KU LEUVEN

EXAM INSTRUCTIONS

D0S92a Operations Strategy in Manufacturing and Services

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21/01/2020 – 8:00AM

Instructions for students

- Please write your identification info (student name, number) on every page!
- **Maximum duration**: 3.00h (from official starting hour of the exam)
- Exam type: written, closed book
- Only the following auxiliary materials are allowed:
  - Pen
  - Programmable calculator
  - Probability tables, attached to this exam bundle
  - Student's blanco formulas addendum (1 hand-written, double-sided A4 page)

- Students are allowed to use their own pen, but should only use the paper provided by the university. Other papers or notebooks are not allowed.
- Mobile phones, smartwatches and other electronic devices should be handed to the invigilators who will keep them for you until the end of the exam. All material such as jackets, backpacks, books and own paper should be left at the back or the front of examination room.
- For any irregularity of a student, all articles in the irregularities section of the exam regulations apply.
- Please check whether your exam bundle contains 5 questions and the cumulative distribution and loss function tables. Immediately ask the invigilator for another bundle if this is not the case. Please do not detach any pages from this bundle.
- Multiple choice questions will be corrected using a correction for guessing.
- There are blank pages following each question. Please use these to answer the questions.
- There's scrap paper at the end of the bundle. Unless explicitly stated in the space provided for solutions, text written in the scrap paper will not be corrected.

Marks

Quest. 1	Quest. 2	Quest. 3	Quest. 4	Quest. 5

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Question 1

Shreveport International is a young startup based in Sint-Pieters-Rode, Belgium. They design and manufacture solar panels and inverters used in residential installations. Since their founding in 2015 they have had success in penetrating the European market; they currently enjoy 24% market share in BeNeLux. Last year, however, President Trump started threatening China with imposing ever more tariffs to their products—escalating the trade war. This suddenly made EU products more attractive to American consumers, and completely changed the business projections of Shreveport International. In a matter of months, inquiries from the US increased 400%. After the initial panic, the leadership team got together and formulated a business plan.

Current sales for the company are 97000 panels per year and the current capacity is 105000 panels per year. Management agrees that the most likely scenario (45% probability) is that sales in the coming years will increase moderately, to 115000 panels/year. They also estimate a 30% probability for sales to increase heavily, to 135000 panels/year, and a 25% probability that sales will actually double to 194000 panels/year.

After analyzing different alternatives they decided that the best action plan is to expand their factory. The best estimate for the costs of the expansion is a linear function of the shape $TC(K) = c_f + c_k * K$, where c_f is the fixed cost of the expansion, and c_k is the variable cost per unit of capacity K. Management agrees that this unstable situation will last for at least 4 years, so they decided that all decisions need to take this time-horizon into account. (You can assume that the full increase in demand and the full capacity expansion already take place during the first year of the time horizon.)

a) **(1 point)** If c_f = €150000; c_k = €409; the per unit margin of each panel, m = €500; the penalty cost for each unit of unmet demand p = €51; and the company uses a discount factor r = 15% per year. What is the optimal expansion decision? (Assume that any capacity expansion will be ready in time for it to be useable during the full 4 years of the time-horizon.)

b) **(2 points)** Calculate the NPV of the decision you recommend in (a).

One of the founders of the company disagrees with this way of deciding upon the expansion. He argues that there is too much uncertainty. His solution is to invest in improving the forecasting/business intelligence capabilities of the company. Doing so would allow the company to perform a detailed study of the market such that the company will be able to know exactly what the demand is going to be. Such a study, however, will require a sizeable investment, and will take considerable time. (The probability for each scenario will not change, but the company will be able to know exactly what the demand for the final 3 years of the time-horizon will be.)

c) **(2 points)** How much would the company be willing to spend in this study? Assume that if the study starts now, then the results will be ready so that whatever capacity expansion is required will be ready for the company to operate during the final 3 years of the time-horizon.

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Question 2

Unbeknownst to them, Shreveport International is the about to experience some tough competition!

Until late last year, their biggest selling solar panel (the SPT-011) had carved a niche in the Belgian market such that it was essentially the only solar panel that mattered in its price range. A new entrant (SolarLife Inc) is considering to enter the market with an inferior innovation (the KWN3000) which would compete head-on with the SVT-011. The willingness-to-pay (WTP) for these products are 600-5x and 300-2x, respectively for the SVT-011 and the KWN3000.

The marginal cost per unit for the SVT-011 is €300 while for the KWN3000, just €120. Assume that both companies price their products optimally. Before the launch of the KWN3000, Shreverport International could be considered as a monopolist in the market.

a) **(1 points)** Draw a sketch of the of the willingness-to-pay curves. Identify which line belongs to each product and graphically show the market split, the profit of each company and the money left on the table.

b) **(2 points)** Calculate the optimal prices for each product after the introduction of the KWN3000. What is the size at which the market splits (given these prices)?

c) **(1 points)** Determine (if any) the percentage increase in the total market size after the launch of the KWN3000, compared to the situation before the launch.

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Question 3

The hospitality industry has taken quite a big hit from the whole COVID-19 thing. Tourism has been down all over the world, and many hotels are struggling. One way for hotels to make up for the loss of revenues that they have sustained is to try and sell advance bookings for next summer, so that they can at least keep some cash flows. The uncertainty for next summer, however, is quite high. No one really knows whether holidays are going to be safe. Thus, hotels are (1) offering attractive promotions for people booking (and paying) in advance, and (2) preparing for an unusually high rate of booking cancellations. There is this one particular hotel in the Italian coast that has asked your help. Hotel Piccolo Lido, in Bordighera is offering a promotion. They will offer a discounted price to travelers booking one of their "deluxe" rooms in advance. Moreover, they will also offer a full refund for any cancelation. The hotel has 54 "deluxe" rooms, and they estimate that the demand curve is $D(p) = 88 - 0.21p$, with p the price in euros. (Assume that daily demand is independent, i.e., there are no multi-day reservations to worry about.)

a) **(2 points)** Suppose that the hotel wants to maximize their daily revenue by using price differentiation. Customers will thus be segmented into two groups. Please calculate:
   - The optimal pricing levels for both segments. (You may assume there is no leakage.)
   - The corresponding maximum revenue.
   - The money left on the table and the passed-up revenue.

b) **(1 points)** The hotel anticipates a lot of uncertainty in the cancelations. They expect that cancelations will be normally distributed with a mean of 15 cancelations per night and a coefficient of variation of 1. As mentioned above, the hotel will refund the full price to guests who cancel. If, on the other hand, a customer has a reservation, but the hotel has run out of "deluxe" rooms, they will bump them to their exclusive "seaview" suites. They estimate the cost of such a bump to be around €155 per room (assume they always have enough of these suites to offer to overbooked customers).
   - What is the optimal number of seats to overbook (give an integer answer)?
   - What is the impact of overbooking on the expected daily revenue (give the answer as a % increase/decrease compared to the no-overbooking case)?

c) **(1 point)** What if the hotel had a limited number of "seaview" suites? Assume that they overbook the number of rooms that you calculated as in (c), but the hotel only has 6 "seaview" suites available. If any more than this number of guests need to be bumped, the hotel has to book a room for them at a neighboring hotel at the cost of €300.
   - What would the expected bumping costs be in this case?

d) **(1 point)** Operationally, the way in which the hotel implements price differentiation is using advance bookings. In particular, they book the rooms at the lowest price until they reach the pre-set advanced booking limit (ABL) at which point they start booking at the higher price. Suppose that the regular demand (i.e., higher price) is normally distributed with a mean of 27 and a standard deviation of 14.
   - What is the optimal protection level for Hotel Piccolo Lido?
   - How many regular (expensive) bookings does the hotel expect to turn down on a given day?

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Question 4

a) **(1 point)** In this course, we said --many times-- that "volatility is bad". Show, mathematically, one case in which an increase in volatility leads to a "bad" outcome. (This can be related to any of the topics we saw.)

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b) **(1 point)** Choose any of the models we saw in the DEA class (CCR or BCC, input or output oriented, envelopment or multiplier form). Write down its optimization form (i.e., the objective function plus constraints) and give a short intuitive interpretation of what the parameters mean.

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c)   **(1 point)** At the very beginning of the course, we discussed different ways of aligning a firms' competitive strategy with its operations strategy. In particular, we saw the *resource perspective* and the *market perspective*, which take opposite views on the question whether strategy should follow structure or the other way around. Choose one of the two perspectives, briefly describe its main idea, and give an example of a real-life company that you would argue follows this perspective.

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Question 5

Please read the following multiple choice questions carefully and provide the answers in the table below. To be considered valid, the answers **need** to be filled in the table in an unambiguous manner. Answers provided directly in the question text will be ignored. Every correct answer will earn you **1 point**, wrong answers will **deduct 0.3 points** each.

Question	Answer
5.1	
5.2	
5.3	

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5.1) Within the context of chaining as a strategy for adding flexibility in manufacturing operations, which statement is incorrect?

A. By using chaining, a manufacturing network can achieve almost all the benefits of "full flexibility" by adding only a handful of links.

B. When chaining, it's important to assign products with negatively correlated demands to the same plant.

C. When the total capacity in the network is much smaller than the expected demand, there is little value in adding flexibility.

D. When the total capacity in the network is much larger than the expected demand, there is little value in adding flexibility.

5.2) Given the part-worth curves for different attributes of a product, we can estimate the WTP curve for a large number of technically different products. Consider a product with a maximum potential market of 1275 customers, and the following part-worth curves:

Atttribute 1	WTP customer 0	WTP customer 1275
Fast	630	0
Faster	1190	0
Fastest	2415	0

Atttribute 2	WTP customer 0	WTP customer 1275
Tiny	1085	1625
Small	1085	1085
Large	1085	525

Assume that a company has a monopoly for the product with attributes: Large and Fastest. What is the price that maximizes the profit, assuming that each product costs €2800 to manufacture?

A. Around €3250.

B. Around €3150.

C. Around €2150.

D. Around €2250.

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5.3) Consider a capacity sizing problem that uses a power CapEx function to model economies of scale.

Which statement is correct:

A. All else equal, for a given value of K, the larger the parameter α, the lower the capacity cost.

B. All else equal, for a given value of K, the larger the parameter α, the higher the capacity cost.

C. The larger the parameter α, the less expensive future expenditures become when measured in present value.
D. None of the above statements are correct.

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Table 1: Standard normal demand distribution function table ($\phi(z)$).

z	-0.09	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0
-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.6	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
-3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
-3.4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
-3.3	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
-3.2	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
-3.1	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.001
-3	0.001	0.001	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013
-2.9	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019
-2.8	0.0019	0.002	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026
-2.7	0.0026	0.0027	0.0028	0.0029	0.003	0.0031	0.0032	0.0033	0.0034	0.0035
-2.6	0.0036	0.0037	0.0038	0.0039	0.004	0.0041	0.0043	0.0044	0.0045	0.0047
-2.5	0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.006	0.0062
-2.4	0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.008	0.0082
-2.3	0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107
-2.2	0.011	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139
-2.1	0.0143	0.0146	0.015	0.0154	0.0158	0.0162	0.0166	0.017	0.0174	0.0179
-2	0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228
-1.9	0.0233	0.0239	0.0244	0.025	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287
-1.8	0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359
-1.7	0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446
-1.6	0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548
-1.5	0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.063	0.0643	0.0655	0.0668
-1.4	0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808
-1.3	0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968
-1.2	0.0985	0.1003	0.102	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151
-1.1	0.117	0.119	0.121	0.123	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357
-1	0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587
-0.9	0.1611	0.1635	0.166	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841
-0.8	0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.209	0.2119
-0.7	0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.242
-0.6	0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743
-0.5	0.2776	0.281	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.305	0.3085
-0.4	0.3121	0.3156	0.3192	0.3228	0.3264	0.33	0.3336	0.3372	0.3409	0.3446
-0.3	0.3483	0.352	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821
-0.2	0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.409	0.4129	0.4168	0.4207
-0.1	0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602
0	0.4641	0.4681	0.4721	0.4761	0.4801	0.484	0.488	0.492	0.496	0.5

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Table 2: Standard normal demand distribution function table ($\phi(z)$).

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.695	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.834	0.8365	0.8389
1	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.877	0.8790	0.881	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.898	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.937	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.983	0.9834	0.9838	0.9842	0.9846	0.985	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.989
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.996	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.997	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.998	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.999	0.999
3.1	0.999	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

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Table 5: Standard normal loss function table, $L(z)$.

z	-0.09	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0
-4	4.0900	4.0800	4.0700	4.0600	4.0500	4.0400	4.0300	4.0200	4.0100	4.0000
-3.9	3.9900	3.9800	3.9700	3.9600	3.9500	3.9400	3.9300	3.9200	3.9100	3.9000
-3.8	3.8900	3.8800	3.8700	3.8600	3.8500	3.8400	3.8300	3.8200	3.8100	3.8000
-3.7	3.7900	3.7800	3.7700	3.7600	3.7500	3.7400	3.7300	3.7200	3.7100	3.7000
-3.6	3.6900	3.6800	3.6700	3.6600	3.6500	3.6400	3.6300	3.6200	3.6100	3.6000
-3.5	3.5900	3.5800	3.5700	3.5600	3.5500	3.5400	3.5301	3.5201	3.5101	3.5001
-3.4	3.4901	3.4801	3.4701	3.4601	3.4501	3.4401	3.4301	3.4201	3.4101	3.4001
-3.3	3.3901	3.3801	3.3701	3.3601	3.3501	3.3401	3.3301	3.3201	3.3101	3.3001
-3.2	3.2901	3.2801	3.2701	3.2601	3.2502	3.2402	3.2302	3.2202	3.2102	3.2002
-3.1	3.1902	3.1802	3.1702	3.1602	3.1502	3.1402	3.1302	3.1202	3.1103	3.1003
-3	3.0903	3.0803	3.0703	3.0603	3.0503	3.0403	3.0303	3.0204	3.0104	3.0004
-2.9	2.9904	2.9804	2.9704	2.9604	2.9505	2.9405	2.9305	2.9205	2.9105	2.9005
-2.8	2.8906	2.8806	2.8706	2.8606	2.8506	2.8407	2.8307	2.8207	2.8107	2.8008
-2.7	2.7908	2.7808	2.7708	2.7609	2.7509	2.7409	2.731	2.721	2.711	2.7011
-2.6	2.6911	2.6811	2.6712	2.6612	2.6512	2.6413	2.6313	2.6214	2.6114	2.6015
-2.5	2.5915	2.5816	2.5716	2.5617	2.5517	2.5418	2.5318	2.5219	2.5119	2.502
-2.4	2.4921	2.4821	2.4722	2.4623	2.4523	2.4424	2.4325	2.4226	2.4126	2.4027
-2.3	2.3928	2.3829	2.373	2.3631	2.3532	2.3433	2.3334	2.3235	2.3136	2.3037
-2.2	2.2938	2.2839	2.274	2.2641	2.2542	2.2444	2.2345	2.2246	2.2147	2.2049
-2.1	2.195	2.1852	2.1753	2.1655	2.1556	2.1458	2.136	2.1261	2.1163	2.1065
-2	2.0966	2.0868	2.077	2.0672	2.0574	2.0476	2.0378	2.028	2.0183	2.0085
-1.9	1.9987	1.989	1.9792	1.9694	1.9597	1.95	1.9402	1.9305	1.9208	1.9111
-1.8	1.9013	1.8916	1.8819	1.8723	1.8626	1.8529	1.8432	1.8336	1.8239	1.8143
-1.7	1.8046	1.795	1.7854	1.7758	1.7662	1.7566	1.747	1.7374	1.7278	1.7183
-1.6	1.7087	1.6992	1.6897	1.6801	1.6706	1.6611	1.6516	1.6422	1.6327	1.6232
-1.5	1.6138	1.6044	1.5949	1.5855	1.5761	1.5667	1.5574	1.548	1.5386	1.5293
-1.4	1.52	1.5107	1.5014	1.4921	1.4828	1.4736	1.4643	1.4551	1.4459	1.4367
-1.3	1.4275	1.4183	1.4092	1.4	1.3909	1.3818	1.3727	1.3636	1.3546	1.3455
-1.2	1.3365	1.3275	1.3185	1.3095	1.3006	1.2917	1.2827	1.2738	1.265	1.2561
-1.1	1.2473	1.2384	1.2296	1.2209	1.2121	1.2034	1.1946	1.1859	1.1773	1.1686
-1	1.16	1.1514	1.1428	1.1342	1.1257	1.1172	1.1087	1.1002	1.0917	1.0833
-0.9	1.0749	1.0665	1.0582	1.0499	1.0416	1.0333	1.025	1.0168	1.0086	1.0004
-0.8	0.9923	0.9842	0.9761	0.968	0.96	0.952	0.944	0.936	0.9281	0.9202
-0.7	0.9123	0.9045	0.8967	0.8889	0.8812	0.8734	0.8658	0.8581	0.8505	0.8429
-0.6	0.8353	0.8278	0.8203	0.8128	0.8054	0.798	0.7906	0.7833	0.7759	0.7687
-0.5	0.7614	0.7542	0.7471	0.7399	0.7328	0.7257	0.7187	0.7117	0.7047	0.6978
-0.4	0.6909	0.684	0.6772	0.6704	0.6637	0.6569	0.6503	0.6436	0.637	0.6304
-0.3	0.6239	0.6174	0.6109	0.6045	0.5981	0.5918	0.5855	0.5792	0.573	0.5668
-0.2	0.5606	0.5545	0.5484	0.5424	0.5363	0.5304	0.5244	0.5186	0.5127	0.5069
-0.1	0.5011	0.4954	0.4897	0.484	0.4784	0.4728	0.4673	0.4618	0.4564	0.4509
0	0.4456	0.4402	0.4349	0.4297	0.4244	0.4193	0.4141	0.409	0.404	0.3989

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Table 6: Standard normal loss function table, $L(z)$.

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.3989	0.394	0.389	0.3841	0.3793	0.3744	0.3697	0.3649	0.3602	0.3556
0.1	0.3509	0.3464	0.3418	0.3373	0.3328	0.3284	0.324	0.3197	0.3154	0.3111
0.2	0.3069	0.3027	0.2986	0.2944	0.2904	0.2863	0.2824	0.2784	0.2745	0.2706
0.3	0.2668	0.263	0.2592	0.2555	0.2518	0.2481	0.2445	0.2409	0.2374	0.2339
0.4	0.2304	0.227	0.2236	0.2203	0.2169	0.2137	0.2104	0.2072	0.204	0.2009
0.5	0.1978	0.1947	0.1917	0.1887	0.1857	0.1828	0.1799	0.1771	0.1742	0.1714
0.6	0.1687	0.1659	0.1633	0.1606	0.1580	0.1554	0.1528	0.1503	0.1478	0.1453
0.7	0.1429	0.1405	0.1381	0.1358	0.1334	0.1312	0.1289	0.1267	0.1245	0.1223
0.8	0.1202	0.1181	0.1160	0.1140	0.1120	0.1100	0.108	0.1061	0.1042	0.1023
0.9	0.1004	0.0986	0.0968	0.095	0.0933	0.0916	0.0899	0.0882	0.0865	0.0849
1	0.0833	0.0817	0.0802	0.0787	0.0772	0.0757	0.0742	0.0728	0.0714	0.07
1.1	0.0686	0.0673	0.0659	0.0646	0.0634	0.0621	0.0609	0.0596	0.0584	0.0573
1.2	0.0561	0.055	0.0538	0.0527	0.0517	0.0506	0.0495	0.0485	0.0475	0.0465
1.3	0.0455	0.0446	0.0436	0.0427	0.0418	0.0409	0.04	0.0392	0.0383	0.0375
1.4	0.0367	0.0359	0.0351	0.0343	0.0336	0.0328	0.0321	0.0314	0.0307	0.03
1.5	0.0293	0.0286	0.028	0.0274	0.0267	0.0261	0.0255	0.0249	0.0244	0.0238
1.6	0.0232	0.0227	0.0222	0.0216	0.0211	0.0206	0.0201	0.0197	0.0192	0.0187
1.7	0.0183	0.0178	0.0174	0.017	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146
1.8	0.0143	0.0139	0.0136	0.0132	0.0129	0.0126	0.0123	0.0119	0.0116	0.0113
1.9	0.0111	0.0108	0.0105	0.0102	0.0100	0.0097	0.0094	0.0092	0.009	0.0087
2	0.0085	0.0083	0.008	0.0078	0.0076	0.0074	0.0072	0.007	0.0068	0.0066
2.1	0.0065	0.0063	0.0061	0.006	0.0058	0.0056	0.0055	0.0053	0.0052	0.005
2.2	0.0049	0.0047	0.0046	0.0045	0.0044	0.0042	0.0041	0.004	0.0039	0.0038
2.3	0.0037	0.0036	0.0035	0.0034	0.0033	0.0032	0.0031	0.003	0.0029	0.0028
2.4	0.0027	0.0026	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021
2.5	0.002	0.0019	0.0019	0.0018	0.0018	0.0017	0.0017	0.0016	0.0016	0.0015
2.6	0.0015	0.0014	0.0014	0.0013	0.0013	0.0012	0.0012	0.0012	0.0011	0.0011
2.7	0.0011	0.0010	0.0010	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008
2.8	0.0008	0.0007	0.0007	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006
2.9	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004
3	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
3.1	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
3.2	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001
3.3	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.4	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.5	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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