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| ***Techniques for Documenting with Proof or Supporting Evidence, and Related Strategies for Problem Solving***  **By David Alderoty © 2016**  **Chapter 23) Technique-22, Evidence Based on Measurements,**  **And Estimates of Magnitude, with Related Concepts**  [**This e-book presents 28 techniques for supporting the validity of the statements you write**](http://www.TechForText.com/DP/List)**.**  **Left click on the above for a list of the techniques**  **This chapter contains a little over 1,200 words**  **If you want to go to chapter 22, left click on the following link:**  [**www.TechForText.com/DP/chapter-22**](http://www.TechForText.com/DP/chapter-22)  **To contact the author use David@TechForText.com**  [**or left click for a website communication form**](http://www.david100.com/Mail)  **Table of Contents, and an Outline of this Chapter**  The following is a hyperlink table of contents, as well as an outline of this chapter. If you left click on a blue underlined heading, the corresponding topic or subtopic will appear on your computer screen. Alternatively, you can scroll down to access the material listed in the table of contents, because this chapter is on one long webpage.  [Topic 1.) Technique 22) Evidence Based on Measurements, and Estimates of Magnitude 3](#_Toc478283209)  [**Subtopic, What are the Measurements and/or Estimates of Magnitude that are Relevant to Your Writing Project?** 5](#_Toc478283210)  [**Subtopic: How to Find the Measurements You Need for a Writing Project** 7](#_Toc478283211)  [**Additional and Supporting Information for This chapter, from Web-Based Articles** 9](#_Toc478283212)  [**Additional and Supporting Information for This Chapter, from Web-Based Videos** 10](#_Toc478283213)  **This E-Book Provides Additional and Supporting Information from other Authors, with Web Links**  This e-book contains links to web-based articles and videos from other authors, for **additional, alternative, and supporting information.** The links are the blue underlined words, presented throughout this e-book. However, some of these links are to access different sections of this e-book, or material on my own websites.  Quotes and paraphrases in this e-book have hyperlinks to access the original source. The quotes are presented in brown text, which is the same color of these words. (The precise text color is RGB Decimal 165, 42, 42, or Hex #a52a2a)  Some of the web links in this e-book will probably fail eventually, because websites may be removed from the web, or placed on a new URL. If a link fails, use the blue underlined words as a search phrase, with [www.Google.com](http://www.google.com/) If the link is for a video, use [www.google.com/videohp](http://www.google.com/videohp) The search will usually bring up the original website, or one or more good alternatives. |

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| ***For those who prefer listening, as an alternative to reading, this book is recorded in an audio format.***  [***For an audio narration of this chapter, left click on these words (requires 10 minutes, and 59 seconds)***](P1.mp3)***.*** |

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| **Topic 1.) Technique 22) Evidence Based on Measurements, and Estimates of Magnitude**  |||  **Technique-22,** measurements, and estimates based on magnitude, include all of the following, based on the way the terminology is used in this topic:  **Measurements or estimates of length, width, height, volume, weight, mass, density, velocity, acceleration, force, energy, power, and time, EXAMPLE:** The above can involve supporting evidence in a business report, for the purchase of a heavy-duty tractor. This would involve physical dimensions of the tractor, as proof that it would fit in the available storage space. The horsepower of the tractor would be supporting evidence, that it is suitable for heavy-duty construction.  **Any type of statistical calculation or estimate that involve size, or magnitude, EXAMPLE:** This can involve statistical calculations or estimates of the size and distance of a star in another galaxy.  **Survey of a population, or a set of entities, EXAMPLE:** This can involve supporting evidence that predicts specific candidate will win an election, such as in a newspaper or magazine article.  **Any type of testing that involves numbers, such as test scores, a number rating scale, or grades that can be represented as numbers, EXAMPLE:** This can involve supporting evidence in a report, to admit a new student into a graduate program, based on the student’s grades and test scores.  **Measurements, calculations, or estimates involving probability, such as to evaluate risks, or the chances of a successful outcome, EXAMPLE:** This can involve supporting evidence in a safety report, which indicates the need for maintenance, or modification in industrial equipment, to reduce the risk of accidents. It can also involve supporting evidence for investments, based on estimates of financial gain.  **Calculations, or estimates of expenses, or cost of a project, EXAMPLE: This can** involve supporting evidence in a feasibility study that shows that the project is reasonable. It can also involve evidence showing that the project is excessively expensive.  **Estimates of financial gains or losses, EXAMPLE:** This can involve supporting evidence in a report, for investing in a new business, or supporting evidence for closing a business that appears to be failing.  **Subtopic, What are the Measurements and/or Estimates of Magnitude that are Relevant to Your Writing Project?**  |||  The following questions represent factors to consider when writing a document that might require measurements or estimates of magnitude.  **What should I measure, and/or what should I estimate?** This of course depends on the document your writing, or the problem or goal that you are dealing with. Measurements in the hard sciences often involve, acceleration, density, energy, force, frequency, mass, pH, power, temperature, time, velocity, viscosity, and wavelength. In the social sciences, measurements often involve statistical evaluations, such as survey results, behavioral and psychological test scores. For additional information see the following web-based sources:  [Measurements in Biology, The Metric System and Data Analysis](http://faculty.lacitycollege.edu/phommas/Measurements%20in%20Biology.pdf)  [The Physics Hypertextbook](http://physics.info/acceleration/)  [Measurements in Chemistry](http://www.vvc.edu/academic/chemistry/Unit%2001%20Lecture%20Fourth%20Edition%20Colored.pdf)  [Understanding Psychological Measurement](http://catalog.flatworldknowledge.com/bookhub/18?e=price_1.0-ch05_s01)  [Understanding Levels and Scales of Measurement](https://www.thoughtco.com/scales-of-measurement-3026571)  [MEASUREMENTS AND SOCIOLOGY](http://www.asanet.org/sites/default/files/savvy/images/asa/docs/pdf/1953%20Presidential%20Address%20(Samuel%20Stouffer).pdf)  **What system should I use to present my measurements and/or estimates of magnitude?** For example, this can involve the Metric System, which involves kilometers, meters, centimeters, kilograms, grams, and milligrams. Alternatively, it could involve the Imperial System, which involves miles, yards, feet, inches, pounds, and ounces. For additional information see the following:  [Base Units of the International System (SI)](https://www.unc.edu/~rowlett/units/sifundam.html)  [The International System](https://www.nist.gov/sites/default/files/documents/2016/12/07/sp330.pdf),  [Fundamentals of Physics/Physics and Measurement](https://en.wikibooks.org/wiki/Fundamentals_of_Physics/Physics_and_Measurement), and  [British Imperial System](https://www.britannica.com/science/British-Imperial-System)  [Measurement in the Social Sciences](https://www.nap.edu/read/13034/chapter/3)  [The Journal of Methods and Measurement in the Social Sciences](https://journals.uair.arizona.edu/index.php/jmmss)  [Measurement Scales in Social Science Research](http://simon.cs.vt.edu/SoSci/converted/Measurement/)  **How should measurements and estimates be displayed?** The data can be displayed in the text, in a separate table, and several other ways.  **How accurate is my measurements?** Measurements are never perfectly accurate, but it must be accurate enough for the specific document, problem, or goal. For example, if the measurements involve the space available for new furniture, plus or minus 0.25 inches would be adequate. However, if the measurements involve the creation of components to manufacture microscopes, 1/100 of an inch would be an inadequate level of precision. For additional information see the following:  [Measurement and Uncertainty Notes](https://www2.southeastern.edu/Academics/Faculty/rallain/plab194/error.html)  [Science NetLinks Estimation and Measurement](http://sciencenetlinks.com/lessons/estimation-and-measurement/)  [Measurements and Error Analysis](http://www.webassign.net/question_assets/unccolphysmechl1/measurements/manual.html)  [Percent Error Formula](http://astro.physics.uiowa.edu/ITU/glossary/percent-error-formula/)  **Subtopic: How to Find the Measurements You Need for a Writing Project**  |||  Often the writer has to rely on published sources for measurements. This is especially true in the hard sciences. [Google](http://www.Google.com) and [Bing](http://www.bing.com), are excellent search engines for obtaining answers to questions that involve measurement. See [www.Google.com](http://www.Google.com) and [www.bing.com](http://www.bing.com) Another good alternative is [Wolfram Alpha Computational Knowledge Engine](http://www.wolframalpha.com) the homepage of their website is at [www.wolframalpha.com](http://www.wolframalpha.com) The wolfram Alpha Engine is especially useful when you need precise answers that change with time. For example, Alpha Engine provided a precise answer to the following question: “How old is Donald Trump?” [From Wolfram Alpha: 70 years 9 months 8 days](https://www.wolframalpha.com/input/?i=%E2%80%9CHow+old+is+Donald+Trump%3F%E2%80%9D) Google provided:  [70 years June 14, 1946](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CHow+old+is+Donald+Trump?%E2%80%9D&*) The answer from Wolfram Alpha changes daily, and if you click on the above link, the answer will be different than the answer I obtained.  Presented below there are some examples of measurements obtained with web-based searches: You can click on the blue underlined words to obtain the source of the information.  Google: [What is the distance from the Earth to the sun?](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=What+is+the+distance+from+the+Earth+to+the+sun?&*) Answer 92.96 million mi  Bing: [Current distance from Earth to Sun is 92.6 million miles (149 million km, 0.99 au)](http://www.bing.com/search?q=What+is+the+distance+from+the+Earth+to+the+sun%3F&qs=n&form=QBLH&sp=-1&pq=what+is+the+distance+from+the+earth+to+the+sun%3F&sc=0-47&sk=&cvid=253528B692E443CF8726A2024848D610)  Google: [“How far is the Moon from the Earth”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CHow+far+is+the+Moon+from+the+Earth%E2%80%9D&*) Answer 238,900 mi  Google: [“How far is Mars from the Earth”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CHow+far+is+Mars+from+the+Earth%E2%80%9D&*) Answer 401 million km apart (249 million miles)  Bing: [“How far is Mars from the Earth”](http://www.bing.com/search?q=%E2%80%9CHow+far+is+Mars+from+the+Earth%E2%80%9D&qs=n&form=QBLH&sp=-1&pq=%E2%80%9Chow+far+is+mars+from+the+earth%E2%80%9D&sc=4-32&sk=&cvid=B325EA926DC6439FA76AE8E0A669A10C) Current: 204.8 million miles (329.5 million km)  Google: [How far is the nearest star from Earth?](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=How+far+is+the+nearest+star+from+Earth?&*) Answer 4.37 light years  Google: [What is the mass of the sun?](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%22What+is+the+mass+of+the+sun?%22&*) Answer 1.989 × 10^30 kg  Google: [What is the mass of the moon?](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=What+is+the+mass+of+the+moon?&*) Answer 7.34767309 × 1022 kilograms  Google: [“What is the mass of Mars”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CWhat+is+the+mass+of+Mars%E2%80%9D&*) Answer 6.39 × 10^23 kg  Bing: [“What is the mass of Mars”](https://www.bing.com/search?q=%E2%80%9CWhat%20is%20the%20mass%20of%20Mars%E2%80%9D&qs=n&form=QBRE&sp=-1&pq=%E2%80%9Cwhat%20is%20the%20mass%20of%20mars%E2%80%9D&sc=8-26&sk=&cvid=0298EB1E35F94D2DAA24BE8079DDFC6B) Mars has a mass of 6.4169 x 1023 kg  Google: [“What is the mass of the Earth”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CWhat+is+the+mass+of+the+Earth%E2%80%9D'&*) 5.972 × 10^24 kg  Google:[“How tall is the Statue of Liberty”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CHow+tall+is+the+Statue+of+Liberty%E2%80%9D&*) Answer 305′  Google:[“How tall is the Eiffel Tower”](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=%E2%80%9CHow+tall+is+the+Eiffel+Tower%E2%80%9D&*) Answer 984′  Google:[“What is the speed of light in water”](https://www.reference.com/science/speed-light-water-cc36399c646cfe33) Answer 225,000 km per second.  Bing: [“What is the speed of light in water”](https://www.reference.com/science/speed-light-water-cc36399c646cfe33) Answer approximately 225,000 km per second  **Additional and Supporting Information for This chapter, from Web-Based Articles**  |||  [Google search: Measurement and calculating the error](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=Measurement+and+calculating+the+error&*)  [Percent Error Equation Formula Calculator, Science, Chemistry, Physics, Biology, Math, Statistics, Experiments](http://www.percenterrorcalculator.com/)  [Uncertainty, Measurements, and Error Analysis](https://engineering.jhu.edu/ei/wp-content/uploads/sites/29/2014/01/Uncertainty-Measurements-and-Error-Analysis-PowerPoint-2015.pdf)  [Precision Measuring Tools](http://www.starrett.com/metrology/metrology-products/precision-measuring-tools)  [Percent Error Calculator](http://www.calculator.net/percent-error-calculator.html)  [Precision Measuring Tools](http://itdc.lbcc.edu/cps/machineTool/precisionTools/precisionToolsALT/precisionTools.htm)  [How To Calculate Percent Error](https://www.thoughtco.com/how-to-calculate-percent-error-609584)  [A Beginner's Guide, To Uncertainty of Measurement Stephanie Bell](https://www.wmo.int/pages/prog/gcos/documents/gruanmanuals/UK_NPL/mgpg11.pdf)  [Google search pages Risk measurement](https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1OPRA_enUS705US705&ion=1&espv=2&ie=UTF-8#q=Risk+measurement&*)  [Risk Measures](http://www.investopedia.com/terms/r/riskmeasures.asp)  [Risk Management vs. Risk Measurement](https://www.cfainstitute.org/learning/products/publications/ipmn/Pages/ipmn.v2011.n1.11.aspx)  **Additional and Supporting Information for This Chapter, from Web-Based Videos**  |||  [YouTube search pages: Measurement and calculation of error](https://www.youtube.com/results?search_query=Measurement+and+calculation+of+error)  [Standard Error of Measurement (part 1)](https://www.youtube.com/watch?v=PZDDWd-jUzM)  [Standard Error of Measurement (part 2)](https://www.youtube.com/watch?v=Nuxg-qoqPTw)  [Calculating Percent Error Example Problem, Shaun Kelly](https://www.youtube.com/watch?v=xqjCU-liA20)  [Percentage Error in Measurement, Peter Blake](https://www.youtube.com/watch?v=9zZUGJEzPCk)  [Error and Percent Error, Tyler DeWitt](https://www.youtube.com/watch?v=h--PfS3E9Ao)  [Converting distance measurements](https://www.youtube.com/watch?v=w7--f3Jf-vo)  [Measurement: History and Standards](https://www.youtube.com/watch?v=zC2Wivnq344)  [The Three Types of Risk Measures](https://www.youtube.com/watch?v=9uCj6AfkBGg)  [YouTube search pages Risk measurement](https://www.youtube.com/results?search_query=Risk+measurement)  **If you want to go to chapter 24 of this e-book, left click on the following link:**  [**www.TechForText.com/DP/chapter-24**](http://www.TechForText.com/DP/chapter-24) |