OPTIMIZING PRICING STRATEGY WITH ROYALTY CONSTRAINTS

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1. Problem Formulation

Suppose there are n platforms or sales formats (e.g., Ebook, Paperback, Retail), each with:

- A unit price p_i for format i
- A royalty margin $m_i \in [0, 1]$ such that you receive $m_i \cdot p_i$ as earnings per unit

We seek to determine the optimal price vector $\mathbf{p} = [p_1, p_2, ..., p_n]$ that:

1. Maximizes total royalty revenue per unit:

$$\max_{\mathbf{p}} \quad R(\mathbf{p}) = \sum_{i=1}^{n} m_i p_i$$

2. Subject to price ordering to reflect increasing value or production cost:

$$p_1 < p_2 < ... < p_n$$

3. And royalty-per-unit support to reflect preference for higher-margin formats:

$$m_1 p_1 \geq m_2 p_2 \geq ... \geq m_n p_n$$

4. With bounds:

$$p_i \in \left[\underline{p}_i, \overline{p}_i\right] \quad \forall i = 1, ..., n$$

This is a constrained nonlinear optimization problem that can be solved using numerical methods (e.g., Sequential Least Squares Programming).

2. Interpretation

The resulting prices $\{p_i\}$ ensure:

- Readers save more by choosing digital or direct options
- Your royalty per sale does not decrease as price increases
- The price structure aligns with perceived value and incentivizes support

3. Python Interpretation

The `optimizer.py` Python program is an interpretation of the previously stated problem, and uses the `uv` package manager to run the program.

```
$ uv sync # syncs the dependencies
$ uv run optimizer.py # runs the optimizer script
```

The `optimize_pricing` function in the `optimizer` program expects two arguments, the platforms and price bounds. The price bounds acts as the minimum and maximum price ranges a book of a particular platform can fall in.

Platform Name	**Margin**
Ebook (Direct)	0.95
Paperback	0.55
Ebook Other	0.35

TABLE 1. Example Platforms

The example pricing bounds used were $(5, 20)$, $(10, 30)$ and $(15, 40)$. With these bounds the following summary is generated:

Platform	Price	Royalty Margin	Royalty per Unit	Ranking
Ebook (Direct)	20.0	0.95	19.0	1
Paperback	30.0	0.55	16.5	2
Ebook Other	40.0	0.35	14.0	3