Learning outcomes

②

THANKS FOR LAITH MANSOUR & „I think she is „RANEEM MOHAMMAD YOUNIS IN THE 1ST LEC & FOR OMAR MOHAMMAD JA'FAR IN THE 2ND LEC FOR COLLABORATION IN THE VIDEO WITH THE DOCTOR 🙏

By the end of this lecture, you would be able to:

- Understand ways and techniques to handle the results of economic evaluations

- Understand what is sensitivity analysis

- Understand the Cost-effectiveness thresholds threshold

- Identify the power of economic evaluations to enable decision making

عمليّ عدد → زادوا
جميع الأرضى عدد
(المزايا الشهريّة)

*semi Fixed (مقيمين)

✱ Fixed

X يتغيّر عددهم computer
بتغيّر المريض (مبنى / MRI)

*Variable (خاص بالمريض)

/springer/
بالدفع فواتير زيادة للأيّ.
المريض تكلفني مثلاً كهرباء

✱ مواصلات

direct
Med
سواء كان تأمين أو شخصي
related to
health care (أ) ضا لبناء مشفى)
Cost
Non
Med :
✱ حضانة لأطفال أمر بالمشفى (أرضا لبناء مشفى)

✳ perspective (مين بتتحمل التكلفة)

دراسات الجدوى الاقتصادية

حكومة ↓

خاص ↓ (فما بعدها)

(شركة تأمين بتتحمل تكلفة ⟶ 70%)

المريض بيدفع بـ ⟶ الـ **30%**
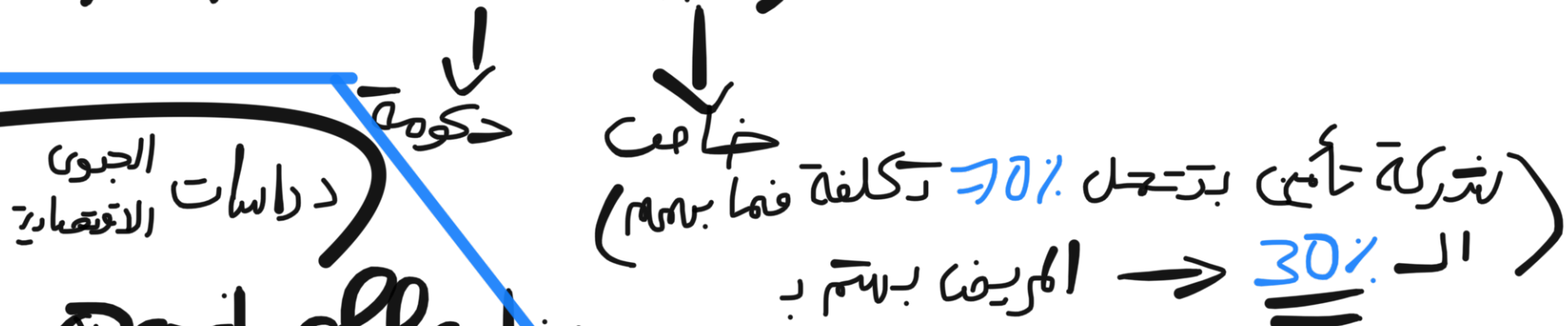
✳ Cost effective

تكلفة عالية ↓   وكفاءة عالية ↓

100%
- quantity of life

— Both collected once we
allocate big resources

(eg: Cancer search 1H, so

how can I economize:
* بتقارن بالInterventions
* بتشوف دراسات ✳✳ Both

✳ Cost Benefit

— quality &quantity

(درجة أكبر) ↓
من الـ Cost
effe

* to allocate resure from begining
* Convert every thing/cancer cells to money ↓

— even the outcome

to do we must compre old Vs New

هو القديم – الجديد
تكاليف ركاليف
وصعالية

Do you remember the cost effectiveness plane?

Cost difference

↳ Incumantal cost
Incumantal out come

التكاليف
نطرح الإضافية
long على ال
Term
فاكدة الغعالية
Eg = ± = (means cost the)
± newly is ↑
than old
(means ↑ effectiv)

NW

New treatment always rejected, i.e. dominated

+

decesion need discussion

?

Intervention less effective and more costly

Intervention more effective and more costly
cost

we reject

NW
NC
بالاسنابة

North east
ICER threshold
لازم أقارنه
عتبة الجدوى
الاقتصادية

+

check Sw SE ممتاز

P8

New treatment always accepted, i.e. dominated

⊖

?

قدره الدولة مستعدة تدفع مقابل تحسين
لحياة سليمة المريض / الها سقف للدفع
for each q aly = 7000 $/2 aly

so very الحد curs refuse Cv2 4 Bul dp

Intervention less effective and less costly

SW

Intervention more effective and less costly

9000 $ so
dangerous ratio
SE.

✱ICER: Incumantal cost effectivness ↑

Think of such case

NW

New service is more costly

NE

Drug B

New service
less effective

+

−

New service is more
effective

SW

−

New service is less costly

SE

How do we decide on whether to accept Drug B?

- Can we afford it? كلا + ل حساب ايش أنا استهمك بهنذا الدواء على حساب دواء ثاني
  - Budget!!

- Can we justified ?
  - What are the consequences of accepting/not accepting it?

- The decision is not black and white unless we draw a line of acceptance
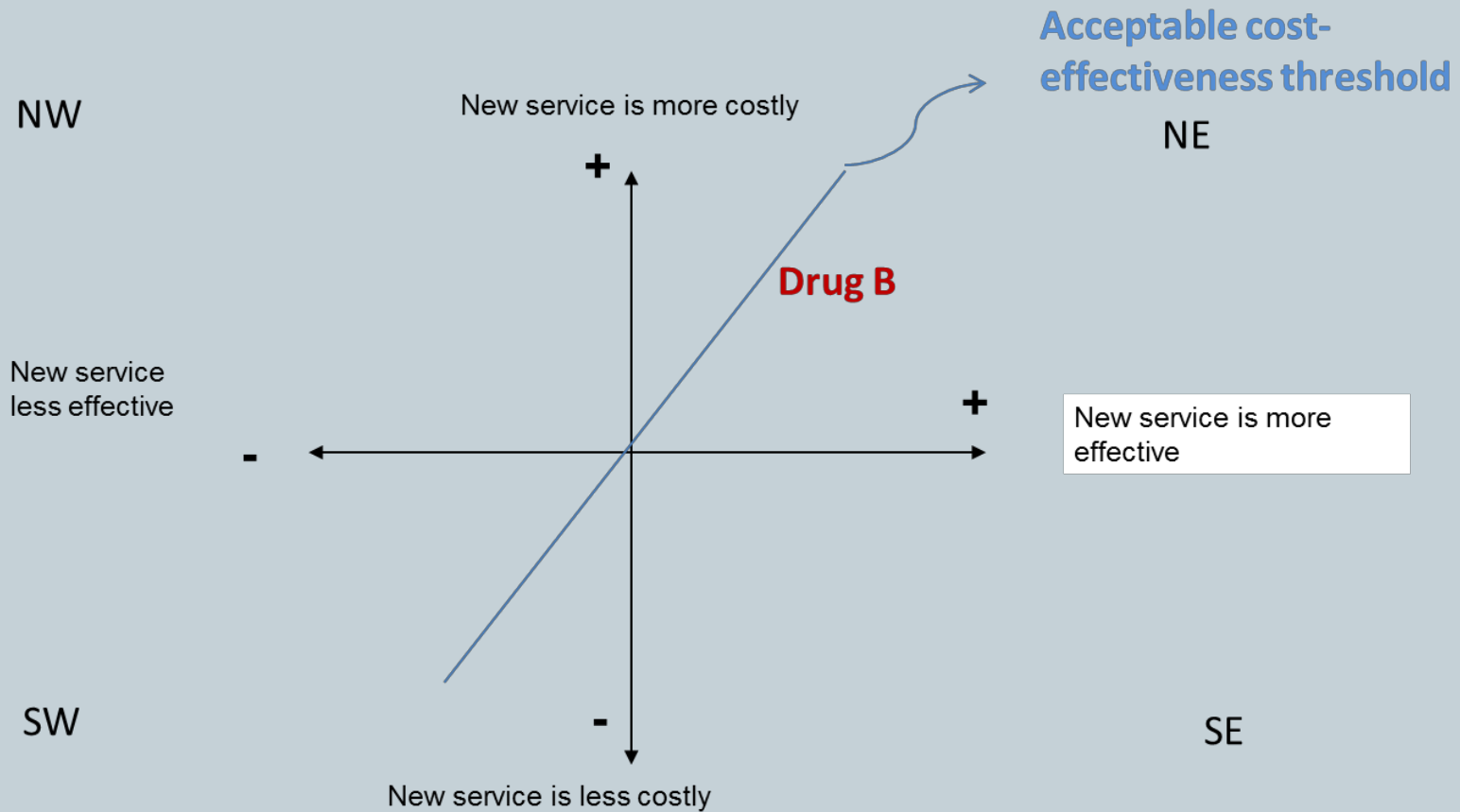
NW

New service is more costly

Acceptable cost-effectiveness threshold

NE

Drug B

+

New service
less effective

- +

New service is more
effective

-

SW

New service is less costly

SE

مذاكرة دواء 5000$ تحت
الـ threshold ممتاز

إلي هو #7000 إلي
حسب المثال برفوق

7 Th, eshold تحت الـ إلي
لنعتمده) لأنه الـ ICER أقل (

check next slide

New intervention more costly

NW   NE

Cost-effectiveness threshold

Cost ineffective

New intervention
is less effective

New intervention is
more effective

Cost effective

SW   SE

New intervention is less costly
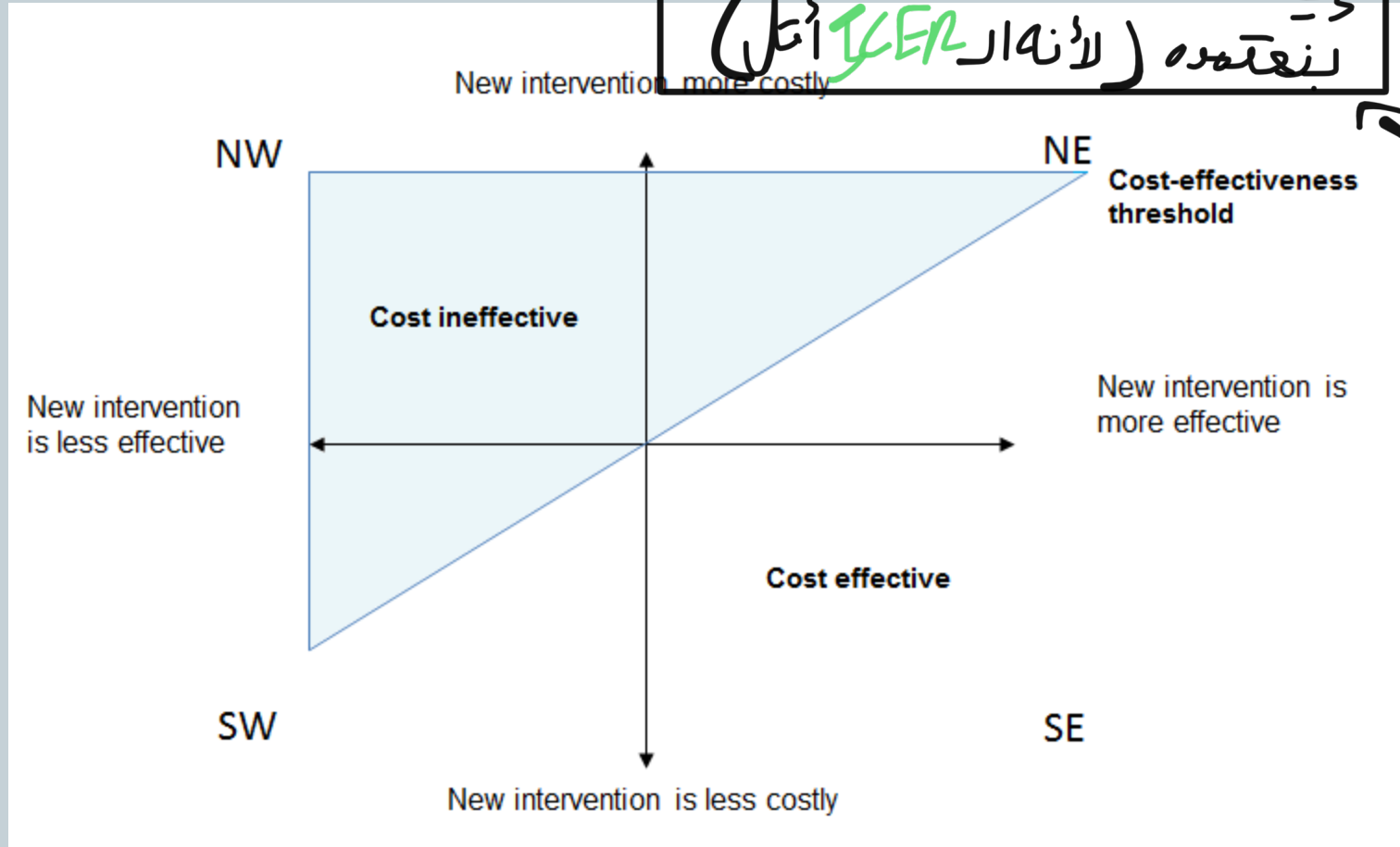
- Incremental Cost-effectiveness Ratio (ICER); the difference in costs between alternatives divided by the difference in outcomes measured

- If the ICER of the new intervention **<** than the acceptable cost-effectiveness threshold then the treatment should be adopted

  - Cost-effectiveness threshold is the value a decision maker is willing to pay for a unit of health gained (e.g QALY or LYG)

لِ حسب eg₂ : معناها كل سنة المريض بكلف
الدولة 5000$ وهي تمثل قيمة (cost)
وليس التكاليف الإجمالية مثال: القديم-الجديد
25/2 2012

- If the government uses a cost effectiveness threshold that is too high, this will promote inefficient uses of NHS resources.

(handwritten Arabic annotations across the slide)
SO Balance
accepted be الازم
لأ معناها حتى الأدوية الى مش كثير مساهمة alahtual
لأنه بالأخير ممكن تخلص الميزانية وممكن مع الوقت ما نعالج الـ Basic diseases

- If however, the threshold is too low, then the most valuable interventions will not be adopted and thus this will not make the best use of available resources.

- E.g. In UK,
  - NHS funds services which cost <£20,000 to < £ 30,000per QALY

Cost-effectiveness thresholds

- Other countries
  - Australia funds AU$69 900/QALY
  - New Zealand funds NZ$20 000/QALY
  - In the USA ($50 000/QALY)
  - In the Netherlands (€80 000/QALY)
  - In Canada (CAN$20 000 - $100 000/QALY).

  Why ?

  There is a range rather than one fixed value?

  Values and decisions might vary across countries or institutions?

(لينك ممكن يكون عم Range)
لكنه في eg special
= cancer population..
drugs
or orphan diseases

★ وهدول بنعالجهم بتكلفة
أعلى لكن هذا لا ينطبق
على كل المجتمع. ★
(next slide)

Why?

- Because, judgements about the acceptability of an intervention is subject to many factors beside the budget and health needs in an area.

- factors including
- The degree of uncertainty surrounding the calculation of ICERs (due to the source of uncertainty around the data source)
- The innovative nature of the intervention (other innovative nature of intervention not captured by the health benefit measure)
- The particular features of the condition and population receiving the intervention

Estimate of Cost-effectiveness threshold

الدكتورة ما ركزت عليه ← "// حسب المعطيات (كنف نعرف الرقم)
عليه

12

- Defining what is an acceptable maximum value or threshold for ICER is difficult and controversial
  - How much is an extra QALY or life year worth? This is a value judgment.
  - It can be explored to some extent through techniques such as trying to identify what a patient or the public might be willing to pay to avoid an unfavourable outcome

  - Some countries use by common consent, e.g provide treatment in the form of coronary bypass grafting: then workout the cost £X per QALY, and so this establishes a baseline for our thinking about how much we value a QALY.

Estimate of Cost-effectiveness threshold

- Set the threshold equal to per capita Gross Domestic Product

- every member of society were to be given a fair share of nation's wealth, they would receive the per capita GDP. The maximum they could therefore spend on health gain in any one year would therefore be the per Capita GDP.

  - If expenditure exceeds this value either the nation is spending more than it earns or some people are receiving less than their fair share.
  - GDP = Gross domestic product; < GDP per capita (Very cost-effective); 1-3 x GDP per capita (cost-effective); > 3 x GDP per capita (not cost-effective)

المعادلة

⟵ Theshold هذا

so ≤ 4k (very cost effect

> 12k (yce)

eg :- بعض الدخل
4000 $/year : so   1-3 * 4000 = 4-12k (Theshold)

What do you explain here in this graph

* more Threshold
means more acceptance to intervention

New service more costly

ICER: 20,000 per QALY

ICER: 10,000 per QALY

NW دو

NE

Drug B

cost effe
لأنه تحت ال
Threshold
Quad هذا ال (سواء كان
أدنى) تحت
أنا لو
Threshold ال

New service more effective

For your Info:-
Threshold كل ما يعلى ال *
بالSE بضيق هون
Sw (n) اننا نقبله) فبنقل احتمالية
لانه اذا قبلته بتكون
رفضت الأفضل واذنت الأكسوأ

SE

New service less costly

بغسرلنا انه صاحب تكلفة
بال بش بكون
فعالية أقل وتكلفة أقل) → *SO discussion occurs does it worth it to same drug B

New service more costly

NW

NE

£30,000

Ceiling ratio
= £30,000 / QALY

Cost
ineffective

New service
less effective
(QALY lost)

Cost
effective

1
QALY

New service
more effective
(QALY gained)

SE

SW

end of Lec1

New service less costly

Pt different in outcomes of interventions ∴ so we depend on Avg تعتمد عليها (more clarify through lecture)

eg :- drug efficacy 40% on avg, for most peple it's SD (Btn 50 & 80 50%. 80%) 40%

* So we don't depend on 1 item of ICER

Uncertainty in PE evaluation

parameters → طالما + Cost إن التغييرات بعد Test لذلك بعد (Avg الي انا يعني) which called senestivity Analysis ما بقي لحالة

- **Remember**
- All PE evaluations present means or proportions as outcomes e.g.

  ○ The mean reduction in blood pressure was 10mmHg (chech next 2 pags)
  ○ The mean cost was £8,500

- These results are all based on samples (which quad we its فيه بنشيك) are now after numbs changed

- If the study was repeated on a different sample we would obtain a slightly different result

So!!

SE الي مع NE إلا كان مثلاً

We need to estimate the boundaries within which the population (real) value is likely to lie (sensitivity analysis) يعرف أن الدواء مناسب إذا صار بنفس Quad

Last time we stopped at the notion of

- No matter how well-executed or comprehensive an economic evaluation, the data on costs and outcomes will inevitably contain various degrees of uncertainty and potential bias.

هذا إلي كنا نشتغل عليه بالفصل الأول رح نوجد كمان

- *Once the ICER has been generated in the primary incremental economic analysis (base case analysis), it is necessary to assess the robustness of these ICER*

  - *Robustness refers to the sensitivity of the ICER to uncertainties in the data*

- **Sensitivity analyses are performed to test the robustness of study results and conclusions when these underlying assumptions or estimates are varied.**

  - This process reveals the degree of uncertainty, imprecision, or methodological controversy in the evaluation.

Sensitivity Analysis

- A standard approach to manage uncertainty in PE evaluations

- A tool that tests the robustness of PE evaluation results and conclusions by holding other evaluation parameters constant, the study results are recalculated. E.g. different discounting rates

- If changing the values of specific variables does not substantially alter the results, you will have more confidence in the original findings

- Sensitivity analysis enhances extrapolation of the results (What does this mean?).

Source of uncertainty

- Sensitivity analysis involves varying parameter estimates across a range and observing how this will impact the conclusion results
- Uncertainty may rise from
  - Diagnosis:

  - Natural history of the disease:

  - Treatment efficacy and effectiveness:

  - The development of adverse events:

  - Resources consumed by treatment options:

Outcome Terms

efficacy: Clinical outcome يعني إلي From RCT (↓ Bias, ↑ Internal validity) depend on data source ← Better

← يعني بنشوف The observation studies (eg → to observe files of pt with **DM**)

- <u>Effectiveness</u> is concerned with what benefits/costs are associated with a new therapy when it is used in the real world whereas <u>efficacy</u> is concerned with measuring the benefit of therapy in controlled conditions (i.e. RCTs)

  - In RCTs, patients are more monitored and where the comparator may not be the one used in the clinical trial.

هون النتائج حساسة sensitive بتتغير بتغيير العوامل الخارجية و هذا سيء

- There is often little evidence available about effectiveness, and we are forced to make *assumptions*

  - These assumptions should be reasonable, and should be transparent, so that they can be challenged.

- *Health Economists like to take into account the possible extremes (i.e. SD or CI) in the analysis rather than the mean*

  → Confidence interval

- Imagine this

- *The mean (95% CI) change in QALY of a drug B was 3 (1,5) and the change in cost is £90,000.*

- *What are the possible costs per QALY (ICER)? Use the mean and then the extreme values? What is the base case ICER? What is the results of sensitivity analysis?*

- *90,000/3 = £30,000 per QALY*

- *90,000/1 = £90,000 per QALY*

- *90,000/5 = £18,000 per QALY*

Uncertainty and variation in PE evaluations

- Variations in the outcomes (previous slide)

  +quality

- Variations exist also around the estimated cost of the intervention

- *Mean (95% CI) usage costs for*
  - *Medicines £30K (10, 50)*
  - *Hospitalisations £20k (10, 30)*
  - *GP visits £30K (10,50)*
  - *Equipment for monitoring £10K (5,15)*

we change 1 parameter eg

so in ▲ I put the 3k and calcu (Re-)

(3k-7k)

- **One way-sensitivity analysis** (Avg تكاليف العلاج of **DM** in year 5000, but it range
  - Varying each uncertain component individually to assess the effect of each on the results of analysis

  لأنه في اختلافات كثيرة
  High bias لأنه في اختلافات كثيرة داتا فيها هون الـ → High bias eg : تكون بين علاج

  here the parameter is Cost *(cost)*

- **Multiway sensitivity analysis**
  - Varying two or more components at the same time   تبين مع علاج

  we change 2 pna

  (so we need more تجارب) *to variation in cost*

- **Threshold analysis**
  - Identifying the critical value of parameters above or below which the conclusions of the study will change

  وهو عكس اول اثنين ⤶ أول بكون tt حد للعتبة هون أنا ما eg what is the maxi dose of **CABG** if more than it il- become higher the threshld

  الاقتصادية تبع الدولة

  العتبة

- **Probabilistic sensitivity analysis**

  PSA + (eg) P28

  - Each parameter (e.g. cost and outcome) has a predefined <u>distribution</u> (range)
  - A computer simulation is run where different values from these ranges are selected randomly, thus resulted in generating different values of incremental costs, outcomes, and ICER that are plotted in a cost effectiveness curve (CEAC)

  التوزيع الطبيعي للاحتمالات / each توزيع has **CI** so we can draw scale

  ⤷ eg : the PT & **DM** for 70 years have uncertainty from 3k-7k *next slide* eg or Look normal / normal distributions

Then we calculate Incumantal cost So By help of Comp. u ask him for eg to do a test 10k times
then put it on CE plane Inc. outcome ute
eg :- if we repeat it for g 1k times each time take number b/n 3M-7M ✓
= so (points ?) = 1K point to see if it's Cost effective or so)
for Incumantal Cost outcome

Example

- The health care provider was able to purchase antibiotic C at a much lower price ICER must be recalculated with this new cost information. (See next page)

- Calculate the new ICER

- What are the types of sensitivity analysis

- Plot it on the cost-effectiveness plane

P24

Analysis	Cost to treat 100 patients		Effectiveness (%)		Incremental effectiveness	Incremental cost	ICER
	Antibiotic C	Antibiotic A	Antibiotic C	Antibiotic A			
Base case	8000	7000	80%	75%			
Antibiotic C	6800	7000	80%	75%			

Handwritten annotations:

in Base case * in quad NE

* in SE لعد الدعم

الجديد — القديم

الجديد ↓

a case Based on Avg

يعني أرخص وأفضل — Let's dominant C

بعد الدعم ↓

هل ال decision تتغير؟

P25

Think of this situation too

- For instance if a study assumes a rate of relapse of duodenal ulcers after treatment of 5% at one year, what happens if the relapse rate were to be actually 2.5%, or 10%?

- This might drastically affect the outcome of a study.

- How many different extreme values are there? (need to take into account all permutations)

- Therefore never just one point on an CE plane

- Plotting a single point on an CE plane is overly simplistic.

- When plotting an ICER it is necessary to take into account the variation in the accuracy of both the estimated costs and outcomes.

Sensitivity analysis would look like this

ما تغير الـ decesion
لأنه نفس الـ Quad
لكن لبعاد عن بعض لذلك
مع تغير الـ Thershold تبع الدولة
في احتمال تتغير النتيجة
(check P30)
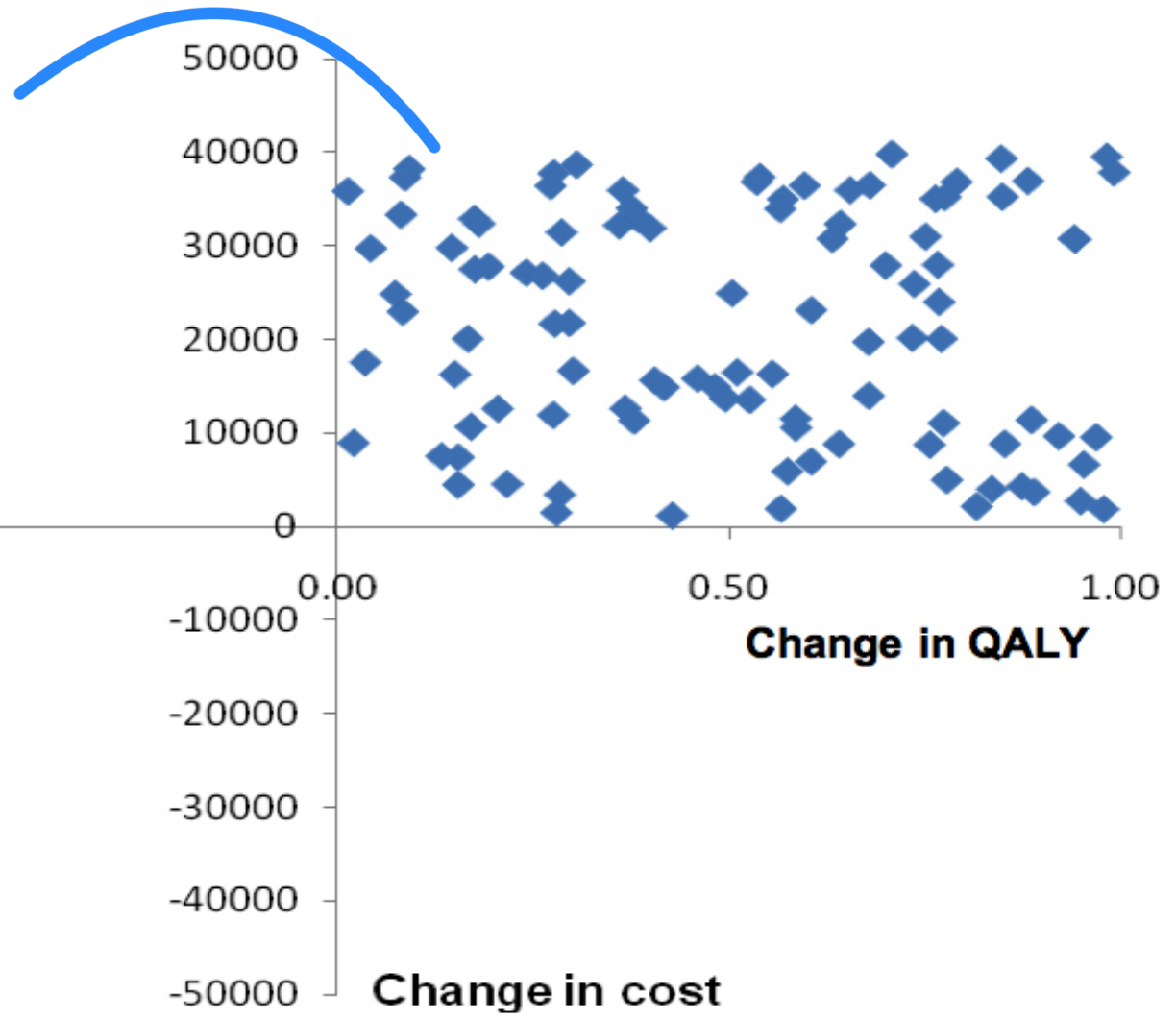
P28

- Any good economic study will challenge their assumptions, by varying them in a *sensitivity analysis*.

- This explores the extent to which a conclusion is dependent on an assumption.

- A sensitivity analysis clarifies what are the critical assumptions and confirm that the results of the evaluation are robust, despite changes in the assumption.

- It is important for any PE evaluation to report the methods used for the sensitivity analysis
- The results of analyses should always be included in the results

- This is important to determine the likelihood of acceptance for an intervention

  - *This is determined from the proportion of points below different thresholds*

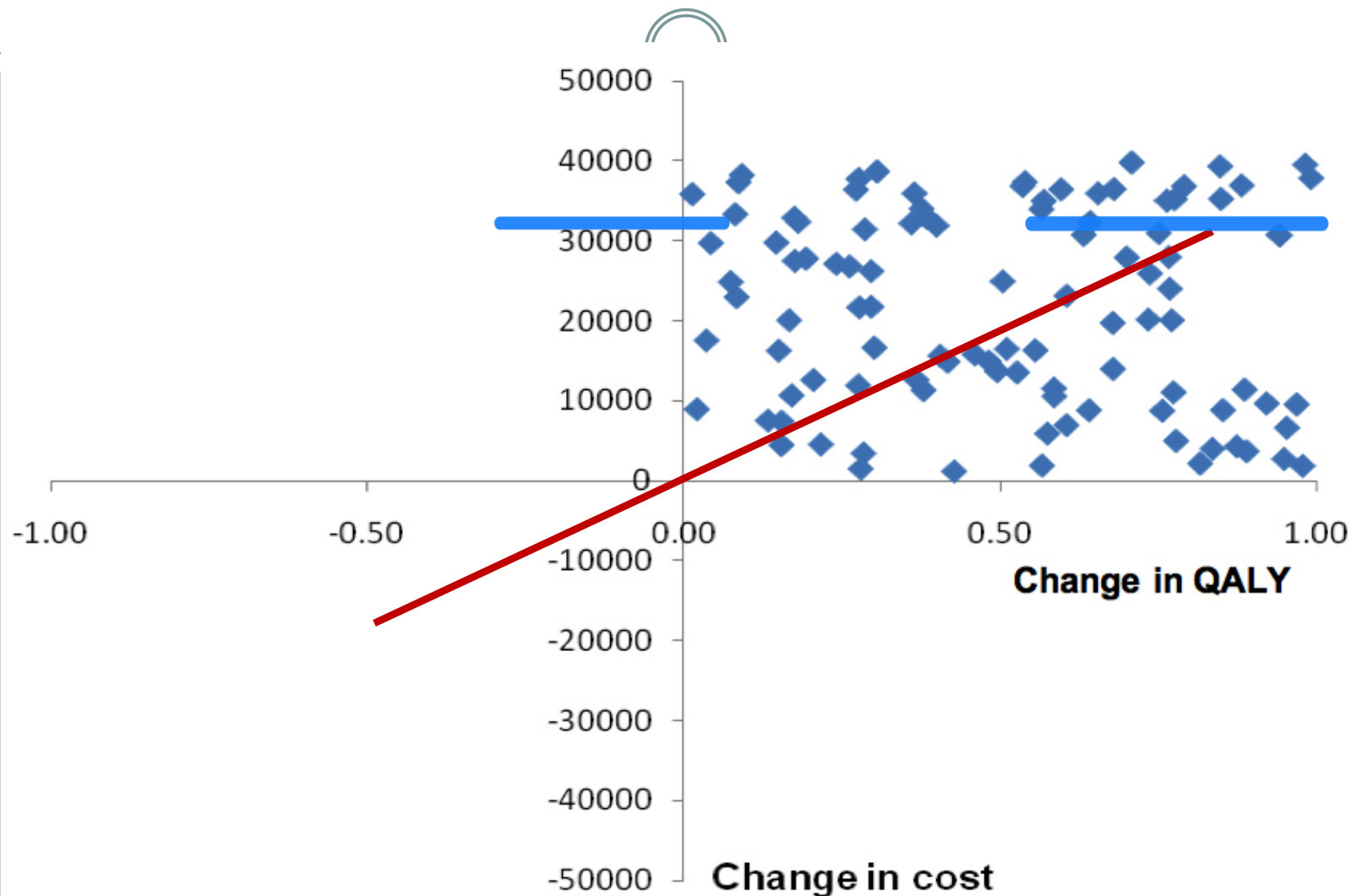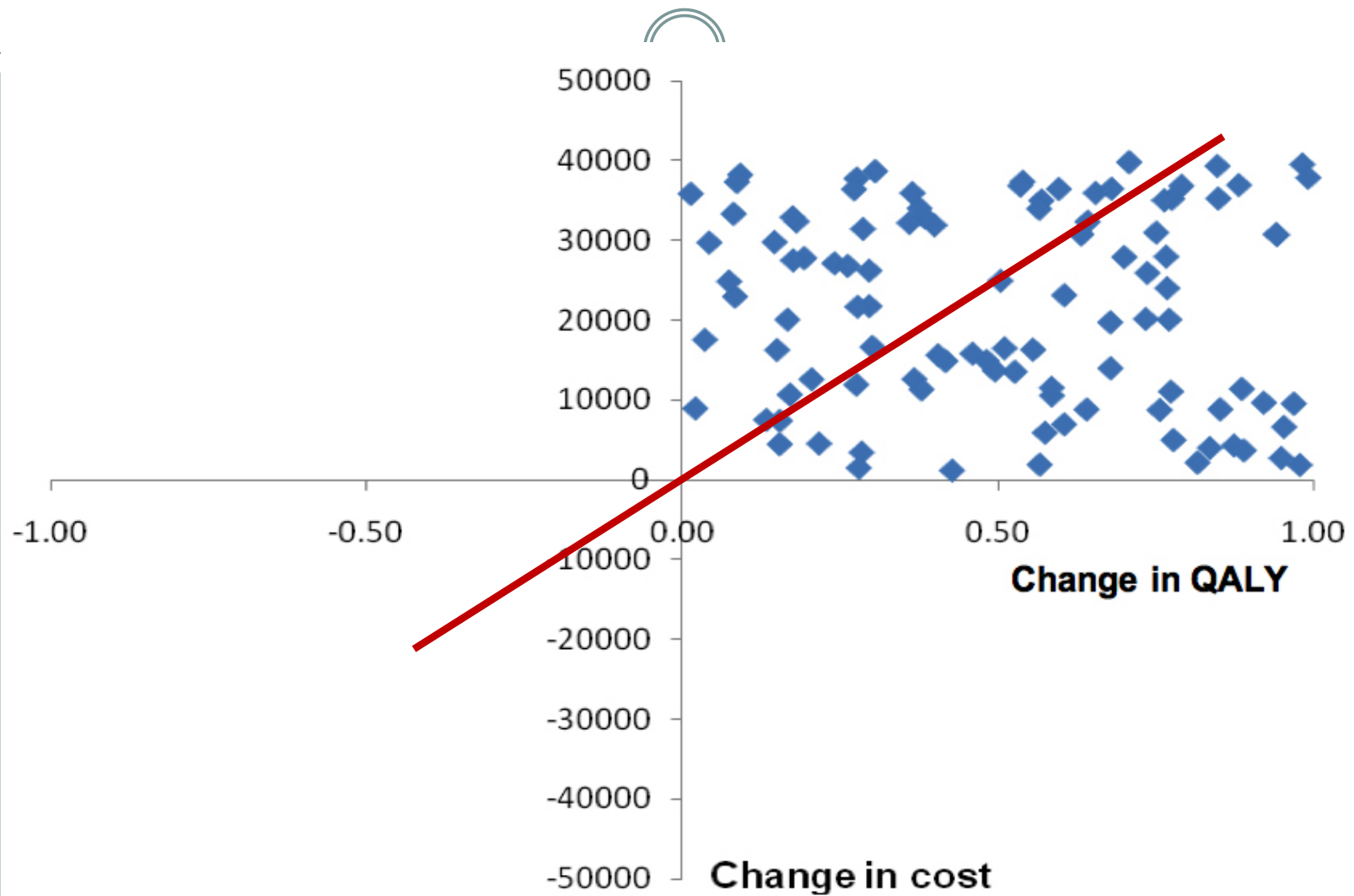# What is the proportion of points demonstrate a Cost per QALY < 10,000?
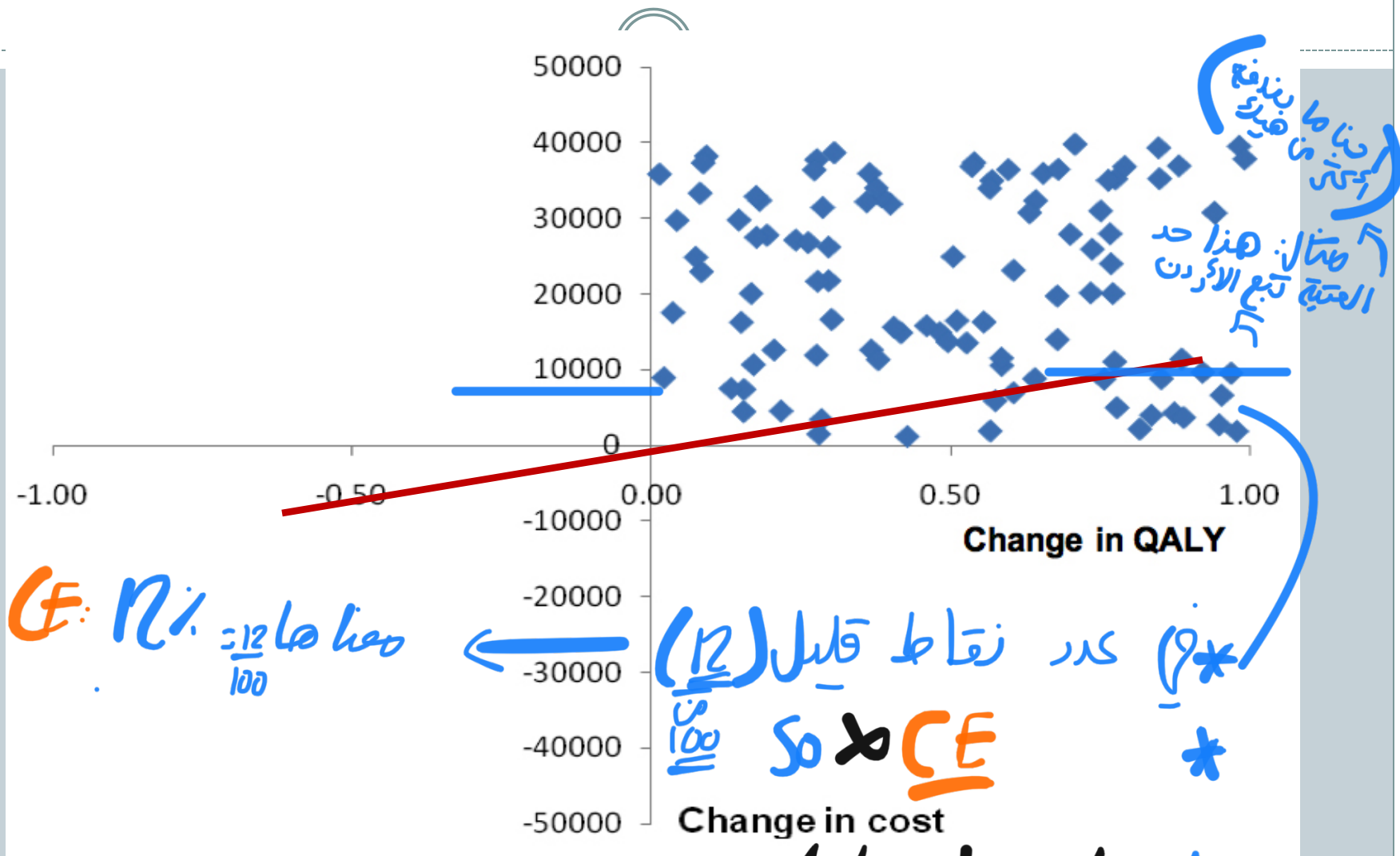
What is the proportion of points demonstrate a Cost per QALY < 20,000?

CE 25% = ‏نقطة‏ 25
‏برضنو قليل‏
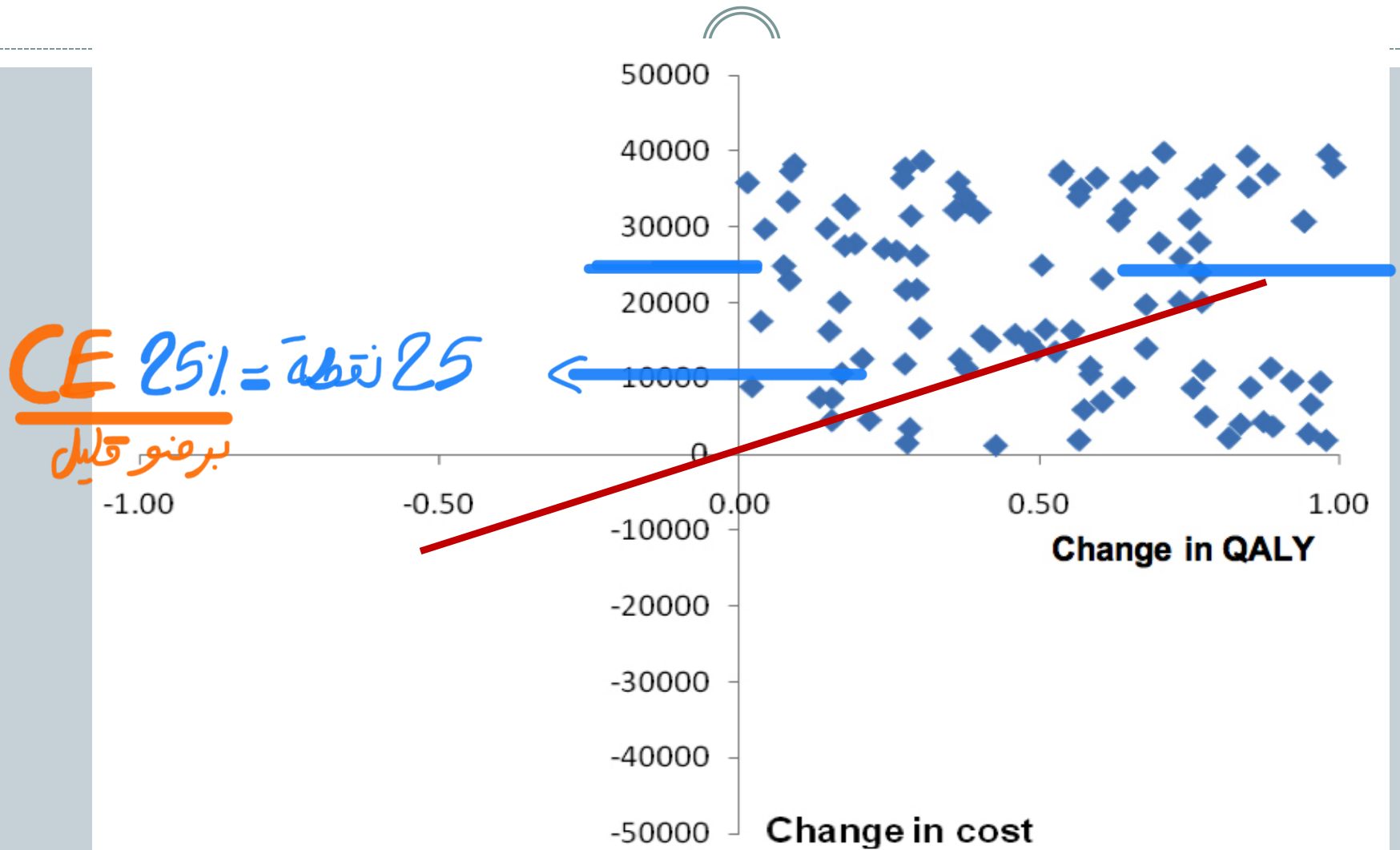
What is the proportion of points demonstrate a Cost per QALY < 30,000?

What is the proportion of points demonstrate a Cost per QALY < 40,000?

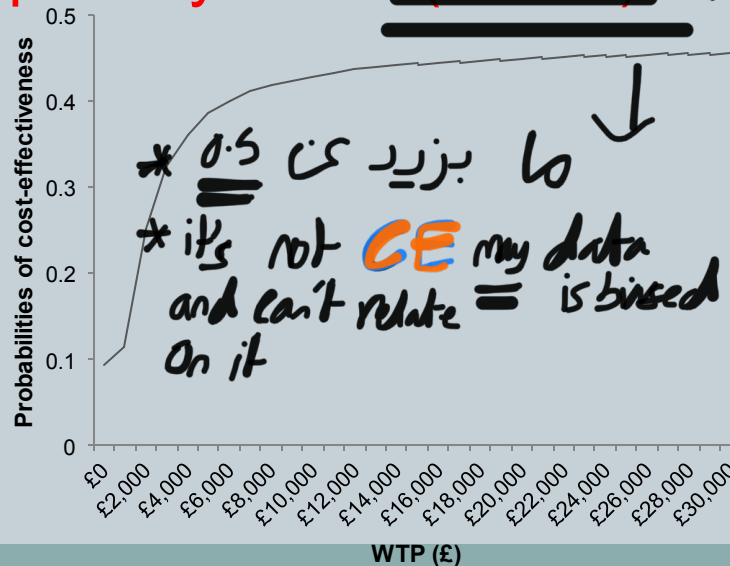- Proportion of points under the cost-effectiveness threshold = likelihood of the intervention being cost effective

- If we plot proportion of points under the cost-effectiveness threshold against the cost-effectiveness threshold this would give the cost effectiveness acceptability curve (CEAC) → only by PSA

eg : The shld 20N in Uk

Range (0 — 30k)

So by PSA calcu

hand-written annotations:

* 0.5 كل يزيد lo ↓

* it's not CE my data and can't relate = is biased on it

(برتفع مع زيادة الـ Range CE منخفض إلى ...ي.

- In the CEAC curve, the probability that intervention is more cost-effective than control group for a range of the decision-maker's WTP(λ) for an extra LYG or QALY are presented.

  ○ The CEAC is constructed by plotting the proportion of the incremental cost-effect pairs (y-axis) that were cost-effective for a range of λ values (x-axis). These proportions are calculated by dividing the number of the incremental cost-effect pairs, lying to the south and east of a ray with a slope equivalent to λ in the cost-effectiveness plan, over the total number of cost-effect pairs.

  ○ This process is repeated numerous times with different values of λ (in the UK ranging from 0 to £30,000)

Summary

- Health economics used to make decisions regarding which interventions to accept

- We accept interventions proven to be the most cost effective use of health resources

- In order to decide this we need to consider
  - **Accepted value of health gain (cost-effectiveness threshold)**
  - **Uncertainty around cost effectiveness estimate (sensitivity analysis)**
  - **Likelihood of being cost effective (CEAC)**

Example: screening for colorectal cancer

program	incremental cost (JDs)	Incremental Life-years gained	ICER
Every 2 years, age 55-74	800,000	400	
Every 1.5 years, age 55-74	700,000	300	
Every Year, age 55-74	1,400,000	500	
Every year, age 50-74	1,700,00	500	

CE threshold = 3000 JDs per life year gained

Which of these we should adapt ?

Answers

- ICERs are: 2000, 2333, 2800 and 3100

- The annual screening aged 55-74 would be adopted