

Using Exact Sciences Models for Understanding Social Phenomena Session 9 – New Product Diffusion

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Question: Is this reasonable?

Answer:

NO. (not maybe; it depends; perhaps not; - just NO)

How to model a new product penetration?

What are the main forces?



Mass advertising in all its forms - TV, Radio, Newspapers, Magazines, Billboards Point-of-sale communications Direct marketing Internet Public Relations Sales people (to some degree)

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p and q – conditional probabilities Given that the individual has not yet adopted, the probability that she'll adopt in the next unit of time because of external influence is p Similarly for q

The Bass diffusion model (Bass 1969)

How many adopters will be added between t and t+ Δt ?

At time t, N adopted the product, and m-N did not.

p(m-N) external influence

q(N/m)(m-N) internal influence







Example

| Time | p(m-N) | q(N/m)(m-N) | dN(t)/dt | N(t) |
|------|--------|-------------|----------|------|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 50 | 0 | 50 | 50 |
| | - | - | | |
| 2 | 48 | 19 | 67 | 117 |
| 3 | 44 | 41 | 85 | 202 |
| 4 | 40 | 64 | 104 | 306 |
| 5 | 35 | 85 | 120 | 426 |
| 6 | 29 | 98 | 127 | 552 |
| 7 | 22 | 99 | 121 | 674 |
| 8 | 16 | 88 | 104 | 778 |
| 9 | 11 | 69 | 80 | 858 |
| 10 | 7 | 49 | 56 | 914 |
| 11 | 4 | 31 | 36 | 950 |
| 12 | 3 | 18 | 22 | 971 |
| 13 | 1 | 11 | 13 | 984 |
| 14 | 1 | 6 | 7 | 991 |
| 15 | 0 | 4 | 4 | 995 |
| 16 | 0 | 2 | 2 | 997 |
| 17 | 0 | 1 | 1 | 998 |
| 18 | 0 | 1 | 1 | 999 |
| 19 | 0 | 0 | 0 | 1000 |
| 20 | 0 | 0 | 0 | 1000 |

p=0.05, q=0.4, m=1000





























p q and m for microwave ovens

Countries differ greatly in their p and q, even for the same product

Internal coefficient q is larger than external coefficient p by an order of magnitude

| | р | q | m |
|----------------|-------|------|--------|
| Austria | 0.006 | 0.29 | 3,060 |
| Belgium | 0.008 | 0.37 | 2,778 |
| Denmark | 0.008 | 0.17 | 1,878 |
| Finland | 0.015 | 0.61 | 1,929 |
| France | 0.013 | 0.36 | 17,024 |
| Germany | 0.007 | 0.36 | 27,915 |
| Greece | 0.002 | 0.19 | 2,789 |
| Ireland | 0.010 | 0.38 | 464 |
| Italy | 0.000 | 0.56 | 5,583 |
| Netherlands | 0.002 | 0.43 | 3,912 |
| Spain | 0.003 | 0.43 | 8,355 |
| Sweden | 0.011 | 0.49 | 3,193 |
| Switzerland | 0.010 | 0.33 | 921 |
| United Kingdom | 0.018 | 0.31 | 22,827 |

| | External - p | Internal - q |
|-----------------------------|--------------|--------------|
| Dishwashers | 0.0026 | 0.13 |
| Electric Refrigerators | 0.0026 | 0.22 |
| Home Freezers | 0.014 | 0.17 |
| Electric Bed Coverings | 0.0058 | 0.24 |
| Clothes Driers | 0.017 | 0.36 |
| Power Lawnmowers | 0.0092 | 0.34 |
| Steam Irons | 0.029 | 0.33 |
| Automatic Coffee Makers | 0.017 | 0.30 |
| Black and White Televisions | 0.028 | 0.25 |
| Room Air Conditioners | 0.010 | 0.43 |
| Water Softeners | 0.018 | 0.29 |
| Boat Trailers | 0.009 | 0.38 |
| Record Plavers | 0.025 | 0.65 |
| Color Televisions | 0.0185 | 0.652 |
| Average | 0.0147 | 0.335 |

| Slow Products | Years to 25% | Years to 50% | Years to 95% |
|-----------------------------|--------------|--------------|--------------|
| Dishwashers | 21.8 | 29.8 | 51.8 |
| Electric Refrigerators | 15.4 | 20.3 | 33.8 |
| Home Freezers | 9.1 | 14.4 | 30.2 |
| Electric Bed Coverings | 10.9 | 15.1 | 26.8 |
| Normal products | | | |
| Clothes Driers | 5.6 | 8.4 | 16.1 |
| Power Lawnmowers | 7.5 | 10.5 | 19.0 |
| Steam Irons | 4.6 | 7.3 | 15.3 |
| Automatic Coffee Makers | 6.2 | 9.3 | 18.4 |
| Black and White Televisions | 5.3 | 8.6 | 18.8 |
| Room Air Conditioners | 6.3 | 8.7 | 15.5 |
| Water Softeners | 6.1 | 9.3 | 18.5 |
| Boat Trailers | 7.1 | 9.9 | 17.5 |
| Fast Products | | | |
| Record Players | 3.4 | 4.9 | 9.2 |
| Color Televisions | 4.0 | 5.6 | 10.2 |
| Average | 6.3 | 9.2 | 17.5 |





| p | 0.01747 | | | | | |
|------|---------|------------|-----------|---------|--------------|-----|
| q | 0.26712 | | | | | |
| m | 4784.11 | | | | | |
| | | | | | | |
| year | sales | cumulative | estimated | sqdiff | sum of squar | res |
| 1984 | 0 | 0 | 0 | 0 | 11997.9 | |
| 1985 | 25 | 25 | 83.5902 | 3432.81 | | |
| 1986 | 70 | 95 | 89.7966 | 391.903 | | |
| 1987 | 100 | 195 | 106.803 | 46.2811 | | |
| 1988 | 150 | 345 | 130.149 | 394.071 | | |
| 1989 | 200 | 545 | 163.074 | 1363.56 | | |
| 1990 | 250 | 795 | 203.065 | 2202.91 | | |
| 1991 | 280 | 1075 | 246.773 | 1104.07 | | |
| 1992 | 300 | 1375 | 287.439 | 157.776 | | |
| 1993 | 300 | 1675 | 321.295 | 453.483 | | |
| 1994 | 310 | 1985 | 345.101 | 1232.07 | | |
| 1995 | 335 | 2320 | 359.142 | 582.813 | | |
| 1996 | 350 | 2670 | 362.25 | 150.062 | | |
| 1997 | 360 | 3030 | 352.111 | 62.2351 | | |
| 1998 | 348 | 3378 | 327.411 | 423.907 | | |
| 1999 | | | 289.777 | | | |







The type of products that can be dealt with the Bass model

Products with infrequent interpurchase time

For frequently purchased products (FMCG – Fast-Moving-Consumer-Goods) whose success crucially depends on repeat purchase, stochastic-brand-choice models are a better choice

High involvement - high priced products

The high price and/or emotional involvement makes the search worthwhile

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