Moon Zoo

Transforming Citizen Science into Publishable Science

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ASTR 630

Dec. 8, 2016

Citizen Science

n. scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions

- Oxford English Dictionary

But why?

1. Human > computer
2. Too much data


ZOONIVERSE

Moon Zoo

- Collected user data from 2010-2015
- Lunar Reconnaissance Orbiter Camera
  - Narrow Angle Camera
- 2016 paper

  The Moon Zoo citizen science project: Preliminary results for the Apollo 17 landing site (Bugiolacchi et al.)

Bugiolacchi et al., 2016

- Goals:
  1. Filter problematic mark-ups
  2. Study clustering methods for multiple annotations per crater
  3. Derive crater degradation index
  4. Identify ways to improve citizen science

- Use images of Apollo 17 landing site with standard Moon Zoo interface

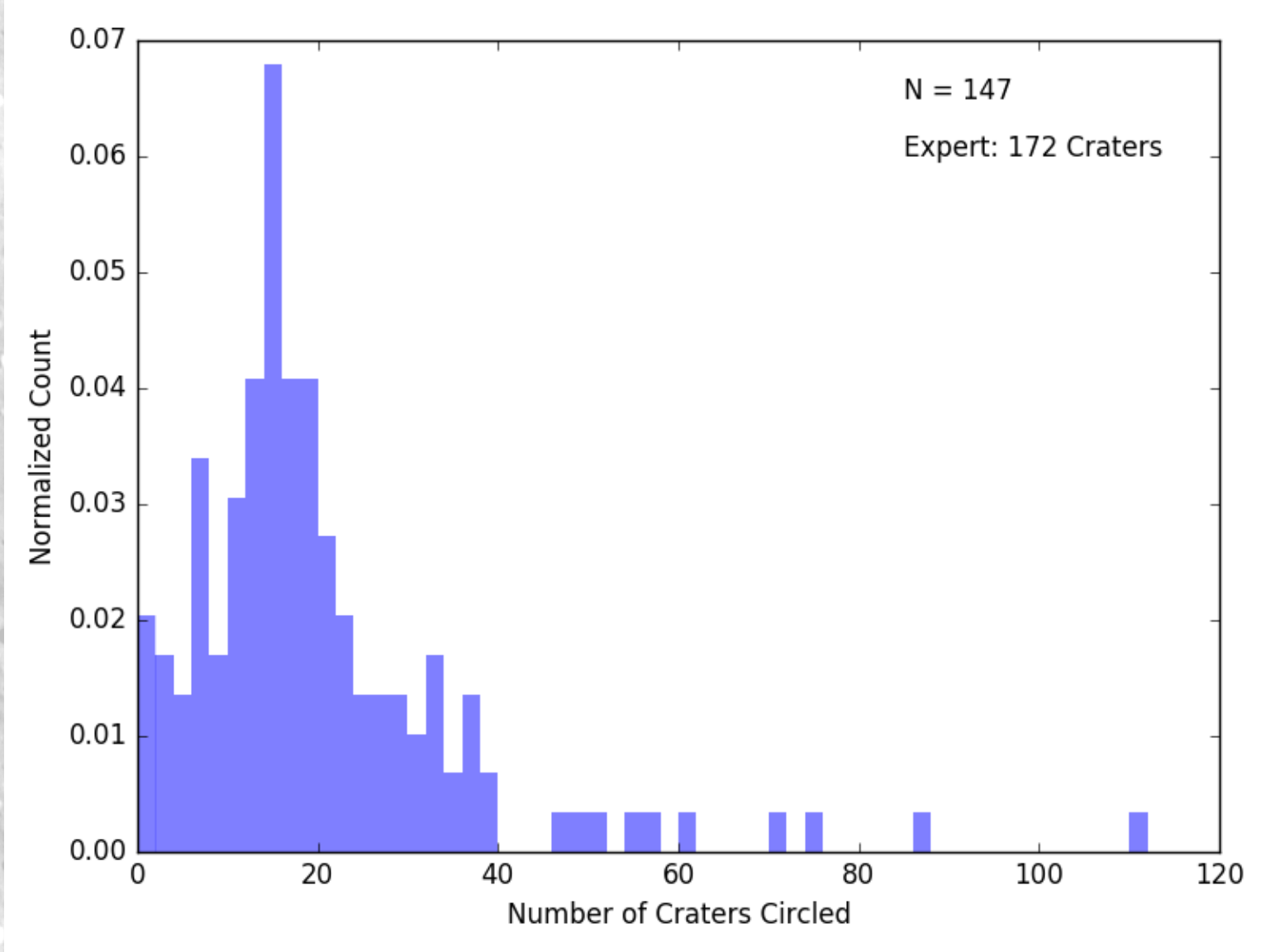
Recreating the Moon Zoo

- Using the same image, designed a worksheet completed by ASTR 101 students
- Image included both elevated and depressed features for reference
- Students asked to circle craters
- Same worksheet given to an expert

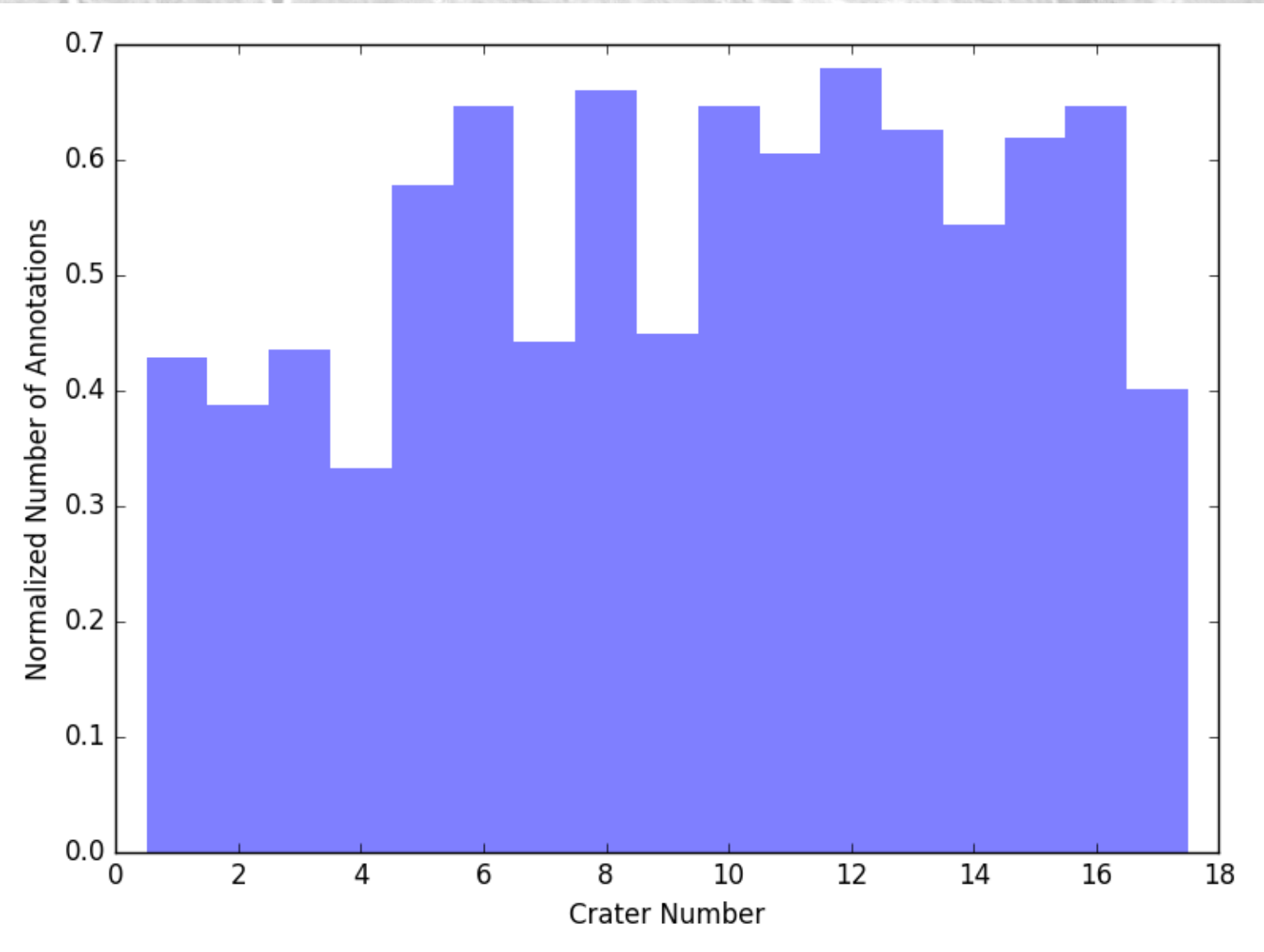
Recreating the Moon Zoo

- Selected 17 craters from the worksheet as “craters of interest”
- Measured the diameters of craters of interest
- Assigned each worksheet with a quality score
- Explored methods to collapse “citizen” data to converge to expert analysis

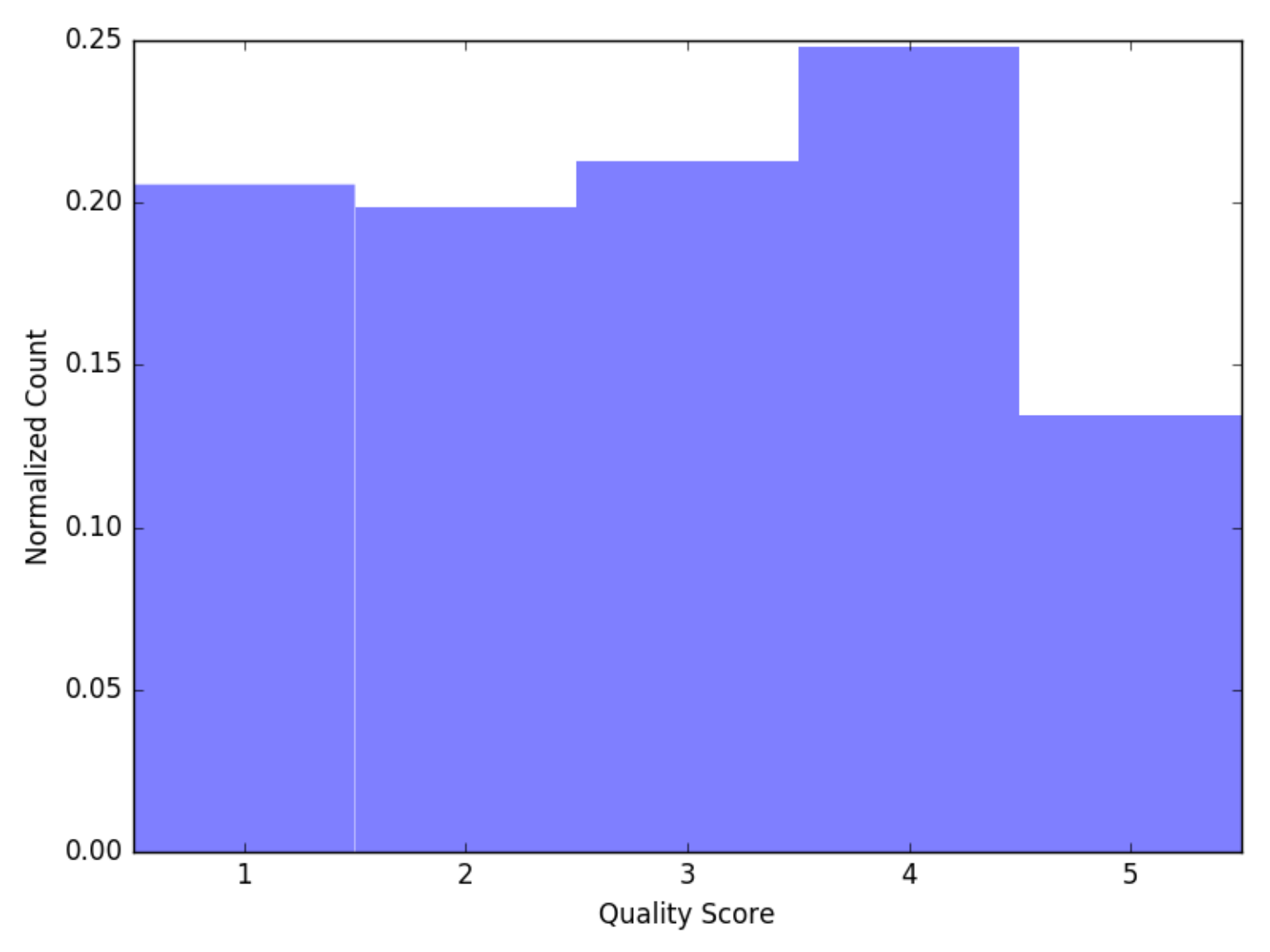
Recreating the Moon Zoo



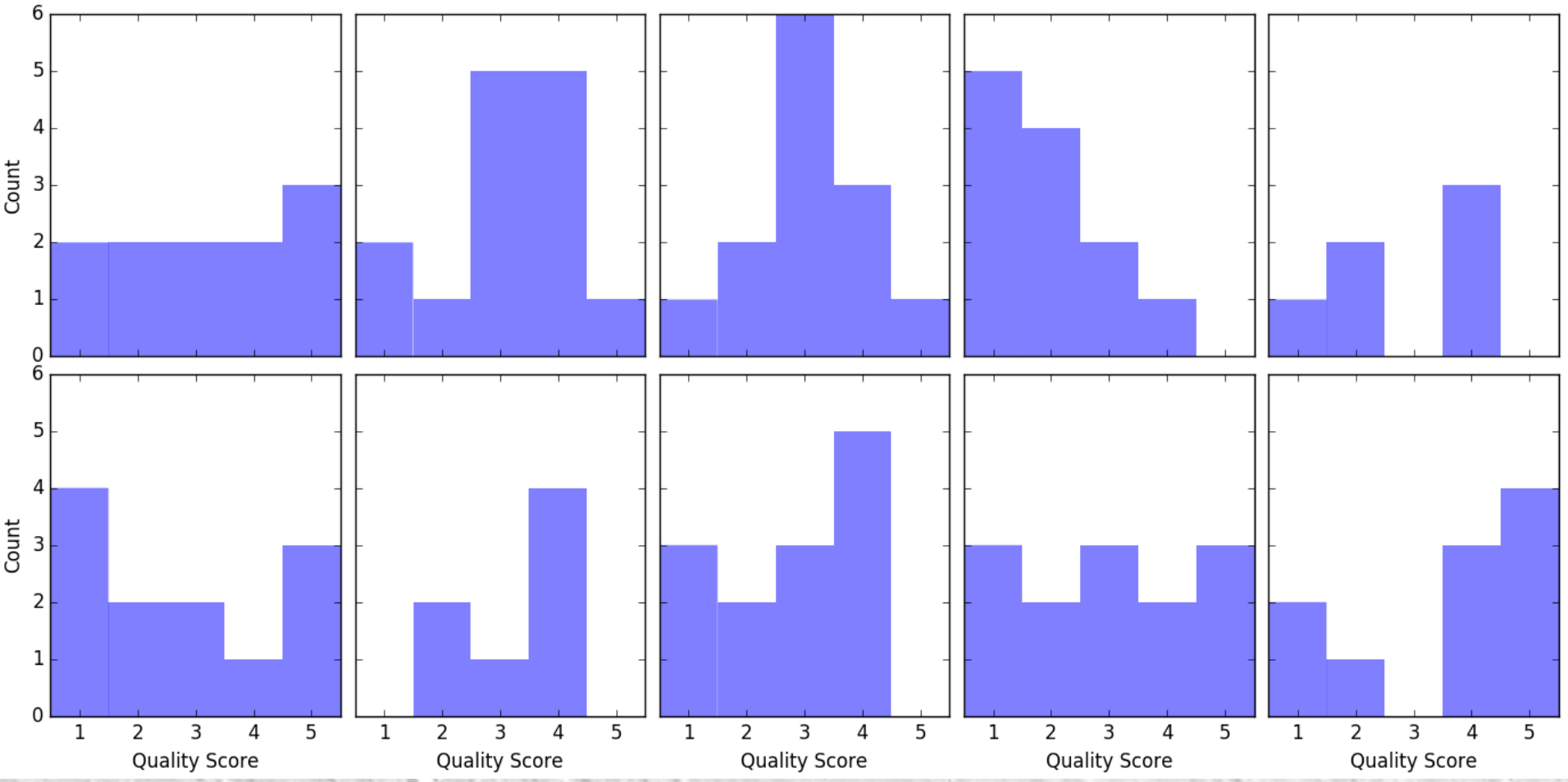
Recreating the Moon Zoo



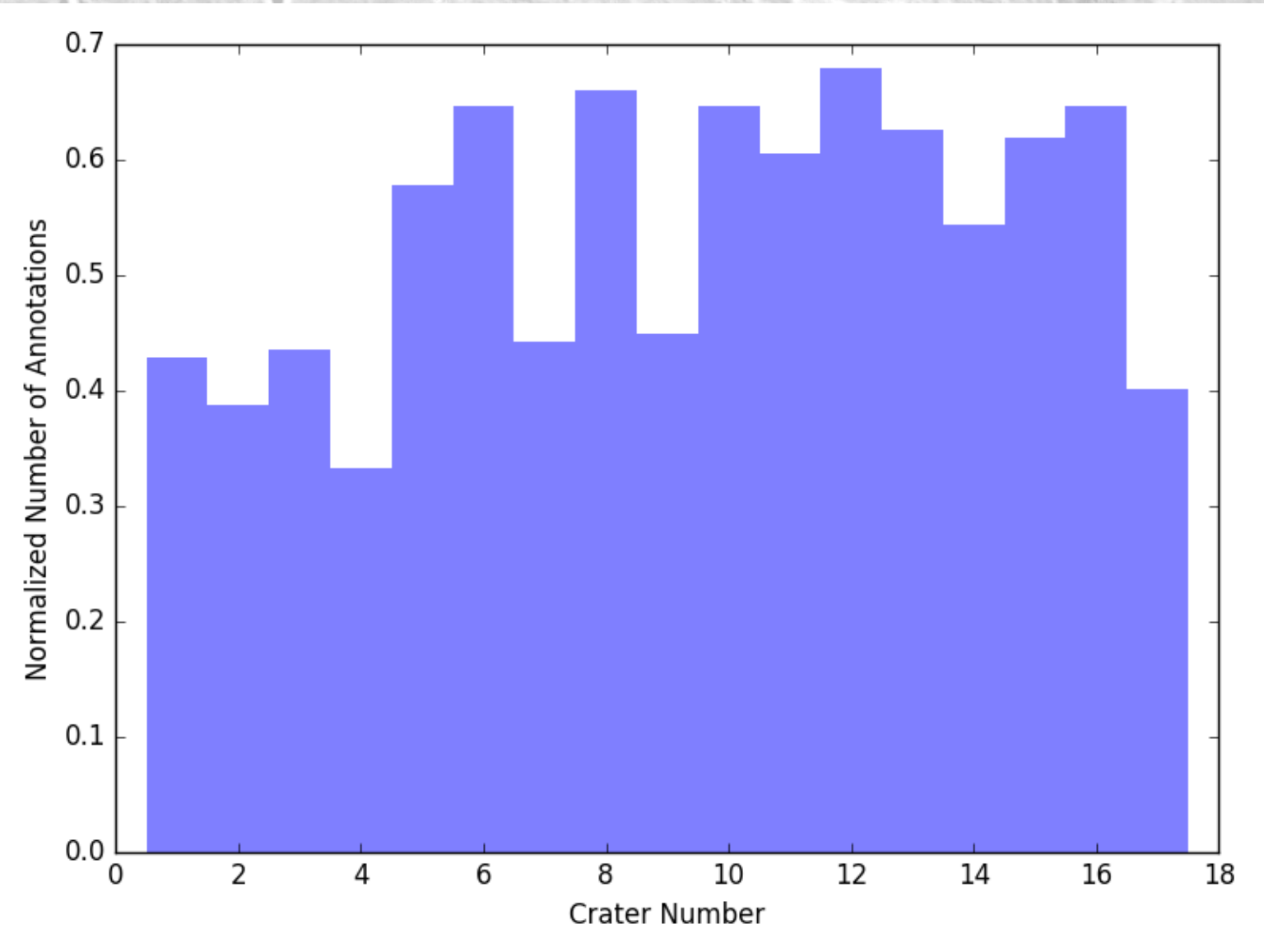
Recreating the Moon Zoo



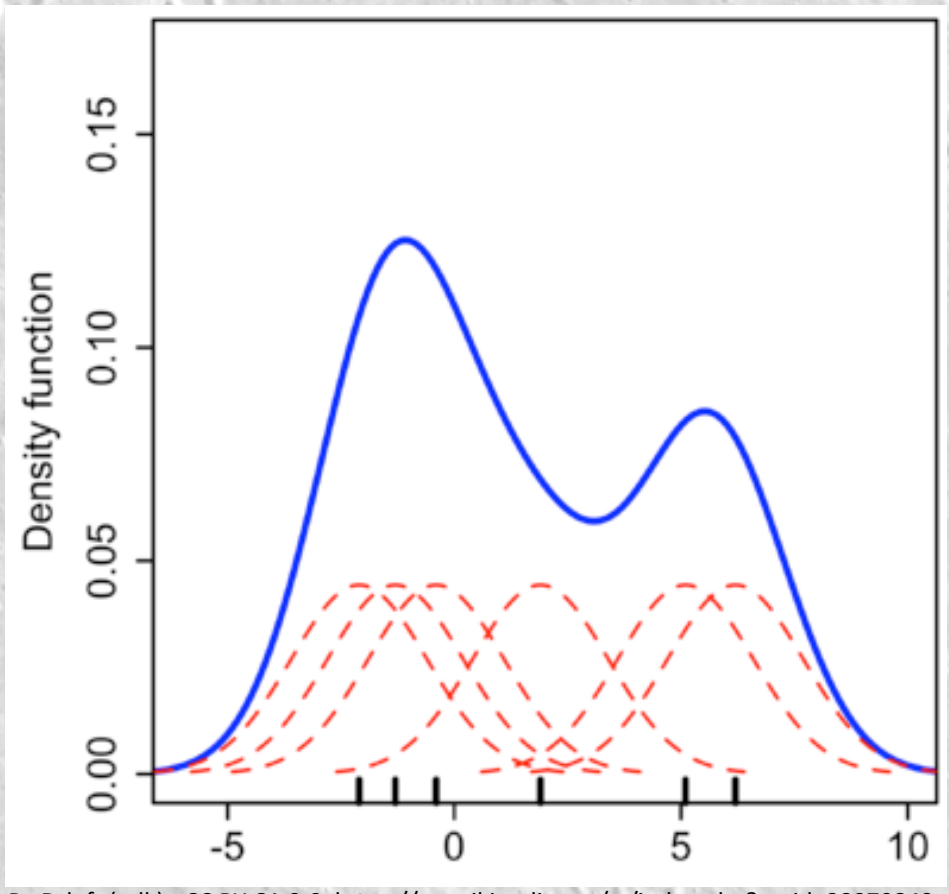
Recreating the Moon Zoo: Data



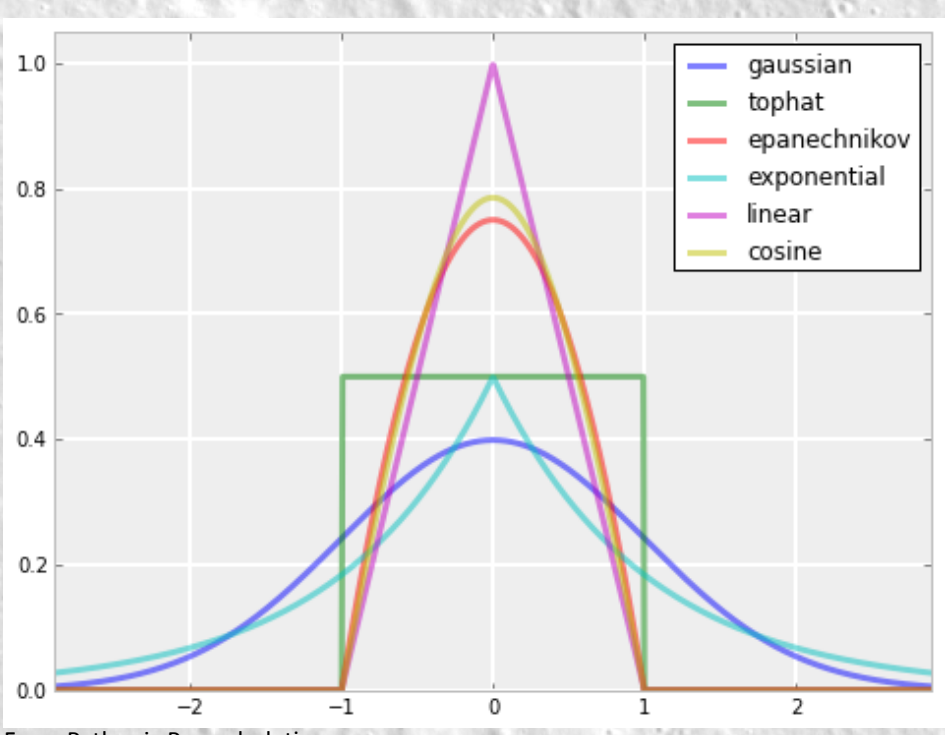
Recreating the Moon Zoo



Kernel Density Estimation

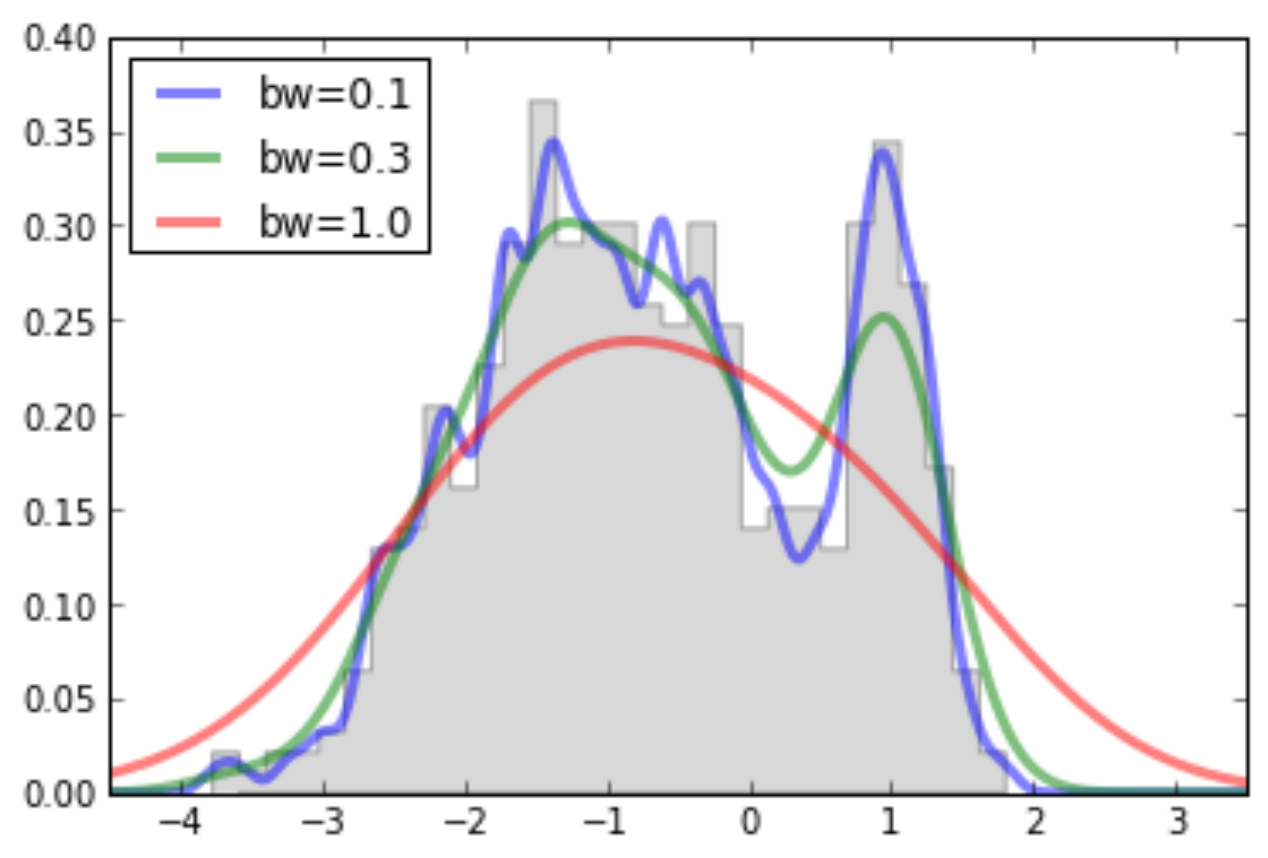


By Drleft (talk) - CC BY-SA 3.0, https://en.wikipedia.org/w/index.php?curid=28979849



From Pythonic Perambulations

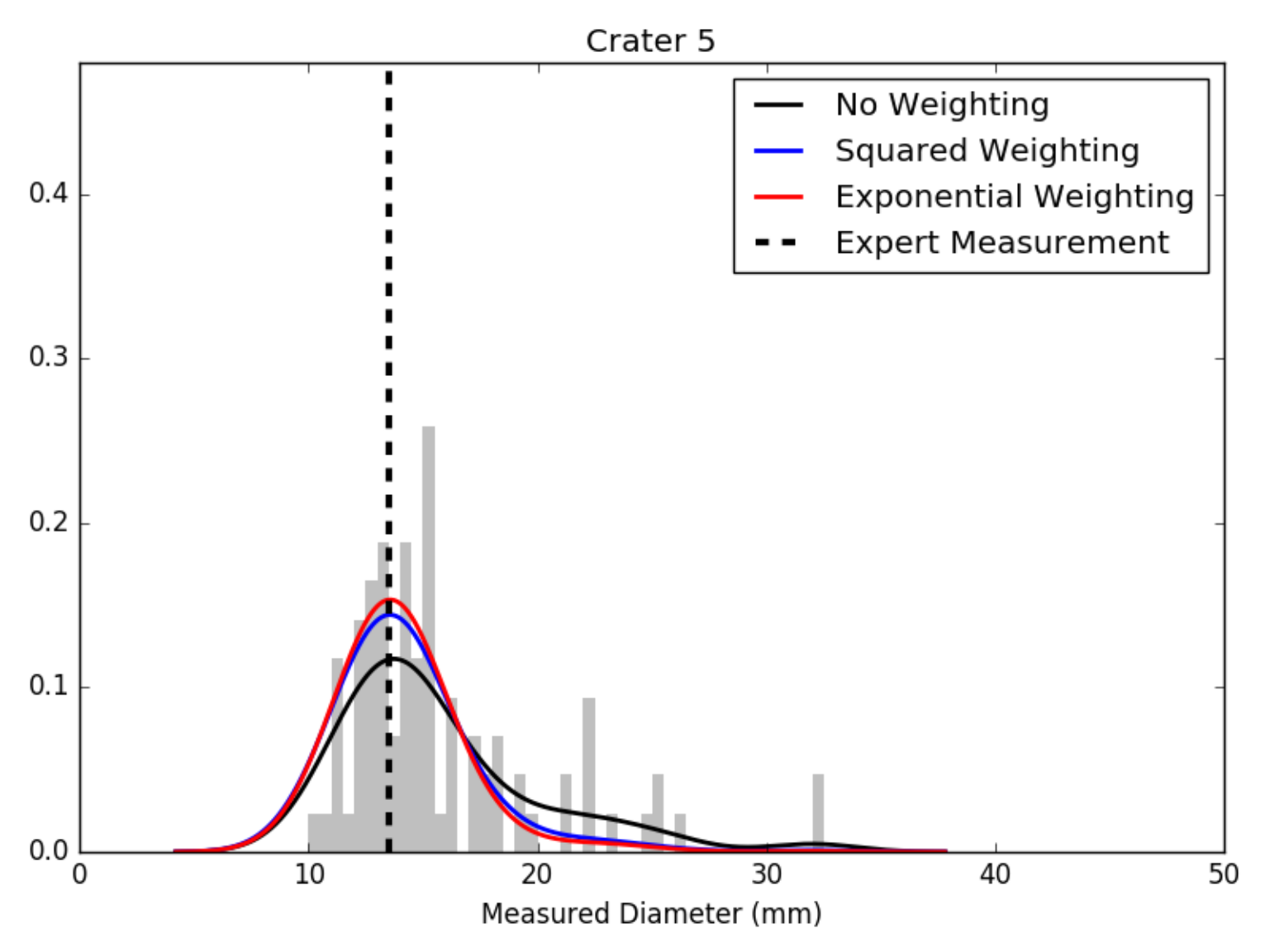
Kernel Density Estimation

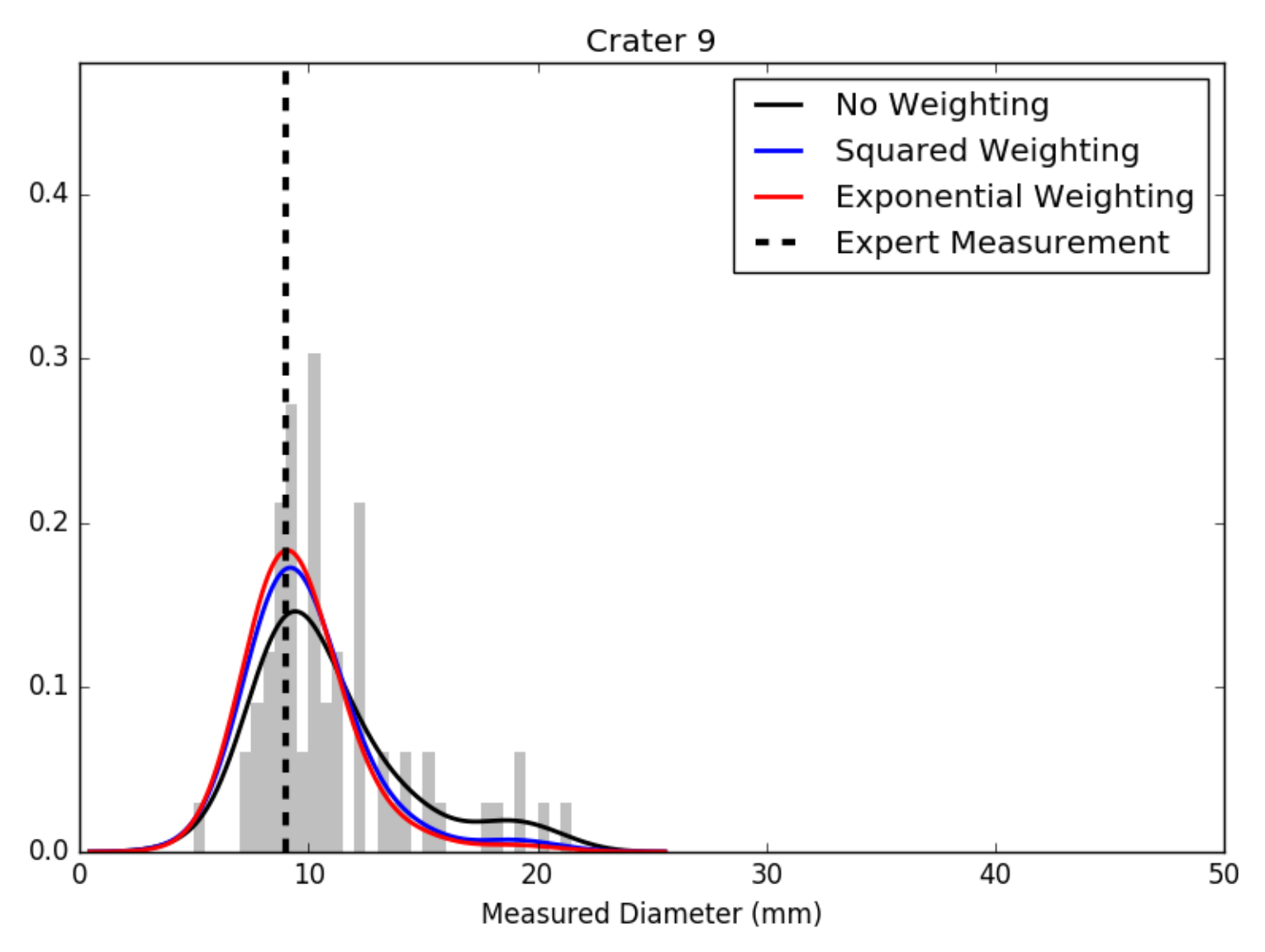


From Pythonic Perambulations

KDE with Student Data

- Python: StatsModels KDEUnivariate
- Gaussian kernel
- Bandwidth: Silverman's "Rule of Thumb
- Explored various ways to weight student responses based on quality score


Crater 5
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
0.2
0.3
0.4
0
10
20
30
40
50
Measured Diameter (mm)


Crater 9
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
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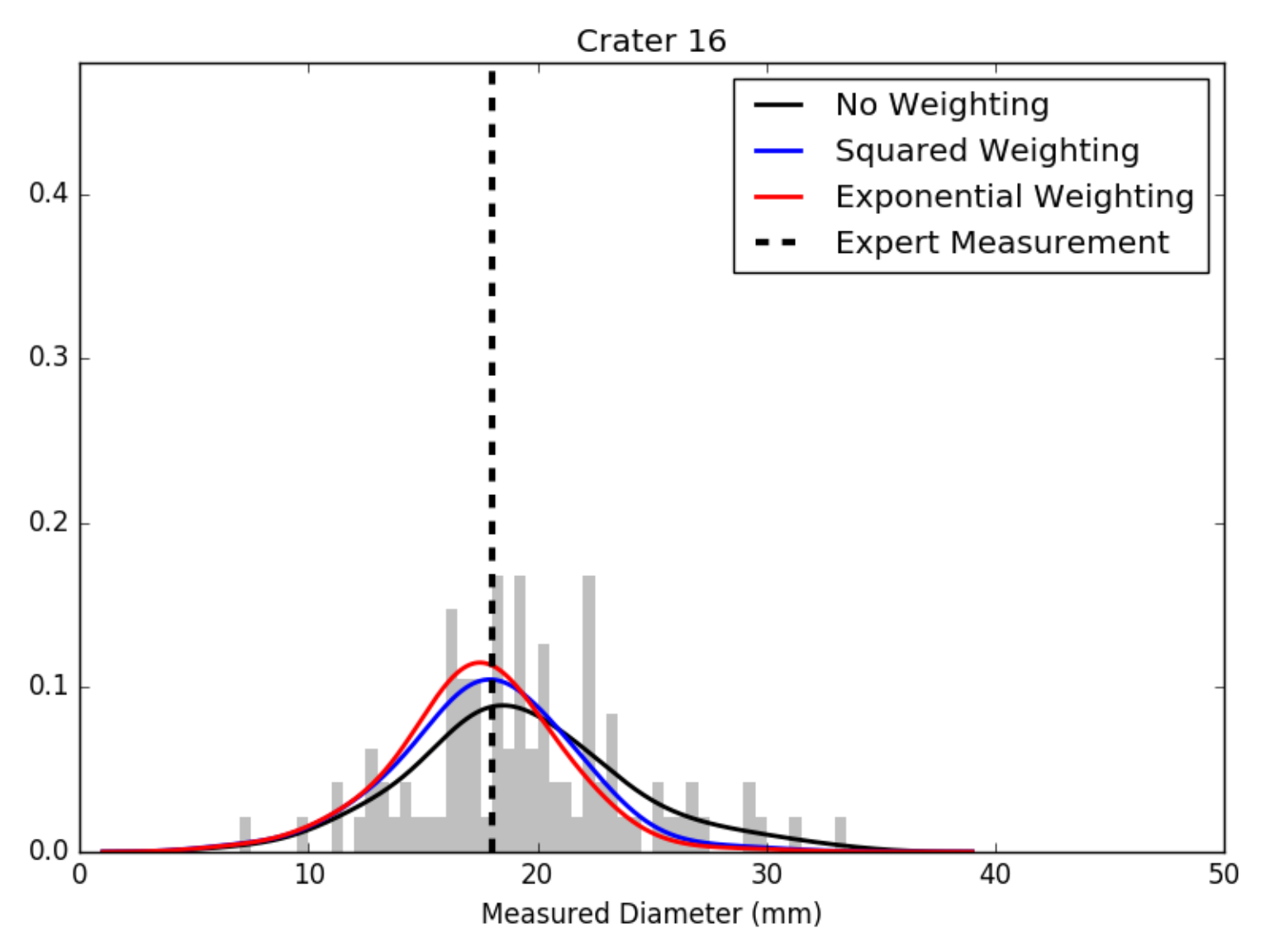
Measured Diameter (mm)


Crater 16
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
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10
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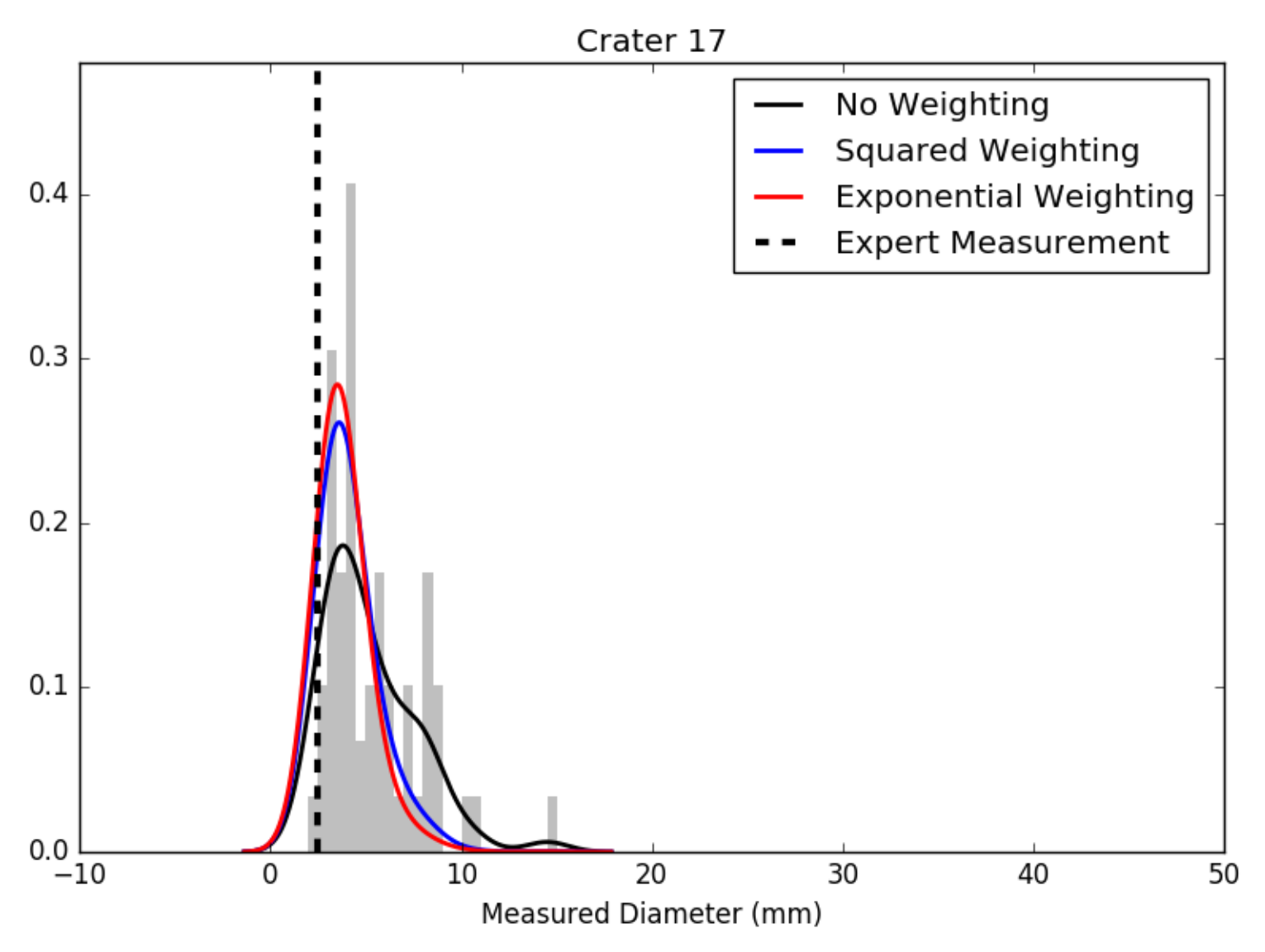
Measured Diameter (mm)


Crater 17
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.4
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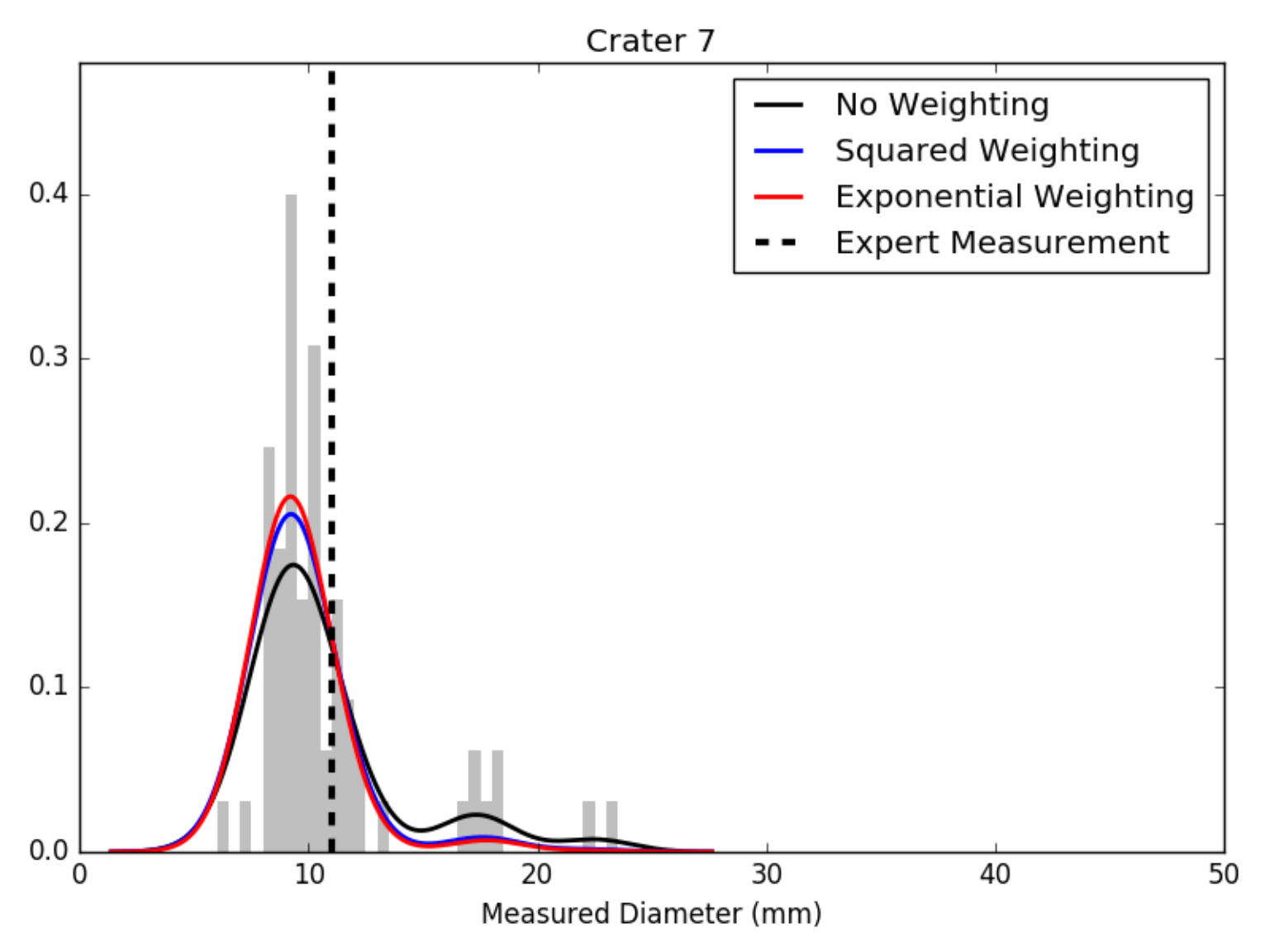
Measured Diameter (mm)


Crater 7
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
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0.3
0.4
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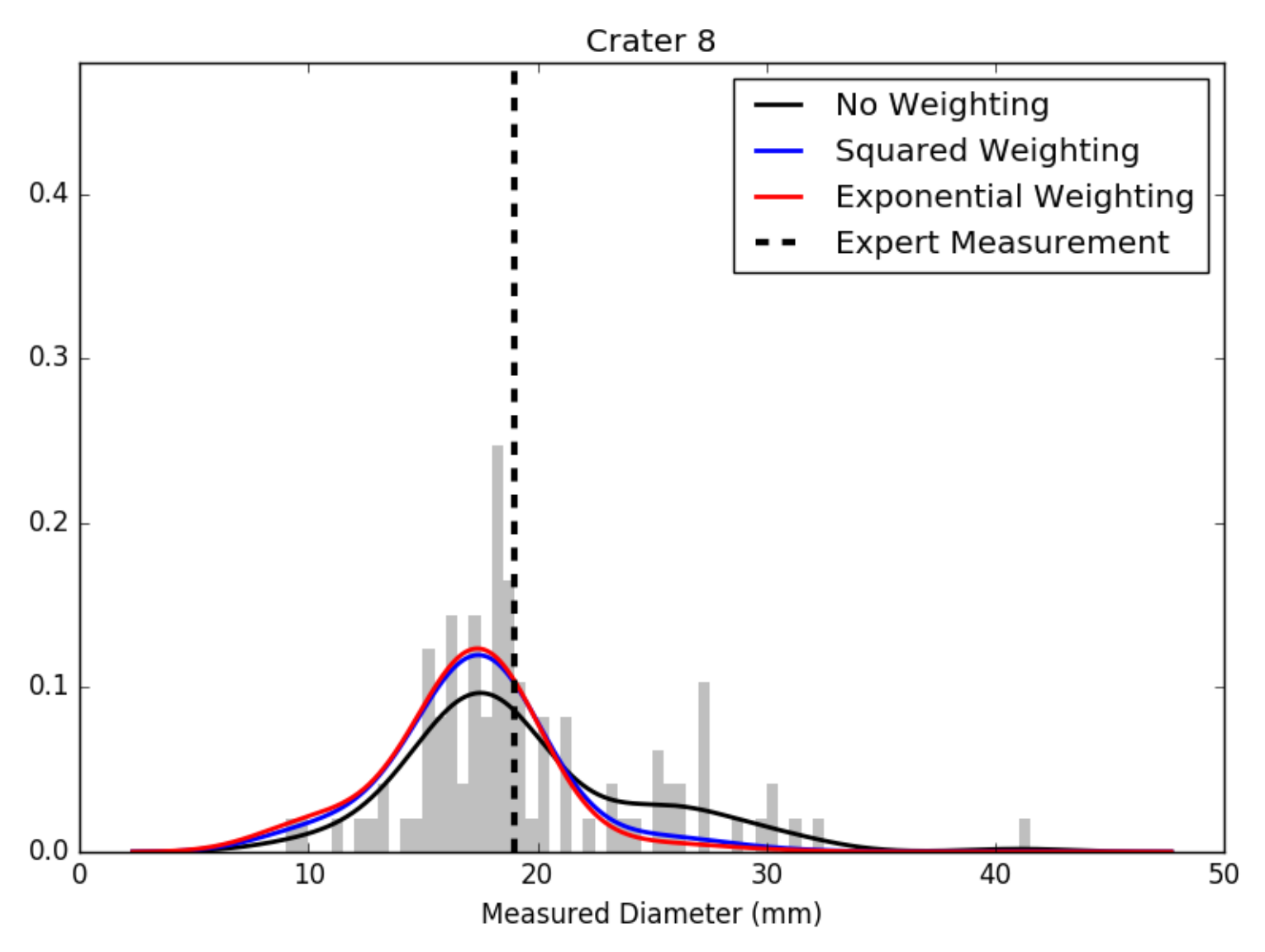
Measured Diameter (mm)


Crater 8
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
0.2
0.3
0.4
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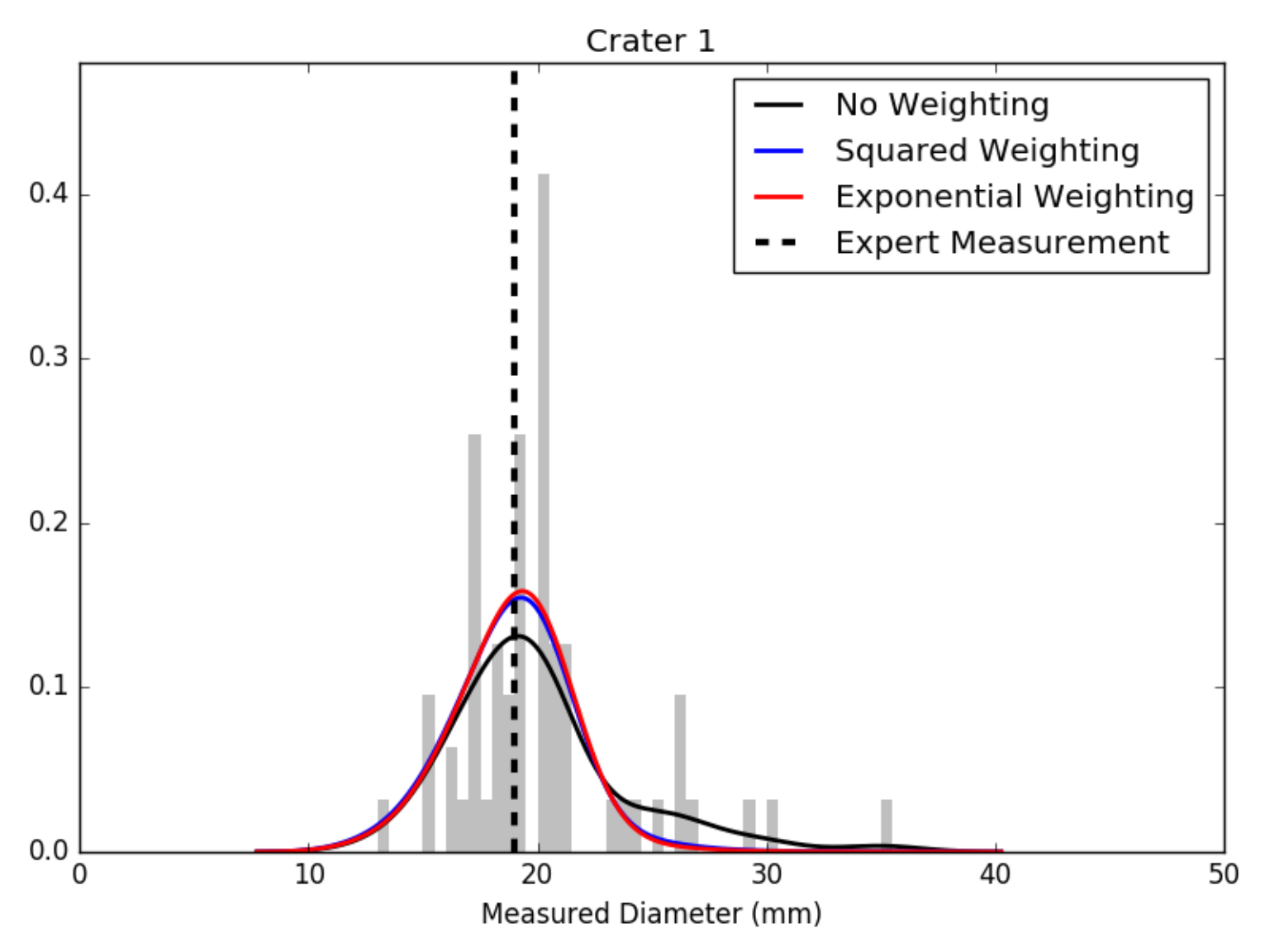
Measured Diameter (mm)

Thanks!


Crater 1
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
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0.4
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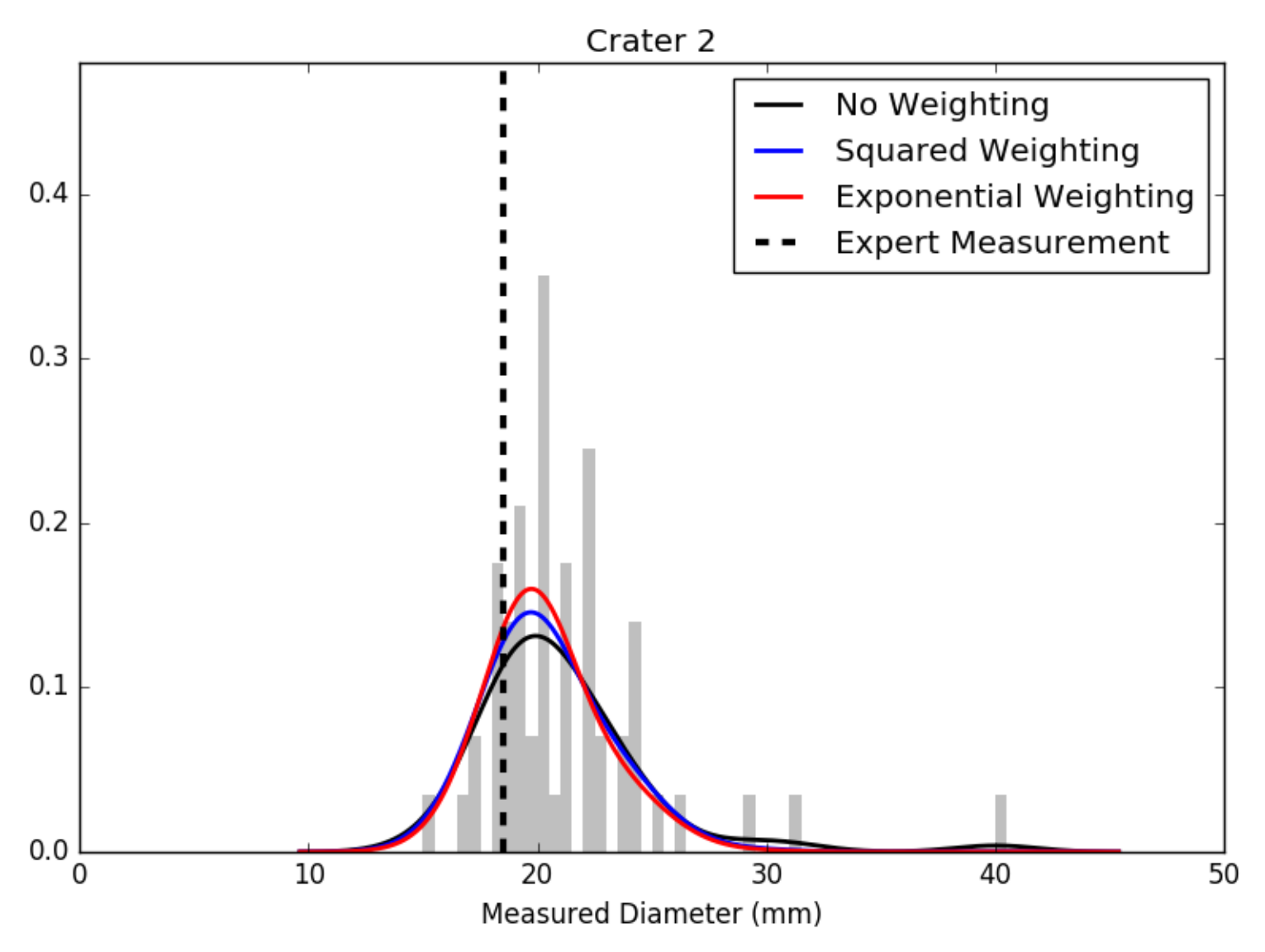
Measured Diameter (mm)


Crater 2
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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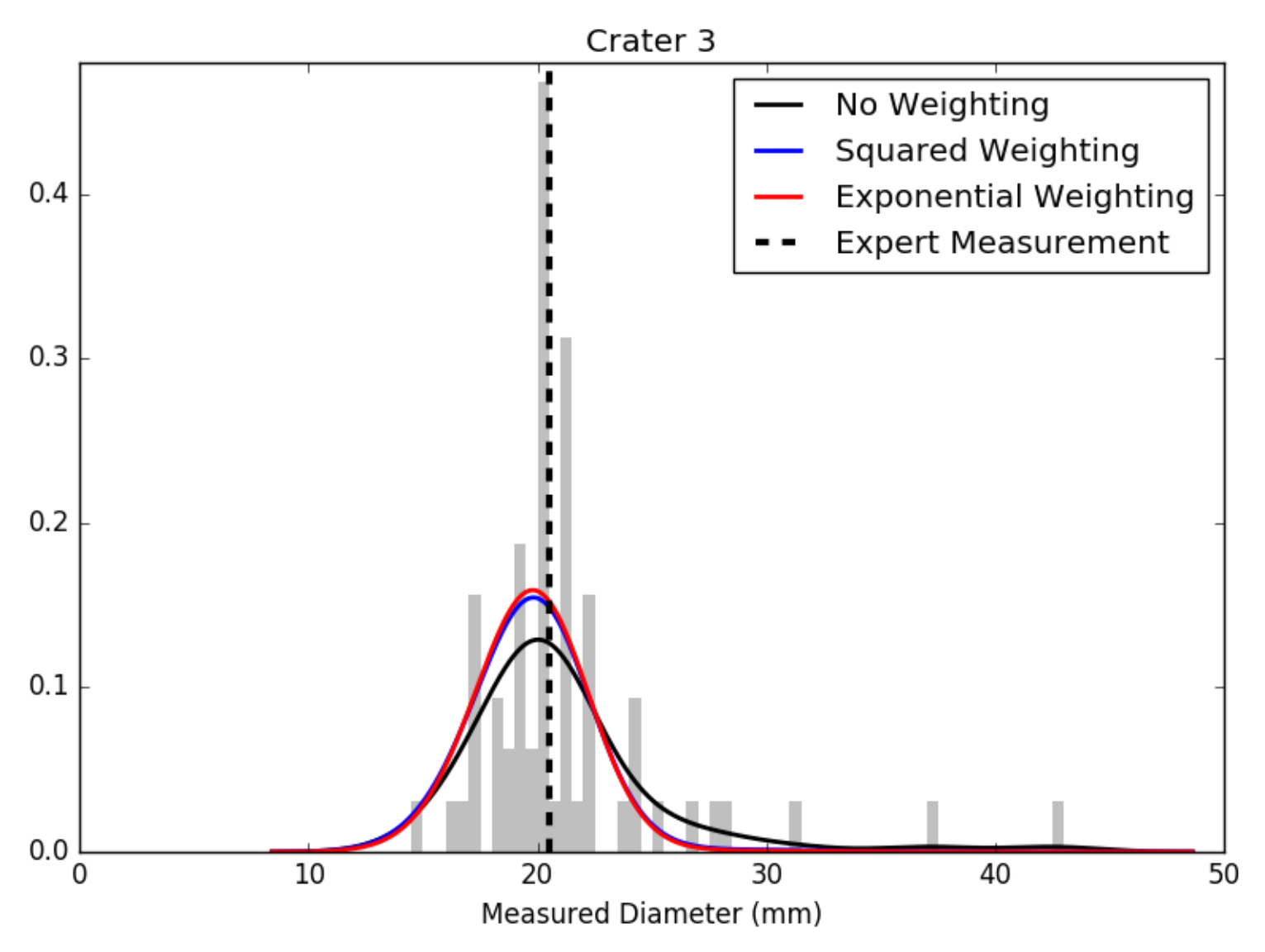
Measured Diameter (mm)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No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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0.4
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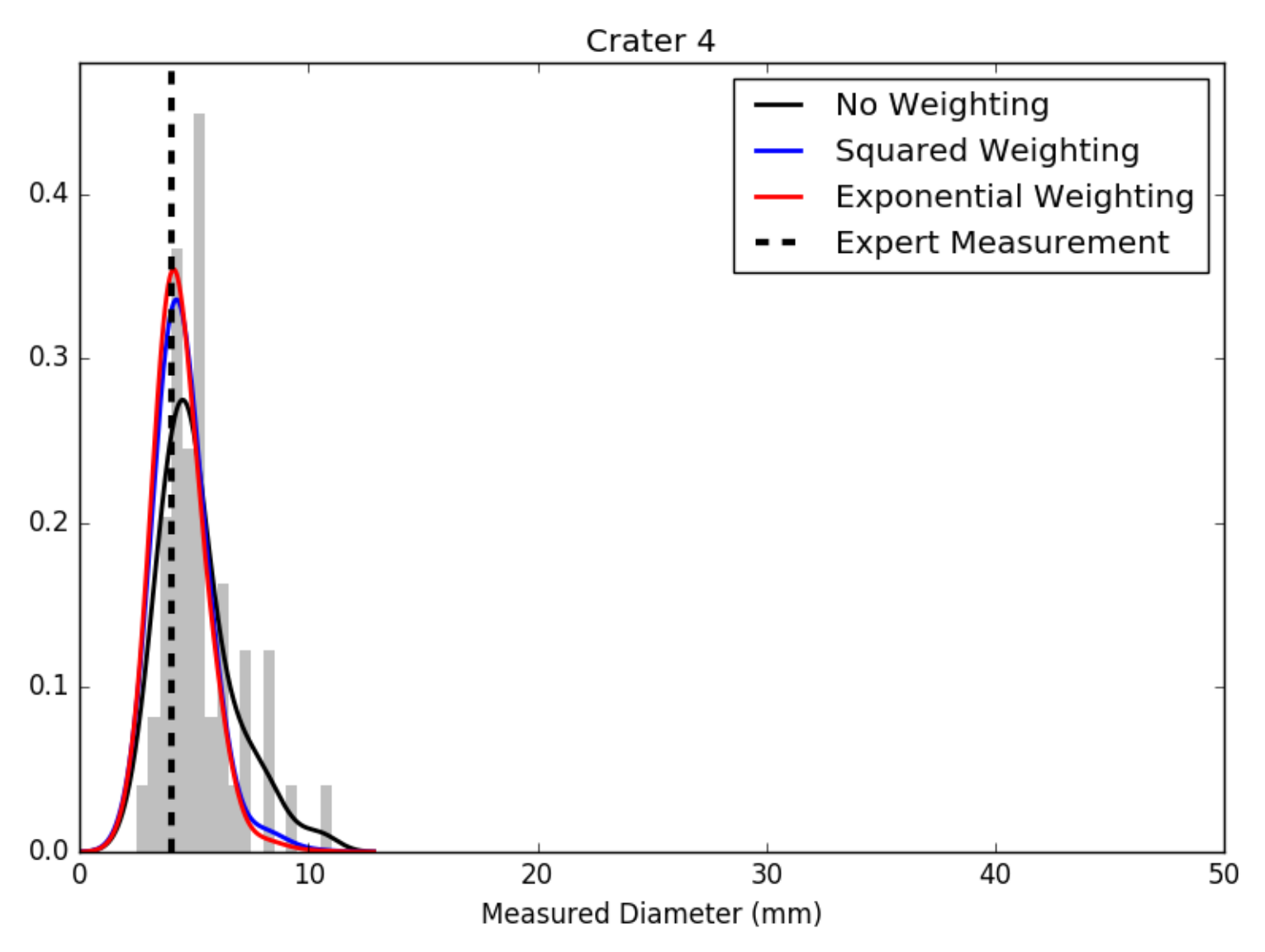
Measured Diameter (mm)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Squared Weighting
Exponential Weighting
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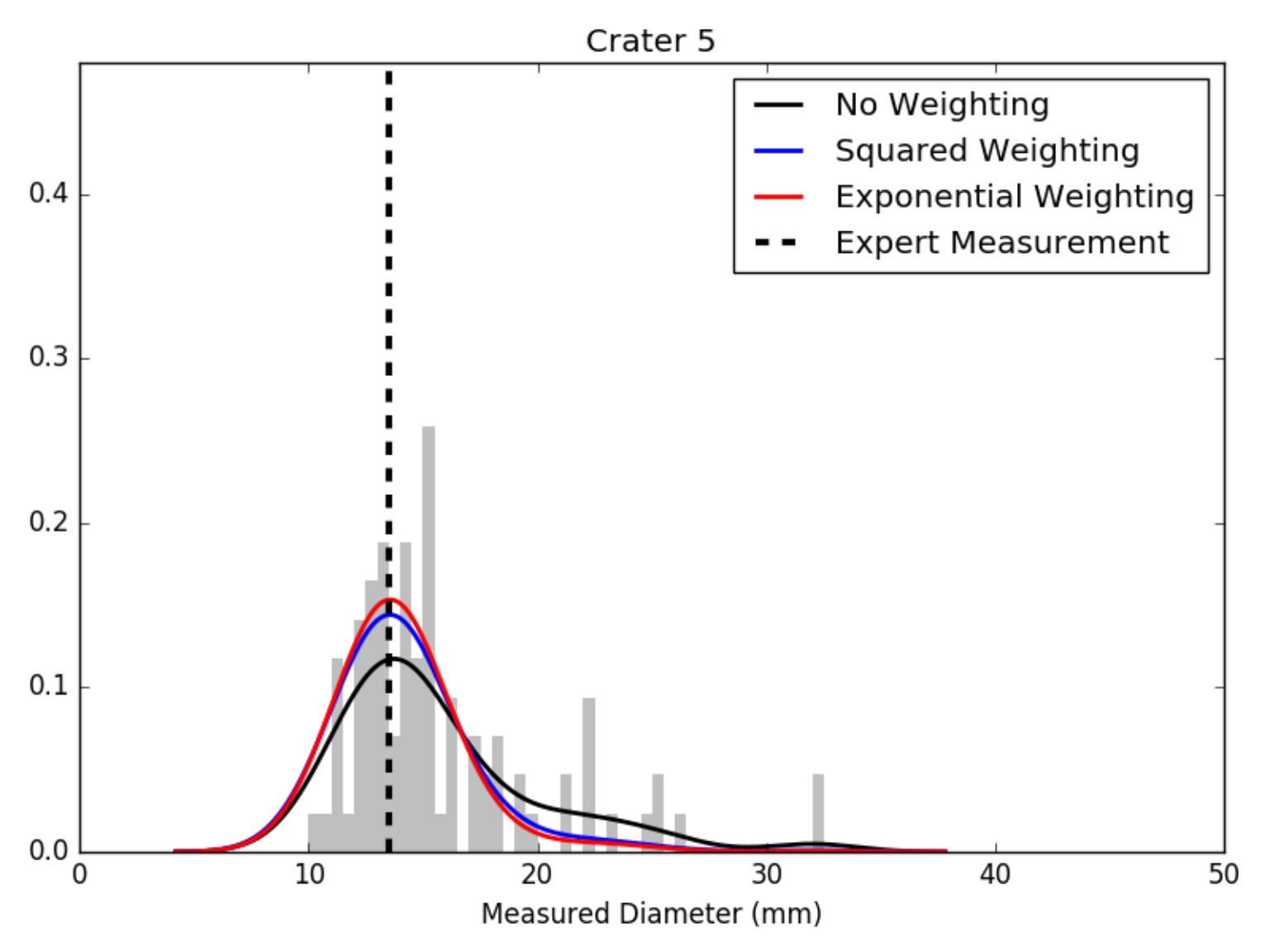
Measured Diameter (mm)


Crater 5
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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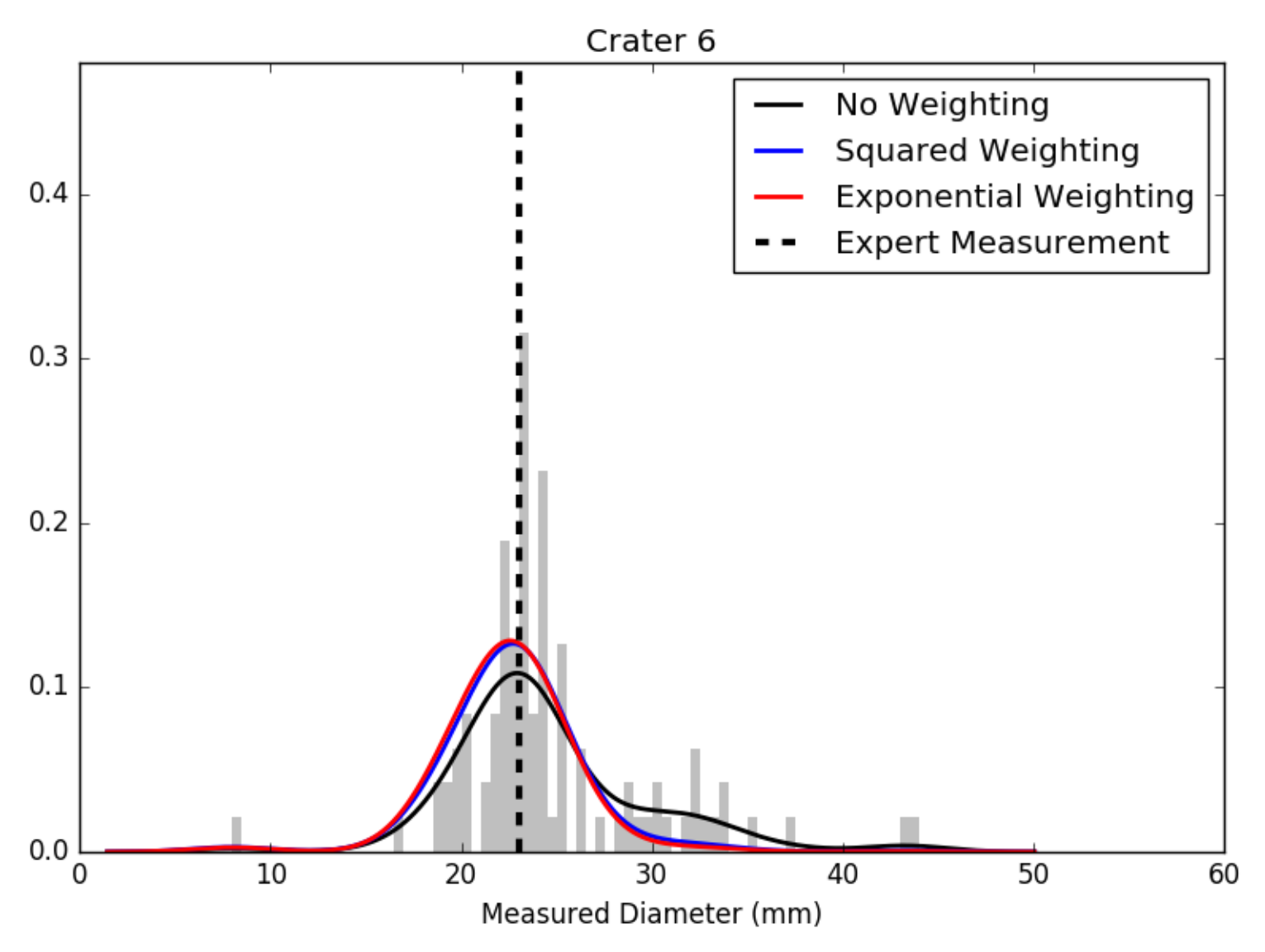
Measured Diameter (mm)


Crater 6
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Squared Weighting
Exponential Weighting
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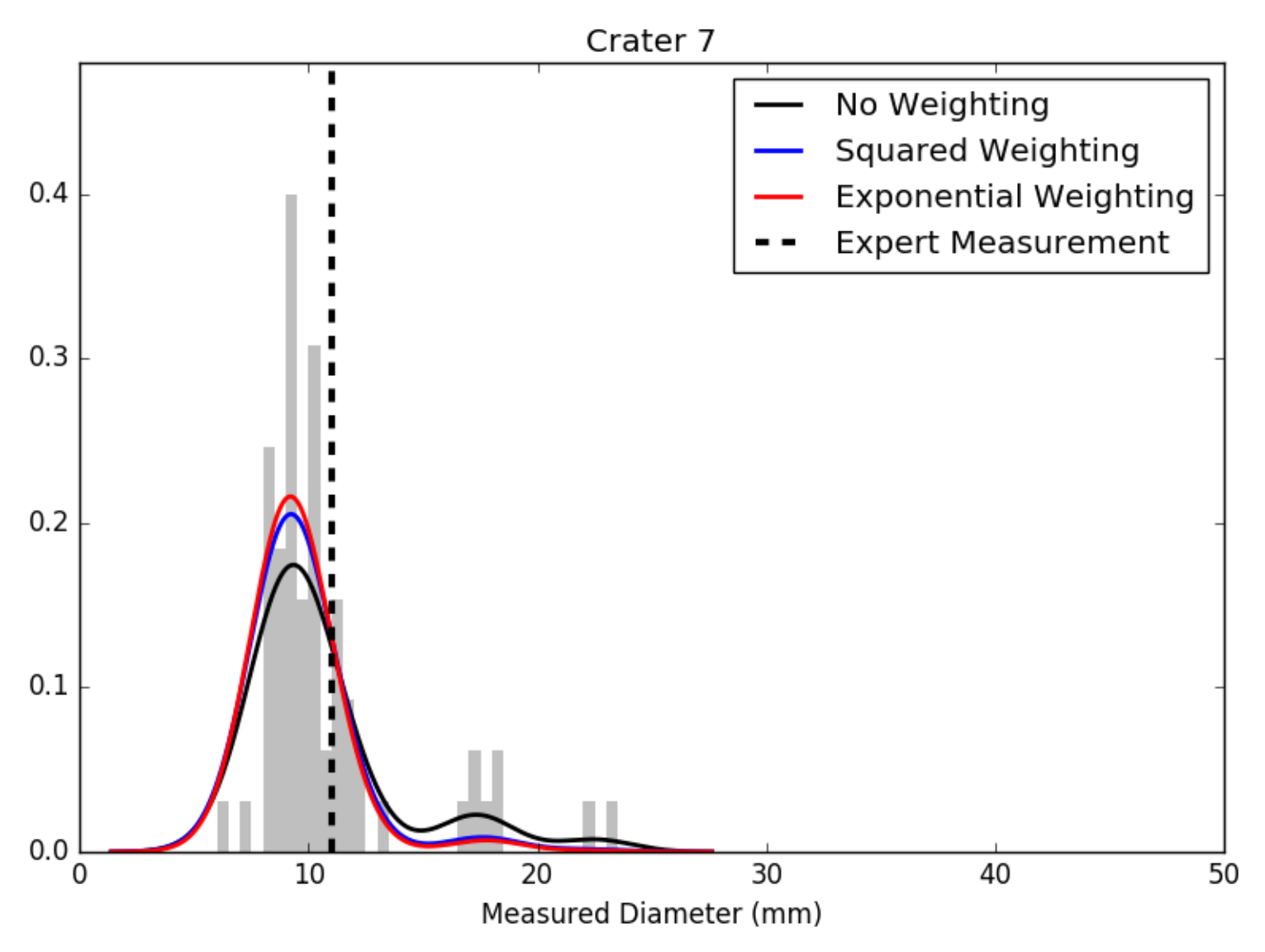
60
Measured Diameter (mm)


Crater 7
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
0.0
0.1
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0.4
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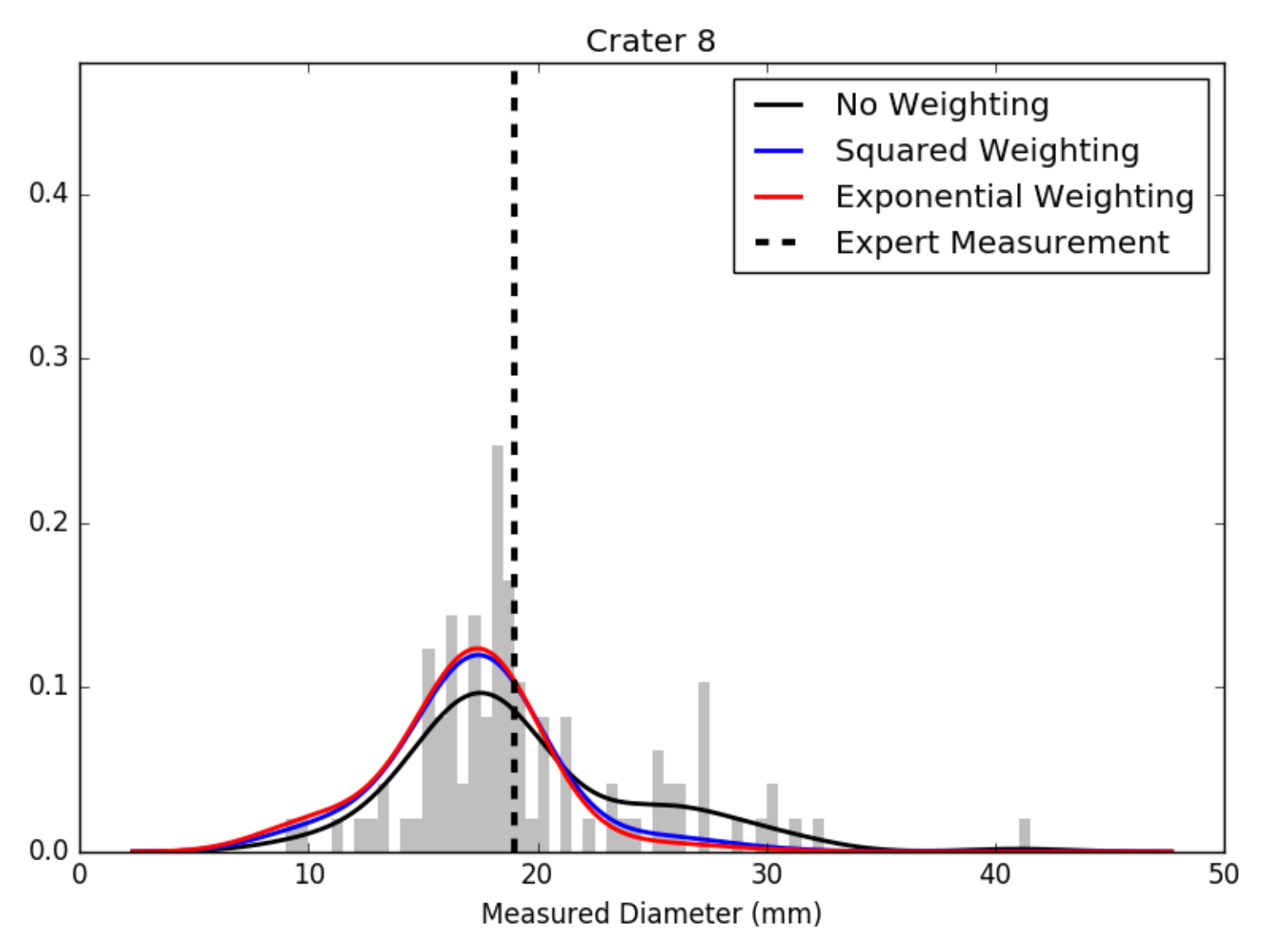
Measured Diameter (mm)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Exponential Weighting
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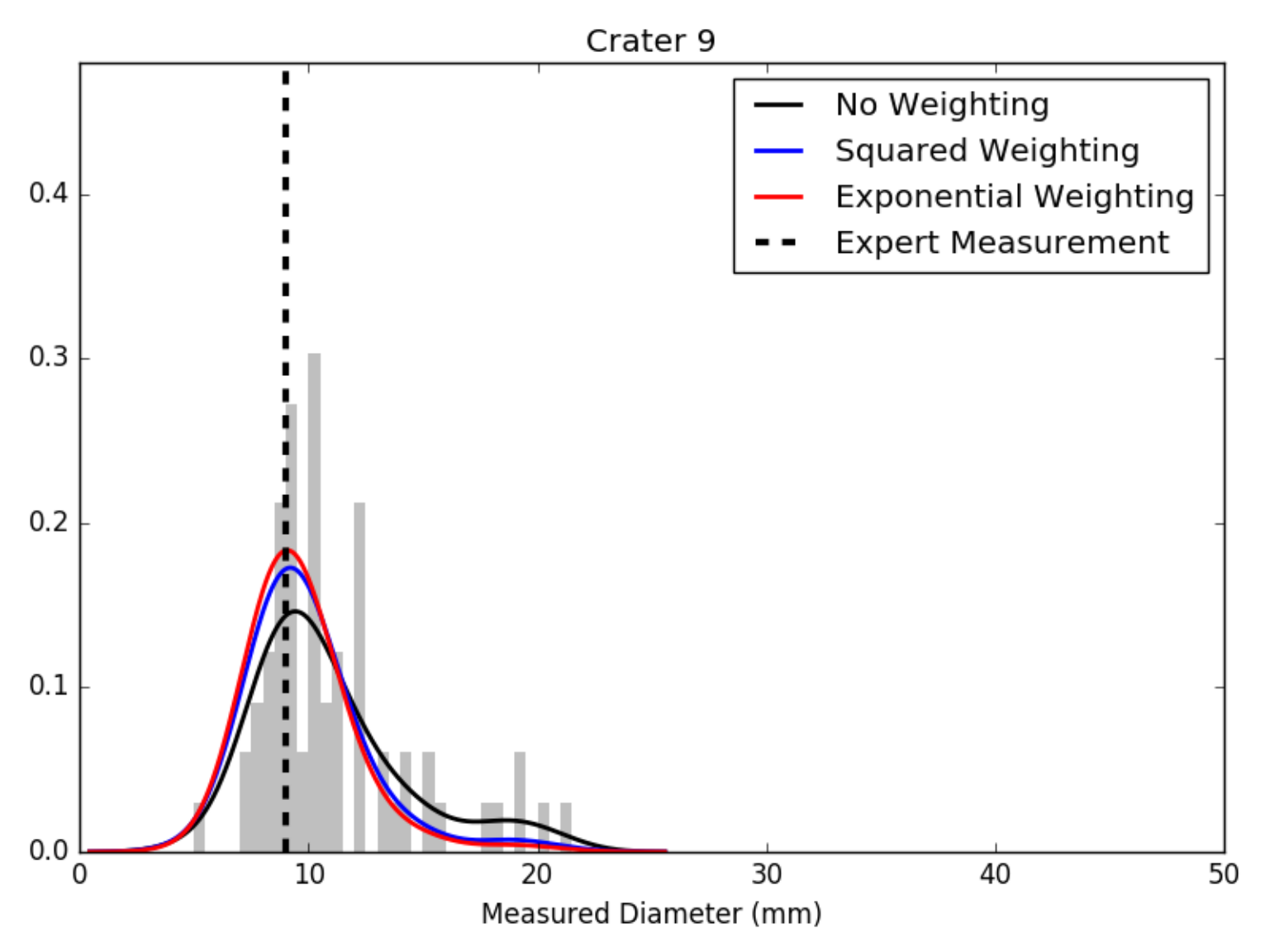
Measured Diameter (mm)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Exponential Weighting
Expert Measurement
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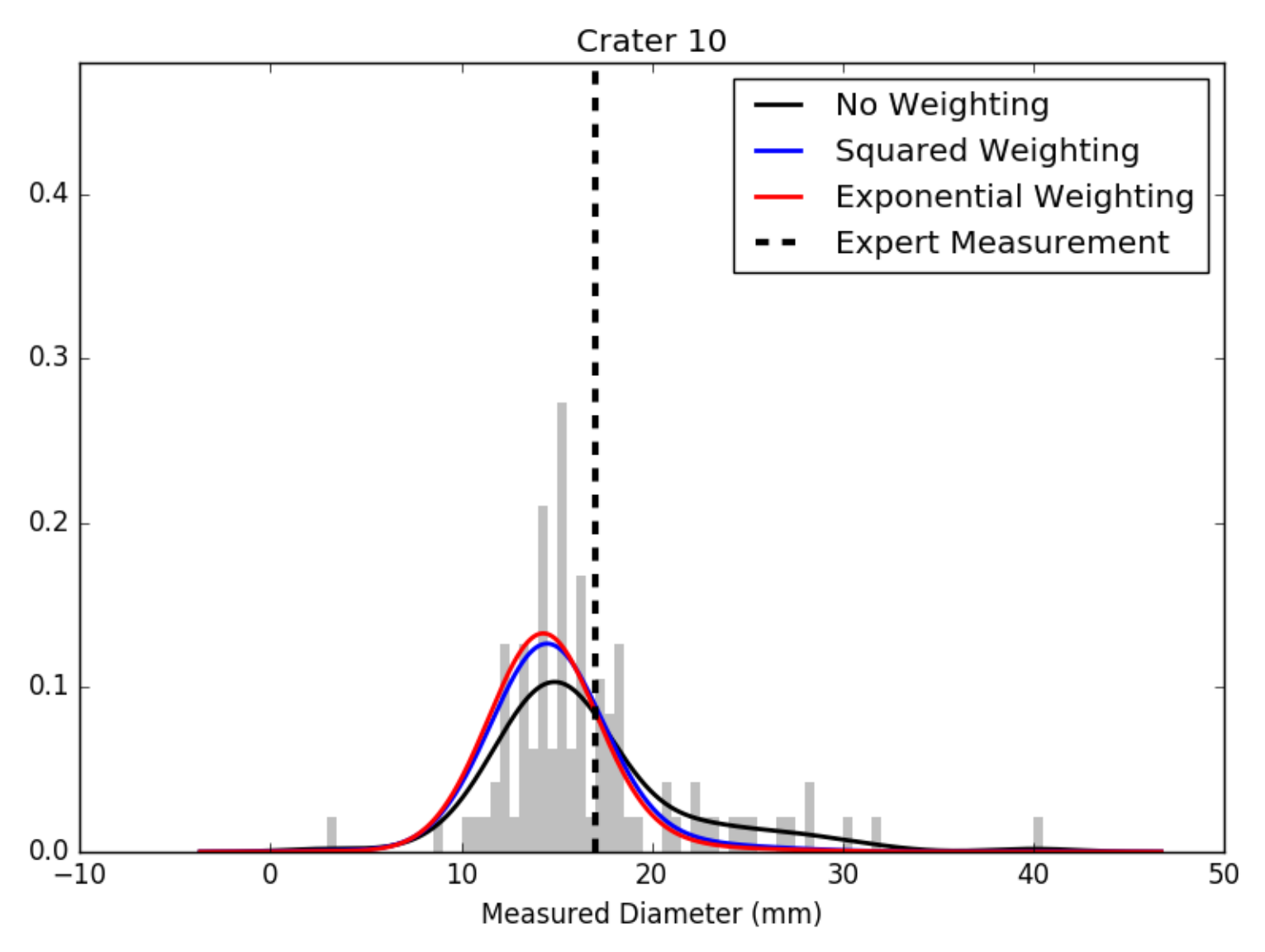
Crater 10
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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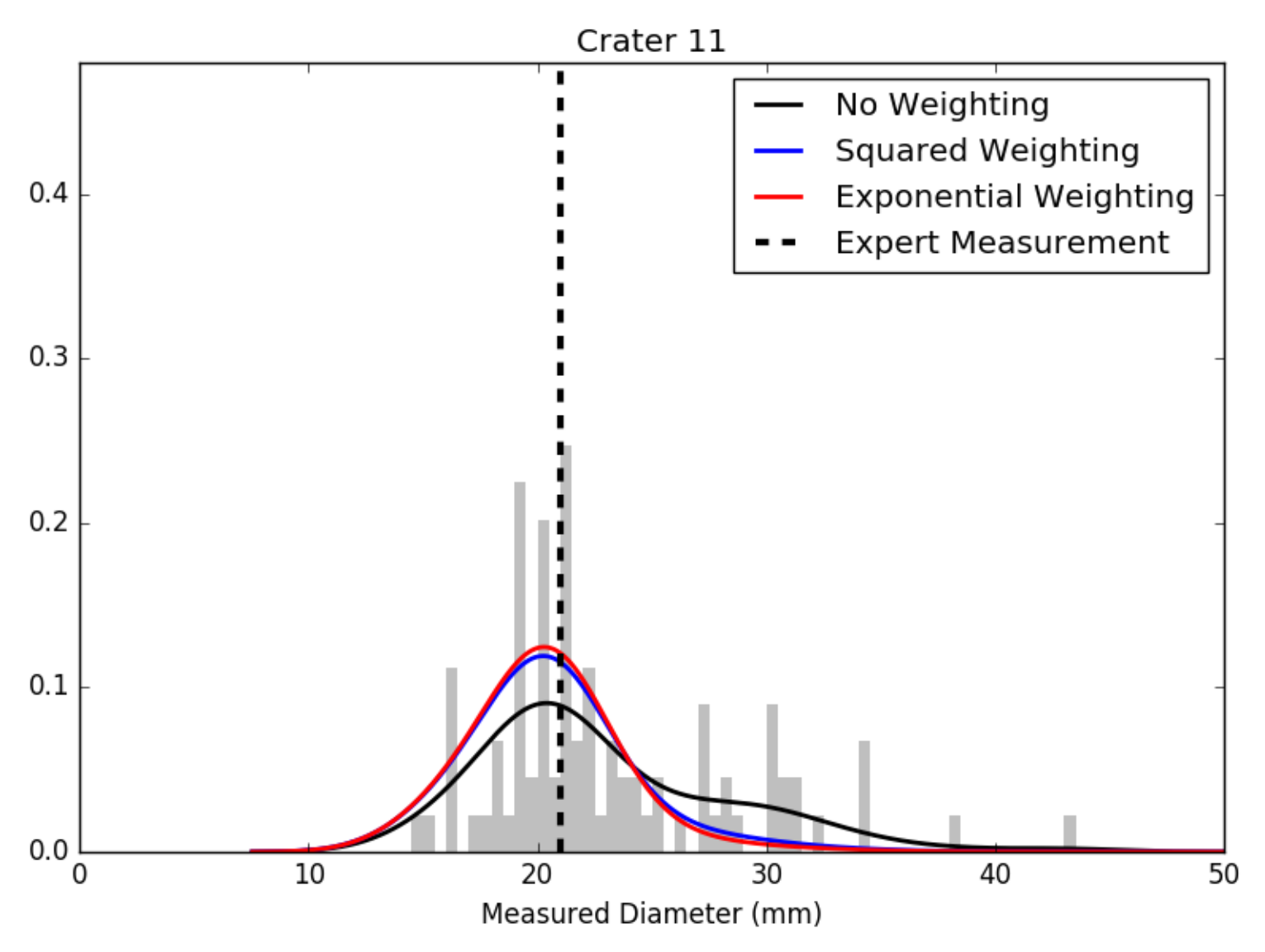
Measured Diameter (mm)


Crater 11
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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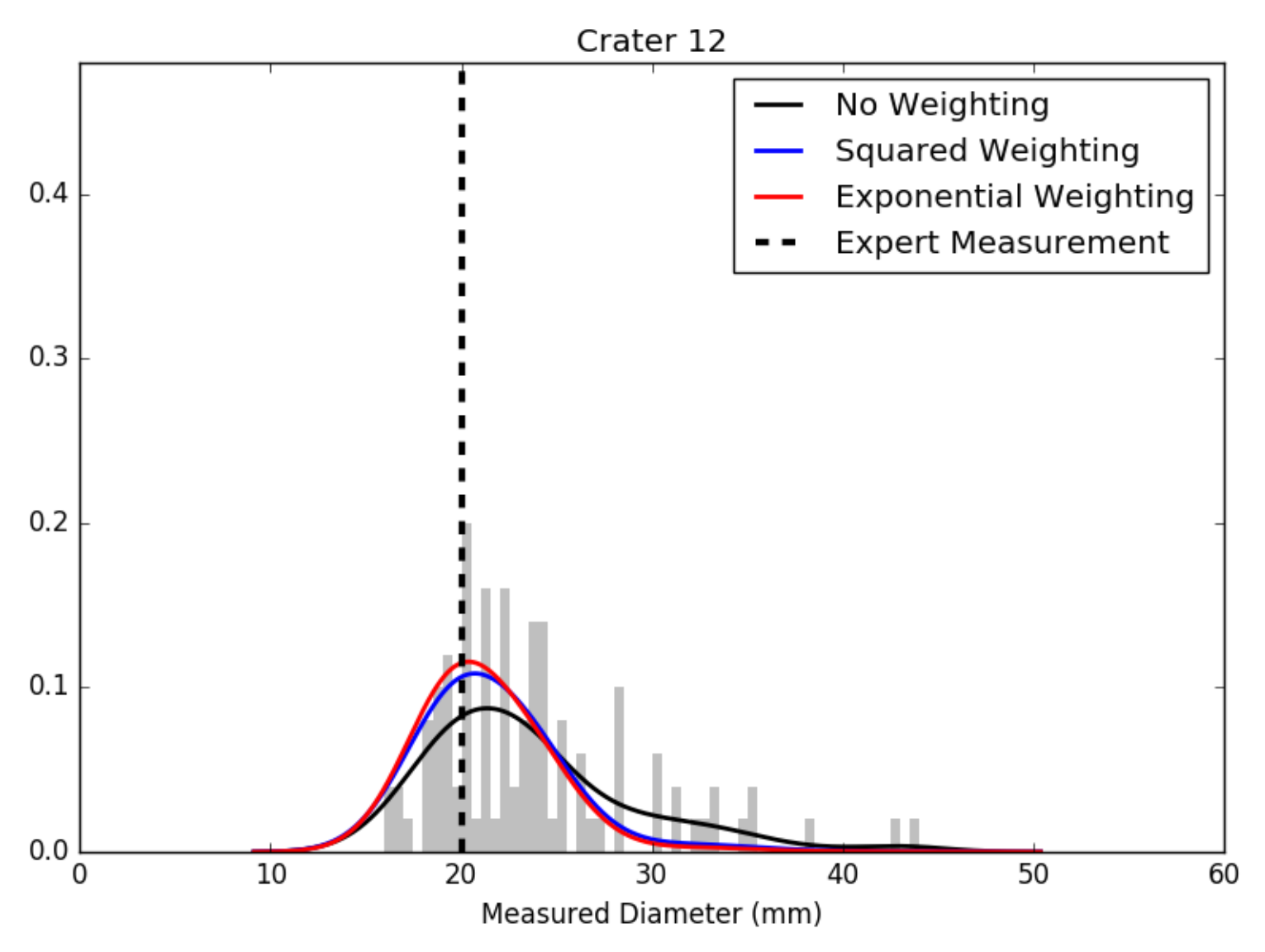
Measured Diameter (mm)


Crater 12
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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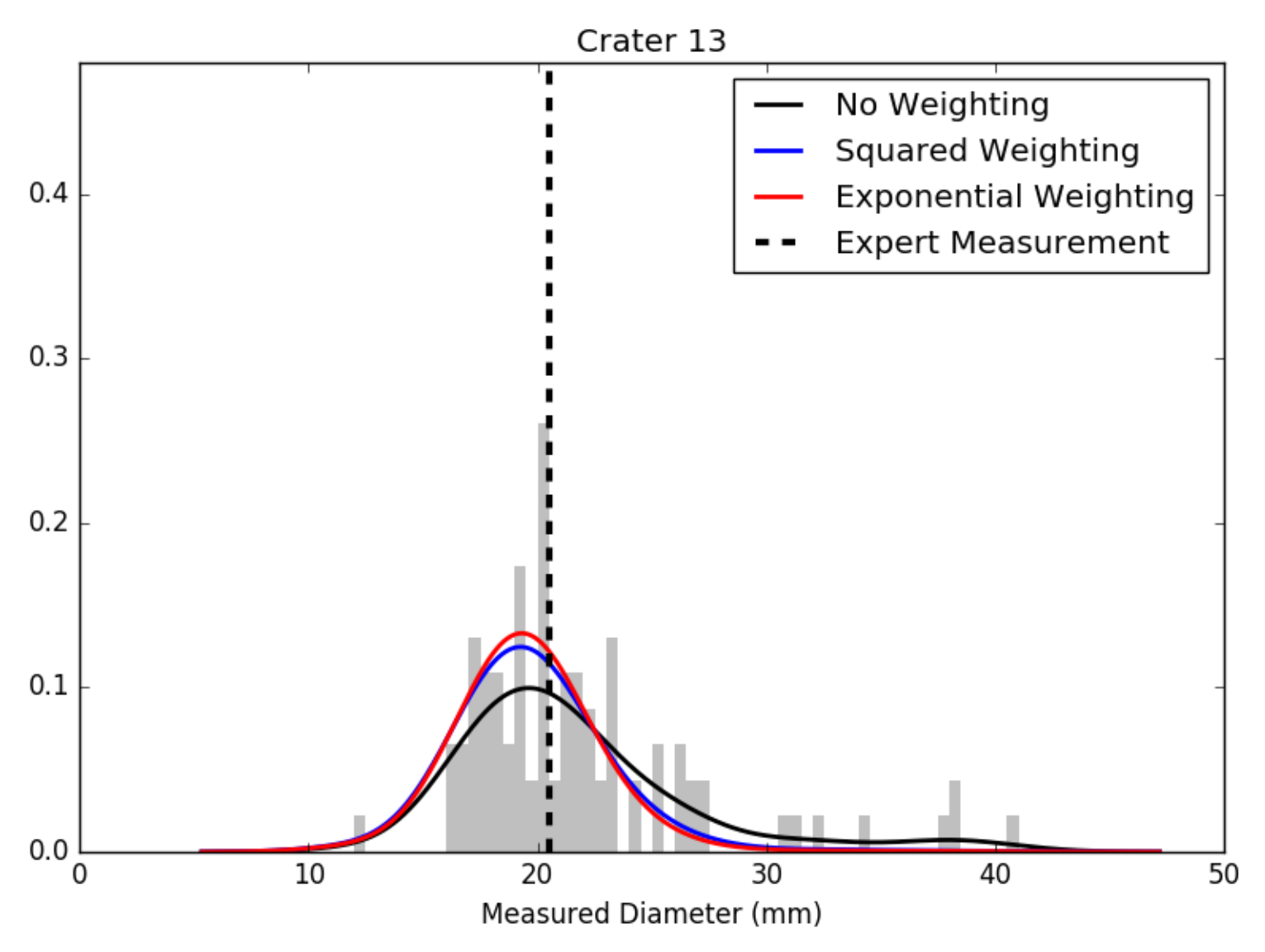
Measured Diameter (mm)


Crater 13
No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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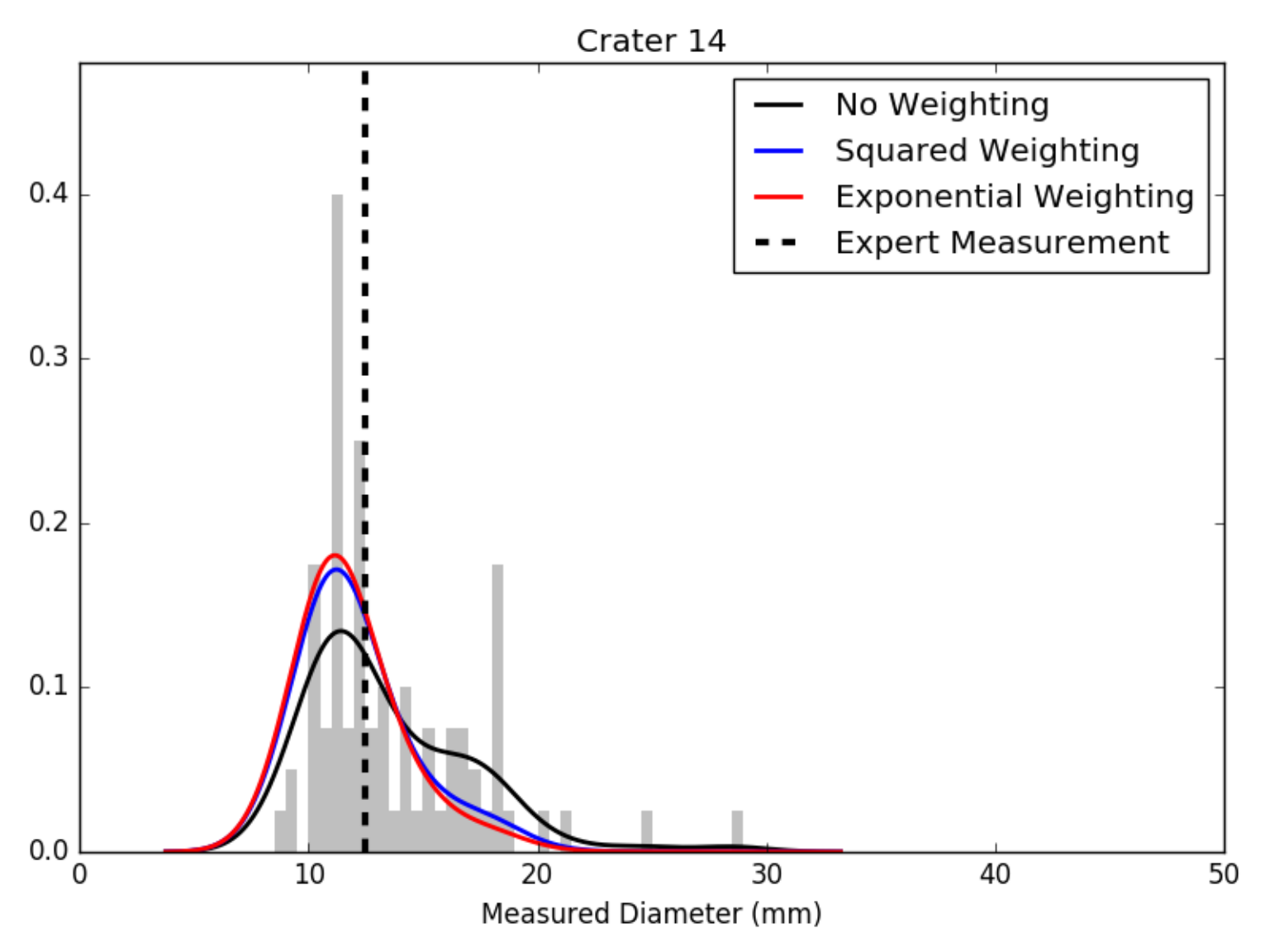
Measured Diameter (mm)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Exponential Weighting
Expert Measurement
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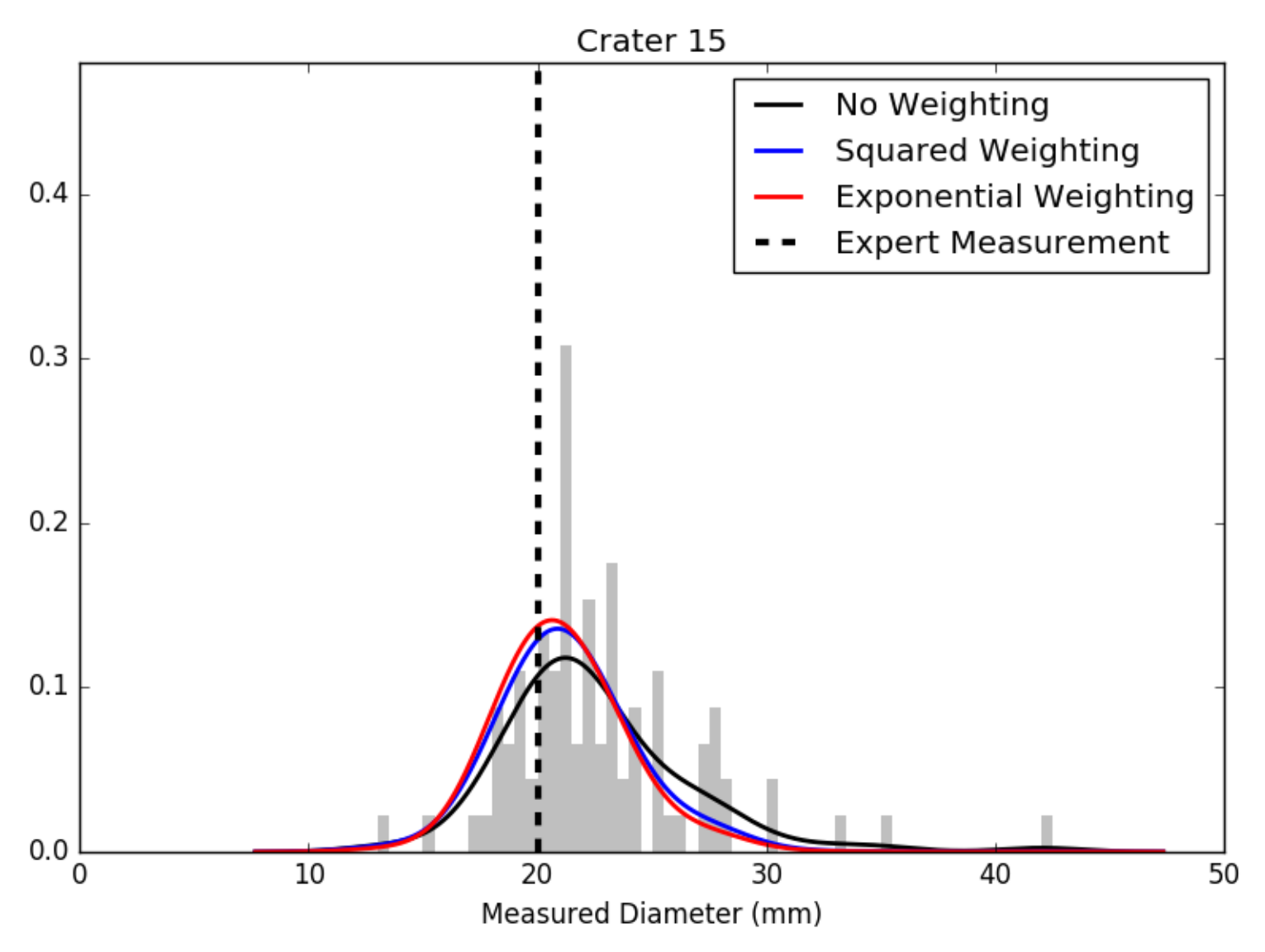
Measured Diameter (mm)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No Weighting
Squared Weighting
Exponential Weighting
Expert Measurement
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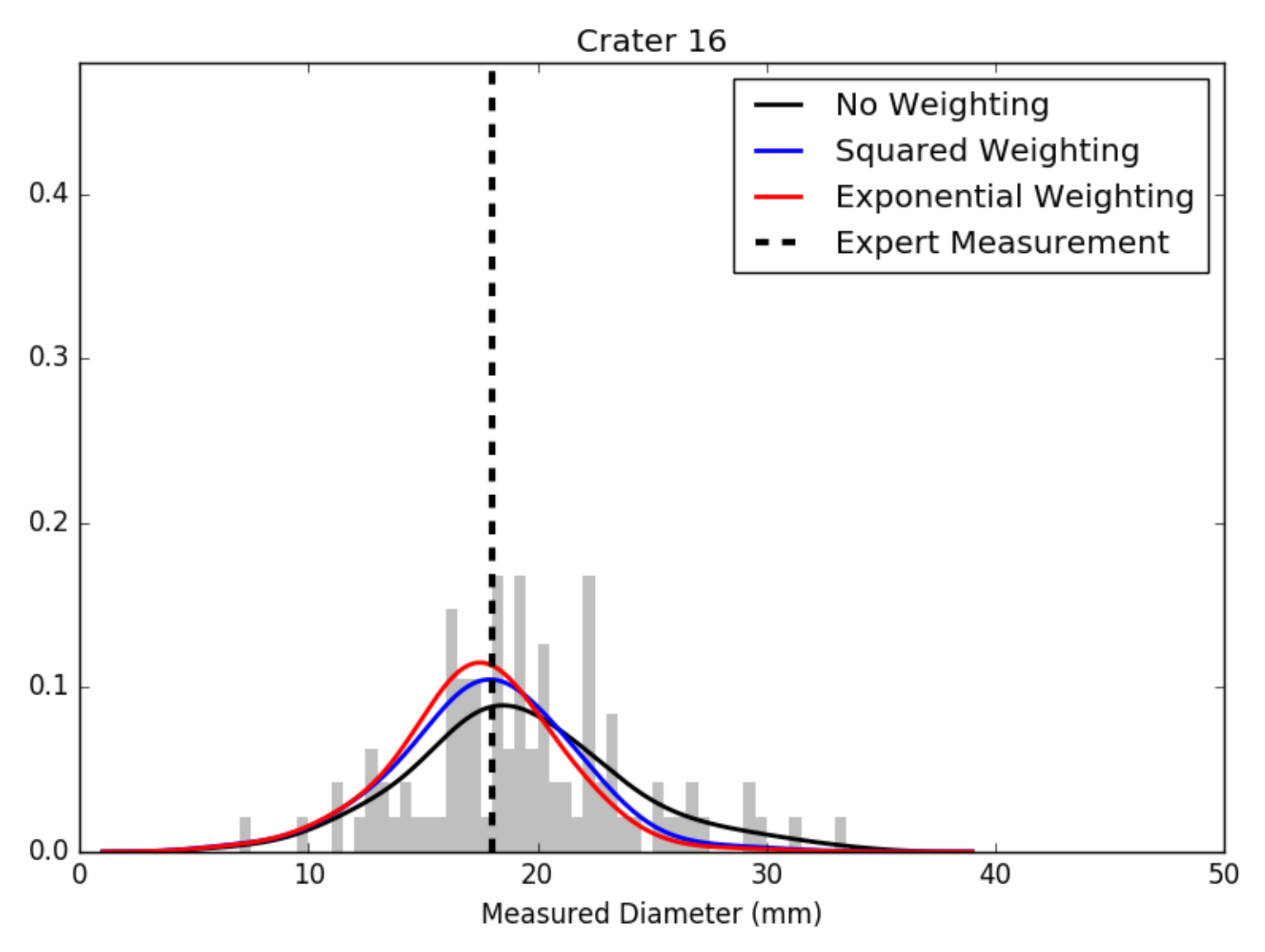
Measured Diameter (mm)


Crater 16
No Weighting
Squared Weighting
Exponential Weighting
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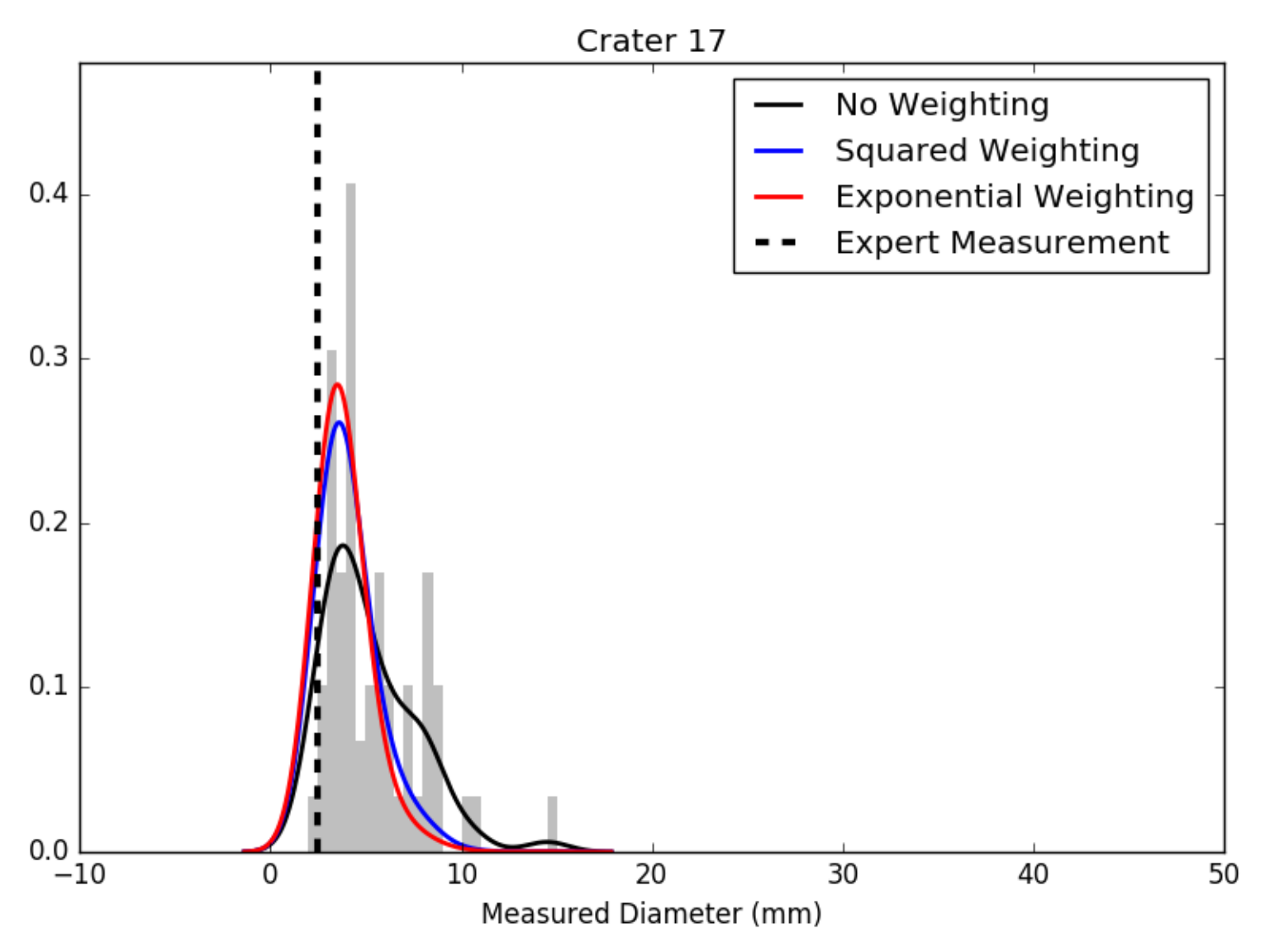
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Expert Measurement
0.4
0.3
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−10
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Measured Diameter (mm)