Increasing competitive advantage through upgrading:

The automotive component manufacturing industry in South Africa

Paul Grota

29621632

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

10 November 2010

Abstract

The research project investigates whether automotive component manufacturers located in South Africa are taking advantage of their participation in global value chains to functionally upgrade. Two factors, namely position in the value chain and global connectedness are assessed in terms of their effect on the propensity for firms to innovate and upgrade. Continuous pressure from value chain leaders to reduce costs coupled with increasing competition from other low-cost, developing economies means that South African automotive component manufacturers have to upgrade to improve their competitiveness and maintain their positions in the global value chain.

This quantitative study analysed data collected through interviews from 76 companies in the National Association of Automotive Component and Allied Manufacturer's database of firms. The results support previous literature and demonstrate that indigenous innovation does occur under certain conditions. Whilst participation in global value chains seems to stimulate innovation, it does not necessarily guarantee that innovation will occur nor does it mean that innovation will automatically result in upgrading. Questions that require further investigation include among others the upgrading trajectory firms over time and a deeper understanding of the

mechanisms used by innovation leaders to absorb and deploy the knowledge and technology obtained from global interactions.

Keywords: Innovation; Upgrading; Global Value Chains

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Name: Paul Grota

Date: 10 November 2010

Acknowledgements

I would like to thank the following individuals who contributed to this research project and who supported me:

- My wife, Tanya, for all her love, patience, support and understanding over the last two years.
- My family and friends for all your constant reassurance, support and motivation to complete this degree.
- My research supervisor, Dr. Helena Barnard, for her pragmatic advice, guidance and support with this research project.
- Accenture South Africa for their financial support and flexible work arrangements that made it possible to successfully complete this degree and still perform effectively at work.

Contents

List of Figures and Tables

1 Introduction

The automotive sector plays a significant role in South Africa's economy, accounting for 7.5% of GDP. The industry consists of numerous manufacturers of light passenger and light, medium and heavy commercial vehicles as well as over 200 component manufacturers. The sector employs 36 000 people and is responsible for 10% of South Africa's exports (SAinfo reporter, 2008).

The post-apartheid removal of South Africa's trade barriers combined with the effects of globalisation has had advantages and disadvantages for the country as well as firms located in South Africa. On the positive side, the volume of South Africa's exports and imports has increased substantially since 1994. However, increased participation in the global market means that firms have also become increasingly subject to fierce global competition (Barnes and Kaplinsky, 2000).

Multinational corporations (MNC) are increasingly being put under pressure to deliver ever improving returns to shareholders. One example of such pressure being exerted is by investors who have reduced the average holding period of shares on the New York Stock Exchange from 26 months in 1990 to just 9 months in 2009. This implies that investors are expecting

companies to generate immediate returns or face disinvestment by shareholders (Moscovitz, 2010).

Value chain fragmentation (Arndt and Kierzkowski, 2001) is one strategy adopted by MNCs to make the most of the competition caused by globalisation enabling MNCs to exploit advantages of location such as low cost labour, skills and natural resources as well as their own and their suppliers' competitive advantages (Kotabe and Murray, 2004). In addition, the configuration of MNC global value chain activities is changing from replication in multiple locations to specialisation in one or a few locations where the appropriation of rent is favourable (Beugelsdijk, Pedersen and Petersen, 2009).

Global value chain fragmentation has provided the opportunity for firms in developing countries to participate in these chains and get exposure to global markets. Participating in global value chains allows both firms and countries to upgrade their capabilities in a more focussed area, thereby accelerating their development (Humphrey, 2004). United Nations Industrial Development Organisation (2002) demonstrates that those countries integrated into global value chains have risen the fastest up the Competitive Industrial Performance ranking.

Firms from developing countries trying to enter into global value chains are deemed to be latecomers and generally exhibit weak capabilities in the areas of marketing, design and technology. Being from developing countries, they do have the advantage of low cost labour, which enables them to compete initially on labour-intensive activities in the value chain (Miotti and Sachwald, 2001).

However, these latecomer firms must be careful not to remain indefinitely in the low-value adding part of the chain. With lead firms' global buyers continuously searching developing countries for low cost manufacturers, competition in this 'commoditised' part of the value chain takes place over cost, driving down the margins of firms trapped in this pit (Barnes and Kaplinsky, 2000).

In order to avoid this pit, firms need to undergo a process of upgrading in order to improve their competitiveness in the global economy (Giuliani, Pietrobelli and Rabellotti, 2005). This is achieved through access to knowledge and technology and learning from buyers within the chain (Pietrobelli and Rabellotti, 2008).

As lead firms increasingly exercise tighter governance over the value chain through 'follow design' and 'follow sourcing' strategies, "a number of

observers have concluded that developing country firms are likely to lose design and engineering capabilities" (Lorentzen and Barnes, 2004 p.472) to the centralised R&D operations of MNCs. One could argue that this will negatively impact the ability of firms to innovate. However, evidence is emerging that this depressing argument is exaggerated and innovation is taking place in developing countries (Humphrey and Memedovic, 2003; Lorentzen and Barnes, 2004).

With 87% of senior managers surveyed in the Boston Consulting Group Survey 2005 agreeing that innovation is essential for the success of an organisation (Von Stamm, 2008) it can be argued that innovation is vital to gain competitive advantage, increase profitability and ensure sustainability.

According to Black (2001), the industry's performance under a more liberalised trade system has generally been considered successful. However, there is serious competition from other developing markets in East Asia and Latin America, continuous pressure by global buyers to reduce margins and reduction in local value added in newer models. Therefore, South African automotive component manufacturers will have to upgrade to improve their competitiveness and maintain their positions in the global value chain (Lorentzen, 2005).

1.1 Research Purpose

The purpose of this research is to establish whether the automotive component manufacturers located in South Africa are taking advantage of their participation in global value chains to functionally upgrade. Two factors, namely position in the value chain and global connectedness are assessed in terms of their effect on the propensity for firms to innovate and upgrade. The outcomes of this research will provide both private business and government with the information required to take the necessary actions to stimulate further innovation in order improve the global competitiveness of South Africa's automotive manufacturing sector and prevent it from gradually sliding into oblivion.

1.2 Research Scope

This research focuses on automotive component manufacturers in South Africa. Only firms that are based in South Africa and belong to the National Association of Automotive Component and Allied Manufacturers (NAACAM) are studied.

2 Literature Review

2.1 Globalisation and its Impact on Competitiveness

In 1994, South Africa achieved its transition to a non-racial government. This led to an economic shift from a closed, protected economy to an open economy attempting to benefit from growth through exports to the global community (Ballard, 2001).

Under the watchful encouragement of multilateral organisations such as the World Bank, International Monetary Fund (IMF) and World Trade Organisation (WTO), trade barriers around the world have been reduced. This has resulted in “the widespread liberalisation of trade and investment regimes in developing countries...” (Lorentzen and Barnes, 2004 p.467). The pace of liberalisation in South Africa was driven forward by the government, resulting in its external trade growing more rapidly than required by the WTO (Jenkins and Siwisa, 1997).

Ballard (2001) asserts that international trade is rules-based and thus governments have to allow foreign producers access to local markets in exchange for local producers to gain access to international markets. The lowering of trade barriers means that governmental protection previously

provided to local firms is reduced, exposing them to intense competition from foreign firms (Lorentzen and Barnes, 2004).

Globalisation is described as “the process whereby distance is becoming less of a barrier to social, cultural, and economic interaction” (Ballard 2001, p.5). Rapid advances in communication and transport technologies played a fundamental part in making globalisation possible. These technologies allow for the transfer of information from one place to another to be achieved relatively inexpensively and at a speed far superior to the past (Archibugi and Iammarino, 2002). The combination of these technological advancements with trade liberalisation has dramatically changed the way production networks are configured. In the past, an entire product may have been made in one location, whereas now companies have the ability to use components and stages of manufacture from all over the world (Ballard 2001).

The nature of competition between firms, industries and nations has changed as a result of globalisation and is demonstrated by the shift in international trade patterns (Gereffi, 1999). Gereffi (1999) identifies that a large growth in imports into developed countries points to a shift in production and exports to an increasing base of manufacturers in developing countries.

This movement in production to developing countries is the crux of the remarkable macroeconomic improvement achieved by a few high-performing Asian economies and is mainly attributed to the development strategy of export-oriented industrialisation (Gereffi, 1999).

By opening the economy and entering global trade, South Africa is facing an extremely competitive environment both in the "...need to enter external markets and to cope with the new entrants to the domestic market" (Barnes and Kaplinsky, 2000, p 797). South Africa has been disadvantaged by entering the global market after its developing country competitors, but it is also advantaged by the fact that it can learn from the successful and failed strategies deployed by developing countries in emerging markets.

2.2 Global Value Chains

2.2.1 The Opportunity to Participate in Global Value Chains

Kaplinsky (2000) and Gereffi, Humphrey and Sturgeon (2005) describe the value chain as the end-to-end process by which material, labour and technology are combined to convert a product from initial conception, through manufacturing, marketing and distribution, culminating with disposal of the product.

Physical separation of the different parts of the chain is described by Arndt and Kierzkowski (2001) as value chain 'fragmentation' which enables production to occur in different countries within or between firms, hence the term global value chain. Other trade theorists refer to the fragmentation process as "'segmentation', 'production sharing', 'integrated production', 'outward processing', or 'vertical specialisation'" (Lall, Albaladejo and Zhang, 2004).

A contributing factor to value chain fragmentation is the increased mobility of capital in contrast to the immobility of labour (Humphrey, 2004). Feenstra (1998) links 'integration of trade' with the 'disintegration of production'. This enables firms to exploit advantages of location such as low cost labour, skills and natural resources amongst others as well as their own and their suppliers' competitive advantages (Kotabe and Murray, 2004).

As a result of increasing globalisation, manufacturing within global value chains has become even more geographically dispersed (Humphrey, 2004), resulting in the disintegration of multinational organisations as the trend to outsource noncore activities, both domestically and abroad, is believed to be beneficial to the firm (Gereffi et al. 2005). However, these global

production networks (GPNs) have also become closely coordinated, due in part, to the role played by the MNC (Humphrey, 2004).

Lall et al. (2004) define GPNs as “international systems set up to optimise production, marketing and innovation by locating products, processes or functions in different countries to benefit from cost, technological, marketing, logistic and other differences” (p.2).

The coordination of GPNs is not limited to vertically-integrated MNCs – instead, globalisation has promoted both organisational and geographical fragmentation (Humphrey, 2004). The global electronics and automotive industries (Sturgeon, 2002; Sturgeon and Lester, 2003) have seen an increase in the trend by MNCs to outsource manufacturing and even design activities to suppliers. This has led to increasingly complex global supply networks capable of providing parts to multiple customers across the world.

Global value chain fragmentation has provided the opportunity for firms in developing countries to participate in these chains and get exposure to global markets and the associated benefits.

2.2.2 Effects of Participating in Global Value Chains

Once entry to global value chains is gained, opportunities exist for local firms to learn from the interactions with buyers belonging to the leaders in the chain (Giuliani et al. 2005). Furthermore, Humphrey (2004) believes that the development of firms and countries can be accelerated by exploiting the opportunities to upgrade their capabilities by participating in global value chains.

Participation is increasingly playing a critical role in providing access to knowledge, improving learning and enhancing innovation in developing country firms (Pietrobelli and Rabellotti, 2008). United Nations Industrial Development Organisation (2002) demonstrates that those countries integrated into global value chains have risen the fastest up the Competitive Industrial Performance ranking. Asian countries such as Japan, South Korea and China amongst others have become leading exporting economies by producing low-technology, labour-intensive products and mastering the dynamics of buyer-driven value chains (Gereffi, 1999).

However, the United Nations Conference on Trade and Development (2002) and Giuliani et al. (2005) provide a contrasting perspective that warns of the potential pitfalls for developing countries from increasing global integration:

- Since lead firms govern global value chains, the future involvement and upgrading prospects of firms from developing countries participating in these chains may be dependent on the decisions and successes of these lead firms;
- If developing country firms participating in these global value chains solely perform labour-intensive, low value-adding activities and don't upgrade to more value-added activities, the benefits associated with technological spillovers won't materialise; and
- In order to enter into global value chains, firms need only to be competitive in a narrow range of operations, such as low-technology assembly. As a result, many firms are capable of participating on global value chains and buyers in these chains can easily promote competition, which may lead firms to race to the bottom.

Given that there are advantages and disadvantages to participating in global value chains, it is clear that firms in developing countries need to ensure they participate in a way that promotes sustainable growth. Giuliani et al. (2005) define this as the 'high road' to competitiveness and contrast it to the 'low road' usually followed by firms in developing countries that competes by driving down margins instead of improving productivity, wages and profits. The difference between following the high or low road is often explained by a firm's ability to upgrade (Giuliani et al. 2005).

2.3 Upgrading through participation in Global Value Chains

"The magnitude and speed of change in the global distribution of production capability is historically unprecedented" (Altenburg, Schmitz and Stamm, 2007, p.325). Up until recently, the production of knowledge and innovation capabilities have remained focussed in the Triad markets (Japan, North America and Western Europe) (Archibugi and Pietrobelli, 2003). However, this is starting to change as there are signs that China and India are advancing their own innovation capabilities (Altenberg et al. 2007).

Humphrey (2004) lists two main competitive disadvantages faced by latecomer firms when attempting to compete in global markets. Firstly, since latecomer firms are from developing countries, they are typically dislocated from the main technological centres and secondly, they are distanced from major international markets and consumers. This results in latecomer firms exhibiting weak capabilities in the areas of marketing, design and technology. However, they do have one advantage stemming from their location, which is an abundant supply of low cost labour (Miotti and Sachwald, 2001).

Thus, the only entry strategy latecomer firms typically have to enter global markets, is to focus on performing the most labour-intensive value-adding

activity in the chain, enabling them to avoid the high costs of R&D and marketing (Miotti and Sachwald, 2001).

Once entry to global value chains has been achieved, firms have the opportunity to undergo a process of upgrading in order to improve their competitiveness in the global economy (Giuliani et al. 2005). Upgrading can be described as increasing efficiency, introducing new products or move into more skilled activities in the value chain (Kaplinsky, 2000).

Humphrey (2004) and Lee (2001) define the various stages in upgrading as follows, with point 1 being the most basic capability and 4 being the most advanced:

1. **Assembly:** Consists solely of production to buyer's specifications using inputs provided by the buyer.
2. **Original Equipment Manufacturer (OEM):** Predominantly consists of production, but can also include a wider range of manufacturing functions such as logistics and sourcing of inputs. Production still takes place according to designs supplied by the buyer who is also responsible for marketing.
3. **Original Design Manufacture (ODM):** Over and above production, the supplier is also partly or fully responsible for designing the product to meet performance criteria specified by

the buyer. In advanced instances, the buyer merely attaches its own label or brand to the product for marketing and distribution purposes.

4. **Original Brand Manufacture (OBM):** The supplier is independent of the buyer and is capable of R&D, production, marketing and distributing its own products under its own brand name.

The upgrading process usually follows a step-wise journey with firms starting out as OEMs, followed by ODMs and finally, but infrequently becoming OBMs (Sturgeon and Lester, 2003).

Sachwald (2001) states that “OEM contracts have been extensively used by latecomer firms from emerging Asian countries as channels of technology, design and production know-how transfer” (p. 11). Gereffi (1999) attributes the success of East Asian firms to their ability to upgrade from assembly to OEM production. Upgrading from Assembly to OEM has been made possible by acquiring production equipment from abroad and repeated learning-by-doing processes, enabling Korean manufacturers to match developed countries in terms of production technology (Lautier, 2001).

However, many Asian firms have gone beyond OEM production and have upgraded from OEM to ODM (Sturgeon and Lester, 2003), whilst some

firms have upgraded even further to OBM status, for example, Korean firms in the automotive (Lautier, 2001) and aerospace and defence industry (Lee, 2001). This has been achieved by firms combining the production expertise gained during the Assembly and OEM stages with newly acquired design and branding capabilities, enabling them to market, distribute and sell their own products in local and international markets (Gereffi, 1999).

Although this strategy has been successful, the process of technological upgrading does not automatically occur. The usual learning-by-doing does not secure the successful transfer of technology and may only upgrade basic skills (Miotti and Sachwald, 2001). Upgrading requires active effort and investment by firms and support from public agencies (Humphrey, 2004).

Giuliani et al. (2005) define upgrading as “innovating to increase value added” (p. 552). Innovation is defined by Geroski, Machin, and Van Reenen (1993) as the “introduction of new or improved products, processes or materials" (p. 209). Thus, given the scope of functions performed at each stage in the upgrading process (OEM, ODM and OBM) and that upgrading takes place through innovation, one could argue that firms at different stages in the upgrading process will have a different focus on what they innovate.

For example, since OEMs manufacture to design, they will tend to compete with other OEMs on their manufacturing capabilities. As a result, their focus will be on innovating processes in order to improve cost, quality and delivery reliability, whereas ODM and OBM firms who design their own products will focus their efforts on innovating their products and/or services.

The process of innovation strengthens a company's internal core competencies. These develop from the various learning processes the firm has passed through. These competencies, together with specific behavioural patterns, enable the company to be more adaptable to market pressures which help the company survive or even obtain reasonable profits over time (Geroski et al. 1993; Malerba and Orsenigo, 1995; Dosi, Marsili, Orsenigo and Salvatore, 1995).

2.4 The Role of Lead Firms in the Value Chain

Value chains are often led by firms whose role is to coordinate and control participants in the chain to ensure outputs meet quality and customer requirements. Buyers belonging to lead firms in a value chain (assemblers and the first tier suppliers) play a role in transferring knowledge along the value chain, providing firms in developing countries with a source of information on participating in global markets (Giuliani et al. 2005).

However, Giuliani et al. (2005) mention that the role played by leaders in assisting firms in their value chains to upgrade is unclear. Gereffi (1999) highlights instances in East Asia where upgrading in local suppliers is almost automatically driven by leaders. In contrast, Pietrobelli and Rabellotti (2008), focussing on Latin America, argue that the role played by the lead firms varies by industry. In particular, Pietrobelli and Rabellotti (2008) found that upgrading in the automotive industry is performed with little support from the buyer who is often just an observer in the process.

Traditionally, automotive value chains have been led by a few firms consisting primarily of the well-known automakers who execute most of the product design, production of engines and transmissions and final assembly (Sturgeon, Memedovic, Van Biesebroeck and Gereffi, 2009). Over the last two decades, outsourcing and increasing collaboration with selected 1st tier suppliers has resulted in the creation of a few large, global suppliers, who have taken on increased roles in design, assembly and foreign investment (Sturgeon et al. 2009).

R&D now happens in conjunction with these 1st tier suppliers, which implies an element of relinquishment in control of design on the part of the automaker. In order to overcome this loss of design control, automakers have tightened overall control of the value chain by employing the strategic

tenets of ‘follow design’ and ‘follow sourcing’ (Lorentzen and Barnes, 2004). These tenets guarantee standardisation of vehicles and components across all geographic locations (Lorentzen and Barnes, 2004).

Due to the efficiency with which MNCs act as organisational mediums to transfer knowledge (Kogut and Zander, 2003), superior technology accumulated centrally by MNC parents transfers to local subsidiaries – even though it requires effort on the part of the subsidiary to absorb it (Marin and Bell, 2006). Lorentzen and Barnes (2004) believe the inflow of foreign technology combined with a ‘no need to reinvent the wheel’ type mentality may deter the need to generate local technology.

“Consequently, a number of observers have concluded that developing country firms are likely to lose design and engineering capabilities” (Lorentzen and Barnes, 2004 p.472) to the centralised R&D operations of MNCs. On the contrary, evidence that these gloomy assessments may exaggerate their case has emerged in various studies (Craig and DeGregori, 2000; Humphrey and Memedovic, 2003; Lorentzen and Barnes, 2004; Lorentzen, Møllgaard and Rojec, 2003).

The example of Mexico (Humphrey and Memedovic, 2003) is cited where extensive process, production systems and organisational innovation have

occurred as well as product innovation in the form of the design and launch of the Volkswagen Beetle. Lorentzen and Barnes (2004) also demonstrated that indigenous innovation does happen in South Africa, albeit using a very small and biased sample of eight carefully selected firms.

In order to reduce costs through efficiencies and economies of scale, automakers have rationalised the number of platforms used to build a larger variety of models. This has been achieved by making locally adapted versions of the same model (Lorentzen and Barnes, 2004) and implies that the opportunity exists for firms to innovate - not only on process, but also on products for the domestic or regional market.

2.5 Summary of Theoretical Framework

Participation in global value chains offer firms the opportunity to improve competitiveness through learning and upgrading (Giuliani et al. 2005). It is apparent that technological upgrading does not happen automatically and requires effort and intervention by private firms and the public sector for it to happen (Humphrey, 2004). There are two factors, amongst others, that have an effect on the propensity for firms to innovate and upgrade. They are: position in the value chain and global connectedness.

Latecomers usually utilise their low-cost labour advantage to enter into global value chains (Miotti and Sachwald, 2001). Through learning and utilising the access to knowledge and technology, firms can upgrade. When upgrading does occur, the trajectory typically follows a similar pattern, i.e., from Assembly to OEM to ODM and finally, but infrequently, to OBM (Sturgeon and Lester, 2003; Humphrey, 2004; Lee, 2001). Thus, participation in global value chains as an OEM supplier can be seen as a stepping stone to ODM and OBM.

From the literature, Figure 1 shows that firms can be categorised into six segments according to their participation in local or global value chains and their functional type (OEM, ODM or OBM).

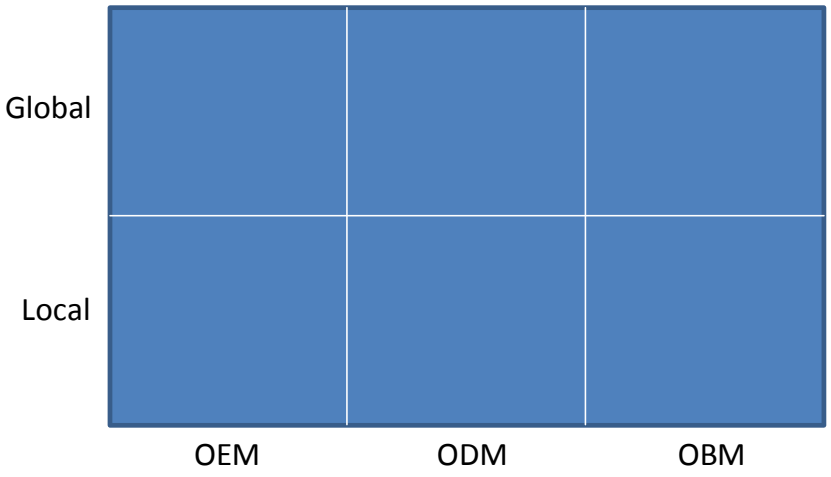


Figure 1: Categorisation by Market and Functional Type

Since upgrading is positively linked to innovation (Giuliani et al. 2005), it can be expected that the nature of innovations change as firms upgrade from production-only capabilities to design and marketing capabilities. Thus, firms engaged purely in Assembly or OEM would innovate manufacturing and logistics processes in order to continuously meet cost and quality pressures from lead firms, whereas firms engaged in ODM or OBM would be more likely to innovate products and/or services. This relationship is depicted in Figure 2 below.

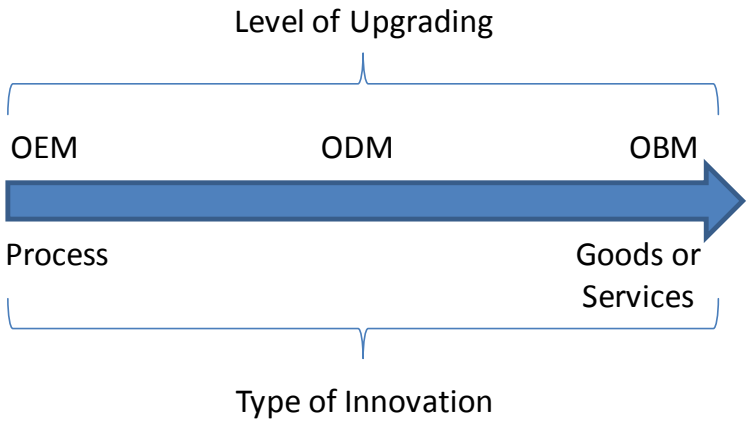


Figure 2: Relationship between Upgrading and Innovation

Furthermore, the global linkage can take various forms such as supplying a global buyer or being the subsidiary of a MNC.

Finally, the potential for South African automotive component manufacturers to survive in a globally competitive world exists, provided

they can innovate and upgrade in order to avoid taking the 'low road' to competitiveness.

The following chapter refines the arguments into four hypotheses.

3 Research Hypotheses

From the literature reviewed, it is clear that developing country firms typically enter global value chains by using their low-cost labour advantage to partake in Assembly or OEM. By performing these functions for global value chain buyers, new entrants gain access to knowledge and technology. If this knowledge and technology is used effectively, OEMs are able to upgrade to ODM and OBM. Thus, OEMs can be seen as the stepping stone for ODMs and OBMs. In order to study this upgrading pattern, one needs to test the following hypotheses:

Research Hypothesis 1a:

Since OEMs focus on process improvements and ODMs and OBMs focus on design of products and services, then it stands to reason that:

- OEMs will be more innovative on processes than ODMs or OBMs.

Research Hypothesis 1b:

Since OEMs focus on process improvements and ODMs and OBMs focus on design of products and services, then it stands to reason that:

- ODMs and OBMs will be more innovative on products than OEMs.

Much has also been said in the literature that talks up the benefits of participating in global value chains. One aspect is the opportunity to learn from global buyers and value chain leaders via the access they provide to knowledge and technology. As a result, it is thought that firms with global linkages have an advantage over firms with local linkages only in their propensity to innovate. In order to test the effect of global linkages on innovation, the following hypotheses need to be tested:

Research Hypothesis 2a:

- Firms with local-only sales will be less innovative on products and processes than firms with global sales.

Research Hypothesis 2b:

- Local-only firms will be less innovative on products and processes than subsidiaries of MNCs.

The next chapter discusses the research methodology used to test these hypotheses.

4 Research Methodology and Design

This section provides details of the research methodology, unit of analysis, population which will be analysed, sample size and sampling method. It also includes further details on the proposed data collection instrument and methodology and the proposed data analysis techniques.

4.1 Research Methodology

A quantitative research method was used. The research aim was to investigate the effect that position in the value chain and global connectedness have on the tendency for South African automotive component manufacturers to innovate and upgrade. Since some understanding of the research problem already exists, Zikmund (2003) suggests that descriptive research could be conducted. Additionally, “the major purpose of descriptive research […] is to describe the characteristics of a population or phenomenon” (Zikmund, 2003, p.55). The study was a cross sectional study, since all the data was collected at a single point in time.

4.2 Proposed Unit of Analysis

The proposed unit of analysis is the firm (a South African automotive component manufacturer).

4.3 Population of Relevance

The population consists of all companies located in South Africa that supply material to, or manufacture or assemble components for the automotive industry.

4.4 Sampling Method and Size

The study targeted all companies who were members of the National Association of Automotive Component and Allied Manufacturers (NAACAM) at the time the data was collected. This study therefore used a census to target “all the individual elements which make up the population” (Zikmund, 2003, p.369). NAACAM’s database contained 174 firms at the time the study was performed.

4.5 Data Collection Tool and Process

The primary data required to conduct this study was collected using a questionnaire. The questionnaire was developed as part of a larger

international project, conducted under the auspices of the University of Lund in Sweden. The base questionnaire was first developed by the University of Lund in interaction with Chinese and Indian researchers, and adapted for South African conditions at a workshop held in South Africa in May 2008. The changes were made by a team of South African academics with input from people in the industry.

This specific research project utilised a number of questions in the questionnaire:

- Whether the firm was a single plant or part of an enterprise group;
- Firm ownership (local or foreign)
- The percentage of firm sales that were OEM, ODM, OBM or other;
- The destination of sales;
- The type of the innovation performed by the firm, such as:
    - product innovation which comprises of goods and services;
    - process innovation which comprises manufacturing and logistics; and
- The extent of the innovation performed by the firm:
    - new to the firm;
    - new to the domestic market;
    - new to the world; or
    - no innovation.

The questionnaire was administered in person by means of an interview. Zikmund (2003) mentions the benefits of collecting data using a personal interview. These include but are not limited to:

- the opportunity to receive feedback, allowing the interviewer to clarify any uncertainty;
- the opportunity to probe respondents to get more accurate or complete answers; and
- the failure to provide a response is less likely to occur.

However, no data collection method is perfect and Zikmund (2003) states that conducting personal interviews also has its drawbacks, such as:

- the risk of not remaining anonymous may discourage participation;
- the interviewer's demographic my influence the respondent; and
- the technique utilised by the interviewers may not be consistent and is subject to interviewer bias.

In order to minimise extent of interviewer bias, training was provided to the Masters of Engineering Management students from the Graduate School of Technology Management at the University of Pretoria conducting the interviews. The aim of the training was to inform the interviewers of the purpose of the questionnaire, the meaning of each question and techniques on how to conduct interviews.

This data collection approach is also subject to various errors such as data processing and/or interviewer error amongst others (Zikmund, 2003). In order to minimise the data processing error, results were captured centrally and the inputs were checked by a faculty member familiar with the automotive industry to ensure consistency in coding.

Finally, the study will be a cross-sectional study as the data will only be collected for a single point in time.

A copy of the questionnaire is attached in Appendix A. The questionnaire makes use of structured questions which increases the codability of answers. The questionnaire contains a large variety of topical questions which will increase the possibility of generating useful insights into the sample members' companies. However, since this study is specifically focused on understanding the innovation activities undertaken by the targeted firms, the additional questions included may pose a risk in requiring an unnecessarily long interview, which may leave the respondent frustrated or fatigued, resulting in additional response errors.

4.6 Data Analysis Approach

Since the data was recorded manually by the interviewer, the first step in the process was to capture the results into a database. Thereafter, the data was subject to an error checking and code verification process in order to ensure that all codes captured were legitimate.

The data was summarised using descriptive statistics such as frequency tables and cross tabulation amongst others (Zikmund, 2003). Simple analysis of this ordered data provided many useful insights from which deductions were drawn.

In order to determine the novelty of innovation on each type of innovation, namely, goods, services, manufacturing and logistics (dependent variables), ordinal values were assigned as per Table 1 on the following page.

Type of Innovation		Novelty of Innovation			
		Absent	New to the firm	New to the domestic market	New to the world
		(0)	(1)	(2)	(3)
Product	Goods				
	Services				
	Overall Product				
Process	Manufacturing				
	Logistics				
	Overall Process				
Total	*Overall Innovation*				

Table 1: Values Assigned to Novelty of Innovation

New scales were created to establish the extent of innovation by 'Overall Product' (Goods + Services) and 'Overall Process' (Manufacturing + Logistics), by adding the highest result for each type of innovation. Thus, the scores for 'Overall Product' and 'Overall Process' can range between 0 and 6. An 'Overall Innovation' score was also created by summing the results for 'Overall Product' and 'Overall Process', with a scoring range of between 0 and 12.

The independent variables being tested are:

- position in the value chain (OEM; ODM or OBM) and
- global connectedness, which consists of two possible linkages:
    - through sales to foreign buyers, or

- through corporate structure, i.e., a MNC subsidiary's relationship with its international head office.

In order to determine if there is any statistical significance in the relationship between the dependent variable and the independent variables, bivariate analysis was used to test the differences in location (Zikmund, 2003). The original approach to testing the independent variable, position in the value chain, was to use the Kruskal-Wallis test since there are three independent samples (Zikmund, 2003), However, due to the number and combination of firms that responded, creating three samples would have resulted in small sample sizes. Therefore it was decided to combine ODM and OBM firms into a group called OTH (Other), which represents all firms that partake in some form of design activity.

Furthermore, since the data is ordinal it is generally more appropriate to use non-parametric statistical procedures (Siegel, 1957). The objective was to test for differences in location between two samples, thus the non-parametric Mann-Whitney U test was used (Siegel, 1957). The Mann-Whitney U test allows for testing differences between groups when "the populations are not normally distributed or when it cannot be assumed that the samples are from populations that are equal in variability" (Zikmund,

2003, p. 543). As an added measure of caution, the Modified Levene test was used to check the samples for equal variances.

The Kolmogorov-Smirnov test was considered as an alternative when samples had unequal variances. The Kolmogorov-Smirnov test tries to determine if two samples differ significantly and is sensitive to differences in both location and shape. The disadvantage is that it isn't able to specify the reason for the difference, for example, location, skewness or kurtosis amongst others. Thus care was taken to check the result before assuming a difference is location exists. When numerous ties existed in a test, it was decided to read the results approximated with correction.

It is worth reminding the reader that the aim of the study is not to identify causal relationships, but rather to explore the aforementioned hypotheses with newly gathered empirical data.

4.7 Potential Research Limitations

These limitations of the research are:

- the scope of the research is limited to the South African automotive industry and cannot be used to make inferences about other industries or developing countries;

- the cross-sectional nature of the study limits the findings to a snap-shot in time as opposed to a longitudinal study which could reveal trends over time;
- the data collected for each element in the sample represents the view and knowledge of a single individual within the firm (although care was taken to remind the respondent to answer on behalf of the firm, his/her interpretation of what innovation means may not be consistent with other employees in the firm); and
- unobvious reasons for why innovation does or doesn't take place in the firm may not be uncovered, e.g. culture, tradition etc.

The following chapter presents the findings obtained from the data analysis as well as the results of the statistical tests.

5 Results

5.1 Participant Responses

As mentioned in section 4.4, NAACAM's database was used to identify the 174 companies that reflect almost the entire population of firms active in the automotive industry at the time the data was collected. Of the 174 companies identified, 76 companies participated in the research, yielding a response rate of 43.7%.

This research project focuses on investigating the impact of two possible drivers of innovation, namely 'Position in the Value Chain' and 'Global Linkages'. In the following sections, the respondents are categorised according to these two factors.

5.1.1 Position in the Value Chain

Figure 3 below displays the responses received, categorised by function, namely OEM, ODM and OBM.

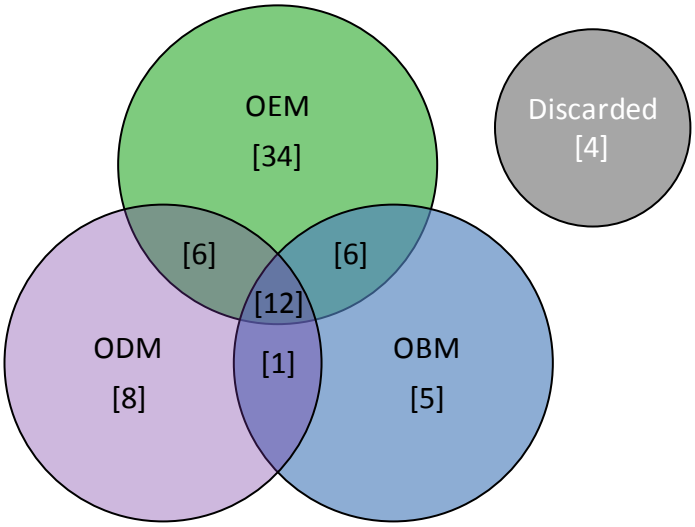


Figure 3: Responses Categorised by Function

Of the 76 responses returned, five required further investigation as it was not possible to categorise the participant based on the data captured. The investigation revealed that one firm could definitely be categorised as ODM, whilst the remaining four data could not be categorised and were discarded.

Thus, according to the definitions of OEM, ODM and OBM explained in section 2.3, it can be deduced that 38 of the 76 respondents partake in some form of design activity (ODM or OBM, hereafter referred to as OTH), whilst 34 respondents manufacture strictly according to the designs provided by the buyer (OEM), four respondents remain uncategorised.

5.1.2 Destination of Sales

Using a firm's destination of sales as an indicator of whether it has local or global linkages, the respondents can be categorised as per Figure 4 below:

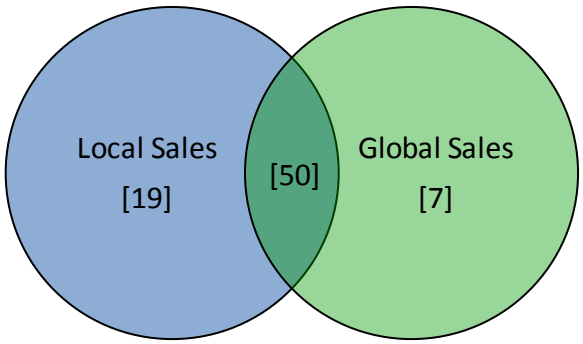


Figure 4: Responses Categorised by Destination of Sales

Thus, 57 respondents interact with global buyers, whereas 19 respondents have local linkages only.

5.1.3 Local Firm or Subsidiary of an MNC

In terms of whether the respondent is a subsidiary of a MNC or a firm with local-linkages only:

- 47 respondents are subsidiaries of firms with a foreign head office;
- 15 respondents are single plant firms with a local head office;
- 12 respondents are subsidiaries of local firms; and
- 2 respondents are the head offices of local firms.

Thus, 47 respondents have global linkages owing to the structure of the enterprise group they belong and 29 respondents have local linkages (see Figure 5 below).

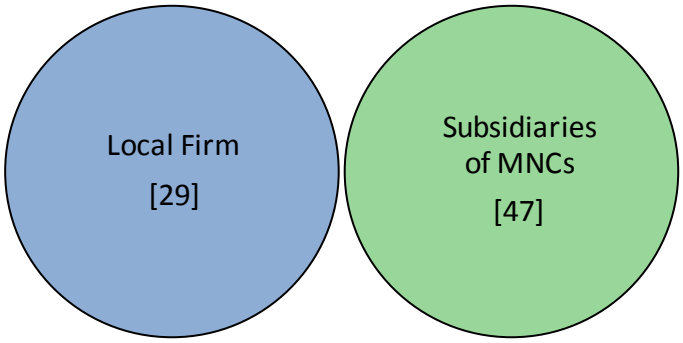


Figure 5: Responses Categorised by Corporate Structure

It must be noted that two responses required further investigation. One firm's head office location was captured as 'unknown', however, it was later found out to be in the United States of America. The other firm stated that it was part of an enterprise group with a head office in Germany, but a value was not captured indicating whether it was the head office or a subsidiary. Since the firm has a physical location in Port Elizabeth, it was deemed to fit the profile of a subsidiary.

5.2 Questionnaire Descriptive Statistics

A summary of the type and extent of innovation being performed by the respondents is shown in Figure 6 below.

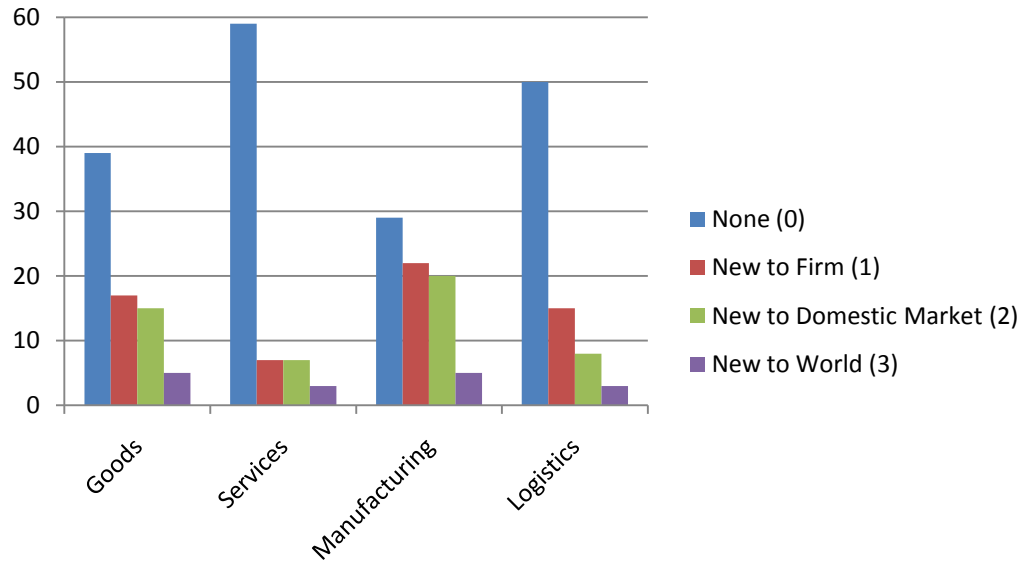


Figure 6: Type and Extent of Innovation Activity

From Figure 6 above and Table 2 on the following page, it can be seen that the most frequent type of innovation undertaken by respondents relates to manufacturing processes, followed by innovation of goods. The least frequent innovation activity takes place on services. In terms of the extent of innovation, the majority of innovations are new to the firm, followed by the domestic market and lastly, the world.

Innovation Type		Extent of Innovation				Total
		None (0)	New to Firm (1)	New to Domestic Market (2)	New to World (3)	
Product	**Goods**	39	17	15	5	**76**
	Services	59	7	7	3	**76**
Process	**Manufacturing**	29	22	20	5	**76**
	Logistics	50	15	8	3	**76**
Total		**177**	**61**	**50**	**16**	

Table 2: Type and Extent of Innovation Activity

Table 3 below provides the descriptive statistics for each type of innovation per category of firm.

Innovation Type		Category	OEM	OTH	Local Sales	Global Sales	Local Firm	Global Subsidiary
		Count of Firms	34	38	19	57	29	47
Product	Goods	Mean	0.765	0.842	0.474	0.930	0.828	0.809
		Std Dev	0.987	0.973	0.772	1.015	0.966	0.992
		Std Error	0.169	0.158	0.177	0.134	0.179	0.145
		Range	3	3	2	3	3	3
	Services	Mean	0.382	0.395	0.158	0.474	0.448	0.362
		Std Dev	0.922	0.718	0.501	0.889	0.827	0.819
		Std Error	0.158	0.116	0.115	0.118	0.154	0.119
		Range	3	2	2	3	3	3
	Overall Product	Mean	1.147	1.237	0.632	1.404	1.276	1.170
		Std Dev	1.579	1.441	1.065	1.591	1.556	1.494
		Std Error	0.271	0.234	0.244	0.211	0.289	0.218
		Range	6	5	4	6	5	6

Innovation Type		Category	OEM	OTH	Local Sales	Global Sales	Local Firm	Global Subsidiary
		Count of Firms	34	38	19	57	29	47
Process	Manufact-uring	Mean	1.265	0.789	0.632	1.140	1.172	0.915
		Std Dev	0.994	0.875	0.831	0.972	1.037	0.905
		Std Error	0.171	0.142	0.191	0.129	0.193	0.132
		Range	3	3	2	3	3	3
	Logistics	Mean	0.676	0.342	0.474	0.544	0.379	0.617
		Std Dev	0.945	0.669	0.772	0.867	0.775	0.874
		Std Error	0.162	0.109	0.177	0.115	0.144	0.127
		Range	3	3	2	3	3	3
	Overall Process	Mean	1.941	1.132	1.105	1.684	1.552	1.532
		Std Dev	1.650	1.095	1.487	1.454	1.270	1.600
		Std Error	0.283	0.178	0.341	0.193	0.236	0.233
		Range	6	3	4	6	4	6
Total	Overall Innovation	Mean	3.088	2.368	1.737	3.088	2.828	2.702
		Std Dev	2.586	2.019	2.104	2.422	2.221	2.536
		Std Error	0.444	0.328	0.483	0.321	0.412	0.370
		Range	12	8	8	12	8	12

Table 3: Type and Extent of Innovation Activity per Firm Category

5.3 Hypothesis Testing

This research project is investigating the effect that two factors, namely position in the value chain and global connectedness have on a firm's propensity to innovate and upgrade. The proposed hypotheses seek to

establish whether these drivers do have an impact on innovation and more specifically, the type of innovation, i.e. product or process innovation.

Hypothesis 1a: OEMs will be more innovative on processes than OTHs (ODMs and OBMs)

By definition, OEM firms manufacture according to design provided by buyers, whilst OTH firms perform some or all of the design activity themselves. Thus, Hypothesis 1a asserts that OEM firms innovate more than OTH firms on process.

Table 4 below demonstrates the results of the t-test performed for innovation on **Overall Process (manufacturing + logistics)**.

Results		OEM	OTH
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		6	
Approximation with Correction	Z-Value	2.0695	
	Probability Level	0.0192	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 4: Test Results for Innovation on Overall Process

A z-value of 2.0695 and a p-value of 0.0192, which is well within the significance level of 0.05, means that the null hypothesis is not accepted

and thus the difference in means between OEM and OTH for manufacturing processes is statistically significant.

Comparing the extent of manufacturing process innovation, Table 5 below shows a p-value of 0.0178 is achieved which means that the null hypothesis is not accepted and thus the difference in means between OEM and OTH for manufacturing processes is statistically significant.

Results		**OEM**	**OTH**
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	2.1011	
	Probability Level	0.0178	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 5: Test Results for Innovation on Manufacturing Processes

When performing the test for logistics processes, a p-value of 0.0597 was achieved which is slightly outside the significance level of 0.05 and thus the null hypotheses is accepted. Although the OTH mean is greater than the OEM mean, the difference is only marginally significant at a level of 0.01. Typically, a larger sample will show significance (see Table 6 below).

Results		OEM	OTH
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	1.5569	
	Probability Level	0.0597	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 6: Test Results for Innovation on Logistics Processes

Hypothesis 1b: OTHs (ODMs and OBMs) will be more innovative on products than OEMs

Hypothesis 1b surmises that OEM firms will innovate less than OTH firms on product as the product designs are provided to them by the buyers. OTH firms on the other hand, need to perform some or all of the design activity for the products they manufacture.

Table 7 below demonstrates the results of the T-Test performed for innovation on **Overall Product (goods + services)**.

Results		OEM	OTH
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		5	
Approximation with Correction	Z-Value	-0.5255	
	Probability Level	0.2996	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 7: Test Results for Innovation on Overall Products

A z-value of -0.5255 and a p-value of 0.2996, which is outside the significance level of 0.05, means that we accept the null hypothesis and thus the difference in means between OEM and OTH goods is non-significant.

Analysing the extent of innovation in terms of goods and services yields a similar result with p-values of 0.3541 and 0.2522 respectively. In both cases the results are non-significant at a level of 0.05. Table 8 and Table 9 below show the results for these tests.

Results		**OEM**	**OTH**
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	-0.3742	
	Probability Level	0.3541	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 8: Test Results for Innovation on Goods

Results		**OEM**	**OTH**
Sample Size		34	38
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	-0.6675	
	Probability Level	0.2522	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 9: Test Results for Innovation on Services

Hypothesis 2a: Firms with local-only sales will be less innovative on products and processes than firms with global sales

According to the literature reviewed in chapter 2, firms with global linkages will innovate more than domestically-focused firms on both products and processes as they benefit greatly from the exchange of information and technology obtained via their interactions with global buyers. Hypothesis 2a asserts that a form of global linkage can be established through sales to global buyers and thus firms with local-only sales will innovate less than firms with global sales.

Table 10 below contains the results of the test performed for **Overall Innovation (Overall Product + Overall Process)**.

Results		Local Sales	Global Sales
Sample Size		19	57
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		8	
Approximation with Correction	Z-Value	-2.3249	
	Probability Level	0.0100	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 10: Test Results for Overall Innovation

A p-value of 0.0100 was obtained which it well within the 0.05 level of significance and the null hypothesis is not accepted. Thus there is overwhelming support for the difference in extent of Overall Innovation

between firms with global linkages through sales and firms with local linkages only.

Table 11 below contains the results for the tests of assumptions for **Overall Product (goods + services)**.

Results		**Local Sales**	**Global Sales**
Sample Size		19	57
Skewness Normality		Reject Normality	
Kurtosis Normality		Reject Normality	
Omnibus Normality		Reject Normality	
Modified-Levene Equal-Variance Test		Reject equal variances	
No of Ties		5	
Mann-Whitney Approximation with Correction	Z-Value	-1.8957	
	Probability Level	0.0290	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 11: Test Results for Innovation on Overall Products

The use of the Kolmogorov-Smirnov (K-S) test was considered due to the rejection of equal variances, however since the skewness, kurtosis and omnibus tests all reject normality in this case, the K-S test will be influenced by these differences and the result may not be truly representative of the differences in location. Since the Mann Whitney U test focuses only on central tendency, which is the objective of this research project, it was decided to use the M-W test results.

A z-value of -1.8957 and a p-value of 0.0290, which is less than the significance level of 0.05, means that the null hypothesis cannot be accepted and thus the difference in means for innovation on products is statistically significant.

Similar tests were performed for goods and services which yielded p-values of 0.0391 and 0.0736 respectively. These significant and marginally significant results demonstrate strong support that firms with global linkages through sales innovate more on products than firms with local linkages only. The detailed results can be found in Appendix D.

Table 12 below demonstrates the results of the T-Test performed for innovation on **Overall Process (manufacturing + logistics)**.

Results		**Local Sales**	**Global Sales**
Sample Size		19	57
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		6	
Approximation with Correction	Z-Value	-1.6378	
	Probability Level	0.0507	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 12: Test Results for Innovation on Overall Processes

A z-value of -1.6378 and a p-value of 0.0507, which is marginally outside the significance level of 0.05, means that the null hypothesis cannot be accepted, although larger sample sizes will typically show significance.

Table 13 and Table 14 below demonstrate the results of the T-Tests performed for innovation on **manufacturing and logistics processes** respectively.

Results		Local Sales	Global Sales
Sample Size		19	57
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	-1.9958	
	Probability Level	0.0230	
	Significance Level	0.05	
	Accept Null Hypothesis	No	

Table 13: Test Results for Innovation on Manufacturing Processes

Results		Local Sales	Global Sales
Sample Size		19	57
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		4	
Approximation with Correction	Z-Value	-0.2426	
	Probability Level	0.4041	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 14: Test Results for Innovation on Logistics Processes

A p-value of 0.0230 for manufacturing processes is well within the 0.05 level of significance and thus the null hypothesis is rejected. This proves that

firms with global linkages through sales are more innovative on manufacturing processes than firms with local linkages only. In terms of logistics processes, a p-value of 0.4041 mean the results were non-significant and the null hypothesis is accepted. The detailed results can be found in Appendix D.

Hypothesis 2b: Local-only firms will be less innovative on products and processes than subsidiaries of MNCs

Another global linkage can be found through the corporate structure of an organisation. South African subsidiaries of MNCs have global linkages via their relationships with their international head offices and/or fellow subsidiaries of the same MNC. Hypothesis 2b surmises that local firms will innovate less than subsidiaries of MNCs due to the lack of global linkages.

Table 15 below demonstrates the results of the T-Test performed for innovation on **Overall Product (goods + services)**.

Results		Local Firms	MNC Subsidiaries
Sample Size		29	47
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		5	
Approximation with Correction	Z-Value	0.3265	
	Probability Level	0.6280	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 15: Test Results for Innovation on Overall Products

A z-value of 0.3265 and a p-value of 0.6280, which is much greater than the significance level of 0.05, means that the null hypothesis cannot be rejected and thus the difference in means for innovation on products is not statistically significant.

Further investigation into the sub-components of product innovation, namely goods and services yielded p-values of 0.5738 and 0.7730 respectively. Both these results are non-significant and thus there is no support for the thought that firms with global linkages via their corporate structures are more innovative on product than firms with local linkages only. The detailed results can be found in Appendix E.

Table 16 below demonstrates the results of the T-Test performed for innovation on **Overall Process (manufacturing + logistics)**.

Results		**Local Firms**	**MNC Subsidiaries**
Sample Size		29	47
Modified-Levene Equal-Variance Test		Cannot reject equal variances	
No of Ties		6	
Approximation with Correction	Z-Value	0.4607	
	Probability Level	0.6775	
	Significance Level	0.05	
	Accept Null Hypothesis	Yes	

Table 16: Test Results for Innovation on Overall Processes

A z-value of 0.4607 and a p-value of 0.6775, which is much greater than the significance level of 0.05, means that the null hypothesis cannot be rejected and thus the difference in means for innovation on services is not statistically significant. Similar to the result achieved on Products, there is no support for the hypothesis that firms with global linkages via their corporate structures are more innovative on processes than firms with local linkages only.

Furthermore, the test results for the overall process sub-components of manufacturing and logistics yielded a non-significant p-value of 0.8525 and a marginally significant p-value of 0.0828 respectively. The detailed results can be found in Appendix E.

5.4 Checks for Robustness

At first, the respondents were categorised by position in the value chain and global linkage (destination of sales or corporate structure) as per Figure 7 and Figure 8 respectively.

Global Sales	26	31
Local Sales	8	11
	OEM	OTH

Figure 7: Respondents Categorised by Position in the Value Chain and Destination of Sales

MNC Subsidiary	20	27
Local Firm	14	15
	OEM	OTH

Figure 8: Respondents Categorised by Position in the Value Chain and Corporate Structure

Since the sample sizes in some of these categories are too small for meaningful analysis, it was decided to perform the analysis between samples made up of position in the value chain and global linkage and not a combination of the two.

.

6 Discussion of Results

The aim of this research was to establish whether the automotive component manufacturers located in South Africa are taking advantage of their participation in global value chains to functionally upgrade. Two factors, namely position in the value chain and global connectedness were assessed in terms of their effect on the propensity for firms to innovate and upgrade.

The hypotheses being tested were:

Hypothesis 1a: OEMs will be more innovative on processes than OTHs (ODMs and OBMs)

Hypothesis 1b: OTHs (ODMs and OBMs) will be more innovative on products than OEMs

Hypothesis 2a: Firms with local-only sales will be less innovative on products and processes than firms with global sales

Hypothesis 2b: Local-only firms will be less innovative on products and processes than subsidiaries of MNCs

In general, evidence exists that innovation is taking place on both product and process and on no less than 16 instances, the innovations were new to the world. This is a noteworthy finding given that the automotive assemblers

that lead these global value chains continue to push the tenets of 'follow design' and 'follow sourcing'. It may be possible that the 'new to the world' innovations are destined for the aftermarket. Nonetheless, they are still remarkable achievements.

Hypothesis 1a: OEMs will be more innovative on processes than OTHs (ODMs and OBMs)

From the results presented in section 5.3.1, there is statistical support for theory that OEMs innovate more on processes than OTHs since the result for Overall Process innovation is significant at the 0.05 probability level. Further investigation reveals that the difference in manufacturing process innovation between OEMs and OTHs is also statistically significant and the 0.05 level, whilst logistics innovation is marginally significant. Thus the hypothesis is well supported.

As mentioned by Barnes and Kaplinsky (2000), competition in the 'commoditised' part of the value chain, i.e., manufacturing is extremely intense as firms compete predominantly on cost to secure high volume contracts from global buyers. One approach to reducing costs is through process improvement. However, focussing solely on reducing costs as a strategy to being competitive ultimately drives down the margins of firms

who remain in the part of the value chain. In order to avoid a race to the bottom, Giuliani et al. (2005) suggest that firms need to undergo a process of upgrading to higher parts of the value chain, such as design, in order to improve their competitiveness.

Hypothesis 1b: OTHs (ODMs and OBMs) will be more innovative on products than OEMs

Whether the results are analysed at the lower level, i.e., innovation on goods or services, or at an overall product level (goods and services combined), the results do not statistically support the hypothesis. An interesting point to note is that the OTH's mean for innovation on goods, services and overall product is greater than the OEM's mean. Whilst there may not be support at a significance level of 0.05, the results are at least in the correct direction as suggested by the theory.

These results could possibly indicate that firms are in the process of upgrading, but the level of upgrading across the industry hasn't reached a significant level as yet. This is evidenced by the fact that 16 of the 34 OEM firms indicated that they performed some form of product innovation. By definition, OEMs are supposed to manufacture to design and thus shouldn't be engaged in any product innovation. This could indicate that these new

products being innovated did not contribute to sales at the time when the data was collected. If sales from these product innovations have since been recorded, it would demonstrate that the firms have upgraded from OEM to ODM or OBM positions in the value chain. This is discussed further in the recommendations for further research below.

At the point in time when the research was conducted, the value chain theory that defines what type of activities take place in the different parts of the chain is only partially supported.

Hypothesis 2a: Firms with local-only sales will be less innovative on products and processes than firms with global sales

When comparing overall innovation (product and process combined), the hypothesis is supported at a significance level of 0.05. Across all four types of innovation, goods, services, manufacturing and logistics, the means of firms with global sales is greater than those with local sales only. When conducting the analysis on the lower level, statistically significant support was found for goods and manufacturing processes and marginal support was found for services.

These results strongly support the theory that firms with global linkages benefit from access to knowledge and technology thus enhancing innovation (Pietrobelli and Rabellotti, 2008). It is clear that in some way or form, firms with global exposure are afforded opportunities to learn from global buyers (Giuliani et al. 2005) and (in most cases) are exploiting these opportunities to upgrade their capabilities. The caveat of 'in most cases' is added since there are nine firms with global sales that did not engage in any form of product or process innovation at the time of the study.

Even with the non-innovating firms included in the test, the one type of global linkage, i.e., interaction with global buyers has been proven to be a driver of innovation. The next hypothesis tests whether the factor of corporate structure is also a driver of innovation.

Hypothesis 2b: Local-only firms will be less innovative on products and processes than subsidiaries of MNCs

When comparing local firms to their global subsidiary counterparts, there was no statistically significant support for one group being more innovative than the other group in any of the areas of innovation, even though the local firms achieved a greater mean score on goods, services and manufacturing processes. These non-significant results contrast to those achieved in the

previous hypothesis. Thus, innovation does not automatically happen as a result of global linkages, but rather on the type of linkage in place.

This supports Marin and Bell (2006) who conducted an investigation into the relationship between structural positions and functional integration of Argentine subsidiaries within their global corporation, global market and local economy and the impact on innovative activity within these subsidiaries. It was found that “subsidiaries with differing structural positions with respect to local/global integration [....] differ significantly in the levels and types of innovative activity they undertake” (Marin and Bell, 2006, p.3).

In this instance, it seems possible that the tendency for MNCs to centralise value-added functions such as design, may reduce the need for subsidiaries to innovate through a ‘no need to reinvent the wheel’ type mentality (Lorentzen and Barnes, 2004). Since local firms don’t have the benefit of an international head office from which to learn and draw knowledge and technology, they are forced to innovate themselves in order increase competitiveness.

Whilst these findings don’t support the hypothesis in question, a positive alternative outcome is that the dim conclusion made by some observers that developing country firms are likely to lose design and engineering

capabilities to the centralised functions of their MNCs (Lorentzen and Barnes, 2004) is also untrue. This research project provides ample evidence that subsidiaries of MNCs in the domestic market are engaging in innovation activities, which supports the findings in Craig and DeGregori (2000); Humphrey and Memedovic (2003); Lorentzen and Barnes (2004); and Lorentzen et al. (2003).

7 Conclusion

The research set out to determine the impact that factors of position in the value chain and global connectedness have on the type and extent of innovation within automotive component manufacturers in South Africa. The literature within this field of research contains some conflicting arguments on how these factors impact innovation and upgrading in this and other sectors.

The studies performed to date in the South African context have mostly been qualitative, utilising case study methodology to identify trends in innovation and determine the forces at play. This study took a departure from this approach and attempted to make use of a qualitative methodology to investigate the theory and analyse the various factors at play.

7.1 Main Findings

The research found a statistically significant difference between the level of process innovation undertaken by OEMs versus OTHs, with OEMs being more innovative in terms of process. This result supported the theory that has been tested in other international markets for both the automotive and other industries. In terms of product innovation, there was no statistical

evidence to say that OTHs are significantly more innovative than OEMs. However, an interesting finding is that some firms who attribute 100% of their sales to OEM activity indicated that they engaged in some form of product innovation. This could possibly be a sign of upgrading in progress.

When analysing the effect that global connectedness has on innovation in locally-based firms, a statistically significant result was achieved when testing connectedness through foreign sales, but a non-significant result was achieved for connectedness through corporate structures. Although this does not prove causality, the finding seems to infer that connectedness to global markets or global buyers increases the extent of innovation in both product and processes.

Thus, it can be concluded for South African automotive component manufacturers, that whilst participation in global value chains seems to induce innovation, it does not necessarily guarantee that innovation will occur nor does it mean that innovation will automatically result in upgrading.

Furthermore, the data collected clearly provides evidence that innovation is occurring within local manufacturing base and supports Lorentzen and Barnes' (2004) dismissal of the arguments that indigenous innovation simply does not happen. It is important that a longitudinal study is

conducted in future to determine whether the innovation activity is on the increase or decrease, before conclusions can be made as to whether South African automotive component manufacturers are winning or losing the battle of competitiveness against their developing country opponents.

7.2 Implications for Government and Business

Participation in global value chains can stimulate learning and the acquisition of technological capabilities. However, upgrading is not automatically guaranteed simply by participating - it requires active effort and investment by firms and support from public agencies (Humphrey, 2004).

Sturgeon and Lester (2002) emphasise the importance of basic policies to support upgrading:

- In order to promote investment by firms in learning, building technological capability and capital equipment, macroeconomic stability and inexpensive credit rates into the future are required; and
- Basic education for general employees and advanced education for engineers and technical employees is needed to enable the evolution up the value chain;

Humphrey (2004) identifies additional policy areas for attention such as:

- Policies to support the development of infrastructure since well-developed infrastructure aids reliability of supply, improves efficiency and contributes towards overall competitiveness;
- Favourable labour migration policies that allow easier access to specialist foreign skills required to support the critical learning process; and
- Trade agreements should be negotiated carefully so as to facilitate and not impede upgrading, such as “preferential access schemes that restrict local content” (p.35).

Miotti and Sachwald (2001) echo these recommendations in their study into how Korean multinationals achieved such extraordinary success. They observed that amongst other interventions:

- Korea invested heavily in education, focussing on developing engineers and technicians;
- Various policies were implemented that combined protection of the domestic market from foreign competition with some competitive motivation from export markets; and
- A range of instruments were introduced to encourage private investment in R&D.

In addition to support from government, firms also have a role to play in upgrading their own capabilities. After all, the ability of a firm to upgrade is dependent on its absorptive capacity and it is up to the leaders of these firms to promote the development of knowledge conversion mechanisms so that knowledge obtained from participation in global value chains can be effectively internalised (Ernst and Kim, 2002). This is critical since "technological transfer and learning largely take place at the level of the firm, while the national environment is mostly a conducive or inhibitive factor" (Miotti and Sachwald, 2001, p.129).

7.3 Recommendations for Future Research

A number of recommendations can be made to increase the insights into the drivers and extent of innovation in the South African automotive component manufacturing industry.

Firstly, the findings in this study speculate that some form of upgrading is taking place and this proposition can be better investigated by means of a longitudinal study. Analysing these firms' innovation activities over time will enable researchers to establish the upgrading trajectory being followed by the respective firms and confirm whether upgrading is indeed happening or whether firms are stuck in their respective positions in the value chain.

Secondly, it would be worthwhile to investigate in more detail the global relationships and sources of information, technology and learning that are enabling these firms to innovate. This will establish if upgrading is being supported by the buyers or if it is being left to the firm to seek inputs from the market, as Giuliani et al. (2005) found in Latin American Clusters, and would provide a deeper insight into how global connectedness or the lack thereof impacts innovation activities.

Lastly, a larger sample size always increases the statistical significance of the results and any attempt to get additional firms to participate in the study is always recommended.

In closing, Zakaria (2010) made this sobering comment about the threat from China to the U.S. economy, “The real challenge we face from China is not that it will keep flooding us with cheap goods. It's actually the opposite: China is moving up the value chain, and this could constitute the most significant new competition to the U.S. economy in the future” (para. 7). This statement is equally sobering for many other developed and developing countries that are not aggressively taking action to improve their firms’ competitiveness.

8 Reference List

Altenburg, T., Schmitz, H., & Stamm, A. (2007). Breakthrough China's and India's transition from production to innovation. *World Development*, *36(2),* 325-344. doi:10.1016/j.worlddev.2007.06.011.

Archibugi, D., & Iammarino, S. (2002). The globalization of technological innovation: definition and evidence. *Review of International Political Economy*, *9(*1*),* 98-122. doi:10.1080/09692290110101126

Archibugi, D., & Pietrobelli, C. (2003). The globalisation of technology and its implications for developing countries: Windows of opportunity or further burden? *Technological Forecasting and Social Change*, *70(*9*),* 861-883. doi:10.1016/S0040-1625(02)00409-2.

Arndt, S., & Kierzkowski, H. (2001). Introduction. In S. Arndt & H. Kierzkowski (Eds.), *Fragmentation: New production patterns in the world economy* (pp. 1-16). Retrieved from http://books.google.co.za/books?hl=en&lr=&id=UI_psyz3TaQC&oi=fnd&pg=PA52&dq=Fragmentation:+New+production+patterns+in+the+world+economy+&ots=vVhehUcoK8&sig=By25TUmXJs0OK-YoKukl5PmrX4Y#v=onepage&q&f=false

Ballard R. (2001). *Preliminary study on the bovine leather value chain in South Africa*. University of KwaZulu Natal, Durban. Retrieved from http://www.sds.ukzn.ac.za/files/rr40.pdf

Barnes, J., & Kaplinsky, R. (2000). Globalization and the death of the local firm? The automobile components sector in South Africa. *Regional Studies*, *34(9),* 797-812. doi:10.1080/00343400020002949

Beugelsdijk, S., Pedersen, T., & Petersen, B. (2009). Is there a trend towards global value chain specialization? - An examination of cross border sales of US foreign affiliates. *Journal of International Management*, *15(2),* 126-141. doi:10.1016/j.intman.2008.08.002

Black, A. (2001). Globalization and restructuring in the South African automotive industry. *Journal of International Development, 13(*6*),* 779-796. doi:10.1002/jid.812

Craig, S.G., & DeGregori, T.R. (2000). The forward and backward flow of technology: the relationship between foreign suppliers and domestic technological advance. *Technovation, 20,* 403–412. doi:10.1016/S0166-4972(00)00008-0

Dosi, G., Marsili, O., Orsenigo, L., & Salvatore, R. (1995) Learning, market selection and the evolution of market structure. *Small Business Economics*, *7(*6*),* 411–436. doi:10.1007/BF01112463

Ernst, D., & Kim, L. (2002). Global production networks, knowledge diffusion, and local capability formation. *Research Policy, 31,* 1417-1429. doi:10.1016/S0048-7333(02)00072-0

Feenstra, R. (1998). Integration of trade and disintegration of production in the global economy. *Journal of Economic Perspectives*, *12(*4*),* 31–50. Retrieved from http://0-www.jstor.org.innopac.up.ac.za/stable/2646893

Gereffi G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, *48(*1*),* 37-70. doi:10.1016/S0022-1996(98)00075-0.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12(*1*),* 78-104. doi:10.1080/09692290500049805

Geroski, P., Machin, S., & Van Reenen, J. (1993). The profitability of innovating firms. *The Rand Journal of Economics, 24(2),* 198–211. Retrieved from http://0-www.jstor.org.innopac.up.ac.za/stable/2555757

Giuliani, E., Pietrobelli, C., & Rabellotti, R. (2005). Upgrading in global value chains: Lessons from Latin American clusters. *World Development, 33(4),* 549-573. doi:10.1016/j.worlddev.2005.01.002

Humphrey, J. (2004, May). *Upgrading in global value chains.* Paper presented at the meeting of the Policy Integration Department, World Commission on the Social Dimension of Globalization, International Labour Office, Geneva.

Humphrey, J., & Memedovic, O. (2003). *The global automotive industry value chain: What prospects for upgrading by developing countries?* Sectoral studies series, United Nations Industrial Development Organisation, Vienna

Jenkins, C., & Siwisa, N. (1997, September). *Overview of trade policy in South Africa*. Paper presented at Trade and Industry Policy Secretariat Annual Forum, Johannesburg.

Kaplinsky, R. (2000). Globalisation and unequalisation: What can be learned from value chain analysis? *Journal of Development Studies*, *37(2),* 117-146. doi:10.1080/713600071

Kogut, B., & Zander, U. (2003). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies*, *34(*6*),* 516-529. doi:10.1057/palgrave.jibs.8400058

Kotabe, M., & Murray, J. (2004). Global sourcing strategy and sustainable competitive advantage. *Industrial Marketing Management*, *33(*1*),* 7-14. doi:10.1016/j.indmarman.2003.08.004.

Lall, S., Albaladejo, M., & Zhang, J. (2004). Mapping fragmentation: Electronics and automobiles in East Asia and Latin America. *Oxford Development Studies*, *32(*3*),* 407-432. doi:10.1080/1360081042000260601

Lautier, M. (2001). The international development of Korean automobile industry. In F Sachwald (Ed.), *Going multinational: The Korean experience of direct investment* (pp. 207-274). London: Routledge.

Lee, K. (2001). Technological catching-up through overseas direct investment: Samsung's camera business. In F Sachwald (Ed.), *Going multinational: The Korean experience of direct investment* (pp. 275-314). London: Routledge.

Lorentzen, J. (2005). The absorptive capacities of South African automotive component suppliers. *World Development, 33(7),* 1153-1182. doi:10.1016/j.worlddev.2005.04.006

Lorentzen, J., & Barnes, J. (2004). Learning, upgrading and innovation in the South African automotive industry. *The European Journal of Development Research*, *16(*3*),* 465-498. doi:10.1080/09578810420002 66598

Lorentzen, J., Møllgaard, P., & Rojec, M. (2003). Host-country absorption of technology: Evidence from automotive supply networks in Eastern Europe. *Industry and Innovation*, *10(*4*),* 415–432. doi:10.1080/1366271032000163658

Malerba, F., & Orsenigo, L. (1995). Technological regimes and sectoral patterns of innovative activities. *Industrial and Corporate Change, 6(*1*),* 83-118. Retrieved from http://0-icc.oxfordjournals.org.innopac.up.ac.za/cgi/content/abstract/6/1/83

Marin, A., & Bell, M. (2006, June). *Knowledge innovation and competitiveness: Dynamics of firms, networks, regions and institutions*. Paper presented at the DRUID Summer Conference, Copenhagen Business School, Denmark.

Miotti, L., & Sachwald, F. (2001). Korean multinationals' strategies and international learning. In F Sachwald (Ed.), *Going multinational: The Korean experience of direct investment* (pp. 127-166). London: Routledge.

Moscovitz, I. (2010, April 14.) The coming financial time bomb. *The Motley Fool*. Retrieved from http://www.fool.com/investing/value/2010/04/14/the-coming-financial-time-bomb.aspx

Pietrobelli, C., & Rabellotti, R. (2008, September). *Innovation systems and global value chains.* Paper presented at the IV Global Conference Centre, Mexico City.

Sachwald, F. (2001). Emerging multinationals: The main issues. In F Sachwald (Ed.), *Going multinational: The Korean experience of direct investment* (pp. 1-16). London: Routledge.

SAinfo reporter. (2008, September). *Latest Key Indicators*. Retrieved from http://www.southafrica.info/business/economy/sectors/automotive-overview.htm

Siegel, S. (1957). Nonparametric statistics. *The American Statistician, 11(*3*)*, 13-19. Retrieved from http://0-www.jstor.org.innopac.up.ac.za/stable/2685679

Sturgeon, T. (2002). Modular production networks: A new American model of industrial organization. *Industrial and Corporate Change*, *11(*3*):* 451-495. doi:10.1093/icc/11.3.451

Sturgeon, T., & Lester, R. (2002, January). *Upgrading East Asian industries: New challenges for local suppliers.* Paper prepared for the World Bank project on East Asia's economic future. Cambridge MA, Industrial Performance Centre, MIT.

Sturgeon, T., & Lester, R. (2003, February). *The new global supply base: New challenges for local suppliers*. Paper prepared for the World Bank project on East Asia's economic future, Cambridge MA, Industrial Performance Centre, MIT.

Sturgeon, T., Memedovic, O., Van Biesebroeck, J., & Gereffi, G. (2009). Globalisation of the automotive industry: main features and trends. *International Journal of Technological Learning, Innovation and Development, 2(*1-2*),* 7-24. Retrieved from http://0-inderscience.metapress.com.innopac.up.ac.za/link.asp?id=e26858k073188471

United Nations Conference on Trade and Development. (2002).*Trade and Development Report.* Geneva. Retrieved from http://www.unctad.org/en/docs/tdr2002_en.pdf

United Nations Industrial Development Organisation. (2002). *Industrial Development Report 2002/2003: Competing through innovation and learning.* Retrieved from http://www.unido.org/fileadmin/user_media/Publications/Pub_free/Industrial_development_report_2002_2003.pdf

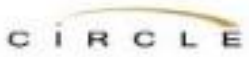
Von Stamm, B. (2008). *Managing innovation, design and creativity.* West Sussex: John Wiley & Sons Ltd.

Zakaria, F. (2010, October 7). The real challenge from China: its people, not its currency. *Time*. Retrieved from http://www.time.com/time/world/article/0,8599,2024090,00.html

Zikmund, W. (2003). *Business research methods.* Ohio: South-Western.

Appendices

Appendix A: Questionnaire



Insert logo of partner institution here

QUESTIONNAIRE FOR FIRMS

"INNOVATION-BASED STRATEGIES FOR GLOBALIZATION"

Questionnaire for "AUTOMOTIVE COMPONENT"

(SOUTH AFRICA)

Person that makes the interview_____

Date of the interview_____

NOTE: Please answer all questions in relation to the status and activities of your unit in 2007

Project – South Africa AUTOMOTIVE COMPONENT

I. COMPANY BACKGROUND

1. Company name _____

2. Is this unit....
☐ A single plant firm
☐ Part of an enterprise group[1] . If part of an enterprise group, this unit is
☐ The head office ☐ A subsidiary

In which country is the head office of your group located?_____

If your unit is part of an enterprise group, please answer all subsequent questions in relation to this plant in SOUTH AFRICA only.

Do not include results from parent or other enterprises outside of SOUTH AFRICA

3. Year of establishment in South Africa _____
4. Location city of this unit _____
5. Web site _____

6. Ownership

☐ Percentage of domestic capital _____%
☐ Percentage of foreign capital _____%

7. Number of employees (average full-time equivalent for 2007)
☐ 1-9 ☐ 50-99 ☐ 250-499 ☐ 1000-2499
☐ 10-49 ☐ 100-249 ☐ 500-999 ☐ More than 2500

8. Please indicate the total sales (in 2007)

Estimation of total sales in RAND _____

Or, alternatively[2]:

☐ Less than 2 million US$ ☐ Between 10-50 million US$ ☐ More than 100 million US$
☐ Between 2-10 million US$ ☐ Between 50-100 million US$

9. Please indicate the estimated percentage of your company's sales according to the following categories:

	% sales
Products **manufactured by your unit** according to design specifications provided by external buyers (*Original Equipment Manufacturing – OEM*)	
Products **developed and designed by your unit according to performance requirements of buyers** (*Original Design Manufacturing – ODM*)	
Products **developed and designed by your unit** and sold under your **own brand** (*Original Brand Manufacturing – OBM*)	
Others (please describe)	

1

Project – South Africa AUTOMOTIVE COMPONENT

10. a Please indicate the destinations of your sales in 2007 (estimated percentage on total sales)

Destination	**% sales**
Domestic market	
North America (US and Canada)	
Western Europe[3]	
Africa (except domestic)	
Other, please specify_____	
	100%

10. b Click here ☐ if you estimate that more than 50% of your domestic sales are further exported to international markets

11. Please indicate the origin of suppliers in 2007 (estimated percentage on total purchases)

Origin	% purchases
Domestic market	
North America (US and Canada)	
Western Europe[4]	
Africa (except domestic)	
Other, please specify_____	
	100%

12. Please indicate to which segments in the automotive industry you supply your main product.

Light vehicles:

☐ Passenger cars
☐ Commercial vehicles

High commercial vehicles:

☐ Medium-heavy commercial vehicles
☐ Heavy trucks
☐ Buses and coaches

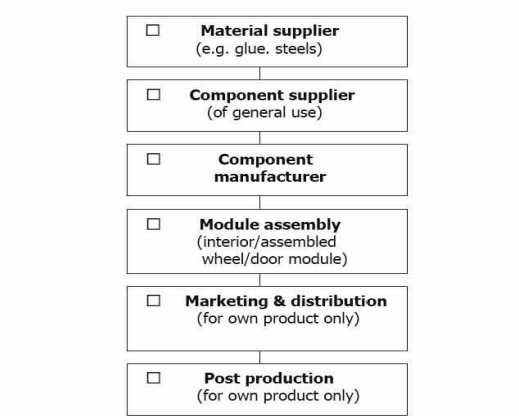
13. Please describe the highest value product, process or activity of your unit (2007)[5]

2

Project – South Africa AUTOMOTIVE COMPONENT

14. a. In the automotive component industry, which of these activities in the value chain did your unit perform in 2007? (Tick each box in the graph where your unit was involved)

Graph I: AUTOMOTIVE COMPONENT INDUSTRY VALUE CHAIN



14. b. As a supplier of automotive components, please indicate if you are:

☐ First tier supplier ☐ Second tier supplier ☐ Third tier supplier ☐ Other _____

II. STRATEGY TO ACCESS LOCAL AND FOREIGN MARKETS

15. Please indicate which strategy is mainly being used to access each of the markets: (mark with a X all that apply)

	Quality[6]	Cost[7]	New products or services	Strategic partnership
Access domestic market	☐	☐	☐	☐
Access markets in other developing countries[8]	☐	☐	☐	☐
Access other markets in industrialized countries	☐	☐	☐	☐

III. RESOURCES

16. a. Is your machinery and equipment behind or ahead the average of the industry in South Africa?

☐ Ahead ☐ Behind ☐ Average ☐ Not known

b. For how many years (ahead or behind)? ____

17. How many patents per employee did your unit register in 2007? ____

3

Project – South Africa AUTOMOTIVE COMPONENT

18. In 2007, what was the estimated proportion of employees in each of the following categories?

a. By position	%
Shop floor	
Supporting staff[9]	
Managers	

b. By education	%
Technical education/training	
University degree	
Postgraduate studies	

19. Does your unit employ any of the following systems of production organization? (check all that apply)

☐ Quality control systems
☐ Just in time
☐ Continuous improvement
☐ Quality circles, team work
☐ Internal manuals
☐ Other (please specify) _____

20. Does your unit have any quality certification? If so, which one?

☐ ISO
☐ Other, please specify_____
☐ Other, please specify_____

21. Do you have an R&D department?

☐ No ☐ Yes, how many employees in the R&D dept as a percentage of total staff?_____ %

IV. TYPE AND IMPORTANCE OF INNOVATION

Product innovation[10] and Process innovation[11]

	22. During 2007, did your unit introduce any of the following innovations? If you did not, leave the rows blank. If you did, please put a cross under one of the three columns indicating the degree of novelty	New to the world[12]	New to domestic market[13]	New to the firm[14]
Product	**P1.** New or significantly **improved goods**[15].			
	P2. New or significantly **improved services**.			
Process	**PR1.** New or significantly **improved methods** of manufacturing[16]			
	PR2. New or significantly **improved logistics**[17]			
Organizational	**O1. New internal management practices**[18]			
	O2. New methods of organising external relations[19]			

Project – South Africa AUTOMOTIVE COMPONENT

23. Which one of the product/process/organizational innovations selected on the previous question 22 **had the most significant impact**[20] **on your unit performance during 2007?** (Please indicate the code P1, P2.....)

_____

24. For the most important innovation for your unit (as selected on question 23) **please indicate who contributed mainly to its development.** (Select the most appropriate option)

☐ Mainly your unit
☐ Your unit together with other companies
☐ Your unit together with a university or research center
☐ Other (please specify)_____

25. Please indicate if this innovation (as selected on question 23) **had an impact on your main strategies to access international or domestic markets.** (Check all that apply)

☐ It contributed to increase the quality of our products or services
☐ It contributed to reduce the costs of manufacturing our products or supplying our services
☐ It helped improving our delivery time
☐ As a consequence, we developed new products or services
☐ Other, please specify

26. Look at the following list of innovation activities. Did your company engage in any of those in 2007? If you did not, leave the rows blank. If you did, please indicate with a cross whether the activity was conducted **mainly** locally, domestically or internationally.	**Local**	**Domestic**	**International**
Intramural R&D[21]			
Extramural R&D[22]			
Acquisition of machinery and equipment[23]			
Acquisition of other external knowledge[24]			
Training[25]			

V. LINKAGES AND CHANNELS

Sources of technology and knowledge

27. Were the following sources of technology and knowledge important for your product/process innovation developed in 2007? If not, leave the rows blank. If yes, please indicate with a cross whether the sources were **mainly** local, domestic or international	**Local**	**Domestic**	**International**
Existing employees (excluding returnees from abroad)			
Existing employees who are returnees from abroad			
Suppliers			
Clients			
Competitors			
Consultancy companies			
Universities			
Government[26]			
Other (please specify)_____			

Project – South Africa AUTOMOTIVE COMPONENT

Content of the collaboration

28. For companies that collaborated with local, domestic or international universities or research centers in 2007, which of these following activities have been important for your unit? (Mark with a X all that apply)	**Local**	**Domestic**	**International**
Training			
Research activities (R&D)			
Other (please specify)_____			

29. For the following transactions with other firms please indicate if in 2007 they took place mainly locally, domestically or internationally. (Please put a cross under one of the three columns)	**Local**	**Domestic**	**International**
Acquisition of inputs			
Acquisition of machinery			
Outsourcing			
Research collaboration			
Other (please specify)_____			

30. For companies that benefited in 2007 from any of the following supporting schemes to foster innovation or technology dissemination, please indicate which of them have been important to support your company's innovation strategies. (Mark with a X all that apply)

	Supporting schemes from		
	From local government	From national government	International funding
Tax incentives			
Funds to develop new products and acquire technology			
Export support[27]			
Information on technological opportunities			
Other (please specify)			

THANK YOU VERY MUCH FOR YOUR PARTICIPATION. WE ARE VERY GRATEFUL!

Person we should contact if there are any queries regarding the form (please fill the form or attach business card):

Name: _____
Job title: _____
Organisation: _____
Phone: _____
Fax: _____
E-mail: _____

6

[1] A group consists of two or more legally defined enterprises under common ownership. Each enterprise in the group may serve different markets, as with national or regional subsidiaries, or serve different product markets. The head office is also part of an enterprise group.
[2] Rand should be converted in US dollar on the basis of 31st December 2007 rate.
[3] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.
[4] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.
[5] By highest value product or process we refer to the most important one in terms of sales, price per unit or volume.
[6] Better quality than your competitors in that market.
[7] Lower costs than your competitors in that market.
[8] Asia, Africa, Latin America etc.
[9] Accounting, financial, administrative, etc.
[10] A product innovation is the market introduction of a new good or service or a significantly improved good or service with respect to its capabilities, such as improved software, user friendliness, components or sub-systems. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.
[11] A process innovation is the implementation of a new or significantly improved production process, distribution method, or support activity for your goods or services. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises. Exclude purely organizational innovations.
[12] Your enterprise introduced a new or significantly improved good or service onto the global market before your competitors.
[13] Your enterprise introduced a new or significantly improved good or service onto the domestic market before your competitors (it may have already been available in other markets).
[14] Your enterprise introduced a new or significantly improved good or service that was already available from your competitors in your market.
[15] Exclude the simple resale of new goods purchased from other enterprises and changes of a solely aesthetic nature.
[16] Include new methods of producing goods or services.
[17] Include delivery or distribution methods for your inputs, goods or services.
[18] For example new business practices for organizing work or procedures, new knowledge management systems, marketing for innovative products and services, new method of workplace organization.
[19] For example with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc.)
[20]The most important impact in terms of sales/export etc.
[21] Creative work undertaken within your enterprise to increase the stock of knowledge and its use to devise new and improved products and processes (including software development).
[22] Same activities as above, but performed by other companies (including other enterprises within your group) or by public or private research organisations and purchased by your enterprise.
[23] Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved products and processes.
[24] Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations.
[25] Internal or external training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes (that is, training related to new products or processes, not training in general).

Project – South Africa AUTOMOTIVE COMPONENT

[26] For Government we mean local/provincial/national departments.
[27] Including attendance to fairs, demonstrations, etc.

Appendix B: Test Results for Hypothesis 1a

Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:10:27 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_OverallProcess

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	1.941176	1.650366	0.2830354	1.365337	2.517016
OEM_1_OTH_2=2	38	1.131579	1.094731	0.1775888	0.7717499	1.491408

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	0.8095976	1.384735	0.3268901	0.1576357	1.461559
Unequal	56.31	0.8095976	1.98044	0.3341359	0.140325	1.47887

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 2.0030

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	1.8364	0.066305	Cannot reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	0.6933	0.488100	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=1)	3.8529	0.145663	Cannot reject normality
Skewness Normality (OEM_1_OTH_2=2)	1.0256	0.305075	Cannot reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	-2.9818	0.002866	Reject normality
Omnibus Normality (OEM_1_OTH_2=2)	9.9428	0.006933	Reject normality
Variance-Ratio Equal-Variance Test	2.2727	0.016420	Reject equal variances
Modified-Levene Equal-Variance Test	1.4711	0.229250	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	823	1418	1241	85.28446
OEM_1_OTH_2=2	469	1210	1387	85.28446

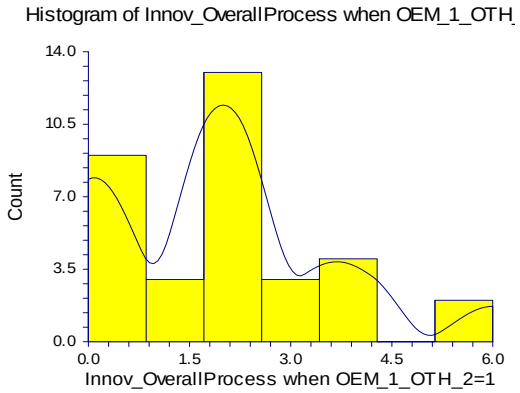
Number Sets of Ties = 6, Multiplicity Factor = 27834

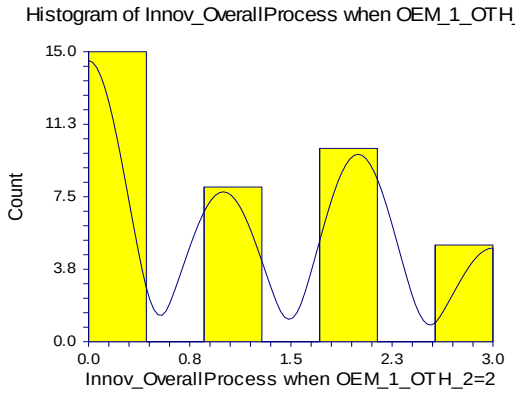
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			2.0754	0.037949	Yes	2.0695	0.038495	Yes
Diff<0			2.0754	0.981026	No	2.0813	0.981295	No
Diff>0			2.0754	0.018974	Yes	2.0695	0.019248	Yes

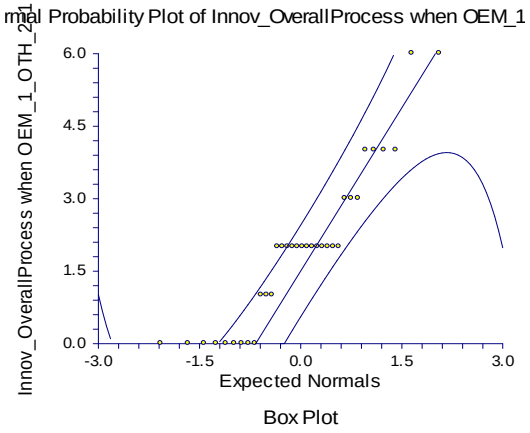
Kolmogorov-Smirnov Test For Different Distributions

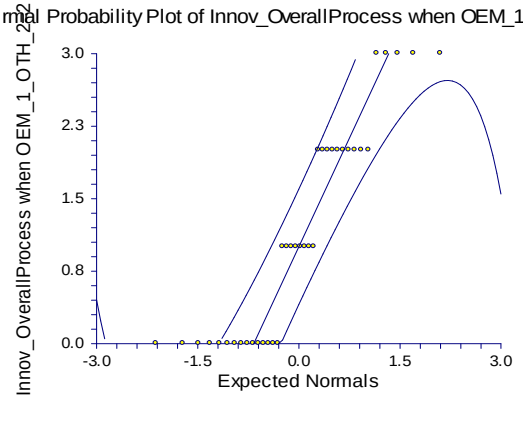
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.252322	0.3211	.050	No	0.1646
D(1)<D(2)	0.000000	0.3211	.025	No	
D(1)>D(2)	0.252322	0.3211	.025	No	

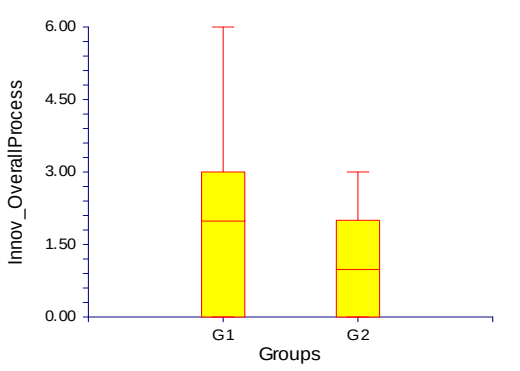
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:17:14 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_Manufacturing

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	1.264706	0.9941899	0.1705022	0.9178166	1.611595
OEM_1_OTH_2=2	38	0.7894737	0.8748094	0.1419128	0.501931	1.077016

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	0.4752322	0.9329939	0.2202489	3.595956E-02	0.9145048
Unequal	66.22	0.4752322	1.324275	0.2218338	3.235374E-02	0.9181107

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 1.9964

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	0.0402	0.967918	Cannot reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	-2.5058	0.012216	Reject normality
Omnibus Normality (OEM_1_OTH_2=1)	6.2808	0.043265	Reject normality
Skewness Normality (OEM_1_OTH_2=2)	2.3680	0.017884	Reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	0.5931	0.553087	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=2)	5.9593	0.050810	Cannot reject normality
Variance-Ratio Equal-Variance Test	1.2916	0.448773	Cannot reject equal variances
Modified-Levene Equal-Variance Test	1.5912	0.211349	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	823.5	1418.5	1241	84.24311
OEM_1_OTH_2=2	468.5	1209.5	1387	84.24311

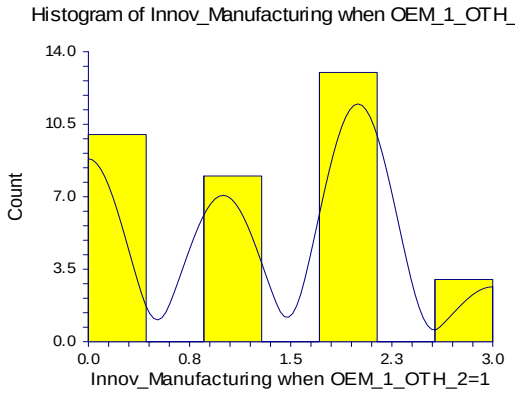
Number Sets of Ties = 4, Multiplicity Factor = 36216

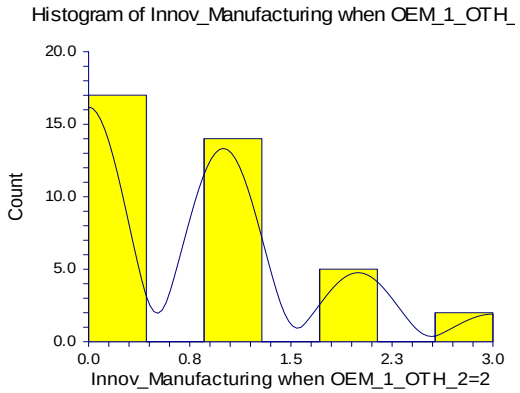
Alternative Hypothesis	Exact Probability Prob Level	Exact Probability Reject H0 at .050	Approximation Without Correction Z-Value	Approximation Without Correction Prob Level	Approximation Without Correction Reject H0 at .050	Approximation With Correction Z-Value	Approximation With Correction Prob Level	Approximation With Correction Reject H0 at .050
Diff<>0			2.1070	0.035118	Yes	2.1011	0.035636	Yes
Diff<0			2.1070	0.982441	No	2.1129	0.982697	No
Diff>0			2.1070	0.017559	Yes	2.1011	0.017818	Yes

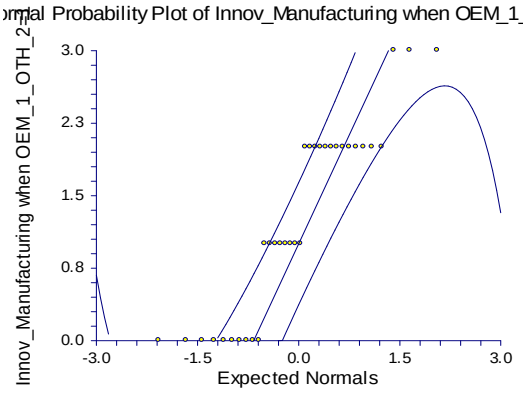
Kolmogorov-Smirnov Test For Different Distributions

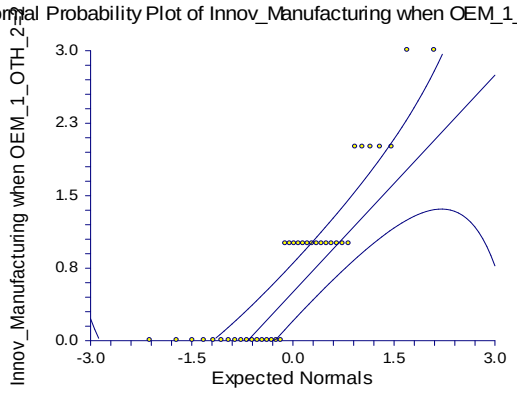
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.286378	0.3211	.050	No	0.0819
D(1)<D(2)	0.000000	0.3211	.025	No	
D(1)>D(2)	0.286378	0.3211	.025	No	

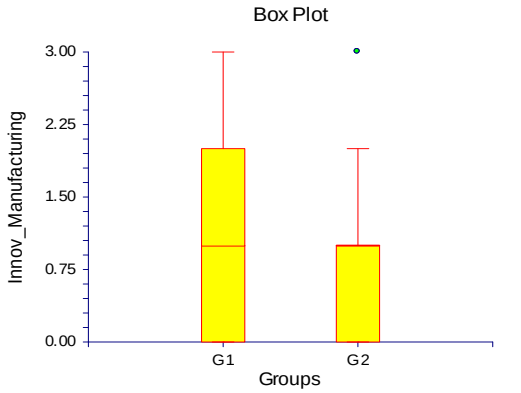
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:18:13 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_Logisitcs

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	0.6764706	0.9445406	0.1619874	0.3469048	1.006036
OEM_1_OTH_2=2	38	0.3421053	0.668856	0.1085028	0.1222577	0.5619528

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	0.3343653	0.8105889	0.1913532	-4.727653E-02	0.7160072
Unequal	58.71	0.3343653	1.157379	0.1949686	-5.580582E-02	0.7245365

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 2.0012

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	2.6996	0.006943	Reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	0.5671	0.570624	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=1)	7.6092	0.022268	Reject normality
Skewness Normality (OEM_1_OTH_2=2)	4.5430	0.000006	Reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	3.5328	0.000411	Reject normality
Omnibus Normality (OEM_1_OTH_2=2)	33.1198	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	1.9942	0.042977	Reject equal variances
Modified-Levene Equal-Variance Test	3.0533	0.084958	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	761.5	1356.5	1241	73.863
OEM_1_OTH_2=2	530.5	1271.5	1387	73.863

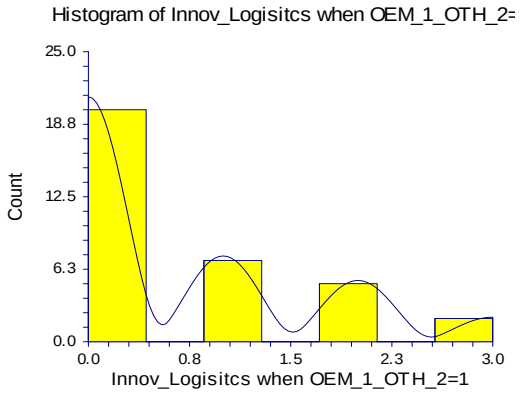
Number Sets of Ties = 4, Multiplicity Factor = 114138

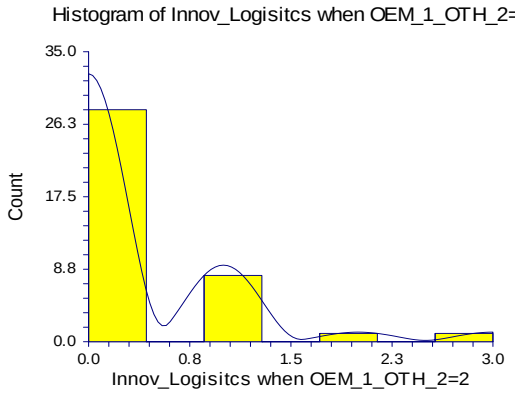
Alternative Hypothesis	Exact Probability Prob Level	Exact Probability Reject H0 at .050	Approximation Without Correction Z-Value	Approximation Without Correction Prob Level	Approximation Without Correction Reject H0 at .050	Approximation With Correction Z-Value	Approximation With Correction Prob Level	Approximation With Correction Reject H0 at .050
Diff<>0			1.5637	0.117887	No	1.5569	0.119486	No
Diff<0			1.5637	0.941057	No	1.5705	0.941848	No
Diff>0			1.5637	0.058943	No	1.5569	0.059743	No

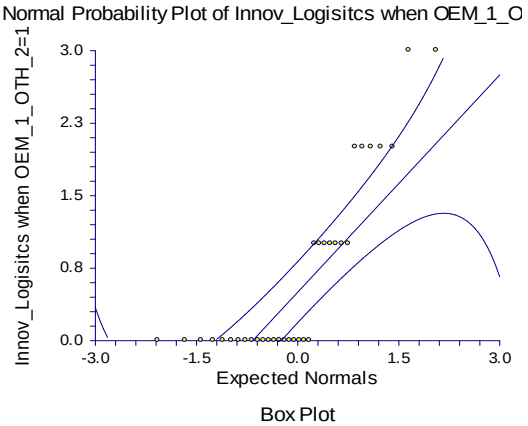
Kolmogorov-Smirnov Test For Different Distributions

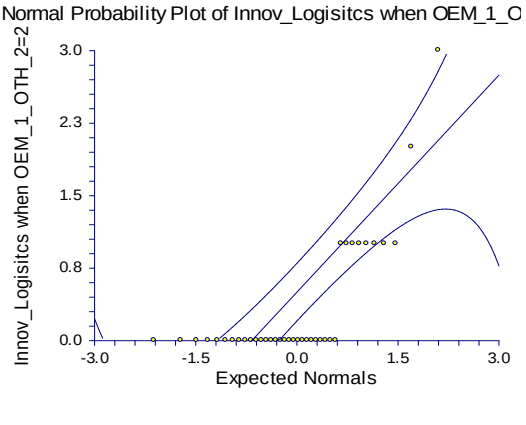
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.153251	0.3211	.050	No	0.7220
D(1)<D(2)	0.000000	0.3211	.025	No	
D(1)>D(2)	0.153251	0.3211	.025	No	

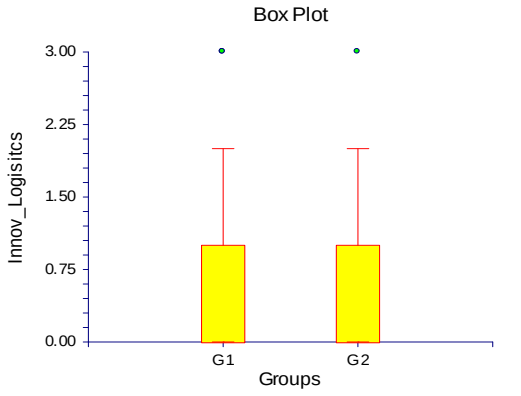
Plots Section











Appendix C: Test Results for Hypothesis 1b

Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:18:57 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_OverallProduct

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	1.147059	1.578882	0.2707761	0.5961607	1.697957
OEM_1_OTH_2=2	38	1.236842	1.441362	0.2338198	0.7630782	1.710606

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	-8.978328E-02	1.507757	0.3559314	-0.799666	0.6200995
Unequal	67.23	-8.978328E-02	2.137848	0.3577589	-0.803829	0.6242625

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 1.9959

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	3.1117	0.001860	Reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	1.6311	0.102874	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=1)	12.3434	0.002088	Reject normality
Skewness Normality (OEM_1_OTH_2=2)	2.5707	0.010149	Reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	0.5659	0.571468	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=2)	6.9288	0.031292	Reject normality
Variance-Ratio Equal-Variance Test	1.1999	0.588202	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0027	0.958914	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	602	1197	1241	82.77451
OEM_1_OTH_2=2	690	1431	1387	82.77451

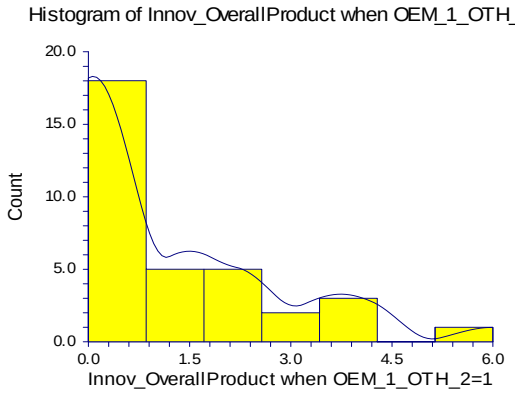
Number Sets of Ties = 5, Multiplicity Factor = 47862

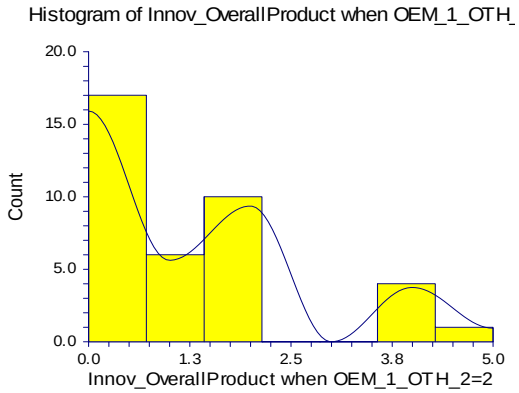
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-0.5316	0.595028	No	-0.5255	0.599219	No
Diff<0			-0.5316	0.297514	No	-0.5255	0.299609	No
Diff>0			-0.5316	0.702486	No	-0.5376	0.704575	No

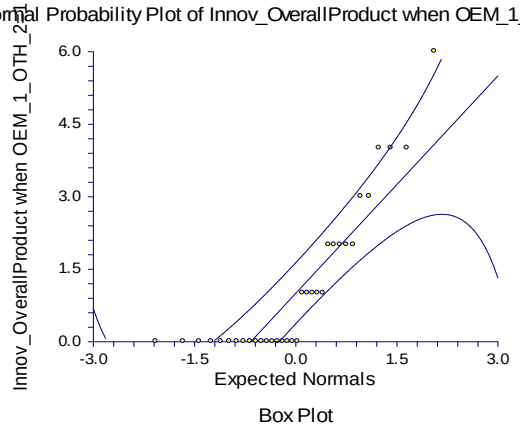
Kolmogorov-Smirnov Test For Different Distributions

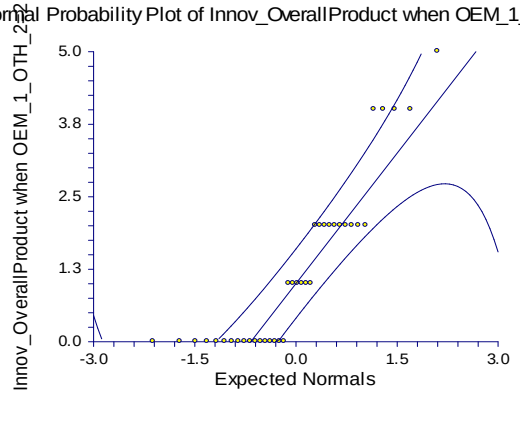
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.082043	0.3211	.050	No	0.9978
D(1)<D(2)	0.082043	0.3211	.025	No	
D(1)>D(2)	0.044892	0.3211	.025	No	

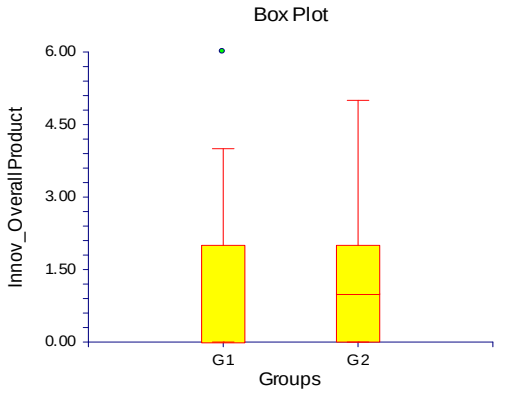
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:19:22 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_Goods

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	0.7647059	0.9865404	0.1691903	0.4204856	1.108926
OEM_1_OTH_2=2	38	0.8421053	0.9733285	0.1578947	0.5221801	1.16203

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	-7.739938E-02	0.9795792	0.2312462	-0.5386053	0.3838066
Unequal	68.90	-7.739938E-02	1.385868	0.2314219	-0.5390854	0.3842866

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 1.9950

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	2.5819	0.009826	Reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	0.4596	0.645796	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=1)	6.8774	0.032107	Reject normality
Skewness Normality (OEM_1_OTH_2=2)	1.8304	0.067195	Cannot reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	-1.3957	0.162811	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=2)	5.2982	0.070717	Cannot reject normality
Variance-Ratio Equal-Variance Test	1.0273	0.931814	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.1685	0.682742	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	615	1210	1241	81.49829
OEM_1_OTH_2=2	677	1418	1387	81.49829

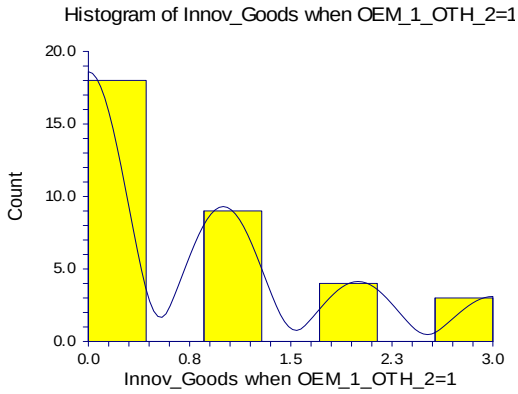
Number Sets of Ties = 4, Multiplicity Factor = 57816

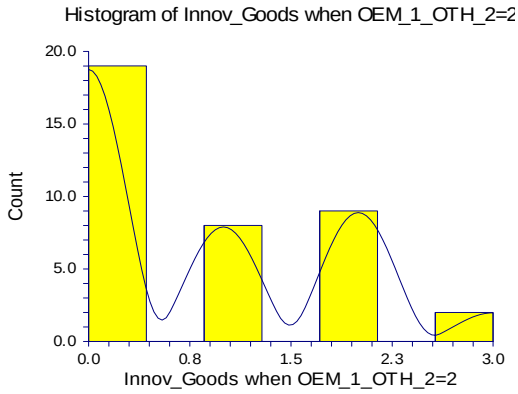
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-0.3804	0.703666	No	-0.3742	0.708225	No
Diff<0			-0.3804	0.351833	No	-0.3742	0.354113	No
Diff>0			-0.3804	0.648167	No	-0.3865	0.650441	No

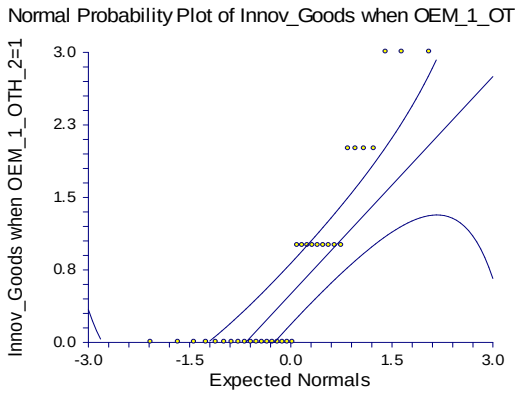
Kolmogorov-Smirnov Test For Different Distributions

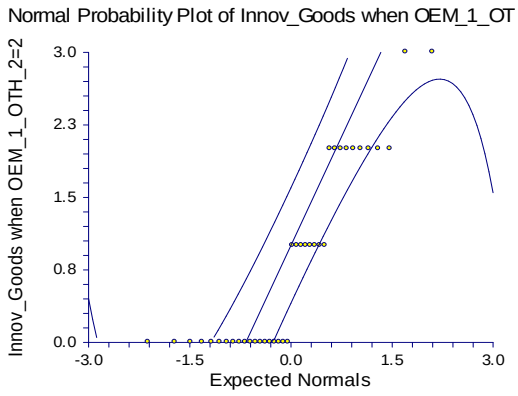
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.083591	0.3211	.050	No	0.9975
D(1)<D(2)	0.083591	0.3211	.025	No	
D(1)>D(2)	0.035604	0.3211	.025	No	

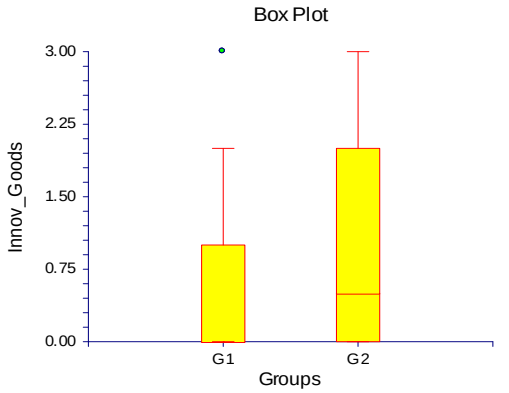
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:20:02 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Filter	Resp_No<>105, 801, 810, 901
Variable	Innov_Services

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
OEM_1_OTH_2=1	34	0.3823529	0.921616	0.1580558	0.0607859	0.70392
OEM_1_OTH_2=2	38	0.3947369	0.7180858	0.1164889	0.1587079	0.6307658

Note: T-alpha (OEM_1_OTH_2=1) = 2.0345, T-alpha (OEM_1_OTH_2=2) = 2.0262

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	70	-0.0123839	0.8203515	0.1936578	-0.3986222	0.3738544
Unequal	62.21	-0.0123839	1.168342	0.1963449	-0.4048448	0.380077

Note: T-alpha (Equal) = 1.9944, T-alpha (Unequal) = 1.9988

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (OEM_1_OTH_2=1)	4.3863	0.000012	Reject normality
Kurtosis Normality (OEM_1_OTH_2=1)	2.9154	0.003553	Reject normality
Omnibus Normality (OEM_1_OTH_2=1)	27.7394	0.000001	Reject normality
Skewness Normality (OEM_1_OTH_2=2)	3.4640	0.000532	Reject normality
Kurtosis Normality (OEM_1_OTH_2=2)	1.2188	0.222917	Cannot reject normality
Omnibus Normality (OEM_1_OTH_2=2)	13.4847	0.001180	Reject normality
Variance-Ratio Equal-Variance Test	1.6472	0.141757	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0041	0.949194	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
OEM_1_OTH_2=1	602.5	1197.5	1241	64.42123
OEM_1_OTH_2=2	689.5	1430.5	1387	64.42123

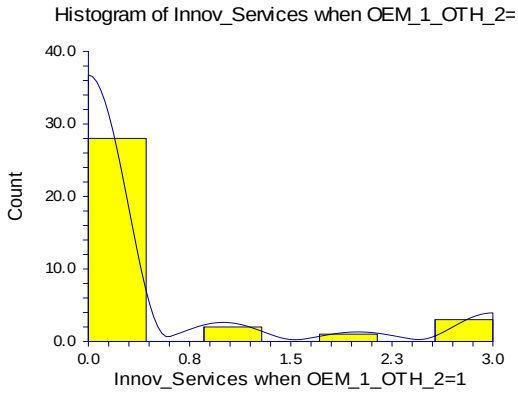
Number Sets of Ties = 4, Multiplicity Factor = 176130

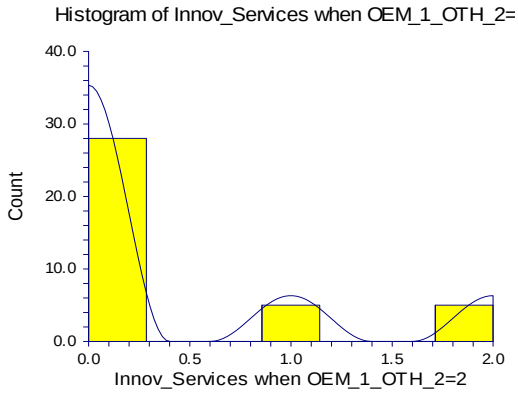
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-0.6752	0.499521	No	-0.6675	0.504464	No
Diff<0			-0.6752	0.249761	No	-0.6675	0.252232	No
Diff>0			-0.6752	0.750239	No	-0.6830	0.752698	No

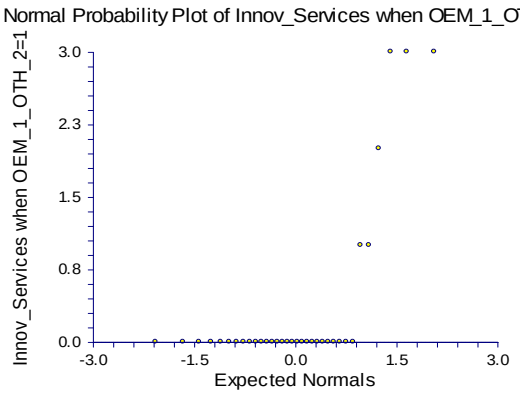
Kolmogorov-Smirnov Test For Different Distributions

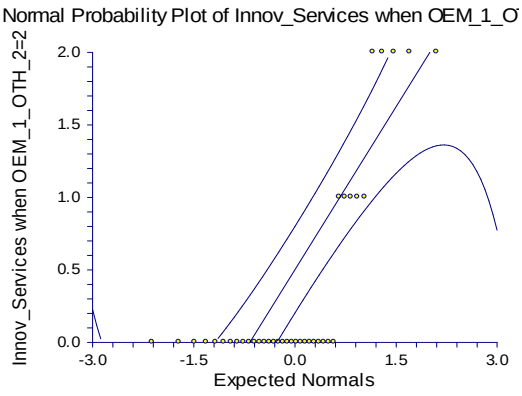
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.088235	0.3211	.050	No	0.9954
D(1)<D(2)	0.086687	0.3211	.025	No	
D(1)>D(2)	0.088235	0.3211	.025	No	

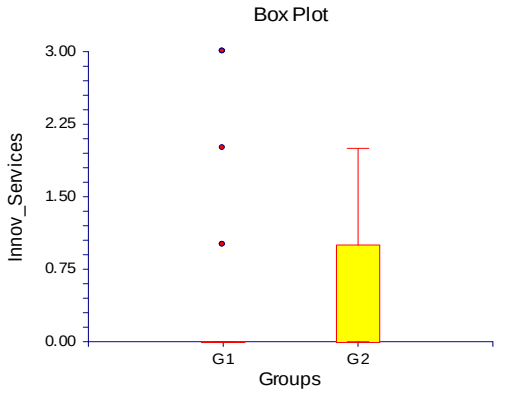
Plots Section











Appendix D: Test Results for Hypothesis 2a

Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:22:10 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_OverallInnovation

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	1.736842	2.10402	0.4826953	0.7227369	2.750947
LOCAL_1_GLOBAL_2=2	57	3.087719	2.422224	0.3208314	2.445017	3.730422

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-1.350877	2.348794	0.6222107	-2.590659	-0.1110953
Unequal	35.21	-1.350877	3.208437	0.5795926	-2.527264	-0.1744907

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0297

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	2.7228	0.006474	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	2.1735	0.029745	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	12.1374	0.002314	Reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	2.9628	0.003049	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	2.1776	0.029433	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	13.5202	0.001159	Reject normality
Variance-Ratio Equal-Variance Test	1.3253	0.518561	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.5493	0.460966	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	350	540	731.5	82.15282
LOCAL_1_GLOBAL_2=2	733	2386	2194.5	82.15282

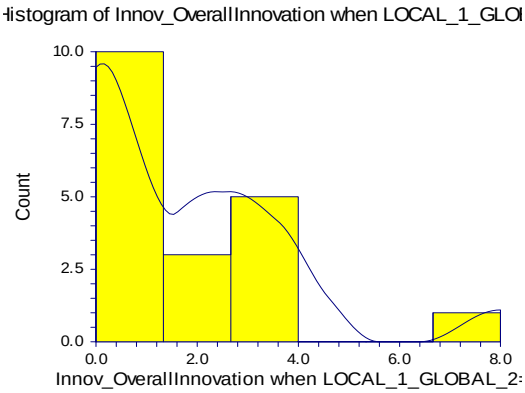
Number Sets of Ties = 8, Multiplicity Factor = 12642

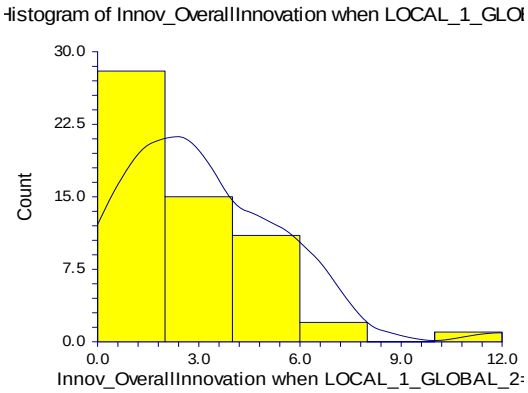
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-2.3310	0.019752	Yes	-2.3249	0.020075	Yes
Diff<0			-2.3310	0.009876	Yes	-2.3249	0.010038	Yes
Diff>0			-2.3310	0.990124	No	-2.3371	0.990283	No

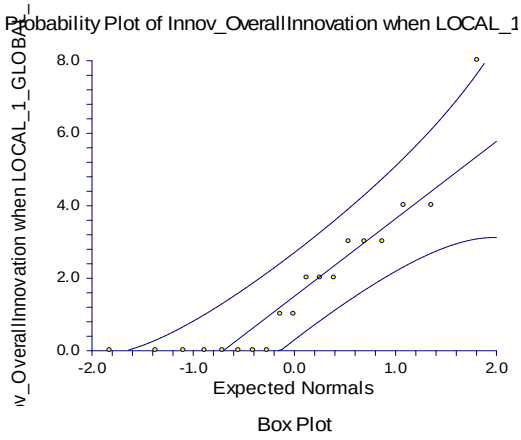
Kolmogorov-Smirnov Test For Different Distributions

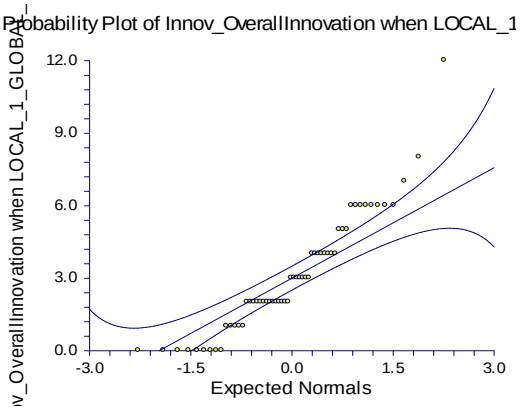
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.280702	0.3411	.050	No	0.1938
D(1)<D(2)	0.280702	0.3411	.025	No	
D(1)>D(2)	0.017544	0.3411	.025	No	

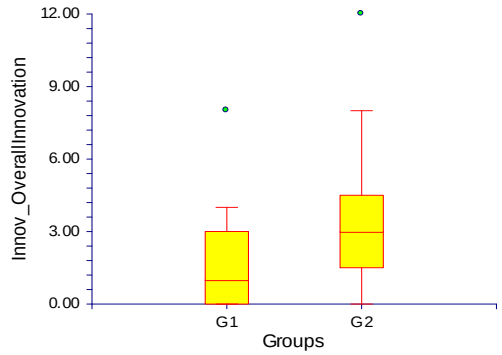
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:26:06 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_OverallProduct

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	0.6315789	1.06513	0.2443577	0.1182025	1.144955
LOCAL_1_GLOBAL_2=2	57	1.403509	1.590818	0.210709	0.9814079	1.82561

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.7719298	1.480232	0.392123	-1.553252	9.39221E-03
Unequal	46.46	-0.7719298	1.914472	0.3226592	-1.421234	-0.1226251

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0124

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	3.3940	0.000689	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	2.7310	0.006315	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	18.9776	0.000076	Reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	2.8114	0.004932	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	0.3344	0.738077	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	8.0159	0.018171	Reject normality
Variance-Ratio Equal-Variance Test	2.2307	0.062421	Cannot reject equal variances
Modified-Levene Equal-Variance Test	5.7016	0.019503	Reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	393.5	583.5	731.5	77.80909
LOCAL_1_GLOBAL_2=2	689.5	2342.5	2194.5	77.80909

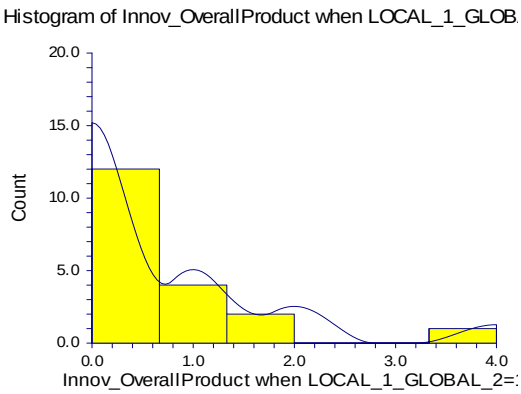
Number Sets of Ties = 5, Multiplicity Factor = 56526

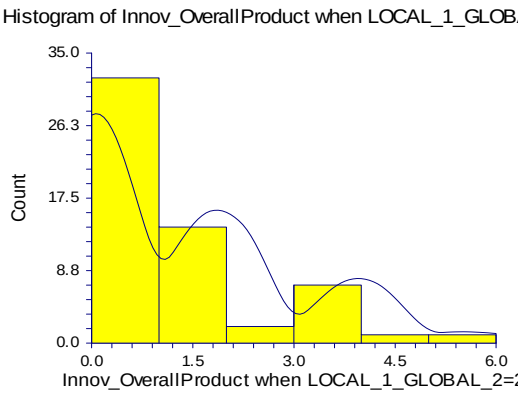
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-1.9021	0.057159	No	-1.8957	0.058004	No
Diff<0			-1.9021	0.028580	Yes	-1.8957	0.029002	Yes
Diff>0			-1.9021	0.971420	No	-1.9085	0.971838	No

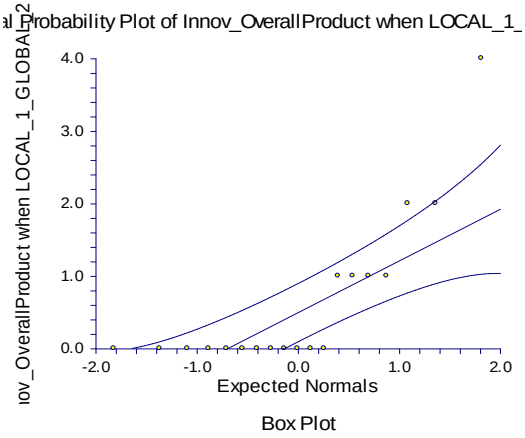
Kolmogorov-Smirnov Test For Different Distributions

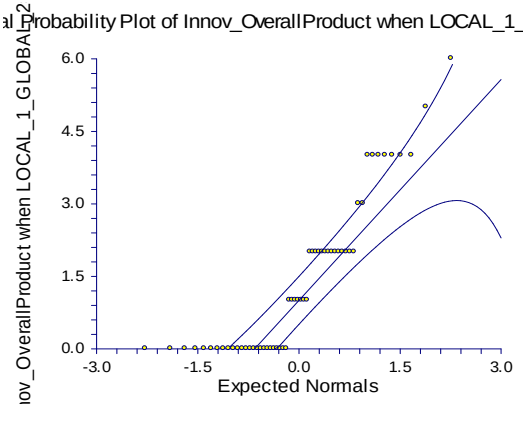
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.280702	0.3411	.050	No	0.1938
D(1)<D(2)	0.280702	0.3411	.025	No	
D(1)>D(2)	0.000000	0.3411	.025	No	

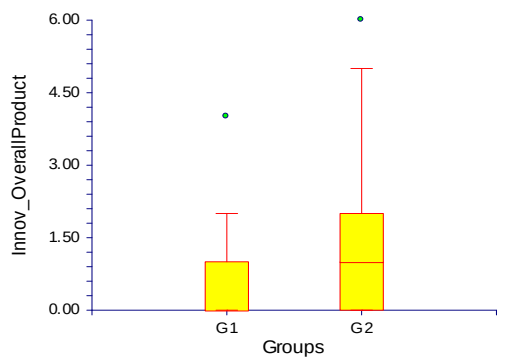
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:26:30 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Goods

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	0.4736842	0.7723284	0.1771843	0.1014338	0.8459346
LOCAL_1_GLOBAL_2=2	57	0.9298246	1.015235	0.1344711	0.6604465	1.199203

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.4561403	0.9618123	0.2547903	-0.9638211	5.154043E-02
Unequal	40.40	-0.4561403	1.275615	0.2224337	-0.9055575	-6.723262E-03

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0205

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	2.3815	0.017241	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	0.4085	0.682871	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	5.8386	0.053972	Cannot reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	2.0931	0.036339	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	-1.7455	0.080903	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	7.4278	0.024382	Reject normality
Variance-Ratio Equal-Variance Test	1.7279	0.199875	Cannot reject equal variances
Modified-Levene Equal-Variance Test	5.0548	0.027535	Reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	406	596	731.5	76.66831
LOCAL_1_GLOBAL_2=2	677	2330	2194.5	76.66831

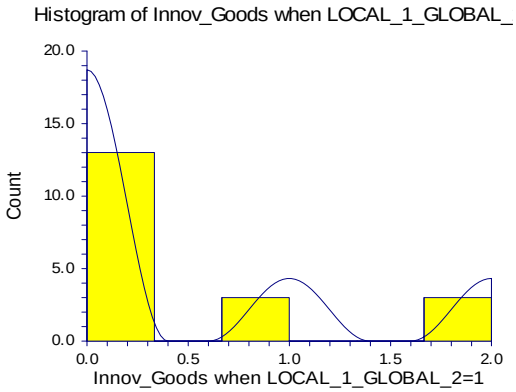
Number Sets of Ties = 4, Multiplicity Factor = 67656

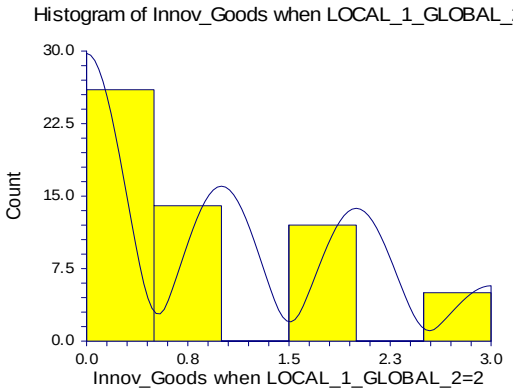
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-1.7674	0.077169	No	-1.7608	0.078267	No
Diff<0			-1.7674	0.038585	Yes	-1.7608	0.039133	Yes
Diff>0			-1.7674	0.961415	No	-1.7739	0.961958	No

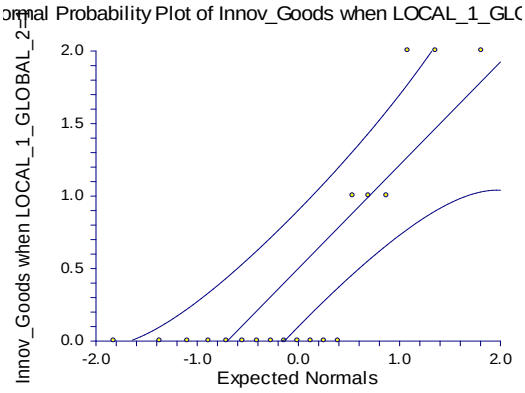
Kolmogorov-Smirnov Test For Different Distributions

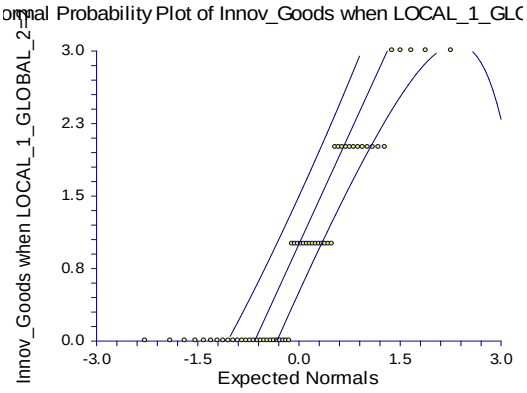
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.228070	0.3411	.050	No	0.4222
D(1)<D(2)	0.228070	0.3411	.025	No	
D(1)>D(2)	0.000000	0.3411	.025	No	

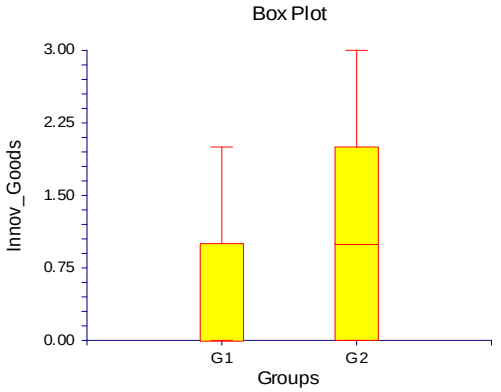
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:27:09 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Services

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	0.1578947	0.5014598	0.1150428	-8.380118E-02	0.3995906
LOCAL_1_GLOBAL_2=2	57	0.4736842	0.8885233	0.1176878	0.2379272	0.7094412

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.3157895	0.8115454	0.2149836	-0.7441537	0.1125748
Unequal	55.76	-0.3157895	1.020263	0.164576	-0.6455062	1.392728E-02

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0034

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	4.5948	0.000004	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	3.9072	0.000093	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	36.3783	0.000000	Reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	4.3817	0.000012	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	2.1818	0.029122	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	23.9593	0.000006	Reject normality
Variance-Ratio Equal-Variance Test	3.1395	0.009477	Reject equal variances
Modified-Levene Equal-Variance Test	2.1577	0.146098	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	453	643	731.5	60.72339
LOCAL_1_GLOBAL_2=2	630	2283	2194.5	60.72339

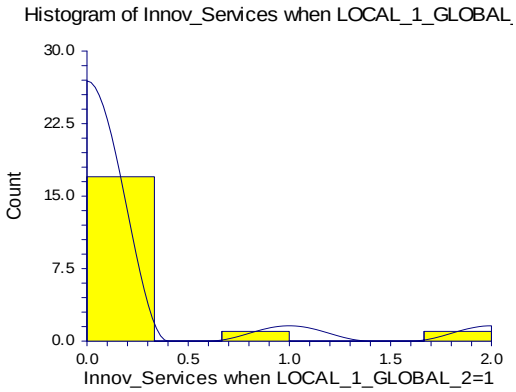
Number Sets of Ties = 4, Multiplicity Factor = 206016

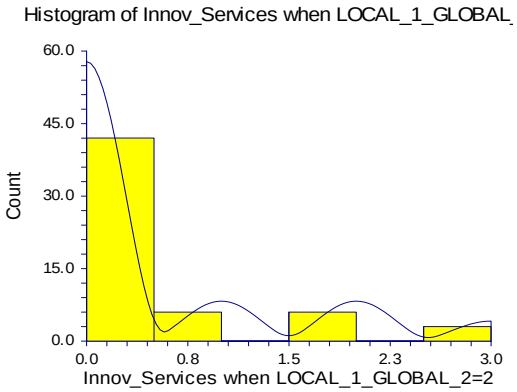
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-1.4574	0.144998	No	-1.4492	0.147283	No
Diff<0			-1.4574	0.072499	No	-1.4492	0.073642	No
Diff>0			-1.4574	0.927501	No	-1.4657	0.928630	No

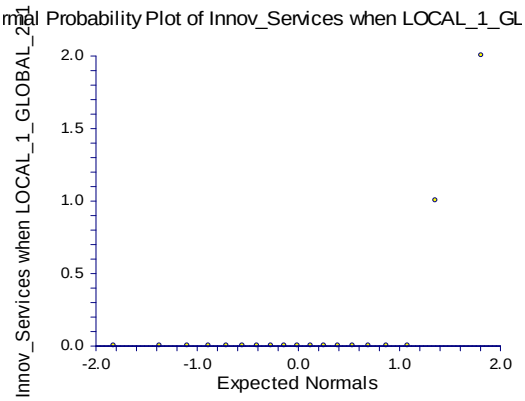
Kolmogorov-Smirnov Test For Different Distributions

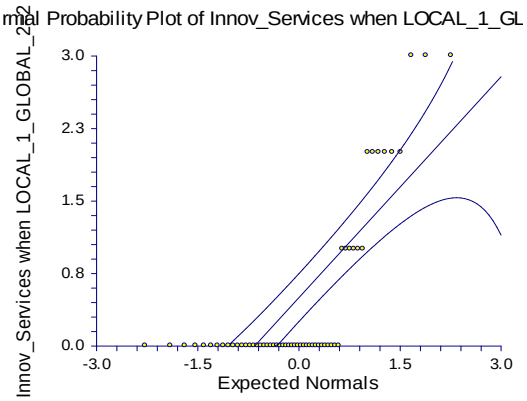
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.157895	0.3411	.050	No	0.8486
D(1)<D(2)	0.157895	0.3411	.025	No	
D(1)>D(2)	0.000000	0.3411	.025	No	

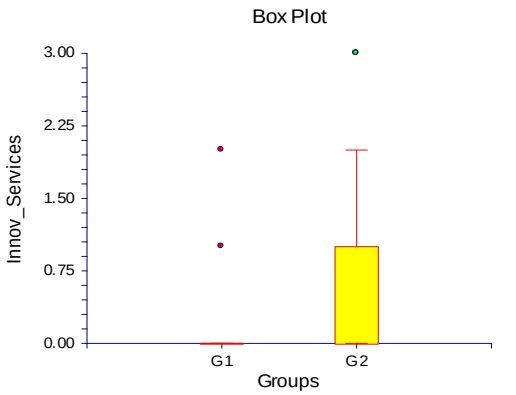
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:27:49 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_OverallProcess

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	1.105263	1.486784	0.3410916	0.3886563	1.82187
LOCAL_1_GLOBAL_2=2	57	1.684211	1.453541	0.1925262	1.298534	2.069887

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.5789474	1.461697	0.387213	-1.350486	0.1925913
Unequal	30.31	-0.5789474	2.079257	0.3916757	-1.378515	0.2206208

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0414

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	1.9689	0.048964	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	-0.3690	0.712121	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	4.0128	0.134475	Cannot reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	2.5967	0.009413	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	1.5720	0.115944	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	9.2140	0.009982	Reject normality
Variance-Ratio Equal-Variance Test	1.0463	0.854439	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0290	0.865181	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	409.5	599.5	731.5	80.29194
LOCAL_1_GLOBAL_2=2	673.5	2326.5	2194.5	80.29194

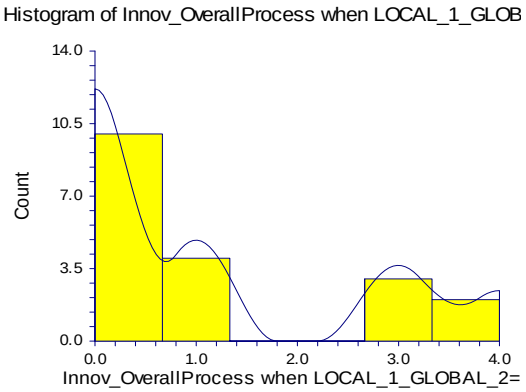
Number Sets of Ties = 6, Multiplicity Factor = 31734

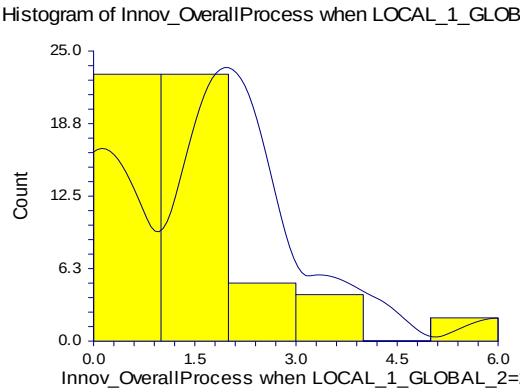
Alternative Hypothesis	Exact Probability Prob Level	Exact Probability Reject H0 at .050	Approximation Without Correction Z-Value	Approximation Without Correction Prob Level	Approximation Without Correction Reject H0 at .050	Approximation With Correction Z-Value	Approximation With Correction Prob Level	Approximation With Correction Reject H0 at .050
Diff<>0			-1.6440	0.100176	No	-1.6378	0.101469	No
Diff<0			-1.6440	0.050088	No	-1.6378	0.050734	No
Diff>0			-1.6440	0.949912	No	-1.6502	0.950552	No

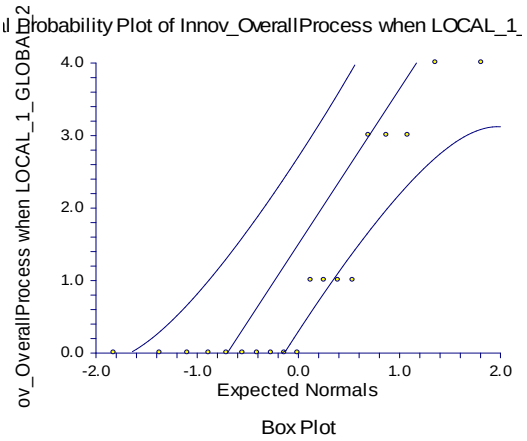
Kolmogorov-Smirnov Test For Different Distributions

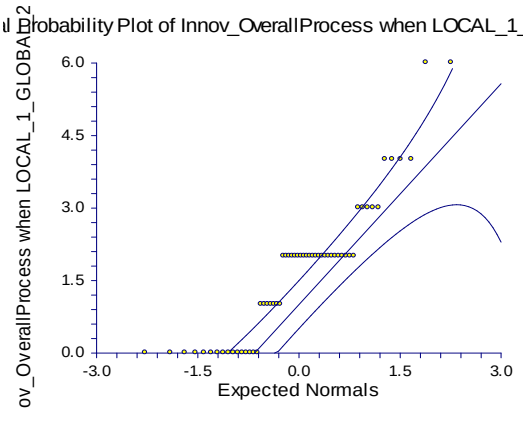
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.333333	0.3411	.050	No	0.0745
D(1)<D(2)	0.333333	0.3411	.025	No	
D(1)>D(2)	0.070175	0.3411	.025	No	

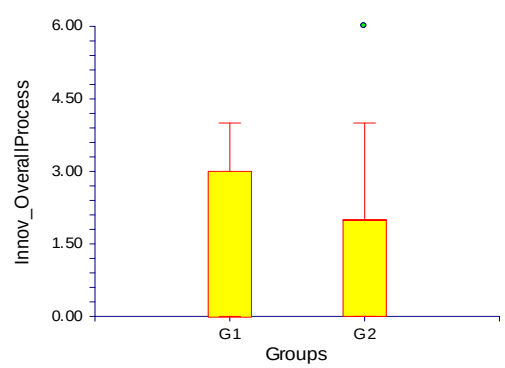
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:28:15 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Manufacturing

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	0.6315789	0.8306976	0.1905751	0.2311955	1.031962
LOCAL_1_GLOBAL_2=2	57	1.140351	0.9717178	0.1287072	0.8825194	1.398182

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.508772	0.9393661	0.2488442	-1.004605	-0.0129391
Unequal	35.77	-0.508772	1.278395	0.2299661	-0.9752677	-4.227616E-02

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0285

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)		1.6042	0.108672 Cannot reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	-1.1918	0.233350	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	3.9938	0.135758	Cannot reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)		1.0239	0.305860 Cannot reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	-2.4399	0.014689	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	7.0018	0.030170	Reject normality
Variance-Ratio Equal-Variance Test	1.3683	0.469125	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.6400	0.426272	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	383	573	731.5	79.16473
LOCAL_1_GLOBAL_2=2	700	2353	2194.5	79.16473

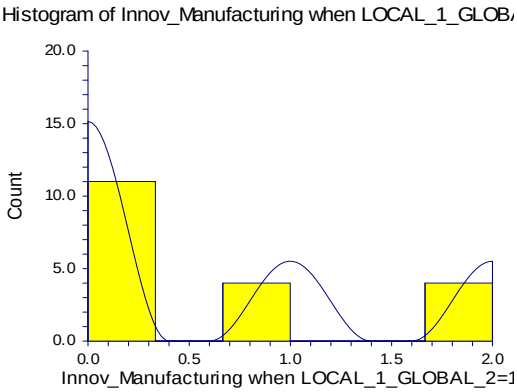
Number Sets of Ties = 4, Multiplicity Factor = 43086

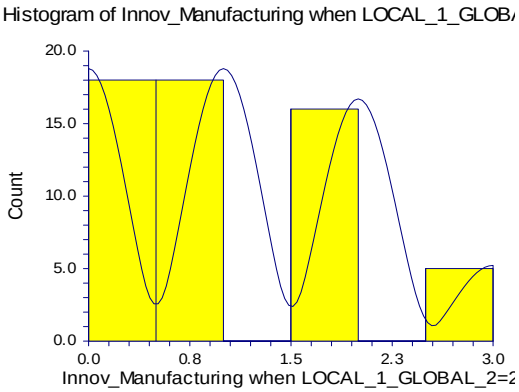
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-2.0022	0.045268	Yes	-1.9958	0.045952	Yes
Diff<0			-2.0022	0.022634	Yes	-1.9958	0.022976	Yes
Diff>0			-2.0022	0.977366	No	-2.0085	0.977703	No

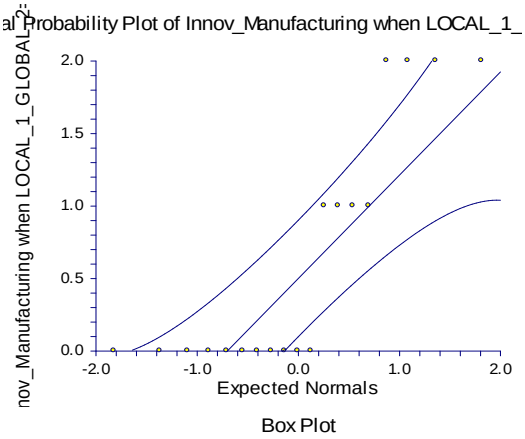
Kolmogorov-Smirnov Test For Different Distributions

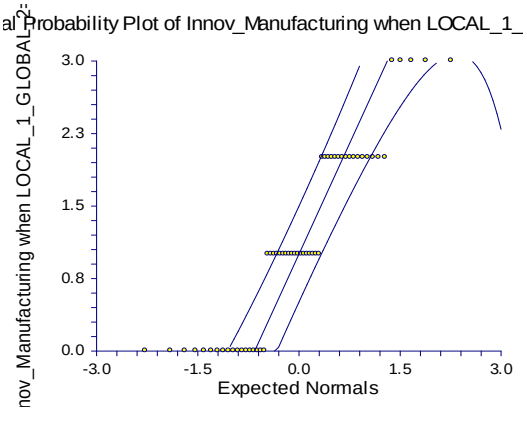
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.263158	0.3411	.050	No	0.2564
D(1)<D(2)	0.263158	0.3411	.025	No	
D(1)>D(2)	0.000000	0.3411	.025	No	

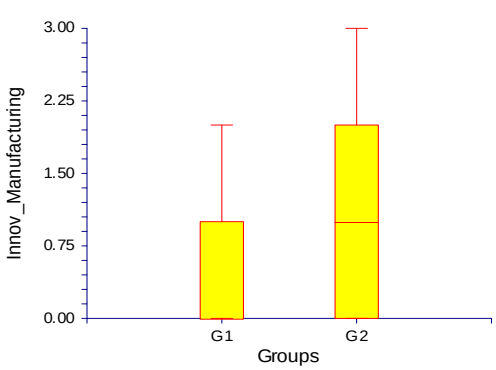
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:29:07 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Logisitcs

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_GLOBAL_2=1	19	0.4736842	0.7723284	0.1771843	0.1014338	0.8459346
LOCAL_1_GLOBAL_2=2	57	0.5438597	0.8674712	0.1148994	0.3136885	0.7740307

Note: T-alpha (LOCAL_1_GLOBAL_2=1) = 2.1009, T-alpha (LOCAL_1_GLOBAL_2=2) = 2.0032

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-7.017544E-02	0.8453146	0.2239293	-0.5163643	0.3760134
Unequal	34.37	-7.017544E-02	1.161463	0.211178	-0.4991714	0.3588206

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0314

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_GLOBAL_2=1)	2.3815	0.017241	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=1)	0.4085	0.682871	Cannot reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=1)	5.8386	0.053972	Cannot reject normality
Skewness Normality (LOCAL_1_GLOBAL_2=2)	4.0679	0.000047	Reject normality
Kurtosis Normality (LOCAL_1_GLOBAL_2=2)	1.9926	0.046306	Reject normality
Omnibus Normality (LOCAL_1_GLOBAL_2=2)	20.5179	0.000035	Reject normality
Variance-Ratio Equal-Variance Test	1.2616	0.600559	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0982	0.754872	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_GLOBAL_2=1	524	714	731.5	70.06651
LOCAL_1_GLOBAL_2=2	559	2212	2194.5	70.06651

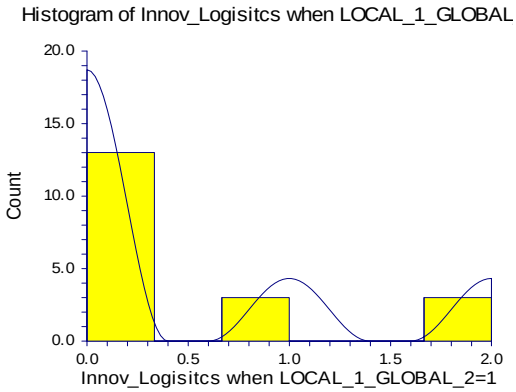
Number Sets of Ties = 4, Multiplicity Factor = 128838

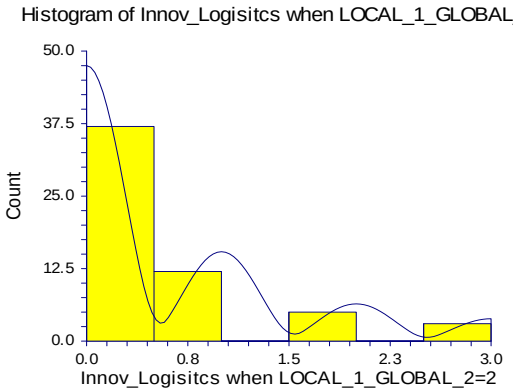
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-0.2498	0.802771	No	-0.2426	0.808295	No
Diff<0			-0.2498	0.401385	No	-0.2426	0.404147	No
Diff>0			-0.2498	0.598615	No	-0.2569	0.601372	No

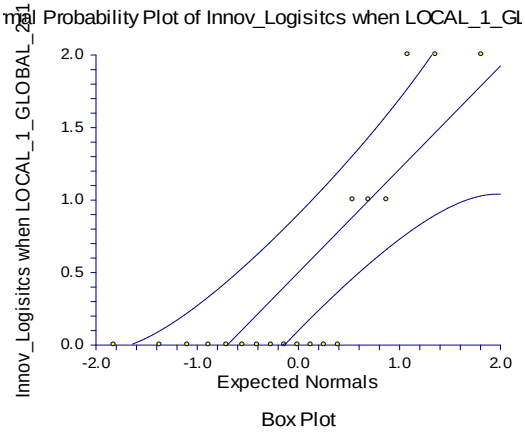
Kolmogorov-Smirnov Test For Different Distributions

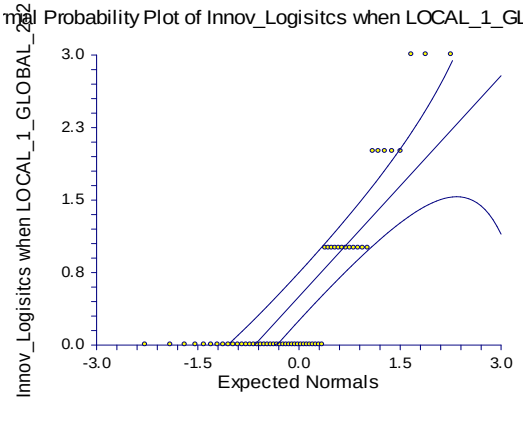
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.052632	0.3411	.050	No	1.0000
D(1)<D(2)	0.052632	0.3411	.025	No	
D(1)>D(2)	0.017544	0.3411	.025	No	

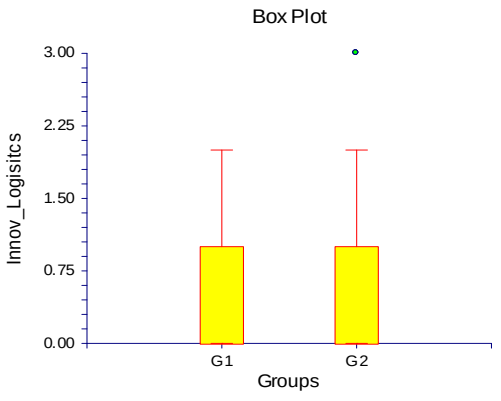
Plots Section











Appendix E: Test Results for Hypothesis 2b

Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:30:19 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable	Innov_OverallInnovation

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	2.827586	2.221148	0.4124568	1.982707	3.672466
LOCAL_1_MNCSubs_2=2	47	2.702128	2.535958	0.3699075	1.957543	3.446713

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	0.1254586	2.421658	0.5718363	-1.01395	1.264867
Unequal	65.40	0.1254586	3.371139	0.5540326	-0.9808921	1.231809

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 1.9969

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	1.7932	0.072938	Cannot reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	0.6126	0.540159	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	3.5909	0.166054	Cannot reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	3.1520	0.001621	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	2.3610	0.018228	Reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	15.5095	0.000429	Reject normality
Variance-Ratio Equal-Variance Test	1.3036	0.459432	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.2671	0.606804	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	725	1160	1116.5	92.1629
LOCAL_1_MNCSubs_2=2	638	1766	1809.5	92.1629

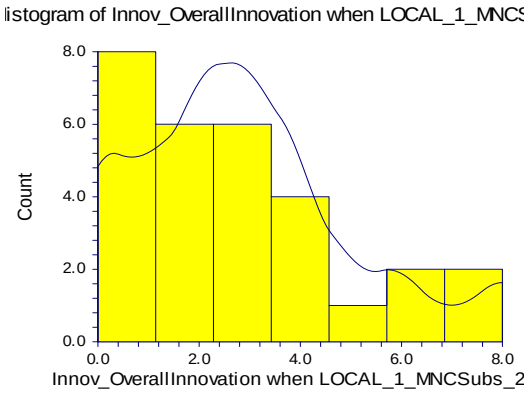
Number Sets of Ties = 8, Multiplicity Factor = 12642

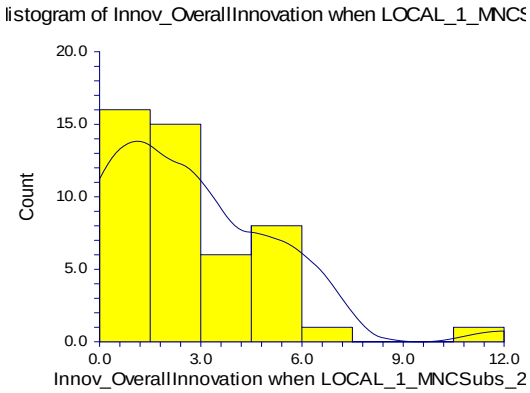
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			0.4720	0.636934	No	0.4666	0.640811	No
Diff<0			0.4720	0.681533	No	0.4774	0.683467	No
Diff>0			0.4720	0.318467	No	0.4666	0.320406	No

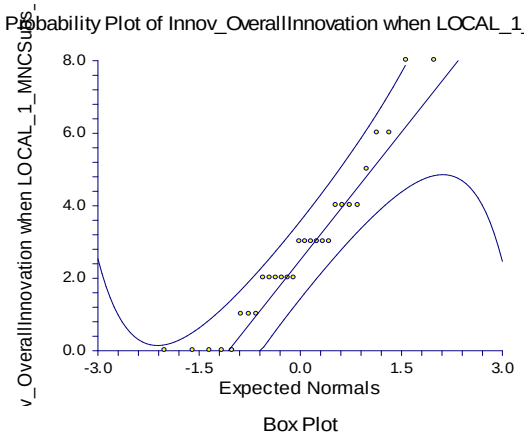
Kolmogorov-Smirnov Test For Different Distributions

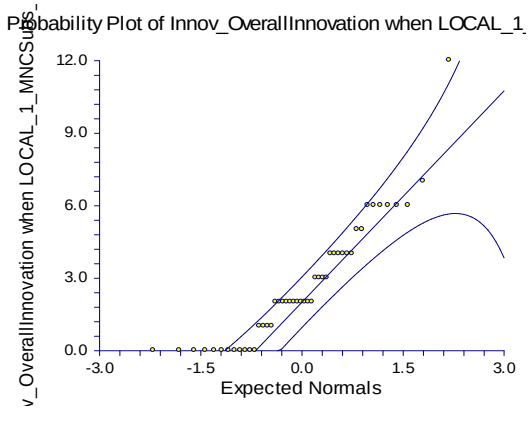
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.091709	0.3211	.050	No	0.9928
D(1)<D(2)	0.040352	0.3211	.025	No	
D(1)>D(2)	0.091709	0.3211	.025	No	

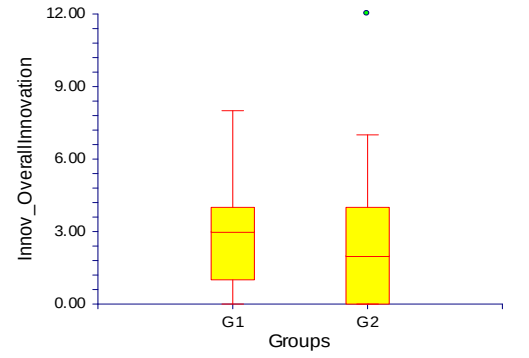
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:35:29 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_OverallProduct

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	1.275862	1.556015	0.2889447	0.6839857	1.867738
LOCAL_1_MNCSubs_2=2	47	1.170213	1.493743	0.2178848	0.7316335	1.608792

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	0.1056493	1.517606	0.3583586	-0.6083958	0.8196944
Unequal	57.57	0.1056493	2.156954	0.3618878	-0.6188641	0.8301627

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0020

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	2.3966	0.016548	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	0.2784	0.780692	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	5.8212	0.054443	Cannot reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	3.2110	0.001323	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	1.5357	0.124616	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	12.6686	0.001774	Reject normality
Variance-Ratio Equal-Variance Test	1.0851	0.788955	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0000	0.994467	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	709.5	1144.5	1116.5	87.28991
LOCAL_1_MNCSubs_2=2	653.5	1781.5	1809.5	87.28991

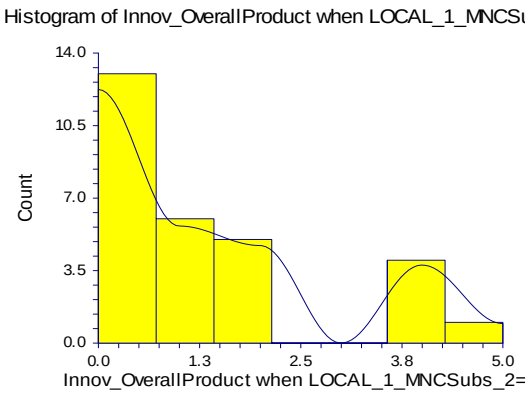
Number Sets of Ties = 5, Multiplicity Factor = 56526

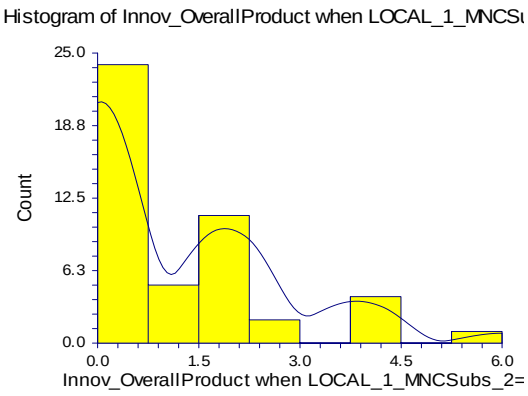
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			0.3208	0.748385	No	0.3150	0.752730	No
Diff<0			0.3208	0.625808	No	0.3265	0.627976	No
Diff>0			0.3208	0.374192	No	0.3150	0.376365	No

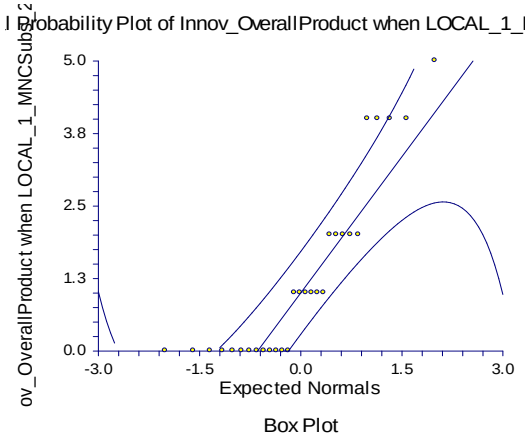
Kolmogorov-Smirnov Test For Different Distributions

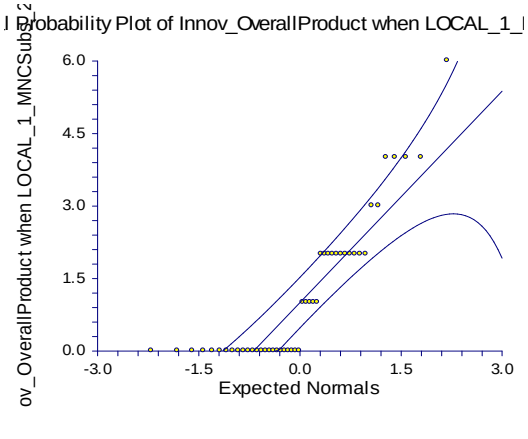
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.066031	0.3211	.050	No	1.0000
D(1)<D(2)	0.038151	0.3211	.025	No	
D(1)>D(2)	0.066031	0.3211	.025	No	

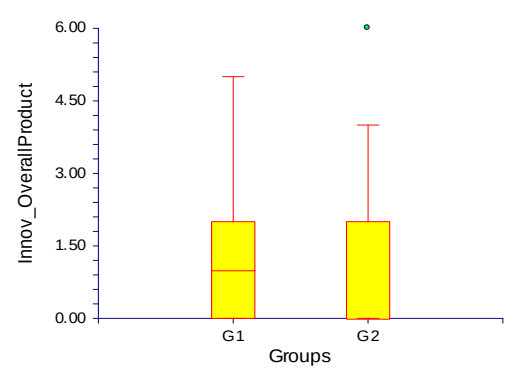
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:35:53 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Goods

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	0.8275862	0.9661767	0.1794145	0.4600722	1.1951
LOCAL_1_MNCSubs_2=2	47	0.8085107	0.9921057	0.1447135	0.5172175	1.099804

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	1.907557E-02	0.9823753	0.2319724	-0.4431395	0.4812906
Unequal	60.66	1.907557E-02	1.384836	0.2305029	-0.4418962	0.4800473

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 1.9999

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	1.9939	0.046166	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	-0.1516	0.879525	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	3.9985	0.135436	Cannot reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	2.2893	0.022062	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	-1.1183	0.263456	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	6.4914	0.038941	Reject normality
Variance-Ratio Equal-Variance Test	1.0544	0.898755	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0058	0.939342	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	697	1132	1116.5	86.01013
LOCAL_1_MNCSubs_2=2	666	1794	1809.5	86.01013

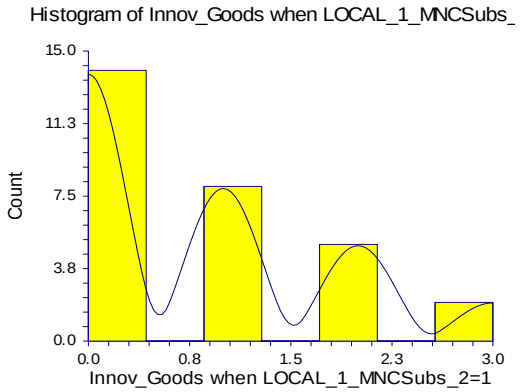
Number Sets of Ties = 4, Multiplicity Factor = 67656

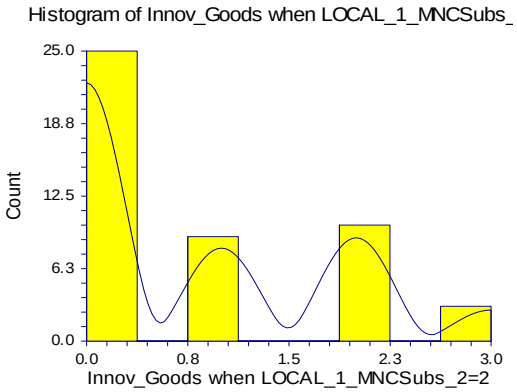
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			0.1802	0.856987	No	0.1744	0.861553	No
Diff<0			0.1802	0.571507	No	0.1860	0.573787	No
Diff>0			0.1802	0.428493	No	0.1744	0.430776	No

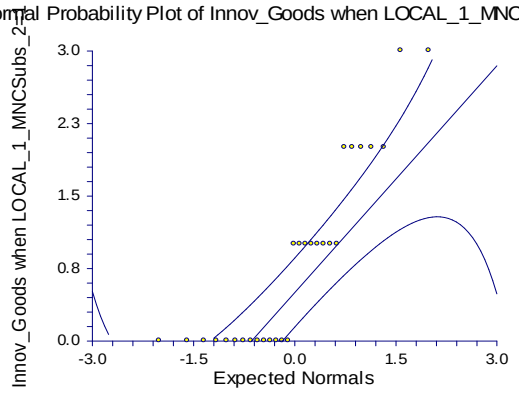
Kolmogorov-Smirnov Test For Different Distributions

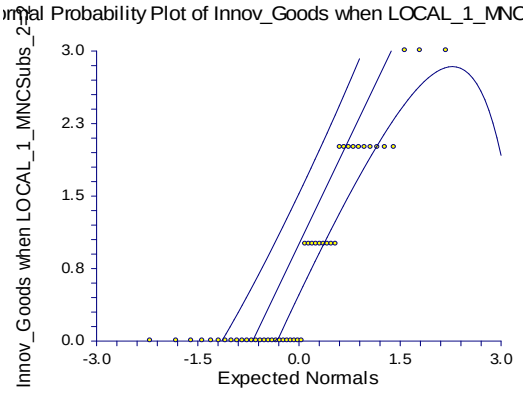
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.049156	0.3211	.050	No	1.0000
D(1)<D(2)	0.035216	0.3211	.025	No	
D(1)>D(2)	0.049156	0.3211	.025	No	

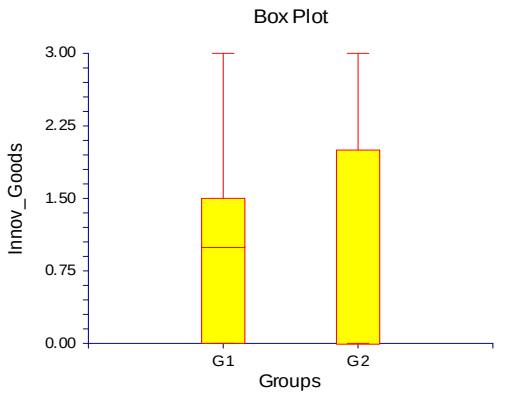
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:36:15 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable	Innov_Services

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	0.4482759	0.8274836	0.1536598	0.133518	0.7630338
LOCAL_1_MNCSubs_2=2	47	0.3617021	0.8189477	0.1194558	0.1212501	0.6021542

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	8.657373E-02	0.8221879	0.1941467	-0.300272	0.4734194
Unequal	58.96	8.657373E-02	1.164218	0.1946305	-0.3028862	0.4760337

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0010

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	3.5054	0.000456	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	2.1094	0.034908	Reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	16.7377	0.000232	Reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	4.7241	0.000002	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	3.0083	0.002627	Reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	31.3664	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	1.0210	0.929557	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.1988	0.656958	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	732	1167	1116.5	68.12236
LOCAL_1_MNCSubs_2=2	631	1759	1809.5	68.12236

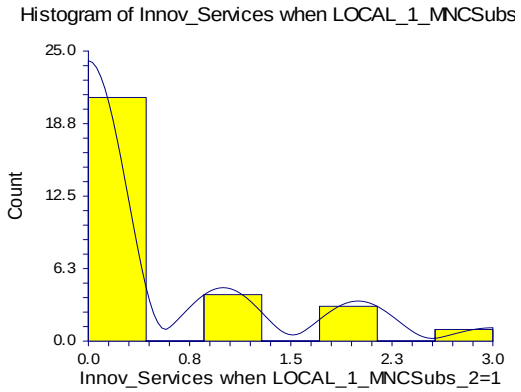
Number Sets of Ties = 4, Multiplicity Factor = 206016

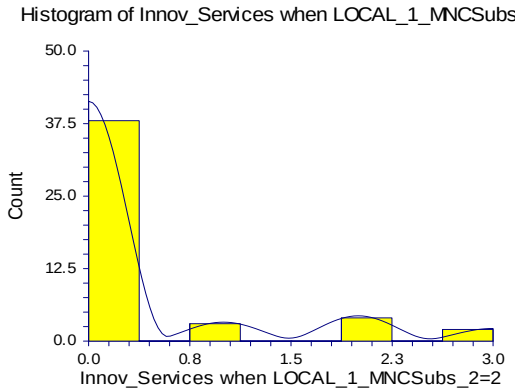
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			0.7413	0.458504	No	0.7340	0.462965	No
Diff<0			0.7413	0.770748	No	0.7487	0.772967	No
Diff>0			0.7413	0.229252	No	0.7340	0.231482	No

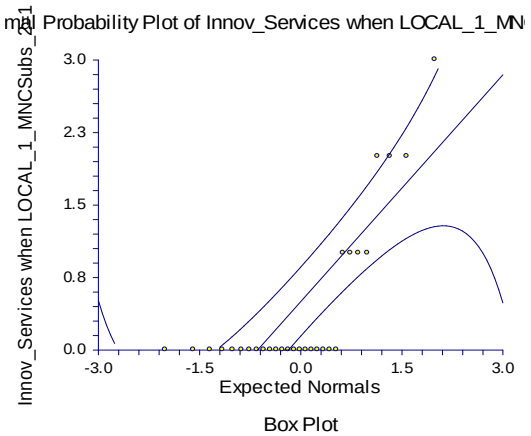
Kolmogorov-Smirnov Test For Different Distributions

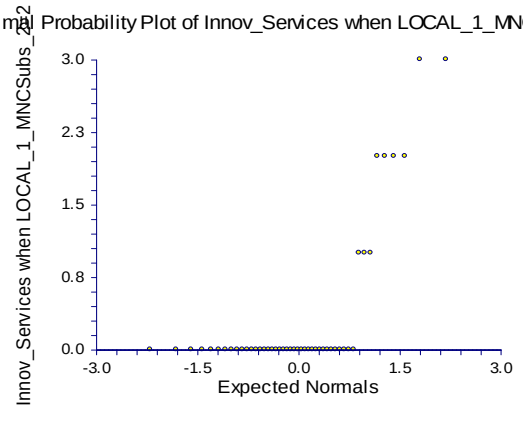
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.084373	0.3211	.050	No	0.9973
D(1)<D(2)	0.008070	0.3211	.025	No	
D(1)>D(2)	0.084373	0.3211	.025	No	

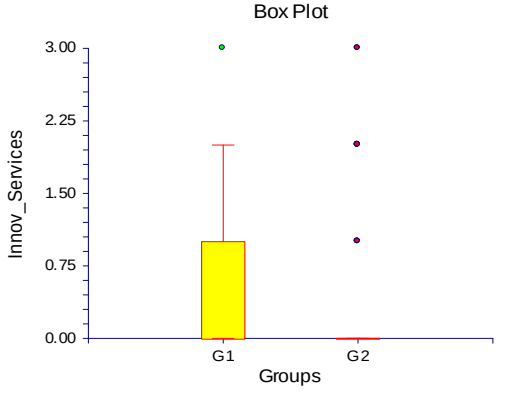
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:36:38 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_OverallProcess

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	1.551724	1.270158	0.2358624	1.068582	2.034866
LOCAL_1_MNCSubs_2=2	47	1.531915	1.599607	0.2333266	1.062253	2.001577

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	1.980924E-02	1.483579	0.3503238	-0.6782261	0.7178446
Unequal	69.25	1.980924E-02	2.042558	0.3317716	-0.6420144	0.6816329

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 1.9948

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	0.6529	0.513843	Cannot reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	-1.5069	0.131839	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	2.6969	0.259637	Cannot reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	2.7432	0.006085	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	1.2259	0.220228	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	9.0279	0.010955	Reject normality
Variance-Ratio Equal-Variance Test	1.5860	0.195748	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.8260	0.366386	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	722.5	1157.5	1116.5	90.07528
LOCAL_1_MNCSubs_2=2	640.5	1768.5	1809.5	90.07528

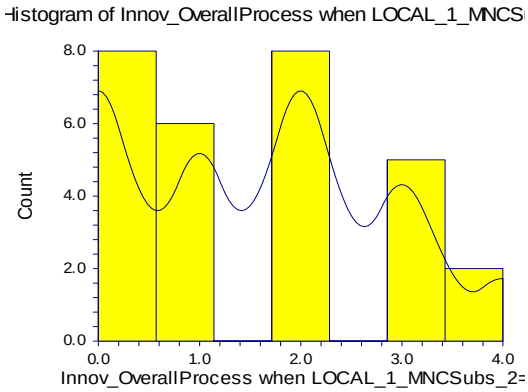
Number Sets of Ties = 6, Multiplicity Factor = 31734

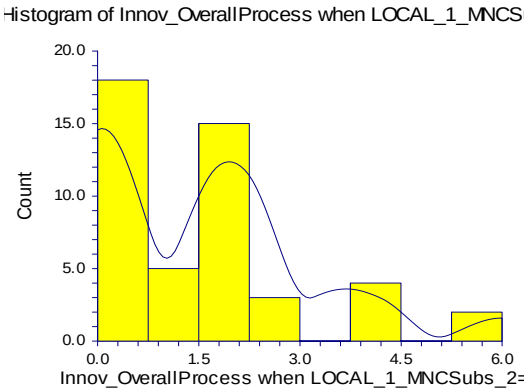
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			0.4552	0.648983	No	0.4496	0.652982	No
Diff<0			0.4552	0.675508	No	0.4607	0.677502	No
Diff>0			0.4552	0.324492	No	0.4496	0.326491	No

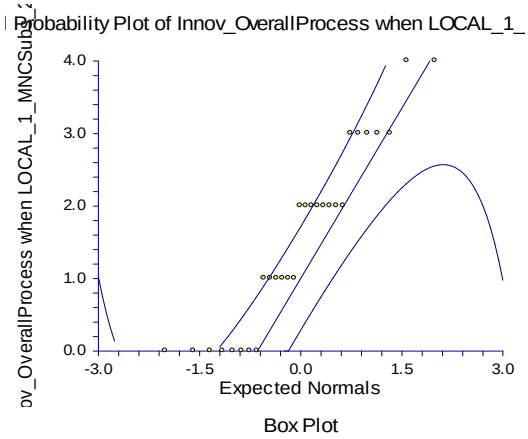
Kolmogorov-Smirnov Test For Different Distributions

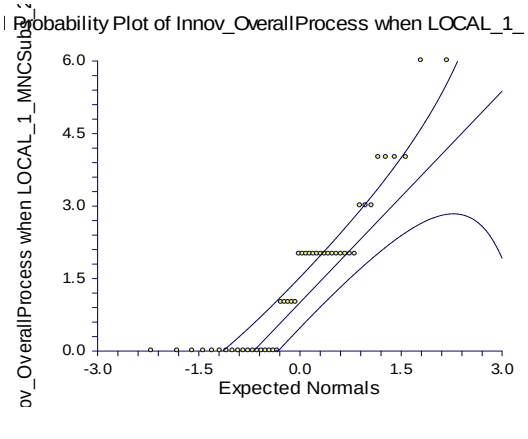
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.107117	0.3211	.050	No	0.9665
D(1)<D(2)	0.058694	0.3211	.025	No	
D(1)>D(2)	0.107117	0.3211	.025	No	

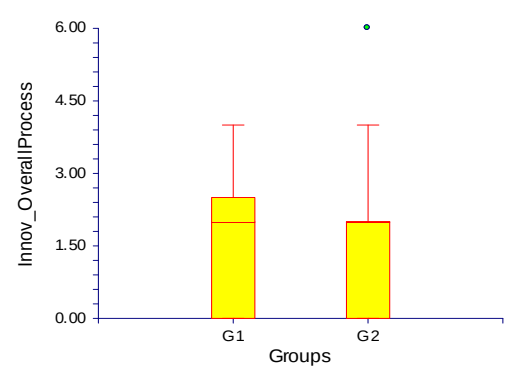
Plots Section











Two-Sample Test Report

Page/Date/Time 1 2010/11/05 01:37:00 PM
Database C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable Innov_Manufacturing

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	1.172414	1.037475	0.1926543	0.7777793	1.567048
LOCAL_1_MNCSubs_2=2	47	0.9148936	0.9048129	0.1319805	0.6492306	1.180557

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	0.2575202	0.9571742	0.2260216	-0.1928376	0.7078779
Unequal	53.30	0.2575202	1.376605	0.2335263	-0.2108122	0.7258526

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 2.0055

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	0.6065	0.544154	Cannot reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	-2.2279	0.025884	Reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	5.3316	0.069543	Cannot reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	1.5758	0.115062	Cannot reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	-1.4220	0.155038	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	4.5052	0.105123	Cannot reject normality
Variance-Ratio Equal-Variance Test	1.3147	0.402595	Cannot reject equal variances
Modified-Levene Equal-Variance Test	1.1166	0.294082	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	774	1209	1116.5	88.81073
LOCAL_1_MNCSubs_2=2	589	1717	1809.5	88.81073

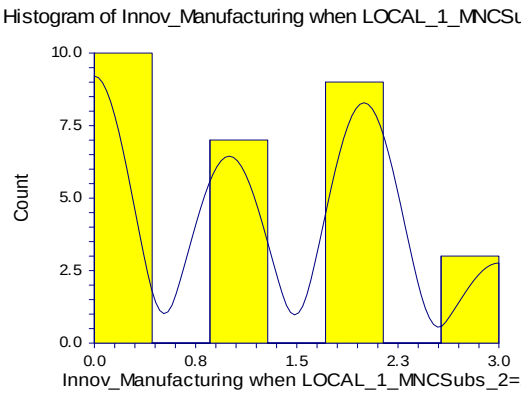
Number Sets of Ties = 4, Multiplicity Factor = 43086

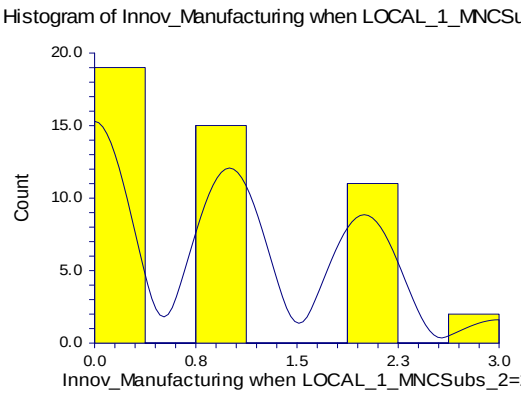
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			1.0415	0.297625	No	1.0359	0.300244	No
Diff<0			1.0415	0.851188	No	1.0472	0.852490	No
Diff>0			1.0415	0.148812	No	1.0359	0.150122	No

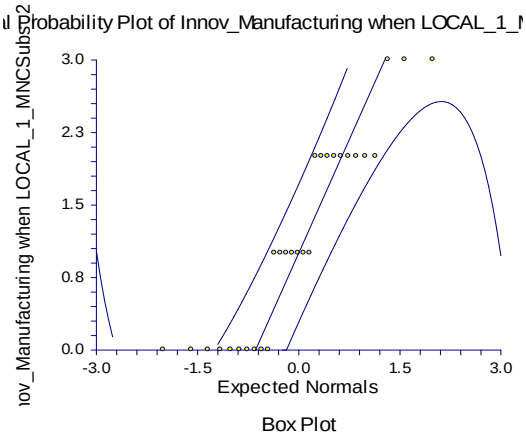
Kolmogorov-Smirnov Test For Different Distributions

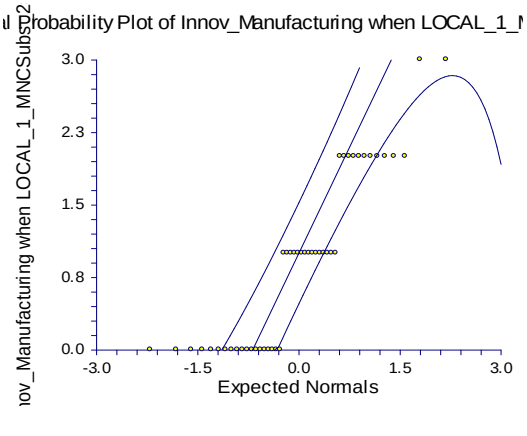
Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.137197	0.3211	.050	No	0.8289
D(1)<D(2)	0.000000	0.3211	.025	No	
D(1)>D(2)	0.137197	0.3211	.025	No	

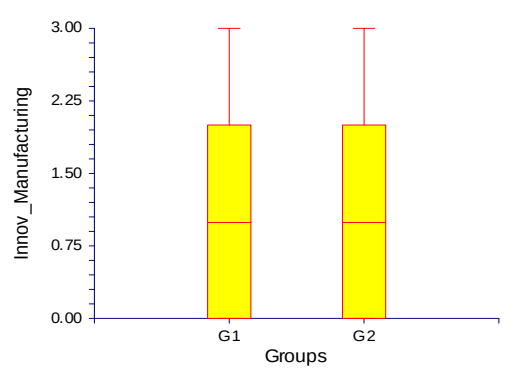
Plots Section











Two-Sample Test Report

Page/Date/Time	1 2010/11/05 01:38:01 PM
Database	C:\Users\paul.grota\Document ... ta\NCSS Files\AutoDataTG2.S0
Variable	Innov_Logisitcs

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95.0% LCL of Mean	95.0% UCL of Mean
LOCAL_1_MNCSubs_2=1	29	0.3793103	0.7752324	0.143957	8.442772E-02	0.674193
LOCAL_1_MNCSubs_2=2	47	0.6170213	0.873603	0.1274281	0.3605218	0.8735207

Note: T-alpha (LOCAL_1_MNCSubs_2=1) = 2.0484, T-alpha (LOCAL_1_MNCSubs_2=2) = 2.0129

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95.0% LCL Difference	95.0% UCL Difference
Equal	74	-0.2377109	0.8377413	0.1978194	-0.6318746	0.1564527
Unequal	64.84	-0.2377109	1.167976	0.1922539	-0.6216865	0.1462647

Note: T-alpha (Equal) = 1.9925, T-alpha (Unequal) = 1.9972

Tests of Assumptions Section

Assumption	Value	Probability	Decision(.050)
Skewness Normality (LOCAL_1_MNCSubs_2=1)	3.9625	0.000074	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=1)	2.8294	0.004664	Reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=1)	23.7070	0.000007	Reject normality
Skewness Normality (LOCAL_1_MNCSubs_2=2)	3.2305	0.001236	Reject normality
Kurtosis Normality (LOCAL_1_MNCSubs_2=2)	1.0701	0.284558	Cannot reject normality
Omnibus Normality (LOCAL_1_MNCSubs_2=2)	11.5816	0.003056	Reject normality
Variance-Ratio Equal-Variance Test	1.2699	0.506097	Cannot reject equal variances
Modified-Levene Equal-Variance Test	1.4440	0.233328	Cannot reject equal variances

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
LOCAL_1_MNCSubs_2=1	572	1007	1116.5	78.60391
LOCAL_1_MNCSubs_2=2	791	1919	1809.5	78.60391

Number Sets of Ties = 4, Multiplicity Factor = 128838

	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050	Z-Value	Prob Level	Reject H0 at .050
Diff<>0			-1.3931	0.163602	No	-1.3867	0.165533	No
Diff<0			-1.3931	0.081801	No	-1.3867	0.082767	No
Diff>0			-1.3931	0.918199	No	-1.3994	0.919157	No

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject H0 if Greater Than	Test Alpha Level	Reject H0 (Test Alpha)	Prob Level
D(1)<>D(2)	0.162876	0.3211	.050	No	0.6570
D(1)<D(2)	0.162876	0.3211	.025	No	
D(1)>D(2)	0.000000	0.3211	.025	No	

Plots Section