CLAIMS

1. A computer-implemented method for personalizing offers, comprising:

collecting response data comprising one or more offers made to each of a plurality of users of a platform and one or more corresponding responses, wherein the one or more offers are selected from a group of offer choices;

creating a training dataset comprising the collected response data and one or more features associated with each of the plurality of users;

training a machine learning model using the training dataset, wherein the trained machine learning model is configured to predict the plurality of users' responses to future offers;

obtaining a plurality of projected profits for the platform using the trained machine learning model, wherein each of the plurality of projected profits corresponds to making one of the group of predetermined offers to one of the plurality of users;

constructing an objective function based on the plurality of projected profits, the objective function comprising a plurality of decision variables;

converting the objective function into a dual objective function;

decomposing the dual objective function into a plurality of objectives corresponding to the plurality of users, each of the plurality of objectives comprising a subset of the plurality of decision variables;

parallelly processing the plurality of objectives to determine values of each subset of the plurality of decision variables;

determining the values of the plurality of decision variables based on the values of the each subset; and

determining, based on the values of the plurality of decision variables, a combination of one or more offers from the group of offer choices for distributing to the plurality of users to maximize a total profit, subject to a total cost limit of the platform.

2. The method of claim 1, wherein:

the plurality of users comprise online sellers; and

the one or more features comprise one or more of the following: seller age, seller gender, seller location, time of registration on the platform, transaction volume, and merchandise information.

3. The method of any of the preceding claims, wherein the creating a training dataset comprises:

generating a plurality of data entries each comprising the one or more features of a corresponding user and one of the one or more offers made to the corresponding user; and

labeling the plurality of data entries based on the one or more corresponding responses.

4. The method of any of the preceding claims, wherein the group of offer choices comprise: an offer choice representing not making an offer.

5. The method of any of the preceding claims, wherein:

the determined combination of one or more offers from the group of offer choices is a combination with repetition; and

the determined combination comprises *N* elements, *N* being the number of the plurality of users.

6. The method of any of the preceding claims, further comprising:

randomly selecting one or more users from the plurality of users; and

making one or more offers randomly selected from the group of offer choices to the randomly selected one or more users.

7. The method of any of the preceding claims, wherein:

a number of the plurality of users is N;

a number of the offer choices is M; and

the determining a combination of one or more offers from the group of offer choices for distributing to the plurality of users comprises: solving an optimization to obtain an $\mathrm{N} * \mathrm{M}$ matrix X, each element X_{ij} of X comprising a value indicating a recommendation about making an j_{th} offer to an i_{th} user, wherein $\forall i \in \{1, \dots, N\}, \forall j \in \{1, \dots, M\}$.

8. The method of claim 7, wherein:

the optimization comprises an integer programming model; and

the each element X_{ij} of X comprises a binary value indicating whether to make the j_{th} offer to the i_{th} user.

9. The method of any of the preceding claims, wherein:

the total profit is determined based on, among the plurality of users, a number of users predicted by the machine learning model to accept the one or more offers.

10. The method of any of the preceding claims, wherein:

the one or more of the offer choices are respectively associated with one or more bonus rewards; and

the total cost limit comprises a limit of a total amount of the bonus rewards for distributing to the plurality of users.

11. The method of claim 10, wherein:

the one or more bonus rewards are conditioned on the online sellers conducting online transactions using a payment system associated with the platform.

12. The method of any of the preceding claims, wherein:

the total cost limit comprises a limit of a number of offers for distributing to the plurality of users.

13. A system for personalizing offers, comprising one or more processors and one or more non-transitory computer-readable memories coupled to the one or more processors and configured with instructions executable by the one or more processors to cause the system to perform operations comprising:

collecting response data comprising one or more offers made to each of a plurality of users of a platform and one or more corresponding responses, wherein the one or more offers are selected from a group of offer choices;

creating a training dataset comprising the collected response data and one or more features associated with each of the plurality of users;

training a machine learning model using the training dataset, wherein the trained machine learning model is configured to predict the plurality of users' responses to future offers;

obtaining a plurality of projected profits for the platform using the trained machine learning model, wherein each of the plurality of projected profits corresponds to making one of the group of predetermined offers to one of the plurality of users;

constructing an objective function based on the plurality of projected profits, the objective function comprising a plurality of decision variables;

converting the objective function into a dual objective function;

decomposing the dual objective function into a plurality of objectives corresponding to the plurality of users, each of the plurality of objectives comprising a subset of the plurality of decision variables;

parallelly processing the plurality of objectives to determine values of each subset of the plurality of decision variables;

determining the values of the plurality of decision variables based on the values of the each subset; and

determining, based on the values of the plurality of decision variables, a combination of one or more offers from the group of offer choices for distributing to the plurality of users to maximize a total profit, subject to a total cost limit of the platform.

14. The system of claim 13, wherein:

the plurality of users comprise online sellers; and

the one or more features comprise one or more of the following: seller age, seller gender, seller location, time of registration on the platform, transaction volume, and merchandise information.

15. The system of any of the claims 13 to 14, wherein the creating a training dataset comprises:

generating a plurality of data entries each comprising the one or more features of a corresponding user and one of the one or more offers made to the corresponding user; and

labeling the plurality of data entries based on the one or more corresponding responses.

16. The system of any of the claims 13 to 15, wherein:

the determined combination of one or more offers from the group of offer choices is a combination with repetition; and

the determined combination comprises *N* elements, *N* being the number of the plurality of users.

17. The system of any of the claims 13 to 16, wherein:

a number of the plurality of users is N;

a number of the offer choices is M; and

the determining one or more of the offer choices for distributing to the plurality of users comprises: solving an optimization to obtain an $\mathrm{N} * \mathrm{M}$ matrix X, each element X_{ij} of X comprising a value indicating a recommendation about making an j_{th} offer to an i_{th} user, wherein $\forall i \in \{1, \dots, N\}, \forall j \in \{1, \dots, M\}$.

18. A non-transitory computer-readable storage medium configured with instructions executable by one or more processors to cause the one or more processors to perform operations comprising:

collecting response data comprising one or more offers made to each of a plurality of users of a platform and one or more corresponding responses, wherein the one or more offers are selected from a group of offer choices;

creating a training dataset comprising the collected response data and one or more features associated with each of the plurality of users;

training a machine learning model using the training dataset, wherein the trained machine learning model is configured to predict the plurality of users' responses to future offers;

obtaining a plurality of projected profits for the platform using the trained machine learning model, wherein each of the plurality of projected profits corresponds to making one of the group of predetermined offers to one of the plurality of users;

constructing an objective function based on the plurality of projected profits, the objective function comprising a plurality of decision variables;

converting the objective function into a dual objective function;

decomposing the dual objective function into a plurality of objectives corresponding to the plurality of users, each of the plurality of objectives comprising a subset of the plurality of decision variables;

parallelly processing the plurality of objectives to determine values of each subset of the plurality of decision variables;

determining the values of the plurality of decision variables based on the values of the each subset; and

determining, based on the values of the plurality of decision variables, a combination of one or more offers from the group of offer choices for distributing to the plurality of users to maximize a total profit, subject to a total cost limit of the platform.

19. The storage medium of claim 18, wherein:

the determined combination of one or more offers from the group of offer choices is a combination with repetition; and

the determined combination comprises *N* elements, *N* being the number of the plurality of users.

20. The storage medium of any of the claims 18 to 19, wherein:

a number of the plurality of users is N;

a number of the offer choices is M; and

the determining one or more of the offer choices for distributing to the plurality of users comprises: solving an optimization to obtain an $N * M$ matrix X, each element X_{ij} of X comprising a value indicating a recommendation about making an j_{th} offer to an i_{th} user, wherein $\forall i \in \{1, \dots, N\}, \forall j \in \{1, \dots, M\}$.