広島大学大学院先進理工系科学研究科 博士課程前期入学試験

Graduate School of Advanced Science and Engineering (Master's Course), Hiroshima University

Entrance Examination

一般選抜（2026 年 1 月実施）

General Selection (January 2026)

解答又は解答例等 及び 出題の意図

Answers or Model Answers / Intent of the Questions

　解答の公表に当たって，一義的な解答が示せない記述式の問題等については，「出題の意図又は複数の若しくは標準的な解答例等」を公表することとしています。

　また，記述式以外の問題についても，標準的な解答例として正答の一つを示している場合があります。

　In publishing answers, "the intent of the questions or multiple or standard examples of answers" are published for essay-type questions for which no univocal answer can be given.

　In addition, one of the correct answers may also be given as an example of a standard answer for questions other than the essay-type.

試　験　科　目　名 Subject	受　験　番　号 Examinee's number
地域・都市計画	M

<注意事項>
　全てのページに科目名，受験番号を記入すること。

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　Write the subject and examinee's number in each sheet.

※選択問題については，選択した問題番号を記入してください。
In case of elective questions, write the selected question number.

Example answers to Question 1

Machine learning methods are mostly working in black-box, lack of explainability and intepretability, although relatively stronger in predictability performance.

Random utility based theoretical models have strong theoretical assumptions, statistical basis, and are thus reliable and are good for interpretability, but also underperform machine learning methods.

The two methods are different in its fundamental assumptions, machine learning is data-driven, while random utility models are theory driven.

There are many examples with applications using the two methods. As an example answer, one can think of mode choice predictions and discuss further on the methodological difference in applications.

Example answers to Question 2

Normal distribution assumption leads to Probit type of models.

When the distribution is assumed to be Gumble, Logit models can be derived.

Example answers to Question 3

Constant indicates a base preference, positive values mean a positive preference to car.

$VOT_{car} = \beta_{car}(TT) / \beta_{car}(TC)$, similarly calculating VOT for other alternatives.

Because unit difference between JPY/min, simple transformation is needed to reach JPY/hour

Discussion in combination with practice can be, for example, the value of time of a job, imagine the average wages for a worker, and compare the value with the calculated values here, and make justifications.

試 験 科 目 名 Subject	受 験 番 号 Examinee's number
交通工学	M

<注意事項>
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Question 1:

(1) Negative externalities refer to costs imposed on others that are not reflected in market prices or individual decision-making. In the context of car use, drivers typically consider only their private costs, such as fuel expenses and travel time, while ignoring the social costs their driving imposes on others. In urban transportation systems, car use generates several important negative externalities. One major example is **traffic congestion**. When an additional car enters a congested road, it increases travel time not only for the driver but also for all other road users. However, the driver does not bear the full cost of this delay imposed on others. Another example is **environmental pollution**, including local air pollutants and greenhouse gas emissions. These emissions contribute to health problems, environmental degradation, and climate change, affecting society as a whole rather than only the driver. Furthermore, **traffic accidents** impose social costs such as medical expenses, emergency services, and productivity losses, many of which are not fully internalized by individual drivers. Because these negative externalities are not fully priced into car use, the level of driving in urban areas tends to be socially excessive compared to the socially optimal level.

(2) Providing car users with the shortest route based solely on individual travel time may lead to undesirable system-wide outcomes for the following reasons. First, information provision may induce a **hunting (oscillation) phenomenon**. When many drivers simultaneously shift to the currently shortest route, congestion rapidly builds up on that route, causing drivers to switch again in subsequent periods. This repeated switching leads to unstable traffic patterns and prevents the system from achieving an efficient and stable state. Second, the shortest route is often **a narrow local street**. Routing traffic onto such streets frequently generates through traffic in residential areas, increasing safety risks for pedestrians and cyclists, as well as noise and environmental burdens. Since these local impacts are not reflected in individual travel time, shortest-route guidance can undermine neighborhood safety and quality of life.

(*Either point is sufficient for full marks*)

Question 2:

One example of a new mobility service is ride-hailing. This service has several advantages and disadvantages when evaluated in terms of efficiency, equity, and externalities.

Advantages:
First, ride-hailing can improve efficiency by reducing waiting times and increasing flexibility in travel, especially in areas or time periods with limited public transport services. Second, it can enhance equity by providing mobility options for people without access to private cars, such as elderly individuals or those who cannot drive. Third, ride-hailing may reduce the need for private car ownership, potentially lowering parking demand in urban areas.

Disadvantages:
First, ride-hailing services can increase negative externalities, particularly traffic congestion and vehicle kilometers traveled, as additional trips are generated. Second, from an equity perspective, these services may primarily benefit higher-income users and exclude those without smartphones or digital literacy. Third, ride-hailing can weaken the financial sustainability of public transport by diverting passengers, which may reduce service quality for transit-dependent users.

Overall, while ride-hailing offers efficiency gains for individual users, it can create social costs and distributional concerns if not properly regulated.

Question 3:

(1) Assume that individual n chooses one mode $m \in \{car, bus, rail\}$. The utility of mode m is given by a linear-in-parameters random utility model: $U_{nm} = V_{nm} + \varepsilon_{nm}$ where the systematic utility V_{nm} is specified as $V_{nm} = \beta_{TT}TT_{nm} + \beta_{TC}TC_{nm} + \beta_{AD}AD_{mn}$, where TT_{nm} is travel time, TC_{nm} is travel cost, and AD_{mn} is access distance for individual n and mode m.

Assuming the error terms ε_{nm} are independently and identically distributed with a Type I extreme value distribution, this leads to a multinomial logit model for mode choice as follows:

$$P_{mn} = \frac{\exp(V_{nm})}{\sum_{m'} \exp(V_{nm'})}$$

(2) Travel time represents the time burden of commuting and is expected to have a negative effect on utility, as longer travel times reduce the attractiveness of a mode. Travel cost captures monetary costs such as fares or fuel expenses and is also expected to negatively affect utility. Access distance reflects the ease of reaching the transport mode, particularly important for public transport. A longer access distance generally lowers the likelihood of choosing that mode. In addition to these variables, other factors may influence mode choice. For example, income may affect sensitivity to travel cost, car ownership may increase the utility of car use, and comfort or reliability variables may capture qualitative differences across modes. Including such variables can improve the behavioral realism of the model.

(3) One limitation of this model is the independence of irrelevant alternatives (IIA) property implied by the multinomial logit specification, which may be unrealistic when alternatives such as bus and rail are similar. Another limitation is that unobserved individual heterogeneity in preferences is not explicitly modeled, which may lead to biased parameter estimates.

Question 4:

(1) There are two available routes:

Upper route: Residential $\to$ A $\to$ CBD, with travel time $T_U = x_1 + 40$.

Lower route: Residential $\to$ B $\to$ CBD, with travel time $T_L = 40 + x_2$.

Let f_U and f_L denote the route flows. Since the total number of commuters is 36, $f_U + f_L = 36$.

At user equilibrium, all used routes have equal travel time:

$f_U + 40 = 40 + f_L$. Thus, $f_U = f_L = 18$.

The equilibrium travel time is $40 + 18 = \textbf{58 minutes}$.

(2) After the construction of the new link between A and B with travel time 5 minutes, a third route becomes available: Residential $\to$ A $\to$ B $\to$ CBD. Let f_U, f_L, and f_M denote the flows on the upper, lower, and middle routes, respectively, with $f_U + f_L + f_M = 36$. The congestible link flows are $x_1 = f_U + f_M$ and $x_2 = f_L + f_M$. The travel times are: $T_U = x_{OA} + 40$, $T_L = 40 + x_{BD}$, and $T_M = x_1 + 5 + x_2$. At equilibrium, all commuters choose the middle route: $f_M = 36, f_U = 0$ and $f_L = 0$. This yields $x_1 = 36$ and $x_2 = 36$, and all routes have **travel time 77 minutes**.

(3) Social welfare is evaluated using total system travel time (TSTT).

Scenario (a): TSTT = $36 \times 58 = 2088$ person-minutes.

Scenario (b): TSTT = $36 \times 77 = 2772$ person-minutes.

Since total system travel time increases after the road construction, **the project does not improve social welfare** (known as Braess's Paradox).

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建築・都市環境学	M

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In case of elective questions, write the selected question number.

【出題の意図】

問題１．建築のパッシブクーリングに関する以下の問題に答えよ。
Question 1. Answer the following questions concerning passive cooling for buildings.

（１）　本研究室で取り組むパッシブクーリングに関する基本的な理解度を把握する。
To examine the degree of basic understanding for the passive cooling that our research group is focusing on.

（２）　本研究室で共同開発する床冷却システムの基本的な理解度を把握する。
To examine the degree of basic understanding for the floor cooling system that is jointly developed by our research group.

（３）　放射冷却システムの典型的なリスクである結露のメカニズムや対処方法に関する理解度を把握する。
To examine the degree of understanding the mechanism of condensation and its countermeasures, which is a typical risk caused by a radiant cooling system.

問題２．住宅内のダンプネスとカビの発生に関する以下の問題に答えよ。
Question 2. Answer the following questions concerning dampness and mold growth in residential buildings.

（１）　住宅内のダンプネスに関する基本的な理解度を把握する。
To examine the degree of basic understating for dampness in buildings.

（２）　カビによる健康被害に関する基本的な理解度を把握する。
To examine the degree of basic understanding for health problems caused by mold growths.

（３）　当該分野で典型的なトレードオフである空気質問題と省エネとのトレードオフについての考えを問う。
To examine the ideas for the trade-off between indoor air quality problems and energy-savings, which is a typical trade-off in our field.

問題３．標準年気象データ（TMY）に関する以下の問題に答えよ。
Question 3. Answer the following questions concerning Typical Meteorological Year (TMY) data.

（１）　TMY の基本的な理解度を把握する。
To examine the degree of basic understanding for the TMY.

（２）　TMY の具体的な利用方法に関する理解度を把握する。
To examine the degree of basic understating for the specific usages of the TMY.

（３）　気象の将来予測方法やそれを用いた TMY 作成手法への理解度を把握する。
To examine the degree of understanding for the weather projection methods and the development methods of TMY based on the projection.

問題4．世帯エネルギー消費に関する以下の問題に答えよ。
Question 4. Answer the following questions concerning household energy consumption.

（1）　世帯エネルギー消費構造に関する基本的な理解度を把握する。
　　　To examine the degree of basic understanding for the structure of household energy consumption.
（2）　Shift, Rebound 現象に関する理解度を把握する。
　　　To examine the degree of understanding for the shift and rebound effects.
（3）　具体的な省エネ手法についての考えを問う。
　　　To examine the ideas of specific energy-saving measures.

問題5．建築内の熱的快適性に関する以下の問題に答えよ。
Question 5. Answer the following questions concerning thermal comfort in buildings.

（1）　作用温度と対比させながら，SET*の特徴を述べさせる。
　　　Let the candidate to describe the characteristics of SET* by comparing with operative temperature.
（2）　風速増加による熱的快適性向上効果は周辺気温によることの理解度を測る。
　　　To examine the degree of understanding for the fact that the effects of wind speed increase on the improvement of thermal comfort vary depending on ambient temperatures.