

IMPROVING QUANTITATIVE LITERACY

Dr. Dona V. Boccio
Queensborough Community College
56th Ave and Springfield Blvd.
Bayside, NY 11364

INTRODUCTION

Improvement of quantitative reasoning skills is an issue at the forefront of mathematics education, both at the undergraduate level and in K-12. The term "quantitative literacy" can be used to describe facility with data analysis, understanding of statistics, or ability to determine the mathematical operations that must be performed to solve verbally-described problems.

The National Adult Literacy Survey, sponsored by the U.S. Department of Education, was conducted in 1992 by the Educational Testing Service and published in September, 1993. The survey used three scales of literacy: prose, document, and quantitative. Quantitative literacy was defined as "the knowledge and skills required to apply arithmetic operations, either alone or sequentially, using numbers embedded in printed materials." [1]

This paper addresses methods by which two-year college faculty can improve quantitative literacy. In my talk, the results of the National Adult Literacy Survey will be summarized. I will then present numerous examples that I have used in my classes to enrich the curriculum and improve both mathematical and reading skills.

LOCATING SUPPLEMENTAL MATERIAL

Textbooks can be supplemented by a wealth of "real-world" examples obtained from newspaper articles, graphs, magazines, advertisements, product labels, financial statements, income tax forms, and other sources. Rather than changing the source material, it is preferable to choose examples carefully to be appropriate to the level of the course.

Extraneous information is almost always present when formulating practical problems, while most textbook applications usually contain none. Omitting nonessential data not only diminishes the authenticity of the problem; it defeats the purpose of using the actual source material to help develop both reading and reasoning skills.

DEVELOPING MATERIAL FOR CLASSROOM USE

When appropriate material is found, several methods of analysis may be possible. A variety of approaches may be discovered, in addition to those that are initially presented.

Examples are presented below, each suitable for different level courses.

Example 1

The following excerpt is from an article in the New York Times on February 28, 1993, entitled "The Latest Pitch: 1040PC and the Promise of a Speedy Refund" [2].

"For 1991, according to the I.R.S., 17 million returns had errors. Of those, the agency sampled 42,000 for close study. More than 30,000 had taxpayer errors, ranging from entering information on the wrong line to subtracting or multiplying wrong. There were also 25,000 I.R.S. errors. (The total comes to more than 42,000 because some returns showed both kinds of errors.)"

After the students have read this, they are asked to consider the following questions:

1. How many tax returns had both taxpayer and IRS errors?
2. How many tax returns had only taxpayer errors?
3. How many tax returns had only IRS errors?

If Venn diagrams have been recently introduced, most students will choose this method to solve the problem (Solution I). Alternately, a system of equations could be utilized (Solution II).

Solution I:

Let T = set of tax returns with taxpayer errors

Let I = set of tax returns with IRS errors

Given: $n(T \cup I) = 42,000$ $n(T) = 30,000$ $n(I) = 25,000$

Find: $n(T \cap I)$
 $n(T \cap I')$
 $n(I \cap T')$

Solution II:

Let x = the number of returns with only taxpayer errors

Let y = the number of returns with only IRS errors

Let z = the number of returns with both taxpayer and IRS errors

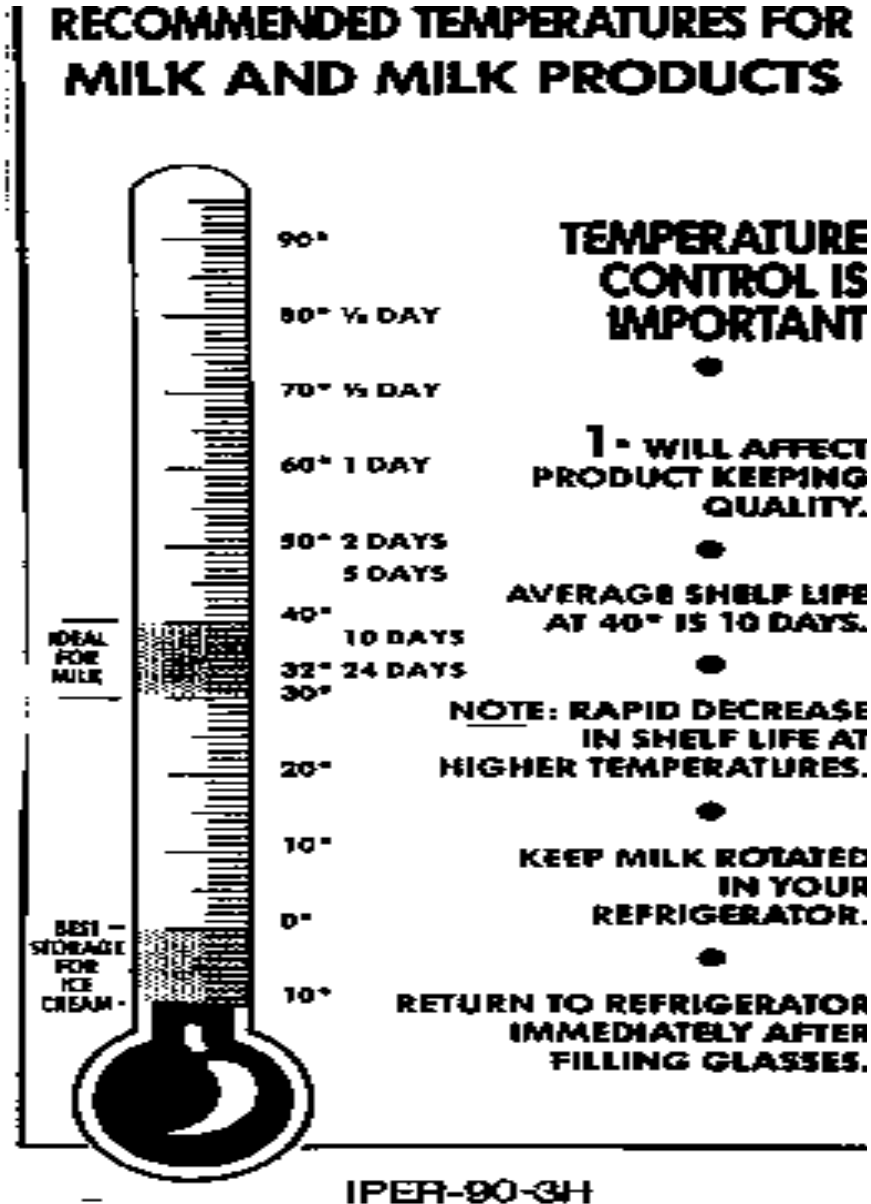
Then $x + y + z = 42,000$
 $x + z = 30,000$
 $y + z = 25,000$

Solve by elimination, substitution, Cramer's Rule, etc.

Example 2

The illustration below was found on a milk carton. The graphing problem stated here may be appropriate for an elementary algebra class; the resulting exponential curve can be examined in more detail in an intermediate algebra or pre-calculus class.

Graph the data given on the side of the milk carton. Use temperature, in degrees Fahrenheit, on the horizontal axis, and average shelf life, in days, on the vertical axis.



Example 3

Many newspapers publish exchange rates for foreign currencies. Students can be directed to refer to an appropriate table or chart to answer the following questions:

As of yesterday:

1. How much was \$10 equivalent to in French francs? How much was \$100 equivalent to in French francs?
2. How much was \$50 equivalent to in Canadian dollars?
3. How much was 100 British pounds equivalent to in US dollars?
4. How much was 352 Japanese yen equivalent to in US dollars?

Example 4

The following three assignments require the same arithmetic operation to be performed. However, Assignment III also necessitates that the student be capable of extracting the relevant information from the printed material.

I. Multiply 60 by 3.1

II. A can of tuna fish contains 3.1 servings. Each serving contains 60 calories. How many calories does the contents of the entire can contain?

III. Read the Nutrition Facts on the tuna fish can label below. How many calories does the contents of the entire can contain?



The image shows a Nutrition Facts label for tuna fish. The label is rectangular with a white background and black text. It is divided into two columns of nutrient information. The left column lists Total Fat, Sat. Fat, Cholest., Sodium, and Protein. The right column lists Total Carb., Fiber, Sugars, and Protein. Below the nutrient list, there are two rows of vitamins and minerals: Vitamin A, Vitamin C, Calcium, Iron, Magnesium, Vitamin B6, Vitamin B-12, and Phosphorus. The label also includes a 'Nutrition Facts' header, a serving size of 2.5 oz (drained), and a calorie count of 70 per serving.

Amount / serving	%DV*	Amount / serving	%DV*
Total Fat 1g	2%	Total Carb. 0g	0%
Sat. Fat 0g	0%	Fiber 0g	0%
Cholest. 25mg	8%	Sugars 0g	0%
Sodium 250mg	10%	Protein 15g	27%
*Percent Daily Values (DV) are based on a 2,000 calorie diet.			
Vitamin A 8% • Vitamin C 0% • Calcium 0% • Iron 0%			
Magn 2% • Vitamin B6 10% • Vitamin B-12 15% • Phosphorus 10%			

Example 5

Here is another set of three assignments that require the same arithmetic operation to be performed. Assignment III necessitates that the student be capable of extracting the relevant information from the printed material.

I. Perform the following subtraction: 5:44 p.m. - 5:23 p.m.

II. The 4:54 p.m. train from Bayside arrives in New York at 5:23 p.m. The 5:17 p.m. train from Bayside arrives in New York at 5:44 p.m. How much later does the 5:17 p.m. train arrive in New York than the 4:54 p.m. train?

III. Use the train schedule to answer the following question:

How much later does the 5:17 p.m. train from Bayside arrive in New York than the 4:54 p.m. train?

FROM NEW YORK AND WOODSIDE							
MONDAY TO FRIDAY, EXCEPT HOLIDAYS							
Leave				Arrive			
New York	Woodside	Flushing	Auburn Dale	Bayside	Doughlaston	Little Neck	
AM	AM	AM	AM	AM	AM	AM	AM
12:19	12:30	12:37	12:43	12:45	12:48	12:50	
1:19	1:30	1:37	1:43	1:45	1:48	1:50	
3:19	3:30	3:37	3:43	3:45	3:48	3:50	
5:19	5:30	5:37	5:43	5:45	5:48	5:50	
6:31	6:42	6:49	6:55	6:57	6:59	7:01	
7:01	7:12	7:20		7:25	7:27	7:30	
7:53	8:05	8:13	8:20	8:22	8:26	8:28	
8:23	8:34	8:41	8:47	8:49	8:52	8:54	
8:50	9:01	9:08	9:14	9:16	9:19	9:21	
9:19	9:30	9:37	9:43	9:45	9:48	9:50	
10:19	10:30	10:37	10:43	10:45	10:48	10:50	
11:19	11:30	11:37	11:43	11:45	11:48	11:50	
12:19	12:30	12:37	12:43	12:45	12:48	12:50	
1:19	1:30	1:37	1:43	1:45	1:48	1:50	
2:19	2:30	2:37	2:43	2:45	2:48	2:50	
3:19	3:30	3:37	3:43	3:45	3:48	3:50	
3:49	4:00	4:07	4:13	4:16	4:19	4:21	
4:25	4:36	4:43	4:50	4:53	4:56	4:58	
4:59	5:10	5:17	5:24	5:27	5:30	5:32	
5:03							
5:11							
5:27	5:40	5:47	5:54	5:58	6:01	6:02	
5:50							
5:55	6:07	6:14	6:21	6:23	6:26	6:28	
6:14	6:25	6:32	6:38	6:41	6:44	6:46	
6:27							
6:45	7:01	7:08	7:14	7:17	7:20	7:22	
7:19	7:30	7:37	7:43	7:45	7:48	7:50	
7:49	8:00	8:07	8:13	8:15	8:18	8:20	
8:19	8:30	8:37	8:43	8:45	8:48	8:50	
8:49	9:00	9:07	9:13	9:15	9:18	9:20	
9:19	9:30	9:37	9:43	9:45	9:48	9:50	
9:49	10:00	10:07	10:13	10:15	10:18	10:20	
10:19	10:30	10:37	10:43	10:45	10:48	10:50	
10:49	11:00	11:07	11:13	11:15	11:18	11:20	
11:19	11:30	11:37	11:43	11:45	11:48	11:50	
11:49	12:00	12:07	12:13	12:15	12:18	12:20	
PM	AM	AM	AM	AM	AM	AM	

TO WOODSIDE AND NEW YORK							
MONDAY TO FRIDAY, EXCEPT HOLIDAYS							
Leave				Arrive			
Little Neck	Doughlaston	Bayside	Auburn Dale	Flushing	Woodside	New York	
AM	AM	AM	AM	AM	AM	AM	AM
12:51	12:53	12:56	12:59	1:05	1:13	1:23	
1:51	1:53	1:56	1:59	2:05	2:12	2:23	
3:51	3:53	3:56	3:59	4:05	4:12	4:23	
5:51	5:53	5:56	5:59	6:05	6:12	6:23	
6:48	6:50	6:53	6:56	7:02	7:09	7:19	
6:35	6:37	6:40	6:43	6:49	6:56	7:06	
6:43	6:45	6:48	6:51	6:57	7:04	7:14	
		7:02		7:08	7:15	7:25	
7:23	7:25	7:28	7:31	7:37	7:44	7:54	
7:53	7:55	7:58	8:01	8:07	8:14	8:24	
8:00	8:11	8:15	8:18	8:24	8:31	8:41	
8:31	8:34	8:37	8:40	8:46	8:53	9:03	
8:41	8:43	8:46	8:49	8:55	9:02	9:12	
8:51	8:53	8:56	8:59	9:05	9:12	9:22	
9:01	9:03	9:06	9:09	9:15	9:22	9:32	
9:11	9:13	9:16	9:19	9:25	9:32	9:42	
9:21	9:23	9:26	9:29	9:35	9:42	9:52	
9:31	9:33	9:36	9:39	9:45	9:52	10:02	
9:41	9:43	9:46	9:49	9:55	10:02	10:12	
9:51	9:53	9:56	9:59	10:05	10:12	10:22	
10:01	10:03	10:06	10:09	10:15	10:22	10:32	
10:11	10:13	10:16	10:19	10:25	10:32	10:42	
10:21	10:23	10:26	10:29	10:35	10:42	10:52	
10:31	10:33	10:36	10:39	10:45	10:52	11:02	
10:41	10:43	10:46	10:49	10:55	11:02	11:12	
10:51	10:53	10:56	10:59	11:05	11:12	11:22	
PM	PM	PM	PM	PM	AM	AM	

SATURDAY, SUNDAY & HOLIDAYS							
AM	AM	AM	AM	AM	AM	AM	AM
12:20	12:30	12:37	12:43	12:46	12:49	12:51	
1:20	1:30	1:37	1:43	1:46	1:49	1:51	
3:20	3:30	3:37	3:43	3:46	3:49	3:51	
5:20	5:30	5:37	5:44	5:46	5:49	5:51	
6:20	6:30	6:37	6:44	6:46	6:49	6:51	
7:20	7:30	7:37	7:44	7:46	7:49	7:51	
8:20	8:30	8:37	8:44	8:46	8:49	8:51	
9:20	9:30	9:37	9:44	9:46	9:49	9:51	
10:20	10:30	10:37	10:44	10:46	10:49	10:51	
11:20	11:30	11:37	11:44	11:46	11:49	11:51	
12:20	12:30	12:37	12:44	12:46	12:49	12:51	
1:20	1:30	1:37	1:44	1:46	1:49	1:51	
2:20	2:30	2:37	2:44	2:46	2:49	2:51	
3:20	3:30	3:37	3:44	3:46	3:49	3:51	
4:20	4:30	4:37	4:44	4:46	4:49	4:51	
5:20	5:30	5:37	5:44	5:46	5:49	5:51	
6:20	6:30	6:37	6:44	6:46	6:49	6:51	
7:20	7:30	7:37	7:44	7:46	7:49	7:51	
8:20	8:30	8:37	8:44	8:46	8:49	8:51	
9:20	9:30	9:37	9:44	9:46	9:49	9:51	
10:20	10:30	10:37	10:44	10:46	10:49	10:51	
11:20	11:30	11:37	11:44	11:46	11:49	11:51	
PM	PM	PM	PM	PM	PM	PM	

CONCLUSION

Presenting source material in its original form, with carefully worded questions, can aid students in acquiring mathematics, reading, and reasoning skills. Instructors can find appropriate problems from newspapers, product labels, and many other everyday materials.

REFERENCES

1. Kirsch, I., Jungeblut, A., Jenkins, L. and Kolstad, A. *Adult Literacy in America*. Wash., DC: U.S. Govt. Printing Office, Sept. 1993.
2. Wald, Matthew. The Latest Pitch: 1040PC and the Promise of a Speedy Refund, *The New York Times*, Feb. 28, 1993, Section F, p.17.