Grant's Tutoring

BASIC STATISTICS 1

Volume 2 of 2

September 2014 edition

Because the book is so large,
the entire Basic Statistics 1 course
has been split into two volumes.

Learn What You Need to Know
Know What You Need to Learn

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HOW TO USE THIS BOOK

I have broken the course up into lessons. Do note that the numbering of my lessons do not necessarily correspond to the numbering of the units in your course outline. Study each lesson until you can do all of my lecture problems from start to finish without any help. Then do the Practise Problems for that lesson. If you are able to solve all the Practise Problems I have given you, then you should have nothing to fear about your exams.

Although NOT ESSENTIAL, you may want to purchase the *Multiple-Choice Problems Set for Basic Statistical Analysis I (Stat 1000)* by Dr. Smiley Cheng. This book is now out of print, but copies may be available at The Book Store. The appendices of my book include complete step-by-step solutions for all the problems and exams in Cheng's book. Be sure to read the "Homework" section at the end of each lesson for important guidance on how to proceed in your studying.

You also need a good, but not expensive, scientific calculator. Any of the makes and models of calculators I discuss in Appendix A are adequate for this course. I give you more advice about calculators at the start of Lesson 1. **Appendix A in this book shows you how to use all major models of calculators.**

I have presented the course in what I consider to be the most logical order. Although my books are designed to follow the course syllabus, it is possible your prof will teach the course in a different order or omit a topic. It is also possible he/she will introduce a topic I do not cover. **Make sure you are attending your class regularly! Stay current with the material, and be aware of what topics are on your exam. Never forget, it is your prof that decides what will be on the exam, so pay attention.**

If you have any questions or difficulties while studying this book, or if you believe you have found a mistake, do not hesitate to contact me. My phone number and website are noted at the bottom of every page in this book. "Grant's Tutoring" is also in the phone book. **I welcome your input and questions.**

Wishing you much success,

Grant Skene

Owner of Grant's Tutoring and author of this book

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- Grant will send you extra study tips and questions of interest throughout the term.
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- If there are any changes in the course work or corrections to this book, you will be the first to know.
- You will also be alerted to upcoming exam prep seminars and other learning aids Grant offers.
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Four ways Grant can help you:

- **Grant's Study Books**

    - **Basic Statistics 1 (Stat 1000)**
    - **Basic Statistics 2 (Stat 2000)**
    - **Linear Algebra and Vector Geometry (Math 1300)**
    - **Matrices for Management (Math 1310)**
    - **Intro Calculus (Math 1500 or Math 1510)**
    - **Calculus for Management (Math 1520)**
    - **Calculus 2 (Math 1700 or 1710)**

  All these books are available at **UMSU Digital Copy Centre**, room 118 University Centre, University of Manitoba. **Grant's books can be purchased there all year round. You can also order a book from Grant directly.** Please allow one business day because the books are made-to-order.

- **Grant's One-Day Exam Prep Seminars**

  These are one-day, 12-hour marathons designed to explain and review all the key concepts in preparation for an upcoming midterm or final exam. Don't delay! Go to www.grantstutoring.com right now to see the date of the next seminar. A seminar is generally held one or two weeks before the exam, but don't risk missing it just because you didn't check the date well in advance. You can also reserve your place at the seminar online. You are not obligated to attend if you reserve a place. You only pay for the seminar if and when you arrive.

- **Grant's Weekly Tutoring Groups**

  This is for the student who wants extra motivation and help keeping on top of things throughout the course. Again, go to www.grantstutoring.com for more details on when the groups are and how they work.

- **Grant's Audio Lectures**

  For less than the cost of 2 hours of one-on-one tutoring, you can listen to over 40 hours of Grant teaching this book. Hear Grant work through examples, and offer that extra bit of explanation beyond the written word. Go to www.grantstutoring.com for more details.

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APPENDICES

SUMMARY OF KEY FORMULAS IN THIS COURSE

Lesson 1. sample standard deviation $= s = \sqrt{\dfrac{\sum\left(x_i - \bar{x}\right)^2}{n-1}}$

Lesson 2. correlation $= r = \dfrac{1}{n-1}\sum\left(\dfrac{x_i - \bar{x}}{s_x}\right)\left(\dfrac{y_i - \bar{y}}{s_y}\right) = \dfrac{\sum\left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)}{\left(n-1\right)s_x s_y}$

slope $= b = r\dfrac{s_y}{s_x}$ intercept $= a = \bar{y} - b\bar{x}$

Lesson 4. standardizing formula for X bell curves: $z = \dfrac{x - \mu}{\sigma}$

Lesson 5. $P\left(A \text{ or } B\right) = P\left(A\right) + P\left(B\right) - P\left(A \text{ and } B\right)$

If A and B are independent: $P\left(A \text{ and } B\right) = P\left(A\right) \times P\left(B\right)$

Lesson 6. If X has a binomial distribution with parameters n and p, then the mean of $X = \mu_X = np$ and the standard deviation of $X = \sigma_X = \sqrt{np\left(1-p\right)}$.

The mean of $\hat{p} = \mu_{\hat{p}} = p$ and the standard deviation $= \sigma_{\hat{p}} = \sqrt{\dfrac{p\left(1-p\right)}{n}}$.

Also, $P\left(X = k\right) = \binom{n}{k} p^k \left(1-p\right)^{n-k}$.

Lesson 7. The mean of $\bar{x} = \mu_{\bar{x}} = \mu$ and the standard deviation $= \sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$.

Central Limit Theorem: If n is large, $\bar{x}$ is approximately normal.

Standardizing formula for $\bar{x}$ bell curves: $z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

Lesson 8. Confidence Intervals for μ: $\bar{x} \pm z^* \dfrac{\sigma}{\sqrt{n}}$ or $\bar{x} \pm t^* \dfrac{s}{\sqrt{n}}$

Sample size determination: $n = \left(\dfrac{z^* \sigma}{m}\right)^2$

Lesson 9. Test statistics for μ: $z = \dfrac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$ or $t = \dfrac{\bar{x} - \mu_0}{s / \sqrt{n}}$

Lesson 11. Confidence interval for p: $\hat{p} \pm z^* \sqrt{\dfrac{\hat{p}\left(1-\hat{p}\right)}{n}}$

Sample size determination: $n = \left(\dfrac{z^*}{m}\right)^2 p^*\left(1-p^*\right)$

Test statistic for p: $z = \dfrac{\hat{p} - p_0}{\sqrt{\dfrac{p_0\left(1-p_0\right)}{n}}}$

STEPS FOR TESTING A HYPOTHESIS

Step 1. State the null and alternative hypotheses (H_0 and H_a), and so determine if the test is 2-tailed, upper-tailed, or lower-tailed.

Step 2. Use the given α (always use α = 5% if none is given) to get the **critical value (z^* or t^*)** from Table D and state the **rejection region**.

If the test is upper-tailed:	Reject H_0 if $z > z^*$ (or $t > t^*$)
If the test is lower-tailed:	Reject H_0 if $z < -z^*$ (or $t < -t^*$)
If the test is 2-tailed:	Reject H_0 if $z < -z^*$ or $z > z^*$ (or Reject H_0 if $t < -t^*$ or $t > t^*$)

Step 3. Compute the **test statistic (z or t)** using the appropriate formula, and see if it lies in the rejection region.

Test statistics: $z = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$ $t = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}}$ $z = \dfrac{\hat{p} - p_0}{\sqrt{\dfrac{p_0(1-p_0)}{n}}}$

Step 4. (Only if specifically asked to do so.) Compute the ***P*-value**.

Draw a bell curve, mark the test statistic (found in Step 3), and shade the area as instructed by H_a. That area is the *P*-value.

Remember, a *P*-value is very handy to know if you are asked to make decisions for more than one value of α.

Reject H_0 if *P*-value < α.

Step 5. State your conclusion.

Either: Reject H_0. There is statistically significant evidence that the alternative hypothesis is correct. (Replace the underlined part with appropriate wording from the problem that says H_a is correct.)

Or: Do not reject H_0. There is no statistically significant evidence that the alternative hypothesis is correct. (Replace the underlined part with appropriate wording from the problem that says we are not convinced that H_a is correct.)