A travel cost analysis of the value of special events: Gemfest in Central Queensland

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Special events play an important part in tourism and recreation choices in Australia, and many receive funding from various levels of government. However, the economic case for funding special events often focuses on estimates of expenditure, employment and indirect impacts rather than estimates of economic benefit or consumer surplus. The study discusses the application of the travel cost method for estimating consumer surplus associated with a special event. The event studied is the annual four-day 'Gemfest' in the sapphire fields of Central Queensland. Surveys were conducted in 1998 and 2002, and the derivations of the appropriate models, welfare calculations and comparisons over time are outlined.

Keywords: travel cost method; special events; consumer surplus; Australia

'Gemfest' is an annual event that is held in the town of Anakie in the sapphire Gemfields of Central Queensland. It is usually held over a four-day period to coincide with the first weekend in August. The Gemfields is a gem fossicking and mining area located on the Tropic of Capricorn approximately 46 km and 320 km west of Emerald and Rockhampton, respectively. The townships of Sapphire and Rubyvale are some 10 km to the north of Anakie, while the township of the Willows is about 20 km to the south-west. The total population of the Gemfields area is between 1,000 and 2,000, with more people locating there in the winter months.
Greater productivity, fewer and more flexible working hours, an ageing population and early retirement options have all increased the time available for recreational activities in Australia and elsewhere. Now people expect more from their free time and want their leisure activities to be more affordable and easily accessible. This has led to a proliferation of community festivals and special events. ‘The establishment and growth of festivals can be looked at as a reaction to market incentives induced by demand,’ writes Frey (1994, p. 31). Originally, these community festivals were organized for reasons such as enhancing and preserving the local culture and history, providing local recreational and leisure opportunities, enhancing the local tourism industry and developing and sustaining the local economy. Now they are major tourism activities in rural communities, where a key reason for conducting them is to enhance the local tourism industry and generate expenditure in the local economy (Long and Perdue, 1990).

The focus of this study is to estimate the economic value of Gemfest in consumer surplus terms through an application of the travel cost method (TCM). This study is novel because it is attempting to estimate the economic or social value (consumer surplus) of an event as distinct from the economic impact (a change in expenditure which could be assessed with input–output analysis). There appears to be little or no research that uses the TCM to estimate the consumer surplus for a short-term event like Gemfest, so this study will expose and address the particular problems of application of the method to events rather than recreation sites. Another contribution of this research is the estimation and comparison of consumer surplus values for the event at two different periods.

The appropriate method for valuing a good depends on various factors, including the nature of the data (revealed or stated preferences), the value to be estimated (use or non-use value or both) and the good to be valued with its linkages to complementary goods. Revealed preference methods like the TCM are suitable for this study because the data used are based on actual observed behaviour.

The demand for visits to the Gemfest can be estimated from the costs incurred while travelling to and from the event. The costs of travel vary from visitor to visitor depending on the point of origin. The advantages of choosing the travel cost method for this study are, first, the data can easily be collected; second, the method is relatively simple and inexpensive to use and the results are also relatively easy to interpret; third, the TCM applies demand theory to estimate and explain the value of a recreation choice (value estimation is based on a simple assumption that the value of a recreation option depends on and is inversely related to the travel costs); and, finally, it is not data-intensive and involves the estimation of a single demand equation for the recreational activity. Furthermore, it is possible to include other exogenous variables in the model. The TCM is also popular because it is generally straightforward to apply (Hueth and Strong, 1984).

The study is organized as follows. In the next section, the TCM methodology and its application to special events is discussed in detail. Then we report the TCM analysis and results of the study. The subsequent section is the sensitivity analysis, where we revisit some of the problems that affected consumer surplus estimates and discuss the results. The final section presents the discussion and concluding remarks.
TCM methodology

The TCM involves two key steps (Read et al., 1999). The first is to derive the 'trip generation function' (TGF) based on the travel costs and other variables associated with the visits, such as income, occupation, the age and education of participants, and the attractiveness of substitute events. The TGF for a zonal travel cost model is defined as:

\[ \frac{V_{hj}}{N_h} = f(TC_h, X_h) \]  

where \( V_{hj} \) = visits from zone \( h \) to site \( j \), \( N_h \) = population of zone \( h \), \( TC_h \) = visit costs from zone \( h \) and \( X_h \) = socio-economic variables which explain visits from zone \( h \). The visitor rate \( V_{hj} / N_h \) is often calculated as visits per 1,000 population in each zone.

The second step is to derive the demand function for entry to the event from the trip generation function using a hypothetical set of additional entry fees. This function is defined as:

\[ Q = \alpha + \beta P \]  

where \( Q \) is the number of visits and \( P \) is the entry fee.

The consumers’ surplus (CS) is then estimated by integrating the area under the demand curve. The demand function estimated by the TCM is the ordinary uncompensated demand function. The welfare measure estimated from it is therefore the Marshallian consumer surplus. However, there are a number of methodological issues that have to be resolved before this travel cost analysis of the Gemfest data is undertaken, and the major ones are now discussed.

General models of trip generation functions

There are two basic variants of TCM depending on the definition of the dependent variable in Equation (1). These are the zonal travel cost model (ZTCM) and the individual travel cost model (ITCM). The choice of a model depends on the nature of the recreation site that is to be valued and the data collected about visitation patterns. Because of the short duration and special event nature of Gemfest, relatively few visitors make more than one visit to the event. The ITCM requires variation in visit rates of individuals per time period, and so cannot be applied to special events. As a result, the zonal model was used for this study. This leads to another issue that needs to be resolved, namely the identification of zones.

Identification of zones

Drawing concentric circles of say 50 or 100 km width around the site is one way to identify zones. Herath (1999) used concentric circles to define zones and then identified major cities within these circles as main sites of origin of visitors. Lockwood and Tracy (1995) identified zones on the basis of postcode clusters which contained approximately equal populations. Beal (1995) based the identification of zones on statistical divisions, which were aggregated...
according to their approximate distance from the site (Carnarvon Gorge). However, the definition and number of zones is often arbitrary or influenced by the availability of population data (Bateman, 1993, p 230).

The present study combines the procedures applied by Beal and Herath. First the zones were identified on the basis of the statistical divisions defined by the Australian Bureau of Statistics (ABS). Then major cities were identified in each zone as the main point of origin of visitors from that zone. Fourteen zones were identified for this study (see Appendix). The population for each zone was calculated from the ABS 2001 census data.

Cost variables

The next issue concerns the definition and treatment of costs of travel and time. There are several problems underlying these definitions, such as the subjectivity of choices, the varying nature of investment in durable goods needed for travel and the debate about the inclusion and treatment of opportunity costs (Randall, 1994). There are three common methods or options for the estimation of travel costs (Bateman, 1993, p 206). Option 1 is to use only petrol costs estimated from travel distance; option 2 is to use full car costs that include petrol, insurance, maintenance and so on, and option 3 is to use the perceived costs as estimated by the respondents.

The most appropriate measure is perceived costs or option 3 (Bennett, 1996). In the survey form, visitors to Gemfest were asked to identify their town of residence, postcode, travel distance and travel costs. While nearly all respondents completed the first three categories, fewer than half gave any estimates of their travel costs. Consequently, it was considered more appropriate to calculate travel costs on the basis of distance travelled\(^2\) (option 2). The cost was calculated by multiplying the distance travelled by a full car cost rate as given by the Australian Tax Office (ATO). This rate allows for the total running cost of the car, including petrol, insurance, depreciation, servicing and repairs.

Although expenses on meals and lodgings may be considered as part of the trip costs, variations in utility could be generated by the additional expense of staying in a five-star hotel (Fletcher \textit{et al}, 1990). If so, then the trip and hotel accommodation should be considered as different goods. Lodging and subsistence expenses vary widely from visitor to visitor, as the choice of lodging is usually discretionary (Randall, 1994). At every point the traveller has a choice to go either ‘first-class or budget’, which would produce vastly different experiences and costs. To minimize these problems, accommodation costs have not been included as part of travel costs for this study.

Opportunity cost of time

Economists recognize the role time plays in the decision to participate in recreational activities and often attempt to incorporate the opportunity cost of time as a component of travel costs in recreational demand models (Feather and Shaw, 1998). Time is likely to be at least as constraining as money in making a decision about recreational activities (McConnell, 1999). The opportunity cost of time could be divided into time spent in travel from point of origin to the recreational site and on-site time (Bateman, 1993, p 208).
In a traditional labour supply model, the opportunity cost of leisure is the foregone money wages and other benefits accruing from work. Often, some percentage of the observed wage rate is used to calculate the opportunity cost of time (Coupal et al., 2001; Fix and Loomis, 1997; and Layman et al., 1996). However, since in the modern era the number of work hours is fixed and there are weekends, public holidays and paid vacations, the traditional definition of this opportunity cost is sometimes not relevant because individuals travel for leisure and recreation during their holidays when there is no loss of income (Ward and Beal, 2000).

The treatment of on-site time is controversial. There are opposing views on its inclusion and treatment in the TCM. Some researchers consider time spent on-site to be exogenously determined and the marginal utility derived from it would be equal to that derived from alternative activities (Whitten and Bennett, 2002). Hence, time spent on-site was treated by these researchers as having no impact on the consumer surplus estimates.

A community-based special event will attract many local visitors. In the case of Gemfest, residents within a 100 km radius comprised about 41.5% of the total visitors, and they tended to come for part of a day when it suited their work schedule. An additional 16.2% of the visitors were on holidays. The opportunity costs of time for both of these groups are expected to be low or even zero. For these reasons, the present study follows the example of Ward and Beal (2000) in assuming that there was no opportunity cost of travel time, and the example of Whitten and Bennett (2002) in assuming that there were no opportunity costs for on-site time.

Substitute sites

The prices of substitute sites have an impact on the estimation of recreational demand (Bateman, 1993, p 218). These variables are rarely included in recreation demand models because it is both expensive and difficult to collect and include such data. Siderelis and Moore (1995), studying rail trails (unused rail tracks used for hiking and other recreational purposes), found that there were no other rail trails close enough to the site in question that could be considered as substitutes by day-trip users. Consequently, they excluded variables for substitutes from the model. Gemfest is a unique event and there are usually no other events that could be considered as substitutes by day-trippers during the four days it is held. So, following Siderelis and Moore’s (1995) view, the variables for substitute sites were excluded in this study.

Multiple-purpose trips

A primary assumption of the method is that the trips were made with a single purpose and to a single destination only. The treatment of multi-destination trips is complicated because it is difficult to allocate cost shares specifically related to the recreational activities in question (Casey et al., 1995). One procedure for estimating travel costs for multiple-destination trips for which the site was not the primary destination is to include only round-trip travel costs from the visitor’s temporary residence to the site of interest (Bowker and Leeworthy, 1998).
There were some international visitors who attended Gemfest. Since the Gemfields is a popular tourist destination for both national and international visitors, it is logical and appropriate to consider the Gemfields to be a temporary place of residence for these international visitors. Visitors to Gemfest whose place of origin is not known (visitors with data missing) were treated in the same way. Therefore, the international visitors (zone 13) and visitors with data missing (zone 14) were included in zone 1 (Gemfields) and treated as locals. In the data analysis only 11 zones were used because zone 12 (Northern Territory) had zero observations and zones 13 and 14 were incorporated into zone 1.

In many cases a visit to the site is not the sole purpose of the trip (Bennett, 1996). This problem is similar to the multi-destination issue. If there are visitors who have travelled for multiple purposes, their costs need to be allocated between the different activities undertaken along the way (Whitten and Bennett, 2002). Coupal et al (2001) studied the degree to which inclusion of visitors with different reasons for recreation affected the value of the recreational activity. They found significant variation in consumer surplus estimates when the heterogeneous nature of visitors was considered. However, TCM can still generate reasonably accurate and policy-relevant estimates of consumer surplus in spite of the researchers' inability to estimate the travel costs accurately or the availability of a procedure to allocate the trip costs to other trip purposes or sites (Stoeckl, 2003a and 2003b).

In this study, more than half the visitor groups surveyed in 2002 said that their main reason for being in the region was Gemfest. This included many of the interstate visitors, because people with a keen interest in gems often make an annual pilgrimage to the event. The analysis was performed on the assumption that visitors made the trip for the single purpose of attending Gemfest. This assumption may mean that consequent estimates of consumer surplus are biased upwards.

Other variables
Inclusion of other variables, especially complementary goods like on-site purchases and other trip activities, tend to improve the specification of the recreational demand models (McKean et al, 1996). The inclusion of visitors' perceptions of the site and its quality was also found greatly to increase the reliability of the consumer surplus estimates (Siderelis et al, 2000). The present study includes the average zonal income in the model for the TGF.

Choice of functional form
The choice of a functional form is important because it significantly affects the size of the consumer surplus estimates (Crocker and Kling, 2000). The TGF (Equation 1) and the demand function (Equation 2) could be specified as a number of functional forms: namely, linear, quadratic, semi-log and double log (Bateman, 1993, p 223; Hanley and Spash, 1993, p 91).

Economic theory is not entirely clear as to the preferred choice of functional form for either of the two functions that have to be estimated (Hanley and Spash, 1993, p 90). The choice of the correct functional form is important in
order to obtain accurate and unbiased estimates of CS, irrespective of whether the travel costs are measured correctly or not (Stoeckl, 2003a and 2003b). The choice of the functional form for both TGF and demand function for the present study should be based on three criteria: economic theory, predictability and statistical specification.

Methods of estimation

Researchers using the TCM overwhelmingly favour ordinary least squares (OLS) regression for data analysis (Ward and Beal, 2000, p 47). However, when observations are grouped and there are different sample sizes for each zone, the problem of heteroskedasticity may arise. This effect must be corrected to guarantee the reliable prediction of visits at actual prices (Bowes and Loomis, 1980). The use of ordinary least squares does not provide best linear unbiased estimates (BLUE) when heteroskedasticity is present (Greene, 1993; Griffiths et al, 1993). The use of generalized least squares (GLS) in situations where heteroskedasticity is present will lower the variance of the estimates of demand parameters and consequently the benefit estimates (Bowes and Loomis, 1980). The present study therefore uses the ordinary least squares to estimate all the models, and the preferred model is then tested for heteroskedasticity. If heteroskedasticity is present then GLS is used to re-estimate the model.

TCM analysis

The travel cost models are developed in three stages. In the first stage, the TGF is estimated and this is then used in the second stage to estimate the demand for visits at a hypothetical set of entry fees. The estimated demand curve is used in the third stage to estimate the consumer surplus. For brevity, the analysis for the 2002 data is shown in detail, and then the preferred model is applied to the 1998 data for comparative purposes.

The data for the study were collected by surveys undertaken in 1998 and 2002 by Central Queensland University for the Gemfest Organization. The sample of respondents for the surveys was selected at random from the actual visitors to the Gemfest. The survey was designed to collect data on the economic impact of the event and the visitors’ attitudes towards it as well as data for this travel cost application. Data were collected from each visitor group on a number of variables, including their place of origin, distance travelled, number of adults in the group, type of overnight accommodation, length of stay and reason for visiting the Gemfields. In 1998, 245 visitors were surveyed and in 2002 the sample totalled 253.

Analysis of 2002 data

Stage 1

The value of the travel cost variable was calculated by using the following formula:
TOURISM ECONOMICS

$$TC = (p \times g) + (distance \times 2 \times \$0.57)$$ (3)

where $TC$ is the travel cost per group, $p$ is the Gemfest entry fee per person, $g$ is the average number of people in each group, distance is the one-way distance to Gemfest, and $\$0.57$ is the average car costs per kilometre as given by the ATO.

Average income and population for each zone were calculated from the census data for 2001 of the Australian Bureau of Statistics. ‘Income’ was defined as the average of the median weekly household income for each zone as given in the ABS census 2001. To obtain the trip generation function the visit rate ($V/N$) was regressed against travel cost and income variables using ordinary least squares, and four functional forms were tested. Coefficients and statistics for all the models for 2002 data are given in Table 1. The estimated coefficient of the income variable in all the models is negative, indicating that people with lower incomes are more likely to attend Gemfest than those with higher incomes. With an entry fee of only $8, it was a cheap entertainment alternative.

The choice of the appropriate functional form is based on three factors, as stated above. A problem with the estimated linear model is that the coefficient of the travel cost variable is not statistically significant. The linear model was therefore rejected and was not considered for further analysis. All the logarithmic forms estimated are theoretically consistent and have statistically significant coefficients for the travel cost variable. The coefficient of the income variable was statistically significant only in the semi-log independent model.

Another criterion for choosing the functional form is the predictive ability of the model. The numbers of visitors predicted by each model was calculated based on the entry fee of $8 per person. The double-log model predicted 321 visitor groups and the semi-log dependent model predicted 922 visitor groups at the existing level of entry fee. These two were the closest to the actual number of groups of 253. Based on the criterion of predictive ability, these two models were considered for further analysis. The final criterion for choosing a functional form concerns the statistical parameters of the estimated models. Both the double-log and the semi-log (D) models are highly significant at a 0.05 level, as indicated by their F-statistics. On the basis of the $R^2$'s, the double-log model was chosen as the preferred model for the trip generation function.

Before moving on to the second stage of demand estimation, the preferred trip generation model was tested for heteroskedasticity using the Chi-square and Goldfeld-Quandt tests and for autocorrelation using the Durbin-Watson (DW) test. The test for autocorrelation showed that autocorrelation might be present. The Chi-square and Goldfeld-Quandt tests showed conclusively that heteroskedasticity was present. Therefore, the double-log model for the trip generation function was re-estimated using GLS to address both these issues.

This new double-log model provides the following TGF for estimating the demand curve:

$$\ln (V) = 4.806 - 2.092 \ln (TC) - 0.0012 \text{ income}$$ (4)

This model has an improved $R^2$ of 0.99. The model and all the estimated coefficients were highly significant at the 0.05 level. It predicted 299 visitor groups at the existing entry fee of $8, which is the closest to the actual number of visitor groups of 253.
Table 1. Regression Statistics for Four Functional Forms of the TGF, 2002.

<table>
<thead>
<tr>
<th>Model</th>
<th>Constant (t-statistic)</th>
<th>TC Coefficients (t-statistic)</th>
<th>Income Coefficients (t-statistic)</th>
<th>Test statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R² (p-value)</td>
</tr>
<tr>
<td>Linear</td>
<td>0.032 (3.198)</td>
<td>-0.0000023 (-1.842)</td>
<td>-0.00003 (-2.605)</td>
<td>0.55 (0.050)</td>
</tr>
<tr>
<td>Semi-log dependent</td>
<td>-3.414 (-1.149)</td>
<td>-0.0016 (-4.237)</td>
<td>-0.0047 (-1.342)</td>
<td>0.71 (0.00)</td>
</tr>
<tr>
<td>Semi-log independent</td>
<td>0.045 (4.568)</td>
<td>-0.0032 (-3.031)</td>
<td>-0.000025 (-2.590)</td>
<td>0.70 (0.010)</td>
</tr>
<tr>
<td>Double-log (OLS)</td>
<td>4.013 (4.677)</td>
<td>-1.9498 (-21.07)</td>
<td>-0.0012 (-1.443)</td>
<td>0.98 (0.00)</td>
</tr>
</tbody>
</table>

The R² value of the model is high, partly because of the automatic minimization of error terms in double-log models, the use of average values in the zonal method, and the small number of zones analysed in the model. The double-log model was selected on the basis of economic theory, predictive ability and statistical specification, even though it did lead to the model being ‘overfitted’.

Stage 2

To estimate the demand function, the entry fee per person was increased and sequentially added to the average cost for each zone. The visitation rates from each zone under these additional costs are predicted from the TGF, and the total expected number of visitors at each hypothetical entry price is computed. The total predicted visits for each level of additional entry fees are summarized in Table 2 and comprise the data for estimation of the demand function.

To estimate the demand function, the number of estimated visits (Q) was regressed against the hypothetical increase in entry fee (P) using OLS. The coefficients for all the demand models for the 2002 data are given in Table 3. The coefficients for the constant and the entry fee (P) are statistically significant in all the models. As with the TGF, the choice of the appropriate functional form for demand is based on three factors. All the models are consistent with economic theory, they all have coefficients that are statistically significant, and the slope of all the estimated demand curves is negative as expected. However, the choke price, or the entry fee at which visits fall to zero, is higher than expected.

Another criterion for choosing the functional form is the predictive ability of the model. The semi-log dependent and linear models predicted numbers of visitors for a zero price increase (107 and 131 visitors, respectively) closest to the actual number of visitor groups (253). Both the linear and the semi-log (D) models were highly significant at the 0.05 level, as indicated by their F-statistics. While the linear model gives an estimate of demand at zero increase in entry fee closest to the observed level, it has the lowest R² value.

However, the choice between the linear and the semi-log (D) models cannot be made on the basis of R² because they have different dependent variables.
Table 2. Estimated demand schedules for Gemfest.

<table>
<thead>
<tr>
<th>Additional entry fee per person ($) (P)</th>
<th>No of visits demanded in 2002 (Q)</th>
<th>No of visits demanded in 1998 (Q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>299</td>
<td>269</td>
</tr>
<tr>
<td>2</td>
<td>280</td>
<td>251</td>
</tr>
<tr>
<td>4</td>
<td>264</td>
<td>237</td>
</tr>
<tr>
<td>6</td>
<td>251</td>
<td>225</td>
</tr>
<tr>
<td>8</td>
<td>240</td>
<td>216</td>
</tr>
<tr>
<td>10</td>
<td>230</td>
<td>208</td>
</tr>
<tr>
<td>50</td>
<td>145</td>
<td>137</td>
</tr>
<tr>
<td>100</td>
<td>108</td>
<td>105</td>
</tr>
<tr>
<td>1,000</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>5,000</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9,000</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>11,300</td>
<td>–</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Regression statistics for four functional forms of demand, 2002.

<table>
<thead>
<tr>
<th>Model</th>
<th>Constant (t-statistic)</th>
<th>Entry fee (t-statistic)</th>
<th>R²</th>
<th>F (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>131.125 (14.034)</td>
<td>-0.024 (-5.485)</td>
<td>0.32</td>
<td>30.08 (0.00)</td>
</tr>
<tr>
<td>Semi-log dependent</td>
<td>4.678 (45.519)</td>
<td>-0.001 (-15.247)</td>
<td>0.78</td>
<td>232.481 (0.00)</td>
</tr>
<tr>
<td>Semi-log independent</td>
<td>297.816 (50.939)</td>
<td>-38.52 (-35.04)</td>
<td>0.95</td>
<td>1227.83 (0.00)</td>
</tr>
<tr>
<td>Double-log (OLS)</td>
<td>7.520 (40.98)</td>
<td>-0.717 (-20.778)</td>
<td>0.87</td>
<td>431.736 (0.00)</td>
</tr>
</tbody>
</table>

Instead, choice of the preferred model can be based on the sum of squares of the residuals, the model with the lowest sum of squares of residuals (SSR) being more appropriate. The semi-log dependent model has the lowest SSR and hence is used for the estimation of consumer surplus. The semi-log dependent demand function is:

\[ \log (Q) = 4.678 - 0.001 P \]  \hspace{1cm} (5)

The demand curve for 2002 from this function is given in Figure 1. Inverted, the above demand curve becomes:

\[ P = 5131.21 - 1055.06 \log Q \]  \hspace{1cm} (6)
Stage 3

Consumer surplus is calculated as the area under the demand curve. The demand functions for Gemfest were estimated in terms of the additional fee visitors would be willing to pay over and above the entry fee they had already paid, so the entire area under the demand curve is consumer surplus. The consumer surplus per person was estimated to be $187. As the total number of tickets sold at the gate for Gemfest in 2002 was 4,383, total consumer surplus in 2002 was about $0.82 million.

Analysis of 1998 data

The functional forms selected for the trip generation function and the demand function using the 2002 data are applied directly to the 1998 data to facilitate the comparison of results. The value of the travel cost variable was calculated by using the same formula as for the 2002 data, with the ATO car costs for 1998 of 0.50 cents per kilometre and the 1998 entry fee to Gemfest of $6 per person. Income and population for each zone were calculated from 1996 census data of the Australian Bureau of Statistics. The model used for estimating the TGF for 1998 was the following double-log functional form estimated using GLS:

\[
\ln (V) = 3.574 - 1.978 \ln (TC) - 0.0013 \text{ income} \quad (7)
\]
The model has an $R^2$ of 0.97. The model and the estimated coefficients are highly significant at the 0.05 level. It predicted 269 visitor groups at the existing entry fee of $6, against the observed number of visitor groups of 245 in 1998.

The estimated demand schedule is given in Table 2. The semi-log dependent demand function and the inverted demand function for 1998 are given in Equations (8) and (9) respectively.

\[
\log(Q) = 4.578 - 0.001P \tag{8}
\]

\[
P = 7071.97 - 1485.21 \log(Q) \tag{9}
\]

This demand equation is used to estimate the consumer surplus for 1998, and the consumer surplus per person was estimated to be $267. The total number of tickets sold in 1998 was 5,644, so total consumer surplus in 1998 was estimated to be about $1.5 million.

**Sensitivity analysis**

Reallocation of visitors to zones

Aggregate consumer surplus estimates are significantly affected by estimates of visitor numbers in each zone (Common and McKenney, 1993). The analysis conducted so far has treated international visitors as locals, and assumed that the interstate visitors were travelling solely for the purpose of attending the Gemfest. The original TGF was based on the inclusion of international visitors and visitors with data missing in zone 1, implying that these visitors had temporary residence in the Gemfields and their marginal costs of visiting were equal to those of zone 1. To test whether these assumptions had a major effect on consumer surplus estimates, two new trip generation functions, Z1 and Z2, were estimated and tested for the 2002 data.

In Z1, the international visitors, visitors with data missing and all visitors from remote states (zones 8 to 11), were incorporated into zone 1 under the assumption that all these visitors (international and from more remote states) were already holidaying in the Gemfields area. This is a little extreme, as it is quite possible that some were attracted to Gemfest from other parts of the Central Highlands or Central Queensland regions. It is difficult to say whether Z1 or the original TGF function is more correct, so Z2 was estimated, in which the international visitors, visitors with data missing and all visitors from remote states were incorporated into zone 4. This represents the assumption that these visitors were in the Central Queensland region and then travelled to Gemfest. The models were estimated using the preferred model format; that is, the double-log functional form for the trip generation function and the semi-log dependent functional form for the demand function.

Likelihood ratio tests were conducted to assess whether the two new TGFs were significantly different from the original one. There was a significant difference between the original model estimated and the Z1 model, implying that the treatment of all distant visitors as locals will reduce estimates of consumer surplus. Leaving them out altogether will make an even greater
difference. However, there was no significant difference between the original model estimated and the Z2 model, in which all distant visitors were treated as being in the regional area before deciding to travel to Gemfest.

Likelihood tests were also conducted between the respective demand functions to see whether the two new demand functions were significantly different from each other and from the original demand function. Significant differences between each were identified. The consumer surplus estimates under the two new scenarios are given in Table 4. The CS estimates from Z1 were lower than the original estimates, while the CS estimates from Z2 were significantly higher. This indicates that the original model is sensitive to different treatments of distant visitors (who are more likely to have travelled for multiple purposes). These tests showed that the treatment of international and distant visitors does potentially have an impact on consumer surplus.

### Table 4. Sensitivity analysis: CS estimates ($) for different allocations of visitors to zones.

<table>
<thead>
<tr>
<th>Function</th>
<th>Total (sample)</th>
<th>Group</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>819,616.85</td>
<td>546.21</td>
<td>187.00</td>
</tr>
<tr>
<td>Z1</td>
<td>398,300.11</td>
<td>265.44</td>
<td>90.87</td>
</tr>
<tr>
<td>Z2</td>
<td>2,517,341.95</td>
<td>1,677.62</td>
<td>574.34</td>
</tr>
</tbody>
</table>

Another potential weakness of the study is the very high values of the choke price\(^{17}\) in both the 1998 and 2002 models, which indicate that the consumer surplus figures could be overestimated. Technically, consumer surplus is the entire area under the demand curve, but the preferred demand curves for this analysis are the semi-log demand curves, which are asymptotic to both axes, implying that CS tends toward infinity. To avoid problems created by the exponential nature of the demand equation, an arbitrary cut-off entry fee could be used to calculate consumer surplus.

The demand schedules were therefore truncated at a $100 entry fee, representing a realistic maximum amount that visitors might pay, and the demand functions were re-estimated. The coefficients for the truncated demand equations for the two years are given in Table 5. The demand functions and the coefficients estimated for both 1998 and 2002 are all significant at a 95% level. The truncated demand models in both years have improved model fits, as indicated by their \(R^2\) values (0.78 for the 2002 and 0.80 for the 1998 demand function).

The consumer surplus estimates for both 1998 and 2002 were recalculated with the truncated demand functions, and the new estimates are given in Table 6. The overall consumer surplus has declined from $210,674.8 in 1998 to $142,105.3 in 2002. All these estimates are much lower than the initial estimates calculated.
Table 5. Regression statistics for the truncated demand functions.

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients</th>
<th>Test statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(t-statistic)</td>
<td>(p-value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(t-statistic)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>1998</td>
<td>556.58</td>
<td>-102.48</td>
</tr>
<tr>
<td></td>
<td>(27.103)</td>
<td>(5.333)</td>
</tr>
<tr>
<td>2002</td>
<td>518.66</td>
<td>-93.67</td>
</tr>
<tr>
<td></td>
<td>(24.411)</td>
<td>(4.735)</td>
</tr>
</tbody>
</table>

Table 6. Sensitivity analysis: CS estimates ($) for truncated demand.

<table>
<thead>
<tr>
<th>Model</th>
<th>Overall</th>
<th>Group</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>210,674.80</td>
<td>96.29</td>
<td>37.33</td>
</tr>
<tr>
<td>2002</td>
<td>142,105.30</td>
<td>94.70</td>
<td>32.42</td>
</tr>
</tbody>
</table>

Discussion

Most studies that apply the travel cost method use cross-sectional data from one season or one year to estimate the demand functions (Cooper and Loomis, 1990; Peterson et al, 1985). This is adequate for making decisions with short timeframes, but it is not enough for making decisions in the long run. Inter-temporal data can be used to detect trends and to test for stability of behaviour (Hellerstein, 1993). Hellerstein used the likelihood ratio and Wald tests to test the stability of the coefficients of the estimated demand equations.

A likelihood ratio test¹⁸ was conducted to see if the demand curves in 1998 and 2002 were significantly different from each other, and the results clearly indicated a significant difference in demand for Gemfest between 2002 and 1998. The consumer surplus estimates calculated for the two years are summarized in Table 7: as can be seen, the total consumer surplus estimates fell by almost half from 1998 to 2002. This indicates that the demand for Gemfest was not very stable between the years 1998 and 2002.

The inter-temporal downward shift in demand could be due to various factors, some of which can be identified from the data sets. First the total number of visitors to the Gemfest event was higher in 1998 (5,644) than in 2002 (4,383). Second, there was a difference in the zonal visitation rate between 1998 and 2002. Visits from zones 1, 3, 5 and 7 were higher in 1998 than in 2002, while visits from the other zones were higher in 2002. Third, the average overall group size was higher in 2002 (2.92) than in 1998 (2.58), meaning that the travel costs per person would have been higher in 1998.

Other reasons for the downward shift in demand could be as follows: (a) the entry fee, which was lower in 1998 ($6) than in 2002 ($8), (b) the fall in tourism levels after 9/11 in 2001, (c) more competition for Gemfest with other events such as the Mt Isa rodeo being organized and conducted around the same time, and (d) a fall in attendance as the novelty of the event diminished.
Conclusion

Major recreational events are important to many regional centres for leisure and tourism purposes. Determining the economic impact of, the benefits accruing from and the value of special events and festivals is becoming important to help justify the expenditure of funding agencies (Murphy and Carmichael, 1991). Estimating the consumer surplus arising from such events will help in justifying the effort and cost of holding the event.

This study is novel in that it uses the TCM to provide estimates of consumer surplus arising from a special event. The TCM is normally used to estimate the value of recreational sites, such as national parks, rather than of events. Most economic analysis of special events focuses on estimating expenditure levels, but estimates of expenditure are not measures of economic value and so the application of the TCM offers a robust welfare measure of the net value of the event in question.

The application of the TCM has been facilitated in this case study by the limited period and remote location of the event in question: attendees had to travel to reach it and were less likely to be involved in multipurpose and multi-destination trips. It may not be as easy to apply the method to other events that do not share these characteristics to the same extent.

This case study also compares the economic value of a special event at two points in time. The value of Gemfest was estimated to be $1.5 million in 1998 and $0.81 million in 2002, demonstrating significant variation. The results suggest that the recreation values were sensitive to the number of visitors and the pattern of costs involved in travelling to the event.

The application of the TCM was sensitive to a number of issues. The treatment of international and other distant visitors (in terms of assignment to travel zones) has the potential to make a significant impact on values, but, given that many special events are aimed at the tourism market, it is not appropriate to ignore these visitors altogether. The standard travel cost problems of dealing with multi-destination and multi-purpose trips were also an issue, although these were reduced by the unique nature of the event. The estimation of travel costs was another issue: in this study, these were assessed on the basis of distance travelled by an average vehicle, which may be a different measure from that used by people to make their estimates before embarking on their trip. The decisions to exclude accommodation costs, opportunity cost of time and a measure of substitute sites from the models will have influenced the final estimates, and could have generated an upward bias in the final estimates of consumer surplus.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Group</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>1,506,891.56</td>
<td>688.85</td>
<td>266.99</td>
</tr>
<tr>
<td>2002</td>
<td>819,883.98</td>
<td>546.21</td>
<td>187.06</td>
</tr>
</tbody>
</table>
The overall method and results are promising in terms of providing a mechanism to value special events and to compare values over time. The application of the travel cost method to special events will require careful attention to design so that assessment issues arising from multi-purpose trips are minimized, but otherwise there is little difference between this and the application of the method to valuing recreation sites. The sensitivity tests conducted demonstrate that values may be influenced by underlying assumptions, indicating that these types of tests should become an integral part of a travel cost exercise.

**Endnotes**

1. There has been some debate over the choice of the dependent variable. Common (1973) explored the use of dependent variables other than \( V_h/N_h \) and found that the choice of dependent variable affects the consumer surplus estimates. In the ZTCM, the dependent variable is the number of visits made from a particular zone, over a specific period of time, divided by the population of that zone. In the ITCM, the dependent variable is simply the number of visits to a site made by each visitor over a specific period of time.

2. The distance for each zone was calculated from the mid-point of each zone to the location of Gemfest. The actual distances were calculated using the Website http://www.whereis.com/whereis/home.jsp.

3. Fix and Loomis (1997) rationalize that, even though time is part of the sacrifice of making a trip, it is not part of the monetary costs of the trip. 'Consumer surplus' is defined as the area under the demand curve, which is the price-quantity space and hence only the monetary costs of the trip should be used for the calculation of CS.

4. See Smith (1989) for a detailed discussion on zero-visit zones.

5. See Ward and Beal (2000, p 47).


8. The travel cost data for both years are available on request from the authors.


10. The tests of significance conducted on the travel cost variable clearly showed that it was not significant. The F and t test results had a \( p \)-value of 0.1, which is greater than the significance level of 0.05.

11. The linear model predicted 28,078 visitor groups and the semi-log independent model predicted 18,752,157 visitor groups at the existing level of entry fee.


13. The DW test statistic was 0.759. This is equal to the Durbin-Watson lower critical value for \( T = 11 \) and \( k = 3 \). The lower critical value = 0.758 and the upper critical value = 1.604. The presence of autocorrelation in the error terms of an OLS regression still results in unbiased coefficient estimates (Green, 1993).

14. Chi-square test value = 1.198 with a \( p \)-value of 0.28. Goldfeld-Quandt test value = 0.332 with a \( p \)-value of 0.41.

15. The average travel costs were calculated following Equation (1).

16. The choke price for 2002 was $9,000.

17. Luzar et al (1992) also found that consumer surplus estimates were sensitive to different demand cut-off points.

18. \( LL_r = -2 \log(\text{likelihood of joint model} - \log(\text{likelihood of 1998} + \log(\text{likelihood of 2002})) \). 

The degrees of freedom are the number of variables estimated in the models; in this case, it is 2.

**References**


Adamowicz, W.L., Fletcher, J.J., and Graham-Tomasl, T. (1989), 'Functional form and the statistical...


Appendix

Zones identified for the study

**Zone 1:** Gemfields (GEM) - where the Gemfest is held, including the towns of Anakie, Sapphire, Rubyvale and Willows.

**Zone 2:** Rest of Emerald Shire (E) - includes the towns of Emerald, Comet and Bogantungan.

**Zone 3:** Rest of Central Highlands (CH) - includes the shires of Bauhinia, Belyando, Duaringa, Jericho and Peak Downs.

**Zone 4:** Rest of Central Queensland (CQ) - includes the Statistical Divisions of Fitzroy, Central West and Mackay.

**Zone 5:** Rest of Queensland (QLD).

**Zone 6:** New South Wales (NSW).

**Zone 7:** Victoria (VIC).

**Zone 8:** South Australia (SA).

**Zone 9:** Western Australia (WA).

**Zone 10:** Tasmania (TAS).

**Zone 11:** Australian Capital Territory (ACT).

**Zone 12:** Northern Territory (NT).

**Zone 13:** International (INT) visitors.

**Zone 14:** Missing data.