

# Actuarial Economic Forecasting

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# Introduction/Background

- Actuarial Economic Forecasting
  - “Actuarial Economics”
  - Applying actuarial theory and techniques to economic forecasting
- An original piece of research
  - No reference to anything like it in academic journals



# Background

- Based on intellectual property developed by Paragon Research Ltd



- Reselling agreement with Rosenblatt Securities

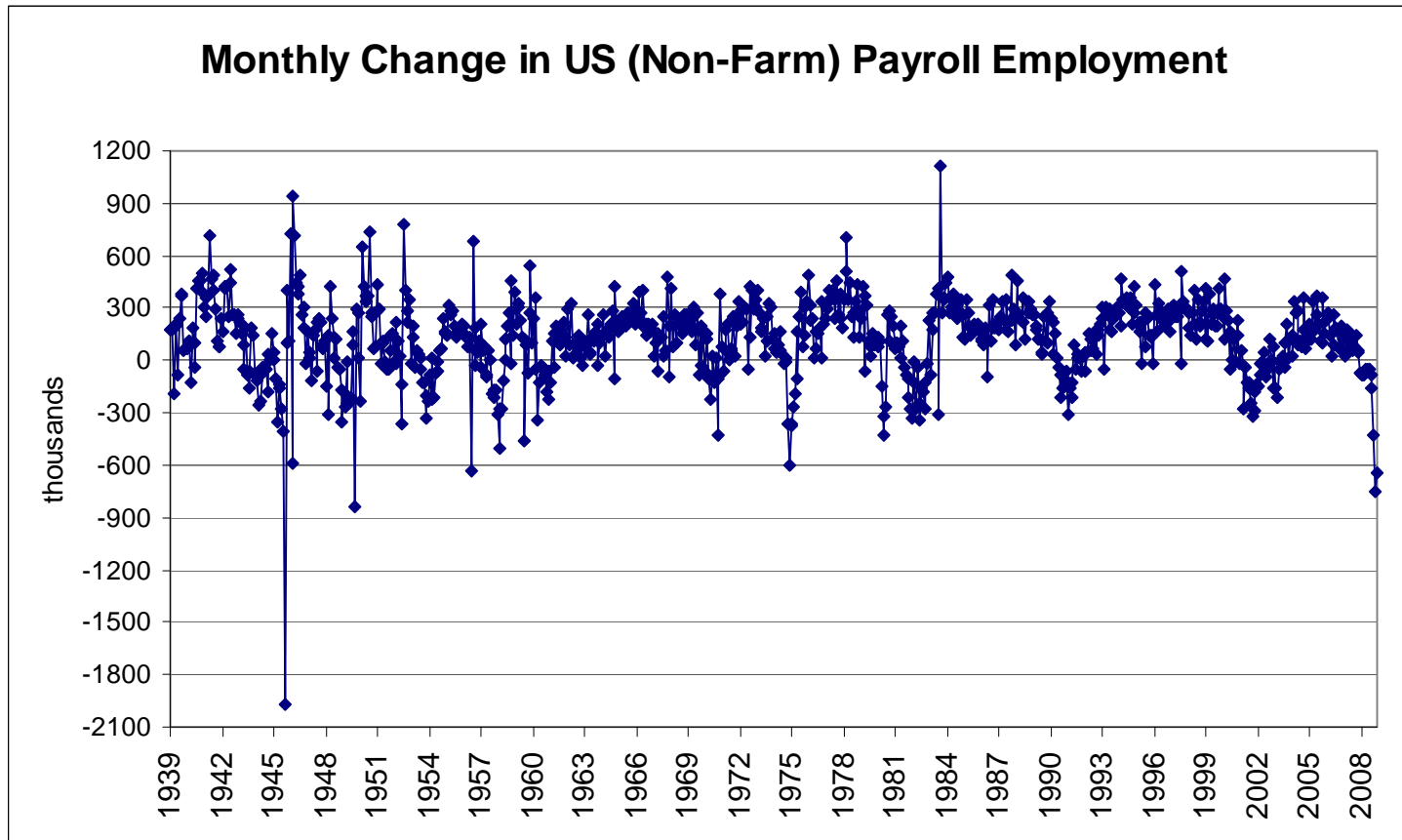


# Background

- Today's presentation
  - Forecasting the outcome of the US Employment Report using Actuarial Economic Forecasting - the Paragon US Payrolls Indicator.
- The US Employment Report is released on the first Friday of each month. It gives the net number of new jobs created in the US during the previous month, the unemployment rate, and any revisions to previous months data.
- This Indicator is part of a series of indicators
  - The Paragon US Consumer Confidence Indicator
  - The Paragon US Manufacturing Indicator
  - The Paragon US Retail Sales Indicator
  - All are based on the same methodologies



# Statistics Background



# Statistics Background

- Monthly change in US employment:
  - Average change approx +120,000
  - Standard deviation approx +230,000 (quite high)
- 120,000 represents only about a 0.1% change in employment.
- Volatile data series - (nobody has a good track record for estimating it)
- Estimation versus consensus estimates even more difficult !!!
  - (markets generally move significantly depending on whether the data was stronger or weaker versus the average consensus estimate among economists)
- General opinion is that the release of the figure is a lottery as to whether it will be higher or lower than the consensus estimate



# Economists Estimates

## Economists Estimates

- Generally an economist would have his/her overall subjective viewpoint in mind as to whether the economy is doing better or worse than the consensus viewpoint.
- Most assume that predicting the employment figure is a lottery – so most don't stick their necks out. Some use the 'on one hand, on the other hand' approach. Cynical view.
- Those that make an estimate would start with their overall viewpoint on the economy (so not to be inconsistent with clients or their bosses). They would take other indicators into account to varying degrees based on their own subjective methodologies.
- Some use econometric techniques to some extent (but this is quite rare in practice).
- There are no economists with good track records for predicting the outcome of the employment report



# Examples

## **HSBC Payrolls Model** (probably the most complicated model I've seen)

- 6 variables – ADP, Initial Jobless Claims, Jobs Hard To Get Index, Jobs Plentiful Index, ISM Employment Index, ISM Services Employment Index
- 7 OLS regressions - using no more than 3 of the above variables at a time. A combined average result from the 7 regressions is used as the estimate
- Based on data going back to 2001 (at the earliest)

### **Problems**

- 61 variables available.
- Data available for much longer periods.
- No adjustment made to the variables to make them correspond to the BLS survey period
- No adjustment for other biases in the input variables





# Examples

## Specific example

- *December 2006 – consensus estimate 100,000*
- *ADP – Minus 40,000*
- *Initial Jobless Claims – No major changes*
- *ISM Employment Indices – no major changes*
- *Consumer Confidence - improvement*
- *Monster index – significantly down*
- *Cont Claims – No major changes*
- *Rasmussen index – down slightly*
- *What estimate would u make?*
- *Outcome was.....*

+196,000



# Actuarial Mortality Investigation 1

**Example – estimating the mortality rate for a 31¼ year old in Actuaria**

## *Data Sources*

- National data - records all deaths in Actuaria
- Insurance policy data - records all deaths of life insurance policyholders in Actuaria
- Club data - records all deaths of club members of clubs in Actuaria



# Actuarial Mortality Investigation 2

## Example – estimating the mortality rate for a 31¼ year old male in Actuarial

*Data available as at 31 Dec 2008*

- National data
  - number of deaths of all males aged 31 in 2008 in Actuarial
  - number of males aged 31 in 2008 in Actuarial
- Insurance policy data
  - number of deaths of all male policyholders aged 31 in 2008 in Actuarial
  - number of male policyholders aged 31 in 2008 in Actuarial
- Club data
  - number of deaths of all male club members aged 31 in 2008 in Actuarial
  - number of male club members aged 31 in 2008 in Actuarial
- *Mortality Rate = # decrements / the number exposed to risk*



# Actuarial Mortality Investigation 3

**Example – estimating the mortality rate for a 31¼ year old male in Actuarial**

## *Results*

- National data = 0.000220
  - Insurance policy data = 0.000243
  - Club data = 0.000201
- 
- So what would u estimate the mortality rate to be?



# Actuarial Mortality Investigation 4

**Example – estimating the mortality rate for a  $31\frac{1}{4}$  year old male in Actuarial**

*Enter Actuarial Mathematics - what would an actuary do? (be more specific)*

***National data***

- Refers to males aged 31 at their last birthday – or on average males aged  $31\frac{1}{2}$

***Insurance data***

- Refers to males aged 31 at their last birthday on their last policy anniversary – or on average males aged 32 (average policy anniversary being 6 months ago when male was  $31\frac{1}{2}$ )

***Club data***

- Refers to males aged 31 at their nearest birthday – or on average males aged 31
- *Rate interval – the period of time over which a life retains the same age label in the investigation – i.e. the age to which the mortality rate refers*



# Actuarial Mortality Investigation 5

**Example – estimating the mortality rate for a 31¼ year old male in Actuarial**

*Mortality rate for a male aged 31.5 = 0.000220*

*Mortality rate for a male aged 31 = 0.000201*

*Also know that the rate from 31 to 31.5 increases by 0.000019, and from 31.5 to 32 it increases by 0.000023*

*So estimate rate for age 31.25 = 0.00021*



# Actuarial Mortality Investigation 6

**Example – estimating the mortality rate for a 31¼ year old male in Actuarial**

*Moral of the story*

*You need to work out more precisely the period to which the data refer*



# Actuarial Mortality Investigation 7

**Example – estimating the mortality rate for a 31¼ year old male in Actuarial**

*But that's not the end of the story either*

*The National Data refers to the overall population. The other data sources have varying degrees of Sampling Bias – or **Heterogeneity** in actuarial jargon*

*These other factors need to be adjusted for, e.g. sex, smoking habits, nature of employment, leisure activity, nutrition etc...*

*Data also need to be **Graduated** (actuarial jargon)..... But we'll leave our actuarial mortality investigation there for today..... now back to the Employment investigation...*





# Possible problems with Economists' estimates

- BLS Employment Survey is carried out on a specific week each month
  - Most (if not all) forecasters do not attempt to estimate these weekly fluctuations which can swamp more general movements in employment levels
- More General Problems
  - Not all indicators are taken into account  
(60+ available, rare for 10+ to get used)
  - Indicators are based on **heterogeneous** samples – like is not compared with like  
(One of the reasons why indicators are not used is that they are not considered to have predictive power – frequently this is because they have not been adjusted correctly for use)
  - Reliance on individual correlation coefficients vs maximum likelihood estimation
  - Not all the data available is taken into account
- Consequently we have
  - Non-credible, statistically insignificant, premature conclusions/results.



# Dealing with weekly fluctuations

Aim – To analyse each employment indicator to see

- 1) over which period (day/week) are the data collected (e.g. 2008 in Mort Investigation)
- 2) over which period (day/week) do the data refer (e.g. what age in the Mort Investigation)

Consequently we can make estimates as to the period of the month that each indicator is referring - and so estimate the weekly fluctuations in employment

- lots of employment indicators to use (surveys, jobless data, job advert data, share prices of employment companies)



# Employment indicators

<i>Indicator</i>	<i>Survey period</i>
<b>BLS</b>	<b>Week containing the 12<sup>th</sup> of the month</b>
ADP	Week containing the 12 <sup>th</sup> of the month (however the report contains biases, e.g. small firms)
ISM	Survey from week 1 to end of the month Average response date slightly after the BLS survey
Conference Board	Survey from 1 <sup>st</sup> of month – mean response after the BLS survey
Jobless claims	Initial jobless claims give one half of the picture Continued claims provide reasonable correspondence
Monster survey	Not seasonally adjusted
Share Prices	Other analyses used.



# Correlations vs Maximum Likelihood indicators

Another problem with traditional estimation processes for the US employment report is the reliance on correlation coefficients between the outcome of the report and the various indicators.

Piecemeal vs holistic

Does not allow for reconciliation of conflicting indicators



# Other problems / adjustments

*Seasonal adjustment (Heterogeneity in actuarial jargon)*

*Regional adjustment (Heterogeneity)*

*Other statistical adjustment / other sampling bias (Heterogeneity)*

*Reconciliation of conflicting indicators*

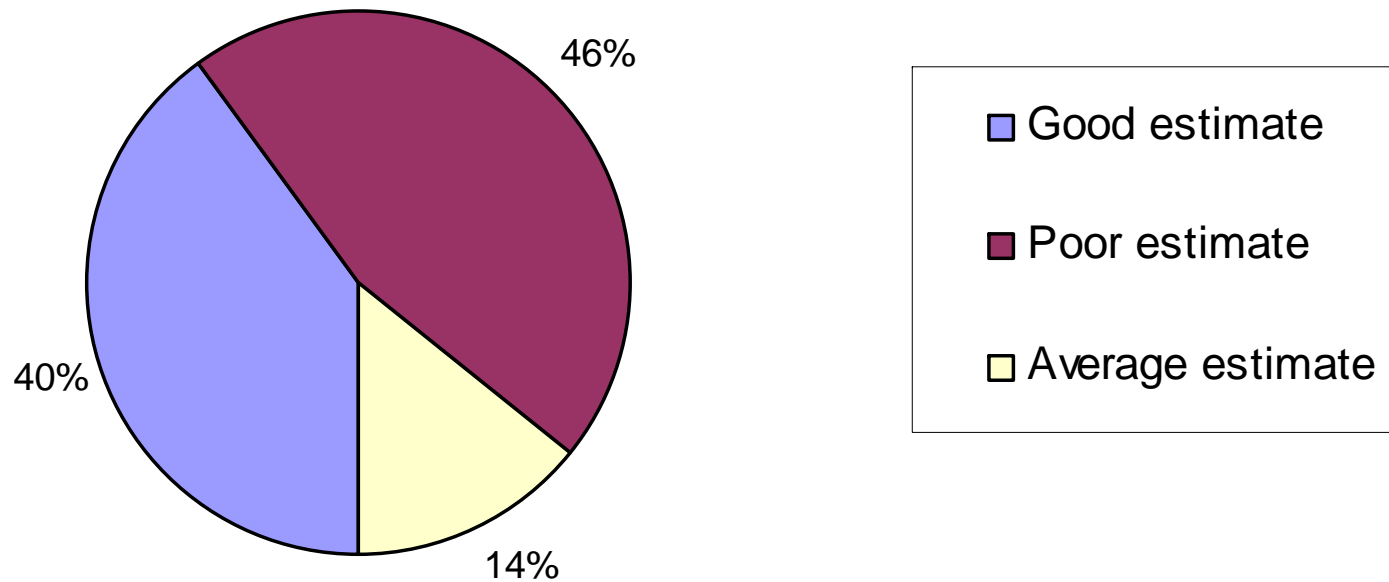
*Amalgamation (or Graduation in actuarial jargon)*

THE KEY IS TO EXTRACT WHATEVER RELEVANT STATISTICALLY CREDIBLE DATA IS AVAILABLE FROM EACH EMPLOYMENT INDICATOR



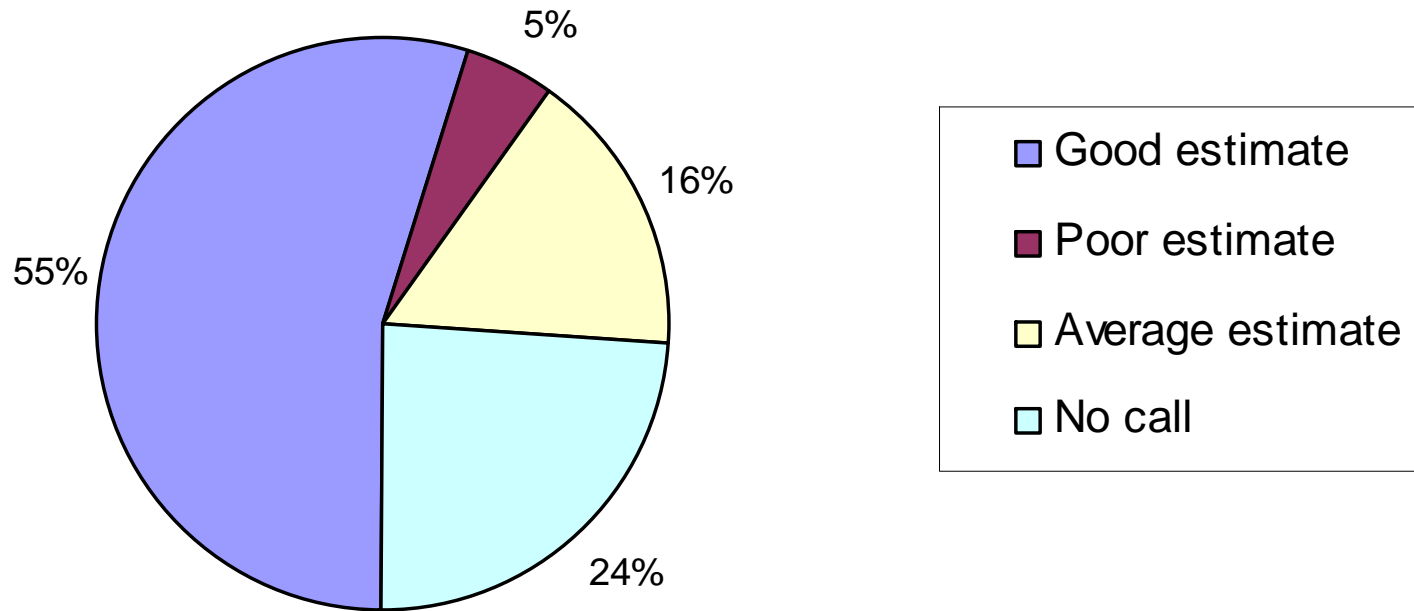
# Results

**ADP Performance Record - May 2006 to date**



# Results

**Paragon Payroll Indicator Performance - 2005 to date**



# Cyclical Positioning

- The analysis is not just a case of getting all the available data and stripping out and aggregating the statistically credible and significant information from the data.
- Also enables an analysis to assess the cyclical positioning of the economy
  - Inventory Correction
  - Growth spurt / slow patch
  - Pronounced growth spurt / slow patch
  - Cyclical upturn / downturn
  - Recovery / recession





# Cyclical Positioning

- Example
  - Stages in employment market cycle
    - Slowdowns in temporary hiring (start of 2007)
    - Falls in share prices of recruitment agencies (peaked in June/July)
    - Slowdown in hiring (Payrolls)
    - Broken down by cyclical/non-cyclical industry groupings
    - Beginning of firings (December – ADP vs Payrolls, big companies began firings!)
    - Broken down by size of company
  - When in one of the stages above, need to monitor likelihood of moving to the next one based on short term predictions of the likely economic prospects
  - By accessing all the components in the employment market this allows easier determination of the cyclical stage of the employment market



# Economic pulse / vital signs

- Another element to the analysis is that it enables an assessment of the underlying 'vitality' of the US Economy
  - Generally speaking the more 'vital' the economy, the better it will be able to withstand shocks
  - The vitality of the economy is probably the best predictor of how the economy will do over the next 6-9 months
  - Attempt to strip each economic indicator down to the core measure within it – combining these gives an assessment of the overall vitality of the US Economy



# Outlook

## Example - US Economic Outlook 1<sup>st</sup> Jan 2008

- Main call is that the employment market has begun to turn down (made over a month ago)
  - Sharp falls in a number of indicators around October/November signalled pronounced weakness
  - Large companies have begun to fire workers as of December, smaller ones may begin to do the same shortly
- Closely watching Non-Residential Construction
  - Leading indicators suggesting a possible slowdown/downturn
- Large manufacturers seem to be suffering, but still strength in smaller firms – but some preliminary signs of weakness here
- Consumer – confidence sharply deteriorated in October, then stabilised until end December - it has broken lower in the last few days – signals potential for further loss in vitality
- Stock Market – Bull Market Trend line in S&P currently being tested. Anecdotal evidence of profit margins feeling the pain of higher input costs. Earnings season will be closely watched



# Applications

- Central Banks
  - US Federal Reserve, Bank of England, ECB etc
- Banks / Investment Banks
- Traders
  
- Insurance Companies & Pension Funds
  - Financial & Economic Assumption setting



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