Decision Analytics | MGSC 662
Team Project Presentation

Modelling *Modelling*

Linear Optimization for Improved Decision-Making

A Modeling Agency Business Context

Project Contributors
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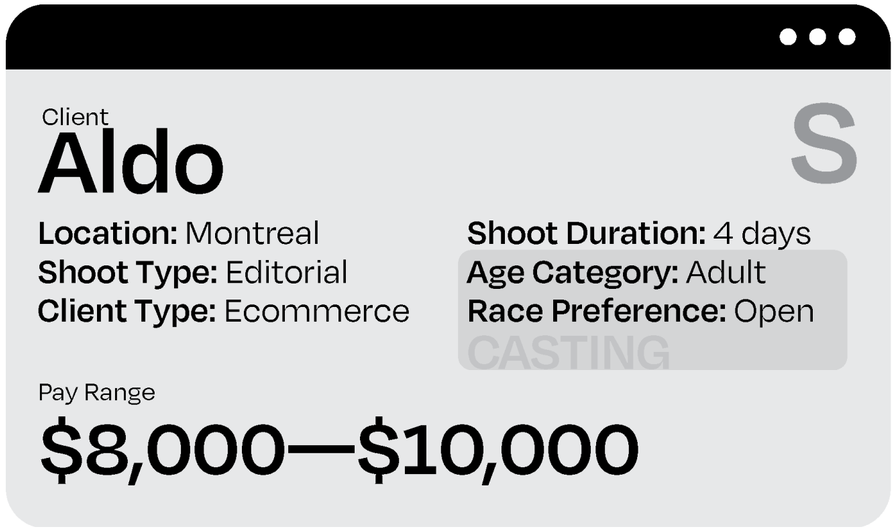
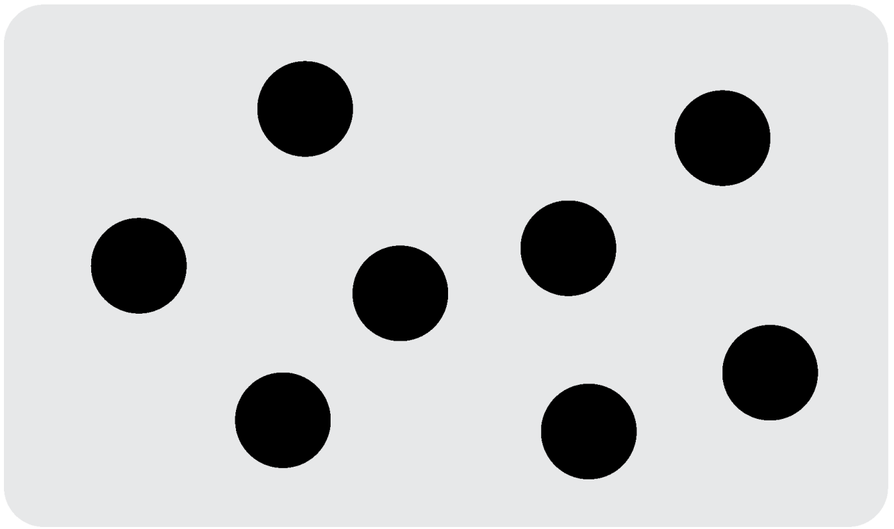
AGENDA

1. Executive Summary
2. Problem Context
3. Mathematical Formulation
   - a. Variables
   - b. Objective Function
   - c. Constraints
4. Results Interpretation
5. Possible Extensions & Challenges
6. Appendix

BACKGROUND CONTEXT AND SIGNIFICANCE



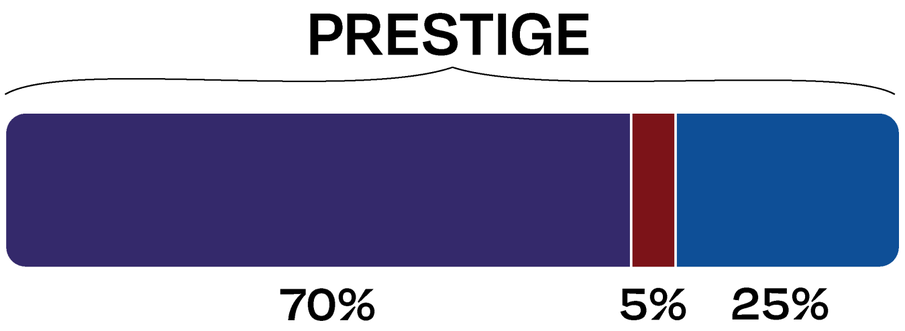


CLIENT **AGENT** **MODELS**

BACKGROUND CONTEXT AND SIGNIFICANCE

CLIENT **AGENT** **MODELS**

PRESTIGE SCORES



PRESTIGE SCORES

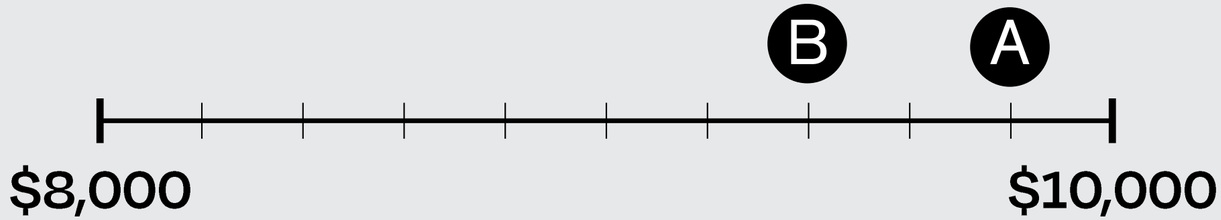
A 9

B 7

HOW MUCH WILL ALDO PAY FOR EACH MODEL?

RECALL: THE PAY RANGE IS $2,000

THE RANGE OF $2,000 IS DIVIDED INTO 10 BINS



WITH MODEL A, ALDO PAYS $9,800

WITH MODEL B, ALDO PAYS $9,400

WHAT ARE THE AGENCY PROFITS?

The agent makes 20% of what the clients pays

WITH MODEL A, ALDO PAYS $9,800

THE AGENCY GETS PAID $1,960 =(0.20*9800)

THE MODEL GETS PAID $7,840 =(0.80*9800)

EXECUTIVE SUMMARY

In the dynamic world of fashion and modeling, agencies face the challenge of maximizing profitability while navigating ethical considerations, societal expectations, and environmental impact scrutiny.

Project Focus: *Our project seeks to tackle these challenges through a linear optimization lens, offering a structured approach to decision-making in modeling agencies.*

Industry Dynamics

Goal: Develop a comprehensive model that balances objectives such as profitability, ethics, diversity, and environmental sustainability, providing a relevant and innovative solution to talent placement and resource management complexities.

Ethical Considerations

The modeling industry's influence on societal norms and its increasing pressure for diversity and inclusivity, coupled with growing environmental concerns, make this problem both pertinent and complex.

Challenges

Aiming for a balance between conflicting objectives, ensuring economic viability alongside social and environmental responsibility in talent placement decisions.

elite

PROBLEM CONTEXT

Project Focus

Developing an optimization model is crucial for Elite Model Look Toronto Agency, aiming to efficiently assign models to diverse jobs while navigating the complexities of the competitive and dynamic modeling industry. This model addresses the agency's modern needs and challenges.

Systematic approach to match models with jobs, maximizing satisfaction and efficiency.

Balancing Factors

- *Model availability*
- *Skills & Experience*
- *Social influence*
- *Client preferences*
- *Environmental Considerations*
- *Ethical Considerations*
- *Industry Practices*
- *Job Requirements*

- **Constraints:** *Involve limited availability, varying pay scales, job requirements, travel logistics, and maintaining a diverse roster of models.*

- **Expected Outcomes:** *Potential benefits include increased efficiency in model-job matching, higher client and model satisfaction, and reduced environmental impact.*

DIVERSE DATA SOURCES

- Key variables focus on model assignments, jobs requirements & information, travel/event scheduling, etc.

- **Data Collection and Integration:**
  - Meticulous integration of:
    - Synthetic data
    - Elite Model Look website-sourced data
    - Real communications data from a former Elite Model team member enriches job-related information.
    - Social Media
    - Google Flights data, etc.

Enhances realism and consistency of our model.

Cf. Master Dataset.

Model Data

- Uniquely identified by model numbers
- Diverse attributes from physical features to professional metrics
- Ethnicity, Work History, factors contributing to the ‘prestige score’
- Model availability for the week

- Geographical details - X and Y coordinates
- CO_2 emissions costs on major urban centers ensuring sustainable considerations
- Models location, enabling spatial analysis

Location & Emissions Data

Jobs Data

- Client-specific job requirements - job location, preferred age, ethnicity, payment range limits, etc.
- Job packages, shoot duration, priority, client type, non-compete agreements

The dataset empowers the agency to align models with suitable opportunities, optimizing resource utilization for successful collaborations

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MATHEMATICAL MODELING

Decision Variables

Let x_{ij} be a binary variable where $x_{ij} = 1$ if model i is assigned to job j, and $x_{ij} = 0$ otherwise.

Objective Function

$$\text{Maximize} \sum_{i,j} [B_{ij} + \frac{R_{ij}}{10} \cdot (\alpha R_i + \beta E_i + \gamma F_i) - \delta C_{ij}] \cdot x_{ij}$$

1. **Base Payment**: B_{ij} representing the **base** payment (i.e. *'Pay Ranger Lower'* in the jobs datset) for assigning model i to job j.
2. **Payment Range**: R_{ij} representing the **range** of payment (i.e. *'Pay Ranger Upper'* - *'Pay Range Lower'* in the jobs dataset) for assigning model i to job j.
3. **Reputation Score**: R_i denoting the reputation score for model i, based on the previous work of the model.
4. **Experience Score**: E_i for model i, based on the number of years worked in the industry.
5. **Following Score**: F_i for model i, based on the number of Instagram followers a model has.
6. **CO2 Emissions**: C_{ij} for assigning model i to job j.

α, β, and γ, are weight factors for reputation (0.7), experience (0.25), and following scores (0.05) respectively.

δ is the penalty factor for CO2 emissions, decided by the management of *EliteToronto*.

Note: The reputation, experience, and following scores are scaled to be between 0 and 10.

CONSTRAINTS

MATHEMATICAL MODELING

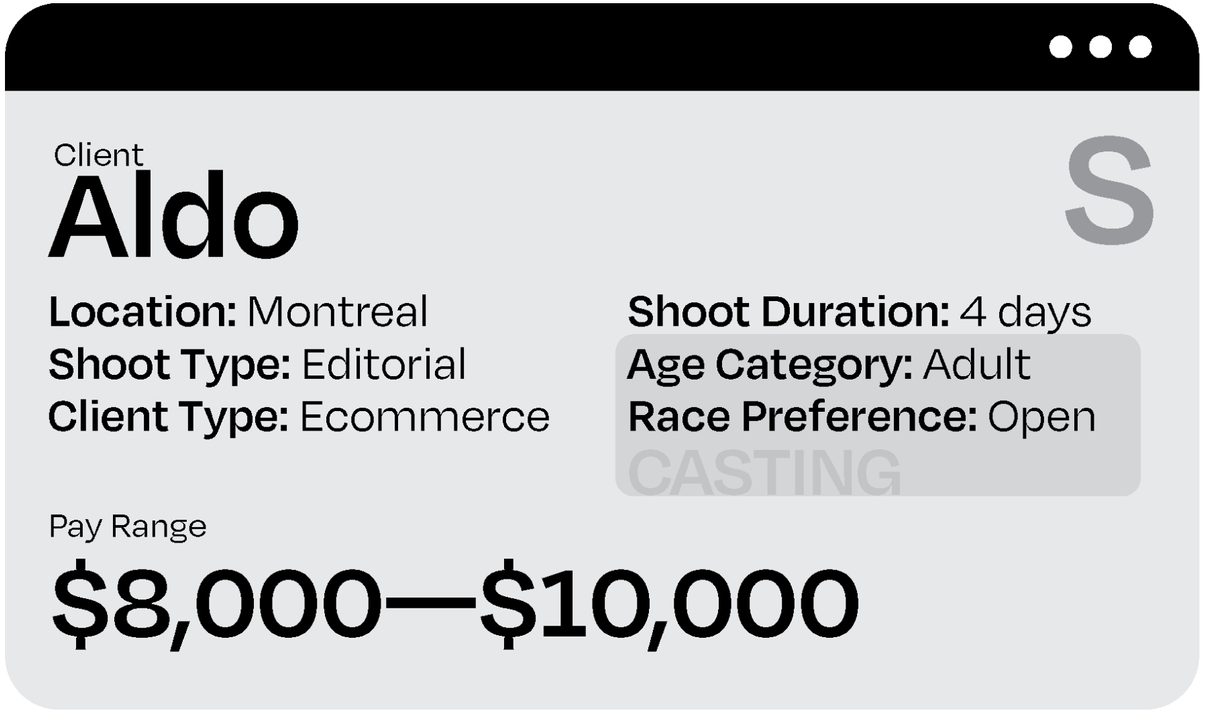
1 **Non-Conflicting Assignment**

2 **One Job per Model**

3 **One Model per Job**

4 **Race Preferences**

5 **Age-Category Preferences**



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MATHEMATICAL MODELING

Constraints

1. **Non-Conflicting Assignments Constraint**:

   For each model and each day of the week, the model can be assigned to at most one job that requires availability on that day.

$$\sum_{j \in \text{Jobs}_{\text{day}}} x_{ij} \leq 1, \quad \forall i \in \text{Models}, \text{day} \in \text{Week}$$

2. **One Model Per Job Constraint**:

   Each job can be assigned to at most one model.

$$\sum_{i \in \text{Models}} x_{ij} \leq 1, \quad \forall j \in \text{Jobs}$$

3. **One Job Per Model Constraint**:

   Each model can be assigned to at most one job.

$$\sum_{j \in \text{Jobs}} x_{ij} \leq 1, \quad \forall i \in \text{Models}$$

Constraints

4. **Ethnicity Constraints**:

   Let e_{ij} be a binary parameter that is 1 if the ethnicity of model i matches the ethnicity preference of job j or if the job preference is 'open', and 0 otherwise.

   For all models i and all jobs j:

$$x_{ij} \leq e_{ij} \quad \forall i \in \text{Models}, \forall j \in \text{Jobs}$$

5. **Age Category Preference Constraints**:

   Let a_{ij} be a binary parameter that is 1 if the age category of model i matches the age category preference of job j or if the job preference is 'open', and 0 otherwise.

   For all models i and all jobs j:

$$x_{ij} \leq a_{ij} \quad \forall i \in \text{Models}, \forall j \in \text{Jobs}$$

PROBLEM EXTENSIONS & CHALLENGES

1. **Non-Compete Agreement**:

   If a model has a non-compete agreement with a client type, the model cannot be assigned to any other job with the same client type.

   For each model i and each unique client type c in the set of all client types C, the non-compete constraint is:

$$\sum_{j \in \text{Jobs} | c_j = c} x_{ij} \leq n_{ic} \quad \forall i \in \text{Models}, \forall c \in C$$

   where c_j is the client type of job j, and n_{ic} is a binary variable which is 1 if model i does not have a non-compete agreement for client type c, and 0 otherwise.

PROBLEM EXTENSIONS & CHALLENGES

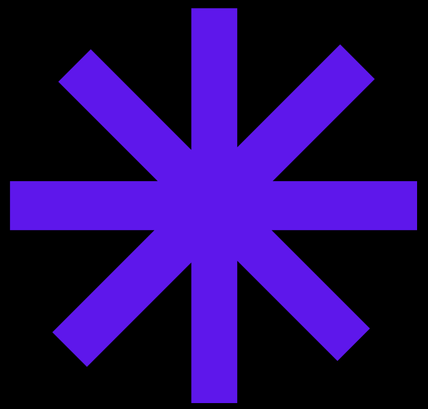
2. **Job-Package**: In reality, some jobs do not pay for the model's travel and accomodation. The revised objective function to incorporate the job-package costs would be:

$$\text{Maximize} \sum_{i,j} \left[B_{ij} + \frac{R_{ij}}{10} \cdot (\alpha R_i + \beta E_i + \gamma F_i) - (1 - k_j) \cdot (D_j R_j + T_{ij}) - \delta C_{ij} \right] \cdot x_{ij}$$

where

- k_j is a binary variable which is 1 if the job j pays for the model's travel and accomodation, and 0 otherwise.
- D_j is the duration of the shoot for job j (in days).
- R_j is the average cost of cost of accomdation per night in the city of job j.
- T_{ij} is the air travel cost from the model i's home city to job j's location.

RESULTS & RECOMMENDATIONS



MODEL ALLOCATION MAPPING

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MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 0
1 UNASSIGNED

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 0.50
1 UNASSIGNED

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 1
1 UNASSIGNED

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 15
1 UNASSIGNED

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 30
8 UNASSIGNED

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 0

1 UNASSIGNED

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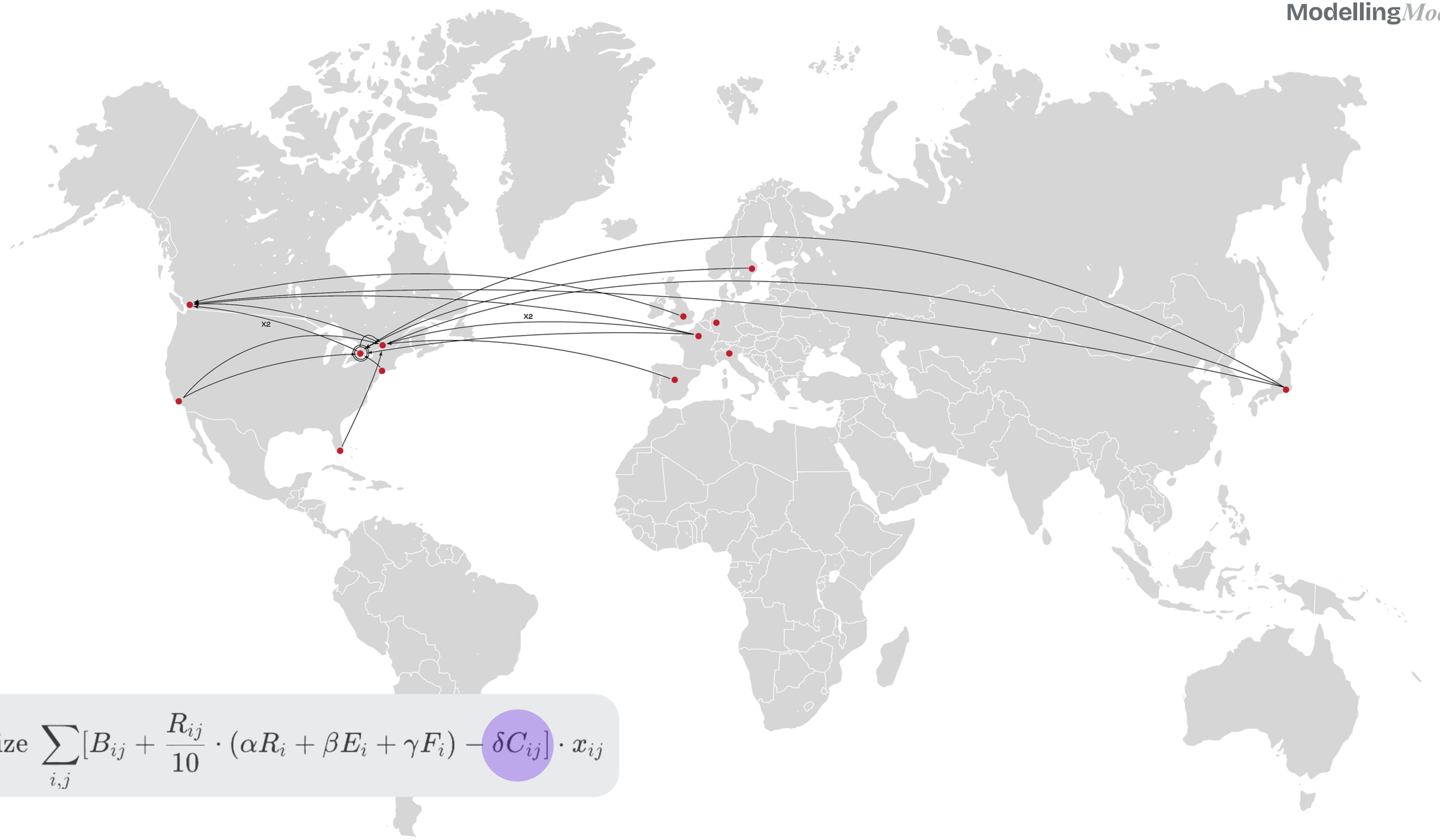

$$\text{Maximize} \sum_{i,j} [B_{ij} + \frac{R_{ij}}{10} \cdot (\alpha R_i + \beta E_i + \gamma F_i) - \delta C_{ij}] \cdot x_{ij}$$

MODEL TO JOB ASSIGNMENT WHEN THE EMISSION WEIGHT = 30

8 UNASSIGNED

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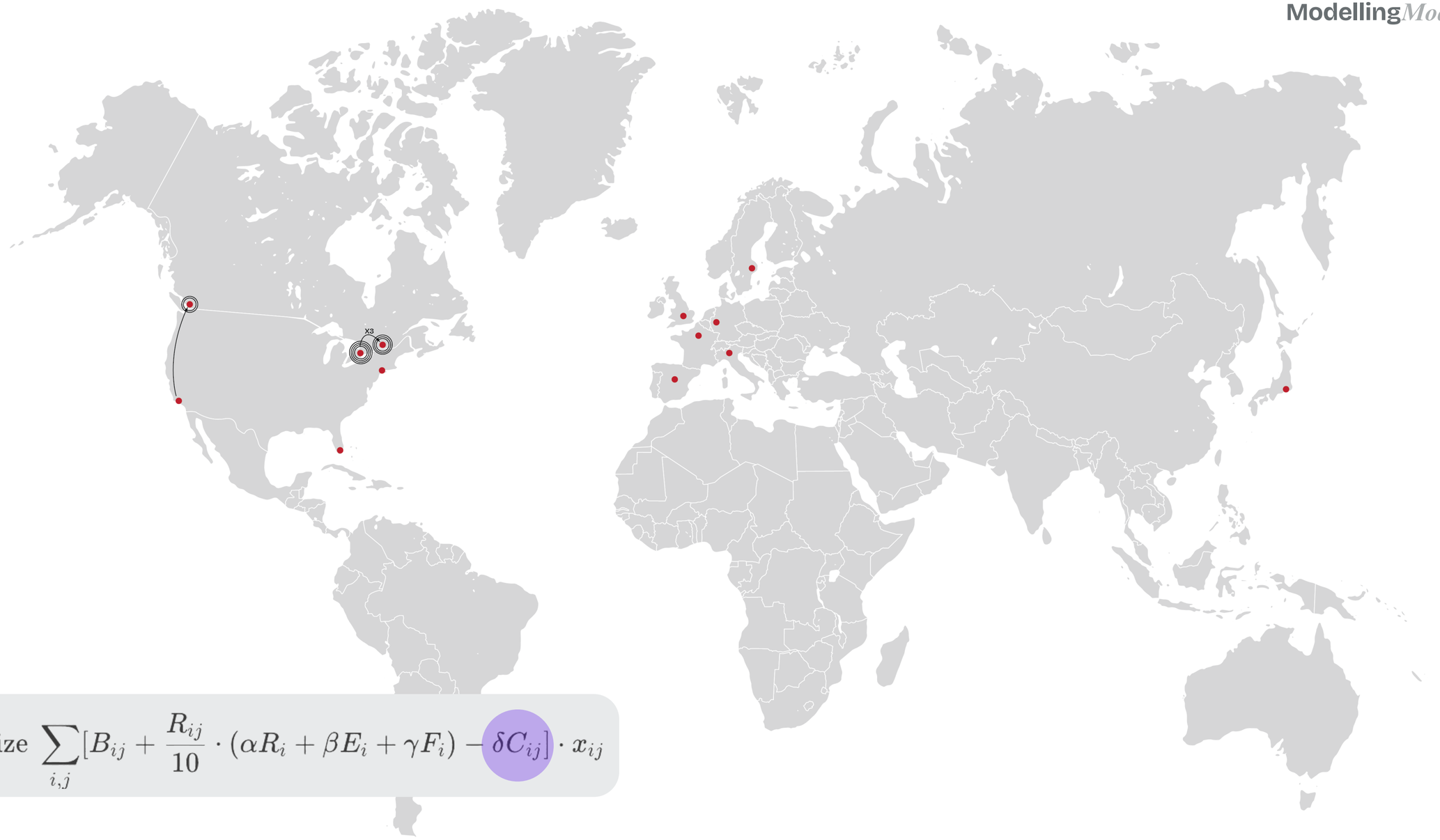
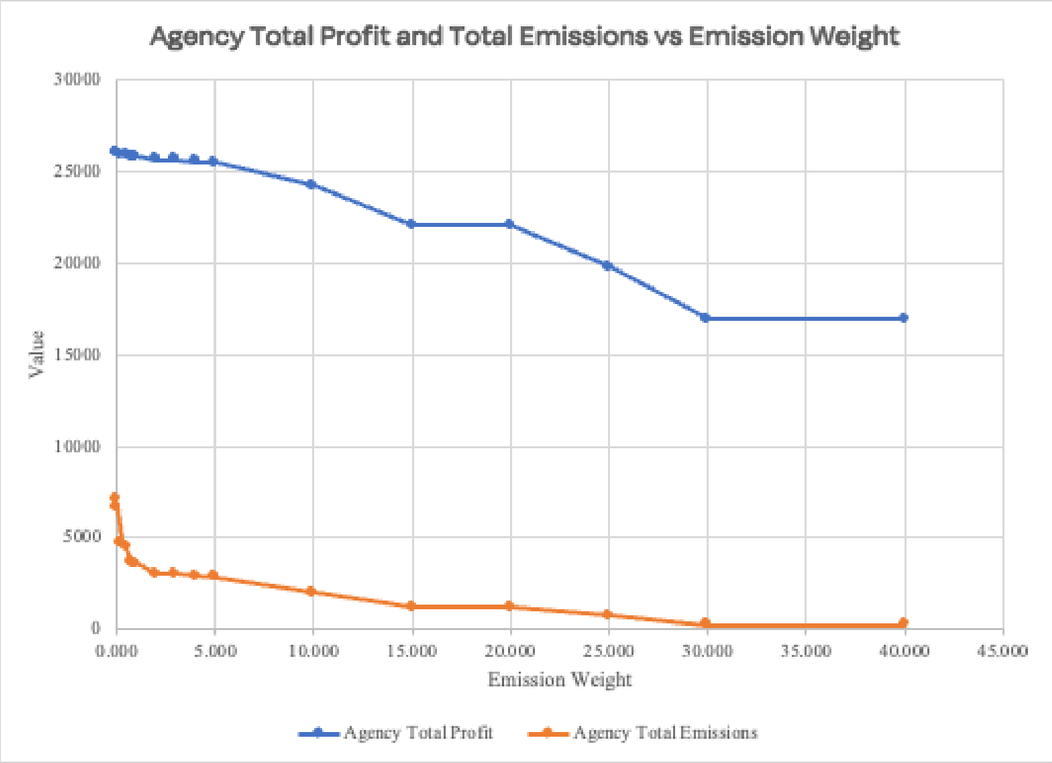


$$\text{Maximize} \sum_{i,j} [B_{ij} + \frac{R_{ij}}{10} \cdot (\alpha R_i + \beta E_i + \gamma F_i) - \delta C_{ij}] \cdot x_{ij}$$

KEY TAKEAWAY



the more the agency pritiortizes reducing CO_2 emissions

the more thier total profits are impacted

RELEVANT INSIGHTS

TALENT POOL

The optimization model has highlighted limitations in our talent pool as some jobs remain unassigned.

This indicates gaps in our agency's capacity to fulfill certain job criteria, possibly due to a lack of diversity in our models' skills or scheduling constraints.

COST OPTIMIZATION

The project's focus on incorporating travel and accommodation expenses into the optimization model offers a nuanced view of cost-efficiency.

The agency can strategically select model assignments that not only meet the job's requirements but also minimize financial outlay.

SUSTAINABILITY

Incorporating CO2 emissions into the model promotes environmentally conscious decision-making. It allows the agency to reduce its carbon footprint by opting for local talent and collaborating with eco-friendly clients. This strategic move not only advances sustainability goals but also strengthens the agency's reputation as an environmentally responsible entity in the marketplace.

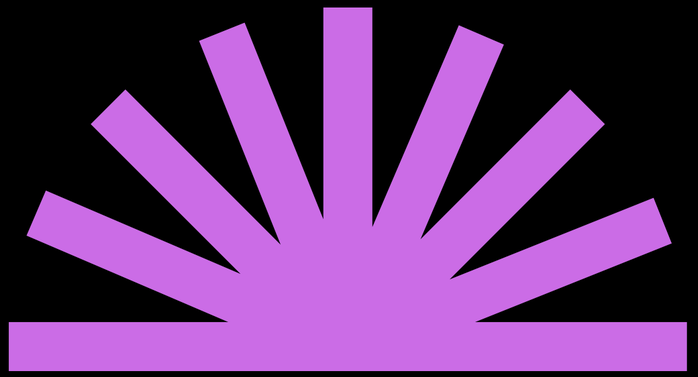
POTENTIAL AREAS FOR FUTURE EXPLORATION

- **SUSTAINABILITY INDEXING**

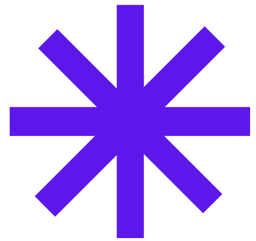
- **MODEL CAREER ADVANCEMENT**

- **EMERGENCY BACK-UPS**

THANK YOU



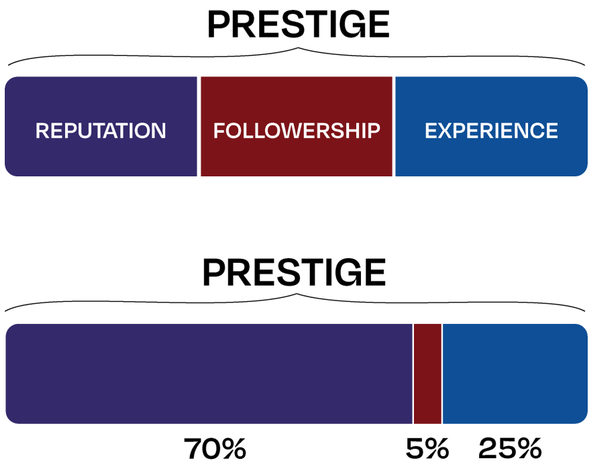
APPENDIX



RESULTS

Model Name	Model Location	Job Name	Job Location	Job Package	Total Job Pay	Total Travel Cost	Model Net Income	Agency Profit	CO2 Emissions
Brodie Scott	Tokyo	Frank And Oak	Vancouver	Yes	5149.35	0	4119.48	1029.87	639
Dwight Ireland	Toronto	Maple Leaf Diamonds	Toronto	Yes	6192.55	0	4954.04	1238.51	0
Hector Raptis	Toronto	Herschel Supply Co.	Vancouver	Yes	6472.43	0	5177.95	1294.49	229
Jacob Cheng	Toronto	Lululemon	Vancouver	Yes	6124.68	0	4899.75	1224.94	229
Justin Lyons	Toronto	Flare Magazine	Toronto	Yes	4523.09	0	3618.47	904.62	0
Malik Lindo Ireland	New York	Canadian Tire	Toronto	No	6883.33	762	4897.07	1224.27	54
Steven Smith	Los Angeles	Holt Renfrew	Toronto	No	7189.56	1016	4938.85	1234.71	244
Michael Gonzalez	Los Angeles	Canada Goose	Vancouver	No	6168.7	615	4442.96	1110.74	117
Steven Lee	Paris	Blue Ruby	Toronto	No	5488.38	799	3751.51	937.88	397
Robert Smith	Paris	Bombardier	Montreal	No	8122.32	1495	5301.86	1325.46	376
Michael Lopez	Tokyo	Aldo	Montreal	No	8182.86	2556	4501.49	1125.37	929
Joshua White	Montreal	Lincoln	Vancouver	No	8937	963	6379.2	1594.8	252
Daniel Jones	Tokyo	Rudsak	Montreal	No	5120.73	2412	2166.98	541.75	929
Ronald Harris	Tokyo	Peace Collective	Toronto	Yes	5953.64	0	4762.91	1190.73	782
Andrew Jackson	Paris	Smythe	Toronto	Yes	5240.41	0	4192.33	1048.08	397
Richard Jones	Paris	Roots Canada	Vancouver	Yes	6547.5	0	5238	1309.5	579
Michael Smith	Miami	Arc'teryx	Montreal	Yes	7400.05	0	5920.04	1480.01	205
David Smith	Stockholm	Magazine "Elle Canada"	Toronto	Yes	4843.3	0	3874.64	968.66	455
Kevin Moore	Madrid	Birks	Montreal	Yes	7330.65	0	5864.52	1466.13	445
David Thomas	Toronto	Mackage	Montreal	No	7615.77	732	5507.02	1376.75	40
Unassigned	N/A	Moose Knuckles	Vancouver	No	3500 - 6900	N/A	0	0	N/A

REPUTATION CALCULATION



S	10
A	8
B	6

Client
Aldo
S

Location: Montreal
Shoot Type: Editorial
Client Type: Ecommerce

Shoot Duration: 4 days
Age Category: Adult
Race Preference: Open

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Pay Range
$8,000—$10,000

Client
Bombardier
B

Location: Montreal
Shoot Type: Commercial
Client Type: Commercial

Shoot Duration: 2 days
Age Category: Senior Adult
Race Preference: White

CASTING

Pay Range
$5,000—$8,000

A *8 reputation score*

Model's Work History

Job 1: A *8*
Job 2: S *10*
Job 3: A *8*
Job 4: B *6*

Calculation

8+10+8+6=32
32/4=8