ECONOMICS OF STREET FOOD VENDERS IN NIGERIA AND AFGHANISTAN

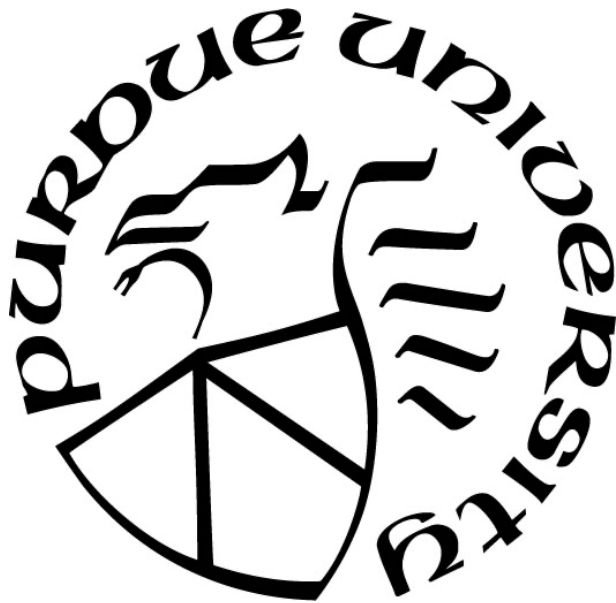by

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I dedicate this thesis to my parents and siblings without whose support this wouldn't have been possible. Secondly, to my wonderful adviser and faculty members. Finally, to the Fulbright program, you guys are amazing keep up the good work around the world.

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When I started writing I thought I will leave this section to the end, as it will be easy to write something. However, as I reached the end of my journey in the MS program at Purdue, acknowledgements seem one of the toughest things to write. I believe there are so many people who helped directly or indirectly to help me reach here that if I try mentioning names, I will surely miss many and this thesis will be a very lengthy document. The people that I can acknowledge right now are first my family who provided tremendous support in helping me through this journey, my faculty members, my amazing adviser and most importantly wonderful friends who encouraged me and helped me achieve this goal.

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ABSTRACT

Of every 10 workers in the world six work in the informal economy, while four out of every five organizations operate in the informal economy. An important sector in the informal economy is street food vending. Street food vendors not only earn their own living but provide a service to the market by making affordable food available quickly to the participants of the street market. While their role in the developing economies cannot be overlooked, not a lot has been known about them. This thesis explores street food vending in Afghanistan and Nigeria. Nigeria is used as an example for the rest of West Africa. In this thesis we will find out what crops are predominantly used by street food vendors, what are the impacts of price volatility on the profitability of street food vendors, are the vendors profitable, and how they make decisions under risk. We will be using tornado graphs, as well histograms, and cumulative density function to determine profitability and risk for street food vendors. We will also be using decision making trees to visualize how decisions are made by street food vendors.

CHAPTER 1.   INTRODUCTION

1.1   The informal economy

The International Labor Organization estimates that of every 10 workers in the world six of them work in the informal economy, while four out of five organizations operate in the informal economy (*Informal Economy (Employment Promotion)*, n.d.). With such a large portion of workers working in the informal economy, not a lot is understood about it, which has bought in more attention from researchers to know more. As capitalism was progressing, it was believed that the informal sector will soon disappear, thus it was not extensively studied in the past (Tinker, n.d.). However, with the turn of the 21st century the informal economy is still thriving both in developed and developing countries.

The International Labor Organization (ILO) defines informal economy as "all economic activities by workers and economic units that are in – law or in practice – not covered or insufficiently covered by formal arrangements" (*ILO*, 2012). Thus, the hotdog vendor at the street corner, or the corn truck that you see every harvest season can be examples of informal economic activities in the United States.

The informal economy is more prevalent in developing countries than developed countries, due to a lack of infrastructure and the lack of a comprehensive formal economic system to cover all the economic activities in these. In addition, poverty and illiteracy plays an important role. For the people who have no source of income or education to get a formal job, working in the informal economy can be a source of income as well as keeping them occupied.

1.2   Developing Countries

Although there are different terms classifying countries that are not doing as well as industrialized countries, as developing or least developed, there are gray areas. There are countries that some might consider developed (i.e. India and China are leading world economies, yet China is newly emerging from poverty while India still suffers from a large number of its people living in poverty (Jennings, n.d.; Scott et al., n.d.)), while others might not. A more precise measure would be the income classification conducted by the World Bank annually. According to the World Bank's Income classification, countries with Gross National Income per Capita of $1035 - $4045 are

middle lower income, while countries below $1035 GNI per capita are lower income countries. World Bank classifies Afghanistan as a low income and Nigeria as middle low income country (*World Bank Country and Lending Groups – World Bank Data Help Desk*, n.d.). Meanwhile, the World Trade Organization does not use a specific definition, it rather allows the countries to choose for themselves whether they should be classified as developed or developing countries. However, other members of WTO can challenge the status a country chooses for itself (developed vs developing) (*WTO | Development - Who Are the Developing Countries in the WTO?*, n.d.). To simplify, we will consider countries with poor infrastructure and a largely poor population as developing. By any definition, the countries that we cover, Afghanistan and Nigeria are countries that striving to become industrialized. As many will agree, developing countries usually have agricultural economies and much of its population depend on agriculture, that is true in case of both Afghanistan, Nigeria and other West African countries.

Afghanistan

The Islamic Republic of Afghanistan located in South Asia, at 33º North and 65º East has spent much of its history in war since its foundation in 1747. With a total area of 652,230 sq Km, it is the 42nd largest country by land area. Despite its mountainous terrain and history of unrest, Afghanistan grows some of the tastiest agricultural crops (MENAFN, n.d.) and has one of the most diverse cuisines. The instability caused much of its population to live in poverty and unemployment. Despite the high rates of illiteracy people have found ways of earning a living in what is known as shughl-e-azad (Persian term for self-employed, literally translating to free employment [not attached to an organization]). One of the ways people earn a living in Afghanistan is through trade in street markets, these are unregulated and some of the largest markets in Afghanistan. In addition to finding all necessary household items, clothing and other tradeable goods, street foods are an important component of these markets. Street food vendors in Afghanistan help keep the markets moving throughout the day by providing affordable and convenient meals to participants of the street market. Despite previous studies in Africa showing street food vendors earn much higher than the minimum wages (Otoo et al., 2011), street food vending is something that is often looked down upon. no significant research has been conducted on the operations and profitability of street food vendors in Afghanistan. Thus, this will be one of

the first projects analyzing street food vendors and their profitability in Afghanistan. (*South Asia ::*
Afghanistan — The World Factbook - Central Intelligence Agency, n.d.)

Nigeria

Officially known as Federal Republic of Nigeria is the 33rd largest country by land area with an area of 923,768 sq. km located in Western Africa. Although it is an OPEC member, unlike the Gulf countries poverty is still prevalent in many parts of Nigeria. With a population of 214 million people, it is the 6th most populous country in the world. According to the CIA World Factbook Nigeria has 16.5% unemployment rate and a 2010 estimate showed 70% of the population lived below the poverty line. This thesis deals with Northern State of Kano in Nigeria. Overall, 53.5% of Nigerians are Muslims with a heavy concentration in Northern Nigeria. Unlike conservative Muslim countries, in Northern Nigeria women are allowed to trade food in the street market. However, this differs based on the family income and economic status. Kano is one of the major states in the cowpea belt of Northern Nigeria. Cowpeas are black eye beans popular in Northern Nigeria, Niger, Burkina Faso and Ghana. With a Human Development Index of 0.534, Nigeria is ranked 158th on HDI ranking and is considered a developing country. As of 2019, Nigeria had $448.12 billion Nominal GDP which is lower than its height in 2014 where its GDP was $568.499 (*Nigeria | Data*, n.d.). Despite the recession, Nigeria is doing relatively better economically compared to the other countries in this study. Nigeria has a Youth Literacy Rate of 75% (*Literacy Rate, Youth Total (% of People Ages 15-24) - Nigeria | Data*, n.d.).

1.3   Unemployment in Developing Countries

Unemployment in developing countries is a difficult benchmark to use and may not give a full picture of the situation as it can be overstated or understated using different measurement. Developing countries usually do not have the resources to produce comprehensive estimates of unemployment for the country, thus the reliability of the estimates is not as high as those produced in developed countries. The numbers for unemployment are usually either underrepresented or overrepresented (*Rivers State Unemployment Figures by NBS Are Fake - Wike | Nairametrics*, n.d.). For instance, the government either counts only official employment as part of the employment rate, or anyone who has ever had a job, despite being a daily laborer and having

worked only for a day in a month. Thus, in some developing countries we see extremely low rates of unemployment from official figures and in some cases extremely high rates. Officials have even raised questions on government produced unemployment data's authenticity (*Rivers State Unemployment Figures by NBS Are Fake - Wike | Nairametrics*, n.d.). Another measurement used by the World Bank to measure effectiveness of development strategies and guide strategist in developing countries is the poverty rate (*Measuring Poverty*, n.d.). Although the poverty rate still does not give a full picture (i.e. being above the poverty line does not mean a good living standard), the data produced in this aspect are more reliable. Thus, this study will use the international poverty line as a benchmark to determine the well-being of street food vendors.

1.4   Vendor Profile

Afghanistan is a conservative society with women handling all the work inside the home, while men work outside the home to earn a living. Even after 20 years of work on women empowerment in Afghanistan, women participation in the labor force has increased to only 21.7% from 14.6% of the Taliban era (*Labor Force Participation Rate, Female (% of Female Population Ages 15+) (Modeled ILO Estimate) - Afghanistan | Data*, n.d.). Male vendors dominate street markets. Yet, an important distinction is the shoppers can be both men and women, in many cases, women are usually the ones shopping groceries for their households. Thus, a Bolani vendor is usually male, although we did see a female vendor while casually observing the day-to-day Bolani business in Darul Aman Road (6th District) on December 31st, 2019. Bolani customers, on the other hand, are both male and female. As prices may differ depending on which city we are talking about, for this study, we will be looking at Bolani vendors in Kabul City.

After the implementation of Islamic Law in Northern Nigeria, the concept of seclusion was introduced. As Lowenberg-DeBoer and Ibro (2008) described it, it is the interpretation of Islamic law about the role of women in Kano and other parts of Northern Nigeria, restricting married women to be in their homes with occasional visits to nearby relatives. However, the practice is usually practiced in higher income families. Besides, as per the Islamic Law, women are given a share in inheritance and land ownership. Meanwhile, men are given heavy tasks. This concept of land ownership, as well as the separation of duties between physically demanding jobs, leaves women with the ability to budget their income as well as think about investment opportunities. Thus, street food vending is mostly operated by women in Northern Nigeria.

As (Otoo et al., 2011), found street food vendors often make more than the official minimum wage. The alternative for women street food vendors is to work as daily laborers or maids, where the wages are close to nothing. Thus, the opportunity cost for street food vendors is close to zero.

1.5   Product Profile

1.5.1   Bolani

Bolani is one of the most common and affordable street foods found in Afghan street markets. It is a staple food of Ramadan and a summer favorite served with Dogh (a yogurt-based Afghan drink). Bolani in its simplest form is a wheat flour bread stuffed with potato, leek, spinach or even meat. However, the most commonly sold and the most affordable variety are potato and leek Bolanis. Bolani is usually prepared by using wheat flour to make dough, the dough is then stuffed with boiled potatoes or partially cooked leek, which in turn is fried in oil. Some bakeries cook Bolani in mud ovens, however, a Bolani vendor needs a more portable solution. Thus, Bolani vendors sell fried Bolanis instead of baked.

1.5.2   Danwake

Danwake is Cowpea based dumpling, made from a mixture of cowpea, cassava flour, Kuku powder, chicken broth and baking soda. The dumplings are boiled in hot water and served with spices. Danwake literally means, product of Cowpea in Hausa language. Traditionally, Danwake was a cowpea only dish, however, as Cowpea supplies become scarce and expensive, the locals found a cheaper substitute, Cassava flour. Cassava flour is a tasteless flour that does not impact the taste of the Danwake, yet it helps in replacing up to 1/3 of the more expensive cowpea needed in making a Danwake.

1.5.3   Kosai

Kosai are traditional fried cowpea-based fritters. They are made by preparing the batter from cowpea, onions, spices. The batter is shaped into small balls and fried in oil. The fried Kosai can be served with spices or plain salt. It is a traditional snack, yet for street vendors who do not have access to regular restaurants this can serve as meals too.

1.6   Objectives

This thesis has the following objectives. Firstly, the thesis aims to find out whether street food vendors are profitable? Secondly, the state of cowpea production will be discussed in the literature review of the thesis. Thirdly, hypothetical budgets for cowpea-based street food vendors in Kano, Nigeria, as well as Bolani vendors in Afghanistan will be developed and analyzed. Fourthly, a Monte Carlo analysis will be used to determine the impact the variability in the incomes of the cowpea street food vendors and how the differences in cowpea prices can impact their profitability throughout the year. Finally, decision trees will provide a better picture of the process cowpea-based street food vendors go through to decide how much to sell each day in different seasons.

CHAPTER 2. LITERATURE REVIEW

2.1 Crops Studied

2.1.1 Cowpea and its importance to Nigeria and West Africa

Scientifically known as Vigna unguiculata, cowpea is a legume grown primarily in West Africa and the United States (Singh et al., 2006), commonly referred to as black-eyed peas in the United States. When potatoes were introduced to Europe, it was a cheap source of proteins other than meat. However, it is 80% water (*Potato, Nutrition and Diet - International Year of the Potato 2008*, n.d.) thus, one needs a lot of it to fulfill their protein needs. In contrast, cowpea has 200-300 grams of crude protein per kilogram (20-30% protein content) and as much as 600 grams of carbohydrates per kilogram (Singh et al., 2006). Meanwhile, FAO reports that only 11% of cowpea seed is made up of water. Thus, making cowpea seeds a more efficient plant-based food.

Due to its ability to be stored outside a refrigerator at a relatively lower price than meat, cowpea is considered an alternative to meat and sometimes referred to as the poor man's meat (Mishili et al., 2009). As of 2017, more than 7.4 million tons of cowpea were produced, more than 90% of which was produced in Africa. Nigeria accounts for 48% of African production and 46% of the world's cowpea production, the largest cowpea producer ("Cowpea," n.d.). Cowpea plays a vital role in the daily lives of West Africans, from the farmers who plant and harvest it to the wholesalers and retailers who sell it, as well as the street food vendors who add value to it and sell them as street food, to homemakers who use it for their meals.

2.1.1.1 State of Cowpea Production in Nigeria

According to the FAO, the top three cowpea producing countries in 1971, Nigeria, Burkina Faso, and Niger, accounted for 77.33% of total cowpea production globally. Production-wise that was 963,422 tons. The largest cowpea producer was Nigeria, accounting for 64.29% of the global output or 801,000 tons on 3.79 million hectares of land, followed by Burkina Faso with a 7.25% share of total production or 90,322 tons produced on 226,000 hectares of land. Finally, Niger accounted for 5.79% of global production on 999,600 hectares of land. Similarly, Nigeria had a yield of 211 kg/ha, half that of Burkina Faso with 400 kg/ha. However, Niger had the lowest yield, producing only 72kg/ha.

In 2001, Niger overtook Burkina Faso and became the second-largest producer of cowpea. The total amount of cowpea produced worldwide had also increased from 1.25 million tons to 3.84 million tons. Now Nigeria was producing 2.17 million tons on 3.62 million hectares of land, Niger was producing 509,469 tons on 3.5 million hectares of land, and Burkina Faso was producing 376,225 tons on 800,500 hectares of land. With advancing technology and improved learning curves, Nigeria's yields increased to 600 kg/ha, while in Niger, it was 145 kg/ha, and Burkina Faso had 370kg/ha. While in 1971, Nigeria produced 64.29% of the world's cowpea, in 2001 it produced 56%, Niger produced 13%, and Burkina Faso 10%. Together these three countries produced 79% of the cowpea in the world. The increasing cowpea production in Nigeria, while its decreasing share in the world cowpea market, indicates that while cowpea was popular in Nigeria, it also gained popularity in other countries.

Additionally, Nigeria saw an increase in production due to its efficiency since the land use decreased between 1971 and 2001. Both in 1971 and 2001, nine out of the ten biggest cowpea producers were in Africa. While in 2001, four out of the ten biggest cowpea producers were in West Africa, in 1971, five out of ten biggest cowpea producers were in West Africa. Once again indicating the popularity of cowpea outside its traditional borders.

While cowpea production has increased significantly at the start of the 21st century, it's interesting to know its most recent state. In 2018, while Nigeria still retained its spot as the biggest cowpea producer globally, it accounted for only 35.96% of the cowpea produced in the world, producing 2.6 million tons on 2.85 million hectares. However, Niger produced 2.37 million tons on 5.88 million hectares of land, accounting for 32.79% of the global production. Burkina Faso produced 630,965 tons on 1.3 million hectares of land, accounting for only 8.70% of the global production. While in some countries the area cultivated shrunk, the increase in production was caused by increasing yields. Nigeria increased its yields from 600kg/ha to 914 kg/ha. Meanwhile, Niger increased its yield from 145kg/ha to 404kg/ha, and Burkina Faso increased its yield from 470kg/ha to 483kg/ha. Increases in yields can be an indicator of better technology, better skills, environmental factors as well as government support, and improved learning curves. While countries in West Africa near the Sahara Desert have been increasing their yields steadily, we notice Ghana country a bit further from Sahara's desert climate produced 1351 kg/ha and Myanmar produced 1142 kg/ha. Thus, despite cowpea being a drought resistant plant, it appears to give higher yields in non-desert green areas.

Table 2.1 Cowpea producing countries ranked by production level in 1971

Area	Year	Unit	Value	Percentage of the World	Area Harvested in Hectares	Percentage of the World	Yield in Kg/Ha
Nigeria	1971	Tons	801000	64.29%	3790000	68.33%	211
Burkina Faso	1971	Tons	90322	7.25%	226000	4.07%	400
Niger	1971	Tons	72100	5.79%	999600	18.02%	72
Uganda	1971	Tons	45000	3.61%	40000	0.72%	1125
DR Congo	1971	Tons	40300	3.23%	62100	1.12%	649
Haiti	1971	Tons	40000	3.21%	82000	1.48%	488
Malawi	1971	Tons	35000	2.81%	58000	1.05%	603
Senegal	1971	Tons	25900	2.08%	70800	1.28%	366
Mali	1971	Tons	20000	1.61%	100000	1.80%	200
South Africa	1971	Tons	14400	1.16%	13000	0.23%	1108
Rest of the World	1971	Tons	61847	4.96%	105383	1.90%	587
World	1971	Tons	1245869	100.00%	5546883	100.00%	225

Source: FAO STATS

Table 2.2 Cowpea Producing Countries Ranked by production in 2001

Country	Year	Unit	Value	Percentage of the World	Area Harvested in Hectares	Percentage of the World	Yield in Kg/ha
Nigeria	2001	Tons	2172000	56%	3620000	39%	600
Niger	2001	Tons	509469	13%	3512464	38%	145
Burkina Faso	2001	Tons	376225	10%	800500	9%	470
Myanmar	2001	Tons	113400	3%	137593	1%	824
United Republic of Tanzania	2001	Tons	113036	3%	152143	2%	743
Mali	2001	Tons	98007	3%	278206	3%	352
Cameroon	2001	Tons	87503	2%	95809	1%	913
Uganda	2001	Tons	59000	2%	65000	1%	908
Malawi	2001	Tons	51056	1%	78247	1%	652
DR Congo	2001	Tons	49510	1%	100000	1%	495
Rest of the World	2001	Tons	218408	6%	362744	4%	602
World Total	2001	Tons	3847614	100%	9202706	100%	418

Source: FAO STATS

Table 2.3 Countries ranked by Cowpea production in 2018

Area	Year	Unit	Value	Percentage of the World	Area Harvested in Hectares	Percentage of the World	Yield in Kg/Ha
Nigeria	2018	Tons	2606912	35.96%	2853097	22.80%	914
Niger	2018	Tons	2376727	32.79%	5889677	47.07%	404
Burkina Faso	2018	Tons	630965	8.70%	1307336	10.45%	483
Ghana	2018	Tons	215350	2.97%	159345	1.27%	1351
United Republic of Tanzania	2018	Tons	202865	2.80%	208059	1.66%	975
Cameroon	2018	Tons	185832	2.56%	209371	1.67%	888
Kenya	2018	Tons	179399	2.47%	260408	2.08%	689
Mali	2018	Tons	157739	2.18%	284451	2.27%	555
Myanmar	2018	Tons	136411	1.88%	119398	0.95%	1142
Sudan	2018	Tons	104667	1.44%	258898	2.07%	404
Others	2018	Tons	452193	6.24%	961372	7.68%	470
World	2018	Tons	7249060	100.00%	12511412	100.00%	579

Source: FAO Stat

Composition of the Cowpea Bean

Cowpea has 22-24 grams of protein in 100 grams of seed while having 56-66 grams of carbohydrate, 11 grams of water, and other necessary nutrients. Compared to 26 grams of protein in 100 grams of beef, cowpea comes short only by 2 to 4 grams. However, considering the little resources needed to produce cowpeas, its smaller carbon footprint, and its relatively lower price, cowpea can be a very good trade of for beef in West Africa, especially for those who may not be able to afford more expensive proteins.

Table 2.4 Chemical Composition of Cowpea (% in 100grams)

	Seeds	Hay	Leaves
Carbohydrate	56-66		8
Protein	22-24		4.7
Water	11	18	85
Crude fibre	5.9-7.3	9.6	2
Ash	3.4-3.9	23.3	
Fat	1.3-1.5	11.3	0.3
Phosphorous	0.146	2.6	0.063
Calcium	0.104-0.076		0.256
Iron	0.005		0.005

Source: Kay, 1979; Tindall, 1983; Quass, 1995

2.1.2 Wheat flour and its importance in Afghanistan

Wheat is considered one of the top three crops cultivated worldwide. In 2018, roughly 865.5m tons of wheat was produces on 238.5m hectares of land worldwide (http://fao.org/faostat/). One of the most common uses of wheat is to mill it into flour which can then be used in baking bread and other baked products. Naan is the staple bread in Afghanistan, baked from whole wheat or bleached wheat flour. Bolani is a slightly more complex version of Naan with the added stuffing and often fried in oil. While bakeries can make bake Bolani along with Naan in their traditional mud oven, having an oven is not practical for street food vendors; thus, they opt for frying Bolani in oil.

Despite its wide availability and popularity in many cultures, wheat has been known to trigger allergies for some people. The allergens usually come from Gluten, for which those allergic to Gluten might want to look for alternatives. Cowpea flour, Cassava, and other flours are good alternatives that can replace wheat flour.

2.2 Culture and Entrepreneurship

Culture plays an important role in a household's decision on how to earn their living. While a supportive culture of entrepreneurship such as the one in the US helps entrepreneurs rise and take the risk, a risk-averse and nonentrepreneurial culture causes people not to undertake entrepreneurial activities. As Lowenberg-DeBoer and Ibro (2008) notes, men in Nigeria usually work in official jobs for lower pay than their wives, who sell cowpea-based foods. Thus, despite the lower income, having an official job satisfies the social status compared to running their own microenterprise.

Meanwhile, (Teixeira & Vasque, 2020) looked at the relation between entrepreneurship and happiness as well as whether culture matters for entrepreneurs. They found that, on average, in the 60 countries that were studied between 2010-2013, entrepreneurship increased the chance of happiness for the entrepreneur. However, culture did matter as their findings showed the happiness obtained from entrepreneurship varied across cultures. For Sub-Saharan Africa and East Europe, the culture increased the happiness obtained from being an entrepreneur, while in the Middle East, the culture had a negative impact on the amount of happiness one could obtain from being an entrepreneur. Once again, reiterating the findings of Lowenberg-DeBoer and Ibro (2008), men in

Nigeria prefer official work even if it pays less than entrepreneurship. Thus, there is a negative culture towards entrepreneurship that must be addressed if we were to help people earn a living from entrepreneurship. Interestingly, the negative culture does not stop women from selling street food in Africa. We can reason that despite an unfavorable culture, entrepreneurship allows women to be financially independent.

2.3   Microenterprises

While there are discussions on what should and what shouldn't be considered a small business, we consider street food vendors as micro-entrepreneurs. We call them micro since, usually, it is just one person of two who runs the business (*What Makes Micro-Entrepreneurs Different Than Entrepreneurs – Solo-Entrepreneurship in Europe*, n.d.). Despite the small amount of initial investment required, that amount still has to be repaid by the vendor; the vendor risks his time working in the business that he/she can use to do daily laborer work. Thus, the vendor is taking a financial risk as well as risking their time. In addition, the vendors solve a problem that is offering affordable, accessible, and quick food to participants of the street market who would otherwise have to leave the market to take a lunch break. Thus, despite their small size, street food vendors are risk-takers and solve a problem in their community. Hence, they are microentrepreneurs.

2.3.1   Importance of Microenterprises

While we come across examples of big entrepreneurial success stories, like food chains such as McDonald's, KFC, or food stores as Kroger's and Walmart, entrepreneurs may not always make it big. Big business is important and provides important services; however, microenterprises like street food vendors are also crucial to market economies. There are a lot of industries that can be formalized and made into giant companies; street foods are not one of them. Microenterprises allow the owners to earn a living and be busy while providing important services to the people around them. Microenterprises provide opportunities for those less fortunate to get a formal education and job, to earn a living, and it also solves various problems for people. For instance, a mobile credit card vendor who sells cell phone credits in voucher cards earns his living through the commission he receives on each credit card; he also helps the people who buy from him. There

aren't many options to buy mobile credits in Afghanistan. Finally, he helps the telecom company to distribute its credit cards through an affordable network of distributors instead of setting up numerous expensive branches and hiring employees to do the job.

2.4 Street Food

Although it has been defined in various ways, (Mwangi et al., 2001, p. 499) defines street food as: "ready-to-eat foods and beverages. Processed or fresh, which are sold at stationary or by mobile vendors in streets and open places as opposed to stores and licensed establishments". This definition fits the premise of this thesis accurately, as the vendors that are studied do not have permanent or fixed locations and can change their locations anytime as they deem necessary.

2.4.1 Importance of Street Food

The vendors are able to make a living, while the buyers can overcome their hunger without having to leave their spot or pay the high cost of restaurant food. A study (Tinker, n.d.), found that nearly half of the total food budget of people in Nigeria and Thailand is spent on street foods. The study found that the smaller and the poorer a family was the more budget they spent on street food, due to its lower price compared to restaurant meals and even homemade food in some cases. For instance, making a Bolani at home will require the individual to buy different ingredients in smaller quantity which will cost significantly more than for the vendor who buys in larger quantities. In addition, it requires time and equipment to make Bolani and cleanup what's left. On the other hand, a Bolani vendor can make them the perfect Bolani for as little as 20AFN (about 30 cents).

In 2013, Steyn et al. reviewed 639 articles in order to find the contribution of street food to adult and children nutrition in developing countries. Of the 639, only twenty-three articles that met the inclusion criteria were retained. The majority of the 23 studies reviewed showed that street foods contributed significantly to both adult and children's diets in terms of energy, protein, and micronutrient intakes. The highest contribution to adults was in Abeokuta, Nigeria, with 50.3% of Energy Intake(EI) in males and 48.3% EI in females (Steyn et al., 2014). While in Contonou, street food contributed 46% to the daily EI of children. Overall, it was observed that street food

contributes between 13% EI to 50% EI for the population of developing countries(Steyn et al., 2014).

In June 2005, K. M. Drabo conducted a survey at Bobo-Dioulasso, Burkina Faso, to profile street food vendors and describe the "main characteristics of street food sector." The study found that, on average, the street food vendor was a married illiterate woman of age 32. While the average consumer of street food was a married man of age 27 who was working in a profit-making activity. This indicates that while street markets are male-dominated, street food vending is a female-dominated activity that is usually conducted by women to support their families. This also means street food vending is a source of income for women who do not have formal education. According to Tinker (1999), more than half the income in developing countries, including Nigeria and Thailand, was spent on street food. Street food and snacks help the poor and undernourished maintain their energy level throughout the day (Tinker, 1999). The affordability of street food is a major advantage for people in developing countries. As noted by (Omemu & Aderoju, 2008)," in Nigeria, it is cheaper to buy street food than to cook it."

2.4.2   Children and Street Food

While children work as family laborers for some food vendors, which can have bad consequences for their future as they cannot go to schools, children are also an important customer segment for street food vendors. Children in developing countries whose parents work and are not able to provide consistent three-time meals, street food, and snacks play an important role. As (Steyn et al., 2014) notes, 50% of children's nutritional value comes from street foods. Street food provides an affordable and accessible source of nutrition for children near their schools. In addition, some of the traditional foods sold by street food vendors are healthier than their commercial counterparts. For instance, Dogh is a common drink in Afghan culture, and it is being sold by street food vendors near schools. While some companies do make commercial Dogh, the homemade Dogh sold by street food vendors are made using only Yogurt, Water, Salt, and lemon (in some cases, pepper is added for flavor). Besides being better than commercial Dogh, they are also far better than Soda drinks sold in nearby shops. Pricewise a soda drink costs 20AFN for 330ml cans, while 500ml of Dogh costs the same 20AFN, and a glass of 250ml is for 10AFN.

2.4.3   Food Safety of Street Food

Food safety is an important aspect of buying street food. In 2008, Omemu and Aderoju conducted a survey among 87 food vendors in Abeokuta, Nigeria, to know more about food safety knowledge and practices of street food vendors. A vast majority of the vendors (85%) were familiar with food-borne illnesses, while 90% knew about microorganisms being able to cause these diseases. However, the knowledge of cleanliness varied among vendors. All the respondents believed they should bathe regularly; however, 80% agreed they needed clean water to wash their hands, while 76% agreed they needed soap water to wash their hands after using the toilet. Meanwhile, 76% of the respondents did not know they should wash their hands after handling money. Less than 50% considered symptoms like a fever as enough reason not to come to work. Thus, while there is some knowledge of basic contamination and a belief that street food vendors should follow certain cleanliness regulations, the vendors lack advanced knowledge of contaminants and how to disinfect their products. Thus, this is an area where the government and social organizations can help raise awareness and make street food safer.

CHAPTER 3.   METHODOLOGY AND DATA

Although the intention was to gather primary data for this thesis, however, due to Covid-19 travel restrictions this was not possible. All historical prices for raw materials for Bolani, as well as Danwake and Kosai are from reliable secondary sources, including FAO (Food and Agricultural Organization), WFP (World Food Program), and FEWS.NET (Famine Early Warning System Network). To ensure the data is realistic an informal observation of Kabul's market was made in December 2019 (pre-Covid restrictions). In addition, the prices in Nigeria were confirmed by Dr. Tahirou Abdulaheye and Bokar Mosa.

3.1   Bolani

Typically, Bolani vendor will only work six days of the week, leaving Friday for prayer and social time. We are assuming a Bolani vendor makes sales of 100 Bolanis in a day. This was also confirmed in our observation, where a typical Bolani vendor would make sales of 65 to 200 Bolanis in a day. The typical price for a Bolani is 20AFN in Kabul's market. Since street foods are a common phenomenon people are aware of the price, thus a vendor cannot arbitrarily increase the price. However, some vendors will reduce the size and price to 10AFN. This will increase their numbers sold however the end result is the same. If someone wants two Bolanis and Bolanis are half the size for 10 AFN they are more likely to buy four instead of two. The ingredients used in Bolani are Wheat flour, Water, Potatoes, Pumpkin, Leek, Oil, Gas and News Paper. Wheat Flour and water are used for the dough, while either Potato, Pumpkin or Leek are used for stuffing. While Leek is cheaper, the most common Bolani found is stuffed with Potatoes and Pumpkin are used mainly in Ramadan. On average a single Bolani contains 200 grams of wheat flour, with smaller Bolanis using 100 grams. To have a rich stuffing a single Bolani will need at least 100 grams of potatoes. Meanwhile, oil is used for frying, while Bolani vendors will try to use the same round of oil as much as possible, after a few Bolanis the Oil smokes and new oil is added. On average a Bolani vendor uses 6 kilograms of oil for 100 Bolani. Gas is used as a cooking source due to high levels of pollution in Kabul, the municipality does not allow wood to be used on roadside stoves. A single Bolani vendor uses 3.15 Kilograms of gas in a day. Finally, to carry Bolani in their hand customers are given newspapers. Old newspapers are sold by weight, we assume an average Bolani

vendor will use 2 kg of newspaper. Finally, leek which is less popular is sold in bunches. We are assuming a Bolani vendor does not use more than six bunches of leeks in day.

3.2   Danwake

As a cowpea-based dumpling, Danwake was originally made with cowpea only. However, as cowpea prices fluctuate during cowpea season and off season, newer Danwake recipes most commonly used by street food vendors use 1/3 cassava flour and 2/3 cowpea flour. Cassava flour for being tasteless does not impact the taste of the final product, yet it helps the vendor produce the same amount of Danwake for a cheaper price when cowpea becomes expensive. In order to make the dumplings soft and help the flour rise Baking Soda is used. Meanwhile, Broth cubes also known as Maggie Chicken Cubes are used for taste, while Kuka Powder is used to help the flour stick together and spices are used for taste. Vendors in Kano, Nigeria, typically use firewood for cooking. While gas is used in Southern Parts of Nigeria such as Lagos, vendors in Kano stick with wood. Typically cowpea based street food vendors work six days of the week (Otoo et al., 2011).

3.3   Kosai

Kosai are deep fried fritters commonly sold in West African street markets. The recipe for Kosai includes cowpea and onion as the main ingredients, while oil is used for frying and wood is used for cooking. In order to prepare cowpea for Kosai, the beans need to be grinded. For carrying Kosai, customers use plastic bags. Although grinding and the plastic bags are not part of the cooking ingredients, they are essential and usually a daily expense for a vendor, thus the analysis will consider them as such. Kosai vendors in Kano, similar to Danwake vendors use firewood, instead of gas as their counterparts will in Lagos. The case for using firewood is even more strengthened when we consider that using gas with Kano's lower prices per serving increases the risk of making a loss in a given day to 25% with the loss being as low as $10 in a day. Further analysis of using gas is provided in the upcoming sections.

For budgeting, we used to excel spreadsheets to organize budgets based on the market prices and historical prices of different ingredients used in the foods that we covered. The initial risk analysis is conducted by @Risk plugin using 10,000 iterations. The data from the iterations was used to generate the histograms, as well as the CDF and Tornado graphs. The histograms and CDFs

give us a better idea of how much average income the vendors have, while the Tornado graphs explains the ingredients that has the highest impact. Knowing the amount of income will help governments and NGOs decide whether it is a good idea to support and encourage microentrepreneurs to earn a living from street food vending, while knowing the results of the Tornado graphs helps the governments decide on which ingredients needs to remain stable in order to have the least impact on the profitability of a street food vendor.

CHAPTER 4.   FINDINGS AND RESULTS

4.1   Profitability

4.1.1   Bolani, Kabul Afghanistan

Daily profit is a major concern for a Bolani vendor, as their livelihood depends on their day-to-day income. Assuming a Bolani vendor works six days a week with most of them taking Friday off. The daily income of a Bolani vendor will be 671.35AFN or $8.61, $51.64 a week, $223.61 a month and $2,555.13 a year. However, adding price fluctuation risk, we can see the daily income a Bolani vendor is somewhat normally distributed between $0 and $15. A further discussion of price fluctuation and risk is presented later. As street food vendors do not have the business capacity to bear loss even for a few days, they avoid loss at all costs. While avoiding loss will show a positive outcome overall, not making the average income would mean they have less food for their family that day.

An average day means 100 sales of regular Bolani. While some vendors may sell even 200 or higher, other can sell less than 100, so we are taking 100 as the average. The average price of a Bolani is 20AFN. Thus, on an average ay a Bolani vendor can expect up to 2000AFN in revenue. Meanwhile 1328.65 AFN is spent on the cost of making the Bolani. The cost of goods sold was obtained from the historical price distribution of the ingredients used in Bolani. For instance, wheat flour prices in Kabul historically had a Kumaraswamy distribution with an alpha 1 of 1.931 and alpha 2 of 4.01. Meanwhile, potato prices in the central Asian market followed a Weibull distribution with an alpha value of 1.47 and beta of 0.189. Since for potatoes the distribution is regional, US dollar is used as the currency for historical prices and is then converted to local Afghani currency when necessary. Oil prices similarly followed a Kumaraswamy distribution with alpha 1 being 0.22 and alpha 2 being 0.380. Global gas prices follow a Gamma distribution with alpha being 3.394 and beta being 26.45. While leek and newspaper do not have a significant impact, for leek an extreme case of triangular distribution with minimum being 10 maximum being 30 and most likely value being 15AFN per bunch was used. Similarly, a mean of 42 and a standard deviation of 8.2 was used for newspaper. Except for gas and potatoes all ingredients are expressed in Afghani. Price of gas and potatoes are first converted to Afghani before being entered into the risk analysis.

To obtain their average daily income a Bolani vendor will on average use 20 kilograms of flour, ten kilograms of potatoes, slightly more than three kilograms of gas, 6 bunches of leeks and 2 kilograms of newspaper for carrying the Bolani. On average a Bolani vendor spends 1328.65 AFN or $3.19 daily on the cost of ingredients needed for that day.

Table 4.1 Ingredients used by Bolani Vendors

Ingredients	Daily Usage	Price per kg		Price in USD		Total Daily	
Flour	20	AFN	21.00	$	0.27	AFN	419.96
Potatoes	10	AFN	30.34	$	0.39	AFN	303.37
Oil	3	AFN	79.37	$	1.02	AFN	238.10
Gas	3.15	AFN	61.50	$	0.79	AFN	193.73
Leek	6.1	AFN	15.00	$	0.19	AFN	91.50
Newspaper	2	AFN	41.00	$	0.53	AFN	82.00
Total				$	3.19	AFN	1,328.65

Subtracting the cost of goods sold we have 671.35AFN as Bolani vendor net income for the day or $8.61. Considering the international definition of the poverty line ($2 a person a day), we can estimate the Bolani vendor can keep a family of four for a day above the poverty line.

Table 4.2 Daily Budget of a Bolani Vendor

Daily Budget for Bolani	
Average Daily Sale	100
Average Price Per Bolani	AFN 20
Daily Revenue	AFN 2,000.00
Cost of Goods sold	AFN 1,328.65
Gross Margin	AFN 671.35
Income Tax	AFN -
Net Income	AFN 671.35
Net Income in USD	$ 8.61

Bolani vendors work six days a week, 4.33 weeks a month and 12 months a year. Knowing these figures allows an estimation of the annual income of a Bolani vendor for the sake of comparison with other businesses that are based on annual income. While a Bolani vendor would rarely consider his annual income as he is more dependent on his day-to-day income, having an annual income figure helps compare his business to other business. On average a Bolani vendor can expect up to $2,555 a year.

Table 4.3 Annual Income Statement of a Bolani vendor

Annual Income Statement of a Bolani Vendor	
Revenue	AFN 623,520.00
Cost of Goods Sold	AFN 414,220.05
Gross Margin	AFN 209,299.95
Equipment	AFN 10,000.00
Income Tax	AFN -
Net Income	AFN 199,299.95
Net Income in USD	$ 2,555.13

4.1.2   Danwake, Kano, Nigeria

As (Otoo et al., 2011) states, on average cowpea based street food vendors work six days a week. As Danwake vendors usually work under the sun rainy months are a challenge for them. However, rain in Kano is not consistent, it can last a few hours or the entire day. On average there is a 51.7% chance of rain between the months of June-September. Thus, during rainy months we assume there will be a 20% rain penalty to the revenue of the Danwake vendor. This is because although the vendor has the raw material and might have grounded their cowpeas, due to rain they cannot sell it for the amount of time that it rains. The vendors do make educated guesses, sometimes when they guess right, they sell the amount of ingredient they bought, however, at other times their guess turns wrong, and they end up either selling less due to rain or buying less expecting it to rain when it doesn't.

The most important ingredients in Danwake are Cowpea and Cassava flour. The two ingredients have the highest impact on the profitability of the vendor, while changes in the prices of these ingredients can significantly impact the bottom line, changes in the price of other ingredients do not. Historically cowpea prices in Kano, Nigeria, followed a Kumaraswamy distribution with alpha 1 being 1.29 and alpha 2 being 2.88. Cassava flour followed a triangular distribution with the minimum price per kilogram being 28.63 Naira, maximum being 466.25 Naira and the most likely price being 236 Naira. An extreme case of 20% fluctuation under a normal distribution was used for the rest of the ingredients. Table 4.4 depicts a nonseasonal daily schedule for cost of ingredients used by the vendor.

Table 4.4 Ingredients used by a Danwake Vendor (Daily not seasonal)

Ingredients used in a day

Name	Unit	Quantity	Price per unit		Total
Cowpea	Kg	6	NGN	214.44	NGN 1286.64
Cassava	Kg	3	NGN	200.00	NGN 600
Baking Soda	Kg	0.06	NGN	1,258.33	NGN 75.5
Chicken Brooth Cubes (Maggie Cubes)	Cubes	10		86.5	865
Kuka Powder	Kg	0.36	NGN	200.00	NGN 72
Spices	Kg	0.5	NGN	100.00	NGN 50
Wood	Kg	10		20	NGN 200

We derive two types of budgets, that is during the dry season and during the rainy season. In the dry season on average a Danwake vendor can make 4734.48 NGN which is equivalent of $13.15, while in rainy season they can make 3294.48 NGN which is $9.15. Thus, during the dry season a Danwake vendor can sustain up to seven family members above the poverty line. However, during rainy season that number comes down to only five family members. Consequently, the average annual income is 1,511,439.72 NGN which is $4,198.44. Meanwhile the average family size in Nigeria is 4.5 people(*Nigeria Average Household Size*, n.d.), while in Kano it is 5.7 (*Kano Household Size, 1981-2019 - Knoema.Com*, n.d.). Table 4.5 depicts the budget of a Danwake vendor in the dry season, the first row depicts the daily budget which is multiplied by 6 to obtain the monthly budget. There are eight months in the dry season thus during the entire year a Danwake vendor earns about 1.5 million Naira during the dry season.

Table 4.5 Danwake Vendor's Daily Budget in Dry Season

Dry Season	Daily Budget	Weekly Budget		Monthly Budget		Seasonal 8 months	
Sales	NGN 7,200.00	NGN	43,200.00	NGN 187,056.00		NGN	1,496,448.00
Cost of Goods Sold	NGN 2,365.52	NGN	14,562.71	NGN	63,056.54	NGN	504,452.35
Gross Margin	NGN 4,834.48	NGN	28,637.29	NGN	123,999.46	NGN	991,995.65
Rent	NGN 100.00	NGN	600.00	NGN	2,598.00	NGN	20,784.00
Net Income	NGN 4,734.48	NGN	28,037.29	NGN	121,401.46	NGN	971,211.65
Net Income in USD	$13.15	NGN	77.88	$	337.23	$	2,697.81

Similar to how the rain will impact the sales of a cowpea food vendor, the prices of ingredients also differ during rainy seasons compared to dry season. During the eight months of dry season a Danwake vendor on average has daily sales of 7200NGN and daily cost of goods sold

of 2365.52NGN, while the rent is fixed at 100NGN charge by the local government. On average in dry season when a vendor can sell for the entire day, a daily earning of 4734.48 or $13.15 can be expected.

In the rainy season the hours worked in a day depends on how well a vendor can guess the weather for the upcoming day. While weather forecasts help, they are not 100% certain. Based on their experience vendors can decided whether to work the entire day, expecting a sunny day, work half a day expecting rain for the other half or take the day off. While prior experience helps, the guesses are not always correct. As a Danwake vendor prepares for the day the night prior, they soak the cowpea beans, wake early in the morning to take the beans to a grinder and prepare the rest of the ingredients. Thus, if the vendor guessed they will have half sales the next day, yet it was sunny the entire day they cannot change their sales by buying more ingredients as it will take time to soak the cowpea, take it to a grinder and prepare the rest of the ingredients. On average, a 20% penalty is expected because of the difference in what the vendor guesses and what actually happens. Meanwhile, the prices of the ingredients are also different in rainy season compared to dry seasons. On average in the rainy season a Danwake vendor has sales of 5769 NGN in a day, with 2365.52 NGN cost of goods sold, 100NGN daily rent and a net income of 3294.48NGn or $9.15. Annually a Danwake vendor can expect $3525.7.

Table 4.6 depicts the budget of a Danwake vendor during the rainy season, the daily budget is multiplied by six to obtain the weekly budget which in turn is multiplied by 4.3 for monthly budget and there are four months in the rainy season thus we have 598,579 NGN revenue in rainy season.

Table 4.6 Danwake Vendor's Daily Budget in Rainy Season

Rainy Season	Daily Budget	Weekly Budget	Monthly Budget	Seasonal 4 months
Sales	NGN 5760	NGN 34,560.00	NGN 149,644.80	NGN 598,579.20
Cost of Goods Sold	NGN 2,365.52	NGN 14,673.12	NGN 63,534.59	NGN 254,138.37
Gross Margin	NGN 3,394.48	NGN 19,886.88	NGN 86,110.21	NGN 344,440.83
Rent	NGN 100	NGN 600.00	NGN 2,598.00	NGN 10,392.00
Net Income	NGN 3,294.48	NGN 19,286.88	NGN 83,512.21	NGN 334,048.83
Net Income in USD	$9.15	$ 53.57	$ 231.98	$ 927.91

Using the seasonal budgets, we can combine the numbers and obtain he annual budget. At the time of conducting research for this thesis the exchange rate for Nigeria Naira to the USD was 360 Naira per USD. Table 4.7 depicts the annual budget of a Danwake vendor.

Table 4.7 Danwake Vendor's Annual Budget

Annual	Naira		USD	
Sales	NGN	2,095,027.20	$	5,819.52
Cost of Goods Sold	NGN	758,590.72	$	2,107.20
Gross Margin	NGN	1,336,436.48	$	3,712.32
Utensil and other cost	NGN	36,000.00	$	100.00
Rent	NGN	31,176.00	$	86.60
Net Income	NGN	1,269,260.48	$	3,525.72

Finally, the findings in this research matches (Otoo et al., 2011) finding, where it was discovered that Cowpea based street food vendors on average earned $8.80 a day in Niamey and $28.90 a day in Kumasi. While the minimum daily wage in Niamey is $2.07 and in Kumasi it is $2.07. Thus, for a Danwake vendor whose other choice of work would be daily labor, Danwake vending has the highest opportunity cost.

4.1.3   Kosai, Kano, Nigeria

This thesis will first present a daily budget for a Kosai vendor based on historical data. We know that there are 4.33 weeks in a month (divide 52 weeks by 12), hence, we can convert the weekly budget into monthly. However, in the monthly budget we already mentioned that there will be a 20% rain penalty thus we have two kinds of monthly budgets. One for months that are non-rainy and thus the Kosai vendors can work at their full potential and the other when there is a chance of rain and Kosai vendors receive a rain penalty on their revenue.

The months of June to September are rainy months in Nigeria. Although rains are usually not consistent, an hour or two rain in the morning can set back a food vendor from most of their morning business, thus we are assuming a 20% penalty on daily revenue for vendors during the rainy season. However, it should be noted that the vendor cannot accurately predict occasional rains, thus they already spent their money on the input it's just the loss of time that is causing them to lose revenue.

Lowenberg-DeBoer and Ibro (2008) found in their research that street food vendors in Kano, Nigeria on average used 6kg of Cowpea. One serving of a Kosai on average is 100 Grams of Cowpea, which means on average a Kosai vendor must make 80 Kosai's a day to consume 6kg of Cowpea. However, we also know that if prices of input increase a Kosai vendor can reduce the quantity of Cowpea in her Kosai serving. Table 4.9 depicts a nonseasonal schedule of costs for ingredients used by a Kosai vendor.

Table 4.8 Ingredients used by a Kosai Vendor (Daily)

Ingredients used	Unit	Daily Quantity	Unit Price	Total Daily Price
Cowpea	Kg	6	214.4432745	1286.659647
Onions	Kg	3	219.765	659.295
Oil	Kg	3	517.695	1553.085
Wood	Kg	5	100	500
Cowpea Grinding expenses	Daily	150	150	150
Plastic bags	Daily	100	1	100
Total				4249.039647

Cowpea prices in Kano followed a Kumaraswamy distribution with alpha 1 of 1.29 and alpha 2 of 2.88. Onion prices were historically uniformly distributed between 133.84NGN per kg to 305.7 NGN per kilogram while cooking oil prices were also uniformly distributed between 450.66 to 584.73 NGN per kilogram. An extreme case of 20% deviation in the prices of the rest of the ingredients are assumed that does not have an impact on the outcomes of the analysis.

Based on the historical prices of the ingredients described, a Kosai vendor on average makes $10.97 daily, if we don't account for rainy days. (Table 4.9)

Table 4.9 Non-seasonal daily budget of Kosai vendor

Non-Seasonal Daily Budget	Naira	USD	
Sales	8000.00	$	22.22
Cost of Goods Sold	3949.04	$	10.97
Gross Margin	4050.96	$	11.25
Rent	100.00	$	0.28
Net Income	3950.96	$	10.97

However, as there will be rainy days and sunny days the income in these days will be different. During the dry season Kosai vendor is expected to earn on average $22.22 in revenue, while paying $10.95 for the cost of making the Kosai and $0.27 (100NGN) as rent to the local municipality. As a result, the daily net income during the dry season will be $10.98. Table (4.10)

Table 4.10 Dry Season Daily Budget of a Kosai vendor

Dry Season Daily Budget	Naira	USD
Sales	8000	22.22222222
Cost of Goods Sold	3945.028918	10.95841366
Gross Margin	4054.971082	11.26380856
Rent	100	0.277777778
Net Income	3954.971082	10.98603078

During the rainy season due to rain penalty the daily revenue of a Kosai vendor is depicted as $17.77 and the net income is $5.51 in table 4.11. The rent is constant as the rate is fixed at 100NGN daily regardless of the season. Table 4.12-4.16 depicts the conversion of daily seasonal budgets to weekly, monthly and finally an annual budget for the Kosai vendor.

Table 4.11 Rainy Season Daily Budget of a Kosai Vendor

Rainy Season Daily Budget	Naira	USD
Sales	6400	17.77777778
Cost of Goods Sold	3955.211831	10.98669953
Gross Margin	2444.788169	6.791078248
Rent	100	0.277777778
Net Income	2344.788169	6.51330047

Table 4.12 Dry Season weekly Budget of a Kosai Vendor

Dry Season Weekly Budget	Naira	USD
Sales	48000	133.333333
Cost of Goods Sold	23670.17351	65.750482
Gross Margin	24329.82649	67.5828514
Rent	600	1.66666667
Net Income	23729.82649	65.9161847

Table 4.13 Rainy Season Weekly Budget of a Kosai vendor

Rainy Season Weekly Budget	Naira	USD	
Sales		38400	106.666667
Cost of Goods Sold		23731.27098	65.9201972
Gross Margin		14668.72902	40.7464695
Rent		600	1.66666667
Net Income		14068.72902	39.0798028

Table 4.14 Dry season monthly budget of a Kosai Vendor

Dry Season Monthly Budget	Naira	USD	
Sales		207840	577.3333333
Cost of Goods Sold		102491.8513	284.6995869
Gross Margin		105348.1487	292.6337464
Rent		2598	7.216666667
Net Income		102750.1487	285.4170798

Table 4.15 Rainy Season Monthly Budget of a Kosai Vendor

Rainy Season Monthly Budget	Naira	USD	
Sales		166272	461.8666667
Cost of Goods Sold		102756.4034	285.4344538
Gross Margin		63515.59664	176.4322129
Rent		2598	7.216666667
Net Income		60917.59664	169.2155462

Table 4.16 Annual Budget of a Kosai Vendor

Annual Budget

Revenue		NGN		USD	
Dry Season	NGN 1,662,720.00				
Rainy Season	NGN 665,088.00				
Total Annual Revenue			NGN 2,327,808.00	NGN	6,466.13
Cost of Goods Sold					
Dry Season	NGN 819,934.81				
Rainy Season	NGN 411,025.61				
Total Cost of Goods Sold			NGN 1,230,960.42	NGN	3,419.33
Gross Margin			NGN 1,096,847.58	NGN	3,046.80
Fixed Expenses	NGN 36,000.00				
Rent	NGN 31,176.00				
Net Income			NGN 1,029,671.58	NGN	2,860.20

In their annual budget as Kosai vendors initially start out with lending their equipment overtime they must buy their own, we are putting aside 36000 Naira or $100 for this purpose. The 36000 Naira is also there to replace worn out equipment, since the equipment are already bought in used condition, and in the street and harsh desert environment that equipment wear out soon.

4.2   Risk Analysis

4.2.1   Bolani, Kabul, Afghanistan

After determining the impact of price fluctuation of ingredients on the profitability of a Bolani vendor, it is important to know how much risk the vendors take. First, ranking the inputs based on the impact they have on the profitability of a Bolani vendor gives the reader an idea of how much each input price impacts the final income of a vendor.

Using 10,000 iterations from @Risk's monte carlos analysis we can also obtain histograms of a Bolani vendor's daily, weekly, monthly and annual profitability. While the daily and annual histograms in USD are presented in this text, the weekly monthly as well as local currency calculation for all the histograms are presented in the appendix.

From the daily budget analysis, we have found that wheat flour has the highest impact on profitability of a Bolani vendor, followed by cooking oil prices, Natural Gas prices, Potato prices and finally Leek and Newspapers that are used for carrying the Bolani.
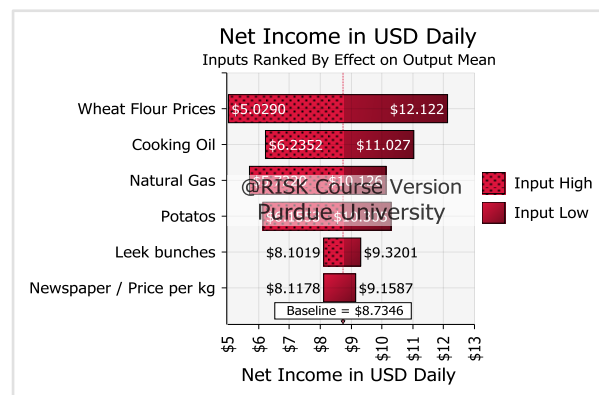
Figure 4.1 Tornado graph for Bolani vendor's daily income

Annual Net Income USD
Inputs Ranked By Effect on Output Mean

Wheat Flour Prices	$1,439.64 $3,650.95
Cooking Oil	
Natural Gas	@RISK Course Version
Potatos	Purdue University
Leek bunches	$2,397.63 $2,777.42
Newspaper / Price per kg	$2,402.59 $2,727.10

Baseline = $2,594.88

Input High
Input Low

Annual Net Income USD
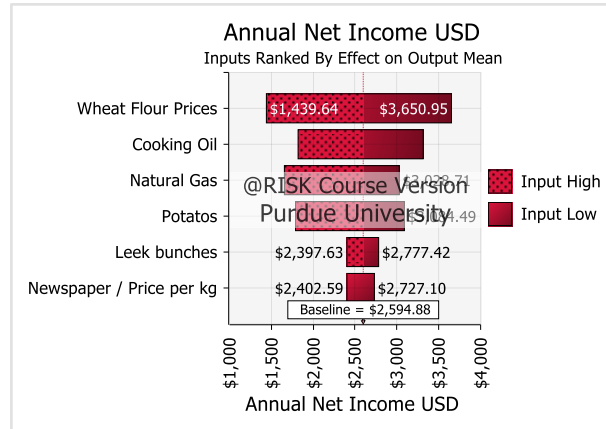
Figure 4.2 Tornado graph for Bolani vendors annual Net income

The mean daily income after allowing fluctuation in prices was $8.35, the median was $8.51 while the standard deviation was $2.71. For a comparison with regular businesses a Bolani vendor on average makes $2473.88 annual after accounting for price fluctuation, while their median income is $2524.66, and the standard deviation is $844.74. Comparing these numbers to our benchmark for poverty on average a Bolani vendor will be able to keep a family of four including himself above the poverty line.

From the cumulative distribution of a Bolani vendor's income it is evident that while losses are avoided, there is a cap for a Bolani vendor at $13. Indeed only 1% of the vendors make above $13 a day. Thus, while a Bolani vendor can serve a family of four above the poverty line, the limit to his ability is a family of six any family bigger than six members will not be able to stay above the poverty line if they have a single bread winner selling Bolani.
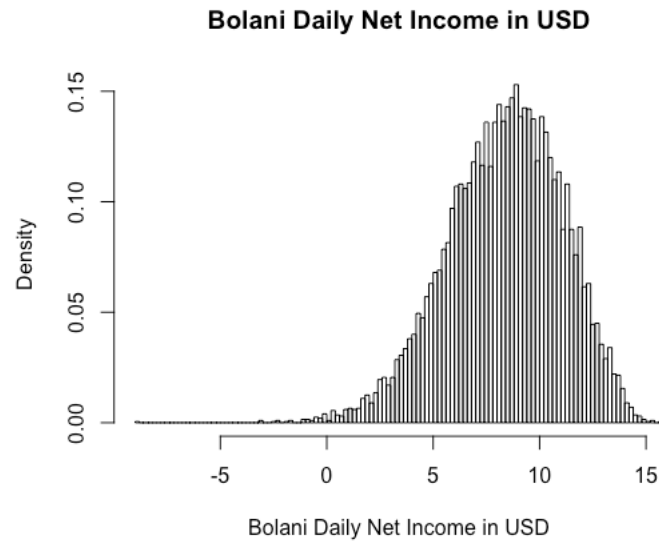
Figure 4.3 Histogram of a Bolani vendor's daily net income in USD
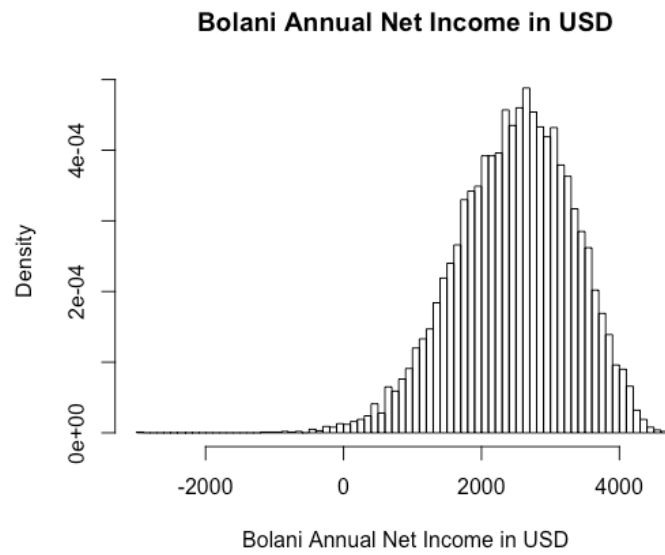
Figure 4.4 Histogram of a Bolani vendor's annual net income in USD

ecdf(x)
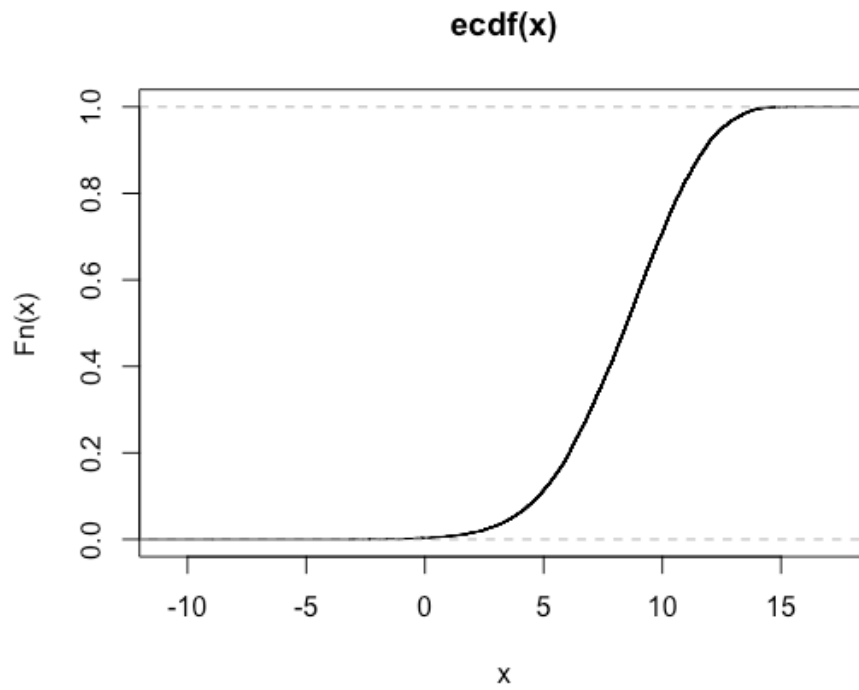
Figure 4.5 Cumulative probability distribution of Bolani vendors daily net income in USD

ecdf(x)
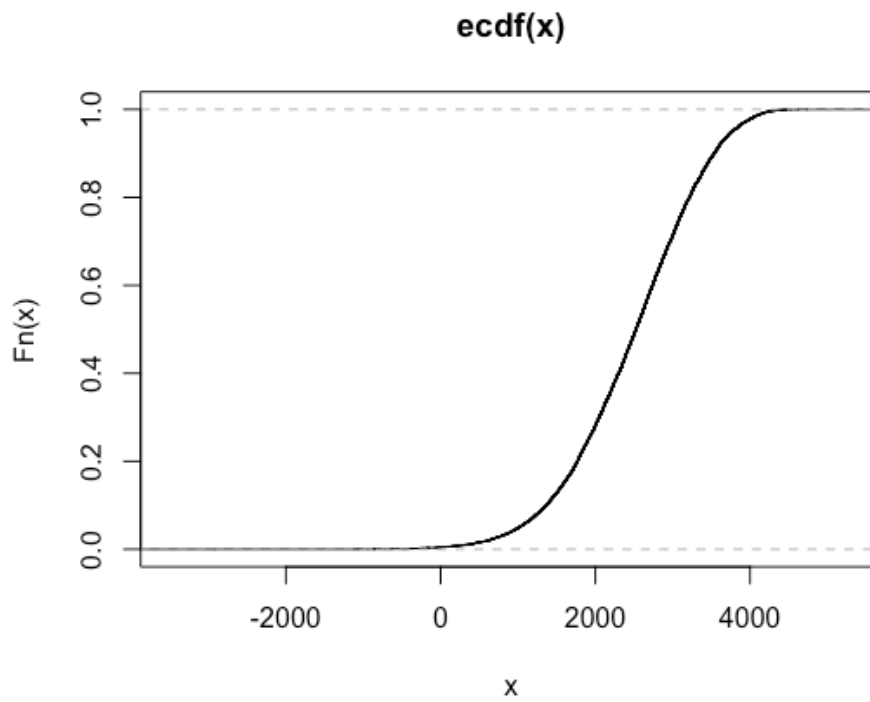
Figure 4.6 Cumulative probability distribution of a Bolani vendors annual net income in USD

4.2.2 Danwake, Kano, Nigeria

The findings of this research show that both in dry and rainy season cowpea price fluctuation has the highest impact on the daily and annual profitability of a Danwake vendor followed by Cassava flour price fluctuations and other ingredients making a small portion of the fluctuation in prices.
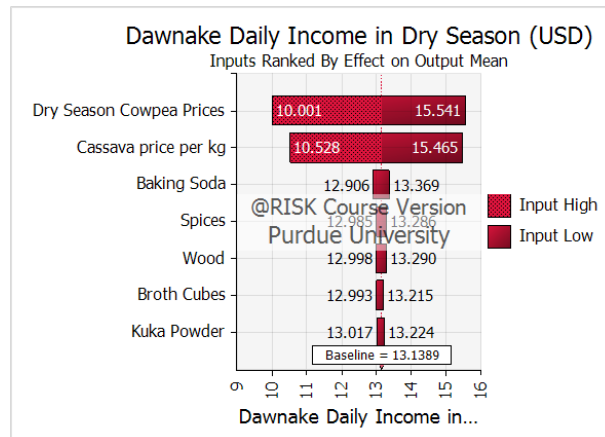
Figure 4.7 Tornado graph of Danwake vendor's daily income in dry season
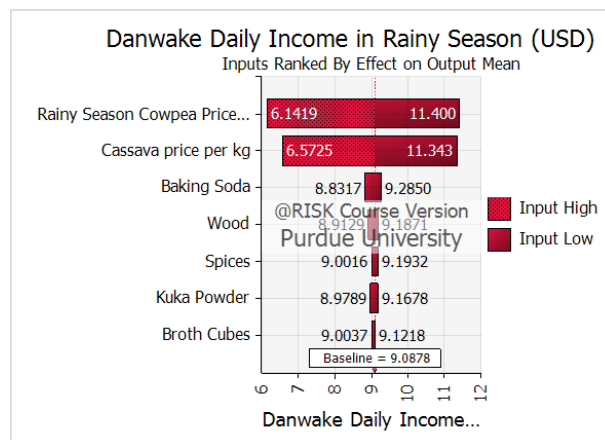
Figure 4.8 Tornado graph of Danwake vendor's annual net income

The mean net income of a Danwake vendor is $12.92 during the dry season and $8.87 in the rainy season while the median income is $13.05 in dry season and $8.99 in the rainy season. Meanwhile the standard deviation of daily income in dry season is $1.71 and it is $1.70 in rainy

season. The mean annual net income a Danwake vendor is $3505.90 while the median income is $3533.42, and the standard deviation is $394.76.

Histograms in figure 4.9 and 4.10 depicts the daily and annual net incomes of a Danwake vendor while figures 4.11 and 4.12 depicts the cumulative probability distribution of a Danwake vendor. While a Danwake vendor does not have significant chances of making a negative net income (net loss), making below average income usually means there will be less food on the table for the family. Thus, the vendors avoid loss at all costs, while their biggest risk is to earn below their daily average.
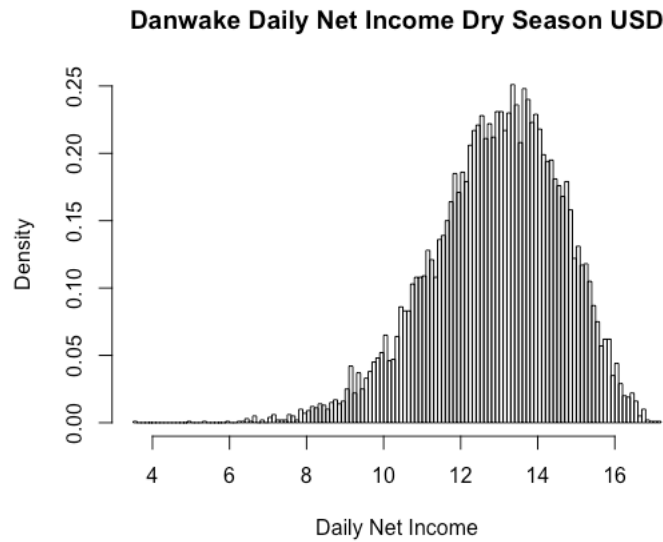
Figure 4.9 Danwake Vendor's Daily Net Income Dry Season USD
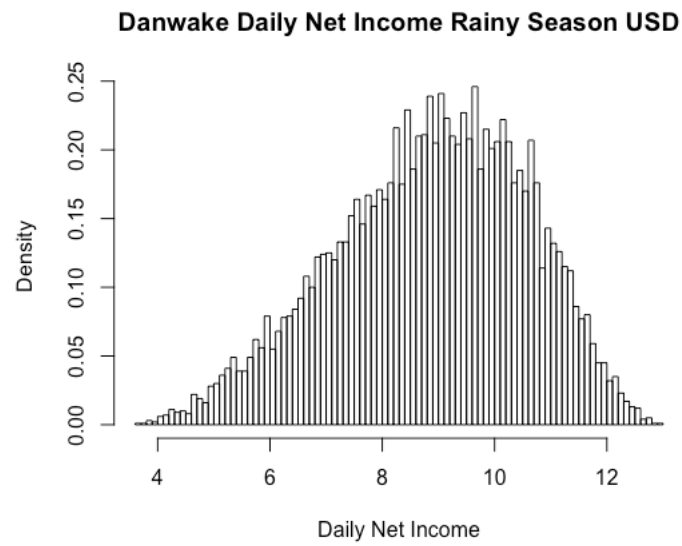
Figure 4.10 Danwake Vendor's Daily Net Income in Rainy Season USD
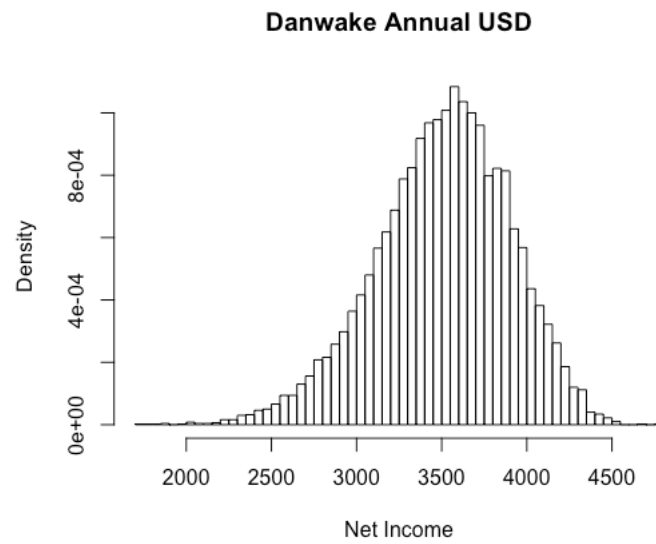
Figure 4.11 Danwake Vendor's Annual Net Income USD

ecdf(x)
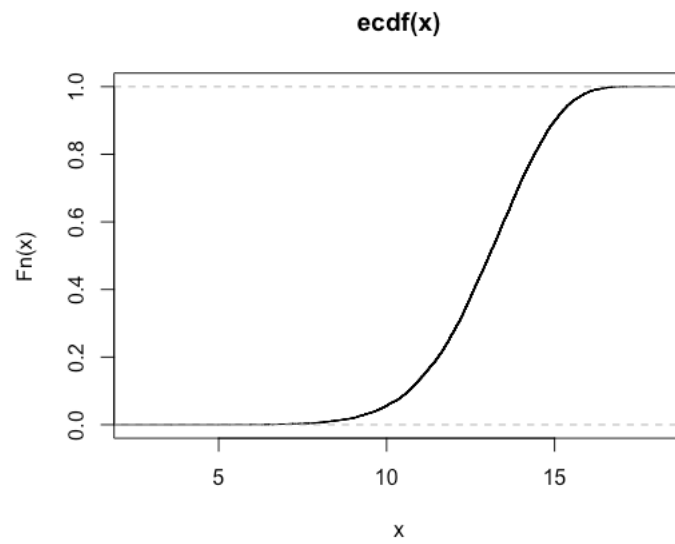
Figure 4.12 CDF of Danwake vendor's daily net income dry season USD

ecdf(x)
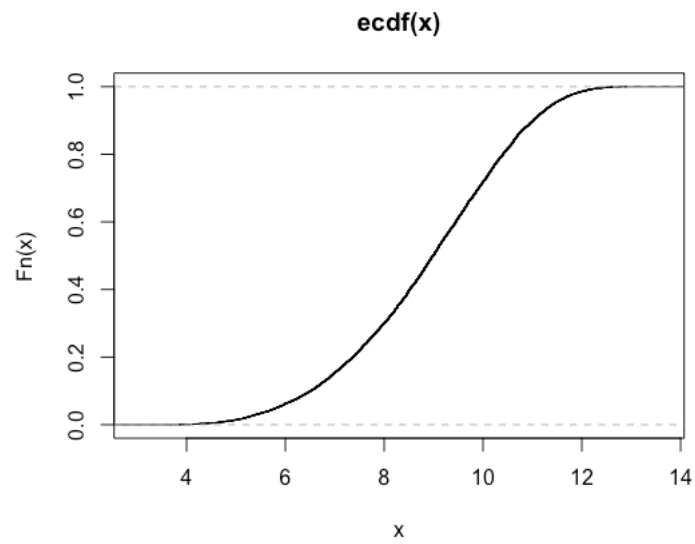
Figure 4.13 CDF of Danwake Vendor's Daily Net Income Rainy Season
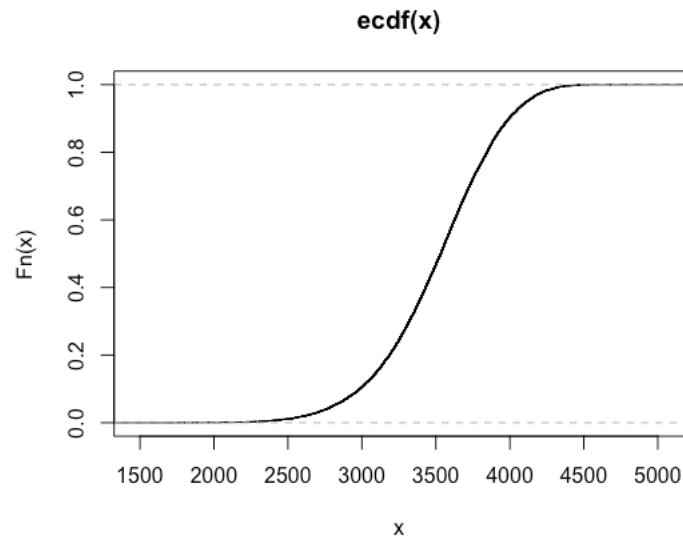
Figure 4.14 CDF of Danwake Vendor's annual net income

4.2.3 Kosai, Kano, Nigeria

Cowpea price fluctuations have the highest impact on profitability of Kosai vendor, followed by onions, oil and then finally grinding, wood and plastic bags. The final three expenses do not have as much of an impact on the profitability of the Kosai vendor.
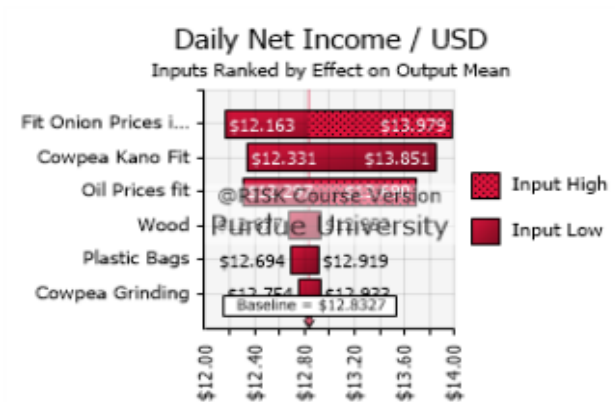
Figure 4.15 Tornado graph of Kosai vendor's Daily Net Income USD

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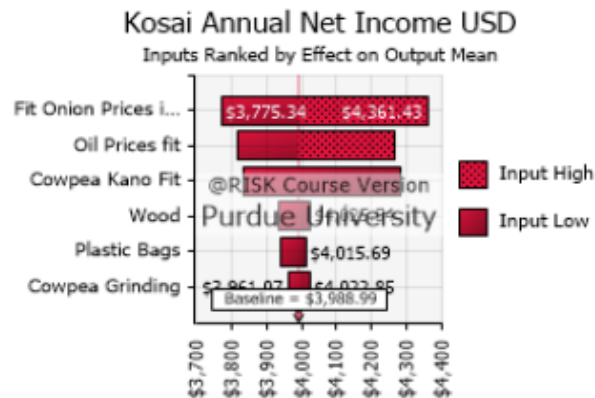
Figure 4.16 Tornado graph of Kosai Vendor's Annual Net income USD

On average a Kosai vendor earns $11.34 daily in dry season while earning a mean net income of $6.84 during rainy season. The median daily net income of a Kosai vendor is $11.39 in dry season and $6.94 in rainy season with standard deviations of $1.48 during dry season and $1.42 during rainy season.

Figures 4.17- 4.19 depicts the histograms for a Kosai vendor's daily during dry season and rainy season as well as annual net income. Figures 4.20 to 4.22 depicts the cumulative probability distribution for a Kosai vendor's daily as well as annual net income. Figures for weekly, and monthly incomes as well as the CDF graphs are provided in the appendix.
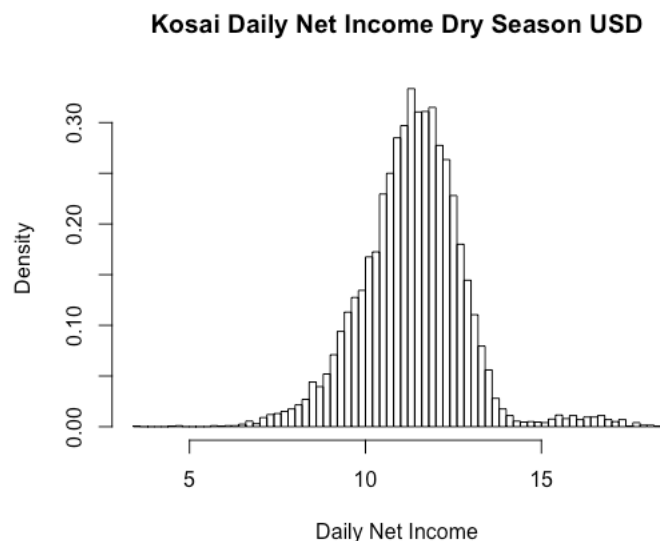
Figure 4.17 Histogram for Kosai Vendor's Daily Net Income Dry Season USD
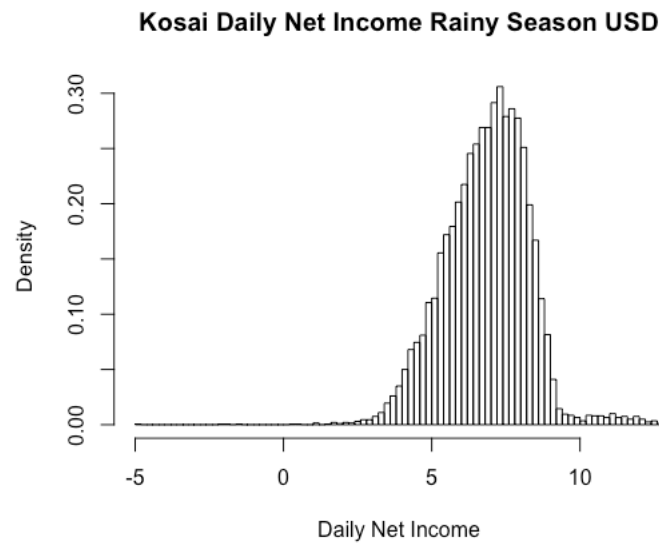
Figure 4.18 Histogram for Kosai Vendor's Daily Net Income Rainy Season USD
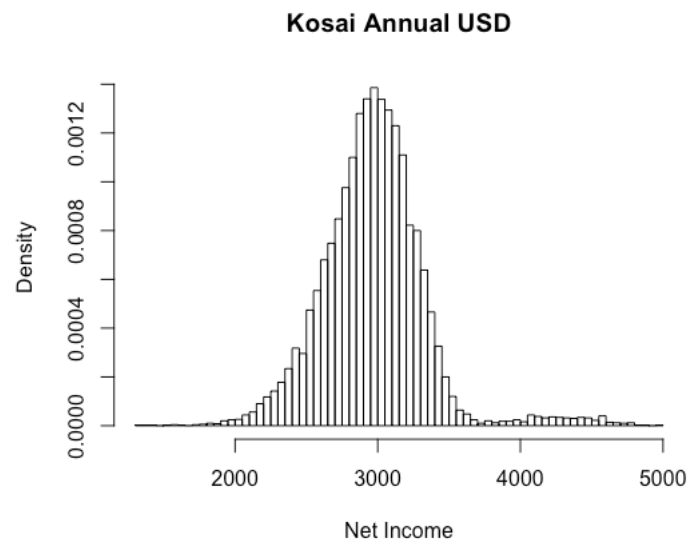
Figure 4.19 Histogram for Kosai Vendor's Annual Net Income USD
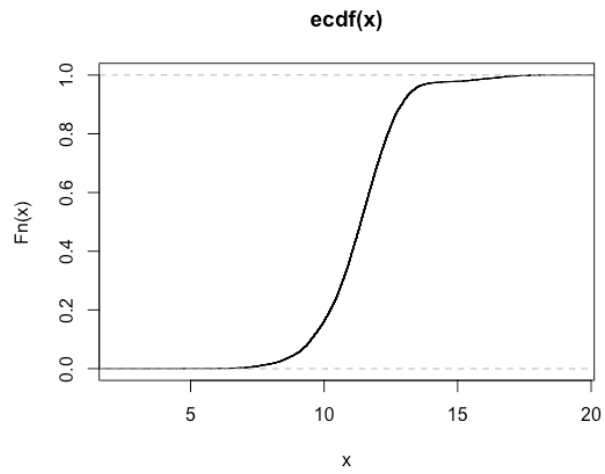
Figure 4.20 CDF for Kosai Vendor's Daily Net Income Dry Season
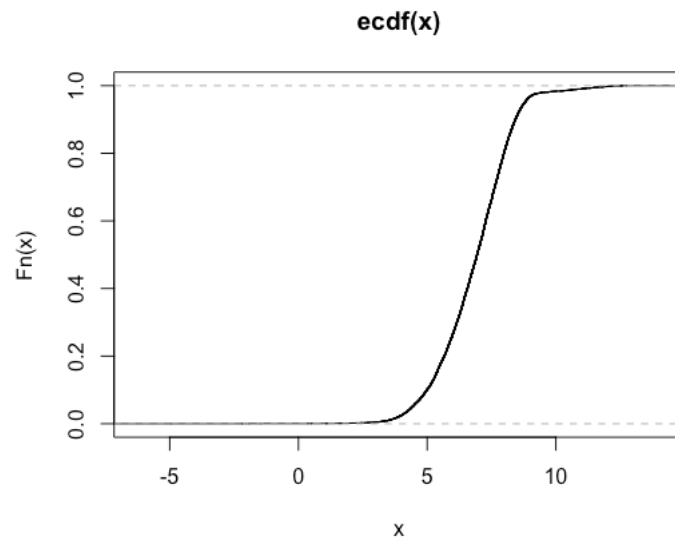
Figure 4.21 CDF for Kosai Vendor's Daily Net Income Rainy Season USD
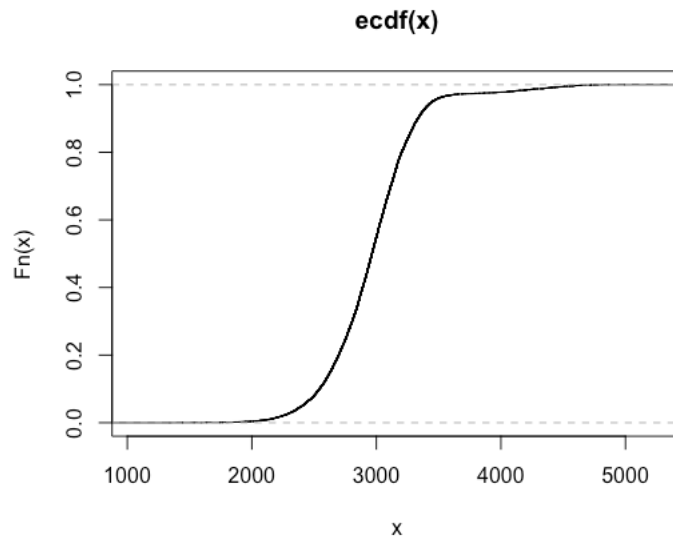
Figure 4.22 CDF for a Kosai Vendor's Annual Net Income USD

Onion prices have the highest impact due to its more volatile prices. However, the quantity of onions used is not always constant. If the cost increases the vendors can reduce the quantity. For the purpose of this study the optimal quantity of onions was used without varying it. However, it is entirely possible for the vendor to use one instead of two onions whenever needed. Thus, accounting for the volatility in onion prices and the decision making of the street food vendor will make cowpea as the highest impacting input.

4.2.4 Why do vendors in developing countries use wood?

One of the questions frequently raised is, why do people not use gas in developing countries, despite these countries being the most vulnerable to climate change and the hardest hit by its impact. While there might be other reasons to it, a major reason boils down to the cost of less polluting combustibles. As both Danwake and Kosai vendors in Kano uses firewood for cooking our original analysis is based on firewood as the burning substance used for cooking. However, as an experiment it is important to see what happens if the vendors decided to use gas. For this we can look at the income projections for a Kosai vendor using gas, which can then be replicated for other vendors.

Since natural gas is a commodity, the global prices of natural gas directly impact street food vendors if they were to use gas. For this example, we replace the firewood from our initial

figures and used natural gas instead. All other price distributions remain constant. Gas prices globally follow a Gamma distribution with alpha being 3.394 and beta being 26.45.

The new model shows that if a Kosai vendor replaced firewood with gas in the dry season their mean net income will be $6.24 with a median income of $6.68 and a standard deviation of $3.55. Meanwhile in the rainy season the mean daily net income will be $1.66 the median will be $2.17 while the standard deviation was $3.43. Thus, in addition to increasing the probability of loss using gas also significantly increases the risk of earning a profit for a vendor as can be seen from the increase in the standard deviation.

With the benefit of lower cost, burning wood also increases greenhouse gases and are harmful for the climate of the countries dependent on it, especially Northern Nigeria where green areas are not as common as the lush green South. Thus, an important topic to look into would be how the government and climate control agencies can help incentivize the use of natural gas and more less polluting fuels.
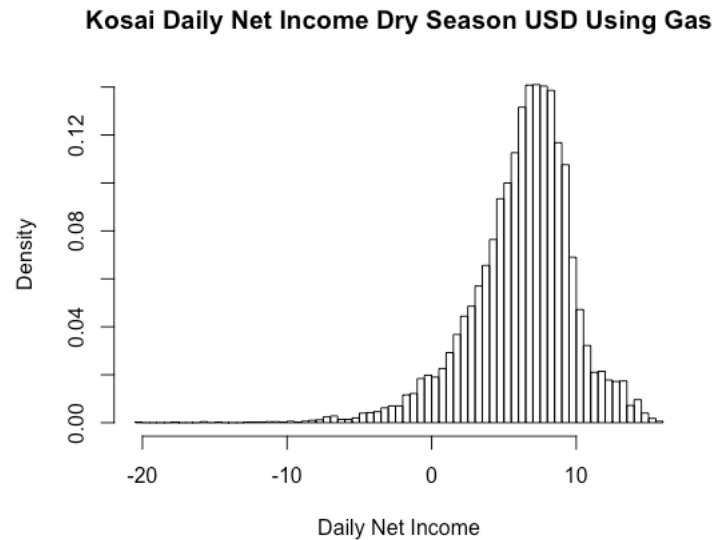
Figure 4.23 Histogram of Kosai Vendor's Daily Net Income Dry Season Gas

Kosai Daily Net Income Rainy Season USD Using Gas
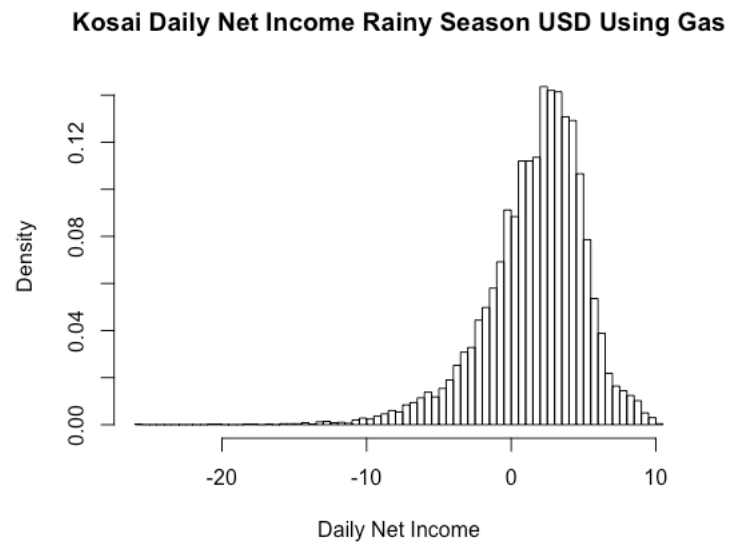
Figure 4.24 Histogram of Kosai Vendor's Daily net Income Rainy Season Using Gas

Kosai Annual USD Using Gas
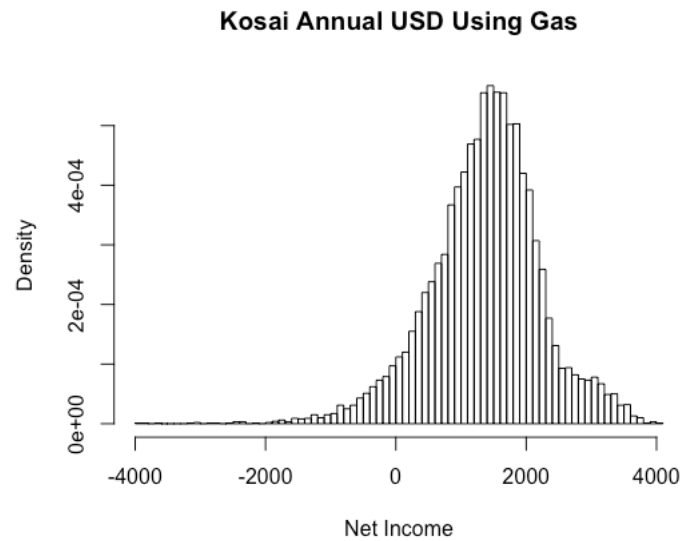
Figure 4.25 Histogram of Kosai Vendor's Annual Net Income Using Gas
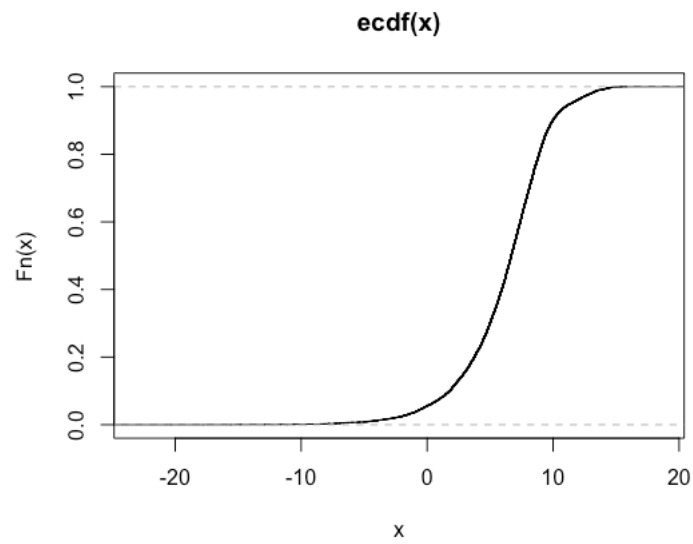
Figure 4.26 CDF of Kosai Vendor's Daily Net Income Dry Season USD
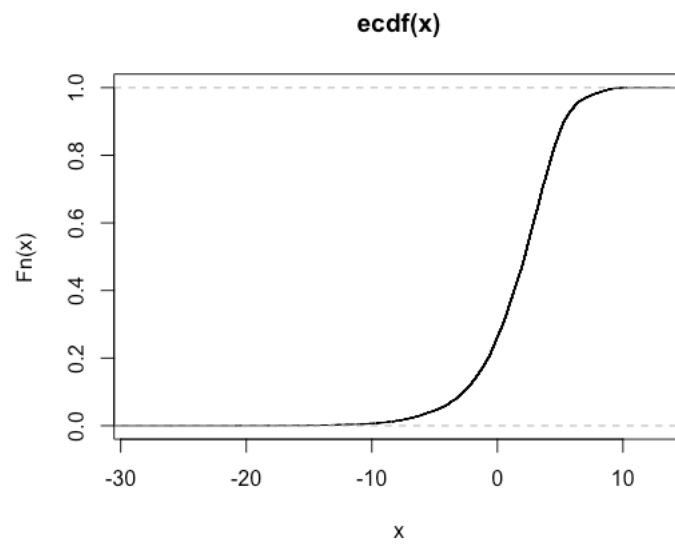
Figure 4.27 CDF of Kosai Vendor's Daily Net Income Rainy Season USD

ecdf(x)
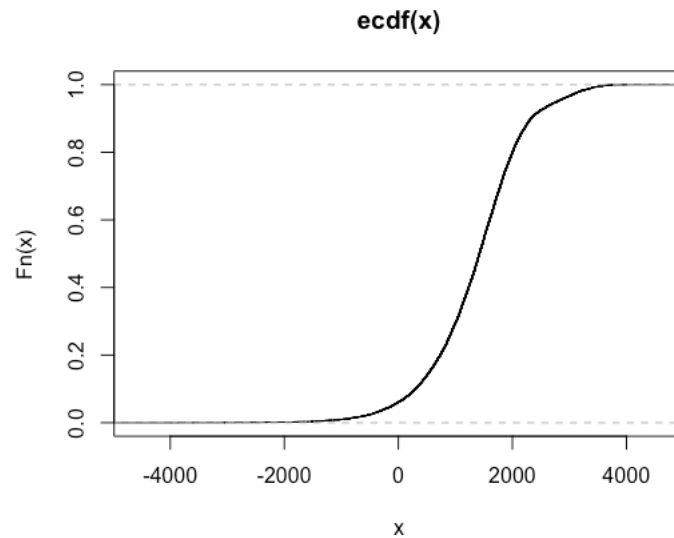
Figure 4.28 CDF of Kosai Vendor's Annual Net Income USD

4.3 Decision making problems faced by the vendors

During the rainy season cowpea-based street food vendors face three decisions the night before working. Firstly, they either prepare for a sunny day, this can be based on how much cloud are in the sky, weather **forecast** and past experience. **S**econdly, they may prepare for half a day of sales or 50% and finally they will prepare for taking the day off expecting it will be a complete washout. It is important to note that the vendors need advance preparation regardless of how the actual day goes. For instance, if a vendor prepares for 50% of the sales for the day and buys that ingredient, that vendor cannot change her mind during the day after finding out it will be a sunny day. Because the cowpea needs to be soaked the night prior, while the grinding is done early in the morning and the rest of the ingredient are also acquired from the market. Suppose we assume that the vendor prepared for 50% sales but it's a sunny day, so she decides she wants 100% of her average revenue. Now she needs soaked cowpea as well as taking that to a grinder and purchasing the rest of the ingredients. Assuming she does find soaked cowpea, the entire process will take so much of her time that it will not make it worth her while to go for a full day sale and the ingredient will go to waste.

Once again assume the vendor prepares for 100% sales but it rains, now the ingredient she prepared including the soaked and grinded cowpea will go bad if she keeps it for the next day. Thus, in short, the vendor plans her day the night prior, the cost of goods sold is paid earlier in the

day and should be treated as a sunk cost, she cannot recover it unless she sells all her produce for that day.

Using PrecisionTree 8.0 we can precisely map the decision-making problem faced by both Kosai and Danwake vendors. In the first step on the left of the decision-making tree, both Kosai and Danwake vendor's face the same question. Should they prepare for a rainy day? They have three choices, either they don't prepare, assuming it will be a sunny day and thus they buy 100% of the ingredients they need, or they prepare for half a day of rain, thus buying 50% of their ingredients and preparing for 50% sales or they prepare for a complete washout and decide to take the day off. As previously explained, these decisions have to be made prior to starting the day and are usually unchangeable throughout the day. The decision cell shows us the highest expected value for the vendor, for Kosai that is $5.15 and for Danwake that's $8.59. Any expected value below these should be rejected. Once a decision is made the vendor faces three chance events, it either rains the entire day, there is rain for half a day and the rest of the day is sunny or there is not rain for the entire day.

For a Kosai vendor, if they prepare for no rain, they would have spent $11.25 on their ingredients. If the day is rainy morning to evening the vendor loses $11.25 with no revenue. However, suppose its half day rain and the other half is sunny, then the vendor will make $11.11 in revenue and still lose $0.14. The only outcome that would allow a positive return is if the vendor guessed correctly and it does not rain, thus she makes $10.97 for the day. Overall, the expected value of not preparing for rain for a Kosai vendor is $5.03.

Assuming a Kosai vendor guesses that the next day will be half rainy half sunny. In this scenario, she will spend $5.77 on ingredients and prepare for half a day of sales. If there is rain morning to evening, she loses all the $5.77 as there will be no sale for the day. However, if it rains half the day as she guessed correctly, she will make $5.345 for that day and if there is no rain she will still make $5.345 for the day, since she cannot buy more ingredients to get more sales. Overall, the expected value in this scenario is $5.15.

The final scenario is the vendor expects a full washout and prepares not ingredients. In this case regardless of what happens, the vendor will have no cost and no revenue. Thus, if the vendor is so risk averse that she wants to avoid every possibility of loss this is a scenario where she will find herself. However, this is rare as the vendors always want to make money and unless they are certain that the next day will be a complete washout, they will not take the day off. Overall, the

highest expected values is if the vendor prepares for half day sale. Yet, the vendor does not always choose to prepare for half day sales and there are other factors at play in her decision making. Thus, sometimes she might guess correctly and have 100% of her revenue other times lose money. Hence, in general there is a 20% penalty in rainy seasons.

Known Inputs	
Sales	22.22
Cost of Goods Sold	10.97
Rent	0.28
Net Income	10.97

Probabilty Distributions	
Probabilty of Rain	51.70%
Washout	1.70%
50% Rain	50.00%
No Rain	48.30%
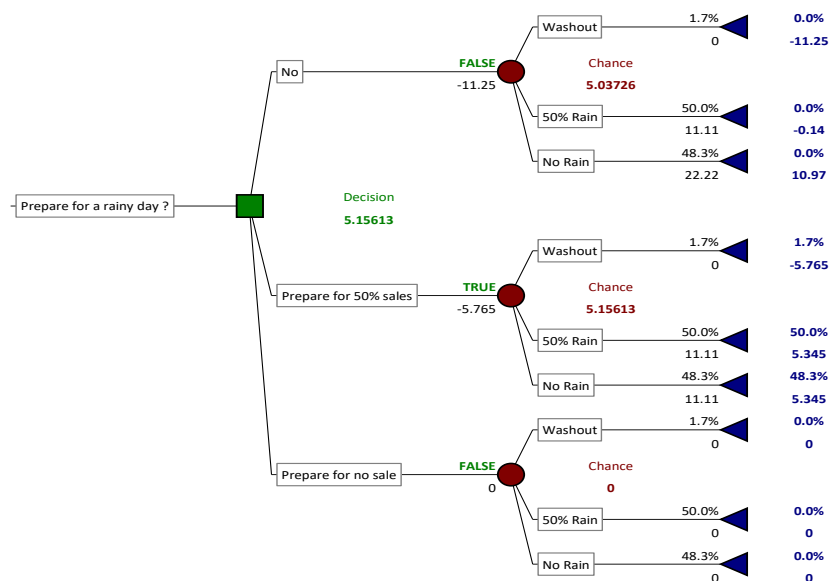
Figure 4.29 Kosai Vendor's Decision tree

Similar to a Kosai vendor, a Danwake vendor also has three decision choices, she either prepares for a sunny day during the four months of rainy season, prepares for half a day rain or takes the day off expecting a complete washout. The highest expected value for a Danwake vendor is $8.59 anything below that should be rejected.

In the first scenario if the Danwake vendor prepares for a sunny day, she will spend $7.02 on her ingredients for the day. If it rains the entire day, she loses all the $7.02 but if it rains for half the day, she can still make $2.98 income despite losing part of her ingredients. A Danwake vendor is better off in terms of her gross margin as a Kosai vendor uses oil and onions in her ingredients,

while a Danwake vendor only uses cowpea and replaces part of the cowpea with more affordable cassava flour. Finally, in case it's a sunny day as the vendor guessed, she will make $12.98 for the day. In total, the expected value for preparing for a sunny day is $5.225 which is less than $8 thus the program marks this branch as false indicating it is not an optimal choice for the vendor given the probabilities.

Second scenario is if the vendor prepares for a half day of rain. In this case, she will purchase $3.65 worth of ingredients. If her guess turns to be incorrect and it rains the entire day, she will lose all the $3.65, however, if her guess is correct and it only rains for half the day, she will make $6.35 and finally if it's a sunny day she will still make $6.35 as her ingredients are limited. Overall, the expected value for preparing for half a day rain is $8.595.
Finally, a risk averse vendor might decide to take the day off, in which case there is no revenue or loss regardless of what happens for that day.

The true of the decision tree branches indicate which branches we should follow. The squares are decision points, circles are chance events, and the triangles are the final outcomes. The expected values do not change with differing probabilities. This is because we already know that there is 51.70% chance of rain so 48.3% chance of no rain. We know the rainy days vary by either being 100% or 50% rainy but a sunny day is always sunny. Thus, we can only vary the probability of 50%-100% rain which on average will not impact the expected value. As an example, we can see the probabilities for a Kosai vendor are at the two extremes while for a Danwake vendor are at the middle.

The excel files accompanying this thesis will allow the reader to change the probabilities and observe that such changes will not increase or decrease the expected values of 50% and 100% rain as the combined probability and expected values do not change.

Known Inputs	
Sales	20
Cost of Goods Sold	6.74
Rent	0.28
Net Income	12.98

Probabilty Distributions	
Probabilty of Rain	51.70%
Washout	1.70%
50% Rain	50.00%
No Rain	48.30%
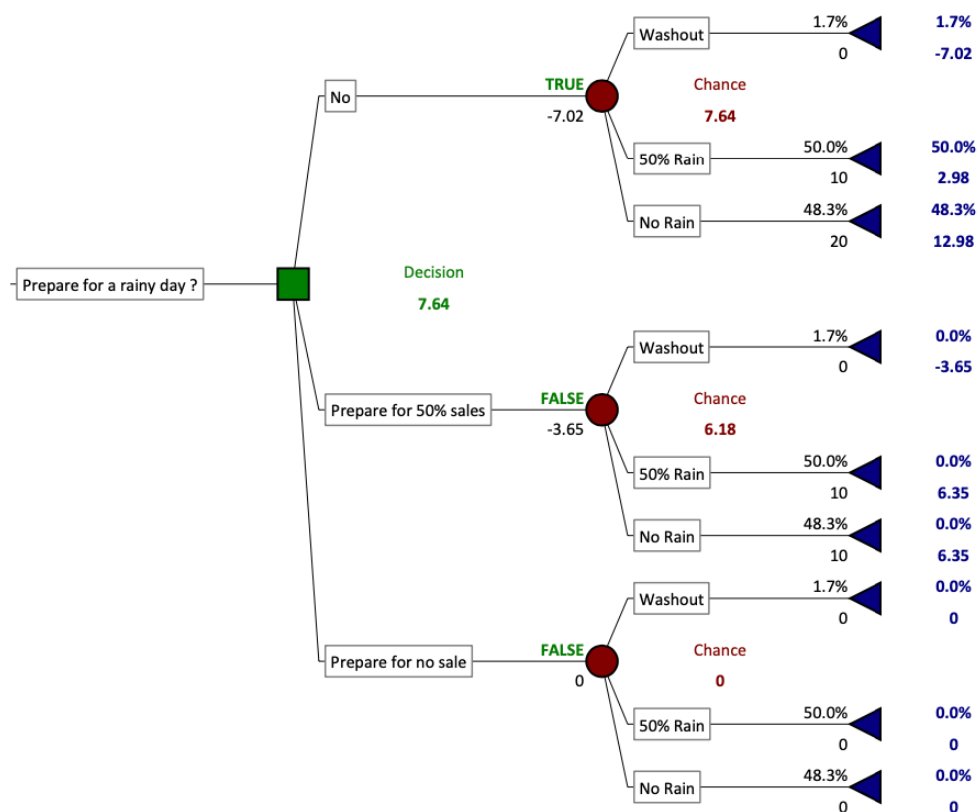
Figure 4.30 Danwake Vendor's Decision tree

4.4 Decision Matrices

Another way of looking at the decision-making problem of a vendor is through the decision matrices. The decision matrices allow us to draw the decision choices as well as chance events in a matrix format for easier representation. The rows will be used to represent decisions and the

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columns represent the chance events. In case of the Danwake and Kosai vendor the rows represent their decision on whether to prepare for 50% sales, 100% sales or take the day off during rainy season, while the columns represent whether it actually rains 100%, 50% or no rain at all. The cells represent net income corresponding to the decision and the event that actually happens.

Matrix 1. Danwake Vendor Decision Problem

Table 4.17 Danwake Vendor Decision Matrix

Choices	Events		
	No Rain	50% Rain	Complete Washout
Don't Prepare for Rain	$12.98	$2.98	($7.02)
Prepare for 50% Rain	$16.30	$6.35	($3.65)
Prepare for Washout	0	0	0

Table 4.18 Kosai Vendor's Decision Matrix

Choices	Events		
	No Rain	50% Rain	Complete Washout
Don't Prepare for Rain	$10.97	($0.14)	($11.25)
Prepare for 50% Rain	$5.345	$5.345	($5.765)
Prepare for Washout	0	0	0

The decision matrices allow us to look at nonprobabilitistic decisions as well. Normally, we will look at the expected value and decide the highest expected value is the best, but people have different risk tolerance, certain people might take higher risks to get more return while others will avoid as much risk as possible. A risk taker might prefer a maximax approach, where the decision maker chooses the decision with the highest outcome regardless of its probability. A risk averse decision maker might choose a maximin approach, where the decision makers try to choose the decision with the highest minimum outcome possible. For instance, in both Danwake and Kosai's case, a risk taker will decide not to prepare for rain as the maximum outcome for Danwake is $12.98 and for Kosai its $10.97 despite the 51.7% probability of rain. A risk averse vendor will choose to take the entire day off even if there is a slightly probability of rain, as both 50% preparation and no preparation for rain have possible negative outcomes. Thus, overall, not all

vendors follow what a statistician might consider the most optimal decision choices. This results in sometimes higher than average while at other times lower than average income.

CHAPTER 5.   CONCLUSION

To conclude, this thesis has covered the developments in cowpea production since 1971 to 2018. While cowpea production has been increasing, most of the increase was due to improvements in yields. This was especially true in case of Nigeria.

We also found that Bolani vendors on average, are profitable. With wheat flour, which is a staple food in Afghanistan having the highest impact on the profitability of a Bolani vendor. Despite their profitability, an average Afghan household consisting of eight members cannot be sufficiently sustained, thus other members of the family may also need to work (*Afghanistan 2015 Demographic and Health Survey - Key Findings*, 2015).

Although Kosai and Danwake vendors can keep a family of four or more above the poverty line, that does not mean everything is well, as the poverty line is the bare minimum. More needs to be done to ensure an improved quality of living. Moreover, as street food vending has little income, street food vendors made sure they do not make large losses and have some profit, that is why we do not see negative numbers in our risk analysis.

Decision trees are an important tool to visualize the decision-making situation vendors face on a daily basis. The decisions with the highest expected value were to prepare for 50% rain, however we also saw that not all vendors have similar risk tolerance, thus not all of them will follow the same set of choices.

While we have probability of rain vs no rain, having more information that can allow higher accuracy in the weather forecasts can help the vendors prepare better for rain and the researchers can use that to predict sales at different times of the day.

To wrap up, the informal economy is integral part of developing countries' economies. Street food vendors, particularly women, play an important role in the day-to-day activities of the informal economy. Despite its important, research is scarce in this area, leaving many issues for future research.

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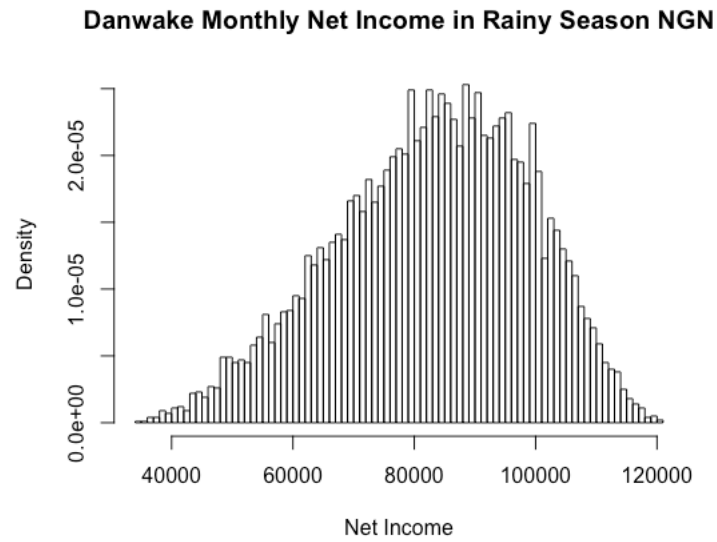
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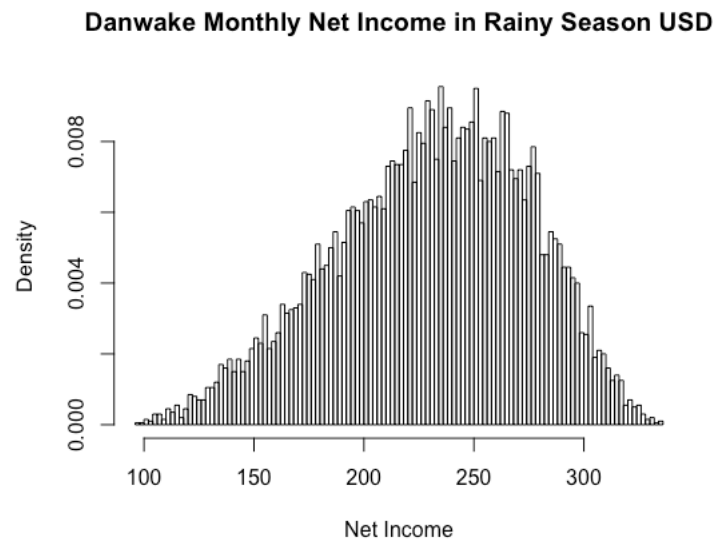
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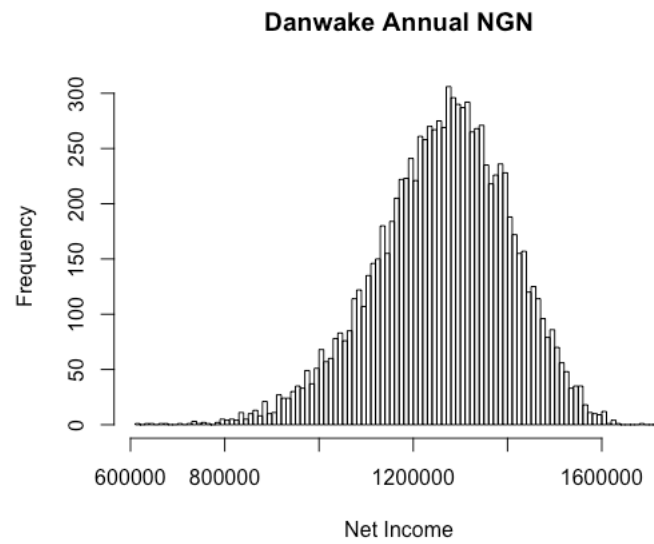
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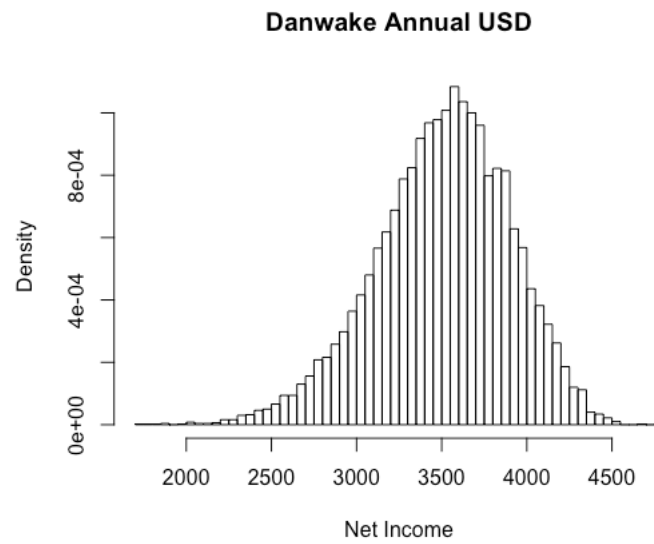
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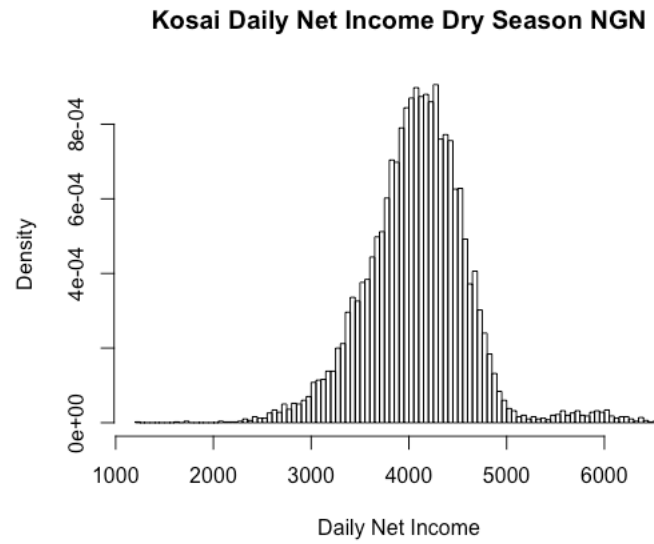
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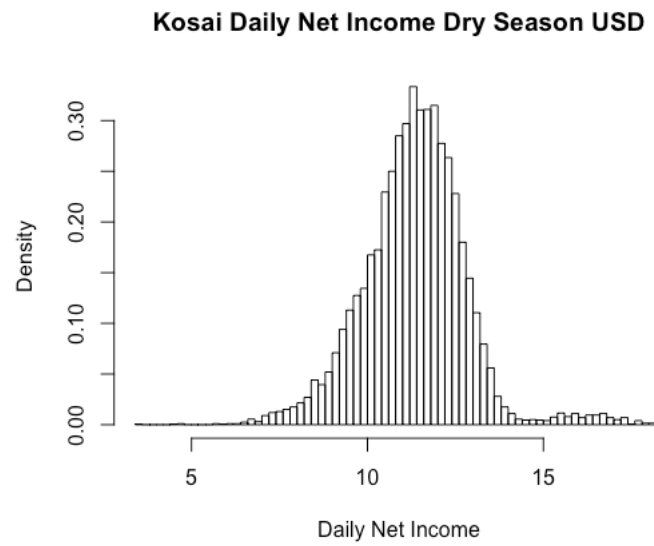
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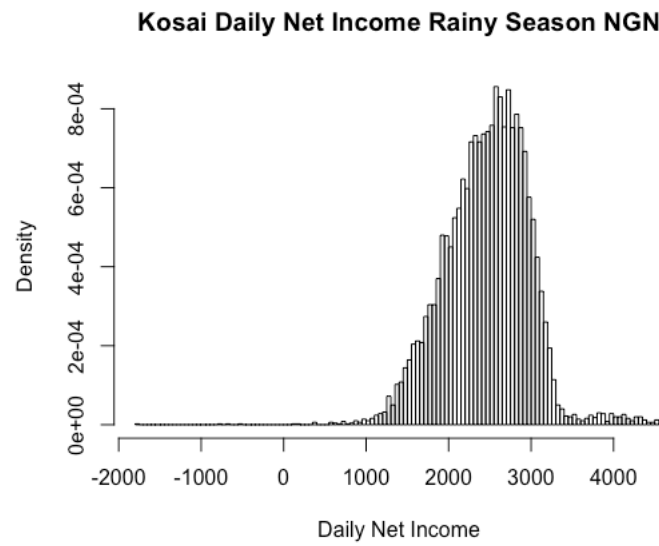
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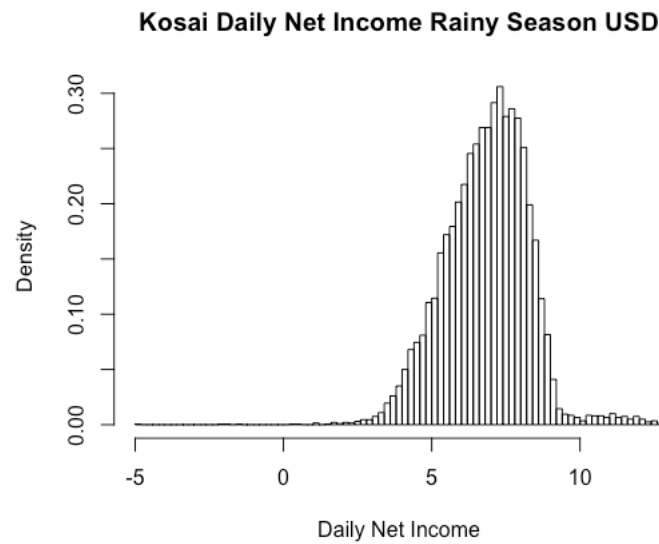
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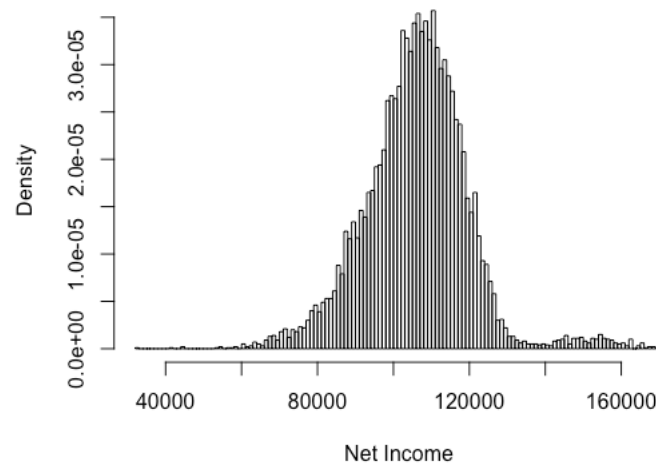
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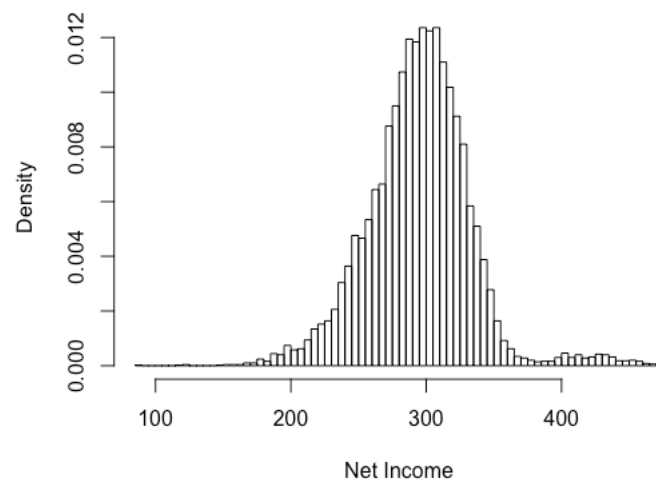
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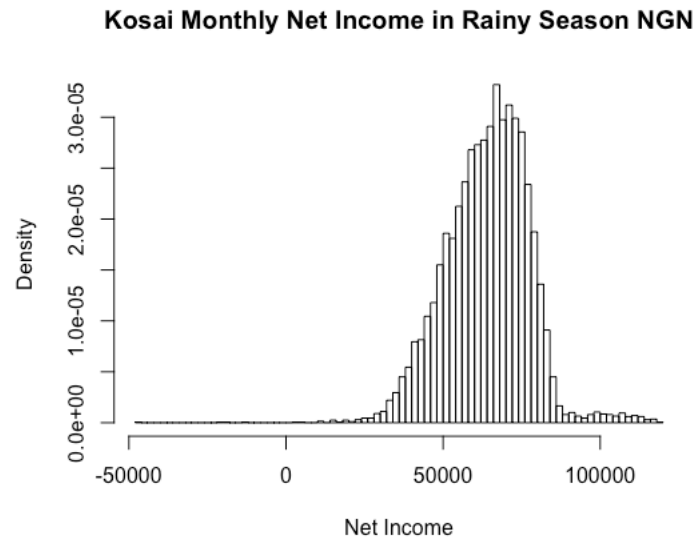
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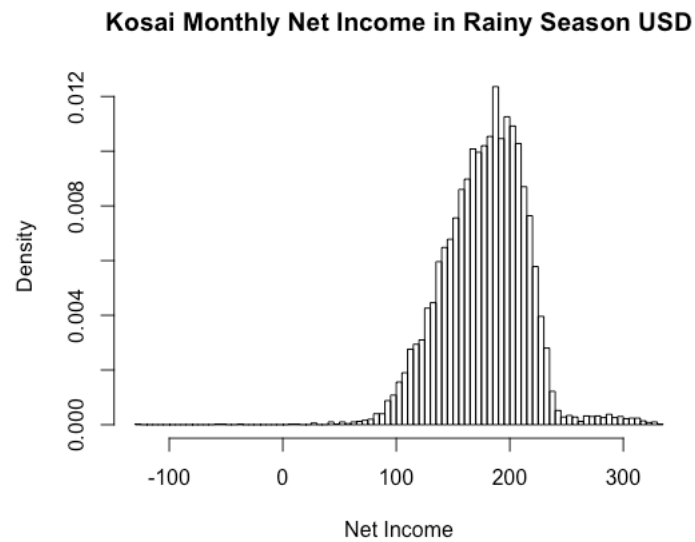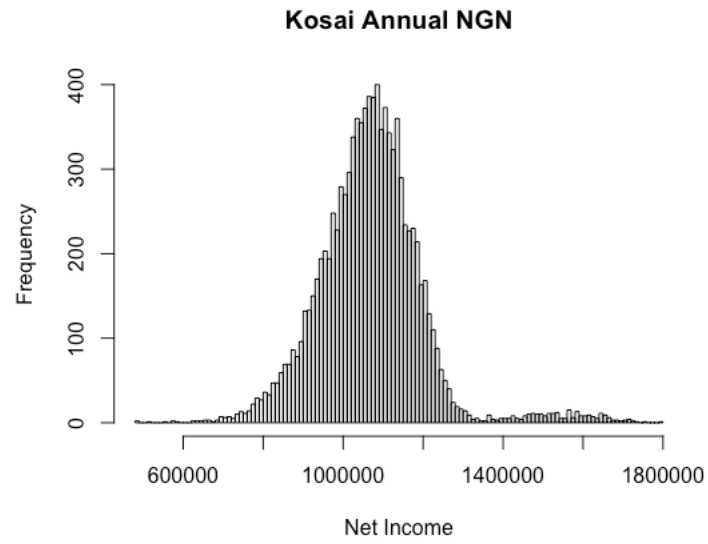
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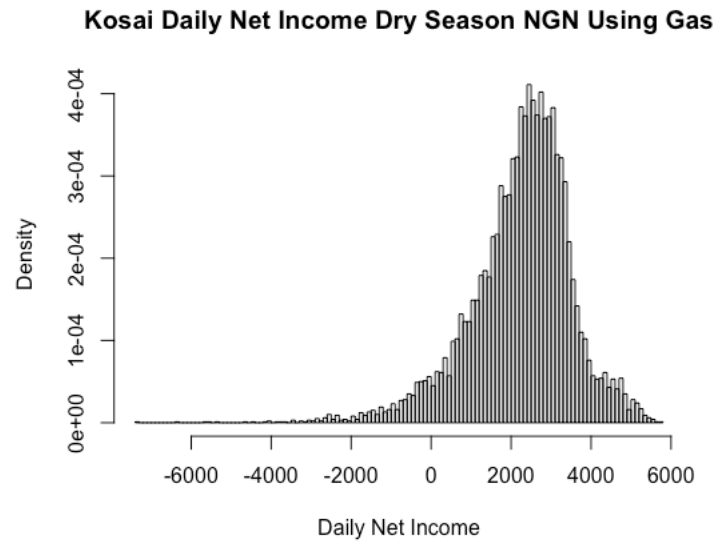
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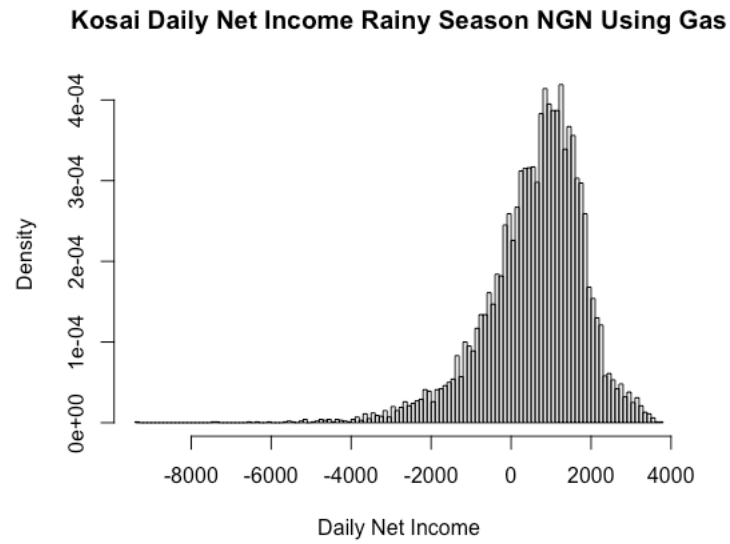
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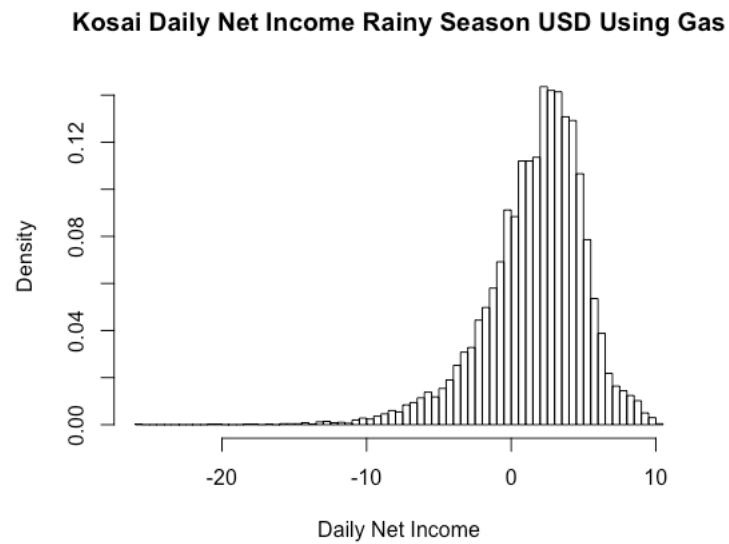
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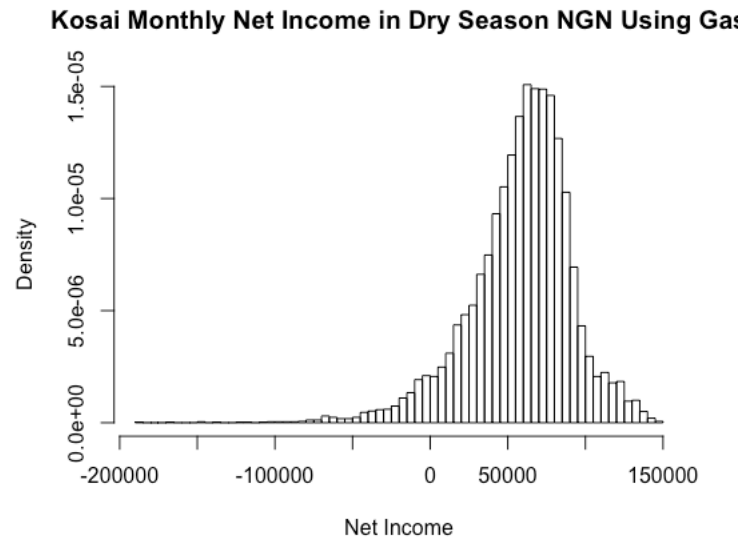
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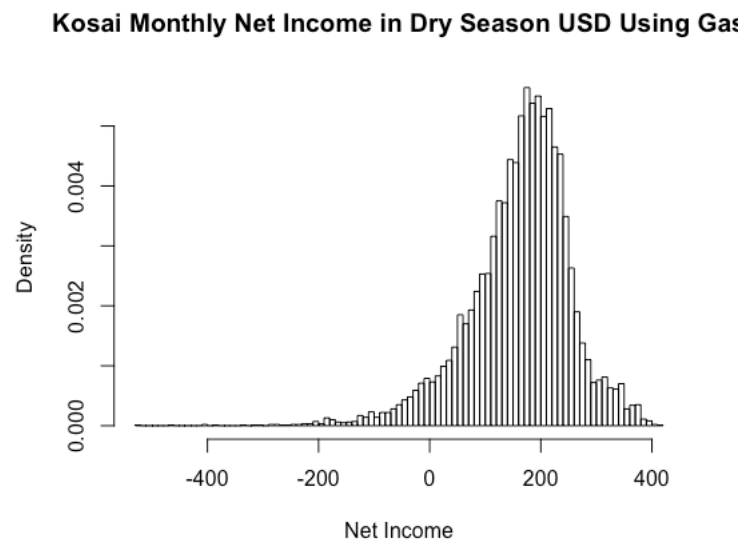
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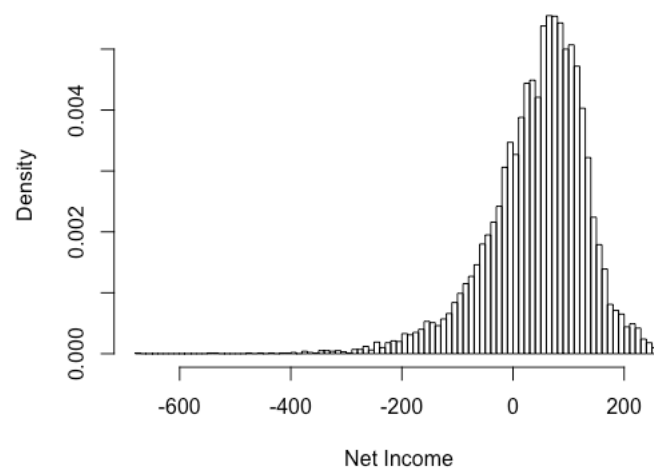
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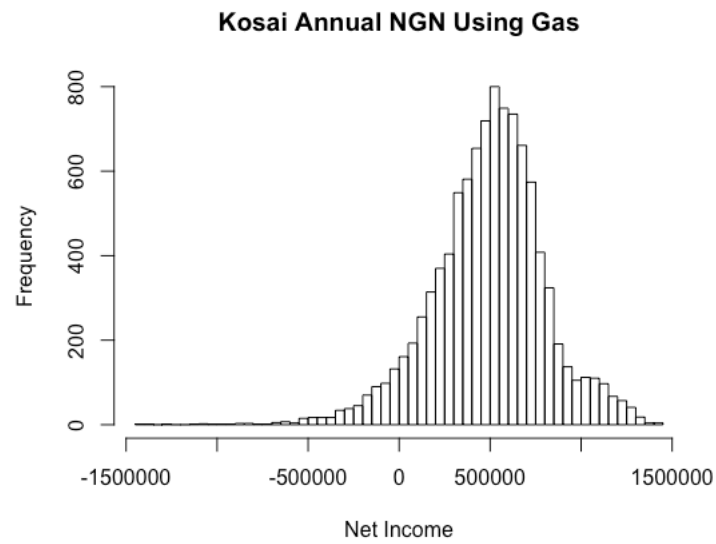
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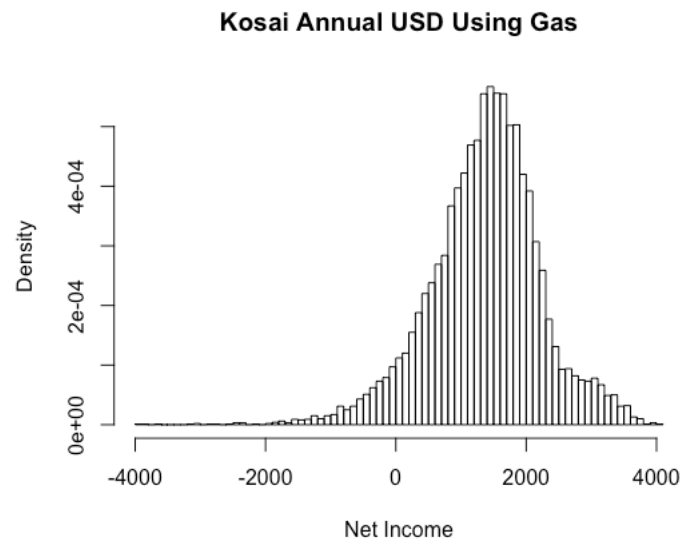
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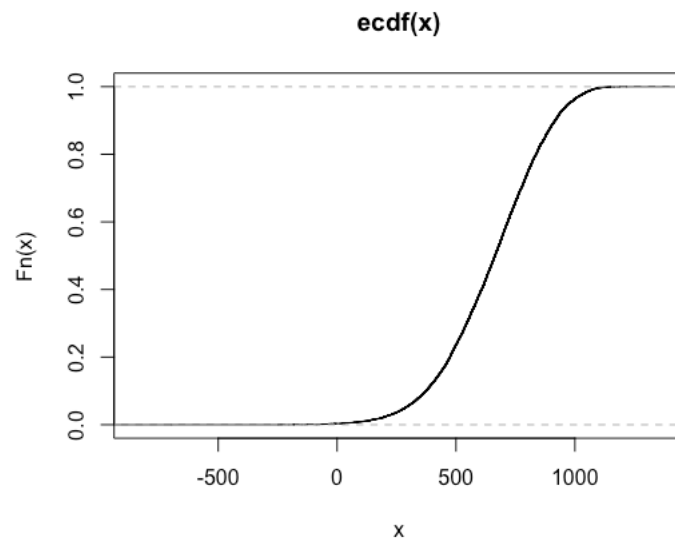
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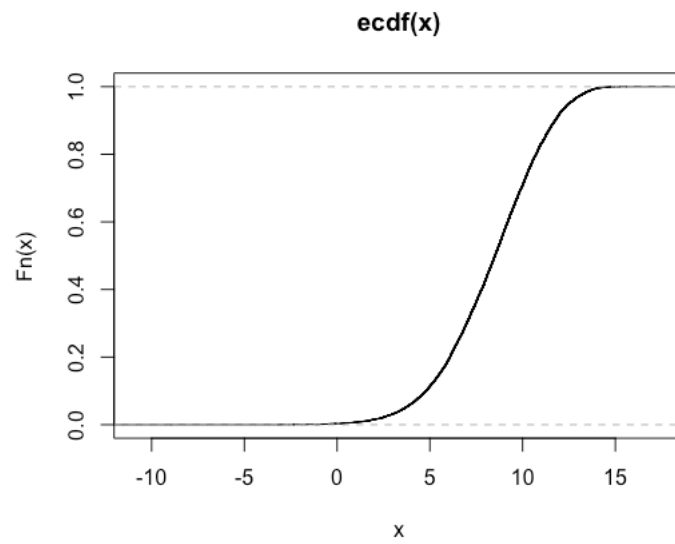
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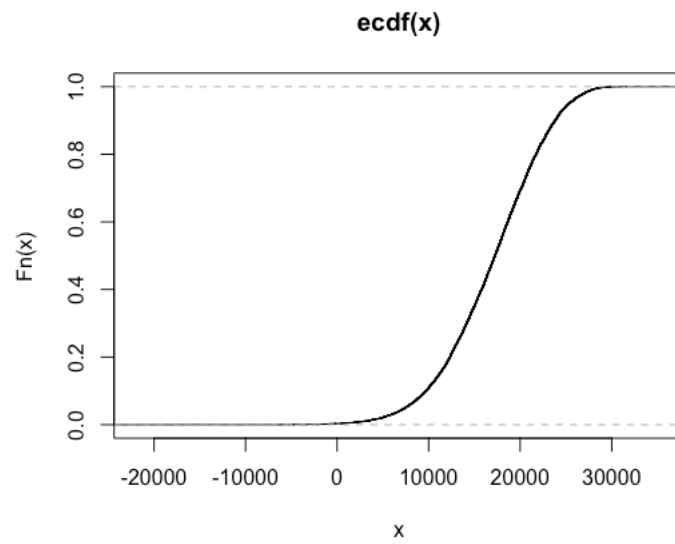
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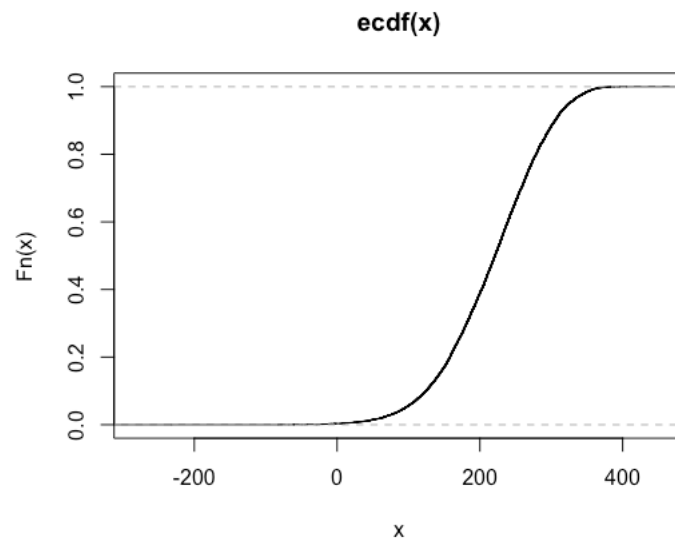
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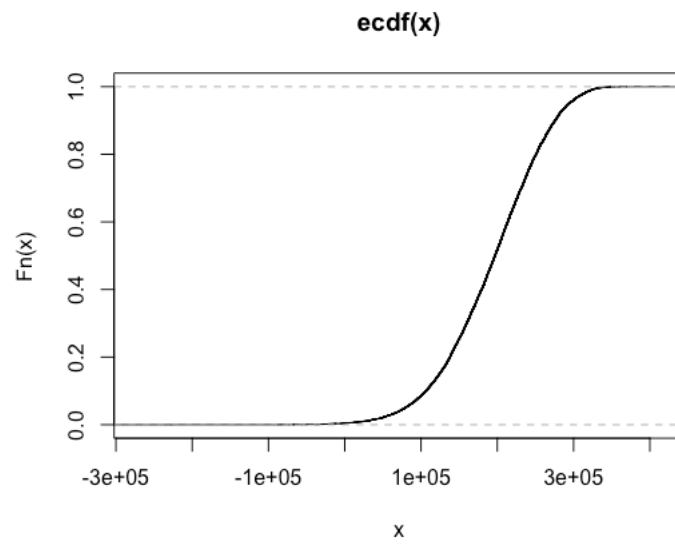
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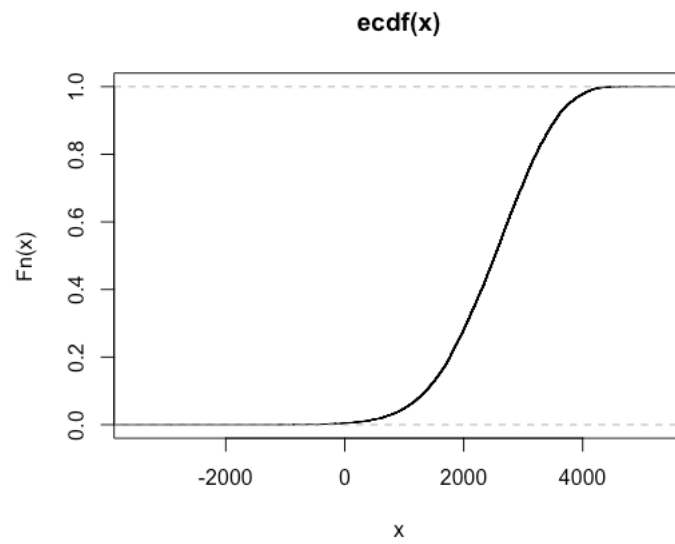
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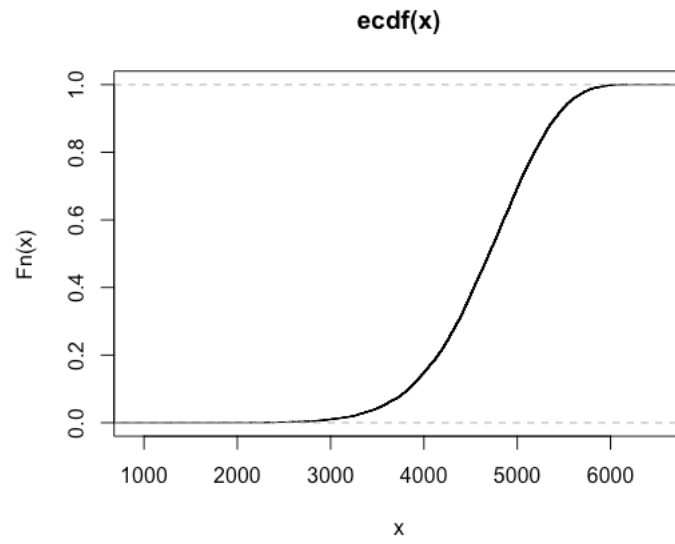
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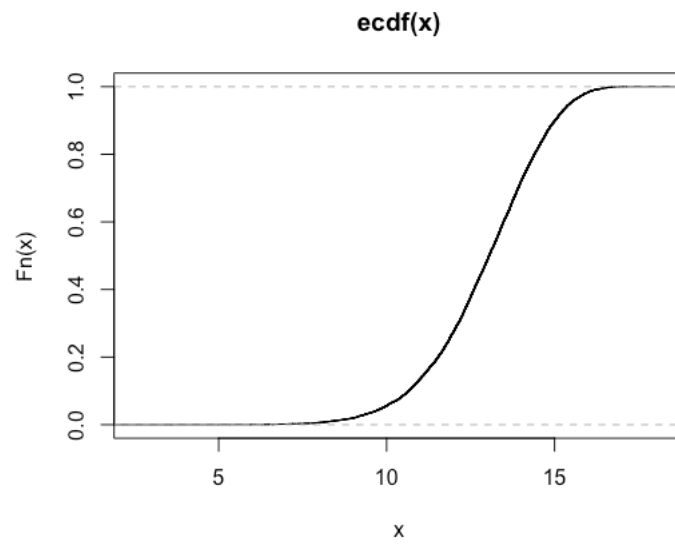
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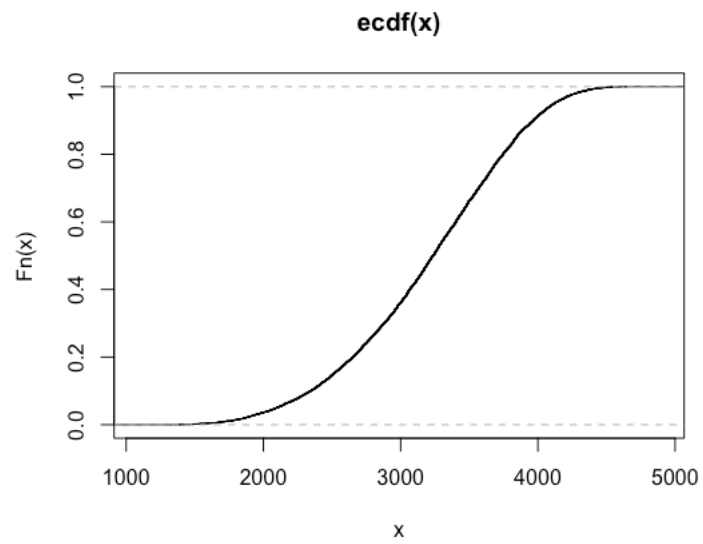
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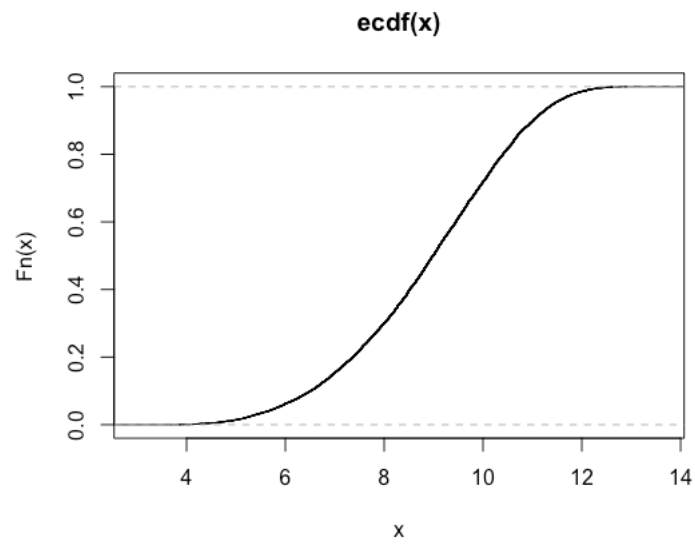
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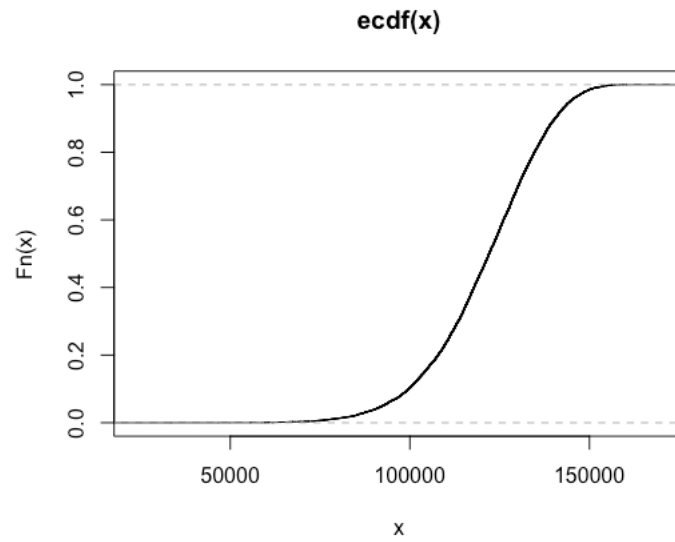
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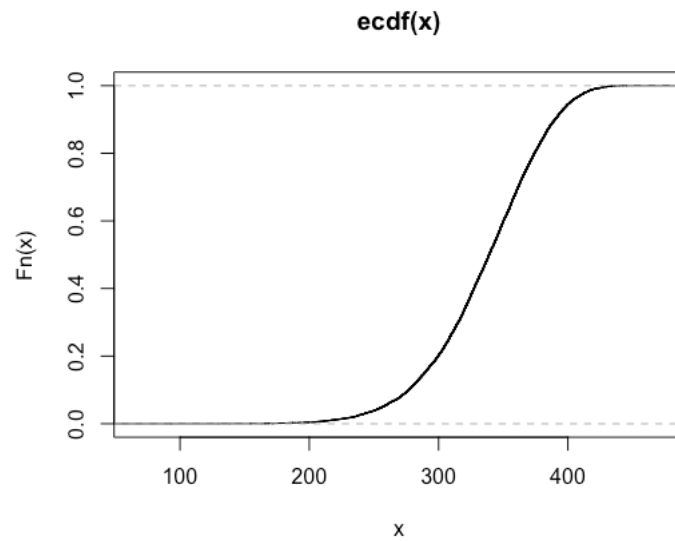
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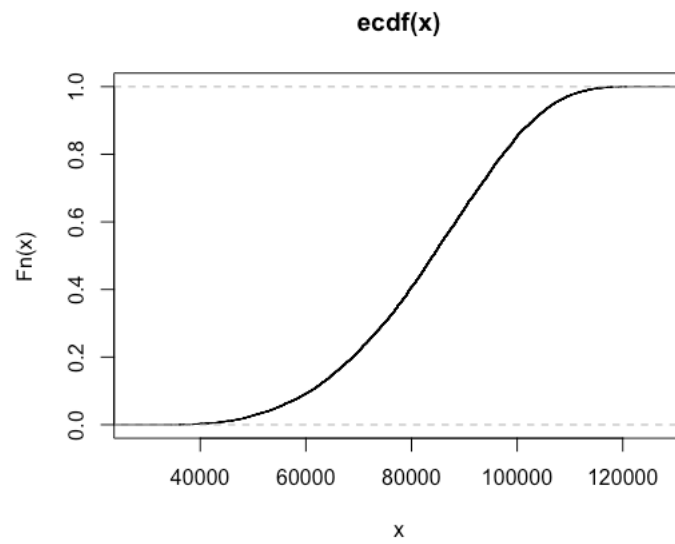
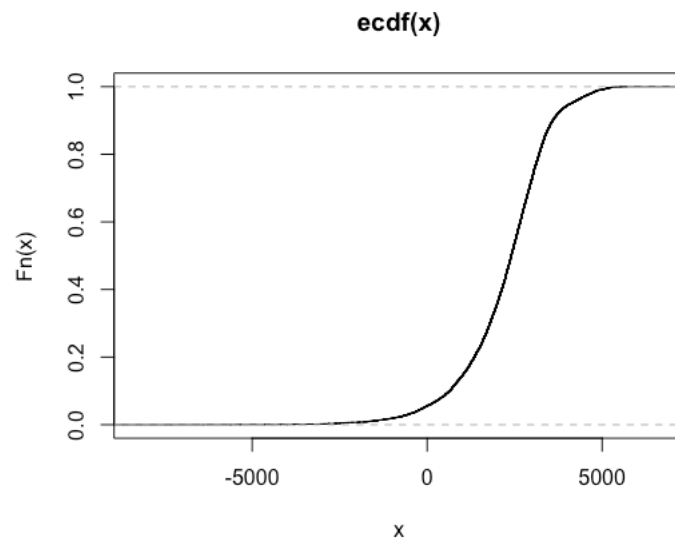A 49 Danwake Vendor's Monthly Net Income CDF in Rainy Season (NGN)

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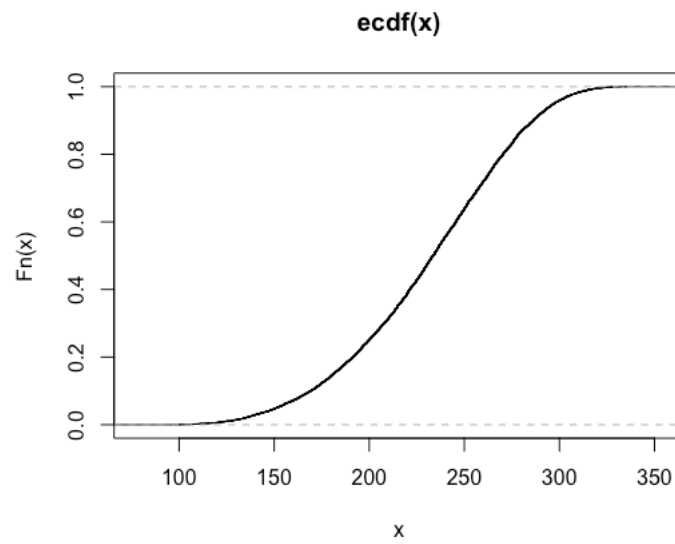
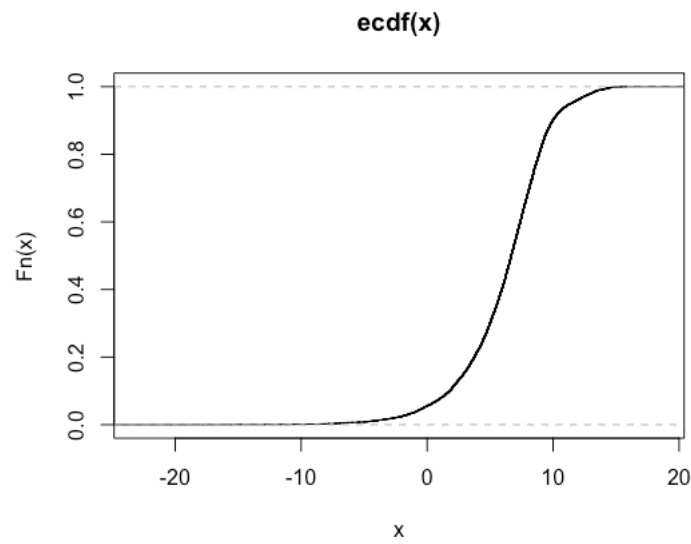A 50 Danwake Vendor's Monthly Net Income CDF in Rainy Season (USD)
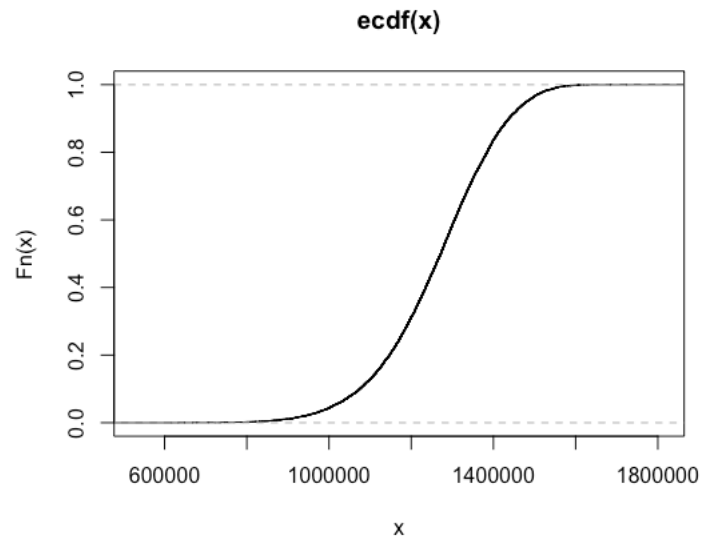
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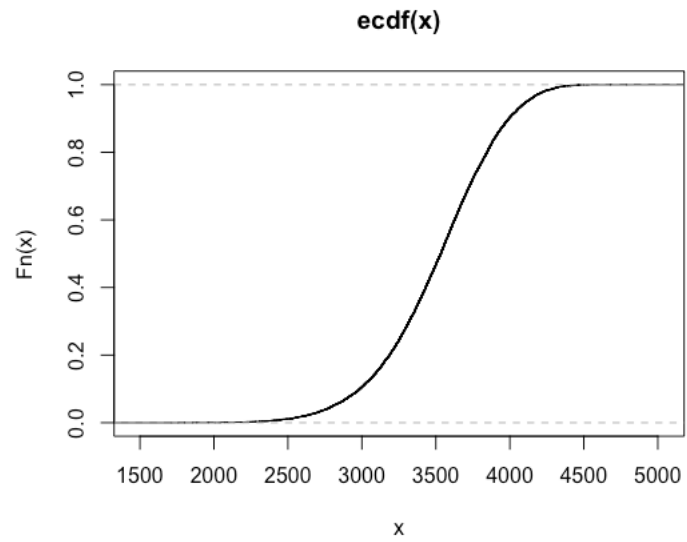
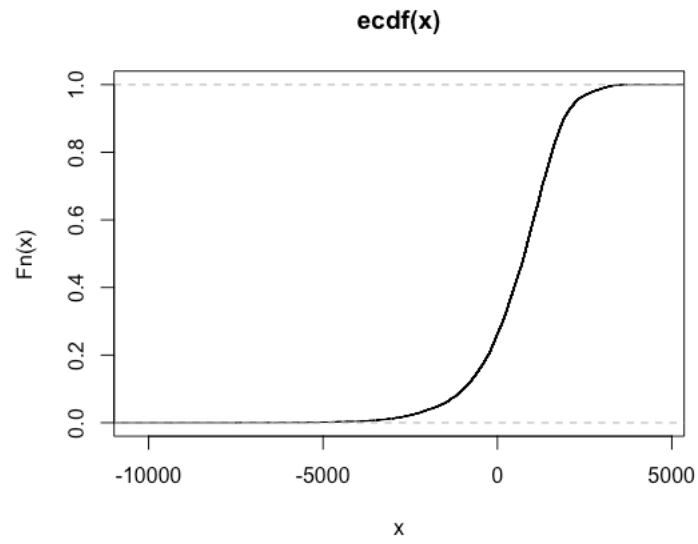A 52 Danwake Vendor's Annual Net Income CDF (USD)
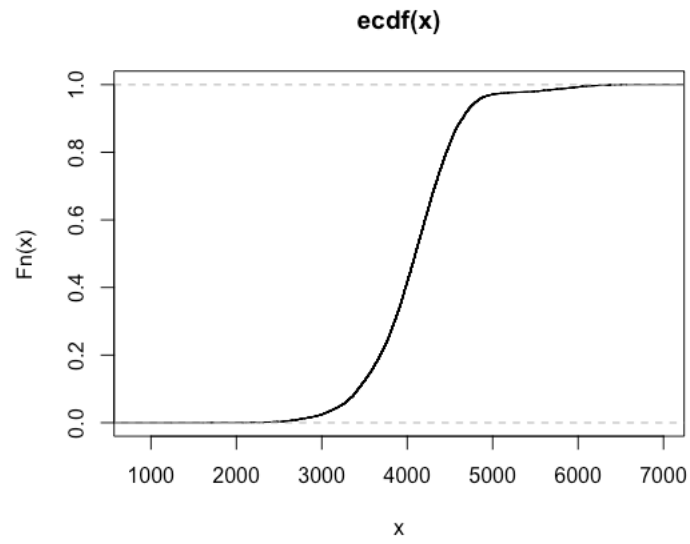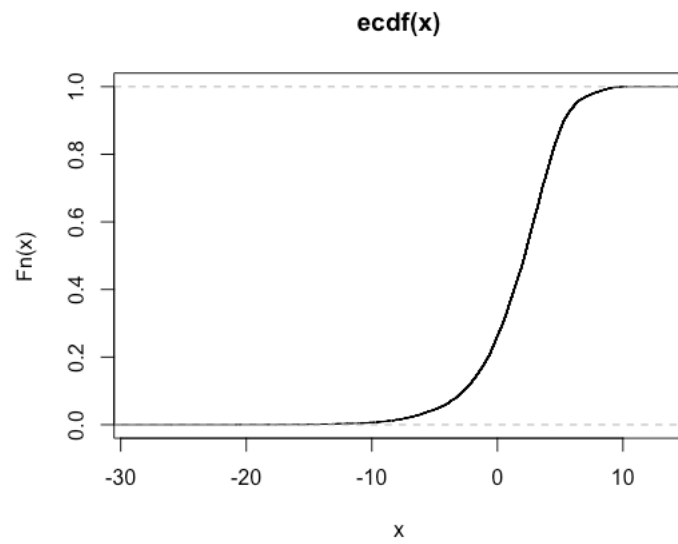
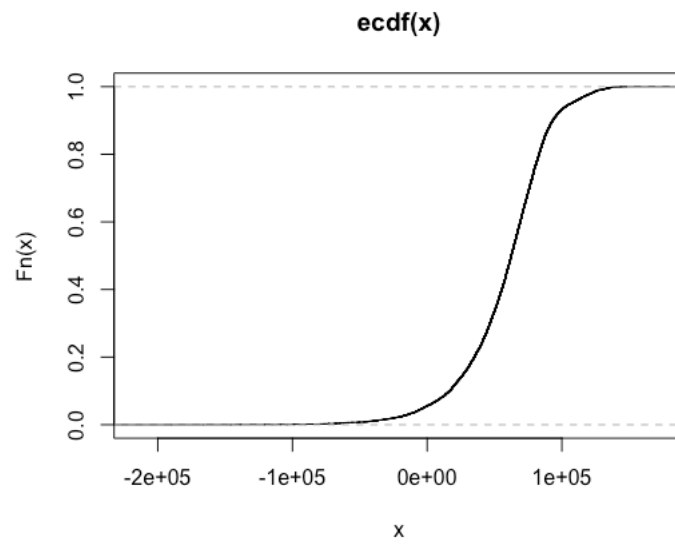A 53 Kosai Vendor's Daily Net Income CDF in Dry Season (NGN)
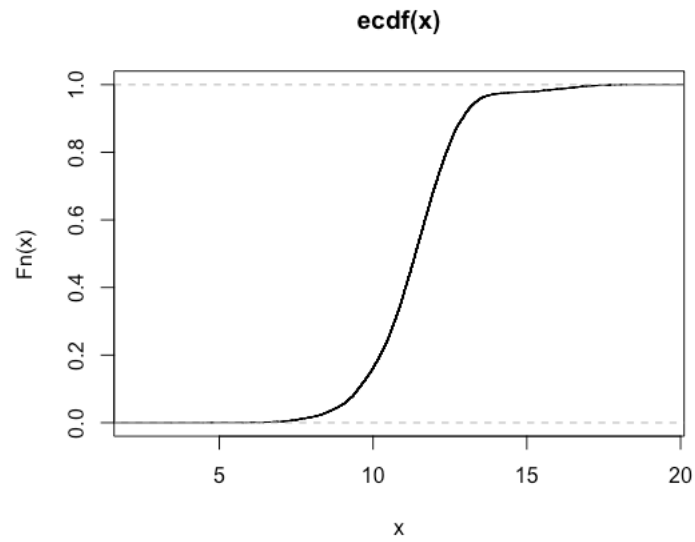
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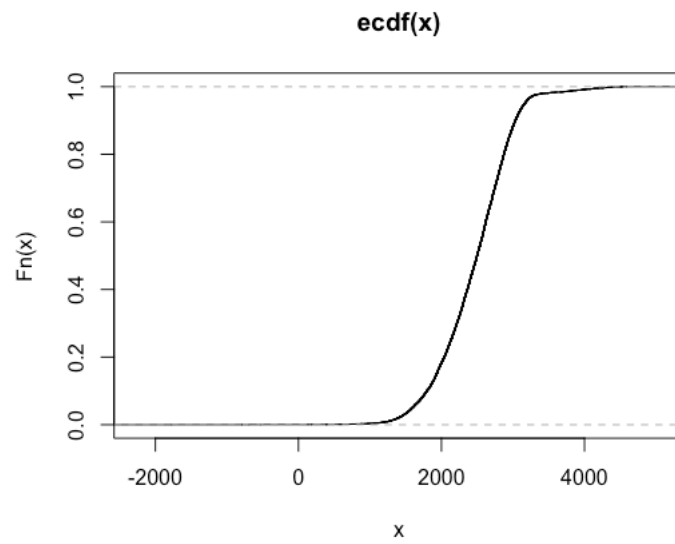
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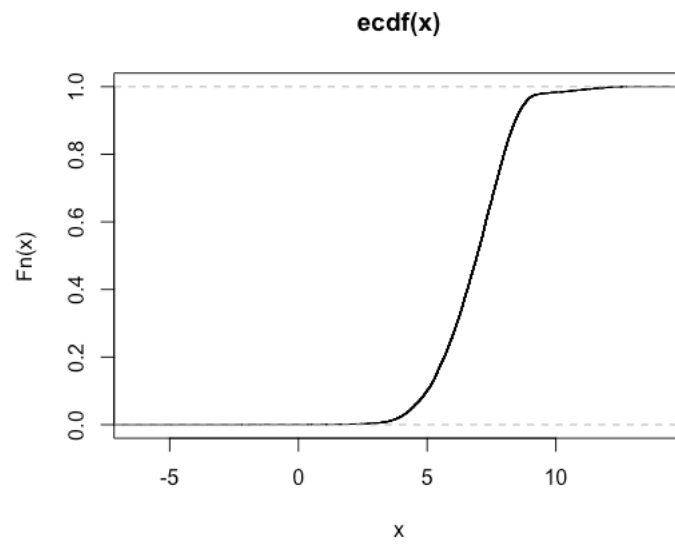
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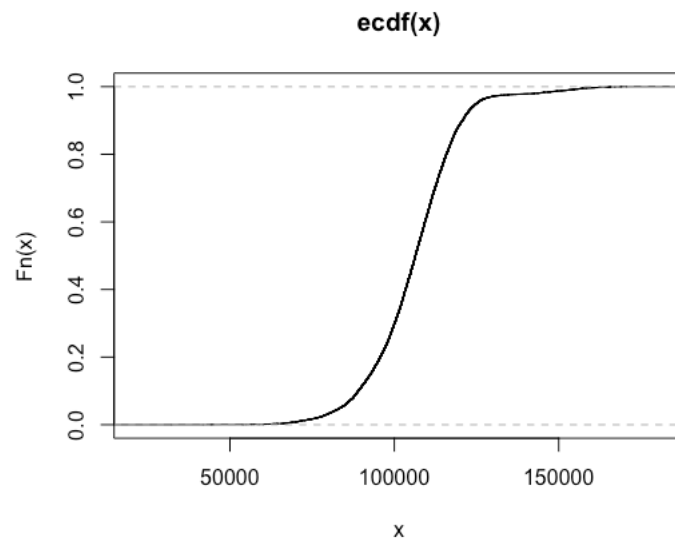
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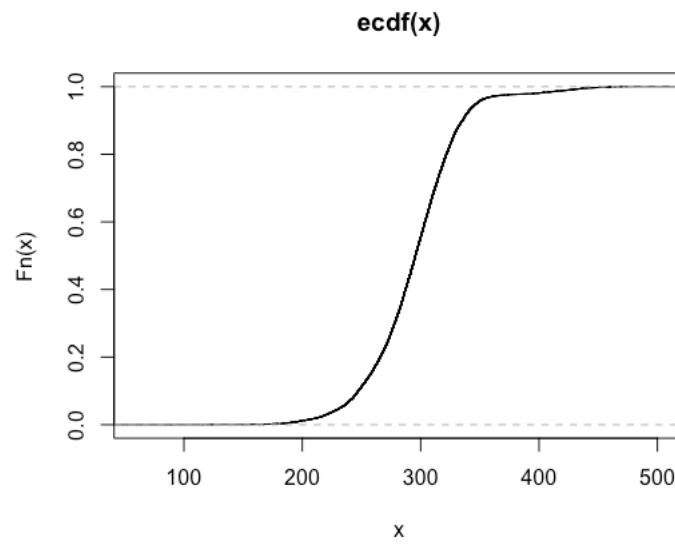
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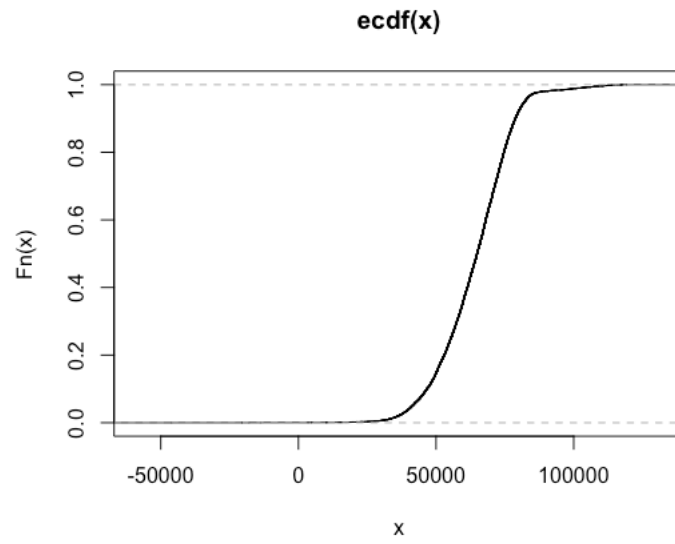
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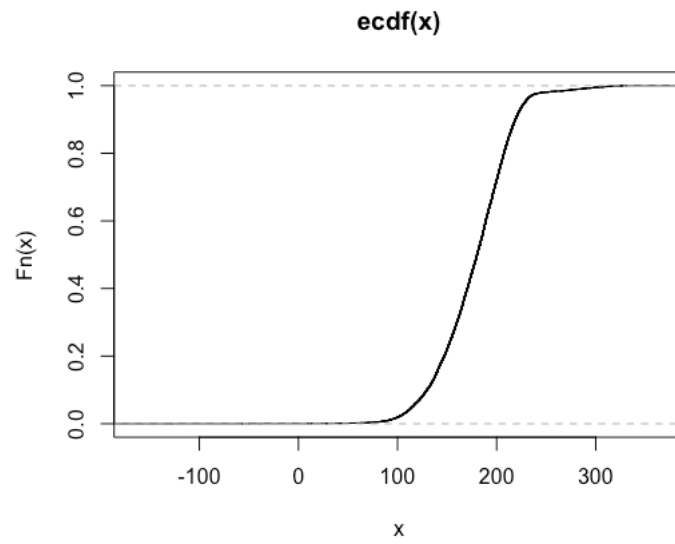
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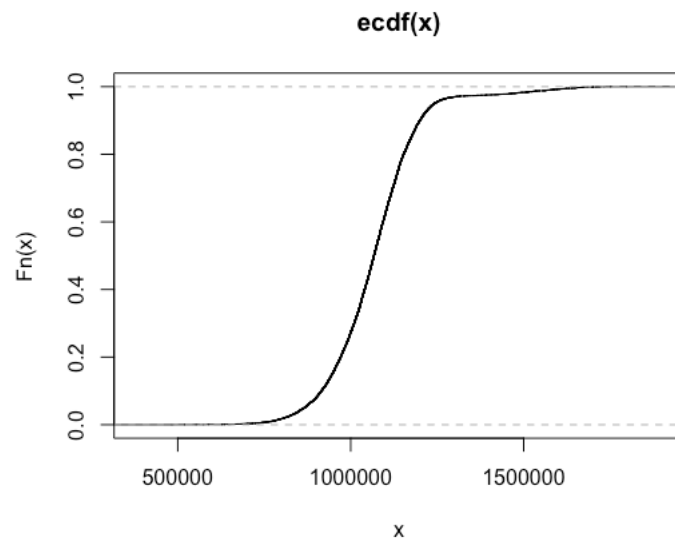
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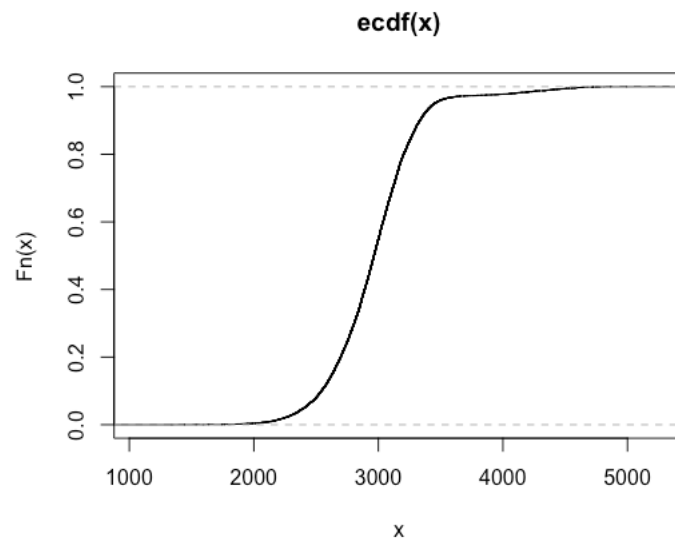
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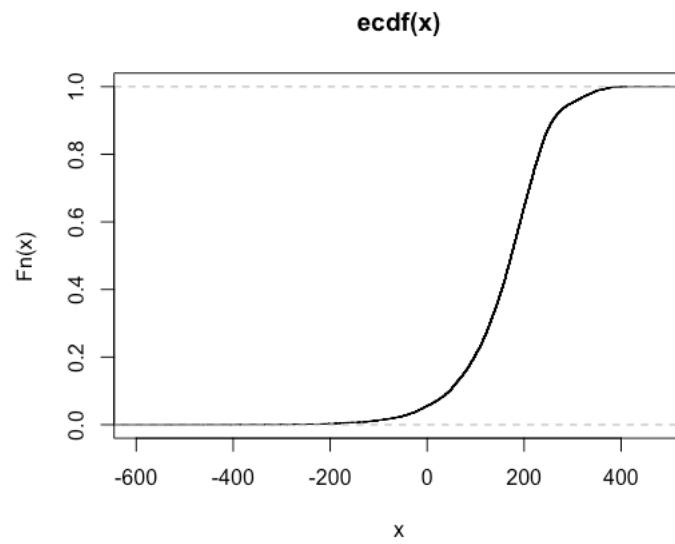A 64 Kosai Vendor's Daily Net Income CDF in Dry Season using gas (USD)

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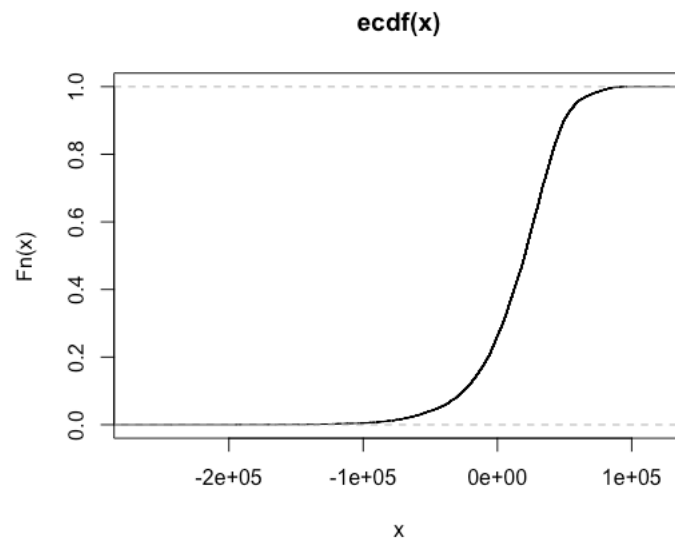A 65 Kosai Vendor's Daily Net Income CDF in Rainy Season using gas (NGN)

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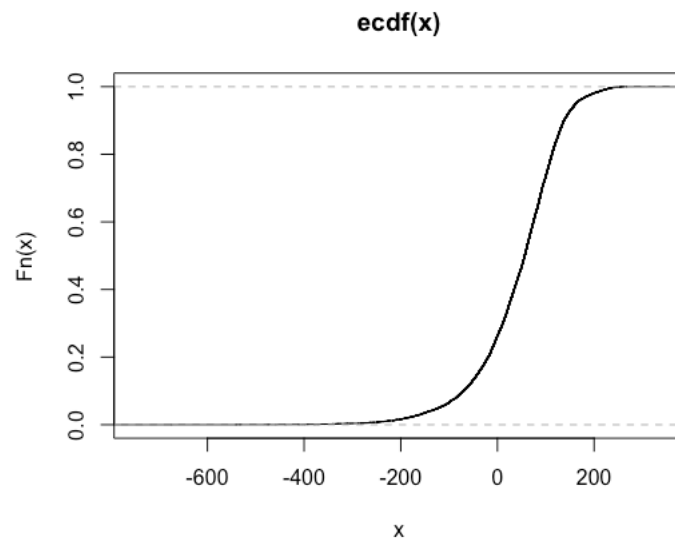A 66 Kosai Vendor's Daily Net Income CDF in Rainy Season using gas (USD)

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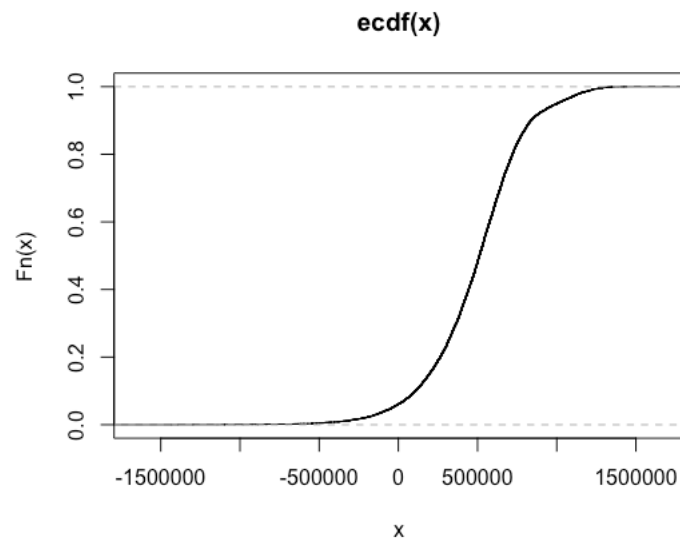

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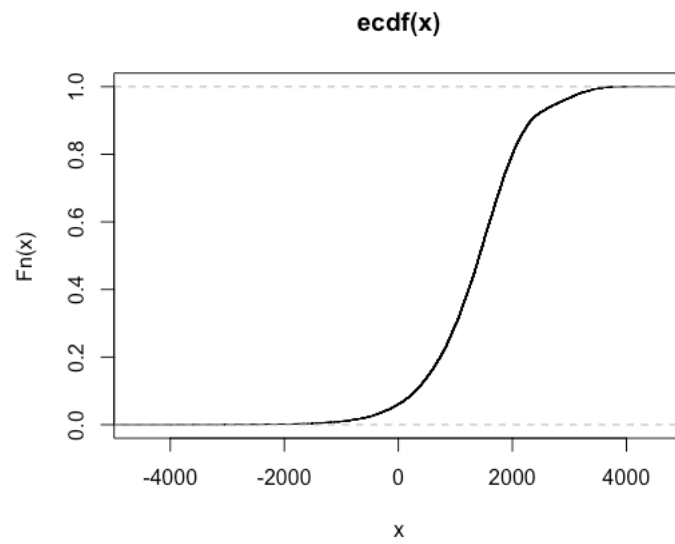A 68 Kosai Vendor's Monthly Net Income CDF in Dry Season using gas (USD)

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