
FAST FOOD
RESTAURANT
QUEUE
OPTIMIZATION
McDonald's

Model assumptions

Seasonal demand

Changes depending on the month

```
coefficients_months = [0.35 + 0.05*abs(k-6) for k in range(12)]
```

Exponential arrival process

For each group

```
ss.expon(scale=3.2).rvs(size = round(demand/2.15))
```

Single and group arrivals

From 1 to 5 people together

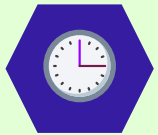
```
ss.rv_discrete(values=([1,2,3,4,5], [0.3,0.4,0.2,0.05,0.05])).rvs(size = round(demand/2.15))
```

Waiting room

If there is no place in the queue people leave and never return

Dynamic demand

Unhappy customers never return



Limited time per period

Open 23 hours per day

```
max(0, coefficients_months[k]*(60000 + ss.norm(scale = 100, loc = 0).rvs()) - missed_clients)
```

Objective

Optimize the revenue by hiring optimal number of cooks

Trade-off

Many cooks,
high salary costs
and saving clients

Few cooks,
low salary costs
and loss of clients

- We hire cooks for the entire duration of work and cannot dismiss them.

Parameters

Price

We looked up average check at fast food in Russia

Costs

Average cost price

Demand

We used attendance from Mcdonalds from 2021

Capacity

For waiting room
We will experiment with it later

Unhappy waiting time

How much waiting time customers tolerate

Seasonal demand

Demand is higher during the summer

Solution

Parameters:
Price = 279 руб.
Cost = 140 руб.
Cooking time = 3 min.
Waiting room capacity = 20
Waiting time until unhappy = 10 min.
Fixed cost = 600.000 руб.
Salary for the day worker = 170.000 руб.

- Our demand changes every period

The optimal amounts of workers at shift is 4

```
0 arrived at 2.5270824452236957
0 left at 5.527082445223696
1 arrived at 5.9253487141872885
2 arrived at 5.9253487141872885
3 arrived at 5.9253487141872885
4 arrived at 5.968539660735096
5 arrived at 5.968539660735096
6 arrived at 5.968539660735096
7 arrived at 8.144242922647333
8 arrived at 8.144242922647333
9 arrived at 8.144242922647333
10 arrived at 8.52900167681491
11 arrived at 8.52900167681491
1 left at 8.925348714187288
2 left at 8.925348714187288
12 arrived at 8.958659037628003
3 left at 11.925348714187288
4 left at 11.925348714187288
5 left at 14.925348714187
```

```
When we have 1 cooks we get -7354092
When we have 2 cooks we get -7548894
When we have 3 cooks we get 3115386
When we have 4 cooks we get 13674372
When we have 5 cooks we get 12041610
When we have 6 cooks we get 11227878
When we have 7 cooks we get 9516870
When we have 8 cooks we get 7290708
When we have 9 cooks we get 4466178
When we have 10 cooks we get 2978592
When we have 11 cooks we get 881322
When we have 12 cooks we get -1073532
When we have 13 cooks we get -2358120
When we have 14 cooks we get -5074320
```

Playing with parameters

Waiting room capacity

Waiting time until unhappy

	10	20	30
10	n_cooks* = 5	n_cooks* = 5	n_cooks* = 4
20	n_cooks* = 3	n_cooks* = 3	n_cooks* = 3
30	n_cooks* = 3	n_cooks* = 3	n_cooks* = 3

Advertising

Now suppose we can increase our base demand by 40.000.
People arrive with smaller intervals so that everyone fits in one month period.
It costs 250.000 руб. per month.

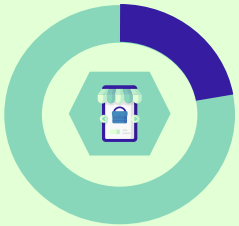
```
When we have 1 cooks with advertising we get -10354092
When we have 2 cooks with advertising we get -10508184
When we have 3 cooks with advertising we get -7792566
When we have 4 cooks with advertising we get 7750566
When we have 5 cooks with advertising we get 12327942
When we have 6 cooks with advertising we get 10791642
When we have 7 cooks with advertising we get 8480886
```

If we advertise we need to hire one more cook.
Our profit is 1.400.000 руб lower.
If we hire 4 cooks our profit is 5.900.000 lower, which is more than cost of advertising of 3.000.000. Why?

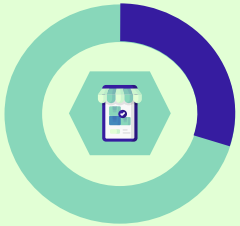
Now, we also work with online-orders

We rent a separate building for delivery and use Delivery club for distribution.
We also hire new cooks who will work on delivery only.
Seasonal demand is reverse: people order more during winter.

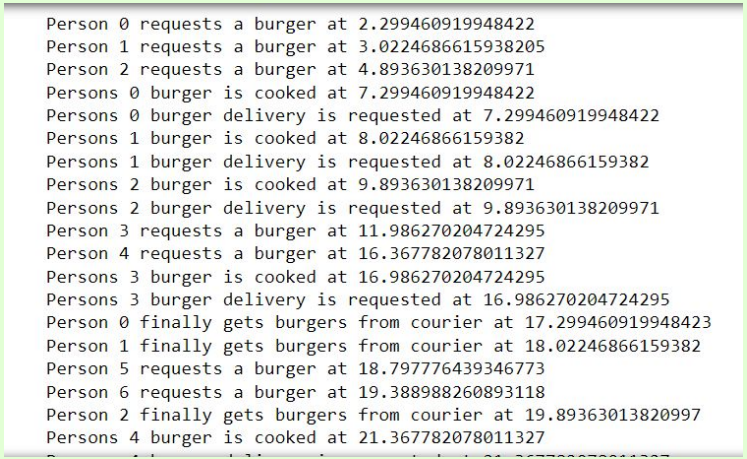
Delivery club couriers are unlimited.



20% fee + salary
Our own couriers



35% fee
Delivery club couriers



Solutions

Parameters changed:

Waiting time until unhappy = 30 min.

Capacity = 100

Fixed costs = 300.000 руб.

With our own couriers we have 2 queues

Our own couriers with their own queue

We get the best profit for 1 cooks when we have 1 couriers and get 6805694.400000002
We get the best profit for 2 cooks when we have 4 couriers and get 20449694.400000002
We get the best profit for 3 cooks when we have 5 couriers and get 19792646.4
We get the best profit for 4 cooks when we have 5 couriers and get 17762251.200000003
We get the best profit for 5 cooks when we have 5 couriers and get 15659875.200000001
We get the best profit for 6 cooks when we have 5 couriers and get 13677945.600000001
We get the best profit for 7 cooks when we have 5 couriers and get 11579875.2

Delivery couriers

When we have 1 cooks we get 2006028
When we have 2 cooks we get 24596929
When we have 3 cooks we get 22555764
When we have 4 cooks we get 20518902
When we have 5 cooks we get 18497562
When we have 6 cooks we get 16464379
When we have 7 cooks we get 14420252

The optimal number of cooks is 2 in both cases.

Our total profit is better when we use Delivery club couriers.