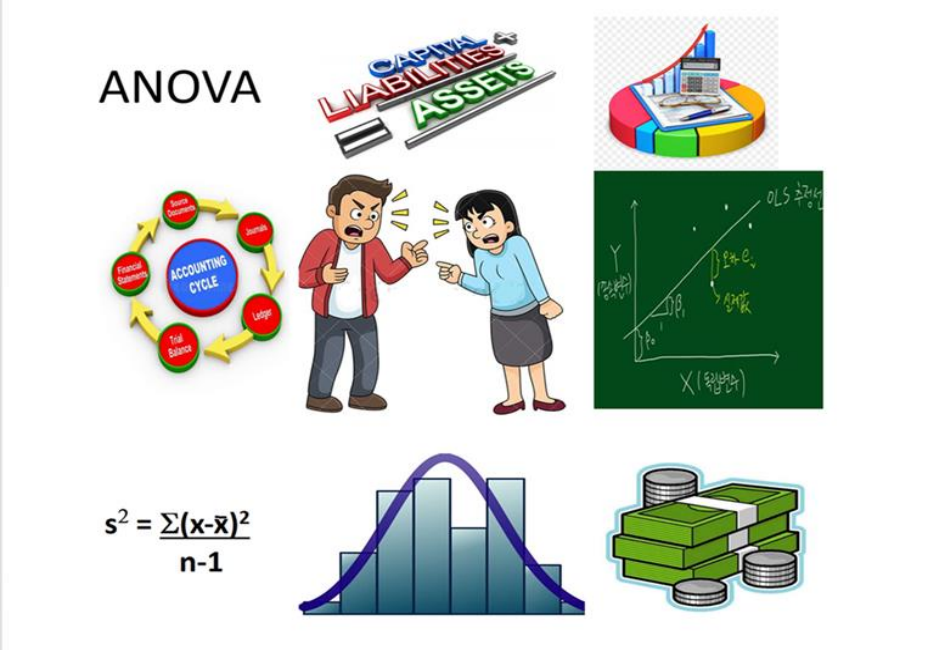
THE ACCOUNTANT/STATISTICIAN PARTNERSHIP

For over 25 years Auditmetrics preformed services as a third-party administrator for Taft-Hartley self-insured health benefits for vision, pharmacy and dental benefits. It set up the claims adjudication procedures including plan consumer explanation of benefits, statistical actuarial assessments and plan management reports. It also developed software resources for public health and health policy development.

IN THE BEGINNING PATH TO AI ANALYTICS STARTED WITH ACCOUNTANTS VS STATISTICIANS

THE DRIVING ENERGY FOR THE AI APPROACH

- ***Massachusetts Rate Setting Commission*** mandate: prospective budgeting of hospitals and other healthcare facilities.
- This required a periodic audit of the health facility by a statistician/ accountant team.
- Unfortunately both numbers people could not agree on a unified analytic frame work.
- Based on Auditmetrics founder Joseph Boffa's past work with accountants and actuaries evaluating health benefits and as a third party administrator (TPA), he was asked by the commissioners to present a seminar covering both disciplines.



ACCOUNTANT/STATISTICIAN PARTNERSHIP TEST

- It occurred when the Commonwealth was being sued by the home healthcare industry.
- Dr. Boffa was informed that he had to attend a pre-trial conference because the plaintiff group included a statistician.
- Home healthcare agencies provide health services for elderly in their home but the industry was suffering from a nurses shortage.
- The law suit was because of the Rate Setting Commission's elimination of a temporary stop gap to shore up the tremendous increase in overtime pay and to provide a sign on bonus for new hires.
- Payrolls are subject to negotiations and not readily changed so in the short term 15% of direct labor costs was added to fixed overhead costs which is not standard allocation since it is double counting.
- The nursing shortage was eventually solved by the Commonwealth increasing funding for nursing programs and an increase of immigrant nurses with green cards.

PRE-TRIAL CONFERENCE

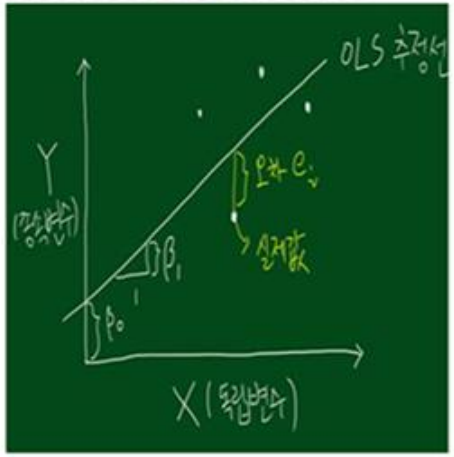
- At the pre-trial conference the plaintiff statistician did present some interesting past research with elderly but it had nothing to do with the issue of removing the temporary added allocation to fixed overhead.
- The discovery conference became heated with the industry side stating "the reduction of funding to the agencies would cause increased deaths of the elderly".
- A small percentage of federal cases, criminal or civil, actually go through the entire trial process. Many parties look to settle their differences during the "pretrial" phase of the process.
- The plaintiffs were not in a mood to come to a settlement.

JUDGES DECISION

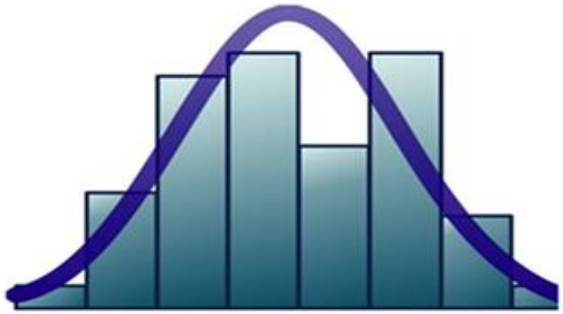
- At the trial the judge stated there would be a pause as she reviewed the process to date. She wanted to do a review before proceeding with the "Battle of Statisticians".
- In the interim Dr. Boffa planned to determine available agency account data to link statistical account data with outcome data such as patient visits, medical procedures performed and health outcome measures.
- The judge eventually dismissed the case since the Commonwealth followed the public open hearing process in announcing both the temporary added allocation and the subsequent suspension of what was clearly originally defined as a temporary allocation.

NEW STATISTICIAN/ACCOUNTANT PARTNERSHIP

ANOVA



$$s^2 = \frac{\Sigma(x-\bar{x})^2}{n-1}$$



STATISTICIAN/ACCOUNTANT PART 2

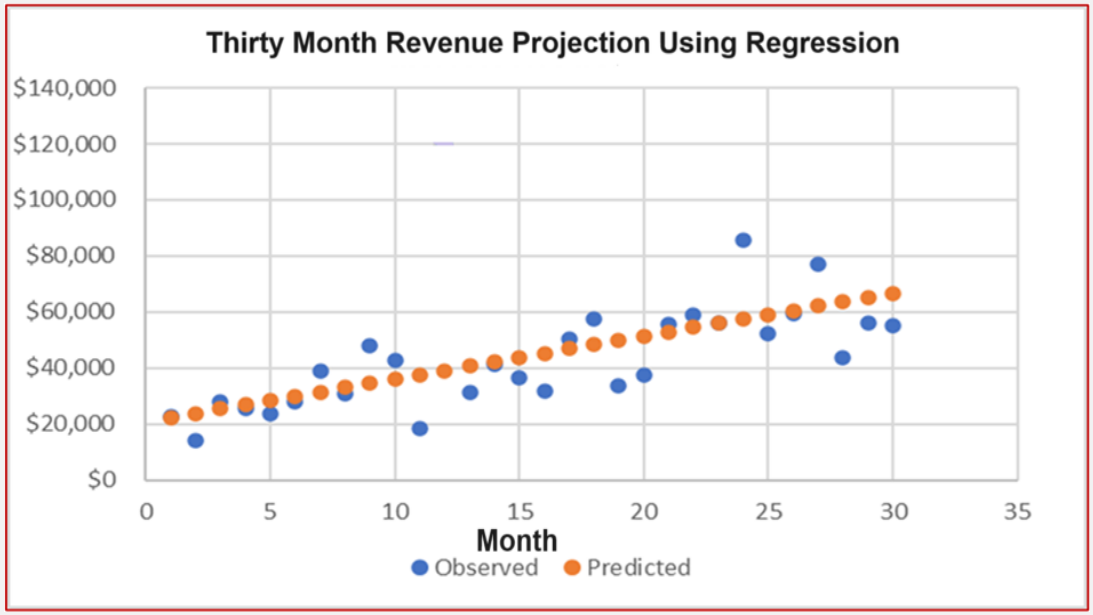
- When Massachusetts decided to get out of the rate setting business it converted the Rate Setting Commission into the Division of Healthcare Finance and Policy. Its new mission is to critically examine the Massachusetts healthcare delivery system to provide objective information, develop and recommend policies and implement strategies that benefit the people of the Commonwealth.
- Dr. Boffa's role was to conduct econometric analysis of the Massachusetts healthcare delivery system during the time of the Massachusetts Healthcare Reform movement which later became the basis of the Affordable Care Act of the U.S. Federal Government.
- He later was asked by a former Rate Setting Commission director to help him implement a Massachusetts Department of Revenue mandate to get sales tax auditors up to speed in implementing the Computer Assisted Audit Techniques(CAATs) program.

PARTNERING WITH ACCOUNTANTS AGAIN

- The CAATs program involves regular intervals of statistical audits.
- This time his experience has taught him the approach was not to start with lectures on statistical theory.
- He decided to modify the software developed for health plan analysis to specifically help auditors quicky obtain a random sample that can be immediately used for an audit.
- That was the start of the current Auditmetrics statistical audit software.
- Though many auditors resisted change, eventually it became clear the time to complete an audit was reduced by at least 50%.
- It turned out that the sales tax audit was also very useful in monitoring cashflow.

CONVERTING SAMPLE DATA FOR FORECASTING CASHFLOW

amount	absamt	TxDate	DataSet	Year	Month	Quarter	MonthCount	MonthTotal
-920	920	1/31/2019	Acme Inc.	2019	1	1	1	$18,407
2107.99	2107.99	2/12/2019	Acme Inc.	2019	2	1	2	$17,408
2000	2000	3/22/2019	Acme Inc.	2019	3	1	3	$21,489
2047.9	2047.9	4/19/2019	Acme Inc.	2019	4	2	4	$24,240
2045.04	2045.04	5/13/2019	Acme Inc.	2019	5	2	5	$22,940
"	"	"	"	"	"	"	"	"
2400	2400	8/13/2019	Acme Inc.	2019	8	3	8	$29,100
2302.84	2302.84	2/9/2021	Acme Inc.	2021	2	1	26	$66,982
2381.32	2381.32	3/26/2021	Acme Inc.	2021	3	1	27	$65,610
2250	2250	4/7/2021	Acme Inc.	2021	4	2	28	$35,279
2403.32	2403.32	5/21/2021	Acme Inc.	2021	5	2	29	$52,524
2229	2229	6/19/2021	Acme Inc.	2021	6	2	30	$54,450



REGRESSION PREDICTION MODEL USING EXCEL

Springer Book - Pages 60 to 67 and 106 to 111

Linear Model Y – a + bX+ error ($S^2_{y.x}$)

REGRESSION SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.70
R Square	0.49
Standard Er	13022
Observatior	30

1. Two and a half years of sales data
2. Sample Size n =1,158
3. Derived from an account of over 22,000 records
4. Montly Sales = $19,056 + $1,439 x MonthCount

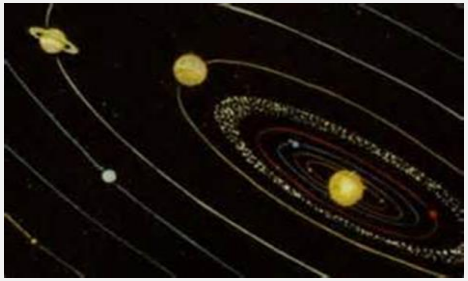
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4652827901	4652827901	27.4	0.0000
Residual	28	4747670722	169559669		
Total	29	9400498623			

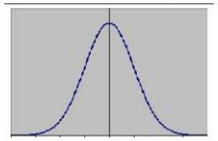
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	19056	4876.2	3.91	0.00054
MonthCoun	1439	274.7	5.24	0.00001

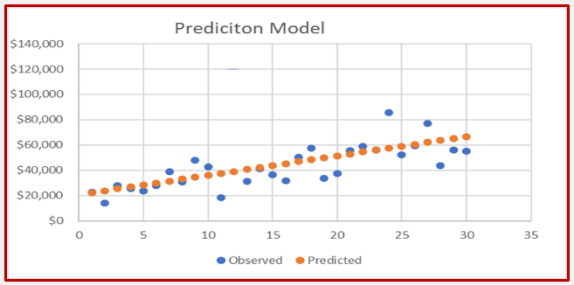
MATHEMATICAL HISTORICAL PERSPECTIVE

Carl Friedrich Gauss



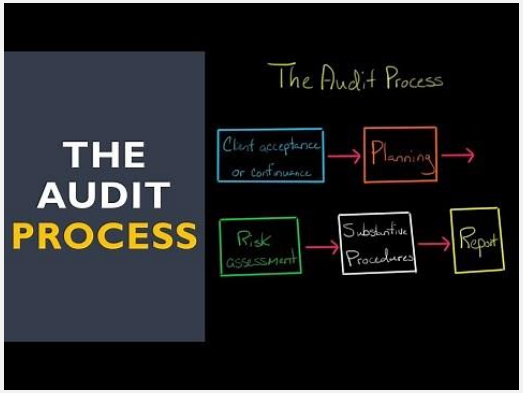
$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



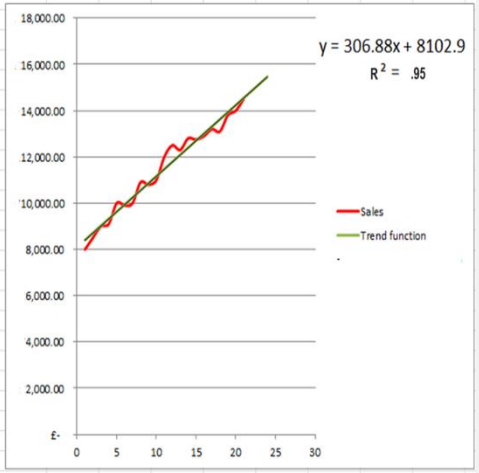


- In 1801 a new heavenly body had been discovered in the asteroid belt and no one could predict its orbit.
- In the end, only one man could, the 24-year-old Karl Friedrich Gauss, who invented a new method of calculating orbits.
- He used two mathematical constructs, the normal curve also referred to as the gaussian curve and the method of least squares also known as regression which he invented.
- Gauss may not have been the mathematician to invent the normal curve but he made it famous when he was the only one who could predict the orbit of the dwarf planet Ceres.
- There's no shortage of applications for these mathematical techniques including stock market fluctuations, human heights, consumer preferences, IQ, drug effectiveness and for our purpose **projecting cashflow and conducting market research.**

FROM AUDIT TO FORECAST



Period	Year	Months	Sales	Trend function	Equation
1	2012	January	8,000.00	8409.74026	8409.78
2	2012	February	8,500.00	8716.623377	8716.66
3	2012	March	9,000.00	9023.506494	9023.54
4	2012	April	9,100.00	9330.38961	9330.42
5	2012	May	10,000.00	9637.272727	9637.3
6	2012	June	9,900.00	9944.155844	9944.18
7	2012	July	10,000.00	10251.03896	10251.06
8	2012	August	10,900.00	10557.92208	10557.94
9	2012	September	10,800.00	10864.80519	10864.82
10	2012	October	11,000.00	11171.68831	11171.7
11	2012	November	12,000.00	11478.57143	11478.58
12	2012	December	12,500.00	11785.45455	11785.46
13	2013	January	12,300.00	12092.33766	12092.34
14	2013	February	12,800.00	12399.22078	12399.22
15	2013	March	12,750.00	12706.1039	12706.1
16	2013	April	12,900.00	13012.98701	13012.98
17	2013	May	13,200.00	13319.87013	13319.86
18	2013	June	13,100.00	13626.75325	13626.74
19	2013	July	13,800.00	13933.63636	13933.62
20	2013	August	14,000.00	14240.51948	14240.5
21	2013	September	14,500.00	14547.4026	14547.38
22	2013	October		14854.28571	14854.26
23	2013	November		15161.16883	15161.14
24	2013	December		15468.05195	15468.02



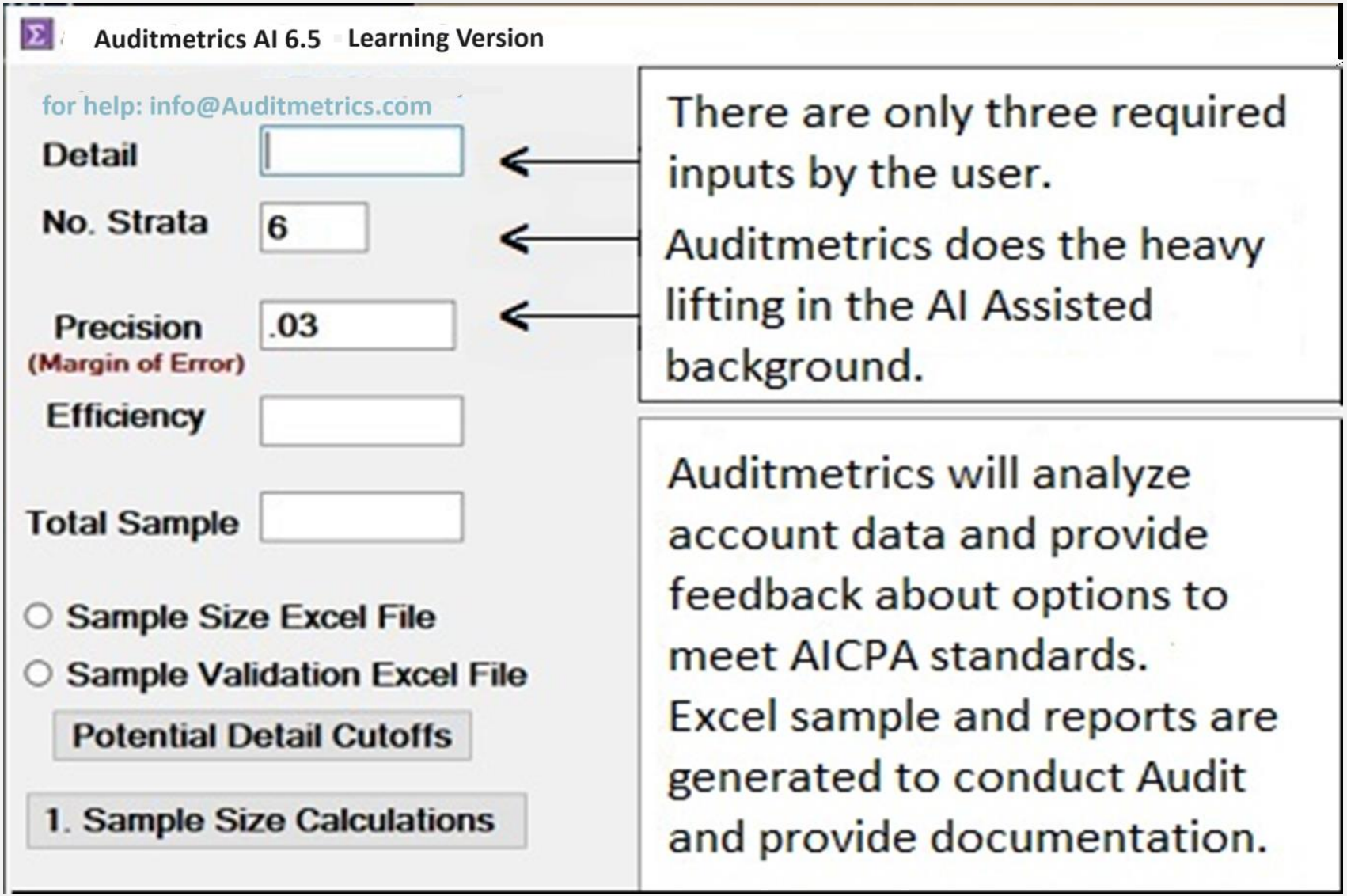
- The audit was first conducted to assure the quality of the business account data.
- The data conversion from audit to regression uncovered a healthy growth rate.
- Projections for the next quarter can be compared to what actually unfolds.
- Any significant deviation from the trend should be carefully investigated
- This basic model can be augmented with other data to analyze customer satisfaction and conduct market research.
- One cannot do this broad systematic analysis without also being closely connected to the personnel and operations of the business.

MULTIPLE REGRESSION FOR QUARTERLY ADJUSTMENT

Springer Book Pages 60 -66 creating quarterly input variables

DataSet	Year	Month	Quarter	MonthCount	Q1	Q2	Q3	MonthTotal
Ace Co.	2019	1	1	1	1	0	0	$18,407
Ace Co.	2019	2	1	2	1	0	0	$17,408
Ace Co.	2019	3	1	3	1	0	0	$21,489
Ace Co.	2019	4	2	4	0	1	0	$24,240
Ace Co.	2019	5	2	5	0	1	0	$22,940
Ace Co.	2019	6	2	6	0	1	0	$30,584
Ace Co.	2019	7	3	7	0	0	1	$29,298
Ace Co.	2019	8	3	8	0	0	1	$29,100
"	"	"	"	"	"	"	"	"

GETTING STARTED WITH AUDITMETRICS®



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