Under-reporting of Fire Starts

A REPORT FOR UNITED ENERGY

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Contents

Summary

Following the disastrous fires in February 2009, the Victorian Government introduced an 'f-factor scheme' to provide incentives for Distribution Network Service Providers to reduce the risk of fire starts and hence reduce the risk and damage caused by fire starts.

The Australian Energy Regulator has the responsibility of setting up and administering the 'f-factor scheme', which is designed to provide incentives for Distribution Network Service Providers to reduce the risk of fire starts and hence reduce the risk and damage caused by fire starts. The target number of fire starts, which forms the basis of the 'f-factor scheme' is based on an average over the last five years. For United Energy, the number of fire starts from 2006 to 2010 was 561.

There has been a concern expressed by the distributors that the number of fire starts recorded historically may be an underestimate, and hence the target may be unrealistically strict. The purpose of this report is to statistically estimate the number of unreported fire starts, using an application of a probability model for underreporting.

The probability model for underreporting has been applied to determine the (actual) total number of fire starts in the United Energy distribution region over the period from 2006 to 2010. The number of recorded fires is 561, but the estimated number has been determined to be 940, with a 95% confidence interval of 771 to 1369.

This result is lower than estimates obtained using Capture-Mark-recapture methods using the United Energy data on fire starts, in conjunction with other databases held by the Country Fire Authority (CFA), and the Metropolitan Fire Brigade (MFB). Both databases from the CFA and the MFB were filtered to ensure that only fire starts which are alleged to have been caused by electricity distribution equipment (and infrastructure) were considered. The results from the Capture-Mark-Recapture analysis will be documented and reported separately.

Declaration

I confirm that, in preparing this report, I have made all inquiries that I believe are desirable and appropriate and that no matters of significance that I regard as relevant have, to my knowledge, been witheld. I have been provided with a copy of the Federal Court's "Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia" and this report has been prepared in accordance with those Guidelines.

Introduction

Following the disastrous fires in February 2009, the Victorian Government introduced an 'f-factor scheme' to provide incentives for Distribution Network Service Providers to reduce the risk of fire starts and hence reduce the risk and damage caused by fire starts.

The Australian Energy Regulator has the responsibility of setting up and administering the scheme. For 2012 to 2015, providers will be rewarded or penalised at a rate of $25,000 for differences in the number of fire starts compared to their target f-factor.

The target number of fire starts is based on an average over the last five years. For United Energy, the number of fire starts from 2006 to 2010 was 561.

There has been a concern expressed by the distributors that the number of fire starts recorded historically may be an underestimate, and hence the target may be unrealistically strict.[1] The purpose of this report is to statistically estimate the number of unreported fire starts, using an application of a probability model for underreporting.

Datasets

In the report I used the following datasets:

- F-Factor -Final Resubmit 200911.xls provided by United Energy.
- Monthly maximum temperature at Moorabbin Airport, from the Bureau of Meterology website `http://www.bom.gov.au/climate/data/`.
- Monthly total rainfall at Moorabbin Airport, from the Bureau of Meterology website `http://www.bom.gov.au/climate/data/`.

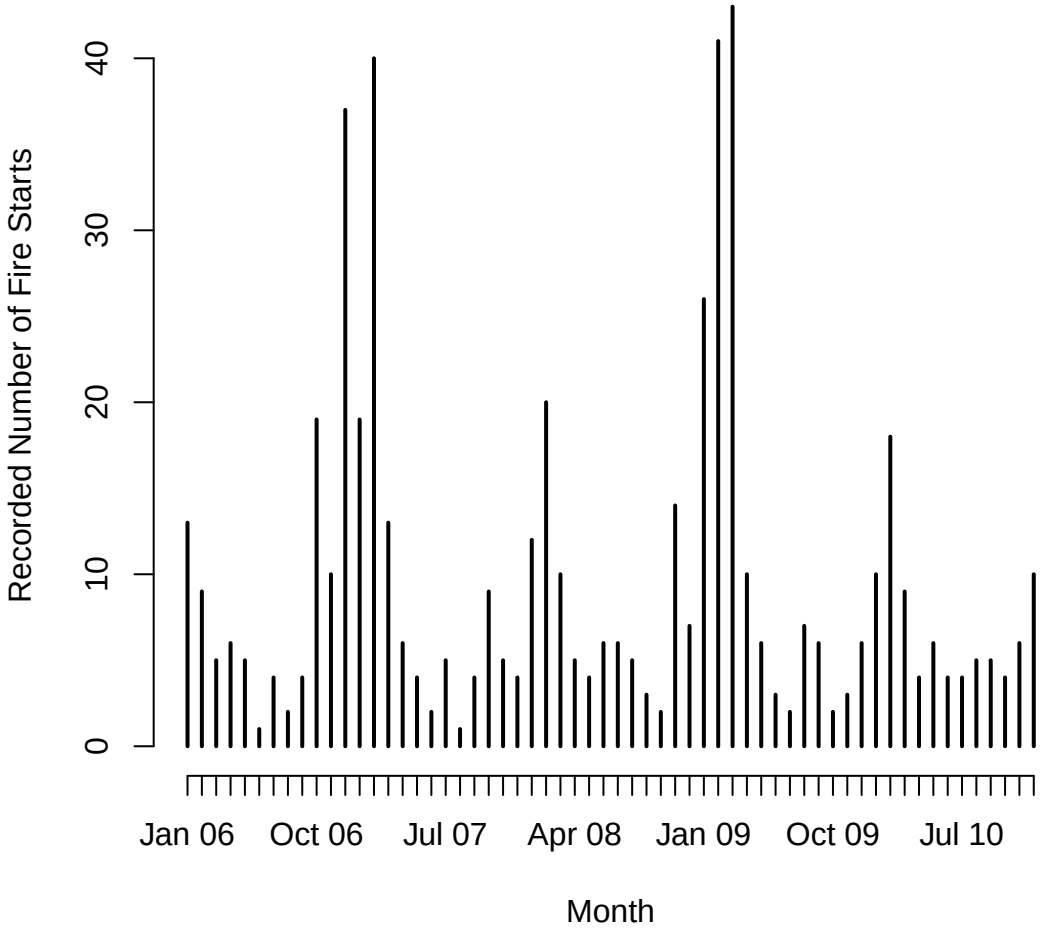
Application of Negative Binomial methods

A modelling approach can be used to estimate the number of fire starts, both recorded and unrecorded.

The model is given by Neubauer et al (2011). The model assumes that the number of firestarts per month that are reported follows a binomial distribution with a constant probability of a fire start being reported, π, but with a poisson distributed number of fire starts occuring where the mean of the poisson distribution is allowed to vary from month to month. In other words, it is assumed that the probability of a fire start being reported

[1] This concern has been acknowledged by the AER in its draft determination; see section 3.5.1.

Figure 1: Number of Recorded Fire Starts by Month



does not vary from one month to the next, but the number of fire starts per month does have a poisson probability distribution with the means of the poisson distributions themselves following a gamma distribution. Combining the distributions, the number of recorded firestarts follows a negative binomial distribution. Based on this model, the expected number

of actual firestarts is

$$\exp\{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\}\pi^{-1}(1-\pi)^{-1/2}$$

where $x_1, x_2, \ldots$ are explanatory variables. Maximum likelihood is used to estimate the β parameters and the probability of reporting a fire start π. The estimate of the number of fire starts, both recorded and unrecorded, is given by

$$\exp\{\hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \ldots\}\hat{\pi}^{-1}(1-\hat{\pi})^{-1/2}$$

Neubauer et al's model focuses on the overdispersion (the excess of the variance of the counts relative to the mean) of the counts, once the systematic effect of the explanatory variables is taken into account. Neubauer et al apply the method to bicycle theft data, and the same and similar models to shop lifting data.

The explanatory variables used were $x_1 =$ monthly maximum temperature and $x_2 =$ log(total rainfall in the previous month). Both variables were centered.

The model was fitted by maximum likelihood. The fitted model is given in Table 1. The model fits the data relatively well. It follows the obvious seasonal pattern, although it does not capture the large number of firestarts in December 2006 and February 2007. The estimated probability of a fire start being recorded was

$$\hat{\pi} = 1 - (1 - (1 - \exp(-.56)))^2 = 0.59$$

and the estimated total number of fire starts, recorded and unrecorded, per month is given by

$$2.64\exp(1.48 + 0.11(\text{Temperature}_t - 21.2) - 0.34\log((\text{Rainfall}_{t-1})/43))$$

giving an overall estimate of 940 over the period of 2006 to 2010. Figure 2 shows the number of recorded firestarts and in addition the estimate of the total of the unrecorded and recorded firestarts.

The estimated probability of reporting a fire start is a non-linear function of the first parameter in the model. Similarly, the estimated number of fire starts over the years 2006 to 2010 is a non-linear function of all the parameters in the model. However, Neubauer et al have empirically shown that the parameter estimates are approximately normally distributed and therefore it is possible to use the estimated parameters and their variance-covariance matrix to examine how precisely the estimated probability could be determined and to obtain an estimate of the total number of recorded and nonrecorded fire starts. This was done by simulating 1000 observations from a multivariate normal distribution with mean equal to the estimated parameters and variance-covariance matrix equal to the variance-covariance matrix of the parameter estimates. The estimated

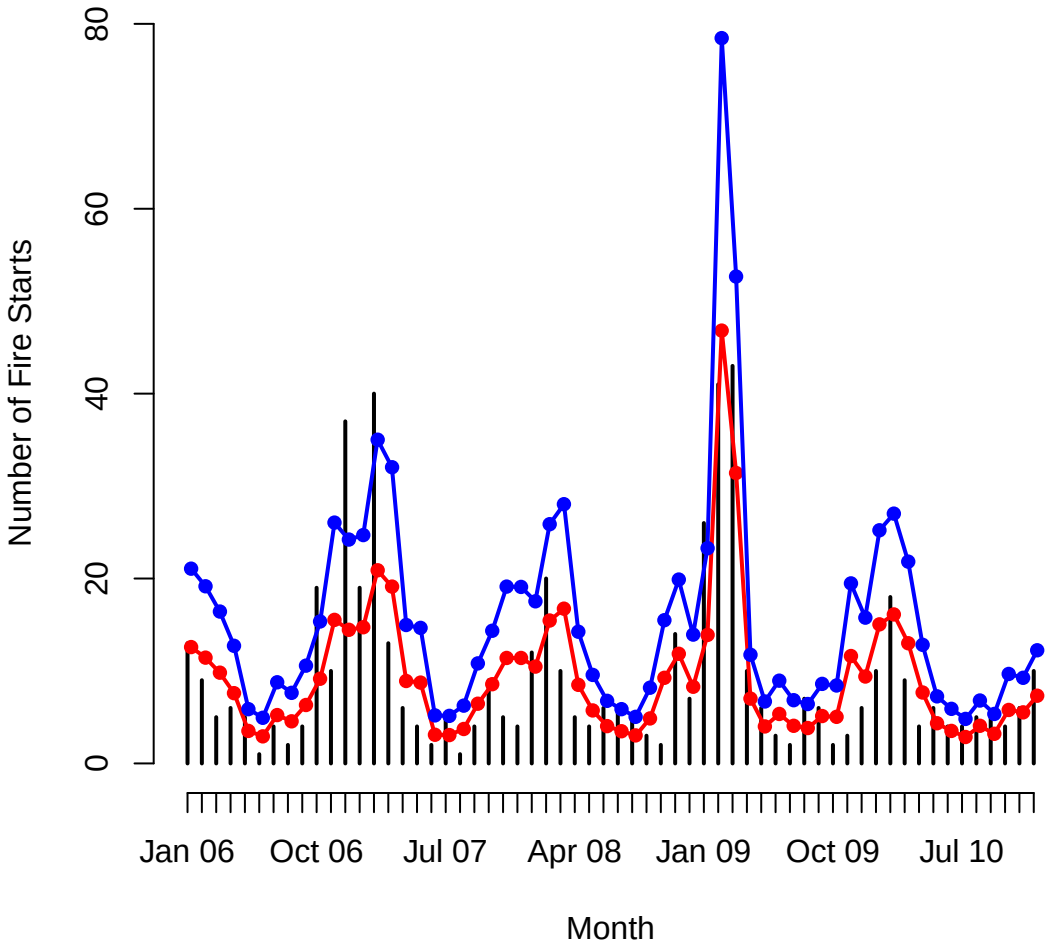
Table 1: Summary of the fitted negative binomial model. The first parameter refers to a transfomation of the reporting probability; the second is the intercept; the third is the temperature regression coefficient; the fourth is the logged and lagged rainfall regression coefficient.

```
--------------------------------------------
Maximum Likelihood estimation
Newton-Raphson maximisation, 6 iterations
Return code 1: gradient close to zero
Log-Likelihood: -167.1823
4  free parameters
Estimates:
      Estimate Std. error
[1,]  0.453977   0.102387
[2,]  1.481167   0.108112
[3,]  0.110620   0.016081
[4,] -0.337236   0.054588
     t value   Pr(> t)
[1,]  4.4339 9.254e-06 ***
[2,] 13.7002 < 2.2e-16 ***
[3,]  6.8789 6.033e-12 ***
[4,] -6.1779 6.496e-10 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1
--------------------------------------------
```

parameters and the variance-covariance matrix are provided by the maximum likelihood routine. For each simulation the estimated probability was determined as well as the estimated number of fire starts. Figure 3 gives the distribution for the probability of reporting. The 95% confidence interval for π is given by (0.4, 0.73), obtained by computing the 2.5 and 97.5 percentiles. Figure 4 gives the distribution for the number of fire starts. The 95% confidence interval for the number of fire starts is (771, 1369), again obtained by computing the 2.5 and 97.5 percentiles.

These estimates need to be confirmed by using other statistical methods, including the Capture-Mark-Recapture method. The Capture-Mark-Recapture approach is used to estimate the number of animals in a closed population. A sample of animals is captured, and each animal captured is marked and then released. Another sample is taken and the proportion of marked animals in the second sample is used to enable an estimate of the total population size. These methods have been successfully employed in other applications such as epidemiology, evaluation of census undercount,

Figure 2: Number of Fire Starts by Month with fitted prediction of recorded fire starts (red) and actual fire starts (recorded and nonrecorded-blue)



and software testing. I have analysed the United Energy data on fire starts, in conjunction with other databases held by the Country Fire Authority (CFA), and the Metropolitan Fire Brigade (MFB). The estimates I have obtained using the Capture-Mark-Recapture method are higher than those derived by using the Neubauer et al approach and will be reported in a subsequent report.

Figure 3: Probability Fire Start Recorded based on fitted negative binomial distribution model.

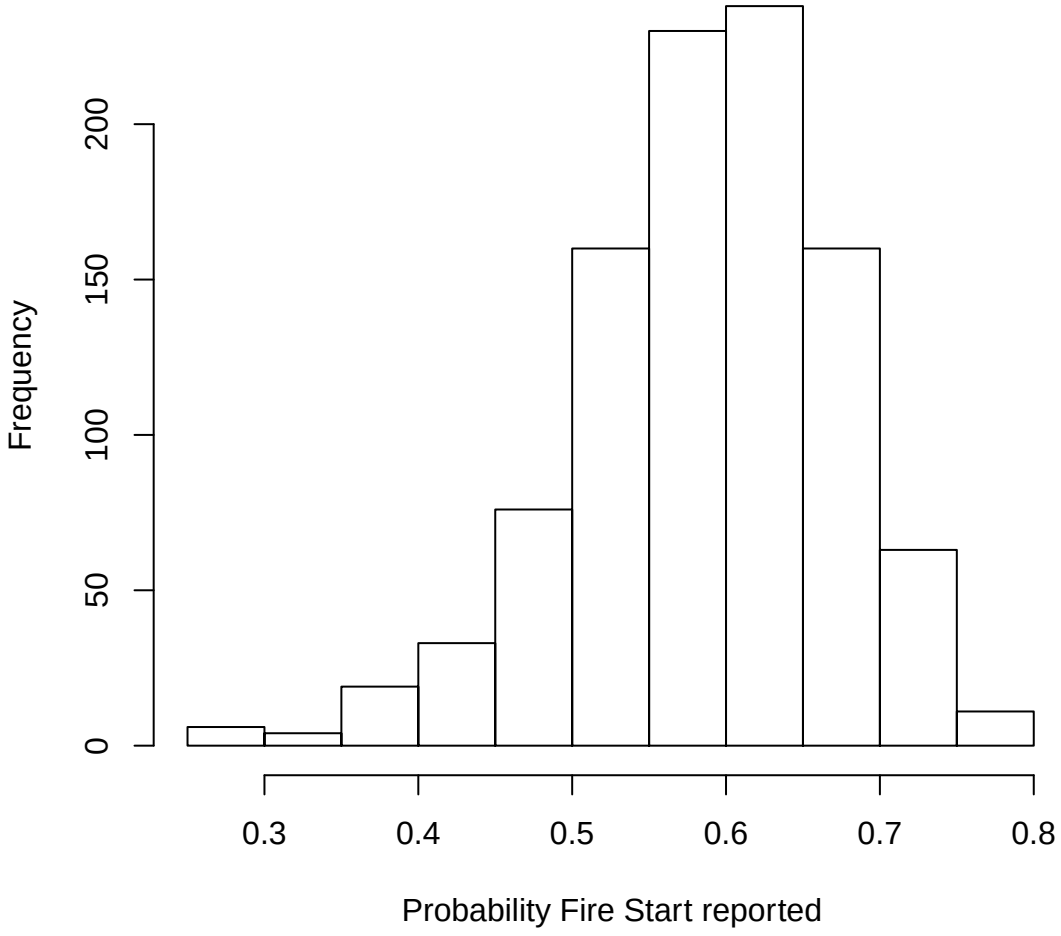
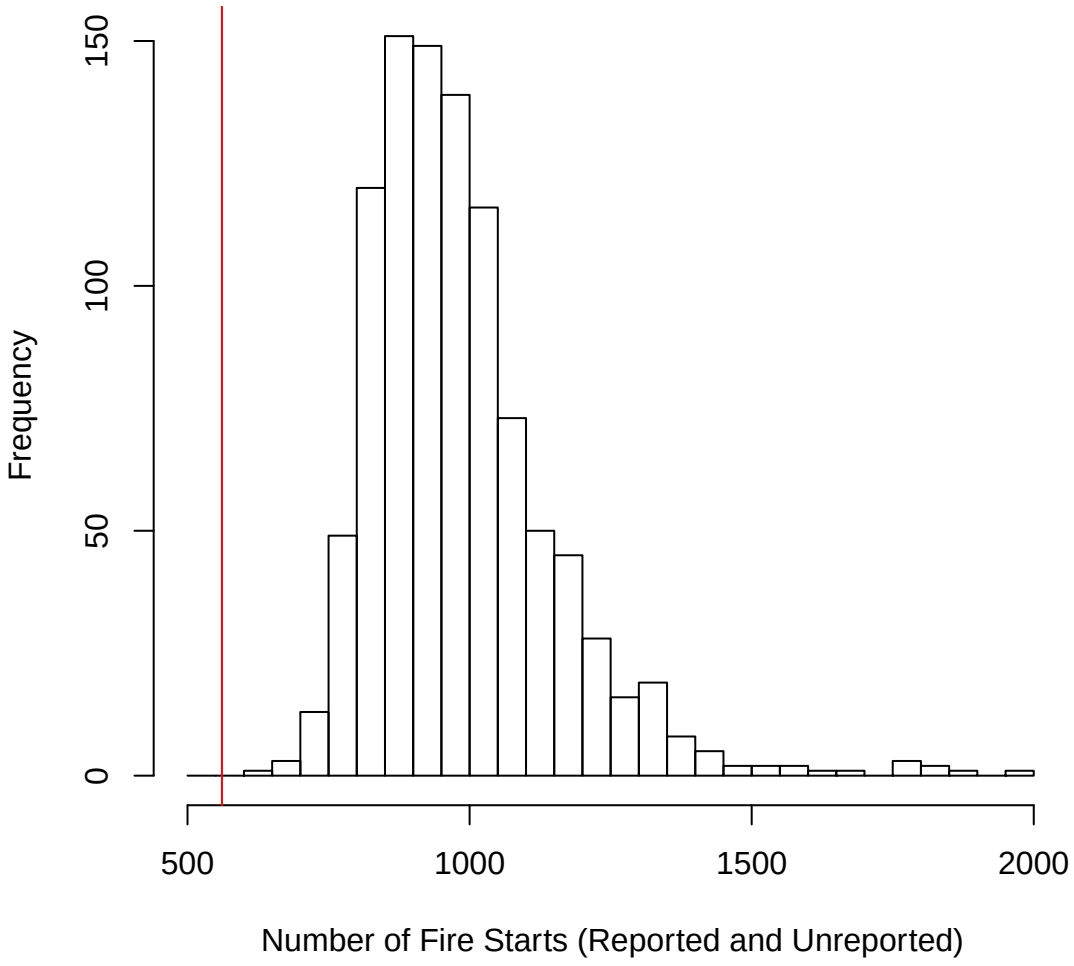


Figure 4: Distribution of Number of Fire Starts based on fitted negative binomial distribution model.



Conclusions

Probability modelling has been applied to determine the (actual) total number of fire starts in the United Energy distribution region over the period from 2006 to 2010. A modelling method has been applied because of the systematic under-reporting of fire starts in the recorded historical data, held by United Energy. The number of recorded fires is 561, but the estimated number has been determined to be 940, with a 95% confidence interval of 771 to 1369.

Based on my statistical analysis, I believe that the estimate of the number of fire starts which I have obtained, 940, is most likely conservative (in other words, low). This belief has been informed by running trials of other statistical methods, including the Capture-Mark-Recapture method. I have analysed the United Energy data on fire starts, in conjunction with other databases held by the Country Fire Authority (CFA), and the Metropolitan Fire Brigade (MFB).

Capture, Mark, Release and Recapture methods are used to estimate the number of animals in a closed population. A sample of animals is captured, and each animal captured is marked and then released. Another sample is taken and the proportion of marked animals in the second sample is used to enable an estimate of the total population size. These methods have been successfully employed in other applications such as epidemiology, evaluation of census undercount, and software testing.

I have applied the Rcapture package (Ballargeon and Rivest, 2007) to the data on fire starts in the United Energy distribution region from the three separate sources: United Energy's own data, and the databases compiled separately by the CFA and the MFB. The databases from the CFA and the MFB were filtered to ensure that only fire starts which are alleged to have been caused by electricity distribution equipment (and infrastructure) were considered. The results from the Capture-Mark-Recapture analysis will be documented and reported separately. I have been unable to complete the reporting in the tight timeframe that has been made available for me to undertake the analysis.

Bibliography

Australian Energy Regulator. (2011) "Draft determinations and Explanatory statement for the draft determinations. F-factor scheme determinations 2012-15 for Victorian electricity distribution network service providers."

Baillargeon, S. and Rivest, L-P. (2007), "Rcapture: Loglinear models for Capture-Recapture in R," *Journal of Statistical Software,* **19** Issue 5. `http://www.jstatsoft.org`

Neubauer,G., Djuras, G., and Fiedl, H. (2011), "Models for underreporting: A bernoulli sampling approach for reported counts," *Austrian Journal of Statistics,* **40**, 85-92.

Full Name:	Neil Thomas Diamond
Academic Qualifications:	B.Sc (Hons) (Monash), Ph.D. (Melbourne), A.Stat

Career History

1977-78	Statistician, ICI Explosives Factory, Deer Park
1979-86	Research Officer, Research Scientist, Senior Research Scientist And Statistics and Computing Team Leader, ICI Central Research Laboratories, Ascot Vale
1987-1989	Lecturer, Department of Mathematics, Computing and Operations Research, Footscray Institute of Technology
(1989)	Visiting Scientist, Center for Quality and Productivity Improvement, University of Wisconsin-Madison, USA.
1990-2003	Senior Lecturer, Department of Computer and Mathematical Sciences, Victoria University of Technology
(1995)	Visiting Fellow, Center for Quality and Productivity Improvement, University of Wisconsin-Madison, USA.
2003-2004	Senior Statistician, Insureware
2004-2006	Senior Lecturer and Deputy Director of Consulting, Department of Econometrics and Business Statistics, Monash University.
2007-	Senior Lecturer and Director of Consulting, Department of Econometrics and Business Statistics, Monash University.
2011-	Associate Professor and Co-ordinator of Statistical Support, Office of Pro-Vice Chancellor (Research and Research Training), Victoria University

Teaching Experience

Monash University

- Business Statistics (First Year), Marketing Research Analysis (Second Year), Survey Data Analysis (Third Year-Clayton and Caulfield).
- Expert Stats Seminars on Software Packages for Statistics, Questionnaire Design, Analysis of Survey Data, and Multivariate Statistics.
- Introduction to Statistics for Pharmacy-five session course:
  - Data handling, exploration, and graphical summaries
  - An overview of basic statistical methods
  - Regression Analysis and extensions
  - Designing experiments and power analysis
  - An overview of more advanced statistical methods

Victoria University of Technology

- Applied Statistics (First Year), Linear Statistical Models, Sampling and Data Analysis (Second Year), Experimental Design (Third Year).
- Statistics for Engineers, Statistics for Nurses, Statistics for Occupational Health.
- Forecasting (Graduate Diploma in Business Science)

Sessional Teaching

- Monash University (1996-2003) Design of Experiments for Masters Students of the Australian Pulp and Paper Institute.
- RMIT (1991, 1996-2002) Design of Experiments for Masters in Quality Management.
- AGSM (1993-1997): Total Quality Management for Graduate Management Qualification.
- Various other: The University of Melbourne, Enterprise Australia, Swinburne Institute of Technology.

Supervision

Principal Supervisor

Gregory Simmons (1994-1997). M.Sc. completed. "Properties of some minimum run resolution IV designs."

Tony Sahama (1995-2003). Ph.D. completed. "Some practical issues in the design and analysis of computer experiments."

Ewa Sztendur (1999-2005). Ph.D. completed. "Precision of the path of steepest ascent in response surface methodology." [As a result of this thesis, Ewa was awarded the 2006 Victoria University Vice-Chancellor's Peak Award for Research and Research Training-Research Degree Graduate.]

Co-supervisor

Keith Hart (1996-1997). M.Sc. completed. "Mean reversion in asset prices and asset allocations in funds management."

Jyoti Behera (1999-2000). M.Eng. completed. "Simulation of container terminals."

Ray Summit (2001-2004). Ph.D. completed. "Analysis of warranty data for automobile data."

Rob Moore (2001-2007). Ph.D. completed. "Computer recognition of musical instruments.

M.Sc. Minor Theses

Milena Shtifelman (1999). Completed. (Monash University Accident Research Centre). "Modelling interactions of factors influencing road trauma trends in Victoria."

Rohan Weliwita (2002). Completed. "Modelling road accident trauma data."

Theses Examination

One M.Sc. major thesis (University of Melbourne) and one M.Sc minor thesis (Victoria University).

Industry Projects

Over 30 projects for the following companies and organisations:

Gas and Fuel Corporation	Ford Australia
Mobil Australia	Fibremakers
ICI Australia	Western General Hospital
Data Sciences	Keilor City Council
AMCOR	Composite Buyers
Davids	Email Westinghouse
Craft Coverings	Australian Wheat Board
CSL	Holding Rubber
Viplas Olympic	Melbourne Water
Federal Airports Corporation	

Research and Consulting Experience

- Ten years with ICI Australia as an industrial statistician initially with the Explosives group and eventually with the research group.
- A Ph.D. from the University of Melbourne entitled "Two-factor interactions in non-regular foldover designs."
- Two six month periods at the Center for Quality and Productivity Improvement at the University of Wisconsin-Madison.
- Extensive consulting and training on behalf of the Centre for Applied Computing and Decision Analysis based at VUT for the following companies:

Data Sciences
Analytical Science Consultants
Glaxo Australia
Enterprise Australia
The LEK partnership
BP Australia
Melbourne Water
Australian Pulp and Paper Institute
Initiating Explosives Systems
Saftec
Datacraft Australia
ICI Australia
Kaolin Australia
AMCOR
Kinhill Group

- Operated the Statistical Consulting Service at Victoria University of Technology from 1992-2002.
- From 2002-2004 worked as a Senior Statistician with Insureware on the analysis of long-tailed liability data.
- From December 2004 to December 2006 Deputy Director of Consulting of Monash University Statistical Consulting Service based in the Department of Econometrics and Business Statistics.
- From January 2007 Director of Consulting of Monash University Statistical Consulting Service based in the Department of Econometrics and Business Statistics.
- Extensive consulting and training on behalf of the Monash University Statistical Consulting Service for the following companies and organisations:

Australian Tax Office
J D McDonald
Port of Melbourne Corporation
Agricola, Wunderlich & Associates
Australian College of Consultant Physicians
Department of Justice
Department of Human Services
IMI Research
Incitec Pivot
Parks Victoria
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Journal Articles

1. Diamond, N.T., (1991). "Two visits to Wisconsin," *Quality Australia*, **7**, 30-31.
2 Diamond, N.T., (1991). "The use of a class of foldover designs as search designs," *Austral. J. Statist*, **33**, 159-166.
3 Diamond, N.T., (1995). "Some properties of a foldover design," *Austral. J. Statist*, **37**, 345-352.
4 Watson, D.E.R., Hallett, R.F., and Diamond, N.T., (1995). "Promoting a collegial approach in a multidisciplinary environment for a total quality improvement process in higher education, " *Assessment & Evaluation in Higher Education*, **20**, 77–88.
5 Van Matre, J. and Diamond, N.T., (1996). "Team work and design of experiments," Quality Engineering, 9, 343–348.
6 Diamond, N.T., (1999). "Overlap probabilities and delay detonators," *Teaching Statistics*, **21**, 52–53. Also published in "Getting the Best from Teaching Statistics", one of the best 50 articles from volumes 15 to 21 of *Teaching Statistics*.
7 Cerone, P. and Diamond, N.T., (2000). "On summing permutations and some statistical properties," *The International Journal of Mathematical Education in Science and Technology*, **32**, 477-485.
8 Behera, J.M., Diamond, N.T., Bhuta, C.J. and Thorpe, G.R.,(2000). "The impact of job assignment rules for straddle carriers on the throughput of container terminal detectors," *Journal of Advanced Transportation*, **34**, 415-454.
9 Sahama, T. and Diamond, N.T., (2001). "Sample size considerations and augmentation of computer experiments," *The Journal of Statistical Computation and Simulation*, **68**, 307-319.
10 Paul, W. and Diamond, N.T., (2001). "Designing a monitoring program for environmental regulation: Part 1-The operating characteristic curve," *Water*: Journal of Australian Water Association, October 2001, 50-54.
11 Sztendur, E.M. and Diamond, N.T., (2002). "Extension to confidence region calculations for the path of steepest ascent," *Journal of Quality Technology*, **34**, 288-295.
12 Paul, W. and Diamond, N.T., (2002). "Designing a monitoring program for environmental regulation: Part 2-Melbourne Water case study," *Water*: Journal of Australian Water Association, February 2002, 33-36.
13 Steart, D.C., Greenwood, D.R., Boon, P.I. and Diamond, N.T., (2002) "Transport of leaf litter in upland streams of Eucalyptus and Nothofagus forests in South Eastern Australia," *Archiv Für Hydrobiologie*, **156**, *43-61*.
14 Peachey, T. C., Diamond, N. T., Abramson, D. A., Sudholt, W., Michailova, A., and Amirriazi, S. (2008). "Fractional factorial design for parameter sweep experiments using Nimrod / E,"*Sci. Program.*, **16**(2-3), 217–230.
15 Sahama, T.R. and Diamond, N.T. (2009) "Computer Experiment-A case study for modelling and simulation of Manufacturing Systems," *Australian Journal of Mechanical Engineering*, **7**(1), 1–8.

Refereed Conference Papers

1. Behera, J., Diamond, N.T., Bhuta, C. and Thorpe, G., (1999). "Simulation: a decision support tool for improving the efficiency of the operation of road vehicles in container terminals," 9th ASIM Dedicated Conference, Berlin, February 2000, 75-86.

2. Jutrisa, I., Diamond, N.T. and Cerone. P., (1999). "Frame size effects on throughput and return traffic in reliable satellite broadcast transmission, " 16th International Teletraffic Congress, Edinburgh, Scotland.

3. Sztendur, E.M. and Diamond, N.T.* (2001). "Inequalities for the precision of the path of steepest ascent in response surface methodology," in Cho, Y.J, Kim, J.K., and Dragomir, S.S. (eds.) *Inequality Theory and Applications*, **1**, *The Proceedings of the Sixth International Conference 2000 on Nonlinear Functional Analysis and Applications*, Chinju and Masan, South Korea, 295-301.

4. Diamond, N.T. and Sztendur, E.M. (2002). "The use of consulting problems in introductory statistics classes", *Proceedings of the 6th International Conference on the Teaching of Statistics*.

5. Summitt, R.A., Cerone. P., and Diamond, N.T. (2002). "Simulation Reliability Estimation from Early Failure Data, *Proceedings of the Fourth International Conference on Modelling and Simulation*, 368-390.

6. Summitt, R.A., Cerone. P., and Diamond, N.T. (2002). "Simulation Reliability Estimation from Early Failure Data II, *Proceedings of the Fourth International Conference on Modelling and Simulation*, 391-396.

7. Sahama, T. And Diamond, N.T. (2008). "Computer Experiment-A case study for modelling and simulation of Manufacturing Systems," 9th Global Conference on Manufacturing and Management.

Reports

A number of confidential reports for ICI Australia from 1977-1987.

Victoria University

Diamond, N.T (1990). "Professional Experience Program at the Center for Quality and Productivity Improvement," Footscray Institute of Technology.

Bisgaard, S. and Diamond, N.T (1991). "A discussion of Taguchi's methods of confirmatory trials," Report No. 60. Center for Quality and Productivity Improvement, University of Wisconsin-Madison.

Diamond, N.T (1996). "Outside Studies Program at the Center for Quality and Productivity Improvement," Victoria University of Technology.

Diamond, N.T (1996). "Statistical Analysis of EPA compliance of the western treatment plant," prepared for Melbourne Water on behalf of Kinhill Engineers.

Diamond, N.T (1996). "Statistical Analysis of EPA compliance of the western treatment plant," prepared for Melbourne Water on behalf of Kinhill Engineers.

Diamond, N.T (1998). "Statistical Analysis of BOD and SS compliance rates and license limits at ETP and WTP," prepared for Melbourne Water.

Diamond, N.T (1998). "Fate of pollutants at WTP-method for determining safety margins," prepared for Egis consulting group.

Bromley, M. and Diamond, N.T (2002). "The manufacture of Laboratory coreboard using various chip furnishes," prepared for Orica adhesives and resins.

Monash University

Hyndman, R.J, Diamond, N.T. and de Silva, A. (2004). "A review of the methodology for identifying potential risky agents," prepared for the Australian Tax Office.

Diamond, N.T. and Hyndman, R.J. (2005). "Sample Size for Maternal and Child Heath Service Evaluation," prepared for the Department of Human Services.

Diamond, N.T. (2005). "Analysis of Customer Satisfaction Survey 2005," prepared for JD Macdonald.

Diamond, N.T. (2005). "Analysis of 2005 Orientation Survey," prepared for Monash Orientation.

Diamond, N.T. (2005). "Analysis of Before and After and Sequential Monadic Concept Consumer Surveys," prepared for IMI-Research.

Diamond, N.T. and Hyndman, R.J. (2005). "The Monash Experience Questionnaire 2003: First Year Students," prepared for CHEQ, Monash University.

Diamond, N.T. and Hyndman, R.J. (2005). "The Monash Experience Questionnaire 2003: The Best and Worst, " prepared for CHEQ, Monash University.

Diamond, N.T. and Hyndman, R.J. (2005). "The Monash Experience Questionnaire 2003: The Best and Worst for First Year Students," prepared for CHEQ, Monash University.

Diamond, N.T. (2005). "Technical Document for DUKC Uncertainty Study," prepared for Port of Melbourne Corporation.

Diamond, N.T. (2005). "DUKC Uncertainty Study-Summary of Results," prepared for Port of Melbourne Corporation.

Diamond, N.T. (2005). "Number of Ship trials for DUKC Uncertainty Study," prepared for Port of Melbourne Corporation.

Diamond, N.T. (2005). "Threshold Criteria for Touch Bottom Probabilities," prepared for Port of Melbourne Corporation.

Diamond, N.T. and Hyndman, R.J. (2006). "The Monash Experience Questionnaire 2005: The Best and Worst," prepared for CHEQ, Monash University.

Diamond, N.T. and Hyndman, R.J. (2006). "The Monash Experience Questionnaire 2005: The Best and Worst for First Year Students," prepared for CHEQ, Monash University.

Diamond, N.T. and Hyndman, R.J. (2006). "The Monash Experience Questionnaire 2005: A Statistical Analysis," prepared for CHEQ, Monash University.

Diamond, N.T. and Hyndman, R.J. (2006). "The Monash Experience Questionnaire 2005: 2005 vs. Pre-2005 Students," prepared for CHEQ, Monash University.

Diamond, N.T. (2006). "Agreement of 110/116 and 111/117 items by Consultant Physicians," prepared for the Australian College of Consultant Physicians.

Diamond, N.T. (2006). "Analysis of Statistical Issues regarding Cornish v Municipal Electoral Tribunal, " prepared for Agricola, Wunderlich & Associates.

Diamond, N.T. (2006). "Analysis of Parks Victoria Staff Allocation," prepared for Parks Victoria.

Diamond, N.T. and Hyndman, R.J. (2006). "Summary of Results of IPL Sales Forecasting Improvement Project," prepared for Incitec Pivot.

Sztendur, E.M. and Diamond, N.T. (2007) "A model for student retention at Monash University", prepared for University retention committee.

Sztendur, E.M. and Diamond, N.T. (2007) "An extension to a model for student retention at Monash University", prepared for University review of coursework committee.

Sztendur, E.M. and Diamond, N.T. (2007) "A model for student academic performance at Monash University", prepared for University review of coursework committee.

Diamond, N.T. (2007). "Analysis of IB student 1st year results at Monash University 2003-2005", prepared for VTAC.

Diamond, N.T. (2008). "Effect of smoking bans on numbers of clients utilising problem gambling counselling and problem gambling financial counselling", prepared for Department of Justice

Diamond, N.T. (2008). "Development of Indices Based Approach for Forecasting Gambling Expenditure at a Local Government Area Level", prepared for Department of Justice

Diamond, N.T. (2008). "Orientation 2007- Analysis of Quantitative results", prepared for University Orientation committee.

Diamond, N.T. (2008). "Orientation 2007- Analysis of Qualitative results, prepared for University Orientation committee.

Diamond, N.T. (2008). "Analysis of Clients presenting to Problem Gambling Counselling Services-2002/03 to 2005/06", prepared for the Department of Justice.

Diamond, N.T. (2008). "Analysis of Clients presenting to Problem Gambling Financial Counselling Services-2001/02 to 2005/06", prepared for the Department of Justice.

Diamond, N.T. (2008). "Analysis of Clients presenting to Problem Gambling Counselling and Problem Gambling Financial Counselling Services-2006/07", prepared for the Department of Justice.

Diamond, N.T. (2008). "The effect of changes to Electronic Gaming Machine numbers on gambling expenditure", prepared for the Department of Justice.

Diamond, N.T. (2009). "Adjustment of Mark Distributions", prepared for the Faculty of Law.

Diamond, N.T. (2009). "Summary of Results for Dyno Nobel Sales Forecasting Improvement Project," prepared for Incitec Pivot.

Diamond, N. and Brooks, R. (2010). "Determining the value of imputation credits: Multicollinearity and Reproducibility Issues", prepared for the Victorian Electricity Distributors.

Booth, R., Diamond, N., and Brooks, R. (2010). "Financial Analysis of Revenues and Expenditures of the AFL and of the AFL Clubs", prepared for the Australian Football League Players' Association.

Diamond, N. and Sztendur, E. (2011). "The Student Barometer 2010. Faculty Results", prepared for Victoria University (6 reports).

Diamond, N. and Sztendur, E. (2011). "The Student Barometer 2010. Campus Results", prepared for Victoria University.

Diamond, N. and Sztendur, E. (2011). "The Student Barometer 2010. Qualitative analysis of comments", prepared for Victoria University (17 reports).

Diamond, N. and Brooks, R. (2011). "Review of SFG 2011 Dividend Drop-off Study", prepared for the South Asutralian Electricity Distributors.

R Packages

Diamond, N.T. (2010), VizCompX

Professional Service

- President, Victorian Branch, Statistical Society of Australia, 2001-2002.
  - Terms as Council Member, Vice-President, and Past President.
- Referee: *Australian and New Zealand Journal of Statistics*, *Biometrika*, *Journal of Statistical Software*

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Our Reference: UE.ED.07.02

By email: Neil.Diamond@buseco.monash.edu.au

Dr Neil Diamond
Room 674, Building 11E
Department of Econometrics and Business Statistics
Monash University
CLAYTON VICTORIA 3800
Australia

Dear Dr Diamond,

Expert report in relation to the historical data on fire starts

The Australian Energy Regulator is responsible for the administration and operation of the f-factor scheme, and has recently released a draft determination, which is to apply over the period from 2012 to 2015[1]. The scheme aims to provide incentives for Distribution Network Service Providers (DNSPs) to reduce the risk of fire starts, and to reduce the risk of loss or damage caused by fire starts[2]. The scheme was developed by the Victorian Government.

An f-factor target has been set, which has been based, in part, on the historical occurrence of fire starts in each distribution network (including the United Energy distribution network) over the period from 2006 to 2010. United Energy has examined its data and has become aware that there was systematic under-reporting of fire starts over the five years from 2006 to 2010. The distribution management system used by the business was aimed at gathering information on faults, with a lesser degree of effort directed towards the gathering of data on fire starts.

An examination of the records in the distribution management system shows that evidence of fires and fire starts was reported in an *ad hoc* fashion. Inconsistent terminology has been used, spelling is inaccurate, and the descriptions in the text field are sometimes incomplete. The questions posed by SKM in relation to specific records in the UE Distribution Management System (DMS) are indicative of some of the problems with the historic recording of information pertaining to fire starts[3].

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[1] AER, Draft determinations and Explanatory statement for the draft determinations, F-factor scheme determinations 2012-15 for Victorian electricity distribution network service providers, Australian Energy Regulator, 5th October 2011.
[2] Energy and Resources Legislation Amendment Bill 2010, Explanatory Memorandum, page 10.
[3] See AER – Guide to Questions – F-Factor Data Verification, questions posed by Terry Krieg, Sinclair Knight Merz, 2nd September 2011.

We are aware that linesmen were not fully briefed on the methods for reporting fire starts, although this situation began to change in 2010. Considering the 2006 to 2010 period as a whole, field personnel appear to have recorded the evidence for fire starts somewhat sporadically. Linesmen were not obliged to note down fire-related symptoms.

Previously, United Energy had formed the view that the reporting of pole and cross-arm fires from 2006 to 2010 was reasonably rigorous and well-founded. However, from a detailed examination of the records, and from discussions with field staff, we are confident that there were a number of pole fires that occurred which have not been documented.

In future, we expect more rigorous reporting of fire starts, because additional effort has been expended on re-training linesmen, and a new and enhanced reporting template has been created. The new template provides for answers to be chosen from among a menu of responses. Hence, there will be less reliance on the direct comments provided by linesmen.

In this context, we would like you to undertake and report on the following task:

- Review and assess the methods which have been applied by the AER in its draft determination to allow, and compensate for past under-recording of fire starts.
- Analyse a number of approaches which might assist in correcting for the past under-reporting of data on fire starts.
- Apply the methods making use of the various databases provided by United Energy.
- Determine a result which can be used as an appropriate benchmark to be adopted by United Energy as its "target" under the f-factor scheme.

Guidelines in preparing your report

Attached are Expert Witness Guidelines issued by the Federal Court of Australia. Although this brief is not in the context of litigation, the Victorian electricity distribution businesses are seeking a rigorously prepared independent view for use in the context of regulatory decision making and you are requested to follow the Guidelines to the extent reasonably possible in the context.

In particular, please:

Identify your relevant area of expertise and provide a curriculum vitae setting out the details of that expertise:

1.1.1. only address matters that are within your expertise;

1.1.2. where you have used factual or data inputs please identify those inputs and the sources;

1.1.3. if you make assumptions, please identify them as such and confirm that they are in your opinion reasonable assumptions to make;

1.1.4. if you undertake empirical work, please identify and explain the methods used by you in a manner that is accessible to a person not expert in your field;

UNITED ENERGY

1.1.5. confirm that you have made all the inquiries that you believe are desirable and appropriate and that no matters of significance that you regard as relevant have, to your knowledge, been withheld from your report; and

1.1.6. please do not provide legal advocacy or argument and please do not use an argumentative tone.

Yours sincerely,

Jeremy T. Rothfield.

Jeremy Rothfield
Network Regulation and Compliance Manager