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AUTHOR Wallace, Johnny M.; Powell, Mike
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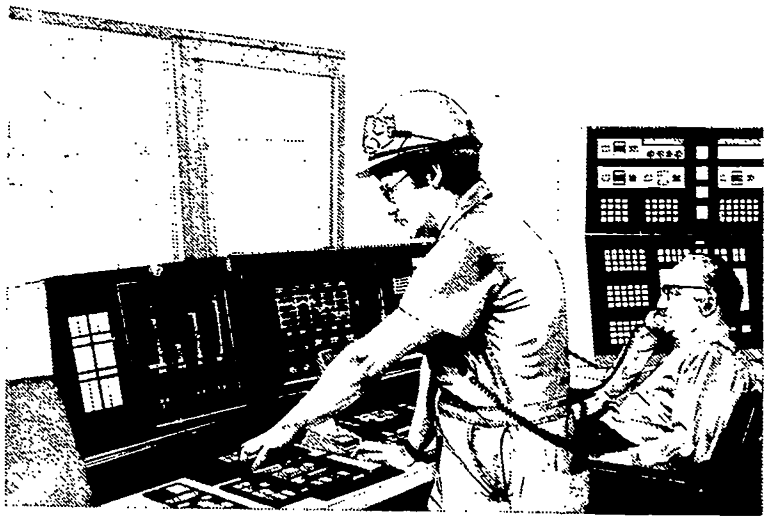
ABSTRACT

This module presents a real-world context in which mathematics skills are used as part of a daily routine. The context is the textile production area of machine operations, and the module aims to help students understand the significance of mathematics skills in interpreting charts and graphs. Materials in the module, most of which are designed for the teacher to duplicate and distribute to students, include the following: (1) information on careers as textile machine operators; (2) a task to be performed with a handout sheet needed for the task; and (3) questions for analysis, related problems, and a teacher's answer key. (KC)

MATHEMATICS FOR THE WORKPLACE



APPLICATIONS FROM TEXTILE MANUFACTURING

(Milliken & Company, Peerless Plant)

A TEACHER'S GUIDE

Developed by:

Mr. Johnny M. Wallace
Associate Director / Curriculum Developer
Partnership for Academic and Career Education

and

Mr. Mike Powell
Personnel Manager
Milliken & Company, Peerless Plant

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Partnership for Academic and Career Education (PACE)
P. O. Box 587
Pendleton, SC 29670
(803-646-8361, ext. 2247)

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Introduction

The workplace of tomorrow will require a level of skills beyond the twelfth grade. Technological advances have necessitated higher levels of mathematics skills for employees to function efficiently in the workplace because employers need workers who can interpret information presented in different formats.

Because of the increased emphasis on high level mathematics skills, teachers must ensure a strong relationship between what they teach in the classroom and what transpires in the real world. Unless students see the importance between what is taught and what is important in real life, they may not be motivated to take their mathematics studies seriously and may not take courses which challenge them as learners.

Examples from real-life settings often help students better understand the need to study and learn mathematics skills taught in the classroom. Real-life applications can provide the needed relevance to motivate students not only to apply themselves to their studies but also to take the highest level of mathematics they are capable of handling successfully. **Mathematics for the Workplace: Applications from Textile Production** is designed to present a real-world context where mathematics skills are used as part of a daily routine. The context for this module is the textile production area of machine operations.

One intent of **Mathematics for the Workplace: Applications from Textile Production** is to help students understand the significance of mathematics skills in interpreting charts and graphs. An additional purpose is to help students see how charted information can be used to compare the same process over a period of time.

Use of The Module

The table of contents lists the sections contained in the module. This section, Use of the Module, gives teachers an explanation of the procedures used in completing the exercise. Not all of the information presented in this module is to be duplicated and given to the students. **There are, however, several sections which should be duplicated and given to the students so they can complete the assignment.**

Pages 3-5 give students an introduction to the career field of textile operators. Included in this section is information on duties of operators, working conditions, and high school preparation. **These pages should be duplicated and given to the students as introductory information.**

Pages 6-7 present a job-related task. In this section, students receive an explanation of the task and information to help them understand the need for the task. This section also provides teachers with an understanding of the requirements to complete the task. This section may be duplicated and given to the students as information.

Pages 8-11 are the answer keys to the questions asked in the lesson. The answer keys give the solutions to each part of the problems.

The appendix contains the handout required to complete the lesson.

Introduction

Textile machine operators, or "associates," as many employers now refer to employees, have the responsibility of transforming fibers, either natural or manmade, into textile products. Textile products include clothing, carpeting, and fabrics used on furniture.

Various stages of fabric development require different types of operators. Machine operators usually specialize in one part of the production process. Operator titles include

- bleachers--dying or bleaching yarn wound on beams, tubes, or coils;
- operators and tenders--operating machines that spin fibers into the yarn to be used in textiles;
- setters and setup operators--preparing and repairing machinery which operators and tenders run;
- bonding setters--setting up and running machines that bond, stretch, and apply finishes to thread.

With the integration of computers into the manufacturing process, operators must now be familiar with all of the various stages of the manufacturing process. In addition, many textile companies are setting up teams which work together to ensure the greatest productivity and efficiency from the machines. This team approach to manufacturing requires operators to rotate through the various operational set-ups.

Duties of Textile Machine Operators

Textile machine operators perform a range of duties. Depending on the type of machines they oversee, operators' duties may include

--maintaining machines;
--troubleshooting to locate problems with machines;
--repairing breaks in fibers;
--monitoring the supply of fibers;
--controlling colors and patterns for fibers.

Working Conditions

Textile machine operators work in buildings where temperature and ventilation may vary. Most buildings have been air conditioned because of the integration of computers into the manufacturing process. Most modern textile plants are free of dust and other materials because of advancements in technology and the corresponding impact on textile manufacturing.

Machine operators usually work eight hours per day or forty hours per week; however, production demands may require them to work overtime. Much of the work done by textile machinery operators can be very repetitious.

High School Preparation

Many of the machines used in textile production today are run by computers. Computer controlled machines require operators to have higher level math and science skills. In order to best prepare for textile machine operations, students should take algebra, science, mechanics, and computer courses.

Students can obtain additional information on textile careers from school guidance offices, libraries, area colleges, or local textile industries.

Postsecondary Education

Because of increased integration of technology into textile production, additional, specific postsecondary training in textile manufacturing processes can enhance advancement opportunities.

Area colleges which offer textile programs are

Tri-County Technical College
Contact: James C. Burns
Department Head
Textile Management Technology
Tri-County Technical College
P. O. Box 587
Pendleton, SC 29670

Clemson University
Contact: C.D. Rogers
Director
Textile Management and Textile Science
Clemson University
Clemson, SC 29634

Earnings and Advancements

Earnings for textile workers are dependent on the years of experience in textile production, skill level and amount of postsecondary education. In upsate South Carolina (1990) salaries ranged from $12,000 (entry-level) to $24,000 (highest skill level). Earnings will also vary depending on the type of machine operated, the size of the company, and the shift worked by the operator.

Machine operators can advance in several ways. They might become instructors and train new employees; assume positions that require higher skills and more supervisory responsibilities or take courses which provide additional skills.

Introduction to the Task

One concern of textile production is the number of defects which are found in fabric while it is being inspected. An inordinate number of defects in the fabric may cause the entire roll to have to be scrapped or sold for second quality material. First quality fabric may have small numbers of defects in the material.

There are different types of defects found in fabric. Defects include

- light or heavy marks--streaks in the materials, usually caused by a missing thread;
- slack or broken picks--resulting in a pucker or fold in the fabric;
- yarn defects--yarn being used in the production process which has an inconsistent diameter or is wavy, puffy, or thin;
- jerk in waste--some type of stray materials has been pulled into the fabric during the weaving process and woven into the material, usually resulting in a bulge;
- other--may include oil from the machine, handprints, smudges or tears in the fabric.

One method used by textile plants to compare the number of defects in fabric is the construction of graphs. Each graph shows the number of defects per production period over a certain length of time. Each bar of the graph is broken into the various types of defects tracked by the company.

Handout 1 gives a graphic display of production periods for one year. The graph gives employees the opportunity to see if the number of defects is being reduced, is increasing, or is remaining constant. Comparisons also include past averages and future projections.

Questions for Analysis

The following questions are examples of the types employees must answer when analyzing the number of defects, and the resulting effect on production, over a period of time. Using Handout 1, answer each of the following questions.

1. What is the average number of total defects that occurred for the first eleven production periods of 1990? What is the average number of defects, by type of defect, for the first eleven production periods in 1990?

2. What three types of defects account for the most major defects during the spinning process?

3. In production period 11, what percentage of the defects resulted from light marks? slack and broken picks? other defects?

4. What was the average number of total defects for the third quarter of production for 1990? Was the average equal to, greater than, or less than the 1990 third quarter target?

5. One way of getting a clearer picture of production period defects is to construct a Pareto's analysis. A Pareto's analysis is done by breaking the total picture into its various components and constructing a graph to show what percentage each component is of the whole picture. Using the data from the 1990 Year to Date analysis, construct a Pareto's analysis to show the percentage breakdown of each type of defect.

ANSWER KEY

1. This question can be answered in one of two ways. The first method is to look at the **90 YTD** or 1990 Year to Date average. By looking at this column, you can see that the average number of total defects for the first eleven production periods is 12.

   The second method which can be used to compute the average number of total defects is to add the number of defects for the eleven production periods and then divide by the number of periods, eleven. The number of defects by production period is

Period 1 = 13	Period 7 = 13
Period 2 = 11	Period 8 = 12
Period 3 = 12	Period 9 = 14
Period 4 = 11	Period 10 = 13
Period 5 = 11	Period 11 = 11.
Period 6 = 13.	

   Adding the number of defects for each period, we get

   13 + 11 + 12 + 11 + 11 + 13 + 13 + 12 + 14 + 13 + 11 = 134.

   Dividing the total, 132, by the number of periods, 11, we get

   134   11 = 12.2

   The average number of defects for the first eleven production periods, rounded to the nearest whole number, is 12.

2. PART A

   The three sources that account for the most major defects in the spinning process are light marks, slack and broken picks, and other.

   PART B

   To answer Part B of the questions, examine the 90 YTD column of the graph. By looking at this column, we find the average number of defects resulting from light marks is 4; the average number of defects resulting from slack and broken picks is 2; and the number of defects from other sources is 3.

3. To compute the percentages of defects occurring from light marks, slack and broken picks, and other sources, we must first determine the number of defects from each source. For production period 11, the number of defects from light marks is 5; the number of defects from slack and broken picks is 2, and the number of defects from other sources is 2.5.

Percentages are computed as follows:

Light Marks $\frac{5}{11}$ X 100 = .4545 X 100 = 45.5%;

Slack and Broken Picks $\frac{2}{11}$ X 100 = .1818 X 100 = 18.2%;

Other Sources $\frac{2.5}{11}$ X 100 = .2272 X 100 = 22.7%.

4. To compute the average number of total defects for the third quarter of production for 1990, we must use production periods 7, 8, and 9. The number of defects for production period 7 is 13; the number of defects for production period 8 is 12; and the number of defects for production period 9 is 14. The total number of defects for the third quarter is

13 + 12 + 14 or 39.

The average number of defects for the third quarter is

39 ÷ 3 or 13.

The 1990 third quarter target was 14 defects. The average number of defects for the third quarter was 13. The average number of defects for the third quarter was less than the third quarter target.

5. A Pareto's analysis is a breakdown of the entire picture into its components. In order to give a percentage breakdown for each type of defect in the 1990 Year to Date column, we must determine the number of defects by category. The number of defects by category is as follows:

Light Marks 4
Slack and Broken Picks 3
Heavy Marks 1
Yarn Defects .5
Split Ends .25
Jerk in Waste .25
Other 3

Percentages by category are

Light Marks $\frac{4}{12}$ X 100 = .333 X 100 = 33.3%;

Slack and Broken Picks $\frac{3}{12}$ X 100 = .25 X 100 = 25%;

Heavy Marks $\frac{1}{12}$ X 100 = . 083 X 100 = 8.3%;

Yarn Defects $\frac{.5}{12}$ X 100 = .042 X 100 = 4.2%;

Split Ends $\frac{.25}{12}$ X 100 = .021 X 100 = 2.1%;

Jerk in Waste $\frac{.25}{12}$ X 100 = .021 X 100 = 2.1%;

Other $\frac{3}{12}$ X 100 = .25 X 100 = 25%.

The Pareto's Analysis

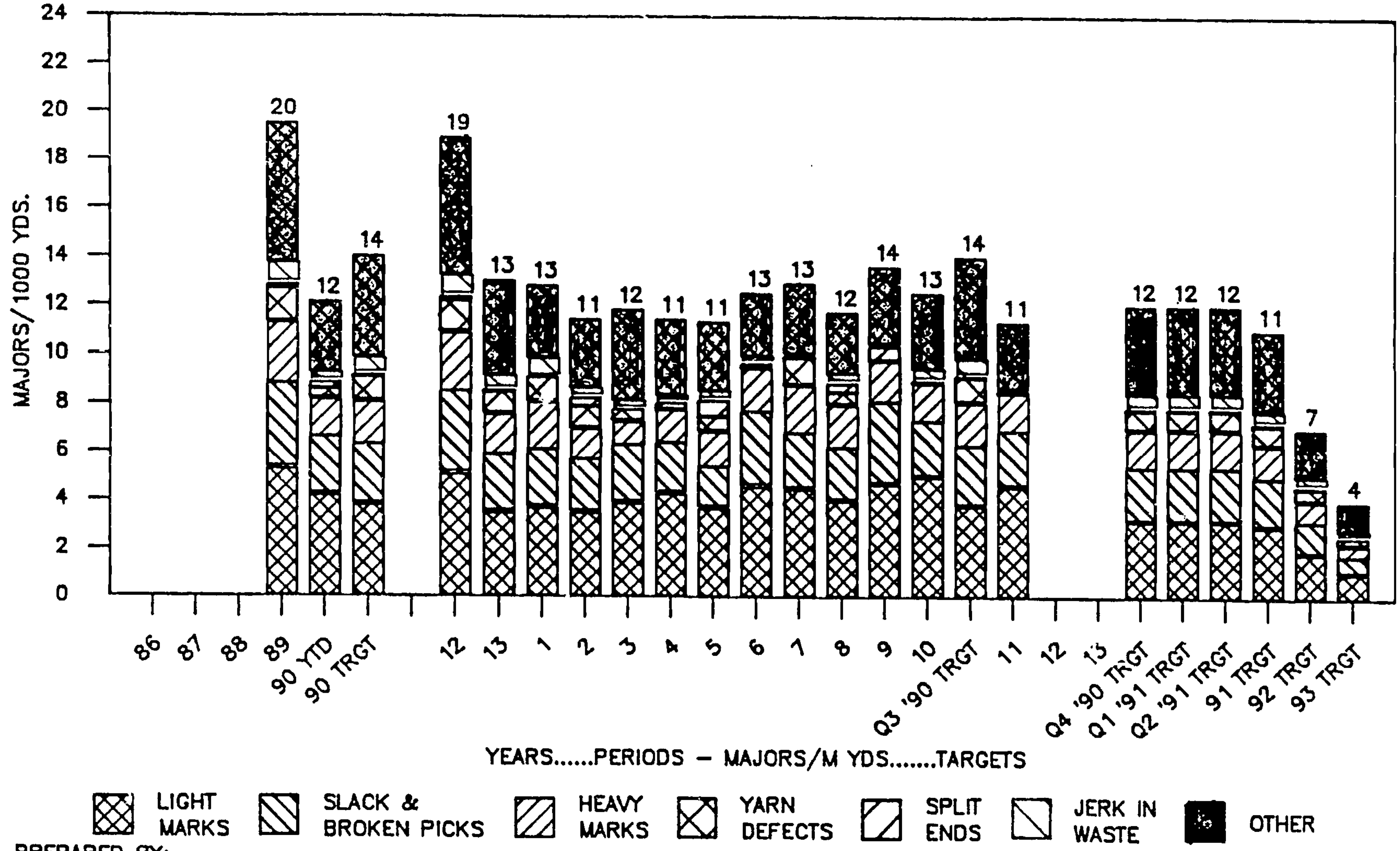
```
                  |
D      Light      |
E      Marks      |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX (33.3%)
F                 |
E      Broken/    |
C      Slack      |
T      Picks      |XXXXXXXXXXXXXXXXXXXXXXXXX (25%)
S                 |
       Heavy      |
       Marks      |XXXXXXXX (8.3%)
                  |
       Yarn       |
       Defects    |XXXX (4.2%)
                  |
       Split      |
       Ends       |XX (2.1%)
                  |
       Jerk in    |
       Waste      |XX (2.1%)
                  |
       Other      |XXXXXXXXXXXXXXXXXXXXXXXXX (25%)
                  |
                  |
                  ----------------------------------------------------
                            10        20        30        40        50

                                   PERCENTAGE
```

APPENDIX

HANDOUT 1

QUALITY OF FIRST QUALITY

MAJOR DEFECTS/1000 YDS. – SPUN FILLING



PREPARED BY:
PRESENTED BY:
DATE: PERIOD 11 – 1990

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