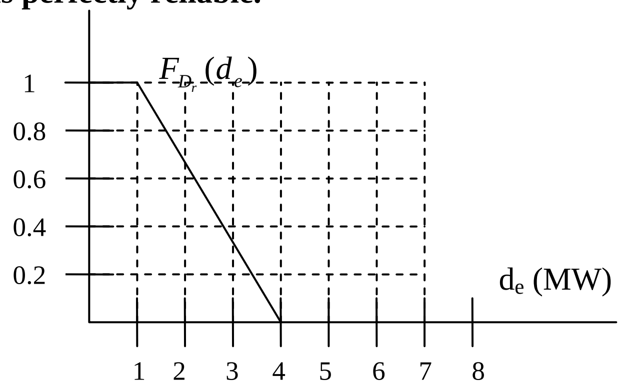
Name: ____

EE 590F, Power System Planning, Exam 2, 75 minutes, Closed book, Closed notes, Calculator Allowed, Off-campus must complete by 11/5 unless otherwise arranged.

1. **(16 pts) A load duration curve expected to characterize the next year for a power system on a small Greek island is given below. The power system has recently experienced a problem such that the system generation capacity for the next year will be only 3 MW. Identify the minimum load, the loss of load probability, the loss of load expectation, and the expected unserved energy, assuming the 3 MW of capacity is perfectly reliable.**



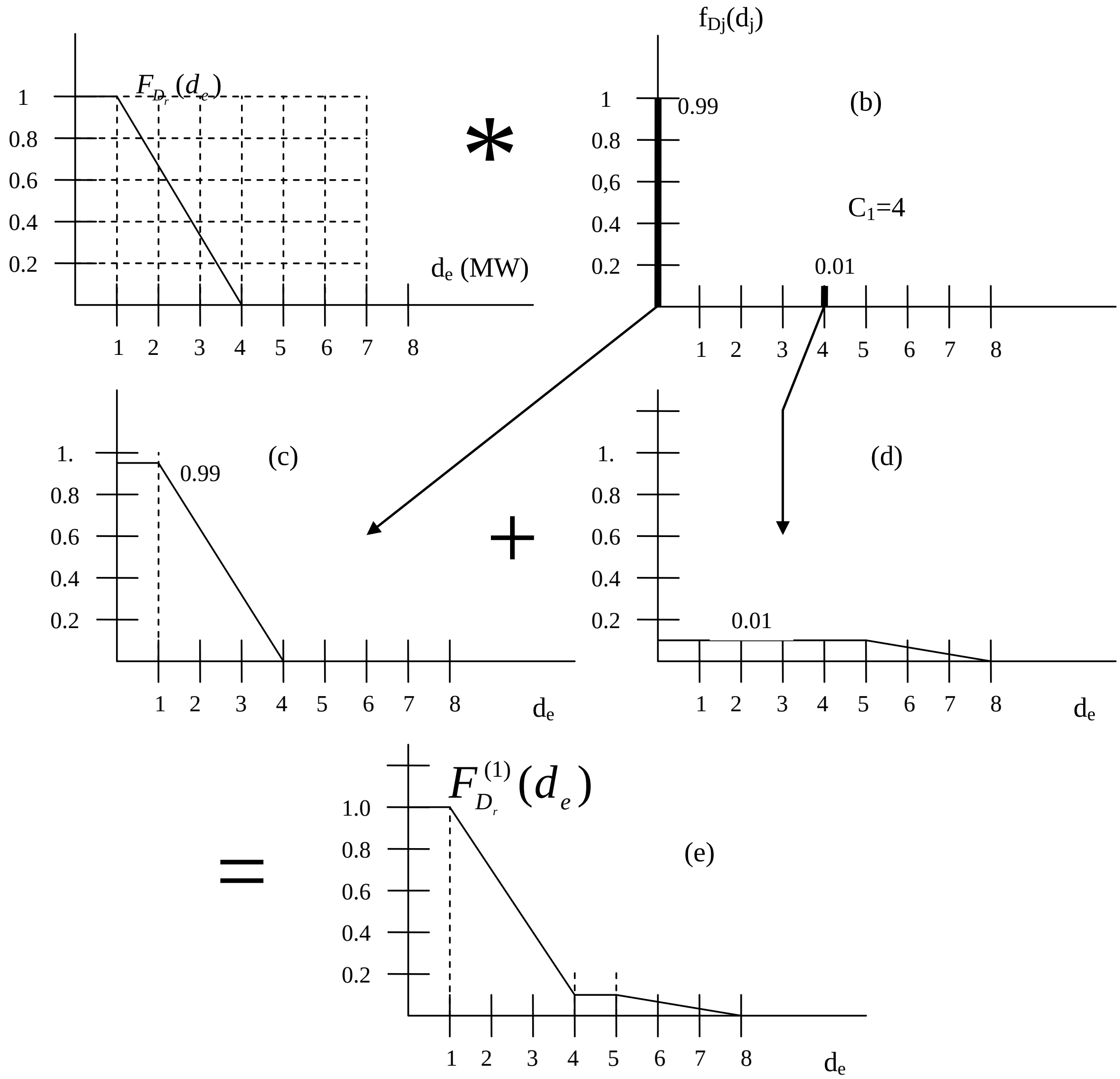
Solution:
Minimum Load=1 MW
LOLP=P(d>3)=0.333
LOLE=0.333*8760=2917 hrs
EUE=Area*T=0.5(1)(.333)(8760)=0.1666(8760)=1460MWhrs

2. **(10 pts) The Greeks have a relatively old generation fleet, and it is estimated that the average time required for any of the units in the Greek island's power system to fail is 900 hours and that the average time it takes for any of these units to be repaired is about 100 hours. All units have 1 MW capacity. Compute the availability and unavailability for one of these units. Ignore maintenance.**

Solution:
MTTF=900hrs, MTTR=100 hrs,
U=MTTR/(MTTF+MTTR)=100/(1000)=0.1
A=MTTF/(MTTF+MTTR)=900/1000=0.9

3. **(14 pts) The Greeks decide to retire all of their old units and purchase one brand new 4 MW unit with force outage rate of 0.01. If this unit supplies all of the island's electric energy, compute loss of load probability and expected unserved energy.**

Solution:



So LOLP=0.01 and
EUE=8760{(1)(0.01)+0.5(3)(0.01)}=219MWhrs

4. **(10 pts) Compute the energy expected to be produced by the 4 MW unit over the year.**

Solution:
E=A*T*Area
where Area is computed from the "previous" load duration curve, i.e., the one before the unit was convolved in, according to

$$Area = \int_{x_{j-1}}^{x_j} F_{D_e}^{(j-1)}(\lambda) d\lambda$$

This is the load duration curve given in the problem statement of problem 1. In this case, x_{j-1}=0 and x_j=4, and so the area is A=(1)(1)+0.5(3)(1)=2.5. The availability is 0.99 so that E=0.99*8760*2.5=<u>21681 MWhrs.</u>

a.	T
b.	T
c.	F
d.	T
e.	F
f.	F
g.	F
h.	F
i.	T
j.	T
k.	F
l.	T
m.	T
n.	T
o.	T
p.	T
q.	F
r.	T
s.	F
t.	T
u.	T
v.	T
w.	F
x.	T
y.	T

5. True-false questions (50 pts):

____a. The economic planning process presented by the MISO engineers is being used to perform a multiregional study including MISO, PJM, SPP, and TVA.

____b. To accomplish long range economic transmission development, a planning horizon of at least 15 years is necessary to encompass the reality that large transmission projects nominally require ten years to complete.

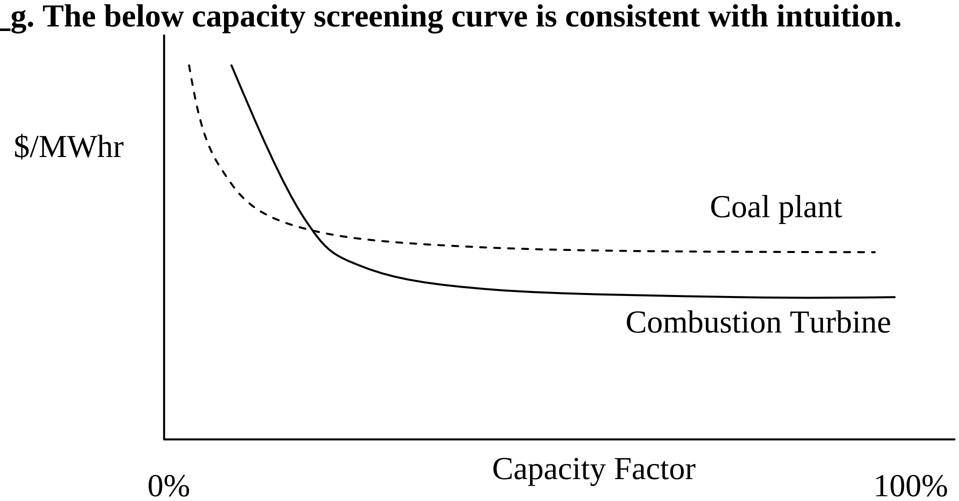
____c. A "queue" referred to in almost all presentations by the MISO engineers referred to an ordering developed by MISO engineers of which transmission-only projects to study first.

____d. A key problem addressed by the MISO economic planning process is whether to site transmission first and then build generation; or, site likely generation and then build the transmission system to support the generation assumptions.

____e. Resources that are forecasted from the EGEAS model are specified by type, timing, and location.

____f. One of the major advantages of the dynamic programming method available within EGEAS is that it remembers an infinite number of states.

____g. The below capacity screening curve is consistent with intuition.



____h. A general rule-based generation siting approach is used in the MISO planning process include the following principles: transmission is not a siting factor, "share the pain" (meaning each company performs their share of the work), and expansion at any one site is limited.

____i. The rule based generation-siting methodology includes a priority order for site selection where retired or mothballed unit sites are favored over Greenfield sites.

____j. Fuel transportation costs are significant influence in MISO's Greenfield siting criteria for fossil-fired plants.

____k. EGEAS solutions may reflect "size bias" where units are chosen just because they are small.

____l. More total capacity is required under high-wind assumptions due to wind being assigned a 15% capacity credit for resource adequacy purposes.

____m. The ability to obtain good performance in all attributes under all futures is more desirable in the MISO planning process than performing extremely well in all attributes for just one future.

____n. Reliability assessment, which includes steady-State contingency analysis, load deliverability analysis, generation deliverability analysis, voltage stability/reactive resource analysis, dynamic/transient stability simulations, small-signal stability analysis, and transfer analysis, is the last network analysis step in the MISO planning process.

____o. The four futures considered in the most recent MISO planning process were (1) Reference- most economic choice of generation with wind mandates; (2) Environmental- $25/ton carbon tax with wind mandates; (3) Fuel Limited-natural gas restricted to 80% with wind mandates; (4) Renewable-40,000 Mw of wind generation including mandates, 20% wind energy across the Midwest ISO.

____p. The total benefit by geographic area that potentially could be "captured" by a conceptual transmission expansion is obtained in the MISO planning process by comparing hourly economic simulations of a constrained base system with that of an unconstrained base system.

____q. In traditional reliability planning, the approach is to find the opportunity and then design a system to capture the economic share of the opportunity.

____r. A key motivation of the "overlay hub" being designed by MISO is that all areas should have direct transmission access to any other area.

____s. The surge impedance loading provides a single number identifying a circuit's capacity under all conditions.

____t. MISO has identified HVDC 800 kV and 765 kV HSIL as having the lowest cost per MW-Mile of all options considered.

____u. It is the case in Iowa, as in most states, that the regulator must find that a proposed line is necessary to serve a public use in order to approve.

____v. Should a state regulator impede new transmission development along a designated national interest corridor, the US Federal government has authority to establish the necessary authority.

____w. Single issue ratemaking is a primary influence on utility energy rates.

____x. Cost of equity, the minimum rate of return a firm must offer shareholders, is usually one of the most contentious issues in a rate proceeding.

_____y. State regulatory authorities influence regional transmission organizations by forming multi-state consortia.