Logistic Regression Model for Entrepreneurial Capability Factors in Tourism Development of the Rural Areas with Bayesian Inference Approach

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Abstract. The logistic regression model is used to analyze the entrepreneurial capability factors in the rural area’s tourism development with the Bayesian inference approach due to a small number of sample sizes. This study is conducted with sixty nascent entrepreneurs from the rural areas at Nagari Batang Barus of Solok regency in West Sumatra, Indonesia. Scaled categorical response variable indicated by insufficient, sufficient, average and excellence as the response category are used to measure the entrepreneurial capability of the respondents. The predictor variables are demographic dimensions, namely gender, education level, and occupation. At the same time, the variables of the entrepreneurial dimension are indicated by entrepreneurial motive, working motive, social motive, individual motive, and economic motive. The result shows that only the predictor variables of social motive and entrepreneurial motive affect significantly with a hit ratio of 76.67%. This model has a better fit by using Bayesian logistic regression with a small sample size. Social motive and entrepreneurial motive have the main rule in developing tourism business in the rural area based on the character of the local inhabitant and creative economy.

1. Introduction
The development of the tourism sector in the Indonesian economy has grown rapidly, which is indicated by the increasing number of tourist visits and foreign exchange income every year. This encourages every region that has become a leading tourist destination in Indonesia to improve the quality of amenities, accessibility, and regional economic arrangement. The local government and local communities are trying to make new breakthroughs so that the tourism sector, which is a leading sector, has large and effective leverage in driving the economy and fostering creative economy entrepreneur groups. Studies on tourism potential as an economic lever have been carried out in various regions through strengthening the capacity and capability of entrepreneurs in rural areas.

The growth of tourist visits has revived local economic activity; this evidence has provided a new direction to accelerate economic growth\textsuperscript{[1,2]} Besides, tourist development has increased the value of economic measure\textsuperscript{[3]} and creative industries among the entrepreneurs’ group\textsuperscript{[4]}. In developing joint
business groups in tourist destination areas, the ability to develop creative economy businesses is a challenge for nascent entrepreneurs in facing global competitiveness. The capability and creative behavior of nascent entrepreneurs should be carried out to develop a joint venture group in local community-based tourism development. There are some studies on developing the rural area into a tourist destination arranged by the local community. The research survey on entrepreneurs’ tourist development has been conducted by sub-cultural tourism motivation \([5]\), value and entrepreneurial motivation \([6,7]\), the performance of SMEs based on motivation and entrepreneurship \([8]\), and also entrepreneurial intention\([9,10]\).

The development of a creative economy at a rural area tourist destination in accordance with nascent entrepreneurs has to expand into sustainable economic activity. The first step is to achieve the goal of a local community-based tourist destination. It is important to know the character and behavior of nascent entrepreneurs by paying attention to their motivation and capabilities to create creative community enterprises. There are specific factors affecting the motivation and capability of local entrepreneurs, and there are applied some methods to measure the factors, robust estimation in predicting entrepreneurial intentions and actions \([11]\), entrepreneurial model by structural equation modeling \([12]\), and cluster-based logistic regression \([13]\). Furthermore, it is also discussed the cultural and creative entrepreneurs’ identity \([14]\), social embeddedness and creative business reconstruction \([15,16]\), and entrepreneurial capability for business incubation \([17]\), sector-based and its promises \([18]\).

This study will discuss the entrepreneurial capability factors in the rural area’s tourist development for developing joint venture enterprises of the creative economy by nascent entrepreneurs. There are some models introduced for tourism research, such as the logit models for entrepreneur support \([19]\) and travelers’ satisfaction with the Bayesian network \([20]\). The ordinal logistic regression method is a non-Gaussian model, the characterization of the variable may explain as Fourier-Stieltjes transform containing Levy measure such as in \([21,22]\), then the probability distribution could be characterized by using its Levy measure of characteristic function in the Bayesian approach. The logistic regression model will be governed with a small number of nascent entrepreneurs in the rural area as respondents for entrepreneurial capability factors has to deal with the appropriate method. This paper proposed the Bayesian inference approach to modeling logistic regression for the entrepreneurial capability factors with a small number of sample sizes and some of the predictor variables.

2. Research Methods
In this study, the data is collected by using a questionnaire that was distributed to sixty nascent entrepreneurs in Nagari Batang Barus of West Sumatra involved in the program of community services for developing tourist destinations with religious attraction in rural area of Indonesia along the year 2020. The questionnaire measures for entrepreneurial capability factor as the response variable \((Y)\) and the predictor variables defined as gender \((X_1)\), age group \((X_2)\), marital status \((X_3)\), education level \((X_4)\), occupation \((X_5)\), group activity \((X_6)\), entrepreneurial motive \((X_7)\), working motive \((X_8)\), social motive \((X_9)\), individual motive \((X_{10})\) and economy motive \((X_{11})\).

The data analysis in this study is performed by using Bayesian logistic regression inference to modeling the relationship between the variables of capability in the ordinal number scale indicated by insufficient, sufficient, average, and excellence with the predictor variable. In addition, it is described the characteristic of respondents by using descriptive statistics, whereas inferential statistics are used to test the significance of the fit model by using the Bayesian inference approach and its comparative on the length of the confident interval of parameter estimation with the Bootstrap replication method.

3. Results and Discussion
This study will perform Bayesian inference for ordinal logistic regression in modeling entrepreneurial capability factor with nascent entrepreneurs as the respondents. The characteristics of these respondents in developing rural area’s tourist destination at Nagari Batang Barus of West Sumatra can be explored through descriptive statistics on its profiles. This description is used to find the first
simple understanding of nascent entrepreneurs profile for its distribution of gender, age group, marital status, education level, occupation, and group activity.

The characteristics of nascent entrepreneurs at Nagari Batang Barus of West Sumatra are presented in Table 1. The proportion of female respondents is more than half, with most of them have culinary endeavors famous as the Minangkabau women of West Sumatra. The age of respondents is dominated under 31 years, even though it is fairly spread into all levels of age. Most of the respondents are married, they are only 36.67% respondents unmarried due to status as a local student. The education levels of respondents spread at all levels with graduating their senior high school as the highest percentage. Meanwhile, the current occupation is dominated by the farmer; it is well known the Solok regency as the best-cultivated area in Indonesia. Furthermore, the group-based activity is fairly spread to all group segmentation.

Table 1. Profile of nascent entrepreneurs in the tourism sector from Nagari Batang Barus of West Sumatra.

| Variable                     | Percentage |
|------------------------------|------------|
| Gender                       |            |
| Male                         | 46.67%     |
| Female                       | 53.33%     |
| Age                          |            |
| 16-20 Years                  | 10.00%     |
| 21-25 Years                  | 15.00%     |
| 26-30 Years                  | 35.00%     |
| >31 Years                    | 40.00%     |
| Marital Status               |            |
| Married                      | 63.33%     |
| Unmarried                    | 36.67%     |
| Education Level              |            |
| Elementary School            | 6.67%      |
| Junior High School           | 20.00%     |
| Senior High School           | 40.00%     |
| Higher Education             | 33.33%     |
| Current Occupation           |            |
| Employee                     | 20.00%     |
| Small Enterprise             | 26.67%     |
| Small Trader                 | 13.33%     |
| Farmer                       | 40.00%     |
| Group Activity               |            |
| Women Empowerment Welfare Group | 23.33%   |
| Village-owned Enterprises    | 13.33%     |
| Youth Group                  | 26.67%     |
| Cultural Group               | 25.00%     |
| Tourism Conscious Group      | 11.67%     |

The characteristics of nascent entrepreneurs have described the profile of respondents. This preview has captured important information regarding gender, age, marital status, education level, current occupation, and group activity. The next step is to establish the best model estimation of Bayesian ordinal logistic regression simultaneously to select the significant variable; the data are tested simultaneously using G statistic test or likelihood ratio test.
Table 2. Model Fitting Information

| Model          | -2 Log Likelihood | Chi-Square | Df | Sig. |
|----------------|-------------------|------------|----|------|
| Intercept Only | 138,437           |            |    |      |
| Final          | 75,183            | 69,550     | 14 | 0.000|

Table 2 has presented model fitting information, it is obtained that the statistical test for $G > \chi^2_{0.05,14}$ with $p$-value < 0.05. This is a rejection of the null hypothesis because the statistic $G$ test is bigger than $\chi^2$ table. This means some predictor variables significantly affected response variables. The next step is to perform the partial test by using the statistic Wald test because the initial hypothesis is rejected. The summaries of the statistic Wald test have presented only significant predictor variables, which $p$-value less than $\alpha=0.05$, such as explained in the Table 3. Therefore, we can conclude that the only two significant predictor variables in the model that are entrepreneurial motive ($X_3$) and social motive ($X_7$).

Table 3. Parameter Estimation

| Variable                  | Estimation | Wald | Df | Sig. |
|---------------------------|------------|------|----|------|
| Entrepreneurial Motive ($X_3$) | 0.288      | 4.453| 1  | 0.035|
| Social Motive ($X_7$)     | 0.527      | 21.882| 1  | 0.000|

The way to create the confidence interval of the estimated parameter in the model is performed by Bootstrap replication as the computational approach with $B = 200$ bootstrap samples for each consists of $n = 60$ observations. This Bootstrap is performed as a comparison of estimation accuracy based on the length of the confidence interval to the Bayesian inference approach, where Bayesian ordinal logistic regression is performed by Markov Chain Monte Carlo (MCMC) simulation for 10,000 iterations with Gibbs sampling technique for parameter estimation. The parameters are obtained after the convergence iteration process that is reached by the stability of the trace plot in Figure 1 for the final results of parameter estimation, where the first step of the Bayesian inference approach of parameter estimation is presented in Table 4. Predictor variables with categorical type data are performed by dummy variables with a number of the categorical type, such as in Table 1.

Table 4. First Parameter Estimation Result with Bayesian Inference

| Parameter   | Mean   | SD     | MC Error | 95% Credible Interval | Lower | Upper |
|-------------|--------|--------|----------|-----------------------|-------|-------|
| $a[1]$      | 27.762 | 5.6927 | 0.2921   | 16.1267               | 38.4271|
| $a[2]$      | 30.631 | 6.0984 | 0.3013   | 19.1685               | 41.1768|
| $a[3]$      | 33.017 | 7.1163 | 0.3295   | 21.9816               | 48.0914|
| $\beta X_1[1]$ | 0.6735 | 1.1815 | 0.0179   | -1.4982               | 2.9712 |
| $\beta X_2[1]$ | -3.2179 | 2.7087 | 0.0567   | -8.8016               | 2.0896 |
| $\beta X_2[2]$ | -1.2033 | 0.7635 | 0.0136   | -2.9801               | 0.2744 |
| $\beta X_2[3]$ | -1.1743 | 0.7735 | 0.0126   | -2.8219               | 0.2834 |
| $\beta X_3[1]$ | 0.5935 | 1.235  | 0.01971  | -1.5587               | 3.1492 |
| $\beta X_4[1]$ | 0.9439 | 1.0856 | 0.0592   | -3.0660               | 5.1674 |
| $\beta X_4[2]$ | 1.5492 | 1.2233 | 0.0619   | -1.7621               | 4.6178 |
| $\beta X_4[3]$ | 2.6283 | 1.4953 | 0.0473   | -0.2511               | 5.2761 |
| $\beta X_5[1]$ | -1.5021| 1.2013 | 0.0326   | -5.0986               | -0.2412|
The variability of the method used in estimating the parameters can also be seen through the MC error as the standard deviation of the batch mean. If the MCMC error value generated is still large, then the MCMC algorithm is repeated with a larger iteration. In this model, the result of MC errors is presented in Table 4 and Table 5 with a relatively small variability value, so that the Bayesian inference approach can be accepted for parameter estimation.

The first parameter estimation results performed by Bayesian inference in Table 4 have described only two significant variables where the credible interval does not consist of zero with small MC Error. The next step is performed Bayesian inference to obtain estimated parameters on only involved the two predictor variables of entrepreneurial motive \((X_5)\) and social motive \((X_7)\) with the final result presented in Table 5.

| Parameter | Mean   | SD    | MC Error | Lower  | Upper  |
|-----------|--------|-------|----------|--------|--------|
| \(\alpha[1]\) | 13.0151 | 2.8796 | 0.0980   | 7.8416 | 17.9512 |
| \(\alpha[2]\) | 15.3946 | 2.9708 | 0.1059   | 9.9816 | 20.8951 |
| \(\alpha[3]\) | 18.1016 | 3.2675 | 0.1165   | 12.6019 | 24.1375 |
| \(\beta.X7\) | 0.3013 | 0.1315 | 0.0049   | 0.0402 | 0.5591 |
| \(\beta.X9\) | 0.5411 | 0.1201 | 0.0034   | 0.3528 | 0.7708 |

**Table 5.** Final Model with Parameter Estimation Result with Bayesian Inference

![Figure 1. Trace Plot of Convergence Parameter Estimation with Bayesian Inference](image)
The confidence interval of each parameter of significant predictor variable in Table 4 as the final result shows the difference where the other predictor variables absent due to an insignificant effect from the first step model. The best ordinal logistic regression models by using the Bayesian inference finally it is obtained in the following mathematical expression:

\[
\text{logit } \pi_i(x) = 13.0151 + 0.3013x_i + 0.5411x_y \\
\text{logit } \pi_i(x) = 15.3946 + 0.3013x_i + 0.5411x_y \\
\text{logit } \pi_i(x) = 18.1016 + 0.3013x_i + 0.5411x_y
\]

| Predictor          | Parameter Estimation | Std Error | 95% Confidence Interval (CI) | Lower | Upper | Length of CI | Lower | Upper | Length of CI |
|--------------------|----------------------|-----------|-----------------------------|-------|-------|--------------|-------|-------|--------------|
| Constant (1)       | 13.0151              | 2.8796    |                             | 7.1289| 19.2933| 12.1644      | 7.1142| 21.6101| 14.4959      |
| Constant (2)       | 15.3946              | 2.9708    |                             | 9.1613| 21.5923| 12.4310      | 9.5091| 24.7360| 15.2269      |
| Constant (3)       | 18.1016              | 3.2675    |                             | 11.8705| 24.8962| 13.0257      | 11.4663| 28.8461| 17.3798      |
| Entrepreneurial Motive (X_3) | 0.3013  | 0.1315 |                             | 0.0261| 0.5762| 0.5501      | 0.0189| 0.6450| 0.6261       |
| Social Motive (X_7) | 0.5411              | 0.1201    |                             | 0.3169| 0.8974| 0.5805      | 0.2942| 0.9923| 0.6981       |

The length of the confidence interval has presented in Table 6. It is performed Bootstrap method as the computational approach to create a confident interval with 200 Bootstrap replications. The results of the Bootstrap method with the computational approach are comparable with the Bayesian inference approach since both of them are generated based on computational simulation. Based on Table 6 we have Bootstrap replication has good performance to build the confidence interval of ordinal logistic regression. However, the Bayesian inference approach has better performance with the length of confidence interval narrower than Bootstrap replication methods for parameter estimation.

The next step will give an explanation of the significant variables that affect the level of entrepreneurial capability of nascent entrepreneurs. The value of the odds ratio is presented in Table 7. The odds ratio for the predictor variable of entrepreneurial motive is 1.3501, this means that increasing one unit entrepreneurial motive will raise the risk of 1.3501 times the high of entrepreneurial capability. Besides, the risk resulted from an increase of 1 unit predictor variable of social motive is 1.7197 times the entrepreneurial capability will be increased because of its odds ratio at the point of 1.7197. In addition, both variables have a positive impact, significantly influence entrepreneurial capability.

| Parameter          | Estimation | Odds Ratio |
|--------------------|------------|------------|
| Entrepreneurial motive | 0.3013    | 1.3501     |
| Social motive      | 0.5411    | 1.7197     |

The last step is to calculate the exact value of the classification between the actual value and the predicted value based on the Bayesian inference of ordinal logistic regression. The model predictions on the response variable are categorized into insufficient, sufficient, average, and excellence wrote
into the accuracy of the classification table. For more details, this miss-classification can be seen in the following Table 8.

| Observation | Prediction | Classification of accuracy percentage |
|-------------|------------|---------------------------------------|
|             | Insufficient | Sufficient | Average | Excellence |                        |
| Insufficient| 9           | 2          | 0       | 0          | 81.82%                  |
| Sufficient  | 1           | 11         | 3       | 1          | 68.75%                  |
| Average     | 0           | 4          | 18      | 2          | 75.00%                  |
| Excellence  | 0           | 0          | 1       | 8          | 88.89%                  |
| Overall percentage |          |            |          |            | 76.67%                  |

The accuracy of the classification of the model of Bayesian inference for ordinal logistic regression is 76.67% as the accuracy of prediction correctly. This accuracy is sufficient enough as a good classification result and feasible used to predict the response variable as the entrepreneurial capability of nascent entrepreneurs at Nagari Batang Barus of West Sumatra.

This study has explored the development of entrepreneurial capability factors in tourism of rural areas as a tourist destination at Nagari Batang Barus of West Sumatra. The results of this study with a small sample size, only sixty respondents have a good performance by using Bayesian inference for ordinal logistic regression. The result shows that only the predictor variable of entrepreneurial motive and social motive have affected the entrepreneurial capability factor, this is in line with the character of the inhabitant of Province of West Sumatra with Minangkabau cultural heritage, where this ethnic is known as the accomplished trader who has a high spirit of togetherness and helps to help in trading.

4. Conclusion
This study gives the analysis of entrepreneurial capability factors in developing tourist destinations of the rural areas at Nagari Batang Barus of West Sumatra. The sixty nascent entrepreneurs from this area involved in the community services programs to explore their preference in developing the area into a tourist destination based on local resource and creative economy. The Bayesian inference method is performed into ordinal logistic regression with the response variable is entrepreneurial capability as a categorical variable associated with insufficient, average, sufficient, and excellence. The result shows that only two predictor variable affected the response variable significantly that are entrepreneurial motive and social motive with hit ratio 76.67%, this value has to confirm the good performance of ordinal logistic regression method deal with the problem, the method of ordinal logistic regression with Bayesian inference approach is good and feasible to model this case. The entrepreneurial motive and social motive have to confirm that nascent entrepreneurs have the high spirit of togetherness in building venture business group as the character of Minangkabau ethnic in expanding their trading and company as specific cultural and heritage at Indonesia.

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