
even
specific
find
remember
life
derive
something
comparison
bit
explain
accurately
case
today's
last
around
assumes
aspect
problems
today
topic
works
time
kind
certain
good
process
range
fit
never
feel
fact
lot
went
love
four
far
questions
following
situations
pretty
go
new
set
keep
size
sum
apply
away
version
dataset
especially
always
why
sometimes
better
real
equations
every
further
terms
archer
math
code
still
part
little
science
capture
describe
methods
theory
take
sample
covered
correct
variance
practice
two
often
law
calculate
sensitive
extremely
central
tendency
best
things
alternative
group
review
events
affected
variability
important
Finally
types
assumptions
application
professor
representation
curious
effectively
visualize
started
related


problem
necessarily
mathematical
interpret
music
positive
specific
recommendation
definitely
started
standard
away
field
actually
though
SD
why
think
calculations
zero
causation
Vintch
go
really
know
causality
independently
wondering
application
professor
sense
questions
State
reviewing
still
natural
mainly
parameters
experiments
examples
learned
look
linear
concept
Keep
equations
amount
approach
even
methods
applied
factors
confused
equal
skills
nonlinear
way
class
relation
speaker
derive
sets
common
last
first
Lastly
same
variables
lot
shared
lecture
captures
range
users
part
basic
types
product
normal
scientist
went
described
just
order
main
negative
help
completely
take
r
strong
combining
iHeartRadio
curve
say
brief
III
world
discussed
thought
explain
strength
intuitive
interesting
aleatory
correlation
own
engine
make
many
show
algebra
never
functions
continue
bit
Finally
life
etc
talked
need
deviation
mean
matrix
gears
number
y
real
idea
Brett
find
regarding
able
up
descriptive
important
shape
variance
system
covariance
two
takeaway
job
considered
algorithm
might
personalization
reason
things
determine
point
Next
another
statistics
distribution
time
data
science
x
analyze
topics
enjoyed
represents
coefficient
quantifies
mentioned
measure
paragraph
get
code
company
model
guest
give
underlying
certain
behind
usually
characterizes
understand
values
relationship
well
probability
side
different
come
below
machine
little
formula
regression
explanation
process
imply
properties
always
information
math
work

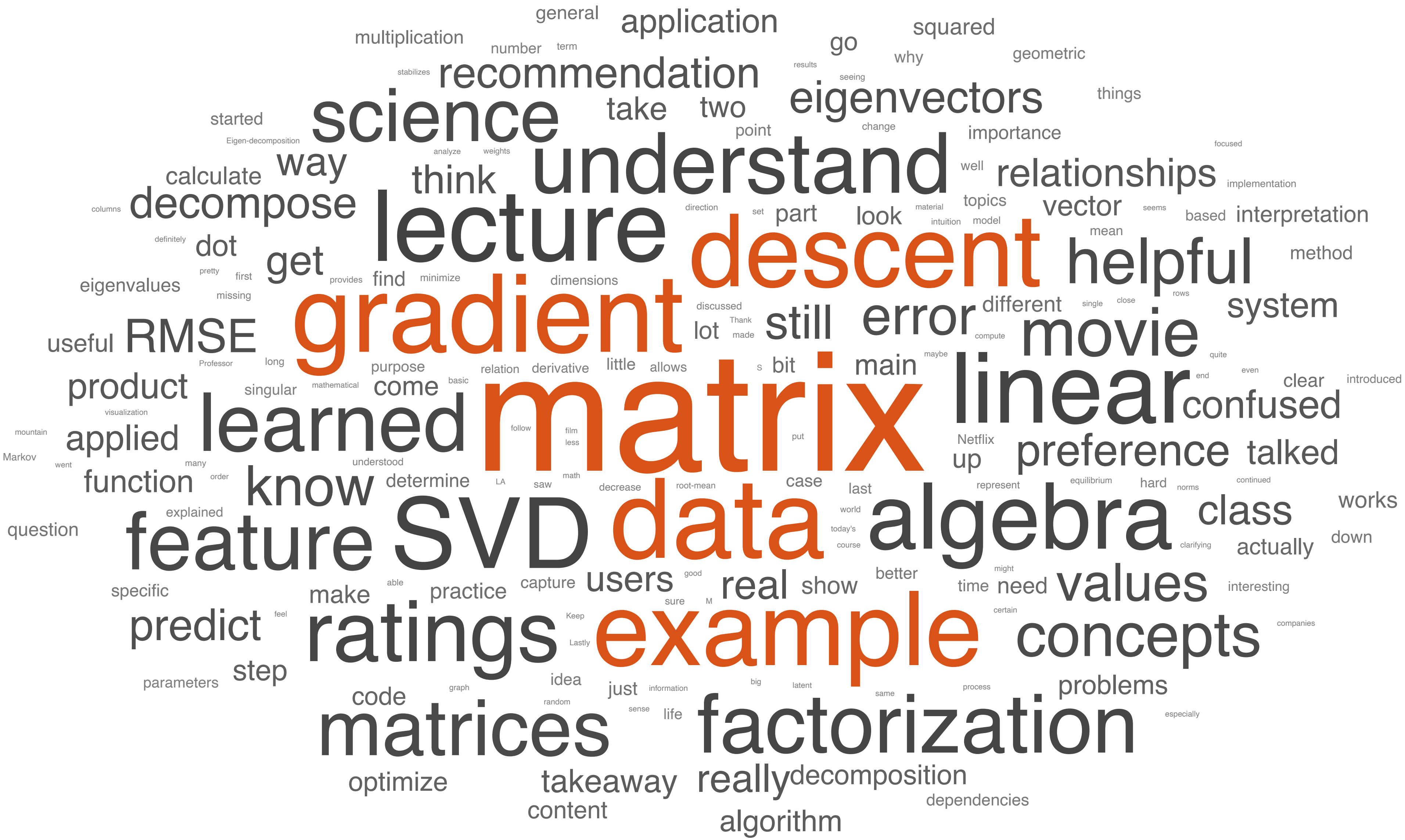
regression
correlation
linear
prediction
data
relationship
learned
variables
descriptive
statistics
line
know
rank
mean
make
different
lecture
Spearman's
monotonic
residuals
distance
standard
non-linear
really
concept
deviation
important
Spearman
minimizes
outcome
squared
takeaway
captures
predictor
based
class
measurements
model
average
understand
examples
value
points
talked
increase
discussed
graph
introduced
coefficients
relies
real
things
methods
just
best
take
main
help
nonlinear
interesting
normal
determined
calculate
useful
relation
way
look
why
two
sum
actual
first
still
beta
fit
get
Pearson
Pearson's
always
topic
scientist
numbers
absolute
wondering
new
analyze
thought
height
trying
describe
algebra
demonstrates
started
accounted
behind
need
dependent
going
misleading
derived
allows
summarizing
algorithm
independent
extremely
works
set
better
called
find
formula
focused
product-moment
results
equation
science
factors
apply
distribution
analysis
away
common
type
known
simple
create
suitable
attempt
finished
interpret
error
state
lot
future
SD
experiments
reason
never
same
explain
moved
last
time
form
world
up
confused
code
little
well
history
covered
kind
r
outliers
luck
causal
order
least
draw
feel
x
y
good
able
slope
end
bit
case
idea
random
think
many
Keep
another
raw
even
general
fields
directly
etc
changes
problems
heavily
decision
underlying
accurate
application
specific
effect
information
professor
individual
expect
learnt
went
alternative
uncertainty
maybe
datasaurus


regression
correlation
confounds
control
variables
multiple
experiment
partial
prediction
mean
know
lecture
linear
learned
model
example
causal
relationship
error
effect
data
main
causation
residuals
factors
understand
dependent
need
general
known
important
make
discussed
takeaway
talked
problem
value
based
measurement
science
think
just
test
true
two
y
x
z
find
better
helpful
why
explain
different
possible
predictor
interesting
outcome
income
recitation
statistical
stronger
education
equation
really
results
account
take
case
situations
look
related
independent
many
specific
well
type
random
apply
theory
practice
link
class
RTTM
definitely
affect
idea
still
part
coding
process
identify
people
actually
confused
simple
extreme
parameters
analysis
natural
way
fallacy
might
things
determine
scientific
IQ
first
go
get
went
work
rule
time
cause
study
concept
always
up
real
observed
GLM
lot
today
line
order
point
function
consider
pattern
strong
reviewed
often
little
end
topic
perform
good
face
seems
method
clarification
explanation
last
average
useful
something
inference
conduct
information
introduced
best
another
cofounds
difficult
term
sure
same
give
kind
fit
bit
say
Keep
create
even
change
expect
brief
exactly
matter
calculate
found
biggest
involves
certain
able
imply
third
condition
implement
influence
assumes
questions
especially
life
covered
additive
exist
clarified
issue
started
mathematical
assignments
further
come
basically

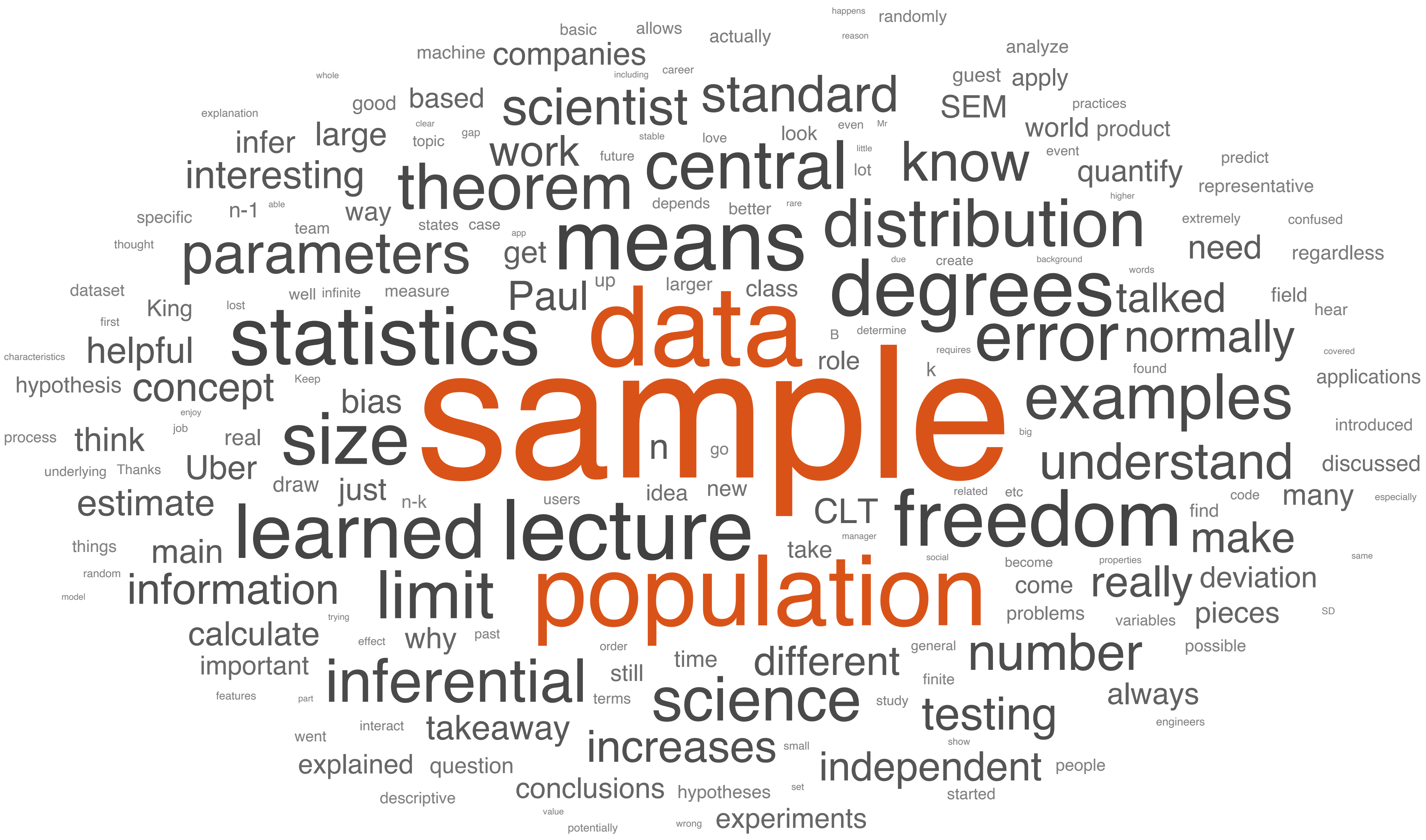

experimental
cross-validation
need problem
intervention
statistical
relationship
analysis
apply
coefficient
actually
avoid
always
possible
still
main
assessment
overfitting
variables
squared
effect
dimensionality
measure
error
just
science
concept
important
experiments
different
assignment
residuals
interesting
curse
variance
confounds
might
control
issue
learn
prediction
scientific
talked
example
keep
better
partial
time
specific
regression
treatments
equation
COD
know
find
enough
understand
conditions
make
account
fit
dataset
two
mean
class
discussed
look
get
things
natural
factors
plane
way
simple
dependent
lot
multiple
lecture
confused
linear
matter
really
terms
data
determination
causality
take
many
outcome
well
model
method
random
interaction
why
correlation
case
value
explained
takeaway
help
observation
type
generalized
independent
parameters
randomly

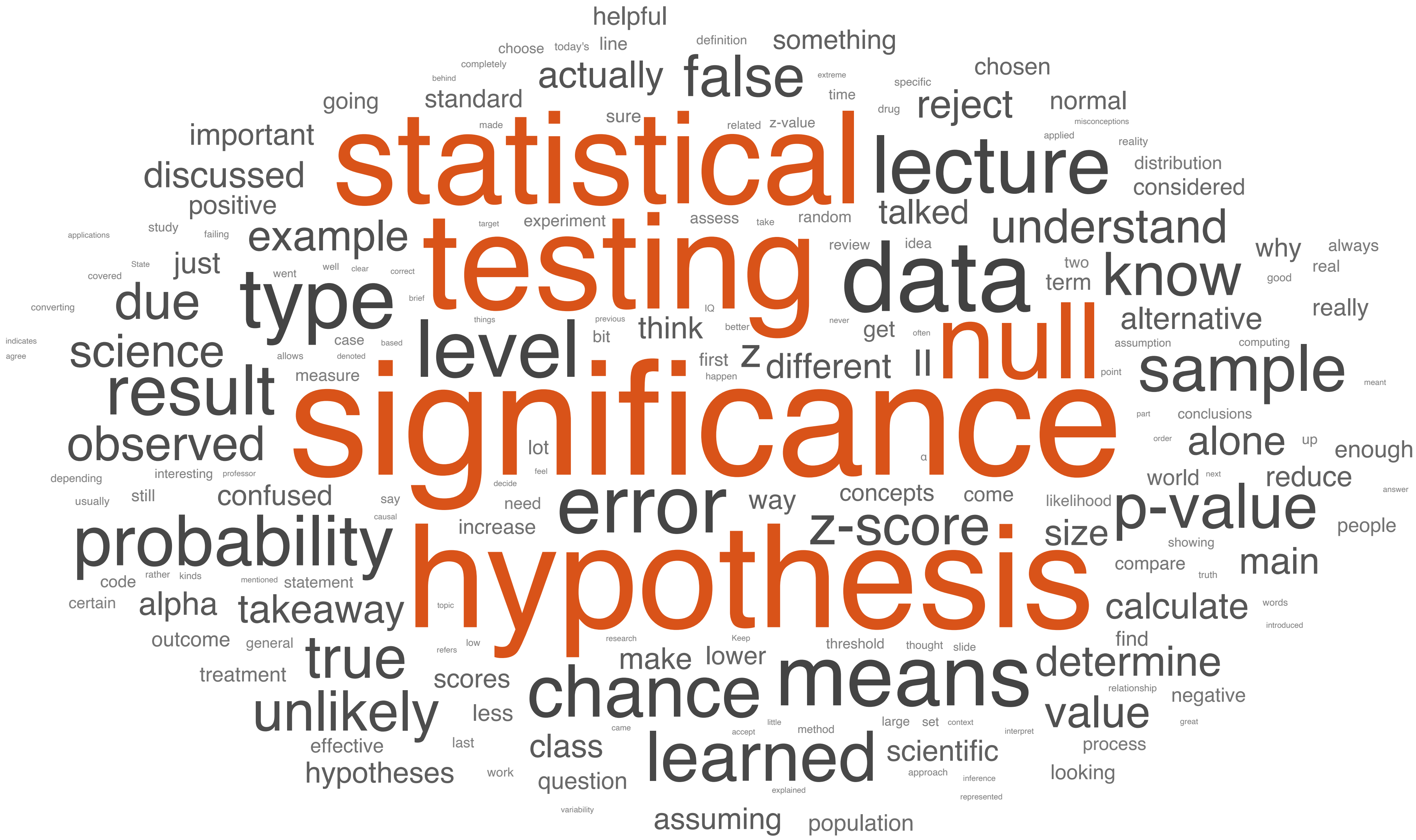


perspective
context
regression
general
factorization
give
future
element
addition
important
still
decompose
stacks
columns
studied
went
related
simple
application
geometric
class
scaling
system
understand
lecture
world
unit
numbers
new
talked
specifically
work
equilibrium
combination
efficient
introduced
time
discussed
explain
Additionally
apply
product
causal
represent
good
algebra
Singular
currently
outer
three
s
topic
better
scalar
review
special
eigenvalues
method
dimensions
first
null
Finally
matrix
transformations
mean
information
sure
real
life
taken
size
allows
get
science
able
interesting
model
diagonal
main
brief
way
part
graph
essentials
including
course
multivariate
etc
terms
input
confused
detail
basis
x
linear
learned
form
takeaway
seems
set
need
looked
bit
definitions
know
today's
change
never
helpful
dependence
data
result
hard
operations
quite
started
relationship
lot
two
up
go
find
zero
equation
useful
stretch
datasets
lost
dot
hares
idea
types
many
case
focused
python
why
again
little
U
identity
SVD
actually
multiplication
foxes
down
just
matrices
think
maybe
end
inverse
make
well
come
example
sum
point
things
rows
problem
math
practice
inner
though
predict
nullspace
population
machine
especially
even
covered
eigenvectors
follow
orthogonal
value
vectors
perform
rules
taking
Keep
rotation
solve
space
multiplied
projection
concepts
output
easier
basic
decomposition
question
different
properties
interpretation
computation
really
knowledge
calculation
transpose

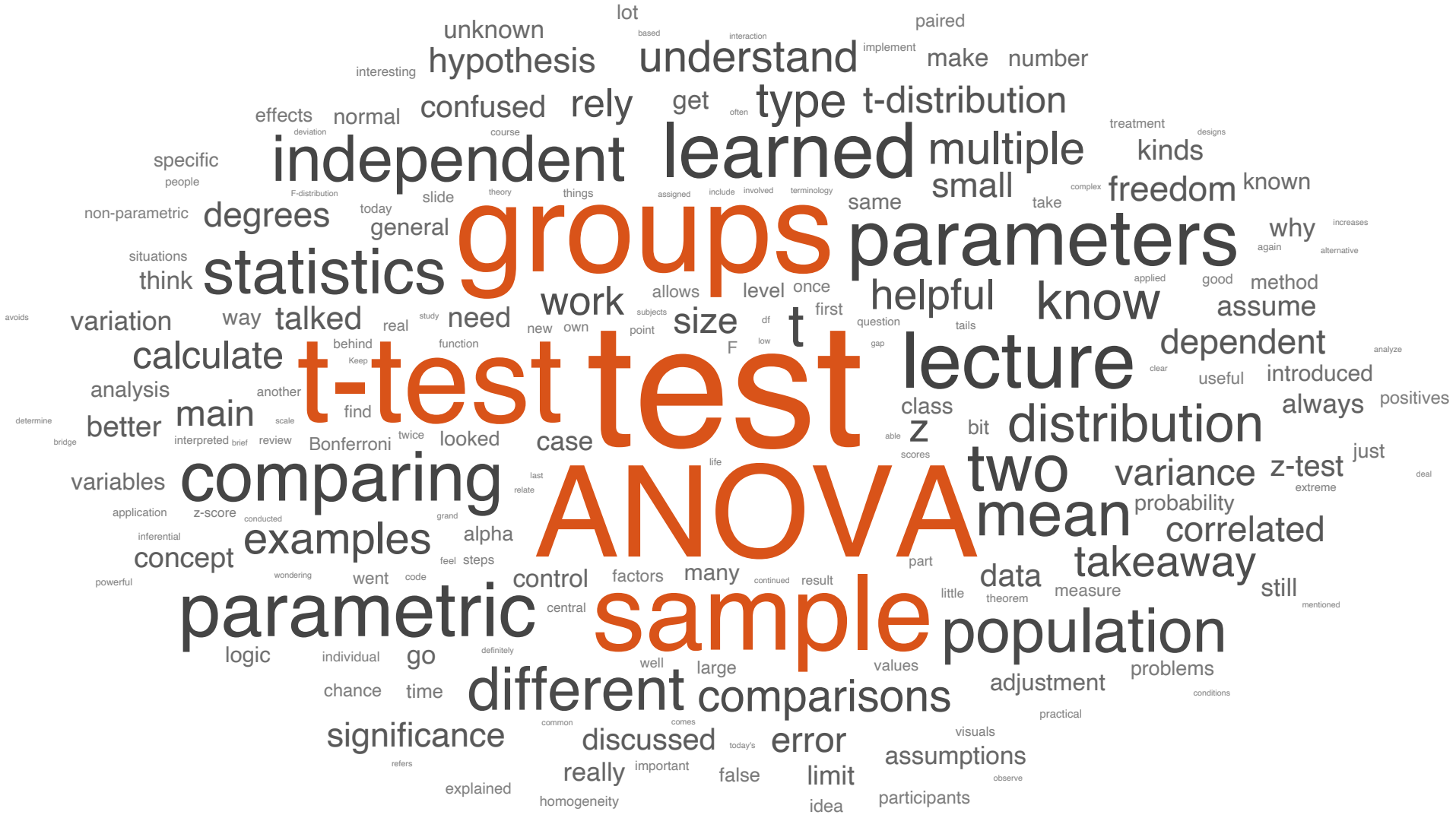

general
application
multiplication
number
term
squared
go
why
geometric
stabilizes
recommendation
results
seeing
things
science
take
two
eigenvectors
started
point
change
importance
Eigen-decomposition
analyze
weights
understand
focused
way
well
relationships
calculate
think
implementation
columns
decompose
lecture
direction
set
part
look
material
topics
vector
seems
based
interpretation
intuition
model
mean
definitely
dot
descent
helpful
method
pretty
first
get
provides
find
minimize
dimensions
eigenvalues
missing
gradient
discussed
different
single
close
rows
system
Thank
still
error
useful
RMSE
lot
made
compute
movie
long
Professor
s
bit
main
maybe
quite
purpose
relation
derivative
little
allows
linear
end
even
clear
introduced
product
basic
come
singular
mathematical
matrix
confused
visualization
learned
follow
film
less
put
Netflix
mountain
applied
preference
talked
Markov
went
many
understood
up
function
order
determine
LA
saw
math
decrease
root-mean
case
last
represent
equilibrium
hard
norms
continued
know
works
question
explained
SVD
data
world
algebra
class
feature
today's
course
clarifying
down
actually
might
specific
able
practice
capture
users
good
real
show
better
time
need
values
interesting
make
sure
M
certain
predict
feel
Keep
example
concepts
companies
ratings
Lastly
step
parameters
idea
just
information
big
latent
process
problems
graph
same
code
random
sense
life
especially
matrices
factorization
optimize
takeaway
really
decomposition
dependencies
content
algorithm

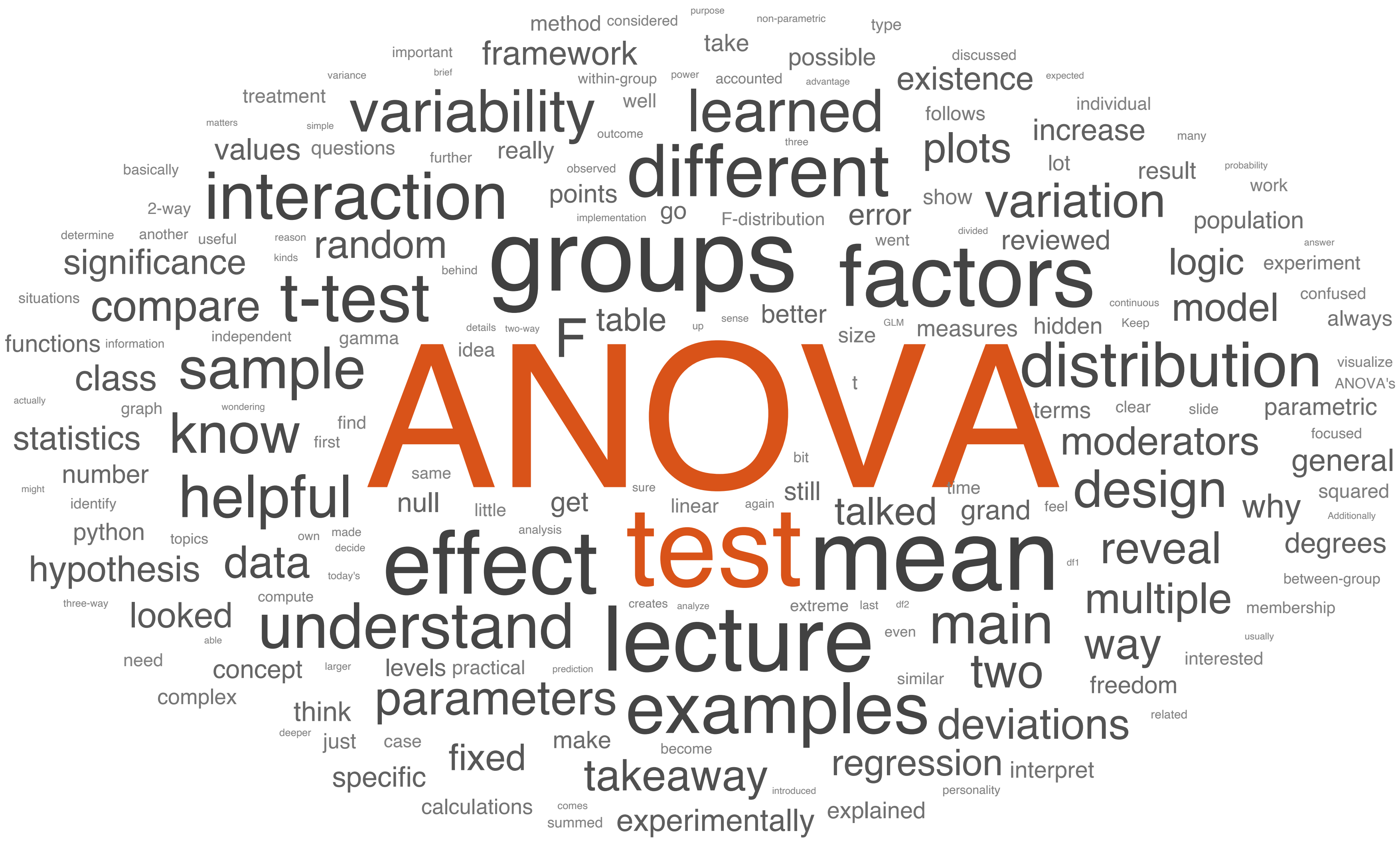
original
determine
balance
factorization
absolute
completely
comparing
beta
validation
science
well
shrink
generalize
helpful
looked
cross-validation
started
prevent
idea
depends
become
reduce
question
cooking
part
learned
lambda
problem
everything
SVD
line
caused
class
review
matrices
visual
situations
length
fit
squared
residuals
works
ones
good
norms
graph
function
reflect
actually
first
coefficients
model
minimize
best
know
value
still
matter
better
sure
increases
introduced
allows
real
test
just
thus
Keep
order
L1
slope
bias
error
algebra
dataset
world
multiple
make
main
variance
data
kind
lecture
confused
add
comes
way
up
lot
code
clear
leakage
called
brief
high
decrease
training
many
linear
feel
regression
sometimes
means
optimal
assumption
discussed
space
method
maybe
need
sum
truth
last
zero
term
go
tradeoff
great
variables
things
think
omelet
went
really
further
provide
why
types
concept
set
definitely
flexible
algorithms
omelette
equation
ridge
regularized
penalty
L2
vector
results
certain
capture
points
cases
again
own
interesting
applied
effect
get
bit
forms
cross
related
happen
talked
time
applications
overfitting
accurate
distance
understand
underfitting
Ln
find
LASSO
number
explain
two
little
different
Finally
new
predictor
ingredients
possible
generalizable
example
take
ground
predictive
issue
create
accuracy
common
important
simple
commensurability
give
takeaway
trying
including
true
matrix
approach
relationship
measure
expectation
essentially

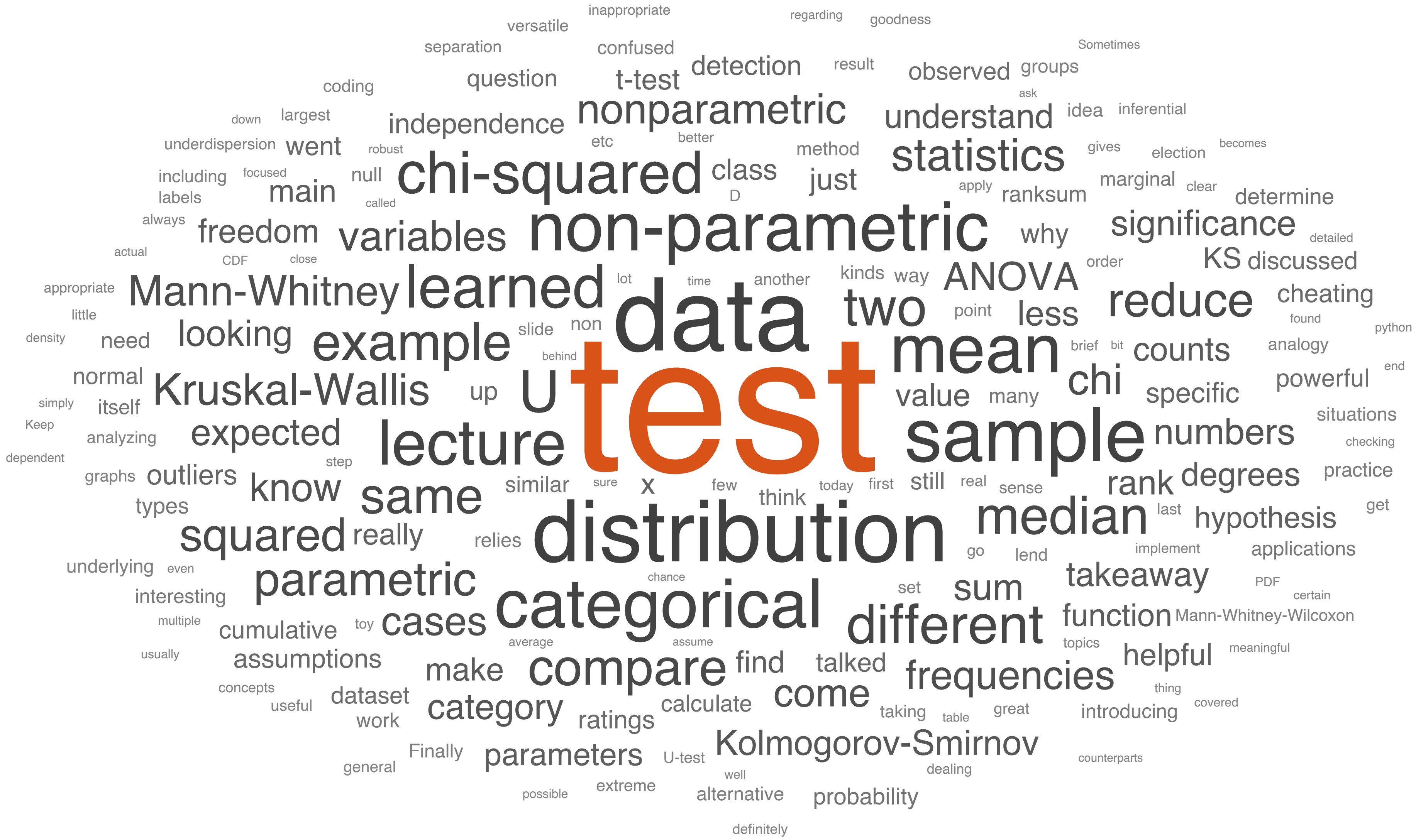

sample
data
population
statistics
means
distribution
degrees
freedom
lecture
learned
theorem
central
parameters
error
size
limit
inferential
science
scientist
standard
know
examples
understand
number
testing
increases
independent
different
normally
talked
make
really
deviation
pieces
always
companies
work
interesting
concept
helpful
estimate
information
calculate
important
takeaway
conclusions
experiments
hypotheses
explained
question
descriptive
main
things
think
Uber
just
draw
bias
real
Paul
get
need
regardless
representative
quantify
world
product
SEM
apply
guest
analyze
randomly
actually
allows
basic
machine
good
based
large
infer
way
team
specific
dataset
King
hypothesis
process
underlying
Thanks
n
go
idea
new
users
n-k
CLT
take
role
class
larger
up
measure
infinite
well
lost
first
characteristics
Keep
enjoy
job
random
model
trying
effect
why
past
order
still
time
terms
general
finite
study
small
set
value
potentially
wrong
went
interact
part
features
show
people
started
engineers
variables
problems
come
become
properties
possible
SD
same
find
many
code
etc
related
manager
social
especially
discussed
introduced
applications
covered
hear
field
found
big
requires
k
determine
B
create
due
background
words
extremely
confused
predict
event
higher
practices
lot
little
rare
better
depends
look
love
stable
future
even
Mr
happens
reason
career
including
whole
explanation
clear
topic
gap
states
case
app
able
n-1
thought

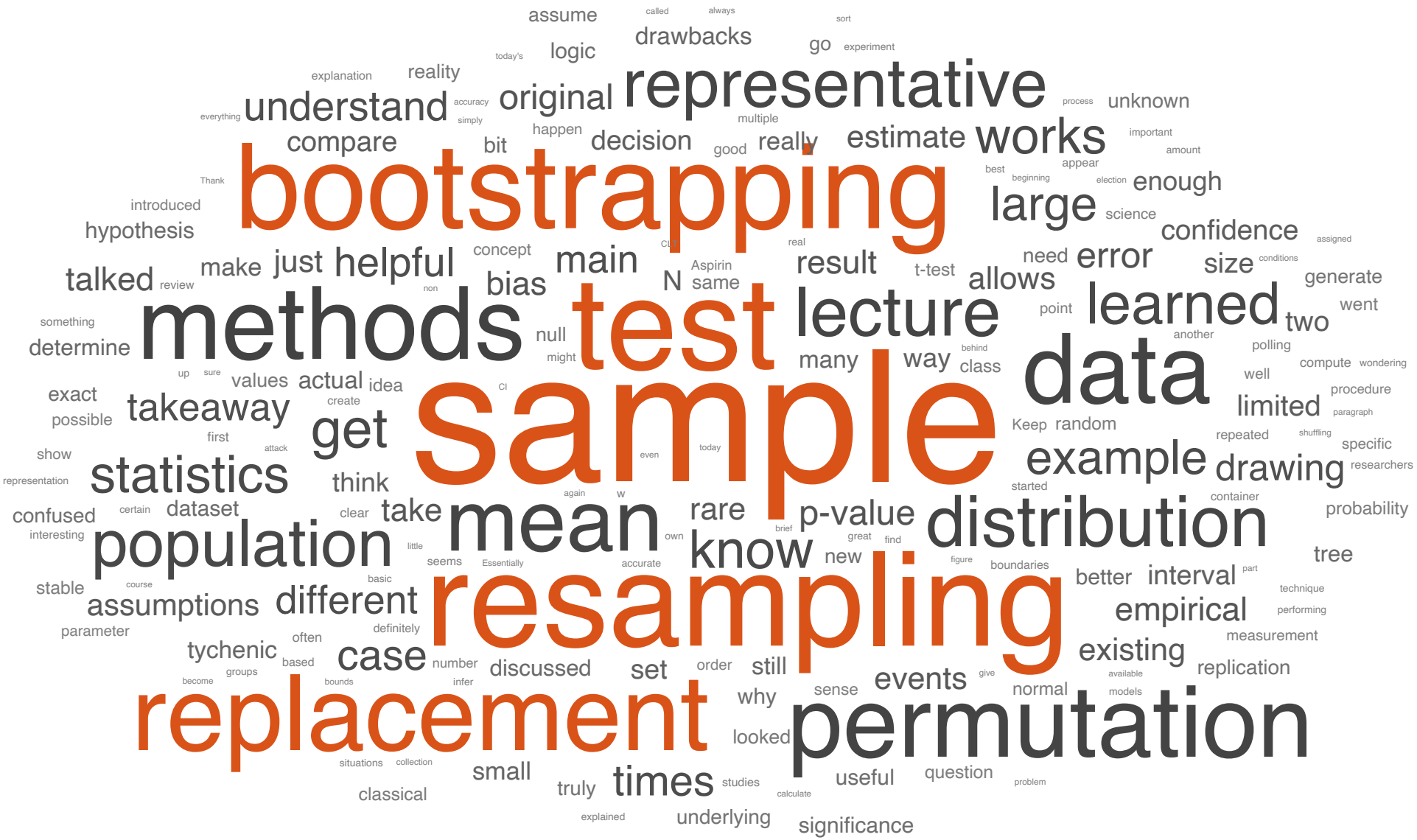


helpful
choose
today's
line
definition
something
completely
actually
false
chosen
behind
extreme
specific
going
standard
time
drug
reject
normal
made
sure
related
z-value
misconceptions
important
applied
reality
statistical
lecture
discussed
distribution
considered
positive
target
experiment
assess
take
random
talked
applications
study
failing
example
testing
understand
review
idea
why
always
State
just
data
two
real
covered
went
well
clear
correct
term
know
good
due
type
brief
converting
things
previous
IQ
never
alternative
really
think
better
get
often
science
bit
case
based
level
null
assumption
computing
indicates
first
z
different
=
allows
denoted
agree
happen
point
sample
result
measure
meant
significance
part
conclusions
observed
lot
order
alone
up
enough
α
depending
interesting
professor
feel
world
next
reduce
decide
usually
still
confused
say
need
error
way
concepts
come
likelihood
p-value
answer
causal
increase
z-score
size
people
probability
showing
compare
main
truth
code
rather
kinds
mentioned
statement
hypothesis
certain
alpha
takeaway
topic
calculate
words
introduced
outcome
general
true
research
Keep
threshold
thought
slide
find
low
refers
make
lower
determine
treatment
means
relationship
scores
negative
chance
unlikely
value
less
came
accept
little
method
large
set
context
interpret
great
effective
last
class
process
scientific
hypotheses
work
learned
approach
inference
looking
question
explained
represented
variability
assuming
population

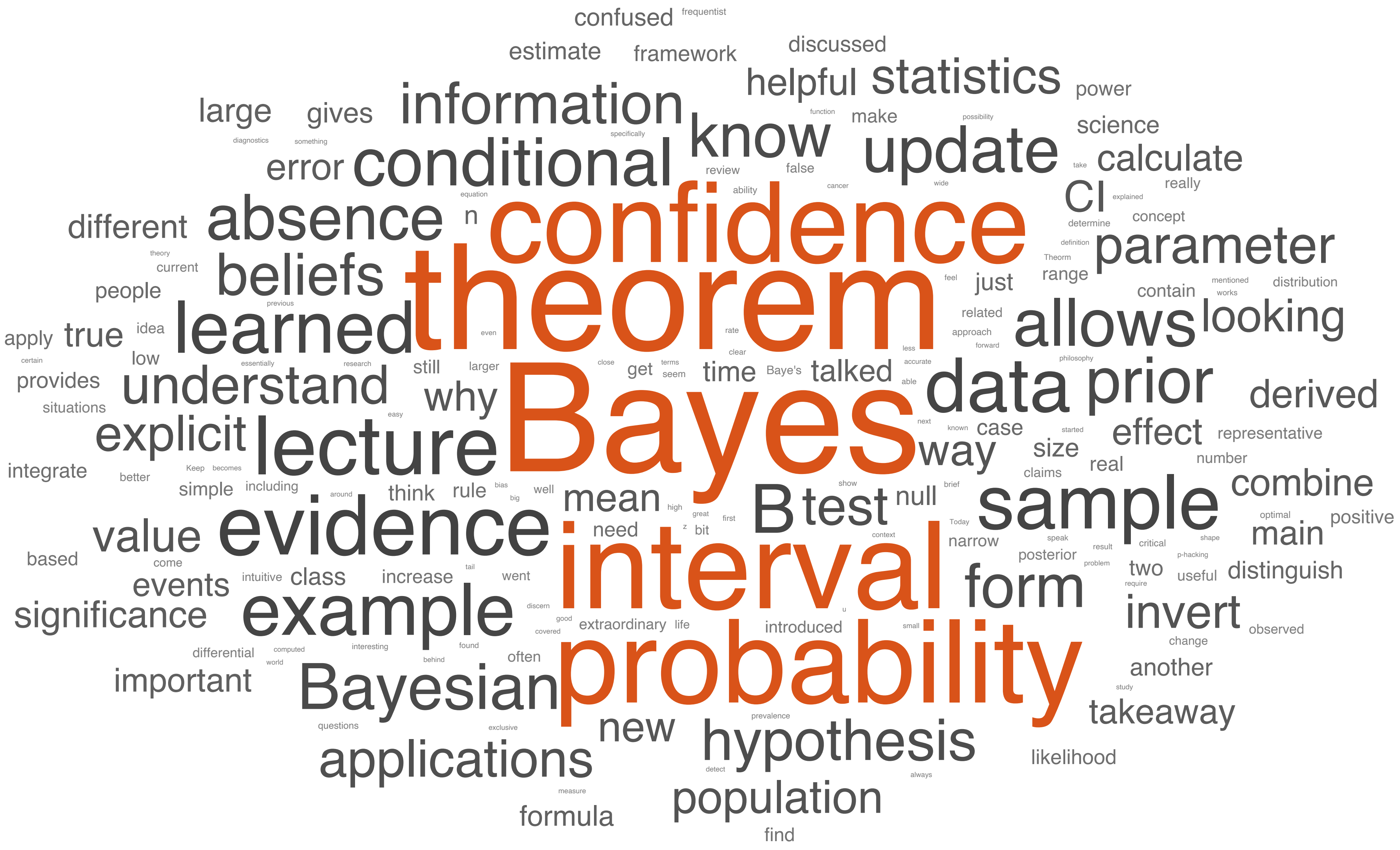

lot
unknown
paired
based
interaction
hypothesis
understand
implement
make
number
interesting
effects
normal
confused
rely
get
type
t-distribution
often
deviation
course
treatment
designs
specific
independent
learned
multiple
kinds
people
small
freedom
known
F-distribution
theory
things
assigned
include
involved
terminology
complex
take
same
non-parametric
degrees
today
slide
general
groups
parameters
why
increases
again
alternative
situations
think
statistics
applied
good
method
allows
level
once
work
helpful
know
assume
variation
way
talked
real
study
need
subjects
size
t
first
avoids
new
own
point
df
question
tails
dependent
behind
function
F
low
gap
calculate
Keep
test
lecture
analyze
clear
useful
introduced
analysis
another
t-test
always
positives
determine
find
class
main
scale
z
bit
distribution
better
bridge
interpreted
brief
review
Bonferroni
twice
looked
case
able
scores
just
variables
comparing
life
last
two
variance
z-test
relate
extreme
deal
probability
application
z-score
conducted
grand
ANOVA
mean
correlated
inferential
examples
alpha
concept
feel
steps
part
takeaway
powerful
wondering
went
code
control
factors
many
continued
result
data
measure
still
little
theorem
mentioned
parametric
central
sample
population
logic
individual
go
definitely
well
large
values
problems
chance
time
different
comparisons
adjustment
conditions
practical
common
comes
visuals
significance
discussed
error
today's
assumptions
refers
really
important
false
limit
observe
explained
homogeneity
idea
participants


method considered purpose non-parametric type
important framework take possible discussed
variance brief within-group power accounted advantage existence expected
treatment well follows individual
matters simple variability learned increase many
values questions outcome three plots
basically further really observed lot result probability
interaction different work
2-way points show variation
implementation go F-distribution error population
determine another useful reason random divided reviewed answer
significance kinds groups went factors logic experiment
situations behind
compare t-test continuous model confused
details two-way table better GLM Keep always
functions information independent gamma F up sense size measures hidden
idea
sample distribution visualize
class ANOVA ANOVA's
actually t
graph wondering terms clear slide parametric
statistics know find
first moderators focused
bit general
number same
might sure time design
helpful still squared
identify null little get linear again grand feel why
talked Additionally
python analysis
topics own made
decide reveal degrees
hypothesis data effect test mean df1
today's between-group
compute
three-way creates analyze extreme last df2 multiple membership
looked
understand main
able even usually
need way
lecture interested
concept larger levels practical prediction two
similar freedom
complex
parameters examples
think related
deeper just case deviations
fixed make
become
specific regression interpret
takeaway
calculations introduced personality
comes explained
summed experimentally

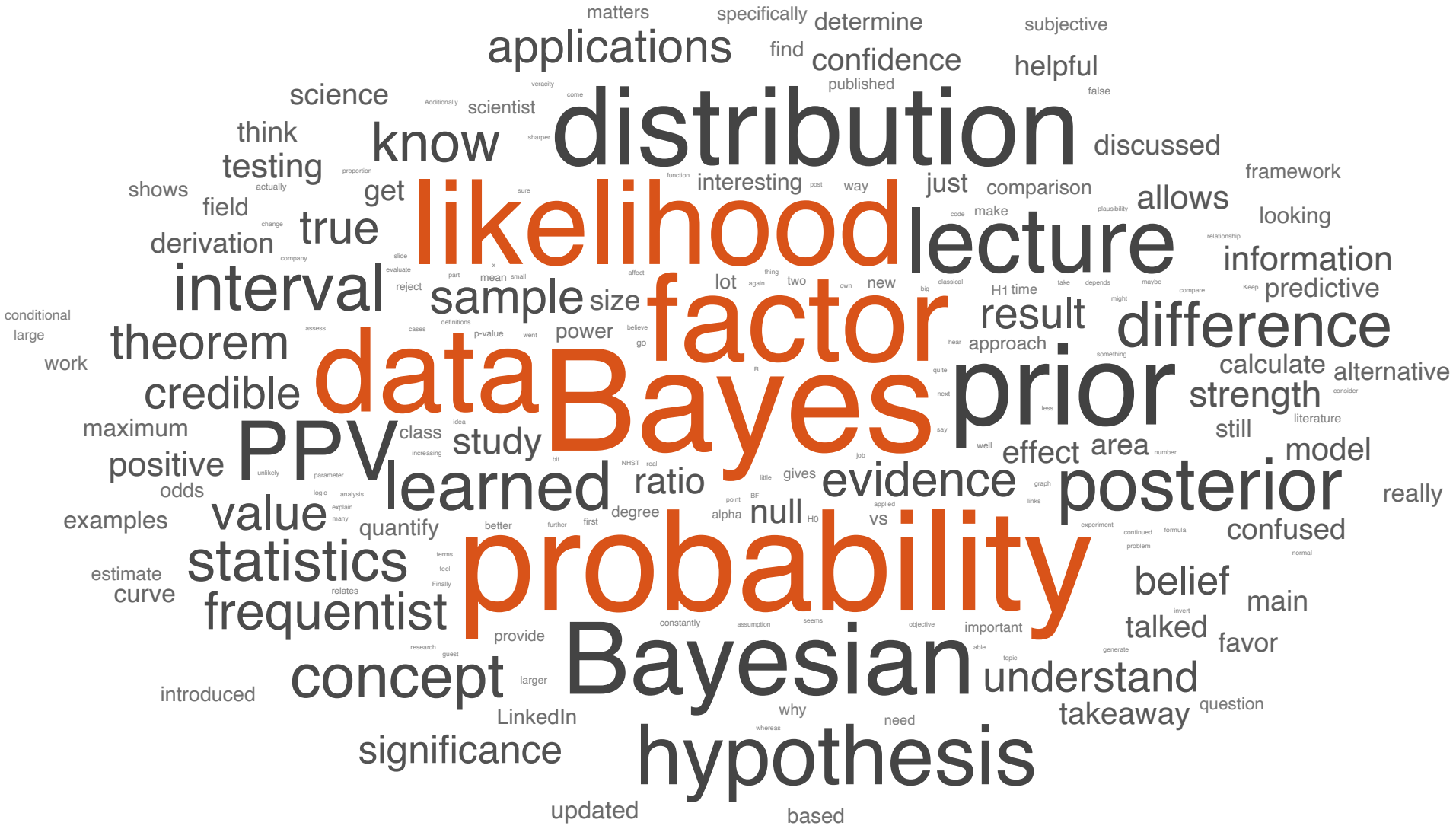

inappropriate
regarding
goodness
versatile
separation
confused
Sometimes
coding
question
t-test
detection
result
observed
groups
ask
down
largest
independence
nonparametric
understand
idea
inferential
underdispersion
went
robust
etc
better
method
statistics
gives
election
becomes
including
focused
null
chi-squared
class
just
marginal
labels
main
called
D
apply
ranksum
clear
determine
always
freedom
variables
non-parametric
why
significance
detailed
actual
CDF
close
order
KS
discussed
appropriate
Mann-Whitney
learned
lot
time
another
kinds
way
ANOVA
little
data
two
reduce
cheating
point
less
found
python
density
need
looking
example
slide
non
mean
brief
bit
counts
analogy
behind
normal
Kruskal-Wallis
up
U
test
chi
specific
powerful
end
simply
itself
value
many
Keep
analyzing
expected
lecture
sample
numbers
situations
checking
dependent
step
graphs
outliers
know
same
similar
sure
x
few
think
today
first
still
real
sense
rank
degrees
practice
types
distribution
median
last
hypothesis
get
squared
really
relies
underlying
even
go
lend
implement
applications
chance
parametric
takeaway
interesting
set
sum
PDF
certain
multiple
cumulative
toy
cases
categorical
different
function
Mann-Whitney-Wilcoxon
average
assume
topics
usually
assumptions
helpful
meaningful
make
compare
find
talked
frequencies
concepts
thing
useful
dataset
category
calculate
come
taking
table
great
introducing
covered
work
ratings
Finally
parameters
U-test
Kolmogorov-Smirnov
counterparts
general
well
dealing
possible
extreme
alternative
probability
definitely

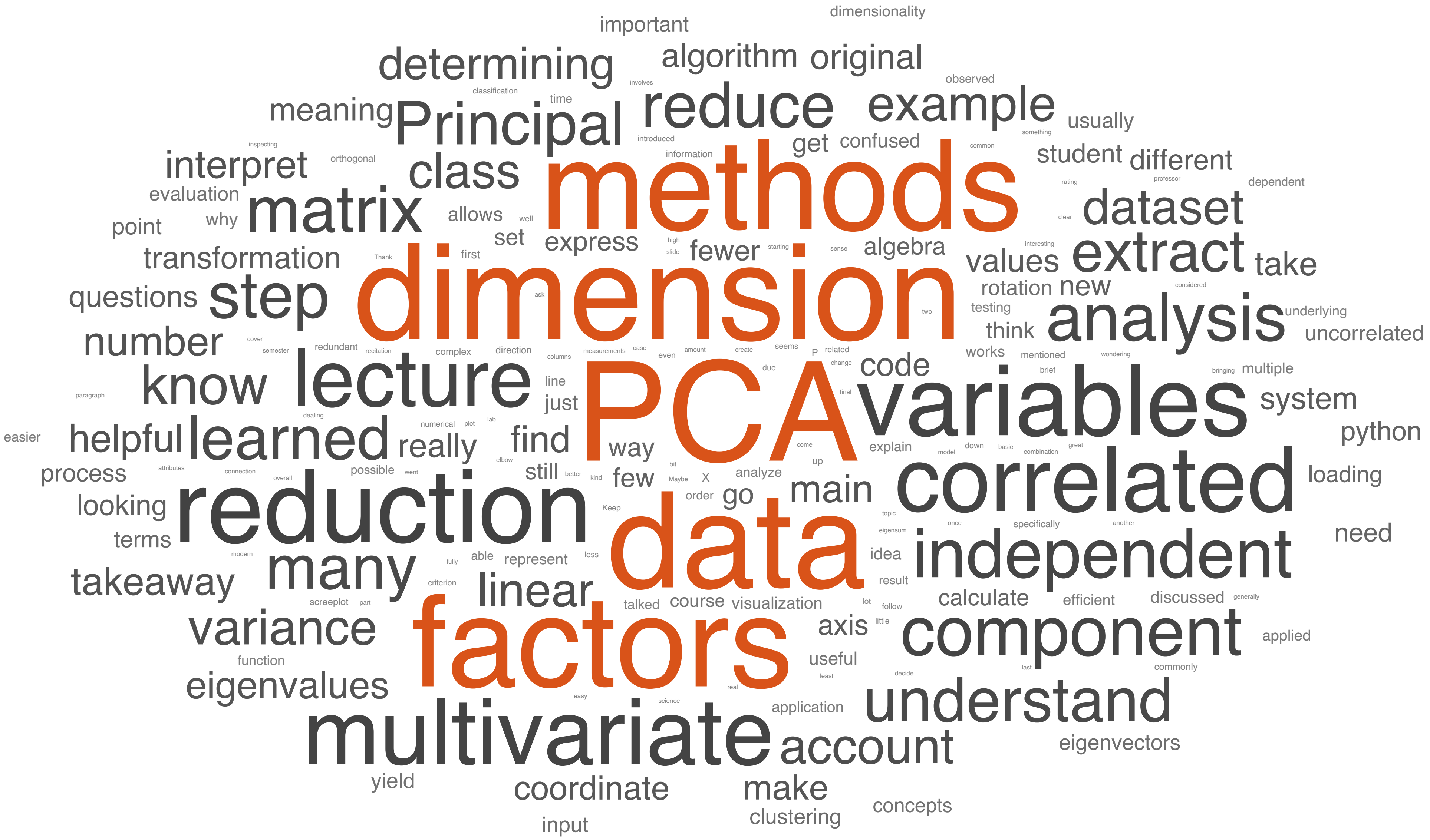

assume
called
always
sort
drawbacks
go
experiment
logic
today's
explanation
reality
representative
understand
original
accuracy
process
unknown
everything
simply
multiple
compare
bit
happen
decision
good
really
estimate
works
important
amount
appear
best
beginning
election
Thank
bootstrapping
enough
introduced
large
science
hypothesis
confidence
assigned
cut
real
concept
main
Aspirin
result
need
error
size
conditions
talked
review
make
just
helpful
bias
N
same
t-test
allows
generate
non
methods
test
lecture
learned
went
something
null
point
two
another
determine
might
many
way
behind
class
polling
data
up
sure
values
actual
idea
CI
well
compute
wondering
exact
create
procedure
takeaway
limited
possible
get
Keep
random
paragraph
first
repeated
shuffling
sample
show
attack
even
today
specific
example
drawing
researchers
representation
think
started
statistics
again
w
container
confused
certain
dataset
clear
take
mean
rare
p-value
distribution
probability
interesting
brief
own
great
find
know
new
tree
population
little
seems
Essentially
accurate
figure
boundaries
basic
better
interval
part
stable
course
resampling
technique
assumptions
different
empirical
performing
parameter
definitely
measurement
often
tychenic
case
existing
based
number
discussed
set
order
still
replication
groups
become
bounds
infer
give
available
events
normal
models
why
sense
replacement
permutation
looked
situations
collection
small
times
useful
question
problem
truly
studies
calculate
classical
explained
underlying
significance

effect
power
size
significant
p-value
statistical
results
sample
p-hacking
lecture
research
intervals
confidence
difference
replication
learned
published
data
false
mean
increase
probability
scientific
understand
talked
Cohen's
error
positives
studies
many
value
making
test
know
science
experiment
deviation
standard
takeaway
type
concept
problem
hypothesis
crisis
important
find
small
way
example
discussed
looking
calculate
interesting
reliable
matters
main
need
get
true
real
really
big
determine
papers
measure
HARKing
practical
flexible
something
why
just
class
normalizes
alpha
smaller
report
high
large
caused
removal
avoid
wondering
relationship
methods
stopping
scientists
actually
beyond
incentivized
null
idea
outliers
lot
always
parameter
introduced
solutions
distribution
alternative
going
level
people
including
enough
things
beta
related
time
still
larger
think
work
evidence
general
two
fail
started
absence
questions
issues
fields
lowering
literature
contain
population
based
reject
estimate
might
case
root
due
groups
Keep
covered
helpful
freedom
variable
show
comparing
degrees
negative
found
tell
seems
allows
d
potential
slide
suggested
applies
considered
higher
possible
better
essentially
order
current
today
detect
able
known
even
number
hacking
discern
manipulation
analysis
confused
low
application
individual
today's
comes
less
feel
lead
chance
world
cheat
reaches
brief
required
regards
accept
another
useful
specifically
often
definitely
clear
threshold
affects
own
part
good
bit
G

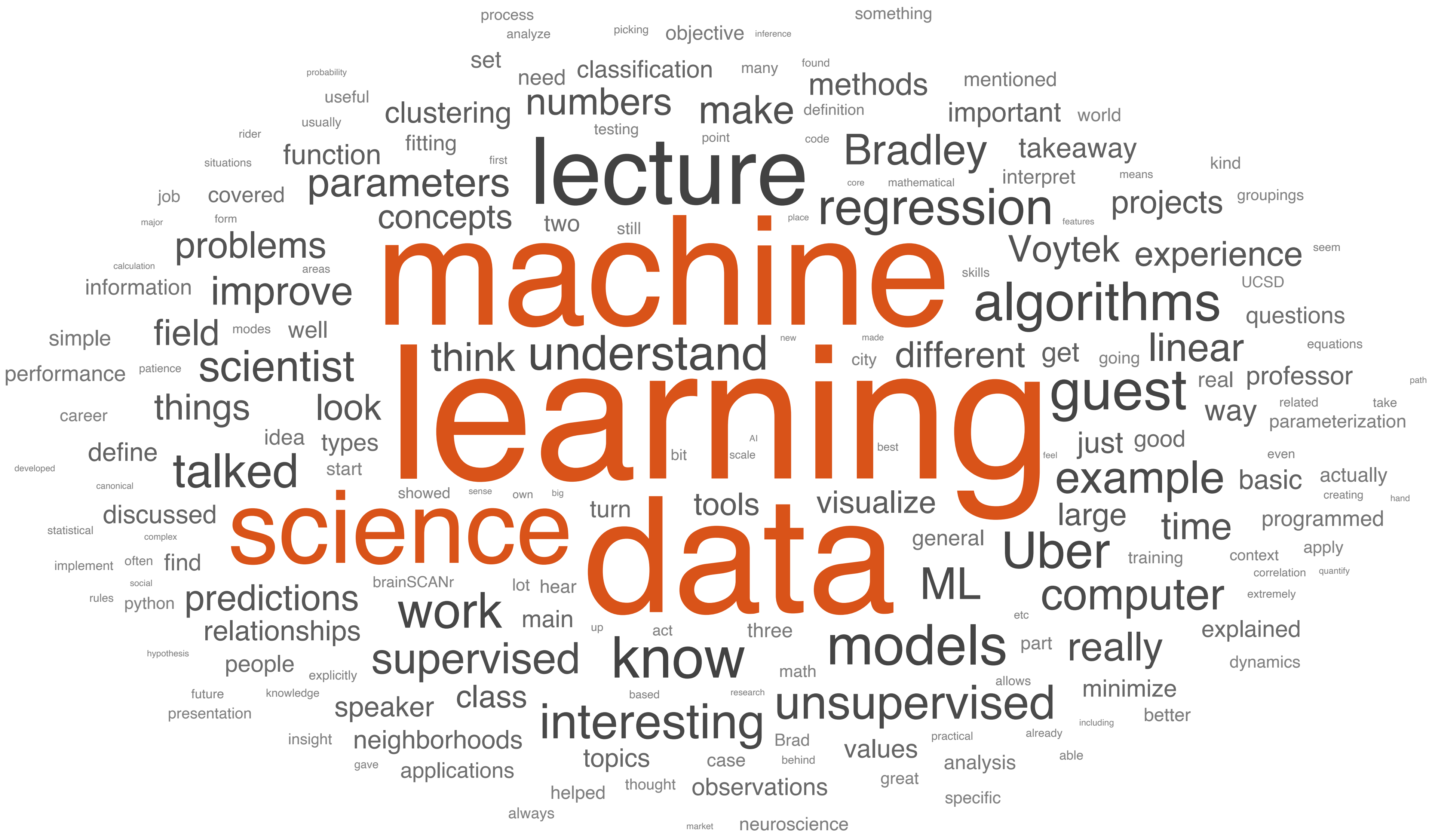


confused
frequentist
estimate
framework
discussed
helpful
statistics
power
large
gives
information
make
science
know
update
calculate
error
conditional
review
false
really
CI
absence
confidence
concept
different
n
parameter
beliefs
theorem
just
range
people
contain
distribution
learned
allows
looking
apply
true
idea
related
approach
low
provides
understand
still
larger
get
time
Baye's
talked
data
prior
derived
situations
why
Bayes
case
explicit
lecture
way
effect
representative
size
integrate
better
real
number
claims
simple
including
think
rule
well
mean
B
test
null
sample
combine
value
evidence
need
bit
narrow
main
positive
based
come
posterior
two
useful
distinguish
events
intuitive
class
increase
went
interval
form
significance
example
invert
extraordinary
life
introduced
observed
change
differential
often
another
important
Bayesian
probability
takeaway
questions
new
hypothesis
applications
likelihood
population
formula
find


matters
specifically
determine
subjective
applications
find
confidence
helpful
published
false
science
scientist
distribution
think
know
discussed
testing
framework
shows
interesting
just
comparison
get
likelihood
allows
field
make
looking
true
lecture
derivation
information
interval
lot
two
new
predictive
sample
size
factor
result
conditional
large
theorem
power
difference
approach
work
data
Bayes
prior
calculate
alternative
credible
strength
maximum
PPV
class
study
still
model
positive
learned
ratio
evidence
effect
area
posterior
really
odds
value
null
examples
quantify
degree
alpha
vs
confused
statistics
probability
belief
estimate
curve
frequentist
main
talked
provide
favor
concept
Bayesian
understand
introduced
takeaway
question
LinkedIn
why
need
significance
hypothesis
updated
based


dimensionality
important
determining
algorithm
original
observed
meaning
Principal
reduce
example
usually
interpret
class
methods
confused
student
different
evaluation
matrix
dataset
dependent
point
why
allows
set
express
fewer
algebra
extract
values
take
transformation
first
dimension
questions
step
rotation
new
analysis
testing
think
underlying
uncorrelated
number
lecture
PCA
variables
code
works
mentioned
multiple
know
system
python
helpful
learned
really
find
just
line
way
explain
easier
correlated
loading
process
possible
still
few
analyze
main
go
order
looking
reduction
data
independent
need
terms
specifically
takeaway
many
linear
idea
result
able
represent
variance
factors
talked
course
visualization
calculate
efficient
discussed
axis
component
applied
function
useful
eigenvalues
commonly
application
understand
multivariate
account
eigenvectors
yield
coordinate
make
clustering
concepts
input


still
non-linear
decision
logarithmic
based
discussed
equations
people
confused
variable
understand
takeaway
words
S-shaped
boundary
find
many
likelihood
probability
predict
binary
grad
today
maximum
1-p
real
projects
better
possible
great
natural
GRE
explain
way
make
function
happening
related
provides
class
unit
thing
type
why
comes
linear
scientist
requires
set
derivation
trying
methods
PhD
Erik's
especially
idea
two
inverse
solves
bounded
general
field
seems
outcome
start
mean
first
Keep
next
guest
hear
logical
logit
just
part
data
get
best
introduced
actually
even
simple
might
MLE
equal
points
world
NBA
brief
cases
lot
science
different
sometimes
experience
classification
know
Estimation
admission
apply
gives
regression
constant
commonly
beta
allows
yet
need
help
well
paragraph
tool
interesting
odds
another
beta1
last
time
talked
clear
certain
really
sigmoidal
practice
team
values
bit
program
vs
example
log
considering
link
fit
learned
enjoyed
ln
go
good
assume
take
effect
useful
always
change
implemented
professor
main
lecture
logistic
work
result
thought
weights
situations
powerful
machine
impact
order
final
deciding
problems
little
event
combination
Erik
scenarios
often
line
nonlinear
tests
explanation
relationship
concepts
predictor
code
model
occurring
planning
distributed
looked
end
think
formula
school
sense
normally
compared
important
graph
chances
number
underlies
questions
slide
applications
specifically
informative
calculate
python

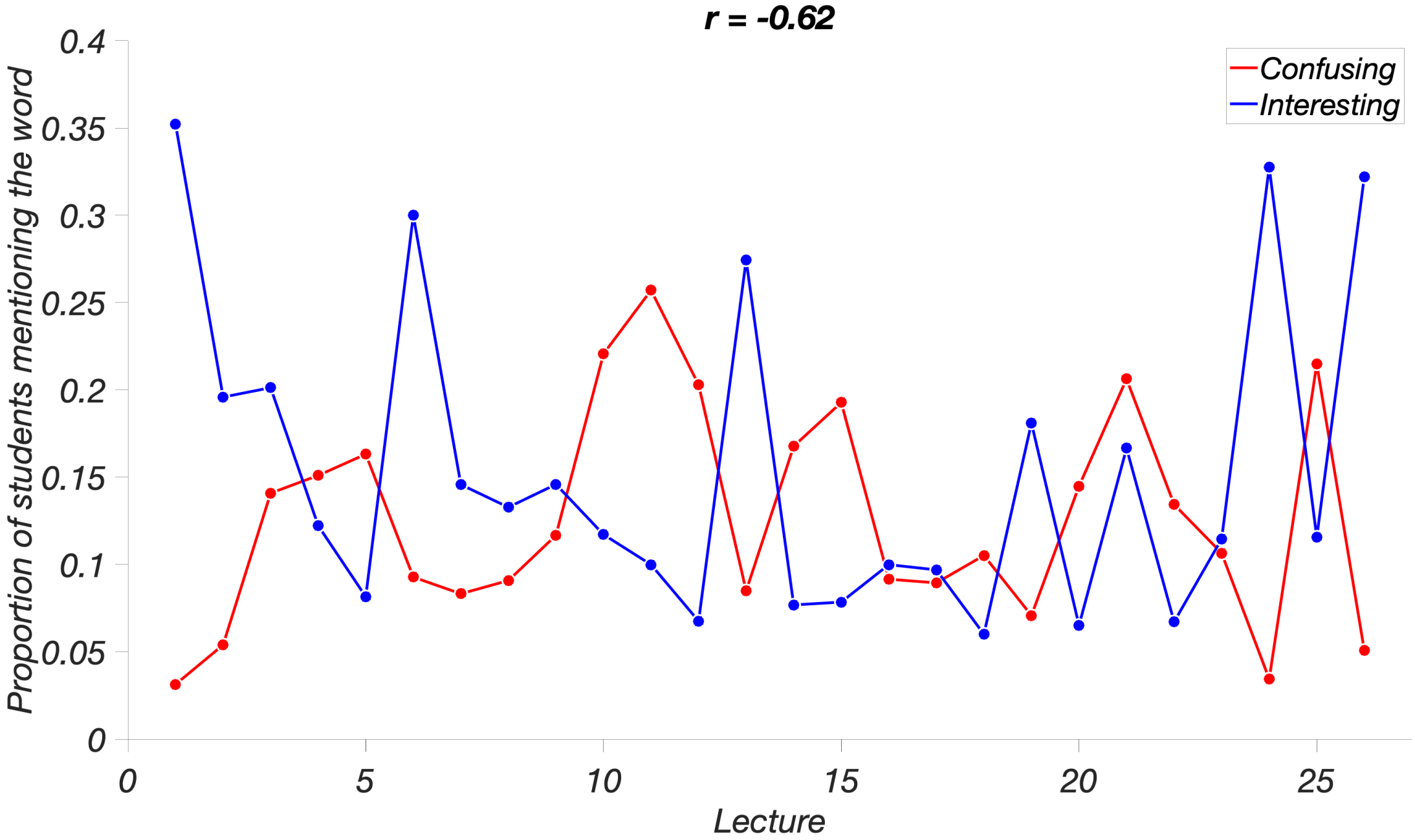


process
something
analyze
picking
objective
inference
set
probability
need
classification
many
found
methods
mentioned
useful
numbers
make
clustering
definition
important
world
usually
testing
rider
point
code
function
fitting
lecture
Bradley
takeaway
situations
first
interpret
kind
means
job
covered
parameters
core
mathematical
projects
groupings
major
form
concepts
two
still
place
regression
features
calculation
problems
machine
Voytek
experience
seem
areas
skills
information
improve
algorithms
UCSD
questions
simple
field
modes
well
new
made
equations
performance
patience
scientist
think
understand
city
different
get
going
linear
professor
path
career
things
look
learning
guest
real
way
related
take
parameterization
idea
types
AI
best
just
good
define
bit
scale
feel
even
developed
start
talked
example
basic
actually
canonical
showed
sense
own
big
creating
hand
discussed
turn
tools
visualize
large
time
programmed
statistical
science
complex
data
general
Uber
training
context
apply
implement
often
find
correlation
quantify
social
brainSCANr
lot
hear
ML
computer
extremely
rules
python
predictions
work
main
etc
relationships
up
act
three
explained
part
hypothesis
supervised
know
models
really
dynamics
people
explicitly
math
allows
minimize
future
knowledge
based
research
class
speaker
unsupervised
presentation
interesting
including
better
already
practical
insight
neighborhoods
Brad
values
gave
topics
case
behind
analysis
able
applications
great
helped
thought
observations
specific
always
market
neuroscience


maximizes
outcome
including
amount
different
location
covered
brief
distance
visualize
toy
need
yield
classify
helps
SVM
lecture
think
optimal
natural
area
moving
many
curve
saw
give
compare
regards
decide
sum
function
just
group
particular
based
classification
silhouette
positive
ROC
equalizes
situation
possible
still
AUC
structure
matrix
main
project
idea
around
K
K-nearest
best
takeaway
python
K-means
method
works
get
RMSE
interesting
randomly
course
student
data
points
values
nearest
make
plot
result
PCA
start
following
dimension
Lastly
mental
mentioned
terms
applications
part
dataset
side
two
KNN
ML
ideal
health
placing
calculate
buffer
provide
centers
tell
vector
talked
Keep
science
false
class
general
characteristic
clustering
neighbor
coefficient
forests
go
own
kind
questions
true
observations
way
inherent
new
final
good
labeled
well
basic
predict
end
process
boundary
determine
algorithm
learning
feel
another
explaining
introduced
divide
predictors
apply
paragraph
take
common
issue
bit
decision
sensitivity
certain
reduce
discussed
check
concepts
range
better
why
means
perform
measure
looking
find
specific
analyze
little
figure
away
set
dimensionality
random
machine
trees
know
really
datapoints
operating
change
important
rate
analysis
model
reduction
maybe
three
space
implementation
types
support
line
number
assess
supervised
seems
receiver
case
went
related
hyperplane
something
accuracy
example
unsupervised
understand
problem
time
solve
minimize
confused


statistical
someone
mistakes
comes
published
size
cautious
making
applied
consider
looking
Pascal
last
kinds
takeaway
studies
scaling
autocorrelation
themselves
states
well
aid
work
information
analysis
misleading
First
speak
paragraph
interesting
mean
points
paradox
discussed
analyzed
never
drawn
major
mainly
seems
analyses
plot
central
completely
own
love
people
overall
class
choose
saw
value
important
connect
problems
briefly
small
fallacy
common
know
might
collected
Professor
project
good
correlation
always
sample
face
final
Another
freedom
talked
logical
context
many
etc
true
just
account
lecture
taken
mentioned
responsible
affect
accurately
factors
degrees
combined
things
time
even
temporal
itself
up
brief
help
real
main
mind
results
data
lead
science
Gambler's
great
Simpson's
research
fair
assume
Quantitative
biases
issues
method
future
population
idea
spatial
right
bias
related
appears
find
numbers
representative
units
justify
avoid
event
shows
same
Keep
case
sure
lot
occur
wrong
process
possible
touched
law
specific
matters
different
interpretation
smaller
feel
covered
theorem
why
implications
examples
need
understand
based
actually
several
potential
semester
pitfalls
certain
students
two
learned
made
Gambler's
pseudoreplication
ethics
limit
take
consequences
careful
counties
get
effective
definitely
unintended
thought
multiple
think
Ludic
reasoning
independent
way
something
groups
power
question
substitute
false
including
equal
conclusions
really
happen
survivorship
variable
Today
concepts
assumptions

Insight: Confusion blocks interest



At least 4 birds!

- Participation
- Immediate and specific feedback
- Aggregated insights
- Retention of material (some digestion)
- …?

Downsides?

Thank you