# The Perfect Dozen[1]:

## The Great Donut Debate

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[1] Perfect Dozen is a Misnomer as we are choosing more than 12 donuts

## *Method*

To find a true "perfect dozen[2]" we have created a utility model for donuts served at the nation's most popular donut provider, Dunkin Donuts (from this point forward will be referred to as "DD"). We took the 35 donuts that are offered year-round at DD and using a combination of research and surveys of our friends, we ranked the 35 in order of popularity. When we found out most people had never even heard of 3 (and coincidentally we found out Excel Solver only works for 32 variable scenarios), we eliminated those three. We were left with a list of 32 donut varieties which can be found below.

The nutrition facts are publicly available on dunkindonuts.com. We used the number of calories in each donut, the grams of total fat, and the grams of protein in each donut in our calculations. Based on the rankings, we assigned a point value to each donut, with the top ranked donut at 1 and the lowest ranked donut at .5 and the rest distributed evenly between 0.5 and 1.0. This number is the beginnings of determining the utility of each donut. Therefore, the highest ranked donut is twice as desired as the least ranked donuts. Because, let's be honest, there's really no bad donut.

If we were to just get 1.0 "utils" out of eating the top ranked donut, you'd just keep eating those forever and never stop. There need to be some constraints in the scenario to make this interesting; which we will introduce here. The utility of the donut is reduced by the result of subtracting 9 from the number of grams of fat in the donut and then dividing by 40. This normalizes the fat content to vary between 0 (Glazed only has 9 grams of fat) and 0.325 (Chocolate Coconut Cake has 22 grams of fat, so [22-9]/40 = 13/40 = 0.325). Protein is a building block for muscle building, so we add to the utility based on the protein content. The donuts only vary between 2 and 5 grams of protein so we divide the grams of protein by 17 and add that result to the utility. The donut with the highest resulting utility is the chocolate Frosted at 1.14 utils, so we normalized the data by dividing all the utilities by 1.2.

Based on this utility ranking, the donut that is least preferred with the worst nutritional value is the Blueberry Cake donut and the most preferred with best nutritional value is the Chocolate Frosted. Mmmmm, I'm hungry.

Now we can make a variety of a dozen donuts and find out the total utility of the dozen. But this is a pretty boring exercise as you would just find your highest "util"-rated and buy 12 of them. So we need to look at how combinations of donuts affect utility. If you had a box of 12 Boston Kreme donuts, your 12th Boston crème would not have the same utility as the 1st. The same could be said for sprinkles or frosting or fillings in general. So we noted 6 common donut characteristics for each variety of donut, "Frosting", "Sprinkles", "Chocolate", "Filling", "Fruit", "Sugar-coating". If you had a dozen donuts that were all Chocolate varieties, you would lose utility based on lack of options.

We made deductions in the total utility for things like lack of variety on type and in Frosting

[2] Again, this is just a catch phrase. Means nothing.

Sprinkles, Chocolate, etc. If more than 5% of the total donuts in the order are the same type of donut, say French Cruller, we deduct utility based on the equation ((Q - .05*TD)^2)/E, where Q is the quantity of French Crullers, TD is the total number of donuts ordered, and E is the number of eaters. So, if you order 36 donuts and 4 were French Crullers, ((4-.05*36)^2)/15 is a .1936 deduction in utility. 5 French Crullers would cause a deduction of .4096 which means marginally, the 5th French Cruller, instead of having a utility of .61, it now has a marginal utility of .394. That means if you hadn't ordered a Coffee Roll Fancy Donut yet, even though you prefer French Crullers to Coffee Rolls individually (.61 vs. .56), you would rather have one Coffee Roll Fancy than a 5th French Cruller.

The deductions for too many chocolate or too many frosted donuts were done in a similar fashion. The percentage thresholds were slightly different than the 5% used with the donut type deduction. Most people like chocolate donuts of some form or variety. Fruit-themed donuts and donuts with fillings are typically a specialty niche and you'd rather not have a selection of donuts fraught with fruit-filled donuts. The thresholds for beginning the exponential deductions for each style of donut are as follows: Frosting - 25%, Sprinkles - 5%, Chocolate - 25%, Filling - 5%, Fruit - 5%, Sugar - 5%. If more than 25% of the donuts are frosted or have chocolate, a deduction increases exponentially for every donut over the threshold. These deductions will allow us to get the donuts we prefer, while keeping nutritional values in mind, and still maintain a diverse selection of donuts.

As far as the number of donuts to buy, we imposed two restrictions with another deduction which we will get to in a minute. The restrictions were that we needed to have at least 1001 calories worth of donuts for each person in the league. This was derived from the FDA claiming breakfast is the most important meal of the day and 2,000 calories is what the average person should intake. As the most important meal of the day, we wanted it to own a plurality on your caloric intake, so at 1001 this is guaranteed. From our research, we also know the average person eats 2.5 donuts in one sitting after a purchase. So we set the limit to 4 donuts per person in the league. We don't want to order a beautiful array of donuts only to have some go to waste. In addition, there was a caloric deduction for extra calories. If it maximized utility to order the limit of 4 donuts per person, we want to impose a deduction for extra-high-calorie donuts so that the members of your league aren't pressured to eat their 4th donut and go for the full 2,000 calories of their day right there. This deduction was equated by finding the surplus in calories over 1,000 per person, multiplying by the total number of people, and dividing by 310, the average calories in the donuts in this study. In other words, if a person had to eat an extra 310 calories in addition to the 1,000 we allotted them for breakfast, they would lose 1 "util" which would at least equal and likely surpass the utility gained by eating the donut (remember, they were distributed on a scale from 0.5 to 1.0 prior to any deductions). This takes over-eating and therefore over-ordering out of the equation.

The lone variables in this scenario are the quantities of each of the 32 types of donuts. The type and style deductions are subtracted from the overall sum of the utilities of each of the donuts chosen for the order.

## *Results*

Using the Solver Add-on for Excel 2007, we created a target cell which is the sum of the total utilities of each donut ordered minus the type, style, and caloric deductions discussed above. This target cell was maximized by changing the 32 variable quantities of donuts ordered. Constraints were added so the total amount of calories exceeded 1000 times the number of people in the league and the total number of donuts ordered did not exceed four times the number of people in the league. The donut quantities were set to be integers greater or equal to zero.

# Perfect Dozen for 30 People

| Variety | Quantity |
|---|---|
| Apple Crumb | 0 |
| Apple Spice | 7 |
| Bavarian Crème | 8 |
| Blueberry Cake | 0 |
| Blueberry Crumb | 0 |
| Boston Kreme | 8 |
| Chocolate Coconut Cake | 0 |
| Chocolate Frosted Cake | 0 |
| Chocolate Frosted | 11 |
| Chocolate Glazed Cake | 7 |
| Chocolate Kreme Filled | 0 |
| Cinnamon Cake | 7 |
| Double Chocolate Cake | 7 |
| Glazed Cake | 0 |
| Glazed | 11 |
| Jelly Filled | 7 |
| Maple Frosted | 8 |
| Marble Frosted | 6 |
| Old Fashioned Cake | 0 |
| Powdered Cake | 8 |
| Strawberry Frosted | 6 |
| Sugar Raised | 11 |
| Vanilla Kreme Filled | 0 |
| French Cruller | 6 |
| Berries 'n Kreme | 0 |
| Apple Fritter | 1 |
| Choclate Iced Bismark | 0 |
| Bow Tie Donut | 1 |
| Chocolate Frosted Coffee Roll | 0 |
| Coffee Roll | 0 |
| Éclair | 0 |
| Glazed Fritter | 0 |

# Perfect Dozen for 15 People

| Variety | Quantity |
|---|---|
| Apple Crumb | 0 |
| Apple Spice | 3 |
| Bavarian Crème | 4 |
| Blueberry Cake | 0 |
| Blueberry Crumb | 0 |
| Boston Kreme | 5 |
| Chocolate Coconut Cake | 0 |
| Chocolate Frosted Cake | 0 |
| Chocolate Frosted | 7 |
| Chocolate Glazed Cake | 4 |
| Chocolate Kreme Filled | 0 |
| Cinnamon Cake | 3 |
| Double Chocolate Cake | 4 |
| Glazed Cake | 0 |
| Glazed | 6 |
| Jelly Filled | 4 |
| Maple Frosted | 3 |
| Marble Frosted | 1 |
| Old Fashioned Cake | 0 |
| Powdered Cake | 4 |
| Strawberry Frosted | 4 |
| Sugar Raised | 7 |
| Vanilla Kreme Filled | 0 |
| French Cruller | 0 |
| Berries 'n Kreme | 0 |
| Apple Fritter | 1 |
| Choclate Iced Bismark | 0 |
| Bow Tie Donut | 0 |
| Chocolate Frosted Coffee Roll | 0 |
| Coffee Roll | 0 |
| Éclair | 0 |
| Glazed Fritter | 0 |