Title page

Title

Internet advertising
final version

Supervisor

J. Komjathy j.komjathy@tue.nl

Authors

Horst, J.P. van der (Joca)	0900760	j.p.v.d.horst@student.tue.nl
Janssen, J.J. (Jolenthe)	0897005	j.j.janssen@student.tue.nl
Otterdijk, V.E.M.I. van (Vera)	0914583	v.e.m.i.v.otterdijk@student.tue.nl
Stavenuiter, L.S. (Lisa)	0894011	l.s.stavenuiter@student.tue.nl
Jong, T. de (Thomas)	0910449	t.d.jong@student.tue.nl

Hand-in date

April 05, 2015

Number of Attachments / Appendices

Appendix A: visualization conceptual model
Appendix B: Accel code and link to working model

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Summary.

This report describes our process of creating a model for an internet marketing agency. The purpose of the model is to reach as many people as possible by email marketing, using the given budget of 10.000 euros. All phases of the modeling process, from problem to concepts, derivations, model, outcomes and back, are dealt with in this report.

Description of the Modeling Process.

Definition phase: context → problem definition and purpose.

6. Context.

Chanel wants to focus on advertising through the Internet to interest a younger audience in buying its products. They hire a marketing agency to run the campaign: A few people will be paid to send e-mails to other people interested in cosmetics. These mails contain a video about Chanel and a coupon to buy a product with a discount. This discount coupon can be activated by forwarding the e-mail within a fixed time period. As a result of forwarding these emails, the audience will grow exponentially for some time. Chanel has a limited budget of 10.000 euros for this campaign.

We, as a marketing bureau, want to work as efficiently as possible. We want to enlarge the quantity of the sales with an effective market strategy. By making an optimization model we can find out which marketing strategy is the most efficient to achieve our goal: reaching the biggest audience, with the limited budget that we have.

7. Problem Definition and Purpose.

How can we reach as many people as possible, in a viral marketing campaign, with a total budget of 10.000 euros?

We have two purposes with our model: we want to predict the number of people reached by our marketing efforts and optimize our strategy based on that.

8. Sub-questions.

- Can the number of forwards of the e-mail be explained by the number of first senders?
- Can the amount of forwards be explained by the amount of discount given by the coupon?
- Is there a relation between the total number of people that receive the e-mail and the number of people that forward the mail to get the discount?

Conceptualization: initial problem → conceptual model.

9. Concepts, properties, values and relations.

In this section we give an overview of the concepts in our model, including their properties and relations. A visualization of the conceptual model is included in appendix A.

Main company.

Description: Chanel is the company that hires the marketing agency for the campaign. They have a fixed budget for this campaign.
Properties: Budget {10.000}€.
Relations: Pays (1) > first senders of email (n).
Pays (1) > coupon (n).

First senders of email.

Description: These people are 'the source' of the 'epidemic' marketing campaign. They are paid by the marketing agency to send the mail with the advertisement to other people.
Properties: Number of {R^+}people.
Amount of people they will send the email to {R^+}people.
Amount of payment {0 … 10.000}€.
Relations: Send mail to (1) > receivers that do not forward (n).
Send mail to (1) > receivers that forward (n).

Receivers that do not forward the mail.

Description: These people receive the mail with the coupon from a forwarder of the mail, or the first sender of the mail. The receivers, that receive an email from a forwarder, are not selected on having an interest in the product. If they are interested in the discount however, they will forward the mail to other people to activate their coupon (and thus become a forwarder). The goal of the model is to find out how to maximize the number of receivers (R_d + R_f).
Properties: Number of {R^+}people.
Relations: Receive email from (1) > first senders of email (1).
Receive email from (1) > receivers that forward the mail (1).

Receivers that forward the mail.

Description: This is a subgroup of the receivers. They are interested in the product and the discount and will forward the mail to new people. By doing this they activate their discount coupon.
Properties: Number of {R^+}people.
Amount of payment {0 … 10.000}€.
Amount of people they will send the email to {R^+}people.
Relations: send email to (1) > receivers that do not forward (n)
send email to (1) > receivers that forward (n)
receive email from (1) > receivers that forward (1)
receive email from (1) > first senders of email (1)
receive discount from (n) > coupon (1)

Conversion rate first senders.

Description: This is the percentage of receivers that forward the mail. This is influenced by the discount given by the coupon. The first senders have a mailing list with people selected

for their interest in the product. Therefore, the conversion rate is different from the one for receivers that forward.
Properties: Forward rate {0 … 100}%.
Relations: Is influenced by (1) > coupon (1).

Conversion rate receivers that forward.
Description: The percentage of receivers that forward the mail. This is influenced by the discount given by the coupon and the time of the year in which the campaign is done.
Properties: Forward rate {0 … 100}%.
Relations: Is influenced by (1) > coupon (1)

Advertisement.
Relations: The mails that people send and receive in this model are advertisements.
Properties: Growth of forwards {R^+}.
Relations: Is spread by (1) > first senders of email (n).
Is spread by (1) > forwarders of email (n).
Contains (1) > coupon (1).
Is influenced by (1) > coupon (1).
Is part of (1) > advertisement (1).
Influences (1) > advertisement (1).

Coupon.
Description: The emails contain a coupon which gives a discount on the product. To activate the discount, the receiver needs to forward the mail. The amount of discount, when higher, positively influences the amount of people that want to activate the coupon by forwarding.
Properties: Discount {0 … 10.000}€.
Extra interest {R+} %.
Relations: Influences (1) > conversion rate (1).
Is paid by (n) > main company (1).
Gives discount to (n) > first senders (1).

Time of year in which the advertising campaign is done.
Description: During holiday seasons like Christmas, the number of people interested in the advertised product will be higher than during other times of the year.
Properties: Holiday season {November, December, January} – H.
Normal season {February, March, April, June, July, August, September, October}.
Extra interest {R+} %.
Relations: Influences (1) > conversion rate (1).

10. Quantities and their Relationships.

Category I – Input of the Functional Model.

Discount.
Unit: €.
Relations:
Influences the conversion rate of the receivers that forward.
Influences how much of the budget can be spent on payment of the first senders.

Amount of first senders.
Unit: people.

Relations:
Influences the amount of receivers, and thereby the amount of receivers that do and do not forward.

Time of year.
Unit: month.
Relations:
Influences the conversion rate of the receivers that forward.

Category II – Output of the Functional Model.

Amount of receivers that do not forward.
Unit: people.
Relations:
Influenced by the amount of first senders.
Influenced by the height of the discount.

Amount of receivers that forward.
Unit: people.
Relations:
Influenced by the amount of first senders.
Influenced by the height of the discount.

Amount of receivers.
Unit: people.
Relations:
Sum of receivers that do not forward and the receivers that do forward.

Costs.
Unit: €.
Relations:
Sum of the discount and the payment of the first senders.

Category III – Limitations from Context.

Budget.
Value: 10.000.
Unit: €
Relations:
Maximum of the sum of the costs.

Conversion rate first senders.
Value: 40.
Unit: %
Relations:
Determines what percentage of the people, emailed by first senders, turns into receivers who forward.

Conversion rate receivers that forward.
Value: 10.
Unit: %
Relations:
Determines the percentage of the people, emailed by receivers who forward, turns into receivers who forward.

Payment of first senders.
Value: 20.

Unit: €
Relations:
Determines the conversion rate of the first senders.

Increase conversion rate receivers that forward due to height of discount.
Value: +10.
Unit: %/€.
Relations:
Increases the conversion rate of the receivers that forward with 10% for each euro discount offered by the coupon. (1 euro discount will increase the default conversionrate of 10% with 10%, so it will be 1.1*10% = 11%).

Amount of people to whom a receiver has to forward to use the coupon.
Value: 3.
Unit: people.
Relations:
Influences the amount of receivers.

11. Approximations and Assumptions.

Use of the coupon: you can only use the coupon if you forward the email to three people.

Conversion rate: percentage of people that receive an email from a first sender, plus the percentage of people that receive an email from any other sender.

40% of the people who receive the email of the first senders, forward the email (with the coupon) to 3 people.

10% of the people who receive the email of the first receivers, forward the email (with the coupon) to 3 people.

After that, the conversion rate stays the same; until the number of people is less than one.

Explanation:
The first senders select a certain group that is interested in our coupon.
The forwarders do not select the type of people to whom they send the email.
That is why we chose a higher conversion rate for the people who receive the email from first senders than the conversion rate for the people who receive the email of initial receivers.

Amount of money first senders:
The first senders receive 20 euros if they send the email to a X amount of people. (see quantities and their relationships).

Influence of time of year:

In the months November through January the number of people who forward increases by 7%

Certain holidays make people give each other presents, therefore sales and presumably also interest in advertisements should be higher in the time leading up to those holidays. To optimize the efficiency of our advertising we want to include this factor into our model.

As holidays like Valentine's Day and Mothers' Day are only likely to influence a specific range of products, we decided not to include those. Christmas on the other hand is celebrated worldwide, by just about any part of society except some religious groups, and gifts can be just about any product.

In 2014 financial concern Deloitte reported a retail sales increase of 4 - 4.5% from November through January in the US, while according to the Office for National Statistics the retail sales in the UK increased as much as 8.7% during the holiday season of 2013.

Conclusion: We chose to adopt a similar value and expect a 7% increase in the number of people who forward the email from November through January. This extra-percentage is the same for the first conversion rate as for the second one.

12. Derivations.

The derivations of our model are basically two formulas: one to calculate the number of people that is reached with the campaign, and another one to calculate the costs of this. The symbols in the formulas are explained in appendix B.

Number of people reached

To improve the readability of this formula, the formula for the intermediate variables 'conversion rate first senders' and 'conversion rate receivers that forward the mail' are in this case noted separately from the main formula to calculate the total number of people.

People $= R_d + R_f$

The main idea is that the total number of people reached in the campaign is equal to the total number of receivers that forward the email plus the total number of receivers that do not forward the email.

People $= R_d + R_f = Fs * R_{fs} + R_{initial} * C_f * R_{rf} + R_2 * C_r * R_{rf} + R_3 * C_r * R_{rf}$ etc.

Our second step is to define the number of receivers that forward, and the number that does not forward. The first wave of emails is sent by the first senders Fs. They send the mail to a certain number of people R_{fs}. The outcome of this is a group of initial receivers called $R_{initial}$

Then the second wave of sent emails starts. This phase is marked blue in the formula. A part of the initial group of receivers $R_{initial}$ will forward the mail, another part won't. The balance between these two groups is controlled by a coëfficient: the concepts conversion rate first senders and conversion rate receivers that forward the mail. By multiplying the initial receivers with the coëffient, we get the number of receivers that forward the mail. By multiplying this number with the number of people they forward the mail to R_{rf}, we get the amount of new people who receive the email, notated as R_2

In the third wave this sequence repeats itself, which is marked in green. The only difference is that the coëffecient is different. We assume that the conversion rate for receivers that forward the mail is lower than for the first senders, because the first senders are paid for mail adresses of interested people. Receivers that want to activate the coupon by forwarding, will send the mail to random people, who are less interested on average.

In the fourth wave (yellow) the sequence is the same as in the third wave, including the use of the same coefficient. The same yields for all the repeated parts there after it. The model is not infinite though. The coëffients that are used, the conversion rates, are less than 1. So the growth of new receivers slows down at each wave, till the number of receivers that forward is less than 1 and the growth is therefore 0. (Assuming that only an integer number of receivers are allowed in this model.)

This part of the model looks like the opposite of a formula for a bank savings account with a certain interest each year. In these kind of formulas the savings of the account grow with for example 5% a year. 100 euro will be 105 euro after a year. After year two the savings grow from 105 euro to 105 * 1.05 = 110.25 euro. It is a recursive function that uses its previous value to calculate the new one. In our derivation the coëffient is not bigger than one, as in the example. So instead from growing to infinity, the number of receivers will decrease.

$C_{-f} = F_{cf} * 1 * (D * E_{discount} * 1 + H * E_{season} * 1 + 1)$

$C_{r} = F_{rf} * 1 * (D * E_{discount} * 1 + H * E_{season} * 1 + 1)$

The conversion rates, which are used as coëffients in our model, are intermediate variables. That's because they are influenced by other quantities, namely the season of the year and the amount of discount given by the coupon.

The formula gives a default forward rate F of two sorts: for first senders and one for receivers that forward. An explanation for this difference is given earlier in this paragraph. To convert the percentage to a proper coëffient we multiply it with one (40% * 1 = 0,4).

Then there is a second component in this formula. The influence of the discount and the time of the year. First we will explain the influence of the discount D. D is an amount of euro's. $E_{discount}$ is the amount of extra interest per euro discount. (It could be 1% per euro discount for example). Multiplying these quantities gives a percentage of extra discount that we multiply with one to get a proper coëffient.
The influence of the time of the year works mainly the same. We define if it is holiday season. If it is, H will be 1 (true). If it is not, H will be zero (false). We multiply this number with E, which is the percentage of extra interest caused by the season. We multiply these quantities with 1 to create another coëfficient.

By adding up the coëffients for extra interest caused by discounts and time of year to 1, we get the coëfficient that controls our normal forward rate. An example: The forward rate could be 40%. The extra interest caused by 5 euros discount is 5% and it is holiday season, which results in another 6% extra interest. Then the conversion rate will be: 40% * 1 * (5% * 1 + 6% * 1 + 1) = 0.4 * (0.05 + 0.06 + 1) = 0.4 * 1.11 = 0.51 = 51%.

As you can see, adding up 1 to the coëfficients of extra interest caused by discount and holiday season is an important step. Without it, the relation would be negative in this formula, causing a higher discount to lower the conversion rate.

Costs.

$B = Fs * P_{fs} + D * R_{f}$

This means that the total budget needed for the campaign is formed by adding two intermediate variables, namely: payments P_{fs} to the total number of first senders FS & the discount D given by each activated coupon to the total number of receivers that forward the email R_{f}.

13. Special Cases.

There are several special cases in this model.

Conversionrate is 1 or more.
In the situation that the conversion rates increases to a value more than or equal to 1, the number of people that forward will stay constant, or grow infinitely. This situation is only possible if the discount of the coupon D is unrealistically high and increases the interest of people to forward the email to 100% or more.

Conversionrate is 0 or approximates it.
In this situation the conversion rate decreases to a value of 0, the number of people that forward will be 0. This situation is only possible if the discount is negative and a high negative number, as this decreases the interest of people to forward to a number that approximates 0.

When first senders reach people relatively cheaper than forwarders.
The first senders are paid to send the mail with the coupon to a certain amount of people. If they get 20 euros to send the mail to 40 people, each person costs 0.50 euros essentially. If the receivers get 3 euros discount after forwarding the email to 3 people, each forward to a new person costs 1 the company euro.

In this situation you get the strange case that the best way to reach the biggest audience for our product, is to spend the whole budget on paying as much first senders as possible, instead of stimulating the forwarding of the email by people who want to use the coupon.
The quality of the reached audience in this special case is questionable though. People who activate the coupon are generally more interested in the product than people who get the email and do nothing with it.

14. Estimates.

Omitting concepts.
In the formalization of our model, we decided to leave out certain concepts. The main property that is missing is the expiration date of the coupon. Instead we use the concept ‘conversion rate’ to make the growth of receivers finite in our model.

Another property that we leave out of the model is the payment to receivers that forward the email. These people already get the discount of the coupon, which they activate by forwarding the email. This is a sufficient stimulus for people to forward the mail and an extra payment to these people has no added value in the model.

Also, we omitted the concept advertisement. It has a property named growth of forwards, which is better represented by the concept conversion rate. Neither has it a role in calculating the audience that is reached by the campaign, which is better represented by the concepts receivers that forward or don’t forward.

Finally, we decided to leave out the influence of the time of year after all. We had indeed found that it does have an influence, but as this influence is relatively small and the concept would complicate our model tremendously, we decided to ignore it.

See 11

Execution phase: formal model → result.

15. Rephrase the problem statement in formal terms.

Earlier in this report we stated that we want to reach as many people as possible, within the given budget. In the context of the formulas that we created this means the following: The maximum value of $R_d + R_f$, while B does not exceed 10 000 euros.

16. Calculations / Implementation / Simulation.

Most of the formulas described in chapter 12 could be transferred directly to Accel. A part of the model that we had to rewrite in a format that was readable for the computer, was the recursive part describing the number of people forwarding the email.

To solve this problem, we contacted lecturer Tijn Borghuis. With his help, we learned how to write down recursive functions in Accel. The main formula to describe the number of people is formulated like this in the model:

# People	$= R_d + R_f = R_1+R_2$
R_1	$= (1+R_{rf}*C_f)*start$
R_{i+1}	$= (1+R_{rf}*C_r)*R_i\{2\|start\}$
start	$= Fs*R_{fs}$

The number of people is described as adding up two functions: one for the first wave of emails, with a higher conversionrate. Then the second formula is chosen (with a lower conversionrate), for the remainder of the model. Like any recursive function, there has to be a start value. This is defined as the product of the number of first senders and the number of people that receive a mail from an individual first sender.

This same rewrite of the derivation takes place in the function to compute the cost.

C	$= Fs * P_{fs} + D * R_f$
Rf	$= Rf_1+Rf_i$
Rf_1	$= (1+R_{rf})*start$
Rf_{i+1}	$= (1+R_{rf})*R_i\{2\|start\}$
start	$= Fs*R_{fs}$

One part of the cost formula, depends on the number of receivers that forward. We can find this number with a recursive function, which works basically the same as in the main formula. Only the number of people that a forwarder sends the mail to is omitted, which results in a formula that gives the total number of receivers that forward the mail (and therefore activate the discount coupon.)

17. Validation and verification; accuracy and precision.

The outcome of our ACCEL model will not be a 100% accurate. This has to do with the fact that we left out certain influences on the model that should have been included for a more precise model. Some would not have a big influence on the model, like the season when the advertisement is released or the variety in interest of the people who receive the mail. Others, however do have a slightly bigger influence. We left out the standard price of the product. A discount of 1 euro on a price of 8 euro is more attractive, than a discount of 1 euro on a price of 50 euro. This creates a situation in our model where a low discount with a high number of first senders reaches more people, than a high discount with fewer first senders. A situation that is fully logical in the model, but maybe not in reality.

Another aspect that affects the precision of the model, is that the sliders of Accell are not really precise. This is especially a problem when we work with discounts lower then €1,-. What we would expect is that the slider goes from 0.1 to 0.2, instead the values jump from 0.2 to 0.7 to 0.95.

The conversion rate has also a big role in the outcomes of our model. We are aware of that influence, but we see that the standard values we use in the model are rather arbitrary: 40% for the first receivers and 10% for the others. Changing this values to 30% and 5% would change the number of reached people heavily, as the conversion rate are part of the recursive functions that are repeated throughout the model.

Conclusion phase: result → solution of the initial problem

18. Presentation and interpretation.

The execution of our model yields a number. However, we can only find this number when looking at a graph. This graph yields an optimalization graph. We have a fixed amount of money which the company can spend, with the help of the model we can make an optimalization graph. This way we can find the number of first senders and amount of discount that gives the best result.

Reflections and Discussions

19. Discussion after the conceptual model.

- We have chosen to leave out the influence of the year. This was the right choice, because leaving it in made our model needlessly complicated.
- We left out the price of the product itself. This might not have been a very good choice, because our results are now not reasonable. Example given: a one euro discount will be of great value if the product costs 3 euros, but if the product costs over 70 euro, the discount would be negligible.

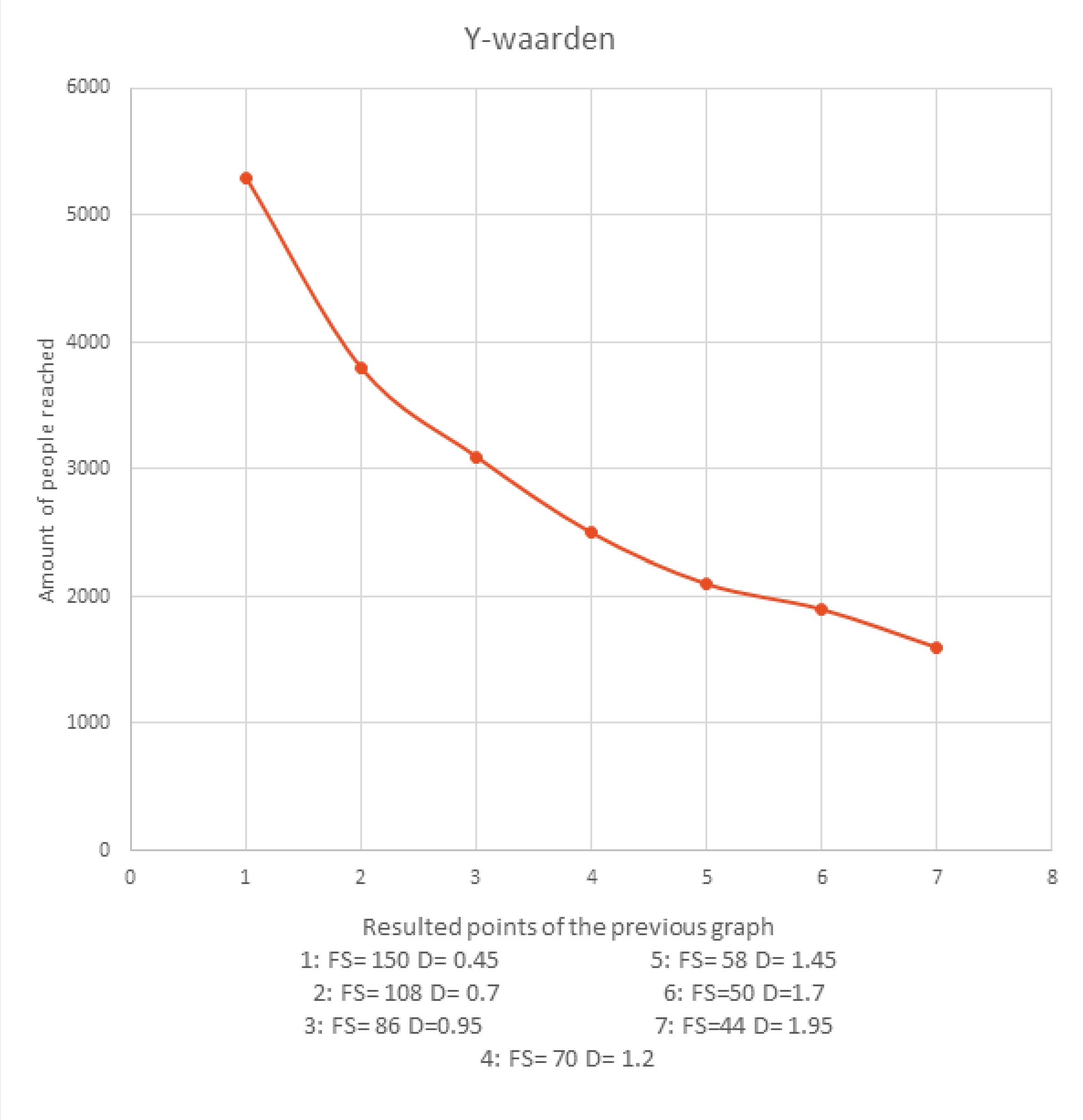
20. Discussion after the formal model.

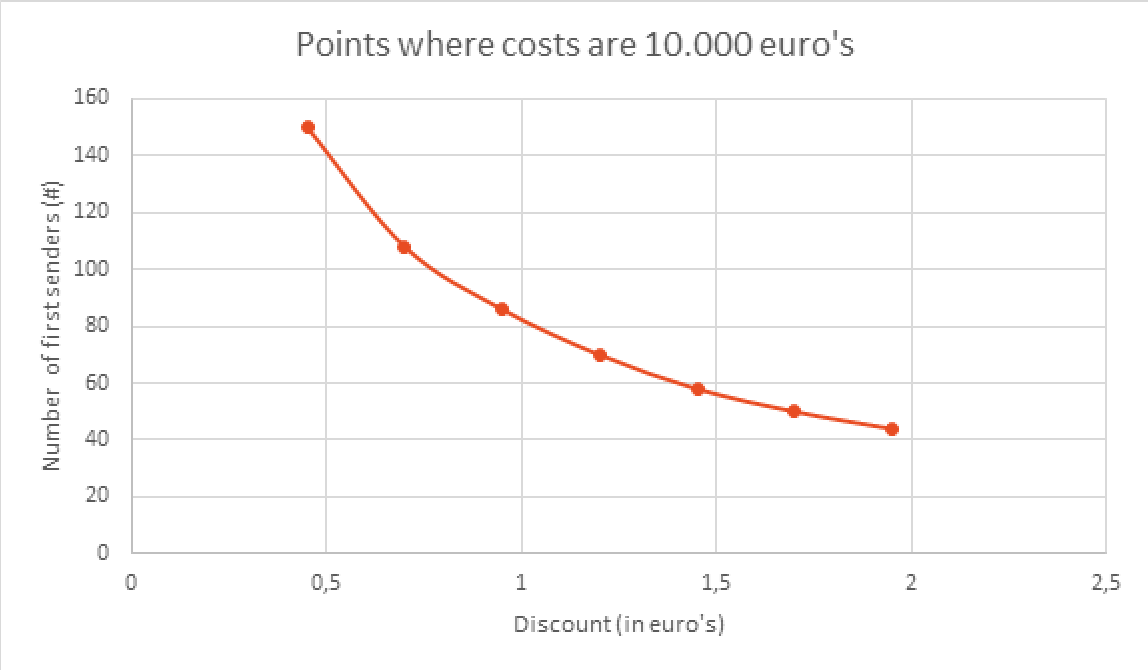
- The discount should have been percentual. This would have made our model way more complex, but it would have given a more realistic result.
- Budget 10.000; this amount of money is fixed, that was right choice because of the fact that we fixed this our model was less complicated. However this particular amount of money could be more because this is a small amount for a big company like Chanel.
- First senders of email: this is a slider in our model because the more first senders there are the more money it costs. But if the amount of first senders is bigger there will be more people reached.
- Conversion rate first senders:while conducting research we found out that approximately 40% of the people emailed by a first sender forwards the email. This number is higher than

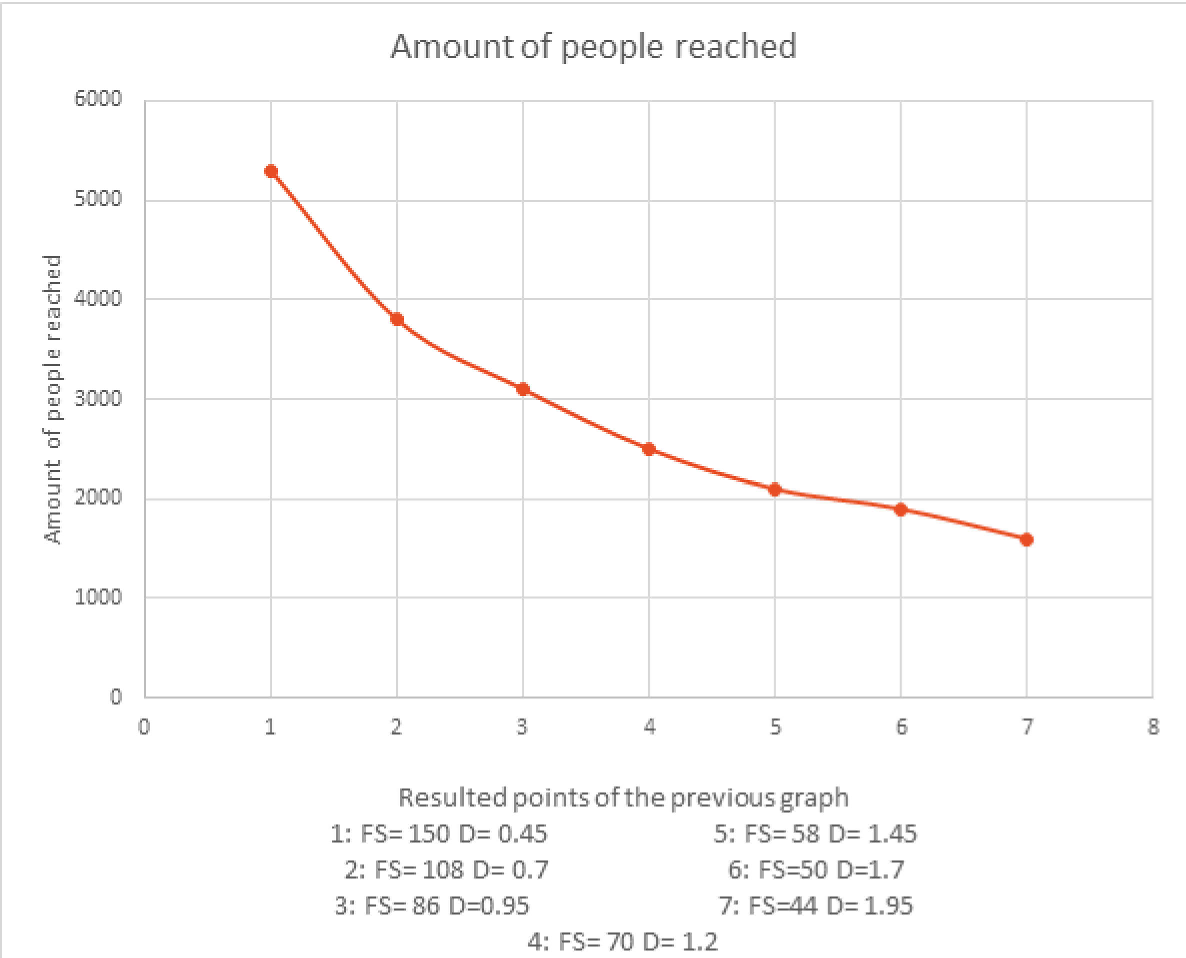
the conversion rate of receivers that forward since first senders are selected because they have a mailing list with people selected for their interest in the product.

- Conversion rate receivers that forward. while conducting research we found out that far less 'forwarders' forward an email. Approximately 10% of the forwarders forward the email in order to profit from the discount.
- Discount is a slider in our model because of the same reason as the first senders

21. Discussion after the result.







- To reach the most people; the discount should be as low as possible and the amount of first senders as high as possible.
- The discount has a smaller influence on the amount of people then on the amount of first senders.

- You can reach the most people (5300) with 150 first sendrs and 0.45 cent of discount.

22. Discussion after the solution of the initial problem.

Our problem definition: How can we reach as many people as possible, in a viral marketing campaign, with a total budget of 10.000 euros?

23. Extension

If we could work another week on the assignment we would definitely change the discount from a variable in euros to a value in percentages.We believe that this would make the result a lot more logical.

Furthermore we would probably choose a fixed price for the product we are advertising for, this way we could have a clearer view of for what discount (reward) people are going to forward the email.

In addition to these two factors, we would like to contact a marketing agency in order to have a clearer view on how a campaign like this works. Because we believe that the searching on the Internet has not fully answered all of our questions yet, and thus has not explained the total process.

24. Necessity for improvement

Genericity: Our model could certainly be more generic. We initially started with a very specific context, where we made a model to advertise a fragrance by Chanel. This influenced certain decisions in the process, due to which our model could not work for every company involved in setting up an internet advertising campaign.

Scalability: As our model should theoretically work with both very large and very small input values, we believe our model to be sufficiently scalable. We could however do more experimenting to validate this assumption.

Specialization: As our stakeholders are rather broad groups, our model is sufficiently specialized.

Audience: We consider our model suited to our audience, as it provides the information the stakeholders want, and they can provide all necessary input.

Convincingness: The convincingness of our model could improve, as most of our assumptions are more educated guesses than that they are based on actual research.

Distinctiveness: Our model has both a predictive function and an optimization purpose. For the latter, it is quite distinctive. The conclusions show clearly that to reach as many people possible within the given budget, you need to balance a low discount and a high number of first senders. For the predictive functions, the distinctiveness of the model varies. For discount values lower than 1, a small change shows a distinctly different outcome in both the number of people reached and the money needed to pay the campaign. This changes however if the discount gets bigger.

Surprise: The goal of our model is not to surprise the user. It should give the user a recommendation for setting the height of the discount and the number of first senders, to achieve the biggest audience for the product within the limited budget.
What was surprising however, was that the optimum point of this model is a combination of a generally low discount and a high number of first senders. This is due the fact that the standard

price is not taken into consideration. So even a low discount on a really expensive product has a positive effect on the number of people. Another reason for the surprising outcome is that unlike the discount, the payment of the first senders is a one-time investment. More people reached, doesn't mean a significant growth in the cost for first senders, though it does for the amount of money spent on the discount. (each forwarder gets a discount. So the more forwarders, the more money spent on discounts.)

Impact: Our model could have a big impact for a company. If the model fails, a company loses the investment in the campaign as well as the expected extra revenue the campaign should have brought. This gives a big responsibility for the makers of the model. That would be positive if the model were near 100% accurate, but could be a problem if the model is not precise enough for a real life situation like ours.

25. Possibilities for improvement

Based on the points we made under part 24, we found a few possibilities for improvement of our model.

In terms of generecity, we could improve our model. Our first context was really bound to a specific product: a perfume of Chanel. We changed that during the process, but it influenced the way our concepts were chosen and the method of setting up the formal model. In a new iteration we could try to get a more generic context, which would hopefully result in a model that is applicable to more companies than just ones that are similar to Chanel.

We could experiment more with large and small values to validate that our model is indeed scalable. For now the model focuses on a campaign that is smaller than an internet marketing campaign in the real world. That was fine in our situation, because it simplifies the process of making the model. This is relevant for inexperienced modelcreators like us. To improve the use of this model for a real campaign, it should be scaled up. Because real internet campaigns involve audiences of millions of people instead of just several thousands as in our model.

We could do more research to back up our assumptions with, so that the model becomes more convincing. For example: our standard conversionrates are numbers that we assumed to be 40% and 10%. Changing this numbers has a big influence on the output of the model. It is therefore better to have some better arguments for this numbers than a single arbitrary assumption.

We could improve the balance in the relationship between the discount and the payment of the first senders. The money spent on discount grows a lot if the audience gets bigger, while the money spend on first senders doesn't cost that much in relation to the extra people reached. That makes it more attractive to invest of first senders, instead of a higher discount. We do not think that this situation would occur a lot in reality.

26. What aspects of your work are you proud of?

First of all we are proud of our teamwork. We made a good team together, communicated well and regularly held meetings.

We are also proud that we made a model for a realistic problem, which we could face in the future in our work.

Mostly we are proud that we managed to make a working model, particularly because we had to contact mr. Borghuijs to get it to work. We are glad that we did not give in and go for an easier formula, but put in some extra effort to prove that our method works. With our model we could actually get results and answers to our questions, which gave a real sense of satisfaction.

27. What have you learned?

We started with no knowledge at all. We felt hopeless in the beginning, since the assignment was very vague for us, we did not really know where to start.

The first thing we did is come up with a context. We learned that it was important to have a set context when working with models. In combination with the problem definition and purpose this is, so to say, your starting point. We already defined Chanel's budget in the context as well.

After that we just followed the steps in the report template. The subquestions we made were helpful as a kind of guidelines. As the course material has a similar structure to the template, we kept up with watching the videolectures and reading the lecture notes, so that we had at each stage sufficient knowledge to complete the different parts of the report.

For various problems we ran across while building our model we managed to find solutions in the course material. We will here highlight a few topics that were particularly helpful in our modeling process.

Modeling purposes (section 1.2) : This helped us figure out that we are making an optimization model, and the exact goal of such a model.

Stages in the modeling process (section 1.4) : This gave us a clear overview of what stages we should go through to build a good model.

Constructing a conceptual model (section 2.5) : We used this for the conceptualization stage of our modeling process. As we had at first no idea how to make a conceptual model, we followed the step-by-step explanation and used the example, after which we managed it.

States and State Charts (section 3.2.1) : This topic came up when it seemed that 'state explosion' could occur in our model. It seemed we would have an infinite amount of receivers due to which we would exceed the budget, but we managed to sufficiently reduce the state space.

A practical route to formal models (section 4.2) : From this we learned how to name concepts and formulate relations, basically how to make a formal model.

The 4-categories approach to building functional models (section 5.2) : The clear descriptions of the different types of variables was very useful to us as we had at first some trouble with understanding the differences between them.

What do we mean by confidence in a model (section 6.1) : This mainly helped us make peace with the fact that our model will not and cannot be 100% accurate.

Criteria for modeling and purposes (section 7.2) : This section helped us find opportunities for improvement in our model. Because of the clear explanations of the evaluation criteria we managed to complete part 24 of our report.

28. Used literature.

Overveld, van, K., Berkum, van, E., & Borghuis, T. (n.d.). *"From Problems to Numbers and Back" Lecture Notes to 'A Discipline-neutral Introduction to Mathematical Modeling'* (2015 ed.). TU/e.

Assumptions

Gustavson, K. (2014, September 24). *No coal here: Holiday forecast calls for 4% growth,* http://www.cnbc.com/id/102021823

Hamilton, S. (2014, January 17) *U.K. Retail Sales Beat Forecasts With Record Christmas Increase*, http://www.bloomberg.com/news/articles/2014-01-17/u-k-retail-sales-surge-2-6-as-small-stores-win-at-christmas

Marketingfacts. *Stats dashboard e-mail marketing* http://www.marketingfacts.nl/statistieken/channel/e_mail_marketing

29. List of Definitions.

B - budget

Fs - First senders of email

R_{fs} - amount of people they will send the email to {R^+}people

P_{fs} - amount of payment {0 … 10.000}€

R_d - Receivers that don't forward the mail

R_f - Receivers that forward the mail

P_{Rf} - amount of payment {0 … 10.000}€

R_{rf} - amount of people they will send the email to {R^+}people

C – Total cost of the campaign

C_f - Conversion rate first senders

F_{cf} - forward rate {0 … 100}%

C_r - Conversion rate receivers that forward

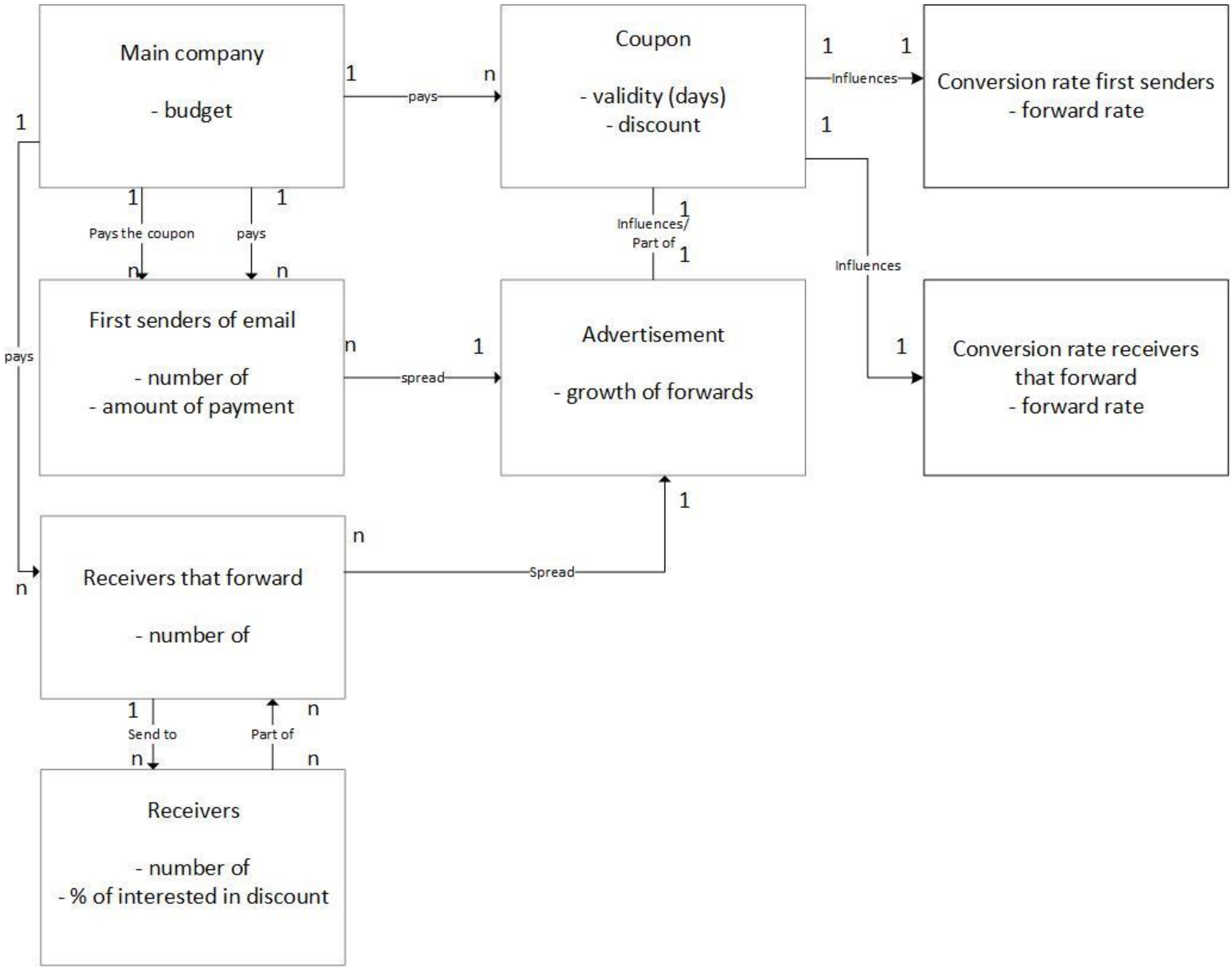
F_{cr} - forward rate {0 … 100}%

Cp - Coupon

D - discount {0 … 10.000}€

$E_{discout}$ - Extra interest {R+} %

Appendix A – Visualization conceptual model.



Appendix B - Accel code

```
People  =  R1+R2                 (cat.=2)
R1      =  (1+Rrf*Cf)*start      (cat.=4)
R2      =  (1+Rrf*Cr)*R1{2|st…   (cat.=4)
start   =  Fs*Rfs                (cat.=4)
Fs      =  slider(1,0,400)       (cat.=1)
Rrf     =  3                     (cat.=3)
Rfs     =  10                    (cat.=3)
Cf      =  0.20*(1+D*E)          (cat.=4)
Cr      =  0.05*(1+D*E)          (cat.=4)
D       =  slider(1,0.2,50)      (cat.=1)
E       =  0.10                  (cat.=3)
B       =  10000                 (cat.=3)
C       =  Fs*Pfs+D*Rf           (cat.=2)
Pfs     =  20                    (cat.=3)
Rf1     =  (1+Rrf)*start         (cat.=4)
Rf2     =  (1+Rrf)*R1{2|start}   (cat.=4)
Rf      =  Rf1+Rf2               (cat.=4)
```

Link to working model:http://www.keesvanoverveld.com/Accel/accel.htm?link=Group9WorkingModel