

The Perceived Importance of Statistics in the Logistics and Transportation Industry

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The area of logistics and transportation (L&T), which traditionally has been viewed as a *cost* center in many organizations, is now being viewed by both practitioners and academics as a *profit* center. Further, companies are realizing that a more thorough understanding of this area could place them in a position of having a clear and recognizable competitive advantage in their industries. The logistics and transportation industry is operating in an extremely competitive marketplace. Given the expansion of global competition and legislative and demographic changes affecting both the L&T industry and those who use its services, it is imperative that all areas of logistics and transportation be understood more thoroughly.

Academic interest in the area can be seen by the number of L&T programs created in the past several years. Presently, there are 51 undergraduate L&T programs in the United States (CLM). Academic research in the area has become more readily available and now covers a wide range of issues. However, several areas have received little or no attention in the logistics and transportation literature. For example, numerous studies have focused on the process used by suppliers to select a motor carrier (Abshire & Premeaux, 1991a, 1991b; Evans & Southard, 1974; Murphy, Daley, & Hall, 1997). Little research has

ABSTRACT. In this article, we examine the quantitative skills necessary for entry-level managers to be successful in the logistics and transportation industry. A mail survey was sent to executives in ocean carriers, motor carriers, and third-party logistics companies. The responses indicated that statistics played either a critical or a supportive role in the operation of their companies. Sampling, graphics, probability, and quality methods were the most widely used statistical techniques. Among available software, the spreadsheet (Excel) was the top choice. We include suggestions for ensuring that appropriate statistical techniques are incorporated into an undergraduate statistical curriculum.

focused on the selection process for those managers who work in and are responsible for guiding the L&T industry into the next century. A review of textbooks used in L&T programs reveals that the majority of topics covered relate more to the specifics of various types of transportation modes than to specific individual skills (marketing, management, etc.) needed by the manager. Though an examination of textbooks used in such programs reveals the wide variety of management skills necessary, an equally wide variety of statistical skills is required to successfully plan and execute various L&T functions.

Therefore, the purpose of this research was to examine the quantitative skills considered necessary for entry-

level managers to succeed in the L&T industry. Specifically, we sought to identify which statistical techniques are seen as most important in the motor carrier, ocean carrier, and third-party logistics (3PL) segments of the overall L&T industry, which techniques are being taught in business schools, and how these two areas might be more closely related in building curriculum. The intent of our research is not to suggest that a new statistics course be created specifically for L&T majors, but rather to provide statistics instructors with input from industry that would help them when considering which topics should receive more attention.

Not surprisingly, we did not find literature that specifically covered the overall areas that need to be included in the quantitative training of managers in the L&T industry. However, a variety of literature does exist that discusses the use and importance of statistics in a general industrial setting, as well as some studies on specific areas of statistics use in the transportation industry.

The American Assembly of Collegiate Schools of Business (AACSB) mandated that undergraduate business majors should possess a basic understanding of mathematics and statistics (AACSB, 1993). However, it did not state specifically how this requirement should be fulfilled. As a result, the indi-

vidual university was left to determine how to assure that the student graduated with the needed information. Many colleges and universities were already providing their undergraduate students with a statistical background as part of their core requirements. Levine (1992) discovered that 61.9% of responding AACSB-accredited schools required 1 semester of statistics, whereas 30.6% required 2 semesters. At the MBA level, fully 90% of responding schools required at least one core-level course in statistics. AACSB-accredited business schools apparently do place a high level of importance on the quantitative backgrounds of their students.

However, it is important to understand exactly what is being taught in these foundational courses. The Levine (1992) study found that the five areas covered most often in undergraduate statistics courses were (a) estimation and hypothesis testing (99.2%), (b) probability distribution (96.8%), (c) linear regression and correlation (94.4%), (d) descriptive statistics (93.7%), and (e) tables and charts (77.8%). Though Guiffrida (1990) noted that the topic of quality assurance was one of the most vital areas for business students to understand, quality assurance was not mentioned as a particularly important aspect of these undergraduate foundation courses.

The lack of quality control exposure has not gone unnoticed. Bowerman and O'Connell (1992) reported that though quality control concepts are vitally important to industry, many business statistics courses do not cover them and the coverage offered is often unrealistic. Strasser and Ozgur (1995) found that hypothesis testing received the highest attention in undergraduate courses. Again, quality control was not given much importance by the majority of their respondents. A more recent study (Parker, Pettijohn, & Keillor, 1999) found that descriptive statistics (97.2%), probability distribution (95.5%), estimation and hypothesis testing (90.9%), and tables and charts (90.0%) were the areas most often included in AACSB-accredited schools of business. Interestingly, only 11.8% included quality and productivity in those courses.

It is clear that students attending

AACSB-accredited business schools are most likely receiving a reasonable foundation in the basic areas of statistics. However, the topics covered may not be the correct ones for inclusion in the required statistics courses.

One other area to be examined when formulating L&T curriculum content is statistical packages and computer usage. Shufeldt and Parmley (1992) reported that, in a survey of 669 AACSB-accredited schools of business, computer applications were not required in approximately one fourth of the schools. Further, they found the most frequently used software packages to be Minitab, SAS, SPSS (formerly SPSSX), and Statpak. Tabatabai and Gamble (1997) also reported that Minitab, SAS, Execustat, and ASP were the most commonly used software in business statistics courses. These findings are particularly important for curriculum development, as Dudley and Dudley (1995) have suggested that for a business school graduate to be productive, particularly in small firms, he or she must be computer literate and skilled in word processing, spreadsheet use, data entry, and electronic information transfers.

Therefore, students enrolled in undergraduate business programs accredited by the AACSB are very likely to have been exposed to at least one statistics course that probably included instruction in the areas of descriptive techniques, probability distribution, hypothesis testing, and tables and chart discussions. Further, those students most likely have had some exposure to computer packages such as Minitab, SAS, SPSS, Execustat, and ASP. These requirements show that both the AACSB and those professors charged with the development of curriculum view an undergraduate statistics course as being an important part of a college education for business students.

We should note that the vast majority of literature related to business statistics is based on the opinions of those who are presently not working in an industry position. Rather than solely examining the topics that academia deems important for business majors, we decided to go directly to individuals working in a particular field to determine what the

industry deems important for a graduate in a specific option area. This study adds to existing statistical education and L&T literature by examining the statistical techniques perceived as most important by those managers currently working in the L&T industry.

Method

We sent a one-page survey to senior executives (directors, vice presidents, and presidents) of 243 L&T companies. The sample companies consisted of third-party logistics (3PL) providers from Armstrong's *Who's Who in Third-Party Logistics*, motor carriers from the top 100 motor carriers of *Transport Topics*, and international containership carriers obtained from the *Journal of Commerce*. All potential respondents were mailed a letter explaining the purpose of the study, a copy of the survey, and a postage-paid return envelope. Ten surveys were returned with bad addresses, resulting in a final sample of 233 companies. A total of 65 usable surveys were returned, resulting in a 28% (65/233) overall response rate.

Nonresponse bias was analyzed by comparing means of early and late respondents on two questions on a Likert-type scale (Armstrong & Overton, 1977). No statistically significant differences were found in the comparisons, so nonresponse bias was not considered a problem.

Results

We analyzed our results by evaluating (a) demographics of the survey respondents by L&T industry segment, (b) the strategic role of statistics within the respondent firm, (c) statistical techniques used by the respondent firm, and (d) statistical software used by the respondent firm.

In Table 1, we show the percentage of respondents within each of the three L&T industry segments. The industry segments were third-party logistics, motor carrier, and ocean carrier providers. Just over half of the respondents identified themselves as 3PL providers, about one third identified themselves as motor carriers, and approximately 12% identified them-

selves as ocean carriers. Three percent of the respondents identified themselves as "other."

All respondents were asked to indi-

cate the role of statistics (critical, supportive, incidental, not used) within their firm. As can be seen in Table 2, when all respondents were grouped

together, the largest percentage (49.2%) indicated that statistics played a supportive role, followed by 36% indicating that statistics was critical to the company's operation. An examination of the three industry segments showed that 61.9% of the motor carrier segment considered statistics critical, whereas the other two industry segments placed statistics in a supportive role. Overall, 86% of the respondents indicated that statistics was either critical to or supportive of the operation of their companies.

In Table 3, we present respondents' use of specific statistical techniques, overall and for each of the three industry segments. Each respondent was given the list of techniques shown in the first column of Table 3 and asked to check those used within their firm. We also performed a chi-square cross-tabulation test for each statistical technique by industry segment to examine the relationship of usage by industry. Five of the relationships were significant at a .10 *p* value or 90% level of confidence. The chi-square test indicated that for these five techniques (probability, sampling, averages, graphics, and quality), the three industry segments differed significantly in their reported use.

An examination of the tabulated responses in Table 3 indicated that sampling and graphics techniques had the highest incidence of use, with more than 60% of the third-party logistics and motor carrier segments indicating that they used these techniques. More than 60% of the motor carrier segment also reported using probability and quality statistical methods. The least used technique across all three industry segments was hypothesis testing.

In Table 4, we present respondents' use of specific statistical software tools, overall and by industry segment, in percentages. Again, respondents checked a list to select software tools used at their firms. We performed a chi-square cross-tabulation test for each software tool by industry segment to examine the relationship of use by industry. Only one of the relationships was significant at a .10 *p* value, or 90% level of confidence. The chi-square test indicated that for the Excel software tool the three industry segments differed significantly in reported usage. Additionally, the data in

TABLE 1. Respondents' Demographics by Industry Segment

Industry segment	Respondents (%)	Sample (%)
Third-party logistics (3PL)	52.3	41
Motor carrier	32.3	41
Ocean carrier	12.3	18
Other	3.1	0

TABLE 2. The Role of Statistics Within Respondents' Firms, in Percentages

Role of statistics	Third-party logistics (3PL)	Motor carrier	Ocean carrier	Overall
Critical	23.5	61.9	37.5	36.9
Supportive	64.7	23.8	62.5	49.2
Incidental	8.8	4.8	0.0	6.2
Nonexistent	2.9	9.5	0.0	7.7

TABLE 3. How Statistics Are Used Within Respondents' Firms, in Percentages

Techniques used	Third-party logistics (3PL)	Motor carrier	Ocean carrier	Overall	<i>p</i> value
Descriptive	32.4	28.6	50.0	32.3	.263
Probability	26.5	61.9	25.0	36.9	.016
Sampling	67.6	76.2	37.5	64.6	.028
Estimation	50.0	33.3	37.5	41.5	.192
Variation	38.2	47.6	25.0	38.5	.228
Averages	38.2	52.4	12.5	38.5	.078
Graphics	61.8	66.7	37.5	58.5	.086
Hypothesis test	14.7	23.8	12.5	16.9	.359
Regression	44.1	33.3	37.5	38.5	.292
Time series	26.5	33.3	25.0	27.7	.382
Forecasting	58.8	42.9	37.5	49.2	.132
Quality	52.9	61.9	25.0	50.8	.076

TABLE 4. Statistical Software Used Within Respondents' Firms, in Percentages

Software used	Third-party logistics (3PL)	Motor carrier	Ocean carrier	Overall	<i>p</i> value
SAS	5.9	19.0	0.0	9.2	.137
SPSS	11.8	9.5	0.0	9.2	.367
EXCEL	91.2	95.2	100	90.8	.000
Lotus 123	32.4	52.4	37.5	38.5	.160
Other	14.7	9.5	12.5	12.3	.447

Table 4 indicate that the statistical software packages SAS and SPSS were used very infrequently, with Excel being used by essentially all the respondents. Ninety-one percent indicated that Excel was their statistical analysis package of choice. This may be because of its pervasiveness on personal computers in industry. Additionally, most respondents did not indicate that they used statistical techniques that would require the purchase of software packages such as SPSS or SAS.

Conclusion

As statistics obviously plays a strategic role in operations in most of the logistics and transportation industry, one could assume that entry-level managers would be expected to possess a solid background in those statistical areas perceived as necessary for firms' success. Our results support a strategic role for statistics, based on the critical or supportive roles indicated by the vast majority of respondents. However, the statistical techniques and software use patterns could not be considered sophisticated or in-depth. Hypothesis testing, regression, and time-series might be considered reasonably advanced statistical techniques, yet only 38% or less of the overall respondents indicated use of any one of these techniques. Additionally, only 9% of the respondents indicated the use of either one of the two statistical software packages SPSS or SAS. The overwhelming majority of respondents indicated the use of the spreadsheet software package Excel.

There are pedagogical implications resulting from both the statistical technique and the statistical software findings. Our findings indicate that the most widely used statistical techniques in the L&T industry are sampling (selection of freight bills for customer service surveys), graphics (pie charts, bar charts, histograms, etc.), and quality control measurement (in statistical process control). However, the literature review revealed that the most widely taught sta-

tistical techniques in colleges and universities are descriptive, probability, estimation, and hypothesis testing (Parker, Pettijohn, & Keillor, 1999).

Additionally, research indicates that the most popular statistical software packages in college and university curricula are the little-used SAS and SPSS (Shufeldt & Parnley, 1992). Regarding the importance of statistical techniques, there is an apparent gap between the perceptions of managers presently working in the L&T industry and those of curriculum developers at AACSB-accredited schools of business. There are at least three possible courses of action to counter this problem.

First, general statistics courses could be redesigned to be more closely aligned with industry's expectations. This may be difficult to accomplish, because such a general statistics course would be designed for all business majors, but separate industries may not expect or desire the same skills in graduates. A potential negative result of deemphasizing the advanced statistical techniques such as regression and hypothesis testing would be a lack of exposure to the basic problem-solving tools that they provided. Before curriculum changes are made, both academics and practitioners must understand the potential ramifications of neglecting the more advanced statistical techniques.

A second solution would be to require all logistics and transportation majors to take an L&T course devoting several weeks to the techniques reported as being desirable or expected. This would assure that the specific techniques expected by industry could be mastered prior to completion of the L&T graduation requirements. This option would require that another topic presently being taught be dropped from the course to accommodate the inclusion of statistical information.

The third and least desirable of the options is to have individual companies provide their own in-house training in graphics and quality statistical techniques and application of those tech-

niques within Excel. Selection of this route could imply that the university system has failed to provide industry with managers with the basic knowledge needed for entry-level positions. Thus, the most favorable course of action would be to institute formal dialogue between practitioners and academics to assure that basic entry-level knowledge requirements are being met.

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