

A Comparison of Textbook Prices between Richland's Bookstore and Online Textbook Stores

Summer 2000

A Project of Math 113
Introduction to Applied Statistics

James D Jones
Associate Professor of Mathematics

Students participating in project

Tiffany Beiler
Brian Blahnik
Tami Brown
Doug Childs
Tom Chumbley
Jill Hickerson
Jerry Hinkle
Julie Holthaus
Mandy Houdasheldt

Jenny Johnson
Sarah Knowles
Joy Krohne
Mary Lahniers
Heather Maines-Smith
Joshua Morrell
Jackie Olinger
Elena Rios
Brian Stewart

Textbook Prices

Introduction

Each semester, the Math 113, Introduction to Applied Statistics, course conducts a major statistical project. During the summer 2000 term, we analyzed new and used textbook prices at Richland's bookstore (College Bookstores of America) and nine online bookstores. Table 8 contains a list of the bookstores compared.

Forty-two courses were selected from the transfer area. They were subdivided by group requirement, although some groups didn't have enough courses alone and were combined for analysis purposes. The courses selected were chosen because they had the highest enrollments for each group requirement. Therefore, the forty-two courses chosen are some of the most populous courses offered during the summer 2000 term. Richland's group requirements, as used in the study, are listed in Table 9 and the courses that were selected are listed in Table 10.

I would like to thank the administrative assistants for preparing and providing us with a list of the textbooks used.

Data Collection

The data collected for each book at each bookstore included the list textbook price, new textbook price, and used textbook price (if available). A new variable, the best textbook price, was the smaller of the new and used textbook prices, that is, the best deal that the student could get at that store. Data was collected between June 6 and June 16, 2000.

There are several potential problems in the data collection process that could lead to error in the analysis.

Data was not collected as to whether the books were actually in stock or not. Some places listed prices for used textbooks, but the used textbooks weren't available. In particular, the Richland bookstore told our students that used textbooks are 75% of the new textbook price. One of the major complaints I hear from students is that there are no used books available at the bookstore. However, our students just multiplied the new price by 0.75 and obtained the used textbook

price for all books. Therefore, Richland's bookstore had more used textbook prices than any other store.

Another piece of data that could have been collected was the estimated shipping time. One of the major conveniences of the on-campus bookstore is that the textbooks are available immediately and there is no wait. Shipping times for the online bookstores could be as long as three weeks.

To make an honest comparison, the shipping prices of the online bookstores should have been computed and the sales tax added for the Richland bookstore and where appropriate on the Internet. This data was not collected or analyzed.

Some textbook stores also buy textbooks back. Data was not collected regarding this. Another common complaint about the Richland bookstore is that they don't buy all of the used textbooks back.

None of the analysis contained in this document uses the group requirement variable. It was determined that there weren't any major differences between the categories of books. This document is intended to show where the differences lie.

There are two major areas of statistics, descriptive and inferential. Descriptive statistics deals with describing data, while inferential statistics deals with making inferences from a smaller group (sample) to a larger group (population). The descriptive statistics will simply say "here are the results of our sample". No attempt is made to say what values are different or are "close enough" to be the same. That is inferential statistics.

The inferential statistics will look at the differences in the samples and see if the results are too unusual to happen by chance alone. That is, it will determine if the results we obtained are due to random sampling errors or if they are due to actual differences in the stores.

Descriptive Statistics

Table 1 summarizes the results. For each bookstore, the number and average price for the new, used (if available), and best textbook prices is shown.

The bookstores had most of the textbooks that we were using for the courses. They ranged from a low of 38 of the 42 (90.5%) textbooks at Classbooks.com and eFollett's to all 42 (100%) of the textbooks at Barnes & Noble.

Four stores, Amazon.com, Barnes & Noble, Fat Brain, and Varsity Books did not carry used textbooks at all. Of those that carried used books, the number of books available in used format ranged from a low of 20 (48.8%) at eCampus to 41 (100.0%) at Richland's bookstore¹.

The overall average cost of a textbook was \$52.4374. The average best textbook price at the stores ranged from a low of \$45.4583 at Richland to a high of \$61.1446 at Fat Brain.

Table 2 shows the results when the stores are ranked from cheapest to most expensive, based on the average textbook prices at each store. The first table, based on the best textbook price is probably the most useful since that is what students will be paying.

Table 3 shows the results when the best price of each textbook is ranked from cheapest (1) to most expensive (10) and then the mean rank of each store is found.

The difference between the two rankings is that Table 2, based on the mean of all the textbooks, may be influenced by individual textbooks that are significantly cheaper or more expensive than other stores. In Table 3, based on the mean rank, the affect of the extreme values have been eliminated. A store that ranks lower in Table 3 is generally somewhat cheaper on more textbooks, while a store than ranks lower in Table 2 is generally much cheaper on some textbooks.

¹Every textbook at Richland's bookstore was considered to have a used price, even if none was available. This is a potentially significant source of non-sampling error.

Inferential Statistics

One of the requirements of hypothesis testing and inferential statistics when testing means is that the values are either normally distributed or that the sample size is at least 31 so that the Central Limit Theorem applies and the means are approximately normally distributed. The number of textbooks was chosen so that the Central Limit Theorem would apply. Moreover, the results of a Kolmogorov Smirnov test performed on the new, used, and best textbook prices indicates that the data is essentially normally distributed.

The class answered several questions during the course of the semester based on the data.

Q1: Which bookstores have an average price significantly different than the overall average of \$52.4374?

The statistical results of the one sample t-test are shown in Table 4. The results are summarized here.

The one sample t-test tests the claim that the mean best textbook price of each store is equal to \$52.4374.

- The best textbook prices at Richland, eCampus, and eFollett are significantly cheaper than the grand mean of \$52.4734.
- The best textbook prices at Barnes & Noble and Fat Brain are significantly more expensive than the grand mean.
- The best textbook prices at Amazon.com, Big Words, Classbook.com, Textbooks.com, and Varsity Books are not significantly different than the grand mean.

A comparison was also ran against the overall mean of \$59.0030 for the new textbook prices and it was found that only eCampus was significantly cheaper on the new textbook prices with an average price \$8.8045 cheaper than the overall mean. This might suggest that if a student were to only purchase new books, they should consider eCampus.

The overall mean used textbook of \$47.9483 was also compared to each store. It was found that none of the bookstores that sell used textbooks differed significantly from that value.

Q2: Is the used textbook price significantly less than the new textbook price?

The statistical results of the paired samples t-test are shown in Table 5. The results are summarized here.

The paired samples t-test tests the claim that there is no difference between the new and used textbook prices.

- For each bookstore that carried used textbooks, the price of the used textbook was significantly less than the new price of the textbooks.
- The overall average used textbook is 80.24% of the new textbook price.
- The average percent of the new textbook price for used textbook prices ranged from a low of 74.72%² at Richland to 86.32% at Textbooks.com.

Amazon.com, Barnes & Noble, Fat Brain, and Varsity Books did not have any used textbooks. Therefore, they are not included in this question.

The students also analyzed the new and used textbook prices according to the six different categories of group requirements. Since the used price was significantly less than the new price for the stores as a whole, it is not surprising to learn that the same is also true for each group requirement category within the stores.

There was only one comparison that didn't yield significant differences, and that was in the Communications category at Big Words. The p-value there was 0.066, so there is no significant difference, but since a one-tailed p-value would be 0.033, we can still say that used books are significantly cheaper than new books.

The inferential statistics for the categorical analysis of differences in new and used prices is not included in the output.

²This is supposed to be 75% according to the students that collected the data. There must have been some miscalculations in the data that was entered. eFollett's is also 75.00%.

Q3: Are there significant differences in the new, used, and best textbook prices at the stores.

The statistical results of a one-way analysis of variance (ANOVA) are shown in Table 6. A means plot that graphically illustrates the differences in the means follows Table 6. The results are summarized here.

The ANOVA procedure tests the claim that the means of all the bookstores are equal to each other against the claim that at least one mean is different.

- There is no significant difference in the new³ or used textbook prices of the different bookstores.
- There is a significant difference in the best textbook price of the stores.

Post hoc tests were performed on the best textbook prices using the least significant differences (LSD) method to see where the differences lied. The comparisons that yielded significant differences at the 0.05 level of significance are shown in Table 7.

There were six groups of equal means, separated into two major groups.

- There is no significant difference in the best textbook price at Richland, eCampus, eFollett, Textbooks.com, Classbook.com, and Big Words.
- There is no significant difference in the best textbook price at Varsity Books, Amazon.com, Barnes & Noble, and Fat Brain.

Generally, the differences that existed were between stores that had used textbook prices and stores that didn't have used textbook prices. The stores that had used textbooks weren't significantly different in price and the ones that didn't have used textbooks weren't significantly different in price.

³When we compared stores individually to the overall mean new textbook price of \$59.0030, we found that eCampus was significantly cheaper, but here we find that there are no significant differences. While this sounds contradictory, it is due to a difference in the tests and what we're testing.

Table 1 - Summary Statistics

Bookstore		New Price	Used Price	Best Price
Richland	N	41	41	41
	Mean	60.8078	45.4383	45.4383
Amazon.com	N	39		39
	Mean	58.9115		58.9115
Barnes & Noble	N	42		42
	Mean	60.8707		60.8707
Big Words	N	40	40	40
	Mean	58.1205	49.4803	49.4685
Classbook.com	N	36	38	38
	Mean	64.5758	49.4108	49.4108
eCampus	N	41	20	41
	Mean	50.1985	48.3370	45.4917
eFollett	N	38	38	38
	Mean	61.8561	46.3918	46.3918
Fat Brain	N	41		41
	Mean	61.1446		61.1446
Textbooks.com	N	41	41	41
	Mean	56.6024	48.8610	48.8610
Varsity Books	N	41		41
	Mean	57.7585		57.7585
Total	N	400	218	402
	Mean	59.0030	47.9483	52.4374

Table 2 - Ranking of Stores by Average Textbook Price

Best Textbook Price

Store	Rank	Best Price
Richland	1	45.438
eCampus	2	45.492
eFollett	3	46.392
Textbooks.com	4	48.861
Classbook.com	5	49.411
Big Words	6	49.469
Varsity Books	7	57.759
Amazon.com	8	58.912
Barnes & Noble	9	60.871
Fat Brain	10	61.145

New Textbook Price

Store	Rank	New Price
eCampus	1	50.1985
Textbooks.com	2	56.6024
Varsity Books	3	57.7585
Big Words	4	58.1205
Amazon.com	5	58.9115
Richland	6	60.8078
Barnes & Noble	7	60.8707
Fat Brain	8	61.1446
eFollett	9	61.8561
Classbook.com	10	64.5758

Used Textbook Price

Store	Rank	Used Price
Richland	1	45.4383
eFollett	2	46.3918
eCampus	3	48.3370
Textbooks.com	4	48.8610
Classbook.com	5	49.4108
Big Words	6	49.4803

Table 3 - Ranking of Stores by Average Rank Per Textbook

Best Textbook Price

Store	Rank	Mean Rank
eFollett	1	2.71
Richland	2	2.76
Classbook.com	3	3.11
eCampus	4	3.22
Textbooks.com	5	4.68
Big Words	6	4.93
Varsity Books	7	6.88
Fat Brain	8	8.06
Amazon.com	9	8.23
Barnes & Noble	10	8.32

New Textbook Price

Store	Rank	Mean Rank
eCampus	1	1.27
Textbooks.com	2	3.04
Big Words	3	4.10
Varsity Books	4	4.12
Classbook.com	5	4.75
Amazon.com	6	6.81
Fat Brain	7	6.89
Barnes & Noble	8	7.24
eFollett	9	7.41
Richland	10	7.41

Used Textbook Price

Store	Rank	Mean Rank
eCampus	1	1.10
Richland	2	2.46
eFollett	3	2.50
Classbook.com	4	2.92
Textbooks.com	5	4.44
Big Words	6	4.55

Table 4 - One Sample T-Test

Comparison of mean best textbook price to overall mean of \$52.4374.

Bookstore	t	df	Sig.	Difference
Richland	-2.406	40	.021*	-6.9991
Amazon.com	1.602	38	.118	6.4741
Barnes & Noble	2.094	41	.043*	8.4333
Big Words	-.901	39	.373	-2.9689
Classbook.com	-1.119	37	.270	-3.0266
eCampus	-2.294	40	.027*	-6.9457
eFollett	-2.035	37	.049*	-6.0456
Fat Brain	2.144	40	.038*	8.7072
Textbooks.com	-1.185	40	.243	-3.5764
Varsity Books	1.370	40	.178	5.3211

* Difference is significant at 0.05 level of significance.

Table 5 - Paired Samples T-Test

Comparison of new and used textbook prices¹.

Bookstore	Mean ²	t	df	Sig.	% ³
Richland	15.3695	14.463	40	.000*	74.72%
Big Words	8.6403	11.848	39	.000*	85.13%
Classbook.com	13.5947	19.510	35	.000*	78.95%
eCampus	9.6490	16.105	19	.000*	83.36%
eFollett	15.4642	15.613	37	.000*	75.00%
Textbooks.com	7.7415	13.598	40	.000*	86.32%

* Difference is significant at 0.05 level of significance.

¹ Amazon.com, Barnes & Noble, Fat Brain, and Varsity Books did not have any used textbooks.

² The mean is the average difference between the new and used textbook prices.

³ The % indicates what percent of new textbook price that the used textbook price is. This is a weighted average. The overall percent is 80.24%

Table 6 - Analysis of Variance

Comparison of each store against the other stores.

	Sum of Squares	df	Mean Square	F	Sig.
New Price					
Between Groups	5404.968	9	600.552	1.028	.417
Within Groups	227879.291	390	584.306		
Total	233284.259	399			
Used Price					
Between Groups	562.689	9	62.521	.180	.996
Within Groups	72155.072	208	346.899		
Total	72717.760	217			
Best Price					
Between Groups	15491.466	9	1721.274	3.600	.000*
Within Groups	187441.043	392	478.166		
Total	202932.510	401			

* Differences are significant at the 0.05 level of significance.

The means plot shows the average best textbook prices of the stores as a line plot.

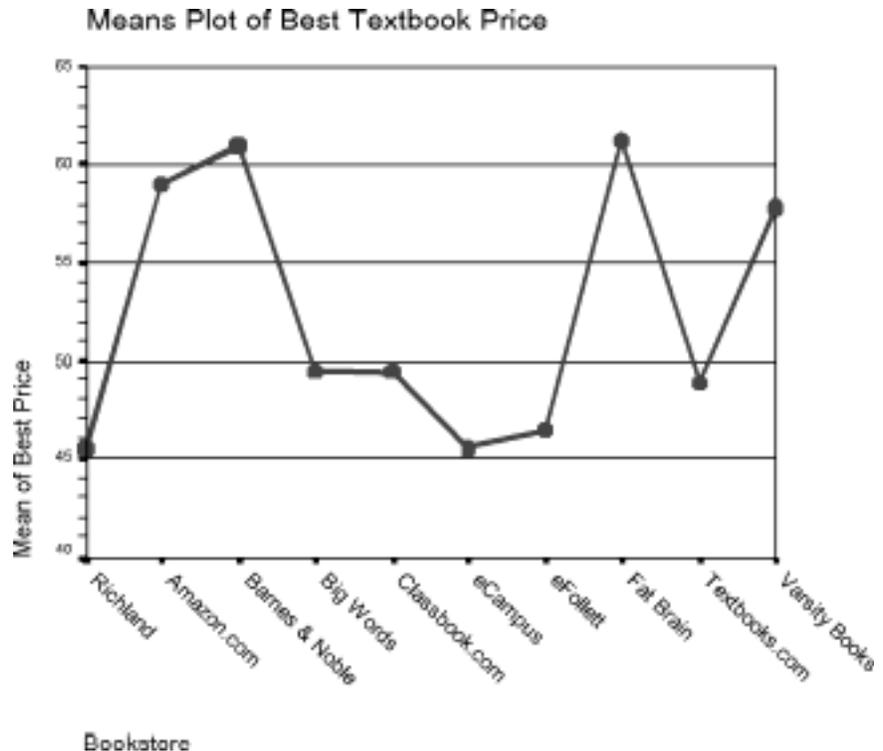


Table 7 - Post Hoc Comparisons
Comparison of individual stores.

Only those stores that have significantly different best textbook prices are shown below.

	Difference¹	Sig.		Difference¹	Sig.
Amazon.com			Fat Brain		
eCampus	13.4198	0.006	Big Words	11.6761	0.017
eFollett	12.5197	0.012	Classbook.com	11.7338	0.018
Richland	13.4732	0.006	eCampus	15.6529	0.001
Textbooks.com	10.0506	0.041	eFollett	14.7528	0.003
Barnes & Noble			Richland	15.7063	0.001
Big Words	11.4022	0.019	Textbooks.com	12.2837	0.011
Classbook.com	11.4599	0.020	Richland		
eCampus	15.3790	0.001	Amazon.com	-13.4732	0.006
eFollett	14.4789	0.003	Barnes & Noble	-15.4324	0.001
Richland	15.4324	0.001	Fat Brain	-15.7063	0.001
Textbooks.com	12.0097	0.013	Varsity Books	-12.3202	0.011
Big Words			Textbooks.com		
Barnes & Noble	-11.4022	0.019	Amazon.com	-10.0506	0.041
Fat Brain	-11.6761	0.017	Barnes & Noble	-12.0097	0.013
Classbook.com			Fat Brain	-12.2837	0.011
Barnes & Noble	-11.4599	0.020	Varsity Books		
Fat Brain	-11.7338	0.018	eCampus	12.2668	0.011
eCampus			eFollett	11.3667	0.021
Amazon.com	-13.4198	0.006	Richland	12.3202	0.011
Barnes & Noble	-15.3790	0.001			
Fat Brain	-15.6529	0.001			
Varsity Books	-12.2668	0.011			
eFollett					
Amazon.com	-12.5197	0.012			
Barnes & Noble	-14.4789	0.003			
Fat Brain	-14.7528	0.003			
Varsity Books	-11.3667	0.021			

¹ A positive difference indicates that the primary store (in bold) is more expensive than the secondary (indented) store. A negative difference means the primary store is less expensive than the secondary store.

Table 8 - List of Bookstores

College Bookstores of America - Richland Bookstore *

Amazon.com - <http://www.amazon.com/>

Barnes & Noble - <http://www.bn.com/>

Big Words - <http://www.bigwords.com/> *

Classbook.com - <http://www.classbook.com/> *

eCampus - <http://www.ecampus.com/> *

eFollett - <http://www.efollett.com/> *

Fat Brain - <http://www.fatbrain.com/>

Textbooks.com - <http://www.textbooks.com/> *

Varsity Books - <http://www.varsitybooks.com/>

* Bookstore carries used textbooks.

Table 9 - List of Group Requirement Categories

Business

Communications

Humanities / Fine Arts

Mathematics

Natural / Life / Physical Sciences

Social Sciences

Table 10 - List of Courses

cis 110	spch 101	engl 115	easci210	econ 231
cis 105	engl 101	af am101	biol 201	socio200
bus 100	engl 102	hist 202	biol 202	psych150
acct 101	engl 110	math 116	biol 220	hist 102
bus 110	human100	math 113	biol 210	psych280
cis 251	music100	math 117	phy s105	econ 232
ot 102	engl 124	math 121	psych110	
cis 285	art 100	math 160	pol s110	
bus 231	hist 112	chem 100	socio110	