AN APPLICATION OF CONTROL CHARTS FOR ATTRIBUTES IN BANKING & INSURANCE INDUSTRY

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ABSTRACT:

Banking and Insurance sectors are rapidly growing in India and there are many opportunities in business & services. The NPA in banking and claims in insurance are two major issues need to be analysis. In this study, we have been collected data for NPA of 21 banks in India and claims of Bajaj Allianz in insurance industry. To test the feasibility of the processes, we have introduced the technique of statistical quality control. The control charts plays an important role to test and maintain the quality of any process through its 3σ-control limits.We have been used two differentcharts for attributes such as p-chart for insurance and u-chart for banking.

Key Words: Insurance Industry, Banks, NPA, Attributes Chart, p-chart, u-chart.

1.INTRODUCTION

Banking system has been modernized in India, in the late 18th century. Bank of Hindustan was the first bank, which established in 1770 and then liquidated in 1829-1832. The second bank, General Bank of India established in 1786, but due to some reasons it was failed in 1791. In British period, some merchants established the Union Bank of Calcutta in the year 1829, earlier it was a private joint stock association but later it convert as partnership association. The Commercial Bank & Calcutta Bank owners made a mutual consent they created Union Bank with replace their two banks.

The Allahabad Bank is the only bank in India, which was established in 1865 and still running today. In the same period (1863) Bank of Upper India was established but it was failed in 1913. The Government of India made a historic regulation in 1948 in banking sector. The major steps was included to regulate bank such that an Indian central banking authority known as Reserve bank of India was established in April 1935 and it was nationalized in first January 1950. Later, in 1949 the banking regulation act was implemented which enable RBI to regulate in inspect and control the banks in India. India is a developing country so there are lots of reforms yet to need for growing business and infrastructure system.In this journey bank plays an important role. There are three types of banks in India like nationalized, public and private bank. The banking sector is

based on the facilities which provide to their customers. So, in this technological era all the banks are committed to its customers. Working age population

According to RBI, banking sector of India is regulating well and have enough capitalized. India hold good position in the world with respect to economic and financial parameters. The economic & finance risk studies advised that banking sector of India should run with global upward trend. Banking in India has adopted advanced methods of payment and e-banking from last five years. India is holding continue a good position in the faster payments innovation index (FPII) in 25 top countries. According to an Economic Survey, working age population to grow by 9.7 million per year during 2021-31 and 4.2 million per year during 2031-41. India's digital lending stood at US$ 45 billion in FY16 and is calculated to reach US$ 1 trillion by FY2023 driven by the 5 fold growth in the digital disbursement.

Loan and Deposit Growth in Various Segments
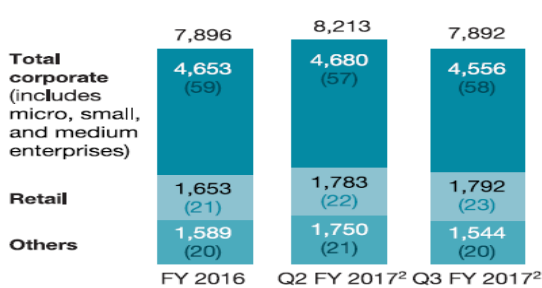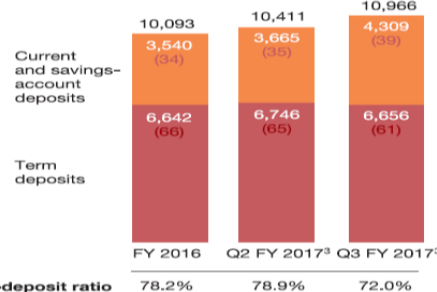
RBI, McKinsey analysis

About the market of banking system includes of 27 public sector banks, 20 private sector banks, 43 foreign banks, 56 regional rural banks, 1,589 urban cooperative banks and 93,550 rural cooperative banks as on year 2017. During FY06–15, deposits grew at a CAGR of 12.9 per cent and reached US$ 1.97 trillion by FY17. Deposits as of Feb 2017, stood at Rs 132.35 lakh crore (US$ 1,893.77 billion).The total equity funding of microfinance sector grew at the rate of 42 year-on-year to Rs 14,206 crore (US$ 2.03 billion) in 2016-17.

Oriental life Insurance was the first insurance company was established in 1818, but it was a private insurance company. Bombay mutual insurance society was established in 1870. Later in the year 1912 an act for Life Insurance Company and provident fund was passed to maintained and regulate the insurance business. In the year 1956, Life insurance sector as well as corporation came into existence by an ordinance. The Life Insurance Corporation absorbed almost 245 Indian and foreign insurance. An act was passed in parliament in 1972 and implemented from the year 1st January, 1973 for General insurance business.

## Demand Curve for life & health insurance is growing rapidly
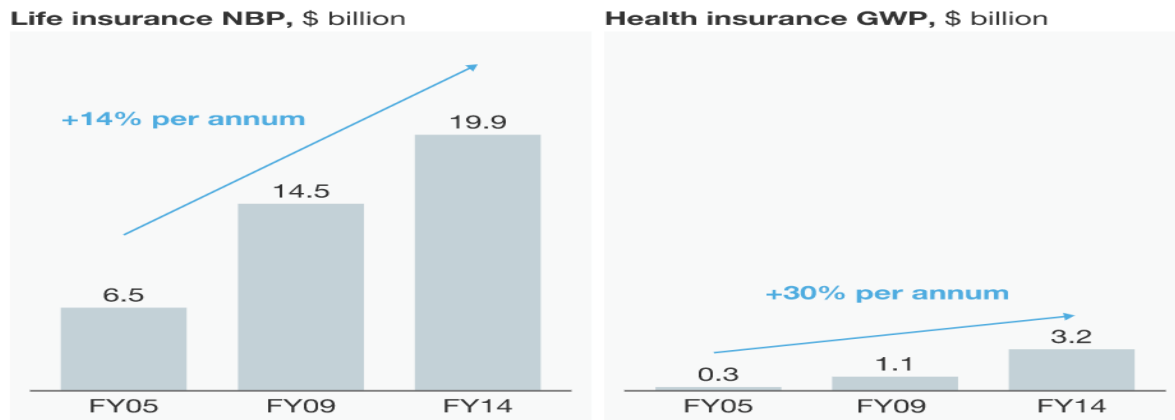
Source: IRDA, McKinsey analysis

Indian insurance industry having 53 insurance companies out of which 24 are in life insurance sectors and 29 are non-life insurance. Life Insurance Corporation (LIC) is the only backbone of public sector insurance company. Second most important insurance company is General Insurance Corporation of India in re-insurance known as (GIC-Re). All the stockholders such as agents, brokers, third party administrators and investigators servicing medical insurance claim.The market is good for insurance business with some improvement in regulatory framework. It is expected that the insurance business will obtain US$ 280 billion by 2020. The industry will grow by 14-15 % per annum for next five years.

About the market of insurance company, government's policy is helping to insuring the uninsured has gradually pushed insurance penetration in India and proliferation of insurance plans. Gross direct premiums of non-life insurers in the country reached US$ 20.54 billion in FY2017 , gross direct premiums reached Rs. 150.25 billion (US$ 1.55 billion), observations a year-on-year growth rate of 14.47 per cent. Overall insurance penetration (premiums as per cent of GDP) in India reached 3.69 per cent in 2017 from 2.71 per cent in 2001.

Growth of private sector life insurance premium and correlation with equity markets, %
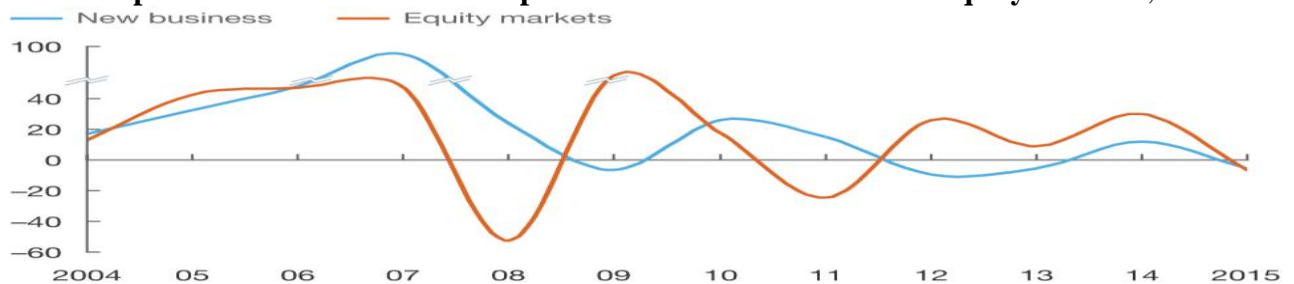
Source: RBI, McKinsey analysis

In FY16, an increment in premium of new life insurance business is 8.24 % annually to Rs 2.15 trillion (US$ 30.7 billion). In FY16, gross direct premiums of non-life insurers obtained US$ 24.82 billion, showing an annual growth rate of 14.03%. Private sector insurers saw a 17 per cent growth in premium collection, the state-owned non-life insurers registered a nine per cent growth in the same period.Thenon-life insurance market share has been contributedin the private sector companies from 13.12 per cent in FY03 to 42.70 per cent in FY17.

Walter Andrew Shewhart (1897-1967), father of Statistical Quality Control was born in New Canton, Illinois. Shewhart worked in Bell Telephone Research Laboratories and described the control chart which launched statistical process control. Control charts are known as Shewhart charts, these charts are used to test whether a manufacturing process is under control. These charts are graphical tool for monitoring any statistical process. These charts are designedto control the parameter of the manufacturing process when distribution is known. Shewhartdivided the variation into two categorize 'chance causes' and 'assignable causes'. There are two types of control charts as
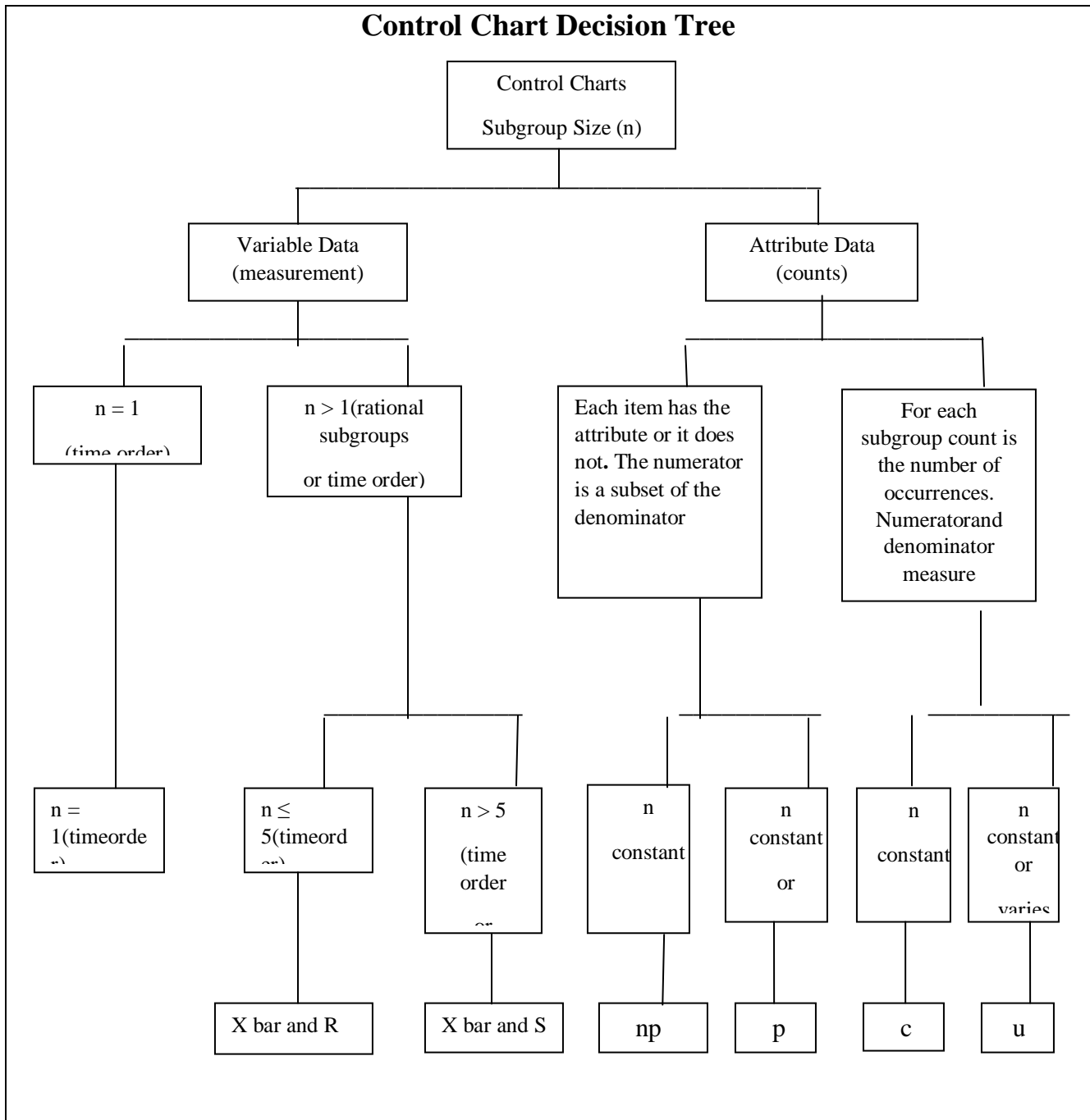
 (1) Charts for variables
(2) Charts for attributes.
If the process is under control, it means that 99.73 % point will lie between the 3sigma control limits. A control chart is based on the followings:

- A statistic to measure the quality characteristic of the items. These measures are from measures of central tendency or measures of dispersion.
- A center line is drawn corresponding to average value.
- Upper Control Limits(UCL) and Lower Control Limits(LCL) for 3sigma control limits are known as Natural Process Limits.

2.OBJECTIVES OF THE STUDY

In this study, the main objectives are as follows:-

(1) To analyze the yearly claims in insurance company (Bajaj Allianz) data and to test whether the companies are considered as good with in the statistical under control with respect to their pre-fixed margin.

(2) To analyze the Non-Performing Assets (NPA) of 21 Banks from India to test if the banks are operating statistical under control within a suitable NPA limit.

Control Chart Decision Tree

Control Charts

Subgroup Size (n)

Variable Data
(measurement)

Attribute Data
(counts)

n = 1
(time order)

n > 1(rational
subgroups
or time order)

Each item has the
attribute or it does
not**.** The numerator
is a subset of the
denominator

For each
subgroup count is
the number of
occurrences.
Numeratorand
denominator
measure

n =
1(timeorder)

n ≤
5(timeorder)

n > 5
(time
order
or

n

constant

n

constant
or

n

constant

n

constant
or

varies

X bar and R

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3.RESEARCH METHODOLOGY

In this study, we have collected data for 2 particular industries which are Banking and Insurance to examine if their processes are operating within statistical control or not.

(1) Insurance Industry

We have collected Insurance data relating to net insurance premium earned and the net insurance claimed by customers for Bajaj Allianz from 2002 to 2017. The data has been collected from company websites and annual reports published by them in the past. Further, control charts were plotted to see if the data lied within the calculated control limits or not.

The company has fixed a margin on fire insurance claims. It means that if the claims are below the margin of what they have earned, they consider a good profit. In the following study, we have analyzed their yearly claims data and checked if the company is doing well in their pre-fixed margin.

Here, we are dealing with proportions. Moreover, claimed insurances can be termed as "defects" in this case, as it leads to loss for the company and the phenomenon of insurances being claimed is the "process". So, in this case, a p-chart is appropriate.

(2) Banking Industry

For Banking industry, we took a sample of 21 public and private sector banks of India and collected data relating to the NPA's (Gross Non-Performing Assets) and Gross Loans Advanced for each of them. The figures were taken as an average of past 5 years to ensure that the numbers were normalized absolving them from any extreme circumstances causing the data to be skewed in that particular year. After that similar to the insurance industry the data was plotted to obtain the control chart and draw necessary conclusions from them.

Every bank has an NPA ratio which analyses the percentage of bad loans in a bank's portfolio. With a high loan default rate, it is one of the most essential ratios in assessing the bank's economic condition. A low NPA ratio is considered to be optimum for a bank. We have analyzed this data to check if the banks are operating within a suitable NPA limit.

Here, we are dealing with 21 banks which constitutes to number of samples. In each bank, we have observed the number of NPA's per Loans Advanced, which in other words can be put as number of bad loans per each bank, where Loans Advanced is not constant for each bank. This makes a u-chart most appropriate in this case.

3.1 METHODS & TOOLS

When quality characteristics are non-measurable then we use attribute charts:
(1) When the attributes can be classified as defective or non-defective (Yes/No or 1/0) basis.
(2) These charts controls the process location and variation with the time in a single chart. The family of attribute charts include (i) p-chart, (ii) np or d chart, (iii) c-chart and

(iv) u-chart.

(1) p-chart

The p-chart is used to control the proportion of non-conforming units in a sample, where the sample proportion (p) is defined as the ratio of the number of non-conforming units to the sample size. The p-chart only accommodates "pass"/"fail"-type inspection.

Control Limits:

$$UCL = \bar{p} + 3\sqrt{\left(\frac{\bar{p}(1-\bar{p})}{n_i}\right)}$$

$$CL = \bar{p} = \frac{\sum p_i}{\sum n_i}$$

$$LCL = \bar{p} - 3\sqrt{\left(\frac{\bar{p}(1-\bar{p})}{n_i}\right)}$$

(2) np/d chart

An np-chart is a control chart used with data collected in subgroups that are the same size. np-charts show how the process, measured by the number of nonconforming items it produces, changes with time. It isused to monitor the **count** of nonconforming units in fixed samples of size.

Assumptions under *np* and *d* charts: The binomial distribution is the basis for the p and d charts and requires the following assumptions:

- The probability of non-conforming items is the same for each unit.
- Each and every unit should be independent.
- The sampling inspection procedure should be constant for each sample.

Interpretations of *p* and *d* charts
1. If all the sample points fall between control limits without breaking regular pattern, the process is called as statistically under control.
2. If some points above the upper limit are represent a case showing deterioration in the process quality so the cause could be identified & removed.
3. If some points below the lower limit are represent a case showing improvement in the manufacturing quality.

(3) c-chart

The c-chart is applicable to the number of defects per unit. Sample size for c-chart may be a single unit like a laptop, or a group of units or it may be a unit of fixed time, length,

area etc. However, a defined sample size should be fixed in the meaning that different samples have essentially equal opportunity for the occurrence of defects.

For example, in case of casting defects a single part (such as base plate or side cover) is the sample size. Control limits for each sample point is same for this chart.

(4) u-chart

The u-chart differs from the c-chart in that it accounts for the possibility that the number or size of inspection units for which non-conformities are to be counted may vary. Examples where u-chart is used may be (i) monitoring the number of new infections in a hospital per day, (ii) monitoring the number of accidents for delivery trucks per day etc. Control limits for each sample point vary.

Control Limits:

$$UCL = \bar{u} + 3\sqrt{\bar{u}/n_i}$$

$$CL = \bar{u} = \sum u_i \Big/ \sum n_i$$

$$u_i = \frac{c_i}{n_i}$$

$$LCL = \bar{u} - 3\sqrt{\bar{u}/n_i}$$

Assumptions under *c* and *u* charts

We use Poisson distribution in this caseand we need some of the following assumptions:

- The number of opportunities or potential locations for nonconformities is very large.
- The probability of nonconforming items is very small and unchanged.
- The sampling inspection procedure is same for every sample.

Interpretations of *c* and *u* charts

1. If all the sample points fall between control limits without breaking regular pattern, the process is called as statistically under control.
2. If some sample points fall outside the control limits (above UCL or below LCL), the process is called statistically out of control.

4.DATA ANALYSIS
(1) INSURANCE INDUSTRY

We have considered Fire Insurance data of *Net Premium Earned* and *Net Insurance Claimed* of Bajaj Allianz from 2002-17.The proportion of insurance claims of each year is given in the table below:

Year	Net Premium Earned (A) (in '000s)	Net Insurance Claimed (B) (in '000s)	p = B/A (Series 1)
2002	10297236	6799371	0.660310301
2003	97454664	27577554	0.282978288
2004	264077883	60570935	0.229367694
2005	526446453	254638005	0.483692128
2006	739934	576907	0.779673593
2007	938215	500871	0.533855246
2008	1225617	497593	0.405993879
2009	1158796	726326	0.626793672
2010	1184691	687735	0.580518464
2011	1131396	619514	0.547566016
2012	1302095	626519	0.481162281
2013	1334994	332863	0.249336701
2014	1446481	450603	0.311516708
2015	1466249	936574	0.638755082
2016	1658503	1112508	0.670790466
2017	1763868	550326	0.311999537

Column 'p' in the above table shows the proportion of claims. Based on this data, a **p-chart** is obtained:
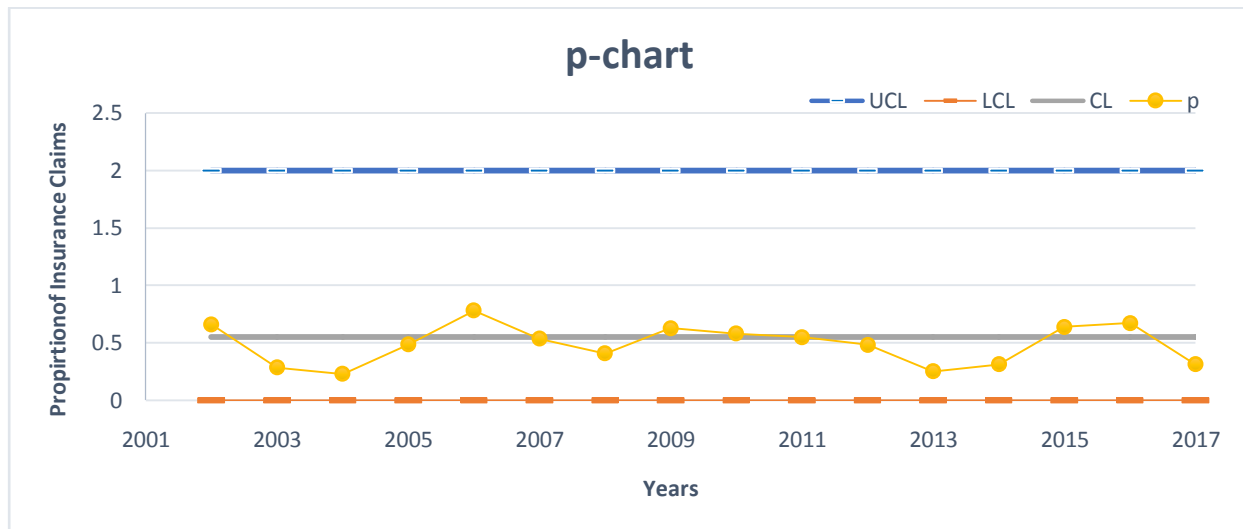
The control limits are calculated to be:

Upper Control Limit (U.C.L.)= 2.001780309

Central Line (C.L.) = 0.50178992

Lower Control Limit (L.C.L.) = 0

INFERENCE:

The variation being examined is the variation in the percentage of fire insurance claimed year by year. This means that the process is consistent and predictable and does not amount to any unaccounted scenarios for the company. On average, we see that 50.2% of the insurance money is claimed. It can be as high as 78% or as low as 23%, the process is in statistical control.

(2) BANKING INDUSTRY

Here we have collected the Gross NPA data and loans advanced for a sample of 21 banks in India. The values for both are in Rs. Crore. The control limits that is the upper control and lower control limits are different for each sample and are calculated with the help of $\bar{u}$ which takes a value of Rs. 0.0686.The value of u_i for every bank signifies that out of every 1 rupee that it lends out to people how much is bank never going to recover from it.

The average value $\bar{u}$ being Rs. 0.0686 means that a bank lending 1 rupee will on average incur a loss of approximately 6 paise on it. After plotting u_i receive the following chart.

S.no.	Bank Name	Gross NPA (c_i)	Loans Advanced (n_i)	$u_i = c_i/n_i$	UCL	LCL
1	Indian Bank	54707.72	758848.9609	0.0721	0.0695	0.0677
2	Bandhan Bank	992.78	67079.7297	0.0148	0.0716	0.0655
3	RBL Bank	2136.52	59019.8895	0.0362	0.0718	0.0653
4	IDFC First Bank	2136.04	87902.8807	0.0243	0.0712	0.0659
5	Jammu and Kashmir Bank	6221.35	69357.3021	0.0897	0.0715	0.0656
6	Canara Bank	153979.44	1777781.9583	0.0866	0.0692	0.0680
7	CSB Bank	352.63	10951.2422	0.0322	0.0761	0.0611
8	Punjab National Bank	312007.28	1920161.7737	0.1625	0.0691	0.0680
9	Bank of Baroda	261055.37	2563920.5684	0.1018	0.0691	0.0681
10	Vijaya Bank	30801.86	502676.0442	0.0613	0.0697	0.0675
11	City Union Bank	977.05	33120.3390	0.0295	0.0729	0.0642
12	State Bank of India	172750.36	2294161.4874	0.0753	0.0691	0.0680
13	HDFC Bank	12649.97	1003965.8730	0.0126	0.0693	0.0678
14	Axis Bank	30233.82	622095.0617	0.0486	0.0696	0.0676
15	ICICI Bank	41409.16	748809.4033	0.0553	0.0695	0.0677
16	Kotak Mahindra Bank	5026.89	223417.3333	0.0225	0.0702	0.0669

17	IndusInd Bank	5146.74	257337.0000	0.0200	0.0701	0.0670
18	Yes Bank	7882.56	244800.0000	0.0322	0.0701	0.0670
19	Bank of India	60661.12	382961.6162	0.1584	0.0698	0.0673
20	IDBI Bank	50027.94	182118.4565	0.2747	0.0704	0.0667
21	Federal Bank	3260.68	111667.1233	0.0292	0.0709	0.0662

u-chart
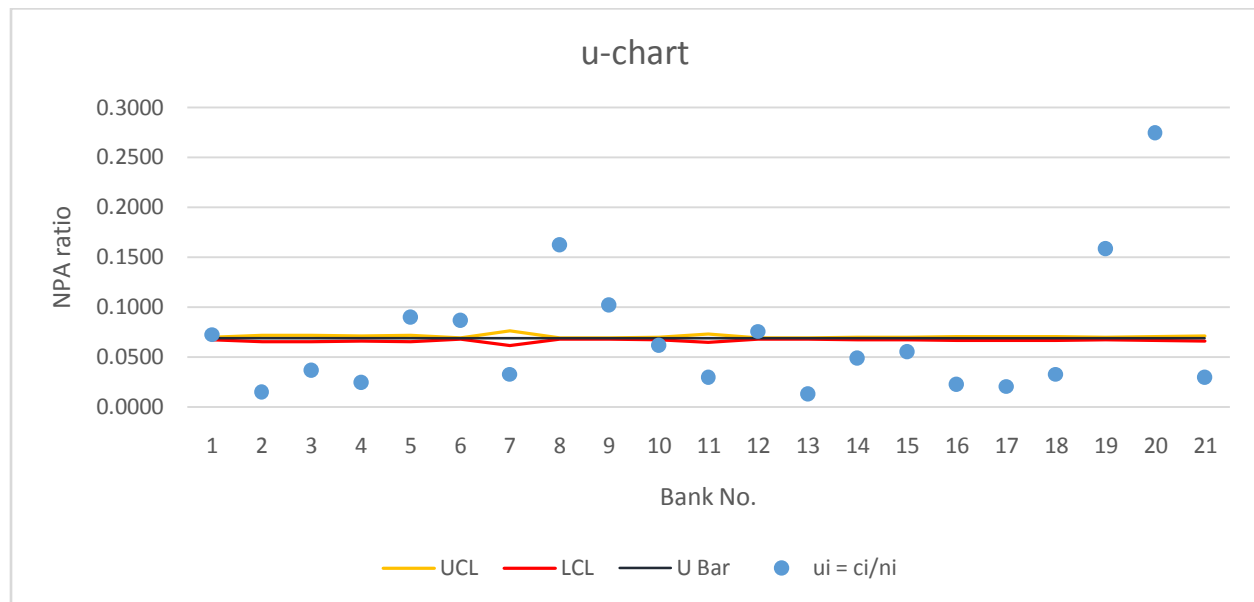
INFERENCE

Here, we can see that the process is 100% out of control. In the scatter plot we can see that most ofthe points are lying below the lower limit while a handful of them lie above the upper control limit.The points lying above shows that banks are operating at a much higher NPA limit than therecommended. But, here even if the process is out of control it does not mean all bad for the banks.The banks which lie below the lower control limit although may seem out of control yetmathematically mean that those banks have a lower NPA limit which is the prime goal of banks.

5. CONCLUSION

(1) Insurance Industry: Case of Bajaj Allianz

The variation being examined is the variation in the percentage of fire insurance claimed year byyear. This means that the process is consistent and predictable and does not amount to

anyunaccounted scenarios for the company. On average, we see that 50.2% of the insurance money isclaimed. It can be as high as 78% or as low as 23%, the process is in statistical control. Thus, theprocess is under control and it is clear since Bajaj being a major private player ensures that itsfunctions are within the optimum limits.

Now even though Bajaj is in control of its process but some major year to year changes were seenand to counter that and to ensure sustained control of process, an insurance company like Bajaj canundertake some measures:

- Minimize the number of missed recovery cases by better recognition of claims information.
- Detect all cases to be recovered earlier in the process through automation which willincrease the chance of recovery.
- Reducing investigation time and costs by analyzing rules and alerts to enable investigators toprioritize and triage potential recovery opportunities.

(2) Banking Industry: Case of NPA in Banks

Now, in case of data for banking sector it was pretty clear that the process is out of control. Yet,on closer look of the data we came across that is was actually a case where most banks wereoperatingunder lower control limits and only 8 banks above the upper control limits. The primaryreason for such differences lies in the management of the banks.

It was seen that most of our banks which were under LCL were **private banks** in India whilethoseabove the UCL constituted as the **public sector banks**. The results hence make a completesense since the private banks are strict and their policies stringent while giving out loans whichreduces the chances of bad loans for them. Such is not the case for PSB's which are often seencareless while giving out loans and have NPA ratios on a very higher side. Hence, we can drawconclusion that private sector banks are performing better than Public sector banks.This process can be controlled by banks through some ways mentioned below:

- Through 'Insolvency and Bankruptcy Code (IBC)', 2016 banks are either reviving the companiesor liquidating them to solve NPAs issue.
- The immediate solution is to sell NPA's. From April 2017, banks are selling more NPAs.
- Banks should thoroughly inspect the company they are giving loans to. Loans to bad companies will lead to lack of money for good investments.
- It's better to display the defaulters' name list publicly. This will cause fear and acts as a deterrent.
- After granting loan, banks should observe the capacity of the company continuously and should beable to assess whether it is about to bankrupt. In this way, banks can sell theassets before the loansbecome NPA.

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