Helwan University
Faculty of Computers and Information

Assignment
calculus revision

Department of Computer Science
Optimization

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1. (Stewart, 2003, P. 53–58, Sec. 15.1, PP. 936–937) Match the function (a) with its graph (labeled A-F on next page) and (b) with its contour map (labeled I-VI). Give reasons for your choices.

$$z = \sin\sqrt{x^2+y^2} \tag{1}$$
$$z = x^2y^2e^{-x^2-y^2} \tag{2}$$
$$z = \frac{1}{x^2+4y^2} \tag{3}$$
$$z = x^3 - 3xy^2 \tag{4}$$
$$z = \sin x \sin y \tag{5}$$
$$z = \sin^2 x + \frac{1}{4}y^2. \tag{6}$$

2. Consider the function $\Phi(t) = \int_{g(t)^{h(t)} f(x,t)dx}$, then Leibniz' rule states:

$$\Phi'(t) = f\left(h(t),t\right)h'(t) - f\left(g(t),t\right)g'(t) + \int_{g(t)}^{h(t)} f'(x,t)\,dx,$$

where all derivatives are taken w.r.t. to t.

   a) Apply Leibniz' rule to find the minima of the function

$$\Phi(t) = \int_{(t-1)}^{-(t-1)^2} (x-t)\,dx.$$

   b) Solve the problem without Leibniz' rule by direct integration then differentiation and conform the two answers.
   c) Provide geometrical interpretation to why Φ has a minimum.

3. Prove that the population median is the best decision under the absolute deviance loss. I.e. the population median is the solution to the following optimization problem

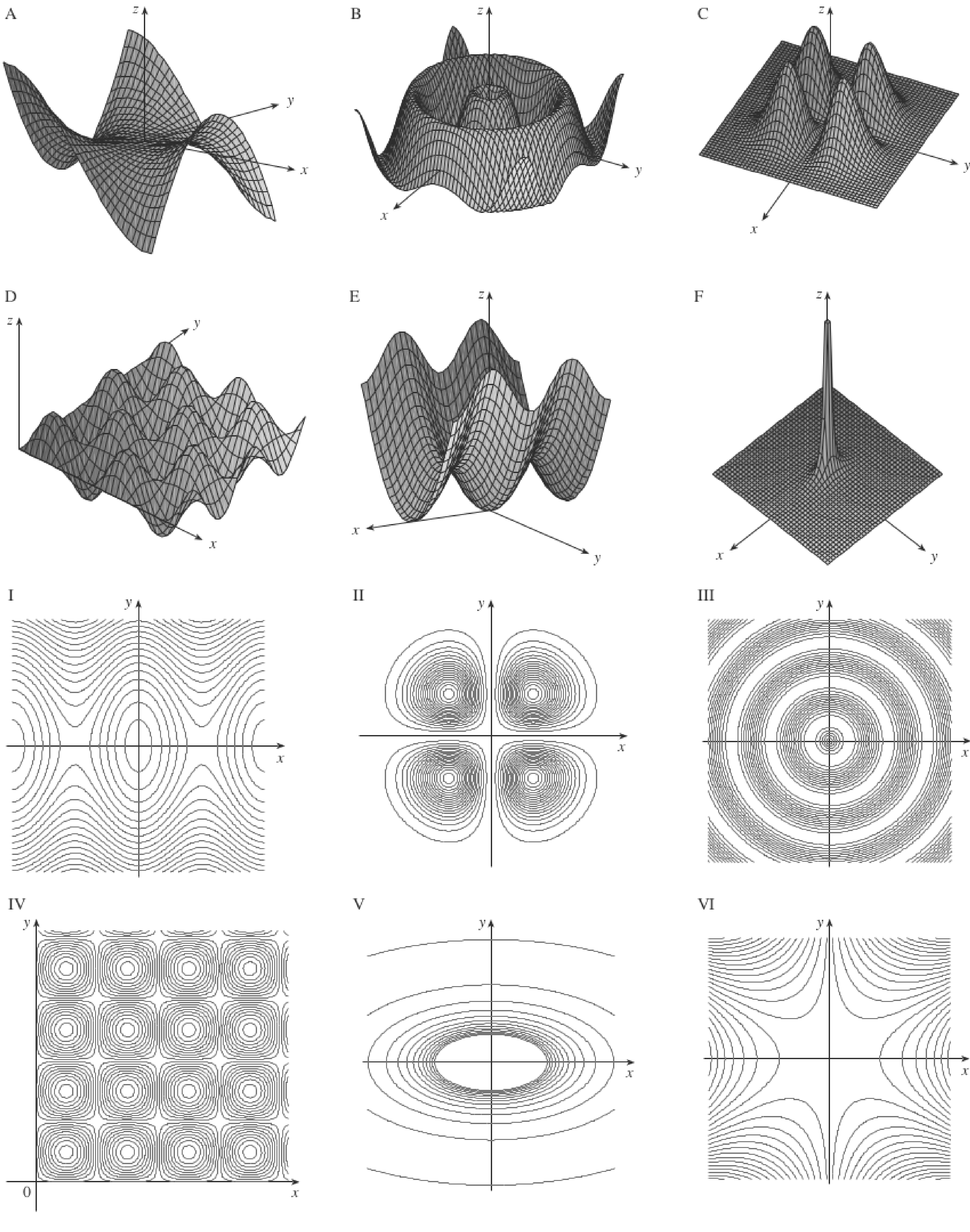
$$\underset{\widehat{X}}{\text{minimize}}\, \mathrm{E}_X\, |X - \widehat{X}|.$$

4. Prove that the sample median is the best decision under the absolute deviance loss for a set of observations. I.e., the sample median is the solution to the following optimization problem

$$\underset{\widehat{X}}{\text{minimize}} \sum_i |X_i - \widehat{X}|.$$

Bibliography

Stewart, J. (2003), *Calculus*, Belmont, CA: Thomson Brooks/Cole, 5th ed.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