Value of Domestic Tourists in Travel and Tourism Industry: Mpumalanga Province, South Africa

Report back to Industry

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5 February 2021

Introduction

What is Tourism?

The World Tourism Organisation defined tourism as follows:

> *"traveling to and staying in places outside their usual environment for not more than one consecutive year and not less than 24 hours for leisure, business and other purposes."*

Eight Sectors of tourism

- **Accommodation**: Is one of the largest and fastest growing sectors in the tourism industry. Constitute about 70% of revenue.
- **Recreational experiences or Travel adventures**: Whether nature or cultural, which is divided into two categories.
  - Hard adventure - Involves some risk and requires strenuous physical exertion on part of the participant.
  - Soft adventure - Is less risky, less strenuous, and requires little or no participation.
- **Attractions**: Is a place of interest where tourists visit - offering leisure/ amusement.

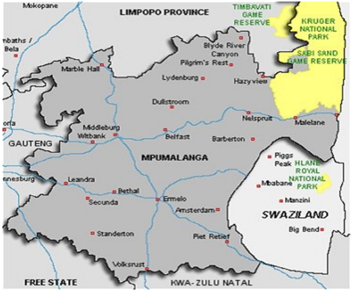
Eight Sectors of tourism

- **Events and conferences**: Contribute economically to communities. Special Events Conferences, Meetings, Trade Shows and Conventions form part.
- **The food and beverage**: Restaurants, bars, etc.
- **Tourism Services**: Made up of the organisations, associations, government agencies and companies that specialises in serving the needs of the tourism industry.
- **Transportation**: Provides for the movement, comfort and enjoyment of people (Road, air, water and rail)
- **Travel Trade**: Supports the bookings and sales in the other sectors (Travel Agencies and Tour Operators).

Mpumalanga

- The province lies in the eastern side of South Africa, also known as the place of the rising sun, and the name Mpumalanga itself means east.
- It bordered by two countries: Swaziland and Mozambique.
- It houses South Africa's 10th World Heritage Site, Barberton Makhonjwa Mountains, declared in July 2018 and the well-known Kruger National Park.

Figure: Map of Mpumalanga



- It is very rich with flora and fauna.
- Amongst its biggest industries are tourism, farming and mining.

Study Problem

The problem to be investigated is how customised packages of tourism products/services can be utilised to mitigate the challenge of catering for the domestic market.

Generally, the tourist industry is focused toward international travellers due to stronger currencies. However, due to the current global pandemic, domestic tourism is considered a means to save national tourism industries.

Problem Solution Approach

We asked the question:

What would encourage a local person to be a domestic tourist?

This question is more specifically aimed at touring within their own province than visiting another province.

However, one of the statements in the original problem presentation implied that whatever solution is found may also be applicable to other provinces.

Therefore, we wanted to take a generalist approach.

By our logical reasoning, the main factor which would encourage domestic tourism from a local's perspective is "getting best bang for buck", that is, minimising the cost for a local.

This is opposite to the viewpoint of a tourist operator which would want to maximise their revenue.

We reasoned that if we could encourage locals to travel by getting them to spend less, this would lead to a win-win scenario for both the tourist and the tourist operator.

Definitions

With our reasoning in mind, instead of considering all eight sectors of tourism, we considered only

- accommodation,
- transportation
- food and beverages
- attractions and recreation.

We reasoned that these would be the foremost consideration of any domestic tourist.

Cost functions

We defined the cost functions

$$
\begin{aligned}
A &= A(n) && \text{(accommodation)} \\
T &= T(n) && \text{(transportation)} \\
F &= F(n) && \text{(food and beverages)} \\
R &= R(n) && \text{(attractions and recreation)}
\end{aligned}
$$

where $n \in \mathbb{N}$, such that $n \geq 1$, represents the number of people.

Package cost function

The cost functions A, T, F, R would then be combined into a single *package cost function*

$$p(n) = \omega_A A(n) + \omega_T T(n) + \omega_F F(n) + \omega_R R(n)$$

where ω_j ($j = \{A, F, R, T\}$) are weights subject to $\omega_A + \omega_F + \omega_R + \omega_T = 1$. (Note that this is package cost per group of people.)

Quality and season

Also of importance to the tourist experience, and costs involved therewith, is the quality of experiences/products as well as seasonal considerations.

Let

$$q \in \{\mathrm{H}, \mathrm{M}, \mathrm{L}\}$$

and

$$s \in \{\mathrm{H}, \mathrm{M}, \mathrm{L}\}$$

where

$$\mathrm{H} = \mathrm{high}, \quad \mathrm{M} = \mathrm{mid}, \quad \mathrm{L} = \mathrm{low}$$

We wanted to keep the model as simple as possible at first and therefore only considered q and s as parameters which would scale costs.

Cost function expressions

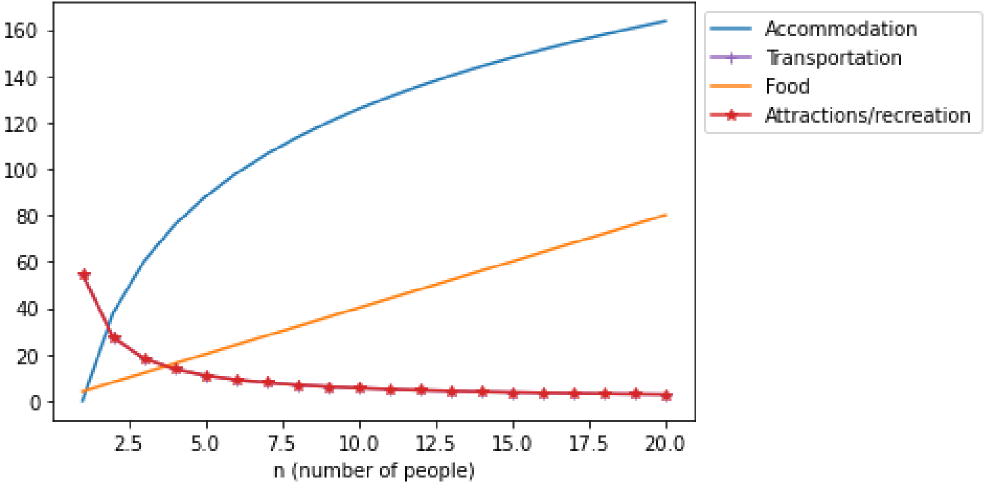
For the individual cost functions we considered

$$A(n) = e^{(q+s)} \ln(n) \qquad F(n) = qns$$

$$T(n) = \frac{e^{q+s}}{n} \qquad R(n) = \frac{e^{q+s}}{n}$$

where one can see the parametric scaling nature of q and s.

Our reasoning behind choosing the cost functions in this manner is in line with our vague understanding of the industry, but was agreed upon by the industry representative.



In hindsight, we realise that T and R should have been chosen differently, but so as to show the same behaviour.

Methodology

Goal

Our original goal was to minimise the package cost function

$$p(n) = \omega_A A(n) + \omega_F F(n) + \omega_T T(n) + \omega_R R(n)$$

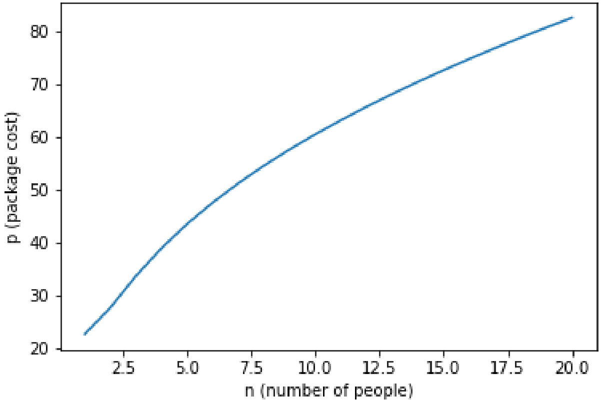
with respect to the weights ω_j depending on certain scenarios that we would consider.

(Maybe even consider this as a multi-objective optimisation problem?)

To get a better feel for the behaviour of our package cost function, we chose weights and plotted p versus n for various scenarios.

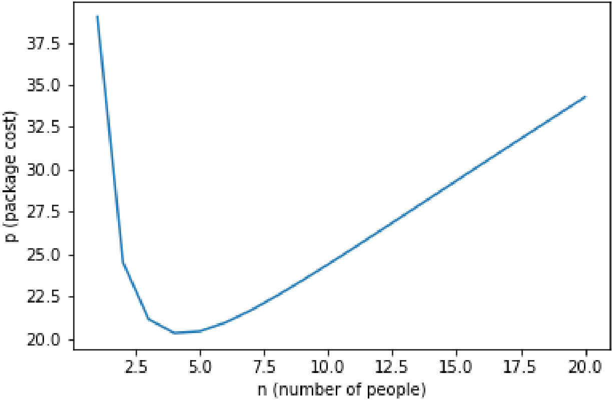
Accommodation preferred

Weights: $\omega_A = 0.4,\ \omega_F = 0.2,\ \omega_T = 0.2,\ \omega_R = 0.2$



Attraction/recreation preferred

Weights: $\omega_A = 0.1,\ \omega_F = 0.2,\ \omega_T = 0.3,\ \omega_R = 0.4$



Lagrange Multiplier Method

At first, we attempted to solve

$$\begin{array}{ll} \text{min} & p(n,\vec{\omega}) = \omega_A A(n) + \omega_F F(n) + \omega_T T(n) + \omega_R R(n) \\ \text{subject to} & \omega_A + \omega_F + \omega_T + \omega_R = 1 \end{array}$$

where $\vec{\omega} = (\omega_A, \omega_F, \omega_T, \omega_R)$, using the Lagrange Multiplier Method.

For this we defined the constraint vector

$$h(n,\vec{\omega}) = \omega_A + \omega_F + \omega_T + \omega_R - 1$$

From $\nabla p(n, \vec{\omega}) + \lambda \nabla h(n, \vec{\omega}) = 0$ we obtained

$$\frac{\omega_A e^{q+s}}{n} - \frac{(\omega_T + \omega_R)e^{q+s}}{n^2} + \omega_F qs = 0$$

$$e^{q+s} \ln(n) + \lambda = 0$$

$$\frac{e^{q+s}}{n} + \lambda = 0 \qquad \text{(repeats because } T = R\text{)}$$

$$qsn + \lambda = 0$$

This system seems untenable because only one equation contains the weights.

When at first you don't succeed... KISS! (Keep It Simple Stupid)

From the earlier figures, it seems a single minimum exists when considering $p = p(n)$ under certain scenarios. Hence, we decided to change tack and tried to minimise

$$p(n) = \omega_A A(n) + \omega_T T(n) + \omega_F F(n) + \omega_R R(n)$$

where the weights are now arbitrarily chosen and constant.

Calculate

$$\frac{\mathrm{d}p}{\mathrm{d}n} = \frac{\omega_A e^{q+s}}{n} - \frac{(\omega_T + \omega_R)e^{q+s}}{n^2} + \omega_F qs$$
$$\frac{\mathrm{d}^2p}{\mathrm{d}n^2} = -\frac{\omega_A e^{q+s}}{n^2} + \frac{2(\omega_T + \omega_R)e^{q+s}}{n^3}$$

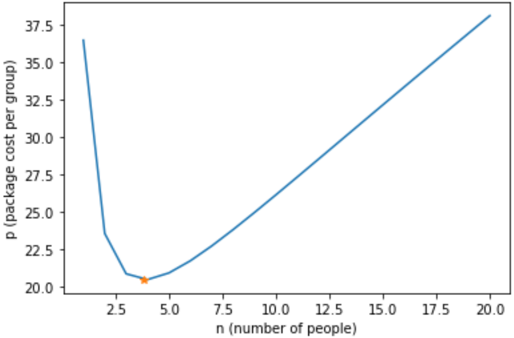
with the requirement, from elementary calculus, that $\mathrm{d}p/\mathrm{d}n = 0$ and $\mathrm{d}^2p/\mathrm{d}n^2 > 0$ for a minimum.

We used the `fsolve` function from SciPy's optimize library to solve $\mathrm{d}p/\mathrm{d}n = 0$. The function failed when we considered ω_A larger than the other weights, but yielded a minimum for other scenarios.

Example (attraction/recreation focus)

Single minimum

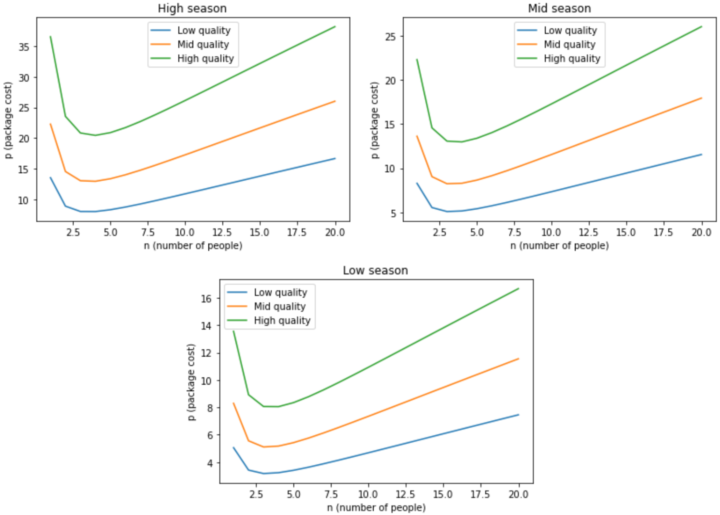
Weights: $\omega_A = 0.1$, $\omega_T = 0.25$, $\omega_F = 0.25$, $\omega_R = 0.4$; Quality: $q = \mathrm{H} = 2$; Season: $s = \mathrm{H} = 2$



Minimum obtained at $n_c \approx 3.82304546$ with $p(n_c) \approx 20.42777633$.

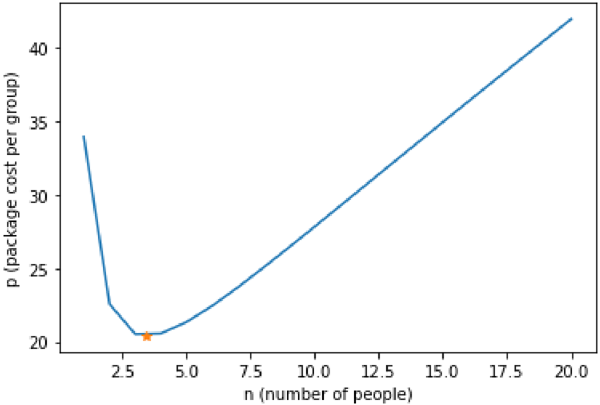
Example (attraction/recreation focus)

Quality variation per season



Example (Transportation/food focus)

Weights: $\omega_A = 0.1,\ \omega_T = 0.4,\ \omega_F = 0.3,\ \omega_R = 0.2$, high quality, high season



$n_c \approx 3.42370405,\ p(n_c) \approx 20.39622473$

Conclusion

Deductions

From our modelling and numerical experiments, we may deduce the following:

- a minimum occurs for scenarios where accommodation is not preferred;
- from numerical experiments it appears that this minimum lies between 3 and 4 people;
- from a tourist point of view, we'd rather book for a smaller group than one large group—even though the price per person might be cheaper for one large group.

Future work

- Choose better cost functions
- Involve more realistic independent variables
- Better formulation of the optimisation problem
- Also consider the optimisation of the tourist operator's revenue simultaneously.
- *Become better at modelling and optimisation!*

Thanks

- University of the Witwatersrand and CoE-MaSS for hosting VMISG 2021.
- Organising committees and technicians for all their hard work to keep things running smoothly.
- Dr Precious Shabalala for her interesting and thought-provoking problem.
- All the group members for their hard work during this week!

Any questions?